PAMIP Webinar Series

Mechanisms of Atmospheric heat transport changes in the ESM hierarchy

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Abstract

Given the uncertainty in all processes involved in polar amplification, elucidating the role of energy and moisture transport is crucial. To assess the role of heat transport by the atmosphere and the ocean, we use the simulations from the Polar Amplification Model Intercomparison Project (PAMIP) to separate the effects of sea ice loss and lower latitude warming. We also complement the PAMIP coupled sea ice loss experiments with a CO_2 doubling experiment in a fixed sea ice state with a full ocean model coupled to WACCM4. The sea ice in the coupled simulations is constrained by a novel hybrid nudging method combining both *ghost-flux* forcing and direct sea ice area nudging.

We describe the eddy poleward heat transport (PHT) between the tropics and the high latitudes using a moist isentropic circulation framework that accounts for moisture and eddy transport. This framework allows for a separation for the northward and southward heat transport and improves the characterization of the change in eddy heat transport. We find that sea ice loss weakens the net heat transport at high latitudes while SST warming/CO_2 doubling increases eddy PHT. Overall, we find that the responses in the coupled and uncoupled framework are qualitatively similar but our results suggest that the mechanisms causing the changes in eddy PHT differ depending on the model setup. The weakening of the eddy PHT in response to sea ice loss widens when coupling to an ocean model because of a weakening of the North Atlantic storm track, a feature of the response missing in the atmosphere-only simulations.

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