Impact of climate change on nitric oxide and nitrous oxide emission from typical landuses in Scotland

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Abstract

Within this work we studied soil fluxes of NO and N_2O in typical landuses across Eastern Scotland and the Highlands under simulated climate change conditions. We found that drought significantly increased N_2O emissions in all landuses except tree-growing areas and natural peatland. Grazed grasslands had higher responses (NO and N_2O) to drought than natural sites. Rewetting significantly increased both NO and N_2O emissions in most landuses. Climate warming and extreme events are likely to increase soil NO and N_2O fluxes from natural and agriculturally managed systems.

Keywords: N_2O, NO, climate change, drought

1. Introduction

The impact of soil type, land use and climate on emission rates of nitric oxide (NO), a precursor of atmospheric ozone, and N_2O, a powerful GHG, are still not well understood (ENA, 2011). The aim of this research was to identify soil NO and N_2O emission rates from typical landuses across Eastern Scotland and estimate potential impacts of climate change.

2. Methods

2.1 Study sites

Soils were collected from the eLTER sites Burnsmuir a&b in the Highlands and Lowlands of Scotland (covered 9 typical landuses; Medinets et al., 2019).

2.2 Flux measurements

Soil core air-flow-through incubation system coupled with NO_x analyser and Picarro G2508 instrument were used to measure NO/ N_2O fluxes under simulated climate change condition (drought at 20/ 25°C; elevated wetting after drought period).

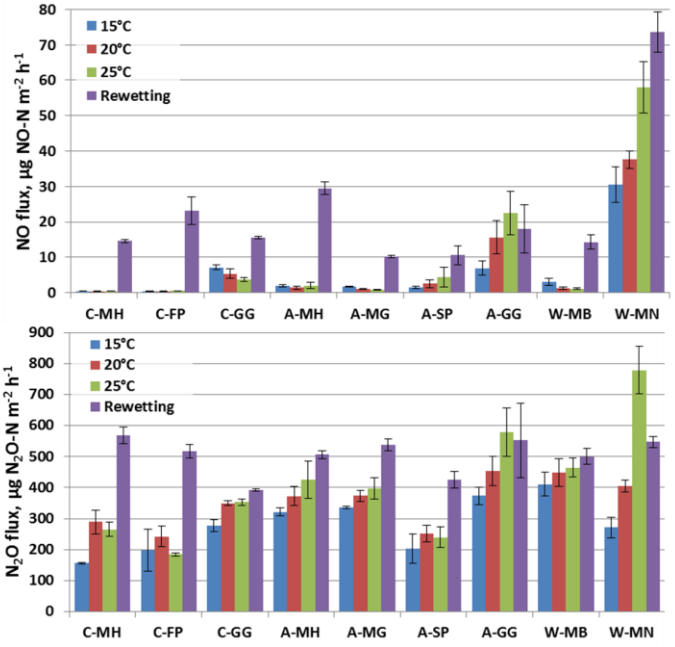

Fig. 1: NO (up) and N_2O (bottom) emission (±SE)

3. Results

Main results of this work are described below and shown in Fig. 1.

3.1 Drought with temperature increase

DT significantly stimulated changes in NO fluxes in N fertilized and grazed Lowlands and peatland exposed to high atmospheric N deposition. DT significantly increased N_2O emissions in all landuses except tree-growing areas and natural peatland. Grazed grasslands, having largest initial NO and N_2O fluxes, had higher responses to DT than natural sites.

3.2 Rewetting after drought at temperature of 20°C

Rewetting significantly increased both NO and N_2O emissions in most landuses. The largest NO response to rewetting was observed at all Highland sites, and the Lowland heather moorland. The largest N_2O response to rewetting was found in the natural moorland site and pine forest in the Highlands.

NO emissions/ pulses were strongly depended on soil NO_3^- content ($r=0.93$, $p<0.0001$).

4. Conclusion

Climate warming and extreme events, such as drought/ flooding cycles are likely to increase soil NO and N2O fluxes from natural and managed systems. Although soil NO emissions are ~10 times smaller than those of N_2O, their impact on air quality is likely to increase as combustion sources of NO_x are declining as a result of successful mitigation.

Acknowledgements

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References

ENA 2011 The European Nitrogen Assessment: Sources. Effects and Policy Perspectives ed M Sutton et al (Cambridge: Cambridge University Press) p 664

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