Geophysical Research Abstracts
Vol. 19, EGU2017-9199, 2017
EGU General Assembly 2017

The partitioning of N_2O emissions between denitrification and other sources in natural and semi-natural land use types in the UK.

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Natural and semi-natural terrestrial ecosystems (unmanaged peatlands and forests, extensive and intensive grasslands) have been under-represented in the UK greenhouse gas (GHG) inventory, thus increasing the uncertainty of annual GHG emission estimates. This uncertainty is further exacerbated by the high spatio-temporal variability of the processes responsible for nitrous oxide (N_2O) emission. The partitioning of N_2O emission to its different sources can further improve our understanding of the controls on the different microbial processes responsible for N_2O production and consumption and ultimately inform GHG mitigation strategies. We have measured *in situ* N_2O fluxes from natural and semi-natural ecosystems in two replicated UK catchments monthly between April 2013 and October 2014. An adapted ^{15}N-Gas Flux method[1] for low level additions of ^{15}N tracer (0.03 - 0.5 kg ^{15}N ha^{-1}) appropriate for natural (unfertilised) ecosystems was used to quantify denitrification[2] and elucidate its relative contribution to net N_2O production. Total N_2O fluxes were 40 times higher in the intensive grasslands than in the peatlands and ranged between 0.05 and 1.98 kg N ha^{-1} y^{-1}. The mean contribution of denitrification to the total N_2O flux (DN_2O/TN_2O) ranged between 9 and 59 % and was lowest in a well-drained forest and highest in a poorly-drained forest soil, while in peatlands and grassland soils it was 48% and 41% on average, respectively. Soil moisture was shown as the key environmental driver regulating the partitioning of N_2O between denitrification and other sources (r^2=0.46) across land use types. Total N_2O fluxes across land use types were explained by a simple regression model (r^2=0.83) including parameters such as total dissolved nitrogen, organic carbon availability and volumetric water content. Nitrous oxide emission factors (EFs) calculated as a fraction of mineral N inputs averaged at 0.4 and 0.9% for the semi-improved and improved grasslands, respectively. Using simulated atmospheric N-deposition data we have estimated the fraction of N deposition-induced N_2O emissions from poorly drained forest, well drained forest and organic soils to be 0.5, 1.6 and 0.3%, respectively. The assumption that 1% of the deposited N on natural ecosystems is emitted as N_2O, may over or under-estimate this source and further information on N_2O sources as well as the development of Tier 2 emission factors should help constrain this uncertainty.

References

[1]Sgouridis F, Stott A & Ullah S, 2016. Application of the ^{15}N-Gas Flux method for measuring in situ N_2 and N_2O fluxes due to denitrification in natural and semi-natural terrestrial ecosystems and comparison with the acetylene inhibition technique. *Biogeosciences, 13, 1821-1835*.

[2]Sgouridis F & Ullah S, 2015. Relative magnitude and controls of *in situ* N_2 and N_2O fluxes due to denitrification in natural and semi-natural terrestrial ecosystems using ^{15}N tracers. *Environmental Science & Technology, vol. 49(24), 14110-14119.*