MIXED-SEDIMENT DYNAMICS AT A BACK-BARRIER BEACH NOURISHMENT

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INTRODUCTION

Sand nourishments are increasingly applied to systems where the morphodynamics are driven by mixed hydrodynamic forcing (i.e., tides and waves) rather than by waves alone. Here, mixed-sand deposits are usually retrofitted to inadequate, hard flood defenses to act as a buffer against erosion and eventually failure of such infrastructure. Introducing different grain sizes into a system leads to more complex, differentiated sediment transport, as coarser fractions are mobilized under different conditions than finer fractions (McCarron et al., 2019). By focusing on a nourishment on the leeward side of a barrier island, we aim to find quantitative answers to the questions where, when and how the mixed-sediment composition changes and how that already is and will be expressed in the morphologic evolution of the area.

METHODS

This research is primarily based on the 6-week SEDMEX (mixed SEDiments in Mixed Energy eXperiment) field campaign conducted in autumn 2021 at the 3.3-km long Prins Hendrikzanddijk (Fig. 1), a recently completed retrofit nourishment on the Dutch barrier island of Texel. We deployed long- and cross-shore arrays of instruments to collect time series of pressure, flow velocity, suspended sediment concentration and (migrating) bedforms. These measurements were complemented by almost daily bed-level measurements and spatiotemporally extensive sets of sediment samples, and at lower temporal (every 2 to 4 months) and spatial resolution before and after the campaign.

RESULTS

Since completion of the sand dike in the second half of 2019, the spit has been building out in the direction of the dominant flood current by some 160 m, while a longshore pattern of alternating accretion and erosion has reshaped its shoreline (Fig. 2). During the SEDMEX campaign, wave heights (Hm0) in few cases reached up to 0.6 m, while tidal currents frequently reached velocities up to 0.5 m/s. The median grain size (D_{50}) of the top 5-6 cm of the intertidal beach ranged from 400 to 2000 µm (mean ~900 µm), fining towards the ends (Fig. 1). Grain-size distributions were generally wide, often revealing polymodality and a very poor degree of sorting. They varied significantly both temporally and spatially, and both in the cross- and longshore directions. Such changes in bed composition often coincided with changes in bed level and beach-step position after a period of increased wave activity. Furthermore, transient patterns of surfacing coarse and shell-rich material often characterized the intertidal beach surface. At the conference we will further elaborate on the observed relations between mixed-sediment sorting and morphologic development in mixed-energy systems.

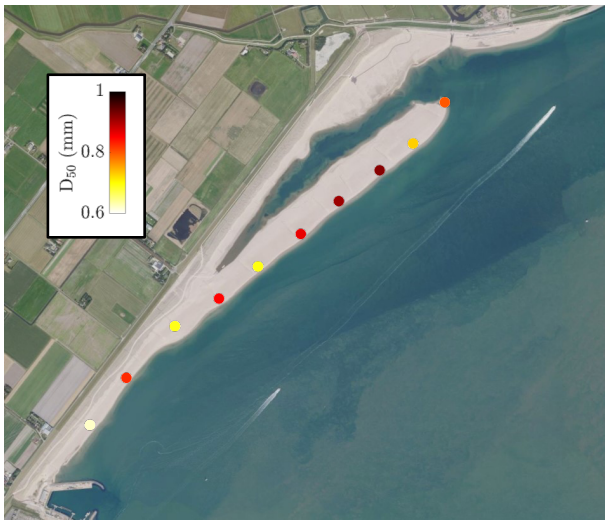

Figure 1 - New sandy dike reinforcement, Texel, NL. Colored dots indicate the intertidal cross-shore mean of D_{50} on 12 December 2020.

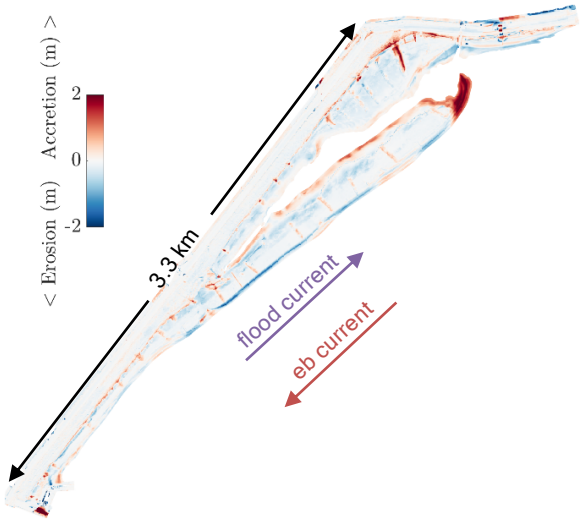

Figure 2 - Net bed-level change since completion.

ACKNOWLEDGEMENTS

This work is part of the NWO-funded project named EURECCA (Effective Upgrades and REtrofits for Coastal Climate Adaptation), grant no. 18035.

REFERENCES

McCarron et al. (2019): The hiding-exposure effect revisited: A method to calculate the mobility of bimodal sediment mixtures. Mar. Geol. 410, 22-31.