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Vertical profile of the trace gas N_2O: A lysimeter soil study

S. Reth (1), W. Graf (1), O. Gefke (1), R. Schilling (2), H.K. Seidlitz (1), and J.C. Munch (2)

(1) Institute of Soil Ecology, GSF- National Research Center for Environment and Health, Department of Environmental Engineering, Ingolstädter Landstrasse 1, 85764 Neuherberg, Germany, sascha.reth@gsf.de

(2) Institute of Soil Ecology, GSF- National Research Center for Environment and Health, Ingolstädter Landstrasse 1, 85764 Neuherberg, Germany

Despite many investigations on the N_2O emission from the upper soil into the atmosphere, there is a lack of knowledge on the N_2O production, especially in the deeper water unsaturated soil zone where the microbial activity can be considerable. To obtain insight into the production, spreading and transport of N_2O in the soil, the N_2O concentration in the soil atmosphere was measured over a time of one year in 4 lysimeters (agricultural soil monoliths of 1 m^2 x 2 m) at 30 cm, 50 cm, 80 cm, 155 cm and 190 cm depth with altogether 86 gas probes. Additionally the N_2O emission into the atmosphere was determined with 20 closed chambers at the soil surface. To determine the N_2O discharge into the groundwater, the N_2O concentrations in the air of seepage tanks were measured.

Parallel the soil temperature and soil water content were recorded in order to quantify their effects on the N_2O production.

Results of the continuous measurements between October 2005 and January 2007 are:

N_2O concentrations are highest in the deeper soil; maximum concentration is found at a depth of 155 cm where the water content is high and the gas transport reduced. The highest N_2O concentration is recorded in a small range of the soil temperature and soil water content. Due to the high solubility of N_2O in water some of the N_2O in the unsaturated zone is exported with the seepage water into the groundwater.