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The Southern Ocean in the AR4 and AR5: Heat, carbon and the ACC

Joellen Russell[†]; Paul Goodman
[†] University of Arizona, USA
Leading author: jrussell@geo.arizona.edu

The links between the Southern Ocean's wind forcing, heat and salt budgets, frontal locations and structure, and velocity structure of the ACC are explored here in a coupled model context by analyzing a suite of the preindustrial control experiments and 20th century experiments from the Intergovernmental Panel on Climate Change's Fourth Assessment Report, and the forthcoming Fifth Assessment Report. Climate models with poleward-intensified westerly winds exhibit a stronger connection between the surface of the Southern Ocean and the abyssal ocean than do models with initially weaker, equatorward-biased westerlies. Poleward-shifted winds result in more vigorous divergence, even as rising atmospheric greenhouse gas levels induce a reduction of the density of surface waters. This divergence translates to significantly higher uptake and storage of heat and anthropogenic carbon dioxide by the Southern Ocean in the future in models with more realistic, poleward-shifted westerlies.