Geophysical Research Abstracts
Vol. 21, EGU2019-5535, 2019
EGU General Assembly 2019

The Impact of Waves and Tides on Residual Sand Transport on a Sediment-poor, Energetic and Macrotidal Continental Shelf

Erin King (1), Daniel Conley (1), Gerd Masselink (1), Nicoletta Leonardi (2), Robert McCarroll (1), and Timothy Scott (1)

(1) School of Biological and Marine Sciences, Plymouth University, Plymouth, UK, (2) School of Environmental Sciences, University of Liverpool, Liverpool, UK

The energetic, macrotidal shelf off South West England was used to investigate and classify the impact of different tide and wave conditions and their interactions on sand transport at a regional scale using a coupled hydrodynamic, wave and sediment transport model (Delft3D). Residual currents and sediment transport patterns are important for the transport and distribution of littoral and shelf sea sediments, the morphological evolution of the coastal and inner continental shelf zones and coastal planning.

Sand transport magnitude and direction across this macrotidal environment are heavily influenced by waves. Median (50% exceedance) and extreme (1% exceedance) wave conditions were simulated during neap and spring tides. Effects such as areas shifting from flood- to ebb-dominant sand transport, reversals in the dominant sand transport path and activation of sand transport at depths of 120m were predicted under extreme forcing relative to tide-only and median wave conditions. Wave-tide interactions cause a significant non-linear enhancement of sand transport magnitude, as determined by the difference between sand transport magnitude in a coupled model and its wave-only and tide-only components.

A new continental shelf classification scheme was created based on sand transport magnitude due to wave-forcing, tide-forcing and non-linear wave-tide interactions. Non-linear interactions are the dominant forcing mechanism for sand transport across most of this macrotidal environment during extreme waves at springs. At neaps, non-linear interactions drive a significant proportion of sand transport under median and extreme waves despite negligible tide-only sand transport. This emphasises the critical need to consider wave-tide interactions when considering sand transport in energetic environments globally.

The above classification method requires a computationally expensive coupled numerical model, and the next step is to make it more generally applicable based on readily available tide and wave characteristics. A weighted K-nearest neighbour classifier was used to predict wave, tide or non-linear interaction dominance of net sand transport based on readily available tide and wave parameters. Of the parameters tested, tide range, mean significant wave height, mean peak period, mean wave direction, water depth and maximum current speed and direction were identified as predictors. Classifications were predicted with an overall accuracy of 81.3% using all identified predictors and 74% using a subset of tide range, mean significant wave height and water depth, based on 5-fold cross validation. A simplified classification scheme was predicted with 93.1% accuracy for all predictors and 88.9% for the subset. This classification scheme may be used to identify the primary forcing mechanisms and relative magnitudes of net sand transport across the shelf across a range of wave-tide regimes, using only readily available wave and tide data as inputs, with benefits to coastal researchers and planners working in energetic, sandy environments worldwide.