Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09583, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09583
EGU General Assembly 2008


# An isopycnic model study of the circulation of Sub-Antarctic Mode Water throughout the global ocean

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The main purpose of the present study is to investigate the circulation of Sub-Antarctic Mode Water (SAMW), which is thought to be important in providing the source of nutrients to drive biological production over large proportions of the world's oceans, after subduction in the Southern Ocean and subsequent re-emergence into the mixed layer elsewhere. A 3˚ resolution HYbrid isopycnic-cartesian Coordinate Ocean general circulation Model (HYCOM) is developed to simulate the global ocean circulation for timescales of up to centuries. The isopycnic nature of the model ocean interior is ideally suited to the goals of this study, which seeks to investigate SAMW subduction, spreading pathways, transit times, and upwelling sites, as well as their sensitivity to perturbations in mixing parameters. After development and validation of the model, a control run of 120 years is undertaken in order to reach a near-equilibrium. A tracer is then injected into the mixed layer for a further 100 years and used to track the spreading of SAMW from the Southern Hemisphere to the Northern Hemisphere. We firstly examine the distribution of the deep winter mixed layer in the Southern Ocean, and identify the source regions where SAMW is subducted into the ocean interior. After following the spreading of the various SAMW types we are able to identify several regions near the equator and in the Northern Hemisphere in which SAMW is returned to the upper-ocean mixed layer. The experiment is repeated within a range of plausible ocean mixing regimes, and conclusions are drawn on the mechanisms by which SAMW supplies nutrients to the upper layers of much of the world's oceans.