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Southern Annular Mode responsible for frontal variability South of Australia

C.O. Dufour (1), J. Le Sommer (1), M.H. England (2), T. Penduff (1,3), and B. Barnier (1)

(1) Laboratoire des Ecoulements Géophysiques et Industriels, UJF/CNRS, Grenoble, France (carolina.dufour@hmg.inpg.fr), (2) Climate Change Research Centre, UNSW, Sydney, Australia, (3) Department of Oceanography, The Florida State University, Tallahassee, Florida

A global $1/4°$ ocean model simulation, performed during the DRAKKAR project, is used to investigate the interseasonal to interannual variability of thermohaline properties in subsurface waters across the Antarctic Circumpolar Current (ACC) South of Australia over the last decades. In the model simulation, subsurface variability appears to be dominated by a mode whose main characteristics are the following: a maximum of variability located at the interface between the Subantarctic Mode Water (SAMW) and the Antarctic Intermediate Water (AAIW), and an intermittent interseasonal period. This dominant mode appears to be consistent with previous studies based on hydrographic sections along the WOCE-SR3 line where the mode was observed and named the *Pulsation Mode*. Further investigations show that the Pulsation Mode is associated with ACC frontal variability constrained by topography. In particular, our detailed study shows that the Pulsation Mode corresponds to a baroclinic adjustment of the ACC to changes in atmospheric winds. Indeed, this mode exhibits a close correlation both with zonal wind stress South of Australia and with the Southern Annular Mode (SAM), the dominant atmospheric mode of Southern Hemisphere variability. On interseasonal to interannual periods, the regional ocean circulation is thus shown to switch between two typical states depending on the phase of the SAM. Although it is still unclear whether the Pulsation Mode induces changes in water masses formation, we emphasize that the structure of hydrographic sections South of Australia depends strongly on the SAM phase, which should therefore be considered when analysing in-situ data.

In this study, model data are used to provide a detailed description of ocean variability and to analyse the associated physical processes. This study thus examplifies how ocean model simulations driven by atmospheric reanalyses can compensate for the scarcity of observational data in the Southern Ocean and offer a complementary view in order to get a better understanding of ocean variability.