

## ***Interactive comment on “WOCE-Argo Global Hydrographic Climatology” by Viktor Gouretski***

**Anonymous Referee #1**

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Review of the manuscript “WOCE-Argo Global Hydrographic Climatology” by Viktor Gouretski submitted for publication in Ocean Science

The paper describes, in great details, the new gridded WOCE-Argo Global Hydrographic Climatology (WAGHC) and compares this new digital oceanographic product to the NOAA World Ocean Atlas 2013 (WOA13). Importantly, the database for both atlases is the same NOAA/NCEI World Ocean Data Base (WOD) with some addition of the profiles from AWI, Germany. Both WAGHC and WOA13 are compiled with  $0.25^\circ \times 0.25^\circ$  horizontal grid resolution, which by all means can be considered as high-resolution for the current state of global observational oceanography. However, WAGHC was computed at both on isobaric or isopycnal surfaces, while WOA13 is provided only on isobaric, which is effectively at fixed depths also called depth levels. The time span of WAGHC, between 2008 and 2012, is much shorter compared to the six decadal climatologies of WOA13 beginning in 1955-1964.

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The methods of data interpolation of WAGHC and WOA13 are significantly different. The most important difference is in using the weighted values of vertically binned data in WAGHC compared to a more traditional way of objective analysis in WOA13. Moreover, WAGHC employs extrapolation of data below 2 km, while WOA13 uses observed data interpolated on the standard depths levels everywhere, including the deep ocean.

Having two considerably different gridded in situ ocean data products provides a unique opportunity to address the key scientific question of paramount importance—how trustworthy are the high-resolution gridded ocean climatologies? If the two products with so many intrinsic differences yield similar results, the answer is positive and thus the entire research perspective of mapping World Ocean looks good. On the contrary, if the differences are too large, the in situ mapping of oceans would become problematic and may be viewed as at least controversial and not yet ready to be implemented.

From that perspective, the results are truly spectacular. Although there are several regions where substantial differences were noticed, overall the two products compare very well indeed. The most striking results are in getting almost identical ocean heat anomalies despite substantially different baseline climatologies. Overall, the paper provides a very important comparison of two digital products with elaborated discussion of the differences and explanation of thereof.

I have no doubts that the paper should be published in Ocean Science with the minor revisions that would address some issues and after some clarifications that, in my view, may improve the presentation. There are some issues though that author may want to address in the revised version.

1. The first and quite important issue is that the title and the text imply that adding Argo data is a novel feature, which is true relative to WGHC, but not to WOA13 that includes over a million of Argo profiles.
2. NODC was replaced by NOAA National Centers for Environmental Information (NCEI) and should be now referred as that (although it may be advised to mention

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that NCEI is formerly NODC when it is first cited).

3. Line 75: The annual and seasonal fields in WOA13 extend to 5500m, not to only 1500m; monthly climatologies do extend only to 1500m.

4. WOD13 contains approximately 12.8 million temperature profiles and 5.4 million salinity profiles with a great deal of the profiles dated after 1957 (the earliest date in WAGHC). Why were only 4,665 profiles retained for WAGHC?

5. For QC, an automated procedure was developed. Although it sounds like this procedure covers most of the problematic spots of removing the outliers, it is well known that no automated QC can be sufficient 100%. WOA13 implements manual QC, which is an integral and important part of the overall QC in that Atlas.

6. Lines 175-178: It looks as WAGHC uses a different approach to averaging the data to generate a climatology if compared to WOA13. In WOA13, the data belonging to each decade are averaged within that particular decade, and the averaged climatology between 1955 and 2012 is computed as averaged over the six decades. Such method prevents biases toward more recent decades with much more data. Including 1957-1984 data in the averages skews the WAGHC climatology toward more recent years even further. The author should mention this important difference between WAGHC and WOA13 because it may contribute to the found differences between these two products.

7. Lines 249-252: In several regions, including the Gulf Stream, GINS, etc., NCEI has recently generated so-called regional climatologies (RC) that are far more accurate and in some cases have a higher resolution (0.1x0.1 degree) [https://www.nodc.noaa.gov/OC5/regional\\_climate/](https://www.nodc.noaa.gov/OC5/regional_climate/). Comparison to those RCs may reduce the discrepancies. Moreover, similarly to numerical models, the differences between isobaric and isopycnal mapping decrease with increase in resolution. Although it is not realistic for the author to compare his results in selected regions with existed RCs in the reviewed research, it would be good for the OS readership to learn that

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such option does exist and the results may be somewhat different, although probably not dramatically.

8. With regard to NCEI RC and ocean heat content, it is worth to mention that finer-resolution mapping leads to significant changes in OHC spatial distribution compared to the one-degree resolution (Seidov et al, GRL, 44, p. 4985-4993, 2017). Moreover, the author did not elaborate on why 0.25x0.25 grid is critical for improvement ocean climatologies, as discussed in (Boyer et al, Int J of Climatology, 25(7), 931-945, 2005).

9. Lines 261-262: This is a false statement. WOA13 on 0.25x0.25 grid is available at all 102 levels, they are NOT replaced by 1x1 degree below 1500m; it is true, however, that monthly fields are limited to the upper 1500m only.

10. Although the overall quality of writing is outstanding, English can still be slightly improved. One common error is the absence of commas after introductory clauses. For example, "Since the late 19th century, the . . ." (line 27) requires a comma after "century"; there are a number of similar mistakes. Although all these comments are not critical, proper addressing them may further improve the manuscript.

To summarize, I recommend publishing this manuscript in Ocean Science after minor revisions.

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