Temperature-Salinity Data from mooring M3, northwest Weddell Sea, 1999-2019

Files in this archive contain temperature-salinity and conductivity-temperature-depth (CTD) profiles collected as part of an ongoing project funded by NOAA's Climate Program Office/ Ocean Observation and Monitoring Division, Arnold L. Gordon, Principal Investigator.

Temperature-Salinity data from mooring M3, and CTD profiles from the vicinity of the mooring from 1999 to 2019 are collected in this archive as two files:

M3_davag_190320.mat – matlab mat file containing data structures for temperature/salinity sensor daily average data for 8 deployments (as described in Fig 3 below)

M2M3CTD_LMGNBP.txt.zip – CTD profile data collected during mooring servicing cruises at and near the M2 and M3 mooring sites from US Antarctic Program vessels L M GOULD and N B PALMER.

Project Summary

The world's deep oceans are filled with water masses formed at the continental margins of Antarctica, with the Weddell Sea a major source. 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. These formation processes include heat exchange with the atmosphere and ice shelves, so 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. 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. 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 properties of the combined outflow of Antarctic Deep and Bottom Water drawn from various sites within the Weddell Sea.

The moorings sites are visited approximately every 2 years, 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. 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.

The data are made publicly available after retrieval from the moorings and suitable data processing has been completed.

