Effect of waves, tides and spatial heterogeneity on initial erosiondeposition patterns in a mixed-energy coastal environment

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Context

- Nourishments are nature-friendly and sustainable coastal protection measures
- Nourishments have been mainly applied to wavedominated coasts (e.g. Sand Motor)
- Nourishment design studies seldomly account for spatial variability of the bed composition (Huisman et al., 2018)



Study Site: Prins Hendrikzanddijk

• Former erosive shoal in the Wadden Sea on the southeast side of Texel adjacent to the 'Texelstroom' channel

Coarse graded sand dike nourishment

- Safety dune (D50 ≈ 300 µm)
- Armor layer (D50 > 600 μ m)
- **Mixed tides and wave** environment:
 - Mean tidal range: 1.4m

Quantify the role of different drivers and graded sediment on erosion and deposition patterns in a mixed-energy environment.

- Moderate waves up to 0.6m
- Steep and short beach face (1:8-1:10)



Water level and currents



Model Performance

Variable	RMSE
Water level	0.072 m
Longshore velocity	0.11 ms ⁻¹
Cross shore velocity	0.03 ms ⁻¹



Sediment entrainment & transport



- Local wind generated waves dominated the wave climate
- Fetch controls wave height
- Single fraction: $D50 = 400 \ \mu m$
- Sediment entrainment due to waves
- Wave-driven onshore bed load

Next steps

- Sensitivity analysis: sediment fractions sizes, amount of sediment fractions and transport formulae
- Simulations with characteristic conditions to capture graded sediment dynamics 2.
- Vary initial bed composition to investigate the influence on sediment transport. 3.

References

Huisman, B. J. A., Ruessink, B. G., de Schipper, M. A., Luijendijk, A. P., & Stive, M. J. F. (2018). Modelling of bed sediment composition changes at the lower shoreface of the Sand Motor. *Coastal Engineering*, 132, 33–49.