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Wave climate changes on the NW European shelf from model downscaling

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Abstract

The potential effects of climate change worldwide are now widely recognized. The threat of sea-level rise and climate change means that coastal engineers are being increasingly asked to make long-term assessments of potential coastal impacts and responses. In the UK, shoreline management planning (for flood and erosion hazards) and spatial planning now takes a 100 year perspective. We need detailed regional forecasts to enable coastal managers to plan for the likely impacts. Any changes in the coastal wave climate may have an important effect on coastal flooding and erosion. Here we discuss methodology for the downscaling from global climate model winds (from the Hadley Centre climate model) to a regional wave model of the UK continental shelf (on 12km grid). We can then assess the variability of the wave climate in different sea areas, depending on the exposure of different coastlines and the effects of different future climate scenarios. The model has been integrated from 1960 to 2100 with a medium GHG emission scenario. Results from two members of a 17-member ensemble which explores the climate model sensitivity are also used to force the wave model for two 30-year time slices (1960-1990 and 2070-2100). Present-day statistics have been validated using the ERA40 reanalysis. Mean and extreme wave statistics have been extracted fro present-day and future climate scenarios.

An application of the model results for coastal management of the UK Norfolk coast is described. The Tyndall Centre for Climate Change Research has just completed a project which has built a Coastal Simulator to support long-term assessment and decision making based on a series of linked models within a nested framework which recognises three spatial scales: (i) the global scale; (ii) the regional scale and (iii) the Simulator domain (a physiographic unit, such as a sub-cell). Within the nesting, the larger scale e.g. the regional wave model described above provides the boundary conditions for the smaller scale. The models feed into each other and describe a range of relevant processes: sea level, tides, surges, waves, sediment transport and coastal morphology. The Simulator includes a dedicated GIS-based user interface which allows a wide range of queries of libraries of model outputs. Different future climate scenarios, including the range of uncertainty, as well as management options can be explored. Sea-level rise is the most important driver of change, with changes in wave conditions causing secondary effects. Shoreline management decisions also have a profound effect on sediment supply and the analysis suggests that removing cliff defences may greatly reduce flooding potential at down-drift locations.