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Denitrification and N2O emission in an N-saturated subtropical forest catchment, southwest China

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Increasing anthropogenic emissions of nitrogen have resulted in locally high deposition rates of reactive nitrogen in China (30-73 kg N ha-1 a-1; Zhang. et al., 2008), primarily as NOx (from fossil fuel combustion) and NH3 (from fertilizer production and animal husbandry). Due to the subtropical, monsoonal climate with high soil temperature and moisture in summer, forests in south China may be expected to show high nitrification and denitrification rates, both of which can cause high N2O emissions.

To estimate the N2O source strength and to investigate N-turnover processes relevant for N removal in subtropical forest, we investigated spatiotemporal patterns of N2O emission along a hydrological flowpath from July to November of 2009 in the TSP catchment (Tieshanping), situated close to Chongqing, one of the biggest cities in southwest China.

Results from the first study year revealed high N cycling rates and N2O emissions during the wet season, (June to September). Surprisingly, soils on the hill slopes showed higher denitrification potentials and N2O emission rates than the wetter groundwater discharge zone at the bottom of the hill slopes. This was probably due to higher soil bulk density and less organic carbon content in the groundwater discharge zone. Highest denitrification potential were found in the O and A layer (< 5cm) of the hillslopes, suggesting that the organic carbon is the limiting factor for N-removal by denitrification in this ecosystem. High N-removal on the hill slopes was confirmed by decreasing NO3- concentrations along the flowpath during hydrologically stable conditions. However, high NO3- concentrations found in stream water during rain events suggest that the retention time of N in the catchment is too short to allow complete removal by denitrification. N2O emission fluxes dropped by two orders of magnitude in the beginning of the dry season, reflecting lower N input and removal rates during winter. Our results show that denitrification and N2O emission in upland soils is an important N sink in chronically N polluted subtropical forests.

Future studies are planned to confirm and further characterize denitrification as main N removal process in this ecosystem. 15N and 18O natural abundance of NO3 as well as Ar:N2 ratios will be analyzed along hydrological flowpaths and compared to in situ N2O emissions and process rates. Apportionment of nitrification and denitrification in N2O production will be studied in a 15N labeling experiment. N2O product stoichiometry of nitrification and denitrification will be investigated in laboratory. Biological N-turnover together with hydrological modeling, constrained by mass balance approaches will be used to scale N removal to the landscape level.

Keywords: Denitrification, N2O, watershed, subtropical forest, N-removal
References:
Zhang, W., Mo, J. M., Yu, G. R., Fang, Y. T., Li, D. J., Lu, X. K., et al. 2008. Emissions of nitrous oxide from three tropical forests in Southern China in response to simulated nitrogen deposition. Plant Soil, 306, 221-236