P12 Temperature and CO2 concentration sensitivities of the soil N-fluxes from an alpine managed grassland

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Beitragsart: Wissenschaftlicher Beitrag
Förderprogramm: Austrian Climate Research Program, ACRP
Projektakronym: ExtremeGrass
Call: ACRP 8th Call
Laufzeit: 04 2016 - 03 2019
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Topic

Climate change is largely attributed to both significant increases in air temperature and in atmospheric CO2 concentrations. The impact of the individual effects of those drivers (warming and elevated CO2) on ecosystem biogeochemical cycles is relatively well studied. However, the interactively effect of temperature and CO2 concentration on the climate system and on the biogeochemical cycling of nutrients, especially N, is still uncertain. Intensive agriculture and combustion of fossil fuels increase the amounts of reactive N, and these compounds, when released to the environment, have a cascade of effects to human health and ecosystems. Especially agricultural activities (e.g. fertilization) may significantly increase the amount of ammonia (NH3), nitrous oxide (N2O) and nitric oxide (NO) released from the soil into the atmosphere, while nitrate (NO3-) leaching to aquatic systems can be enhanced as well. N2O is a direct GHG with a global warming potential 300 times higher than CO2. In particular, fertilized and managed grasslands, which are common in Central Europe, are supposed to exceed soil N2O fluxes of other land use types such as croplands, wetlands or forests.

Method

The aim of this study is to evaluate the response of warming, elevated CO2 concentrations and their combined effect on the N-gas emissions and N-pools of managed grassland in Central Europe. The project is being implemented on an experimental site in a mountain region (Raumberg-Gumpenstein) using a replicated factorial approach involving three levels of soil temperature (ambient, + 1.5 and + 3 °C) and of CO2 concentrations (ambient, + 150 and + 300 ppm), respectively. In autumn 2016, after grass harvesting, two intact soil cores were sampled from each plot to conduct a lab incubation experiment. Prior to the incubation, each core received an equivalent of 15 kg N ha-1 fertilizer in form of NH4NO3 and emissions of NH3, NOx and N2O were monitored automatically at a constant temperature of 22 °C and at a water filled pore space of 60 %. Subsequently, soil cores were incubated at different temperatures 5, 10, 15, 20 and 25 °C for 24 h to evaluate the temperature sensitivity of soil N2O and NOx fluxes. Finally, different N pools (DON, Nmic, NH4+ and NO3-) and the bulk density were examined.

Results

Preliminary results show a lower ammonium concentration at extreme treatments (+3 °C, + 300 ppm + 3 °C and + 300 ppm) compared to ambient plots. Further, NO3- concentrations at treatments with a temperature increase of + 3 °C and+ 1.5 °C were higher than at ambient plots. Additionally the microbial nitrogen (Nmic) showed a slightly higher concentration at extreme treatments and with a temperature increase of 1.5 °C. A high spatial variation of N-fluxes was observed, both within and across treatments. As expected, soil N2O efflux increased with increasing soil temperature. Responses of N2O fluxes to different in situ soil temperatures and CO2 concentrations are currently being evaluated through non-linear and non-additive models (e.g. Gaussian and a generalization of the Arrhenius equation, Lloyd and Taylor model) to disentangle the effects of multiple factors of climate change on the emissions of N-trace gas fluxes. However, our results present only a seasonal snapshot and need to be confirmed in the field.