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A laboratory analogue of current-topography interaction in the Southern Ocean.

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The Antarctic Circumpolar Current (ACC) is an active site of turbulent mixing in the circulation of Southern Ocean (SO). This is attributed to the instabilities of waves and eddies resulting from the interaction of geostrophic flow with bottom topography.

For the first time, the dynamics of the Antarctic Circumpolar Current is reproduced in the laboratory using the rotating Coriolis platform with diameter 13m. The tank is filled with a 1m thick layer of uniformly stratified salt water. A uniform circular current around the tank is produced by a small change of tank rotation speed which persists by inertia for the duration of the experiment, during which the flow conditions can be considered quasi-steady. Spherical cap(s) was introduce as bottom topography in the flow configuration. The experimental module was divided into two cases: with Coriolis effect and without Coriolis effect. Several experiments with multiple caps to mimic rough topography features were conducted with various values of Froude and Rossby number.

Waves and eddies resulting from the interaction of the flow with the topography were studied. It was realised that rotation greatly enhances vertical transport of momentum from the bottom. Inertial oscillations were observed and likely contribute to this transport. Turbulence generation was observed close the topography but also in the fluid interior far above it, which presumably results from wave breaking. Consistently, analysis of the density probes showed vertical mixing in the water column both at the bottom and in the interior. The link with the theoretical modelling by Nikurashin & Ferrari (2010) and Labreuche et al. (2016) will be discussed.