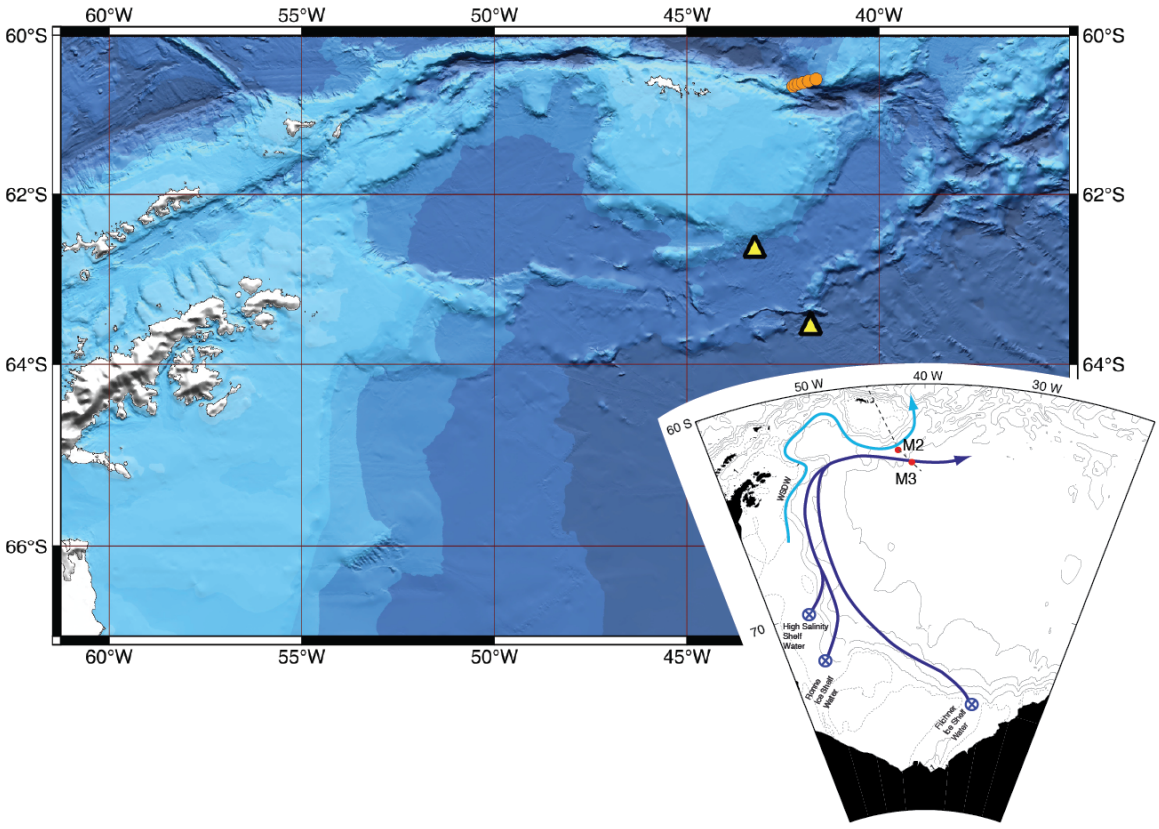
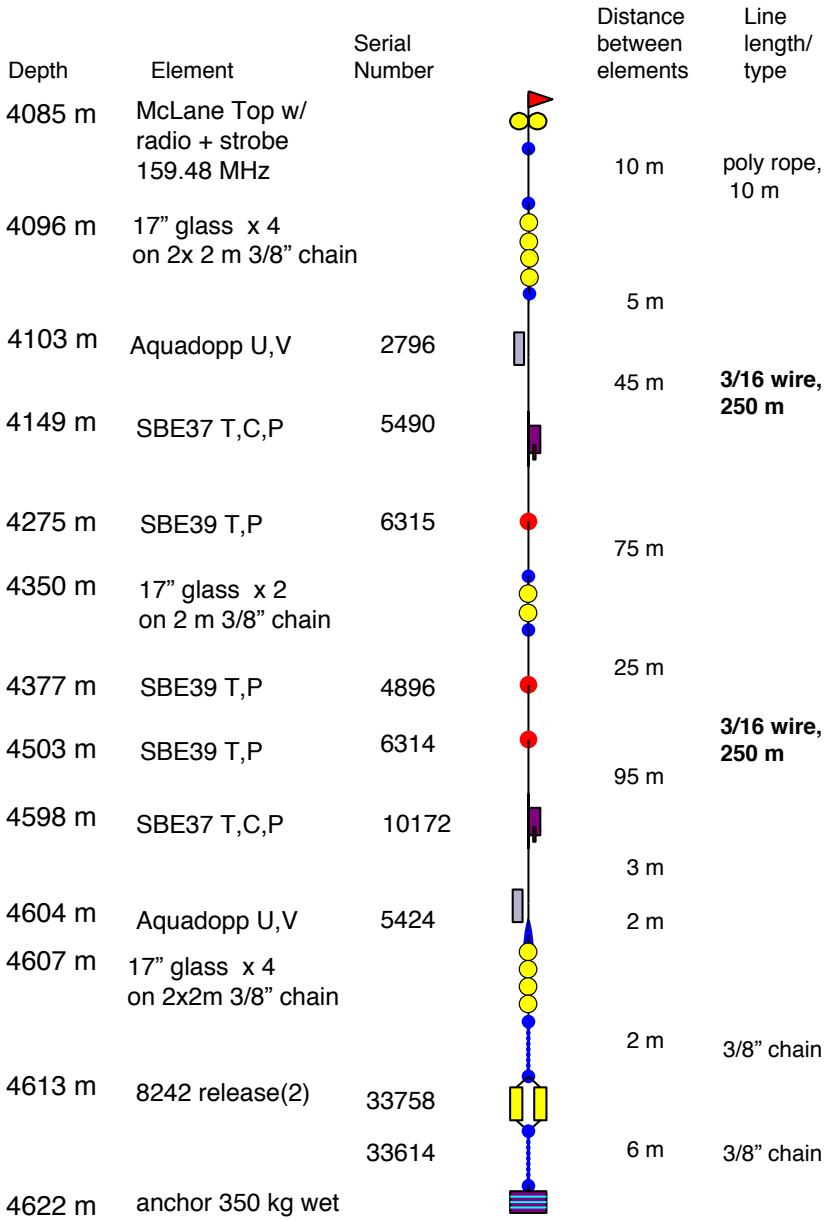


Figure 1. Weddell mooring locations, and schematic of deep and bottom water flow from source regions to the mooring array.

Weddell Orkney Plateau Moorings M3 (typical configuration)



Nominal Position: Lat S 63° 32.0' Lon W 041° 46.6'
Depth 4622 m

Figure 2. Mooring M3 configuration (typical). Data from the SBE37 instruments near the bottom and approximately 500 above the bottom are available in this archive. The SBE37 instruments are Sea-Bird Electronics temperature-conductivity-pressure (TCP) recorders. Salinity is computed from the raw T,C and P data before averaging.

The mooring data comprise daily averages from 8 separate deployments, designated in Figure 3 by letters A through I.

