Transport Structure in the Southern Atlantic Ocean and the meridional coherence of the Atlantic Meridional Overturning Circulation

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Abstract

Southern Atlantic Ocean plays an important role in the Atlantic meridional overturning circulation (AMOC), connecting it to the Indian and Pacific Oceans as part of the global overturning circulation system, yet the detailed time mean circulation structure in this region and the large-scale spatial pattern of the AMOC variability remain unclear. This study investigates these basic questions using results from a long-term, eddy-resolving global ocean-sea ice simulation, which is shown to represent reasonably well the observed meridional transports at 34°S and the zonal transports through the Drake Passage at 65°W and the open area southwest of Africa. The model results suggest that a) the upper limb of the AMOC originates from the warm Agulhas leakage; the colder water from the Drake Passage does not contribute to the upper AMOC directly, but modifies the temperature/salinity properties of water that flows northward across 34°S; b) the North Atlantic deep water (NADW) in the lower limb of AMOC flows southward in the deep western boundary current all the way to about 45°S and then turns eastward to flow across the Mid-Atlantic Ridge near 42°S, although recirculation around the Vitoria-Trindade seamount chain near 20°S brings NADW into the offshore interior of the Brazil Basin; c) the AMOC variability from seasonal to decadal time scales shows good meridional coherence throughout the Atlantic Ocean, especially from 35°S to about 35°N, where diapycnal water mass transformation between the upper and lower limbs of the AMOC is expected to be small.