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Does CMIP6 better constrain projections of 21st century Antarctic sea ice loss?

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Results from CMIP5 have previously suggested that ensemble regression techniques or model selection may provide solutions to the challenge of making projections of future Antarctic sea ice area (SIA) in the presence of large historical biases. Here, we revisit and extend such analysis incorporating the CMIP6 ensemble, which shows modest improvements in some aspects of sea ice simulation and in particular a reduction of inter-model spread in historical SIA. We focus on the strongest forcing scenarios analysed, CMIP5 RCP85 and CMIP6 SSP5.85.

In summer (February) the historical climatology of SIA is a strong linear constraint on projections of SIA in both generations. This is because the strong forcing leads to the loss of the majority of summer SIA in each model, so that the models that start with greater SIA exhibit greater reductions. Differences between CMIP5 and CMIP6 are largely explained by the fact that, compared to CMIP6, CMIP5 contains many more models that have very large positive biases in historical SIA and do not lose the majority of ice.

In winter (September), a much smaller proportion of SIA is lost, but inter-model spread in SIA climatology still explains just under half the variance in projections of SIA change, in both CMIP5 and CMIP6. The mean historical winter climatology is similar between generations, as is the regression slope of SIA change against SIA climatology. However, there is a greater reduction of SIA in CMIP6 than CMIP5. We find this to be statistically related to greater global mean warming in CMIP6 than CMIP5, and therefore potentially to the larger climate sensitivity in the CMIP6 ensemble.

These findings imply that, depending on season, a different balance of local (SIA climatology) and global (GMST change) drivers can be used to explain the inter-model and inter-generation spread in projections of SIA loss. They also firmly tie our ability to project Antarctic SIA loss to our understanding of the fidelity of higher CMIP6 climate sensitivity. Questions remain about whether models are correct in their simulation of Antarctic SIA sensitivity to global surface temperature.