Evaluating Ammonia Deposition Rates for Deciduous Forest using Measurements and Modelling

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Introduction and aim

Atmospheric ammonia (NH₃) deposition is important in ecosystem modelling as nitrogen (N) deposition enhances photosynthesis at leaf level and might stimulate the growth of N limited forests [de Vries et al. (2009) For. Ecol. and Man.]. However, measurements of atmospheric NH₃ fluxes for forests are limited and very uncertain. The aim of this presentation is 1) to investigate observed atmospheric NH₃ concentration and fluxes above deciduous forest and 2) to examine the performance of the Danish local-scale deposition model OML-DEP for calculating the dry deposition of NH₃ to deciduous forest, by comparing calculations with advanced flux measurements.

Method

Vertical atmospheric NH₃ fluxes were measured in campaigns during 2010 and 2011 using the relaxed eddy accumulation (REA) technique at the Danish Fluxnet forest site Lille Bøgeskov, Sora. Calculations of concentration and dry deposition are performed using the local-scale deposition model OML-DEP applied in the Danish Ammonia Modelling System (DAMOS) [Geels et al. BGD]. The DAMOS calculations are based on state-of-the-art emission inventories with hourly time resolution and a spatial resolution down to single farm level [Skjøth et al. (2011) ACPD].

Results

Lille Bøgeskov (55°29’13”N, 11°38’45”E) consists predominantly of 82-year-old beech trees (Fagus sylvatica) with an averagely height of 26 m. Scattered stands of conifers constitute about 20% of the forest area. The meteorological mast is located in the centre giving fetches from 500 m to 1 km.

Leaf area index

Ammonia sources

Evident NH₃ emissions in 2010 are observed after defoliation begins, indicating the potential of forest acting both as a sink and source for atmospheric NH₃.

NH₃ deposition is seen when wind is coming from south while the flux is small from the N-E and N-W directions (i.e. Oct 2011). I June 2011, emissions of NH₃ in the daytime occurred while the flux was small during nights. The NH₃ flux indicates a fine correlation with u*.

Conclusion and outlook

- The atmospheric concentration and flux for Lille Bøgeskov are highly dependent on local meteorology and forests phenology, as well as the spatial distributions of local anthropogenic NH₃ sources.
- OML-DEP simulates the atmospheric concentration of NH₃ well for periods of app. two weeks, however the model does not consider vegetative and soil NH₃ emissions from non-agricultural areas, and is therefore not able to simulate NH₃ emissions for Lille Bøgeskov.
- A contribution to NH₃ emissions from the forest could exist from advection of NH₃ emitted from local anthropogenic NH₃ sources and from re-emissions after leaf fall.

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