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Microhabitat Effects on N_2O Emissions from Floodplain Soils under Controlled Conditions

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Semi-terrestrial soils such as floodplain soils are considered to be potential hotspots of nitrous oxide (N_2O) emissions. The quantitative assessment of N_2O release from these hotspots under field conditions, and of the microbial pathways that underlie net N_2O production (ammonium oxidation, nitrifier-denitrification, and denitrification) is challenging because of their high spatial and temporal variability. The production and consumption of N_2O appears to be linked to the presence or absence of micro-niches, providing specific conditions that may be favorable to either of the relevant microbial pathways. Flood events have been shown to trigger moments of enhanced N_2O emission through a close coupling of niches with high and low oxygen availabilities. This coupling might be modulated by microhabitat effects related to soil aggregate formation, root soil interactions and the degradation of organic matter accumulations. In order to assess how these factors can modulate N_2O production and consumption under simulated flooding/drying conditions, we have set up a mesocosm experiment with N-rich floodplain soils comprising different combinations of soil aggregate size classes and inert matrix material. These model soils were either planted with basket willow (*Salix viminalis* L.), mixed with leaf litter, or left untreated. Throughout a simulated flood event, we repeatedly measured the net N_2O production rate. In addition, soil water content, redox potential, as well as C and N substrate availability were monitored. In order to gain insight into the sources of, and biogeochemical controls on N_2O production, we also measured the bulk $\delta^{15}N$ signature of the produced N_2O, as well as its intramolecular ^{15}N site preference (SP). In this presentation we focus on a period of enhanced N_2O emission during the drying phase after 48 hrs of flooding. We will discuss the observed emission patterns in the context of possible treatment effects. Soils with large aggregates showed a tendency to emit more N_2O than small-aggregate soils. *Salix viminalis* strongly suppressed the N_2O emissions, fully compensating for any aggregate effects. Litter accumulation on the other hand enhanced N_2O emission from well-aggregated soils, but showed only a small effect in combination with small aggregates. In moments of highest emission rates, the measured $\delta^{15}N_{bulk}$ of headspace N_2O was considerably lower relative to atmospheric N_2O ($\delta^{15}N$ between -20 ‰ and -25 ‰) in the amended treatments, suggesting N_2O production by denitrification or by nitrifier-denitrification. Untreated mesocosms produced an even lower $\delta^{15}N_{bulk}$ (-40‰). Similarly, aggregate formation/size seemed to affect the N_2O $\delta^{15}N_{bulk}$ values, suggesting different net N_2O production dynamics under different microhabitat conditions, which will be elucidated further, using ^{15}N site preference SP data. Combining stable isotope techniques with quantitative flux data from a mesoscale laboratory experiment, our data highlight the importance of microhabitat effects in modulating N_2O emission from floodplain soils. It also underscores their influence on the N_2O production pathways involved in the occurrence of N_2O emission hot spots and moments.