Geophysical Research Abstracts, Vol. 7, 10623, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10623

Parameterisation of environmental factors affecting microbial N trace gas production by chemostat studies

K. Butterbach-Bahl (1), M. Kesik (1), S. Blagodatsky (2), H. Papen (1)

(1) Institute for Meteorology and Climate Research, Atmospheric Environmental Research (IMK-IFU), Karlsruhe Research Centre, 82467 Garmisch-Partenkirchen, Germany

(2) Institute of Physicochemical and Biological Problems in Soil Science, Russian Academy of Sciences,142290 Pushchino, Russia

On a global scale soils are important sources for the atmospheric trace gases nitrous and nitric oxide, both of which contribute either directly or indirectly to global warming. In soils N_2O and NO are mainly produced by the microbial processes of nitrification and denitrification. Both processes are regulated by various environmental factors, from which temperature, pH and soil moisture which can be regarded as a proxi for the actual mean redox potential in soils are the most prominent ones. Up to now several studies have been published in which changes in microbial production of N-trace gases by soil micro-organisms under different pH, temperature or substrate conditions have been investigated in the framework of controlled field experiments.

However, in many field studies no clear effects of e.g. pH and temperature could be demonstrated, since the mentioned environmental factors as well as substrate availability and the magnitude of the involved microbial processes of nitrification and denitrification are extremely variable under field conditions. To overcome this problem and to directly study the effect of changes in pH, temperature and substrate quality on N_2O and NO production by common soil microorganisms we performed a series of chemostat experiments with two heterotrophic nitrifiers namely *Alcaligenes faecalis* subspecies *parafaecalis* and *Paracoccus pantotrophus*.

All factors investigated showed a pronounced effect on N trace gas production. E.g. Q_{10} values for NO and N_2O production by *A. faecalis* for the temperature range from 4-32˚C were 3.9 and 1.8. The effect of substrate pH on N trace gas production was more complex. Besides a local optimum at neutral pH values a significant increase in

N trace gas production was found for pH values <4.0. Since this increase at low pH values was only partly due to chemo-denitrification, which was only significant for NO production but not for N_2O production, our findings indicate that the leakage rate of involved microbial processes such as nitrification and denitrification are highly depending on pH. Furthermore, we also found marked pulses of N_2O and NO production under microaerobic conditions when the culture media were switched from aerobic to anaerobic conditions. However, this pulse was missing for NO when switching from anaerobic to aerobic conditions, which indicates that enzymes of the denitrification chain are differently sensitive to oxygen.

The results obtained provided a basis to further improve the description of microbial processes in the mechanistic model PnET-N-DNDC and, thus, to improve the prediction of N trace gas emissions from forest soils.