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Phosphorus fluxes in a poldered temporary inundated peatland- from soil to surface water

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On a 55 ha test field situated in a former polder of the Spreewald wetland region in Eastern Germany performed investigations aimed to identify phosphorus release and retention behavior with respect to different hydrological conditions.

To derive sound insights into mobilization/retention processes as well as for calculating the dominant pathways of phosphorus emissions to the surface water, research included field investigations in soils, soil porewater, shallow groundwater, ditch bed sediments and sediment porewater as well as parameters related to hydrology.

At two transects constructed between parallel main ditches considering temporally inundated topographically lower parts of the polder as well as topographically higher parts not affected by inundation, main hydraulic conditions alternate seasonally from exfiltration during wintertime to infiltration during summertime. However, significant differences in quantity and seasonality of daily leakage rates were calculated by groundwater modeling considering each groundwater transect.

Phosphorus mobilization from the soils were found to be related to inundation time ranging between maximum porewater concentration values of 2.8 to 4.2 mgSRP L^{-1} (ditch near site) to 5 to 20 mgSRP L^{-1} (site far away from ditch). While diffusive SRP fluxes to inundation water range from 0.1-2.3 mgSRP m^{-2} d^{-1} (ditch near site) and 2.5-8.4 mgSRP m^{-2} d^{-1} (site far away from ditch) shallow groundwater SRP concentrations beneath the plain were affected by seepage with slightly increasing concentrations shortly after inundation from 0.2 to 0.3 mgL^{-1} but decreasing concentrations with time to minimum concentrations of 0.05 mgL^{-1} especially when soils falling

dry. Shallow groundwater near the ditch is influenced by a distinct infiltration phase transporting sediment porewater SRP resulting in concentrations increasing from 0.01 to 1.2 mgL^{-1}. However, SRP porewater concentrations at the sediment-surface water interface significantly decrease during phases of infiltration compared to exfiltrating periods expressing the influence of oxic conditions on phosphorus retention in the ditch sediments.

Phosphorus balances for both transects imply that groundwater is the dominant pathway for phosphorus release to surface water while effective retention at the soil/sediment-surface water/groundwater interface was documented by redox implied precipitation of SRP with FeOOH. While phosphorus release to surface water in the topographic higher parts is groundwater dominated only in the lower part characterized by infiltration and inundation potential phosphorus release is mainly related to diffusive transport from the peat soils to the inundation water counteracted by sedimentation processes. Considering groundwater flow, diffusive fluxes at the soil water interface, as well as sedimentation from the water column and at the sediment surface water transition zone the upper polder parts act as a source for phosphorus, while the lower inundated parts act as a sink for phosphorus over the year.