An understanding of coastal morphology and sediment dynamics is essential for the management of coastal resources. **Hannah Evans** gives an example from Great Yarmouth, Norfolk.

Vital coastal barriers

British coastal areas contain a variety of important resources, including wind farms, pipeline routes, marine aggregates and sensitive habitats in the offshore zone, and buildings, infrastructure, scenic landscapes and sensitive habitats on land. As the offshore and onshore elements of these coastal areas are linked through the exchange of sediment, a thorough knowledge of the underlying processes is essential for management of the resources. Predicted future rises in relative sea level and increased storminess mean that coastal areas are likely to be among the most sensitive to climate change.

The British Geological Survey possesses a large capability for coastal zone research. Current projects include:

- terrestrial LIDAR (light detection and ranging) scanning and dGPS (differential global positioning system) profiling of beaches in Holderness
- investigation of persistent organic pollutants in the Thames Estuary
- examination of ancient sea-level changes in the Thames Estuary
- 3D modelling of beach sediment volume at Great Yarmouth.

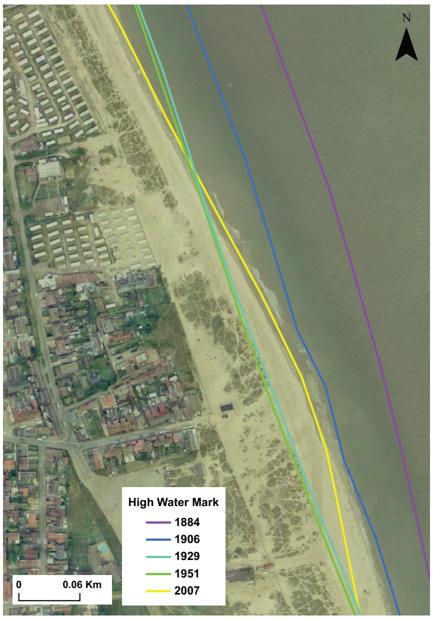
An understanding of coastal morphology and sediment dynamics is especially pertinent in areas such as the Great Yarmouth region of Norfolk where the coastal geomorphology protects low-lying inland areas such as the Norfolk Broads from extensive flooding. Indeed, previous research has identified periods of marine inundation occurring in this region throughout the Holocene epoch (approximately the last 12 000 years) and has linked these to past sea-level rises in the absence of coastal barriers.

The British Geological Survey Terrestrial LIDAR equipment deployed in beach surveys.

Despite this vital protective function, the role of coastal barriers as sediment sinks is often neglected from studies of coastal sediment dynamics. In the context of Great Yarmouth, little is known of the volume of sediment held within the coastal barrier (the Great Yarmouth spit) or of the short-term fluctuations in the spit's sediment storage capacity. Such gaps in our knowledge of coastal sediment budgets mean that the effects of climate change are difficult to forecast.

The Crown Estate–Caird Research Fellowship was undertaken to address this knowledge gap. The specific aims of this research were to:

- calculate spit sediment volume
- investigate spit morphological change
- identify potential forcings for this change



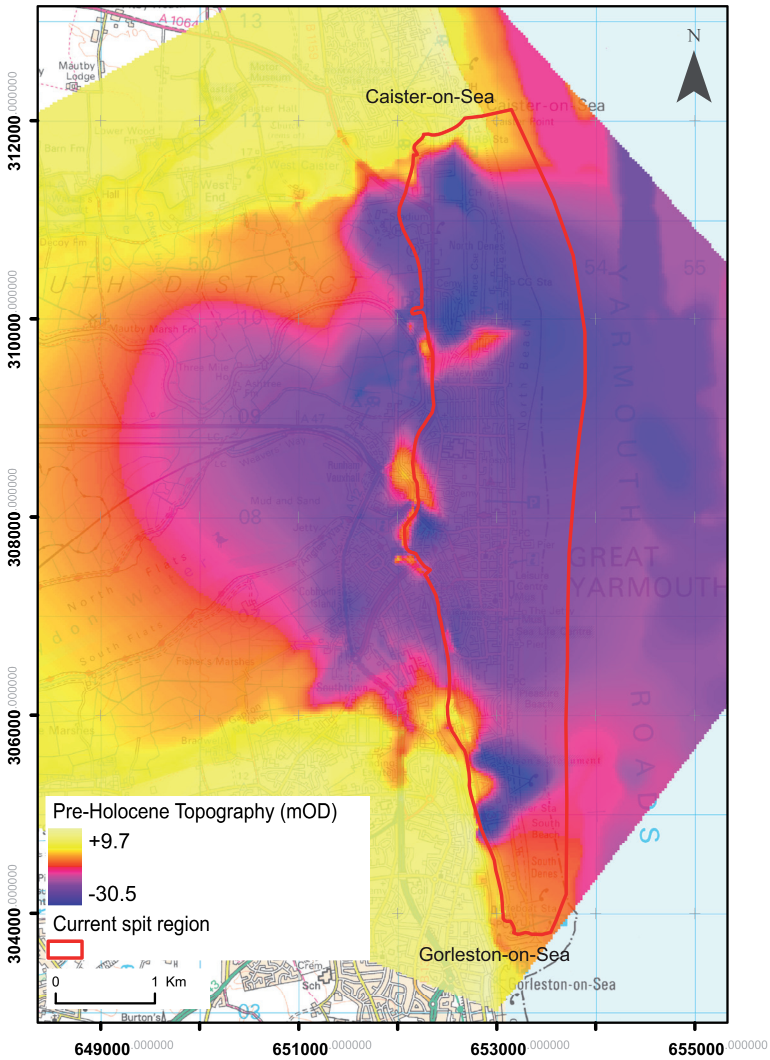
Mean high water positions at North Denes (top) and Caister-on-Sea (bottom), Great Yarmouth digitised from OS topographic maps.

- determine likely future morphological trends in the light of predicted climate change.

Our 3D modelling of the Great Yarmouth spit revealed the existence of a wide palaeovalley within the pre-Holocene deposits. This feature cuts the modern coastline between Caister-on-Sea and Gorleston-on-Sea and was subjected to marine inundation prior to spit development. Some 190 x 10^6m^3 of sediment is contained within the current spit, 11 per cent less than a longer form documented to exist prior to 1613AD. Loss of this extra sediment is attributed to the interruption of littoral drift patterns by early harbour engineering works.

Examination of historical maps reveals a general trend of landward retreat of the coastline prior to 1800. Sea level rise at an average rate of +1.5 mmyr^{-1} during the last 1000 years may account for this. Shorter-term (1884 to present) morphological change, identified from map and aerial photograph evidence, is seen to vary spatially and temporally in response to coastal engineering works and storm events. Predicted future regional changes in sea-level and storminess are likely to cause landward retreat of the coastline or narrowing of the intertidal zone along defended sections.

The Great Yarmouth coast has experienced significant morphological change during the Holocene including:



Pre-Holocene topography of the Great Yarmouth area derived from 3D modelling. Extensive interrogation of borehole data to the west of the Great Yarmouth coast study area was beyond the study's remit. The trough's western limit is, therefore, only loosely defined and the feature is best regarded as a palaeovalley rather than an embayment.

The Scroby Sands Wind Farm lying offshore of Great Yarmouth, Norfolk.

- marine inundation
- barrier development
- formation of an elongate spit and subsequent truncation of this feature

Whilst, relative sea-level change may account for a general landward migration of the coastline throughout the last 1000 years, shorter-term perturbations appear better related to individual storm events and coastal engineering works. Predicted future climate change is likely to cause landward retreat of the coastline and intertidal narrowing.

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