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Flux measurements of NH_x and NO_y with a dual-channel converter above an intensively managed grassland on peat

Pascal Wintjen[1], Jeremy Rüffer[1], Liv Sokolowsky[1], Christof Ammann[2], and Christian Brümmer[1]
[1]Thünen Institut, Agrarklimaschutz, Braunschweig, Germany (pascal.wintjen@thuenen.de)
[2]Swiss Federal Research Station Agroscope, Zürich, Switzerland

We designed a fast-response two-channel converter called NO_y-TRANC for eddy covariance measurements of reduced and oxidized reactive nitrogen compounds (N_r). It is a combination of the Total Reactive Atmospheric Nitrogen Converter (TRANC), which converts all reactive forms of nitrogen (ΣN_r), except for nitrous oxide (N_2O) and molecular nitrogen (N_2), to nitrogen monoxide (NO), and a heated gold catalyst, which converts NO_y to NO. NO_x, which is the sum of NO and nitrogen dioxide (NO_2), and higher oxidized nitrogen compounds are described by the term NO_y. The NO_y-TRANC is coupled to a two-channel chemiluminescence detector (CLD) for measuring NO. Due to a high sampling frequency and a fast response time, the system meets the requirements for flux calculation based on the eddy-covariance method. With this setup, a separation of ΣN_r fluxes in reduced and oxidized nitrogen can be done.

We conducted flux measurements at a typically deeply drained, intensively managed grassland site on peat in an intensive dairy region in Northwest Germany for one year. ΣN_r concentration was 12.4 ppb and NO_y concentration was 6.3 ppb on average. We observed mostly emission fluxes at the site after the first fertilization in early spring. The winter month were characterized by slight nitrogen dry deposition. Monthly median of ΣN_r fluxes ranged from -8 to 57 ng N $m^{-2}s^{-1}$ with the exchange being enhanced during summer. We found that ΣN_r and NO_y dry emission were comparatively higher under dry conditions, i.e., low air humidity and soil moisture. The emission factors of applied nitrogen after the respective fertilization released as NH_x can reach up to 2.0%.

Site management included five fertilization events and five grass cuts. The first fertilization event was at the end of March starting with mineral fertilizer followed by organic fertilizer a week later. The fertilization scheme was the same for second and third event, but approximately two days were between the application of the fertilizer types. The second fertilization was at the end of May, subsequent fertilizations were done in intervals of 4-5 weeks. Only for the fourth and fifth event, organic fertilizer was used. Organic fertilizer was injected in slits made by v-shaped discs, mineral fertilizer was spread on the soil surface. The emission factor was lower after the first fertilization event compared to events in summer probably indicating a beginning nitrogen saturation after the first fertilization.

Our study demonstrates the application of a novel measurement technique for the determination reactive nitrogen compounds and gives insight into the exchange characteristics of reactive

nitrogen under a common agricultural management.