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Ocean heat transport as a driver of sea ice extent in CMIP6 models

Jake Aylmer[1], David Ferreira[1], and Daniel Feltham[1,2]
[1]Department of Meteorology, University of Reading, Reading, United Kingdom
[2]Centre for Polar Observation and Modelling, University of Reading, Reading, United Kingdom

Estimating long-term projections of sea ice extent is a key part of understanding the possible future climate state. This is hampered by uncertainties within and across comprehensive climate models, and the relative importance and nature of contributing factors are not fully understood. Here, we investigate the role of ocean and atmospheric forcing on sea ice on multidecadal time scales.

Pre-industrial control simulations of 19 CMIP6 models are analysed. Sea ice extent is negatively correlated with ocean heat transport (OHT), and positively correlated with atmospheric heat (moist-static energy) transport (AHT), in both hemispheres. In most models, increased OHT into the Arctic enhances surface fluxes in the Atlantic sector just south of the sea ice edge, which in turn increases the AHT convergence at higher latitudes. In the southern ocean, increased OHT directly increases the mean ocean–ice heat flux while AHT plays no direct role. Sensitivities of the sea ice cover to OHT are consistent with predictions from an idealised energy balance model (EBM), which is fitted to each model in turn. This shows that the sensitivities are constrained by atmospheric radiation parameters and the mean surface temperature response, with no explicit dependence on ocean parameters. These results are a step towards quantifying the effect of ocean biases on sea ice uncertainty in climate projections.