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Assessing the impact of man-made structures: effect of a jetty on wave climate

Maria Amelia Araujo, Steven Wallbridge, and Liam Fernand

Centre for Environment, Fisheries & Aquaculture Science (CEFAS) Pakefield Road, Lowestoft, NR33 0HT, UK (amelia.araujo@cefas.co.uk)

Worldwide there has been increase in the development of man-made near shore marine structures like jetties. The presence of these may drive some local changes to sediment availability and transport rates; aligned to this is greater scrutiny of such developments. To quantify the potential impacts of such developments a case study is considered here of a typical jetty located on a soft erodible coast. The effect on the nearshore wave climate is assessed using the Artemis/Telemac2D numerical modelling system.

Artemis has capability in the context of computing wave action where surface waves come into contact with hard structures such as walls, breakwaters and coastal defence infrastructure. This model includes important parameters such as reflection of waves by an obstacle and diffraction behind an obstacle. Based on literature, a reflection coefficient of 0.95 has been considered in this study. Artemis can be used to simulate multidirectional random waves and includes effects of bottom friction, bathymetric breaking and energy dissipation. Telemac2D provides the free-surface, water depth and depth-averaged velocity components.

An external coupling between Artemis and Telemac2D was made to evaluate the combined wave and currents forces at the bed in order to calculate the nearshore bed shear stresses and the sediment transport rates. Wave and tide velocities were generated by the models and then combined by exporting tidal flow values at appropriate stages of tide (peak flood and peak ebb) onto a 10m regular grid over the jetty domain and combining with exported wave parameters over the same grid.

The jetty was considered as a tubular piled structure perpendicular to an eastward facing shoreline, about 600m long, with five rows of piles across width and around one hundred columns along length. The local scour predicted to be generated by the structure due to waves and currents has been included in the bathymetry.

Results show that for south-southeast (SSE) waves, the reduction in wave height ranges from 30-80%, with the largest waves being the ones more affected and with an alongshore impact of about 100 to 250m to the north. The reduction in wave height is greater for the east-northeast (ENE) waves (60-80%), corresponding to an alongshore impact of about 100 to 150m to the south. Bed shear stress calculations at a point in the lee of the jetty, where waves are strongly attenuated, show significant reductions in the bed shear stress when the jetty is introduced, indicating reduced sediment transport. Overall, these effects are local, occur close to the jetty, and result in reduced sediment re-suspension into the water column by waves and alongshore transport in the “lee” of the structure.