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Interactive comment on "Monitoring ocean heat content from the current generation of global ocean observing systems" *by* K. von Schuckmann et al.

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Dear Editor Dr. Andreas Sterl, dear Reviewer #1, dear Reviewer #2,

Thank you for your careful reading and constructive comments, which greatly improved our manuscript. We have addressed each of reviewer's comments and suggestions, as described in the attached response. In particular, we have rewritten much of the manuscript and reduced the number of figures, to make it shorter and clearer, in line with suggestions from the reviewers.

You will find below a detailed point-by-point response for both anonymous reviewers, and we hope that you find that the paper is suitable for publication in Ocean Science.

Sincerely,

Karina von Schuckmann Jean-Baptiste Sallée, Don Chambers, Pierre-Yves Le Traon, Cecile Cabanes, Fabienne Gaillard, Sabrina Speich and Mathieu Hamon

Point-by-point response:

Reviewer #2:

1) It should be made clear in the Abstract that the inter-comparison of the three observation systems has been made from the Argo perspective. It should be also stressed that the Argo system permits the estimation of the halo-steric Seal Level change component only.

We have made clear in the abstract (and title) that the inter-comparison of the three observation systems has been made from the Argo perspective. We did not include the specification of halo-steric sea level from Argo in the abstract as we do not discuss this in this in the new version of the manuscript.

2) The introduction should be re-worked substantially. At several places here the authors should explicitly tell WHAT is meant. For instance, the second sentence should directly indicate (A) which time series are meant and (B) what is meant by "integrated" time series (integrated spatially, or vertically, or both??) Therefore it remains completely unclear for the reader what the Global Ocean Indicators are. This is an important point: the GOI are discussed throughout the paper and a proper definition of them must be given at the beginning of the paper.

We have substantially re-worked the introduction, and we have added better description of used thermology, e.g. GOIs. Concerning the sentence starting at line 4, p. 927, we have excluded this paragraph from the introduction.

3) Data section. “The GOIs associated to OHC and SSL are evaluated : : :”. Please, be more specific here: how many GOIs are available for OHC&SSL? Just two time series or more?? It is not necessary clear for the people who are not involved in this issue. I would suggest to put description of each data type (ARGO, GRACE, AVISO) into separate subsections (2.1, 2.2, 2.3)

We have put the description of each data type (ARGO, GRACE, AVISO) and method (sea level budget) into separate subsections (2.1, 2.2, 2.3, and 2.4) to better clarify the data section.

4) The reported strong impact of the Indonesian Archipelago area on the SL time series is an important issue and should be described in more details. I also found some inconsistencies on the map showing SL steric trends (Fig. 4b). The authors say that almost no Argo measurements exist in this area. On the other hand, the Fig.4b does show not-dummy trend values in the Indonesian box. Do these not-dummy values come from the excessive spatial interpolation? Were other (non-ARGO) hydrographic data used for the analysis?? - This needs explanation. Further inspection of the Fig.4b (which was not easy as the figure is rather small) revealed further “puzzles”. The no dummy SL-trend values are found in the Yellow Sea, Caspian Sea, Azov Sea, Baltic Sea, Hudson Bay, and Persian Gulf. ALL these areas correspond to shallow regions which are NOT covered with ARGO observations. Do these areas also have impact on the global trends? Were they accounted for or not? Why the trend estimates were still possible (according to Fig 4b) in these areas???

i) We have added additional information on the gridded data product used in section 2.1., giving the information that regional steric trends shown in Figure 4b are based on Argo and other hydrograpic data, thus explaining why there are non-zero trend values. We have discussed this issue as well in section 3.3 by adding: “Argo floats are rarely placed in shelves and marginal seas, nor do they cover regions of seasonal and permanent ice cover. The latter is not a condition found in the tropics, but the former is. Moreover, with our method for GSSL estimations (von Schuckmann and Le Traon,

2011) we exclude all data where the bathymetry is shallower than 1000m depth, which in turn eliminates the impact of marginal seas in our analysis of GSSL. The largest marginal sea in the TO is the relatively shallow area of the Indonesian Archipelago, which is poorly sampled by Argo, and excluded from our GSSL analysis. However, the total sea level estimated from altimetry generally includes this area, but it was excluded in the subsampled altimeter estimation used for Figure 3b.”

ii) We have as well answered the second part of this comment in section 3.3 by adding: “Regional steric sea level as derived from the D2CA1S2 re-analysis (see section 2.1) shows high SLSTERIC trends in the western tropical Pacific, and in the eastern tropical Indian Ocean, but values close to zero in the Indonesian Archipelago area (Figure 4b). These low trend values are based on the excessive spatial interpolation, as almost no hydrographic data have been included in the D2CA1S2 re-analysis for this area (see von Schuckmann et al., 2009, their Figure 2).”

iii) Some sensitivity tests had been performed to check the influence of marginal seas Northern and Baltic Sea, Mediterranean Sea) on global integrals, and the impact was negligible small (within error bars).

5.) Fig 6b. The , units for the OHC here are obviously wrong. The figure shows OHC values PER UNIT DEPTH. Respectively, Jm-2 should be changed to Jm-1. (The unit Jm-2 is relevant for the OHC value integrated over a certain depth range).

We have removed this figure to focus more on the results of the analysis.

Minor comments:

I suggest to stress the independence of the three observing systems from each other both in the introduction and in the Discussion sections:

We have changed this. We have moved information on the global sea level budget into section 2, which is renamed: Data and method.

Section 4: I am not sure if the word “sector” is a proper one when such zonal subdivi-

sion of the Global Ocean is made. Please, ask British or American colleagues:

We have changed “sector” to “area”

Figs 4a and 4b are interesting. I suggest to increase the size of the maps, and to carefully mask the regions where no ARGO data (Fig4b) exist.

We have increased the maps and added the data mask for testing the sensitivity also in Figure 4b.

Please also note the supplement to this comment:
http://www.ocean-sci-discuss.net/10/C532/2013/osd-10-C532-2013-supplement.pdf

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Interactive comment on Ocean Sci. Discuss., 10, 923, 2013.