Responsible Geographies and Geographies of Response

Educating Geographers in an Era of the Anthropocene

Ph.D. Thesis
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Contents

Foreword

I urge you to be skeptical towards all you are going to read. Empowered with positive skepticism, individually and collectively we enrich academic understanding, responses and responsibilities to urgent issues in present time. Through positive skepticism, radical critique and engagement, academia produces new knowledge and insights; insights that do not always serve the interest of those in authority. This dissertation examine the role of academia in society, responses and responsibilities when confronted with some of its own "most groundbreaking" [scientific] discoveries of our time [that]…tell us that human beings have caused global warming over the cause of their history" (Malm and Hornborg 2014, p. 66). Responsible Geographies and Geographies of Response is more than a study of how academia and geographers respond to issues of climate change and sustainability: It aims to enrich a radical awareness and critical examination of some of the social dynamics that enclose academics at work by ways in which the scientific climate and responses to climate change are mutually conditioned. Once again I urge you to hold a skeptical attitude toward what you are going to read. Through mind we change (what) matter(s).

Acknowledgement

It is tempting but wrong to think that the writing of a thesis is one (wo)man's work. While many hours are spent in isolation it is at the same time a process of connecting. Connections continue to have great emancipatory potentials when meetings take place. With gratitude, hospitality and encouragement I have been enriched by a number of people and their co-presence have heavily influenced my work.

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Abstract (Danish)

Denne afhandling undersøger danske geografers artikulering af ansvar for og svar på at repræsentere globale miljømæssige forandringer. Med udgangspunkt i tesen om antropogene klimaforandringer belyses geografers kampe om at repræsentere og udvikle menneske-natur traditionen. Hovedvægten ligger på den teoretiske del, der gennem 'the social nature approach' dels behandler denne teses ontologiske og epistemologiske konsekvenser i et faghistorisk perspektiv, dels undersøger geografers svar og ansvar for co-produktive elementer, som denne tese indebærer. Det konkluderes, at selvom geografer finder 'sustainability' konceptet relevant for faget, adresseres det implicit snarere end eksplicit. Dette medfører en række modsætninger (og dilemmaer i forhold til at håndtere dem). Begrebet tilegnes implicit, men generelt afvises det at adressere 'sustainability' eksplicit blandt andet pga. af den kritik og de politiske undertoner, der ofte medfølger. 'Geographies of response and responsibility' undersøger faglige kampe over at repræsentere globale miljømæssige forandringer.

Abstract (English)

This dissertation engages with Danish University geographers at work and their explication of the role of geography in shaping socio-environmental debates in an era of the anthropocene. Situating sustainability concepts in a history-geographical context the dissertation examines responses and responsibilities concerning academic fights over representing global environmental change. A major part concerns the theoretical basis and draws inspiration from a series of critical geographical work on the marketization of universities, and relates this tincture to the wider education for sustainability in higher education literature. The methodological framework is based on the social nature approach that tangles these quite distinct epistemological communities by consulting the socio-natures produced. It is concluded that though geographers find sustainability themes important to geography, sustainability is more often implicit than it is explicit. This produces a number of dilemmas and contradictions since geographers both seek to distance themselves from produced politics while at the same time elucidating them. Geographies of response and responsibilities address the battleground over the reading and writing of global environmental change.

Keywords: Geography Education, Interdisciplinary academic spaces of work, Academic responses to Climate Change, Sustainability, Anthropocene, Space-Time Dialectics, Social Nature, Paradoxical Natures – Paradoxical Cultures

Introduction

Half a century ago few academics studied *global* environmental change. One could be lucky to sniff out one or two at a geographical department. If so, these geographers, climatologists and meteorologists were largely considered to have lost track with their discipline. Studying global environmental change was irrelevant, a non-scientific task and in the academic mainstream considered to be occupied by academics freaking out. The epistemic borders of geography at the time had a prominent status in studying human-environmental interactions. By contrast geographers of today can hardly be said to be agenda setting in the study or in the public (academic) debate and fight over representing socio-environmental change. While nature-society interactions have long been part of geography's raison d'étre, identity and imaginations, geographers generally have lost track with or play a marginal role in shaping contemporary environmental debates, Castree (2002) complains: *"Although I will suggest there are no easy answers to the question of how geographers should involve themselves in the environmental debate, I will argue (possibly at my peril) that they are all too frequently conspicuous by their absence when and where it really matters"* (Castree 2002, p. 358).

It is one thing that studies in the human-environment tradition proceeded in ways that largely ignored global environmental change half a century ago. It is quite another thing and far more striking that pari passu with the anthropogenic climate change thesis gains currency, geographers are *conspicuous by their absence.* Insofar as this is the case, it is not only striking, it must also cause puzzle and concern. Where on earth are they? Have they lost courage?

The aim of this study is twofold. First, I aim to provide an examination of geographers' engagement in environmental debates or the lack of engagement. Thus I address university scholars' articulation of responses and responsibilities, in representing the socio-environmental interface, how it is socially construed, made and remade (Braun and Castree 1998) in curricula concerning global environmental change. Exploring how socio-environmental curricula get produced is particularly interesting in the subject of geography and yet, in line with Castree's observation, I suspect, it receives little priority in the education of geographers. *"Although human-environment research is thriving in geography and receiving recognition outside the*

discipline, the curriculum—which we contend is the bedrock of future development in the field—is wanting" (Yarnal and Neff 2004, p. 28).

Insofar as geographers find themselves in *"a disciplinary inferiority complex that stops us producing 'big environmental ideas"* as Castree (2002, p. 362) speculates, I find it particularly relevant to take up utopian environmental ideas like sustainability for inspection in order to examine how geographers shape environmental debates in a period of time when the anthropogenic climate change thesis seems widely manifested in academia (Chapter 1).

Second, inspired by the social nature approach (Castree 2001), I address geographers in their making of socio-natural representations, and their articulation of dilemmas, controversies and contradictions concerning sustainability in curricula. Thus, it is part of the project to examine where geographical educations are heading and which struggles and interests involved in representing global environmental change. Addressing political ecologies through education of geographers and how different kinds of social natures are being taught and embodied (e.g. manifested through concepts like sustainability or the anthropocene), I address methodological, theoretical and political implications hereof. A substantial part of the dissertation therefore will deal with philosophy of science. As my research interest lies in the interface between geographical imaginations and geographical identities relating to cultural politics of representing socio-environmental change, I address dilemmas concerning geographer's articulation of responses and responsibilities, and not least as participants themselves, in construing and approaching the socio-natural interface (Demeritt 2009).

By pointing to the work of David Harvey and Noel Castree the study of sustainability challenges cannot be meaningfully undertaken without addressing power relations within the wider context in which relationships between nature, society and geographical education gets constituted. Exploring geographer's articulation of responses and responsibilities as a fight over assembling socio-environmental curricula, it is not only a matter of examination. Insofar as geographers are reluctant to address global environmental change in these anthropogenic times, the intention is also to challenge status quo. In consequence, this study is located in three distinct and yet related bodies of literature.

Relationships between geography, knowledge and responsibility are indeed a sensible issue, when approaching debates concerning anthropogenic climate change. As Castree (2014, p. xvii) notes, scholars and their institutions have a particular responsibility, as researchers publish countless papers that shape thinking, imaginations and future actions concerning global environmental change. Recently a number of geographers (e.g. Massey 2004, McEvan and Goodman 2010) have called for a more firm examination of responsible geographies. Highlighted as the 'moral-turn' (though frankly, it is nothing new) these authors call for interventions and practices that address connections between moral agency, knowledge production, ethics and politics. The moral turn has covered a vast spectrum of issues including environmental (injustice), the climate change thesis and so forth. Although connections have been made and *the ethics of sustainability are compatible with the ethics of care"* (Cheryl. 2010 et al., p. 106) the 'moral turn' has yet to be linked with the sustainability in higher education literature. Though this study is not directly anchored in the body of literature concerning 'the moral turn in geography', I find inspiration from the 'relational understanding of responsibility' (Massey 2004) and take it into a wider debate of geographical education in examining geographers response when representing the socio-natural interface.
The body of literature addressing the sustainability in higher education debate (see chapter 6 for a state of the art discussion) can both be embodied in geography (e.g. Huckle 2002, Bednarz 2006, Sayer 2009 or Lui 2011) and approached in a more interdisciplinary tone (Weisz and Clark 2011). In both cases sustainability in higher education or sustainability science literature set a normative horizon that orchestrates an ethical obligation to address sustainability across disciplines. *"I think that no matter what faculty students are doing their degree in, every student should take a course on sustainability. Maybe one term in their first year. Therefore, no matter if you are an economic student, a music student, an engineer, or whatever, you take a course on sustainability. It is so central to how we deal with 21-century problems that it should be a mandatory course for everybody"* (Interview, Will Steffen).
As the idea of the knowledge society is institutionalized insisting on multidisciplinary and user driven innovation to approach societal challenges like sustainability and climate change I also draw inspiration from a series of critical analyses on the marketization of universities (e.g. Castree and Sparke 2000, Dowling 2008, Berg 2012). Relating this tincture of geographical work to the body of the sustainability in higher education literature (Higgit 2006, Maxey 2009). I seek to anchor this examination in a much more critical fashion than much work on sustainability in academia, that have often gloomed by the absence of analysing power relations

(Mansfield 2009). Both David Harvey and Noel Castree use the term sustainability in various and highly fascinating ways[1] and find critical ways of embracing its fallacies. Inspired by the space-time dialectics of David Harvey and Noel Castree and their treatment of concepts like sustainability, I indend a similar critical curve in examining the multiple ways in which sustainability finds its way into academia. In scrutinizing the ways in which socio-environmental problems is framed by the Danish geographical community I will render a critical study of geographers in action when representing the socio-environmental interface through sustainability concepts. What is the role of sustainability in geography in shaping responses to environmental change in the Anthropocene?

1 "Environmental policy is frequently a means whereby those in positions of power further their own interests, it is also an essential instrument for achieving a more just and sustainable future" (Castree 2002, p. 360). "It is hard to oppose all of this specificity and particularity without appeal to universal principles. Dispossession entails the loss of rights. Hence the turn to a universalistic rhetoric of human rights, dignity, sustainable ecological practices, environmental rights, and the like, as the basis for unified oppositional politics" (Harvey 2005, p. 178). "The sprawling urbanization process was dynamic, but both environmentally unsustainable and geographically uneven" (Harvey, 2012, p. 50). "It [Capitalism red.] is inherently growth-oriented: profit rather than, say, social equity or environmental sustainability, is the primary goal" (Castree 2001, p. 193).

Chapter 1

When Climate Changes Science -Change(?)

"Not everything that counts can be counted and not everything that can be counted counts"

William Bruce Cameron

In 2004 Naomi Oreskes wrote a short paper. A short paper, now heavily quoted, in which she claims that scientific consensus on climate change exists to the extent that 97 % of research articles in high-impact factor journals like *Science* and *Nature*, confirm the thesis that climate change is fundamentally anthropogenic. Having examined 928 abstracts of peer reviewed articles in journals specialized in climate change she concludes that no article in her (construed) data set refutes the thesis on human induced climate change: *"virtually all professional climate scientists…agree on the reality of human-induced climate change, debate continues on tempo and mode"* (Oreskes 2004, p. 1686).

The planetary crisis, on which scientists seem to form a common consensus platform does not imply a new era of 'consensus science'. Rather it imposes challenges to 'classical' socio-natural epistemologies, academic responses and responsibilities.

First scientific work, processes of understanding, and truth seeking is not a matter of voting. Though 97 percent of an epistemic research community find evidence of climate change to be anthropogenic, the three percent can be right. The validity of scientific findings is not judged on the basis of voting, ratified in the court or through political processes by the government (in that sense fundamentally undemocratic). Scientific findings achieve its validity, reliability and truthfulness due to scientific methods, standards, systematic scrutiniza-

tion, ongoing verification, etc. Nevertheless scientific standards, methods, and processes of verification are dynamic and change over time as new 'common knowledge' gets established.

Second, responses and responsibilities to climate change are generated in a wide spectrum of possible outcomes, among individuals, different social groups, institutions, organizations, and governments (Chakrabarty 2009). Although consensus seems established and situates anthropogenic climate change as a 'scientific fact', a multitude of (possible) responses within and beyond 'the ivory tower' are produced. These 'scientific facts' have the conjoint capacity to assemble scientists and non-human nature in ways that affect one another. The consensus thesis, however, does not imply a new era of 'consensus science' on the matter of climate(s). Rather the apparently new paradigm of 'scientific consensus' is far from establishing a new consensus as to scientific response(abilities), methods, standards and approaches in conceptualizing the human-environment nexus. It produces interdisciplinary, integrative, and epistemological challenges.

Third, the consensus thesis on anthropogenic climate change is a process of socializing nature (Castree 2001). As Malm and Hornborg (2014, p. 66) argue anthropogenic climate change involves a more serious examination of "humanity" as a driving force, not the natural. Hereby they point to the social practices, power and biases that incur both in the natural and social sciences. To claim that global warming is real and is caused by humans is to claim that nature is also social (Braun and Castree 1998) and yet basic natural laws are unaffected. The process of socializing nature produces a number of scientific tensions and interests, internally within the scientific process of conducting knowledge and externally as to societal responses to that knowledge. The recognition that global environmental change somehow is socially produced is precisely the core of the consensus thesis, while the idea of an external and objective nature is uphold by the natural sciences (Demeritt 2002), e.g. in the modelling culture on climate changes (see chapter 8). This produces challenges within both the social and natural sciences in assembling the natural and social.

Certainly there exists some kind of scientific consensus on anthropogenic climate change, and Oreskes' (2004) thesis can be confirmed in a number of ways[1]. Quasi-scientific bodies like IPCC (2007), UNEP, and the World Meteorological Organization (WMO) are not alone in this stance (Table 1.1).

Bodies like the American Geophysical Union (AGU 2013), American Physical Society (APS 2007), UK Royal Society (RS and NAS 2014), US National Academy of Sciences (RS and NAS 2014), The American Meteorological Society (AMS 2014), the Geological Society of America (GSA 2010), the American Association for the Advancement of Science (AAAS 2009), American Chemical Society (ACS 2013), and many more, have all featured reports, resolutions or consensus statements in which they find the evidence on anthropogenic climate change overwhelming to the extent that they urge societal responses to it (Appendix 1.1).

In line with the above mentioned science institutions and academies (Table 1.1 and Appendix 1.1) the American Physical Society is pretty straight forward in envisioning particular socio-ecological futures: *"If no mitigating actions are taken, significant disruptions in the Earth's physical and ecological systems, social systems, security and human health are likely to occur. We must reduce emissions of greenhouse gases beginning now"* (APS 2007, p. 1). Thus, the Science Academies (Table 1.2 and Appendix 1.1) collectively urge for global responses to the current knowledge on climate change. As such APS envisions long term sustainable post carbon societies and Earth-System management stabilized within planetary capacities, boundaries, limits, and dynamics.

One could now expect geographical societies have responded in similar ways – envisioning similar utopian post-carbon and sustainable futures. In contrast,

1 Cook et al. (2013) find 97.1 % of more than 4000 peer reviewed articles from the past 20 years support the thesis that global warming is mainly or entirely human induced. NASA (2014) also confirms the finding on 97 %, that 'climate scientists' find global warming is real and triggered by humans. Doran and Zimmerman (2009) suggest that 93% of actively publishing climate scientists find that humans have contributed to global warming. Also Anderegg et al. (2010) and Stenhouse et al., (2014) confirm these studies, though the latter report that 75% of AMS members actively publishing on climate change, "view human activity as the primary cause of recent climate change" (Stenhouse et al., 2014, p. 1035).

Table1.1: Science Academies and Response (abilities) to Climate Change	
American Geophysical Union (AGU 2013)	"Humanity is the major influence on the global climate change observed over the past 50 years. Rapid societal responses can significantly lessen negative outcomes. Human activities are changing Earth's climate. At the global level, atmospheric concentrations of carbon dioxide and other heat-trapping greenhouse gases have increased sharply since the Industrial Revolution. Fossil fuel burning dominates this increase. Human-caused increases in greenhouse gases are responsible for most of the observed global average surface warming of roughly 0.8°C (1.5°F) over the past 140 years. Because natural processes cannot quickly remove some of these gases (notably carbon dioxide) from the atmosphere, our past, present, and future emissions will influence the climate system for millennia" (AGU 2013, p. 1). Reaffirmed 2003, 2007, 2012, and 2013.
American Physical Society (APS 2007)	"The evidence is incontrovertible: Global warming is occurring. If no mitigating actions are taken, significant disruptions in the Earth's physical and ecological systems, social systems, security and human health are likely to occur. We must reduce emissions of greenhouse gases beginning now" (APS, 2007).
UK Royal Society (RS) and US National Academy of Sciences (RS and NAS 2014)	"Climate change is one of the defining issues of our time. It is now more certain than ever, based on many lines of evidence, that humans are changing Earth's climate. The atmosphere and oceans have warmed, accompanied by sea-level rise, a strong decline in Arctic sea ice, and other climate-related changes" (RS and NAS 2014, Foreword).
The American Meteorological Society (AMS 2014)	"There is now clear evidence that the mean annual temperature at the Earth's surface, averaged over the entire globe, has been increasing in the past 200 years. There is also clear evidence that the abundance of greenhouse gases has increased over the same period (…). Because human activities are contributing to climate change, we have a collective responsibility to develop and undertake carefully considered response actions" (AMS 2014, p. 1). reaffirmed from 2003
The Geological Society of America (GSA 2010)	"The Geological Society of America (GSA) concurs with assessments by the National Academies of Science (2005), the National Research Council (2006), and the Intergovernmental Panel on Climate Change (IPCC, 2007) that global climate has warmed and that human activities (mainly greenhouse-gas emissions) account for most of the warming since the middle 1900s." (GSA 2010). The text is from 2006 revised 2010.

American Association for the Advancement of Science (AAAS 2009)	"The American Association for the Advancement of Science (AAAS) has reaffirmed the position of its Board of Directors and the leaders of 18 respected organizations, who concluded based on multiple lines of scientific evidence that global climate change caused by human activities is now underway, and it is a growing threat to society. The vast preponderance of evidence, based on years of research conducted by a wide array of different investigators at many institutions, clearly indicates that global climate change is real, it is caused largely by human activities, and the need to take action is urgent" (AAAS 2009, p. 1). In 2006, the AAAS board made a similar statement.
American Chemical Society (ACS 2013)	"Comprehensive scientific assessments of our current and potential future climates clearly indicate that climate change is real, largely attributable to emissions from human activities, and potentially a very serious problem" (2013). Note the text is originally from 2004, reaffirmed 2013.

however, the UK Royal Geographical Society (RGS)[2], Swedish Society for Anthropology and Geography (SSAG), Geographical Society of China (GSC), American Geographical Society (AGS), German Geographical Society (DGfG), Danish Royal Geographical Society (DGS), Russian Geographical Society (RGS Russia), Royal Canadian Geographical Society (RCGS), Norwegian Geographical Society (NGS), French Geographical Society (FGS), Indian Geographical Society (ISG) have not prepared such policy statements, resolutions or declarations[3] . As far as I know, only the Association of American Geographers (AAG 2006) and the International Geographical Union (IGU 2007) have made an English written, publically available resolution, declaration or policy statement on climate change (Box 1.2). Whereas the AAG made a resolution on climate change in 2006, the RGS has not done so nor participated in any joint declaration. Thus, AAG

2 Though no policy statements, recommendations, resolutions or declarations, the RGS strategy states; "In the coming years we shall witness ever more rapid changes in technology, a more globalized economy, changes in our climate, pressure on mineral and water resources as never before and, almost certainly, changes in where and how we live. As the human population soars towards the 8 billion mark, the pressures on the planet and its finite resources will increase and with it will come ever greater need for people to understand how we are changing our planet and how we can better manage it" (RGS 2012, p. 2). This may apply for the other Geographical Societies as well.

3 The research was undertaken during the fall of 2014, consulting each society's homepage. It must be noted that the search was only done in English (apart from the Nordic geographical societies) and thus, resolutions, statements or declarations may have been prepared in the societies respective languages.

Box 1.2: AAG Resolution Requesting Action on Climate Change

(passed March 11, 2006)

"WHEREAS,

Climate change is a process that constitutes a major threat to Earth's environment and to the well-being of people in all nations;

WHEREAS,

Geography is an integrative science that synthesizes and analyzes data regarding human-environmental relationships, thereby increasing understanding about global climate change and contributing to more informed policy decisions;

WHEREAS,

Members of the Association of American Geographers (AAG) petitioned the AAG Council to consider this issue;

WHEREAS,

Global scientific efforts established a substantial body of evidence and reached a scientific consensus on global climate change, including reports from the Intergovernmental Panel on Climate Change (IPCC) and Arctic Climate Impact Assessment (ACIA), among others;

WHEREAS,

The International Polar Year for science and research takes place from March 1, 2007 to March 1, 2009, focusing on the Polar Regions, which are affected by climate change at a greater rate than middle and lower latitudes; and

WHEREAS,

Eleven national science academies, including the US National Academy of Sciences, issued a joint statement on June 7, 2005, that calls on world leaders to take prompt action to reduce the causes of climate change, adapt to its impacts, and include the issue in all relevant national and international strategies.

THEREFORE BE IT RESOLVED that,

The Association of American Geographers (AAG) affirms the international scientific consensus on climate change, including endorsement of the June 7, 2005, joint statement of the national academies entitled "Global Response to Climate Change";

continues next page

BE IT FURTHER RESOLVED that,

The AAG urges the US Government to take a leadership role in addressing climate change, support open scientific debate about the issue, and fully cooperate with the Intergovernmental Panel on Climate Change (IPCC), the Arctic Climate Impact Assessment (ACIA) of the Arctic Council, the national science academies, and other governmental and nongovernmental organizations, as well as with the international community of countries, to better scientifically understand climate change and to develop sound policies to attenuate greenhouse gas emissions;

BE IT FURTHER RESOLVED that,

The AAG enjoins the US Government to act upon commitments made by the US in the UNFCCC, May 9, 1992, and ratify the Kyoto Protocol and Rulebook that is presently international law;

BE IT FURTHER RESOLVED that,

The AAG encourages geographers to continue to engage in climate change research, *education* [emphasis added], scientific assessments, policy discussions, and political action, as they deem appropriate; and

BE IT FURTHER RESOLVED that,

The AAG, as an important representative organization of geographic science, direct its Council and President to establish a committee to draft a formal position paper as a reference document on global climate change" (AAG Resolution on Climate Change 2006, p. 1-2).

and RGS respond in different ways. Nevertheless the scientific consensus thesis on climate change seems also strongly manifested within the discipline of geography.

Responses to the scientific consensus on climate change are organized geographically by ways in which they also surpass disciplinary borders e.g. of geography. Insofar as institutional and disciplinary responses to climate change vary, it can be noted that academic Societies from Arts and Humanities have not so far responded to climate change with similar position statements, resolutions or declarations. According to Malm and Hornborg (2014) climate change discourses are largely dominated by science, not by social scientists, and the growing recognition that humanity is transforming the geo-biosphere is mainly orchestrated from science. This is paradoxical since the natural science claim humans are the dominant force in transforming the climate (Barnosky et al., 2014) and yet the dominant scientific view has clung to the idea that nature is external. The academic work has been organized into disciplinary

constructs, so that the natural sciences dealt with nature, and if nature was ever dealt with within the Humanities and Arts, it was as cultural assemblages (Harvey 1996).

Thus it can be observed that responses to the 'scientific consensus on anthropogenic climate change' are dissipated and organized vertically between disciplines and horizontally within particular disciplines, traditions and epistemic communities. It should be noted that the level of 'convince' is both disciplinary organized into different epistemic communities, and methodological sensible e.g. with respect of the use of terminology. Hereby it reflects the traditional one dimensional division of academic labor between the natural and social sciences, whereby response(abilities) to climate change form academic geographies (of socio-natural engagement), e.g. through institutional writings of such responses (universities, science bodies and academies), epistemic boundaries, (inter)disciplinary responses as well as in terms of relevance, urgency and positionality.

Whereas responsibility refers to a concern for and/or taking care/action of the socio-natural assemblage in long term post-fossil and sustainable ways (e.g. as represented by the Science Academies above), responses refer to all sorts of social outcomes (e.g. climate gradualism, climate catastrophism or climate skepticism), and the social practices of valuation, evaluation, judging and representing the socio-environmental nexus.

1.1 Responsible Geographies

Whatever response(ability) academics, institutions or societies take with regard to the scientific consensus on anthropogenic climate change, the consensus is precisely that humans including scientists write particular socio-natural and geographical futures with different socio-ecological and meteorological outcomes. It follows that science impacts at a planetary level are not politically neutral, have never been, and cannot be for reasons that will be discussed in greater detail in chapter 4. The inculcation of the ideology of science thesis, however, is anything but new (e.g. Harvey 1974b, p. 256). Whereas the natural science model assumes scientific knowledge is value-free and universally true for all people, places, and times (rinsed or corrected for the researcher's positionality), the ideology of science thesis finds it is impossible to separate scientific conduct, methods, and purpose from the context in which that knowledge is produced (Haraway 1988). All researchers agree that bias is unacceptable and uphold a clear distinction bet-

ween science and ideology. But from the ideology of science perspective: *"Bias comes not from having ethical and political positions – this is inevitable – but from not acknowledging them. Not only does such acknowledgment help to unmask any bias that is implicit in those views, but it helps to provide a way of responding critically and sensitively to the research"* (Griffith 1998, p. 133).

Such assumptions have a long and widespread history corralled into a vast body of traditions, covering various forms of Science and Technology Studies, Critical Pragmatism, neo-Marxism, post-Colonialism, Feminism, Structuralism or neo-Modernism. What is new is the recognition that scientific work impacts at a planetary scale. Thus the scientific consensus on climate change encounters socio-natural processes that implies an ethic of responsibility[4] (within and across disciplines of examining, exploring, judging and evaluating the human environment nexus) rather than solely and ethic of conviction (Castree, Demeritt and Liveman 2009, p. 10), precisely because it produces an impact on socio-environmental futures. Insofar as epistemic communities recognize their reading and writing produce an impact regardless of positionality, responses to the anthropogenic climate change commands and 'experimental ethos' (Lorimer 2012) imposing 'grant' ethics and responsibilities across scale, imaginary and disciplinary borders as to our role in determining and co-producing global environmental change. *"Taking responsibility for how our engagement and intervention in nature proceeds, and the consequences to different social groups, what is it to act responsibly, to act with awareness that we will surely be answerable for our actions? How should we relate the unfolding of this moment of responsibility, so that we can perceive what is being demanded of us at this time?"* (Szerszynski 2010, p. 10).

4 Originally Max Weber suggested two political educational purposes: ethic of conviction (Gesinnungsethik) and ethic of responsibility (Verantwortungsethik).
Ethic of responsibility refers to the belief that an action only has meaning if it produces (known, assumed or believed) empirical effects, hence desired outcomes. Desired outcomes are aligned to cause and effect and why actors individually or collectively correct procedures (technical instrumentality) for fulfilling aims that are oriented toward desired actions and consequence. Ethic of conviction refers to the free and autonomous choice of value and meaning, and is sometimes seen as opposite to ethics of responsibility. For Weber however, ethic of conviction is a boundary concept, where individuals have to create purpose, meaning and positionality, through a series of individual and collective decisions. In other words one can only take responsibility if it is individually desired, with individual or collective aims. Only then, the two forms of ethics become commensurable (Sung Ho, 2012).

As the above examination of Science Academies (Table 1.1) illustrates, these scientific institutions produce rhetorical 'political ecological' commitments to act in responsible ways. Whatever concept (form of appearance) through which the problematic is addressed; sustainability, the anthropocence[5], geo-engineering[6], resilience or climate adaption/mitigation, they all (though in quit different ways) seek to address the socio-natural dynamics that lie behind (form of realization).

Looking at how universities are responding to climate change, the notion of sustainability remains dominant to academic institutions, climate policies, and strategies, though epistemic responses(abilities) are highly contested (see Box 1.1-1.2). By way of illustration the so-called top 25 ranked universities in the world (Times Higher Education) and their institutional response (abilities) toward addressing climate change is most frequently featured around the notion of sustainability (Appendix 1.2). It is symptomatic to note how accepted these quantitative matrixes have been for measuring qualitative change, and how at the same time ranking systems that measure greening of university campi are disregarded (e.g. Green League in the UK). It is far easier to measure and to quantify quantitative features like, co2 emission, waste, water or energy consumption from a particular campus than to transform qualitative features like 'quality and excellence' into quantitative. If ranking systems is an account of anything relevant for scientists at work (gain insights, discover, understand, perceive, know, explain and comprehend), it counts, accounts, internalizes and produces power (see chapter 2). Thus, universities and academic institutions internalize power and demonstrate how crucial these processes are as to the cultural politics of representing the socio-natural interface e.g. through sustainability (Harvey 1996, p. 68).

Despite endless criticism for more than four decades sustainability seems featured as one of the most dominant rhetorical responses in university and science institutions' policies and strategies (Box 1.1-1.2 and Appendix 1.2). Thus the most 'mainstream' response(abilities) from science institutions to the recognition

5 The Anthropocene narrative holds the perspective that James Watt's invention of the steam engine is the fundamental dynamic behind global environmental change (see Glossary). I reject that, through the example of Jevons theorem.

6 Geo-engineering is like postponing the problem into the future (like 'to pie in the trousers'), and similarly to carbon management responses that fail to integrate the multiple and social dynamics that take part in shaping our future climate, I will examine how geographers respond through sustainability.

of global environmental interdependence, anthropogenic climate change, the anthropocene or planetary boundaries have been to produce policy statements, institutional commitments, discourses and agendas for sustainability in all sort of ways. Whereas a number of new terms like geo-engineering, planetary ecosystem governance or the anthropocene have bargained terrain in academic discourses, sustainability has been preached for 40 years or so (Carson 1962, Meadows et al., 1972, Brundtland 1987).

In the same period of time, the concentration of CO_2 in the atmosphere grew from 337 PPM (approx. growth rate were 0.85 per cent per year in the 1960 to 2.0 per cent per year in the 2010) to 398 PPM as of 2014 (US NOAA 2014). During that period, nearly three-quarters of the anthropogenic driven rise in CO_2 concentration took place. Accompanied by a 15 fold increase in the global economy (Steffen, Crutzen and McNeill 2007, p. 618), a tripling in the petroleum consumption, and a global energy supply that increased from 6107 Mtoe in 1971 to 12.717 Mtoe in 2012 (IEA 2012), it seems polemic to talk about sustainability (Appendix 1.3).

Rather William Stanley Jevons' (1835-1882) theorem applies. In *The Coal Question* (1866) Jevons remarks that greater efficiency in the use of fossil fuels leads to an overall increased demand. *"Now the same principles apply, with even greater force and distinctness, to the use of such a general agent as coal. It is the very economy of its use which leads to its extensive consumption. It has been so in the past, and it will be so in the future. Nor is it difficult to see how this paradox arises"* (Jevons 1866, chapter VII, p. 6)[7].

7 Note that Jevons refers to coal as an agent (a geological agent), relevant to discussion in Chapter 8, on the use and practice of modelling. Given that coal is a finite resource, Jevons raised the question of 'sustainability' as part of what is nowadays referred the peak oil hypothesis, including subjects like limits to growth, over population and the 'resilience' of single resource dependency.

This is another way of saying that since the industrial revolution or so energy freed when scientists and entrepreneurs invent a new method, practice or technology, has been used elsewhere so the net-demand has increased[8].

As sustainability challenges have been outspoken for more than four decades now, and the collective path have been fundamentally unsustainable, it is ever more relevant to find *"critical ways to think about how differences in ecological, economic, cultural, political and social conditions get produced"* (Harvey 1996, p. 5) in examining how concepts like sustainability finds its way into academia.

Contradictions of sustainability however, are not so interesting in itself (see chapter 4). Geographers have a long history of, (as a number of related disciplines) pointing towards them (Castree 2001, Huckle 2002, Mansfield 2009, Chatterton and Masey 2009, Morgan 2011). What is far more interesting is how academics respond to them. As geography professors are all aware of contradictions of sustainability I shall particularly address contested ideas of sustainability and how geographers in their teaching practices respond to and *"encourages geographers to continue to engage in climate change research, education, scientific assessments, policy discussions, and political action"* (AAG 2006, p. 2).

1.2 Geographies of Response

Disciplines do not represent themselves, disciplines are represented. Insofar as academia is organized into divisions of disciplinary work, geography is one organized between the natural and social sciences. Within the academic division of labor, the birth of modern geography in the UK for instance (established as a

8 Similarly Max Weber (1864-1920), emphasized the rationality of fossil fuel consumption in relation to his well-known iron cage (instrumental rationality): "The tremendous cosmos of modern economic order…is now bound to the technical and economic conditions of machine production which today determine the lives of all the individuals who are born into this mechanism, not only those directly concerned with economic acquisition, with irresistible force. Perhaps it will so determine them until the last ton of fossilized coal [fuel] is burnt" (Weber 1930, p. 181, here quoted from Szerszynski, 2005, p. 24). Despite his early 'prediction' of the fossil fuel nexus to the rise of modernity and the spirit of capitalism, he has only recently been reexamined in socio-ecological debates. Weber, however, analyses processes of rationalization developed on the basis of religious world views, and he fails to understand the multiple dynamics of modernity related to scientific progress.

university discipline), became a gathering point in which Mackinder argued, that geography should *"bridge one of the greatest of all gaps"* (Mackinder 1887, p. 145) referring to the disciplinary division between the natural sciences and humanities.

> *"Although space and region have since joined human-environment relations as central organizing concepts for the discipline [geography red.], many still see geography as the 'original integrated environmental science"* (Castree et al., 2009, p. 1).

This stance has been made throughout the history of the discipline and Turner (2002), Yarnal and Neff (2004), and Zimmerer (2007) have recently argued that human–environment relations are a unifying subject that holds the discipline (physical and human geographers) together. Thus, the teaching of geography has both in the past and in the present sought academic identity through 'the geographical experiment'; that is, *'an experiment in keeping nature and culture under the one umbrella'* (Livingstone 1992, p. 190).

Whereas the argument at Mackinder's time, to fill the gap of academic work divisions by establishing a new discipline today's work divisions are quite different. Since the 1960s the integrative approach has melted into a broad spectrum of related nature-society disciplines (e.g. ecological economics, environmental sociology, environmental management, industrial ecology, sustainability science, earth system science and climate science to mention a few). These newer disciplines re-shape disciplinary boarders and change the 'socio-natural divisions of work' in ways that are both an opportunity and a challenge to geography. While modern geography has addressed the human-environmental nexus for more than two centuries, there are simply too many epistemic communities interested in the subject to be let alone to geographers (Thrift 2002). Rather, and due to increasing competition, the newer disciplines have come to occupy much of that (academic) space so that *"especially in North America, Environmental Studies have replaced Geography at many universities"* (Rasmussen and Arler 2010, p. 40).

Processes reshaping the socio-natural interface organized according to (inter)disciplines also relate to changes in funding structures. As universities are undergoing profound changes in governance structures these years, division of academics at work cannot be written without including these wider processes of marketization and disciplinary market segmentation (see Chapter 2). While an increasing body of science funding agencies (e.g. US NRC 2010) allocates money for 'integrative

environmental science' (as responses to climate change and sustainability challenges among others) it is both an opportunity and a challenge to geography. An opportunity in that it remains one of the 'core' areas kept under the (disciplinary) umbrella of (environmental) geography (Turner 2002, Castree et al., 2009). A challenge in that it reconfigures disciplinary borders that are not supportive in bringing physical and human geographers together. As Thrift puts it (2002, p. 292) 'times are with geography', yet challenging to the discipline. Though neoliberal trends in university governance concurrently support interdisciplinary and collaborative projects through (inter) disciplinary alliance imposed by co-research funding schemes, it does not necessarily make space for sustainability in academia (Maxey 2009).

As Castree, Demeritt and Liverman, (2009, p. 14) argue: *"There is no 'context-free' knowledge and the precise role that environmental geographers play in wider epistemic debates on human–environment relations in academia and society will depend almost entirely upon how the university (re)defines itself as an institution".*

These wider trends of neoliberalizing universities do not only reconfigure what it means to be an academic and a geographer, but reshape disciplinary boundaries, responses and responsibilities to climate change (Dowling 2010). In chapter 2, I examine in greater detail how these neoliberal processes of governing higher education also co-produce academic spaces of (un)sustainability that are particularly subject to external pressures, students' 'career' choices and interests that 'act' in 'competition' (Castree 2011).

In an interview with Nigel Thrift with regard to academic responsibilities on climate change, these multifaceted dilemmas are beautifully conveyed: "*Well first I am not sure if they* [universities red.] *have any more responsibility than many other institutions. Neither I am sure if geographers have any more responsibility than other disciplines. But, if you wanted to argue that case, I think that it will be on the basis that they [universities red.] educate large numbers for the future planet. For me that is probably the most important responsibility they have and that education should include some issues around sustainability. This can be addressed in many different ways, in curricula, in the environment itself, and actually funny enough, having in all processes at the university, some reference to measurement of sustainability (…). The only issue I face is you need some way of judging that in comparison to other topics that should be part of curriculum as well. And I think sustainability is an important value, but it is not the only one"* (Interview, Nigel Thrift).

Like many other disciplines geography fights for its place, territory, borders and disciplinary right under increasing marketization of academia. Fights that produce spaces of (un)sustainability while fighting for the subject in academia and geography.

It is now more than forty years ago Peter Gould famously called on geographers to reflect on and review their curricula (Gould 1973), since they take part in shaping and governing our thoughts, imaginations, aspirations, emotions and actions. As Geography education is not only exploring and teaching what the human-environmental interface is about, but also how it is made sensible and co-produced for, with and/or by the students it covers a vast spectrum of responsibilities in capturing and dealing with it (Castree 2014). Governing higher education with reference to socio-natures therefore is much more than explaining the state of climate change in the 21st century, but a process of reading, writing and re-making it (Braun and Castree 1998, Szerszynski 2010). To examine how geographers (at Danish Universities) respond and produce responsibilities to global environmental challenges through fights over assembling curricula when exposed to sustainability (1.1- 1.3) the following research questions are addressed: *What are the role(s) of sustainability in geography in shaping socio-environmental debates in the Anthropocene?*

1.3 Research Questions:

- What spaces of work do the introduction of the market in academia, leave for sustainability analysis in geography? (Chapter 2)
- Why is the power of reference crucial for how academics and geographers (academia) incorporate/make use of sustainability in academia? (Chapter 3)
- How is the dialectical approach developed to examine how geographers respond to the paradoxes, contradictions and dilemmas of sustainability? (Chapter 4)
- What does the 'geographical experiment' look like when confronted with climate change and sustainability? (Chapter 5)
- How do geographers conceptualize response(abilities) to issues of sustainability and climate change in education programs? (Chapter 6)
- How do geographers respond to the paradoxes, contradictions and dilemmas of sustainability? (Chapter 7)
- What can critical human geography offer climate change modelling? (Chapter 8)

1.4 Structure of the Dissertation

The research is not only designed as an exploration of how geographers respond to dilemmas of sustainability, but also what they say about political-economic organization and how geographers respond to it. Hereby research questions dialectically comprehend a horizontal and institutional analysis of university responses to climate change and a vertical analysis, in examining the discipline of geography. The study takes a second nature approach in examining the politics of representing nature and particularly addresses fight over representing socio-ecological changes through sustainability concepts in curricula. Thus the study does not concern didactics and how students learn (un)sustain(abilities), but solely addresses the fights over representing nature through sustainability in curricula.

The dissertation is divided into three Parts. Part 1 '*Sustainability as a Double Edged Sword'* (including this chapter) addresses the problems from a wider institutional context and relates it to the discipline. Chapter 2 "Critical Geography and the Neoliberal University" examines how marketization of universities change conditions for academics at work with impact in shaping spaces of sustainability, responses and responsibilities, internally and externally. Hereby it illustrates the multifaceted character of academia's responses to (un)sustainability and addresses the changing climate for academics at work and climate change entangled between internal and external activism.

Part 2 *'Anthologies and Ontologies on Social Nature(s)'* takes a second nature approach in building a comprehensive methodological framework to address contradictions of sustainability in geography and academia. Chapter 3 considers the power of reference and examines sustainability concepts in between keywords and buzzword. Whereas Chapter 4 "Space-Time Dialectics and Contradictions of Sustainability" provides a methodological foundation from which contradictions of representing socio-natural changes through sustainability concepts are addressed, Chapter 5 "A Theory of Spatio Temporal Tides and Waves" takes a history-geographical approach in representing socio-natural changes.

Part 3 '*Geographers at Work: Reclaiming the high Grounds and Sustainability Contradictions*' is divided into three chapters that present an empirical analysis of how geographers make use of sustainability in Danish University Geography Programs. Chapter 6 "Geographers at Work: Re-Naturalizing the Human-Environment

Theme" examines how geographers find sustainability theses relevant to their discipline but reluctant to explicate it in the classroom. Chapter 7 critically addresses how sustainability produces significant dilemmas that tend to frame education as a change agent that socializes students to accept certain kinds of explanations, values and pre-analytic assumptions. Then internal and external contradictory elements are examined, both within and across different sustainability approaches, and it is questioned what we want with the concept in geography. The final chapter discusses the role of geography in shaping environmental debates in an era of the Anthropocene. In turning to the "The Social Nature(s) of Climate Change Modelling" it critically addresses modelling culture when confronted with multilateral ontologies.

Chapter 2

Critical Geography and the Neoliberal University

"The school is the last expenditure upon which America should be willing to economize."

(Franklin D. Roosevelt)

In 1798 Immanuel Kant wrote *'Der Streit der Facultäten'*. A short text, nowadays barely quoted, in which he celebrates the scientific fight between faculties and disciplines[1]. *'The Dispute between Faculties'* is the last work published by Kant himself, and often considered a key text for the rise of the modern university. In the text he outlays the autonomy of universities internally as a fight between faculties, disciplines and individuals and externally as a fight over independence from the state and the church while at the same time serving them.

Before we turn to changes in the academic working climate and how spaces of sustainability mean very different things to the management of universities and critical geographers (academics) at work, we will first examine Kant's account on the inner and outer organization of a university. Against this background of thought, the governance of academic knowledge is considered in a Danish context. As universities are becoming more and more dominant in the

1 The text gives exemplary arguments for the freedom to conduct research which marks a break with the church and the state. As the first social scientist pointing toward the modern subject he points his own philosophy to university governance emphasizing the research process also as an internal fight between faculties. Later, merging research and education his ideas became foundational for the rise of the modern Humboldt University. At this point I hope you ponder what Immanuel Kant has to do with the changing climate and climate change at universities – if you see no connection at this stage I hope you do so by the end of the chapter.

knowledge economy, university governance changes in ways that also reconfigure circumstances under which sustainability is orchestrated in academia[2] . The second part discusses sustainability as a double level of controversy. In addressing the dual character of sustainability it is examined how the concept both serves as a strategic tool for the management of universities and as a concept for critical, alternative and emancipatory potentials much related to ideas of academic freedom. The final part turns to the convergent and divergent relationships between sustainability and the liberalizations of universities to examine ways in which structural changes make space for sustainability in geography.

Questions for the chapter:

- What spaces of work do the introduction of the market in academia, leave for sustainability analysis in geography?
- How does the knowledge economy affect climate(s) under which academics work, and how do (critical) geographers respond to it?

2.1 Kant and the Dispute between Faculties as Academic Working Climate(s)

The internal and external dynamics of knowledge production and its organization is subject to ongoing debate. What is interesting about *Der Streit der Facultäten* is not only what it has to say about the organization and relevance of power relations and (a)symmetries to the conduct of research, but also how this is spatially nested. As to the internal dispute, Kant found a certain and 'powerful' spatial organization of the campus ordered hierarchically between higher and lower faculties. The higher faculties comprised disciplinary Theology, Law and Medicine. The lower faculties were gathered around disciplines like philosophy,

2 It is beyond the scope of this dissertation to address how market like universities in different spaces and stages (and different ways) affect the organization and output of academia. Likewise it is beyond the scope to address the thesis of declining quality as the critics of this development often turn to. Embedding the study in a Danish context is both an empirical and practical necessity

history, geography, social studies and natural science (Gerhardt and Meyer 2005)[3] . These distinctions and their disciplinary reputation, power and prestige still exist, though changed completely as well as they are embodied in hierarchies, identities and cultures of reputational capital, e.g. through the art of reference making (Chapter 3). The higher faculties and disciplines differ from lower faculties because they have an immediate purpose or service to provide the state. Kant calls the students of these disciplines *Geschäftsleute,* in that they are educated to serve the interests of the state, not their own personal and free realization (Kant [1798] 1979)[4]. Geschäftsleute of today are sometimes measured in monetary terms as a source of identifying their relative economic contribution to the national economy: Theology, Law and Medicine (servants of the church, servants of the administration upholding the states dominance and control, and servants securing its workers' health). Since Kant the church has been replaced by the market and Geschäftsleute occupying higher faculties are generally technicians and businessmen conceived higher on the socio-economic ladder than say a geographer. Yet it is worth mentioning that both lower and higher faculties are regulated by the state (accreditation), and higher faculties of today (technicians and businessmen) are less regulated than lower faculties – the less contributing faculties to society in monetary terms are disciplined in order to sustain economic growth.

The lower faculties in contrast have no responsibilities in the sense that these disciplines have no purpose or immediate function to serve the government, the church or the market (those in authority). Lower faculties have nothing to offer at first stance: *"It is less essential to the operation of the State"* as Evans (2008, p. 486) phrases it. To Kant of course studies at lower faculties are illuminating/enlighte-

3 Both lower and higher faculties are regulated by the state why both categories are both different from the Anglo-Saxon university tradition and problematic for universities of today. Problematic since all disciplines are regulated by the state, they can also be said to be regulated for the state. In the case of geography (as a lower discipline) the Danish high school reforms (e.g. the Gymnasiereform 2005) heavily regulates the curriculum, much in favor of physical geography (another lower faculty discipline at the time - today a higher ordered faculty). Thus, higher and lower faculties can both be said to be hierarchical organized within disciplines and regulated by the state in securing particular subjects, it be regarded higher or lower or certain subdivision of the distinction.

4 It is worth noting that the dispute between higher and lower faculties later became foundational for the distinction between polytechnic institutions and universities. Polytechnic institutions differ from universities in that the problem based academic work takes part in the form of production. Thus, problems are not necessarily derived from 'truth seeking' e.g. on climate change or conditions of (for) sustainability, but on the form of production and their effectiveness.

ning (idiom to basic research) precisely because lower faculty sciences have no immediate interests and purpose, apart from searching truthful knowledge, new insights, and processes of realization: the pursuit of rational enquiry.

Higher and lower faculties also have common grounds: searching for evidence, valid and true knowledge. Both lower and higher faculties share methods, procedures and academic standards as the means for the conduct of research. Whereas lower faculties have truth seeking as the only purpose, according to Kant, higher faculties, besides truth seeking, are also infiltrated by serving other interests (church, government, agencies or market interests)[5]. This recognition makes Kant conclude that: the dispute between faculties serves as a legitimate process of validation precisely distinguishing scientific knowledge from other forms of knowledge. In that Kant distinguishes between legitimate and illegitimate processes of validating scientific knowledge.

> *"Indeed, the pursuit of truth requires independence of mind and the possibility, the right, and even the duty to criticize accepted notions which are adopted by a given society"* (Thorens 1996, p. 268).

As power of reason (and abstraction) varies between epistemic communities, conflicts arise from the fact that they overlap and investigate a subject from different disciplinary angels. These fights are fully legitimate and to Kant disagreement, rivalry and competition is a key for advancing the research processes. Also fight over standards, methods and criteria e.g. between faculties, disciplines and individual researchers are legitimate as long as it (solely) concerns the power of reasoning: the search for truth (Evans 2008). Illegitimate fights by contrast occur when epistemic communities exclude other epistemic communities from engaging in the scientific debate (individuals, disciplines or traditions as boundary making), when the scientific debate is blurred for non-scientific external purposes, or when infiltrated with other interests than the pursuit of reason and truth. Illegitimate fights then turn into dogmatic justification, evaluation and validation of such knowledge (Kant [1798] 1979). It is worth mentioning that legitimate and illegitimate fights can both be internal within the dispute between faculties and/

5 It needs hardly to be mentioned that medicine also has truth seeking as the highest goal, not necessarily being a problem that the research is funded by particular agencies, disseminated and found useful in society. It is the purpose of scientific findings. In this respect I distance from the elitist project of Kant.

or external. Note how the legitimate and illegitimate fight is not far from what Castree (2000) terms academic activism inside and outside the discipline. With the illegitimate fight in mind, however, we first turn to the external dispute.

As to the external dispute, Kant recognizes that universities are related to the state as a dispute over control and organization of research and education. The state is the ruler, the university is its servant: providing knowledge and *Geschäftsleute* (Gerhardt and Meyer 2005, p. 41). For Kant the purpose in question is how universities can uphold the freedom to conduct research, ensuring truth seeking and a legitimate scientific fight, while being funded by, regulated by and serving the state. While funding is a crucial subject for the relationship between the university and the state, Kant stresses the governmental authority, domination and control (of thought) is the critical factor rather than financial allocations in themselves (Evans 2008). Funding is only a means through which domination and ideological control can be manifested. It is worth noting that in systems where private funding is more widespread these funding schemes are also governed by the state e.g. through tax reduction (Harvey 2005).

Likewise a dispute in itself is non-scientific – an intellectual dispute (and associated power relations) is a means through which results, methods, standards and procedures are scrutinized but, the fight in itself is not 'truth seeking' (in that I distance myself from Kant since I do not conceive intellectual fights necessarily ensure 'truth seeking'). The fight itself only (re)distributes power, control and dominance over truth seeking processes. Hence, asymmetric power relations (internally between researchers, disciplines or faculties, or externally between the university and politico-economic interests) may favour particular social interests rather than valid, accurate and true knowledge. Likewise I should perhaps stress that in contrast to Kant, I conceive no singular and universal truth or any pregiven and absolute truths (see chapter 4).

While new innovations, inventions, insights and knowledge are not always in the interest of those in authority[6], Kant insists that truth and accurate knowledge is in the interest of society as a whole (the commons). Kant draws the conclusion that the external disputes serve another purpose (political fight over resources), hence illegitimate as to the conduction of independent and true knowledge. Yet

6 Private commons as knowledge control can only be validated by those invited by the principal.

there are many other interests in play that blur the distinction between internal and external fights. A case in mind is Bourdieu's symbolic power in academia (homo academicus). It is not solely a question whether the fights are internal and external, but as much a question of who in academia gain the power to define what is to be considered legitimate knowledge (Bourdieu 2004). Bourdieu's symbolic capital is an element of the external and internal fights knitting them together and yet characteristics may be distinct in one or both spheres or within epistemic communities. In chapter 3 I point to the power of making references as a form of symbolic capital in academia and relate it to Foucault's "truth regimes". By doing so, the fight between truth regimes cannot be upheld in the dualistic construct between internal and external fights, but is complimentary to one another. Consequently, it is hard to uphold the 'internal purity' as fully separated from the external (and dirty) reality in practice. The internal fights can be just as dirty, as scientists (internal) studies the (external) world. The truth produced internally in the university system then, becomes externalized (and internalized) when used in practice, whether in the 'politics of earth system governance' or technological innovations, it produces an impact. Academic knowledge is external activism and holds another element blurring the internal and the external, again distinguished from solely being a matter of symbolic capital.

Kant's argument appears as if only external fights hold political elements while the internal and intellectual fight can be freed from such constraints when managed as 'the individual freedom to conduct research'. In chapter 4 limitations of such a stance will be examined in greater detail. While it is hard to uphold Kant's elitist and idealistic project it was exactly to distinguish between the internal and external academic activism (Castree 2000), to ensure the latter. University governance therefore, should be organized in ways that liberate academics at work from external interests, Kant argued. Thus universities, the conduction of research, and teaching must be independent and secularized from the state or any other interests[7].

7 This contrasts to today's Modus 2 and 3 debates. As a consequence Kant's universal truth seeking project confined to the internal dispute aligned to ideas of the ivory tower, today's Modus 1 debate. In contrast to Modus 1, Modus 2 and 3 do not uphold a clear distinction between internal and the external fight. Rather it should be broken down, e.g. as user driven innovation, civic science (modus 3) or enhancing relations and the value of universities' 'production', e.g. between science and industry (Modus 2).

> *"The university whose raison d'être, if one compares it to other teaching and research institutions, lies in its contribution to the development of mankind and society through the search for truth for its own sake and through its preservation and dissemination in training elites, and (…) the fulfillment of its mission of active guardian of high level culture"* (Thorens 2006, p. 96).

Universities' autonomy is a fundamental pillar for the conduction of independent knowledge and the individual freedom to seek truthfulness and valid knowledge. Insofar as knowledge production undergoes an internal fight where lower and higher ordered disciplines critically scrutinize one another, no discipline or individual have full autonomy in validating the quality of own or others knowledge, and yet philosophy had a special responsibility, Kant argued (Evans 2008). Philosophy, Kant argued, has an authoritative role (or higher ordered status) as to the internal fight, since the discipline has no conflict of interests (Kant [1798]1979). Though the argument is respectable, its implications are problematic. First, the very moment a discipline engages in validating applied knowledge on behalf of other disciplines, it is no longer independent. No discipline, institution nor individual researcher can be fully liberated from the societal, historical and geographical context in which they work (see chapter 4). Second, accepting and reconfiguring disciplinary hierarchies exactly suggests that disciplines also serve their own interests. Thus Kant directs power to his own discipline (claiming the high grounds, see Stoddard 1987 in chapter 6), without considering how philosophy will become infiltrated when 'monopolizing' the validating processes of knowledge. Thirdly, the elitist projects of Kant's ivory tower are based on a philosophy of science in which the relation between science and societal development is imperfect and suggesting modus 2 or 3 research approaches as (partly) illegitimate[8].

The recognition makes Kant advocate that academic disputes are not only of outmost relevance to the conduction of research, teaching, learning, and processes of free and independent realization. That is to say that the internal intellectual fights serve the state: as a process of evidence, validation and emancipation to the benefit of humanity (Gerhardt and Meyer 2005).

8 Scientific production and the individual freedom to conduct research is a structural organization of power. Obviously, magnificent and truthful knowledge is created outside the boundaries of academic freedoms. Yet academic freedoms are regarded as one of the central ways in which production of knowledge is ensured the best quality (Thorens 1996, p. 272).

Though Kant concludes the intellectual fight between lower and higher faculties in particular validates knowledge from the latter, he is far from rejecting external state regulation. This is a necessity. As long as the relationship between universities and the state does not interfere with the internal fight, but is managed as an external political fight over size and allocation of resources, (in contrast to defining problems, themes, approaches or theories) the autonomy of universities and the basis for pure reasoning will remain intact.

As regulation of higher faculties is complex and subject to governance and control over the relevant competences, the management of lower faculties is simple, Kant suggests. The reason is that the only regulating force concerning lower faculties is reasoning: Critique of Pure Reason (Evans 2008, p. 484). It is symptomatic to note that Kant leaves space for theology in modern science. For now, however, it is enough to note that Kant upholds the academic division of work into disciplinary constructs as the core of serving scientific fights. I shall return to interdisciplinary academic spaces at the end of the chapter.

Though dictums from the church can be said to have been replaced by the market, it is important to stress that the dynamics of the latter are fundamentally different[9]. While Castree agitates for academic independence he does not share the same vision of an 'ivory tower'. Rather it is neither desirable nor possible *"A principal function of universities is not only to create new knowledge (concepts, arguments, evidence, etc.) but also to ensure that this knowledge travels beyond its originators so as to participate in the drama that is human existence on the planet"* (Castree, 2014, p. xxiv).

Before I examine academic climate(s) and implications for sustainability analysis under neoliberal changes, I shall first address the academic dispute over climate change in between an internal and external (il)legitimate fight.

9 As the church has no relevance on university governance in Scandinavia I do not consider relations between the state and the church. Yet in claiming the church has been replaced by the market, it is important to stress the governmental dynamics are fundamentally different. As to the external power influencing research and education, dictums from the Church were based on religious dogmatism. They can so to speak be replicated for centuries with only little change. Ideas of the market as an external power influencing research and education, in contrast, is less controllable, transformative and with ever changing dynamics – hence the circumstances under which the competitive game takes place. Though (market) competition is a competition (fight) against others to preserving business interests, it is very different from an academic dispute (competition on truth seeking).

2.2 The Dispute over Climate Change

Chapter 1 addressed responsible geographies concerning the anthropogenic climate thesis. As researchers produce knowledge that shapes thinking, imaginations and future actions in ways that are particularly delicate on the matter of climate change, universities have a particular responsibility, it was argued. As ordinary people (or experts), we are not only sensible when judging the premises and circumstances in which the 'climate war' takes place. As non-experts we (as individuals, politicians, citizens, students or researchers) are fundamentally dependent on the claims and interests of others (e.g. climate researchers, Universities, IPCC, think-tanks, private laboratories, media enterprises) both in shaping our own positionality and in the reading and writing of different aspects of global environmental change (Castree 2014, p. xvii). These mediated climate writings are sometimes referred to as third nature. Third nature in contrast to first and second nature (see Glossary) is represented through television, magazines and the media industry, providing images as powerful means in shaping opinion and believes about nature (Braun and Castree 1998). Media construct stories and narratives on climate change readily to be consumed. They perform social narratives (not necessarily critically reflected, scrutinized and realized by the reader) that may be further mediated in debates and conversations, as socially transferred stories, that according to Braun and Castree preserve the interest of the writer. Now one could suspect that third nature is always entangled as an external fight[10]. Chapter 3 however examines third natures within the academic practice of reading and writing. With the internal and external fight in mind however, (the organization of knowledge production) I first address 'wars over reading and writing the climate' and academic responses to it. In so doing, I consult the scientific consensus thesis on climate change (chapter 1) and discuss it in between a legitimate and illegitimate fight.

In November 2009, University of East Angela's Climate Research Unit (RCU), one of the major British research institutions concerned with natural and anthro-

10 This is far from the case. Scientific knowledge on the matter of climate is also written and disseminated (inform policy maker perspective about the state of the climate, see chapter 1 and 8) in reports or mediated through students. Third nature being transferred through media enterprises or through other forms of dissemination e.g. of scientific knowledge, are quite different exercises, but the latter can nevertheless hold an element of third nature (though the student researcher relationship in lectures or seminars may hold an element of dialogue to raise critical awareness).

pogenic climate change, was hacked. Just prior to the Climate Summit in Copenhagen (2009), more than 1000 emails and 3,000 other documents from climate researchers were leaked (UK House of Commons 2011, p. 5)[11] and underscores the controversy over climate change to be a political minefield (e.g. Lomborg). It remains unknown by whom and why the research unit was hacked. Yet, one can be certain that it was not in support of the unit, their work, nor validated their scientific results on scientific premises. Rather it aimed to question the validity of the anthropogenic climate change thesis as conspiracy from science itself and thus to effect discussions over third nature. *"Contributors to climate change debate websites and written submissions to the former Science and Technology Committee claimed that the leaked material showed a deliberate and systematic attempt by leading climate scientists to manipulate climate data, arbitrarily adjusting and "cherry-picking" data that supported their global warming claims and deleting adverse data that questioned their their theories"* (UK House of Commons 2011, p. 6). The assault was external and illegitimate, disconcerting to the unit, its researchers and to 'science' itself and illustrates the relevance for upholding a distinction between the internal and external dispute. As Martin Rees, President of the Royal Society, expressed: *"It is important that people have the utmost confidence in the science of climate change. Where legitimate doubts are raised about any piece of science they must be fully investigated – that is how science works. The Royal Society will provide advice to the University of East Anglia in identifying independent assessors to conduct this reappraisal"* (Royal Society 2010). Two years later, the UK House of Commons' Science and Technology Committee (2011) finished an internal scrutinization of the episode. The committee found the internal fight legitimate with 'rigor and honesty', but noted that it is careless and inappropriate to share unpublished manuscript with third parties (UK House of Commons 2011, p. 24). Third parties in this context are actors not directly involved in the research process (e.g. business, NGO's, governmental agencies or Think Tanks), hence external and potentially subject to blurring the legitimate fight. The leak occasioned a wide public debate, where different stakeholders (particularly in favor of climate skepticism) argued that scientists were manipulating data to 'make' climate change happen, rather than searching for legitimate, accurate and true knowledge. It is in this light the position papers from Scientific Associations listed in Chapter 1 (box 2.1), are both part of a general dissemination of scientific knowledge, and subject to writing political ecologies over future climate(s).

