Identifying key drivers of intra annual DIP concentration in the western Wadden Sea: importance of intertidal flats.

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The western Wadden Sea experienced strong reduction of riverine dissolved inorganic phosphate (DIP) loadings over the last decades, causing changes in monthly variations of DIP concentrations. However, it is still questioned what the drivers are for the observed intra annual variation in DIP. It is hypothesized that the sediment biogeochemistry may control DIP concentration in the overlying water. In a shallow coastal system that comprises 40–60% of tidal flat area—inhabited by a dense microphytobenthos (MPB) community—the question rises whether MPB communities influence the flux between sediment and the water column. MPB communities either influence the DIP flux directly by nutrient uptake or indirectly by altering the geochemical environment (e.g. redox potential and pH) through O_2 production and CO_2 consumption as a result of photosynthesis. In both cases this may result in lower flux to the water column, which consequently leads to DIP concentrations that limit pelagic primary production. We tested whether intra annual variations of DIP concentrations are driven by algal uptake, mineralization processes or biogeochemical alterations in the sediment by MPB with three different models. Model 1 and 2 describe DIP dynamics solely by algal uptake and consecutive remineralization. Model 2 differentiates between pelagic and benthic uptake, while model 1 combines both as one algal pool. Model 3 also includes biogeochemistry of DIP in the sediment such as adsorption onto FeOOH. The models were tested against a measured dataset on DIP fluxes, pore water and water column DIP concentration and chlorophyll *a* analyses acquired through one year (2010) of repeated field campaigns at the Balgzand intertidal flat. The results suggest that model 1 and 2 can explain the major changes in DIP concentration of the water column, but are insufficiently able to simulate the prolonged period of low DIP concentration during summer. Model 3 was able to better explain the low DIP concentration during this period, which suggests that biogeochemical processes controlled by MPB should be considered when interpreting DIP dynamics in the western Wadden Sea.