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The morphological evolution of an artificially breached shingle barrier beach

Jonathan Dale (1), Heidi Burgess (1), and Andrew Cundy (2)

(1) School of Environment and Technology, University of Brighton, Brighton, United Kingdom, (2) Ocean and Earth Science, National Oceanography Centre (Southampton), University of Southampton, Southampton, United Kingdom

Shingle beaches and barriers, found globally across many high- and mid-latitude, wave-dominated coasts, act as an effective natural form of coastal flood defence, absorbing wave energy and dynamically adapting to seasonal (and longer term) changes in wave climate. However, during extreme storm events barrier beaches are susceptible to overtopping, rollback and breaching. As a result they may require management measures such as groynes, sediment recharge and re-profiling, temporally stabilising the barrier, to maintain the necessary level of flood defence. These techniques are becoming increasingly unviable economically due to the constant maintenance and repair work required, especially given the possible increase in the rate of sea level rise, and in the frequency and magnitude of storm surge events, associated with climate change. This is particularly the case for instances when the land being protected by these defences is of lower economic value compared to the defence maintenance costs.

A potential solution is to allow the breaching of the barrier beach, either artificially or naturally by not maintaining the defences, following the construction of new defences inland, a processes known as managed realignment. Whilst previous studies have focused on the internal evolution of managed realignment sites, there is a shortage of understanding regarding the morphological evolution of the breach area following site inundation and its subsequent influence on site hydrodynamics. This study investigates the change in breach, and surrounding shingle barrier beach, morphology at the Medmerry Managed Realignment Site, on the south coast of the United Kingdom. The Medmerry scheme, the largest open coast managed realignment site in Europe, was designed to provide a 1 in 1000 year level of coastal flood defence, decreasing to 1 in 100 year over the site's 100 year design lifetime. Site construction began in autumn 2011, with the site being breached in September 2013 through a single opening created in the barrier beach forming a semi-diurnal, mesotidal (typical spring tidal range of 4 m) semi-enclosed estuarine system.

This study analyses terrestrial laser scanner and RTK GPS topography survey data, collected by the Channel Coastal Observatory (https://www.channelcoast.org/), over a four year period following site inundation. These data are used to assess changes in breach volume, and are in turn compared to changes in the tidal variability, analysed using near-constant, high frequency, depth measurements recorded from two measurements periods two years apart (winter 2015-16 and winter 2017-18). Results indicate that, following site inundation, the beach has narrowed and rolled back in excess of 50 m distance. The breach itself has widened with beach arms pivoting, significantly alternating the position of the intertidal drainage channels.

The findings from this study are discussed in terms of the implications for site development, considering the importance of breach design in site construction and the interaction between anthropogenic (engineered) and natural driving forces. These findings have implications for the design and construction of future managed realignment sites, and provides an insight into the impact and response of barrier beach breaching during storm and extreme weather events.