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Modelling the ocean around South Africa: Interactions between the Agulhas Current and the ACC

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Regional ocean models are extraordinarily useful tools as complements to global models, since they work at higher spatial and temporal resolutions and parameters can be adapted to the particular conditions in the region of interest. These advantages are bought with new potential issues at the boundaries of the modelled region. At open boundaries, a global model has to provide boundary conditions such as velocity, temperature, and salinity, necessarily obtained at coarser resolution and with less accuracy.

The region we focus on is the surroundings of South Africa, comprising parts of the Southern Atlantic and Southern Indian Ocean as well as the Southern Ocean down to the ice shelves of Antarctica. We attempt to better understand the dynamics of the Agulhas Current, which has been shown to have far-reaching impacts also on the Meridional Overturning Circulation and, thereby, on the world's climate. With our study region expanded southwards, including a fraction of the Antarctic Circumpolar Current (ACC), we investigate the local current-current interactions which are conveyed by small-scale turbulences. In our analysis, we focus on sea surface height and ocean bottom pressure and the different forcing terms that influence these two variables.

We configure a version of the Regional Ocean Modelling System (ROMS) to simulate ocean dynamics around South Africa, forced with ERA-Interim atmospheric data, and explore the sensitivity to various choices of boundary conditions. The horizontal resolution of $0.25^\circ \times 0.25^\circ$ at 32 vertical levels is supposed to resolve mesoscale eddies as well as the climatologically important shedding of Agulhas rings. To show the capabilities of our model, we compare the output in terms of sea-surface heights to altimetric measurements provided by AVISO. In-situ data of ocean bottom pressure measured in the ACC path adds to the observational database. The study area is especially promising as, additionally, we can show whether the simulations of an integrated ocean bottom pressure signal correspond to the residuals in measurements of the Superconducting Gravimeter in Sutherland, South Africa.