science summary

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Characterisation and prediction of large-scale, long-term change of coastal geomorphological behaviours

Science Summary SC060074/SS

Systems mapping and modelling could help coastal managers to better understand how their coastline has evolved and how it might continue to change from natural processes and man-made interventions such as defences and seawalls, according to a report by the Environment Agency.

The shape and function of coastal areas, characterised by their geomorphology, is influenced by natural processes and man-made pressures. With the advent of climate change, it is vital to understand and predict coastal geomorphological change in order to assess flooding and erosion risks and to plan and develop sustainable coastal management solutions.

Until now, our capability to predict coastal morphological change on a broad scale has been limited and has not always allowed us to fully consider the possible impacts of coastal management options and climate change in strategic planning and decision-making.

This report addresses this issue by developing a framework and conceptual model to predict long-term and large-scale geomorphological evolution. Users of this approach can thus build and test their understanding and treatment of coastal and estuarine environments.

The project analyses the geomorphological behaviour of the coastal system as a whole and explores the links between its component parts. This approach provides a stepping stone to generic tools that can be applied at any UK location. A coastal system is made up of features (such as open coast, estuary), which combine and interact over a range of timescales. These features are themselves made up of one or more geomorphological elements (such as beach, seacliff, saltmarsh) which form the basic building blocks of the coastal system and as such, are the starting point for this study. In many areas, the coastal system will be constrained at a large scale by geological controls, such as headlands, and supply of sediments forming the main geomorphological features.

To understand coastal change, a conceptual model of the geomorphological features and elements that are involved is required. The conceptual model underpins the building of evidence on coastal behaviour in a consistent fashion for any location, and provides the basis for assessing the impacts of coastal management options including the cessation of management.

This project devised a clear and graphical way to map coastal geomorphological systems and their interactions. The method should prove useful when debating how a coastal system works and should provide a clear point of reference for refining that understanding. The mapping approach is scale independent and a useful starting point for analysis of geomorphological systems and for strategic planning. It helps with the construction of baseline knowledge and formal understanding, highlights uncertainty and removes the 'hidden' processes behind existing coastal prediction methods. The approach was applied here to three coastal locations and easy-to-follow guidance is included in the report. Independent assessment of the approach was carried out at another location which confirmed the approach is useful in the Shoreline Management Planning process in identifying broad scale links. It can help in developing skills and training for coastal managers and can also form a means of communication between professional and interested groups.

Expert geomorphological analysis and systems analysis were applied alongside an evaluation of existing engineering tools and methods to measure coastal change. The report shows that the system map-based conceptual model can be developed numerically to proof of concept level for a coupled coast and estuary system. This used existing behavioural models (SCAPE and ASMITA) linked through sediment exchange to model the interaction of a fictional but realistic shoreline. The sediment flux along the coast, change in shoreline position and change in estuary volumes were modelled to show how the results could be used to help coastal management decisions.

The report makes a number of recommendations for the development of methods to cover a wider range of coastal features.

In the long term, this research will help coastal practitioners from local authorities, the Environment Agency, the Department for Environment, Food and Rural Affairs (Defra) and others involved in strategic planning to assess risks, and plan for future change in coastal areas. It will enable better planning of coastal works and interventions, and better understanding of the consequences of not intervening. The results of the research will help the Environment Agency at a strategic planning level and also in the delivery of the Coastal Vision with respect to large-scale coastal management and localised interventions and works.

This summary relates to information from Science Project SC060074, reported in detail in the following output(s):

Science Report: SC060074/SR1
Title: Characterisation and prediction of large-scale, long-term change of coastal geomorphological behaviours: Final Science Report.
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