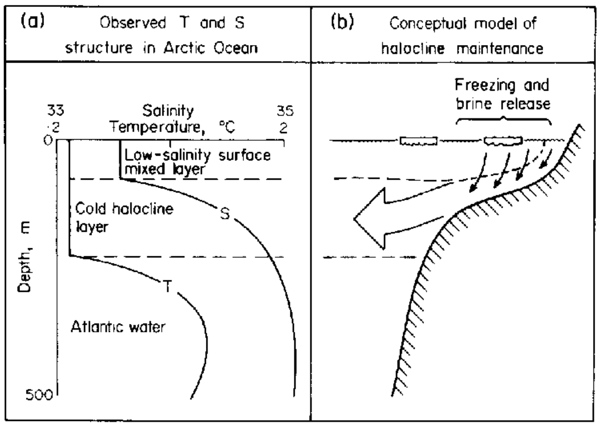
MAST 4667/667: Introduction to Arctic Oceanography (Fall 2014)

Oct.-2, 2014

Workshop/Homework-4: The Arctic Halocline – Part-2

Data: Ice-Tethered Profiler (ITP) at http://www.whoi.edu/website/itp/overview

Introduction. The Arctic Ocean's sea ice cover depends critically on the vertical density stratification that insulates heat at depth from the ice cover at the surface. The so-called halocline provides this stratification maintained by dense water formation in coastal polynyas (Aagaard et al, 1981)*:



Jin Sha posted averaged profiles of the stability frequency $N^2 = -g/\rho\ \partial\rho/\partial z$ for his ITP buoy that drifted from the North Pole into Fram Strait. His results may suggest a formal definition of an upper and lower halocline.

Goal. Define and quantify properties of the Arctic Halocline as it evolves in space and time using ITP buoy data.

Assignment.
Use Jin's prior work above to define halocline properties. Use files denst.dat and freeze.dat that are online.

1. Estimate a density anomaly $\sigma = \rho$-1000 where ρ is the density of seawater in kg/m^3 that you may compute as σ=24+0.8*(S-30) from salinity S.

2. Determine the stability frequency N from $N^2 = -g/\rho\ \partial\rho/\partial z$, where g=9.81 m/s^2, $\rho=\rho(x,y,z,t)$ is the density and $\partial\rho/\partial z$ is vertical density gradient. Find the depth, temperature, and salinity at the location where N^2 has its maximum which we here define as the core of the halocline for ~50-day averages (~200 profiles).

3. How does the primary maximum of N^2 vary in time and space?

4. Plot your clean T=T(S) as symbols over contours of σ=26, 27, and 28 kg/m^3 as well as the freezing temperature $T_f=T_f(S)$ for sea water for reference. Use S from 30 to 35.

5. Post graphics to describe the core of the halocline on your web-pages.

[*scientific computing and interpretation*]

(*) Aagaard, K., et al, 1981: On the halocline of the Arctic Ocean, Deep Sea Res., 28, 529-545.