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Decadal intertidal vegetation development in an estuary and its effect on the wave damping capacity

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Intertidal vegetation is renowned for its capacity to reduce wave energy and thereby enhance coastal safety. At present, this concept is well established on local scales (meters to marsh-mudflat system) and relatively short terms (hours to years). However, the development of intertidal vegetation on larger scales (i.e. the spatial scale of an estuary and the temporal scale of decades) is unknown. Consequently, it is impossible at the moment to quantify the wave damping capacity at these scales. In this paper, the decadal spatiotemporal characteristics and dynamics of intertidal vegetation are studied by combining available data (e.g. from field surveys) and remote sensing techniques (Combining SAR and optical remote sensing). For this analysis, the Scheldt estuary, with a tidal reach of more than 160km from the mouth near Vlissingen, the Netherlands, till Gent, Belgium, is used as study area. Intertidal vegetation located in salt, brackish and freshwater environments is considered to cover the changes in salinity regimes in estuaries. More specifically, the vegetation species considered in this study are: Common glasswort (*Salicornia europaea*), Common cordgrass (*Spartina anglica*), Saltmarsh bulrush (*Scirpus maritimus*), Common reed (*Phragmites australis*) and Common willow (*Salix alba*). The variability in vegetation distribution in this study has three components: (1) the areal extent i.e. total marsh dimensions and associated variability in this (expansion/retreat) (2) the variability in vegetation characteristics e.g. density, biomass, height and seasonality and (3) shifts in vegetation species i.e. going from one species to another at the same location over time. Since the wave damping capacity of a vegetated intertidal area is a combination of the wave attenuation from the bottom friction and the attenuation due to the presence of vegetation, the bed topography corresponding to the vegetation pattern is established from laser altimetry (LiDAR) data. Ultimately, the wave damping capacity of intertidal vegetated areas under various storm conditions is determined using a Simulating WAves Nearshore (SWAN) model, based on the spatial vegetation patterns and characteristics, as well as the variation in bathymetry. Quantification of the decadal dynamics of intertidal vegetation in estuaries and its impact on the wave damping capacity will help us to give recommendations for the effectiveness and the design of nature-based coastal protection measures.