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. The Antarctic Deep Water Rate of Export (ANDREX) project aims at quantifying the role of the Weddell gyre in global ocean circulation and biogeochemical cycling through the first systematic hydrographic and tracer measurements along the gyre’s outer rim. These measurements (including temperature, salinity, nutrients, carbon system parameters, chlorofluorocarbons, sulphur hexafluoride, oxygen isotopes and noble gases) 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. Such an analysis will help shed lights on several key open questions about the role of the Weddell gyre in the global circulation. Of particular interest is the quantification of bottom water formation and the density profile of ventilation in the Weddell Sea, as well as an assessment of the region's role in biogeochemical cycling and anthropogenic carbon sequestration. In this presentation, we will discuss the initial results of the box inverse model, focussing on the physical circulation and bottom water formation rates in the Weddell gyre.