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Ocean Science Discussions

Interactive comment on "Towards closure of regional heat budgets in the North Atlantic using Argo floats and surface flux datasets" *by* N. C. Wells et al.

Anonymous Referee #2

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Review of “Towards closure of regional heat budgets in the North Atlantic using Argo floats and surface flux datasets” by Wells et al. submitted to Ocean Science Discussion.

Recommendation: This paper can be conditionally accepted, subject for revision.

General:

The paper represents an attempt to estimate seasonal heat budget of the upper layer of the mid latitudinal and subpolar North Atlantic using surface air-sea flux data sets and ARGO float data. This is very challenging task, since seasonal variations in the

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upper layer of the North Atlantic are critically important for estimation of climatologically significant processes, like deep convection, ventilation, etc. Paper is well written and brings quite novel understanding of many aspects of the problem, providing new quantitative estimates. Before being accepted, it, however, should undergo a revision according the caveats outlined below.

Specific comments:

1. When outlining the general goal of the study in the Introduction, I would suggest to add a para addressing the major processes steering the budgets on this specific space scale for this specific area. Some lines about the circulation mechanisms, increasing ventilation of the upper ocean layer along the NAC, convection in the Irminger Sea and Lab Sea should be mentioned along with the northward inflow and overflows at the northern boundary. It would be reasonable to stress that we know a little about seasonal cycle of these processes from observations (it is worth to mention here say Lamb and Bunker 1982, which was a pioneering study of the upper ocean heat budget involving subsurface data). Since that time mostly model studies have contributed to the understanding. However, they were primarily focused on either climate mean (annual) conditions or interannual variability. Furthermore, in the model simulations, it was even easier sometimes to quantify balances for intermediate and deep waters rather than for the upper layer (probably due to very high noise in the upper layer and strong constraint of the upper layer circulation by the forcing function. Good example of this kind is Boening et al. (1996, see figs 6,9). Other model analyses were focused more on meridional heat transport and the role of different factors in its formation (Eden and Willebrand 2001, Gulev et al. 2003). In this respect regional 10-degree cell analysis performed by the authors would be the step forward.

2. Of course the choice of 1999-2005 period was strongly constrained by the ARGO data availability. Nevertheless some speculations, involving physical thinking on how this period was representative and what were the major air-sea interaction and hydrography events in the NA during this period would be useful.

OSD

6, S9–S12, 2009

3. I understand that MLD averaged over 10-degree cells may be smaller compared to what we expect from a higher resolution data (or model experiments). I think, this should be commented somehow in page 103.

4. Surface heat flux fields form NOC climatology and NCEP are quite different (see fig 3, table 1). RMS errors say something, but not describe the nature of the differences. First, it is somehow poorly explained whether this was original SOC flux or the “tuned” SOC flux. Among the potential reasons for the disagreement, the authors may discuss difference in parameterizations used, but also sampling effect which should be quite pronounced in the SOC/NOC climatology. For instance Gulev et al. (2007) argued that sampling errors may be up to 60-80 W/m2 in the subpolar North Atlantic and that these biases may have a systematic nature in some regions.

5. All wind-driven components of the advection (both NCEP and NOC – based) were derived, I guess, from monthly means. If computed from individual snapshots, they may be different. I understand that it is difficult to quantify this effect using the data, but some comments should be given.

6. Figures/tables. Although they are informative, but quite different to make an overview assessments. Would it be possible for climate means and say for 2 seasons to perform at least 3-4 figs as geographic maps with 10-degree boxes in which basic components could be given in numbers of different color. This also about using arrows for advection quantification is such a figure(s).

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OSD

6, S9–S12, 2009

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Interactive comment on Ocean Sci. Discuss., 6, 95, 2009.