MODELLING RAPID COASTAL CATCH-UP AFTER DEFENCE REMOVAL ALONG THE SOFT CLIFF COAST OF HAPPISBURGH, UK

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INTRODUCTION

There are currently no well-established methods of predicting coastal catch-up, i.e. the response of shores to the removal of existing coast protection. Such estimates are vital to inform decisions around the renewal of such structures. At a deeper level, the lack of predictive methods undermines progress towards more sustainable approaches to coastal management, and the implementation of policies of managed realignment. Some progress has been made in recent years using the SCAPE numerical modelling tool (e.g. Walkden et al, 2015). That study demonstrated coastal response that included retreat beyond the position the shore would have been expected to reach in the absence of coast protection (i.e. coast protection apparently causing a net loss of land). That study raised important questions, but was limited in the respect that it represented the coast in two-dimensions (i.e. without alongshore interactions). In this work we illustrate how the novel Coastal Modelling Environment (CoastalME, Payo et al. 2017) is able to reproduce coastal catch-up at Happisburgh at the East coast of UK, and to do so with more physical realism than was possible with the SCAPE model, including accounting for alongshore variations).

CASE STUDY: HAPPISBURGH RAPID EROSION

Happisburgh is a UK coastal village, that faces the southern North Sea. It has a population of 1400 people and around 600 houses. This is an erosional area, and historic records indicate that over 250 m of land were lost to the sea between 1600 and 1850. Happisburgh's 10m high cliffs are composed of weak glacial tills and were defended with wooden revetments in 1958 and groynes in 1968 (Brown, 2008). Routine maintenance of defences was undertaken until the 1980s but by 1991, damage led to partial defence removal on safety grounds. Remaining defences were then outflanked. Subsequently (after 33 years of reduced retreat due to protection), erosion was re-initiated along a 900m stretch of coast. In 14 years it created a 100m deep parabolic embayment (see Figure 1). Recession has continued since then, moderated by occasional emergency works.

COASTAL MODELLING ENVIRONMENT

In the applied framework (CoastalME), coastal morphology is represented through the dynamic linking of raster and geometrical objects. A grid of raster cells provides the data structure for representing quasi-3-D spatial heterogeneity and sediment conservation. Other geometrical objects (lines, areas and volumes) that are consistent with, and derived from, the raster structure represent a library of coastal elements (e.g. shoreline, beach profiles and estuary volumes) as required by different landform-specific models.

Wave energy flux – the main driver of cliff and shore platform erosion and alongshore sediment transport – can be characterized by the wave height, period and angle at breaking. The CoastalME framework permits wave propagation to be calculated either using the current DEM (i.e. as in many coastal area models), or by assuming a simplified bathymetry (e.g. bottom contours parallel to the shoreline).

The use of CoastalME offers distinct improvements over the previous SCAPE-based study in that processes are described with greater realism, alongshore coastal interactions are captured and the historic sequence of coastal construction/ decommissioning is represented more precisely.

The paper will present the results from the study and discuss implications for coastal management. It will focus, in particular on the question of whether the installation of coast protection has resulted in a net loss of land at Happisburgh. The implications for sustainable long-term coastal management will also be explored.

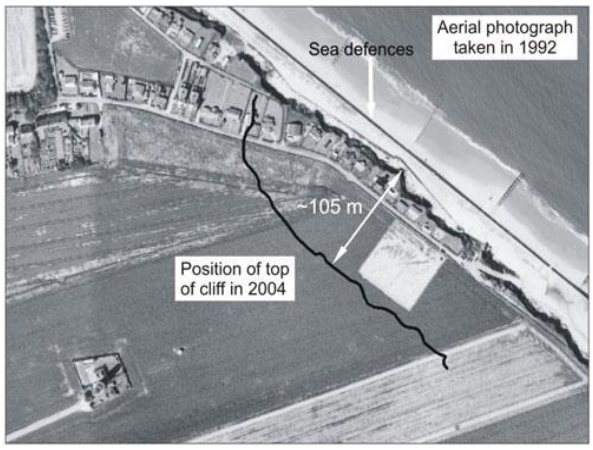

Figure 1 –Coastal change at Happisburgh, 1992 - 2004; the black line shows the location of the cliff top in 2004, as recorded by the British Geological Survey.

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