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Warmer Southern Ocean sea surface temperatures and a larger sea ice reduction during the Last Interglacial: New core measurements and model simulations

Content

The response of the Antarctic and Southern Ocean climate system to global warming is uncertain. The paucity, and the short length of, weather records from this region cause difficulty in evaluating climate model projections. If we can determine the response of the Antarctic region to Last Interglacial forcing, the last time Antarctica was significantly warmer than present, we can use this data to assess climate models performance under warm conditions.

Alongside running new model simulations, we produce new Last Interglacial marine core measurements, using our new diatom transfer function proxy data from nine marine sediment cores located south of the modern Antarctic Polar Front (Chadwick et al, 2022ab). Peak Last Interglacial proxy summer sea surface temperature anomalies, relative to the preindustrial, show heterogeneity between the Southern Ocean sectors, with the Pacific sector 0-1.5 C warmer than preindustrial but multiple Atlantic and Indian sector records showing a peak warming of >2.5 C. Combining these new proxy records with the Capron et al. (2017) synthesis, we reconstruct a mean Southern Ocean warming of 2.1 ± 1.6 C, relative to the preindustrial (Chadwick et al, in review). This appears to be consistent with our interpretation, based on Antarctic ice cores, of a large summertime sea ice loss during this period (Holloway et al, 2016; 2017).

Whilst our Heinrich 11 meltwater-forced climate model simulations yield a reasonable match to our summer sea surface temperature anomalies, none of our current UK model run is fully consistent with these September sea ice concentrations from our marine cores measurements (Holloway et al, 2018; Chadwick et al, in review; Guarino et al, in review). That said, including Heinrich 11 meltwater forcing in Last Interglacial climate simulations improves the fit. Longer (3000 to 4000 year) climate more run times are required to fully test the consistency between models and data.

Primary authors: Dr ALLEN, Claire (BAS); SIME, Louise (British Antarctic Survey); Dr CHADWICK, Matthew (BAS); Dr GUARINO, Maria-Vittoria (University of Leeds)

Presenter: SIME, Louise (British Antarctic Survey)

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