Geophysical Research Abstracts
Vol. 19, EGU2017-10267-2, 2017
EGU General Assembly 2017

Storm impacts on a high energy sandy beach system, northwest Ireland: short (event) to long term (decadal) behaviour

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Long-term monitoring of beach dynamics is an important element in risk prevention and management of both natural and human resources at the coast. The predicted intensification in storminess (frequency, duration and magnitude), partly associated with climate change, represents a pressing concern for coastal communities globally and has undoubtedly led to an improvement in available techniques and technologies for observation and analysis.

Here we examine a high energy Atlantic beach system at Five Fingers strand (NW Ireland) to help understand hydrodynamic forcing on beach response under various wave energy scenarios. The system, which has been modally attuned to a large swell wave environment, periodically undergoes significant morphological changes over various spatial and temporal scales manifest in the development and movements of dynamic nearshore bars and a nearshore ebb-tide delta. A combination of field and laboratory techniques (GPS, Terrestrial Laser Scanning (TLS) Instrumentation, Drone surveys) implemented from the shoreface to the beach, captures the response and evolution of the system over the short (event), medium (weeks to months) and long-term (multiyear) timescale. Numerical modelling of nearshore wave hydrodynamics (using SWAN wave simulation model) helps understanding wave forcing across shoreface area and is ran under a number of iterative time intervals.

Here, we investigate the role of infrequent and sometimes extreme events in the system to understand the importance of clustering of storminess and the occurrence of single high-magnitude storm events that perturb the inlet-beach system and thus induce key morphodynamic changes. Preliminary results show that ultimately the configuration of the ebb-tide channel influences the geomorphic response of the system. In the short term, a storm induced erosion of the shoreface is observed, which also appears to lead to changes in the ebb-tide channel, and ultimately the welding of a nearshore bar system at the northern part of the site over the medium to long term. We also observe that modal conditions favour intertidal beach recovery in the short and medium term, with a resulting southerly drift of sediment with an offshore return of sediment via the ebb-channel (multi-year response).

This work demonstrates that coastal hazard analysis, approached at an appropriate site-specific scale and with suitable numerical modelling and field techniques, must include capturing data on nearshore forcing parameters that are driving shoreline response over various timescales. Understanding of these nearshore and intertidal morphodynamics is an important prelude to examining how a sandy shoreline behaves in response to high energy forcing. We advocate that morphodynamic self-adjustment of the beach system to a set of varying climatic conditions associated with increases in storminess, will have important implications for future coastline response.