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Ocean Science
Discussions

Interactive comment on "Distribution of intermediate water masses in the subtropical northeast Atlantic" *by* I. Bashmachnikov et al.

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We would like to thank the referee for a thorough analysis of our paper, comments and suggestions, which helped to improve the manuscript. The answers to referee comments and the changes introduced in the text are listed below, as well as attached in the Supplement PDF file.

General Comments:

The manuscript "Distribution of intermediate water masses in the subtropical northeast Atlantic" by Bashmachnikov, Nascimento, Neves, and Menezes describes exactly what its title claims. The paper provides a detailed description of water masses in the NE Atlantic, matching distribution maps from an OMP with velocities derived from lagrain-

gian floats. Fundamentally the work seems sound and will be relevant to researchers interested in the water masses of the NE Atlantic. My most significant comment is a structural one. The introduction & conclusion of the paper lack strong motivating statements that clearly put the work in a broader context. The reader is asked to immediately confront the very detailed and complex description of water masses in the literature review starting in section 1.1. I felt like I didn't yet have sufficient motivation to know why it was important to struggle through all the complexity of the water mass structure of the region. Perhaps this is a specific issue I have not being thoroughly immersed in the NE Atlantic research community, but I feel strongly that the paper could be greatly improved by motivating the work more clearly, and perhaps reducing the detail given in sections 1.1-1.3. Otherwise the scientific methods and assumptions are reasonable, and mostly clearly outlined. The data used is presented clearly and well referenced. The results seem to largely confirm the overview given in the introduction, but have value by using independent climatological data sets. Reply: The following paragraphs are added to the Introduction to clearly state the motivation of this work: "In this work we study distributions of water types in the Subtropical NE Atlantic (25- 45ïĆř N and 5-35ïĆř W). Some general features of the distributions are described in a number of studies (Tsuchiya et al., 1992; Pérez et al., 1998; Poole and Tomczak, 1999; van Aken, 2000a, b; van Aken, 2001; Pérez et al., 2001; Cabeçadas et al., 2002; Alvaréz et al., 2004; Barbero et al., 2010; Louarn and Morin, 2011). The early works, though, present only qualitative description of the distributions of water types, based on subjective criteria. The more recent ones apply qualitative estimates (mostly based on the Optimum Multiparameter Analysis), but only to particular synoptic sections. Qualitative description of climatological distributions of mid-depths water types has not been performed. The present study, being a generalization of the previous works, also defines the depths of the cores of each of the mid-depth water types, as well as refines the limits of their spreading. The details on the change in the water type percentages with the distance from the source are also given. The detailed knowledge of the distributions of water types permits depicturing the major pathways of water particles across the mid-

depths ocean, otherwise too slow and turbulent to confidently derive those pathways from a limited number of observations with the existing direct methods. The detailed distributions can be further used for studies of diapycnal and along-isopycnal mixing intensities in the study region. Below we present a brief overview of water types in the subtropical NE Atlantic. The list of the main acronyms is presented in Table 1. Their known distributions are schematically summarised in Fig. 1."

Specific Comments:

1) I found it difficult to create a picture in my head of the overview of water masses described in sections 1.1-1.3. There are no references to figures in this section. I felt that some schematics or TS figures to be referenced by the descriptions in the text would help. Also maybe a map of the region with labels for important reference locations like the MAR, Azores, Canaries, etc. It is difficult to envision the spatial and TS distributions in your mind even if they are precisely described in the text. Particularly because of the huge number of numbers (temps, salinities, lats, longs) I found myself lost very quickly in the introduction. I would suggest that the authors try to simplify and use figure references rather than so much written quantitative description. The tables can hold much of the quantitative water mass definitions that the reader needs to know for the OMP. Reply: A schematic figure (new Fig. 1) is added to Introduction. The mid-depth and deep water types, described in Introduction, are marked. The water type characteristics are listed in Table 2. In the new version we send the reader to this table and replace in Introduction most of the quantitative measures water type properties with the qualitative ones (as high oxygen, low salinity). The exception are characteristics of water types, not summarized in Table 2.

2) The description of how eddy motions are removed from the float velocities is unclear. page 777, line 28 refers to 'blanking' the parts of trajectories that meet the eddy criteria. Reply: The paragraph is now moved to Appendix 1. We changed the phrase to: "The first step is to detect and remove the parts of the drifter trajectories within mesoscale eddies. To avoid the related bias, since mesoscale eddies are known to often have

velocities significantly different from those of the ambient flow, and may even travel against the flow (Morel, 1995)."

then page 778 line 14 talks about 'filtered' trajectories. I'm not clear on whether the velocity records are filtered or the eddy parts are just removed. What type of filtering is used? Reply: The parts of the trajectories are removed (see above). Word "filtered" is removed from the phrase: "The float trajectories are further collected for the selected reference depth levels, using all floats from the depth interval $\pm$500-m around a particular reference level."

