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Simulating the Last Interglacial Greenland isotope peak: the role of Arctic sea ice changes

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Measurements of Last Interglacial (LIG) stable water isotopes in all available seven Greenland ice cores show that between present day and the LIG peak, there was an increase in δ18O in northwestern (NEEM and Camp Century), central (NGRIP, GISP2 and GRIP), eastern (Renland) and southern Greenland (DYE3) (Johnsen and Vinther 2007; NEEM community members, 2013). Previous isotopic climate simulations of the LIG do not capture the observed Greenland δ18O increases (e.g. Gierz et al., 2017, Masson-Delmotte et al., 2011; Sjolte et al., 2014). Here, we use the isotope-enabled HadCM3 (UK Met Office coupled atmosphere-ocean GCM) to investigate whether a retreat of Northern Hemisphere (NH) sea ice was responsible for this model-data disagreement. Our results suggest that changes in sea ice conditions are key to understand the LIG isotopic increase over Greenland. Sea ice loss in combination with increased sea surface temperatures (SSTs), over the Arctic, enriches δ18O values over Greenland: water vapour enriched in heavy isotopes and a shorter distillation path may help explain these results. We show, for the first time, that our simulations of the response to Arctic sea ice reduction are capable of producing the observed Greenland δ18O increases at NEEM, NGRIP, GIPS2 and Camp Century sites. However, we underestimate changes at Renland, DYE3 and GRIP locations. Additional LIG Arctic sea ice proxies, alongside further modelling studies looking at the combined impact of a smaller Greenland ice sheet (GIS) and sea ice retreat may help explain the remaining model-data mismatches.