Geophysical Research Abstracts
Vol. 20, EGU2018-12303, 2018
EGU General Assembly 2018

Correcting high-frequency losses in reactive nitrogen flux measurements – Adjustments, applications and controlling factors

Pascal Wintjen (1), Christof Ammann (2), Undine Zöll (1), Frederik Schrader (1), and Christian Brümmer (1)

(1) Thünen Institute of Climate-Smart Agriculture, Braunschweig, Germany (pascal.wintjen@thuenen.de), (2) Swiss Federal Research Station Agroscope, 8046, Zürich, Switzerland

Nitrogen (N) is an important nutrient in the biosphere. Its amount in the atmosphere has strongly increased in the last century due to human activities. Atmospheric deposition of reactive N-compounds influences the productivity of natural ecosystems and its carbon dioxide exchange. As increasing N deposition may become harmful for a variety of ecosystems, it is necessary to thoroughly estimate the nitrogen exchange between biosphere and atmosphere.

We measure the nitrogen mixing ratios with a converter for reactive nitrogen (TRANC: Total Reactive Atmospheric Nitrogen Converter). The TRANC converts all reactive nitrogen compounds to nitric oxide (NO) and is coupled to a fast-response chemiluminescence detector (CLD), thereby making the TRANC-CLD system suitable for flux calculation based on the Eddy Covariance (EC) technique.

Due to common issues arising from experimental setups such as closed-path systems or heating of intake tubes and the general high reactivity of most N gases and aerosols, -the fluxes are usually damped by a certain factor in the high frequency range. Common approaches to account for these high frequency losses (Ibrom et al., 2007; Fratini et al., 2012) are mainly optimized for inert greenhouse gases like CO_2 and CH_4 or water vapor.

In this study, we further develop an algorithm to calculate factors accounting -for flux losses in the high frequency range for NO and for different meteorological situations. The approach is based on the principle of the spectral correction method developed by Ammann (1998). The basic idea of this routine is the spectral comparison of the vertical wind speed and temperature cospectra with the vertical wind speed and reactive N cospectra by applying spectral transfer functions.

We tested our algorithm with a set of campaign data conducted at different ecosystems. We found that an optimized transfer function is essential for deriving reliable correction factors (CF). CF were mainly in the range of 1.6 to 1.3 for a short grass peatland and between 1.3 to 1.2 for a mixed forest. Due to different canopy height at the two sites, measurements were done at different heights above the plant canopy. The size of eddies and substantially different footprint sizes may have played an important role for the difference in CF. They were further found to be insensitive to wind speed and atmospheric stability. Our study presents a step forward in correcting high-frequency losses in EC measurements of reactive N fluxes for estimating reliable landscape scale nitrogen budgets.