Geophysical Research Abstracts, Vol. 7, 05467, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05467

Soil N_2O Emission at low temperatures depends on denitrifier community composition

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Denitrification in unsaturated soils is a major contributor to atmospheric N_2O. Winter emissions are particularly high for some soils, and the causes for this are not well understood. We studied the kinetics of N_2O production and consumption by incubating soil slurries at temperatures ranging from 0 to 15˚C. By ensuring low concentrations of nitrogenous electron acceptors, we mimicked electron acceptor depletion assumed to occur in anaerobic microsites during winter. Relative net accumulation of N_2O, denitrification rates, and response of N_2O metabolism to decreasing temperatures differed strongly between the communities. Apparent N_2O threshold concentrations were found for one community, below which no further reduction took place. The denitrifying communities were analysed by PCR, using primers for *nirK* and *nosZ*, and the PCR products were analysed by cloning, sequencing, and subsequent phylogenetic analysis.. Large differences both in composition and diversity were found between the communities. The community with high apparent propensity for N_2O emission (high N_2O/N_2 product ratio and a low temperature threshold for N_2O reductase) had different gene composition (and low genetic heterogeneity) compared to the other extreme (very low N_2O/N_2 product ratio and no low temperature threshold, high genetic heterogeneity). The observations suggest that microbiology has a role to play in addition to the holistic approaches used so far, to understand the biogeochemistry of N_2O. Further investigations will involve analysis of gene regulation in isolated organisms, and phenotypic characterization regarding enzyme kinetics and isotopic signatures in N_2O metabolism.