11 See Giddens (2009) the Politics of Climate Change for an examination of the UEA case.

Box 2.1: UK Meteorological Office (MET) Statement in Response to the Hacking at University of East Angela's Climate Research Unit

"We, members of the UK science community, have the utmost confidence in the observational evidence for global warming and the scientific basis for concluding that it is due primarily to human activities. The evidence and the science are deep and extensive. (…). They come from decades of painstaking and meticulous research, by many thousands of scientists across the world who adhere to the highest levels of professional integrity"

(UK Met Office, 2009, p. 1)

As to the specific leak scientific responses followed in defense of science (Box 2.1). By way of illustration the UK Meteorological Office (Met) made a statement in response to the stolen emails from University of East Anglia's Climate Research Unit (UK Met Office 2009). The statement, in defense of science and scientific methods, were signed by 121 British Universities and 1700 scientists signed to highlight the accuracy and rigorous scientific evidence (Box 2.1).

Also the US National Academy of Science (NAS) responded to the hacking of climate scientists at work. In a statement signed by 255 members of NAS the organized power of scientific response(abilities) both defend the politico-ecological agendas set by the pursuit of knowledge on climate change and the legitimate and internal fight; the scientific climate under which scientific methods, standards, approaches and its integrity are shaped (Box 2.2). At first sight this is paradoxical. The statement rejects 'public' criticism and yet criticism is part of any scientific method. The problem to the UK Met Office, NAS and approx. 1900 researchers signing the statements, however, is that the 'public' criticism is external and should be subject to the same scientific standards: processes of scrutinization, examination of the empirical basis upon which claims are made, double blind tests, peer-reviews and so forth.

Research undertaken under the intergovernmental panel on climate change (IPCC) by contrast, demonstrates an extensive internal fight (always legitimate?), both within the body itself and between faculties (other research units, universities and individual researchers). Giddens for instance makes the argument that more than 2500 scientists, reviewers and authors from 130 countries have contributed to the latest work undertaken by IPCC, all subject, peer review, evaluating pro-

Box. 2.2: Climate Change and the Integrity of Science

"We are deeply disturbed by the recent escalation of political assaults on scientists in general and climate scientists in particular (…). There is compelling, comprehensive, and consistent objective evidence that humans are changing the climate in ways that threaten or societies and the ecosystem on which we depend. Many recent assaults on climate science and, more disturbingly, on climate scientists by climate change deniers, are typically driven by special interests or dogma, not by an honest effort to provide an alternative theory that credibly satisfies the evidence. The Intergovernmental Panel on Climate Change (IPCC) and other scientific assessments of climate change, which involve thousands of scientists producing massive and comprehensive reports, have, quite expectedly and normally, made some mistakes. When errors are pointed out, they are corrected. But there is nothing remotely identified in the recent events that changes the fundamental conclusions about climate change"

(National Academy of Sciences: Letter published in Science magazine, May 7 2010, p 1).

cedures and a heavy scientific fight. Yet, the anthropogenic climate change thesis (chapter 1) has manifested a scientific working climate where space for critical intervention, e.g. from climate skepticism within a legitimate internal fight, are limited, according to its critics (see below).

As to the tension between the internal and external fight the letter from NAS (box 2.2) suggests the former is legitimate and predominated by those in advocacy of climate gradualism, the latter illegitimate, typically occupied by voices in advocacy of climate skepticism[12] *"Most of the skeptics' attack can be immediately dismissed for a number of reasons that are not science-based. Some sceptics are funded by special interest groups, often fossil fuel lobby groups that have much to loose if fossil fuel use is significantly reduced. They often use cherry-picked data and flawed logic to cast doubt on science involved"* (Oldfield and Steffen 2014, p. 71). The 'climate wars' and the external critic of scientific evidence are characterized by being or-

12 By contrast to the scientific consensus thesis on climate change no such consensus thesis can be found in external 'wars' over the writing of climate change. For the external fights, 52 % of the Americans for instance, believe that global warming is taking place ('scientific fact') and that it is mostly human caused (Leiserowitz et al., 2014, p. 7). According to the survey from Yale and Georg Madison University, "half of the Americans (52%) think that global warming, if it is happening, is mostly human caused. By contrast, one in three (32%) say they think it is due mostly to natural changes in the environment" (Leiserowitz et al., 2014, p. 7). By contrast Oreskes (2004) and Cook et al., (2013) suggest that 97 % of peer reviewed articles on climate change find it to be mainly caused by human activities (see chapter 1).

chestrated on political, not scientific grounds and when claimed to be based on scientific grounds (hence internal and legitimate), it is funded by agencies with particular (business) interests mediated through so-called think tanks or private research institutions (knowledge for sale perspective). By way of illustration Newell (2000) and Muttitt (2003) show how particularly the oil and coal industry and their lobby organizations have been directly involved in activities with the aim to undermine the evidence of climate scientists. Through surveys of their literature Newell (2000) suggests these 'think tanks' have not only been well funded and well organized by various lobby groups, they have been established with the main goal to make sure that *"climate change becomes a non-issue"* (Newell 2000, p. 98). So far, the external fight and illegitimate strategies used in the climate "wars" have made no impact on the anthropogenic climate change thesis among scientists (chapter 1). Nevertheless, the external fight and assault on climate change research demonstrates the danger of the knowledge for sales perspectives, precisely because the external (principal in authority) political battlefields over 'writing' and envisioning future climate(s) seek to intervene in the management of scientific of knowledge (agent/researcher), with pre-defined results or results serving the interests of those in authority.

Now one could think with the consensus thesis in mind that climate skepticism is illegitimate. This is not the case. Climate skepticism can be both legitimate and illegitimate as well as 'results' in favor of climate gradualism, climate catastrophism or any other perspective. Climate skepticism, climate gradualism or climate radicalism, can be fought both on an illegitimate and legitimate basis in the nexus between internal and external fights. Climate Skepticism (or any other perspective) based on an internal and legitimate fight e.g. represented by Charles Greeley Abbots or Henrik Svensmark is absolutely crucial (e.g. stemming from inter-planetary activities like sun spot activity). It does not only question established truths (or dogmatism), as that of the apparent scientific consensus on anthropogenic climate changes, but also enhances the pursuit of scientific evidence through rivalry over competing explanations. Thus, if spaces for climate skepticism and critical intervention are diminishing within academia, it is also narrowing the purpose of 'lower faculties' that secure valid, evident and truthful knowledge according to Kant's text.

In consulting the legitimate and illegitimate fight, the consensus thesis on climate change (see chapter 1), nevertheless suggests, there is little internal fight

over the reality of human induced climate change. While the consensus thesis on anthropogenic climate change seem to change toward a 'fact', controversy continues to exist on the societal implications, tempi and consequences of these changes, the methods, approaches and dynamics in modeling and explaining them (Oreskes 2004). In the light of the consensus thesis Karl Popper have stated that all knowledge claims (and their practical consequences) are only valid, if they withstand 'never ending' criticism, from all sorts of theoretical angles, traditions, and approaches. Only then, new insights can be accepted as valid knowledge. For more than a century and since Spotswood Wilson (1858)[13], John Tyndahl (1872), Svante Arrhenius (1896) and the establishment of IPCC (1988), the internal fight over anthropogenic climate change has deeply tested, questioned and examined the thesis. Evidence to support or reject the thesis has gradually been found robust enough in wide epistemic circles, to transform toward a 'scientific fact' (see chapter 1).

In contrast to Kant that emphasized the role of lower faculties of particular importance to the fight over and completion between truthful explanations, it is precisely because of the (political) implications that the climate change thesis has been subject to such extensive review process and scrutiny (the internal academic dispute). How struggles over climate change and the scientific climate contingently play out, facilitate or hinder possible sustainability futures as academic activism from within and without, will be subject to analysis in the remaining part of the chapter. In particular it is addressed what ideas of the knowledge economy are related to academic responses concerning climate change or sustainability analysis in geography. How does the knowledge economy affect climate(s) under which academics work, and how do (critical) geographers respond to it?

13 J. Spotswood Wilson's article (1858) 'On the General and Gradual Desiccation of the Earth and Atmosphere' is known as one of the early contributions on emissions of greenhouse gases and their possible implications. During the 1890's the work of Arvid Högsbom and Langley, in comparing CO2 cycles in nature with industrial emissions makes Svante Arrhenius (1896), calculate that a doubling of CO2 in the atmosphere will lead to global average temperature increases of 5-6 degrees. A halving of atmospheric CO2 would decrease global average temperatures between 4 and 5 degrees. Because of the emission data from 1896 he suggests that global warming will take more than thousand years and be beneficial to humanity.

2.3 The Dispute over Academic Climate(s) – Regimes of Accountability and the Disciplining of Academics at Work

"If it can't be measured it doesn't count", so said a university rector when interviewed on the relevance of sustainability in higher education in negotiating with the government (Interview, Pam Freedman).

While universities have always been tangled and governed in between the market, the state and other authorities, governmental structures under which universities work has changed considerably since the 1980s. As universities have grown in size their importance to the so-called knowledge economy equally grows. Universities have increasingly been recognized as engines for economic growth and studies of the marketization of universities are often organized around various aspects concerning private/public funding (ownership and partnership), internal and external financial pressures (Pinheiro et al., 2014)[14]. Another entrance point comes from STS studies and 'technologies of power' as an organizing principle of academic life (Lave et al., 2010), BFI being an illuminating example (see below). A third angle discusses the commodification of scientific knowledge; patenting, licensing, and 'knowledge for sale' (Slaughter and Rhodes 2004). A fourth perspective addresses student and staff mobility in the forefront of wider globalization processes imposing institutional change (Howells et al., 2014) by ways in which the commodification of higher education forces students/staff to also move (geographically and/or mentally) where the money is. Also human geographers have pointed to the consequences of 'neoliberal times' and the scalar politics affecting academics at work (Paasi 2005, Castree et al., 2006, Dowling 2008). For the purpose of this dissertation, I draw on the 'critical geographical' tradition represented by Castree. Few geographical studies however explore sustainability in relation to the corporate agenda of universities (Higgitt 2006 and Maxey 2009 being an exception in the British literature) in a Nordic context.

Since corporate discourses of Danish universities do not have a date of issue, Aagaard (2011) and Gorm Hansen (2011) characterize it as an epochal process

14 The concept of knowledge economy has been heavily promoted by the OECD and the World Bank. OECD and the World Bank have launched so-called performance based indicators based on statistics that spatially create a competitive system where countries are ranked according to their relative performance as 'knowledge economies'. See e.g. the World Bank's Knowledge Economy Index (www.worldbank.org/kam).

from the 1980s. Gorm Hansen (2011, p. 161), Aagaard (2011, p. 368), and Andersen (2014, p. 1), among others, find that a set of reforms ties universities and the corporate world together in ways that the past decade demonstrates a neoliberal turn in Danish research policy. Andersen (2002, p.80) calls the governmental transition a break with 500 years of democratic governance at the university, being the largest change since the opening of Copenhagen University in 1479[15].

According to these authors New Public Management (NPM) models have been implemented (Aagaard 2011, p. 424), reforms have imposed market-like competition within public funding (Box 2.3), discourses in favor of market competition have become mainstream, competition over external funding has increased and new accounting practices focusing on cost-effectiveness to the knowledge economy have become commonplace (Auken and Emmiche 2010).

Box 2.3. Market like Allocation of Public Funding

The model designed to allocate extra means of Basic public funding establish market competition over public in ways that 25 % is allocated through published research output (BFI), 20% on the basis of external funding (the ones good at fundraising are economically rewarded), 10 % on the production of Ph.D. students and 45 % after the STÅ system (Auken and Emmiche 2010) . The Danish Government regulates the university sector with a 2 pct. annual reduction in the total contribution from the state. With respect to public funding of the STÅ system (STÅ = full-time student equivalent) universities face declining STÅ-revenues due to lower "taxi-meter" rates resulting in lower 'revenue per student'. As the state has administrative control over the total number of students enrolled at Danish Universities, the student reduction plans (2014) it imposes pressure on financial stability, hence increasing competition and reliance on external resources.

15 The professor kingdom (Professorvældet) until 1968 was not democratic at all. Rather the elitist university (ivory tower) was organized as a feudal system in which the internal power relations were fundamentally hierarchical. Thus, universities were organized as a feudal system prior to 1968, highly problematic to Kant's ideas in practice. It may only be a short period from 1968 or so, an internally democratic system was put in place. By the university reform of 2003 the internal democracy was replaced by external representatives, NPM and top-down structures. Today external board members coming from the business community occupy the majority of the board of directors at Danish universities. Also the election of the university management (e.g. rector) is no longer democratic within the university.

Although discourses on the subject are growing and market like governance structures have been put in place, it is hard to think of any other sector being more regulated. Insofar as one can speak of an actual marketization of Danish Universities, more bureaucracy follows. Academic capitalism is defined as the market driven or market like universities that generate external revenue from education and research (Slaughter and Rhodes 2004). In a Danish or Scandinavian context the term is inadequate since the university system is not subject to these practices. Nevertheless, competition over funding and students are becoming more important for the financial sustainability of universities, hence market-like governance structures with indirect markets, institutional and individualized competition, e.g. self-promotion, fundraising and brand like activities. Though the Danish system has undergone profound changes during the past decade, there are no student fees and you can only speak of the creation of market-like competition within public funding and marginally greater reliance on external funding. Likewise publish or perish systems are not yet part of the Danish University System. To speak of an actual neoliberalization of Danish Universities, therefore is far from the case. Yet, *"If, in even only a general sense, the idea of a knowledge society holds good, then it obliges us to look again at the functions of the university as well as the wider context in which it now operates"* (Castree, Demeritt and Liveman 2009, p. 12).

As government policies and new administrative systems do not necessarily seek to influence academic freedom, it has nevertheless narrowed the academic space, thinking and modes of production (From Science to Invoice, Patents, Development of Research Councils toward more strategic management of science). Critical geographers have pointed to the growing salience of govermentalities and subject formations changing the ways in which scientists work (Dowling 2010)[16].

Like Kant found the governance structures and funding schemes a crucial subject, authors like Castree and Sparke (2000) also stress that it is not financial allocation in itself that is of interest, but the performative character that follows. Likewise, it is not the creation of market-like competition of universities that is the problem in itself, but the increasing political/ideological management, control and

16 Any university system involves particular governmentalities. It is not so that no govermentalitie(s) exist under ideals of the Humboldt university system. Critics of the corporate agenda are often orchestrated as if scientists come from a powerless space in a vacuum governed by: the romanticism of pre-capitalist universities. Power structures are just reconfigured through new means of organizing and valuating scientific work in contemporary society.

regulation over the internal fight that follows. Like Kant problematized external pressures from the state, Harvey and Castree (e.g. Harvey 1974a, Castree and Sparke 2000) problematize how the state is a primary agent promoting market-based solutions in ways that change education from a public toward a private good[17]. Neoliberal ideologies have also arisen from within universities as well and even critical geographers by their critics both occupy subject positions that they benefit from and reproduce neoliberalism themselves (Sheppard in Castree et al., 2006, Berg 2012).

In the following therefore, I do not intend to examine the epochal changes nor the form of appearance e.g. BFI accountability, ranking and audit systems (Auken and Emmiche 2010), creation of market-like competition in public funding (Aagaard 2011), ideas of strong leadership, grand writing and the new academic fundraising cultures (Gorm Hansen 2011), or the increasing level of temporary positions (Rigsrevisionen 2012)[18]. Rather it is the form of realization and how it is related to conditions of sustainability analysis in academia, both as internalizing and externalizing processes.

The co-production of governmental changes must also be considered and how they do not only give form but are also performative to and shape contents (see Castree et al., 2006). Thus it is the dual character and how governmental re-structuration transforms academic cultures within and beyond the university

17 In 'A brief History of Neoliberalism' Harvey (2005, p. 162) examines how the state is a primary neoliberal agent in the case of British/American university policy. "The advocates of the neoliberal way now occupy positions of considerable influence in education (the universities and many 'think tanks'), in media, in corporate boardrooms and financial institutions, in key state institutions" (Harvey 2005, p. 3). Critics of the corporate agenda in the Anglo-Saxon literature argue "it has resulted in a new capitalist academic social order of inequality and exploitation, in ways that challenge the common conception that academics should be motivated by the pursuit of new knowledge and the elevation of learning over profit" (Hoffman 2012, p. 12).

18 In 2012 The National Audit Office of Denmark (Rigsrevisionen 2012) critiques the increasing use of part time lecturers, assistant professors (adjunkter) or graduate student instructors to undertake "research based education." Among the critics of the neoliberal agenda, temporary staff (cheaper and less qualified) is often used as an indicator of 'neoliberal universities' (Hoffman 2012, p. 13). Other indicators that the critics in the Anglo-Saxon literature often point to (e.g. Lave et al., 2010) is a tendency to reliance on a higher private funding ratio, higher student fees, a globalized market on knowledge for sale, a tendency to the winner takes it all, increased competition between universities (financial resources, reputational resources, the most talented student scientist), calculating students investing in degrees and shopping for qualifications and so forth.

that is of interest. Henceforth, we turn to academic governmentalies in relation to sustainability analysis.

2.3.1 Contested Ideas of Sustainability and what it Means to the Corporate Agenda of University Management

Insofar as the external fight is internalized to the university management, it is designed to measure the importance of knowledge transfer into the knowledge economy. In consequence the dispute between faculties is as much an external and internal fight between academia and the administration of it as well as a fight over the management, jurisdiction and control over the academic fight. In the following I consider two examples to build my argument of how these administrative processes change conditions for sustainability analysis in academia. First I consider the Danish Bibliometric Research Indicator, BFI[19] (equivalent to the Research Excellence Framework, REF). In so doing I set a more abstract debate of the ways in which auditing produces particular modes of thinking about (un) sustaianability(ies) from within, often without academics become aware of it. Secondly, I consider conditions for the internal (inter)disciplinary fight to illustrate that both examples are subject to internalizing and externalizing processes determining conditions under which the fight over contested ideas of sustainability become apparent.

The Danish bibliometric research indicator (BFI) is an illuminating example of (dis)accounting practices that both projects internal and external pressures of academic fights changing the conditions under which scientists work.

Assumed to measure the output and productivity of scientific knowledge production, notions of quality and excellences are reduced to articles published in journals that meet the requirements according to the BFI list (the methodology of measuring quality is paradoxically undertaken through quantitative methods). The quantitative output of scientific knowledge is measured as papers published in specific journals and translated into BFI points (0.5 up to 8) according to a number of criteria (Auken and Emmicke 2010). Note that journals indexed in the BFI list with the highest points (impact factor) are mainly Anglo-Saxon hence

19 The beauty about ranking, meriting and auditing systems is that they can be a measure for the level of bureaucracy itself. Insofar as these schemes measure cost-effectiveness, it is somewhat contradictory that universities face more and more regulation due to the very same measurements imposing a new culture of administrative and governmental control.

intimately linked to the academic governmentalities imposed by the REF. BFI points are converted into monetary forms, transferring money to the institution at which the scientists work. Hence, the BFI system creates an individual monopoly rent, institutionally marketable and ready for extraction affecting the financial sustainability of universities. As the individual researchers know how many points they have 'acquired' each year, and as the administration recognizes (and is able to individually account them) the value of these points, it creates a certain form of governmentality. These apparently objective, technical administrative systems have progressively imposed 'the law of monetary value' (see Castree et al., 2006 for REF) onto the university system with the aim to measure the output and quality of research (Auken and Emmicke 2010). Thus, the performativity of these appealingly neutral merit systems produce a particular form of governmentality (though they are set in place to produce excellence) that intensifies economic thinking as a rubric of subject formation, actions and responses forming and form academic govermentalities allowed through technology of power (Dowling 2008, Berg 2012). It follows that scientific work is no longer solely valued internally for its quality and externally for its usefulness, but in monetary terms, as an assumed improvement of injecting marketable knowledge, improving 'academic competivity' in the assumed global competitive system. Henceforth BFI (ranking and impact factors) performs changing networks that constitute particular power relations (ACME, Editoral collective, 2007) in ways, that subjected to Kant's theorem inflicts an illegitimate fight (the political fight/competition over resources) rather than insuring the fight between faculties (academics). The internalization of external pressures to academics at work does not only transfer the validating power inherent in the dispute between faculties toward the editors and reviewers of journals, designers and administrators of these auditing schemes, but also produces new subject formations as measuring a given piece of academic work (Castree et al., 2006) changing conditions for sustainability analysis (Dowling 2010). As academics are becoming subject to fundraising activities, BFI or student fishing for the institution or for 'own survival', academic governmentalities change toward fulfilling the recruitments of performing factors (illegitimate and external fight) rather than solely searching for truth and the highest quality in education and research (internal and legitimate fight).

What I have argued so far is that the increasing level of administrative/political/ideological control produces an asymmetry between academics and the management of these academics, as to the relevance, significance and quality of their

work. Insofar as the administrative level advances governmental authority over the quality of academic work, these judgment practices are illegitimate in Kant's sense, precisely because the power balance is shifting the internal dispute toward administrative bodies. Academic self- governance and its relative autonomy (governmentality) become narrowed as the researcher or student have to live up to externally defined criteria for quality, impact or relevance that replace particular interests with the pursuit of personal, independent and free knowledge. Hereby we face a double bias in that the structural changes under which knowledge production takes place, influence the forming of scientific thesis and premises within a profit seeking mode of imagining problems, challenges and possibilities. Under such disciplining regimes, financial sustainability is of outmost relevance to the university management (Appendix 2.1). Accounting schemes do not only capture the colonization of higher education by market driven interests, but also the public private boundaries in which normative assumptions of academic life are being transformed (Berg 2012). Hence the fundament upon which scientific claims, quality, and relevance are based is changing. Facing the supra complexity of climate change, (scaling from the body to the atmosphere) also commodity sustainability dilemmas in academia and how academics actively respond to it (Maxey 2009, Dowling 2010).

As research funding in meeting socio-environmental challenges grow, it is somewhat contradictory to the claim that these accounting schemes narrow spaces for pluralism and in scientific analysis of say sustainability. Rather than asking if there is space for sustainability analysis, the question is what kind of sustainability analysis the accounting, indexing and ranking practices produce. *"If, through financial or other levers, a discipline is steered heavily by outside interests, then there is the strong possibility for a reduction in epistemic diversity and the rise of new paradigms in Kuhn's original, subject-wide sense"* (Castree, Demeritt and Liveman 2009, p. 12).

2.3.2. Internal Dispute, Externalized Competition and (inter)Disciplinary Academic Spaces of Work

Chapter 1 reflected on geography through the binoculars of Mackinder. It argued how disciplines like geography is under pressure. Insofar as the internal dispute in examining socio-environmental change has intensified (e.g. earth science, climate research, sustainability science, geography or similar disciplines) interdisciplinary spaces are most welcomed in Kant's perspective. With the dispute between faculties Kant particularly addressed disciplinary biases (monopolization of truth within

disciplines or traditions) by subjecting disciplinary knowledge with interdisciplinary scrutinization (knowledge claims at all scales be it subjective, institutional or disciplinary). It follows that fights in disciplinary space produce disciplinary 'truths' and when subjected to scrutinization in interdisciplinary space, new modes of 'truth finding' emerge. Kant's project is both reflexive and intersubjective (Gerhardt and Meyer 2005). He sought to overcome the organization of higher and lower faculties by challenging disciplinary hierarchies. The argument contrasts Evans (2008) in that he finds Kant upholds disciplinary constructs, never being able to go beyond them. Disciplinary constructs, however, constitute and is constitutive of interdisciplinary dialogue (see chapter 4). It follows that ensuring dialogue between faculties fosters interdisciplinary spaces of organizing academic work better ensures the free pursuit of knowledge at all scales (interdisciplinary truth). In terms of academic spaces for geography therefore, it is most welcomed, that geography does no longer uphold its disciplinary raison-d'étre, due to the academic division of labor (see chapter 6). Spaces for geography (different from academic spaces and their geographies), therefore internally depend on the development of related disciplines (Thrift 2002). But first and foremost it is the disciplines own ability to pursue the highest quality and by being able to come with relevant disciplinary angles to the interdisciplinary academic dispute (this reproduces disciplinary citations, ranking and indexing).

As Kant found that uneven (disciplinary) academic spaces weaken the internal academic dispute/competition, a number of studies (Paasi 2005, Castree et al., 2006, Wells et al., 2009, Berg 2012) demonstrate that accounting schemes equaling to the BFI produce uneven, yet globalized (inter)disciplinary geographies (Appendix 2.1). These authors point to a hegemonic and geographically uneven (Anglo-Saxon) knowledge production, less likely to accept localized and contextual work. In the same vein Rafols et al., (2012) empirically illustrate how the REF system structurally produces a bias against interdisciplinary research, but in the case of business studies. Across journals, Lee (2006) argues it is generally harder to get interdisciplinary work accepted, due to the fact that the culture of reviewing processes are often of disciplinary origin. As Thrift (2002) notes, a young say physical geographer in his/hers publishing strategy needs not only to consider impact factors and BFI scores, but is less likely to publish in a human geographical journal, since there is no audience (possible quotations) for one another beyond their specific journals. Thus, the interdisciplinary disadvantage is also disciplinarily manifested. As Wells et al., (2009) mentioned:

> *"The RAE has come to so dominate British academic life that there is little incentive or reward for any other activity, be it teaching or local engagement, or any form of publication outside the mainstream, top-ranked, academic journals. It needs hardly be added that there are no environmental journals ranked within the British business and economics disciplines, or highly ranked generally [18]. Given that individual career prospects are also heavily influenced by publication in top ranked academic journals, there is a 'double bias' against engagement on local RSIs: they involve a subject matter that is not recognized as a legitimate and defined field of activity within the discipline of business, economics and management in academia; and by their local and practical orientation they are less likely to form the basis of a publishable piece of work in a leading international (by which one can often read 'American') journal"* (Wells et al., 2009, p. 1119).

As the current REF or BFI system designed to influence publishing strategies so researchers go for the highest credit (rational instrumentality), it does not award time consuming activities (fieldwork), engagement, collaboration or dialogue within the broader society (public lectures, action research) fundamental for sustainability analysis. The geographical dimension of research allocation, say from a regional body in Denmark, faces contradictory elements in terms of the geographical distribution of research output. The globalized hegemonic academic cultural space imposed by schemes like BFI rewards publication in prestigious international journals, not transferring knowledge back to the region. Thus national or local funding and the system to measure value for money reward different spatialized governmentalities (Paasi 2005). Against this background Maxey (2009) argues that spaces for academics to set the research agenda themselves is diminishing hence spaces for academic activism and radical research. Thus, spaces for alternative modes of dealing with sustainability diminish, Maxey (2009) concludes.

Securing the university's financial sustainability for conducting research and education aligns to Castree's advocacy for taking the fight in our own households. What Castree (2000, 2002) argues is that academics must challenge the neoliberal restructuring of higher education by doing academic work that *"makes universities less sausage factories and more institutions where critical thinking is not grist for the next peer reviewed article"* (Castree 2002, p. 108). Likewise Hudkinson (2009) argues that for those academics who believe in the fight for environmental and social justice, it is by making academia a secure space with care for learning (Hudkinson 2009, p. 463). Facing agendas affecting sustainability analysis urges us to

ask such questions addressing both conditions for the internal scientific climate and the external dispute over possible sustainability futures.

2.3.3. Contested Ideas of Managing Sustainability and What it Means to Academics at Work[20]

Wherever universities are, there is an intellectual dispute. Humboldt's university reforms were indeed designed to spiral such intellectual fights (Gerhardt and Meyer 2005). Universities are of course still places where researchers set different agendas individually and collectively. By defining financial sustainability as an organizational concept, I take a perspective that addresses the academic division/organization of labor in relation to sustainability analysis. In so doing it is the sustainability of academic spaces that is my concern or rather how the academic space organizes sustainability analysis. Maxey (2009) and Higgit (2006) addresses sustainability in the context of neoliberal universities and demonstrates how the greening (university) agenda often parallel neo-colonial corporate agendas (ecological modernization, market environmentalism). For Maxey (2009) sustainability becomes a critical platform synonymous with academic freedom. For him the individual student's and researchers academic freedom best serves the sustainability agenda. Hence sustainability in academia hold the Humboldt University as an ideal. This require flatter and more horizontal structures, ensuring the external and interdisciplinary dispute, in contrast to hierarchical and neoliberal forms of organizing and managing knowledge productions, including corporate sustainability agendas (Maxey 2009). As Mansfield (2009) puts it, the power of representation is never far from the rivalry over defining or incorporating (infiltrating) sustainability into academia, both as a cumulative strategy for improving the universities images and as a concept for critical analysis. Both neoliberal and different critical discourses demonstrate a fight over defining the core of the concept, legitimizing different agendas of sustainably. I recognize the importance of the fight over different versions of sustainability and its possible meanings. A complimentary approach I argue is equally important. A complementary approach in advocacy for the interdisciplinary and academic spaces under different sustainability analysis and agendas are fought.

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20 recognize the analysis set is embedded in an Anglo-Saxon based literature only partly relevant to the Danish university system being fundamentally institutional and that the sustainability is addressed as an organizational concept. Accordingly, its presumptions and theoretical depth are of institutional origin. In Part III, however, I examine the individual teacher's beliefs on the relevance, explication and conditions for sustainability

A complementary approach needed concerning sustainability analysis in academia. As Massey calls for a global sense of place she challenges the *"understanding that we care first for, and have our first responsibilities towards, those nearest"* (Massey 2004, p. 9) scaling from our body, home, city, region and the state toward less 'caring capacities' (carrying capacities) at the global scale. Noting that 'global space' is no more than the sum of relations, connections, embodiments and practices (Massey 2004, p. 9), she calls for an alternative and relational (interdisciplinary) policy of space. Through these lenses the integrative and relational dimensions "*is as much about managing ourselves and each other as managing resources, the sense we make of ourselves can limit or leverage sustainability achievements"* (Clarke and Clarke 2012, p. 571).

Box 2.4: Academic Institutions and 'Sustainable' Response (abilities)

"At UBC, sustainability is not just a word to define – it's a word that defines us. Through our collective efforts in education, research, partnerships and operations, UBC advances sustainability on our campus and beyond. Our goal is to commit, integrate, demonstrate and inspire"

University of British Columbia, Strategic Plan – Place and Promise, 2014).

A complementary approach that, is to cultivate interdisciplinary discussion is transformative and integrative academic spaces and thus spurring academic fights over climate change and sustainable approaches to it. Sustainability is condemned to the interdisciplinary approaches questioning the deep social, political economic and socio-environmental transformation if it is to address responses and responsibilities that shape utopias to navigate upon (Box 2.4).

As Harvey argued forty years ago *"there is the task of building a genuinely humanistic literature which collapses the artificial (almost schizophrenic) dualisms between fact and value, subject and object, man and nature, science and human interface"* (Harvey 1974a, p. 24) Sustainability is one of the concepts aiming at just that.

2.4 Conclusion

The chapter argued that the ways in which different notions of sustainability analysis are perpetuated in academia, both mobilize neo-liberal interests that accelerate thinking of universities as marketable entities (organization of academic space) and simultaneously serve as a concept for alternative and radical critics concerning socio-environmental change and the commodification of academia. Insofar as the external fight is internalized to the university management, policy agendas and governance structures are part of addressing the introduction, use and explication of sustainability analysis in academia. Through the marketization of universities, I address how this is also internalized into academic sustainability analysis.

The corporate idea of university management (e.g. through sustainability) is gaining terrain in the 'knowledge economy', and so ideals of the Humboldt University is narrowing. Then it was argued modern universities face a fundamental tension in addressing sustainability response(abilities), tied up between scientific and educational processes in searching for scientific knowledge and securing the financial sustainability (independence) for educational and scientific purposes (through marketing, branding and reputational capital). This will be subject to analysis in chapter 6 where mainstream sustainability in higher education debates, e.g. in journals like Cleaner Production or Sustainability in Higher Education, orchestrates marketization of sustainability. This is relevant precisely because sustainability is a buzzword that legitimize different agendas in academia. As both processes hugely influence and (re)scale notions of sustainability and pre-fill positions often without being aware of it, chapter 3 addresses academic governmentalities affecting the art of making reference to the socio-natural. As discursive strategies tend to manage the heterogeneity of discourses to one's own advantage, the use of sustainability concepts in academia is a key for understanding how academics respond to contradictory elements of (un)sustainability.

Chapter 3

Keywords, Buzzwords and the Power of Reference

"If the experiments of physics seem remote from humanities and social science, it is worth remembering that among the instruments and apparatus employed for research, the most important are our concepts"
(Richards I.A., here quoted in Clark and Clark 2009, p. 316).

A Companion to Environmental Geography, (2009) edited by Noel Castree, David Demeritt, Diana Liverman and Bruce Rhodes can be said to be one recent key reading/writing in environmental geography. Divided into four parts: 'Concepts', 'Approaches', 'Practices' and 'Topics' the chapters are written by so-called leading figures like Karen Bakker, Bruce Braun and Karl S. Zimmerer. Part I covers 'concepts'. While the very first chapter (written by Bruce Braun) features the concept of 'Nature', the second chapter (written by Becky Mansfield) features the concept of 'Sustainability', not 'Scale' (chapter 7), 'Vulnerability/Resilience' (chapter 8) or 'Biodiversity' (chapter 4). Until recently, 'Sustainability' was largely considered a buzzword. Is it no longer the case? Has sustainability now become a key concept in geography? And what does it imply when referring to the socio-natural?

Chapter 2 examined the inculcation of sustainability concurrently brought into a neoliberal agenda of maintaining and managing universities. The chapter argued that the ways in which different notions of sustainability perpetuated both mobilize neo-liberal interests and accelerate thinking of universities as marketable entities and simultaneously as a source for critical intervention. While branding, marketing and securing universities' financial sustainability shape into 'buzzwords', it is worthwhile first to consider some characteristics distinguishing keywords from buzzwords. Then, the chapter turns to what I shall call the power of reference. The power of reference refers to an academic governmental form (tactics) in making

references to the socio-natural in ways that hugely influence and (re)scale notions of sustainability and pre-fill positions often without the reader/writer is aware of it.

Question for the chapter:

- Why is the power of reference crucial for how academics and geographers (academia) incorporate/make use of sustainability in academia?
- How can sustainability concepts in academia be entangled in between buzzwords and keywords?

3.1 The Art of Making References - Distinguishing Keywords from Buzzwords

According to Castree (2014, p. 8) three characteristics distinguish keywords from buzzwords. Let us consider those three characteristics in relation to sustainability in geography. First, Castree argues keywords do not come and go. Keywords tend to be stable. Keywords are more or less unaffected by economic, cultural or ideological changes. Even in academia keywords tend to be unaffected by political pressure or changes in funding mechanisms. Although academics lean towards key concepts and the power they inhere, they do not in general signify 'state of the art'. Currently a concept like the 'anthropocene' seem to indicate the 'state of the art', and Castree has joined this effort (Castree 2015). Keywords, however, are immune to quick fixes as the power of referencing, funding mechanisms or 'politico-ecological winds' at a given time and place (See chapter 2 and 5). If one considers the use of sustainability in geography, it quickly becomes clear that the concept does not meet the first criteria. Nevertheless, the concept has been preached for forty years and seems to be one of the kind, that will not go away neither in academia nor in civic society (Chapter 6 examines sustainability as marketing geography, and points toward mixed feelings of using buzzwords in academia).

The second feature that distinguishes keywords from buzzwords has to do with the context within which the words are used. According to Castree (2014, p. 9) keywords are ordinary, used widespread and frequently in all sorts of contexts. Keywords are familiar within or even beyond a given academic episteme. Sustainability better applies here *"Sustainability is a concept that appears everywhere around us and that we critically need to address. It is heavily used in the rhetoric of political*

discourse and hard to avoid as a human geographer. It is a great example of a fuzzy concept that all of us use intended and unintended" (Interview 22).

Also within academia the concept of sustainability finds widespread use. Although the use of it always relates to criticism in geography and some refuses to use it, it seems that it has found its way into academia being (being more than?) just a buzzword. Despite of and because of its critics, sustainability orchestrates the whole spectrum of political discourse, serving neoliberal agendas or the left, or produces a critique of both (see chapter 2). Used in all sorts of ways, meaning different things to different people, sustainability better applies here. It is precisely the widespread use and the 'use' of its diffuse character (interests involved in doing so), that provides the concept with its capacity to 'go round the back' and legitimizes a given agenda (Harvey, 1996, p. 144). Insofar as the concept is used in academia it seems to make space for sustainability as external academic activism (see chapter 1), while it gains little space for internal activism due to its low status (buzzword) in geography (see Part III).

The third characteristic that distinguishes a keyword from a buzzword, according to Castree, concerns the 'social force' these concepts inhabit (Castree 2014). In academia the 'social force' accompanied by the use of sustainability does not apply as a keyword. In fact one could make a little academic test. By mentioning sustainability a real academic will immediately 'wrinkle his/her nose', draw upon a critical attitude, and instantly associate all the criticism attached to it. *"When I hear the term sustainability, I always step back – when it occurs I immediately get a critical awareness"* (Interview 7). In contrast keywords possess the ability to unhinderedly sort our mode of thinking, give direction and draw upon the distinctive power that lies in giving reference to something or somebody of general acceptance.

Whereas keywords are used unimpededly in thinking about the power of reference (conscious boundary making – one can only attend one arena at the same time), terms like sustainability is heavily scrutinized though, frankly, it may be equally difficult to clarify the word of nature. For Raymond Williams nature "*may be one the most complex word in the British language since the idea of it (…) contains, though often unnoticed, an extraordinary amount of human history…(…) both complicated and changing as other ideas change*" (Williams here quoted in Harvey, 1996, p. 26). Hereby Williams examines how nature, this extraordinary, complex, fuzzy, slippery and difficult concepts, holds power that is normalized

by ways in which they govern and direct our thinking. Keywords produce imaginative geographies that positively lead the audience in a desired direction. At this point I claim nature is a keyword, sustainability a buzzword and yet both are extraordinarily fuzzy, slippery and contingent. The imaginary geographies both comprehend and encompass huge amounts of tacit power, with quite different political ecologies as a result (See box 1.2). Note how natural science historically has been a branch of discipline(s) that by name engages in studying 'nature' (Demeritt 2002). Disciplines and departments that carry sustainability in their name have only recently begun (see box 1.3). Whereas the former finds nature to be external and objective, the latter recognizes that 'nature cannot pre-exist its construction' as Haraway puts it.

The fact that humans can never escape their socio-natural embeddedness made 'nature' a keyword to Williams, and one that performs political action and analysis often without noting it (Harvey 1996, p. 27). Conceptions, abstractions and the ways in which academics make reference to the (socio)natural therefore write environmental geographies, whereby changing a concept provides an approach to understand social and cultural changes. As humans can never escape their socio-natural embeddedness other prevailing concepts arise when referring to, responding to, writing and re-writing global environmental change. Whether regarded as key concepts or not, they represent responses to those changes.

What should be clear is that the three characteristics do not only distinguish key concepts from buzzwords, they are also defined out of time-space configurations; the time scales given, the spatial organization and through their historical and contextual differentiation (see chapter 4). Moreover, they co-produce mental geographies with specific connotations to the socio-natural. Both Castree (2001) and Harvey (1996) pay particular attention to the incorporation of space and place as in-situ-actions when theorizing over socio-environmental change. I want to pay particular attention to this in chapter 5 (Spatio-temporal tides and waves) in terms of referencing to the natural. In what follows I am not so interested in whether geographers regard sustainability as a keyword or as a buzzword. I am far more interested in how sustainability finds its way into academia, how geographers refer to it, use it, respond to it and consider our responsibilities in referring to global environmental change (Part III). What is the intended and unintended 'use' within the academic fight as interview 22 (page 63) referred to?

To do so it is worthwhile spelling out what I mean by the power of references as an academic practice. The following consider 5 dimensions of making (powerful) references. These will be re-examined in Part III.

3.2 Practicing Discourses and Discourses of Practice

Academics do tremendous work on deconstruction and reconstruction. Academia produces genealogies, develops new concepts, theories and ideas that wonderfully spiral into manifestations and strategies embracing huge amounts of tacit knowledge. In our individual academic work, we take a theoretical framework, in my case David Harvey (1996) and Noel Castree (2014) and blend them in a number of related theories, with a bit of caution to demonstrate the state of the art. In so doing we spend great effort in framing our work as new (Harvey 2005, p. 40). Again there is always an underlying caution to promote one's own stand and perspective in finding a place in academia. For a young researcher for instance, it is a well-known strategy to kick-start the carreer attacking well-known researchers and hoping for response to the critiques given (Sheppard in Castree et al., 2006, p. 134). As young researchers Harvey and Castree were taking part in that game themselves (See Explanation in Geography 1969). Years later, as recognized researchers, they are all too familiar with academic strategies using theoretical icons to make a place in academia to make space for them. In finding one's place to undertake research for better, more accurate and valid scientific knowledge, one needs to find a space to shape a career platform (fight over symbolic and reputational capital).

As argued in chapter 2 policy agendas and governance structures are part of addressing the introduction, use and explication of sustainability in academia. Subject to corporate, administrative and governmental processes, the chapter addressed the subtle ways in which the organizational form possesses a structuring effect under which academic work is carried out (Castree et al., 2006). In finding and shaping place in academia, spaces of work have huge effects to govern-mentalities of that work. Practicing power of references therefore is both shaping and is shaped by the scientific climate with effect on the sustainability of the work environment itself, as well as the governmental forms under which sustainability develops is orchestrated and theorized (Mansfield 2009). Academic governmentalities, then, are both filled with presumptions and statements concaving huge amounts of

tacit knowledge, which is why the power of references as phenomenon becomes a problem, particularly within discussions of sustainability in educational and scientific practices.

3.3 The Power of Reference

Originally coined by Michel Foucault the term governmentality refers to the self-government (the conduct of people's conduct) whereby individuals (willingly) undertake work in the interest of the principal. Thus, on the basis of (invisible) principal-agent structures, individuals govern themselves in accordance with the interest of the principal. BFI, insecurity in jobs and temporary positions are examples relevant to spaces of academic work (see chapter 2). For Foucault it describes how subjects are involved in projects of their own, through their own free will, while the freedom is dictated by others (to live up to moral judgments, institutional values, measurements, and accounting practices, etc.). Governments, institutions, communities, and authorities have huge direct and indirect impact on individuals' norms, attitudes, and practices. Direct as regulative that the subject is aware of, indirect as 'hidden' regulative shaping/guiding thoughts, modes of thinking, imaginations, and practices that the subject is not necessarily reflexive about (Dowling 2010). Govermentalitie(s) thus take(s) part in shaping geographical imaginations. Academic governmentalities, refer to hidden and regulative references in the making of scientific knowledge and what is of particular interest in this context is its significance for making reference to nature. Academic governmentalities refer to the process of self-governance within academia, seeking to capture the ways in which university governance and knowledge management affect the mind, belief, and mode of thinking. Thus academic governmentality holds a critical attitude towards the freedom to conduct research by addressing a number of implicit structural layers of (assymetric)power, with reference to symbols, codes of conduct, tacit norms, and tactics (Berg in Castree 2006, p. 766). Shaping the social valuation of splendid, superb, and excellence work (e.g. through awards, credits, honors, merits, bonuses or in more subtle forms), the power of reference describes how these processes come to justify theories, methods, assumptions, themes or concepts, while they at the same time make reference to nature. Power of reference connotes how academics make reference and the powers involved in doing so, both as a process of self-governance within academia, which affects reference practices in narrow terms (the ways in which

we quote and reference) and in a broad sense how academics make reference (to references) when representing cultures of nature(s) or vice versa. Thus, it is an academic form of governmentality, (in science and education, affecting the mind, belief, and mode of thinking) that shapes social practices and the habitual power in representing a given scientific problem, paradoxes or phenomena in a certain way that simultaneously produce layers of hidden (tacit and tactic) knowledge yet authoritative truth (Haraway 1988).

As far as the 'power of reference' is concerned, it is relevant to address a number of related dimensions in examining when academics refer to sustainability. In selecting any theory that work has developed on the basis of outstanding literature, say Harvey's analysis of the credit form, as refinements of Marx's work (Harvey 1982). That work includes an immense body of related theories (reference list of 13 pages) that, in turn, has been developed from previous work with an immense body of literature. In our individual and collective knowledge production we enrich a theory with a number of related theories; it may be a bit of Nigel Thrift here, a bit of Doreen Massey and Anthony Giddens there. While producing a hidden critique of the latter, it is all framed within invisible layers of tacit knowledge when framing our own work on Friedrich Von Hayek, Adam Smith or Marx, though never explicated, of course (Harvey 1974b). The powerful layers of silence, however, continue. In choosing brilliant and superb work by Michel Foucault, Michel Callon, Bruno Latour or Phillipe Descolar (geographies of choosing French, opposed to Anglo-Saxon cultures of theory)[1], there are also huge amounts of organized power (and strategy) involved. Making theoretical reference embraces the first dimension of the 'power of references' and certainly has a geographical dimension (Passi 2005), e.g. when given reference to the socio-natural (see chapter 6).

Choosing famous, well known, and established academic theorists (As I do), has besides the tendency to represent superb work, also the tendency to produce an

1 The South American, South-Asian Subcontinent represent other cultural-continental geographies. Harvey's or Castree's work can also be geographically linked to an Anglo-Saxon tradition, subject both to metropolitan zones, Eurocentric and North American regions and traditions, with less focus on other parts of the world (Sheppard 2006). Likewise geographies of sustainability are highly Eurocentric, discussed and theorized mostly in the Western world, Northern Europe and Japan (Chakrabarty 2009).

authoritative argument[2] (credibility, liability, evidence, and validity) to one's own work, while assembling well-known cultural-habitual references to the reader. Leading figures represent a layer of authoritative 'truths' or established 'norms' within different research communities that among other things serve the body of shared cultural references. Harvey and Castree can certainly be examples of this within and beyond the radical geography tradition. What icons say or do have impact on dialogues within that episteme, and how scientific and (inter)disciplinary epistemic communities develop. In this process the importance of icons has an impact on regulative practices of how I and you conceive the world (Castree 2014, p. 22). Harvey, and I would say, Castree, are such icons, academic celebrities or even academic brands with canonical effects (Thrift 2006, p. 225), with a demand for, a market for them, that in turn perform that market (see number of references, number of young students attending their public lectures, number of books sold, etc.)[3]. Whether it is suitable that a scientific community incorporates a language of sustainability or not, epistemic work produces asymmetric power relations with effects on the condition of sustainability (equity) as well as on inclusion and exclusion of features, themes or approaches (Castree 2014, p. 97). The power of references produces an effect on habitual power in representing a given problem or paradoxes in a certain way (codes and conducts) in order to get recognition (sustainability has little or no prestige in many scientific communities)[4].

The 'power of reference' can also be said to be organized within and between disciplines. Massey (1999) wonderfully depicts how 'the power of references' is organized as a strategy in referring to 'harder sciences'. Hereby Massey depicts

2 Note, while there exist no commonly accepted scientific rules for references, there are ertainly consensus on recommendations that can be subject to epistemic communities, disciplines and journal articles. When is it necessary to quote, why and on what grounds?

3 David Harvey, for instance are quoted 19.804 times (Condition of Postmodernity) whereas his less quoted articles come to approx. 500 quotations (as of September 2014). This makes Harvey one of the most quoted geographers. In comparison Anthony Giddens accounts for approx. 29.300 quotations (The Constitution of Society: Outline of the Theory of Structuration) as one of the heaviest quoted social scientists.

4 One indicator for the power of references can be studied in the way in which phenomena like name dropping are done, and how we respond to it. Did namedropping have the intended effect? Name dropping for instance is a common feature in journal articles, as a simple way to represent complicated matters, through an authoritative reference. Take a look at this text for instance and mark the number of references you are already familiar with. References can thus be supportive for arguments one cannot convincingly make oneself (see legitimation in glossary).

the 'envy of physics' as the tendency whereby 'soft sciences' often make reference to 'harder sciences' to bolster one's argument. It may be cultural geographers who appeal to urban geographers, who in turn may plea to physical geographers. Physical geographers in turn provide their work with a note to geologists or chemists and even better a famous one that in turn may refer to physics. Note how the 'envy of physics' relates to Kant's higher and lower faculties affecting the academic (interdisciplinary) spaces organizing the internal dispute (see chapter 2). She argues that this habit (why we do it) appeals to an implicit imagination (stemming from the positivistic turn and among others manifested through the spatial analysis, see chapter 5) that affects relations between disciplines as a form of hierarchy (as auditing, meriting, and publishing strategies grow in importance academic publishing tactics by making reference change).

This form of higher authority among others converts into reference strategies and arguments that are deeply suspect since it incorporates a nomothetic approach (see chapter 2). The irony to Massey is that physics have moved on (Massey 1999). This observation has deep implications to the interdisciplinary dimension of sustainability and climate changes, and how these problems are researched, organized, and tackled under a given episteme. By way of illustration climate changes modelling is dominated by 'hard sciences' and economists (Urry 2011, p. 3), reducing human behavior to a matter of instrumental rationality (see Chapter 8). Making power to references, therefore, is a way of being reflexive about how academic work environments (climate) is influenced by academic governmental(ities).

The 'power of references' also involves how academics give phenomena, processes or themes ontological and epistemological status[5]. Whatever phenomena under investigation, it is interesting how something is given status as a problem, how we give it relevance, attention or impact, how we give explanation to it, and interests involved in doing so. Questioning the existing order of representations therefore is a question of when a phenomenon, object, theory or data are given ontological and epistemological status, are given agency, are given explanatory power in relation to the problem at hand (Castree 2001). The question is what kind of data we consider epistemologically relevant to that phenomenon. The question is what

5 Tacit knowledge also provides a filter. Since tacit knowledge in contrast to codified knowledge cannot be disseminated through texts, the power of reference is hugely associated with tacit knowledge and situated knowledge (Haraway 1988).

kind of explanatory power we give these data, whether we give it causal explanations, intentional explanations, functional explanations, rational explanations, evolutionary explanations or some sort of combination. The question is how much power and agency we give these data with what kind of explanation and with what interests attributed to it (Rasmussen and Arler 2010, p. 42). But, perhaps most challenging, the question is what kind of ontological status, and what kind of explanatory power we give a phenomenon, in relation to other phenomena, and what kind of status, weight, explanation and relation we give these phenomena and data, theories and methods. This has deep implications to how we theorize on sustainability; organize its complexity, its holistic and particular dimensions (Mansfield 2009). As Harvey (1969) puts it, 'a theme gives rise to theorize' and how human-nature relationships are considered implicitly or explicitly can be examined through the way we give phenomena methodological, ontological and epistemological status and different kinds of explanations.

The power of references can also be attributed to a particular theme or a specific concept, i.e. environmental degradation, political ecology or environmental (in) justice. Here it is not only interesting to observe how themes and concepts sometimes merge, overlap and blur into one another with particular effects, but also how concepts or themes are organized (often implicitly) as power configurations that produce (epistemic) political ecologies in themselves. For instance concepts like sustainability or the anthropocene have been promulgated in a multitude of possible (and impossible) ways, from which e.g. 1) one distances oneself 2) epistemic communities find there center and points of identification, 3) concepts are replaced by others, they rise and fall (see Chapter 5), all with effects to how we make reference to nature. Scientists are often hungry for attention, recognition and funding, which is why even 'climate or sustainability scientists' reflect as much about the power of reference, relations and career opportunities through sustainability, than necessarily contributing to a more sustainable society in itself.

The power of reference, however, holds yet another dimension concerning the economy of the power of reference or the economy of quotations. In returning to chapter 2 and BFI as a funding scheme, it illustrates the economy in the making of references. Any research application is subject to BFI. Applications for funding represent written words, carefully selected, that again are based on long CVs, number of articles and their presumed impact (Berg in Castree et al., 2006). Academic writings carefully refer to keywords mixed with concepts considered to

have the desired impact. The cultures of quoting (what, why and how we do it), project assumed 'impacts' by the writer/reader in ways that transform arguments, findings, and positions into calculative 'impacts', e.g. Journal Ranking, Impact factors or BFI (Auken and Emmicke 2010). Hence the better rank/impact, the better change for profiting from the economy of quotation/reference e.g. through external funding. The neoliberilization of quoting is an important entrance point in understanding diverse processes affecting the academic life (Anglofication), not least the intensification of economic thinking, subject positions and academic govermentalities, through which sustainability, climate change and response(ability) are understood (Sheppard in Castree et al., 2006, Dowling 2010). How different sustainability concepts are influenced by the power of references illustrate an exercise that embeds multiple layers and possible political meanings. Through the neoliberal logic of quotation/reference making it follows that it becomes a strategy to take a stance e.g. a critical stance toward the consensus thesis on anthropogenic climate change (Chapter 1), in order to improve the changes to get quoted rather than (solely) contributing to the academic dispute.

Until know we have looked into five dimensions of the power of references and conveyed its relevance for science in general and for sustainability in particular due to its extensive complexity and diffuse character. In the following I shall argue for the relevance of space-time dialectics in understanding all the silence, power, interests, and political implications involved in addressing sustainability in academia.

3.4 The Dialectics of Sustainable Discourse

There are at least four dimensions relevant for bringing a Marxist and dialectical approach into the analysis of contested ideas, interests, institutionalization, and paradoxes in the use of sustainability in academia. First dialectics offer a consistent approach, and the the dynamics of the social production of nature thesis are addressed through a number of moments entangling relations between labor processes, production, technological development and knowledge related to capital (Castree 2001, p. 191).

A second dimension worth to bear in mind concerns relations between science and society, in that science has proved to be a significant force for societal development (and vice versa) that also engages in reproducing environmental/sustainability

problems. A history-geographical perspective is relational and reminds us that the dialectics of human-environmental interactions as well as associated geographical imaginations are nothing new (Harvey 1996). Hereby it offers a way to go beyond buzzwords and keywords by challenging dominant assumptions, conventions and representational modes that accept the 'reality of construction'. Third, as sustainability is all about how to use nature and systems it is also worthwhile looking at the politics and power in regulating production processes and social practices within and beyond academia itself. Attached to the internal fight it offers a perspective that rather than avoiding criticism, (polished momentums and engagement in the politeness of academic discourse fulfilling the requirements of the reviewers in order to publish) challenge and criticize everything there is, including itself (Castree 2001). Finally the relevance of bringing a dialectical perspective on sustainability involves a relational approach, not confined to the disciplinary divide. Integrative to the three former it relates to the materiality of ideas, thoughts and knowledge (science and education) for engendering economic, cultural, social and technological change.

> *"The separation of the world into two distinct domains – nature and society – is a habit of thought that demands to be challenged, both on conceptual and ethical political grounds"* (Braun 2009, p. 22).

Much theory building in the social and natural sciences seems little established with respect to its material dimension of reference making (see chapter 4), e.g. how the academic division of labor is organized into separate disciplines in the (natural versus social) sciences. Dialectics transcend a one-dimensional perspective in thinking about the material side of social practices that sometimes seem underdeveloped in sustainability discourses. Consequently one has to look at relations between social practices and habits of thoughts, (in academia) in ways that fundamentally reject e.g. Descartes' and Newton's ontological dualism that separates nature from society (Harvey 1996, p. 123). If one would like to explore sustainable transition, one needs to establish relations between mind and matter, society and nature. The matter matters, and there needs to be developed more appropriate methodological approaches not only in the interface between social and natural sciences, but also in ways that templates the duality between the material form and the social processes of valuation (Harvey 1996). Claiming that matter matters rejects all non-materialist ontologies and theories, but also transgresses disciplinary boarders and disciplinary identities, since they are both processors

and owners of forming materials in new ways. This appears to be the case e.g. when thoughts (innovations) are transferred into commodities and resources. Simultaneously rejecting these processes bear reference to nature and is part of shaping of peoples identities, values and behavior.

> *"Even when our relation to nature seems most immediate, it is profoundly shaped by the narratives, knowledge and technologies that enable experience"*
>
> (Braun 2002, p. 15).

Such reflections are fundamental as different concepts (ecology, sustainability, first and second nature) reside in different socio-material ontologies. It follows that different socio-material ontologies produce radically different socio-environmental geographies. Sustainability approaches cannot be reduced to be only a matter of fact, but also a matter of concern, response and responsibility over representing the human-environmental interface. Subsequently, we imagine connections between modes of thought and materials, between modes of thought, societal practices and planning. From this perspective dialectics are based upon an intra- and extra-discursive reality, implying that elements independent of human perception are sometimes formed through human practices (and vice versa). The reverse is also true, that elements dependent on human perception have sometimes (no) influence on material processes (Demeritt 2002, p. 779). Studying sustainability discourses in academia is therefore also a journey in space and time; a journey into how different philosophies of science produce different geographies that influence our thinking and educational practices (Harvey 1996, p. 326).

To make sense of different forms of academic sustainability discourses and their social nature(s) dialectics address science as a complex process of ordering statements of all sorts. As scientific knowledge is organized in statements about the world, the dialectics of sustainability discourses in academia are organized into hierarchies and certain ways of governing power (Harvey 1974b). As scientific enquiry on sustainability is often considered a low status subject in geography as well as in other social sciences, the concept sometimes serves as an academic dustbin for the rest of us, the less excelling researchers. To reveal the use of sustainability in academia, therefore, is as much a matter of power (concern) as a matter of fact, given that the whole spectrum of reading and writing nature involves cognition, moral reasoning, and aesthetic expression (Castree 2014, p. 25). As climate/sustainability science produces knowledge, from which socio-ecological decisions

mutually change, forms of appearance, and forms of realization, states of being, and modes of representing it becomes of evermore importance to understand how academia also is a melting pot of political import (and export) with implications to planning, organization and control of the otherness we call nature.

The complexity, ambiguity and contradictory elements of sustainability request a relational approach that incorporates mode of reasoning on geographical imaginations; a mode of reasoning to make sense of sustainability challenges produced and distributed across multiple spatio-temporal scales (Mansfield 2009). As Harvey argues we *"badly need a much more unified language than we currently possess for exercising the joint responsibility toward nature that resides with the social and biological/physical sciences"* (Harvey 1996, p. 190). Dialectics splinter the disciplinary construct between social and natural sciences, sub-disciplinary or thematic categorization.

3.5 Conclusion

To summarize I first touched upon entangling sustainability between buzzwords and keywords. Then I elaborated on five dimensions of the power of reference and conveyed its relevance for science in general and for sustainability in particular. Precisely because of their fluid, complex, contradictory, and diffuse character (open to interpretation) the power of references has substantial importance to sustainability and how the concept find its ways and are represented in academia. The challenge of course is that when examining the use of sustainability in academia, one is subject to the power of reference, why spaces of that work and uses of sustainability needs to be turned upon oneself (and academia itself). How can this be achieved independently from the power of reference, will be addressed in chapter 4?

Next, we touched upon the dialectics of sustainability discourses in academia pointing towards four dimensions in advocacy for a relational perspective. To Harvey and Castree it is precisely links between these four dimensions that hold the power of knowledge, the use of ideas, thoughts, mental habits, concepts and theories that structure power as ordered representations, and then taken into the domain of political struggles in the corridors (Harvey 1974b, p. 267). The power and struggle for (un)sustainability can be viewed much in the same way, why an integrative (holistic) approach is particularly relevant.

