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Investigating the Sensitivity of North Sea Glacial Isostatic Adjustment during the Last Interglacial to the Penultimate Deglaciation of Global Ice Sheets

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The Last Interglacial (LIG; MIS 5e) period (130 - 115 ka) saw the last time in Earth's history that polar temperatures reached 3 - 5 °C above pre-industrial values causing the Greenland and Antarctic ice sheets to shrink to sizes smaller than those of today. Similar polar temperature increases are predicted in the coming decades and the LIG period could therefore help to shed light on ice-sheet and sea-level responses to a warming world.

LIG estuarine sediments preserved in the North Sea region are promising study sites for identification of the Antarctic ice sheet's relative contribution to LIG sea level, as well as for the reconstruction of both the magnitude and rate of LIG sea-level change during the interglacial. For these purposes, sea-level records in the region must be corrected for the impacts of glacial isostatic adjustment (GIA) which is primarily a consequence of two components: the evolution of terrestrial ice masses during the Penultimate Deglaciation (MIS 6), predominantly the near-field Eurasian ice sheet, and the viscoelastic structure of the solid Earth.

The relative paucity of geological constraints on characteristics of the MIS 6 Eurasian ice sheet makes it challenging to evaluate its effect on sea level in the North Sea region. In order to model the Eurasian ice extent, thickness, and volume during the Penultimate Deglaciation we use a simple ice sheet model (Gowan et al. 2016), calibrated against models of the Last Glacial Maximum. By employing a gravitationally consistent sea-level model (Kendall et al. 2005), we generate a large ensemble of GIA outputs that spans the uncertainty in parameters controlling both the viscoelastic earth model and the evolution of global ice sheets during the Penultimate Deglaciation. By performing spatial sensitivity analysis with this ensemble, we are able to demonstrate the relative importance of each parameter in controlling North Sea GIA. Our comprehensive approach to exploring uncertainties in both the global ice sheet evolution and solid earth response provides significant advances in our understanding of LIG sea level.