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The Southern Ocean frontal system south of Africa calculated from satellite-derived dynamic height

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The Antarctic Circumpolar Current (ACC) distinguishes itself from the other major ocean currents by many features. It is both the strongest (about 130 Sv) and the longest (over more than 24000 km) current, flowing west to east around Antarctica without any land barrier at the latitude of Drake Passage (at the southern tip of the American continent). Its ability to connect the Atlantic, Indian and Pacific oceans confers the ACC a crucial and unique role in the organization of the global ocean circulation.

Meridional exchanges within the ACC can occur as small-size eddies, with diameters of the order of 20 km. These eddies concentrate along several jets that space out northward from the edge of the ice cover to the southern subtropics. Air-sea interactions, bottom topography constraints and eddy-mean flow interactions act on these jets and lead to several filamentation processes that alter their location and intensity, which can make their detection as fronts somewhat uneasy.

The ACC jets indeed correspond to pronounced horizontal gradients in temperature or salinity, and hence in density. Their definition, which usually stems from hydrological data, confines them to four major frontal areas that are (from south to north): the Southern Front, the Polar Front, the Sub-Antarctic Front and the Subtropical front. The severe atmospheric conditions that prevail in the ACC region complicate the implementation of systematic in situ measurements, such as those obtained from the repeated GoodHope sections south of Africa. ARGO float deployment in the Southern Ocean and upper ocean density structure deduced from absolute sea level measurements define here useful complements for a regular monitoring of these frontal regions.

In this study, we use weekly AVISO absolute sea level data, gridded at 1/3° from October 1992 to July 2009, to infer the presence of fronts in the neighbourhood (30° on either side) of the GoodHope cruises that follow the Greenwich Meridian south of 55°S and connect straight further north to the southern tip of Africa. Unlike frameworks previously published, we emphasize for a given front, when defined locally (i.e. at a given longitude), relative persistence in time of the corresponding absolute sea level value. For the dates that match the occurrence of a GoodHope cruise, the fronts deduced from the processing of altimetry data are compared to the fronts calculated directly from hydrographic measurements. Geographic remapping over the ocean domain south of Africa shows zonal discontinuities in the fronts and gives evidence for regional along-front sea level slopes. These patterns may be analyzed in the light of topographic constraints or regional specificities such as the retroflection of the Agulhas Current south of Africa.