April 7, 2008: Intro to thermohaline circulation theory

- Observations: conservative properties of seawater
- Schematic deep ocean circulation: theory and observation
- Dynamical example: Great Salinity anomaly of the early 1970s

What is the role of the Atlantic Ocean in decadal climate variability?
Potential temperature profile: Atlantic (25W)

Lynn and Reid (1968) referenced in Talley (2000)
Salinity profile: Atlantic (25W)

Lynn and Reid (1968) referenced in Talley (2000)
Potential density profile: Atlantic (25W)

Lynn and Reid (1968) referenced in Talley (2000) – referenced to 4000m depth
Water mass properties: salinity, temperature, density

Thermohaline circulation: theory

Stommel and Arons' abyssal circulation; image from http://storm.uchicago.edu/~gidon/ and Stommel (1958)
Meridional, interbasin, overturning ocean circulation

Schmitz (1996) referenced in Talley (2007); also cf. Gordon et al. (1986)
Decadal variability of deep water formation?

Belkin (2003)
Summary

• The deep ocean circulation is driven (crudely speaking) by the balance between downward diffusion of heat from warm surface layers and the upward motion of cold, deep waters.

• The properties of these cold deep waters are set by surface fluxes of heat and freshwater in the polar oceans during winter.

• Once away from the surface, these properties are conservative, characteristic of unique water masses, and indicative of mixing between masses.

• The thermohaline circulation operates on timescales of hundreds to thousands of years, and may vary on decadal timescales, via surface density anomalies advected with surface currents into deep water formation regions in the North Atlantic.


