Geophysical Research Abstracts
Vol. 17, EGU2015-15719-2, 2015
EGU General Assembly 2015

Does External Forcing Interfere with the AMOC's influence on North Atlantic Sea Surface Temperature?

Neil Tandon and Paul Kushner

Department of Physics, University of Toronto , Toronto, Canada (neil.tandon@utoronto.ca

Numerous studies have suggested that variations in the strength of the Atlantic Meridional Overturning Circulation (AMOC) can drive variations in North Atlantic sea surface temperature (NASST). Such a relationship raises the prospect of predicting NASST changes years in advance. The recent study of Zhang and Wang (2013), however, has raised questions about the ability of coupled models to reproduce this behaviour. Specifically, they show that some models (like CCSM4) produce a negative correlation between indices of the AMOC and NASST, while other models (like CanESM2) produce a positive correlation. Their analysis was based on linearly detrended output from the CMIP5 20th century historical simulations.

We demonstrate that, even after detrending, the presence of time-varying external forcing has a confounding influence on the AMOC-NASST relationship. First, we present calculations from nine pre-industrial control simulations showing that, in the absence of forced variability, all nine models produce positive simultaneous correlations between the AMOC and NASST. Even when we split the control simulations into shorter segments, the positive AMOC-NASST correlation remains. This suggests that forced variability–and not simulation length–explains the apparent inconsistency of the AMOC-NASST relationship in the CMIP5 historical simulations.

We provide additional support for this claim by presenting analysis of the CESM1 29-member "large ensemble" covering the period 1920-2005. The ensemble mean NASST index shows a slight cooling trend from 1940 to 1965 and a warming trend thereafter, corresponding approximately to trends in aerosol forcing. The ensemble mean AMOC index is mostly flat from 1940 to 1960, and increases from 1960 to 1980. Thus, the ensemble means of the AMOC and NASST have a slightly negative simultaneous correlation, and some realizations exhibit this "forced relationship," even after removing the linear trend. However, when the ensemble mean is first subtracted from each realization, then all realizations show a positive AMOC-NASST correlation. Since the ensemble mean is an estimate of forced variability, this suggests that properly removing forced variability is key to obtaining an AMOC-NASST relationship that is robust across all models and all realisations.