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Phosphorus storage and mobilization in coastal Phragmites wetlands: Influence of local-scale hydrodynamics

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Coastal Phragmites wetlands are at the interface between terrestrial and aquatic ecosystems and are of paramount importance for nutrient regulation. They can act both as sinks and sources for phosphorus, depending on environmental conditions, sediment properties as well as on antecedent nutrient loading and sorption capacity of the sediments. The Darss-Zingst Bodden Chain is a shallow lagoon system at the German Baltic Sea coast with a long eutrophication history. It is lined almost at its entire length by reed wetlands. In order to elucidate under which conditions these wetlands act as sources or sinks for phosphorus, in-situ data of chemo-physical characteristics of water and sediment samples were combined with hydrodynamic measurements and laboratory experiments. Small-scale basin structures within the wetland serve as sinks for fine-grained particles rich in phosphorus, iron, manganese and organic matter. Without turbulent mixing the bottom water and the sediment surface lack replenishment of oxygen. During stagnant periods with low water level, low turbulence and thus low-oxygen conditions phosphorus from the sediments is released. But the sediments are capable of becoming sinks again once oxygen is resupplied. A thin oxic sediment surface layer rich in iron and manganese adsorbs phosphorus quickly. We demonstrate that sediments in coastal Phragmites wetlands can serve both as sources and sinks of soluble reactive phosphorus on a very short time-scale, depending on local-scale hydrodynamics and the state of the oxic-anoxic sediment interface.