

# **Long-term AMOC changes in NCAR ocean/sea ice and community climate system model twentieth century climate simulations**

Who M. Kim and Ping Chang

*Department of Oceanography, Texas A&M University, Texas, College Station*

## **ABSTRACT**

Long-term changes of the Atlantic meridional overturning circulation (AMOC) are thought to be closely linked to changes in surface buoyancy in the subpolar North Atlantic, which naturally leads to a notion that the AMOC has been weakening during recent decades under global warming. While coupled model simulations mostly support this notion, many ocean reanalyses and ocean model simulations forced by best estimates of the atmospheric state do not show a decreasing AMOC. Instead, they in general show a strengthening of the AMOC during the late twentieth century. In this study, the opposite AMOC trends during the late twentieth century (1961-2005) in a forced (POP2) and a coupled model (CCSM4) sharing the identical ocean model is examined to elucidate this intriguing discrepancy. In POP2, while the upper ocean buoyancy in the major convection region of the LS is steady, the wintertime surface heat loss from the ocean to the atmosphere shows a positive trend. Consequently, an increasing convective activity in the LS appears to be responsible for the upward AMOC trend during the late twentieth century. In CCSM4, although the upper ocean buoyancy also increases, the wintertime surface heat loss over the LS decreases more significantly. Therefore, it appears that the surface heat flux is the controlling factor for the downward AMOC trend also in CCSM4. A further analysis indicates that in both POP2 and CCSM4, the wintertime heat flux trend is generated to a great extent by changes in storm activity and the associated turbulent heat flux (increasing and decreasing in POP2 and CCSM4, respectively). Therefore, we hypothesize that the trend in the storm activity over the convection region is responsible for the AMOC trend in both simulations. This study suggests that synoptic atmospheric variability needs to be accurately represented in climate models in assessing long-term AMOC changes in response to a warming scenario.