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Nitrogenous gas emissions induced by abiotic nitrite reactions with soil organic matter of a Norway spruce forest

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As an important intermediate of the nitrogen cycle, nitrite is highly reactive to soil organic matter (SOM) in forest soils under acidic conditions. However, there is little knowledge about how much its abiotic reactions with SOM contribute to nitrogen (N) gas emissions of forest soils till now. In this study, we provide data on N gas (N2O, NO, NO_2) emissions from abiotic nitrite reactions with different fractions of soil organic matter in spruce forest soil, as well as the mechanisms involved. Soil samples were taken from the Oh layer at the TERENO-Wüstebach catchment, Germany, where Norway spruce (Picea abies) dominates. SOM was fractionated into dissolved organic matter (DOM), fulvic acid (FA), humic acid (HA) and humin (HN) according to their solubility. The dynamics of simultaneous NO_x and N2O emissions were analyzed with a dynamic flow-through chamber system, coupled to an infrared laser absorption analyzer for N2O and a chemo-luminescence analyzer for NO_x (NO and NO_2), which allowed emission measurements with high time resolution. The 15N labelling technique was used for tracing the fate of nitrite-N towards establishment of a total N balance. When nitrite was added to the soil fractions, a large amount of NO_x was immediately emitted, mostly in the form of NO. N2O emission was delayed by approximately 0.5-1 h. The NO and N2O emission pattern could be almost perfectly fitted with the Hill equation. The N2O formation rates increased significantly in the following order: DOM, FA, HA and HN, while the total amounts of the gases emitted increased significantly in the opposite order. These results revealed that abiotic reactions of nitrite with SOM in spruce forest soil play an important role in N gas emissions, while the chemical nature of the different SOM fractions determines the rate and amount of N gas emissions.