Geophysical Research Abstracts
Vol. 19, EGU2017-5193, 2017
EGU General Assembly 2017

Southern Ocean eddy compensation in a forced eddy-resolving GCM

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Contemporary eddy-resolving model studies have demonstrated that the common parameterisation of isopycnal mixing in the ocean is subject to limitations in the Southern Ocean where the mesoscale eddies are of leading order importance to the dynamics. We here present forced simulations from the Community Earth System Model on a global $1/10^\circ$ and 1° horizontal grid, the latter employing an eddy parameterisation, where the strength of the zonal wind stress south of $25^\circ S$ has been varied. With a 50% zonally symmetric increase of the wind stress, we show that the two models arrive at two radically different solutions in terms of the large-scale circulation, with an increase of the deep inflow of water to the Southern Ocean at $40^\circ S$ by 50% in the high resolution model against 20% at coarse resolution. Together with a weaker vertical displacement of the pycnocline in the 1° model, these results suggest that the parameterised eddies have an overly strong compensating effect on the water mass transformation compared to the explicit eddies. Implications for eddy mixing parameterisations will be discussed.