Field-based decadal wave attenuating capacity of combined tidal flats and salt marshes

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Abstract

Foreshores consisting of both bare tidal flats and vegetated salt marshes are found worldwide and they are well studied for their wave attenuating capacity. However, most studies only focus on the small scale: just some isolated locations in space and only up to several years in time. In order to stimulate the implementation of foreshores serving as reliable coastal defense on a large scale, we need to quantify the decadal wave attenuating capacity of the foreshore on the scale of an estuary. To study this, a unique bathymetrical dataset is analyzed, covering the geometry of the Westerschelde estuary (The Netherlands) over a time-span of 65 years. From this dataset, six study sites were extracted (both sheltered sites and exposed sites to the prevailing wind direction) and divided into transects. This resulted in 36 transects covering the entire foreshore (composed of the bare tidal flat and the vegetated salt marsh). The wave attenuation of all transects under daily conditions (with and without vegetation) and design conditions (i.e. events statistically occurring once every 10,000 years) was modelled.

Overall, the spatial variability of the geometry of a single foreshore was observed to be much larger than the temporal variability. Temporal changes in salt marsh width did not follow the variability of the entire foreshore. Both under daily and design conditions, vegetation contributes to decreasing wave energy and decreases the variability of incoming wave energy, thereby decreasing the wave load on the dike. The southern foreshores, sheltered from the prevailing wind direction, were more efficient in wave attenuation than the exposed northern foreshores. A linear relation between marsh width and wave attenuation over a period of 65 years was observed at all marshes. The present study provides insights needed to calculate the length of a salt marsh to obtain a desired minimum wave attenuating capacity.

Keywords:

Wave attenuation Coastal protection Building with Nature Foreshore Salt marsh Nature Based Flood Defense SWAN