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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.

Anonymous Referee #1

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This manuscript discusses a comparison of variations in anomalies of near-global and regional integrals of ocean heat content (from in situ temperature and salinity data) ocean sea surface height (from satellite altimeter data) and ocean mass (from satellite gravimetry data). The main new finding of interest is that including the relatively shallow area around the Indonesian Archipelago in global integrals is important to closing global sea level and heat budgets on interannual to decadal time scales. However, the manuscript seems to be organized around how the result was found and spends far too much space rehashing points that have already been discussed more precisely and less confusingly in the existing scientific literature. It does not spend enough space on the new result (which is only given a single rather confusing paragraph and a sin-

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gle rather confusing figure). Also, the English usage in the manuscript is poor. The manuscript will require major revision prior to publication in Ocean Science.

Specific comments that should be addressed prior to publication are given below, indexed by page (P) and line (L) number when appropriate.

1. The manuscript should be completely rewritten (including a title change) to focus on the major point of interest, that consideration of the region around Indonesia is important in closing regional and global ocean heat and sea level budgets on interannual to decadal time scales. Please rework the title, text, and figures to focus on this important point, and condense the rest of the material, which is already discussed in other papers in a more precise fashion, to a much smaller, concise summary supporting the main new result.

2. Overall, the English usage is often poor in the manuscript and needs improvement. There are far too many issues requiring attention than can be pointed out specifically in a review, and they will presumably change with a major rewrite. At any rate, copyediting is not the job of a reviewer. Perhaps the third author should spend a bit of time editing the manuscript for usage after it has been revised, just prior to resubmission.

3. P924, L14 and following. The units of W/m² can be ambiguous. What is the surface area in question? Is it the area of the world ocean, the area of the world ocean between 60°S and 60°N, or the surface area of the Earth? Any of these are plausible, and the latter is widely used in climate studies which consider top-of-the-atmosphere balances. Please consider using TeraWatts instead, or specify the surface area used in the calculation.

4. P924, L16-17. The Indonesian Archipelago is not a "basin", but a region of the ocean.

5. P925, L8-10. This sentence is awkward and ambiguous. What is "the ocean component" of the sea level budget?

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6. P926, L 9-10. Also this assumption relies on nothing changing in the deep ocean below 1500 m.

7. P926, L16-19. Purkey and Johnson (2010) estimate 0.15 ± 0.10 mm/yr sea level rise, and 0.10 ± 0.06 W/m² of warming (applied to the surface area of the earth) below the 2000-m sampling limit of Argo.

8. P930, L3-4 & elsewhere. Sentences like "Fig. x shows . . ." and "Blah blah are shown in Fig. 1" duplicate the figure caption and make poor topic sentences. In this instance, one could just delete the first sentence and refer to Figure 1 parenthetically at the end of the second sentence. Those actions would make sure the topic sentence stands out in its rightful place at the start of the paragraph, and eliminate unnecessary duplication of text already in the figure caption that just ruins the flow of the argument anyways.

9. P930, L21-23. This sentence is unclear and confusing. Please rewrite it.

10. P931, L3-5. Is this statement correct? The contribution of haline contraction to sea level, when integrated globally, is almost two orders of magnitude smaller than the contribution of the mass changes associated with it (e.g. Munk, 2003, Science). Thus it would seem that accounting for mass changes would be necessary (e.g. Boening et al., 2011, Geophys. Res. Lett.) but that halosteric effects should be negligible, at least for global averages.

11. P931, L5-8. Please be more precise with dates and numbers here and throughout. Estimating the trend in SSH from the start of the AVISO series to any given date shows that the trend is > 3.4 mm/yr for end dates between early 2001 and early 2007, but thereafter falling to 3.13 mm/yr by an end date of early 2012, and only partly recovering to 3.17 mm/yr by an end date of early 2013. One doesn't need all that detail, but try to be precise with dates and numbers for the detail given.

12. P932, L1-3. If the errors cancel, why would one increase the trend error? Do they

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add, and not cancel?

13. P932, L10 & L20. Again, eliminate poor topic sentences like this one that duplicate parts of the figure captions.

14. P933, L7-13. Including some appropriate references to studies that support these statements might be useful for some interested readers.

15. P934, L3-4. Again, the topic sentence is poor and duplicates the figure caption.

16. P934, L3-9. This paragraph is confusing and would benefit from a total rewrite.

17. P935, L1-7. Could interannual variability in Labrador Sea Water (LSW) ventilation, or variability in other components of North Atlantic Deep Water, also be a factor?

18. P935, L24 - P936, L1. This portion of the text is not clear at all.

19. P937, L1. The phrase "coarse Argo sampling" is not correct. It is really that shelves are hardly sampled at all by Argo, and the marginal seas are poorly sampled, along with regions of seasonal (and permanent) ice cover.

20. P937, L7. What are "instrument fail functions"? Perhaps "instrument failure modes" would be more appropriate here?

21. P937, L14 - P938, L2. Detecting small changes as the residual of the difference of two large numbers is almost never a useful exercise. One is never sure if there is some unknown bias error that is small with respect to the signal being measured, but large with respect to the residual being calculated.

22. P937, L14 - P938, L2. Deep observations can also be useful for estimating circulation or ventilation changes (e.g. Kouketsu et al., 2011, J. Geophys. Res.; Purkey and Johnson, 2013, J. Climate). Also, one can not calibrate Argo salinities with confidence without deep shipboard measurements that are carefully calibrated with bottle salinity data standardized by IAPSO Standard Sea Water.

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23. P944. Change the last sentence to "Error bars include data . . . but not systematic errors."

24. P946. Should read "Same as Fig. 2, . . ." and should be " -0.6 ± 0.6 " (minus sign missing).

25. P947. There must be a better way to tell this story, which is perhaps the main new result detailed in this manuscript. Between the figure and the text, it is hopelessly confusing as it is now.

26. P948, Change "belt" to "band".

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

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