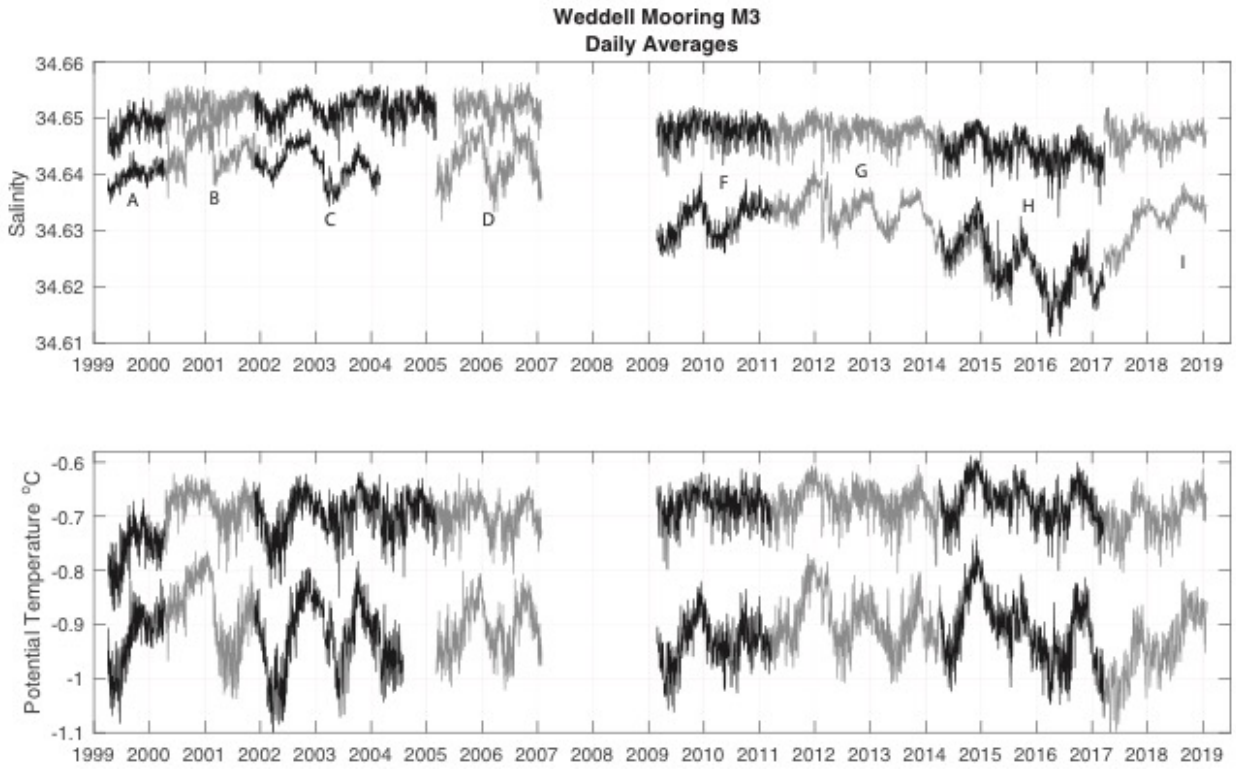


Figure 3. Salinity (upper) and Potential Temperature from the lower and upper SBE37 TCP recorders from all M_3 deployments. Each letter designates one deployment. Deployment E is missing due to failed mooring recovery. The gap at the end of deployment C is due to premature battery failure of the instrument. Note that deployments G and H overlap in time from 2014 to 2015. The two moorings were located within 2 km of one another. As of 11 Nov 2019, data from deployment I had not yet received post-recovery calibration. The deployment designators A-I correspond to file names in the archived data set.

Data from all sensors are typically archived at OceanSITES:

https://dods.ndbc.noaa.gov/thredds/catalog/data/oceansites/DATA/WDW/catalog.html

Suggested additional reading:

Abrahamsen, E. P., A. J. S. Meijers, K. L. Polzin, A. C. Naveira Garabato, B. A. King, Y. L. Firing, J.-B. Sallée, K. L. Sheen, A. L. Gordon, B. A. Huber, and M. P. Meredith, 2019: Stabilization of dense Antarctic water supply to the Atlantic Ocean overturning circulation. Nature Climate Change. 10.1038/s41558-019-0561-2

Gordon, A. L., B. Huber, D. McKee, and M. Visbeck, 2010: A seasonal cycle in the export of bottom water from the Weddell Sea. Nature Geosci, 3, 551-556.

McKee, D. C., X. Yuan, A. L. Gordon, B. A. Huber, and Z. Dong, 2011: Climate impact on interannual variability of Weddell Sea Bottom Water. J. Geophys. Res.-Oceans, 116.

Meredith, M. P., A. L. Gordon, A. C. Naveira Garabato, E. P. Abrahamsen, B. A. Huber, L. Jullion, and H. J. Venables, 2011: Synchronous intensification and warming of Antarctic Bottom Water outflow from the Weddell Gyre. Geophys. Res. Let., 38.

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