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Interactive comment on "Distribution of Water Masses in the Atlantic Ocean based on GLODAPv2" *by* Mian Liu and Toste Tanhua

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The paper uses the most comprehensive ocean database to apply objectively defined source water types (in a companion paper) to quantify the distribution of water masses in the Atlantic Ocean.

The paper is put sloppily together and will require a careful reading by someone not too close to the original manuscript to iron out the many grammatical errors and other inconsistencies. I do not consider it the role of the reviewer to do that, but here are a few pointers as to what has to be done:

a) The reference "Swift, S.M.: Activity patterns of pipistrelle bats (Pipistrellus pipistrellus) in north east Scotland. Journal of Zoology 190, âĂĺ526 285-295, 1980" has no

place in an oceanography paper. I assume in an effort to be as comprehensive as possible the author meant " Swift, J. H., K. Aagaard and S. Aage-Malmberg (1980) The contribution of the Denmark strait overflow to the deep North Atlantic. Deep Sea Research Part A. Oceanographic Research Papers 27, 29-42." and went astray in his Google search.

b) " For instance, the process of deep water formation from near surface waters enable the effects of air-sea gas exchange to penetrate the deep waters." uses the wrong form in the verb, and similar with many sentences.

c) " Base on above results, Tomczak (1981) extended the analysis" should read "Based . . ." and similar with many sentences.

Turning to the scientific content of the paper, it may be noted that the evaluation of the paper depends strongly on the referees' assessment of the companion paper "Characteristics of Water Masses in the Atlantic Ocean based on GLODAPv2", which has been assessed as requiring major amendments. So a final assessment of this paper has to await the authors' reaction to the assessment of the companion paper, henceforth referred to as Liu and Tanhua (submitted).

The main issue with Liu and Tanhua (submitted) is the representation of Central Water in the upper of their four layers. Leaving this issue aside for the moment, the lower three layers are shown in Figures 5 to 12. These figures fall into two groups, one showing water mass distributions on potential density surfaces (Figures 5, 7 and 10) and one showing vertical sections (Figures 6, 8, 9, 11 and 12). Turning to the first group for the moment, their captions say "around core potential density", and the text says "see table 3 in the companion paper, Liu and Tanhua, 2019 for definitions". Given that the definitions in that table are essential for the understanding of the current paper, the table should be reproduced here as Table 2 of the current paper, and I shall refer to it henceforth as Table 2. It then becomes clear that the "core potential density" used in the figures (and mentioned in the text in section 3) is not always the same as the one

given in the table. Do these figures have to be redone using the correct core densities, or is it sufficient to add an explanation for the choice of potential densities used in the figures? The authors will have to answer that question.

The second group of figures requires a similar explanation. Have they been derived from the core properties of Table 2? If so, they are based on valid mixing results. If not, the authors have to explain. I am also surprised about the smoothness of the distributions. Mixing distributions based on actual vertical section observations usually show much variability from station to station. Have the distributions been smoothed in any way? In any case, a statement how the figures were derived is necessary.

As an aside, I am disappointed how little use has been made in OMP analysis of the objective smoothing algorithm of de Brauwere et al. (2007). I am not asking that this paper should be redone using that algorithm, but I hope that anyone planning to apply OMP analysis to section data and reading this review will have a look at their technique.

Turning now to the issue of Central Water (Figures 3 and 4), the issue is that Central Waters cannot be defined by a single source water type as given in Table 2. This has been discussed in detail in the review of Liu and Tanhua (submitted). Figure 3 can possibly be accepted as is if the figure was built from the core potential densities of Table 2, which then represent the correct parameter representation from the linear Central Water parameter relationship at that particular density. But the core densities given in the figure do not correspond to those given in Table 2; so are the parameter properties calculated for the given density surfaces from the linear parameter relationships, or are they simply taken from Table 2 and applied to a different density surface? If the latter is the case the distribution shown would certainly be in error, and the figure has to be redone.

The situation is more serious with Figure 4. Table 1 lists the 12 OMP runs of the study. It has to be interpreted as runs that use the parameter values of Table 2 as source water types and calculate the mixing between them. Any run that involves Central

Water (runs 1, 2, 5, 6, 7 and 8) would give erroneous results of the Central Water is represented by only a single source water type. Take, for example, ENACW. In Figure 4 it is found at nearly 100% at potential density 27.04, in accordance to its values in Table 2, above 500 m depth. If we go down to 700 m, say, ENACW would still be the dominant water mass but with different parameter values according to its linear parameter relationships. OPM analysis based on a single value taken from Table 2 would result in much lower ENACW presence at 700 m depth, as shown in the figure. These runs will have to be done again with proper linear parameter relationships for the Central Waters.

In summary, much work has to be done to turn this paper into a publishable document. As it stands, it will then be an interesting contribution to the distribution of water masses in the Atlantic Ocean. It may even form the basis for future work towards a volumetric assessment of all Atlantic Ocean water masses, which would be a major and significant contribution to oceanography.

Regarding some minor points:

a) The text mentions 13 OMP runs as listed in Table 1. The table contains only 12 runs.

b)The reference to Lia and Tanhua (companion paper) is missing.

References: Liu and Tanhua (submitted): Distribution of Water Masses in the Atlantic Ocean based on GLODAPv2. Ocean Sci. Discuss., https://doi.org/10.5194/os-2018-140.

De Brauwere, A., S. H. M. Jaquet, F. de Ridder, F. Dehairs, R. Pintelon, J. Shoukens and W. Bayens (2007) Water mass distributions in the Southern Ocean derived from a parametric analysis of mixing water masses. JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 112, C02021, doi:10.1029/2006JC003742.

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