Weddell Sea Moorings

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Project Summary

The world's deep oceans are filled with water masses formed at the continental margins of Antarctica. The Weddell Sea is a major source of these so-called Antarctic Deep and Bottom Waters. Relatively warm, salty water originating in the North Atlantic enters the Weddell Gyre to the east of the Greenwich Meridian as Circumpolar Deep Water (CDW). As it traverses the gyre, the CDW cools and freshens, mixing with Antarctic waters, feeding bottom water-forming processes on the continental shelves, and interacting with floating ice shelves to produce Weddell Deep and Bottom water types. Because these formation processes include heat exchange with the atmosphere and ice shelves, the properties of the water masses formed carry an imprint of any recent changes in atmospheric and shelf ice characteristics, including temperature, distribution of shelf and sea ice, and shifts in large scale wind stress patterns such as those associated with the Southern Annular Mode (SAM) and El Nino/Southern Oscillation (ENSO).

The goal of this project is to observe the properties of the Weddell deep and bottom waters as they exit the Weddell system to contribute to the world's deep ocean basins. Observations of this type are essential to understanding the oceanic component of the climate system, especially the exchange of heat and fresh water between the poles and equator. The data obtained over the course of a decade and more can be used to better understand deep water formation and long term changes in ocean circulation and their relation to the climate system. To obtain the necessary measurements, this project maintains an array of oceanographic moorings south of the South Orkney Islands in the Northwest Weddell Sea to provide a time series of the combined outflow (currents and temperature/salinity) of Antarctic Deep and Bottom Water drawn from various sites within the Weddell Sea. The observation sites were selected to monitor the integrated properties of the outflowing deep and bottom waters after they have traversed the key formation sites in the western Weddell Sea.

The moorings sites are visited approximately every 2 years, with ship time made available under the auspices of an Agreement of Cooperation between Lamont-Doherty Earth Observatory of Columbia University (LDEO) and the British Antarctic Survey (BAS). The agreement with BAS provides for sharing of equipment, personnel and data between LDEO and BAS, with BAS providing the ship time to do so. Under this agreement, by sharing material resources with BAS, we have been able to expand the mooring array to encompass the Orkney Passage to the east of the Orkney Plateau, a site of potential escape of Weddell Deep Water into the Southern Ocean. Our collaboration with BAS will continue, so this work is part of an international effort.

The data are made publicly available after retrieval from the moorings and suitable data processing has been completed. Real or near real time data reporting is not yet technically feasible for these sites as they are covered by pack ice for most of the year. The data are archived at the project web site [http://www.ldeo.columbia.edu/res/div/ocp/CORC-ARCHES/cm_data/] and at the OceanSITES data portal [http://www.oceansites.org]. To date,

the data have been used by diverse groups of ocean and climate modelers, educators and observational oceanographers. Publications and data from this project have been cited in more than 10 publications by other researchers, including 5 in the past year.

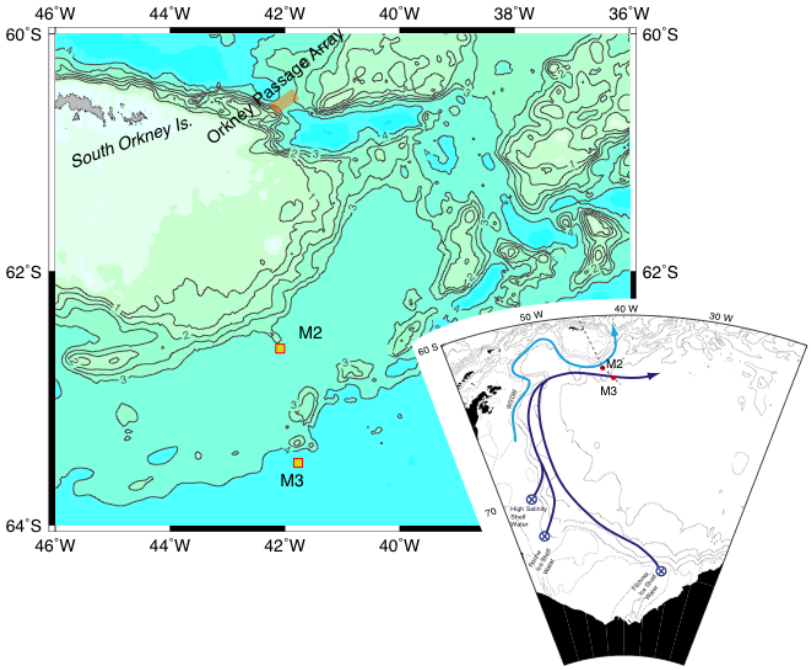

Figure 1. Weddell mooring locations, and schematic of deep and bottom water flow from source regions to the mooring array.