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# Multiproxy geochemical reconstruction of storminess, hydroclimate, and fire since the mid-Holocene in northwestern Ireland

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Wildfires, volcanic eruptions, and aeolian mineral dust mobilisation play an important role in redistributing particles, nutrients, and carbon across the Earth system. However, the long-term coupling among atmospheric circulation, hydroclimate, and fire activity in the eastern North Atlantic remains poorly constrained. Improving this understanding is particularly relevant given projected increases in climate variability and peatland drying under future warming.

Here we present a multi-proxy reconstruction of wind, fire, and hydroclimate variability since the mid-Holocene from Glenties Bog, a coastal blanket bog in western Ireland. We combine grain-size analysis, inorganic geochemistry, plant macrofossils, and molecular organic indicators to identify changes in wind strength, peatland moisture balance, and fire activity over the last 8,000 years. The analytical approach includes laser grain-size analysis, spectroscopic (FTIR-ATR), elemental (ED-XRF), and loss-on-ignition measurements, together with plant macrofossil analysis. The results were related to a chronological framework by AMS $^{14}$C dating (n=8).

Our results indicate centennial-scale variability in storminess and fire incidence throughout the Holocene. The mid-Holocene Thermal Maximum was characterised by relatively weak winds and increased fire activity, consistent with drier peatland conditions. Temperature evolution on millennial timescales appears to have governed the background wind and hydroclimate over Ireland, while volcanic forcing became more important during the cooler late Holocene. During parts of the late Holocene, periods of elevated volcanic forcing and grand solar minima were associated with increased storminess. In contrast, no association between storminess and volcanic forcing is observed during the warmer mid-Holocene, indicating that the climate state at the time of volcanic forcing governs the atmospheric response to volcanic perturbations.

These results indicate that future warming may lead to distinct changes in wind strength, hydroclimate, and fire regimes. In particular, climate-change-induced lowering of peatland water tables may increase the susceptibility of blanket bogs to intense and deep peatland fires, with potential consequences for regional carbon cycling and fire-induced atmospheric pollution.