In chapter 4 I shall critically elaborate on dialectical assumptions. This enables me to bring the power of reference into an educational context in part III, and discuss how it produces particular geographies as hidden curricula. Hereby we will scale the power of references with specific reference to geographical imaginations. In doing so, I particularly address the material side of the power of references. In navigating among all the tacit knowledge produced around the dialectics of sustainability discourses in academia, it is worth considering space-time dialectics as an endeavor to understand how a given thing, theory or phenomenon also represent something other (representations of representations) than it seemingly stands for, and how such representations also inhabit socio-material practices.

Chapter 4

Space-Time Dialectics and Contradictions of Sustainability

"An ecological history begins by assuming a dynamic and changing relationship between environment and culture, one as apt to produce contradictions as continuities"
(William Cronon in Harvey 1996, p. 27)

It is an ongoing discussion whether the world is fundamentally dialectic or dialectics are a set of assumptions upon the world. In this chapter I will pursue the argument that it is both. In chapter 2, the plethora of complex elements of sustainability was outlined. It was argued that sustainability concepts unfold as a double edged sword that both serves neoliberal agendas restructuring universities, and provides a critical platform from which conditions for academic work on (for) sustainability can be addressed. Chapter 3 entangled sustainability in between buzzwords and keywords. When sustainability concepts are that fluid, diffuse and contradictory, it was argued, the power of references play a significant role on the ways in which sustainability concepts find their ways and are represented in academia. This chapter aims to address the power (within and beyond) of knowledge production, and to explore how issues of sustainability are framed with respect to different power relations. Much theorization of sustainability in higher education currently overlooks the corporate agenda that brands universities as sustainable, while changing academic spaces for engaging with critical and alternative modes of dealing with sustainability. Within the body of sustainability in higher education (see chapter 6) these connections are often not theorized why this chapter engages with contradictory elements of sustainability. Hereby it establishes a methodological basis to address sustainability in academia, tampered between scientific knowledge and policy, between educational practices and political agendas, whatever these are promoting sustainability or not. In so doing, the chapter takes you on a journey into space-time dialectics. It is suggested

that space-time dialectics are particularly helpful in examining geographers at work, influenced by governmentalities, and how they make use of sustainability in curricula programs. The objective of the remaining part of the chapter is to clarify assumptions of space-time dialectics related to sustainability and I discuss implications for further work. During the journey I do not only intend to outlay and qualify some of the assumptions and positionality this work rely upon, but also to engage, inspire, provoke, stimulate and cultivate debates.

Questions for the Chapter:

- How is the dialectical approach developed to examine how geographers respond to the paradoxes, contradictions and dilemmas of sustainability?
- Why are concepts like time and space important to analyze sustainability, and how can dialectics be helpful in navigating among spatio-temporal scales?

4.1 Space-Time Dialectics, Sustainability and the Human Environment Interface

David Harvey may be one of the most prominent thinkers to have brought dialectics into geography. His dialectics are probably best known in his geographical theory of capital accumulation. Concerning the human-environmental interface, his dialectics is most comprehensively theorized in *Justice, Nature and Geography of Difference* (JNGD) in which Harvey describes his work as *"a dialectical, historical-geographical and materialist theory,(…)[that] deals with totalities, particularities, motion and fixity in a certain way"* (Harvey 1996, p. 9).

Dialectics is a broad plethora of philosophical thinking that derives from Hegel, Leibniz, Marx and a host of others. Dialectics may be roughly subdivided e.g. into systematic dialectics from the late Hegel, into historical dialectics, material dialectics, universal dialectics or phenomenological dialectical thought (Castree 1996). Thus, modes of dialectical reasoning appear in various forms. What is addressed in this chapter though is the relational dialectics developed by Harvey and Castree, or what has also been termed space-time dialectics. As far as possible I will render an approach to understand the dialectics of Harvey and Castree. One, however, must be open (and skeptical) to individual creativity and variability, as well as to a single methodological template that fully reproduce their work.

David Harvey and Noel Castree can be read in many ways[1]. Whatever paths it may lead through, there remains a fundamental critique of the power of knowledge construction and the power of geographical imagination in its broadest sense. They both insist that mental representations and modes of thought cannot escape geographical imaginations (Harvey 2005, p. 221, Castree 2003, p. 204) why geographical knowledge is not confined to any discipline in particular. Both insist that representations are always structured geographically in one way or another, why a critical analysis of concepts like space, place, nature and environment remain fundamental to social theory or the production of scientific knowledge itself (Harvey 1996). Both examine how capitalism has structuring effects on geographical manifestations, knowledge production, beliefs, the functioning of research and education in society and economic-ecological material practices.

> *"Although environmental policy is frequently a means whereby those in positions of power further their own interests, it is also an essential instrument for achieving a more just and sustainable future"* (Castree 2002, p. 360).

To Harvey and Castree, therefore, geographical knowledge, ideas, thoughts and concepts, lies the heart of emancipatory potentials, geographical imagination and sustainable alternatives, though structured under constraints of capitalism as a dominant form of spatial governance (e.g. in Spaces of Hope).

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1 The early Harvey has a positivist and hypothetical-deductive approach (Explanation in Geography) whereby geographical knowledge is logic, systematic and generalizable. The young Harvey was certainly non-marxist, the older deeply engaged with readings through Marxian dialectics. Castree, though in an earlier stage of his career, can similarly be read through his engagement with Marxist theory related to dialectical environmental thought. Harvey and Castree, also tackle the problems from different angles. While both assemble their work from a Marxist tradition, Castree does in much of his work go beyond its borders, see Castree 2014 or his work related to ANT (Castree 2002). In contrast, Harvey sees capitalism as an integrated whole (Harvey 1987). As the elderly Harvey uses the lenses of Marx in every turn, Castree, has a prism that also uses other entry points to his analysis. Castree also adapts non-Marxist theories and approaches in analyzing the human environmental interface. As Harvey develop a spatialisation of Marx he extends the work into production of space, spatial fixes and its contradictory element to capital accumulations, he tirelessly works within the abbeys of capitalism, as a dialectical totality. One could say that Harvey works in depth from a materialist register inspired by system dialectics, Castree in breath and beyond the labyrinth of capitalism, always from a dialectical approaches in analyzing the 'politics' of nature (Castree 2001, p. 191). The former aims to develop a body of theoretical thought that emphasizes the spatial element of the human environment interface, the latter the socio-cultural element.

Now one could imagine that dialectics presuppose that everything relates to everything in any given context. This is far from being the case. To Castree, dialectics is a *"logical development of a system of categories, from the most simple and indeterminate to the most rich and concrete, by virtue of the contradictory imperatives of each successive form"* (Castree 1996, p. 352). Rather dialectics spur a debate of when phenomena relate, how they do so, and the state of such relations. Thus, the dialectics of Harvey and Castree do not hold a flat ontology, where everything relates e.g. unconstrained of power. Yet it is not a relational perspective that produces a flat ontology (nature-society is network, assemblages or rhizomes that we cannot go beyond), but the rejection of a deep ontology, (deep structures, mechanism, dynamics and relations) not directly (or not) observable. Thus, if everything relates to everything it is at best in particular and asymmetric ways, that cannot be observed unconstrained of deep structures, relations or dynamics. While Castree speaks of system dialectics that hold certain power geometries (Castree 2002, p. 121), Harvey (2011, p. 19) distinguishes between seven such related power geometries that integrate (deep) dynamics between 1) technological progress and use of scientific knowledge 2) institutional arrangements and regulation 3) knowledge structures, and mental conceptions 4) organization of material practices, production and consumption, 5) social practice, 6) and work, 7) all of which dialectically relate to nature (See figure 4.1.).

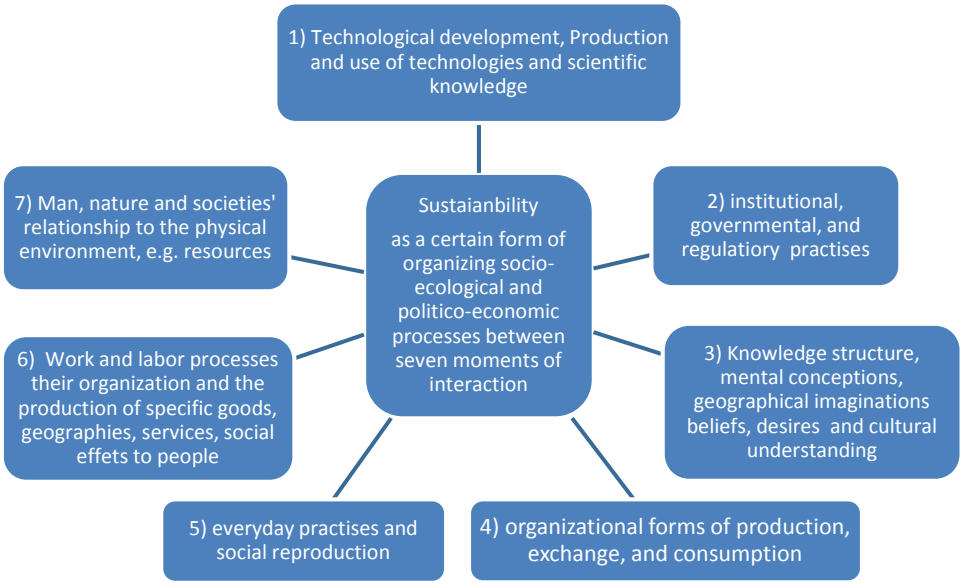

Figure 4.1. *Sustainability, dialectics and seven moments of interaction. From Harvey 2011, p. 19).*

At this stage the figure (Figure 4.1) seems banal. Yet, *"the danger to social theory is to see one of the elements as determinant of all the others"* (Harvey 2010, p. 196). To hold one of them constant makes an impotent theory, and yet it is what most theorizing on sustainability in higher education does. More intriguing, a vast body of theoretical work on sustainability in higher education reflects upon one or a few of these dimensions at best. In both cases, a tremendous exclusory process with respect to their interrelatedness (interdisciplinary) effects goes one, precisely because they fail to understand how they are relational to one another[2].

> *"Each one of these moments is internally dynamic, marked by tensions and contradictions (just think of our mental conceptions of the world), but all of them are codependent and coevolve in relation to each other within a totality"*
>
> (Harvey 2011, p. 19).

Imagine for instance how a theory of sustainable transition would look when taking these seven moments of interaction, their relations and internal and external contradictions into consideration. Then, one must address and challenge internal contradictions of sustainable transition theory, to achieve sustainable transition. It is another way of saying that changing to a sustainability language (in science and education) may not in itself produce physical change as assumed by much theorizing over sustainability in higher education or the 'dissemination of scientific knowledge' perspective. Dialectics represent a mode of thinking relevant to address the material dimension of representing sustainability issues in academia. Contemplating these dynamics into sustainability in academia is no simple task yet illuminating to geographical imaginations across discipline. In order to theorize over sustainability in academia as a comprehensive socio-environmental and interdisciplinary framework (that enables us to examine contradictions as continuities) the remaining part of this chapter is devoted to examine ontological prepositions related to the

2 Asbestos is an illuminating example. As early as in 1898 the first concerns of asbestos's injuring effects on human health were reported. It took precisely the UK Government a century of thinking before responding to scientific knowledge, when they finally banned asbestos in 1998 (EEA 2001, p. 11). Thus 1) technological development and knowledge 2) institutional government and regulation, 3) mental conceptions, 4) production and consumption 5) everyday practices 6) work and labor environment and 7) natural resources were related to one another both with regard to the introduction and the banning of asbestos.

seven moment of interaction. In bringing these dimensions together, we find the heart of geographical imaginary.

4.2. Geographical Imaginary: Scaling and Materializing the Power of Reference

What is interesting when one seeks to materialize the power of reference (or academic governmentalities for the sake) is not only the difficulties and deep methodological waters one enters touching the human-environmental interface, but how scientific responses have arisen out of academic (imaginary) boundaries. Whatever perspective on the quest of socio-nature(s), imaginary boundaries are part of assembling academic responses that (im)materialize and politicize our thoughts and disciplines, curricula, and texts. Yet, transcending disciplinary borders have historically proved extraordinarily difficult. This is for instance the case 1) when biological concepts of 'natural selection', 'evolution' or 'natural competition' are imported into economic theory e.g. in contrast to 'diversity', 'symbiosis', 'succession' or 'food chain'; or 2) when disciplinary boundaries in the social sciences demand that ecological or biophysical processes have no relevance to the project at hand (Clark and Clark 2012). Castree's and Harvey's point is how imaginary (and even disciplinary) boundaries have political effects, whatever perspective we take.

To materialize references has historically involved huge amounts of political import. A case in point is the biological vocabulary built into social theory (Social Darwinism, Fascism, Nazism) why there are good reasons for keeping away from the socio-natural interface or the 'geographical experiment' (Harvey 1996, p. 191). That others have fail however, does not imply that that the task is irrelevant in understanding the antropocene (it is impossible without integrating the social and natural as dynamically related), but suggests that assembling the interface involves political import (and export), values and contradictions. Taking a dialectical approach involves an effort to understand how conceptions of the environment, nature or sustainability change historically (Castree 2003).

It follows that a dialectical approach invites us to examine how our conceptual, disciplinary and epistemic framing (Castree 2014) unavoidably builds theoretical fencing posts. Conceptual fencing posts do not only (re)order epistemological and ontological assumptions of the human-environment interface. Conceptual

fencing posts are part of construing and de-construing disciplinary and academic epistemes (borders) in ways that make us accept sustainability, ecology or the environment, e.g. to conventional economic theory, financial speculation or mathematical modelling (see chapter 8).

Consequently, space-time dialectics insist on holding a materialist approach on social processes. This has a number of implications: 1) The social forms relate to structural and material forms, though structural forms apply to society, materiality, social or external nature in different ways. By way of illustration, hydrological flows are organized with and without influence from human beings. 2) Furthermore, material practices relate in ways that social practices and/or individuals can change or are changed by structural/material forms 3) and thus give rise to new socio-material forms and relations between them (Castree 1996, p. 347). From this follow conjunctures and productive tensions between epistemological reflexivity and its effects on real transformation. It implies that 4) even the generalizable forms and analytical categories are always under transformation as part of reality (Clark and Clark 2012). Consequently dialectics capture underlying processes or intends to do so, (e.g. claimed in the power of reference) holding that underlying processes and surface appearances intertwine as dialectical contradictions. Therein lies that physical, biological conditions and processes relate to social and economic projects, why biological and physical elements cannot be treated as passive to the human geographical history (Harvey 1996, p. 192). Humans are actively transforming them. Humans actively transform the ontology of our physical and social realities (anthropocene, climate change, gene modification). From this follows that, whatever ontology 'we' speak from it inhabits dynamic elements. Thus assumptions are analytical representations of what is assumed to be ontologically distinct. To better grasp there internal and external interrelations, and the degree to which they cover each other I have noted that Harvey elsewhere operates with a number of assumptions that the seven moments of interaction rest upon. In

JNGD, Harvey summarizes 11 assumptions[3] as a coherent and consistent mode of reasoning (Harvey 1996, p. 46-57) over socio-ecological change. Anchoring sustainability with these assumptions aims to transcend surface appearances and address opposition, antagonism and contradiction within it. Thus, challenging imaginary boundaries of sustainability is also an act of changing mode of representation and vice versa.

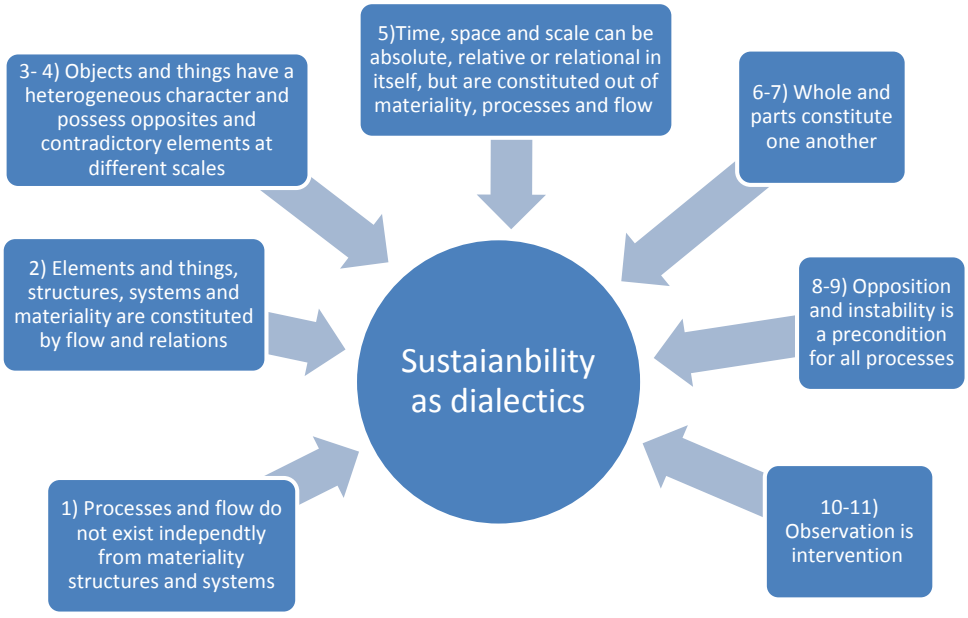

Figure 4.2. *Sustainability, dialectics, and seven assumptions (from Harvey 1996, p. 46-57).*

3 Harvey summarizes 11 prepositions of his dialectical method: 1) processes, flow and relations must be prioritized over analysis of things, elements and structures, 2) elements and things are constituted out of flow, processes and relations, 3) systems and things are inherently contradictory through the processes that constitute them, 4) things are always heterogeneous at every level, 5) space and time are neither absolute nor external to processes, but are contingent and constrained with them, 6) Parts and wholes are mutually constitutive to each other, 7) parts and wholes entail "interchangeability of subject and object of cause and effect", 8) transformative processes arise out of contradiction, 9) change is a characteristic of all systems and all aspects of systems, 10) dialectical enquiry itself is a process that produce permanence, 11) Going back to Aristotle exploration of possible worlds is integral to dialectical thinking (Harvey 1996, p 46-57).

Harvey puts little emphasis in explaining where the 11 assumption stem from. As I read Harvey though, the question is not whether there are 11, 16 or 25 ontological assumptions, since they cannot be looked upon in isolation[4]. Rather the key lies in understanding them as distinct, but related categories so their genesis is mutually linked and opposite elements on one another. Consequently, they are overlapping and intersecting, sometimes knitted together with effects to one another sometimes drifting apart. The challenge of course is that contradictory elements in and between the 7 moments of interaction are to be turned upon academia itself. Can this be maintained independently from the power of reference? The answer is simply that it cannot. Nevertheless, one can be more or less reflexive about it (see 4.3.7).

4.3 Assumptions, Space-Time Dialectics and Contradictions of Sustainability

In the following I take a critical stane that considers contradictory elements and different representational forms of sustainability. In doing so, I hold a critical attitude towards the interest involved in different expressions, explanations and representations. By looking closer into the seven assumptions, I strive for transgressing disciplinary boundaries when examining (contradictions of) sustainability, while inhabiting the terrains of academic work in the making of the power of reference. In the following, I spell each of seven assumptions out in relation to sustainability.

4 1-2). If elements and things are constituted by flow and relations, then it follows that they do not exist independently from one another. Harvey hereby suggests that processes, flow and relations must be prioritized over analysis of things and structures. Yet if they are mutually constitutive one must emphasize both simultaneously. Prioritizing one of them will do a half analysis. 3-4) are merged. Since things have a heterogeneous character and is constituted so at every level, it also follows by taking preposition 5 into consideration. 5) space-time processes are given their own dimension, though they are also constituted out of social processes. One could likewise merge 3) 4) and 5) since they all deal with the matter of scale, between wholes and parts. 6-7 is merged. If parts and wholes constitute each other, and taking 3) 4) into consideration, it follows that parts and wholes, subject and object have and interchangeable character. 8-9) are merged as transformative processes (change) arise out of contradictions it follows that change is a character of all systems, subsystems and so forth (things, structures, elements or even processes change character). Therefore if one take 2) 3) and 10) into account dialectical work itself produces permanence (and change) and have tensions to 8, if one look upon it as an isolated phenomenon. Dialectical work produces permanence and change (permanent change) simultaneously as science explores new knowledge, giving rise to new possible worlds. 10) are merged with 11).

4.3.1 Processes, flows and relations do not exist independently from materiality, structures and systems

Most people have a meaning of the weather, and for some of us, it has huge importance in shaping our everyday life. But can scientists speak about the weather or climate change, without speaking about themselves?

In case we are unwilling to accept that scientists (ranging from the bodies, everyday knowledge to expert knowledge) can speak objectively about the weather, it has a number of implications. (i) First, in giving up the assumption that one can speak objectively of the weather, the climate system and nature, without incorporating oneself, (beliefs, desires, attitudes and aspirations), it splinters Cartesian assumptions that separate mind and matter, weather systems and knowledge systems, thought and action, between consciousness and materiality, theory and practice (Harvey 1996, p. 48). Yet, a classical example of the history of binary thinking is powerfully reproduced in scientific work manifested into disciplinary constructs dividing the natural from the social. Such binary, dual and dichotomist knowledge systems have no purchase and become absurd if one suggests that it is impossible to speak about nature without speaking about ourselves. As Braun puts it *"to speak of nature is to presuppose an ontology"* (Braun 2006, p. 193).

If one accepts to go beyond binary systems, absolutism and essentialism, then a whole new set of ontological assumptions arises. (ii) If one cannot separate the weather systems from society, materiality or consciousness, then any anthropogenic perspective on climate change needs ontologies that bridge the socio-material nexus. (iii) How to stratify them produces radically different forms of assuming, producing and consuming the human environment interface (different sustainability assemblages and agendas). (iv) Out of them arise different 'natures of environmental spaces', in the range of different 'hybrid' forms to low or intensified interactions (no interactions here, and some there). Under one set of circumstances there might be relations under another, there may not. (v) For this reason, (among others) Harvey, Castree and a number of critical thinkers find *internalized relations* become a fundamental position in conceptualizing the human-environment interface whether 1) in a low or high intensified nexus 2) in geographical scale, disciplinary, physically or mentally 3) as well as in and between different temporalities. (vi) Therefore the quest is how to give weight and ontological status to processes, dynamics, relations and flow, rather than materiality, structures or systems in itself. Epistemologically, it is only possible to

study processes, flow, and interaction, by analyzing relations between empirical observations (Harvey 1996, p. 49).

In reading and writing the weather (climate change), ranging from everyday knowledge to expert knowledge, one should also study what Castree (2001) defines as social natures. To Castree nature is not only defined and construed socially, but also modified physically by humans (at all scales, from genetics to climate change), with particular social interests involved in such transformations (Castree 2001, p. 3). In speaking about the weather nature is made social just as society is made natural why one cannot read and write the weather without addressing what gives rise to such conversations, interests involved in them and the production and consumption brought about.

Addressing the first assumption suggests that sustainability must be analyzed in terms of *relationships.* Different ontologies on the human environment interface produce radically different socio-environmental geographies and geographical imaginations of dealing with sustainability. If processes, flows and relations do not exist independently from materiality, structures and systems it has a number of methodological implications. First, scientific discourses are part of producing the materiel realities; why any constructivist theory that does not incorporate material realities, must be rejected. The powers of references and academic episteme(s) certainly have a material side that cannot be reduced to simple semantics (Castree 2014). Neither can materiality be reduced to simple and objective facts. Hereby it follows that different imaginative geographies have different material effects, though never in isolation from other moments of interaction.

A dialectical approach on sustainability is particularly helpful because it transcends classical socio-environmental (disciplinary manifested) divides that allow integration of other domains and social-material spheres of interaction. By approaching social transformative processes on environmental change (and vice versa) it becomes clear how the social dimension of environmental challenges is often excluded in scientific discourses (Harvey 1996, p. 119). Thus, disciplinary arrangements (disciplinary order) and the order of the power of references are often contradictory to socio—material processes, e.g. when the social side of human-environmental interaction is detached from thinking about it.

4.3.2 Elements and things, structures, systems, and materiality is constituted by flow and movement

As far as the first assumption (4.2.1) is concerned, it suggests that there is a material side of any aspect of social life. The second suggests that there is not only a material side of social processes; they are also constituted out of them. To Harvey (1996 p. 49) it follows that things, elements, and structures that appear to have a fixed and permanent status, must be analyzed in terms of processes as part of their being. If process and flows constitute elements and structures, one methodological fix-point becomes to examine through which processes a phenomenon is produced and sustained rather than accepting it as an object with a character of permanence in itself (Harvey 1996, p. 50). It is indeed a hard endeavor and can make one's head hurt to think along these lines; but when we do so, it follows that 'we' give different elements, things, processes and systems different temporalities (see 4.3.4). Accordingly, the Andes Mountains, tectonic formations, glass, money or urban structures that seem to have a permanent structure, are always in a flux. Things, elements, and structure that have a permanent character do not resist the forces of flow (as Harvey puts it) why permanence is also constituted out of processes related to them. Processes also take part in producing resistant and permanent structures (say glacial and interglacial periods). Things that seem to hold a permanent character (organizations, institutions or materiality) will at some point tip from one point to another in which a new state of permanence will arise (Harvey 1996, p. 7). It is also true when (re)scaling phenomena. By way of illustration when scaling or rescaling, processes also constitute materiality and structures; *"under one set of circumstances as a wave, and in another as a particle"* (Bohm and Peat, here quoted in Harvey 1996, p. 50). In other words, electrons appear as both things and flow simultaneously. Energy (flow) and materials

(thing) are constitutive to one another[5]. It makes Harvey suggest that neither energy nor materials can be prioritized for analysis without serious loss of understanding (Harvey 1996). If it is so, one must i) localize spheres of interaction ii) and what kind (state) of interactions/forces (symmetric or asymmetric, synergetic or catalytic, linear or un-linear, causal or chaotic e.g.) these relations are characterized by. Thus, small changes can have important effects in one circumstance and important changes can have small effects in another. The method, therefore, only gives rise to examine the state of relations and processes. Dialectics therefore have limited status when analyzing linear, causal or absolute elements, e.g. in the physical environment, since a phenomenon holding a causal relation may not do so under other circumstances, unless treated as isolated with a permanent and universal character. At one scale a dialectical perspective will reject concepts like planetary boundaries, since they hold a fixed and absolute character explaining planetary limits. At another, a dialectical perspective can incorporate planetary boundaries, precisely because of the planetary limits sustainability (e.g. Rome Club) concepts rely upon. Consequently, dialectics hold contradictory elements to sustainability in itself (see 4.3.4).

Addressing the second assumption suggests that sustainability must be analyzed in terms of *processes* that constitute conditions for (un)sustainability in itself. If it is true, as suggested in the first assumption, that there is a material side of social practices, and if it is true that these are constituted out of processes and flow in and between a number of spheres, then changes of dynamics, processes or relations in one sphere may change relations in another sphere of interaction.

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5 Note here an element of the envy of physics that Harvey may be subject to.
Harvey (1969, 2004) appeals to Einstein (power of reference). "The idea of simultaneity in the physical universe, he taught us [Einstein red.], has to be abandoned. It is impossible to understand space independent of time under this formulation and this mandates an important shift of language from space and time to space-time or spatiotemporality" (Harvey 2004, p. 3). Harvey goes on to suggest that it was only when physicists began to think in terms of processes and relations that modern quantum physics arises (Harvey 1996, p. 50). But as he does so, he does not put much emphasis in addressing what a process is. As processes and energy can hardly be separated, Einstein's theory (E= mc2) that energy equals mass, implying that neither energy nor mass can be destroyed, challenges dialectical thought since it imply absolute, universal and constant boundaries (closed system). If we accept the concept of spatio-temporalities, it follows it must be intimately related to energy. Time, however, is (like matter and energy) assumed a constant, at the speed of light, while space is what bends or is acknowledged as relative. Nevertheless, the speed of light (the highest possible speed in time and space) is also absolute, while simultaneously relative and relational. From Einstein's viewpoint space is relative in the double sense. What he meant was, that geometries are multiple, and the ones we choose, hence a particular spatio-temoral frame, is relativized by the subject (Harvey 2004, p. 3).

Consequently scientific knowledge, technology, and (discourses) develop e.g. in relation to economic growth, dialectically affecting one another. Development of scientific knowledge (and management of it), therefore also holds specific ways of dealing with nature (Castree 2001) that cannot be left unaddressed from validating processes in monetary and non-monetary terms[6].

The production of space cannot be thought of independently from the production of nature. No part can be construed without the other: In advancing the assumption that a given material condition is constituted by processes and flow, into sustainability it provides a whole set of questions, that methodologically give rise to asking by what process a phenomenon is constituted and how it is sustained (Harvey 1996, p. 203)[7]. This question fosters a way of thinking in respect of sustainability, and I have spent great effort thinking about how the unsustainable (society) is sustained? What sustains unsustainability in academia, that both engage with its solutions while forming, creating and reproducing unsustainability?

4.3.3 Objects and subjects have a heterogeneous character and possess opposites and contradictory elements at different scales.

It is the core of academic work to generate scientific facts, e.g. about the state of climate change or conditions of (un)sustainability. Quite often, and despite the two first assumptions, material things, elements, and systems (not least processes) are treated as if they were irreducible facts, hence unproblematic assertions about the world.

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6 Flows of money link to material flows giving rise to understand how circulation of capital create places, factories or cities, and how the lack of flow of capital undermines other places, factories, cities or neighborhoods (Harvey 2005). Suggesting there is always a material dimension to money implies that increased productivity to better ones profitability rate changes how land and resources are viewed, used and managed. Through the process of valuation in monetary and non-monetary terms, nature is reduced to resources. What can be turned into resources in money terms and the way they are dynamic and changes over time, among other changes through the process of knowledge and technologies. The point here is that flow and circulation of money have a quite different temporality than ecosystems.

7 if it is so as a number of neo-Marxian thinkers have claimed, that capital produces nature (Smith 2010, Harvey 1996, Castree 2002), it may also be capital circulation (related to scientific knowledge, technological development and other moments of interactions) that will be the vehicle for the future socio-ecological process (sustainability?). In fact, exploring sustainability challenges through capital circulation may be an effective means in addressing contradictory elements of sustainability, but also in understanding the forms it takes in an educational context (chapter 2).

When scientists, students or citizens explore the world it inevitably is also a sophisticated exercise of reductionism[8]. Reductionism is part of the analytical genesis. At some point any person needs to give things, words or processes (temporarily) a solid character to be able to speak of it. In so doing, one creates a beginning and end simultaneously, wherein facts are given a valid and permanent status. Facts, therefore, are always heterogeneous, and have opposites as a precondition (Harvey 1996, p. 52). If there is anything to this assumption, it has a number of consequences for our mode of thinking. This can be addressed by answering the following question: Does reductionism have explanatory power in itself?

Everything (including abstraction) can be reduced to smaller parts of other (related) things, hence with some element of difference or oppositional effects within it (see 4.3.5). Water is a molecular compound of hydrogen and oxygen. Hydrogen and oxygen are two atoms in the periodic system. Atoms may be reduced to protons, electrons and photons that in turn may be reduced to fundamental fermions (quarks, leptons, antiquarks, and antileptons) which are constituted by elementary "matter" and "antimatter" particles as well as fundamental bosons which are said to intermediate interactions between fermions (National Research Council 2006, Kuhlmann 2013). As atoms (Greek for indivisible), elementary particles are particles whose substructure is unknown.

Objects and things can always be subdivided into smaller entities in relation to one another. What is interesting about the water I set out to explain, is that through reductionism this type of explanation is undertaken by changing the scale to ever smaller parts – to explain water consisting of something else? By reducing to ever smaller spatio-temporal figurations, the entities are given apparent explanatory power.

Coinciding with the two first assumptions, a system at one level of abstraction, only becomes part of a whole at another level of abstraction. I shall return to implications for spatial analysis (see 4.3.4 and 4.3.5), but for now, it is the material dissolution setting academic (imaginary) boundaries that are of interest.

8 We say, when analyzing data, that every statement from our dataset is coded and categorized to distill the essence (through abstraction).

What is defined as an object a thing or a structure (setting boundaries and borders for analysis), always has inherent differentiation/diversification (Castree 2014). Heterogeneity, though, has a deeper meaning than diversity, dispersion or complexity as Harvey notes. Heterogeneity is much more than diversity since *"the parts and processes confront each other as opposites, conditional on the wholes of which they are part"* (Ollman in Harvey 1996, p. 54).

In consequence, if heterogeneity and complexity is part of what things (phenomena, subjects, structures and processes) are or their apparent manifestation, it follows we should emphasize the processes internalized by opposites imbedded within and between them.

Addressing the third assumption in the context of sustainability one therefore must look into sustainability in terms of *boundary making*, also where these are not currently imagined (disciplinarily, theoretically or conceptually). Imaginative geographies then, are elaborately imaginative at the same time material with different spatio-temporal effects. Hereby the process of setting borders and boundaries (geography) real or figurative, conceptually or modelled (thought and practice), becomes of crucial importance, since borders (stretching from rhizome to absolute) determine (localize) relations, processes and contradictory elements. Borders in breath (disciplinary, thematic, fields of research), and in depth (epistemological and ontological) have set the bounds for the intangible development of concepts like space, time, and scale, under which such theories and concepts develop. Changes in borders' change spatio-temporal figurations and hereby modify the circumstances (conditions) under which concepts, theories and abstractions develop. Thus, setting borders is potentially constitutive as opposites in different spatio-temporal scales. This gives rise to the fourth assumption, geographers across the field have long engaged with.

4.3.4 Time, space and, scale can be absolute, relative or relational in itself, but are constituted out of materiality, processes and flow

As different societies have produced radically different thoughts and practices about time and space, space is a system of social relations, shaped by human practice and biophysical processes (Harvey 1996, p. 203). Though Harvey is concerned with relational space and scales as relational, Smith (2010) remarks that there has been: *"an extensive silence on the question of scale"(…). The theory of geographical scale – more correctly the theory of the production of geographical scale – is grossly underdeveloped. In effect, there is no social theory of geographical scale, not to mention*

an historical materialist one. And yet it plays a crucial part in our whole geographical construction of material life" (Smith 2010, p. 72).

Hereby Smith along with Harvey, Castree and others note that any social theory collapses when not taking into consideration time and space. This point is true when economists omit spatial dimensions of aggregated market demands, or when Weber in his abstract theoretical work incorporate processes of temporal change, keeping the spatial dimension constant (Harvey 1996, p. 9). Insofar as social theories collapse when not taking into consideration spatio-temporal dynamics, what implications does it have for socio-ecological relations?

To better hold a grip on the question, I follow six[9] stepping stones Harvey laid down toward a spatial analysis of socio-ecological process (Harvey 1996, p. 112). It is now common among a large majority of human and physical geographers that processes, dynamics or flow do not operate in, but constitute time and space. In accepting such a stance it follows that multiple time-spaces exist in different scales in accordance with the phenomena under investigation. Subsequently, different elements and processes produce different spatio-temporalities. Massey formulates it in this way: *"A number of human geographers are now trying to rethink space as integrally spacetime and to conceptualize space-time as relative (defined in terms of the entities 'within' it), relational (as constituted through the operation of social relations, through which the 'entities' are also constituted) and integral to the constitution of the entities themselves (the entities are local timespaces)"* (Massey 1999, p. 284).

Whatever perspective, it be causal, intentional, evolutionary (ranging from intensive interactions apparent everywhere to low interactions apparent somewhere), they produce different spatio-temporalities. Thus, assuming *where* interactions link

9 1) The discursive activity of mapping space is fundamental to the structuring of any kind of knowledge. Situatedness, location or positionality, therefore is mapping of the space in real terms or metaphorically.
2) Mapping is a discourse activity that involves power, why it is a fundamental tool for political control.
3) Social relations are always spatial, why social activities produce mapping activities in itself. Spatial relations are produced of social relations. 4) Material practices transform spaces of experience from which all knowledge of spatiality is derived. 5) Institutions are produced in and produce space. Institutions manifestate territorializations – of control and surveillance, terrains of jurisdiction, organization and administration. 6) The imaginary (thought) is a fertile source of all sorts of possible spatial worlds (Harvey 1996, p.112-113).

phenomena, systems and structures and with *what* effects measured, it produces mental time-space coordinates. In assuming where interactions link phenomena, we concurrently scale these links, and in scaling these links, we concurrently give different spheres of interaction different temporalities (Harvey 1996, p. 203). Then, it follows that claiming processes, and flow do not exist independently from structures, systems and things, produce a particular form of imagining spatio-temporal figurations itself. Concepts of time and space in other words, affect the way one understands the world, and provide a whole set of representations that act upon that world. In a splendid analysis by Casey (2001) he enfolds spatio-temporal dynamics stretching from bodies engagement with space-places to global networks of organizing space: *"There is no place without self and no self without place (…). A body is shaped by the places it has come to know and that have come to it – come to take up residence in it (…). The reverse is also true: places are themselves altered by our having been in them"* (Casey 2001, p. 688).

There are seemingly no limits to spatio-temporal abstraction and theoretical complexity. The point, however, is: when time and space are also constituted out of social processes, then the construction of geographical scales and space, are crucial for discussion of socio-ecological processes (in and between different scales).

Insofar that processes, dynamics, and flows do not operate in but constitute time and space, then time-space(s) *"is neither absolute, relative, or relational in itself, but it can become one or all simultaneously depending on the circumstances"* (Harvey 1973, p. 13). Space is produced at one or all scales simultaneously, constituted by the human practices related to it. Harvey goes on with a massive critique in claiming that distance cannot be measured in a Newtonian metric abstracted in pure absolute space. It *"can only be measured in terms of process and activity"* (Harvey 1969, p. 210). Distance or space cannot be measured in a Newtonian metric, without I would hasten to say, incorporating process and activities that relate point A with B. Here I think it reveals a problem to Harvey's criticism of Newtonian or Cartesian space, since he both rejects it (Harvey 1996, p. 123) and accepts it (Harvey 2004, p. 4) at the same time. To my understanding Harvey emphasizes relational space, but temporarily space can be absolute or relative. I myself have the same struggle and accept absolute, relative, relational and other multiple spaces as long as they potentially relate, link, and constitute one another. The difference is that I have my doubt in accepting it to be only temporarily constituted and accepting the hierarchies between them.

"I often find myself presuming in my practices that there is some hierarchy at work among them in the sense that relational space can embrace the relative and the absolute, relative space can embrace the absolute, but absolute space is just absolute and that is that" (Harvey 2004, p. 7). Though I am not clarified, the reverse dimension may also be true. By way of illustration, concepts like planetary boundaries or the Anthropocene hold a planetary character hence absolute space (the assumption problematic too, e.g. Harvey 1974b), while sustainability concepts or socio-ecological difference continuously re-scale such quests and produces global environmental change. Therefore absolute space may also be said to be able to hold relative and relational space within it. In being willing to also sort the 'hierarchy' the other way around; absolute space can also embrace relative and relational space, simply because they interact and relate to one another, and are constituted out of the interplay between them. Thus, multiple time-spaces are related to and constituted by different practices, why they are potentially contradictory to one another.

Addressing the assumption in the context of sustainability possesses a number of challenges. Theorizing over spatio-temporal dimensions of sustainability need to take into consideration the multiple spatio-temporal dynamics produced within and between ecological, geochemical, atmospheric or biosphere processes coupled with social practices and societal ways of organizing such practices. Different disciplines, often without putting much attention to it, operate within particular spatio-temporal assumptions. This is challenging to academic work, since spatial scales at which human beings operate as ecological agents (in academia and elsewhere) are dynamic and also change. Geologists investigate in times over periods over millions of years, whereas economics operate in quite different spatio-temporal scales (Rasmussen and Arler 2010, p. 43). Spatio-temporal ordering then is a battleground of controversy between different disciplines. Economists, when examining exploitation of natural resources, set time-scales in accordance with the interest rate. In contrast geologists may look at exploitation of natural resources differently, advocating for quite different time scales. What I want to argue is that inter-linkages between different spatio-temporalities ranging from geochemical cycles, eco-systemic cycles to capital cycles, becomes crucial to any debate on sustainability, and that understanding of spatio-temporal rhythms in different spheres require a different framework, and yet a framework that is able to approach inter-linkages between them if one wants to examine sustainability or global climate change.

Hence the challenges of dynamic and changing scales in and between different spheres of interaction produce contradictory elements between them. If the time horizon is set by practices of capitalism, then it may not correspond to eco-systemic temporalities. The purpose of the rhetoric of sustainability is to some extent to direct think about time horizons encountered in the market. What is rational or considered to be rational or efficient in one spatial scale, may be irrational and inefficient in another. The question of level of abstraction and scale has been raised by geographers again and again (Harvey 1996, Massey 1999, Smith 2010). In the context of sustainability, e.g. in education for sustainability or sustainable transition theory, the issue of scale has largely been left unaddressed (Raven et al., 2012). This will be examined more carefully in chapter 5 and 6. The power of reference (power struggles) must take into consideration the capacity to understand how spatio-temporal scales are produced within academia. As different disciplines operate in quite different spatio-temporal scales, translation between culturally embodied spatio-temporal organizations of socio-ecological processes is crucial if to achieve "more" sustainable practices (Harvey 1996, p. 204). Hence, changing spatio-temporal ordering (scalar politics) becomes vital to reshape contradictory elements of socio-ecological processes in a more 'sustainable' direction.

4.3.5 Whole and parts constitute one another

When taken together, the previous assumptions (1) elements, structures and things relate and (2) are constituted out of flow, (3) have a heterogeneous character, and (4) operate at multiple spatio-temporal scales, suggest that parts constitutes wholes and vice versa. The assumption that parts constitute wholes is crucial to Harvey's and Castree's space-time dialectics. Assuming that parts are constituted from wholes has a number of implications for processes of internalization that go much beyond dialectical reasoning[10]. The principle also applies to (parts) of the natural science phenomena (Prigogine 1986). Rare earth metals for example only occur in mineral and not in elemental form. This is not to say that the whole always has relation to parts in a given situation or for a given phenomenon. But assuming that the whole is constituted by its parts is to claim that whatever phenomenon under investigation has always relations to something

10 It is a principle in Hermeneutics as it is in Anthony Gidden's theory of structuration where neither micro, macro nor meso-analyses are sufficient. In his duality of structure, for instance, Giddens suggests that institutions form structures and structures form institutions, agents and institutions mutually affect and are affected by one another, while reproducing a particular state of being.

else, and the task is to understand what this might be (Harvey 1996). This has further epistemological implications.

Insofar as parts and wholes constitute one another, it is possible to find the general (universal) in the particular (specific) and vice versa. It is hard to undertake an analysis of parts without taking into consideration their relation to the whole. Such an analysis is impotent, and challenges the construction of much contemporary research that divides and subdivides into ever more narrow and specialized fields of study. Ever narrowing disciplinary constructs holds contradictory elements to sustainability, since they have limited capacity to explore holistic and interdisciplinary dimensions related to that phenomenon (see chapter 2). Methodologically it is equally important to swing the pendulum between whole and part.

By way of example, Harvey suggests (1996, p. 54) that as you are breathing, you constitute yourself. It would be hard to live without the oxygen you are taking in. Now, in that very same process the chemical composition of the air changes within you. As you breathe out you transform the atmosphere. In other words, you are constituted by the air, as you transform yourself; hence it gives a new constitutive composition. If you disagree you may try to pull a placket over your head and see if you change the micro-environment. This is why the outset of the chapter claimed that dialectics is both a set of assumptions and that the world is dialectic simultaneously.

The same can be said to be true, when you up- or downscale the assumption, though it cannot be reduced to a matter of scale alone. I as a human being do not constitute the Earth's life crust. To argue that I constitute the atmosphere would be deeply un-asymmetric, rather it constitutes me. The atmosphere whatever the composition, does fine without me and in that sense it is external nature. My life practices and breath have close to no effect on the atmosphere. In upscaling, my effect on the atmosphere is reduced - the constitutive elements are reduced. Now, take all human beings, their life practices, engines, houses, and helicopters. Then a cumulative effect is said to transform the atmosphere, to (re)constitute the chemical composition of the atmosphere/stratosphere, among others through aerosols, CO_2 or ozone (Prigogine 1986). Dialectical links in the human environment interface then constitute new atmospheric conditions, from which the asymmetric component melts into air. Rather cumulative small effects co-constitute large scale effects. Interactions, and connections become constitutive for down-scaling

and up-scaling processes simultaneously. Whole and part are constitutive to one another (Harvey 1996, p. 54).

Addressing the assumption in the context of sustainability implies that anthropogenic climate change is constituted by the whole of which it is part. Conditions for (un)sustainability potentially inhabit and operate at all scales why it can only be imagined when recognizing how whole and part constitute one another. At first glance this has a character that seems to depict everything as equally important. This is far from the case, since assuming that wholes constitute parts and vice versa must be analyzed together with the other assumptions in play. To incorporate the seven moments of interaction in a consistent language and their dialectical socio-material temporalities, is to acknowledge how whole and part constitutes socio-ecological and meteorological futures.

4.3.6 Oppositions and instability is a precondition for all processes

In the third assumption, it was suggested that elements, things, and structures are inhabited by oppositions as part of their being. If opposition, contradictory elements and heterogeneity are part of the apparent status of things, then processes of internalization become oppositional with limited explanatory power. It is in the interaction between elements, structures or things, potentials for transformation are embedded. Change is part of what things, structures and elements are, and potential for change takes place in the interaction between wholes and parts, between subject and object. Thus individuals and things/institutions are both subject and object to social processes of transformation (Harvey 1996, p. 54). This is both the case in general, e.g. in the interface between human-environmental interactions or for particular phenomena, e.g. in biology, where organisms are both subject and object to evolution, as Harvey argues. In a footnote, Hans Jonas wonderfully depicts that the metabolism of an organism is *"not a peripheral activity engaged in by a constant core: it is the total mode of continuity (self- continuation) of the subject of life itself', its 'constant becoming'"* (Jonas 1966, fn. 13, in Szerszynski 2010, p. 12).

Tensions and contradictions take different forms (see figure 4.3). How contradictions are organized and represented hold different forms of power. Contradictions can form binary tensions between two objects/subjects. Contradictions can be organized as tensions between three elements (e.g. subject, object, structures) or be multi-relational. Contradictions can be internalized or externalized to a particular object/subject or phenomena. Contradictions and tensions however,

can also be characterized by a spectrum of tensions between two or more objects. A spectrum of tensions can upscale and downscale vertically, horizontally or in multiple geometries and spheres, until a certain state break down (absolute limit). To complicate matters further the spectrum can be organized symmetrically, be asymmetric, linear or un-linear, direct or abrupt/stratified. Bridging a given spectrum organized binarily or multi-relationally, is also subject to different kinds of relations, it be causal, intentional, relative, evolutionary or emotional. Consequently, contradictions of contradictions, may be causal and binary phenomena in one scale, but relate to emotional tensions in another, which is the case for anthropogenic climate changes. Hence contradictory elements exists in and between e.g. 1) different temporalities 2) causal events, intentional events, or evolutionary events or 3) between absolute, relative and relational space (see also 4.3.4). Tensions and contradictions are also dynamic and subject to continuous development. Under one set of circumstances a phenomenon can be constituted out of causal relations under another by intentional relations. Contradictions therefore are never held constant[11], but change as rupture and response to various material responses, socio-ecological responses and institutional regulations.

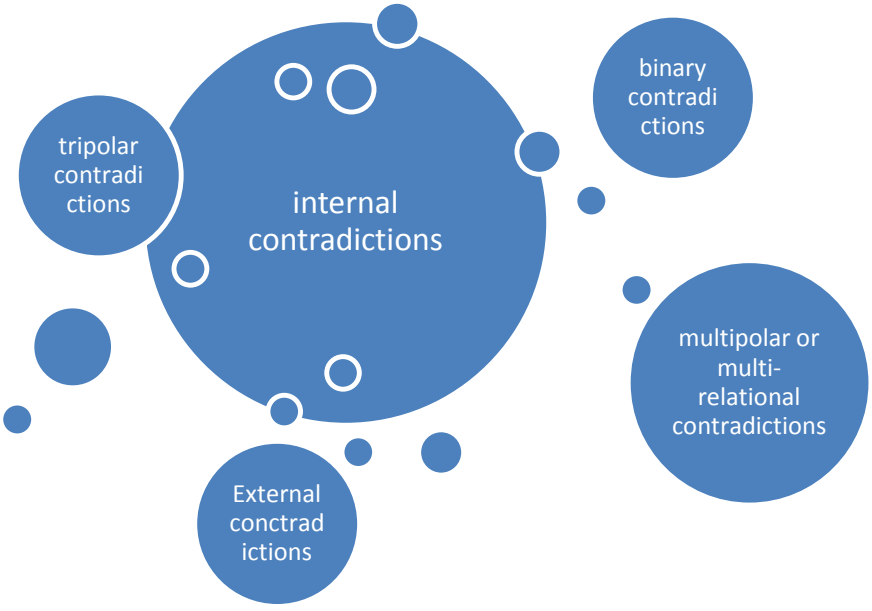

Figure 4.3 *Contradictions of contradictions and there organizational form (inspired by Prigogine 1986 and Harvey 1996).*

11 Can contradictions accumulate? Yes, until a certain point where they create a new state of stability/contradictory phenomena.

To say that oppositions and instability are a precondition to all processes implies that change or transformation is a characteristic for all systems and subsystems. Therefore, transformation and change are always part of what things are or appear to be. The implication are that change, transformation and instability are rather the norm than the exception, why Harvey suggests *"the appearance of stability of things or systems is what have to be explained"* (Harvey 1996 p. 54).

Addressing the assumption with respect to sustainability is contradictory in itself. Hence sustainability should also be considered in terms of *the non-equilibrium thesis*, where irreversibility can lead to a new set of structures and organizational forms (Zimmerer 1994) and by accepting balances and certain levels of stability. The extensive methodological disentanglement of oppositions and instability is a reason why dialectics generally make little appeal to causal explanations. With multi-causality, instability and contradictory elements follow. In dealing with the dialectics of climate change, however, it is hard to acknowledge and at the same time reject causal effects. In chapter 8 I examine this in greater detail. As causal relations are objective to absolute space, it is hard to reject absolute space and at the same time accept anthropogenic climate change fundamentally triggered by rising CO_2 concentrations in the atmosphere. Climate change cannot be captured in an absolute space alone, since dynamics actually change.

Oppositional forces therefore are nodal points with transformative activity (Harvey 1996, p. 54). The dialectics are embodied in material and social relations and therefore is also a process that generates opposition and undermines permanence while producing new. Whitehead (1969, p. 28 in Harvey 1996, p. 54) beautifully relates the presumption to education in stating that *"the principle of process is that being is constituted by becoming".* It follow that learning processes potentially change practices, hence a possible solution to overcome contradictory elements of sustainability (see Part III). Thinking about (un)sustainability in terms of internal and external contradictions is imperative, yet largely absent in the literature on sustainability in higher education.

4.3.7 Observation is intervention

Taking into consideration the assumption of internalization, whole and parts, instability or heterogeneity implies that relations between researcher and the field again are dialectical (between subject and object). Harvey calls this 'two active subjects' why one rather than asking whether the production of knew knowledge

is 'true' or 'false', should engage in questioning under what circumstances is this knowledge produced. Under what circumstances are knowledge produced and what does this knowledge serve to produce (Harvey 1974b, p. 162). Haraway formulates it a little differently in suggesting that 'we' always speak from somewhere and this 'somewhere' has a particular reference to (embodied) time and space. Tacit knowledge is not innocent but one of the greatest terrains of the power of reference. They are claims of being 'nowhere'. To Haraway though, being 'nowhere' is another word for objectivism, which provide the powerful capacity to influence (authority) governmental cultures and schemes (Haraway 1988, p. 584).

According to her all knowledge is situated. Embodied knowledge is subject to and requires responsibilities as to the production, use and dissemination of that knowledge. Physicists like Werner Heisenberg, Niels Bohr and Albert Einstein came to similar conclusions (note the envy of physics). Similar to Haraway, Heisenberg once famously noted *'to observe the behavior of a system is to intervene in it'* (Heisenberg in Harvey 1996, p. 56). Heisenberg is known as the father of the uncertainty principle in quantum physics, which describes that the act of observation has an impact on the object observed. This recognition made him state that the more you want to see the less you see, why atoms are not things, and have no objective existence. Absolute causal determinism is impossible, according to Heisenberg. It is nothing new that observation is intervention (Heisenberg, Bohr). What is new is the emerging understanding that it happens both at an atomic and planetary scale (See chapter 1).

What Harvey quests is rather different orders of normativity (false or true/good or bad), or the distinction between descriptive and nomothetic sciences. Scientific work and scientific knowledge change the world. Distinction between value and facts is fundamental to post-normal science, but is impossible to achieve from a dialectical perspective (Harvey 1996, p. 10). Rather it is about addressing a second order of normativity engaged with how scientific knowledge claims react on dilemmas, power structures and interests that create contradictions themselves. So, instead of value (truth or false/good or bad) it is the process of valuation that is of interest.

If you imagine the third assumption (objects and things have always a heterogeneous character) it inhabits a contradictory element to processes of internalization, hence limited explanatory power (Harvey 1996, p. 53). I absorb the world with

regard to intentional characteristics. Interests subjected to any research agenda, therefore hold processes of intentional internalization. The processes of internalization though, hold a number of unintentional characteristics beyond one's control. Knowledge, intentions and action/practice then, are created in and are elements of the very same process (Casey 2001). They are created in the same social space, in the same space-time coordinates why processes of internalization take place in relatively small spheres of realization, in which the intentional interests, individual or organizational are fundamental to that process of realization. According to Harvey it is therefore never a matter of choosing between different forms of neutral knowledge but choosing between different forms of normative knowledge (Harvey 1996, p. 57). As man transforms nature, he transforms himself. As man transforms himself and nature, he transforms the weather systems and himself in a constant process of continuation. *"In an era when nature is less natural that at any times in human history – an era when even the human body is becoming subject to social reengineering – it seems to me that geographers must become participants in, not spectators of, the momentous socio-natural changes of our time"* (Castree 2001, p. 18). Critical examination of natural change is also a critical examination of society. Socio-political projects are ecological projects and vice versa, why geographical imaginary, regulation and concepts of nature and environment are omnipresent in everything we say and do. *"If, furthermore, concepts, discourses, and theories can operate, when internalized in socio-ecological practices and actions, as 'material forces' that shape history, then the present battles being waged over the concepts of 'nature' and of environment are of immense importance"* (Harvey 1996, p. 174).

Whatever perspective on the use of sustainability in academia one take, the positions are by no means exclusive to each other. Environmental-ecological issues are interwoven in particular social purposes that also inhere in science and education. Control over natural resources (of others and of work) in the name of climate change, sustainability or resource scarcity is never far from scientific knowledge (Clark and Clark 2012). Looking more closely at the way(s) sustainability concepts and politics interrelate becomes imperative if to better handle (valuable) approaches to environmental/ecological questions in research and education.

4.4 Conclusions

At the outset of the chapter I suggested dialectics is both a set of assumptions about the world, but also that the world actually holds a multitude of dialectical relations. In presuming that nature(s) is also socially produced at all scales, I argued that this is actually the case while external nature is still omnipresent. Insofar as different natures are socially produced out of different social practices (different philosophies of science produce different geographies) this has a number of methodological consequences for scientific and educational practices (and beyond). Yet, there are so many prefixes, approaches, dualism, relations, tensions, and ways to methodologically embrace them that it will continue to be a battlefield that constantly changes.

Through the seven presumptions, I have tried to argue this: sustainability is contradictory in itself; it is fundamentally a multi-complex and wicked problem, since there is no center in society from where the problem can be addressed, controlled and managed. Though uncontrollable the processes need to be directed in one way or another if to achieve towards sustainability.

Ultimately, when it comes to the end of the day, models, measurements, methods, though ever more specialized, are subject to questions of why we do it, they are subject to references, ethics/norm, power and representation. Is it better representations and models that can help us with the value/ethical dilemmas and respond to climate change? The continuous expansion of complexity, specialized and sophisticated knowledge, models and approaches as a means to deal with uncertainty, cannot tell us what to do in practice, how to respond and what our responsibilities are. Control and complexity become the greatest paradox. This does not only apply to sustainability, but also concepts like geo-engineering, the anthropocene, ecosystem governance that all provide geopolitical infrastructures – to govern the socio-natural interface.

Locating sustainability discourses in the ontology and epistemology of chapter 4, produces a post-political space of engagement where the future is not given. When envisioning sustainability in academia therefore, no simple strategies or best practices exist in taking the seven assumptions into consideration. But, one can point at contradictions and try to understand them, and find better ways to respond to them. In part III I am not so interested in *what* the contradictions are, but *how* geographers respond to them. Henceforth I enter the field of practice

to substance geographers at work and better understand how they find ways to respond to them.

Theorizing over sustainability one needs to take into consideration multiple spatio-temporal dynamics produced within and between socio-ecological scales. This is challenging to academic work, since spatial scales by means of which human beings operate as ecological agents (in academia and elsewhere) are dynamic and also change. As different disciplines operate in quite different spatio-temporal scales, translation between culturally embodied spatio-temporal organizations of socio-ecological processes is crucial if to achieve "more" sustainable practices as so many these days advocate for. Changing spatio-temporal ordering (scalar politics) becomes vital to reshape contradictory elements of socio-ecological processes in a more 'sustainable' direction. Sustainability must be analyzed in terms of spatial difference and yet much theorizing over sustainability in higher education is little concerned with its geographical implications. Critical examination of sustainability in academia then, addresses inherent socio-natures produced, scales and their impulses affecting management of socio-environmental change. Imposing such reflections into the body of sustainability discourses in academia and their geographies of response(ability) is intimately linked to the power of reference and the ways it gives reference to an emerging politico-ecological governmentality through (supra-artificial) sustain-abilities.

Chapter 5

Spatio-Temporal Tides and Waves and Abstractions of the Human Environment Interface

"We cannot talk about the world of "nature" or "environment" without simultaneously revealing how space and time are being constituted within such processes"
(Harvey 1996, p. 263).

As it has proved hard to methodologically engage with nature-society and explain whether a particular phenomenon is anthropogenic or not, theory is vital to make sense of how the human environment nexus gets established through concepts like sustainability (Castree 2001). Approaches in conceptualizing the human-environmental interface has changed considerably historically. For those in advocacy of sustainability concepts, this is important in two contexts: First the sustainability approach does barely elaborate on this distinction. Environmental change becomes anthropogenic per se. Secondly, and for this reason, one should look closely at the ways in which environmental conceptualizations and politics interrelate if to better handle approaches to environmental/ecological questions in academia. Against this background, this chapter has two aims. Enabled with presumptions from chapter 4, we first theoretically develop what I shall call spatio-temporal tides and waves of the human environment interface[1]. What is interesting about the materiality of spatio-temporal tides and waves, is that it by no means follows trends on the great acceleration and contradictions of sustainability as outlined in

1 With Spatio-temporal tides and waves there is nothing new under the sun theoretically. I do not claim to establish a new theoretical framework. Rather, in following the social nature approach, the history of human-environmental interactions is considered in relation to the anthropogenic climate change thesis.

chapter 1. The remaining part of the chapter takes these co-productive nature(s) into consideration when developing methods for the further analysis in Part III.

Questions for the chapter:

- What does the 'geographical experiment' look like when confronted with climate change and sustainability?
- How do different history-geographical traditions (of determinism, spatial analysis, radical geography, cultural turn and new materialism) respond/ incorporate concepts like climate change and sustainability, and what is the significance to geographical imaginations?
- How is the method in this project developed to research geographers' response (ability) to concepts like sustainability and climate change and contested socio-natures involved in this?

5.1 Anthologies and Ontologies of Social Nature(s)

For centuries geographers have been concerned with understanding and explaining human-environment interactions and geography is sometimes characterized as one of the most prominent and oldest disciplines in the conceptualization of human-environment interactions that integrates elements from natural and social sciences (Rasmussen and Arler 2010).

It can be questioned whether Alexander von Humboldt (1769-1859) falls into the epistemic boarders of geography and geographers. Nevertheless, he is repeatedly portrayed as one of the immediate forefathers of modern human-environment interactions in geography and early environmental science (Harvey 1998, Turner, 2002, Zimmerer 2006). Humboldt's advocacy of geognocy (today's Earth Science) considerably contributed to modern environmental science along with a number of other scholars at the time. According to Harvey his work marks an entry point to modern geography. *"Humboldt's work lies at the end of a period that, beginning with the Renaissance, experienced a massive explosion in geographical knowledge and geographical sensibilities"* (Harvey 1998, p. 724).

