Mid-Holocene paleostorminess in north-western Ireland inferred from grain size, mineral and molecular content

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Substantial uncertainties exist regarding how future climate change will affect storminess (a term that includes both storm frequency and intensity) in Ireland and the British Isles. Knowledge about spatiotemporal variations of past storminess can contribute to a better understanding of the mechanisms that govern storminess on centennial to millennial time-scales, and shed light on the potential impact of external forcing on future storminess in climate models. Here, we present a storm record, covering the last 8000 years, reconstructed from a coastal bog, located in north-western Ireland. The sequence was analyzed for grain size by laser diffraction (Mastersizer 3000), chemical (EMMA-XRF), mineral (pXRD) and molecular composition (FTIR-ATR). The chronology of the peat sequence was built on 11 AMS radiocarbon dates. The deposit characteristics, location and low inorganic content suggests that minerals were aeolian transported to the bog throughout the studied period. The grain size results allowed identification of periods of increased wind strengths and storminess, and also estimation of minimum wind velocities (Bagnold, 1941, adapated by Mckenna Neuman, 2003) required to entrain particles above >100 µm. Cluster analysis of the grain size frequency curves, together with a ratio between coarse and fine sand, allowed identification of eleven periods of increased storminess (cal BP): 6150–5500 (1); 4970–4130 (2); 4000 (3); 3490–3290 (4); 3230 (5); 2850–2590 (6); 2170–1920 (7); 1440 (8); 1225–890 (9); 620–470 (10); 290–230 (11). The minimum velocities required to entrain the coarsest particles during these periods varied from 6–9 m s^{-1} (22 to 32 km h^{-1}). The results show that during mid-Holocene (8.2–4.2 ka) an initial period of deposition of fine grain sizes, was followed by two longer cycles, of *c.* 1000 years each, where progressively coarse particles were deposited, implying a progressive increase in wind strengths. During this period the sea level was lower and the local beach sources located further away, implying that sand particles were transported a longer distance compared to when the sea level stabilized *c*. 5 ka. From 4.2 ka, shifts in storm frequency and duration were noted, with a higher number of shorter events occurring. Taken together, the results suggests that stronger winds were more common during the mid-Holocene compared to late Holocene, possibly related to a eastward shift of the Iceland low during the warmer mid-Holocene (Curran et al. 2019). Comparison between our results and regional peat paleostorm records from Islay (Kylander et al., 2020) and Hebrides (Orme et al., 2016) show an anti-correlation with the Islay record while little to no similarities with the Hebrides records was observed. This may be related to latitudinal shifts of the storm track in the past, that different methodological approaches were applied, or a combination. By extending the number of peat paleostorm records in the region, with similar analytical approaches, could help identify spatiotemporal shifts of the North Atlantic storm track during Holocene, and increase the understanding of the processes governing the storm track on longer time-scales.

References

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