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Wave-vegetation interactions within Baltic coastal reed beds

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In the context of sea level rise and the possibility of associated increased storminess the role of low-lying vegetated coastal margins as natural sea defences (as well as important conservation areas) is becoming increasingly critical to the sustainable management of coasts. At the same time, the function of such types of coastal environments as providers of a range of local and global ecosystem services has become more widely recognised. While a range of previous studies have highlighted the significance of vegetation as a natural wave energy buffer, few studies have systematically investigated the variation of this function under varying water depth and wave exposure. This paper presents detailed field measurements of wave spectra along two *Phragmites australis* reed beds under conditions of varying water depths and levels of exposure on the shores of the southern Baltic Sea. Results are discussed in the context of the meteorological conditions and geomorphological controls affecting the vegetated zone. Significant wave height attenuation reached a maximum of 2.6 % m^{-1} and 11.8 % m^{-1} at the transition from open water into the reed vegetation at the sheltered and exposed sites respectively. Wave attenuation through the emergent reed vegetation was significantly lower in greater water depths, suggesting (i) a reduced influence of bed friction by small shoots/roots and/or (ii) drag reduction due to flexing of plants when the wave motion is impacting stems at a greater height above the bed. For a given water depth, wave dissipation increased with increasing incident wave height, however, suggesting that, despite their ability to flex, reed stems may be rigid enough to cause increased drag under greater wave forcing. The higher frequency part of the wave spectrum (> 0.5 Hz) was preferentially reduced at the reed margin, confirming the theoretical wave frequency dependence of bottom friction. The results presented have implications for wider-ranging questions about the possible impact of increased water depths (sea level rise) and increased storm surge frequency. The possible significance of biogeomorphological thresholds is discussed and the need for flexible coastal management approaches highlighted.