Geophysical Research Abstracts
Vol. 21, EGU2019-212, 2019
EGU General Assembly 2019

NitroTrace: Using isotopes to trace the effects of changing precipitation regimes on nitrous oxide emission pathways in grasslands

Eliza Harris (1), Elena Stoll (1), Benjamin Wolf (2), David Kraus (2), Johannes Ingrisch (1), David Reinthaler (1), and Michael Bahn (1)

(1) Plant, Soil and Ecosystem Processes Research Group, Institute of Ecology, University of Innsbruck, Innsbruck, Austria (eliza.harris@uibk.ac.at), (2) Regionalization of Biogenic Trace Gas Fluxes Research Group, IMK-IFU, Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany

Nitrous oxide (N_2O) is a strong greenhouse gas and an important ozone-depleting substance released from natural and anthropogenic sources, in particular microbial production in soils via nitrification and denitrification. The extent of these pathways – controlled by many competing factors, including moisture and climate, land use, and soil properties – is a key uncertainty in the nitrogen cycle. Future climate scenarios predict increased summer drought and heavier winter precipitation for European mountain grasslands. Drought has generally been observed to reduce N_2O production, with large pulses upon rewetting that may even lead to overall increased emissions. However, the effects of drought, rewetting, and increased precipitation on specific N_2O production and consumption pathways are relatively unknown, complicating efforts to understand observations and model and mitigate emissions.

We hypothesise that the relative importance of N_2O from nitrification will increase during drought treatment, however strong denitrification will cause an emission pulse upon rewetting that will increase the overall contribution of denitrification to N_2O emissions. These changes will be evident in a changing N_2O isotopic composition, in particular site preference, throughout drought and rewetting. This study presents the first online isotopic measurements of N_2O emitted from grassland monoliths subjected to an experimental precipitation changes including a strong drought, to directly investigate the effects on N_2O production and consumption pathways.

Between May and November 2018, 16 soil monoliths from the sub-alpine LTER-CWN grassland site in Stubaital, Austria, were subjected to different combinations of drought, rewetting, high precipitation, and flooding. A LICOR flux measurement system using automated chambers was directly interfaced with a Picarro spectrometer to monitor CO_2, CH_4 and H_2O fluxes in a closed recirculation loop, with subsampling to a second Picarro spectrometer (model G5131-i) for online measurements of N_2O fluxes and isotopic composition. This innovative set up allowed automated monitoring of monolith N_2O emissions at a time resolution of <2 hours throughout the experimental period, with a particular focus on emission dynamics following rewetting and flooding. Soil moisture and temperature measurements, as well as soil sampling for the $\delta^{15}N$ of NO_3^- and NH_4^+, will be brought together with automated isotope data to gain a detailed view of N_2O production and consumption. These measurements will be complemented with modelling results from LandscapeDNDC coupled to the "SIMONE" offline nitrogen isotope model to allow a new depth of understanding of the effects of changing precipitation regimes on grassland N_2O emissions.