Wave attenuation by vegetated foreshores under storm conditions: evidence from the field

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1. Introduction

It is recognized that vegetated foreshores like salt marshes can reduce hydraulic loads on coastal dikes, potentially allowing for more slender dike designs. However, quantitative field evidence of the load reduction during severe storm conditions is lacking.

Existing models that relate quantities like the two-percent wave run-up height to flotsam levels (e.g. IJnsen, 1983) are based on the assumption of a Rayleigh distribution for the wave height. On shallow foreshores, wave height distributions deviate from the Rayleigh distribution (Battjes & Groenendijk, 2000). We will show a new model, based on the current unique combination of measured incident wave conditions and measured flotsam levels.

Figure 1: Two lines of flotsam ('veekranden') on the dike at the transition from a mudflat to a salt marsh

2. Methodology

Starting from November 2014, wave gauges have been deployed at five transects in the Western Scheldt (2), the Wadden Sea, Nieuwe Maas and Zwarte Meer, to quantify wave attenuation by *Spartina*, *Scirpus*, *Elytrigia* and *Phragmites* vegetation.

On January 11th, a heavy storm has hit the Dutch coast, with water levels reaching 3.3 m+NAP at Eemshaven. After this storm, the position of the flotsam – mostly organic debris, transported towards the dike by waves– has been measured on the outer slope of the Wadden dike between Eemshaven and Lauwersoog (Figure 1). The flotsam level corresponds to the highest wave run-up during the highest still water level during the storm surge.

During the same storm, wave sensors have been deployed, five perpendicular to the dike to investigate the wave transformation over the salt marsh, and four parallel to the dike, to quantify the wave height distribution near the dike for different foreshore types: tidal flats, pioneer salt marsh and mature salt marsh.

3. Results

The flotsam levels were considerably lower behind the salt marshes than behind the mudflats (Figure 1).

Based on our measurements, we will present the wave attenuation capability of different plant species.

4. Conclusions

- Salt marshes bordering coastal dikes contribute significantly to the reduction of wave loads on the dike, compared to bare mudflats.
- The reduction of wave loads primarily depends on the geometry of the vegetated foreshore, and on the vegetation species present.
- Flotsam levels are a useful indicator for wave run-up, provided that sufficient insight is available about the wave height distribution.

References

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