

The Past and Future of Antarctic Sea Ice: The Last Interglacial

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According to the most recent IPCC report, sea ice is expected to decline in both the Southern and Northern Hemispheres in the future. In particular, current climate models predict a reduction of the Antarctic sea ice of about 50–60% by the next two centuries.

Recent modelling and paleoclimate reconstruction studies indicate a substantial (up to 50–60%) retreat of the Southern Hemisphere (SH) sea ice during the Last Interglacial (LIG) period, between 130 000 and 116 000 years Before Present (BP).

Because there has not been a recent retreat event in the Southern Hemisphere to constrain climate models, the analogy between the Last Interglacial and the projected sea ice retreat events offers a unique opportunity to improve our understanding of what drives a (major) sea ice retreat.

We propose to test a set of hypotheses on the causes of the LIG sea ice retreat. To do so, we set up a CMIP6-PMIP4 last interglacial experiment (lig127k) using the global coupled HadGEM3-GC3.1 model. This experiment has now run for 200 model-years.

The lig127k experiment is designed to address how the Earth system responds to the stronger orbital forcing that occurred 127 ka, compared to today. Here we present our preliminary results on the climate response to the last interglacial orbital forcing. We investigate the role of the radiative forcing in causing a reduction of SH sea ice by analysing Sea Ice Concentration, SST, Surface Air Temperature and other climate variables, along with the SAM and ENSO climate modes. We compare the LIG both against reference CMIP6 preindustrial and historical simulations, and against observations.

We find that time series of annual mean sea ice area during the LIG shows a negative trend. However, the decline is small. We suggest that radiative forcing alone is unlikely to explain the major LIG sea ice retreat event. Additional sensitivity tests to test the effects of a weakened AMOC (because of the concomitant melting of the Greenland Ice Sheet) and the consequences of a collapse of the West Antarctic Ice Sheet on the atmospheric and oceanic circulation are thus in the process of being set up. The lig127k experiment will be the reference simulation against which these additional sensitivity experiments will be examined.