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The contribution of the Weddell Sea to the global biogechemical cyles

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Bottom water formation in the Southern Ocean plays a fundamental role in the lower branch of the Meridional Overturning Circulation and in the global biogeochemical cycles, by ventilating and cooling the deepest layer of the world's ocean and sequestering carbon and nutrients. Within the framework of the Antarctic Deep Water Rates of Export (ANDREX) project, we aim to evaluate the role of the Weddell gyre – and in particular the formation of Antarctic Bottom Water (AABW) in this region - in global ocean circulation and biogeochemical cycling through the first systematic hydrographic and tracer measurements along the gyre's outer rim (including temperature, salinity, nutrients, carbon system parameters, chlorofluorocarbons, sulphur hexafluoride, oxygen isotopes and noble gases). In this work, the nutrient chemical fields are combined with velocity measurements in a box inverse model to obtain a self-consistent estimate of the physical and biogeochemical transports across the rim of the Weddell gyre and of the rate at which the deep ocean is ventilated from the gyre. Preliminary budgets of dissolved inorganic nutrients (nitrate, phosphate and silicate) are computed for the Weddell Sea and vertical transports of individual nutrients into/out of the gyre and net air-sea exchanges within the gyre are determined. We show sections of the data being used (model velocity field and optimally interpolated nutrient sections) and seek to distinguish between vertical fluxes due to physical processes, which are represented explicitly in the inverse model, and those driven by the biological pump, which can be estimated by summing the physical horizontal and vertical fluxes in density classes. An initial assessment of nutrient subduction into the abyssal ocean associated with the export of AABW from the gyre is presented. The context of these results with regard to implications for controls on ocean circulation and climate against a background of a changing hydrological cycle are discussed.