

Simulated Atlantic Multi-Decadal and Atlantic Meridional Overturning Circulation Variability during the 20th century in CCSM4, CESM Large Ensemble, and forced ocean simulations

Who M. Kim (whokim@tamu.edu) and Ping Chang
Department of Oceanography, Texas A&M University

Steve Yeager and Gokhan Danabasoglu
National Center for Atmospheric Research

Abstract

The observed north Atlantic sea surface temperature (SST) exhibits a multi-decadal variability, known as the Atlantic Multi-Decadal Variability (AMV). Plausible mechanisms responsible for this multi-decadal variability include multi-decadal variability in the Atlantic meridional overturning circulation (AMOC) (e.g., Knight et al. 2006) and combined influence of greenhouse gas induced warming and aerosol induced cooling (Booth et al. 2012).

In this study, we examine both these mechanisms by analyzing and comparing simulated AMV and AMOC in an ensemble of 6 CCSM4 and an ensemble of 30 CESM 20th century simulations (CESM-LE), as well as a surface-forced hindcast simulation (POP) utilizing the same ocean and sea-ice models as in CCSM4 and CESM-LE. POP covers only the second half of the 20th century, but shows a better agreement with the observed AMV than CCSM4 and CESM-LE, although the ensemble-mean AMV in CESM-LE reasonably reproduces the observed AMV during the 20th century, while that in CCSM4 does not. We analyze the difference in AMV-AMOC relationship and show that both external forcing and AMOC variability contribute to the AMV.