Relationships between external forcing, AMO, subsurface temperature and AMOC in the CESM Large Ensemble

Previous studies suggested that internal variability, in particular the Atlantic Meridional Overturning Circulation (AMOC), drives the Atlantic Multidecadal Oscillation (AMO). More recently, this view has been challenged and new evidence has emerged that aerosols and greenhouse gases could play a role in driving the AMO. Here we test these alternative hypotheses using the CESM Large Ensemble and Last Millennium Ensemble. By computing the ensemble mean we isolate the radiatively forced component of the AMO, while we estimate the role of internal variability (from the AMOC and other processes) using the ensemble spread. We find that observed phase changes of the AMO cannot be explained in the absence of historical forcings. Further, we find that 68-75% of the AMO variance in this model is driven by radiative forcing only. We also test the controls on Atlantic subsurface temperature anomalies which have previously been attributed to AMOC, and find, rather, that external forcing plays a role in generating an anti-correlation between the surface and subsurface tropical Atlantic temperature in this model. Finally, we discuss the caveats and implications for predictability.