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Spatial variations in abrupt temperature and seasonality changes in western Europe during the Last Glacial to Interglacial Transition (LGIT): δ18O from lacustrine carbonates as evidence for climate dynamics

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The analysis of δ18O values from a range of archives has revolutionised our understanding of abrupt climate changes. This is primarily because, unlike many biological proxies, the δ18O signal of meteoric water responds extremely rapidly to temperature changes. Lacustrine carbonates have proved a particularly important archive in this respect. In the British Isles the δ18O analysis of such records has shown that the climatic stratigraphy, i.e. the pattern of warming and cooling events, of the LGIT is comparable to that of Greenland. However, these observations have so far been based upon a limited number of sites, which restrict our ability to talk about regional variability in isotopic, and hence climatic, response. In this study we integrate LGIT records from a number of new locations from across the British Isles with previously published studies from across western Europe. This compilation produces a network of sites on a west to east and north to south gradient across the westernmost part of Europe. The key finding of this compilation is that there is large spatial variability in the magnitude of δ18O shifts associated with abrupt climatic events, particularly the short-lived climatic oscillations that occur during Greenland Interstadial (GI1). The magnitude of δ18O shifts associated with these events increase from west to east, although part of this shift can be explained by the resolution of each record, it is primarily a real signal and implies that the scale of climatic shifts become greater with increasing continentality. Significantly, the magnitude of the δ18O shifts, when compared with biological proxy-based reconstructions of summer temperatures implies that much of the isotopic variability has to be explained by changes in winter temperatures. This work, therefore, provides detailed evidence, not only for spatial variations in climatic response but also for the relative importance of changes in summer versus winter temperatures. The magnitude of δ18O variations is greatest in the highest latitude/altitude sites (Northern Scotland) where the magnitude of isotopic shifts through GI1 are as great, and in some cases greater, a magnitude than those seen in Greenland. This variability is not seen in southern sites implying the existence, during the LGIT, of strong north to south gradients in climatic response across the British Isles.