Dynamics of Intermediate Water Circulation in the Subtropieal South Atlantic

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ABSTRACT

The circulation of the low-salinity Antarctic Intermediate Water in the South Atlantic and the associated dynamical processes are studied, using recent and historical hydrographic profiles, Lagrangian and Eulerian current measurements as well as wind stress observations. The circulation pattern inferred for the Antarctic Intermediate Water supports the hypothesis of an anticyclonic basinwide recirculation of the intermediate water in the subtropics. The eastward current of the intermediate anticyclone is fed mainly by water recirculated in the Brazil Current and by the Malvinas Current. An additional source region is the Polar Frontal zone of the South Atlantic. The Transport in the meandering eastward current ranges from 6 to 26 Sv (Sv $= 10^6$ m^3 s^{-1}). The Transport of the comparably uniform westward flow of the gyre varies between 10 and 30 Sv. Both transports vary with longitude. At the western boundary near 28°S, in the Santos Bifurcation, the westward current splits into two branches. About three-quarters of the 19 Sv at 40°W go south as an intermediate western boundary current. The remaining quarter flows northward along the western boundary. Simulations with a simple model of the ventilated thermocline reveal that the wind-driven subtropical gyre has a vertical extent of over 1200 m. The transports derived from the simulations suggest that about 90% of the Transport in the westward branch of the intermediate gyre und about 50% of the Transport in the eastward branch can be attributed to the wind-driven circulation. The structure of the simulated gyre deviates from observations to some extent. The discrepancies between the simulations and the observations are most likely caused by the interoceanic exchange south of Africa, the dynamics of the boundary currents, the nonlinearity, and the seasonal variability of the wind field. A simulation with an inflow/outflow condition for the eastern boundary reduces the transport deviations in the eastward current to about 20%. The results support the hypothesis that the wind field is of major importance for the subtropical circulation of Antarctic Intermediate Water followed by the interoceanic exchange. The simulations suggest that the westward transport in the subtropical gyre undergoes seasonal variations. The transports and the structure of the intermediate subtropical gyre from the Parallel Ocean Climate Model (Semtner- Chervin model) agree better with observations.