Ocean Sci. Discuss., 10, C196–C198, 2013
www.ocean-sci-discuss.net/10/C196/2013/

Ocean Science
Discussions
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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.

Anonymous Referee #1

Received and published: 10 May 2013

This paper considers the coupling of the eastern and western halves of the sub-polar gyre of the North Atlantic Ocean and the role of salt transport. The authors use two different numerical models to consider the roles that salinity and volume transport anomalies have on the salt transport. This leads into a discussion on feedback mechanisms on water formation in the Labrador Sea and climatic implications.

Unfortunately I would have to recommend rejecting the manuscript in its present form due to a significant issue with the authors underlying understanding of salt transport and its potential implications. For their idea that salinity anomalies (as compared to volume transport anomalies) are not significant in driving high latitude oceanic variability is wrong (and completely disregards a huge body of published literature on this subject). Fundamentally, the authors are forgetting that salinity over most of the world's

ocean varies only slightly, and thus even small differences can have significant impacts. Considering just the impact on density, what the authors call a small anomaly of '0.1' in terms of salinity (34.9 vs 35.0) would lead to a density anomaly of ∼0.08 kg m**3 for 4C at the ocean's surface, which is significant.

Going into more detail, the authors look at variations in the flux of salt, and examine the relative importance of variations/anomalies in salinity and volume transport. And find the relative changes in volume transport are much larger than the relative changes in salinity. Two orders larger in fact, as they state on page 566. This is true, and does mean that anomalies in the volume transport will drive the anomalies in the amount (grams) of salt being transported. But the number of grams of salt being transported into a region isn't especially significant on its own. What matters is how that salt is partitioned and thus how the salinity of the incoming waters compare to those already in the region. Thus, those small differences in salinity that the authors say are negligible are crucial in determining the changes in water masses and the impact on densities, water formation, etc. Many studies have shown that changes smaller than the 0.1 g/kg that the authors use can have big impacts. That's why people compute quantities like freshwater content, as by removing a reference, one can see that salinity anomalies like 0.1 are big compared to the typical oceanic variations in salinity.

Beyond this, there are all sorts of issues with the paper. A detailed discussion of the very extensive literature (both observational and modelling)on this region/topic is missing. The models used are not really validated for the region in question. And the significant differences between them are not properly explained. I am not sure why the authors are focussing on the upper layer salinity as that salt gets taken up in mode water formation in the eastern subpolar gyre. As well, the mixed layer is probably not a good proxy for the upper layer transports given how much it varies in depth over the course of the year. And, for the purposes of restratifying the Labrador Sea, Straneo (2006) and Yashayaev (2007) show very nicely that this convergence occurs between 200-700 m. Yet the authors show no anomalies in this depth range in the Labrador

Sea. So even if their wasn't the issue in logic discussed above, I would not be sure how realistic the results presented were.

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