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Shoreline change and storm forcing over the last two centuries in Dundrum Bay (Northern Ireland)

Edoardo Grottoli, Melanie Biausque, Derek Jackson, and Andrew Cooper

Shoreline change and storm forcing are analysed for Murlough and Ballykinler beaches (Dundrum Bay, Northern Ireland) over the last two centuries. The two beaches are divided by a pronounced ebb tidal delta and an inlet channel connecting the outer Dundrum Bay with the inner bay. Twenty-four shorelines were digitised from multiple datasets (historical maps, aerial photos, orthophotos and GNSS surveys) covering from 1833 to 2020. The seaward dune vegetation line was selected as shoreline proxy. Shoreline uncertainty was assessed considering various errors inherent from each dataset from which the shoreline was digitised. A coeval storm dataset since 1825 and an extreme water levels (EWLs) dataset from 1901 to 2020 were built using hindcasted wave parameters, historical news and recorded water levels from two local tide gauges. Volume changes from 1963 to 2014 were calculated applying the Structure-from-Motion technique to historical aerial photos.

Over the entire study period, Murlough displayed a retreat trend along 90% of its shoreline, whereas Ballykinler experienced an accretional pattern along 86% of its length. Three foredune blowouts characterise Murlough beach with an increasing landward extent toward the inlet. Murlough's blowouts were reactivated and underwent recovery multiple times throughout the analysed period. In Ballykinler, a large blowout generated in 1951 is now replaced by an advancement trend particularly over the last 20 years.

On both sites, the largest blowouts were evident in 1951 and a clear erosive signature was also left by the 2013-2014 winter storm season. Three consecutive EWLs were recorded in 1946 and at the start of 2014, indicating that prolonged EWL events combined with a cluster of storms, were a significant driver of episodic coastal retreat phases. Volume analyses from 1963 to 2014 confirm that the sand moves from Murlough toward Ballykinler whose foredune gained more than twice the sand volume lost from the foredune in Murlough. Comparisons of recent and historical beach profiles of Ballykinler confirmed a beach growth of about one meter in elevation since 1963 throughout the entire beach profile. The role of the ebb tidal delta linked to wave energy dissipation and wave direction requires further investigation to explain the entire sediment dynamics of the study site.