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Seasonal variations of the nature-based shoreline protection value of tidal marshes

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Tidal marsh conservation and restoration for nature-based mitigation of coastal flood and erosion risks is increasingly proposed as an additional, sustainable shoreline protection strategy to cope with increasing risks related to global change. Tidal marshes are known to provide shoreline protection as their aboveground biomass attenuates waves and their belowground biomass contributes to reducing erosion rates. The aim of this study was to quantify the impact of seasonal differences of both aboveground and belowground tidal marsh plant biomass on wave attenuation and erosion-sedimentation rates. Changes in hydrodynamics and sediment dynamics were measured during 17 months along three sea-to-land transects of 50 m length in the Elbe estuary (Germany). Simultaneously, changes in biomass of the monospecific pioneer vegetation (Bolboschoenus maritimus) were measured monthly. We found a positive correlation of wave and flow attenuation rate and the seasonal variation of aboveground biomass. In summer, above-ground biomass and associated wave and flow attenuation rates are highest; while above-ground biomass is washed away during the first storms in autumn or winter, resulting in low wave and attenuation rates. Contrastingly, maximum incoming wave heights and flow velocities occur during winter, indicating that wave and flow attenuation is most needed then. However, our results suggest that hibernating root biomass sustains low erosion rates in winter. Although wave attenuation by pioneer marshes is highly variable throughout seasons and pioneer marshes alone are not sufficiently effective, they might facilitate the survival of higher, more inland marshes, and as such contribute indirectly to nature-based shoreline protection.