In a historical perspective it is interesting to observe that invitations to upscale ecological themes have been numerous during the past centuries. *"The view of*

geography as human ecology has quite a long history" (Harvey 1969, p. 115) and since Joachim Schouw (1789-1852), Vidal de la Blache (1845-1918), or John Mackinder (1861-1947) geographers like Harlan Barrows (1877-1960), Carl O. Sauer (1889-1975), Gunnel Forsberg (1962) and Stoddart (1965) have argued for up scaling ecological themes defining the discipline in ways that geographers should study human beings in relation to their geographical environment (Christiansen 1967, Harvey 1998, Turner 2002, Zimmerer 2006). Though these authors are far from agreeing upon the meaning of what is environmental and how to study it *"The theme of the man-environment relation has never been far from the heart of geographical research, and for many it has functioned as the overriding theme"* (Harvey 1969, p. 115).

As early as 1865 George Pekins March argued in *Man and Nature or Physical Geography as Modified by Human Action* that ancient civilizations collapsed due to environmental degradation. Throughout the 1920s it was suggested that geography effectively was human ecology studying humans' influence on and adjustment to the environment (Barrows 1923).

The history of the human environment theme, however, has taken multiple forms and methodological approaches over the years. Some geographers conceptualize the human-environment theme more or less *ad hoc,* implicitly or explicitly whereas others organize it into constructs separating human and nature or build certain interfaces. Though assumptions of the human environment theme are sometimes implicit, they hold 'tacit information' that is mediated through scientific and educational practices (Demeritt 2002). Therefore we must never ignore the nexus between (tacit) knowledge and power, e.g. in the construction and use of models nor in representations of nature in science and education. Following Harvey, geographers build explanations on the way a theme is constituted; *"A theme acts as a directive by indicating the sort of facts the geographer ought to collect and by suggesting a mode of organization of those facts"* (Harvey 1969, p. 116).

A theme gives rise to theorize as Harvey puts it, and how the human-environment theme is considered implicitly or explicitly can be examined through the way

different kinds of explanations are perpetuated[2]. The history of studying the society-nature interface, make us better understand the geopolitics of scientific and educational practices that constitute the 'object of study', and fundamentally shaping questions asked and data collected (Braun 2006).

What is to be considered relevant to the human-environment theme varies from discipline to discipline. I therefore refer to the human-environment theme as organized assumptions about the way we categorize parts of the world that are not to be considered only within the earth system and human system, respectively.

Whereas the human environment theme organizes the world thematically, human-environment interaction reflects how we build explanation of interactions within the human-environment theme epistemologically (Castree 2001). Methodological reflections on relations and dynamics are focal points to explain a given phenomenon and why it is so. Thus, the explanation of effects and interaction (either it be causal, intentional, functional or instrumental) also signifies conceptualizations of problems and associated solutions (Hansen and Simonsen 2004).

Let us briefly recapitulate some insights from chapter 4, before we consider spatio-temporal tides and waves. Smith (2010) formulates 'the production of nature' thesis as a concept that extends spatial theoretical work of 'the production of space' and amalgamates the spatial chronological theme with the human environment theme. For Harvey, Castree or Massey human-environmental issues often are intrigued by antagonistic discourses, habitually tightly bound to (implicit) political visions. *"Since spaces, times, and places are relationally defined by processes, they are contingent upon the attributes of processes that simultaneously define and shape what is customarily referred to as 'environment'…[T]he idea that spatio- temporality can be examined independently of those processes evoked in environmental and ecological work cannot be sustained. From this perspective, the traditional dichotomies to be found within the geographical tradition between spatial science and environmental issues, between systematic and regional (place-bound) geographies appear totally false precisely because space-time, place, and environment are all embedded in substantial processes whose attributes cannot be examined independently of the diverse spatio- temporalities such*

2 It must be observed however, that facts are also a socially produced (It was not a concern to the early Harvey). Facts are not objective, neutral, independent data constellations, but carry the same value-ladenness as does a theme for which reason it is also of importance to consider how facts are socially accomplished.

processes contain. The implications for the philosophy of geographical thought are immense" (Harvey 1996, p. 263–4).

Massey grasps such methodological reflections wonderfully and shows how nature and society interactions must be studied as *"endless, mobile, restless, given to violence and unpredictability* (Massey 2006, p. 38). Critical examination of sustainability in academia then, addresses inherent socio-natures produced, scales and their impulses affecting management and planning of socio-environmental change.

From a history-geographical approach I address 'spatio-temporal tides and waves' intersecting, overlapping and conflicting (Turner 2002). Whereas spatio-temporal tides refer to, how different ontological and epistemological positions change the ways in which scientists deal with the human-environment interface and hence the different political ecologies inscribed within them, spatio-temporal waves refer to the relevance, frequency and intensity given to the human-environment themes, whatever topic explored.

5.2 Spatio-Temporal Tides and Waves – Co-Constructing Nature(s)

Following Massey (2006), geographical representations are a mosaic of understandings often in opposition to other representations and the interface between the spatial chorological approach and the human-environment theme has been a dominating source of (often) conflicting identities in geography (Turner 2002). For centuries there has been much controversy, enthusiasm and vigor around core dimensions of human-environment interaction for which reason I will briefly draw attention to how determinism, spatial analysis, radical geography, the cultural turn and the new materialism (new material turn) reconfigured the human-environment theme (See also Pattison 1964). Hereby the history of spatio-temporal tides and waves are examined through the roots of determinism, possibilism, particularism and absolutism and the way different traditions interpret and explain regularities, rationalities and relations. I will consider each approach (tide) in turn, partly as historical epoches (waves) and yet overlapping. The approach taken risk homogenizing the debate over the human-environmental nexus (epochs as colonializing

trends)[3] and could benefit from holding a more nuanced debate reflecting on epochal changes in representing the human-environmental interface. Keeping the debate simple, I seek to reflect on tensions between key characteristics and epochal historical changes omnipresent to 'the scientific consensus thesis'.

5.2.1 Nature(s) of Determinism and Determining Nature(s)

According to figures like Birkeland (1998), Smith (2010) or Harvey (1996) the history of environmental determinism can be characterized in epochs (waves), though approaches conceiving nature as the ruling determinant neither gained full recognition in geography (Christiansen 1967) nor can be said to have fully died in contemporary debates (see below). Debates in the eighteenth and early nineteenth centuries were largely concerned with environmental determinism (e.g. with roots from Darwin) versus possibilism and whether culture or nature plays a determining part (Turner 2002). Deterministic explanations are often causal and seek to demonstrate how bio-physical factors such as climate, soil and altitude determine social and economic activity. Nature is external, and the domination of nature thesis particularly inscribed in the enlightenment tradition synonymously relate to other geographical dualisms as that of city and country, center and periphery, civilization and wilderness (Castree 2001, Smith 2010). By way of illustration, in 'Jorden og Menneskelivet' (The Earth and the Human Life), the handbook that for some decades was core reading for Danish students of geography, had deep roots in environmental determinism.

> *"The task of geography is to depict the Earth as the home and field of activity of human beings. Land and people, nature and culture, are the topics the geographer strives to connect; his [sic!] goal is to demonstrate how human life and culture are conditioned by the Earth's natural conditions and utilize the possibilities afforded by the Earth's nature"* (Vahl and Hatt 1922, p. 1; here quoted in translation from Larsen 2009, p.15).

Environmental determinism presupposes a zero-sum game between the natural and the social, of which and how one determines the other. In other cases environmental determinism separates the physical from the social, like the disciplinary separation of the natural sciences from the social (Christiansen 1967). The

3 For those less satisfied with the proceeding, I suggest they consult Grove (1996), Harvey (1996) or Castree (2005).

dichotomy continuing in nineteenth and early twentieth centuries profoundly captured debates into the question whether and how nature played a determining part over society and culture, and how among others science provided a useful tool to free humanity from these irksome fetters. Legitimation of knowledge in the enlightenment tradition objectified nature to be instrumentally used, tamed and exploited (Harvey 1996, p. 121). Nature dominates culture not vice versa and *"the general good of mankind (…) is knowledge that is useful in life (…) to render ourselves the masters and possessors of nature"* (Descartes in Harvey 1996, p. 121).

Classical human ecologists in geography, e.g. represented by Stoddard or Christiansen, studied human practices through biology's positivist binoculars (human ecology has moved on, but at the time the positivist approach had a dominant position e.g. in Danish geography). In so doing human beings was studied in their habitat (Harvey 1996, p. 191) why environmental determinism were criticized for incorporating a language (methods and approaches) e.g. from biology into social theory (e.g. Social Darwinism, methodological naturalism or classical human ecology). Thus environmental determinism presupposes a one-dimensional ordering, a one-dimensional hierarchy between and within the physical and the social in which ideological struggles are 'naturalized'. The political implications of the Berkeley[4] and Chicago[5] School (at which environmental determinism long persisted) were criticized for looking upon culture as a super-organic phenomenon, as an independent object, producing a certain form of environmentalism. Such antagonisms have political implications because they involve an attitude of detachment while at the same time holding a perspective of scientific objectivism (Birkeland 1998). According to Stoddard (1987) the criticism gained to a point where the 'geographical experiment' in the study socio-environmental interactions nearly died as geography fractioned.

4 Carl Sauer (Berkeley School) was interested in the relation between culture and nature (nature as culture and vice versa). Embedded in traditional geography and regionalism (prior to spatial analysis) he is concerned with material cultures and how culture shapes material/geographical expressions and structures (Turner 2002). Sauer's positivist theory concerned the cultural understanding of human environmental interaction and how culture's material aspects changes over time. Henceforth he was aware of how 'mode of thinking' influences how humans interact with their surroundings in terming 'the morphology of landscape' (Christiansen 1967) but never took the ontological and epistemological consequences of it.

5 The Chicago School e.g. remained insisting on a positivist version of resource geography, emphasizing human choices between different resources, and the (potential) environmental risk and hazards associated a given practice (Turner 2002).

While the teaching of geography has both in the past and in the present sought academic identity through 'the geographical experiment'; that is, *'an experiment in keeping nature and culture under the one umbrella'* (Livingstone 1992, p. 190), the 'umbrella' of environmental determinism lost credibility in part because of the critics coming from radical geographers, in part because of the environmental movement 'outdated' the debate during the 1960s (see next section).

Heritage from environmental determinism still features in contemporary climate debates, though debates whether nature dominates culture have shifted completely: humans are now dominating nature, not vice versa. Humans are the determining, overruling and driving force in global environmental change according to the anthropogenic climate change thesis. In its extreme humans determine future global environmental change to the extent it is portrayed as climate catastrophism (E.g. James Hansen) or through concepts like the anthropocene (Steffen et al., 2007). In arguing for sustainable planetary governance, geo-engineering or earth system management (Barnosky et al., 2014) that "*render ourselves the masters and possessors of nature"* (Descartes in Harvey 1996, p. 121), the domination of external nature with technocentric means (Mansfield 2009) undergo a process of internalization. The human impact on nature thesis reconfigures traditions of determinism; culture determines nature while it is still considered external. Nevertheless, as soon as 'we' speak of sustainability, the anthropocene, geo-engineering or anthropogenic climate change, nature is denaturalized as Castree (2014) coins it. In one moment the anthropogenic climate change thesis speaks of observed and objective changes, in the next, they become renaturalized when these observations are taken into decision-making, e.g. in stabilizing the climate, hence balancing human-environmental interaction.

Likewise, at the other end of the determinism debate, the domination of nature thesis (internal nature undergo a process of externalization), can hardly address anthropogenic processes of climate change, but remain undisputed in the tradition of climate skepticism (the thesis is rejected by externalization). The atmosphere remains external and unaffected by human practices. Thus, it resolves into the terrains of external nature, implying that humans have no impact on the climate or physical environmental change at its extreme.

Also in the context of theorizing over sustainability in higher education, the determinism thesis comes into being in acknowledging humans play the determining

part of socio-ecological transformations (society harms nature destructively) while reconfiguring traditions of determinism to environmentalism (Castree 2001). Those in favor of environmentalism hold the perspective that 'we' need to reestablish the balance between a zero-sum game of human-environmental determining factors (equalizing the human and the social as a determining force as an attempt to control global environmental change) e.g. promulgated through assumptions of climate catastrophism or in avoiding 'natural disasters' that 'bite back on us' (see Castree 2001, Barnosky et al., 2014).

5.2.2 Nature(s) of Description – Descriptive Natures

Another shift in the way geographers have dealt with human-environment interactions relates to the descriptive tradition and the spatial analysis (Turner 2002, Hansen and Simonsen 2004). During the mid-20th human-environment interactions (re)emerge and challenge simple environmental determinism (Rasmussen and Arler 2010). Positivism became a platform to combat what was regarded speculative science, why universal regularities and causal effects of the nature-society nexus became a focal point of study. Thus a dominant wave of the ways in which geographers deal with human-environment interactions relates to the descriptive tradition/spatial analysis (Hansen and Simonsen 2004). The move from ideographic toward a nomothetic approach in geography reconfigured the human-environment theme, since it could not also encompass environmental determinism. *"This obviously implied that the traditional focus of Geography on Human-Environment relationships lost its defining status"* (Rasmussen and Arler 2010, p. 38)[6].

Such mechanistic and universal perspectives (positivism) from which nature is ultimately fixed and which encompasses a set of general rather than contextual characteristics made human- physical geography drift apart. Ecology was looked upon with much skepticism since it had limited possibilities of quantification, not well suitable for casual and quantitative approaches. The dualism of nature and society was also (and widespread) institutionalized into disciplinary departments of physical geography and human geography, into theoretical constructs, and into education and curricula (Stoddard 1987). Subsequently, Kantian geography

6 In the same vein Turner (2002, p. 63) argues "The central place of the human-environment identity was downgraded in geographic thought during the last half of the twentieth century, a time in which the spatial-chorological identity held formal dominion".

emphasizing spatial or chorological topographies gained support in favor (and often opposed to) of the human-environment theme (e.g. Humboldt's note and Mode see Zimmerer 2006), and especially the 1960s and 1970s marked a period dominated by the spatial-chorological approach (Rasmussen and Arler 2010). From the 1960s, however, the focus on environmental problems particularly emerged within the natural sciences, and this in turn gave inspiration to (re)engage with system ecology and human ecology (Rasmussen and Arler 2010). Correspondingly, Zimmerer (2010) discusses nature-society articles from (1911-2010) in the 'Annals of the American Association of Geographers' and shows that the number of articles is nearly as high around the 1960s as during the 1990s and 2000s.

The spatial analysis approaches presumes mechanistic and general characteristics whereby ecological systems are studied as characterized by the thesis of equilibrium, balance and stability (Zimmerer 1994). Interestingly, (according to Rasmussen and Arler 2010) criticism mostly came from radical geographers (internal fight) and the rise of the environmental movement (external fight) led to a reengagement with the human environmental interface e.g. in industries' impacts on local environments.

The spatio temporal tides and waves concerning determinism and the spatial analysis have a common background: nature(s) is explored through assumptions of scientific objectivism. Nature is external and through the study of it, 'we' can find the true condition of nature(s) (Castree 2001). In a holistic manner the anthropogenic climate change thesis is organized within the framework of cause and effect, limitations and opportunities by ways in which 'we' can speak of different conditions caused by different human practices. It follows that the 'unsustainability' of natural management is when natural use is not maximized fully due to devastating practices. Approaching sustainability as a technical issue produces technocratic knowledge that is unable to treat nature as anything but a resource (Mansfield 2009). As a result different facts provided produce different scenarios, which legitimize different uses of natural resources. Commitment to a theory of knowledge, according to which any phenomenon natural or social, is to be explained through systems of laws and causalities do not fit well with the social dimension concerning responses and responsibilities of climate change, the anthropocene or sustainability. Yet, they are predominant in environmental science, climate science, and earth observation, and will be critically addressed through the culture of climate change modelling in chapter 8.

5.2.3 Radical Geography: The Production of Nature and the Production of (Scientific) Climates

During the 1960s radical geography grew in response to the spatial analysis. Paradoxically radical geographers did not put much emphasis in the matter of nature (wave). Rather they spend much effort in fighting the positivist heritage (tide) of the spatial analysis. By way of illustration Fitzsimmons (1989, p. 106)[7] argued that *"most work by geographers (…) has continued a peculiar silence on the question of social Nature"* and in doing so, she reacted from within radical geography. Fitzsimmons (1989) demonstrates how only a few geographers show interest in the human-environment relationship during the 1980s, and by comparing conceptions of space with conceptions of nature she emphasizes how geographical thought is imbalanced, not emphasizing the latter. Though Smith (2010[1984]) had already coined the term production of nature Fitzimmons pointed to radical geographers reluctance in examining the social character of engaging with nature(s). One of the reasons of the 'peculiar silence' (including Danish geography, perhaps most notably apart from Bue Nielsen) was the fear of being associated with external nature. It is precisely the dominance of *external nature* in science that inevitably associates a taste for positivism that keeps radical geographers avoiding it. Hence the danger of the concept of nature relates to the power of reference (chapter 3). Fairly enough, also many other themes are on the agenda, e.g. production of space in development geography, urban geography and the like, yet by ways in which it establishes an ontological dualism separating from nature (another conceptual way of keeping/accepting external nature). It follows that one must also criticize the division of academic labor within radical geography that separated concepts of society and nature, by not examining the latter.

Though the early stages of radical geography reduces the production of nature to a quest for resources and production, it later came to embrace scientific 'progress' as mutually conditioning global environmental change. To produce knowledge about nature is to come to embody knowledge claims in relation with multiple

7 Though Fitzsimmons argued *"the peculiar silence on the question of…nature"* (Fitzsimmon here qouted in Castree 2001, p. 111), Castree in his quotation leaves out the social nature "*peculiar silence on the question of social Nature"* (Fitzsimmons 1989, p. 106), the very same term he envisions to develop, since he phrases it, social nature has the capacity to transcend one dimensional nature toward recognizing the construction of human-environmental relations; social nature(s). Her aim was not to argue for what later became the cultural turn (see below) or a non-material approach, but having radical geographers to take up the quest of the social production of nature.

actors and regimes of expertise and their terms and conceptual claims about the environment (Demeritt 2002).

By pointing back to chapter 2, the production of nature involves relations between capitalism and the governance of science and yet science and the economic system are commonly thought of as separate, non-intersecting entities. *"Science is pivotal to present day human-nature relations, and yet the 'nature' of science is widely misunderstood"* (Castree 2001, p. 194).

With the production of nature thesis (and the production of space) radical geographers point to the socializing processes of (re)shaping nature always imbedded in the abyss of capitalism. *"It has been capital circulation that has made nature what it is (…). It is not fashionable these days, of course, to evoke directly a triumphalist attitude to nature. But I think it is important to understand that this is what both the theory and practice of capitalistic political economy entails (…). The prevailing practices dictate profit-driven transformation of environmental conditions and an approach to nature which treats of it as a passive set of assets to be scientifically assessed, used and valued in commercial (money) terms"* (Harvey 1996, p. 131).

The (un)sustainability of contemporary socio-environmental change, therefore heavily depends on keeping capitalism going. By the same token Castree (2003) argues commodities are not only things; but also processes and socio-natural relations, and their different spatio-temporalities are (temporality of climate change and accelerating capitalism) constitutive to and mutually form each other. Along these lines Sayer argues, when greener technologies or products are designed to be more profitable than current ones, then capitalism would go for them - *"not because they were greener, but precisely because they were more profitable"* (Sayer 2009, p. 350)[8].

The production of knowledge, conversely produce effects for environmental governance that cannot go beyond production of different kinds of political ecologies, with authoritative claims, rights and regimes. *"The translation of the environmental problem into the domain of expert discourses permits the internaliza-*

8 The capitalist countries, Harvey argues, keep preaching that overpopulation puts pressure on resources, while at the same time arguing that the rich West needs to consume ever more resources to contribute to "sustainable growth" (Harvey 1996, p. 144, see also Harvey 1974b).

tion of environmental politics and regulator activity largely within the embrace of the state apparatus, or more loosely, under the influence of corporate and state finance of research and development" (Harvey 1996, p. 375).

From this perspective the normative conditions science arrives from envisions different forms of political ecology, weather recognized throughout the scientific practices or not. What counts as nature(s) depends on the perspective of the scientist as Castree puts it, and interests involved in the research agenda, either reflective interests, commercial interests, self-promotion and recognition, political attitudes or unconscious elements. Whatever perspective, nature as external, ecocentrism or sustainability approaches, is selective according to the speaker's purpose (Castree 2001, p. 9). Dealing with human-environmental relations, therefore, is neither an objective nor neutral act. This seems extraordinarily important both in discussion on education for sustainability, as well as politics of the knowledge economy, since what is considered to be the material form, the social form and the value form affects the production of nature in science and education and vice versa.

> *"It was science that revealed global problems (acid rain, global warming, and ozone holes) demanding wide-ranging collective action beyond nation state boarders, thereby posing a challenge (legal, institutional, cultural) to the closed bureaucratic rationality of the nation state"* (Harvey 1996, p. 378).

While Castree has grown out of the production of nature debate he begins to communicate with the cultural turn and new materialism, hence illustrative to some of the later movements in radical geography (see below). *"It [Capitalism red.] is inherently growth-oriented: profit rather than, say, social equity or environmental sustainability, is the primary goal"* (Castree, 2001, p. 193) he also suggests that *"Marxism is a necessary but not sufficient approach to understanding and responding politically to the capitalist production of nature/s in the twenty first century"* (Castree 2001 p. 191). As the governance of science remains the largest producer of non-media representations of nature(s) with huge political implications for our rational, ethical and aesthetic practices, Castree (2014, p. 246) points to the relevance bringing of a dialogue between radical geographers, the new materialism while embracing insights that came out of the cultural turn.

5.2.4 Natures of Cultures and Cultures of Natures

The cultural or linguistic turn is yet another spatio-temporal tide and wave that influenced human-environment debates, though it never gained much attention in physical geography. The cultural turn can be viewed as a reaction to the materialism in radical geography, among others, with the discursive power of language in mind. According to Birkeland (1998) the cultural turn led to a shift in the relationship between nature and culture favoring socio-spatial formations so that *"cultural geography has lost touch with its basic relationship to the concept of nature"* (Birkeland 1998, p. 230). Though Birkeland advocates for quite different geographies than Fitzsimmons in dealing with representations of nature both agree that the tedious waves dealing with nature are lacking. Correspondingly Zimmerer's (2010) analysis of the 'Annals of the Association of American Geographers' reveal that articles thematically (waves) covering society environmental relations during the 1980s is only half of that of the 1960s. Interestingly geographical representations of human-environment interfaces decline as a myriad of interdisciplinary fields arise. (see chapter 1).

Discursive constructions share concern for the effects of the power of reference for which reason constructionism, particularism and contextual approaches tend to engage in critical examination of ways in which nature is socially construed (Birkeland 1998). The culture of understanding nature nevertheless faces the dilemma of the prison of language: that we can never know if our conceptual construction of nature corresponds to how nature actually appears (Demeritt 2002, p. 774). Social constructivism as a purely linguistic project finds its base in post-structuralism, that is – a project detached from the materiality of nature. The problem of society – nature dualism lies in the culture (communication, narratives, images) while related to third nature. Social constructivism that involves a material construction (e.g. through communications), are closer related to radical geography and social production of nature. Much of the difference between post-structuralism/linguistic turn and radical geography, precisely lies in the fact that the former is ontologically and epistemologically detached from its material underpinnings (Hansen and Simonsen 2004). Immaterial versions of representations of nature, is fully rejected by Marxist scholars. Yet, while upholding the language of Marxism, Castree brings dialogue into being in being enriched from the 'discursive materialism' in the cultural turn and the new materialism, e.g. in his latest book examining third nature and the construction nature(s) in the media industry (Castree 2014).

Associated with the problem of distinguishing anthropogenic from non-anthropogenic processes both the spatial analysis and the cultural turn have hard times in distinguishing and knitting repercussions. Though methodological approaches to the human-nature interactions have receded, explanations may not be reduced to cultural turn(s) nor spatial analysis (quantitative revolution). Despite conceptualizations of culture are fundamental to environmental challenges and material conditions, one of the problems I have with the social construction of the nature perspective (social nature) concerning anthropogenic climate change is how to deal with irreversible processes and tipping points (that cannot be construed back). While it has never been the aim of social constructivism to deal with irreversible processes or tipping points, it is a necessity if to seriously build a social nature perspective concerning the anthropogenic climate change thesis. There remain unsolved problems that the new materialism has taken into quest.

5.2.5. New materialisms – New (Interactive) Social Natures

Though social construction is part of reality, it does not imply that humans can construct and reconstruct, manufacture and remanufacture global environmental change in accordance with their will (Castree 2001). Above we saw how radical geography in contrast to the cultural turn claims a strong ontological position about the materiality of nature's construction while both reject classical divides between subject/object and society/nature dualisms. In so doing, both find different ways out of positivism and the external nature concept, and yet both face unsolved challenges. One response has come from scholars inspired by Actor Network Theory (ANT) and the new materialism (e.g. Thrift 2002, Castree 2002, Whatmore 2006, Lorimer 2012)[9]. These scholars challenge 'privileged' ontologies that favors human agency as *the* transformative source for environmental change. Whatmore (2006) is exemplary in illustrating attempts to overcome discussion that seeks to determine 'the agent(s)' of socio-ecological change. To her relational ontologies comprise 'hybrid' or 'cyborg' forms of human – environment interactions, e.g. as co-existing inhabited landscapes, rhizome landscapes, multinatural ontologies, vital materialism or dynamic ecologies, where non-human agencies are mutual and equally emphasized. As Lorimer (2012, p. 594) notes *"There is now a diverse array of non-deterministic and non-dualistic materialisms that circumvent the realist-relativist impasse that plagued debates between the social and natural sciences in the 1990s"*.

9 In human geography the new materialism and the multinatural ontologies that follow have been strongly influenced by Latour and Haraway and their critique of ontological dualism.

In contrast to scholars in favor of the cultural turn, the 'new materialism' sticks to realism. But, whereas ANT holds a flat ontology critical geographers imbed their work in critical realism and/or Marxism. ANT insists on interactive agents – alive or not – with privileged multinatural ontologies. Whereas Harvey and Castree do also acknowledge a non-human world (external nature with non-human ontologies/agencies) they hasten to add, that it becomes internalized either when theorized or by human practices. Internalization involves (asymmetric) power relations among others. For ANT in contrast, non-human actors and human actors have privileged status, yet in different ways (Castree 2002). Things possess their own agency. It follows that global environmental change is just as much materially produced and transformed by non-human actors as it is by human actors. Rather global environmental change is a result of changing relations and networks between non-humans and humans (Lorimer 2012). While I am inspired by the new materialism as the anthropocene narrative is much celebrated these years, the new materialism sometimes bear connotations to a new positivism or methodological naturalism for reasons not fully clear to me (see chapter 8).

The new materialism thus distinguishes between first (external) and second (human) nature(s) while knitting them. While second nature is defined on the realms of a first non-human and external nature, accepting external nature as its pre-existence, social nature more aggressively insists that nature has always been socially determined. Nature is made social just as society is made natural (Castree 2001, p. 18) why the 'anthropocene' must rather be though commensurable with the 'oecocene'.

By pointing to social nature he splinters the dichotomy between first and second nature. Though still not clarified I find it problematic to uphold external nature (with own agency) and still rejecting its dualism. While Castree (2002) criticizes ANT in misinterpreting asymmetric power relations (and deep ontology) he is willing to incorporate it, e.g. when discussing Marxism with ANT. Yet it is hard to uphold social nature - that rejects nature to be external per se (non-human nature is diminishing). Entering the field of rhizome ontologies with interactive agents become a misty zone with 'equalizing' interactive agents. In consequence the anthropogenic climate change thesis can never be fully accepted, since humans cannot be though independently as the dominant force. Castree (including myself) finds inspiration from the new materialism e.g. when speaking of third nature in media production. By pointing to the power of representations Castree extends

and develops radical geography in dialogue with non-Marxist approaches. New materialism and ANT, become inspirational sources, though he never accepts the implications of its ontologies (Castree 2014), precisely because new materialism (e.g. 'anthropocene') has little to say about political economy and the commodification (neo-liberalization) of nature (e.g. 'oecocene').

Concerning sustainability in higher education, the history of spatio-temporal tides and waves underline the relevance to critically explore how contested values, norms, aesthetic expressions are omnipresent in representing the socio-natural – the social natures in curricula constructs. As I take a social nature approach in examining the use, integration and explication of sustainability in geography, it is worth while briefly to consider the relations between the two.

The social nature approach holds a perspective according to which nature *is* social. An example is the reinsertion of nature in cities arguing that cities are socio natures with their distancing habitats and faunas (Thrift 2002) challenging the idea that processes of urbanisation progressively distance nature (external nature) from the urban, rather it produces social natures. To Castree, nature is not only defined, and construed socially, but also modified physically by humans (at all scales, from genetics to climate change), with particular social interests involved in such transformations (Castree, 2001, p. 3). Nature is social all the way down (genetic modification to climate change) as Castree puts it, why nature is produced in accordance with technological, cultural and economic interests. Through the exploitation of natural resources and commodification of nature, humans actively appropriate, transform and change nature, and in doing so, 'man transforms himself'. Nature therefore is historically constructed environments, why in an era where the anthropogenic narrative gets so much attention (become an agent in itself) it seem relevant to reflect upon science engagement in acting on the external world and response(abilities) in changing it. *"As long as men exists, the history of nature and the history of men is mutually conditioned (…) by acting on the external world and changing it, [we] at the same time change [our] own nature"* (Marx here quoted in Harvey 1996, p.173).

If the social nature approach holds nature to be 'social all the way down', in scale and intensity and by ways in which social-ecological transformation proves to have 'world change importance' (Castree 2001, p. 1), then sustainability and the social nature approach at least has one common platform: they both find nature to be

anthropogenic. They both reject external nature, that nature can be objectively studied. They both reject absolute space, hence epistemologically unable to deal with planetary boundaries, non-human and externally driven environmental change (volcanic eruption or earthquakes). Rather nature is formed and made, produced and remade by human actions at all scales (Castree 2001). Taking a social nature approach enables me to examine how nature(s) are socially embodied in geography education, through concepts like sustainability. It is another way of saying that concepts like external nature, universal nature or social nature, not only change over time, but vary between disciplines and academic traditions – inhabiting spatio-temporal tides and waves concerning the socio-natural interface. The above implies there are no simple facts, no standard solutions; knowledge is contextual and culturally imbedded. The work undertaken in this dissertation, therefore, by no means claims to find the right way to address (the right) questions nor to find the right solutions to that problem (see chapter 4 and 5). Nevertheless, the work insists on the relevance of the questions asked and the approaches undertaken to address them, hence a qualified and reflective method that contributes to the academic discussion over contested ideas of sustainability. This is imperative to contemporary (un)sustainability debates in academia and higher education.

5.3 Co-constructing Methods: Approaching Spatio-Temporal Tides and Waves

As illustrated in the previous section, the history of the human environment theme has taken multiple forms and methodological approaches over the years. Thus, geographical representations perpetuate a mosaic of understandings often in opposition to other representations (Turner 2002). This section elaborates the methods used to examine the hypothesis that the human environment theme is under reconfiguration being denaturalized e.g. through sustainability and in what ways contested ideas on sustainability have materialized in contemporary Danish geographical education. In doing so the history-geographical approach conducted can be viewed as an experiment that both develops and is developed from the interplay between spatio-temporal tides and waves and the 'messy' empirical reality. The methodological experiment insisting on a framework that amalgamates the spatial chronological theme with the human environment theme. It insists on transcending classical divides between human and physical geography, disciplinary traditions or cultural and natural divides (Birkeland 1998), whatever the infor-

mants say. This is radical in that the methodological approach insists that human practices and discourses always relate to nature also when externalized, rejected by the informants, practitioner or when informants are unconscious about it (See e.g. Harvey 1996, p. 189). Many slip-falls lie waiting and though Braun welcomes 'speculative' biopolitics and experimental epistemologies since *"socio-nature names [are] an open rather than a closed field, eco-politics must be orientated not towards conversation (…) but to the possibilities and consequences of a 'new earth' and a 'new humanity' that is still to come"* (Braun 2006, p. 219), it places particular responsibilities on to the researcher's shoulder[10]. It also places great responsibility on the researcher as co-producer and re-representative of reality. The mental experiment in keeping the socio-natural under one umbrella for geographical imaginations (Livingstone 1992), then contrast more formal empirical test experiments, in which *"a broad and vaguely defined framework is seen as a prerequisite for gaining new and unexpected insights into the op-ended and complex nature of society-environment co-evolution"* (Weisz and Clark 2011, p. 284).

Nevertheless, such an approach makes it possible to study how students become geographically trained as to interpretive explanations of human-nature interactions. Consequently, the analysis of how issues of sustainability are addressed in geographical education becomes as much a methodological and identical question (researcher's subject positions) as a thematic one (Turner 2002).

Intended learning outcomes always represent a fight over content that assemble 'curricula constructs' with effects to how the human-environment theme is taught. For this reason it is found valuable to encompass educational-political geographies of how sustainability themes are reflected in curricula (and their formal requirements); and how these formal (and informal) learning outcome requirements are enacted in the education of geographers (Molin 2006). In this way it is possible to comprehend inclusion/exclusion of features and themes as a practice concerning the building of geographical explanation and how it affects analyses, practices or policies.

10 Though always to be continued, at some point one has to come to an end and enter into a dialogue on the work undertaken, its limitations and significance. In chapter 4 i have tried to outline my positionality the best I can.

5.3.1 Data Collection and Sample

Discourses on materiality, whether mediated through text or in the classroom, become dialectically tides and waves (of internalized and externalized 'facts') by ways in which different domains form habitual practices that also represent struggles of interests. As any curricula development can be viewed as educational-ideological configurations, the empirical analysis is based on (peer) expert interviews with research geographers (Table 5.1 and appendix 5.1) to particularly address their teaching, opinion, use and explication of sustainability (Appendix 5.3 and 5.4)[11]. Based on a phenomenological tradition (see below), departure is taken from the individual interviewee's experiences, and the focus is on the subjective perception of the investigated topic. The respondents were asked if they find climate change and sustainability issues important to geographical education, what they think of the sustainability concept in geography, and if they include sustainability themes in their own teaching. Thus, questions of the interview were centered on perceptions of sustainability as it appears to the teachers/researchers themselves and are accepted as representations of their thoughts and ideas about a given topic. With open questions, I was particularly interested in the direction the discussion is taken by the responders'. It would, I though at the time, contribute to a diverse set of dilemmas/contradictions and paradoxes within and between academics – in a more nuanced way than predefining dilemmas and contradictory elements in interview questions.

At the time of designing the survey and compiling the interviews, I was positioned in a literature study on education for sustainability – not Harvey and Castree. In this way the interviews and the later analysis (see below) reflect a movement, from education for sustainability typologies toward the social nature approach. In retrospective, a mixture of Anglo-Saxon history-geographical literature, typologies of teaching on sustainability/climate change issues in Swedish geography and interviews with Danish geographers, reflect the different literature contexts in which I have been. As I learned the discussion on education for sustainability in geography are much stronger in Sweden than in Denmark a literature study was undertaken to identify studies that has dealt with contemporary environmental geography teaching in Scandinavia. No articles, however, dealt with teaching sustainability in neither in the Norwegian, Danish nor Swedish Journals of Geography. This

11 Interviews, study regulations and declarations from the International Geographical Union (IGU) are not featured in the reference list, but found in appendix 5.1and 5.2.

Table 5.1. *Sample of Interview Participants: Interview with 31 Danish Research Geographers*

Gender	*Geographical background*	*Title*	*Institution*	*Age*
Male	Physical	Ass Prof	Copenhagen	40-49
Male	Human	Ass Prof	Copenhagen	50-59
Male	Human	Ass Prof	Roskilde	60+
Female	Physical	Professor	Aalborg	60+
Male	Human	Ass Prof	Roskilde	50-59
Male	Human	Ass Prof	Copenhagen	50-59
Male	Physical	Professor	Copenhagen	60+
Female	Human	Ass Prof	Copenhagen	40-49
Female	Human	Professor	Roskilde	60+
Male	Physical	Professor	Copenhagen	50-59
Male	Physical	Ass Prof	Copenhagen	50-59
Male	Human	Ass Prof	Roskilde	60+
Male	Human	Ass Prof	Aalborg	40-49
Male	Physical	Ass Prof	Copenhagen	40-49
Male	Human	Ass Prof	Copenhagen	30-39
Male	Physical	Ass Prof	Roskilde	60+
Female	Human	Ass Prof	Roskilde	50-59
Male	Physical	Ass Prof	Copenhagen	30-39
Male	Physical	Ass Prof	Copenhagen	50-59
Female	Human	Ass Prof	Copenhagen	40-49
Male	Physical	Ass Prof	Aalborg	40-49
Male	Human	Ass Prof	Copenhagen	50-59
Male	Human	Professor	Roskilde	60+
Male	Physical	Professor	Copenhagen	60+
Male	Physical	Ass Prof	Roskilde	60+
Male	Physical	Ass Prof	Copenhagen	50-59
Male	Human	Ass Prof	Roskilde	50-59
Female	Physical	Professor	Copenhagen	60+
Male	Human	Ass Prof	Roskilde	50-59
Male	Human	Ass Prof	Copenhagen	50-59
Female	Physical	Ass Prof	Roskilde	40-49
Male: 24	Physical:15	Ass Prof: 24	Aalborg:3	30-39: 2
Female: 7	Human:16	Professor: 7	Copenhagen:17	40-49: 7
			Roskilde:11	50-59: 12
				60+: 10

illustrates the widespread skepticism that clings to this 'un-academic' concept in geography while interring (infiltrating) academia, but also the relevance of the publishing culture (chapter 3). Yet sustainability seems to receive more recognition in Swedish geography and the literature being more developed (E.g. Östman 1995, Öhman and Östman 2002, Sandell, Öhman and Östman 2003, Sund and Wichman 2008). In a Scandinavian context Molin (2006), Sætre (2009), Grahn (2011) dissertations serve as examples of how sustainability and climate change issues have been dealt with in geography. These authors discuss different sustainability typologies (or undertake content analysis in geography teaching). As Grahn (2011) most notably theorize geography teacher's engagement in climate change and sustainability his work is most applicable to the purpose of this study.

The second empirical basis comes from study regulations. Study regulations (see appendix 5.2.) can be acknowledged as the 'law' that constitutes the legal and administrative basis[12], from which courses, curricula and educational practices developed upon (Roskilde University 2005, 2006, 2014; Copenhagen University 2009a, 2009b and Aalborg University 2010a, 2010b, 2011, see appendix 5.2).[13] They state the administrative and juridical basis of the study and are written by the individual study boards for each education, but are in practice heavily regulated

12 The discursive practices of the external censor body (censorkorps) were also examined to see whether discussions on the role of geography on sustainability features had taken place. Nevertheless no results appeared and the external censor body will not be included further. Also the Royal Danish Geographical Society (RDGS) were examined for featuring climate change or sustainability issues in the geography education. Since its establishment (RDGS 1876) it has never been detached from educational questions (Christiansen 2005, p. 7).

13 Studies at Danish universities undergo accreditation by an independent body appointed by the Danish Ministry of Education and educational legislation can also form the content of the study. In these years this process seems ever more relevant as the 'quality' of each education is 'judged' by 'market-relevance' (see chapter 2). Also the universities' administration may propose changes to the study board. Study regulations state the purpose of the study, structure of the study, contents, acquired skills, competences, courses, projects and seminars, and examination procedures. Sustainability has been integrated into study regulations at Copenhagen University and Aalborg University from 2009. Before this the term was not present in study regulations in geography.

through direct and indirect political regulation (see chapter 2)[14]. Study regulations are reformed independently by the study boards at the respective institutions, yet on the basis of former study regulations and external accreditation. The the method enables to comprehend how socially constructed ecosystems are represented in curricula. Sustainability themes were identified in study regulations and systematically, coded and categorized into the framework of Grahn's (2011) sustainability/climate change approaches.

During 2012 interviews were conducted with almost all permanent employed geographers at three Danish universities, the only higher education institutions in the country offering geography programmes. Interviews were undertaken by knocking doors and thus partly random in terms of who were present during the three weeks interviews were undertaken. No informants refused to contribute and 31 out of a total number of 43 permanent research professors involved in educating geographers were interviewed hereof 24 full-time professors at Copenhagen University, 15 full-time professors at Roskilde University and four full-time professors at Aalborg University (see appendix 5.1.)[15]. Accordingly, the number of researchers interviewed follows the size of the study programs at Aalborg, Copenhagen and Roskilde Universities. Interviews were undertaken and recorded in Danish of a length between 20-60 minutes (See appendix 5.3 for the interview

14 With the reform of 2004 (known as the Gymnasiereformen 2005), geography was threatened and almost did not survive in secondary schools (like in the 1980s). The argument was that geographical knowledge was obtained in other subjects. However, due to a focus on geography as a science subject geography survived even more reduced and now under the name physical geography. This has meant a restructuring of learning objectives and a focus on new teaching approaches (Volkers 2007) whereby changes in the secondary geography curriculum have also led to changes in the university curriculum. For example, the secondary school reform of 2005 and later changes have served as leverage at the university by introducing structural changes to curricula in order to comply with upper secondary school teacher requirements (BEK nr 692 af 23/06/2010, and BEK nr 735 af 22/06/2010).

15 Though Ph.D. students, teaching assistants, external lectures and assistant professors (adjunct), undertake part of the teaching, they were not included in the empirical design, since they are not considered part of the core staff in defining curricula.

guide)[16]. The sample deal with 31 interviews and transcriptions have only been translated to English when used in quotations. Table 5.1 summarizes key figures from the informants. Note the sample is dominated by elderly (white) men, as for Danish universities in general where approximately 10 percent female become professors. In order to examine geographical traditions and their different responses to issues of climate change and sustainability, responders were asked which of Pattison's (1964) four traditions best represent their work. If anything, however, the interview material turned out to be random when categorized into gender, human and physical geographers, age groups, Pattison's traditions, professorship or institution (as the problem of Molin's and Gran's typologies). The mosaic of responses turned out to be random when categorized into these general features. From a phenomenological approach, as we shall see, other mosaics of the cultural politics of representing nature powerfully spur.

At the time being I listened through all the interviews with Grahn and Molin's conceptualizations in mind. It turned out that their categories (Grahn for instance develops three categories through which geographers addresses climate change. Grahn's and Molin's typologies have historical origin to some of the traditions outlined above) did not fit well with the empirical work[17]. By approaching Noel Castree and David Harvey, I gained a more dynamic involvement with the interviews. At the time of approaching the empirical material I also turned to chapter 13 in JNGD (in which Harvey addresses market environmentalism, ecological modernization and so forth), but once again, though I found the political ecologies applicable, they also came to violate with a more disperse and delicate tone.

16 It is important to stress that the first part of the interview guide concerns fieldwork, the second part seeks to join fieldwork and sustainability (as a learning methodology) whereas the third part questions the use, explication, attitude, and opinion towards teaching sustainability in geography (see appendix 5.3). This is important because links between fieldwork and sustainability were part of the research questions when the interview guide was designed, but is not analyzed upon in the dissertation. Instead the interview data on fieldwork were applied in another article (Appendix 5.5). In total, the dataset consists of approx. 20.6 hours recorded interview material, whereby only the last half is used in the dissertation.

17 To begin with the qualitative analysis was constructed by thematically condensing the interview material for each individual interview, coding each interview on its own basis. Then, interviews were cross analyzed to examine joint features as described by Braun and Clarke (2006). Hereafter the interview material was categorized into Grahn's (2011) classification of sustainability/climate change approaches in geography. The method allows us to make a thematic analysis with Grahn's (2011) the three sustainability/climate change approaches, and at the same time examine if approaches and themes go beyond the theoretical framework

First, then I found a firmer grip of the analysis by turning to the social nature approach. In this respect, a thematic approach is not inductive as elaborated in Braun and Clarke (2006), but constitutes interplays between theoretical categories and empirical material. The meaning being that the task is to represent (construed) empirical data, (that represent a messy, sometimes conflictual and irregular world) and translate them into an abstract theoretical domain[18].

At the time of interviewing it may not have been clear that I wanted to shed light on sustainability by relating it to the history of the discipline. My aim was to address the problematic through the history of the discipline. In retrospective, when responders express their commitment to human-environmental debates through sustainability or the anthropocene it is not the same as these should be colonialized into every corner of the discipline. My personal aim though is not to change status quo and fill in sustainability in curricula whenever possible – (this sounds ridiculous to me) but to understand how geographers respond to contradictions, dilemmas and paradoxes and potentially find more progressive ways of dealing with them. Elevating these into investigation parameters, e.g. of sustainability typologies, seems to me to violate the phenomenological underpinnings of this study.

18 This is another way of saying that one, as a research strategy, can pick theories (references) that you already agree with (or disagree with, hence write against), but this does not in itself provide any meaningful verification. See also chapter 3.

Chapter 6

Geographers at Work: Re-naturalizing the Human-Environment Theme[1]

"It is a peculiar fact that, while environmental issues have always been central to geography's disciplinary identity, one rarely pauses to consider what is 'environmental' about the issues in question" (Castree 2002, p. 357).

As outlined in chapter 1 consensus exists among scientific and geographical communities as to cause and effect of climate change and unsustainable production patterns. Controversy arises when dealing with strategic actions and solutions since a given position legitimizes a given political agenda (Morgan 2011). Imagining climate change often transforms into remarkable geopolitical agendas and sustainability is sometimes considered to be one of such possible solutions (Appendix 1.2). Omnipresent to the nexus between research, policy and learning, sustainability themes are inherently complex and their possible meanings fiercely contested. The geopolitics of education for sustainable development (ESD), environmental education (EE) sustainability in higher education (HESD), education for sustainability (EfS) or similar acronyms produce complex dilemmas, that tend to frame education as a change agent that socializes students to accept certain kinds of explanations and pre-analytic assumptions to deal with an academic pro-

1 Part of the chapter has been published in an uncritical version in "Grindsted TS (2014) The Matter of Geography in Education for Sustainable Development: The Case of Danish University Geography, Chapter 2 in W. Leal Filho (ed.), Transformative Approaches to Sustainable Development at Universities, World Sustainability Series, Springer, Switzerland, 2014, DOI 10.1007/978-3-319-08837-2_2.).

blem (Lambert & Morgan 2009). While a number of studies engaged in dealing with geography education and sustainability is growing, there are only limited studies on the second nature approach in explaining, describing and evaluating how students are taught in thinking about nature(s) of sustainability in higher geographical education. This chapter aims to contribute to this particular field of knowledge by providing an empirical analysis of the education of geographers in Denmark. Henceforth I examine the individual teacher's beliefs, responses and articulation of responsibilities concerning the relevance, explication contested ideas and conditions for sustainability. Drawing from chapter 2, Part III begins with a general reflection on 'corporate' agendas of greening educational policy and geographical responses to make sustainability subject to academic debates.

Questions for the Chapter:

- How do geographers conceptualize response(abilities) to issues of sustainability and climate change in education programs?
- Is the human environment theme being reconfigured and denaturalized more closely associated with sustainability in geography?
- How do geographical education programs contribute to sustainability?
- How are issues of sustainability addressed in Curricula?
- What is the influence of the Lucerne Declaration, EU or National ESD plans concerning Danish University Geography?

6.1 Greening Educational Policy and Response(abilities) from Geography?

Since the Stockholm Conference on the Human Environment (1972) that first established a relation between education and sustainable development, the Rio Declaration (1992) and a number of subsequent declarations, policies and national strategies have promoted the idea of integrating sustainability into all disciplines and academic traditions. Today more than 31 declarations on sustainability in higher education have been made and during the past few years also declarations that address specific disciplines have developed as responses that also serve the corporate agenda (Grindsted and Holm 2012). In 2007 the International Geographical Union Commission on Geographical Education (IGU CGE) officially announced their commitment to the "Lucerne Declaration on Geographical

Education for Sustainable Development" in addition to the UN Decade of Education for Sustainable Development (UN DESD) 2005–2014 (IGU CGE 2007). Declarations as well as the UN DESD are designed to produce an impact on policy. By way of example the 2005 Graz Declaration on Committing Universities to Sustainable Development (made under the umbrella of the European University Association and UNESCO) was developed to encourage the European Ministers of Education to integrate sustainability into the Bologna process. Thus the aim was to *"Call on Ministers (…) to use sustainable development as a framework for the enhancement of the social dimension of European Higher Education as well as to contribute to the attractiveness of the European Higher Education Area"* (Graz Declaration 2005, p. 2).

Sustainability issues have also gradually been incorporated in the Bologna process (meeting in Bergen, 2005), and in Louvain-la-Neuve (2009) the European Ministers of Education decided to keep sustainability as a research topic for the next decade. Furthermore, the EU Commission has encouraged EU member states to use the UN DESD 2005–2014 as a point of reference in the development of national educational policies and plans (EU Commission 2009). Correspondingly, The European University Association's annual rectors' conference (2012) carried the theme "Europe for Sustainable Universities". The EUA President, Maria Helena Nazaré, recognized that the challenges of sustainability is one of the greatest challenges for humanity: *"Sustainability is the biggest issue for humanity on Earth; universities should be a role model to integrate sustainability into its activities, should contribute by informing (…) sustainable values and achievements should be part of education"* (Interview, Maria Helena Nazaré).

In a Nordic context, national sustainability strategies in higher education[2] have been prepared for supporting sustainable growth. How the greening agenda of educational policies influence various disciplines and academic traditions is particularly interesting in geography due to its strong tradition concerning the human-environment theme. As illustrated in chapter 2, geography as any other scientific discipline, changes as to external pressures, political responses, hot issues and internal debates. Green washing have long been big industry. Also sustainable

2 National education for sustainability strategies have been prepared by the Norwegian Government (2007), Danish Ministry of Education (2008), Finnish strategy for the Decade of Education for Sustainable Development (2006), Iceland, (2002) and the Swedish Higher Education Act (2006) that encourage higher education to integrate sustainability.

university policies and 'the greening of curricula agenda' is as much a way of finding new arguments for counter environmentalism as it has become subject for branding universities, attracting funding and students (Brown and Cloke 2009). To its critics, CSR is nothing else but PR exercises, based on the dictums of market environmentalism and regardless of the social and ecological costs (Harvey 1996)[3]. So, why should it be so different in academia?

6.2 Is the Human-Environment Theme Being Reconfigured in Geography?

Three interesting perspectives substantiate the hypothesis that the environment theme is under reconfiguration in geography, but also suggest a discrepancy between 'responses and responsibilities' concerning sustainability education in geography. However this does not imply that all geographers working on human-environment interactions conceive their research activities in terms of sustainability. Nothing could be more contradictory[4]. Geography is much more than sustainability and most research geographers find their field of study has no relevance to the topic at hand. Nevertheless, when interviewed, the following three tendencies suggest changes in discourse coalitions toward being associated with sustainability that also marks spatio-temporal changes related to the power of reference.

3 My problem with Harvey (1996) is that though an institution's carbon emission may continue to increase (stabilize or decline) it does not necessarily mean that nothing is done or that it is not a real objective. Jevon's theorem in chapter one illustrates why it is so difficult. See e.g. Cornell University's Back Casting model (Climate Action Plan) is one of the most progressive carbon management plans I have seen so far. According to the homepage Cornell has reduced carbon emission by close to 50% with 1990 as a baseline. Back casting with net zero emissions in 2050 each year the plan sets a maximum limit of GHG emissions in metric tons (Co2e) (http://www.sustainablecampus.cornell.edu/initiatives/climate-action-plan). They may not succeed, but it is not the same as the plan was set up solely as a PR stunt. Universities are also confined under the logic of capital, and subject to navigate within these dynamics. To claim that any climate plan is a PR stunt is interlocking and speculative as if nothing can be changed.

4 According to the methodological assumptions in chapter 4, geographers or scholars stating they are not working on the human-environment theme or sustainability, bear relations to it anyway. Yet, sustainability (or human-environment interactions) has no privilege above other topics (hierarchies, thematically or approaches).

6.2.1 Educating Nature(s): Geographical Declarations and Emblems of Sustainability

The development of geographical declarations demonstrates a remarkable shift in conceptualizing the human-environmental interface. The International Geographical Union (IGU) have developed three declarations, i.e. The International Charter on Geographical Education (1992), The International Declaration on Geographical Education for Cultural Diversity (2000), and The Lucerne Declaration (2007). The three declarations demonstrate a shift in the role of geography. First of all it suggests a shift in the role(s) and geographical identities from the spatial chronological theme, toward a discipline performing a key role in solving sustainable challenges (Lucerne Declaration 2007). From a shrinking and globalized world (Charter on Geographical Education 1992), with spatial transformations of economic, social and political significance, the Lucerne Declaration suggests the discipline should take a leading role in academia addressing sustainable challenges on Earth.

By way of example the International Charter of Geographical Education (1992) scarcely pays attention to the human-environment theme. Though human-environmental interactions are mentioned once *"concern for the quality and planning of the environment and human habitat for future generations"* (Geographical Charter 1992, p. 1), issues of globalization related to human rights remain the central focus. (The Geographical Charter (1992) was developed the same year as the Rio (1992) conference and Agenda 21, Chap. "Experiences of 'Reflective Action': Forging Links Between Student Informal Activity and Curriculum Learning for Sustainability"). The Lucerne Declaration by contrast states that the themes of the UNDESD 2005–2014 are very much in common with geography's objects of study. Thus the declaration *"is a proposal to integrate sustainable development (…) based on the conviction that knowledge, skills, attitudes and values learned in the geography classroom inspire decisions and actions contributing to the goals of the UNDESD. "The paradigm of sustainable development should be integrated into the teaching of Geography at all levels"* (Lucerne Declaration 2007, p. 243) [5].

5 In the declaration it is claimed that nearly all topics of the UNDESD 2005-2014 possess a geographic dimension, for which reason geography is bound to integrate the concept of ESD.

In table 6.1 below a word search condenses key aspects of the human-environment theme in the Geographic Education Declaration (1992), International Declaration on Geographical Education for Cultural Diversity (2000) and Lucerne Declaration (2007) sketching the role of geography (Appendix 5.2). As can be seen from Table 6.1 sustainability was not mentioned in 1992, once in 2000 and 60 times in 2007 which marks a noteworthy increase in the quantification of "sustainable related content". Moreover table 6.1. shows changes of key concepts in geography representing tides and waves of the social production of nature. Consequently, declarations, through the means of abstraction, intend to reconfigure educational-politico assemblages of intended learning outcome that come to embody scientific habitual traditions (Cotton et al., 2013).

Table 6.1. *Sustainability and the human-environment theme in the Geographical Declarations (IGU)*

International Charter on Geographical Education (1992)	**International Declaration on Geographical Education for Cultural Diversity (2000)**	**Lucerne Declaration on Geographical Education for Sustainable Development (2007)**
Sustainable: 0	Sustainable: 1	Sustainable: 60
Pollution, Contamination, Hazards: 0	Pollution, Contamination, Hazards: 1	Pollution, Contamination, Hazards: 1
Climate change/ global warming: 0	Climate change/ global warming: 1	Climate change/ global warming: 2
Ecology: 0	Ecology: 0	Ecology: 7
Environment: 2	Environment: 13	Environment: 13
Emission, greenhouse gas: 0	Emission, greenhouse gas: 0	Emission, greenhouse gas: 0
Nature: 0	Nature: 1	Nature: 8
Energy: 0	Energy: 0	Energy: 3
Biodiversity: 0	Biodiversity: 0	Biodiversity: 1
Human-nature interaction: 1	Human-nature interaction: 6	Human-nature interaction: 14

Examination of declarations suggests that social-ecological and political-economic processes are not only intertwined, but also that core themes in geography, and thus geographical identities are under reconfiguration. Castree (2014, p. 19) refers to such processes as processes of epistemic re-naturalization (re)defining the part

of the world (things, phenomena or processes) members of that community refer to as nature. For whatever reason (see also chapter 5), the content analysis of declarations illustrates an intellectual history down scaling the human environment theme during the late 1980s and early 1990s, as Stoddart (1987), Fitzsimmons (1989), Birkeland (1998) and Zimmerer (2010) among others have argued. Recall for instance Zimmeres's analysis in which he discusses nature-society articles from 1911-2010 in the 'Annals of the American Association of Geographers'. Zimmerer (2010) reveals that articles covering society environmental relations during the 1980s are only half of the 1960s. Then, from the 1990s the "Annals" reengage with nature–society articles that more than doubled and became nearly as high as around the 1960s.

Interestingly during this period (1960-1990) geographical representations of human-environment interfaces decline whereas a myriad of interdisciplinary fields, from ecological economics, environmental management, to sustainability science grow (Rasmussen and Arler 2010). Though in the context of sustainability, the declaration analysis suggest that over a period of 15 years, the human environment theme represents such tides and waves, that does not only reestablish connection to the concept of nature, but approaches it through the binoculars of sustainability.

6.2.2 Educating Nature(s) - Promoting Sustainable Cultures

Compatibly with the above section, the international literature review suggests it is not hard to find geographers pushing the agenda for up scaling sustainability. For example, Bednarz (2006, p. 239) states: *"It seems that non-geographers also think that geography has an important role to play in environmental education (…) many geographers have defined geography as a discipline with a major, if not primary, interest in human—environmental interactions".*

As shown in chapter 5, geography has a long history of invitations to upscale ecological themes that today partly seem to be ritualized around sustainability, the anthropocene and similar globalized socio-environmental concepts. By way of illustration a dozen of researchers (e.g. Huckle 2002, Chalkley 2006, Whitehead 2007, Westaway 2009, Sayer 2009, Firth 2011, Morgan 2011, Cotton et al., 2013) to mention a few, offer an explanation of why geographers find the human-environment theme to be a platform for linking sustainability and geography. The recognition that geographical knowledge has importance for sustainable development makes Westaway (2009, p. 9) state that geography has

a special role, maybe even above other disciplines: *"Sustainable development is the extrinsic educational purpose that geography is best, indeed almost uniquely, equipped to serve (…). There is little doubt that geography is the best place to take the lead on sustainable development in schools."*

Such claims are indeed problematic (see chapter 2 and section 4.6.2.), but authenticating the human environment theme gives geography its raison d'étre in the struggle for having a share in sustainability issues. Pushing the agenda for up scaling sustainability also features in research politics. An example is the U.S. National Research Council (2010) report that promotes the relevance of the nature-society issues in geography; merely in the context of sustainability. Thus, the nature-society as well as the spatial dimension of sustainability becomes a major pillar that geography seeks to patentee. These both signify imagined (or real) competition with other fields of studies and are inconsistent with the claimed interdisciplinary dimension of geography (see below).

6.2.3 Natures of Cultures: Preaching Contradictions of Sustainability

Zimmerer (2010), Lui (2011), Kidman and Papadimitriou (2012) demonstrate how geographers' research of human-environment interactions particularly relating to environmental issues (like sustainability) has increased exponentially. Karatzoglou (2013) illustrates how leading journals on sustainability in higher education, like International Journal of Sustainability in Higher Education and Journal of Cleaner Production reveal a similar growth[6] as well as in more disciplinary oriented journals like journal of geography in higher education. Despite the increasing numbers of articles, Lui (2011) shows how the number of articles contrasts with efforts to integrate sustainability into curriculum in practice. *"An examination of publications in sustainability education journals also reveals geography's lack of participation in sustainable education"* (Lui 2011, p. 249).

