How well do the climate models (CMIP5) represent the water properties of the Atlantic meridional overturning circulation?

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The Atlantic meridional overturning circulation (AMOC) plays a fundamental role in the Earth's climate system by carrying, redistributing heat and freshwater through ocean basins, and interacting with the atmosphere. The diagnostics of AMOC in the state-of-the-art climate models (CMIP5) have been traditionally focused on the volume transport (strength) of the AMOC. A simple diagnostics of the meridional volume transports projected on potential temperature-salinity plane is defined here to characterize the basic temperature-salinity properties of the northward and southward AMOC limbs in the CMIP5 models. We found that, compared to high-resolution simulation, all CMIP5 models exhibit a colder northward limb and a warmer southward limb. The resulting smaller temperature contrast between the upper and lower AMOC limbs is the main reason for a weaker northward heat transport in CMIP5 models on average, even though the heat transports among different CMIP5 models are still correlated with the modeled volume transport of the AMOC. Different processes that may contribute to the warmer lower limb of the AMOC is examined.

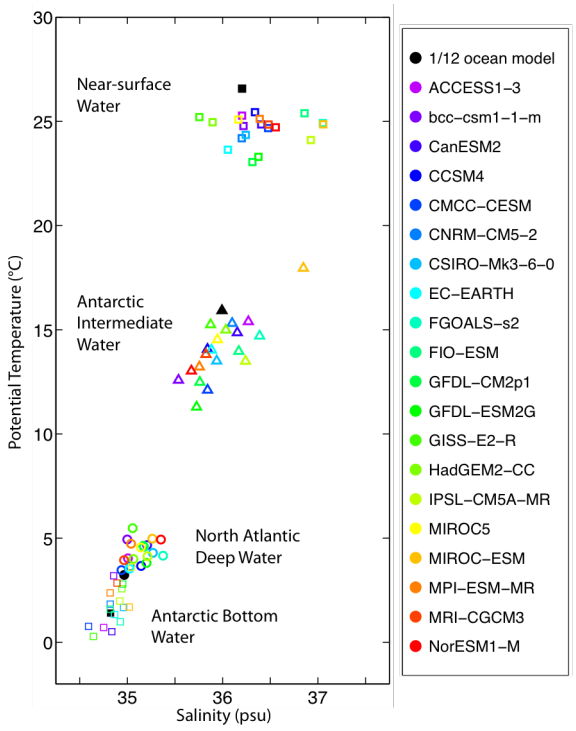

Figure 1. temperature-salinity characters of different water masses of the AMOC in high-resolution Ocean model (black) and climate models CMIP5 (color).