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Meridional overturning in the thermally-driven ocean

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As opposed to the wind-driven ocean circulation, there is no commonly accepted dynamical framework for rationalizing the buoyancy-driven circulation. However, an analytical model of the overturning exists, based on the quasigeostrophic model of Pedlosky (1969) and studied subsequently by Salmon (1986), LaCasce (2004) and Pedloksy and Spall (2005). A key aspect is that the overturning in the model is determined almost exclusively by upwelling and sinking occurring in the interior; the boundary layers have little net contribution to the vertical transport. Thus the overturning in the model can be understood by the baroclinic flow in the interior, which is conceptually simple. The only exception is when a form of "convection" is allowed, in which case the northern boundary can contribute significantly as well. We review key aspects of the model circulation and demonstrate how the boundary current dynamics are consistent between models with different frictional parameterizations. We also compare to numerical simulations using a full GCM in an idealized basin.

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