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A multi-model CMIP6 study of Arctic sea ice at 127 ka: Sea ice data compilation and model differences

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The Last interglacial (LIG) is a period with increased summer insolation at high northern latitudes, which results in strong changes in the terrestrial and marine cryosphere. Understanding the mechanisms for this response via climate modelling and comparing the models' representation of climate reconstructions is one of the objectives set up by the Paleoclimate Modelling Intercomparison Project for its contribution to the sixth phase of the Coupled Model Intercomparison Project. Here we analyse the results from 12 climate models in terms of Arctic sea ice. The mean pre-industrial to LIG reduction in minimum sea ice area (SIA) reaches 59% (multi-model mean LIG area is 2.21 mill. km2, compared to 5.85 mill. km2 for the PI), and the range of model results for LIG minimum sea ice area (from 0.02 to 5.65 mill. km2) is larger than for PI (from 4.10 to 8.30 mill. km2). On the other hand there is little change for the maximum sea ice area (which is 12 mill. km2 for both the PI and the LIG, with a standard deviation of 1.04 mill. km2 for PI and 1.21 mill. km2 for LIG). To evaluate the model results we synthesize LIG sea ice data from marine cores collected in the Arctic Ocean, Nordic Seas and northern North Atlantic. South of 78°N, in the Atlantic and Nordic seas, the LIG was seasonally ice-free. North of 78°N there are some discrepancies between sea ice reconstructions based on dinocysts/foraminifers/ostracods and IP25: some sites have both seasonal and perennial interpretations based on the same core, but different indicators. Because of the conflicting interpretations it is not possible for any one model to match every data point in our data synthesis, or say whether the Arctic was seasonally ice-free. Drivers for the inter-model differences are: different phasing of the up and down short-wave anomalies over the Arctic ocean, associated with differences in model albedo; possible cloud property differences, in terms of optical depth; LIG ocean circulation changes which occur for some, but not all, LIG simulations. Finally we note that inter-comparisons between the LIG

simulations, and simulations with moderate CO2 increase (during the transition to high CO2 levels), may yield insight into likely 21C Arctic sea ice changes using these LIG simulations.

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