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Changing mid-latitude westerlies and their impact to Southern Ocean eddies in a coarse resolution ocean model.

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State-of-the-art models of the Earth's climate system usually comprise - among other components - coarse resolution non-eddy permitting ocean general circulation models (OGCMs). Therein, the effects of baroclinic eddies are used to be highly parameterized mainly following the concept by Gent and McWilliams (1990), where the bolus velocity is calculated from the product of a constant Gent-McWilliams diffusivity (K_{GM}) times the gradient of the isopycnal slopes. In such models an intensification of the mid-latitude westerlies over the Southern Ocean (SO) leads to a steepening of the slopes of the isopycnals and a strengthening of the Antarctic Circumpolar Current (ACC) and the Atlantic meridional overturning circulation (AMOC) in association with a more vigorous northbound Ekman flux. However, recent simulations employing eddy resolving OGCMs reveal an accelerated increase of the southward eddy transport when amplifying the SO mid-latitude westerlies, which nearly entirely compensate the enhanced Ekman flux. As a result, the increase in the strength of the ACC and the AMOC is considerably smaller in eddy resolving than in non-eddy resolving models when subjected to elevated SO wind stresses.

Here we present simulations employing a coarse resolution OGCM on base of MOM-3 incorporating an eddy parameterization in which eddy compensation is considerably enhanced by the use of a non-constant spatially varying value of K_{GM}. We will show, that parameterized effective diffusivities K_{GM} attain maximum values comparable to those derived from eddy resolving simulations. Although the degree of eddy compensations under changing SO mid-latitude westerlies remains below the level as suggested by eddy resolving models and observations, our approach permits a more physical representation of the effects of eddies in non-eddy resolving OGCMs.