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Towards predicting decadal shoreline change on a global scale

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Abstract:
Currently available assessments of future shoreline change indicate that many or most of the world's coastlines will experience shoreline retreat through the 21st century, potentially leading to massive loss of beach area and biodiversity in the coastal zone. This, in turn, would impact the safety against flooding and local economies.
Understanding and predicting coastal planform change (i.e. coastline position as viewed from above) is severely limited by incomplete or insufficiently tested models, incomplete nearshore wave conditions and satellite-derived shorelines that are often unreliable at a local scale.
For modelling coastal planform evolution very promising approaches were recently developed and are being tested at many sites (e.g. Roelvink et al., 20201 , www.shorelines.nl). The main data required are (satellite-derived) coastlines, for initialization and calibration, hard natural or man-made structures and nearshore wave conditions. While ERA5 provides data at 60 km resolution, transformation to nearshore is required and needs very efficient methods, currently being validated, for detailed application at a global scale. Additional data that may be required may be river sediment supply rates, inlet locations and widths, and vegetation characteristics.
The main transport mechanism for sandy beaches is alongshore wave-driven transport; this is dominant at longer timescales, but cross-shore components such as dune erosion, aeolian transport and wave-driven cross-shore processes can dominate shorter timescales and are therefore accounted for, as are various types of structures (groynes, offshore breakwaters, permeable breakwaters, headlands, revetments…). In a recent joint-industry project, ShorelineS-TKI, led by Deltares and IHE Delft with 20 international partners, major improvements were implemented and much effort was put into making the model more robust and better documented. For mud coasts, the transport is dominated by wind-driven alongshore flows, where tides and waves regulate the suspension of fine sediment. Wave-driven flow can also contribute to this transport. A novel 1D approach to simulate the evolution of mud/mangrove coasts is currently under development.
In the lecture we will discuss the components of a methodology to predict shoreline change anywhere and outline the reasoning behind and the path towards predicting it everywhere.

Reference

ROELVINK D., HUISMAN B., ELGHANDOUR A., GHONIM M., REYNS J. (2020). *Efficient modeling of complex sandy coastal evolution at monthly to century time scales*. Frontiers in Marine Science, Sec. Coastal Ocean Processes, volume 7, https://doi.org/10.3389/fmars.2020.00535