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Interactive comment on "Coupling of eastern and western subpolar North Atlantic: salt transport in the Irminger Current" *by* A. Born et al.

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We would like to thank Reviewer #1 for his comments as they highlight the importance of our manuscript. It was our aim to illustrate the importance of dynamics on the distribution of salinity in the ocean, and in particular the subpolar North Atlantic, a topic that is plagued by untested preconceptions and generalized analogies. From the comments, we understand that there are shortcomings in the presentation of our results, but at the same time we see confirmation that our study addresses an important subject that needs clarification. It is unfortunate that the review fails to include one key analysis of our work, the calculation of salt divergence, which answers many of the questions raised.

The primary criticism of Reviewer #1 is the alleged claim that salinity anomalies are

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not important for high latitude ocean variability. Quite the contrary is the case and we sincerely regret if poor wording has led to this misunderstanding, as our results certainly attribute a high importance to salinity anomalies. However, while the importance of salinity changes is beyond doubt, the more interesting question concerns the origin of those changes. Besides freshwater fluxes from the atmosphere, land and sea ice, changes in salinity can be the result of two oceanic processes: the simple transport of a water mass of different salinity from afar by invariable advection or differential variations in the transport itself.

It is true that changes in salt transport into a certain region by themselves are not a good indicator of how the salinity changes there. Calculating freshwater fluxes is one alternative, but heavily depends on the reference salinity chosen. To be precise, the reference salinity should be the one of the target region, so in the discretized framework of a numerical model it is different in every grid box. The calculation of the divergence of salt transport does just that in a very elegant way, and provides a result in the readily understandable unit of psu per unit time. The result of this analysis is that changes in the volume transport do indeed cause salinification through the action of eddies, while variations in the salinity of the source region do not contribute significantly. We did not expect this result to be controversial as in fact similar findings have been published recently and were considered an important improvement in the realism of CCSM4 (Danabasoglu et al., 2012b in our manuscript).

Related to the same reference and many others, we want to just briefly note that the criticism that the two models used in our study are not validated for the North Atlantic runs counter to the literature we reference.

We note that the reviewers then refers to "all sorts of issues". We would have appreciated more concrete and constructive criticism so that we are in a position to address shortcomings and improve the manuscript. Without more substantive details, however, we are afraid that we cannot act on such unspecific comments.

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In summary, we note that our results are independent from the analysis of salt or freshwater transport, and in fact the divergence of salt transport that we calculated is the more accurate measure. Since this central part of our work is crucial to our primary argument but has not at all been mentioned in the review, we fear that it may have been overlooked, perhaps as a result of insufficient description.

Unfortunately, without a more detailed review, we will not be able to make more specific revisions in addition to planned improvements of the introduction, a better description of the general role of small salinity variations, and a more detailed discussion of particular literature such as e.g. Danabasoglu et al., 2012.

Sincerely, A. Born, T.F. Stocker, A.B. Sandø

Interactive comment on Ocean Sci. Discuss., 10, 555, 2013.