Geophysical Research Abstracts,
Vol. 10, EGU2008-A-03380, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-03380
EGU General Assembly 2008

Subsoil nitrous oxide production reveals high spatial heterogeneity

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Forest soils in the temperate zone can act as sources of N_2O. However, surface N_2O efflux often reveals high spatial variability which cannot be attributed to obvious patterns. We hypothesized that vertical partitioning of this efflux could aid in the understanding of this heterogeneity. The aim of this study was to quantify depth profiles of N_2O production at an apparently homogeneous forest site and to evaluate the spatial differences in comparison to the vertical distribution of soil respiration.

We assessed soil gas fluxes by parametrizing the instationary diffusion transport equation with measured gas diffusion coefficients, and by fitting a segmented function consisting of 2^{nd} order polynomials to observed gas concentrations in the soil air. In a *Picea abies (L.) Karst.* stand on a dystric Cambisol, two apparently homogeneous 2 m^2 plots have been equipped with gas sampling probes in 8 depths of up to 90 cm, with 7 replications. Sampling was conducted once every two weeks for 13 months.

The mean surface efflux of N_2O-N of both plots was 1.1 kg $ha^{-1}a^{-1}$ from which the forest floor contributed 64%, the Ah horizon (above 20 cm) 24%, and the Bw (20 -70 cm) 13 %. The contribution of the dense C horizon (below 70 cm) was negligible. Mean efflux of the two plots differed by a factor of ca. 1.3 whereas the mineral soil contribution differed by a factor of ca. 6. Sporadic events of N_2O concentrations slightly below ambient were observed in the low-emission plot indicating net consumption. However, in no depth did CO_2 production differ by more than a factor 1.4 between the plots. Time variability of horizon specific CO_2 release could be satisfactorily explained with soil temperature. For N_2O, no correlation to temperature or

moisture could be revealed.

We conclude from the consistently different N_2O regimes in adjacent profiles, that vertical partitioning of N_2O exchange is much more important to understanding spatial patterns than we expected from the reported data on CO_2 exchange. There is some evidence that in the mineral soil of the low-production plot the N_2O consuming processes dominate. Further research is needed to reveal whether minor differences in soil structure, water transport, or soil biota distribution are responsible for the switch from net production to net consumption.