The last Welsh Ice Cap. Part 1, modelling its evolution, sensitivity and associated climate

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A high-resolution, three-dimensional, thermomechanical ice-flow model is used to investigate the glaciodynamics of the Last Glacial Maximum Welsh Ice Cap – a large, independent ice centre of the British-Irish Ice Sheet. The model uses higher-order physics to solve longitudinal stresses, and is coupled to climate via a distributed, positive degree-day mass-balance scheme. A suite of model experiments driven by the GISP2 δ 180 curve was initiated from a climatic optimum at 38.3 ka BP through to the Devensian/Holocene boundary to identify an icecap configuration compatible with available empirical evidence. An enhanced cooling from present of 11.85°C and strong precipitation suppression are required between 27.4 and 23.5 ka BP for the modelled icecap to attain well-established empirical limits, a scenario probably associated with Heinrich Event-2 and the potential collapse of thermohaline circulation in the North Atlantic. The experiments indicate ice-dispersal centres located in North and Mid Wales, the latter being essential for forcing ice southwards of the Brecon Beacons during the Last Glacial Maximum. Deglaciation of the Welsh Ice Cap was relatively rapid, occurring within one millennium. Dynamic stability is governed largely by the dominance and vigour with which fastflowing outlet glaciers drain the icecap interior, which in turn are linked to variations in the climatic forcing. The distribution of permanently cold-based ice across the uplands and summits indicates the probable preservation of relict landscapes in these areas throughout the full glacial cycle.