Simulating tides and waves in the East Coast of Scotland

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Are you a student? Yes

North Sea is one of the most extensively studied shelf seas and its hydrodynamic behavior has been modeled by many investigators. However, most iof this effort has been devoted to the general circulation due to tide, wind and buoyancy inputs. There is a lack of modeling effort on wave activity, and especially on the interaction of waves and tidal effects.

Some previous works highlighted the presence of three amphidromic points for the main tidal harmonic component (M_2) in the North Sea, one near English Channel, one near Danish coast and one at Southern-West tip of the Norway coastline. Wave fields that may interact with this structure of tidal phase and amplitude arise from local wind stress within the North Sea, and long-range wave propagation from the Atlantic and Norwegian Sea.

As part of the EPSRC TeraWatt project on renewable energy resources, we concentrated on combined modeling of tides and waves off the east coast of Scotland using the MIKE 3 by DHI modelling software.

We focused on an area centred on Stonehaven bay which is the location of a Marine Scotland long term hydrographic and ecological monitoring site. The domain extended north into the Moray Firth, and south to the Farne Island.

Boundary data for the model were provided by sea level tidal oscillations derived from a satellite altimetry based global tidal model, and by output from a whole-Atlantic wave model. For calibration and validation, we used tide-gauge data from the UK sealevel recorder network, and wave data from buoys in the Moray Firth, Firth of Forth and Aberdeen Bay.

Our results show that the model was very successful at predicting the phase and amplitude of the major tidal harmonics in the region. The simulated wave fields were also a good representation of the observed data with respect to locally generated waves and waves propagating into the region from the Atlantic. However, the results show that there is a significant element of the eastern Scottish wave field which originates in the Arctic sector of the Norwegian Sea, that was not captured by our model boundary conditions.

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