

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

Sept.-25, 2014

### Workshop/Homework-4: The Arctic Halocline (MS/PhD students only)

Data: Ice-Tethered Profiler (ITP) at <http://www.who.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 as it consists of very cold, somewhat salty, somewhat fresh waters whose density is lower than that of the Atlantic layer below. Coastal processes are believed to intermittently provide this halocline water via dense water formation in coastal polynyas and leads that subsequently mix near the bottom on continental shelves as these dense waters slide towards the deep basin (Aagaard et al, 1981)

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

**Assignment.** Select all profile from your buoy for the following tasks

1. Plot your clean ITP profiles over contours of density and decide on the range of salinity ( $S_{\min}$ ,  $S_{\max}$ ) where most of the density variations in your profiles resides. Files `denst.dat` and `freeze.dat` are on the class web-site

[gridding, plotting]

2. Discuss with your class mates to find a consensus on what  $S_{\min}$  and  $S_{\max}$  should be for the entire Arctic to be used in task #3.

[quantitative arguments, setting standards]

3. For the range of salinities selected in #2 estimate the stability frequency  $N$  from

$$N^2 = -g/\rho \partial\rho/\partial z$$

where  $g=9.81 \text{ m/s}^2$ ,  $\rho=\rho(x,y,z,t)$  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.

[coding differentiation]

3. Create and post on your web-pages graphics to describe the core of the halocline to share with your peers.

[graphing, quantitative interpretation]

4. Post a single data file on your class web-page for other people to use.

[web-posting, data sharing]

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