Subantarctic Mode Water formation and transformation in an eddy-permitting Southern Ocean State Estimate

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Formation, destruction and transport pathways of Subantarctic Mode Water (SAMW) are examined using the results of an eddy-permitting data assimilating ocean model (the Southern Ocean State Estimate, SOSE), for years 2005 and 2006. SOSE accurately reproduces SAMW densities as determined by hydrography so that the Walin analysis, which requires the knowledge of surface buoyancy flux and surface density fields, yields 6.9 /- 1.6 Sv of SEISAMW (with sigma theta 26.8) and 4.8 /- 2.2 Sv of East Pacific SAMW (with sigma theta 27.0) for years 2005 and 2006. The net formation of SAMW in the sigma theta range 2.6.8-27.0 at the surface was 14.1 /- 1.3 Sv. A near-cancellation of buoyancy fluxes associated with freshwater flux (net precipitation causing freshening) and air-sea heat flux (which can be of either sign) occurs in SAMW density range. Southeast Pacific SAMW (with sigma theta 27.0) was formed in both years from denser water by freshening whereas Southeast Indian SAMW (SEISAMW, with sigma theta 26.8) was formed from both lighter water (by ocean heat loss) and denser water (by freshening) in year 2005 and only from denser water (by ocean heat gain and freshening) in year 2006. The main characteristics of SOSE mass transport across 30 S are southward transport of thermocline water (TW) with sigma theta less than 25.7, which is largest in the Indian sector (9.8 Sv), and northward transport of mode water (MW), which is distributed over all three ocean sectors: 4.7 Sv from the Pacific, 4.4 Sv from the Atlantic and 1.8 Sv from the Indian Ocean are exported in SAMW density range, with sigma theta between 26.7 and 27.0 kg/m3.