Variability in AMOC strength modifies the Northern Hemisphere surface temperature response in the CESM Large Ensemble

Elizabeth A. Maroon[1] (elizabeth.maroon@colorado.edu), Jennifer E. Kay[1,2], Kristopher B. Karnauskas[1,2]
[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder
[2]Department of Atmospheric and Oceanic Sciences, University of Colorado Boulder

AMOC strength is projected to decrease due to anthropogenic warming, with many potential ramifications for the climate system. Here, we explore the influence of AMOC strength variability on Northern Hemisphere surface temperature. We use historical and future forcing simulations from the CESM Large Ensemble, which allows the robust discrimination between the forced climate response and internal climate variability. Consistent with previous modeling of future climate, the ensemble mean AMOC strength weakens while the ensemble mean surface temperature increases. Going beyond the ensemble mean, we look at the variability in the surface temperature response that can be attributed to variability in AMOC strength. We find that ensemble members with weaker AMOC reductions have a larger increase in extratropical Northern Hemisphere temperature. An AMOC that is 0.5 Sverdrups stronger than the ensemble mean is associated with 0.20K and 0.13K higher extratropical Northern Hemisphere temperature in the historical and future ensembles, respectively. This variability in surface temperature is equivalent to 54% and 2% of the forced temperature response in these two scenarios. In some locations of the North Atlantic, the magnitude of the surface temperature response attributed to variability in AMOC strength is greater than 30% of the forced future temperature response. Assessment of long preindustrial control runs also suggests that internal variability in AMOC strength can modulate Northern Hemisphere temperature. Intrigued by these results, we are examining mechanisms that could explain how AMOC variability modulates Northern Hemisphere temperature. Specifically, we are exploring poleward heat transport and local climate feedbacks – two elements that may explain this relationship.