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Dynamics of redox potential and nutrient turnover in dry floodplain soils during a simulated rain fall event

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Floodplain soils experience highly dynamic wet and dry cycles that trigger changes in redox conditions and as such play a crucial role for environmental nutrient cycling and pollutant fate.

To elucidate the effects of varying water saturation on the predominant biogeochemical processes and their dynamics we simulated a heavy rain fall event with subsequent steady rain over ten consecutive days at a plot of arable soil in a floodplain near Tübingen, southwest Germany. We monitored how soil redox conditions, redox sensitive soil constituents and microbial communities responded to changing water saturation.

The experiment design was fully randomized comprising irrigated plots mimicking rain events and dry controls.

Multi-level redox probes recorded in situ redox potentials at 10 cm intervals down to 90 cm depth on irrigated and dry plots. The initially dry soil showed redox potentials of +600 mV. The simulated heavy rain fall provoked a drop in redox potentials within hours in depths down to 40 cm and within a delay of 1 to 2 days in depths down to 60 cm. Subsequent steady rain lead to a decrease of the redox potentials to a minimum of -200 mV to -300 mV in depths of 20 to 30 cm and -100 mV in depths of 40 to 50 cm.

Soil cores were retrieved throughout the experiment to identify microbial communities and to determine depth profiles of nitrate, ammonium, adsorbed and poorly crystalline iron as well as total iron, and sulfide and sulfate in the pore water and the solid phase.

The high resolution temporal data on changes in redox potential, soil chemistry and soil microbial communities will be presented and discussed in terms of the predominant biogeochemical processes in the soil profile.