A number of studies (Yarnal and Neff 2004, Bednarz 2006, Higgitt 2006, Chalkley 2006, Westawey 2009, Lui 2011, Morgan, 2011) find that geography in the US, UK and other countries has been reluctant to integrate sustainability issues into

6 I found no articles that dealt with education for sustainability neither in the Norwegian, Danish nor Swedish Journals of Geography, nor in the Annals of the Association of American Geographers (literature review undertaken in spring 2013). In a Scandinavian context Molin (2006), Sætre (2009), Grahn (2011) serve as examples of how sustainability has been dealt with in geography.

curricula. As Andrew Sayer puts it: *"Global warming presents an enormous threat to humanity, but the response from academia, including geography, has been relatively slow (…). I find this surprising, indeed astonishing, for there could hardly be a more important geographical topic"* (Sayer 2009, p. 350).

Despite of the fact that more than half of the world's land surface is changed by human activities with an ever-accelerating speed, in an increasingly unequal world, geographers seem reluctant to take into consideration the notion of sustainability. Additionally, Turner (2002), Yarnal and Neff (2004) Bednarz (2006), Sayer (2009) and Lui (2011) identify an imbalance in that American and British geographers' involvement in environmental and sustainability research has grown significantly, e.g. in publications, whereas courses and curricula hardly not integrate sustainability[7]. This suggests a discrepancy between statements of the "role of sustainability in geography" and geographers' involvement in research on sustainability themes, the claimed high grounds of geography. Hence, there appears to be little evidence that sustainability is recognized as a central concern in geography within the US or UK in practice (Lui 2011, Morgan 2011).

The power of reference addressed through thematic changes in the declaration analysis, demonstrates changes in teaching nature(s), representing tides and waves that: 1) suggest nature practically represented as externalised from disciplinary constructs within human geography toward being associated with sustainability. Consequently, nature as external is replaced with socio-natures as sustainability approach treats nature as anthropogenic relations and does not elaborate on this distinction. 2) Engagement with nature as addressed in the declaration analysis represents a shift in norms, values and attitudes when dealing with such themes. Hence, reconfiguration of and re-representing key concepts, is as much a fight over disciplinary borders, identities and core themes as it is over analysing *for* change. To Harvey *"sustainability is a debate about the preservation of a particular social order rather than a debate about preservation of nature"* (Harvey 1996, p. 148). If this is also the case within academia will be addressed in the following sections. Before addressing dynamics and related contradictions in greater detail, I will first address what research geographers' find their discipline contribute with to the sustainability debate.

7 Especially at many universities in North America, Environmental Studies have replaced Geography (Rasmussen & Arler 2010).

6.3 Curricula Constructs in an Era of the Anthropocene

In the previous section declaration analysis and the international literature survey (e.g. Huckle 2002, Bednarz 2006, Sayer 2009, Firth 2011) suggested that sustainability issues find resonance through human-environment interactions. For Bednarz (2006) and Westaway (2009) this is an opportunity to articulate that geography has a special role to play. Reflected in study regulations (see appendix 5.1) and interviews (see appendix 5.2) this section examines how geographers make use of sustainability concepts. To do so, it is useful to scrutinize both what geographers find their discipline contributing with to the sustainability debate in academia, as well as what contested ideas of introducing sustainability might entail.

6.3.1 How do Geographical Education Programs Contribute to Sustainability?

The duality of social and ecological problems takes an interesting turn when asking geographers how geography contributes to sustainability analysis in academia. Two geographers interviewed reject to use sustainability concepts at all (Interview 5, 17). Though sustainability concepts are heavily criticized and most geographers prefer other terms they still feature in study regulations (table 6.2) and are integrated into study regulations at Copenhagen University and Aalborg University from 2009[8]. Before this sustainability was not present in geography study regulations at Danish universities, though a number of related terms e.g. human ecology, manipulated ecosystems, ecological modelling, system adaption and natural capacities can be traced back to the 1970s and 1980s (e.g. Study regulation, Copenhagen University 1983, p. 50). Similarly, interviews with the heads of study boards suggest sustainability has found its way into the discipline:

> *"Sustainability is of huge importance to geography. I would say that sustainability is essential for the subject knowledge in geography, for courses, classes and an underlying basis for comprehending the world. The study regulation in integrative geography will be revised, but also in the new version sustainability will remain central"* (Interview 13, Head of the Study Board Aalborg University).

8 The discursive practices of the external censor corps (cencorkorps) were also examined to see whether discussions on the role of geography for sustainability or climate change had taken place as well as the Royal Danish Geographical Society (RDGS) were examined for featuring climate change or sustainability issues in the context of geography education. This was not the case. See method chapter 5.

Table 6.2. *Sustainability and the human-environment theme in the Geographical Study Regulations at Aalborg University, Copenhagen University and Roskilde University*

Study regulation Copenhagen University	**Study regulation Aalborg University**	**Study regulation, Roskilde University**
Sustainable: 2 (2)* (0)**	Sustainable: 79 (18)*(0)**(61)***	Sustainable: 14 (0)*(14)**
Pollution, Contamination, Hazards: 5 (5)(0)	Pollution, Contamination, Hazards: 18 (0)(18)(0)	Pollution, Contamination, Hazards: 0 (0) (0)
Climate change/ global warming: 24 (23)(1)	Climate change/ global warming: 13 (0)(12)(1)	Climate change/ global warming: 5 (0) (5)
Ecology: 1 (0)(1)	Ecology: 26 (8)(18)(0)	Ecology: 2 (1) (1)
Environment: 23 (18)(6)	Environment: 64 (15)(10)(39)	Environment: 10 (2)(8)
Emission, greenhouse gas: 4 (4)(0)	Emission, greenhouse gas: 1 (0)(1)(0)	Emission, greenhouse gas: 0
Nature: 6 (2)(4)	Nature: 51 (23)(27)(1)	Nature: 17(1) (16)
Energy: 3 (2)(1)	Energy: 11 (9)(0)(2)	Energy: 0 (0) (0)
Biodiversity: 0 (0)(0)	Biodiversity: 1 (0)(1)(0)	Biodiversity: 0 (0) (0)
Human-nature interaction: 11 (7)(4)	Human-nature interaction: 37 (11)(12)(14)	Human-nature interaction: 8 (1) (7)
Example from study regulation	Example from study regulation	Example from study regulation
"[Students analyse] human environment interactions from a broad range of theoretical approaches. [They are able to critically] address interdisciplinary problems and global environmental challenges, among others climate change (…) and sustainability. (Study regulation, Master, Copehagen University, 2009, p. 7).	"[Students obtain] skills and knowledge to use scientific theories and concepts in analyzing and assessing sustainability and spatial change from an integrative perspective" (Study regulation, Master, Aalborg University, 2010, p. 8).	"[Students demonstrate insight] into geomorphological processes, landscape structures and knowledge on the development of sustainability concepts, their use in planning and regulation of the landscape (…). They can independently formulate a policy, strategy or plan to achieve sustainable [bio]diversity" (Study Regulation, Bachelor, Roskilde University, 2014, p. 12).

Roskilde University, Study Regulation in Geography, 2006 (bachelor, master), 2014 (bachelor)**; Copenhagen University, Study Regulation in Geography 2009 (master)* 2009 (bachelor)**; Aalborg University, Study Regulation in Geography, 2011(bachelor)*, 2010 (master, physical geography)**, 2010 (integrative geography)****

The concept of sustainability is of huge importance to geography at Copenhagen University, but also related concepts as resilience, vulnerability or ecology. Sustainability is a silver-line to many topics, but it is nothing we have discussed in the Study Board. It is just there" (Interview 1, Head of the Study Board Copenhagen University).

"I think the responsibility for dealing with sustainability rests with geography is necessary. Still it requires that students choose such themes in courses and projects. We do not predefine thematic learning outcomes. Instead, we are much more specific as to which methods, theories and approaches they should acquire. Here holistic approaches are central to the education" (Interview 3, Head of the Study Board Roskilde University).

Though the interviews demonstrate great variety and geographers in the interview sample both find sustainability relevant and remain critical to the concept, 29 of 31 geographers (including members of the study board) find their discipline can contribute to sustainability analysis in three distinct ways (see Box 6.1-6.3). 1) Geography as an integrative discipline that merges the natural and social sciences 2) geographical approaches concerning the spatio-temporal dimension of sustainability 3) and geographical methods and interdisciplinary approaches. These dimensions will be examined each in turn.

6.3.2 Interdisciplinary Disciplines

The multiple ways geographers engage with sustainable issues, suggests it is an interdisciplinary discipline (contradictory) that excels in analyzing socio-ecological dynamics from a holistic and integrative approach: *"Geography has a major role on sustainability. Many disciplines concentrate upon relatively narrowed subjects, whereas geography possesses the broadness which is an important dimension of sustainability. Geography is particularly potent because of its interdisciplinary approach as many other disciplines do not encompass. Moreover, geography merges the natural sciences and social sciences"* (Interview 1).

"Geography is an integrative discipline. Integrative approaches integrate economic, social and physical aspects. Sustainability are not only well suited for geography that deals with interactions between the human ecosystem and the earth system, but a precondition to understand its multiple dimensions" (Interview 14). The anthropogenic climate change thesis precisely suggests that phenomena at global scales are caused

by cumulative small scale activities in local places. But the reverse is also true. Activities in local places generate impact at global scale, that in turn exacerbates phenomena in yet other localities. Henceforth, students may not appropriately understand sustainability issues if they lack and understanding of the climatological, hydrological or environmental processes that work in nature. Likewise explanations are misguided if sustainability analysis ignores social dynamics and economic activities. "*Geography knowledge is important to sustainability [ESD red.] and distinguished from other disciplines, because a narrow disciplinary focus may not unfold problems of sustainability that operates at multiple scales, but also because it establishes an approach analyzing the material form the social and the economic form of materiality* (Interview 30).

Box 6.1 Reclaiming the High Grounds - The importance of Sustainability to Geography or the Importance of Geography for Sustainability Analysis

"Sustainability is absolutely a central concept to the education. Much of what we do is about sustainability in one way or another. I do not myself work on these issues, but it is my understanding that many colleguees engage with it, also as part of their teaching" (Interview 16).

"As a geographer it is imperative to understand the spatial distribution of environmental harm, and how this distribution is organized in and between different societies, between rich and poor or between the North and South" (Interview 2).

"I think geography is self-written in taking part in discussions on sustainability. We range competences from the natural science and social science. To join these competences is necessary to get a better understanding of the dynamics of socio-environmental change, and hence be able to respond to it" (Interview 27).

"Sustainability is now and important part of geography, because it comply with many interests in the discipline to integrate different perspectives - also because sustainability has a highly discursive status in environmental and energy policies. I find sustainability is a political and ideological concept, even a strong yet diffuse one – thereby I haven't said too much" (Interview 4).

"Sustainability is a considerable component in geography; it is part of our DNA and much of what we do. Sustainability is a part of geography, a part of the identity, but not a part of all the things we work on" (Interview 6).

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"Sustainability is absolutely central in the education [geography red.]. I am quite certain that the concept in its modern form was born in the discipline. When I think back to the 1970s sustainability and ecology was a central part of the education" (Interview 7).

"The way I look at education is as a process of "self-realization" and I find that related to be able to think in terms of sustainability. There is an implicit relation between sustainability and education, not only for geographers but others as well" (Interview 11).

"Sustainability is a concept relevant for understanding relations between natural remises and natural capacities and how humans adapt to them. Human interactions and feedback mechanisms are part of sustainability, like CO2 fluxes, the carbon budget and the like. The environmental changes we explore today are all relevant to discuss in relation to human impacts and adaption. In that, I find sustainability relevant for geography" (Interview 10).

"I originally come from biology before I turned into the discipline. Biotopes came long before sustainability. I can certainly follow that one often work on geographical themes without sustainability is considered at all, but in reality it is deeply buried in the stuff geography is made of. In our description and understanding of land surface changes, then a metabolism perspective is always there, hence sustainability. It is nothing new, yet it only exists as small niches. The broad sustainability notion is quite hard not to be confronted with in the discipline, but as a frame of prepositions seldom unfolded in our daily discourses…(…). When I teach in planning I always make it clear to the student that we cannot talk about regulation without considering long term, effects and what we aim for (Interview 25).

Claiming that geography is distinguished from other disciplines in the analysis of sustainability challenges as interconnected spaces does not only underscore the envy of physics (Massey 1999), materialized as the envy of theoretically mastering the human-environment nexus, but does also illustrate contradictory elements of the use of sustainability in academia. First, it conveys disciplinary contradictions of sustainability, as unsustainability is fundamentally an interdisciplinary real phenomenon, but analyzed from a discipline. More challenging, when de-construing the study regulations of Roskilde University (2006, 2014), it turns out that ecological themes, climate change, environmental or sustainable challenges are only written into physical geography. Competition between different disciplines in claiming the high grounds of analyzing sustainability (best cases, best practice, theories or methodologies) contradicts the interdisciplinary ambition (chapter 2). That is

analysis of the problem(s) from its core (though wicked or multiple), rather than taking point of departure from a discipline.

6.3.3 Socio-Nature(s), Sustainability and Socio-Physical Disciplinary Omnipresence

Another aspect found critical is geography's role in bridging the natural and social sciences. *"Geography can contribute in a unique way to sustainable development, especially regarding the integration of knowledge between social and natural sciences. In this way, geography plays a crucial role in dealing with sustainable challenges that you do not find in the tradition of many other disciplines, e.g. Sociology. Secondly, sustainability has an immanent spatial dimension"* (Interview 19).

As a result it is argued that current environmental problems not only call for research and education that epistemologically transcend traditional disciplinary divides, challenging the problems in its complexity, but also seek to bridge the gap between natural and social sciences in dealing with sustainability. Sustainability approaches are widely assumed to be able to encompass a gathering point for human and physical geography (Interview 27). To this may be added that geography has a distinct role being able to enrich related disciplinary discussions on ESD. *"I find that geography has a responsibility to deal with issues of sustainability. We range competences and skills from the social and natural sciences – a holistic approach is imperative for dealing with sustainability"* (Interview 22). Thus geographical imaginations, and identities of their imaginations, position the discipline to contribute to sustainability analysis in ways that not only epistemologically transcend traditional disciplinary divides, challenging the problems in its complexity, but also seek to bridge the gap between natural and social sciences.

6.3.4 Scaling Sustainability

Additionally, complex interaction between nature and society and the spatio-temporal dimension of sustainability, requires methodological approaches to grasp such interactions that may even be impossible without geographical knowledge. *"Before specialization, all students will acquire a holistic and broad basis of knowledge and approaches, about soil science, climate change, society and urban development. [1.5 years of study red.]. This broad foundation enables students to think critically and analyze side effects of a given phenomenon or human action. This body of knowledge is vital for sustainability, in order to understand side effects in very different areas and scales. Such questions I would say are only possible to deal with through geographical skills"* (Interview 8).

Thus the arguments corralled in the interview material connote to Mike Hulme's (2008) argument, that geographical identities are central to climate change and ways to address challenges of sustainability. *"Making human sense of climate change needs the distinctive intuition and skills of the geographer"* (Hulme 2008, p. 5). Hence, he points to modes of thinking and connecting cultural assemblages with ideas of sustainability patterns across scale. As different disciplines operate in quite different spatio-temporal scales, translation between culturally embodied spatio-temporal organizations of socio-ecological processes is crucial if to achieve "more" sustainable practices as so many these days advocate for. If the time horizon is set by practices of capitalism, then they may not correspond to ecosystem temporalities. The purpose of the rhetoric of sustainability is to some extent to direct thinking about time horizons encountered in the market (Harvey 1996). For much sustainability theorization therefore, it is not only about encouraging students to understand the world in terms of relationships, rather than in terms of objects and structures, but also to encourage students to think in terms of different spatio-temporal dynamics.

Integrating the production of space and nature as a fundamental perspective of abstraction in e.g. area differentiation generates geographical knowledge and methodologies that make it possible to manage risks involved in the spatial distribution of problems. Non geographical methodologies fail to understand such dynamics of spatial distribution and thus sustainability may even be seen as a common ground bridging the spatial chorological approach and the human-environment theme. The gradual perspective on climate change (scientific consensus thesis chapter 1) are particularly reflected in study regulations (Study Regulation, Aalborg University 2010). If it is assumed that a dialectic approach comprehends the complexity of socio-spatial and economic-ecological processes, and this, in turn, will make us recognize that environmental/social problems mutually interact, are spatially distributed, and produce different effects in different spatial scales. These pre-analytic assumptions are fundamental to the sustainability analysis in academia and the interview suggests that geographers find their education programs emphasize how the matter of scale and the analysis of environmental problems are inseparable (Interview,1,2,3… minus, 5, 12, 17 and 31).

As reflected in the international literature (e.g. Bednarz 2006, Whitehead 2007, Westaway 2009, Sayer 2009, Firth 2011,) also Danish university geographers find resonance in human-environment interactions by ways in which geography is given a particular role for dealing with sustainability issues. Though the inter-

views reveal recognition of the importance of sustainability to geography it also demonstrates that most geography teachers remain critical to the concept itself and/or find it is better as an implicit basis for educating geographers. "*When I teach in accessibility for instance, then the aspect of sustainability is in the background. Whether or not sustainability is there [on the curriculum] depends how explicitly it should be mentioned. I rarely mention the term, but implicitly sustainability is the main objective for what we do and why we study it in this way. Sustainability is part of all geographers mindset I would say; sometimes so penetrated that one may not need to explicate it"* (Interview 20).

This may be one of the reasons why the analysis of study regulations reveals that sustainability has a limited status in geography educations in practice (see Box 6.2). In chapter 7, dilemmas of teaching sustainability as an implicit notion will

Box 6.2. Sustainability Critiques and Critical Intervention

"Sustainability is rejected fully by the top international writers in geography. Why do we keep discussing it - It is completely irrelevant. Sustainability is about politics and has nothing to provide in academia" (Interview 5).

"I only see the use of sustainability relevant if it can attract students to geography (….). It is an elusive and imaginary concept, a concept of fantasies about paradise like futures, without any directions or progress. I think that is unhelpful for critical research in geography and elsewhere" (Interview 28).

"I do not like the concept at all; it is an empty significant and quite useless - I do not use it. Much of the literature on sustainability bores me to tears. I think we as geographers should be much more critical about it. The idea behind sustainability is reasonable, it is reasonable to think of ways that can address the problems that we face on global environmental stress. But I don't think sustainability solve that problem at all. It is misguiding. Another problem with the term is that it does not consider class issues, sex, social differentiation, it does not consider that we have fundamentally antagonistic interests in this world. It is impossible to make an systematic analysis and address those issues with that concept" (Interview 17).

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"Sustainability is used an misused in all sorts of ways, but it is about how we govern the natural resources that we have in a given geographical location – how we govern the relationship between humans and the environment. Do we maintain our natural resources, and natural sinks in ways that consider future generations? I think the concept have been misused to the extent that if we consider it in our education, we should set critical criteria's, methods and approaches for analysing it in specific contexts. Only if it is contextual and clearly defined it can be taken seriously in science. What is the natural limit we cannot surpass? What is the climate limits that we want? What are the visions that we have? If sustainability put that on the agenda through specific analysis I think it applies for geography. It is misused in so many ways that I think it is a serious problem to consider it for scientific analysis. I think the concept is essential to geography, but it should be used specifically and approach with scientific standards to be useful" (Interview 31).

"No I don't find sustainability important to geography it is a buzzword if anything. It is a concept without fantasy, without hope to imagine other futures – rather it is a concept that has stranded still for 20 years. On the other hand, I have sympathy with the underlying idea – but to me there is multiple and much more fascinating ways. We need new and much more progressive ways to address environmental problems, climate change and resource problems. I think that we have run out of alternative ways. I have undertaken much teaching these issues throughout the years e.g. on natural resources, the ways we use them and the consequences, but I also call it many other things." What do you call it? *"Environmental injustice, the carbon finance game, the global warming experiment"* (Interview 21).

"Since Harlan Brundland sustainability really came on everybody lips and it nearly became a package that even geographers bought. So first, we should be critical about it and consider its political meanings. We study relations between human and nature, so it can be a relevant concept to geography, but it depends how broadly we define it. Only if it is broadly defined, it take a holistic we and integrate different geographical traditions, I think it is relevant to us. If it solely regard natural resources it is not relevant as a concept that can bring us together. But as a broad thematic term, I could imagine it to bring us together and having great discussions from all sorts of angles. I can see sustainability as a concept that all can identify themselves with and contribute to" (Interview 27).

"Sustainability is a concept that appear everywhere around us that we critically need to address. It is heavily used in the rhetoric of political discourse and hard to avoid as a human geographer. It is a great example of a fussy concept that all of us used intended and unintended. When it occurs I always step back - I get a critical awareness" (Interview 22).

be discussed in greater detail. As most remain critical to the concept itself, hence reluctant to explicate it in the classroom, we shall now turn to explore how sustainability is addressed in study programs/curricula before considering dilemmas and contradictory elements of addressing sustainability.

6.4 How are Issues of Sustainability Addressed in Curricula?

An examination of the preamble of the Aalborg, Copenhagen and Roskilde universities' curricula indicates a methodological foundation in which interconnectedness, processes and flows are given a primary status rather than fixed objects, direct causalities and permanencies. According to Rasmussen and Arler (2010) ecological analysis often focuses on environmental problems from an interdisciplinary angel, often addressed through normative and problem oriented approaches. Insofar as sustainability analysis in geography feature under the interdisciplinary and normative umbrella study regulation requires that: *"students should acquire knowledge on human influences on ecosystems and the most important anthropogenic changes in history. They should be able to critically reflect on different philosophical views upon nature and its implications (…) understand concepts of sustainability and ecosystems in relation to elasticity and robustness to be able to analyze interactions between human activity (demands) and nature's capacity and limits*" (Study Regulation, Aalborg University 2010a, p. 29). Emphasis on processes and dynamics in study regulations undermines debates on environmental determinism, e.g. in the context of finite resource constraints (see Box 6.3). In this way dealing with issues of sustainability reformulates previous deterministic concepts into ecological principles and balances, such as carrying capacity or the environmental footprint (Interview 16) that corresponds to what Firth (2011) and Morgan (2011) call sustainability learning as understanding interconnectedness, processes and dynamics in different spatio-temporal scales or particularly referring to spatially and temporally nested eco-systems. Henceforth study regulations demonstrate conceptual changes reflecting spatio-temporal tides and waves in dealing with the human environment nexus. Study regulations undergo what Castree (2014, p. 19) terms renaturalization. A process by which what is regarded natural, also become social, within that epistemic community. Hereby 'larger' parts of the natural as external are epistemologically re-naturalized towards dynamic conceptualizations of human-nature interaction that claims a strong ontological position about the socio-material construction of nature as anthropogenic or simply unsustainable.

There seems to be only little distinction between encouragements of the Lucerne Declaration and geographical education programs as to interdisciplinary approaches. By way of illustration the study regulation at Roskilde University

Box 6.3 How can Geography Contribute to Addressing Sustainability?

"There are countless bookshelves on the top of sustainability. But, if we really want to take it seriously you need to study it in practice. I think it is centrally to verify theories on sustainability in practice, and one of the ways to do that is to go out in practice, to use geographical methods that relate to real world experiments, to go on fieldwork. Only in this way we can verify if all these fancy theories have anything to say" (Interview 4).

"That geographers in particular should be exceptionally skilled to analyze sustainability resource management, climate change and all the rest. I can certainly understand that somebody would claim so, but I don't" (Interview 17).

"Is sustainability relevant to geography? - I taught about it yesterday. I think it is. The topic we always address is how to plan a sound (prudent) interface between the social and nature. (…). I think an teach always on environmental impacts, economic and social impacts of a particular proposal. Maybe it is because that I am from the human-environment tradition, that I find sustainability to be that important to geography" (Interview 18).

"A geographer should have a good understanding of the spatial context and of multivariable problems. Sustainability is one of such. Sustainability is not important to the education but I think the students should have an idea of what sustainability is" (Interview 19).

"I do find sustainability relevant to geography, but I would hasten to add that it is extremely complex and involve a good spatial understanding. It takes a lot of effort to see these connections e.g. in land use analysis, where sustainability is only meaningful if connected to the experiences, and practices of those who use that area" (Interview 11).

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"Nothing is sustainable in modern societies and our western lifestyles have been exported globally. Half of the world's populations now live in cities. Nutrients are exported from the farmland as import to the cities. Now we feed the farmland with fertilizers- nutrients exported to the cities are not returned to the farmland an in that we break the nutrient cycle – at a larger and larger scale as global urbanization grow. I need to refine the picture…. For the nitrogen cycle, this is not really a problem. For phosphor though it is truthfully an unsustainable story. In the future this will worsen, as we begin to pour NPK fertilizers [Nitrogen, Phosphor, Potassium red.] at marginal farmland, to increase production, to expand production, to stay competitive, to feed growing populations or whatever, then … When first India and China also expand their production through NPK pouring, then we got phosphor mines for approximately 50 years, we find a few more, say to sustain production for 150 years, but then the game is over (…). *It is an elementary part of being a geographer to be able to think along these lines, at different scales. The same apply for the course in soil science. 50 years ago the entire education was production oriented, to expand production and be more efficient. Today, it is equally important to address environmental stress. I am not sure if my fellow geographers in India and China do that. I am sure they do, but they have another project going on… Nevertheless, when we optimise farmland production through fertilises, leaching increases. We respond to that. What levels will we accept, and what is unacceptable"* (Interview 24).

"Sustainability is related to geography yes, we can only study sustainability by studying places and through spatial analysis. To me everything else would be meaningless" (Interview 9).

"I have taught on sustainability themes. Though I think it is an awful concept we should be highly sceptical about, it is relevant to consider in relation to domination and power over nature, world views upon nature and the like. Sustainability is part of such political analysis" (Interview 22).

"students are given a body of knowledge on economic geography, natural processes and planning – also in an context of sustainability – so that they will be able to analyze the impact of a given plan or action in ecological, economic and social terms" (Interview 3).

requires problem based group work so that *"Students should be able to look upon scientific problems and solutions in an interdisciplinary approach – not only from particular disciplinary premises, but also by including relevant theories, methods and philosophical interpretations from related disciplines"* (Study Regulation, Roskilde University 2006, p. 23). Though study regulations do not go into detail in describing which methods to be used, it stimulates the basis for methodological and interdisciplinary reflection on real world problems. A holistic understanding of wicked problems like sustainability or climate change requires a reflective rather than an explanatory or commercial ambition (Interview 2,8,11,27). In terms of sustainability critical thinking is essential to understand different practices and agendas in play to be able to find possible solutions to sustainability challenges.

The spatial-temporal dimensions of sustainability in curricula focus on processes in different time scales and spatial contexts. By way of example the graduate geographical qualification profile *Ecological climatology and climate change, causes, effects, limitation and adaption* at Copenhagen University seeks to integrate the range from geological to economic time scales in its very complexity, processes and dynamics e.g. when integrated into modelling . The aim is to gain fundamental knowledge on climate change in history, relations between climate systems, ecosystems and land use, as well as relations between climate and the content of GHG gasses in the atmosphere. Thus the learning outcome is to be able to work with climate data and environmental observation in various scales to grasp complex relationship between physical and economic activities affecting the global climate (Study Regulation, Copenhagen University 2009b, p. 8). Moreover students will be able to analyze consequences of mechanisms used to prevent climate changes and assess its consequences, modeling GCM's to construe previous and future climate scenarios (Study Regulation, Copenhagen University 2009). The specialization illustrates how curricula seek to explain contemporary challenges to sustainability (e.g. desertification and deforestation) in its interconnectedness and complexity (see chapter 8).

However, it seems that Aalborg and Copenhagen Universities attach greater importance to the human environment theme as sustainability and environmental challenges. The reason is that urban geography is dominant at Roskilde University that has a strong spatial tradition in favor of the spatial-chorological approach. Likevise at it is only one of six qualification profiles (transformation of cities) at Copenhagen University that do not explicate su-

stainability, climate nor energy and resource themes (Study Regulation, Copenhagen University 2006, p. 5). Here too, the reason may be that urban geography traditionally has identified itself as being closer to the spatial chorological theme.

This will be further addressed in chapter 7, as it contrasts Castree's and Harvey's theoretical work (Chapter 4). Whereas Aalborg and Copenhagen Universities require various courses and projects in which sustainability or climate change is central, Roskilde University does not address sustainability as a mandatory theme in its curriculum, except from one course in physical geography (Study regulation, Roskilde University 2006, p. 4). Aalborg University offers the most proactive geographical program dealing with issues of sustainability at BA level where 80 of 180 ECTS (and similarly at MA level) are allocated to various human-environment themes, mostly within issues of sustainability, climate change and environmental stress.

6.5 What Is the Influence on Danish Universities of the Lucerne Declaration, EU or National ESD Plans Concerning Geography?

The interviews revealed that the Lucerne declaration was unknown for geographers at Copenhagen, Roskilde and Aalborg Universities and has neither been dealt with in the study boards nor on any other occasion. *"I have never heard of the declaration and it has neither been discussed in the study board nor during teachers meetings"* (Interview 1). It therefore goes without saying that the Lucerne Declaration has not produced an impact at the Danish universities. Additionally heads of the study boards in geography as well as the general interview sample, suggest there has been no direct or indirect impact thematically (in terms of sustainability) on geography education, neither from EU, national plans nor legislation. The finding suggest that geography has been relatively unchanged regardless of sustainability policies in higher education. Instead the declaration (and curricula) can be considered to be a product of specific history-geographical circumstances signaling geographical representations of the human environment theme. What sustainability in geography is instead influenced by is university governance, funding and external reputational capital (Box 6.4).

And yet, as the Chair of the Study Board at Copenhagen University explains: *"sustainability is not something we discuss, it is not necessary to discuss what you agree*

upon and which already is there" (Interview 1). Though sustainability themes take various forms in geography at Copenhagen and Aalborg Universities, the chairs of the study boards do not find it is necessary to develop the study of sustainability further: "*Well, I see no need for improving the sustainable content quantitatively. I would say it is saturated. Sustainability issues are filling out much of the education*

Box 6.4: Making space for sustainability in geography – marketing the ambition?

"Sustainability is an important concept in geography. It is important that what we aim to strive for sustainability. It is not easy. We can only make sustainability work in our educations if there is money for it. If there are no students applying for those courses then we will have no sustainability in our education. How do we secure that the program is not just thrown away when there is no more money and the funding stops" (Interview 30).

"All the research I do or teach, is contributing to a knowledge base that is used in planning and practice, in directing it toward a more sustainable path. It is absolutely central and geography should grasp a hold on these issues more seriously. The problem for not doing that is that all of us now think so much on what the young people think (…). This is problematic, student enrollment is now a business and we need to attract student" (Interview 16).

"I think sustainability is unhelpful for critical research in geography and elsewhere (…). I only see the use of sustainability relevant if it can attract students to geography" (Interview 25).

"I think geography has a responsibility to take aspects of sustainability into consideration in the bachelor program. (…). Sustainability or environmental issues does not interest many young people in Denmark. As a rector I saw how less and less students enrolled in studies like environmental science. It is a problem that we do not have more students that engages with environmental change. The issues have less concern for students than 10 years ago and we see these studies have problems with low student recruitment. We have also seen how relations between physical and human geography are widening. This give less opportunity for establishing the holistic approach that sustainability require" (Interview 3).

"I think the concept is essential to geography, but it should be used specifically and approached with scientific standards to be useful. If our soundings see the concept as a non-scientific term and we use it, it is a problem for our reputation in the field" (Interview 31).

already, so I see no need of giving it more room, but sustainability will remain a core dimension of geography also in the long run" (Interview 3). Also at Aalborg University geography seems to be saturated: *"Sustainability is already integrated at many levels and has a strong critical mass. I do not see a point in enhancing it further. Environmental sustainability has the strongest position though, so in a way we could enhance aspects of social sustainability"* (Interview 13).

Thematic shifts in declarations thus reflect tides and waves that also illustrate a move toward moral obligations (Lucerne Declaration 2007). The Lucerne Declaration (2007) as the only declaration explicates a norm based learning approach dealing with nature. *"Sustainable development implies (…) development of new production and consumption patterns, as well as new life styles, and last but not least by the creation of a new ethic for the individual through lifelong education, including Geographical Education"* (Lucerne Declaration 2007, p. 245). Study regulations and interviews by contrast never explicit ethics, norms or attitudes associated sustainability (Aalborg University, 2010, 2011; Copenhagen University, 2009a, 2009b; Roskilde University, 2006). To provide students with skills that enable them to become change agents that serve the normative agenda of sustainability has no purpose in geography; interviews suggest: *"Sustainable values and ethical questions is an individual matter, and have not been debated at an institutional level. It is nothing we seek to form common consensus about – that we will like to form students in a certain way. Teachers possess different agendas and enrich students with different perspectives"* (Interview 9). In contrast to the Lucerne Declaration that resembles discourses of climate catastrophes and what Lambert and Morgan (2009) have termed ESD as moral development, the interview analysis demonstrates that Danish university geography rejects ideas of dealing with ESD moral, and only finds sustainability notions acceptable if considered as an analytical concept.

6.6 Conclusion - Toward Analyzing Contradictions

As we saw geography finds resonance in human-environment interactions, therefore an opportunity to articulate that geography has a particular role in dealing with sustainability. The analysis of study regulations, interviews and geography declarations suggests that the human-environment theme is re-naturalized toward more notably being associated with sustainability. Though nearly all Danish geographers interviewed remain critical to the concept, hence reluctant to explicate

it in the classroom, 29 of 31 geographers find sustainability concepts relevant to geography. Two geographers interviewed rejected to use sustainability concepts at all. Though environmental issues are important to geography, they suggested, related concepts are better suited for studying environmental concerns. Nevertheless, geographers find their discipline makes a particular contribution to sustainability analysis in three important ways. First, geography's strong tradition in the human-environment theme provides a methodological basis for dealing with issues of sustainability. Second, the spatio-temporal dimensions of sustainability call for geographical approaches to be able to understand the dynamics, complexity and interactions in various scales. Third, it is widely claimed that geography contributes by its interdisciplinary approaches to bridge the social and natural sciences. Dealing with geographical imaginations may not only better prepare students, teachers and practitioners in understanding sustainability challenges in various spatial contexts, but also may help us better understand that, what appears to be a solution in one scale may produce sustainability challenges in another. To achieve such an understanding is not only relevant for geographers, but is relevant to sustainability analysis in various (inter) disciplinary contexts. Although issues of sustainability and climate change have been materialized in Danish geographical curricula, it has a limited status in practise. Geographers remain critical to the concept itself, hence reluctant to explicate it, and/or find it more suitable as an implicit notion.

Distinguishing between external nature and co-created natural environments is an extraordinarily difficult task. As sustainability is an anthropogenic concept it cannot transcend that distinction (see chapter 4). Thus the epistemological process of re-naturalizing nature within the geographic episteme is also a process by which imaginative geographies of external nature shrinks. Hereby, nature that previously was regarded as external, reconfigures and is de-naturalized to also be part of the social. Insofar as sustainability concepts gain terrain, spatio-temporal tides and waves suggest that the process of diminishing external nature is taught implicitly, simultaneously demonstrating changes in ethics. This finding is problematic not only to contested ideas of sustainability, but also demonstrates internal and external contradictory elements when dealing with the dual character of the moral, policy, ethical and facto-contextual spatio-temporal changes attached to it. As a concluding remark, engagement with sustainability as an implicit notion rather than explicit, opens the paradox that global climate change is catalyzing examination of ecological ethics, both in society and within academia, while humanity's

failure in responding to climate change turns into a moral storm that is hidden away. The chapter thus critically addresses how political ecologies and ethics are both supporting and challenging the current range of practices by incorporating and hiding them simultaneously. This dual character will be addressed in the following chapter that critically deals with internal and external contradictions of hiding and promoting sustainability simultaneously.

Chapter 7

Educating Geographers in an Era of the Anthropocene: Paradoxical Natures – Paradoxical Cultures[1]

"The remaking of nature (…) becomes, quite simply, a focal point for a nexus of political-economic relations, social identities, cultural orderings, and political aspirations of all kinds" (Castree and Braun 1998, p. 5).

In chapter 6 we saw how nearly all geographers interviewed found sustainability issues essential to geography, but remained critical about the notion. This illustrates that there are contradictory elements to the claimed relevance of geographical work. The aim of this chapter is to examine in greater detail how geographers respond to paradoxes, contradictions and dilemmas of sustainability and how they address these dilemmas in their teaching. This chapter argues that sustainability takes form as hidden politics by the ways in which geographers respond to sustainability dilemmas. Hereby the cultural politics of representing nature produce political ecologies embedded as hidden curricula. In the remaining part of the chapter we critically address paradoxical natures and cultures. It is concluded that geographers both seek to distance themselves from produced politics while at the same time elucidating them. First, however, we shall see how this converts into two educational strategies for putting sustainability on the agenda and at the same time hiding it. This contrasts the critical research agenda we set out in chapter 1, stating that scientific biases do not arise from having ethical or political positions. Rather,

1 Part of the chapter is forthcoming in Grindsted, T.S. (2015). Educating Geographers in an Era of the Anthropocene: Paradoxical Natures – Paradoxical Cultures, Journal of Cleaner Production, doi: 10.1016/j.jclepro.2014.10.086.

biases arise from not acknowledging them or simply hiding interests and agendas involved in coping with them. We shall return to that at the end of the chapter.

Questions for the chapter:

- How do geographers respond to the paradoxes, contradictions and dilemmas of sustainability?
- How do research geographers address dilemmas of teaching sustainability?

7.1 Paradoxical Cultures - Paradoxical Natures: Integrating Sustainability into Curricula as an Implicit Notion

Before we turn to educational strategies for putting sustainability on the agenda, let us briefly recapitulate the second nature approach. In chapters 4 and 5 we discussed Castree (2001) and Harvey (1996), and it was argued that nature is not only defined and construed socially, but also modified physically by humans, with particular social interests involved in such transformations. It follows that knowledge is complex mixtures of knowing nature(s) that constitute power relations with different socio-material effects. Then we saw how both the second nature approach and sustainability have a common stance –natural transformation is anthropogenic per se, why these concepts are unable to distinguish between non-human and human impacts on environmental change. If we have ever been able to do so, the history of spatio-temporal tides and waves underline the relevance of addressing the social character of nature. In tandem the social nature approach encourages us to critically explore how in thought and practice politically contested values, moral or ethical aspects are assembled when representing the ever accelerating interactions of the human-environment interface (Castree 2001). As neither scientists nor students can escape the value-laden proxy of sustainability, it inevitably produces fractions and frictions and the ways we perceive such tensions, contradictions, and dilemmas hugely influence how we (inter)act (and vice versa). With these reflections in mind, let us turn to how sustainability dilemmas get assembled in curricula constructs. In what follows these response(abilities) are discussed through two subcategories, namely 1) the substitution of concepts and 2) sustainability as implicit curricula. These represent two educational strategies for dealing with dilemmas that both put sustainability on the agenda and at the same time hide it.

7.2 Frictions and Fractions: the Importance of Sustainability and the Substitution of Concepts

The first source of reluctance to explicate sustainability in the classroom involves criticism of values, ethics, moral and norms implicated in framing scientific work around such concepts. Dilemmas lie in the nexus between multiple normative agendas and different sustainability concepts that simultaneously reject the value-laden content from which the concept cannot escape. *'Sustainability is a considerable sub-component to geographical work. Sustainability is a part of geography in itself as a mass balance principle, systemic contemplations and its holistic and interdisciplinary dimensions. Having said that, many other aspects are important to geographers and the phrase is sometimes inevitable. I prefer other terms, but the underlying basis is crucial to geography"* (Interview 13).

Though a substantial number of the geographers interviewed find sustainability themes relevant to geography, the concept in itself rather belongs to the political sphere than the scientific (Box 7.1).

It is indeed funny that interview 25 refers to interview 26 (Box 7.1) and by doing so contradicts itself. My aim though is not to expose geographical ambivalences, rather I point towards mixed feelings in between using 'buzzwords' in academia,

Box 7.1. Dilemmas of practicing sustainability in geography

I have the problem as [a geographer at Copenhagen University red. See Interview 26] that sustainability is okay for politicians, but it has a lack of clear definition and a lack of methods and research on it, hence for science (…). It is so politically biased that it is unhelpful for any scientific analysis. Therefore it is not relevant to geography. I only see the use of sustainability relevant if it can attract students to geography (…). The concept is extraordinarily bad, because it more or less correspond to geography. Competences in humanities and arts, social sciences and natural sciences all possess variables that have something to say on that concept. It is so politically biased that it is unhelpful for any scientific analysis. It is an elusive and imaginary concept, a concept of fantasies about paradise like futures. I think that is unhelpful for critical research in geography and elsewhere" (Interview 25).

"Sustainability is a frequently used concept and absolutely central to the education. It takes up a considerable part of my teaching and a central part of the discipline in general" (Interview 26).

flittering within geographical identities. Yet, as *"the concept is extraordinarily bad, because it more or less correspond to geography"* (Interview 25), it produces hyper complex dilemmas (see also Lambert 1999) that follow two trajectories of criticism contradictory to the claimed relevance for contested ideas of geographical work. The first form of disputed criticism encapsulates substitution of concepts as a specific strategy related to the power of reference. Because of the norm and political by-products sustainability concepts rely upon (as well as any theme, key concepts or disciplines obtain power relations) one solution at first glance, is to replace the concept with another. *"I don't think sustainability should be part of geography education. But it is. Sustainability is rejected fully by the top international writers in geography. In Sweden resilience is now the concept in use among geographers. In UK and the US it is replaced with robustness and vulnerability. They have all recognized that sustainability is empty. Nobody knows what sustainability is - but we keep it! Why do we keep discussing it - it is completely irrelevant. Sustainability is about politics and has nothing to provide in academia. We need to eliminate the concept of sustainability and replace it with ecology. Sustainability is an empty concept that leads to nowhere. Instead robustness or resilience for instance, concentrates ecological discussions into awareness of the conditions of a particular matter. So, resilience and ecology that is what should be central in geography"* (Interview 5).

A number of things are going on here. Replacing the concept with another enacts the power of reference in ways in which it appears that dilemmas, challenges and contradictory elements are overcome by replacing them to more specific terms, yet with similar normative agendas. The implication appears to be to replace concepts, rather than replacing the relevance of themes and underlying dynamics such concepts envision to represent. As challenges of sustainability cannot be reduced to semantics, frictions of being sympathetic to the notion of sustainability collide with the political implications (Box 7.2).

An interview with John Urry (2013) exemplifies the extraordinary difficulties in studying conditions for (un)sustainability while substituting the concept because of its fallacies. In the interview, he was asked about his recent book at the time, *'Climate Change and Society'* (2011), in which models for social innovation toward a low carbon society are depicted. 'In many ways one may argue that the essence of your book unfolds around the concept of sustainability. You do not use the term; are there any particular reasons for that'?

Box 7.2. Replacement of Concepts as a Strategy to Address Dilemmas of Sustainability

"When I am a counselor, I ask students to use other terms because it is more precise. Still it is about how we respond to climate change – to environmental change and how we consider that in our planning (…). So it is there and is not there. I think much of it has to do with finding less political concepts. We use other terms instead" (Interview 8).

> *"I think sustainability concepts bring important perspectives to our education. I do not myself work on the concept though. I work on arctic research. We call it different things, but it is essentially the same, when we talk about responses to climate change in the arctic. How the international climate negotiations develop on the basis of research on how sealers in Greenland adapt to their climate or if we study agricultural farming in Africa, then sustainability is all there"* (Interview 30).

"I teach in climate change, relate it to the Kyoto Protocol and international politics. We discuss if there are any long term solutions to the problem – hence sustainable. In this sense sustainability is relevant for geography, but I do not use the term very often. I use other terms instead" (Interview 11).

> *"What is sustainability about? – I find it too diffuse, abstract and multifaceted to be useful. It appears as social, environmental and economic sustainability and is misused to the extent that you can't imagine. I do not know why sustainability should have any more status – why it should be given special emphasis and stand before any other concept in our geographical repertoire"* (Interview 22).

"Sustainability is an extremely political concept and we all have huge difficulties in defining it. Sustainability is a concept that raises awareness on certain problems. It is suitable for that. As an analytical concept it is not part of the geographical vocabulary why I do not find sustainability important to geography. I regard the whole question of environmental change, climate change and all of that important to the future of geography, but what concept we find best suitable for describing these processes - if sustainability is one of those concepts I am not really certain. Yet the underlying basis is there" (Interview 9).

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I think sustainability is an important concept for the education, not least when we teach on approaches to grasp the human-environmental interface. But we also work with a number of related concepts like resilience, vulnerability, climate change and so on. We should not limit ourselves, but consider the contributions of each individual concept, their dynamics and relations. It is urgent I think" (Interview 28).

"I regard the interface between human and nature a considerable aspect of geography, so in this way I think sustainability is relevant. But if it is the concept of sustainability or another concept - I am not so sure if sustainability should have any more status than other concepts, maybe it is because I have great difficulties with that concept in the first place.(…) I do not teach in sustainability or in topics that I call sustainability. But it is not the same as I don't consider the global environmental crisis. The body of environmental though is there" (Interview 20).

"I don't find sustainability important to geography it is a buzzword if anything. (…). On the other hand, I have sympathy with the underlying idea – the integrative aspect of addressing economic, environmental and social issues at the same time – but this need not to be framed within the corridors of sustainability" (Interview 21).

"I think sustainability must be very central for the geography education - I will say so, though I never thought about it before - sustainability is central to our discipline, how we understand ourselves and how we understand the world. I never use the term myself though" (Interview 14).

"I don't like the term sustainability, I almost never use it. I do not think sustainable means anything. I think it was a very helpful term to use in the 1980s, but it is now got used like a free flow taken over by almost all organizations and firms, so that everything is now sustainable development and therefore it is a kind of meaningless empty term. That's one problem, but secondly I don't really think that any development is sustainable. I simply use the term low carbon or carbon restrictions, which obviously is too simple as well (…). So, low carbon practice is a phrase I would use and low carbon ethic and that should be embodied and embedded into education. Values to me again is quite interesting and most people don't have them in terms of low carbon societies, depicting differences in what they say and what they do (...). So that is a challenge for education isn't it?" (Interview, John Urry).

Replacing sustainability by low carbon society is way more precise. Nevertheless, though more precise, the complexity, normative horizons, and political biases are neither destroyed nor eliminated. Material changes are concurrently going towards more intensified carbon practices, fundamentally in an unsustainable direction (Rockström et al., 2009, Barnosky et al., 2014).

Harvey (1996) once called for a 'political theory of nature' that particularly takes an entry point from which one can re-conceptualize an increasingly hybrid economic, technological, societal, conceptual and cultural world. One can of cause avoid the concept of sustainability or replace it with another – but conceptual spaces of addressing complex, anthropogenic and interconnected global environmental change require broad, interdisciplinary and hence inevitable concepts.

Though related concepts may be more dynamic, progressive and intriguing, (or simply serve another academic agenda) they cannot escape the complexity, normative horizons and policy figurations involved in representing global environmental change. To replace one concept with another as a solution in itself is to ignore the material changes the concepts seek to explain, if it solely ends up in dispute about terminology. *"Is sustainability relevant in the education? - Hmm, yes, and especially because it got all the media publicity – but you could easily think the education without sustainability at all. Then, we just approach the same thing, the same goal, from another angel. All the research I do or teach, is contributing to a knowledge base that is used in planning in practice, in directing it toward a more sustainable path"* (Interview 16).

When using related concepts, it is also a strategy to avoid all the political commitment and branding arising from sustainability, assuming this is not transferred (or to replace the politics of sustainability with another politically value socio-natural concept e.g. the anthropocene). Such proposals seem just as problematic and fall into the arms of the prison of language, in which fight over terminology is also a debate about preserving a particular epistemic (academic) order. Another dimension of the power of reference is also going on. When we shift concepts, we shift scale, spatio-temporal dynamics, hence the normative horizons are always inherent in academia (Harvey 1996). The power of reference and rivalry over replacement of concepts, consequently transform into a struggle over different spatio-temporal tides and waves.

The whole question about environmental issues is of importance to geography, but which concept is most suitable in analysing human-environmental concerns, encapsulates discussions of the analytical and ontological status such concepts rely upon. *"Sustainability does not have the same ontological status as do a number of key concepts in geography. Landscape, region, place, nation to global – all bear a strong ontological status. Sustainability is not part of these concepts (…). It is a political concept rather than an analytical concept"* (Interview 17).

As sustainability does not have the same ontological status as a number of geographical key concepts e.g. (external) nature, the strategic use of concepts to direct our thinking (geographical imaginations) become powerfully apparent (Chapter 3). Making reference to the socio-natural through sustainability in contrast to (external)nature makes us aware of the powerful and normative reference to governing the socio-natural, hence subject for discussion, whereas consulted with concepts like(external) nature, the socio-natural is re-represented as if descriptive, apparently without governing forces. As any concept that intends to represent the natural, non-natural or certain interfaces, sustainability ontologically integrates human and nature as an inescapable reality. In bridging environmental, economic and social domains, it offers an alternative epistemology (Chapter 4). Hence it provides a way of thinking that raises key political issues of our time. Thus sustainability ascends as an (political) practice that only exists if the natural, material and social are addressed collectively (Whitehead 2007). In that sense it is both a political and analytical concept (Box 7.2).

To claim that the concept is only political, hence non-analytical, is to assume there is no relation between the two, when key concepts with high ontological status are used. This raises a number of related issues: It ignores that a number of geographical concepts with high ontological status have historically changed and separated humans from the environment (the use of the term money in conventional economics being an obvious example[2]). Therefore ontological 'status' (as power of reference) also holds a preserving (paradigmatic) element, accepting assumptions as unquestionable. It assumes that the use of concepts in academia correspond to the use of it in the political domain. Insofar as sustainability is used

2 It is to argue that the debate over definition of money is an academic exercise with no political implications, while in conventional economics e.g. the implication of the definition is to ontologically separate society from the environment.

differently among different social groups and in different epistemic communities, its normative meaning and ideologies of nature shift. To hide it by replacing concepts or redefining it is a strategy that downplays the political aspects of scientific work. Henceforth sustainability spur debate on how one integrate the natural and social linked to the social dynamics in modern society, how one respond to it, and why when analyzing socio-ecological systems in different spatial and temporal scales it turn out to be unsustainable (Mansfield 2009, p. 38). Another relevant aspect however, that the methods concerning the empirical work is not fully able to reflect upon, is to consider how replacement of concepts in itself may be a political strategy. Though nearly all Danish geographers interviewed remain critical to the concept of sustainability itself, hence reluctant to explicate it in the classroom, they find sustainability or related concepts (resilience, vulnerability, ecology, anthropocene etc.) representing socio-ecological issues essential to geography and choosing or rejecting the language of sustainability or any other concept serve particular political ecologies.

Addressing sustainability is like swimming against ontological tides and waves. As action or inaction with respect to sustainability or assembling the human-environmental nexus is unavoidably value laden. We need to address the hidden normative, moral and policy configurations of sustainability and discuss dilemmas, contradictions and paradoxes involved in hiding different agendas, as well as their epistemological and ontological consequences.

7.3 Frictions and Fractions: Integration of Sustainability as Implicit Curricula – Learning Agendas of Socializing 'Sustainable' Nature(s)

Another subcategory identified underlines the teaching of sustainability as an implicit notion (see box 7.3). Most of the researchers interviewed, when reflecting on their teaching, rarely address sustainability explicitly, but integrate sustainability into curricula as an implicit notion. *"Sustainability is absolutely central in geography – at least implicitly. The reason why it is not important as an explicit concept is because I do not as such teach in sustainability, but much of my teaching nevertheless concerns artifacts of sustainability. Students are highly interested in these matters, but we do also call them climate adaption, resilience, vulnerability among others"* (Interview 29).

Box 7.3. Teaching Sustainability as an Implicit Notion

Sustainability is a considerable sub-component to geographical work. Sustainability is a part of geography in itself as a mass balance principle, systemic contemplations and its holistic and interdisciplinary dimensions. Having said that, many other aspects are important to geographers and the phrase is sometimes inevitable. I prefer other terms, but the underlying basis is crucial to geography" (Interview 10).

> *"If I directly teach in sustainability it is a matter of how explicit it should be mentioned. I do not mention the term very often, close to never, but implicitly it is there as an aim we are striving for. Sustainability is part of all geographers' mindset, and the way we look upon things, sometimes so strongly that it is not an explicit part of our references. We think of it in this way, because we naturally are interested in minimizing effects of climate change pollution and the use of natural resources"* (Interview 6).

"The concept is extraordinarily bad, because it more or less correspond to geography. Competences in humanities and arts, social sciences and natural sciences all possess variables that have something to say on that concept. In geography however, we bring these aspects together. The term (sustainability red.) is so politically biased that it is unhelpful for any scientific analysis. I think that is unhelpful for critical research in geography and elsewhere so. But you ask me if I have ever taught in sustainability – yes implicitly. I teach in water security – how we manage and maintain our water resources, risks, uncertainty, balances, improvements and decline – in this way one can argue that it embraces sustainability – but only implicitly" (Interview 25).

> *"Sustainability plays a major role in geography. It is such a central dimension, so - sometimes we do not talk about it, because it is an underlying basis from where we work"* (Interview 13).

"Sustainability is an important part of geography, at least implicitly. The reason why it is not that important as an explicit concept is that much of the teaching I do, does not necessarily relate to sustainability, so it is more like artefacts of sustainability" (Interview 4).

> *"I have taught sustainability in various ways, but never as an overall theme. A number of the studies I have undertaking draw on sustainability implicitly, and the concept could very well address part of my work. But I would tend to say that we also did 'sustainability work' long before the concept became present"* (Interview 23).

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"Is sustainability relevant for geography? I am not sure. I work on climate change and there is a clear element of sustainability. But to me the concept means everything and nothing. It can be a natural system in balance with the surrounding environments, or the same system developing in some way that humans find sustainable or not. I work on perm frost. When the perm frost melts is it then a result of things not being in a stable and balanced condition? Is it affected by humans? I find the whole question on feedback mechanism, balances and tipping points relevant for the field and questions on human effects on these dynamics. So as an overall [unspoken red.] frame it is there" (Interview 11).

> *"Sustainability is a concept to understand the greater aspects of many processes that relate to one another – I think along these lines in my research and teaching, but I never use it explicitly"* (Interview 15).

"When I teach in accessibility for instance, then the aspect of sustainability is in the background. Whether or not sustainability is there [on the curriculum] depends how explicitly it should be mentioned. I rarely mention the term, but implicitly sustainability is the main objective for what we do and why we study it in this way. Sustainability is part of all geographers' mind-set I would say; sometimes so penetrated that one may not need to explicate it" (Interview 20).

Thus, most of the researchers reflecting on their teaching find sustainability inherent, but rarely expressed as a concept, or find the whole question about sustainability of importance, but the concept unhelpful. The trajectory enfolds criticism of values, ethics, moral and norms implicated in framing scientific work around such concepts.

This implicit dimension of teaching sustainability is not at all easy to capture and holds huge amounts of cultural schooling (Turner 2002, Cotton et al., 2013). Nearly all geographers interviewed found sustainability issues essential to geography, but remain critical to the concept itself, dilemmas of using sustainability remain looping. As the Chair of the Study Board at Copenhagen University explains: *"Sustainability is not something we discuss, it is not necessary to discuss what you agree upon and which already is there"* (Interview 1). However, this does not imply that the human-environment theme undergoes transformations toward uniform conceptualizations, but that normative and methodological horizons change as new knowledge emerges.

This outlines the contradiction that the importance of sustainability contrasts the teaching of it as hidden curricula. Thus, tacit configurations depict the supra-complexity of sustainability in curricula constructs. Along these lines another contradiction comes into play: the willingness to teach sustainability as an implicit norm orientation is highly acceptable among geographers, but contrasts the criticism of the concept given by the very same geographers. The criticism of the concept is projected back on the field, hidden because of its political biases (Interview 1, 7, 16, 22, 24, 28). In this way the specific knowledge claim is produced by scholars that intentionally find an objective enquiry to be an integral part of philosophy of science according to which the world exist independently of the observer and can be transferred into unbiased and objective knowledge. Thus the non-human world is framed as quasi-objective (though particularly within the fact-based approach). Yet, most geographers fully reject the idea that the human-environmental interface can be studied on objective grounds. Nevertheless the form of appearance seems exactly to be 'objective' (forms of realization) when biases and modes of representing (power of reference) convert into hiding the moral and political incarnation of sustainability. Replacing concepts like the anthropocene, resilience, climate change or geo-engineering faces the same challenges, and the strategy rather turns the 'moral' and 'political' appreciation into a technical issue (Mansfield 2009).

Does this imply, if scientists, scholars or geographers do not make sustainability explicit, but are willing to accept it, inherent politics are not there? Tacit information neither is logical, consistent nor reflected methodologically; still it carries huge amounts of knowledge that exists in the interface between subject and object, between human and nature relevant to the spatio-temporal figurations of co-constructing nature (Demeritt 2002). The human-environment theme therefore embeds organized assumptions through the way we categorize parts of the world, whatever concept we attach to it.

Similar to the replacement of concept strategy, sustainability as an implicit notion becomes bearer of policy intrigued dilemmas in the nexus between science and policy, human and environment. Whether explicated as particular contributions that 'reclaim the high grounds' of geography (Stoddard 1987) or intrinsic depictions that (both) seek to distance from produced politics and elucidate them simultaneously, the implicit extrapolation of sustainability converts into a form of hidden curricula, tacit holism, accompanying hidden political ecologies. While

seemingly expressing neutrality, as if sustainability is not there, it bears relation to the co-construction of environmental consciousness that tends to be in advocacy of the teacher's belief (cultural embodiment), without the student (observer) becoming aware of it (Cotton et al., 2013).

The dilemma of course is that sustainability requires critical thinking, which is why tensions, conflicts and rivalry become constitutive and contradictory to sustaining sustainability simultaneously. Thus it ends up with the same dilemma as does the eco-centric perspectives; it produces instantaneous objectivism on subjective grounds (Castree 2001). Implicit sustainability in curricula however may encourage several other explanations, controversies and contradictions.

To hide discussion of tacit curricula is contradictory e.g. to the 'sustainability as politics' itself, since students are excepted to be aware and critical towards agendas, interests, and strategies involved in claiming particular sustainability agendas: except from the hidden curricula taught, the intrinsic social nature(s) associated with sustainability teaching. The puzzle, from the second nature perspective is that students learn to analyze the politico-ecological jigsaw of sustainability approaches as well. These strategies of hiding political ecologies, whatever sustainability approaches on the agenda, uniform intrinsic natures about sustainability cultures. Dilemmas in explications of the value-laden proxy of sustainability may be one of the reasons why the analysis reveals that sustainability has a limited status in geography educations in practice.

7.4 Discussion: Dilemmas, Paradoxes and Contradictions within and between Sustainability Approaches

While contemporary education for sustainability literature is grossly nested in the need for critical, holistic and interdisciplinary learning approaches (Rieckmann 2012) the mainstream literature on sustainability in higher education is little established on the paradoxical natures and cultures in engaging with ever accelerating human-nature interactions (Nor the neoliberal agenda as discussed in chapter 2 and 6). The two sustainability typologies identified in this chapter: 1) sustainability approaches as implicit curriculum, and 2) sustainability approaches as replacement of concepts, paradoxically enough hide the fact that dealing with the socio-natural interface is a matter of choice, whatever perspective one takes

(it be external nature, universal nature or intrinsic nature). Hereby the two sub-categories of scholars seek to distance themselves from produced politics, whilst at the same time elucidating them. This contrasts the critical research agenda we set out in chapter 1, stating that scientific *"bias comes not from having ethical and political positions – this is inevitable – but from not acknowledging them"* (Griffith 1998, p.133) or hiding them. In this final section, I discuss how striking it is to what extend power relations (political ecologies) are written out of dealing with sustainability approaches in the classroom, and I relate it to the education for sustainability literature, that 'uncritically' finds critical approaches to be imperative.

Though analyzed in the context of geography, 'unwritten power' and the contradictions that follow, surpass the borders of geography, relevant to academics and practitioners engaged in teaching and writing global environmental change in various interdisciplinary contexts. Rieckmann (2012), for instance, points to sustainability competency in handling incomplete and complex information. With the two sub-typologies in mind this could be extended to also envision competency in analyzing and handling contradictions and paradoxes that align with particular sustainability problems at hand. To use higher education as a means and strategy through which 'sustainable' solutions spur, the mainstream literature frequently turns into search for 'best practices', drivers and barriers, challenges and opportunities (Martin and Jucker 2005, Karatzoglou 2013).

