Nature-based flood protection: The efficiency of vegetated foreshore for reducing wave loads on coastal dikes

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Abstract

This paper analyses the effect of vegetation on wave damping under severe storm conditions, based on a combination of field measurements and numerical modelling. The field measurements of wave attenuation by vegetation were performed on two salt marshes with two representative but contrasting coastal wetland vegetation types: cordgrass (Spartinaanglica) and grass weed (Scirpusmaritimus). The former is found in salty environments, whereas the latter is found in brackish environments. The measurements have added to the range with the highest water depth sand wave heights presented in the literature so far. A numerical wave model (SWAN) has been calibrated and validated using the new field data. It appeared that the model was well capable of reproducing the observed decay in wave height over the salt marsh. The model has been applied to compute the re-duction of the incident wave height on a dike for various realistic foreshore configurations and hydraulic loading conditions. Additionally, the efficiency of vegetated foreshores in reducing wave loads on the dike has been investigated, where wave loads were quantified using a computed wave run-up height and wave overtopping discharge. The outcomes show that vegetated foreshores reduce wave loads on coastal dikes significantly, also for the large inundation depths that occur during storms and with the vegetation being in winter state. The effect of the fore shore on the wave loads varies with wave height to water depth ratio on the foreshore. The presence of vegetation on the foreshore extends the range of water depths for which a foreshore can be applied for effective reduction of wave loads, and prevents intense wave breaking on the foreshore to occur. This research demonstrates that vegetated foreshores can be considered as a promising supplement to conventional engineering methods for dike reinforcement.