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A chronology for the retreat of the Irish Sea Ice-Stream using Bayesian modelling techniques

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During Marine Isotope Stage (MIS) 2 the Irish Sea Basin was occupied by the Irish Sea Ice-Stream (ISIS), a major outlet for ice which had accumulated in the British and Irish Ice Sheet (BIIS). The flow dynamics and flow phasing of this portion of the BIIS during maximum extent, the Last Glacial Maximum (LGM), and subsequent retreat are poorly understood due to a lack of chronological control. To improve understanding of the timing of maximum ice-stream extent and subsequent retreat, we have compiled the available chronological data for deposits associated with this phase of glaciation. These chronological data were arranged in an expected order using the geomorphological, stratigraphical and sedimentological field evidence. The relative order model broadly comprised a younging sequence from before the advance to LGM limits through subsequent retreat stages. Bayesian modelling techniques were used to evaluate the conformability of this pseudo-stratigraphical relative order model. Lack of conformity in the relative order model either implied problems with individual age determinations or that the relative order of events within the model is flawed, and in both cases the problems required explanation. The relative order model contained 52 age determinations for various phases of ice advance and retreat. Bayesian analysis showed that the relative order model, constructed with information provided by stratigraphical, geomorphological and geographical evidence was conformable with the existing chronology. The incorporation of prior information within the Bayesian framework enabled the refining of probability-based age estimates for the advance and retreat history of the ISIS. The expansion of ISIS to the maximum extent advancing across southern Ireland and into the Celtic Sea appears constrained to between 24.2-22.1 cal. kyr BP. Retreat stage ice-marginal positions are constrained to between 23.9-21.4 cal. kyr BP in Co. Wexford, south-eastern Ireland and between 23.3-20.2 cal. kyr BP on the Llŷn Peninsula, north-western Wales. Radiocarbon dating of fauna within glacigenic sediments in north-eastern Ireland and luminescence dating of ice marginal sandur deposits on the Isle of Man constrain the Heinrich Event 1/Killard Point Stadial readvance to between 17.7-16.2 cal. kyr BP. Ice retreat rates, calculated from these phase age estimates suggest that the ISIS retreated rapidly (470-100 metres per annum) from LGM limits in the Celtic Sea to the coastlines of Ireland and Wales, where it stabilised and began to retreat in a slower and more oscillatory manner (65-20 metres per annum). Sea-level modellers require more accurate glacial reconstructions in order to predict the timing and magnitude of glacial rebound and its implications for relative sea-level. This is especially important due to the ongoing debate concerning the retreat of the ISIS being characterised by widespread glaciomarine sedimentation or a dominantly terrestrially-based ice-stream margin.