The implication of this analysis is that scholars, scientist and students must deconstruct concepts like barriers and drivers, challenges and opportunities and more carefully reflect on power and interest involved in producing such agendas. Similarly, scholars across disciplines need to reflect more carefully on contradictions and paradoxes. The implication of the former is that journal articles, teaching and dissemination of knowledge also risk being subject to green washing and branding itself (Chapter 2). The increasing regime of accountability, instrumentality, BFI, ranking and quantitative measuring of 'quality', when reduced to best practise, drivers, barriers and oppotunities, seem to be based on certain values and simplified forms of quality narratives (the innovative power of competition), while such accounting systems may be dysfunktional to sustainability analysis in itself. This is particularly related to the power of reference and interests involved in being highest on sustainable metric leagues, best practice cases, and referencing influenced by the politics of indexing and ranking (appendix 1.2). The implication of the latter is that students should also be invited to think critically about the subtle power

plays and political ecologies engaged in different sustainability approaches and their socio-material effects. This encourages students, teachers and practitioners to explore the double level of controversy (Lambert 1999, Morgan 2011) of thematic and methodological and socio-environmental paradoxes, whatever perspective on nature we take.

Dialogue about these issues may not only better prepare students, teachers, researchers and practitioners for dealing with wicked and controversial problems like sustainability and anthropogenic climate change, but may also make students better understand the geopolitics of scientific and educational practices, interests and political ecologies produced. While sustainability concepts promote multiple and conflicting visions it is interesting to observe that ecocentric and gradual sustainability perspectives are neither represented in the interviews nor study regulations. Approaches outside mainstream sustainability (ecological modernization, market environmentalism, environmental justice), e.g. critical or radical approaches (climate catastrophism, eco-Marxism or eco-feminism) are neither reflected in interviews nor study regulations (Study regulation, Roskilde University 2005, 2006; Copenhagen University, 2009a+b; Aalborg University, 2010a+b, 2011).

What types of social natures exist within the sustainability approaches taught with what interests involved? Who benefits from those political ecologies produced and with what socio-ecological consequences? The simple answer is that hiding agendas of sustainability is a peculiar response(ability) in tackling climate change. Responding to climate change require fundamental change in power relations and the dominant form of business as usual developments (Sayer 2009), but in the context of teaching on sustainability, the co-productive practices, power, domination, ideology and control within educational practices are hidden.

Taking a critical perspective on higher education encourages students to addressing the multiple dilemmas, complexities and contradictions involved in agendas for sustainability – and the role of education and science in the 21st century (Harvey 1974a). Rather, the hidden curricula serve as a form of status quo development. The empirical analysis (and the limitations hereof) suggests that geographers' (un) engagement in the sustainability discourse, co-produce socio-material thought with material effects, whereby the critical attitude towards sustainability, fundamentally turns into non-academic activism or uncritical critical engagement in responding to sustainability challenges. Whatever approach or perspective on

global environmental change we take, political choices and values are situated in the play of power that strives for particular normative goals. Harvey (1996) points to values and normative horizons as 'utopian moments of reflectivity' embedded in practices of power over possible futures.

As Harvey (1974b) has once argued, the possibility futures produced in science and education are never a question of choosing between different forms of objective and neutral knowledge, but between different forms of normative knowledge. The multiple ways geographers and academia respond to anthropogenic climate change, co-produce educational-politico assemblages of intended learning outcome, with particular socio-ecological effects. Dealing with dilemmas of sustainability is a matter of choice, in line with what Castree (1999) calls activism inside and outside the discipline. Thus, avoiding taking (multiple) stances, whatever they might be, as a response to the huge dilemmas of dealing with global environmental change (rivalry over different political ecologies) suggests we must live with the biases, contradictions, frictions and fractions of producing paradoxical cultures and paradoxical nature(s). There might, however, be more progressive ways of responding to them than hiding them away.

Whatever perspective, the knowledge produced and modelled engender different scenarios, which legitimize different actions and uses of natural resources. This recognition, produces a double level of controversy since, when willing to accept sustainability as inherent in curricula, it is like accepting not being reflective about the values, norms, ontologies, and organized assumptions. The concept of sustainability involves value-laden choice (as any other approach, theme or concept), but framing (un)sustainabilities amongst geographers hides this by replacing concepts and producing implicit curricula. The hidden teaching approach on sustainability is contradictory in itself, since students are expected to be aware of interests, and strategies involved in claiming particular sustainability agendas, except from the hidden curricula, and the immanent social natures of (sustainability) teaching.

As humanity is faced with the global environmental change in an era of the anthropocene (Crutzen 2002), spatio-temporal tides and waves of dealing with the human environment interactions are ever more complex, producing ever more complex paradoxical natures and cultures. The quest for geographers is how to tackle these paradoxes, contradictions and dilemmas and how we respond to them.

7.5 Conclusions

This chapter presents an empirical analysis of research geographers' dilemmas of teaching sustainability. From the second nature perspective the study addresses contested ideas of integrating sustainability into curricula. Despite the multiple ways and agendas researchers are engaged in when teaching university geography some common features of addressing dilemmas, paradoxes and contradictions have been identified. While a large majority of research geographers find sustainability themes central to educating geographers, they remain highly skeptical to the notion, hence reluctant to use the concept of sustainability in the classroom. Thus, sustainability is more often addressed implicitly than explicitly. This is partly due to the normative and political character of the concept, partly due to its fuzziness and the criticism attached to it. The claimed relevance of sustainability is found contradictory to the actual practice of addressing sustainability as an implicit notion. As a consequence, the ways geographers engage in teaching sustainability is predominantly hidden or non-existent (according to whose perspective). In both cases paradoxical natures of paradoxical cultures are taught.

Further, the chapter reveals two sub-typologies: 1) sustainability as implicit curricula, and 2) sustainability as replacement of concepts, which represent two different educational strategies for putting sustainability on the agenda while at the same time hiding it. As a consequence it is concluded that the multiple ways geographers deal with sustainability issues produce paradoxical culture-natures(s), as they both seek to distance themselves from produced politics while at the same time elucidating them.

This has deep implications across disciplines (e.g. science, engineering, business academics) since frictions and fractions within and between different sustainability approaches are inherently interdisciplinary, yet geography in particular seem to be under pressure when confronted with sustainable dilemmas due to its history. This illustrates how difficult it is to deal with global environmental change for academia, as biases of scientific work fall back on academia as both observation and intervention. With the objective science we changed the world why the denaturalization of nature is an argument for (re)considering the concept in geography.

In order to transcend the paradoxical-culture-natures identified, scholars, students, and practitioners across disciplines need to address normative, fact or

policy configurations of sustainability and discuss dilemmas, contradictions, and paradoxes involved in different agendas to better respond to them. In the final chapter I point to the cultural politics of climate change modelling. In so doing I both address what human geography may offer climate change modelling as to assembling the human-environmental interface and I consider it as an experiment in how geographers more progressively can participate in shaping environmental debates in the anthropocene.

8. The Social Natures of Climate Change Modelling[1]

"Essentially, all models are wrong, but some are useful. … [T]he practical question is how wrong do they have to be to not be useful" (Box & Draper 1987, p. 74).

Research on society-environment interactions on climate change often reduces human behaviour to economic rationality when construed in sophisticated climate models and sometimes in non-geographical representations. Based on the previous chapters the need to comprehensively take into consideration methodological approaches concerning the interface of society-environment interactions seems highly relevant to contemporary conceptual modelling of climate change adaption and mitigation, as also ethical dilemmas and contradictions (chapter 7) are deeply problematic to climate modelling. The geographical experiment of keeping nature and society under one conceptual umbrella is not least relevant to the modeling culture of socio-environmental change. This requires enormous engagement across disciplines and the disciplinary boundaries. The final chapter therefore takes the mental experiment and projects it to conceptual models. That is, a mental experiments of imagining the socio-cultural interface within the modelling culture as "*an unusual, but insightful element in an academic article"* (Weisz and Clark 2011, p. 284). Mental experiments concerning conceptual modeling of global environmental change, contrast mathematical approaches of modeling (the system under consideration is defined a priori as a means of designing and testing hypotheses), but seek to cultivate interdisciplinary debate, transcend and enrich ever more specialized disciplines. From a history-geographical perspective

1 A previous version of the chapter is published in Grindsted T.S. (2014). *What Can Human Geography Offer Climate Change Modelling?*, in M. Singh., and R.B Singh (eds.), Climate Change and Biodiversity, Advances in Geographical and Environmental Sciences, Springer, DOI 10.1007/978-4-431-54838-6_18

(chapters 4 and 5) it is discussed how notions of objective models are increasingly challenged in an era of the Anthropocene. It points towards a discussion of interdisciplinary challenges and the ways in which different traditions conceptualize the human environment interface. Then, rhizome ontologies are considered and how different traditions interpret and explain regularities, rationalities, and pre-analytic assumptions. Lastly we discuss challenges of constructing nature(s) and how we better understand the (geo) politics of climate change modeling. Human geography offers an understanding of the (geo) politics of climate modelling that addresses different kinds of political ecologies inscribed in them. Thus it is concluded, regardless of which perspective on nature we take, that climate models are agents themselves and equally perform different kinds of political ecologies.

Questions for the Chapter:

- What can critical human geography offer climate change modelling?
- What kind of climate modeling for what kind of socio-ecological future?

8.1 Human Environment Interfaces in an Era of the Anthropocene

In chapter 1 we outlined the consensus thesis among scientific communities as to the cause and effect of climate change and unsustainable production patterns. Consensus exists to the extent that 97 % of research articles in high-impact factor journals like Science suggest that climate change is fundamentally anthropogenic (Oreskes 2004). The history of human-environmental interaction is indeed astonishing. Today, the scientific consensus on anthropogenic climate change (chapter 1) suggests humans interact with the physical environment to the extent that humans are transforming the planet at multiple scales, and manifests the idea that humans are an geological agent moving the Holocene toward a new geological era, i.e. the Anthropocene (Crutzen 2002). The Anthropocene refers to the magnitude, scale and acceleration of per capita exploitation of natural resources that transforms the biogeography for millennia to come. During the past century we have witnessed massive land cover and land use changes of the Earth. From 1900 to 2011 the world's population has grown by a factor four (from 1.6 billion to 7 billion in 2011) accompanied by a growth in cattle and pig production to more than 1400 and 800 million respectively. Irrigated areas constitute five times the amount. Urbanization grew by a factor of 13, energy use by a factor of 16, and

industrial output by a factor of 40 (Crutzen 2002, Steffens et al., 2011). In the same period rainforests were reduced by 20 %. Deforestation, however, is only a droplet compared to the reduction of manifold biotopes by the agricultural demand for cropland (appendix 1.3). Today, more than half of the world's land surface has been changed by human activities which illustrates the very need for geographical representations in understanding transformations of the Earth life support system (Reenberg 2006).

The journey of geographical transformations is also a journey of the nature of time and space (Massey 1999) as argued in chapter 4. The changing geography of the world's physical environment, the biogeography and land use mutually transform humans and their environments. Therefore methodological and geographical reflections of the human-environment interactions seem more relevant than ever. Prediction of future climates and planetary constraints are indeed beneficial and the geographical imagination is central to climate- and land-use model building (O'Sullivan 2005).

By way of illustration Eugene Linden has showed how interdisciplinary constructs needed to be coupled with geographical imaginations, before climate modelling came about. Thus satellite images needed to be assembled before a unified account of past, present, and future climate data formed global assemblages of explaining the climate systems[2]: *"A system in which everything, from earth's position in its orbit around the sun to what's growing on the ground, influences climate. How the climate system balances these various inputs and feedbacks is a problem complex as life itself"* (Eugene Linden here quoted in Urry 2011, p. 23).

8.2.1 Human and Nature: integration of data and disciplines

Human and physical geography will change remarkably in decades to come if the processes of climate change predicted is even half right (IPCC 2013). Global Climate Models (GCM) integrate Earth Observation Data (EO), Remote Sensing (e.g. Landsat) coupled with socio-economic data that help us understand the material and biogeographical transformation of the environment (Reenberg 2006; Dangermond & Artz 2010). The study of human-environment interfaces, however, is a subject in which many traditional disciplinary approaches often fail

2 Note that the conclusions drawn e.g. from The Club of Rome (Meadows et al. 1972) and Our Common Future (Brundtland 1987) are subject to computing models (See chapter 1).

to properly address methodological, epistemological and ontological pre-analytic assumptions in time and scale (chapter 4). In fact many contemporary challenges cannot be adequately addressed within the boundaries of traditional disciplines. " *Even that ingrained counterposition between so-called 'natural' and 'social' is increasingly being questioned, and my conviction is that if they are now up for reinspection and problematization, then geographers should be in a good position to make a leading contribution"* (Massey 1999, p. 261).

The idea of institutionalizing interdisciplinary approaches constantly challenge traditional disciplinary boundaries of human-environment interface(s), e.g. Human Ecology, Environmental Studies, Earth System Science, Geography, Ecological Economics, Landscape Ecology and Sustainability Science. Divergence and convergence between these contested disciplinary constructs in reorganizing sciences engaged in environmental change are confronted with a number of multi-scalar methodological problems not to mention constructions of geographical imagination.

By way of example much contemporary climate change modeling assumes seeming neutrality and objectivity while at the same time often designed with non-spatial representations (Globium is an exception of the latter). Climate models as well as land modeling are based upon huge amounts of sophisticated statistical properties including assumptions of behavior of many features (human or non-human). Compounded as *'neutral landscape models'* (Turner 2005, p. 324), these models are (whether GTAP, IMAGE, AgLU, IMPACT, GLOBIOM, ABLUM, GIS or GCM) organized reductions of geographical representations, or more challengingly, super artificial objective reductionism of human-environment interactions often construed as partial or general equilibriums (Hertel et al., 2010). As there are no correct models (see quotation in the introduction to the chapter) nor analogies (Part II), these need to be conceptually challenged (Norgaard and Kallis 2011 in Weisz and Clark 2011). Not only because mental experiments (models are experiments themselves) are particularly useful to epistemological fights that cultivate and foster reflexive debates over the use, explication and the consciousness (culture) these models assemble, but because they are co-producers of socio-environmental interaction.

8.2.2 Anthropogeography

Geographers have long challenged the idea of objective non-human nature, giving

rise to concepts like 'second nature', the 'politics of Nature' or even 'multinatural ontologies' well before Paul Crutzen (2002) coined the term `anthropocene´ (Harvey 1996, Lorimer 2012).[3] Interaction between the natural and social worlds has indeed proven difficult to conceive epistemologically, e.g. in social physics, when ecological economists seek to integrate the language of biology into economic theory, or more notably when biological concepts have entered social theory (Harvey 1996, Clark and Clark 2012). Nonetheless, anthropogenic climate change is a socio-material phenomenon and we need better epistemological and methodological approaches to grasp these challenges (Lorimer 2012).

Thus, we examine if the multiple traditions of human-environment interactions within human geography (spatio-temporal tides and waves in chapter 5) have anything to offer climate change modeling. Can we possibly draw some insightful perceptions from the history of human-environmental interactions in understanding the 'nature(s)' of climate change modeling?

8.3 Spatio-Temporal Figurations and the Geopolitics Modeling

As previously discussed space configurations vary considerably in different sciences. Geologists assemble processes of ecological climatology over millions to billions of years. Evolutionary biologists assemble explanatory power to data stretching thousands to millions of years, whereas many social scientists and economists in particular, are constrained into time-scales of weeks, years and decades due to the practice of discounting (Rasmussen & Arler 2010). These pre-analytic assumptions are fundamental to modeling climate change, and illustrate how the matter of scale and environmental problems are inseparable processes in different time-scales and spatial contexts. According to Prigogine (2000) natural science has proved an experiment that held time as a constant. In contrast conventional economics held space as a constant (Harvey 1996) and prove huge epistemological challenges when modelled together, or mixed in climate change models. Unifying such a (inter)disciplinary spectrum of different spatio-temporal figurations into representations of climate models poses huge methodological challenges. Moreover,

3 The idea of the Anthropocene can also be traced back to a number of thinkers in the early 19th century, e.g. Valdimir Vernadsky's , mankind's geochemical work, Eduard Suess's concept of the anthropogenic transformation of the biosphere into the noösphere or man as an geological agent (Steffens et al., 2011).

the complexity involved in understanding global climate changes and humans' engagement in transforming it, integrate data with causal, functional and intentional explanations (Rasmussen & Arler 2010). Debate over which data to give explanatory power (agency), is strongly influenced by the time-space figurations and *"the way that spatio-temporal processes are studied is strongly influenced by the model of space and time that is adopted"* (Raper & Livingstone 1995, p. 262). The word for the weather, in fact, bears reference to environmental change and has etymological roots in words for 'time'. In Latin the relation between weather and time is galvanized in words like tempestas, in Frensh its derivate is temps, and tempest in English, in Greek Kairos, as well as in most other European languages (Szerszynski 2010). Reading of weather and weather systems is also today an exercise of imagining changes in time and space.

8.4 Multiple Spatio-Temporalities – Multiple Rationalities

Among Human geographers it is widely acknowledged that space is neither absolute, relative, nor relational in itself. Space is produced at one or all scales simultaneously, constituted by the human practices related to it. Some phenomena are represented one dimensional or assumed to be constituted in absolute space as freely unconstrained entities (Harvey 1987). Within human geography it is a general disciplinary assumption that spatio-temporalities are constituted through social processeses and interaction with entities with which they mutually constitute entities of indeterminism (Massey 1999). Also in physics and natural sciences such ideas have developed, e.g. as biogeochemical ontologies of 'interdependence' (Prigogine 2008). For authors like Harvey, Thrift or Massey, space and time are integral elements to one another, encompassing multiple spatio-temporalities, constituted by interactions between entities, by which entities are constituted themselves (Harvey 1987, Massey 1999). That is, phenomena, e.g. in absolute space, cannot be captured with certain representational characteristics of behavior or be given certain actions under which they act rationally (humans- or non-humans), without taking into consideration interactions with other spatio-temporal scales (see section 4.3.4). It is essentially another way of saying that linear modeling produces linear results, and such constructs do not capture multiple-spatio temporal interactions. As Massey (1999) points out, complexity increases as it becomes apparent that entities conceived epistemologically are also constituted by multiple scales and temporalities inhabited within them (relational

space). Thus we experience conflicts and contradictions between different spatial scales. Subsequently, what seems to be rational in a given scale may not be rational in another; what may be conceived rational in a given spatio-temporal configuration may not in another (Harvey 1987). Human geographers have much to offer conceptual model building in this regard.

By way of example, at one level deforestation is rational to the local farmers in order to expand their production. As biofuel production puts pressure on land use in one location, it may affect e.g. price elasticity elsewhere, not to mention prices on cropland. Thus, relative and redistributive factors are at play. On another scale deforestation is irrational and produces externalities to e.g. tourism, a net-loss of biodiversity (for the biotech industries' 'diversity bank'), or climate change mitigation strategies. The problem of land demand is geographically redistributed so in one (relational) scale, afforestation is a rational human action, irrational in another. It therefore becomes more and more evident that contested ideas of 'the market efficiency hypothesis' as equilibrium constructs in climate change or land use modeling are challenged by conflicts between different scales, ranging from local to global spatio-temporal figurations *"This scale mismatch between an ecosystem (function) and the management set by humans to control or use it constitutes challenges of a theoretical as well as of a more practical nature"* (Reenberg 2006, p. 2). This is not to say that we cannot build models that seek to generate scenarios for the futures(s) that fundamentally rely on equilibrium theses, but that we may have several equilibrium configurations in different scales, potentially in conflict with one another. It is not the same as different spatio-temporal scales outrage one another and produce a certain kind of status-quo (a new super-equilibrium), with implications of creating new balances or states of stability. This would be like accepting slicing up time and space – ontologically in absolute space. Rather than prioritizing multiple time-scales (in a kind of competition) they are constitutive and contradictory to one another (Massey 1999).

Correspondingly, even in physics, Prigogine formulates 'a far from equilibrium thesis' assuming that any system is both linear and un-linear and Kleidon (2012) even form a planetary disequilibrium thesis. While Prigogine accepts relations to be causal in some spheres of interaction, he refuses simple linear processes (Prigogine, 2004). Causal effects do exist within particular relations in certain spatio-temporal scales. Causal effects exist in multiple versions. But what is causal in one time and scale may not be causal in another: from small changes that generate large effects

(and vice versa), from general processes to contingent events (and vice versa), from local geographical contexts to general or global phenomena (and vice versa). As Cohen and Stevard remarkably note, any system is *"Regularities of behavior that somehow seem to transcend their own ingredients"* (Cohen and Stevard 1994, p. 232) why concepts of cause relations or equilibrium need to be viewed dynamically, as always over-floating and interchangeable contingents within and across supposed social and physical spheres. Thus the potential of tipping from domain to domain is always apparent, why emphasis on tipping points, thresholds, abrupt changes or unpredictability, should equally generate deep reflection by the ways in which we assemble conceptual climate modeling (Prigogine 1986, Zimmerer, 1994, Kleidon 2012). A world view of such complexity and 'multi-causality' suggests that simple linear and mechanistic scientific approaches sometimes needs to be substituted sometimes supplemented with dialectical reasoning (Harvey 1996). System thinking refers specifically to the assumption of self-regulating systems, implying that systems possess self- regulating mechanism (much like the Gaia hypothesis). Prigogine terms them as dissipative structures, because future is always un-given. Though neither Prigogine nor Bertalanffy explicated ontological assumptions that established a spatio-temporal theory of human-environmental interactions, they emphasize holism over reductionism and organism over mechanism. If human geography has anything to offer climate change/land use modeling it is to engage in debates on spatial representations that treat concepts like time and space relationally, produced by the nature(s) and behavior of entities that inhabit them, rather than time and space themselves independent from the entities they are containing (Massey 1999). To perceive entities as relational constitutions is a fundamentally different approach to spatial modeling of environmental problems, as well as fundamental to the ontological dualism between society-nature (Raper & Livingstone 1995, Castree 2001). This has further implications that might be relevant to consider in relation to spatio-temporal tides and waves and pre-analytical assumptions adopted in any 'modeling culture'.

8.5 Modeling Spatio-Temporal Tides and Waves in an Era of the Anthropocene

To define systems, their character and relations to other systems is a journey of geospatial imagination, where one should always question conceptualizations of entities. In this section, the context of space-time relations objectifying nature(s)

is examined. Then spaces of (i)rrationalities are discussed as to different spatio-temporal tides and waves adopted. Lastly relational ontologies are discussed in the context of Agent Based Modeling. It is argued that Agent Based Modeling engage in such integrative methodological constructs, why we need to develop more appropriate methodological approaches taking into consideration the history of human material interaction.

8.5.1 Anthropogenic models and objectifications of nature(s)

While models focus on the constitution of entities this operates within an object-oriented universe (Brown et al., 2005, Dangermond & Artz 2010). To Massey, approaches in different kinds of representational modeling are *"explicitly object-oriented and the objects come before the space-times"* (Massey 1999). By way of example, Hertel (2011) concludes that prominent long term agricultural models (e.g. GTAP), tend to treat supply and demand elasticity based on near term characteristic, why they are not well suited to envision long run economic/environmental dynamics. Thus, GTAP tend to adopt short term elasticity characteristics in predicting long term trends. *"The tendency to date has been to focus on readily observed, high frequency events, while neglecting some of the important factors which drive the long run dynamics of the system"* (Hertel 2011, p. 271). While supply and demand of say corn are aggregated so that a global prize appears as an empirical fact, supply and demand are constituted by multiple heterogeneous characteristics. Though global demand or supply may be aggregated, it is constituted by multiple localized events, responses and capabilities. Interactions are geographically constituted across different spatio-temporalities. Thus relational ontologies accept an aggregated global prize, but are far from reducing it to an objective reality. The surface has its right, but should not dominate at the expense of theory or the philosophy of model building.

The state of much scientific climate change modeling is not only challenged by the objectivism of the social side of climate change, but also the very nature thesis it relies upon. The anthropocene incurs core challenges to the modern (science) understandings of nature as a pure, singular and objective thing separated from human-environmental transformations in multiple scales (Lorimer 2012). By way of illustration it is inconsistent to both talk about anthropogenic climate change adaption or mitigation and at the same time argue for a purely objective nature (of science) opposed to culture. Thus the anthropocene challenges the modern science-politics settlement, where natural science speaks for an objective nature

(Deremit 2002). Thus the consequence of the modelled (and objective results) telling us that humans take an active part in changing the climate, and denaturalize nature. The material/relational human-environment ontologies force us to develop a move from a purely mechanical and external view of nature towards more dynamic conceptualizations of human-nature interfaces in climate (land use) model building. Mutual construction implies a rejection of classical divides of subject/object and society/nature dualisms central to anthropocentrism and essentialist assumptions of conceptual models (Birkeland 1998). Yet, subject-object and society-nature reunioning have to be conceptualized in much climate change modeling and suggest that we engage in explaining entities of reductionism, indeterminacy, path-dependency or irreversible processes that our conceptualizations derive from. The following is to argue that debate, questions, rivalry and 'tentative' struggles over problems of 'rhizome interfaces' that both natural and social sciences have in common, provide a simulative platform to engage in the challenges of reimagining the multiple dynamics shaping conceptual climate change modeling.

8.5.2 Spaces of (i)rrationalities and the equilibrium thesis - mimicking the quantitative revolution

The systems of geospatial imagination are often organized hierarchically with related systems and subsystems, and accompanied interactions whether causal, linear, abrupt or unpredictable. Systems and models are closely related and widely used as representations of reality in natural and parts of the social sciences. Yet, the terminology of models is extremely diffuse and preoccupied with much skepticism in social sciences, perhaps except for economics (Rasmussen & Arler 2010). Much conceptual climate model building reduces human-nature interactions to questions of economic calculation. Though economics is important, a lot more than economics is going on in human-environmental interfaces, and economy has a limited explanatory power in itself (Urry 2011). By way of illustration, mainstream economics have historically treated energy as a free good. In fact any natural resource has been considered a free input to economic growth. Thus energy or material resources are first treated as a free good (despite we live on a finite planet), then like a commodity as any other, not perceiving the dynamic relations and the material constraints they rely upon (Kock 2012). Discussions on environmental determinism precisely engage in portraying fixed entities (like resources) and weighting them as cultural and natural factors (spatial and temporal figurations) in competition to one another, and thereby a sort of hierarchy also weighting disciplinary knowledge like economic factors opposed to cultural

knowledge, implicitly or explicitly (Harvey 1974b). The problem of cause is how fixity, stability and equilibriums explain change and socio-ecological transformations. Models are not able to deal with all uncertainties in complex non-linear dynamics systems, nor interconnections between systems and subsystems (Zimmerer 1994), hence we should comprehensively and critically question how models are assembled and what type of knowledge for what purpose that arises from them. When Monica Turner (2005) for example advocates that landscape ecology should "*develop a more mechanistic understanding of the relationship between pattern and process"* (Turner 2005, p. 319) it contrasts Zimmerer's (1994) advocacy for landscape ecology and its effort in understanding biophysical environments also under non-equilibrium conditions. Geographers have long challenged the equilibrium and stability thesis. Thus human geographers are in a good position to critically scrutinize e.g. the sub-politics of elasticity parameters construed as well as consequences of spatio-temporal figurations associated with it (Hertel et al., 2010).

Commitment to a theory of knowledge, according to which any phenomenon natural or social is to be explained through systems of laws and causalities mimicking the quantitative revolution, does not fit well with the social dimension of climate change, irreversible processes nor abrupt changes (see chapter 5). According to this perspective climate change can be instrumentally adjusted as a form of global technocratic climate management (Urry 2011). In this sense the gradualist perspective of climate models carries references to the quantitative revolution. In recent years the human-environment theme dominated by gradualist approaches to climate change seems to convent a new form of positivism' in much climate change modelling. If it is assumed that a dialectic approach comprehends the complexity of socio-spatial and economic-ecological processes, this, in turn, will make us recognize that environmental/social problems mutually interact, are spatially distributed, and produce different effects in different spatial scales (Harvey 1996). Interdisciplinary approaches seem fundamental to the analysis of wicked problems, multi-complex and multivariable interactions associated with climate change, and the methodological challenges associated with rhizome ontologies, giving different kinds of data agency in models.

8.5.3 Agent Based Modeling and rhizome ontologies

For various reasons Agent Based Modeling (ABM) has received much attention in recent years. First of all ABM offers a methodological approach integrating human

decisions e.g. on land use, based on monetary and non-monetary 'calculations' from particular agents as a starting point. Particularly the integrative approach to model individual decision making, interactions, and social non-monetary processes that dynamically link to environmental processes has been considered a central advantage (Brown et al., 2005, Turner 2005, Matthews et al., 2007, Barton et al., 2010). Privileged ontologies that favor human agency in transforming the environment have long been challenged by much human geographical work that also gives non-humans agency (Lorimer, 2012). To give non-humans agency is precisely what ABM does (Turner 2005). These actor-networks originate from the field of artificial intelligence and individual based modeling. Accordingly actors are given agency that simulates certain characteristics so they interact both with each other and their environment. Thus more than human interactions (Whatmore 2006) in ABM is modeled in ways that agents can take and change decisions based on interactions with other agents and the environment (new methodological naturalism). As responses dynamically change, Whatmore's notion of more than human agency becomes integrated into the framework of ABM, and implies that the environment is an agent too[4]. Whether human or non-human they become subject to subjectivity. This makes a whole lot of difference to modeling dynamics, yet it seems to promulgate new forms of positivism in modeling of land use/climate change. *"The behavior of the whole system depends on the aggregated individual behavior of each agent. This allows the influence of human decision-making on the environment to be incorporated in a mechanistic and spatial explicit way, also taking into account social interaction, adaption and decision-making at different levels"* (Matthews et al., 2007, p.1448). Consequently, ABM operates in an objective universe, with ever more sophisticated aggregation matrixes of interactive events, not encompassing that the whole is more than the sum of its parts. Non-humans are multiple automated agents, yet regarded autonomous in the software language, created with rules for formulating decisions while interacting with the environment: *They are instantiated ('activated') on virtual landscapes and allowed to act and interact over time without intervention by the researcher"*(Barton et al., 2010, p. 5383). AGM gives agency as a form of new positivism, where 'deterministic reductionism' is assembled to simple models as a sum of perceived components (Urry 2011). As to Whatmore's (2006) configurations of 'more than human' ABM opens the journey for an 'objective structuralism' as mechanistic arrangements of

4 Note chapter 1 in which Jevons theorem were outlined and the coal question in which he consider coal as an agent – non-human agency.

these human and non-human configurations, while ignoring the very subjective model culture they are design from. ABM however, is in a position to integrate different rationalities in play in different scales, their relational dynamics, contradictions and subordinate characteristics. If greater reliability of models, they should be able to run forward as well as backward simultaneously (historical approach); should be able to start at different points in time, space and scale, and derive the same results. Complexity increases, however, as it is argued that models and their seemingly neutrality (O'Sullivan 2005; Barton et al., 2010) is challenged by the very idea that models are agents themselves.

8.6 The Geopolitics Models (Continued)

> *"There is now the promise of what Wark (1994) calls "third nature" – that is, the simulated natures of everyday TV and magazines, games like SimEarth, or the extraordinary optics of the geographical information system (GIS) all of which provide new, powerful means of manipulating nature as information"*
>
> (Castree and Braun 1998, p. 4).

In this final section I discuss some of the contributions the social nature perspective in geography can offer climate change modeling. The terminology of models and modeling is extremely diffuse and human geographers are in a good position to make a leading contribution as to the spatio-temporal implications associated with it. The famous quotation by Box and Draper (1987) quoted in the introduction of the chapter, spurred a vivid debate as to the use (fullness) of models. Today it is more relevant than ever as the emerging state of much modeling integrates the social side of (inter) action. The ways we perceive the world hugely influence how we act (and vice versa). By analogy, Clegg and Hardy state that the normative connections embed *"ways of seeing which act back on and reflect existing ways of seeing"* (Clegg and Hardy in Alvesson & Sköldberg 2009, p. 248). To frame models as objective unbiased observation of human-environment interaction is to ignore the power relations inherent in any research agenda. Power relations form the very interpretative categories the models are designed from (Demeritt 2002).

At conferences you hear again and again the debate over representing data of climate change, and how to disseminate complex data so that policy makers take them seriously and respond to them (RGS Conference 2014, who devoted

a theme to the Anthropocene in which the question was heavily debated and receive the title of the RGS 2015). The 'inform policy makers" perspective builds on the assumption that the right knowledge (precise, accurate and valid) will inform but also produce an impact. Drawing from chapter 4it was argued that models, though ever more specialized, are subject to the power of representing the socio-natural interface, reading and writing future climates. Those generally positioned in the canvas of objectivism, natural science or economics generally better succeed in arguing they purely 'inform policy makers' (external activism) by producing apparently descriptive scenarios and imaginations of future climates. The (geo)politics of climate change models have bearings to actions taken and therefore 'interact' with the environment itself. Models are then an agent in it-self that acts and interacts with other agents, and consequently take part in shaping new meteorological and socio-ecological futures. Models also become a political tool that helps construe different scenarios to take decisions upon. Thus modeling different climate future(s) or land use scenarios exactly is value laden representations with an intention to impact other agents (Harvey 1974b). In that sense climate models convert into sophisticated forms of geopolitics and geo-engineering. The gradual perspective in much model building assumes that better technical management of human-environment relationship, e.g. through better and more accurate modeling, is needed and enhance the knowledge decision relies upon (Urry 2011). For this reason, responses cannot be reduced to a simple quest of techno-fixes as carbon control[5]. Thus models are also emergencies of geo-engineering or planetary management, that foster model scenarios of adjustment, themselves taking part in modifying metrological future(s). Political settlements of modeling future(s) where scientists speak of an objective nature, providing facts about that objective nature, and politicians ask for facts to take decisions upon, makes Haraway conceptualize dynamics of charm as a sense of 'response-ability', by which different kinds of agents have adaptive transformative and resistive capabilities that affect and is affected by others' actions in that relationship. Such hybrid ontologies do not only pose questions to models as neutral representations of reality and illustrate the need for critical approaches to the intentional content of model results; they also unfold that it is politically insufficient to analytically constrain debates into the endless dialectics, hybridity and uncertainty involved in future climate scenario building (Loritmer 2012). What I have argued here

5 This accompanies techniques of carbon offsetting, carbon storage and all sorts of management models.

is that the cultural politics of climate change modelling enfold second and third natures, but modelled fundamentally on the basis of first nature. The social side of land use/climate change models are crucial for designing future scenarios and associated decisions based on such models, why another approach to modeling is required as to the politics of modeling, not least an awareness about the limits to what policy input these models arrive from and the politics produced. We therefore also need to ask what kind of climate or land use modeling for what kind of socio-ecological future? Who decide the culture of modeling construction, on what grounds and through what processes, and how do they influence decision making processes? Agent Based Modeling has brought much dynamism into the modeling culture. It will be interesting to observe whether or not climate change models will also be able to take into consideration themselves as agents and the geopolitical implications hereof.

Chaptet 9

Final Discussion

"Sustainability is the art of keeping the future navigable"
(Hägerstrand 2009, p. 187 here quoted in Weisz and Clark 2011, p. 286)

Representing Global Environmental Change as Information – Academic Co-constructions of Socio-Ecological Futures

In this dissertation I show that sustainability in academia is as much a concept for branding and marketing universities, disciplines and educations as it is an analytical concept. Anyone who makes use of the concept, e.g. institutions, politicians, researchers, students or individuals take part in re-defining what it means – hence struggle over possible futures within academia and beyond. Outlining the successful mobilization of sustainability discourses among others manifested through the 'scientific consensus thesis' I show how sustainability across disciplines and institutional domains respires a whole set of conceptual (and contested) responses and responsibilities, envisioning particular sustainable post-carbon futures. In examining the propagation of sustainability within academia and in political discourses of university governance the concept both functions as sustaining and naturalizing neoliberal regimes of contemporary university governance and as a critical platform to reinterpret and criticize the former. Hereby I address the internal and external fight over shaping space for academics' responses (and responsibilities) to global environmental change in between two university ideas of very different origin; academic sustainability among critical geographers is aligned to (illusory) ideals of the Humboldt University and a system of ideas (Zeitgeist) associated with NPM, financial sustainability and market environmentalism. As such, the dissertation demonstrates richness of academic uses, responses and responsibilities that lay open the terrain of dilemmas, contradictions and paradoxes in co-producing socio-environmental change mixed in between the idea of sustainability as a market oriented or commercial strategy or sustainability as an interdisciplinary, holistic and academic concept imbedded in academic independence.

As a consequence, and precisely because of its fluid, complex, contradictory and diffuse character I consider the power of references and its substantial importance for how the concept finds its ways and are represented in academia. By pointing to the power of reference, sustainability is entangled in between buzzwords and keywords, demonstrating two different strategies of legitimation. Turning to the concept of 'nature' I claim that whereas 'nature' features a key concept in geography, sustainability features as a buzzword. Yet both nature and sustainability are extraordinarily fuzzy, slippery and contingent. In the same vein and precisely because of its fluid character, academic governmentalities hugely influence and (re)scale and prefill notions of sustainability in academia.

While external nature is relevant, it is increasingly challenged since one cannot uphold external nature and the anthropogenic climate change thesis at the same time. In consequence, I turn to the modelling culture in the final chapter and expose climate models to the epistemological implications of the modeled thesis of anthropogenic climate change. In turning to the epistemology of climate change models I discuss how they are fundamentally based on an external and objective nature (positivism). As it is discussed throughout the dissertation, ideas of an external and objective nature (first nature) is challenged at all scales by the anthropogenic climate change thesis, precisely because, the models tells us, human activities are a driving force of global environmental change (second nature). One cannot uphold an objective and external nature and claiming its transformation is anthropogenic. Hence the models become self-contradictory, I argue, and remain an analytical problem that cannot be left unaddressed. The scientific process of making socio-environmental change sensible as information (third nature) either based in or modeled through the epistemology of internal or external nature, universal or social nature, involves taking a stance, because different ontologies produce different geographies. Hereby it follows that different imaginative geographies have different material effects, e.g. by the ways in which scientists 'inform policy makers' of observed and modeled changes. Modelling climate changes scenarios affects the media, individuals and international policy why the duality of social responses (to model scenarios) and the imaginative and possible atmospheric futures that stem from them, makes us act (emotionally, cognitively, morally and economically) by internalizing third nature. Insofar as academics take part in co-producing global environmental change, this call for critical engagement with inherent socio-natures produced and their impulses affecting management of socio-environmental change. Global environmental change,

whether conceptualized through concepts like anthropogenic climate change, the anthropocene narrative or sustainability, forces academics to take a stance, respond and take responsibility, precisely because the thesis implies that also academics at work co-produce socio-environmental change in the reading and writing of it. This is the basic reason why I pose the following question.

- What is the role of sustainability in geography in shaping responses to environmental change in the Anthropocene?

One of the first attempts in addressing the question is to turn to interviews. Based on interviews with 31 research geographers I address the relevance of sustainability in geography and find a number of internal and external reasons. The research suggests that the main internal reasons are the following:

Although geographers are highly reluctant to explicate the concept in the classroom and 2 of 31 researchers refuse to use the concept at all, one finding is that the relevance of sustainability in geography is subject to the internal academic fight for having a share in sustainability. This is repeated, first, through geography's strong tradition in the human-environment theme that provides a methodological basis for dealing with such issues. Second, the spatio-temporal dimensions of sustainability call for geographical approaches to be able to understand, its dynamics, complexity and interactions in various scales. Third, it is claimed that geography contributes by geography's interdisciplinary approaches to bridge the social and natural sciences. Reclaiming the high grounds due to the interdisciplinary history over assembling socio-natures, as well as the spatial dimension, convert to internal reasons why geography has a major role for sustainability analysis and in turn a disciplinary pillar that geography seeks to patentee. These signify both imagined and real competition with other fields of studies, hence become externalized and inconsistent with the claimed interdisciplinary dimension of geography. In contrast to internal explanations, the external reasons are the following:

If it is so that sustainability is able to attract students it has a role to play in geography, a number of interviews suggest. Such claims concern the discipline's attractiveness, through which sustainability becomes a matter of marketing. Insofar as sustainability provides geography reputational capital and becomes a means through which funding and students can be attracted, it has a place in

geography (Interview 20, 16). Enrolment and the number of students is now big business. Hence a number of the interviewed researchers address and criticize the martetization of universities in arguing for the relevance for sustainability in geography. Despite being considered a low status concept for critical analysis the internal fight is also becoming externally marketed since individuals, disciplines and institutions are more dependent on securing their financial sustainability. The external reason of marketing the discipline through sustainability, however also enfolds the other way around. Sustainability is absolutely central to geography, but the problem of including it is that it has little appeal to students and student recruitment. Another concern with using sustainability in geography relates to the disciplines and the individual researcher's reputational capital. Thus, if it is regarded non-scientific within geography or in related disciplines, it is not only a problem for research collaboration, but also for funding and publishing. Hence, the external reasons for keeping or rejecting sustainability in geography is part of the wider marketization of universities, which has little to do with the concepts analytical capacity. Hence, representing socio-environmental change through concepts like sustainability, climate change or the anthropocene is as much a fight for disciplinary boarders, identities and core themes as it is over analyzing *for* change. Rather it concerns the internalizing and externalizing processes of what Kant's labeled the external fight (chapter 2) and the power of representing the socio-environmental interface through buzzwords and keywords (chapter 3). The future of sustainability in geography becomes more dependent on its ability to attract students and external research funding. The analysis suggests that geographers also find themselves subject to preserving the academic and disciplinary social order that makes geography have a seat at the 'high scientific table' (Turner 2002). Hence sustainability has a place in geography if it supports the discipline's or the individual geographers' reputational capital (that I am also subject to) rather than if it provides an insightful approach to analyze global environmental change (See Harvey 1996, p. 148).

Then I examine the internal fight over curricula constructs in Danish university geography. Addressing geographers' responses to paradoxes, contradictions and dilemmas of sustainability in their teaching I conclude that though geographers find sustainability themes important to geography, it is rather taught implicitly than it is explicitly. As a consequence the ways in which geographers engage in teaching sustainability is predominantly hidden or non-existent. Thus the claimed 'high grounds' are contradictory to the actual practice. This is partly due to the

normative and political character of the concept, partly due to its fluid and open character and the criticism attached to it. This research suggests geographers find two strategies in responding to the dilemmas for putting sustainability on the agenda and at the same time hiding it.

1) Teaching sustainability as replacement of concepts. It involves the power of reference to replace one concept with another. Though one can agree or not with changed power configurations and the analytical capacity it entails, one has to be aware of the interests involved in doing so. 2) Teaching sustainability as hidden curricula. This is a related response in dealing with the political byproducts and the critique of sustainability, one cannot hide from.

While seemingly expressing neutrality both strategies engage in the co-construction of environmental consciousness, without the student (observer) becoming aware of it. Insofar as teaching sustainability by hiding it, it is contradictory. It is contradictory when study regulations specify students should excel in critical analysis and be able to reflect upon the social, economic and environmental consequences over a given planning proposal, but not being so as to the education, teachers positions, claims and hidden agendas. To hide discussion of tacit curricula is contradictory when students are expected to be aware and critical towards agendas, interests, and strategies involved in claiming particular sustainability agendas: except from the hidden curricula, the (intrinsic) immanent social nature(s) of promoting sustainability cultures. The dilemma of course is that sustainability requires critical thinking, which is why tensions, conflicts and rivalry become constitutive and contradictory to sustaining sustainability simultaneously. Against this background it is concluded that the multiple ways geographers deal with sustainability issues produce paradoxical culture-natures when dealing with dilemmas of sustainability, as they both seek to distance themselves from produced politics while at the same time elucidating them. Thus, avoiding taking (multiple) stances, whatever they might be, as a response to global environmental change (rivalry over different political ecologies) both reproduce and challenge the status quo.

Studying contradictions, frictions and fractions create progressive ways of analysing global environmental change. As geographers and academics we already take part in writing the story of socio-ecological futures. Why should we hide it away?

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Glossary

Anthropocene: Is sometimes said to be coined by Paul Crutzen (2001), though it bears relation to Valdimir Vernadsky's, mankind's geochemical work, Eduard Suess's concept of the anthropogenic transformation of the biosphere into the noösphere or man as an geological agent. In addition, the Italian geologist Antonio Stoppani coined the 'anthropozoic era' a century ago (Steffens et al., 2011). The concept refers to humanity as *the* driving force transforming the planet from one geological epoch (the Holocene) toward a new geological era, the anthropocene (Crutzen 2001). Thus, the anthropocene refers to an epoch from which human actions' impact global environmental change. By pointing to a set of data, from atmospheric aerosols, Co2 and NH4 concentration, to biodiversity loss over consumption of fertilizers and so forth, the anthropocene encompasses the magnitude, scale and acceleration of per capita exploitation of natural resources changing the biogeography for millennia to come (Steffen, Crutzen and McNeill 2007, Rockström et al., 2009). What is fascinating about the concept is that it describes cumulative global environmental impacts driven from human activities since the industrialization or so. Global environmental change, however, is assembled in an artefact interdisciplinary fashion (the natural sciences) e.g. from geology, plant geography, climatology, earth science and oceanography that describe social impacts on the physical environment (see chapter 3). From apparently objective reasons, it describes how human activities enforce global environmental change. Therefore, I also have some concerns as the concept assembles non-human world changes produced by human practice. First and foremost the concept possesses no explanatory power as to the social dynamics that have brought about the Anthropocene. Consequently, it blurs relations between human and nature as if it is all the same and yet gives explanatory power to social forces (Loritmer 2012). The concept bears no relation to its own political ecologies, nor the socio-politico and economic power it tries to depict. In that sense, it has a flat ontology, from which relations are all symmetric (e.g. no power asymmetries), for instance not being able to analyze, the 'geological agent' that first and foremost concerns the most wealthy on earth. Finally, the concept's interdisciplinary character is at best only 'half interdisciplinary'. It is paradoxical that the anthropocene narrative is dominated by science, not by social science, and portrays the very need for a social theorization of practices and power that also melt into the natural sciences (Malm and Hornborg 2014). What is interesting is that the anthropocene has no

explanatory power concerning societal change as does the concept of sustainability. Both concepts are highly fascinating and problematic. Both concern global environmental change, whereas sustainability is a scalar concept, the antropocene is a planetary assemblage, holding planetary boundaries. Both concepts describe global (to local) environmental change, but from different ontological and epistemological grounds. But most fascinating to this study, whereas the former concepts have high 'reputative' status in the (socio)environmental sciences, the latter is often regarded as non-academic. See the power of reference chapter 3.

Academic episteme: Refers to academic boundary making, whereby a group of people (students and researchers) mix disciplinary identity with ontological presumptions, disciplinary knowledge, methods, scientific standards, norms and guidelines as to validity, truthfulness and acceptability of what is regarded scientific knowledge. Academic episteme form cultural-habitual references within that disciplinary community (Castree 2014, p. 42-43). The term episteme is developed by Foucault based on the Greek word for science or knowledge. Thus an episteme refers to a system of thoughts that conditions particular sciences, practices, cultures and findings. Foucault also links epistemes to the rules that govern knowledge, judge and evaluate knowledge, hence the production of validity, reliability and criteria for truth and scientific knowledge (Dictionary of Hum Geography 2009, p. 206). See academic governmentality.

Academic activism: Within geography academic activism is sometimes corralled as the (political) relevance of the discipline to address real-world problems. In Radical geography, Harvey (1974a+b) brought the idea into being as direct involvement in solving social and ecological problems. In that respect the concept is practice oriented and bears relation to action research and the civic science tradition. It frequently concerns 'whom' research and knowledge is produced for. In this context I approach the concept to 'the classroom' (Gould 1973) inspired by what Castree has called activism inside and outside the discipline. Academic activism also spans from those taking an active part in politics outside the ivory tower. Nevertheless, I concur with those who find academic activism a theoretical and academic endeavor that engages and fuel, negotiate and enrich contemporary debates. The bottom line, however is, regardless of perspective, that academic activists seek to bridge the theoretical and practical interface (See Dictionary of Hum Geography 2009, p. 5).

Academic governmentaly(ities): Originally coined by Michel Foucault as the conduct of people's conduct. Governmentality refers to self-government, through a process whereby individuals (willingly) undertake work in the interest of the principal. Thus, on the basis of (invisible) principal-agent structures, individuals govern themselves in accordance with the interest of the principal. Insecurity in jobs and temporary positions is an example relevant to spaces of academic work (see chapter 2). For Foucault, it describes how subjects are involved in projects of their own, through their own free will, while the freedom is dictated by others (to live up to moral judgments, institutional values, measurements and accounting practices, etc.). Governments, institutions, communities and authorities have huge direct and indirect impact on individuals' norms, attitudes and practices. Direct as regulative that the subject is aware of, indirect as 'hidden' regulative shaping/guiding thoughts, modes of thinking, imaginations and practices, that the subject is not necessarily reflective about. Govermentalitie(s) thus take part in shaping geographical imaginations, why the influence one poses on another, holds power asymmetries. I bring governmentality into the context of academic work. Academic governmentalities, refer to hidden and regulative references in the making of scientific knowledge and what is of particular interest in this context is it's significance for making reference to nature. Academic governmentalities refer to the process of self-governance within academia, seeking to capture the ways in which university governance and knowledge management affect the mind, belief and mode of thinking. Thus academic governmentality holds a critical attitude towards a number of implicit structural layers of (assymetric)power, with reference to symbols, codes of conduct and networks, shaping the social valuation of splendid, superb and excellent work (e.g. through awards, credits, honors, merits, bonuses or in more subtle forms) that come to justify, theories, methods, assumptions, approaches themes or concepts.

Area of responsibility: (see also responsibility) refers to individual anchoring points that remind the teacher of the aim and ethical codex of his/her teaching. I distinguish from Sund and Wickmans (2008, p. 145) 'object of responsibility' in holding a scalar dimension to (areas of) responsibility. As defined by Sund and Wickman (2008) object of responsibility refer to an academic ethical codex that is based on the normative values aiming for sustainability, socio-environmental justice that the teacher/student habitually care and take responsibility for. I project areas of responsibility as an entry point to examine contested ideas and tensions and political ecologies over assembling curricula concerning the human environmental interface.

Environmental romantics: Is an aesthetic and emotional expression that has a conservative element of bringing nature 'back' as it 'was'. Politically it aims to 'restore' the beauty of nature, landscapes and the human relationship with it. It draws from emotional aesthetics in claiming to care for nature in ways in which 'we' listen to nature itself (Smith 2010, p. 280).

Climate gradualism: Applies to the IPCC perspective on climate change and its projections between six scenarios and social cost. The vast majority of earth and climate scientists hold the gradual perspective. IPCC models gradual global climate change as a linear process. In terms of planetary boundaries, it holds that natural resources will not limit the expansion of global production, for a while. Natural limits will only occur in the long run due to planetary boundaries and the earth-systems carrying capacity as 'natural sinks', particularly carbon sinks.

Climate catastrophism: James Hansen is one of the main proponents of climate catastrophism. He finds scientific evidence on climate change is underestimated. Hansen argues that a 'safe level of operation', climate geo-engineering should not exceed 350 ppm (Today it is 498 ppm). From space science, and knowledge on Venus, Hansen claims that as atmospheric Co_2 concentration and temperatures increased the planet's surface water vanished into space. Hansen finds 'a runaway' could be possible for the earth too. *"I've come to conclude that if we burn all reserves of oil, gas and coal, there is a substantial change, we will initiate the runaway of greenhouse"* and continues, that if all the tar sands and all the shade oil is also burned *"I believe the Venus syndrome is a dead certainty"* (Hansen 2009, p. 236). Also James Lovelock holds the climate catastrophism perspective, as well as other so-called prominent researchers. Climate catastrophism also applies to other genres, from religion to all sorts of public opinions. These non-science claims are termed climate apocalypse.

Climate optimism: Holds the perspective that climate change in general will benefit humanity. While some may bear the burdens (in some geographical areas and regions), global warming will generally contribute to humanity's welfare globally. Arguments often turn to pre-historical climates, e.g. the little ice age and how it harmed societies.

Climate skepticism: Scientists and lay people in advocacy of climate scepticism believe there is not such a thing as anthropogenic global warming. Climate

skepticism critically examines the validity and uncertainties of 'gradual' climate science, and does on the existing basis not find solid facts that climate change a) is happening and b) if happening, is anthropogenic. Proponents of climate skepticism spend much time and efforts in testing and undermining scientific 'facts' conducted over the past thirty years (falsification). As climate change portrayed in the media frequently attributes to single events (like a hurricane, drought or flooding), climate sceptics certainly have a point as to the level of hypocrisy that also guides the debate. Climate sceptics, however, seldom conduct their critics based on scientific standards (Newell 2000, Muttitt 2003, Urry 2011, p. 88, Castree 2014, p. 263) but also represent a political viewpoint that serving those with 'carbon interests'.

Cultures of nature(s): refers to the cultural understandings of what is natural. The concept therefore represents nature as culturally defined. Representing nature is an epistemological endeavor relating to the thinking and understanding of nature, knowing and transforming nature in science and everyday practice. Cultures of nature are a set of ideas about nature, what nature is and what is considered natural in a given time and place (Castree 2014, p. 84). See also natures of culture(s).

Denaturalization: A concept derived from Noel Castree that captures a process by which a thing or process that normally and until previously was regarded to be natural is argued unnatural, e.g. genes as genetically modified as product of society (Castree, 2014, p. 7-8). Thus, denaturalization refers to human intervention in natural processes. Confronted with the anthropogenic climate change thesis it is emphasized to happen at a planetary scale. In a strong version nature is dead, in a weak version what is regarded as natural is shrinking.

Epistemic Community: In contrast to the academic episteme, an epistemic community refers to a disciplinary community of researchers and practitioners that share common themes, approaches, interests, norms, values and ethics. Though it is 'interdisciplinarily organized', e.g. in the study of interdisciplinary phenomena like sustainability and climate change, the epistemic community that share the interests for a particular subject, drawing joint academic boundaries. In any case, the community is shaped around (inter)disciplinary borders that distinguish it from other epistemic communities. For Castree (2014, p. 45) epistemic communities exist around two frameworks, spatially linked, that also apply for academic epistemes. First, they all occupy the same institutional space, the uni-

versity ground and the campus in which they work. Second, they share academic values and standards for knowledge production; to find new knowledge, search for the truth(s), and accuracy in a systematic, rigorous, methodologically sound and comprehensive way. (See academic episteme). What should be clear is that both academic epistemes and communities relate to Kant's powerful and spatial framework of higher and lower faculties.

Epistemic (geographical) identities: Any epistemic discipline embraces norms and cultures that invite researchers and students to play roles that are recognized as valuable to that community. Hereby the student identifies him- or herself to the culture, norm, practice and interests of that community in order to be member of the discipline (Castree, 2014, p. 78). What is relevant in this context is how epistemic identities produce space. An earth scientist or physical geographer, when describing a nature in a specific geographical location, say Copenhagen, make reference to the physical landscape, geological and hydrological processes, vegetation systems – features that stretch from years to millennia. An economist will project another spatio-temporal scale on the same area that is culturally framed within that discipline, e.g. reading environmental change through the lenses of discounting. A biologist would read and write the very same landscape through habitats, soil science, biodiversity and zoology. All give insightful readings, writings of nature and conditions for (un)sustainability. All readings of 'the condition of nature' in that landscape that incorporate disciplinary boundaries and identities. It follows that a discipline does not exist prior to space, it occupies space, produces space and is also manifested through culturally imbedded geographical imaginations. Epistemic identities that represent a mixture of institutional settings, universities, institutes, research communities, disciplines and bodily scalar associations to these settings, exemplify how loose identities can be (Castree 2014).

External nature (first nature): Describes what is considered to be naturally defined as the non-human part of the world. Nature is 'out there' ontologically separated from society. A number of theorists make an effort in describing the ontological dualism arising from the enlightenment tradition (Harvey 1996, Smith 2010). These critical geographers point towards discussing first nature as an organized form of reductionism within modern sciences that marginalized other perspectives on nature. Smith (2010) traces the view of first nature to the rise of modern science with figures like Copernicus, Descartes and Newton that fundamentally separate nature from society. In that, the separation of nature from society also produced

academic spaces organizing spaces of academic work into distinct disciplines. Whereas first nature has even functioned as a paradigmatic construct both within the natural and social sciences it suggests nature to be universal, autonomous and attributed configurations of absolute space (Hansen and Simonsen 2005). Such mechanistic perspectives on nature separated subject from object, while it at the same time promoted the idea (e.g. Bacon) of producing scientific knowledge to gain control over nature (Harvey 1996). What I want to point toward here is how the perspective of an objective and external nature is increasingly challenged by anthropogenic climate change and yet external non-human nature(s) are real (volcanic eruption, earthquakes etc). Further, if one holds to the idea of an external nature, it implies that there are 'more out there than we humans' can imagine, know, influence and control.

Geographical imagination: In the Dictionary of Human Geography (2009) the very first sentence on geographical imagination runs like this: *"A sensitivity towards the significance of place and space, landscape and nature, in the constitution and conduct of life on earth… The geographical imagination as he saw it [H.C. Prince (1962) red.] was a response to places and landscapes, above all to their co-mingling of culture and nature that calls into action our powers of sympathetic insight and imaginative understanding ad whose rendering is a creative are"* (Cosgrove 2006 in Dictionary of Hum Geography 2009, p. 282). Thus disciplines like geography are subject to its own imaginary production of space, that Cosgrove called abstract geographical paintings. Harvey (1974b) brings geographical imaginations into a wider debate over individual recognition of the role of space and their own position in that environmental/spatial surrounding. Hereby he points to the specific use and spatial forms created by others (institutions, science, state, etc.) that the geographer is subject to. The way geographical imagination is used in this context projects the (inter)disciplinary and intellectual bordering, as spatially nested entry points for imagining possible socio-ecological futures. Hence, in the contest of sustainability, it advocates to acquire the capacity to think in abstract, planetary and environmentally interdependent term (Hulme 2008). Thus, processes of learning (identity) are linked to responsibility and possible responses to global environmental change (Massey 2004). Geographical imagination is a process of spatial contextualization through practices and learning (Dict of Hum geography 2009, p. 284).

Geographical identity: Comes in several forms. The novelty of being is constituted by becoming, and holds a process whereby identity becomes professionally embodied in civic life. Every human being holds geographical identities (e.g. nationalism). While the term is loosely and vividly used, it seeks to capture changing conceptions as related to human subject positions, and identities (and vice versa) and how these changes also connote modes of thinking about sustainability. Thus it is a project of spatial self-realization that also becomes a question of who we are and where we are going (Dict of Hum Geography 2009, p. 366). This is firmly rooted in learning processes and actualization of a being through education and desires for understanding, exploring as part of imagining ones future being.

Geo-engineering: Can largely be divided into two strategies of earth-system governance, one that reflects the sun's radiation back into space and one that removes GHG from the atmosphere. So far IPCC has concluded that geo-engineering projects *are "largely speculative and with the risk of unknown side effects*". Also The Royal Society also elaborated a report on geo-engineering arguing that we have to explore all technical possibilities (except social and political) to challenge climate change (Royal Society 2009, Geo-engineering the Climate, London). The report concluded that no geo-engineering methods are currently promising. Though geo-engineering is likely to be technically possible uncertainties of their effectiveness and side effects are widely unknown. The Royal Society notes that no major research projects on geo-engineering exists and notes that the international scientific community should carry through such studies to provide evidence of what might be feasible (the politics of producing knowledge). Yet, geo-engineering is a technological fix that does not consider the social dynamics, international governance and climate wars that lie behind the challenges (see Jevons chapter 1). Further geo-engineering is a neoliberal project in that it is probably one of the cheapest ways to 'deal' with climate change (cost-effectiveness) though it rather postpone problems of accumulating Co2 in the atmosphere into the future. Since geo-engineering is designed to 'protecting' earth from warming as projecting sun rays back into space, is like allowing GHG content in the atmosphere, without increasing temperatures.

