Morphological evolution of estuary mouths with wave-current interaction modelled over centuries

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Introduction

Geological reconstructions of the Old Rhine estuary on the Dutch Coast suggest that this environment has been shaped by tides, river, vegetation and waves. During the late Holocene this Rhine branch was able to form an extensive delta before its closure

(Van Heteren & Van der Spek, 2008). 4500 yr BP Wave forcing is usually negleted into long term morphological studies. Therefore, the goal is to access the effect of wave current interaction on the hydrodynamics, sediment transport and resulting morphology over centuries.



Methods

Numerical Simulations in Delft3D/ SWAN with idealized estuaries considering tides, river discharge and waves onto a sandy uniform bed. Sediment transport was calculated with Van Rijn 2007 - TRANSPOR2004 (Van Rijn & Walstra, 2004).





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HYDRODYNAMICS









Into Words

Wave Current interaction on estuaries are important for long term morphology due to spacial and temporal effects on currents and therefore sediment transport. CURRENTS WAVE STIRRING

- Wave action creates a zone of different current magnitude and direction in addition of the
- river jet. This wave induced current is directed towards the estuary, localed on its flanks.
- Wave Current interaction enhances velocities on the nearshore shallow areas

BAR PATTERN

- Wave dominant deltas tend to form only ebb tidal delta while River deltas form several elongated bars between distributary channels.
- Waves are responsible for sediment stirring and erosion on very shallow waters. This effect diminishes the number of bars within the delta.

CHANNEL NETWORK

• River dominant deltas have more complex and dynamic channel network due to bifurcation of channels and bar formation and expansion.



Van Heteren, S. & Van der Spek, A.J.F., 2008. Waar is de delta van de Oude Rijn? Grondboor en Hamer 3/4, 72-76 (in Dutch).

Van Rijn, L.C. & Walstra, D.J.R., 2004 Description of TRANSPOR2004 and implementation in Delft3D-ONLINE: interim report. Deltares (WL)