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Ocean Science Discussions

Interactive comment on "Analyses of altimetry errors using Argo and GRACE data" *by* J.-F. Legeais et al.

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We thank Reviewer 1, Don Chambers, for his comments that will be accounted for to improve the manuscript. We respond below point by point to each comment.

[1] Section 3 of the manuscript describes (in less than 20 lines) the method used to compare altimeter and in-situ measurements. We originally thought this part would be useful for the reader. However, we agree that sensitivity analyses associated with all elements of this section are discussed in section 5. So indeed, section 3 is a bit redundant and we agree to delete this section in the next version of the manuscript. We will make sure that enough information is provided in the introduction (section 1) so that the reader is not lost.

[2] Section 4 describes Cal/Val altimetry results achieved thanks to the method of com-

parison. We wanted to present first what the method allows to do, which then leads to the necessity of better characterizing associated uncertainties (section 5). However, we agree that this section 4 looks like a catalog with some references to already published work. So we plan to move most of these results of section 3 in the introduction (section 1).

[3] Following the two previous comments, we will delete sections 3 and 4 and move section 5 up to section 3. Any portions of the old section 3 and 4 that are not already discussed either in the introduction (section 1) or in section 5 will be included here (new section 3).

[4] As requested, we will rephrase section 2.3 in the new version of the manuscript in order to better describe the total and steric sea level and explain why the ocean mass contribution to the sea level is needed. Additional references will be included. As suggested, the sentence "as proposed by the University of South Florida" will be replaced by "as provided by the University of South Florida". Regarding the question whether the GRGS maps include the time-variable global mean mass, we can mention that the estimation of these maps are based on the hypothesis that the total mass of the Earth does not change. Thus, the mean mass over the ocean is varying and it is related with the mass exchange with the continents and the atmosphere. This will be mentioned in the revised version of the paper.

[5] In Fig. 9, the trend of the SLA – DHA – GRGS ocean mass has been estimated after applying a global GIA correction of -1.1 mm/yr to the GRGS ocean mass time series. In addition, the GRGS ocean mass grids have been collocated at the positions and date of each Argo profiles. We don't use the global mean over the ocean. We agree that this global value of GIA correction is specific to the averaging kernel used (Chambers et al., 2010) and is not adapted to the GRGS solution. In order to give an answer to the referee comment (and to compute both curves of Fig. 9 in a more homogeneous way), we have used the GRGS grids over the global ocean with a 300km mask. And (in agreement with the GRGS experts), we have used the mean (over the

global ocean with a 300km mask) of the GIA rates for compressible Earth, using ICE5G ice history and VM2 viscosity profile from F.W.Landerer (Geruo et al., 2013). This leads to a GIA correction of -1.7 mm/yr (instead of the -1.1 mm/yr previously used). Then, the altimeter drift (SLA-DHA-OM) computed with this approach is -0.2 mm/yr, which is the same as the one obtained with the use of the global mean OM from Johnson and Chambers (2013), as in Fig. 9. As both trends are computed homogeneously with this approach (contrary to what was initially done in Fig. 9), we will present these new results in the updated version of the manuscript and stress the importance of the GIA correction.

A. Geruo, J. Wahr, and S. Zhong: Computations of the viscoelastic response of a 3-D compressible Earth to surface loading: an application to Glacial Isostatic Adjustment in Antarctica and Canada, Geophys. J. Int., 2013, 192, 557-572. doi: 10.1093/gji/ggs030

[6] In the paper, the fit uncertainty provided with the trend estimations is what can be called the standard error. This means that the width of the confidence interval of the trend estimations is one standard deviation (33%) of the statistical distribution of the estimator of the trend. Note that in addition of this fit uncertainty, there are systematic errors associated with the method of comparison of altimeter data with in-situ measurements. However, when the SLA-DHA differences are computed in two different situations (for instance with a new and a reference altimeter geophysical correction or in the East and West hemispheres), the realizations of these systematic errors are the same in both computations. Thus, they cancel each other, which makes possible to detect some trend differences. These elements will be included in the new version of the article (beginning of the current section 5).

Minor comments: [1] We will ask the editor for a copy-editing of the manuscript by native English speaker. If it is not possible, we will do this before submitting the new version.

[2] The expansion and contraction of the water column due to temperature and salinity

changes will be clearly attributed to the steric effect. We agree that the term “thermohaline” is rather attributed to the vertical circulation related to density differences and this term will not be used anymore is the context of the manuscript.

[3] The sentence at the beginning of section 5.7 regarding the choice of the reference level of integration of Argo profiles needs indeed some clarification. The comment provided by the reviewer is correct and we propose to mention the following sentence in the updated version: “The integration of the Argo T/S profiles for the computation of the in-situ steric dynamic heights requires a reference level (pressure). As all floats do not reach the same depth, the steric signal will be well sampled through the water column with a deep reference level but the shallower floats will not be used. On the opposite, more floats will be used with a shallow reference level but the vertical steric signal will be less sampled.”

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