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What sets the surface eddy mass flux in the Southern Ocean?

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The OCCAM global, eddy-permitting ocean general circulation model has been used to investigate the surface eddy mass flux in the Southern Ocean. The isopycnal eddy mass flux in the surface layer is almost uniformly poleward and scales well with the local Ekman transport. This seems at odds with other models and observations suggesting topographic localization of the eddy fluxes with locally, large rotational components. Integrated over the thermocline depth the eddy fluxes do show such topographic localization. The surface eddy mass flux is mainly a consequence of the intermittent deepening of the mixed layer with the seasonal cycle, which redistributes the Ekman transport over the stack of layers that eventually become ventilated. Baroclinic instability gives rise to much smaller eddy-induced transports. Independent of the framework in which the residual mean flow is analyzed (isopycnal or geometric), the eddy-induced transport that opposes the wind-driven Ekman flow only partially compensates the Deacon Cell. The associated overturning cell is about 5 Sv, responsible for a cancellation of the Deacon Cell of 30\%. In geometric coordinates a strong signature (14 Sv) of the Deacon Cell remains for the residual mean flow. Only after transformation to density coordinates a further reduction with 10 Sv is obtained. Zonal tilting of isopycnals makes along-isopycnal recirculations appear as vertical overturning cells in geometric coordinates. These cells disappear in the isopycnal framework without any eddy-induced transport being involved.