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Factors controlling the dynamics of Arsenic in floodplain soils at the Elbe river (Germany)

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Floodplain soils are exposed to periodical flooding. Large temporal and spatial variations of flooding cause respective fluctuations of soil moisture regimes resulting in frequent drastic changes in Eh- and pH- conditions, soil matrix potential (ψ), soil temperature as well as kinetics of Fe^{2+}, dissolved organic carbon (DOC), NO_3^-, PO_4^{3-}, and SO_4^{2-}. Concentrations of arsenic exceed critical limits, set by the German Soil Conservation Law, in bulk soil, soil solution and groundwater at various sites of the riverrine of the Elbe. We monitored impacts of factors controlling the dynamics of arsenic in five reference floodplain soils of the Elbe River (Germany) at three depths with three replications, in soil solution as well as groundwater over four years.

Temporal variations of arsenic concentrations in soil solution and groundwater are showing similar pattern like Fe^{2+}, PO_4^{3-}, and DOC concentrations, while Eh and concentrations of NO_3^-, and SO_4^{2-} reveal reverse pattern to that of arsenic. Soil temperature, soil moisture, ψ and pH did not show clear relationships to the temporal variability of arsenic in these soils. Solubility of arsenic was low under oxidized and high under anaerobic conditions. Multiple regression analyses revealed that Fe^{2+} and

Eh are the most important factors controlling the dynamics of As concentrations in these soils, explaining 50 % of the temporal variability of arsenic in soil solution and groundwater.

In laboratory we simulated flooding in biogeochemical microcosm to study and to quantify the transformation of arsenic under controlled redox potential and pH values, where we conducted various Eh- conditions according to these in nature. Therefore we incubated soil samples in four replications in soil-water-suspensions (soil/water-ratio 1 : 8) of Eutric Fluvisols, Mollic Fluvisols and Eutric Gleysols, which are commonly found along the Elbe River.