3rd International Conference on Earth System Modelling
Vol. , 3ICESM-159, 2012
3rd International Conference on Earth System Modelling

Trends in the Antarctic Circumpolar Current in ocean models at increasing resolution

L. Patara, C. Böning, and A. Biastoch
Helmholtz-Zentrum für Ozeanforschung Kiel (GEOMAR)

Climate models project a large increase of the Antarctic Circumpolar Current (ACC) and of the Southern Ocean meridional overturning circulation under scenarios of increased greenhouse gases and strengthened Southern Hemisphere westerly winds. On the other hand, recent observational and modelling studies indicate a much lower sensitivity of the ocean circulation to wind changes, and relate this to the strong Southern Ocean eddy field, as yet unresolved by climate models. Understanding how the Southern Ocean circulation may change in a warming climate is a key question in today's research, since it may affect the uptake of heat and anthropogenic CO_2 on the global scale. In this study we assess the role of explicitly simulated mesoscale eddies in the Southern Ocean with a suite of global ocean-sea ice models at increasing horizontal resolution. The global NEMO-LIM ocean-sea ice model is first used to perform ocean simulations at horizontal resolutions of 1/2° (non-eddying) and 1/4° (partially-resolved eddies). Already a partial resolution of eddies leads to a reduced sensitivity of the circulation to the enhanced Southern Hemisphere Westerlies during the period 1948-2007. By means of a "two-way" nesting approach, we then developed an ocean-sea ice model achieving the resolution necessary (1/12°) to explicitly resolve most eddies in the Southern Ocean. This high-resolution model was used to i) assess how the explicit simulation of Southern Ocean eddies affects the response of the ACC to wind changes, and to ii) isolate the dynamical effects of regional eddy fields in the global ocean circulation.