COASTAL OVERWASH – THE IMPACTS OF A 100-YEAR STORM FLOOD EVENT IN SOUTH-EASTERN DENMARK

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INTRODUCTION

Coastal overwash where water and sediment flow over the beach crest can be highly damaging to human properties and infrastructure. This involves a need for accurate overwash prediction for planners and engineers. On the other hand, on undisturbed coastlines, overwash makes an important sediment contribution to the system. Contributions which are key for spits and barrier islands to keep up with predicted future sea level rises. Based on a recent 100-year storm event in the eastern Baltic Sea in 2023, we asses both the predictive capability of a storm impact model (Sallenger, 2000), and the cross-shore sediment exchange associated with washover fans.

STORM EVENT

On October 20-21, 2023 south-eastern Denmark experienced a 100-year storm flood event, resulting in extreme beach erosion, damaged houses and infrastructure, and a number of overwashes. The coastal environment of the area (Figure 1) is micro-tidal, and fetch-limited, dominated by small (< 1 m) local wind waves. However, on Oct. 20-21 strong easterly winds of mean speeds of up to 28 m/s resulted in wave heights of up to 4 m. In addition to that, the strong wind in combination with seiching in the Baltic Sea resulted in surge levels of up to 2 m. The extreme water levels were due to several days of westerly winds prior to Oct. 20, pushing extra water into the Baltic Sea (Figure 1). As the wind-direction turned to the east, these water masses returned through the narrow straits between Denmark and Sweden/Germany. The spatial variability of washover fans in the area is examined using satellite images.

STORM IMPACT MODEL

Sallenger (2000) proposed a storm impact model based, on the relation between water levels (due to tide, surge and waves) and beach profile (elevation of dune or berm). In this model, overwash occurs when surge levels and wave run-up are at dune crest level. The predictive capabilities of the model are tested for the semi-enclosed Baltic Sea where surge and wave-run up levels can be out of phase due to seiching. A number of observed washover fans from different sites in the area are selected for model-data comparison. The expected impact of the storm flood event is estimated based on pre-storm beach morphology using a national lidar-derived digital elevation model (DEM) from 2015 together with measured storm water levels, and modeled nearshore wave heights using a calibrated and validated SWAN wave model (Adell et al., 2023).

SEDIMENT BUDGETS

In addition, for selected washover fans fieldwork and UAV surveys are carried out in order to quantify sediment budgets. SfM image processing is performed on drone images in order to generate DEMs of the washover fans. Elevation changes were then calculated between 2015 (national DEM) and 2023 (local SfM DEMs) (Hansen et al., 2021).

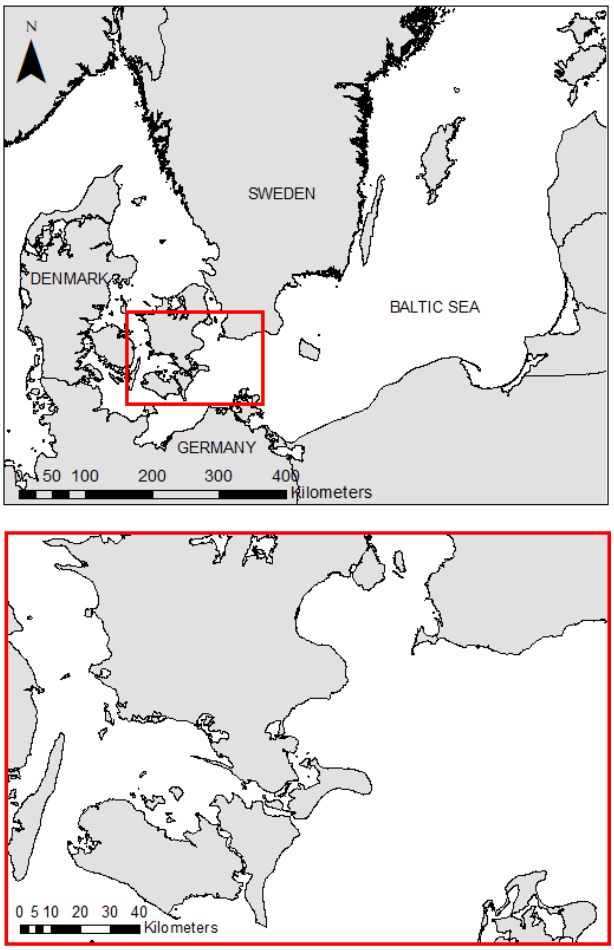

Figure 1 – Overview map of the western Baltic Sea (upper) and zoom-in on the south-eastern Denmark (lower)

REFERENCES

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