3) Figures 9 & 10 really helped clarify all the written description. I realize these are results, not introduction, but this is the kind of visual explanation that is lacking in the introduction. Reply: A schematic figure (new Fig. 1), showing the water masses entering the study region, is now added to Introduction.

Technical corrections:

[I will use the page # and the line # to indicate the location of a correction. For example section 770, line 12 will be 770.12. I will write WC when the Word Choice in my opinion could be better, i.e. the chosen word is inappropriate or confusing.

-The abstract contains some references to things/acronyms that are not defined, making interpretation of parts of the abstract difficult. In particular: the "first transition line" line A.11. What is the first transition line? Reply: Words "transition line" are replaced with "lines". The phrase is changed to: "The MW in the Atlantic spreads as three cores of different density: the upper MW core (northwest of the line 28ïĆř W 35ïĆř N - 14ïĆř W 44ïĆř N) is found in the neutral density range of 27.65-27.70 kg m-3 at the depths of 900-1000 m; the main MW core (between the line above and the line 35ïĆř W 28ïĆř N - 10ïĆř W 37ïĆř N) has neutral density of around 27.75 kg m-3 and is found at 1000-1100 m; the lower MW core (southeast of the line 35ïĆř W 28ïĆř N - 10ïĆř W 37ïĆř N) has neutral density around 27.80 kg m-3 and is found at 1250-1350 m."

Secondly: the MUC is used but not defined until somewhere late in the paper (line A.19). The abstract should be self contained and accessible without reference to the text. Reply: The abbreviation is replaced with “the Mediterranean Undercurrent”.

-line 770.14: “verified”, WC. Should be ‘met’ or something like that. Reply: Thank you, the phrase is changed to “In the NE Atlantic those conditions are met along the frontal zones of the branches of the North Atlantic Current (Tomczak and Godfrey, 2003; Cianca et al., 2009)”

-line 770.18 “results” should be singular Reply: Thank you, it is changed to “The deep convection is a result of”

-line 770.25 Water Masses and Source Water Types have distinct definitions in the Tomczak et al papers. The former is a result of linear mixing of the latter. Reply: The phrase is changed to “When a subduction/convection process is regular, large collections of water parcels with a common formation history are formed, the source water types (Tomczak and Large, 1989). They can spread long distances across the ocean without a significant change of their properties.”

-line 775.3- first definition of Mediterranean Undercurrent, although used before Reply: In Abstract the abbreviation is replaced with “the Mediterranean Undercurrent”.

–line 776.4 “fractions” -WC- should be ‘types’ Reply: Thank you, this is corrected.

- 776.7-10: NADW flows about half and half east (3Sv IFR& Faroe Bank Channel) and west (3Sv Denmark Strait) of Iceland over the Greenland-Scotland Ridge. See Hansen & Osterhus 2000. Not maily through the Denmark Strait Reply: The phrase is changed to “The NADW spreads south through Denmark Strait west of Iceland, as well as east of Iceland (Hansen and Osterhus, 2000).”

- 776.9: “Island” should be Iceland Reply: Thank you, this is corrected.

-778.26 I assume “SD” is standard deviation, but it should be defined before the abbreviation is used. Reply: The text is changed to “ is the mean standard deviation of

meridional and zonal components of the flow”.

-781.3 : “urges for”, not quite right word choice Reply: The phrase is changed to “A non-trivial value of requires the system to be over-determined”.

-788.7-8 WC: “There can be also detected: : :” and “Luck of”, needs re-wording Reply: The phrases are changed to: “Deep traces of the eastwards directed North Atlantic Current at 45ïĆř N and the Azores Current at 35ïĆř N are also visible. A continuous northwards bottom trapped transport along the northwestern slope of Africa is not detected.”

-Figure 13. The description of the offshore plotting of planetary Beta is confusing. Meridional variations are still hard to see, but is is 10ËĘ-9 smaller than topographic Beta? Is it relevant then? Also the arrow pointing to C. St. Vincent in the right hand panel is pointing somewhere off. Reply: This section is completely re-written. The more complete equation is used, which includes JEBAR effect, which appears to stronger affect the dynamics of the MUC.

-Figures 9-11. mAAIW is labeled on the figures as AA. Needs to be consistent with mAAIW in text. Reply: Thank you, this is corrected.

Figure 12. Nice figure, but its hard to see black arrows on brown and the yellow arrows on tan. Reply: The background colour intensity is decreased to see the arrows better.

Please also note the supplement to this comment:
http://www.ocean-sci-discuss.net/12/C497/2015/osd-12-C497-2015-supplement.pdf

Interactive comment on Ocean Sci. Discuss., 12, 769, 2015.