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Regional scale trends in the timing and magnitude of Little Ice Age glacial maxima in Europe and the North Atlantic

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Reconstructing the configuration of atmospheric/oceanic circulation during past climate perturbations is crucial for understanding how the climate system responds to changing forcing mechanisms. The most recent Holocene climatic perturbation, the Little Ice Age (LIA), covered the period ca AD 1200-1900 and has been widely recorded in a series of documented, early instrumental and palaeo-proxy data. Past research has used such data from the European/North Atlantic regions to elucidate the spatio-temporal distribution of heat and moisture related to possible changes in dominant modes of atmospheric/oceanic circulation such as the North Atlantic Oscillation. Despite this, interpretations of climate dynamics based on such reconstructions are often contradictory, for example in terms of constraining the prevailing position of the North Atlantic storm track. Until recently, glacial variability during the LIA has been considered somewhat separately from the large-scale climate dynamics which are thought to have characterised the period. Several recent studies have suggested that apparent asynchrony in the timing of the LIA glacial maximum between regions in Europe and the North Atlantic was controlled by shifts in large-scale oceanic/atmospheric circulation patterns. However, such interpretations have been based predominantly on single glacier comparisons and no understanding of regional-scale trends has been presented.

This research aims to synthesise published data on the timing and maximum extent of glacier advances across Europe and the North Atlantic during the LIA. A standardised approach for estimating the glacier equilibrium line altitude (ELA) associated with the LIA maximum was systematically applied to digitised moraine outlines derived from the published literature. This involved using an equilibrium profile equation to reconstruct palaeo-glacier surface geometry and estimating ELA from appropriate balance ratios. ELA was reconstructed for over 150 glaciers and stored in a database alongside information relating to the timing of the LIA maximum, based on published dates using a variety of methods. An attempt was also made to correct for the lag time between glacier frontal response and the climatic drivers of glacier retreat. Trends in the timing and magnitude of the LIA glacial maximum were then mapped at a regional scale in order to analyse proposed changes to oceanic/atmospheric circulation patterns in the context of a more complete understanding of glacial variability than has been presented hitherto.