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The influence of diapycnal mixing on quasi-steady overturning states in the Indian Ocean

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A regional general circulation model (GCM) of the Indian Ocean is used to investigate the influence of prescribed diapycnal diffusivity (Kd) on quasi-steady states of the meridional overturning circulation (MOC). The model has open boundaries at 35°S and 123°E where velocity, temperature and salinity are prescribed at each time step. The results suggest that quasi-steady overturning states in the Indian Ocean are reached on century time scales. The size and structure of the MOC is controlled by the distribution of Kd and the southern boundary conditions. The distribution of Kd required to support the prescribed deep inflow at the model southern boundary can be estimated using a 1-D advective-diffusive balance in isopycnal layers. By implementing this approach we are able to support 70-90% of the prescribed deep inflow in quasi-steady state. The two estimates of the flow field near 32°S used to force the southern boundary imply a highly non-uniform distribution of Kd, as do recent estimates of Kd based on hydrographic observations. This work highlights the need to implement realistic estimates of (non-uniform) Kd in ocean and coupled ocean-atmosphere GCMs when investigating quasi-equilibrium model states.