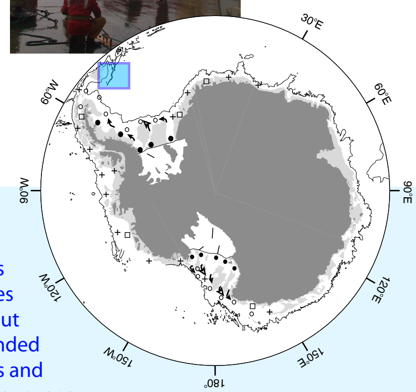
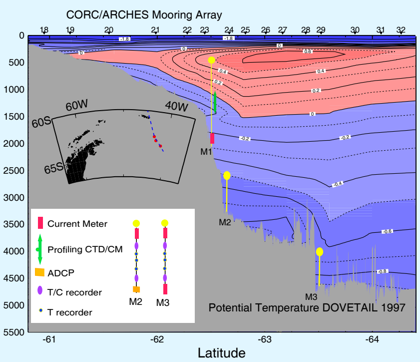
Monitoring Deep- and Bottom-water Outflow in the Weddell Sea

Past global climate change seems to be tied closely with large-scale ocean circulation either as an active element, amplifier; or global communicator of climate change. The oceans transport large amounts of heat from tropics to higher latitudes, and between ocean basins. Some of this heat transport is due to horizontal wind driven circulation, however, most of it is facilitated by the density-driven thermohaline circulation.

Observations of the ocean are necessary to describe the present state and future evolution of the climate system. These observations play three important roles to further our understanding of climate change: (1) They will provide insight into the processes that are thought to play an important role. (2) They provide the data to validate global climate models that are then used for a more complete assessment of possible system responses. (3) If maintained over a long period of time they allow the state of the climate system to be tracked directly and provide the baseline from which predictions can be attempted.



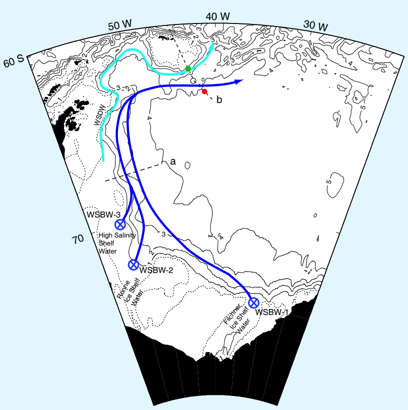
Weddell Sea



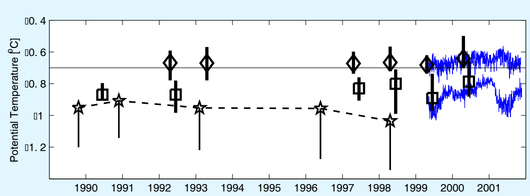
Potential temperature section south of the South Orkney Islands from the 1997 DOVETAIL program (Gordon, et al. 2001), with the location of the CORC/ARCHES mooring array indicated schematically. The moorings were first installed in early 1999 from the R/V L M Gould. They have since been serviced approximately annually from the NSF/OPP-operated L M Gould and RVIB N B Palmer, and the NApOc Ary Rongel (operated for the Brazilian Antarctic Program by the Brazilian Navy).

Weddell Sea Bottom Water is one of the densest water masses in the world oceans. As such, it and similar dense water masses formed in other locations around Antarctica spread throughout the deep part of the world's oceans. The goal of the NOAA-funded CORC/ARCHES project is to observe changes of the properties and strength of the outflow of Weddell Sea Deep and Bottom Water over a period of at least ten years. Since the Weddell Sea is a major source of deep water, changes in the outflowing deep and bottom waters formed there will in turn affect the global circulation.

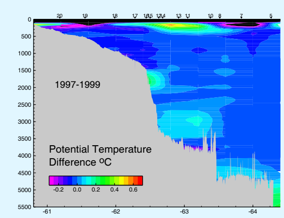
Weddell Sea Bottom Water (WSBW) is formed by three processes: near shore convection, open ocean convection, and ice shelf interaction. These processes occur on very small time and space scales, and are therefore very difficult to monitor directly. Additionally, the Southern Ocean poses a significant challenge to instrumental ocean observations. This is because portions of the basins are permanently ice covered and the entire area is frequented by icebergs, making access difficult, use of autonomous Lagrangian floats impossible, and severely constraining the depth of the uppermost sensors of moorings.



Bathymetric map of the Weddell Sea Gyre indicating the position of several streams of newly formed Weddell Sea Bottom Water (Gordon et al. 2001) and the CORC/ARCHES repeat section and mooring array.



Potential temperature time series obtained from repeat hydrographic sections in the northwestern Weddell gyre. Diamonds denote the mean temperature between 2600 and 3200 m water depth near 62.5 S 43.5 W (near M2). Squares denote the mean temperature between 4000 and 4600 m water depth near 63.5 S 42.0 W (near M3). The bars covers the total range of observed temperatures. The thin blue lines represent the 40h low pass filtered temperatures averaged over all sensors at mooring M2 and M3 respectively. The stars are the plume-mean temperatures from Fahrbach et al. (2001) at their upstream array location. The solid line connects the plume mean with the coldest temperature found during each survey. (after Visbeck, et al., 2001).



Potential temperature differences between CORC/ARCHES repeat sections and the 1997 DOVETAIL section.