Simulating Meridional Overturning Circulation Water Mass Pathways and Variability in the South Atlantic

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Abstract:

The objective of this project, which began in September 2013, is to improve our understanding of the pathways of the upper and lower limbs of the Meridional Overturning Circulation (MOC) in the South Atlantic (SA). Our research is focused on the analysis of state-of-the-art high-resolution NOAA/GFDL coupled climate model and ocean-only simulations, non-eddying CMIP and IPCC AR5 models including the NOAA/GFDL coarse resolution models, process-oriented numerical experiments using regional ocean models, and observations. Here we report on the development of a high-resolution nested model (1/12° resolution in the SA) using the Regional Ocean Modeling System and present results from two preliminary numerical simulations using this model configuration: a benchmark simulation and a simulation where the Vitória-Trindade Ridge at 20°S has been removed. These simulations are used to study the sensitivity of one of the deep SAMOC water mass pathways, that of the Deep Western Boundary Current, to changes in model topography using passive tracers released within the model at different density levels. As a first step to understanding the variability of the MOC inherent to the NOAA/GFDL numerical simulations, we analyzed the sensitivity of the seasonal cycle of the maximum northward volume transport by the MOC to wind forcing at the latitudes of the RAPID/MOCHA array (nominally 26.5°N) and the developing SAMBA array (nominally 34.5°S). The NOAA/GFDL simulations include the state-of-

the-art eddy-permitting NOAA/GFDL climate model simulations (CM2.5 and its ocean-only counterpart) and a non-eddying IPCC AR4 simulation (CM2.1). Ten years of output from the NOAA/GFDL simulations are compared with similarly long observational records collected at those two latitudes and a two-layer idealized ocean model (Zhao and Johns, 2014) forced with the winds produced by the coupled climate or used to drive the ocean-only simulations.