Geophysical Research Abstracts
Vol. 13, EGU2011-12060, 2011
EGU General Assembly 2011

The competition between Atlantic and Antarctic overturning cells

Kevin Oliver

University of Southampton, National Oceanography Centre, Southampton, School of Ocean and Earth Science, United Kingdom (k.oliver@noc.soton.ac.uk)

The “thermocline scaling” is central to our conceptual understanding of how the global meridional overturning circulation (MOC) is driven. The scaling has been successful at predicting the dependence of the MOC on its key controls (diapycnal mixing, Southern Ocean winds, and surface density gradients) in idealised numerical studies, but its general applicability is limited by the assumption of a single overturning cell. Here, an extension of this theory to an MOC with Atlantic and Antarctic overturning cells is presented.

The extended theory makes the following predictions for the equilibrium MOC, supported by output from two numerical models, including realistic bathymetry experiments with the Earth System model GENIE:

(1) The canonical 2/3 power law relating diapycnal diffusivity - or, more generally, the gravitational potential energy (GPE) source - to MOC strength, is valid if applied to the combined overturning in both Atlantic and Antarctic cells.
(2) The relative strength of the Atlantic and Antarctic cells is governed by the difference in density between surface waters in the two regions of dense water formation.
(3) Upwelling is concentrated close to GPE source regions.

In this framework, the global MOC can be viewed as a competition, between the Atlantic and Antarctic cells, for the GPE resource associated with work done by the wind and tides on the ocean.