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Extreme coastal storms along the north coast of Ireland: hydrodynamic forcing and beach response during the winter seasons of 2013/14 and 2014/15

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The increase in storminess (frequency, duration and magnitude) and the occurrence of extreme coastal storms partly associated with climate change, represent pressing concerns for coastal communities in many regions globally. The Atlantic seaboard of Europe has recently experienced record-breaking winter seasons, particularly in Ireland and the UK, where the 2013/14 winter was characterised as the stormiest on record according to measured levels of total precipitation, extreme wind speeds, and particularly the frequency and intensity of cyclone activity. The enhanced cyclone activity during 2013/14 has resulted in unprecedented sequences of extreme water levels and energetic waves and gave rise to widespread coastal erosion and flooding, setting new benchmarks for coastal analysis and offered a glimpse of future storm impact scenarios.

A regional analysis of hydrodynamic forcing along the north coast of Ireland over the last two extended winter seasons (October to March) has revealed that, although 2013/14 was indeed characterised by an exceptional frequency and intensity of coastal storms, the 2014/15 extended winter was significantly stormier. Not only was the number of individual storm events higher, but also the duration and intensity was greater, including record values of offshore significant wave height.

The geomorphic response along the sandy coastal stretches of the north coast of Ireland, evaluated from morphological change at a diverse group of beach sites, revealed considerable differences in beach erosion and actual shoreline response. Variability in beach changes during these two extreme winter seasons is attributed to a variety of factors. These include localised coastal orientation relative to particular storm tracks, the embayed and highly compartmentalised setting of most of the beaches, as well as site-specific morphodynamic mechanisms such as large rip-current cells forcing the onset and/or reactivation of erosional hotspots. Such heterogeneous coastal and nearshore responses have implications for the assessment and forecasting of local coastal physical response under a changing climate.