Global Commons (Global good). Global commons is a geographically scaled concept in which planetary boundaries can only meaningfully be conceptualized as common (Harvey 2004, p. 549). UNEP have been successful in promoting the concept. Aligned with carrying capacities, global or planetary commons' as-

semble the (non)planetary-resource governance that lie outside of the political reach of any nation state.

Intrinsic nature: Refers to a certain quality or defining the property of something *"the distinguishing quality of living and inanimate phenomena, including human beings"* (Castree 2014, p. 10) as Castree puts it. The quality includes aesthetic expressions. Furthermore it connotes the idea that entities in nature have agency, properties, and exhibit behaviors. Deep ecologists build their theories within that position, commonly reflected in Mother Nature or that nature has value of its own (see Castree, 2014, p. 10).

Naturalization: To Noel Castree naturalization refers to a process by which, individuals, groups or societies commonly (re)define the part of the world (things, phenomena or processes) we call nature. Thus, naturalization refer to conventions about what is natural (Castree, 2014, p. 19).

Moral valuation/judgment: Behavior, attitudes and statements with the aim to tell others and make others act in accordance with what is regarded proper, correct and responsible thoughts and (in)action. In an educational perspective Sund and Wickman (2008) find moral judgments as culturally codified into a habitual codex assembling areas of responsibilities.

Legitimation: refers to a process whereby the creation and maintenance of ideas, actions and decisions is argued, organized and sorted in accordance to different legitimation strategies, implicit or explicit. Different legitimation strategies include the argument for a decision or position by making reference to e.g. authority (authorization), utility (rationalization) or narrative (mythopoesis) or value systems (moral evaluation). Se power of reference and note that no of these strategies are commensurable to scientific standards (for the pursuit of truth, accurate and valid knowledge). Yet academics are subject to them.

Planetary Boundary: The concepts planetary boundary is universal and ultimately fixed, thus relating to external nature and yet affected by humans. Planetary boundaries imagine the Earth as a closed system. Inter-planetary boundaries refer to astronomic processes in the solar system affecting climate on Earth (Rockström et al., 2009, Oldfield and Steffens 2014). The difference from planetary boundaries is that inter-planetary boundaries are by no way affected by humans, whereas

(some) planetary boundaries are said to be so e.g. in earth science, global climate science, that come to determine the politics over defining carrying capacities.

Political Ecology (in Science and Education): With figures like Humboldt and Haeckel a number of biologists and geographers originally developed ideas of 'oecologie' as the science of living organisms in relation to their environment (Zimmerer 2006). Political ecology is broadly defined as the study of relations between society and the humanized nature. Herby the study of political struggles takes point of departure in the environmental/ecosystem to be explicitly addressed in the analysis of local-global cultural dynamics, international trade relations or relations between past and present as well as relations to political economy. In this context *Political Ecology in Science and Education*, addresses the scientific and educational character of evaluating and producing nature(s) in its bio-cultural-political complexity. Thus the scientific and educational character of political ecology involves the nexus between the state, knowledge production (technology and education) and the market. As far as political ecologies in science and education are concerned, they relate to the nexus between the 'politics of space', (state, territories, organizational and institutional structures), 'environmental spaces' involve spatially nested ecosystems, 'spaces of knowledge' and 'spaces of work' referring to the market dynamics as also relating to natural transformation. Political ecology and political economy coincide. Thus, political ecology is nested in the link between power distribution and productive forces and their relationship to nature. Political ecology expands political economy with an analysis of political-economic activities not only with regard to how political/economic activities relate to and transform the environment, but also how it defines ecosystems/nature. Whereas political economic thinkers (ranging from conservative thinkers like Malthus to Marx) had accepted the value-laden character e.g. of disciplines like economy (Harvey 1974a), 20th century economists are among others characterized by separating politics from economics, economics from nature as an scientific and objective enterprise in itself. Wherein different agents (previously termed class relations/struggles) had different interests over organization of economic activities, scientists similarly have struggles over defining, analyzing and valuing the human-environmental interface. How these processes are embedded in science and education is of interest political ecology.

Production of nature: Is a concept developed by Niel Smith, David Harvey among others based on a Marxist understanding of the human-environmental interface.

The concept extends to the spatial theoretical work of 'the production of space' and amalgamates the spatial chronological theme with the human environment theme, particularly produced through economic forces organized under capitalism. Nature and society are dimensions of the same phenomena continuously knitted together, so that *"We cannot talk about the world of nature or environment without simultaneously revealing how space and time are being constituted within such processes"* (Harvey, 1996, p. 263).

Power of references: Refers to the-self governmental processes by which statements, assumptions or themes are represented. The concept seek to capture the academic form of governmentality that bear effects to the habitual power of representing a given scientific problem or paradoxes in a certain way by also producing layers of hidden (tacit and tactic) knowledge yet, authoritative truth (see also academic governmentality).

Responsibility: Responsible geographies refer to epistemic ethics or more broadly academic ethics based on codex associated with environmental justice (see. Dictionary of Human Geography 2009, p. 211). Responsibility orchestrates processes by which the ethics of producing and representing socio-ecological change (within an epistemic community) also manifest in culturally codes and conducts of responding (answering to what, by whom and why are we responsible) in theoretical and practical terms to anthropogenic driven global (and local) environmental change. Confronted with planetary borders, whatever perspective one takes on responses and responsibilities they all form particular socio-natural climates inhabiting distinct political ecologies. In the broader society these response(abilities) range a pamphlet of connections and disconnections that advocate particular social practices, from denial of climate change to activism, from climate scepticism to climate catastrophism.

Social nature (second nature): A perspective according to which nature *is* social, e.g. through processes of urbanisation that progressively distance nature (external nature) from the urban it produces social natures. An example is the reinsertion of nature in cities arguing that cities are socio natures with their distancing habitats and faunas (Thrift 2002). To Castree, nature is not only defined, and construed socially, but also modified physically by humans (at all scales, from genetics to climate change), with particular social interests involved in such transformations (Castree, 2001, p. 3). Nature is social all the way down as Castree puts it, why

nature it appears to us, is produced and transformed appreciably to technological, cultural and economic interests (Castree 2001, Harvey 1996). Through the exploitation of natural resources and commodification of nature humans actively appropriate, transform and change nature, and in doing so, 'man transforms himself'. Nature therefore is historically constructed environments through planning; maintaining and regulating intensified practices that (re)shape *"The intertwinnings of social and ecological projects in daily practices as well as in the realms of ideology, representations, esthetics, and the like are such as to make every social (including literary or artistic) project a project about nature, environment, and ecosystems, and vice versa"* (Harvey, 1996, p. 189). While second nature is defined on the realms of a first non-human and external nature, thus accepting external nature, social nature more aggressively insists that nature has always been culturally determined. Nature is made social just as society is made natural. Nature is socio-nature.

Spatio-temporal tides and waves: refers to (inter)disciplinary and history-geographical assembles of the socio-natural interface, by which natural or social phenomena, things or processes and the interface between them are given geographical references and are geographically abstracted Whereas spatio-temporal tides refer to how different ontological and epistemological positions change the ways in which scientists deal with the human-environment interface and hence the different political ecologies inscribed within them, spatio-temporal waves refer to the relevance, frequency and intensity given to the human-environment themes, whatever topic explored (See Castree, Demeritt and Liverman 2009).

Sustainability: is a contested and widespread concept within academia and beyond. Sustainability is both an analytical concept, a theoretical concept, a political concept and an ethical concept, and an utopian concept, rejecting that these spheres can be fully separated. As Harvey argued forty years ago *"there is the task of building a genuinely humanistic literature which collapses the artificial (almost schizophrenic) dualisms between fact and value, subject and object, man and nature, science and human interface"* (Harvey 1974b, p. 24) sustainability is one of the concepts aiming just that. Though sustainability means different things to different people, it concerns the management and planning of the human-environmental interface. As Mansfield (2009, p. 37) note, sustainability is "wildly popular as a way of thinking about the needs of people and the environment by enhancing human well-being without undermining ecological integrity". In academia sustainability insists in integrating environmental, economic and social (material)assemblages in ways

that the study of any social, economic or environmental development can only be acknowledged if it takes place in all (three) aspects simultaneously. In that social nature and sustainability have a common background, non-human and external nature cannot be incorporated into the framework – hence external and 'natural' global or local environmental change. Thus academic sustainability is interdisciplinary and holds an integrative perspective that assembles socio-environmental changes in multiple spheres of interaction. In practice sustainability connotes a mass balance principle determined under planetary boundaries. Any analysis of 'sustainability' produces particular political ecologies, holding a conservative element. Yet proponents in favor of sustainability argue that basing an analysis on external nature is just as political as basing it on social nature. Nevertheless sustainability is also politically used in ways that intent to preserve the interests of those conceptualizing it. It is beyond the scope of this dissertation to define a commensurable understanding of the political meanings of the use of the concept in academia. If such a thing exists, it is individually contingent, multifaceted and contested. Yet, as discussed in chapter 1, a number of science societies emphasize sustainability as responsibilities to addressing climate change, whereby it represent the visions and fight over understanding, regulating and managing (local)global environmental commons, referring to equitable post fossil-carbon societies. Sustainability gathers a planetary common and yet orchestrated at all scales.

In politics the concept captures the fight over defining the effects on any development that occurs in the social, economic or social sphere, in a way (e.g. economic growth) that it does not exist on behalf of the other (e.g. environment). If so, development is only a matter of geographical redistribution of goods and bads, hence said to be unsustainable. Thus sustainability is a political socio-material vision for the future. Sustainability refers to a particular political-ideological process of regulation, sorting, directing and planning socio-material interaction. In this project political ecologies of representing sustainability (global environmental changes through sustainability) relates to the intellectual dispute and defined as a fight over and responsibilities acknowledged for representing socio-environmental interactions, to conceptually assemble and theoretically understanding socio-ecological and politico-economic processes between seven moments of interaction (see chapter 3). Furthermore the concept contemplate a standpoint from which the student or researcher have the freedom to individually challenge, address and produce and actively respond to the political fight over reading and writing socio-ecological, within academia. Hence, sustainability is also a utopian concept over

envisioning and imagining possible geographical futures, whereby the concept does only have a discursive existence that is yet to be materialized and converted into practical future existence.

Appendix

Appendix 1.1

Joined Science Academy Statement:

Global Response to Climate Change (2005)

"The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions (…).We urge all nations, in the line with the UNFCCC principles, to take prompt action to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies. As national science academies, we commit to working with governments to help develop and implement the national and international response to the challenge of climate change. G8 nations have been responsible for much of the past greenhouse gas emissions. As parties to the UNFCCC, G8 nations are committed to showing leadership in addressing climate change and assisting developing nations to meet the challenges of adaptation and mitigation"

Signed by the following Science Academy Presidents: Academia Brasiliera de Ciências, Brazil; Royal Society of Canada, Canada; Chinese Academy of Sciences, China; Academié des Sciences, France; Deutsche Akademie der Naturforscher, Germany; Indian National Science Academy, India; Accademia dei Lincei, Italy; Science Council of Japan, Japan; Russian Academy of Sciences, Russia; Royal Society, United Kingdom, National Academy of Sciences, United States of America.

Box 1.2. – G8 + 5 Science academies (2005), Joined Science Academy Statement: Global Response to Climate Change, p. 1-2.

Climate Science Letter (AAAS 2009, p. 1):

"We, as leaders of scientific organizations, write to state the consensus scientific view. Observations throughout the world make it clear that climate change is occurring, and rigorous scientific research demonstrates that the greenhouse gases emitted by human activities are the primary driver. (…). Moreover, there is strong evidence that ongoing climate change will have broad impacts on society, including the global economy and on the environment. (…). If we are to avoid the most severe impacts of climate change, emissions of greenhouse gases must be dramatically reduced. In addition, adaptation will be necessary to address those impacts that are already unavoidable. Adaptation efforts include improved infrastructure design, more sustainable management of water and other natural resources, modified agricultural practices, and improved emergency responses to storms, floods, fires and heat waves"

Signed by the following Science Academy Presidents: AAAS and American Chemical Society, American Geophysical Union, American Institute of Biological Sciences, American Meteorological Society. American Society of Agronomy, American Society of Plant Biologists, American Statistical Association, Association of Ecosystem Research Centers, Botanical Society of America, Crop Science Society of America, Ecological Society of America, Natural Science Collections Alliance, Organization of Biological Field Stations, Society for Industrial and Applied Mathematics, Society of Systematic Biologists, Soil Science Society of America, University Corporation for Atmospheric Research).

Appendix 1.2

The so-called top universities and institutional 'sustainable' responses (abilities) to climate change

Rank*	Institution	Location	Sustainability plan/ strategy	Reference	Example of key strategy statements/ Rector Statement
1	California Institute of Technology	United states	2013 Annual Sustainability Report	www.sustainability.caltech.edu/	"Sustainability at Caltech aims to enhance Caltech's core mission of research and education"
2	Harvard University	United states	Harvard University Sustainability Plan	http://green.harvard.edu/commitment/our-plan	"Creating a sustainable campus strengthens our core research and teaching mission, and it acknowledges that the challenges before us are complex and interconnected" President Drew Gilpin Faust
3	University of Oxford	United Kingdom	Environmental Sustainability Report 2012/2013	sustainability.admin.ox.ac.uk.	"Environmental Sustainability is the responsibility of all of us" Andrew Hamilton, Vice-Chancellor
4	Stanford University	United States	Campus Sustainability Progress 2013	**sustainable**.**stanford**.*edu*/	"Stanford's approach to sustainability research and curricula (….) recognizes that addressing key global sustainability challenges, such as climate change and universal access to clean energy, water, and food for a growing population, will require the collaboration of experts from many disciplines".
5	University of Cambridge	United Kingdom	Environmental Policy	http://www.environment.admin.cam.ac.uk/	"The need to reduce carbon emissions and improve the sustainability of the world's activities provides Cambridge with responsibilities and opportunities. Our world-leading research in many different areas of energy, environment and sustainability will make major contributions to fundamental understanding and to everyday practice, while our teaching needs to equip the next generation of leaders to understand and influence the future."

6	Massachusetts Institute of Technology (MIT)	United States	Next Generation Strategy 2014	https://**sustainability**.**mit**.edu/	"Here at MIT, we have set out to establish a Next Generation Campus Sustainability Platform"
7	Princeton University	United States	The Princeton University Sustainability Plan	*www.sustain.***princeton***.edu/*	"What will Princeton look like with Climate Change?"
8	University of California, Berkeley	United States	Campus Sustainability Report and Climate Action Plan	**sustainability**.**berkeley**.*edu/*	"UC Berkeley works to find solutions to global environmental, economic, and social challenges--inequality, climate change, food security, water shortages and more"
9	Imperial College London	United Kingdom	Carbon management and sustainable activities report 2013	*www.***imperial***.ac.uk/***sustainability**	"we take our environmental responsibilities very seriously and aim to implement the most sustainable means in our operations"
9	Yale University	United States	Yale Sustaianbility Strategic Plan 2013-2016	**sustainability**.**yale***.edu/*	"Global climate change and its consequences are critical challenges of our time, and Yale has important and necessary roles to play in addressing them. Yale's commitment to sustainability is a fundamental part of the University's enterprise" President Peter Salovey
11	University of Chicago	United States	Strategic Sustainability Plan	**sustainability**.**uchicago**.*edu/*	"At the University of Chicago, we are seeking to place clear parameters and identify measurable results around what it means to be truly sustainable"
12	University of California, Los Angeles (UCLA)	United States	UCLA Grand Challenge in Environment and Sustainability: Thriving a Hotter Los Angeles	*www.sustain.***ucla***.edu/*	"UCLA is a living laboratory for climate and sustainability research where undergraduate, graduate, and professional students engage with staff and faculty to pilot new technologies and policies on the university campus."

13	ETH Zürich – Swiss Federal Institute of Technology	Switzerland	Sustainanbility Report 2013	*www.ethz.ch/en/the-eth-zurich/sustainability.html*	"Sustainability at ETH Zurich is integrated into research, teaching, and operations and is a substantial element of university life"
14	Columbia University	United States	Sustainable Columbia 2014	*http://environment.columbia.edu/*	"we're proud as an institution to join in a shared commitment to a more sustainable environment in our local community and across the globe." Columbia University is taking action to reduce our carbon footprint. If we lead by example, we will improve the sense of responsibility felt by our community for their actions through both education and demonstration"
15	Johns Hopkins University	United States	Sustainability Report and climate change task force report	www.**sustainability**.**jhu**.edu/	"Sustainability has been a core part of the Johns Hopkins experience for decades".
16	University of Pennsylvania	United States	Climate Action Plan 2.0	*www.***upenn**.*edu/***sustainability/**	"I am pleased to present the University of Pennsylvania's Climate Action Plan 2.0, our roadmap for environmental sustainability (…). The future of our University, and beyond, depends on it" Amy Gutmann, President
17	University of Michigan	United States	Office of Sustainability Business Plan & Annual Report of Activity	**sustainability**.**umich**.*edu/*	"To compliment our academic work, we are establishing an office of campus sustainability to be on the front line of accessing and improving how the university uses energy, recycled materials, and builds facilities." Mary Sue Coleman, President
18	Duke University	United States	Sustaianbility Strategic Plan	**sustainability**.**duke***.edu/*	"Duke University seeks to attain and maintain a place of leadership in all that we do. This includes leadership in environmental stewardship and sustainability on campus."

19	Cornell University	United States	Cornell Climate Action Plan	**cornell**.*edu*/**sustainability**/	"Cornell supports research, scholarship, and the practical application of knowledge that address one of humankind's greatest challenges: achieving a sustainable world for all. *It is imperative that Cornell continue to work across campuses, sectors, and continents to meet the needs of society: strive for climate neutrality, innovate, and lead the way to a cleaner, safer, more stable world."* David J. Skorton, President
20	University of Toronto	Canada	Sustainability Yearbook	www.**sustainability**.**utoronto**.**ca**/	"An innovative culture of sustainability thrives on our three campuses thanks to the combined efforts of students, faculty, and staff" Meric Gertler, President
21	Northwestern University	United States	Strategic Plan for Sustainability	www.**northwestern.edu/sustainability**/	"As one of the world's leading academic institutions, Northwestern University recognizes its role in addressing the global challenges of sustainability and climate change. Northwestern University's strategic plan states that we will "Engage with the world… expanding our impact at home and abroad." The University's approach is to immerse our students and faculty in leading environmental curriculum and research and to commit to improving our own carbon footprint".
22	University College London (UCL)	United Kingdom	UCL's Environmental Sustainability Strategy	http://www.ucl.ac.uk/greenucl/our-commitments	"UCL's Environmental Sustainability Strategy establishes a framework to tackle the environmental impacts of the Institution's operations (e.g. carbon emissions, …) in the context of supporting and enhancing the Institution's core academic activities"

23	The University of Tokyo	Japan	TSCP Sustainable Campus Project	*http://www.tscp.u-tokyo.ac.jp/en/index.html*	"The University of Tokyo has made it one of its missions to contribute to the realization of a sustainable society by creating a sustainable campus, while at the same time vitalizing research and education, by drawing on its wealth of existing intellectual resources"
24	Carnegie Mellow University	United States	Leading the Way. Setting the Standard.	www.**cmu**.edu/environment/	"Environmental innovation is an integral part of Carnegie Mellon's culture, curriculum and practice (…). Sustainability has been integrated into the curriculum in all seven colleges of the University"
25	National University of Singapore (NUS)	Singapore	Sustainable NUS	*http://nus.edu.sg/oes/*	"To effect a total shift to environmental sustainability in all aspects of campus life by integrating sustainability into our operations, planning, construction, education, research, instruction, and public service"

**Times Higher Education 2014. Webpages accessed during December 5 to 16 2014.*

Appendix 1.3. Anthropogenic Climate Change?						
Year	**Atmospheric Co2 Concentration (ppmv)**	**Annual mean growth rate Co2**	**Economic Growth (OECD, GDP TOTAL, PER CAPITA, US DOLLAR, 1970-2013)**	**OECD Total Primary Energy Consumption (Oil, Coal Gass) in Quadrillion Btu**	**Total Global CO2 Emissions from Fossil-Fuel Burning 1750-2010 (million metric tons of carbon)**	**Per capita emission estimates (metric tons of carbon)**
Range interglacial periods (400-0 KYR BC)	~262-300					
Range Glacial periods (400-0 KYR BC)	~180-205					
1000	279					
1500	282					
1600	276					
1700	277					
1750	277				3	
1775	279				4	
1800	283				8	
1825	284				17	
1850	285				54	
1875	289				188	
1900	296				534	
1925	305				975	
1950	311				1630	0,69
1959	315.97	0.94			2459	0,83
1960	316.91	0.54			2569	0,85
1961	317.64	0.95			2580	0,84

1962	318.45	0.64			2686	0,86
1963	318.99	0.71			2833	0,88
1964	319.62	0.28			2999	0,92
1965	320.04	1.02			3130	0,94
1966	321.38	1.24			3288	0,97
1967	322.16	0.74			3393	0,98
1968	323.04	1.03			3566	1,01
1969	324.62	1.31			3780	1,05
1970	325.68	1.06	3 551		4053	1,1
1971	326.32	0.85	3 824		4208	1,12
1972	327.45	1.69	4 160		4376	1,14
1973	329.68	1.22	4 604		4614	1,18
1974	330.18	0.78	5 019		4623	1,16
1975	331.08	1.13	5 448		4596	1,13
1976	332.05	0.84	5 970		4846	1,18
1977	333.78	2.10	6 512		5026	1,19
1978	335.41	1.30	7 215		5087	1,19
1979	336.78	1.75	8 040		5369	1,23
1980	338.68	1.73	8 788	179,13	5315	1,2
1981	340.10	1.43	9 736	175,14	5152	1,14
1982	341.44	0.96	10 261	170,33	5113	1,11
1983	343.03	2.13	10 893	170,06	5094	1,09
1984	344.58	1.36	11 722	177,7	5280	1,11
1985	346.04	1.25	12 468	180,3	5439	1,12
1986	347.39	1.48	12 996	182,39	5607	1,14
1987	349.16	2.29	13 705	187,59	5752	1,15
1988	351.56	2.13	14 730	193,6	5965	1,17
1989	353.07	1.32	15 760	197,71	6097	1,17
1990	354.35	1.19	16 697	198,59	6127	1,16
1991	355.57	0.99	17 342	200,85	6217	1,16
1992	356.38	0.48	17 977	202,97	6164	1,13
1993	357.07	1.40	18 510	206,57	6162	1,11
1994	358.82	1.91	19 339	210,11	6266	1,11
1995	360.80	1.99	20 078	215,1	6398	1,12
1996	362.59	1.25	20 955	222,08	6542	1,13
1997	363.71	1.91	21 945	224,61	6651	1,13

1998	366.65	2.93	22 682	225,11	6643	1,12
1999	368.33	0.93	23 599	229,36	6610	1,1
2000	369.52	1.62	25 079	233,69	6765	1,11
2001	371.13	1.58	25 886	232,27	6927	1,12
2002	373.22	2.53	26 655	234,11	6996	1,12
2003	375.77	2.29	27 467	236,54	7463	1,17
2004	377.49	1.56	28 950	241,94	7807	1,21
2005	379.80	2.52	30 450	243,18	8093	1,24
2006	381.90	1.76	32 461	243,78	8370	1,27
2007	383.76	2.22	34 003	245,44	8566	1,28
2008	385.59	1.60	34 780	242,64	8783	1,3
2009	387.37	1.89	33 823	231,76	8740	1,28
2010	389.85	2.42	35 034	240,48	9167	1,33
2011	391.63	1.87	36 325	238,71		
2012	393.82	2.65	37 139	235,2		
2013	396.48	2.05	37 876			
2014	398.55	2.28				
2015 (January)	399,96					
Source:	**1**	**2**	**3**	**4**	**5**	**6**

1. http://www.esrl.noaa.gov/gmd/ccgg/trends/#mlo_data U.S. National Oceanic & Atmospheric Administration (NOAA), Earth System Research Laboratory Global Monitoring Division (Accessed February 19 2015)
2. http://www.esrl.noaa.gov/gmd/ccgg/trends/#mlo_growth U.S. National Oceanic & Atmospheric Administration (NOAA), Earth System Research Laboratory Global Monitoring Division (Accessed February 19 2015)
3. http://data.oecd.org/gdp/gross-domestic-product-gdp.htm OECD statistics, Gross Domestic Product (Accessed February 19 2015)
4. http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=44&pid=44&aid=2&cid=CG5,&syid=1980&eyid=2012&unit=QBTU US. Department of Energy (EIA), International Energy Statistics (Accessed February 19 2015)
5. http://cdiac.ornl.gov/ftp/ndp030/global.1751_2010.ems US. Department of Energy (EIA) Carbon Dioxide Information Analysis Center (Accessed February 19 2015)
6. http://cdiac.ornl.gov/ftp/ndp030/global.1751_2010.ems US. Department of Energy (EIA) Carbon Dioxide Information Analysis Center (Accessed February 19 2015)

According to Barnola et al., (2003) there is a close correlation between main trends of atmospheric CO_2 concentration for each glacial cycle. Thus, major transitions from the lowest to the highest values recorded are associated with glacial-interglacial transitions, during the past 420 kyr. Barnola et al., (2003) find atmospheric carbon cycles ($CO_{2)}$ rises from 180 to 280-300 ppmv between glacial and interglacial cycles. Thus, Pre-industrial Holocene levels of are around 280 ppmv are found during all inter-glacials period the highest record (~300 ppmv) found approximately 323 kyr BP (Barnola et al., 2003). Similarely historic CH4 Records demonstrate similar glacial and interglacial cycles, and Atmospheric concentrations of CH_4 during the Holocene ranged from 676 to 716 ppb before about 1750 *"After 1750 concentratios began to increase to their present value of more than 1700 ppb"*(Etheridge et al., 2002). *Between 1800 and 2000 atmospheric co2 concentration from 283 to 369 accompanied by an immense industrialization (…). Between 1800 and 2000 population grew more than six-fold, the global economy about 50-fold, and energy use about 40-fold"* (Steffen et al,. 2007, p. 616). What should be clear is with the rise of modern capitalistic societies atmospheric Co2 records have increased 25 % since 1960. Compared with the past 400 kyr glacial and interglacial periods, the atmospheric Co2 concentration is approx. 100 ppm higher than recorded during that period.

In 2008, the Advanced capitalist societies in the Western World, inhabited 18 % of the world's population, but were responsible for 72 % of global CO2 emissions emitted since 1850 (Malm and Hornborg 2014, p. 64). Roughly, the geographical difference of emissions, accompanies the distribution of wealth globally. The poorest 45 % of the worlds population account for 7 % of the global GHG emissions, while the 7% riches are responsible for 50 % of the global emissions. Thus an average American, despite the huge inequalities within the country, bear the same emissions for their lifestyle and social practices as 500 citizens from Burundi, Nepal, Mali, Cambodia or Afghanistan.

Appendix 2.1: Regimes of accountability and uneven geographical academic spaces

ISI web of knowledge is another example of the creation of personal monopoly rent outlined in space. Ranking, Merit Systems or Audit systems, depending on their technical construction, also create the credit form in terms of institutional rent. Institutional rent is the institutionally marketable capital of reputation (Harvard and Oxford) and the influence these imaginaries have on funding, quoting etc. (which in turn, improve funding opportunities). What should be clear is that ranking and audit systems of individuals, departments and universities are critical for research funding and 'financial attractiveness'. Some Editorial collectives of well-established journals have been critical to the development. By way of illustration the Editorial collective of ACME (2007) points out how indexing and auditing produce neoliberal practices of accounting research, which has nothing to do with double blind reviews. Since audit schemes are originally developed for financial purposes, they are not only making and creating markets. Ranking and audit systems are also performing markets (Castree et al., 2006). What BFI ensures is that the work of an individual researcher (or a collective) is no longer solely qualitatively valued, examined and judged, it is also quantitatively valued in monetary terms. "Academics are thus being asked to become responsible for the increasingly capitalist-like accumulation strategies of universities, and one way of ensuring that they do so is through the disciplining practices of impact factors and journal ranking systems" (Editoral Collective, ACME, 2007, p. 132). Hence these forms of accountability create a new scientific climate for individuals and collectives. I want to point to two paradoxical elements the scientific climate of marketing knowledge. First, asymmetric power relations appear to contradict any form of competition. In tandem and more challenging the methodological assumption is based upon the idea that quantitative methods are able to measure quality (not qualitative methods). If you introduce market like competition of say public funding, then it may have the intended effect for a period of time: it incites researchers to spend all their might and effort in writing the best proposals, but as time passes by, some institutions become richer than others (Auken and Emmicke 2010). Consequently richer institutions have the possibility to set aside resources to make better proposals, employ highly estimated researchers, have a better record, and so on. What you produce is no longer competition, but uneven geographical development. Consequently there is a fundamental contradiction in that funding councils (e.g. Danish Ministry of Education) on one hand commit themselves to competition for quality, and on the other hand the very same com-

petition rewards uneven power relations. Secondly, I pointed to the credit form of BFI. When BFI and other merit systems capitalize academic knowledge (so called high quality journals), then they are not so different from the pay journals (which are considered low quality) and are now commonplace. So called high impact factor journals are often corporate owed by a group of global media enterprises, and the wider indexing e.g. ISI Web of Science Journal Index is owned by the private corp. Thomason Scientific. A number of so-called high impact factor are profit driven Journals and turn into business with exactly the same circulation of knowledge economies as do the pay journals.

Appendix 5.1: List of interview participants

Nigel Thrift: Professor, Geography, Vice-Chancellor and President, University of Warwick, UK.

Maria Helena Nazaré: Professor, Physics, President, European University Association, Brussels, Belgium.

John Urry: Professor, Sociology, Lancaster University, UK

Pam Freedman: Professor, Neurochemistry, Vice-Chancellor, University of Gothenburg, Sweden.

Will Steffens, Professor, Sustainability and Earth System Science, Executive Director, ANU Climate Change Institute, Australian National University, Australia.

Danish Research Geographers

NB the list is random and not chronological with the coding numbers in interview references.

Anne Lorentzen: Professor, Human Geography, Aalborg University, Department of Development and Planning.

Niels H. Jensen: Associate Professor, Physical Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Thorbjørn Andersen: Associate Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Henrik Toft Jensen: Associate Professor, Human Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Torben Birch-Thomsen: Associate Professor, Human Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Henrik Breuning-Madsen: Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Anne Gravsholt Busck: Associate Professor, Human Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Kirsten Simonsen: Professor, Human Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Bo Elberling: Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Rasmus Fensholt: Associate Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Peter Skriver: Associate Professor, Human Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Thomas Friborg: Associate Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Birger Hansen: Associate Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Høgni Hansen: Associate Professor, Human Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Kristine Juul: Associate Professor, Human Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Martin Rudbæk Jepsen: Associate Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Aart Kroon: Associate Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Marianne Larsen: Associate Professor, Human Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Morten Lauge Pedersen: Associate Professor, Physical Geography, Aalborg University, Department of Development and Planning

Lasse Møller-Jensen: Associate Professor, Human Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Jesper Brandt: Professor, Physical Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Morten Pejrup: Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Peter Frederiksen: Associate Professor, Physical Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Kjeld Rasmussen: Associate Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Lasse Kofoed: Associate Professor, Human Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Anette Reenberg: Professor, Physical Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Keld Buciek: Associate Professor, Human Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Lars Winther: Associate Professor, Human Geography, Copenhagen University, Department of Geosciences and Natural Resource Management, Section of Geography.

Henrik Gutzon Larsen: Associate Professor, Human Geography, Aalborg University, Department of Development and Planning

Eva Bøgh: Associate Professor, Physical Geography, Roskilde University, Department of Environmental, Social and Spatial Change.

Anonymous Lecturer: Geography Department in Denmark.

Appendix 5.2. List of study regulation documents

Study regulation for geography at Roskilde University (2005), Bachelor, Department of Environmental, Social and Spatial Change.

Study regulation for geography at Roskilde University (2006), Bachelor and Master, Department of Environmental, Social and Spatial Change.

Study regulation for geography at Roskilde University (2014), Bachelor, Department of Environmental, Social and Spatial Change.

Study regulation for geography at Copenhagen University (2009a), Bachelor, Department for Geography and Geology.

Study regulation for geography at Copenhagen University (2009b), Master, Department for Geography and Geology.

Study regulation for geography at Aalborg University (2010a), Bachelor, Department of Development and Planning.

Study regulation for geography at Aalborg University (2010b), Master, Department of Development and Planning.

Study regulation for geography at Aalborg University (2011), Bachelor, Department of Development and Planning.

Study regulation for integrative geography at Aalborg University (2010), Master, Department of Development and Planning.

List of IGU Declarations concerning the environment

IGU GCE (1992). International Charter on Geographical Education. The Commission on Geographical Education of the International Geographical Union (IGU CGE).

IGU GCE (2000). International Declaration on Geographical Education for Cultural Diversity. The Commission on Geographical Education of the International Geographical Union (IGU CGE).

IGU GCE (2007). Lucerne Declaration (2007). International Geographical Union Commission on Geographical Education (IGU CGE), Geographiedidaktische Forschungen, 42, 243—250.

Appendix 5.3. Interview guide, open interview questions

English

1. In 1964 Pattison published a paper on his thoughts on geographical traditions. He identified 4 distinct traditions within the discipline of geography. In 1990 the paper was re-published. Pattison's four traditions have been used by a number of geographers, including David Harvey that in a paper from 2009 used Patterson's nomenclature. Patterson's four traditions are:

    a. The spatial tradition with a focus on localization, distance, position, and place. Later the spatial tradition became more diverse.
    b. The area study tradition represents a regional focus, analysis of regional development, regions and boundaries, inclusive relations to nearby regions connections and networks.
    c. The man-land tradition emphasizes relations between human interactions with their environment, resources, opportunities and constraints concerning the physical environment and nature.
    d. The earth science tradition concern, the study of the earth, soil, oceans and the atmosphere as well as related aspects of nature, its processes and dynamics.

Which one of the above mentioned traditions do you find best relate to your teaching?*

**We assume that your research and teaching activities will largely correlate to the same tradition. If not so, please include more traditions in your answer.*

2. In continuation of the tradition or the traditions you have pointed out, we will like to ask more specifically to scientific methods in education: **Are there (geographical) methods that are more relevant for students to acquire than others within the geographical tradition you relate to?**

3. We are interested in understanding the role of fieldwork for the education of geographers: **What is the role of fieldwork in the education of geographers at your institution?**

4. What do you understand by fieldwork?

5. ***What do you consider the most important students acquire through fieldwork?***

6. ***Can you become a geographer without being on fieldwork as part of your education?***

7. We are also interested in the use of the concept sustainability in geography education: **Do you see a connection between sustainability and fieldwork?**

8. Do you regard the sustainability concept as an influential/important concept for the education of geographers?

9. What is your opinion concerning the use of concepts like sustainability in the education of geographers?

10. Have you taught on sustainability issues yourself?

11. **How do you regard the use of sustainability concepts within your area of expertise?**

Appendix 5.4

Interview guide –Will Steffens (June 17, 2014), Nigel Thrift (May 23, 2013), Pam Freedman (April 22, 2012) and Maria Helena Nazaré (April 22, 2012).

The role of universities in society

- Do universities have a particular responsibility to address sustainability?
- Do discipline like geography; have a responsibility to deal with issues like sustainability?

Education

- Universities educate future leaders and decision makers – their decisions also rely on a certain academic culture – Do you think universities should include sustainable values and achievements as criteria for curriculum development? (competences and skills)
- How can higher education models integrate sustainability (vision)?
- What do you regard as the key tensions in rethinking the university system to become more sustainable?

Universities

- In 2012 we saw among others "the Council for the Defence of British Universities (CDBU)" as responses to politic-economic models of the neoliberal university. First, do you see a marketization and instrumentalization of universities?
- Do you see notions of the neoliberal university have relation to how academia responds to climate change?
- Should financial structures and grant models address issues of sustainability?
- What do you regard as the key tensions in rethinking the university system toward producing social-innovative models for a low carbon society?

Interview guide, John Urry, January 25, 2013

- In your book, Climate Change and Society, you introduce the concept carbon sociology. How do you see sociology transforms toward a carbon sociology, and what are the main drivers for that?
- Could the idea of carbon sociology be extended to all fields of sciences?
- Do universities have a particular responsibility to address sustainability?
- Do discipline like geography; have a responsibility to deal with issues like sustainability?

Education

- Universities educate future leaders and decision makers – their decisions also rely on a certain academic culture – Do you think universities should include sustainable values and achievements as criteria for curriculum development? (competences and skills)
- In chapter six, you depict models for social innovation toward a low carbon society. Do you find processes of social innovation (utopia) may be relevant in higher education?

University

- In 2012 we saw among others "the Council for the Defence of British Universities (CDBU)" as responses to politic-economic models of the neoliberal university. First, do you see a marketization and instrumentalization of universities?
- Do you see notions of the neoliberal university have relation to how academia responds to climate change?
- Should financial structures and grant models address issues of sustainability?
- What do you regard as the key tensions in rethinking the university system toward producing social-innovative models for a low carbon society?

In,' Climate Change and Society', you depict models for social innovation toward a low carbon society. In many ways one may argue that the essence unfolds around the concept of sustainability. You do not use the term; are there any particular reasons for that?

Appendix 5.5

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Educating geographers in an era of the anthropocene: paradoxical natures – paradoxical cultures

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ABSTRACT

Geographical imaginations are vital to make sense of challenges to sustainability which are produced and distributed across scale. Yet, a number of studies find that geography has been reluctant to integrate sustainability issues in its curricula. Geography is particularly interesting and can contribute to education for sustainability debates in various disciplines due to its strong tradition within the human-environment theme. This article presents an empirical analysis of contested ideas of sustainability approaches in Danish University geography degree programs, and the significance given to them by geographers. Hereby the paper critically examines political ecologies when introducing sustainability themes into the curricula. In so doing, it is discussed how different sustainability typologies in education bear relation to different ways of dealing with spatio-temporal tides and waves of the human-environment interface. It is concluded that though geographers find sustainability themes important to geography, sustainability is more often implicit than it is explicit. This produces a number of dilemmas and contradictions since geographers both seek to distance themselves from produced politics while at the same time elucidating them. This finding reveals contradictions within and between traditional ESD approaches, counterproductive to the aims of different typologies themselves. Since frictions between different ESD approaches are fundamentally interdisciplinary, the relevance of this finding is significant across disciplines. Thus, scholars and students should learn to go beyond the geopolitics of education in order to transcend the paradoxical-culture-natures identified.

1. Introduction

Humans interact with the physical environment to the extent that humans are now transforming the planet from one geological epoch, the Holocene, towards a new geological era, the Anthropocene (Crutzen, 2002; Steffens et al., 2011). The history of human-environmental interaction is indeed astonishing and the anthropocene conceptualizes the magnitude, scale and acceleration of the per capita exploitation of natural resources (Reenberg, 2006; Griggs et al., 2013).[1] The journey of geographical transformations is also a journey of the nature of time and space, which is why geographical representations are absolutely vital to make sense of human-environment interaction and their policy implications (Castree, 2001). As Sayer states, "Global warming presents an enormous threat to humanity, but the response from academia, including geography, has been relatively slow (…). I find this surprising, indeed astonishing, for there could hardly be a more important geographical topic" (Sayer, 2009, p. 350).

In a world, where more than half of the planet's land surface has been changed by human activities, geographers like Yarnal and Neff (2004), Westaway (2009) and Lui (2011), reveal that the integration of sustainable themes into curricula is desirable in the UK and US and in some other European countries, e.g. Germany. In general there is consensus among scientific and geographical communities concerning the cause and effect of climate change and unsustainable production patterns. Cook et al. (2013) find that in 97.1% of more than 4000 peer reviewed articles published over the past 20 years it is asserted that global warming is mainly or entirely human induced. Correspondingly Oreskes (2004) shows that 97% of research articles in high-impact factor journals like Science, find climate change to be fundamentally anthropogenic. Controversy, however, arises when dealing with strategic actions and solutions to sustainability challenges since a given position legitimizes a given political agenda (Morgan, 2011). Thus, the geopolitics of education for sustainable development (ESD),

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[1] The idea of the Anthropocene, can be traced back to a number of thinkers in the early 19th Century, e.g. Valdimir Vernadsky's, mankind's geochemical work, Eduard Suess's anthropogenic transformation of the biosphere into the neösphere or humans as an geological agent (Steffen et al., 2011).

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0959-6526/

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environmental education (EE) sustainability in higher education (HESD) or similar acronyms, produce complex dilemmas (Corcoran and Wals, 2004; Sterling et al., 2013). This inevitably tends to frame education as a change agent that socializes students into accepting certain kinds of explanations, values and pre-analytic assumptions (Lozano et al., 2013a; Hesselbarth and Schaltegger, 2014).

While studies dealing with ESD and geography are growing (e.g. Chalkley, 2006; Westaway, 2009; Firth, 2011), there is only a limited number of studies on the second nature approach in explaining, describing and evaluating how sustainability is socialized in geography in higher education. A second nature perspective argues that nature is inescapably social. Nature is not only defined and construed socially, but also modified physically by humans (at all scales, from genetics to climate change), with particular social interests involved in such transformations (Castree, 2001, p. 3). According to the second nature perspective, nature-society relations intertwine through socio-ecological processes in such a way that any dualism becomes meaningless, why any examination of nature cannot ignore the social interests involved in such work, either in research, in the classroom or text books. Consequently, in any examination inheres political ecologies that cannot escape from the social processes of valuating nature(s). The need to comprehensively take into consideration methodological approaches in the interface of society–environment interactions seems highly relevant to contemporary and future sustainability challenges (Yarnal and Neff, 2004). Thus the background of this study is based on a geographical approach, addressing spatio-temporal figurations associated with ESD theorization of the human environment interface. The rationale of the study takes a second nature perspective, to explore ESD approaches in geography.

This paper contributes to this particular field of knowledge by providing an empirical analysis of the ESD in education of geographers in Denmark. By providing a retrospective view of the development of the human-environment theme the study explores what geographical approaches may offer to the ESD debate. Secondly, it presents an empirical analysis of contested ideas of sustainability approaches in Danish University geography, and the significance given by researchers for the education of geographers. Lastly, the politics of representing nature in relation to society (Greenberg and Park, 1994) when introducing sustainability themes into curricula are critically examined. Through the case of Danish University geography the following questions have been addressed. 1) What ESD approaches are to be identified in geography? 2) What political ecologies can be associated with them? and 3) how do research geographers address dilemmas of ESD? The remaining part of the paper discusses ESD typologies and contradictions, dilemmas and paradoxes of representing sustainability nature(s). Hereby the findings of this paper on ESD as a fact based approach, ESD as a norm based approach, and ESD as a policy based approach are discussed (Molin, 2006; Grahn, 2011) and a comparison is made between Vare and Scott (2007) ESD 1 and ESD 2 approaches, Burandt and Barth (2010) syndrome and scenario approach. First, however, it is valuable to reflect upon what the author has elsewhere called spatio-temporal tides and waves (Grindsted, 2013) to examine how different ESD approaches bear relation to representing the human – environment interface. Whereas spatio-temporal tides refer to how different ontological and epistemological positions change the ways in which scientists deal with human-environment interactions, spatio-temporal waves refer to the relevance, frequency and intensity given to the human-environment interface, whatever topic is explored.

2. Spatio-temporal tides and waves and representations of the human – environment interface

Geography may be one of the most prominent and oldest disciplines concerned with the conceptualization of human-environment interactions (Rasmussen and Arler, 2010). In a historical perspective it is interesting to observe that invitations to upscale ecological themes have been numerous during the past centuries. Geography goes much beyond dealing with the human-environment nexus, sustainability or climate change. Still to many: *"The theme of man-environment relation has never been far from the heart of geographical research, and for many it has functioned as the overriding theme"* (Harvey, 1969, p.115). Since Vidal de la Blache (1845–1918), Alexander von Humboldt (1769–1859) or John Mackinder (1861–1947) geographers like Harlan Barrows (1923), Carl O. Sauer (1927), Forsberg (1962) or Stoddard (1967) have argued for upscaling ecological themes by defining the discipline in such a way that geographers need to study human beings in relation to their environment (Christiansen, 1967; Stoddard, 1987; Turner, 2002).

The history of the human environment theme, however, has taken multiple forms and methodological approaches over the years. Some geographers conceptualize the human-environment theme more or less *ad hoc,* implicitly or explicitly, whereas others organize it in constructs separating human and nature or build certain interfaces.

Dialogue about these issues in ESD may not only better prepare students for dealing with wicked and controversial problems like sustainability, resilience or climate change. Dialogue about these issues may also make students better understand the geopolitics of scientific and educational practices that constitute the "object of study" and fundamentally shape the relevance of geographical thinking, questions asked and data collected (Castree, 2001). Turner (2002) illustrates how the interface between the spatial chorological approach and the human-environment theme has been the dominating source of (often) conflicting identities. Therefore the issue of human-environment reconfigurations is addressed in the interface between identities that have dominated in geography. These are conceived of as complex spatio-temporal tides and waves intersecting, overlapping and conflicting; as a mosaic of understandings often in opposition to other geographical representations. For this reason next section, briefly consider how determinism, the quantitative revolution and the cultural turn reconfigured the human-environment theme.

2.1. Determination of nature – natures of determination

One spatio-temporal tide and wave concerns the eighteenth and nineteenth centuries' debates on environmental determinism with their roots in Darwin. This debate argued against possibilism and whether culture or nature played the determining part in the relationship (Christiansen, 1967). Explanations of determinism are often causal and seek to demonstrate how bio-physical factors such as climate, soil and altitude determine social and economic activity or vice versa. Nature is external, is objective and exists independently from humans (Castree, 2001). Legitimation of geographical knowledge relates to how geographers construct their object of study and within the enlightenment tradition geographers built explanations that objectified nature to be instrumentally used, tamed and exploited (Harvey, 1996). Environmental determinism is still present in today's sustainability debates, though the discussion whether nature dominates culture has shifted completely. In the context of ESD much environmentalism acknowledges that societies harm nature destructively across scales ranging from climate change to

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biodiversity loss. Humans play the dominant part of such socio-ecological transformations and reconfigure traditions of determinism; culture determines nature not vice versa (e.g. climate catastrophism).

2.2. Natures of description – descriptive natures

Another shift in the way geographers have dealt with human-environment interactions relates to the descriptive tradition and the quantitative revolution. Both studies on industrial society's impact on local environments and the rise of the descriptive tradition challenged simple environmental determinism (Turner, 2002). Positivism became a platform to combat what was regarded as speculative science, which is why universal regularities and causal effects of the nature-society nexus became a focal point of study. Mechanistic and universal nature(s) refers to nature as external assuming society and nature are to be separated ontologically. Nature is non-social and it follows that natural resources are fixed why 'sustainable solutions' refers to more efficient environmental management of these (external) resources. Such mechanistic and universal perspectives from which nature is ultimately fixed and which encompasses a set of general rather than contextual characteristics made human- and physical geography drift apart: *"This obviously implied that the traditional focus of Geography on Human-Environment relationships lost its defining status"* (Rasmussen and Arler, 2010, p. 38). Thus, ontological dualism, as that of separating nature and society, was largely institutionalized into disciplinary departments of physical geography and human geography, into theoretical constructs, and into education and curricula (Stoddard, 1987). The concept of nature is often constructed in opposition to the concept of culture, either implicitly or explicitly, and suffers from dualist thinking as does much Western philosophy. Such antagonisms have political implications because they involve an attitude of detachment while at the same time espousing a perspective of scientific objectivism (Birkeland, 1998). In the context of ESD, nature is explored through assumptions of scientific objectivism – nature 'can speak for itself'. By way of illustration, the gradualist perspective of climate change carries references to the quantitative revolution whereby researchers only need to elaborate the best methodological tools to be able to find "objective facts" about nature's condition (Castree, 2001).

2.3. Cultures of nature – nature of cultures

The cultural or linguistic turn is yet another spatio-temporal tide and wave that influenced human-environment debates. According to Fitzsimmons (1989) and Birkeland (1998), among others, the cultural turn led to a shift in the relationship between nature and culture favoring socio-spatial formations so that *"cultural geography has lost touch with its basic relationship to the concept of nature"* (Birkeland, 1998, p. 230). Discursive constructions do share concern for the effects of power for which reason constructionism tends to be engaged in a critique of the way nature is construed. Constructions of nature nevertheless face the dilemma of the prison of language: that one can never know if our conceptual construction of nature corresponds to how nature actually appears (Demeritt, 2002). Yet, conceptualizations of culture are fundamental to environmental challenges. First, different traditions interpret and explain (ir)regularities, (ir)rationalities, and pre-analytical assumptions differently; from environmentalism, determinism, particularism, absolutism to essentialism (Rasmussen and Arler, 2010). Consequently, scholars fail to understand human environment interactions when ignoring the power relations, domination and contested ideas involved in explaining socio-natural transformations. Second, knowledge is complex mixtures of knowing nature(s) that constitute complex power relations with different socio-material effects (Harvey, 1996). Dealing with human-environmental relations is neither an objective nor a neutral act. Further, and more intriguing, knowledge produced tends to be technocratic and politically biased, while claiming objective scientific status (Fitzsimmons, 1989; Lambert and Morgan, 2009). In the context of ESD, the history of spatio-temporal tides and waves underline the relevance of addressing the social character of nature and critically exploring how in thought and practice the politically contested values, moral or ethical aspects is dealt with when sustainability gets assembled in curricula constructs.

3. Methods

Discourses on materiality, whether mediated through text or in the classroom, become dialectically tides and waves (of internalized and externalized 'facts') by ways in which different domains form habitual practices (Cook et al., 2013; Barth et al., 2014). This study is based on the use of (peer) expert interviews and analysis of study regulations (Table 1; appendix 1). As any curricula development can be viewed as educational-ideological configurations, the empirical analysis is based on interviews with research geographers to particularly address their teaching, opinion, use and explication of sustainability. Interviews were based in a phenomenological tradition, whereby departure is taken from the individual interviewee's experiences, and the focus is on the subjective perception of the investigated topic. Thus, educational-political configurations were studied in line with three ESD approaches, discussed by Skolverket (2001), Molin (2006) and Grahn (2011). These authors discuss the following three ESD typologies, here briefly reflected in a condensed

Table 1
Sample of interview participants.

Responder	Gender	Geographical background	Title	Institution	Age
1	Male	Physical	Ass Prof	Copenhagen	40–49
2	Male	Human	Ass Prof	Copenhagen	50–59
3	Male	Human	Ass Prof	Roskilde	60+
4	Female	Physical	Professor	Aalborg	60+
5	Male	Physical	Ass Prof	Roskilde	50–59
6	Male	Human	Ass Prof	Copenhagen	50–59
7	Male	Physical	Professor	Copenhagen	60+
8	Female	Human	Ass Prof	Copenhagen	40–49
9	Female	Human	Professor	Roskilde	60+
10	Male	Physical	Professor	Copenhagen	50–59
11	Male	Physical	Ass Prof	Copenhagen	50–59
12	Male	Human	Ass Prof	Roskilde	60+
13	Male	Human	Ass Prof	Aalborg	40–49
14	Male	Physical	Ass Prof	Copenhagen	40–49
15	Male	Human	Ass Prof	Copenhagen	30–39
16	Male	Physical	Ass Prof	Roskilde	60+
17	Female	Human	Ass Prof	Roskilde	50–59
18	Male	Physical	Ass Prof	Copenhagen	30–39
19	Male	Physical	Ass Prof	Copenhagen	50–59
20	Female	Human	Ass Prof	Copenhagen	40–49
21	Male	Physical	Ass Prof	Aalborg	40–49
22	Male	Human	Ass Prof	Copenhagen	50–59
23	Male	Physical	Professor	Roskilde	60+
24	Male	Physical	Professor	Copenhagen	60+
25	Male	Physical	Ass Prof	Roskilde	60+
26	Male	Physical	Ass Prof	Copenhagen	50–59
27	Male	Human	Ass Prof	Roskilde	50–59
28	Female	Physical	Professor	Copenhagen	60+
29	Male	Human	Ass Prof	Roskilde	50–59
30	Male	Human	Ass Prof	Copenhagen	50–59
31	Female	Physical	Ass Prof	Roskilde	40–49
Responders	Male: 24	Physical:17	Ass Prof: 24	Aalborg:3	30–39: 2
Total: 31	Female: 7	Human:14	Professor: 7	Copenhagen:17	40–49: 7
				Roskilde:11	50–59: 12
					60+: 10

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form. First, *the fact-based sustainability approach* is based on the idea of providing students with the right facts (that the teacher/science claims to possess) that will make them able to become knowledgeable decision makers taking sustainability into consideration (Skolverket, 2001; Grahn, 2011). Fact based sustainability approaches connote tides and waves from the quantitative revolution. Solutions are to be revealed from science itself, through better methods and scientific facts. This implies that previous knowledge has been misguiding sustainability practices or is essentially wrong (typology of essentialism). *The norm based sustainability approach* in contrast, portrays values and norms as one of the core problems of unsustainable production patterns (Molin, 2006) closely aligned to ecocentrism. Ecocentrism outlines a profound critique of existing production systems, as it relies upon a mechanistic/technocratic worldview. Ecocentric perspectives incurred into the norm based ESD approaches produces a moral/ethical critique of the mechanical view on nature within the descriptive tradition. Thus it suggests that humans have lost touch with nature, and need to replace the mechanistic world view (that produces technocratic knowledge and is unable to treat nature as anything but a resource), with an esthetic ecological perspective (Castree, 2001). In many ways norm based sustainability learning bears reference to a reciprocal form of environmental determinism that aims to enable students to take norm/ethical decisions based on scientific facts (that the teacher/science claims to possess). But, it can also take form within the quantitative revolution, replacing mechanical conceptualizations of nature with an ecocentric perspective. *The policy-based sustainability* approach depicts unsustainability as fundamentally a political matter (politics involved in decision making in various scales, individually or collectively). In contrast to the previous ESD approaches, students are no longer expected to take the right decision (Skolverket, 2001). Instead multiple perspectives are presented, conflicts, interests and democracy perspectives, in understanding fights and negotiations about natural resources and equity debates between and across generations. Thus, (re)-constructivism provides the underlying basis that enables students to critically examine alternatives, prospects and interests involved in pursuing particular plans, solutions and strategies (Grahn, 2011). In practice the three typologies are intertwined in ways that go much beyond the rhetoric of sustainability. Yet, the three ESD typologies bear relation to different ways of dealing with spatio-temporal tides and waves. How these developments influence ESD debates in various disciplines is in particular interesting in geography due to its strong tradition in the human-environment theme (Turner, 2002; Bednarz, 2006; Cotton et al., 2013).

3.1. Data collection, process and sample

A thematic analysis was used to structure the empirical data (Braun and Clarke, 2006). The interviews were produced in line with Skolverket (2001) and Grahn (2011) using meaning condensation as described by Bryman and Bell (2011). Study regulations (see appendix 1) can be acknowledged as the 'law' that constitutes the legal and administrative basis, from which courses, curricula and educational practices developed (Roskilde University 2005, 2006; Copenhagen University 2009a, 2009b and Aalborg University 2010a, 2010b, 2011). Study regulations state the administrative and juridical basis of the study and are written by the individual study boards for each education.[2] Since 2009 the term sustainability features in study regulations at Copenhagen University and Aalborg University.

For this reason sustainability themes were identified in study regulations and systematically, coded and categorized into the framework of the fact, norm and policy based sustainability approaches. Examination of study regulations were combined with in depth interviews with the chairs of the study boards including interviews with 31 of 43 fulltime associate professors and professors attached to the education of geographers at Copenhagen, Roskilde and Aalborg University (the three Danish universities that offer an MA in geography). Thus, 31 out of a total number of 43 permanent research professors involved in educating geographers were interviewed, hereof 24 full-time professors at Copenhagen University, 15 full-time professors at Roskilde University and four full-time professors at Aalborg University. Accordingly, the numbers of researchers interviewed follow the size of the study programs at Aalborg, Copenhagen and Roskilde Universities. Interviews were undertaken and recorded in Danish during 2012. As the sample deal with 31 interviews, transcription has only been translated into English when used in quotations. Interview were anonymized and coded, following a qualitative content analysis approach as described by Bryman and Bell (2011). Table 1 summarizes key figures from the interview participants. Note the sample is gendered by being dominated by elderly men, as for Danish universities in general where approximately 10 percent female become professors.

The respondents were asked if they find climate change and sustainability issues important to geographical education, what they think of the concept of sustainability in relation to geography, and if they include sustainability themes in their own teaching (Adriansen and Madsen, 2009). Based upon open questions, interviews particularly address geographers' opinion, use and explication of sustainability in their teaching (Bryman and Bell, 2011). Thus, interview questions were centered on perceptions of sustainability as it appears to the teachers/researchers themselves. The qualitative analysis was constructed by thematically condensing the interview material for each individual interview, coding each interview on its own basis. Then, interviews were cross analyzed to examine joint features as described by Braun and Clarke (2006). Hereafter the interview material was categorized into Skolverket (2001) and Grahn (2011) classification of ESD. In this respect, a thematic approach is not inductive as elaborated in Braun and Clarke (2006), but constitutes interplays between theoretical categories and empirical material. This method allows us to examine the interplay between different data and return to the theoretical constraints to examine their validity.

4. Curricula development at the human – environment interface: dilemmas of approaches to sustainability

In what follows, a combination of interviews and study regulations are analyzed according to the Norm-, Fact and Policy based ESD approach. As appears from the international literature (e.g. Huckle, 2002; Bednarz, 2006; Sayer, 2009; Firth, 2011) geography finds resonance in human-environment interactions, so an opportunity to articulate geography's particular role in dealing with sustainability. Jahn et al. (2011) serves as an example of how geographers find the human-environment theme to be a platform for linking ESD and geography. *"The subject geography is of importance in the context of ESD due to the analyses of human-environment-interactions and their implications on a geographic area"* (Jahn et al., 2011, p. 22). Though nearly all Danish geographers interviewed remain critical towards the concept of sustainability itself, 29 of the 31 geographers interviewed find sustainability or related concepts representing environmental issues, essential to

[2] Studies at Danish universities undergo accreditation by an independent body appointed by the Danish Ministry of Education. Also the universities' administration may propose changes to the study board. Study regulations state the purpose of the study, structure of the study, content, acquired skills, competences, courses, projects and seminars, and procedures for examination.

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Table 2
Interviews on sustainability approaches in geography: Examples of fact-based, norm-based and policy-based learning perspectives.

ESD as fact-based sustainability learning:	ESD as norm-based sustainability learning:	ESD as policy-based sustainability learning
Key characteristics • Providing students with the right facts based on a mass-balance principle between humans and their engagement with nature • Possess knowledge on and exceling in analysis of ecological variables • Damage control, minimize current environmental problems through science and technology • Ontological dualism, nature as external • Essentialism/absolutism, based on scientific facts, it is obvious what needs to be done	**Key characteristics:** • Values and norms as a central means for addressing sustainability • Sustainability as a value that challenges existing production and consumption patterns • Developing a sense of a balanced relationship between human and nature • Distinguish between facts and norms • Ontologically intertwining the natural and the social • ESD as discursive constructionism	**Key characteristics:** • Depicts unsustainability as fundamentally a political matter • Critical engagement with the politics of (un)sustainability and relation/correlation between geographical location of natural resources and geographical distribution of wealth, economic growth and environmental harm. • Multiple perspectives, power conflicts, interests and democracy, in understanding fights and negotiations about socio-ecological challenges • Nature as internal and external • ESD as reconstructivism
Example by quotation *"One of the core questions is: Are the data we observe today in balance? In many respects such questions are the same as the idea of sustainability. Geographers are qualified in explaining facts about the spatial dimension of data observed. Students should be exemplary in analyzing the spatial dimension of environmental facts"* (Interview 16).	***Example by quotation*** *"Occasionally I reflect upon the normative horizon in planning and what we want in a teaching perspective. As I teach in adaption and transferability the sustainability approach is strongly integrated. But, I do not use the term very often. Rather sustainability is an implicit notion, an overall goal to strive for.* (Interview 3).	***Example by quotation*** *"Sustainability has become important to geography since it corresponds to the interest of geography in always integrating different perspectives to address a problem. Because sustainability is a politico-ideological concept, even a strong one I teach students to remain critical about its implications, theoretically, methodologically and epistemologically"* (Interview 25).

geography. Two geographers interviewed rejected using sustainability concepts at all. Though environmental issues are important to geography, they suggested related concepts like ecology, resilience or vulnerability are better suited for studying environmental concerns (Interview, 5, 17). The analysis therefore also illustrates fractions and frictions in the interface between the fact-based, norm-based and policy-based ESD. As can be seen from Table 2, norm-based, fact-based and policy-based ESD approaches are identified in the interviews and both human and physical geographers contribute to them.

