Thema: On the impact of topography on a zonally reentrant current

Titel: **On the impact of topography on a zonally reentrant current. An idealized model study.**

Master Thesis

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Abstract

The Antarctic Circumpolar Current (ACC) circles of the longest and strongest current system in the World Oceans around Antarctica. By connecting the Pacific, Indian and Atlantic Ocean, the significant role of the Southern Ocean (SO) and the ACC for the climate system and the global Meridional Overturning Circulation (MOC) manifests. Many approaches exist to explain the zonal transport of the ACC. Some try to apply the Sverdrup relation to the zonally unbounded SO, others are based on considerations of the zonal averaged balance of momentum.

Olbers et al. [2007] developed another theory from the analysis of the local balances of vorticity, baroclinic potential energy and vertically integrated momentum, which finally allowed them to derive a new theory for the transport of the ACC. The theory, called the "baroclinic Stommel equation", is formally similar to the classical Stommel model, but involves the most important processes and baroclinicity forcing the ACC.

In this thesis, an idealized ACC configuration similar to Viebahn and Eden [2010] is used in the Python Ocean Model [pyOM; Eden, 2011] to investigate the effect of topography, of increasing wind stress and of the lateral eddy diffusivity of the meso-scale eddy parameterization of Gent and McWilliams [1990] on the transport of the ACC. Therefore, a number of idealized topographies are implemented in the model at (i) non-eddy permitting resolution using the meso-scale eddy parameterization of Gent and McWilliams [1990] and (ii) at eddy-permitting resolution. The important balances, which the baroclinic Stommel equation comprises, are analyzed in the idealized ACC model. The bottom topography and the effect of bottom pressure torque related to it turn out to be substantial in the balances of vorticity. Finally, the baroclinic Stommel equation allows to derive the zonal transport of the ACC, which is compared to the idealized ACC model. A dependence of the underlying topography arises, which can be related to the relation of bottom pressure torque and a torque related to eddy diffusion of density. At eddy permitting resolution the "eddy saturation effect" of Hallberg and Gnanadesikan [2001] evolves in the idealized model, although the shape of the topography appears to have a crucial impact on the saturation state of the ACC.