Geophysical Research Abstracts
Vol. 21, EGU2019-12513, 2019
EGU General Assembly 2019

Reactive nitrogen exchange between biosphere and atmosphere – lessons learned from applying novel measurement techniques over different land use

Christian Brümmer (1), Undine Zöll (1), Frederik Schrader (1), Pascal Wintjen (1), Christof Ammann (2), Antje Lucas-Moffat (1), Jeremy Rüffer (1), Jean-Pierre Delorme (1), and Martijn Schaap (3)

(1) Thünen-Institute, Climate-Smart Agriculture, Braunschweig, Germany (christian.bruemmer@thuenen.de), (2) Swiss Federal Research Station Agroscope, Zurich, Switzerland (christof.ammann@agroscope.admin.ch), (3) TNO, Department of Climate, Air and Sustainability, Utrecht, The Netherlands (martijn.schaap@tno.nl)

Field campaigns were carried out to investigate biosphere-atmosphere exchange of reactive nitrogen compounds with the aim to test novel measurement techniques in eddy-covariance setups for continuous determination of ammonia and total reactive nitrogen fluxes. While high-frequency concentrations of ammonia were measured with a quantum cascade laser absorption spectrometer, a custom-built converter coupled to a chemiluminescence detector was used for the determination of total reactive nitrogen. Campaigns were conducted above cropland, forest and peatland ecosystems. Substantial high-frequency damping on fluxes in the range of 15-35% was observed. Damping was found to be dependent on land use and its specific setup, but appeared to be mainly invariant with wind speed and atmospheric stability. Nitrogen fluxes showed strong diurnal variability after fertilization on arable land with peak emission during midday. Moderate diurnal variability with highest uptake around noon was found at a forest site located in a national park. Exchange patterns were mainly controlled by concentration and to a lesser extent by light, vapour pressure deficit, and surface wetness depending on season and land use. An analysis of multidimensional functional relationships with artificial neural networks showed that up to 50% of the variability in nitrogen fluxes could be explained when the three most dominating factors were used. While measured data and results from a state-of-the-art inferential exchange scheme compared fairly well, a combination of the two approaches could be used for determining seasonal nitrogen budgets for natural and semi-natural sites. The results help improve our knowledge of the temporal variability of surface-atmosphere exchange over different ecosystems, thereby providing useful validation opportunities for inferential models. It is highly desired to complement standard long-term observations of greenhouse gases – at least at some selected key sites – with high-frequency reactive nitrogen measurements to strengthen process understanding of coupled nitrogen and carbon cycles.