Estimates of the seasonal variability of volume, heat, and freshwater fluxes in the eastern subpolar North Atlantic

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1) Motivation
The Extended Ellett Line (EEL) is a repeat hydrographic section with a 40 year history. Understanding of the variability in the area may help climate predictions1. Rough winter weather results in fewer winter occupations. Previous work has resolved interannual variability2 but not seasons3.

2) Our Goals
Contribute to the search for a seasonal cycle of volume, heat and freshwater fluxes with winter glider occupations.

Merge glider data with ship and float data. Sampling on a single section may be impacted by spatial and temporal aliasing of the eddy variability4.

3) Where would we expect geostrophic transports to reflect the seasonal cycle?

Model-based conclusions:
• Good correlations in the RT, RHP and southern IB are not isolated to a particular section.
• Difficult to resolve the northern IB. There is strong, bottom-intensified flow over sloping topography here due to the overflow water.
• There is a seasonal cycle in the model absolute velocity field which is consistent with the geostrophic velocity field.
• However, the uncertainties in the seasonal cycle can be impacted by strong interannual variability.

4) Data sources and Quality Control (QC)

Challenges: Assumptions are needed for processing SeaGlider data6 but QC’ing glider data based on ship & float data may remove variability observed by gliders.

Glider profiles every ~5 km but ships & floats profile every ~10-100 km. The density of glider profiles can bias climatologies and the QC process.

Solution: all profiles that fall in each year, season, and ¼ø x ¼ø bin are isopycnally averaged. The statistical envelope of the binned profiles is used to QC ship, float, and glider data together6. Here, we using 1.2x10⁶ profiles with 7.9x10⁶ S,T,P triplets, which are 83% and 90% of the input into the QC filter, respectively.

5) Volume, heat, and freshwater fluxes

Figure 3: Example of T-S space statistical data QC filter in a 1° x 1° square in RT. Accepted points are shaded by pressure. 0-2000 dbar, rejected points are black + symbols and the mean and ±2.3 std of the binned profiles at each density level are shown in green & red, respectively.

Here, glider data are retained at 92%, similar to ship & float data. Compare to 77% for separate QC5.

Figure 4: Seasonal RT fluxes using geostrophic transports referenced to, and summed above, 1200 m in a smoothed, ¼ø, 3D, QC’d, seasonal climatology. The black line is the EEL, others are the dotted sections shown in Fig. 1.

Conclusions:
• No clear seasonal cycle yet, but transport consistent with previous work5.
• Geostrophic fluxes are sensitive to smoothing since they are based on density gradients. More data (update ship and float database, more glider missions this winter) will help reduce the smoothing. Also, revisit the data pipeline to minimize smoothing.
• Estimate error bars with a “leave-some-out” analysis.

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