Geophysical Research Abstracts
Vol. 12, EGU2010-6727, 2010
EGU General Assembly 2010

Characterization of the temporal dynamics of soil CO2 and N gas production (NO, N2O, N2) under varying environmental conditions

Rui Wang (1,2), Klaus Butterbach-Bahl (2), Nicolas Brüggemann (2), and Xunhua Zheng (1)

(1) LAPC, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing (xunhua.zheng@post.iap.ac.cn), (2) Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research, Atmospheric Environmental Research (IMK-IFU), Garmisch-Partenkirchen, Germany (Klaus.Butterbach-Bah@kit.edu)

The characterization of environmental drivers of soil N gas losses remains largely uncertain, since our ability to measure and follow temporal dynamics of N2 production via denitrification as well simultaneous gaseous losses of NO, N2O and CO2 is still limited. To overcome this problem we further developed the gas flow soil core technique (e.g Butterbach-Bahl et al., 2002; Dannenmann et al., 2008) in such a way that simultaneous measurements of gaseous losses of CO2, NO, N2O and N2 can be done. Since measurements of N2 production with this technique requires the establishment of an N2 free atmosphere, i.e. exchange of the soil atmosphere with a N2-free gas mixture, we also investigated different pre-incubation conditions (temperature, O2 content) to minimize the effect of the atmosphere exchange process on the target parameters N gas production and fluxes. Finally we tested our experimental setup and determined the dynamic of CO2 and N gas production for varying environmental conditions (temperature, nitrate content, C availability) and for agricultural soils with different properties (SOC, texture, pH). For this we followed N and C gas fluxes over a period of up to three weeks and supplemented these measurements with observation of changes in soil microbial biomass and concentrations of dissolved organic and inorganic nitrogen. This allowed us to establish full nitrogen balances and to trace the sources for N gas production, i.e. changes in inorganic and organic N pools. Our experiments e.g. show that following a switch from aerobic to anaerobic soil incubation conditions, N2O as well as NO production can outweigh N2 production in the first few hours, whereas CO2 production remains largely unaffected. After approx. 1-2 day N2 production peaked, whereas production of N2O and NO as well as CO2 was already starting to decline. Depending on incubation conditions and investigated soils, N2O and NO production ceased after 5-10 days, whereas N2 production continued – depending on the nitrate availability at the start of the experiments - for another 5-10 days, before finally no N2 production stopped. Typical rates of N2 production following establishment of anaerobiosis were up to 1500-2000 μg N kg-1 SDW h-1, whereas peak emissions of N2O or NO were approx. a factor of 2-3 lower. Our experiments clearly show that ratios of N and C gas production change very dynamically following the initialization of anaerobiosis. The obtained results are allowing to test our current understanding of denitrification in soils and to develop an improved parameterization for the denitrification process as needed for biogeochemical models.

Butterbach-Bahl K., Willibald G., Papen H., 2002, Soil core method for direct simultaneous determination of N2 and N2O emissions from forest soils. Plant and Soil, 240, 105-116
Dannenmann M., Butterbach-Bahl K., Gasche R., Willibald G., Papen H., 2008, Dinitrogen emissions and the N2:N2O emission ratio of a Rendzic Leptosol as influenced by pH and forest thinning. Soil Biol. Biochem. 40, 2317-2323