Geophysical Research Abstracts, Vol. 8, 07403, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07403

The Turnover of N_2O in Soils at low O_2 Concentrations

B. Vieten (1), F. Conen (1), A. Neftel (2), T. Blunier (3)

(1) Institute of Environmental Geosciences, University of Basel, Switzerland, (2) FAL, Agroscope, Reckenholz, Switzerland, (3) Climate and Environmental Physics, Physics Institute, University of Bern, Switzerland (b.vieten@unibas.ch / Phone: +41-61-2673661)

The project aims to improve the understanding of the bi-directional exchange of N_2O in agricultural soils by measuring gross production and uptake of N_2O within the soil profile. The overall hypotheses are that a large fraction of the gross production of N_2O is consumed before it is emitted to the atmosphere. Consumption is hypothesized to be a biological process with a first order kinetics.

Soils from three different locations in central Europe were studied in flow-through laboratory incubations for their behavior regarding N_2O consumption, using a N_2O/O_2 matrix (changes of N_2O and O_2 concentrations in time cycles). With this matrix the exchange of N_2O and O_2 could be determined at different combinations of N_2O and O_2 concentrations. At O_2 concentrations of 20 % and 2 % soils were small or zero net N_2O sources. No significant uptake (< 0.5 pmol g^{-1} soil h^{-1}) of N_2O was found. Net uptake of N_2O was induced by low O_2 concentrations starting about 20 h after the change from 2 % to 0.2 % O_2. Net uptake rates were lineally dependent on N_2O concentrations up to about 1 ppm N_2O. At greater N_2O concentrations N_2O uptake rates approached saturation. The relative rate of N_2O uptake was exceeding the one of O_2 up to 15 times. Most likely the 20-fold larger solubility of N_2O in water compared to O_2 is responsible for this apparent preferential uptake.

To see whether part of the N_2O-N consumed remained in the soil, we exposed soil samples in a flow-through system for 11 days with 99 % labelled $^{15}N_2O$ (1.8 ppm N_2O, 0.2 % O_2, balance He). No change in $\delta^{15}N$ of the soil organic matter was found, indicating that > 99.9 % of N_2O must have been converted to N_2. In similar experiments with unlabelled N_2O at $O_2 < 1$ %, the fractionation factor for N_2O to N_2 transformation was about -12