

Interactive comment on “Water mass distributions and transports for the 2014 GEOVIDE cruise in the North Atlantic” by Maribel I. García-Ibáñez et al.

Anonymous Referee #1

Received and published: 20 November 2017

Review: Water mass distribution and transports for the 2014 GEOVIDE cruise in the North Atlantic, Garcia-Ibanez et al.

Summary of paper:

Garcia-Ibanez et al. present data from a single section between Canada and Portugal in 2014 as part of the GEOTRACES programme. They use eOMP to decompose the water column into its constituent water masses and then combine these results with velocity estimates (Zunino et al., this issue) to estimate the transport of individual water masses (Greenland to Portugal only). Finally, the manuscript compares the 2014 results with the previously published 2002-2010 mean. The authors use the same methodology as Garcia-Ibanez et al., 2015, in part to enable easy comparison between the 2002-2010 mean and the 2014 results. However, this introduces some potential

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problems in interpretation due to time-invariant SWT definitions. This paper is less sophisticated than Garcia-Ibanez et al., 2015 as it focusses on a single year's data and does a simple comparison with the long-term mean. However, I believe that the manuscript will be of use to those using and interpreting the GEOTRACES data. In particular I think the ability of eOMP to identify the individual water masses is a powerful tool.

Main / Science comments:

(1) The main problem I have with the manuscript is section 4.1, and the interpretation of an increase in the proportion of ISOW.

(i) The authors use time-invariant SWT definitions. However, it is known that the LSW definitions in particular vary temporally related to the intensity and depth of winter convection in the Labrador Sea. LSW has become warmer and more saline recently - as noted by the authors e.g. P10, L21-24. Surely an alternative explanation for the apparent increase in the proportion of ISOW is that it is an artefact of a salinification of the LSW source water whilst the eOMP uses a constant SWT? (And potentially also as a result of an increase in the salinity of Faroe Bank Channel bottom water: Hansen et al., 2016, Ocean Science, 12, doi: 10.5194/os-12-1205-2016)

(ii) I also disagree with the statement on P11, L8-10 that the observed salinization of the deep-bottom waters of the section supports the idea that more SPMW is entrained into ISOW. Firstly the eOMP results (Fig. 6) does not show increased SPMW in the ISOW region. Secondly Zunino et al., Fig 7 suggests to me that the salinification has occurred in the LSW rather than the ISOW.

(2) Similarly, I think that the ISOW transport discussed in Section 4.2 and the conclusion is higher as a result of the LSW (and ISOW?) salinification, rather than because of an increase in ISOW per se.

(3) I feel that the final paragraph of section 2.3 discussing the robustness of the eOMP

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is important, but there are points that I don't understand:

(i) what standard deviation did you perturb the SWTs by? (i.e. what is the standard deviation in Table 1).

(ii) re. the uncertainties in the last column of Table 1 – is this the uncertainty introduced if just that SWT is perturbed? What does this tell us about total errors e.g. if more than one SWT is perturbed at the same time?

(iii) I find the last sentence in the paragraph about the correlation coefficients difficult to follow. Is it the same as in Garcia-Ibanez et al., 2015? If so the corresponding sentence in that paper is clearer: 'the model's ability to reproduce the measured values is given as the correlation coefficient (r^2) between the measured (water samples) and the expected values for the SWTs properties (values of the properties of each water sample obtained by substituting X_i 's in equation 3). The r^2 values are higher than xxx indicating again the reliability of our method.'

(iv) Table S1. I don't understand how these standard deviations were generated? It says they are almost the same as the accuracies, but in section 2.1 the given accuracies are quite different to those in table S1. Maybe expand table heading?

Minor Comments:

(1) P7, L3-8: mention that very little SAIW4 is seen in the section, almost looks like it's not present from Fig. 4h

(2) P7, L18: also suggest referencing de Jong and de Steur, 2016, GRL, 43, doi10.1002/2016GL069596 for measurements in the Irminger Sea.

(3) Section 3.2: Why have you only calculated volume transports for the Greenland-Portugal part of the section?

(4) P8, L30: Can you say anything about how errors associated with the eOMP will contribute to the water mass volume transport errors? Or are the water mass volume

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errors a lower bound estimate because no errors in the eOMP are taken into account?

(5) P9, L5: please could you add a few words / sentence describing how Zunino et al. defined the AMOC intensity?

(6) P10, L33: reference should really be de Jong and de Steur, 2016 rather than Yashayaev and Loder, 2016. de Jong and de Steur, 2016 present results from the Irminger Sea whereas Yashayaev and Loder, 2016 focus on the Labrador Sea.

(7) Section 4.2 Think need to mention that most changes in water mass volume transports between 2014 and 2002-2010 mean are within errors, with the exception of PIW and maybe just ISOW.

(8) P12, L22: please add more up-to-date reference for the DSOW transport estimates, Jochumsen et al., 2017, JGR Oceans, 122, doi:10.1002/2017JC012803.

