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Measuring and modelling dry deposition of ammonia to deciduous forest using high temporal and spatial resolution techniques

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Abstract

To compare vertical NH3 concentrations and fluxes measured above deciduous forest using Conditional Time Average Gradient (COTAG) and Relaxed Eddy Accumulation (REA). To examine the performance of the Danish applied local-scale deposition model OML-DEP on calculating dry deposition of NH3 to deciduous forest, by comparing calculations with new flux measurements.

Conclusion

• Measurements and model calculations are in good agreement on estimating atmospheric NH3 concentration.
• REA indicate a clearly bi-directional NH3 flux while fluxes determined using COTAG are non significant and associated with high uncertainty.
• There is a further need for improving the description of dry deposition in local-scale models whereby the NH3 vegetative emission and its contribution to the atmospheric NH3 flux is considered.

Method

Vertical fluxes of NH3 was measured above a beech forest (Fagus sylvatica) in Denmark from 10 August to 11 November 2010 using the long-term COTAG technique (29.8 m and 34 m) and the high time resolution technique REA (3 m). Calculations of concentration and dry deposition are performed using the local-scale deposition model OML-DEP applied in DAMOS (ref. 2). 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 (ref. 4).

Concentrations

NH3 concentration above Lille Bøgeskov measured using OML-DEP and COTAG Denuder (29.8 m) in four sampling periods and REA WEDD (33 m) only in the fourth sampling period and calculated by OML-DEP through the full measuring period.

Fluxes

NH3 fluxes above Lille Bøgeskov for 10 August – 11 November 2010 along with leaf area index (LAI) and CO2 fluxes.

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References

1. Frohn et al. (2008), Nitrogen load of nature areas in Eastern Jutland (DK). – Final report (in Danish: Kvælstofbelastning af nature områder i Østjylland). National Environmental Research Institute, Aarhus University, P.O. Box 358, Frederiksborgvej 399, DK-4000 Roskilde.
2. Stevens et al. (2004), Vegetative emission into account in calculating NH3 deposition fluxes. Furthermore, the calculated flux seems underestimated due to an underestimation of the turbulent transport to the canopy.

The conditional COTAG fluxes indicate non significant deposition fluxes and the comparable conditional averaged REA fluxes indicate emission fluxes. Though the uncertainty on the estimated COTAG fluxes indicate that the flux could be oppositely directed.