Norm-based ESD approaches are least represented in the interviews. Whereas a few interviews are explicit in teaching ethics and values (Interview, 2, 3, 8, 10, 14, 24, 27, 30) they structure normativity agendas as implicit curricula (Cotton et al., 2013). Normativity agendas in favor of sustainability are generally rejected. If considered at all, they are represented as democracy perspectives, a critical understanding of power relations, and in favor of a holistic approach. Moreover it represents an interdisciplinary and integrated understanding of the physical, ecological, economic, socio-cultural and political systems that shape the world (Interview, 3, 6, 10, 24, 30). To provide students with skills that enable them to become change agents that serve the normative agenda of sustainability has no purpose in geography; interviewees suggest, "*Sustainable values and ethical questions are* an individual matter, and have not been debated at an institutional level. It is nothing we seek to form *a common consensus about – that we will like to form students in a certain way. Teachers have different agendas and enrich students with different perspectives"* (Interview, 9). Study regulations never explicitly address ethics, norms, nor attitudes associated with ESD or similar topics, though any curricula can be said to exist outside the boundaries of implicit curricula constructs (Aalborg University, 2010a+b, 2011; Copenhagen University, 2009a+b; Roskilde University, 2006; Interviews). Thus, Danish Master degrees in geography seem, though reluctantly, to engage in what Vare and Scott (2007) have termed ESD 2 learning. Whereas ESD 1 refers to moral development under*"the promotion of informed, skilled behaviors and ways of thinking, useful in the short-term where the need is clearly defined"* (Vare and Scott, 2007, p. 191), ESD 2 learning, is about building learners' capacity to think critically about sustainability problems, also "about what experts say and to test ideas, exploring the dilemmas and contradictions inherent to sustainable living" (Vare and Scott, 2007, p. 191).

Fact-based ESD approaches as described by Skolverket (2001), Grahn (2011) among others, represent nature as an integrated part of socio-environmental interaction, still to be epistemologically objectified. Students become experts in producing, describing, and using scientific facts, and in testing their validity, limitations and possible application in society (Copenhagen University, 2009a; Aalborg University, 2011). The dominant position connotes 'a more than fact-based perspective'. Facts represent complex climate systems and social practices. Assumptions of synthetic cause and effect scenarios need supplementation of the social dimension of climate change (interview, 1, 4, 9, 11, 12, 16, 19, 26). Despite the recognition that 1) facts are historically contingent and change over time, and 2) sustainability is a contested term that cannot be reduced to simple facts, assemblages from the quantitative revolution is reminiscent. Thus, the fact-based ESD approach relies on the grounds of scientific objectivism from where scientists can speak about "the true condition of nature" in absolute terms. Hereby science can derive objective facts about nature and how society harms the biosphere. It follows that ESD as facts about sustainability or climate change, outlays a profound critique of existing production and consumption systems, while judgments on the basis on scientific facts convert into normative, moral or policy formulations, that replaces a mechanistic worldview of nature with 'objective' ecocentrism (Castree, 2001). Also in study regulations fact-based curricula constructs deal with 'management of sustainability, through objective methodologies' (Interview, 6, 8, 15, 18, 21, 28). Though facts are dynamic and change over time, it is assumed that sustainability can be instrumentally controlled and adjusted by decision making based upon objective scientific facts. Thus, the ESD as facts ignore that these facts derived on objective grounds are extrapolated to provide adequate knowledge to better manage the very same objective nature. Rather it replaces previous facts about nature with new facts, the one derived from a mechanistic/instrumental world view, the latter from an ecocentric one, while both are claimed to be 'objective in nature'.

Policy-based ESD approaches bear connotations to the second nature perspective, power dynamics and interests involved in education. Policy based ESD therefore suggests that issues of sustainability are a matter of politics rather than moral or empirical facts. The understanding of wicked problems like sustainability or climate change requires a reflective rather than an explanatory or commercial ambition asking, what kind of sustainability with what

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kind of agendas (Interview, 2, 5, 12, 13, 16, 28). *"Sustainability requires a holistic approach, thus different agendas and perspectives are part of education to let the students think critically"* (Interview, 25). Sustainability concepts are not only complex because they convey multiple meanings; they are also outlived in images and storylines, (from commercials, to media and utopian thinking) used by businesses (that pollutes and profits from nature simultaneously), governments (who possesses the legal power to control and manage human environment interactions) and organizations (that politically engage in rights to manage nature) to argue for particular 'sustainability' interests (Castree, 2001). Critical thinking and interdisciplinary approaches, therefore, are essential to understanding different practices and agendas in play as different agencies acknowledge sustainability challenges and solutions differently (Interview, 4, 7, 9, 12, 15, 20, 23, 31). While explication of sustainability concepts promotes multiple and conflicting interests, it is assumed that nature is produced differently under different governmental forms, *"As a geographer it is imperative to understand the spatial distribution of environmental harm, and how this distribution is organized in and between different societies, between rich and poor or between the North and South"* (Interview, 3). It is interesting to observe that ecocentric and gradual sustainability perspectives are represented in the interviews. Approaches outside mainstream sustainable development, e.g. critical or radical approaches (deep ecology, eco-Marxism or eco-feminism) are neither reflected in interviews nor study regulations (Study regulation, Roskilde University 2005, 2006; Copenhagen University, 2009a+b; Aalborg University, 2010a+b, 2011).

The multiple ways geographers engage in teaching sustainability suggest responses that go beyond the traditional ESD 1 and ESD 2 (Vare and Scott, 2007), fact-, norm- and policy-based ESD approaches (Skolverket, 2001; Molin, 2006; Grahn, 2011). In practice the three ESD learning approaches enfold and unfold into one another and produce complex dilemmas that encompass educational-politico geographies of how sustainability themes are enacted.

5. Findings: paradoxical cultures – paradoxical natures: integrating sustainability into curricula as an implicit notion

As nearly all geographers interviewed found sustainability issues essential to geography, but remain critical about the notion, it illustrates contradictory elements to the claimed relevance of geographical work. As neither scientists nor students can escape the value-laden proxy of sustainability significant dilemmas, fractions and frictions emerge when integrating sustainability into curricula. Dilemmas, however, also go beyond fact-, norm- and policy-based ESD approaches. In what follows this is discussed through two subcategories, namely 1) the substitution of concepts and 2) ESD as implicit curricula. These represent two educational strategies for putting sustainability on the agenda and at the same time hiding it.

5.1. Frictions and fractions: the importance of sustainability and the substitution of concepts

The first source of reluctance to explicate sustainability in the classroom involves criticism of values, ethics, moral and norms implicated in framing scientific work around such concepts. Dilemmas lie in the nexus between multiple normative agendas, different sustainability concepts that simultaneously reject the value-laden content from which the concept cannot escape. *'Sustainability is a considerable sub-component to geographical work. Sustainability is part of geography in itself as a mass balance principle and systemic contemplations, through geography's* holistic and interdisciplinary dimensions. Having said that, many other aspects are important to geographers and the phrase is sometimes inevitable. I prefer other terms, but the underlying basis is crucial to geography" (Interview, 13).

Though a substantial number of the geographers interviewed find sustainability themes relevant to geography, the concept in itself rather belongs to the political sphere than the scientific. Because of the norm and political by-products sustainability concepts rely upon (as well as any theme, key concepts or disciplines), one solution is at first glance to replace the concept with another (Interview, 1, 5, 6, 10, 12, 16, 17, 20, 22, 24, 25, 31). "We need to eliminate the concept of sustainability and replace it with ecology. Sustainability is an empty concept that leads to nowhere. Instead robustness or resilience for instance, concentrates ecological discussions into awareness of the conditi*ons of a particular matter. So resilience and ecology that is what should be central in geography"* (Interview, 22).

The implication appears to be to replace concepts rather than replacing the relevance of themes such concepts envision depicting. As challenges of sustainability cannot be reduced to semantics, frictions of being sympathetic to the notion of sustainability, collide with the political implications. Though related concepts may be more dynamic, progressive and intriguing, they cannot escape the complexity, normative horizons and policy figurations involved in dealing with nature. To replace one concept with another as a solution in itself, is to ignore the material changes the concepts seek to explain, if it solely ends up in dispute about terminology (Demeritt, 2002). Thus, the whole question about environmental issues is of importance to geography, but which concept is most suitable in analysing human-environmental concerns, encapsulates discussions of the analytical and ontological status such concepts rely upon. *"Sustainability does not have the same ontological status as a number of key concepts in geography. Landscape, region, place, nation to global – all bear a strong ontological status. Sustainability is not part of these concepts (…). It is a political concept rather than an analytical concept"* (Interview, 17).

Ontological assumptions as to displacements of concepts, however, reveal another aspect that should be borne in mind. From the second nature perspective, the human environment theme amalgamates the spatio-chorological theme and cannot be construed as being opposed to one another (Harvey, 1996). In contrast curricula constructs in favor of the spatial-chorological approach like urban studies (transformation of cities, one of six MA qualification profiles at Copenhagen University), do not explicate nature and environment, sustainability, climate change nor resource themes (Study regulation, Copenhagen University, 2009, p. 5; Roskilde University, 2006). The reason may be that urban geography is dominant in these courses. Urban geography has a strong spatial tradition often separated from the human environment theme (Turner, 2002). This is inherently paradoxical since much of the theoretical work urban studies rely upon (e.g. David Harvey, Doreen Massey and Nigel Thrift), refuse ontological dualism, separating human and nature. Addressing sustainability is like swimming against ontological tides and waves in the spatio-chorological tradition (Interview, 5, 6, 9, 14, 15, 18, 21, 22, 25, 31). These concepts however are generally little reflected upon with respect to their epistemological and ontological status. As action or inaction is unavoidably value laden, scholars, students, and practitioners need to transcend normative, moral or policy configurations of ESD learning and discuss dilemmas, contradictions and paradoxes involved in different agendas, as well as their epistemological and ontological consequences.

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5.2. Frictions and fractions: integration of sustainability as implicit curricula – learning agendas of socializing 'sustainable' nature(s)

Another subcategory identified underlines sustainability as an implicit notion (Interview, 3, 4, 6, 9, 10, 12, 14, 15, 22, 23, 25, 26, 28, 29). Thus, most of the researchers interviewed, when reflecting on their teaching, rarely address sustainability explicitly, but integrate sustainability into curricula as an implicit notion. *"Sustainability is absolutely central in geography – at least implicitly*. The reason why it is not important as an explicit concept is because I do not as such teach in sustainability, but much of my teaching nevertheless *concerns artifacts of sustainability. Students are highly interested in these matters, but we do also call them climate adaption, resilience, vulnerability among others"* (Interview, 29). This outlines the contradiction that the importance of sustainability contrasts ESD as implicit curricula. Thus, ESD as tacit configurations depicts the supra-complexity of sustainability in curricula constructs. This illustrates another contradiction: the willingness to teach sustainability as an implicit norm orientation is highly acceptable among geographers, and contrasts reluctance and criticism to explicate the concept in classroom because of its biases. It merely hides them (Interview, 1, 7, 16, 22, 24, 28). The finding contradict the fact-based, the norm-based and the policy-based ESD approaches, and are counterproductive to the claimed and explicit relevance of them. Then, if scientists, scholars or geographers do not make sustainability explicit, but are willing to accept it, inherent politics are not there? Tacit information is neither logical, consistent nor reflected methodologically; still it carries huge amounts of knowledge that exists in the interface between subject and object, between human and nature relevant to the spatio-temporal figurations (tides and waves) of co-constructing nature (Demeritt, 2002). The human-environment theme therefore embeds organized assumptions by the way one categorizes parts of the world, whatever concept attached to it (Harvey, 1996). Similar to the replacement strategy, sustainability as an implicit notion becomes bearer of policy intrigued dilemmas. Whether explicated as particular contributions that 'reclaim the high grounds' of geography (Stoddard, 1987) or intrinsic depictions that (both) seek to distance from produced politics and elucidate them simultaneously, the implicit extrapolation of sustainability converts into a form of implicit curriculum, accompanying political ecologies. While seemingly expressing neutrality, as if sustainability is not there, it bears relation to the co-construction of environmental consciousness that tends to be in advocacy of the teacher's belief (cultural embodiment), without the student (observer) becoming aware of it (Cotton et al., 2013).

The dilemma of course is that sustainability requires critical thinking, which is why tensions, conflicts and rivalry become constitutive and contradictory to sustaining sustainability simultaneously. To hide discussion of tacit curricula is contradictory to 'ESD as politics' itself, since students are taught to be aware and critical towards agendas, interests, and strategies involved in claiming particular sustainability agendas: except from the implicit curricula, the immanent social natures associated with sustainability teaching. The puzzle from the second nature perspective is that students learn to analyze the politico-ecological jigsaw of ESD approaches as well. These ESD approaches uniform intrinsic natures about sustainability cultures. Dilemmas in explications and explanation of the value-laden proxy of sustainability may be one of the reasons why the analysis of study regulations reveals that sustainability has a limited status in geography educations in practice.

6. Discussion: dilemmas, paradoxes and contradictions within and between ESD approaches

While contemporary ESD literature is nested in the need for critical, holistic and interdisciplinary learning approaches (Rieckmann, 2012; Adomßent et al., 2014) few turn into theoretical discussions on the paradoxical natures and cultures in engaging with ever accelerating human–nature interactions. From the second nature perspective (Castree, 2001), traditional ESD typologies (Skolverket, 2001; Vare and Scott, 2007; Grahn, 2011) have been analyzed, and a number of contradictions, frictions and fractions have been conveyed within and beyond the fact-based, norm-based and policy-based ESD approaches. Thus, researchers engaged in teaching university geography both find sustainability themes central to educating geographers, and are reluctant to use the concept of sustainability in the classroom. Both categories of scholars seek to distance themselves from produced politics, whilst at the same time elucidating them.

Though analyzed in the context of geography, these contradictions surpass the borders of geography, and are therefore relevant to ESD practitioners in various interdisciplinary contexts. Rieckmann (2012), for instance, points to ESD competency in handling incomplete and complex information. With the two sub-typologies in mind, this could be extended to also envision competency in analyzing and handling contradictions and paradoxes that align with particular sustainability problems at hand, in order to produce solutions that can overcome them. One implication of the paper is that scientists, scholars and practitioners must deconstruct concepts like barriers and drivers, challenges and opportunities that much ESD builds upon (Segalás et al., 2010; Karatzoglou, 2013). Similarly, scholars across disciplines need to reflect more carefully on contradictions and paradoxes as well. The implication of the former is that journal articles, teaching and dissemination of knowledge also risk being subject to green washing and branding itself (interests involved in being highest on sustainable metric leagues, best practice cases). The implication of the latter may be that students should also be invited to think critically about the subtle political ecologies engaged in different ESD approaches and their socio-material effects. This enables students, teachers and practitioners to explore the double level of controversy, (Lambert, 1999; Morgan, 2011) thematic and methodological, socio-environmental paradoxes, whatever perspective on nature is taken. Thus, different ontologies (tides) and anthologies (waves) have different socio-material effects, as e.g. norm-, fact- and policy-based sustainability approaches produce different political ecologies. What types of social natures exist within ESD with what interests involved? Who benefit from those political ecologies produced and with what socio-ecological consequences? Such a perspective encourages students to understand the multiple dilemmas, complexities and contradictions involved in ESD itself.

Though fact-, norm- and policy-based ESD approaches are identified, contradictions, frictions and fractions suggest one must not only live with, but also address and respond to social biases of producing paradoxical cultures and paradoxical nature(s). What is considered the right knowledge, skills and attitude in norm-, fact- and policy-based ESD approaches exhibits rivalry over different political ecologies. Henceforth educational-politico assemblages of intended learning outcome, produce different social natures, why scientists and students must strive for better understandings of how such depictions come to embody scientific habitual traditions (Castree, 2001; Cook et al., 2013).

By analogy, Burandt and Barth (2010) discuss the syndrome ESD approach and scenario ESD approach in the context of sustain-

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ability science. The syndrome approach is based on the thesis that the dynamics of global change can be attributed and addressed through a number of manageable and functional patterns. It is the non-sustainable courses of these dynamic patterns that are identified as syndromes to global environmental change (Burandt and Barth, 2010) – and thus can be re-managed and manufactured in more sustainable ways. In contrast the scenario approach fosters systematic thinking about future socio-ecological change, integrating complex, long-term and uncertain issues. In an educational context, therefore, the scenario approach benefit from being fundamentally interdisciplinary. It fosters interdisciplinary thinking that engages in critical thinking about setting future results, back-casting and modelling them.

The syndrome approach bears relation to the fact-based learning approach by analyzing facts about the assumed syndrome conditions of nature. Developed by the German Advisory Council on Global Change the syndrome approach represents spatio-temporal tides and waves from which ESD practitioners and scientists "as doctors" need to intervene in nature. Fact-based learning transforms complex systems into organized 'objective' knowledge constructs, by ways in which scientific knowledge mutually becomes organized power relations as to what kind of knowledge to be instrumentally used to adjust interaction with nature (Urry, 2011). In this approach, nature is a source and a raw material for production that can be exploited in different ways (Burandt and Barth, 2010). It follows that the syndrome of natural management is when natural use is not maximized fully due to devastating practices. In a holistic manner organized within the framework of cause – effect, limitations and opportunities of natural resource management, one can speak of different syndrome conditions caused by different actions. As a result different facts provided and modeled produce different scenarios, which legitimize different actions and uses of natural resources. Thus, syndrome and fact-based ESD approaches concurrently produce ESD as politics. This recognition featured in ESD as an implicit notion produces a double level of controversy since, when willing to accept sustainability as inherent in curricula, it is like accepting not being reflective about the values, norms, ontologies, and organized assumptions. Consequently also implicit curricula convert into implicit political ecologies.

Also the policy based-ESD approach faces controversy that represents different spatio-temporal tides and waves. Vare and Scott (2007), Burandt and Barth (2010), and Grahn (2011) suggest different ESD typologies (e.g. ESD1, ESD 2, syndrome approach, scenario ESD approach) and innovative approaches to integrate ESD (Barth et al., 2014). These approaches, in different ways distinguish values from facts and policies from norms, while at the same time they claims the importance of ethics and values (Lozano et al., 2013b; Wals, 2014). Policy based ESD suggests students no longer learn the norms, values, explanations or attitudes that the teacher or those in authority claim most suitable. Thus, the typology appears as if political ecologies are no longer embedded within them. The implicit curriculum either ESD represented as an implicit notion, or manifold through the policy-based ESD approach, is contradictory in itself since students are expected to be aware of interests and strategies involved in claiming particular sustainability agendas, except from the implicit curricula, and the immanent social natures of (sustainability) cultures in teaching.

Whatever ESD approach or perspective on nature one takes, political choices and values are situated in the play of power that strives for particular normative goals. Harvey (1996) points to values and normative horizons as 'utopian moments of reflectivity' embedded in practices of power over possible futures. Therefore the possible futures produced in science and education are never a question of choosing between different forms of objective and neutral knowledge, but between different forms of normative knowledge. In this perspective ESD connotes to nature(s) aligned with bio-centrism and/or ecocentrism assumed to process society toward a more sustainable condition (Hesselbarth and Schaltegger, 2014; Wals, 2014). As humanity are faced with the Anthropocene era (Crutzen, 2002), spatio-temporal tides and waves of dealing with the human environment interactions are ever more complex, producing ever more complex paradoxical natures and cultures. The quest for ESD is how to tackle these paradoxes across disciplines since frictions and fractions within and between different ESD approaches are inherently interdisciplinary.

7. Conclusions

This paper presents an empirical analysis of research geographers' considerations when integrating sustainability into Danish University geography curriculum programs. From the second nature perspective the study addresses contested ideas of integrating sustainability into curriculum and discusses the relevance of geographical imaginations on human–nature interactions when dealing with ESD approaches.

From the analysis it can firstly be concluded that, though 29 of 31 research geographers interviewed find sustainability essential to geography, nearly all remain critical of sustainability concepts, hence reluctant to explicate them. Thus, sustainability is more often addressed implicitly than explicitly. The claimed relevance of ESD is contradictory to the actual practice of addressing sustainability as an implicit notion. Secondly, it can therefore be concluded that the ways geographers engage in teaching sustainability also go beyond the ESD 1 and ESD 2, fact-, norm- and policy-based ESD approaches. Thus, the study reveals two sub-typologies: 1) ESD as implicit curricula, and 2) ESD as replacement of concepts, which represent two different educational strategies for putting sustainability on the agenda while hiding it. This finding reveals contradictions within and between the fact-based, the norm-based and the policy-based ESD approaches, which are counterproductive to the aims of different typologies themselves. It is thirdly concluded that geographers produce paradoxical culture-natures(s) when dealing with dilemmas of sustainability, as they both seek to distance themselves from produced politics while at the same time elucidating them. This has deep implications across disciplines (e.g. science, engineering, business academics). In order to transcend the paradoxical-culture-natures identified, scholars, students and practitioners across discipline need to address normative, fact or policy configurations of ESD and discuss dilemmas, contradictions and paradoxes involved in different agendas to better respond to them.

8. Further research

The research presented in this article opens the terrain of a second nature approach in exploring contested ideas of ESD. Though the study analyzes the 'nature(s)' of ESD in geography, contradictions surpass the borders of geography, and the findings are relevant to ESD practitioners and future research across discipline. In particular this study suggests further examination should address contradictory elements in and between different ESD approaches. This may include but are not limited to:

- Examination of ESD practices that look beyond barriers and drivers, challenges and opportunities as much ESD built upon, since sustainability contradictions and paradoxes are imbedded in them as well.
- ESD need approaching sustainability challenges with geographical imaginations in various spatial contexts. What

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appears to be a solution in one scale may produce sustainability challenges in another. To achieve such an understanding is not only relevant for geographers, but is relevant to ESD in various (inter) disciplinary contexts
- Critical self-examination and studies of scholars, students and practitioners own reflectiveness towards the normative, moral or policy configurations within ESD learning and the dilemmas, contradictions and paradoxes that cling to them.
- Examination of ESD as a practice that addresses and produces particular socio-natures.
- Further research, across discipline on ESD as replacement of concepts and ESD as implicit curricula. Can similar tendencies be found in other disciplines, areas or themes?
- Examine and develop curricula so that students learn to analyze the contradictory elements of sustainability, ESD approaches and the implicit curricula as well. How can curricula programs further develop and integrate this?

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Appendix 1. List of study regulation documents

Study regulation for geography at Roskilde University (2006), Bachelor and Master, Department of Environmental, Social and Spatial Change.
Study regulation for geography at Copenhagen University (2009a), Bachelor, Department for Geography and Geology.
Study regulation for geography at Copenhagen University (2009b), Master, Department for Geography and Geology.
Study regulation for geography at Aalborg University (2010a), Bachelor, Department of Development and Planning.
Study regulation for geography at Aalborg University (2010b), Master, Department of Development and Planning.
Study regulation for geography at Aalborg University (2011), Bachelor, Department of Development and Planning.

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Appendix 7.1

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RIGEO
Review of International Geographical Education Online
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'One just better understands.....when standing out there': Fieldwork as a Learning Methodology in University Education of Danish Geographers

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Abstract

The process of becoming a geographer is by no means simple and incorporates huge amounts of disciplinary embodiment. This paper provides an example of how this is enacted by exploring the perceptions of fieldwork within the education of Danish geographers. Firstly, the history of education of Danish geographers is unfolded. Secondly, it is shown that despite quite different organisational structures, in terms of the way that fieldwork is introduced and the educational structure in general; only little variations in learning objectives can be identified between the three Danish universities that educate geographers. Thirdly, based on an empirical study of Danish university geographers, we find three different perceptions of fieldwork as a learning methodology: fieldwork as an outdoor laboratory, fieldwork as sensuous realisation and fieldwork as a meta-theoretical practice. The results show that these three perceptions are not allocated to different academics or traditions, meaning that the individual researcher often encompasses more than one view of fieldwork either in relation to his or her own research or in relation to the education of future geographers. The categories of fieldwork presented, therefore, do not support the often claimed dichotomy between physical and human geography. Instead, the openness of geography as a synthesis discipline is found.

Keywords: Perceptions of fieldwork, learning methodology, university level, Denmark

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Introduction

In the public imagination geographers tend to be identified with maps, globes, travel plans and fieldwork. The research field of geography is constantly contested both from within the research field itself and from the outside when, for example, new fields of knowledge emerge like climate change (for a UK example see Sidaway & Johnston 2007).

All this has relevance to the education of new geographers. They are entering a field in constant development and are supposed to navigate their own enactment of being a geographer. The process of becoming a geographer is by no means simple and enfolds huge amounts of disciplinary embodiment. Studies have shown that adapting geographical competences is significantly different in different cultural settings, which give emphasis to various elements of geography (Simandan 2002, Nairn 2007). A growing number of papers in this journal (RIGEO) focus on geography education in different countries and cultural settings. Through their analyses of the great variety of geography education we have a rich source of understanding the issues of becoming a geographer, however more implicitly explored (e.g. Resnik Planinc 2011, Giorda & Di Palma 2011, Segeren 2012).

In this paper we aim to contribute to this particular field of knowledge by providing an empirical analysis of the education of geographers in Denmark. This is done by, firstly, providing a retrospective view of the development of geography at university level and its relations to secondary school level. Secondly, we present an empirical analysis of contested ideas of fieldwork given significance by researchers at universities for the education of geographers. The analysis is framed by Zenlinsky's three fieldwork categories (Zelinsky 2001). Finally, we discuss the results that have bearing on the education of future geographers and the importance of different cultural settings when studying fieldwork traditions in geography.

The methodological approach of emphasising fieldwork to embrace contemporary geography consists of a duality. Firstly, it suggests the notion of becoming familiar with the field(s) of geography throughout education. Secondly, it suggests the idea of being situated in the field as a learning methodology. By exploring contested ideas of fieldwork, it is hoped to go beyond this being and becoming in geographical education (Gould 1999, Zelinsky 2001).

Human geographers' fieldwork is sometimes cocooned as the art of collecting shared memories in public space, while physical geographers tend to associate fieldwork with objective data collection and their spatial characteristcs in the physical environment (Fuller et al. 2006, DeLyser & Karolczyk 2010). Others see fieldwork as the art of bringing together theory and practice. For others again fieldwork represents a methodological approach to bring space into being in theoretical formulations. Certainly, most of us agree that fieldwork is a learning methodology (Scott, Fuller & Gaskin 2006, Hovorka & Wolf 2009). Fieldwork is relevant to many geographers and is by many considered to be among the core 'cultural' training and educational efforts in becoming a geographer (Kent et al. 1997, Fuller et al. 2006, Hope 2009). This brings us to our research questions: How, therefore, is fieldwork taught in contemporary Danish

geography? How is fieldwork represented in curricula? And how do university geography researchers conceive of fieldwork as a learning methodology?

Methodology

The methodological approach to analyse the current teaching of geography is designed to examine, firstly, the history of Danish geography – in particular, to emphasise the human-nature theme, in which fieldwork traditions dominate – secondly, the present educational-politico framework of how fieldwork is given priority in curricula (and their formal requirements); and thirdly, how these requirements are enacted in practice, their status in university geographers' interpretation of fieldwork as an educational tool. For many university geographers' fieldwork has served as a central component not only of their own education but also later in their research and teaching activities. For this reason, we found it valuable to consider the plurality of geographical interpretations by exploring the complexity and multi-dynamical ways in which fieldwork is practised and contested by Danish university geographers (Hope 2009). The concept of fieldwork is indeed dynamic and enriches geographical work in multiple ways and traditions. Often clear geographical imaginations blossom when fieldwork is mentioned. Yet, it is sometimes hard to give a concise and condensed answer of what fieldwork actually is and how we learn to practise it. This is simply because fieldwork is something we do tacitly, implicitly and explicitly (Sæther 2007). The methodological approach, therefore, aims to grasp the duality between becoming familiar with the field(s) of geography and being situated in the field as a learning methodology (Gould 1999).

To address this duality of being and becoming, we analyse the empirical data through an analytic design inspired by Zelinsky's (2001) argument for three general categories of fieldwork. The first is a commercialised form of fieldwork, in which the fieldwork is based on the normative agenda to support the interst of a client. Fieldwork with a reflective rather than a commercial ambition is included in Zelinsky's second category. Here, fieldwork is conducted to solve a research question. Fieldwork may be standardised through new ways that need to be integrated into the existing schema. The last category is fieldwork as an ad hoc, impulsive and informal practice (Zelinsky 2001). In this paper, the fieldwork categories of Zelinsky are used as a framework for analysis since they stress multiplicity in explaining human-nature representations, while leaving room for understanding how such depictions come to embody scientific habitual history-disciplinary traditions. Thus, all empirical interview data and study regulations were categorised and condensed into Zelinsky's framework. In this way, we hope that the analysis has much to say about contested ideas of fieldwork within geography and can unfold how fieldwork encompasses multiple geographical disciplinary approaches. Moreover, emphasis on fieldwork serves as a way of highlighting traditional distinctions between physical and human geography. Thus, recognition of the diversity among human geographers and physical geographers who, for instance, do not work with human-nature relationships, is combined with asking, for example, about human-nature relationships within fieldwork in the contemporary education of geographers. This approach makes it possible to see how fieldwork is conceptualized and how this influence how students become geographically trained and their understanding of

human-nature interactions developed (Hovorka & Wolf 2009, DeLyser & Karolczyk 2010).

Data collection, process and sample

During 2012, interviews were conducted with almost all permanent employed geographers at three Danish universities, the only higher education insitutions in the country offering geography programmes. The interviews had a special focus on fieldwork in relation to the education of geographers. All full-time, permanent scientific staff, associate professors and professors teaching geography at Copenhagen, Roskilde and Aalborg universities were interviewed, except researchers who were either on fieldwork themselves, visiting other universities, attending conferences, or authors of this paper. Thus, 31 of 42 university geographers were interviewed – 42 being the total number of permanent researchers of geography involved in the education of geographers in higher education programmes in Denmark. In total, 24 full-time associate professors and professors at Copenhagen University, 15 full-time associate professors and professors at Roskilde University and four full-time associate professors and professors at Aalborg University were interviewed.

The authors of this paper are both insiders and outsiders in relation to former and present colleagues within this group of university geographers. Further, all three authors are insiders in relation to the research matter, because we are all doing research within the field of geography like our interviewees. To address this double insider role, we have followed the recommendations of Adriansen & Madsen (2009). Firstly, we acknowledged that some interviewees were too close to establish an interview/interviewee relationship and, therefore, certain that the author doing the interview was not too close to the interviewee. Secondly, we paid special attention to pursuing 'you know' answers. In the interview-situation the responders were all asked similar questions about the role of fieldwork for the education of geographers. What did they understand by fieldwork? And what did they regard as the most important things they learnt through fieldwork? Further, in their opinion, can one become a geographer without being on fieldwork during his or her education? These questions qualify our examination of contested ideas of fieldwork as a learning methodology. To be insiders in relation to one's research matter means that we have access to and produce valuable research results otherwise not found (within the field of geography, see e.g. Simadan 2002, Madsen & Adriansen 2006, Madsen & Winsløw 2009).

A thematic analysis was used to analyse and structure the empirical data (Braun & Clarke 2006). The thematic analysis was situated in a phenomenological approach, where departure is taken from the individual interviewee's experiences, and the focus is on the subjective perception of the investigated topic. The research data were produced in line with Zelinsky's fieldwork categories using meaning condensation as described by Kvale (1996). In this respect, a thematic approach is not inductive as elaborated in Braun & Clarke (2006), but constitutes an interplay between theoretical categoreis and empirical material. To organise the data material and construct the resulting categories, we posed an analytical question: what are the interviewees' perception of the role and

relevance of fieldwork in the education of geographers in relation to the outcome for the students, and in relation to the students' process of becoming a geographer?

Interview methods are valuable in the analysis of contested ideas of fieldwork, but were also supplemented by examination of study regulations to explore the formal depictions of fieldwork. Since study regulations can be acknowledged as the 'law' that constitutes the legal and administrative basis, they are considered to be a useful analytical object reflecting the background from which courses, curricula and educational practices develop (Roskilde University 2006, Copenhagen University 2009a, 2009b and Aalborg University 2010a, 2010b, 2011). Thus, in these documents fieldwork, field courses and fieldwork requirements were identified.

Findings

History of geography education in Denmark

The teaching of geography in Danish universities has both in the past and in the present sought academic identity through 'the geographical experiment'; that is, 'an experiment in keeping nature and culture under the one umbrella' (Livingstone 1992:190). Indeed, in 'Jorden og Menneskelivet' (The Earth and the Human Life), the tellingly entitled four-volume handbook that for some decades was core reading for Danish students of geography, the field was (with an underlying measure of environmental determinism) specified in this way:

> *The task of geography is to depict the Earth as the home and field of activity of human beings. Land and people, nature and culture, are the topics the geographer strives to connect; his [sic!] goal is to demonstrate how human life and culture are conditioned by the Earth's natural conditions and utilise the possibilities afforded by the Earth's nature (Vahl & Hatt 1922: 1; here quoted in translation from Larsen 2009:15).*

As one may note, fieldwork is not far from the heart, the methodological study that brings together nature and culture, land and people.

In their emphasis on the physical conditions for economic life, Vahl and Hatt could be said to follow the tradition of Malthe Conrad Bruun (1775–1826), the exiled Dane, who in Paris (as Malte-Brun) authored the renowned *Précis de la Géographie Universelle* (1810–1829) and, in 1821, co-founded the first geographical society, Société de Géographie (Bredal 2011). As we will outline in this section, such focus on the human-nature relationship has been both a cornerstone and a stumbling block in the evolution of Danish university geography, in which the notion and use of fieldwork seems to play its part.

In name, if certainly not always in practice, geography has been a part of the Danish university world since c.1635, when the first professor of geography and history was appointed at Copenhagen University. Until the establishment of Aarhus University, in 1928, Copenhagen housed the only university in Denmark. Yet, the field was for long a more or less neglected appendage to other teaching and research interests, and we have to look to the second half of the nineteenth century for the emergence of geography as a

distinct university discipline (Christiansen, Kingo Jacobsen & Nielsen 1979). As in several other countries, the establishment of Danish university geography was preceded by the 1876 formation of a geographical society: The Royal Danish Geographical Society (RDGS). The establishment of the RDGS was not detached from educational questions. Its object was (and is) thus 'both to further knowledge about the Earth and its inhabitants and to extend the interest in the geographical science' (quoted in Christiansen 2005:7), and one of its architects, Edvard Erslev (1824–1892), was a prominent autodidact geographer, a teacher of school geography and the author of several influential geographical textbooks. Yet, the initiators mainly represented military, commercial and explorative interest (Illeris 1999, Christiansen 2005).

The RDGS played a part in the establishment of Danish university geography, but it was particularly the introduction of geography as an upper secondary school subject – and the resulting need for qualified teachers – that, in 1883, led to the appointment of Ernst Løffler (1835–1911) as reader in geography. Løffler's position, which five years later was transformed into a professorship, was thus directly linked to the 1883 introduction of a graduate-level final examination (skoleembedseksamen) in natural history and geography aimed at teaching in the upper secondary school. Shortly before his death, Løffler wrote that it had been the vocation of his life 'to bring geography to our university as an established and fully-entitled subject' (quoted in Buciek 1999:41), and his personal struggle to get an academic foothold was intimately linked with the establishment of geography at Copenhagen University. Much like Halford Mackinder argued that it 'is the duty of the geographer to build a bridge across the abyss', between the natural sciences and the study of humanity, '[l]op off either limb of geography and you maim it in its noblest part' (Mackinder 1887:145), Løffler found that 'neither nature nor the human life can be excluded without in that way maiming geography as a science' (quoted in Christiansen, Kingo Jacobsen & Nielsen 1979:393). Also, for Løffler, a 'holistic' approach to human-nature relationships was a key to the academic identity of geography. He emphasised the human side, however, and was not pleased by the discipline's drift towards the natural sciences in the last decade of his life (Buciek 1999). It should in this respect be kept in mind that the introduction of geography had been met with scepticism at the Faculty of Science, which questioned the need of geography, as 'all the component parts of the field are already present'; this opposition was particularly overcome by the new need for geography teachers (Christiansen 2005:13). The education of teachers for the upper secondary school came in many ways to mark the development of Danish geography education for the next hundred years. In the words of Martin Vahl (1869–1946), professor of (physical) geography (1921–1940): 'the vast majority of those who study geography at Copenhagen University intend to become teachers in the upper secondary school' (Vahl 1924:122). In fact, looking back on the early history of geography at Copenhagen University, three geography professors found that 'scientific geography has paid dearly for sacrificing so much of its strength on the altar of the school' (Christiansen, Kingo Jacobsen & Nielsen 1979:391).

To qualify graduates for the upper secondary school was also the primary reason for establishing Danish geography education at Aarhus University. More specifically, the aim was also to qualify history graduates to teach geography. For this reason, and in

contrast to the situation at Copenhagen University, the chair in geography was situated at the Faculty of Arts. This was undoubtedly the reason for the Copenhagen professors' emphasis on physical geography!

Today, Aarhus University no longer offers a Master's Degree in Geography, and many related disciplines at the university have substituted much of what geographers previously regarded to be core geographical themes. In contemporary Danish universities, a Geography Master's Degree is offered at Aalborg, Copenhagen and Roskilde. The three institutions, however, have quite different educational structures and organizational traditions, which make them interesting subjects for analysis. The diversity in teaching geography is still set to be inherited by the history-geographical battlefields described above of which human-environment relationships continue to provide dynamism, enthusiasm and lively discussion. Intended learning outcome is always influenced by political configurations. Fieldwork by no means counteracts, but remains a gathering point for human and physical geography to assemble as 'curricula constructs' and to determine how fieldwork is taught (Illeris 2012).

Present education of Danish geographers and fieldwork affiliations

In the Danish school system geography is taught as an independent subject from lower secondary school (7–9 class) and in upper secondary school (1–3 G)[4]; it is mandatory in the first year and optional in the following two years. In primary school, geography is taught in 1–6 as 'Natur og teknik' (Nature and Technology) together with physics, chemistry and biology.

The education of teachers in Denmark is split in two: one for primary teachers that takes place at University Colleges (CVU), and one for secondary teachers and university teachers that takes place at the universities. Besides the keen relationship between geography at university and in upper secondary school, which is demonstrated in the history of geography education, contemporary geography is also characterised by strong relations between the geography curriculum at university and the secondary level. Within the last 30 years, the subject of geography has lived a turbulent life in secondary school (STX and HF). The relation between human and physical geography has been in focus especially. In the beginning of the 1970s, geology disappeared from the school subject of geography and physical geography could only be included to explain cultural problems. Thereby, human geography alone denoted the subject (Dolin 2007). In the 1980s, the role of geography in secondary school was threatened and the number of hours was reduced significantly. However, today the relation between human and physical geography is equal. With the reform of 2004 (known as the Gymnasiereformen 2005), geography was once again threatened and almost did not survive in secondary schools. The argument was that geographical knowledge was obtained in other subjects. However, due to a focus on geography as a science subject geography survived even more reduced and now under the name physical geography.

[4] In Denmark there are four types of upper-secondary schools giving equal opportunity to enter the higher education system (HTX, HHX, HF and STX). STX is a non-vocational general type of upper secondary school; HF is the same but focused and can be completed in two years compared with three years for STX. Both HHX and HTX are vocational schools specializing in business and science and technology respectively. Only at STX and HF is geography part of the curriculum.

This has meant a restructuring of learning objectives and a focus on new teaching approaches (Volkers 2007).

There has been a dual relation between the development of geography at the universities and the secondary level. It has been argued that the 'collapse' of the subject in secondary school was the result of the extensive discussions in the 1970s about the identity of geography at the university level as regards human and physical geography (Dolin 2007). However, the changes in the secondary geography curriculum have also led to changes in the university curriculum. For example, the secondary school reform of 2005 and later changes have served as leverage at the university by introducing structural changes to curricula in order to comply with upper secondary school teacher requirements (BEK nr 692 af 23/06/2010, and BEK nr 735 af 22/06/2010).

At all three universities (Copenhagen, Roskilde and Aalborg), where an education in geography is offered, both physical and human geography are taught. Thus, both research and teaching in physical and human geography take place.

Geography at Copenhagen is organised to allow students to have a minor subject besides geography (and vice versa). Therefore, 45 of 180 ECTS at the undergraduate level are allocated to a subdicipline to meet the upper secondary teacher requirements. The structure of the study complies with secondary school reform to educate two disciplinary teachers. Thus, bachelor students are introduced to core geographical theories and methods that correlate themes required to educate upper secondary school teachers. Based on problem-based analysis students are introduced to obligatory courses in physical and human geography. Obligatory courses for undergraduate students are, among others, Basic Statistics (7.5 ECTS), the Physical & Human Landscape (15 ECTS), GIS & Cartography (7.5 ECTS) and Climate, Soil & Water (7.5 ECTS) (Study regulation 2009a).

At graduate level secondary school requirements no longer give precedence to courses offered. Students choose one of the six specialisations offered that differentiate the Master of Science in Geography & Geoinformatics into the following qualification profiles: 1) Ecological Climatology and Climate Changes, 2) Geomorphology, Processes and Landscapes, 3) Global Environmental Soil Sciences, 4) Remote Sensing of the Bio-Geosphere, 5) Environment, Society and Development and 6) Transformation of Cities and Landscapes (Study regulation, 2009b). Thus, the education is structured to give core geographical qualifications supplemented with qualification profiles of the student's choice.

As for fieldwork requirements in study regulations at the University of Copenhagen, two obligatory field courses are given at bachelor level. The organisational structure does not per se encourage interdisciplinary links between physical and human geography – one field course is given in human (7.5 ECTS) and physical (7.5 ECTS) geography respectively. At graduate level 15 ECTS are allocated to six optional courses of which four are field courses: Field- and method course (15 ECTS), Field and method course SLUSE (15 ECTS), Faces analysis and field techniques (7.5 ECTS) and Process studies and field technique (7.5 ECTS) (Study regulation 2009b).

Geography at Roskilde is strongly influenced by the university's tradition in problem-based learning (PBL) since its birth in 1972. Today, all education is still organised around one and a half year's interdisciplinary study either within arts and humanities, social sciences, natural sciences or human-technological sciences. For this reason, specialisation within geography takes place after one and a half years of study. Moreover, students supplement geography with another discipline at bachelor and Master level. The diversity and multivariable skills among the students gives a profound interdisciplinary milieu when introduced to geography. This is continued in geography; the study regulation requires problem-based group work so that students 'collaborate with each other – also with students from another scientific background (…) which fosters different perspectives and resources to solve a scientific problem' (Study regulation 2006:23). Secondly, the organisational structure of the education seeks to establish overlapping functions between physical and human geography: 'students should be able to look upon scientific problems and solutions in an interdisciplinary approach – not only from particular disciplinary premises, but also by including relevant theories, methods and philosophical interpretations from related disciplines' (Study regulation 2006:23). Thus, students have courses, seminars and lectures accounting for 15 ECTS each term and problem-based group work accounting for 15 ECTS, in which students under supervision specialise in a geographical topic of their choice.

As regards fieldwork requirements, one obligatory field course (7.5 ECTS) encompasses 'further specialisation within cultural, human and physical field methods' (Study regulation 2006:12). The course requires 2–3 weeks of fieldwork in another country plus planning and reporting. It is worthwhile emphasising that the fieldcourse is not seperated in terms of human and physical geography as is the case at Copenhagen and Aalborg universities. In practice, however, physical and human geographers tend to form groups and lecturing activities within their particluar discipline during the course.

Geography at Aalborg University has a similar model; problem-based learning (PBL) as a fundamental learning approach throughout education. However, geography remains a full-time study both at undergraduate and graduate level. Hence, the education of geographers is organized around problem-based group-work (Study regulation 2011). Geography is a five-year study, however; education is structured in such a way as to allow students to have a minor or major subject besides geography in order to meet the upper secondary school teacher requirements. You may choose to study geography for one and a half years and another discipline for three and a half years (or vice versa), or geography for five years. In relation to fieldwork requirements, in the study regulation we find a similar structure as that at Copenhagen University. At bachelor level two obligatory 5 ECTS courses are offered, in human and physical geography. At graduate level two obligatory courses are offered in physical geography which includes fieldwork methods (Applied Methods in Physical Geography, 20 ECTS and Measurement Technology and Data Acquisition, 5 ECTS). Both courses emphasize the ability of students to: 'plan a literature review and field and/or laboratory work. […] and plan and carry out the measurement program for field and laboratory measurements' (Study regulation 2010c:10). There are no obligatory fieldcourses or requirements for the Master in Integrative Geography (Study Regulation 2010a).

In terms of all three university educational programmes in geography, the fieldwork supplements the students field projects as well as problem-based groupwork projects, bachelor and master theses. Despite quite different organisational structures, as regards how fieldwork is introduced to future geographers or the educational structure in general, only little variation in learning objectives is identified between the three educations in Denmark. Thus, the ability to identify and methodologically process complex geographical questions as well as understand spatial differentiation and how physical and social structures work in different scales remain core requirements. Moreover, students should be able to evaluate critically their own geographical qualifications and relation to other fields of science, and differentiation in theory, methods and empirical data from neighbouring disciplinary constructs (Study regulation, Copenhagen 2009b:3, Roskilde 2006:23, Aalborg 2011:4). Furthermore, it is emphasised that becoming a geographer allows students to plan their own learning strategies, visions and contexts that lead to critical and independent geographical analysis. Differentiation and the mobility of learning- and interpersonal skills are accentuated geographical qualifications, which enable students to collaborate in interdisciplinary teams as well as reflect upon their own field in relation to associated disciplines. These competences are, according to the interviewing material, in particular, associated with inclusion of fieldwork in the education of geographers (Interview 2012).

Fieldwork as a learning methodology

In the following, we examine the notions of fieldwork among current university geographers in Denmark. We found that the ways in which geographers perceive and conduct fieldwork are endlessly varied. Still, it is possible to condense common and conflicting fieldwork characteristics that are considered valuable in becoming a geographer. Fieldwork means being situated in a multitude of interconnections that allow students to reflect upon their own geographical imaginations; the context or community they are situated in brings together a range of tacit knowledge, everyday knowledge and expert knowledge (interview 2012). Through a multitude of interactions the fieldworker slowly develops a sense of what should be considered important, contradictory or repulsive: 'Fieldwork is like a handicraft; one needs to learn through education, especially students should obtain a critical attitude towards their field and their own situatedness in compiling field data' (Interview 2012).

Fieldwork is a craft that students should excel in, because it is a learning methodology that can be used to build up a good sense of geo-spatial appreciation. Thus, Danish university geographers strongly advocate the practice of fieldwork as a means of allowing students systematically and critically to make their own experiences of spatiality and exploration of an area. They should be trained to conduct this independently and be able to combine a multitude of probe samplings and triangulation strategies to understand complex correlations in their contextuality (Interview 2012).

One of the major recurrences in the interviewing material is that the education of geographers would be impoverished if fieldwork were eliminated. Even for those geographers who said that one could in principle become a geographer without fieldwork, they also contemplate that one miss an dimension, even if this missing

dimension remains undefined. To the question 'Can you become a geographer without doing fieldwork during your education?' 23 answered 'no', 1 answered 'yes' and 7 answered 'yes' but it will be an impoverished education (Interview 2012). This missing dimension is not at all easy to capture and hold an element of tacit knowledge or cultural schooling that few of us reflect upon in our daily practices as geographers. Yet, fieldwork as a learning methodology holds a strong position and only one geographer did not find fieldwork necessary in becoming a geographer, which corresponds to the findings by Scott, Fuller & Gaskin (2006). This missing dimension is represented in many forms and connotes a mysterious experience. It involves being visually confronted with the field and thus to ascertain synchronously different and liveable geographical representations: 'students always become more enthusiastic after being in the field; one suddenly just understands matematical formulas much better having seen the natural laws at work right in front of you' (Interview 2012). The mysterious learning element represented in the interviews corresponds to the findings of a British review: 'fieldwork gives opportunities for learning which cannot be duplicated in the classroom. It greatly enhances students' understanding of geographical features and concepts, and allows students to develop specific as well as general skills' (HMI 1992, here quoted in Fuller et al. 2006:199).

Knowledge and processes of realization are mutually associated with a given learning environment. Realization is often recognized as something tacit and is actively influenced by the learning environment (Illeris 2012). In the following, we view fieldwork as a learning methodology, which demonstrates a multitude of leaning processes that take place as a hybridity between different 'kinds' of information. Tacit knowledge experiences, we argue, are important learning outcomes of fieldwork.

This shared and tacit knowledge are difficult to define, yet learning to codify knowledge in the interaction with the field and understanding the different spatio-temporal dynamics and processes give rise to experiencing the richness of the learning process during fieldwork. The following sections use Zelinsky's (2001) categories of fieldwork to capture and elaborate the different traditions regarded as important by Danish university geographers in the 'tacitity of becoming' a geographer through fieldwork. As mentioned, according to Zelinsky, there are three general categories of fieldwork: fieldwork as a commercialised practice with the normative agenda to support the interests of a client; fieldwork as a scientific activity to solve a research question with reflective rather than commercial ambition; and fieldwork as an adhoc, impulsive and informal practice (Zelinsky 2001). Only the two latter conceptions of fieldwork were identified in the interviewing material. We discuss Zelinsky's categories by condensing three subordinate categories of fieldwork into a learning methodology. These are: fieldwork as an outdoor laboratory, fieldwork as sensuous realisation and fieldwork as a meta-theoretical practice (as shown in Table 1).

Table 1.
Three categories of fieldwork as a learning methodology found among Danish geographers in higher education.

Fieldwork as an outdoor laboratory	Fieldwork as a sensuous realization	Fieldwork as a meta-theoretical practice
Characteristics The transference of the laboratory to the field is more than merely upscaling the laboratory. Fieldwork as an outdoor laboratory offers an approach not possible to duplicate at home. The contextuality of the field is actively beeing involved in data sampling, processing and analysis. From spatio-temporal 'aha' erlebnis towards erfarung.	*Characteristics* The flaneur fieldworker is an archetype to read spatial representations. An approach in which senses and experiencing the place are actively involved in the fieldwork, not only the intellect. İntuition and imagining the field as active information carrier is possible when schemes and control are set aside.	*Characteristics* Fieldwork as a dialectical approach to involve actively relations between theory and practice. Fieldwork is a process of learning how to operationalise theory, qualitatively or quantitatively, as a standardised, schematic analytical approach, though sometimes revised under fieldwork.
Example by quotation 'Much can be learned theoretically from books, classes and so on, but to develop theoretical work into understandings, it be climatological, geological or hydrological processes in nature, one has to be in the field to understand the full potential of spatial analysis'	*Example by quotation* 'To be able to actively involve the field as information carrier, and to understand the interactive proces between field, practice and theory'.	*Example by quotation* 'The fulfilment of theory and operationalisation of theoretical concepts in the field'.

In the following subsections, we explore the three categories of fieldwork as a learning methodology (shown in Table 1).

Fieldwork as an outdoor laboratory

Fieldwork as an outdoor laboratory is expressed in two forms. The first is a one-to-one constellation of the laboratory, meaning that the laboratory is simply transferred to the field. The second form conceives of fieldwork as a methodology that offers the scientists an approach that is not possible to copy or upscale in the laboratory. Some

sort of contextual element is catalysed into the data. It is necessary to understand under which contextual and geospatial circumstances the data are collected in order to be able to interpret the spatiality and contextual elements in analysing such data (Interview 2012). Fieldwork as an outdoor laboratory is a widely used metaphor in the interview material. Further, it is most commonly, but not exclusively, mentioned by geographers with an inclination towards physical geography. Two main configurations can be identified. One presents fieldwork as a method that gives access to objective field data. Fieldwork, in this respect, is associated with the act of objective and concise data collection; to know how to measure correctly and set up your instruments, while considering space, time and scale (Interveiw 2012). The second characteristic assumes that scientific objectification also becomes an internalised personal process to be able to collect data objectively; to learn how to address difficulties in data collection can only be learned through analytical trials and experiences. Here, an element of 'Aha erlebnis' is involved in the fieldwork process that somehow allows the fieldworker to explore observations and insights simultaneously that would not have been expected (Interview 2012). Thus, fieldwork as an outdoor laboratory suggests that fieldwork actively brings into being the context dependent elements into constructions of context independent elements or general laws: 'One just better understands natural laws at play when standing out there' (Interview 2012). What comes into play is some sort of scientific sensuousness in experiencing the field and understanding relations between wholes and parts.

Fieldwork as sensuous realisation

Fieldwork as sensuous realisation corresponds to Zelinsky's last category of fieldwork as an ad hoc based pratice (Zelinsky 2001). It is the most difficult category to grasp, but also the most intriguing in that the realisation process holds a huge amount of tacit knowledge. This perception of fieldwork is also widely present in our empirical material both from geographers inclined towards human geography and towards physical geography. In this regard, fieldwork is simply an ad hoc, impulsive effort, an adventure into unknown places. The flaneur fieldworker is an archetype used by Zelinsky to characterise fieldwork: 'altogether informal, sometimes hovering on the margins of consciousness, a sensibility ecumenically attuned to all innovations in the sensed environment, to every manner of loss, gain, and the unexpected, dedicated to absorbing a dynamic world without a set agenda' (Zelinsky 2001:7). The flaneurial fieldwork most readily comes into our minds when new countries, cultures and places are visited for the very first time. However, we may as well be in our own neighbourhood. It is how geographers record the field through the senses, and where the senses are actively involved in the fieldwork, not only the intellect. This enables the fieldworker 'to be able to actively involve the field as information carrier, and to understand the interactive process between field, practice and theory' (Interview 2012). What we suggest here, is that the informal learning environment produce a sensuous realisation in which socio-spatial imagination becomes a constitutive force of representing the field visually in the nexus between everyday knowledge, tacit knowledge and professional knowledge: 'The landscape is perceived differently for people who live and work there, e.g. as spaces of production, whereas visitors may explore it as a space of recreation. To understand such

very different interpretations of the very same space one needs to concider how I myself read space through senses. When I try to understand how I myself understand the field, and how I myself absorb and read space all my senses are actively involved. I also hear, smell and feel space so to speak' (Interview 2012).

Fieldwork becomes an intuitive, simultaneous and continued process in bringing together all these differnt forms of socio-spatial information. Some may claim that fieldwork as sensous realisation is neither methodologically systematic, stringent nor objective, but fieldwork as sensous realisation begins where scientific standards end, where it is no longer possible to argue objectively for all the dexterity and skills the scientific work is based upon.

Fieldwork as a meta-theoretical practice

Zelinsky's second cateogry describes a fieldwork approach applied to solve a scientific problem. Although the two previous characteristics of fielwork also suggest different meta-epistemological assumptions of ways to learn the scientific practice of conducting fieldwork, they do not grasp the duality of theory and practice. Among the interviewed university geographers, such a duality is grasped in the inherent notion of fieldwork as a constant search for new ways of understanding the problem and associated methods. By way of example, this involves learning to observe detail and wholes, in realising how things are interconnected, reconnected or detached under different circumstances: 'the fulfilment of theory and operationalisation of theoretical concepts in the field' (Interview 2012). In other words, 'in fieldwork you learn to operationalise theory, and to critically scrutinise your own or others' quantitative and qualitative representations of an area' (Interview 2012). However, it is also to synthesise, as others metioned, using the senses of hearing, seeing and feeling: 'geography has in its identity that you learn a whole lot of your understanding of the world through fieldwork' (Interview 2012). This notion of fieldwork is the less represented in our empirical material.

Fieldwork may be standardised, e.g. in understanding plant succession as climate change. Sometimes the field turns out to be different than was assumed in the field plan; this why new ways need to be integrated into the existing schema (Zelinsky 2001). A number of the interviewed university geographers mention field diary as an important process of realisation. Keeping a field diary is an important way of being aware of how new knowledge develops and becomes internalised during fieldwork. Looking back at the first field notes sometimes make the first field experiences simple, obvious, or self-evident. The diary, however, captures the tacit learning involved in fieldwork, and can reveal the significance of students' learning processes during fieldwork (Interview 2012). The field diary metaphor in the interviews becomes a manifestation of continuous interplay between theory and practice.

Conclusion and Discussion

Based on an empirical study of university geographers involved in the education of geographers in higher education programmes in Denmark and their perception of the role of fieldwork in the education of future geographers, we found three subcategories

of fieldwork as a learning methodology: fieldwork as an outdoor laboratory, fieldwork as sensuous realisation and fieldwork as a meta-theoretical practice.

Interestingly, the three empirical perceptions of fieldwork were not allocated to different academics or traditions, meaning that the individual researcher often encompassed more than one view of fieldwork either in relation to his or her own research or in relation to the education of future geographers. For this reason, the categories of fieldwork presented among university geographers at Danish Universities do not support the often claimed dichotomy between physical and human geography. This points towards the openness of geography as a synthesis discipline even though not realised in the individual researcher's own research practice – an openness that is also included in the teaching practice of fieldwork. Thus, when we tend to devide geography thematically into either human or physical traditions, in human-nature, earth science or spatio chronological orientations, these dichotomies express contested ideas of fieldwork that do not necessarily concide with the perceptions of fieldwork among university geographers educating future secondary school teachers. This has bearings not only on the education of geographers at the universities but also the Danish secondary school where geography is presently taught as physical geography with a significant amount of geology. In such a context, we find that fieldwork has a role to play in understanding geography as a subject that can transcend the gap between science and social science subjects. In this way, fieldwork demonstrates that real world problems can be addressed by using both physical and human geography, and that the whole is greater than the individual parts.

In our findings, one perception of fieldwork seems to align with such notion of fieldwork as transcending: 'One just better understands…..when standing out there' point of view. This perception of the value of fieldwork includes quite different sensitivities for the outcome of fieldwork. As regards moving the laboratory outside, 'something just happens' that change the perception towards the view that the meaning of fieldwork is to co-construct meaning in interrelation with the field; the whole is greater than the sum of the parts and the understanding transcends the particularity of the situation. The whole spectrum of these views acknowledges that being in the field adds something and that this something is important in the education of future geographers. In this way, the fieldwork learning objective goes beoynd what can be promulgated in curricula constructs, and becoming a geographer is also actively being involved in space.

If we turn to the literature, Scott, Fuller & Gaskin (2006) find that lecturers' perception of fieldwork was that of a pedagogical application that supports students to contextualise theory and actively helps them to carry a problem-based approach. However, while none of the respondents in Scott, Fuller & Gaskin (2006) related fieldwork to experimental learning, this is the case for the three categories of fieldwork as a learning methodology developed in this paper. Also, in the studies of Stokes, Magnier & Weaver (2011) and Wall & Speake (2012) the perception of fieldwork among university research staff is found to vary. This point to the importance of conducting studies of perceptions of fieldwork among staff in different cultural settings because as we started to address in this paper, different cultural settings give precedence

to various elements of geography also within the use of fieldwork. This is important if we are, as argued by Hill and Woodland (2002), to substantiate its place in higher education.

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Interview with 31 professors and associate professors allocated to geography education at Aalborg, Copenhagen and Roskilde universities, Denmark.

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