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Impacts from high energy events on sandy coasts: the importance of concurrent forcing parameters

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Low-frequency, high-magnitude storm events can significantly alter dune-fringed coastlines, at times displacing substantial volumes of dune and beach sediment as well as changing the configuration of coastal landforms and shoreline position. Increases in storm frequency and intensity in the north Atlantic in recent years has heightened potential risk to coastal environments and human infrastructure. Understanding precisely how such storm events impact sandy coasts therefore is important in near future coastal management.

This study highlights the impacts of two separate storms occurring along the northwest Irish coast in late 2017 and mid-2018. Storm Ophelia (October 2017) and Storm Hector (June 2018) are examined in terms of forcing factors such as wind speed and direction, local (modelled and measured) wave heights and direction, tidal levels and incursion (wave run up) extent. We describe local impacts that occurred along a 1.2 km sandy coastline site in NW Ireland and outline actual impacts that unfolded during both storm events when they were at their peak intensity. Using terrestrial laser scanning surveys and fixed point photography, we describe local changes in intertidal sediment volume dynamics and shoreline-dune edge changes.

For Storm Ophelia, during maximum wind conditions, nearshore waves of around 2 m were observed with an oblique to parallel orientation and were coincident with medium to low tide (around 0.8m) resulting in minimum erosional impact, demonstrating that damage may not always develop as predicted. The majority of the sediment redistribution occurred within the intertidal and lower beach zone with some limited dune trimming in the southern section. Asynchronous high water (tide levels), localised offshore winds as well as coastline orientation relative to the storm winds and waves appears to play a significant role in reducing coastal erosional impact. Storm Hector, on the other hand although initially described as a lower energy event than Ophelia, contained forcing factors such as high tide level, wave heights and onshore wind direction that presented synchronicity with each other when the storm passed the study site. Onshore-directed nearshore waves were over 4 m in height and waters levels reached 2.5 m close to the site, producing much more pronounced sediment displacement and more significant dune scarping in places.

Storm magnitude is therefore not a direct indicator of coastal impact, with the synchronicity of local forcing factors being likely the most important driver of actual coastal response along dune-fringed coasts. Antecedent beach conditions such as dune toe height, intertidal configuration can also help to modulate the degree of final impact.