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Historical records of storm frequency on the Shetland Islands (UK) – Preliminary insights from lake sediment cores and coastal wave modelling

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Severe storms, their extreme waves and surges pose the greatest natural hazard to the coasts of northwestern Europe, commonly resulting in infrastructural damages and high financial losses. Proxy records of past storminess are important for assessing future risks that may arise from storm surges and assessing whether storm activity has increased in recent decades. High-resolution records of North Atlantic storminess are generally limited to instrumental weather data or historical documentation of the past 50 to 200 years. Since the most destructive and severe storms passing over Europe originate in the North Atlantic, the Shetland Islands serve as a window to cyclogenesis in this region. In our research, we extracted lacustrine sediments of the coastal freshwater lake Loch of Flugarth on Mainland, Shetland Islands, that is separated from the ocean by a low sand and gravel barrier. A series of distinct sand layers intercalated in the otherwise fine-grained, organic-rich lake deposits and examined using particle-size analysis, microfossils, TOC and XRF, may represent storm overwash or aeolian transport mechanisms, both either pointing towards individual storm events or shorter phases of high storm activity. Based on radiocarbon data of some selected layers, the investigated sediment sequence covers ca. 1500 years and a Bayesian age-depth model is being established. In combination with a hydrodynamic wave model based on Delft3D-Flow, we simulate a critical threshold value at which waves may reach the lake to determine the sensitivity of the sedimentary archive. With the inclusion of historical documentation and observations, our multi-methodological approach aims at reaching a better understanding of the recurrence pattern of extreme storm events on the Shetland Islands over the last 1500 years. This implies further insights into the parameters driving extra-tropical storms in the wider region as well as the role and variability of the North Atlantic Oscillation across the targeted time frame.

