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Modelling coastal processes and morphological changes of the UK east coast in support of coastal decision-making

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The coastline of Eastern England is home to about one quarter of the UK's coastal habitats, including intertidal salt marshes, tidal flats and sand dunes. These geomorphic features are of great importance to the local wildlife, global biodiversity, marine environment and human society and economy. Due to sea-level rise and the occurrence of extreme weather conditions, the coastline of Eastern England is under high risk of erosion and recession, which could lead to tidal inundation of sites such as the RSPB Minsmere Reserve and power generation infrastructure at Sizewell.

This research responds to the need for sustainable shoreline management plans of the UK east coast through sensitivity studies at the Dunwich-Sizewell area, Suffolk, UK. Particular interest is on the long-term morphodynamic response of the study area to possible environmental variations associated with global climate change. Key coastal processes, i.e. current, waves and sediment transport, and morphological evolution are studied using a process-based numerical model under the following scenarios: current mean sea level + calm wave conditions, current mean sea level + storms, sea level rise + calm wave conditions, and sea level rise + storms, all with a 'do nothing' management plan which allows the coastal environment to exist and respond dynamically. As a further aspect of this research, rules will be generalized for reduced-complexity, system-based modelling.

Alternative management plans, including 'managed realignment' and 'advance the line', are also investigated in this research under the same environmental forcing scenarios, for the purposes of protection of infrastructure of national importance and conservation of wetland habitats. Both 'hard' and 'soft' engineering options, such as groynes and beach nourishment respectively, are considered. A more ecohydrological option which utilizes aquatic plant communities for wave energy dissipation and sediment trapping is also studied. The last option requires the numerical models to be modified based on understandings obtained through analysis of on-site observations and laboratory measurements.