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Temperature and moisture effects on nitrogen oxides emissions from different European forest soils

A. Schindlbacher (1), S. Zechmeister-Boltenstern (1) and K. Butterbach-Bahl (2)

(1) Institute of Forest Ecology, Federal Office and Research Centre for Forests - BFW, Seckendorff-Gudent-Weg 8, A-1131 Vienna, Austria, (2) Institute for Meteorology and Climate Research, Atmospheric Environmental Research, Karlsruhe Research Center, Kreuzeckbahnstrasse 19, D-82467 Garmisch-Partenkirchen, Germany, (andreas.schindlbacher@bfw.gv.at / Fax: +43-1-87838-1250 / Phone: +43-1-87838-3218)

Nitrogen oxides promote the greenhouse effect and the formation of tropospheric ozone. Due to global warming and increasing nitrogen deposition, forest soils are considered to become enlarged sources of NO and N_2O. Within the EU-Project NOFRETETE intact soil cores were collected from a transect through Europe. To avoid overlapping effects of soil moisture and temperature, nitrogen oxides emissions were measured fully automatically under controlled laboratory conditions (temperature: 5-20˚C, moisture: 0-300 kPa).

The combination of soil temperature and soil moisture could explain a better part of variations in NO (up to 74%) and N_2O (up to 86%) emissions for individual soils, but average emissions differed significantly between various forest soils. While boreal forest soil showed hardly any emission, NO emissions from the German spruce forest soil receiving highest yearly nitrogen inputs largely exceeded emissions from all other soils. Average N_2O emissions from this soil tended also to be highest, but did not differ significantly from other soils.

NO and N_2O emissions showed a positive exponential relationship to soil temperature. N_2O emissions from various soils responded more uniformly to temperature than NO emissions. With activation energies up to 199 kJ mol^{-1}, NO emissions from two Central European beech forest soils responded exceptionally strong to changes in soil temperature. In these soils chemodenitrification may play a decisive role.

N_2O emissions increased with increasing water filled pore space (WFPS) or decreas-

ing water tension, respectively. Maximal N_2O emissions were measured between 80 and 95% WFPS or 0 kPa water tension. Optimal moisture for NO emission differed significantly between the soils, and ranged between 15% WFPS in sandy Italian floodplain soil and 65% in loamy Austrian beech forest soils. Since there was no correlation with soil texture or soil density, the different moisture optima may be related to a specific adaptation of the microbial communities to the annual soil moisture regimes of the sites.