Geophysical Research Abstracts
Vol. 13, EGU2011-4481, 2011
EGU General Assembly 2011

Towards the development of a modeling framework for the study of Southern Ocean variability from interannual to multi-decadal time scales

Lavinia Patara, Claus Böning, Arne Biastoch, and Erik Behrens
Leibniz Institute of Marine Sciences (IFM-GEOMAR), Kiel, Germany (lpatara@ifm-geomar.de)

The aim of this study is to develop a modeling framework suitable for investigating the interannual to multi-decadal responses of the Southern Ocean to wind changes. It is in fact hypothesized that anthropogenic climate change may affect the location and intensity of mid-latitude westerly winds, thereby influencing the Antarctic Circumpolar Current (ACC) transport, the meridional overturning circulation, as well as potentially the ocean CO_2 uptake. Recent studies moreover suggest that ocean mesoscale eddies may be importantly involved in the ACC response to wind changes, owing to their capability of transporting heat poleward. Ocean general circulation models are a valuable tool for investigating Southern Ocean variability on decadal and multi-decadal time scales, yet their applicability is often hindered by spurious model drifts. We investigate the nature and causes of the model spurious drifts in the Southern Ocean within the NEMO modeling framework at 1/2° and 1/4° resolution (ORCA05 and ORCA025). We diagnose a steady decrease of the ACC transport (0.38 Sv year^{-1}) in the course of a 130-year climatological simulation and find this drift to be related to a loss of high-density water masses south of 60°S. This bias is hardly solvable within modeling frameworks at an intermediate resolution, which lack the explicit representation of small-scale processes leading to bottom water formation close to the Antarctica coast. We therefore propose to contain the model spurious drift by applying, south of the ACC, a weak relaxation of deep temperature and salinity to observed climatologies: we find that the model spurious drift is reduced whilst the ACC dynamics is left capable to freely evolve. We subsequently show how the applied deep restoring affects the temporal evolution of the ACC transport and of the meridional overturning circulation. We finally present how the "corrected" ORCA05 simulation will be used as a baseline for a high-resolution two-way nesting approach in the Southern Ocean, discussing possible strategies and related issues.