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Interactive comment on "Uncertainty in Satellite estimate of Global Mean Sea Level changes, trend and acceleration" *by* Michaël Ablain et al.

Michaël Ablain et al.

ablainmichael1@gmail.com

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RC1 : This paper provides the first estimate of an error variance-covariance matrix for altimeter measurements of global mean sea level rise. The authors then derive a 90% confidence interval of GMSL on a 10-day basis and estimate the trend and acceleration of GMSL over 5 year or longer intervals. Overall the paper is easy to understand and could potentially provide a useful quantification of uncertainty. However, my primary concern is with the treatment of GIA uncertainty and the authors must address this.

Answer to RC1: We thank reviewer 1 for this positive review. In the revised manuscript and the detailed response below we now address reviewer 1's concern about the treatment of the GRD correction associated to present day mass loss. We thank reviewer

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Discussion paper

1 for pointing us to this flaw in the manuscript.

RC1 : The authors note that they use the Spada 2017 estimate of 0.05 mm/year for GIA uncertainty. This uncertainty estimate is for the GIA component due to the ongoing changes in the Earth's crust since the last glacial maximum (LGM) but does not include modern day melt contributions to GIA. As the authors are aware, the LGM-GIA response is typically accounted for in altimeter-based estimates of GMSL by adding 0.3 mm/yr to the altimeter-derived estimate of GMSL. However, this estimate does not account for deformations of the ocean bottom due to modern melt, which can introduce biases in both the mean trend and acceleration term. See, for example, Frederikse et al. 2017 and Lickley et al. 2018. This correction need not be included if the authors wish to use altimeter measurements to estimate changes in sea surface height instead of sea level. However, the authors explicitly reference estimates of changes in sea level (lines 117- 120) where they compare altimeter estimates of GMSL to changes in ocean volume as measured by tide gauges, or the sum of the contributions to changes in ocean volume. To be consistent, I believe this additional source of GIA uncertainty should be accounted for. Alternatively, they could remove the GIA estimate altogether and state upfront that this is an estimate of the uncertainty in sea surface height and cannot be compared to volumetric changes in sea level.

Answer to RC1: Reviewer 1 is right, we need to include the Frederikse et al. (2017) and Lickley et al. (2018) elastic correction in our study because we compare altimeter estimates of GMSL rise to changes in ocean volume as measured by tide gauges. We now correct our estimate of the GMSL rise by +0.10 mm/yr (in the text and in figures 1, 4 and 9) as recommended by Frederikse et al. (2017). The uncertainty in this correction arises mainly from uncertainty associated to the procedure to solve the sea level equation, uncertainty in the choice of the Love numbers, uncertainty generated by the truncation degree of the spherical harmonics and the uncertainty in the mass redistribution. Because the elastic response of the Earth and its main parameters (i.e. the sea level equation, the Love numbers, the spherical harmonic development) are

reasonably well defined (Mitrovica et al., 2011), the uncertainty in this correction is largely dominated by uncertainties in the mass redistribution (Frederikse et al. 2017). The uncertainty on the mass redistribution is about $\pm$10% on the current ice mass loss (e.g. Blazquez et al. 2018, The WCRP sea level budget group 2018). Since the elastic response of the solid Earth is linear , the uncertainty in the ocean bottom motion associated to the uncertainty in the mass redistribution should also amount $\pm$10% of the total correction. It yields an uncertainty of $\pm$0.01 mm/yr on the elastic correction. This uncertainty is very small. It is an order of magnitude smaller than the uncertainty considered in this study (see Table 1). So we neglect this source of uncertainty in our study. We now write a paragraph on line 335 to explain this.

RC1 : Specific Comments:There are a number of grammatical errors and issues with vocabulary choice through-out. Please check! Here are a few examples: Line 41: add an s to “altimeter” Replace “confidence enve-lope” with “confidence interval”

Answer to RC1: corrected

RC1 : throughout Line 86: replace “the GMSL” with “GMSL”.Line 96: Add “us” after “enables” and remove the “s” on “metrics”

Answer to RC1: corrected

RC1 : Other issues: Line 307, should be ‘âĹij’ not ‘=’ Please label axes on Figure 5 and 9.

Answer to RC1: corrected

Please also note the supplement to this comment:
https://www.earth-syst-sci-data-discuss.net/essd-2019-10/essd-2019-10-AC1-supplement.pdf

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