Comments figures:

(1) Figure 3: please can you check the colour for group 10, as it seems to be different between a and c?

(2) Figure 3: there seems to be one dot on the Canadian Shelf that has been assigned to group 4 when it looks as if it maybe more appropriate to be assigned to group 1?

(3) Figure 4 caption: don't think need '(on a per one basis)'

(4) Figure 4 caption: 'Consult Table 1...' rather than 'Confront Table 1...'

(5) Figure 5 caption: 'Consult Table 1...' rather than 'Confront Table 1...'

(6) Figure 5 caption: Add sentence about what error bars are

(7) Figure 5: consider moving IrSPMW down, so have all water masses that contribute to upper limb of AMOC, and then all water masses that contribute to lower limb (?)

(8) Figure 6 caption: don't think need '(on a per one basis)'

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- (9) Figure 6 caption: 'Consult Table 1...' rather than 'Confront Table 1...'
- (10) Figure 6: consider using different colour-scale e.g. one that has white around 0, warm colours for positive anomalies and cool colours for negative anomalies.
- (11) Figure S1: please make axis lines thicker
- (12) Figure S1: what are the units for plot a?
- (13) Figure S2: consider using different colour-scale e.g. one that has white around 0, warm colours for positive anomalies and cool colours for negative anomalies.
- ***English / Typo suggestions:***
- (1) P2, L7: insert word '...that enable us to trace back.'
- (2) P2, L15: insert word '.... as in the subpolar...'
- (3) P2, L22: replace 'in' with 'of' '.... consisted of 78...'
- (4) P2, L23-24: don't need to mention Short, Large, etc stations.
- (5) P2, L25: mention what SBE43 is
- (6) P2, L25: insert word '.... was used as a reference...'
- (7) P2, L25: insert word '.... reference for the physical...'
- (8) P2, L27: replace 'in' with 'at' '.... performed at all...'
- (9) P2, L28: don't need CFA abbreviation as not used again in manuscript
- (10) P2, L29: 'dividing' not 'diving'
- (11) P2, L30: please give the accuracy for nutrients in $\mu\text{mol kg}^{-1}$ rather than μM
- (12) P3, L21: insert 'that' '.... NEADW that can be...'
- (13) P3, L33: don't use 'lcSPMW' anywhere else in the paper. Do you mean SPMW7?

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- (14) P4, L14: 'constraint' not 'constrain'
- (15) P4, L22-25: don't think you need these lines. Mention it separating out biological and mixing components will be valuable when interpreting TEI distributions but then don't show in manuscript!
- (16) P5, L6-8: re-order words '.... Iceland Basin, with the θ -S of SPMW8 being representative of that formed within the Iceland Basin. and the θ -S of SPMW7 to that found over the eastern...'
- (17) P5, L18: 'crossed' not 'crossing'
- (18) P5, L26: remove 'set'
- (19) P5, L29: 'was' not 'were' '.... NEADWU was'
- (20) P6, L6: change to '...allowed an assessment of...'
- (21) P6, L9: change word order '....(Fig 4a.b), with ENACW12 being...'
- (22) P6, L28: insert 'to' '.... NAC leads to the formation...'
- (23) P7, L4: change word order '...., with SAIW6 being the...'
- (24) P7, L10: insert 's' '.... LSW concentrations reaching...'
- (25) P7, L11: insert 'the' '.... from the surface...'
- (26) P7, L15: change word order '.... with the first 1000 dbar of the Irminger Sea being dominated.....'
- (27) P7, L16: 'mixture' not 'mixing'
- (28) P7, L18: insert 'water' '.... LSW-like water...'
- (29) P7, L23:24: change word order 'Some authors refer to the admixture..... found over and around the Reykjanes Ridge as Icelandic Slope Water.....'

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- (30) P8, L22: 'hydrographic' rather than 'hydrological' ?
- (31) P9, L5: insert words '... intensity of the AMOC....'
- (32) P9, L24: insert 'our' 'Since our OMP analysis....'
- (33) P9, L24: remove 'the' '.... time invariant properties....'
- (34) P10, L6: add 's' and 'it' '... greater depths it is LSW....'
- (35) P10, L17: add 'the' '.... at the expense....'
- (36) P10, L29: add 'with the' '(Fig 6e), with the redistribution....'
- (37) P11, L7: change 'con la'
- (38) P11, L16: do the authors mean Greenland Slope rather than Greenland Shelf?
- (39) P12, L12: insert 'an' '.... to an average....'
- (40) P13, L1: change to '.... allows identification of the water.....'
- (41) P13, L20: insert 'with the' '...2002-2010, with the increase related....'
- (42) Abstract, P1, L19: insert 's' '....colder end-members of the....'
- (43) Abstract, P1, L21: insert 'with the' '... 2002-2010, with the increase....'
- (44) Abstract, P1, L25: 'identification of' not 'identifying'

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2017-355>, 2017.