# Response to second reviewer (anonymous)

Response: Thank you very much for your review, we have complied with all of the changes you've requested.

Kind regards,
Rémi Jugier

General: I appreciate having been given the opportunity to review a preprint of "On the uncertainty associated with detecting global and local mean sea level drifts on Sentinel-3A and Sentinel-3B altimetry missions" by Jugier et al. The paper is well organized and written, and provides an excellent overview of sources of uncertainty in satellite altimetry measurements of sea level trends, differences between missions, and implications for resulting sea-level rise estimates. It rigorously quantifies drift in GMSL trends between satellite altimetry missions and by comparison to tide gauge records, allowing for some of the uncertainty to be accounted for, and guiding future improvements in altimetry and uncertainty analysis. The work provides important new insight to uncertainty in satellite altimetry-based inferences of sea level, which is crucial for understanding future sea level changes and associated impacts, as well as the use of altimetry data to support modelling. I provide only some minor specific comments and suggested technical corrections.

Specific comments:

Lines 33-35: It is not immediately clear what is meant by "At the local scale", although the authors refer to a scale of 2400 km in Line 18. I suspect the authors are referring to the fact that there are spatial variations in sea-level rise across the global oceans. If so, I suggest changing this sentence to begin "Rates of sea-level rise vary spatially in the range 0 to 6 mm yr-1…". Alternatively, explain what is meant by local scales, e.g. "Over distances of 2400 km, sea-level rise rates vary by between 0 and 6 mm yr-1…" I note that later in the paper, three different local scales (240 km to 2400 km) are referred to. It is not clear which of these local scales the range 0-6mm/yr applies to. We agree with you that the use of the term "local scales" can be confusing. In our minds, we used "local scales" as opposed to "global scale". In practice, "local scales" range from a hundred kilometers to a few thousand kilometers. We have applied your first suggestion, and elsewhere in the paper, as you've suggested, we've made things clearer. Firstly, we've used "regional scales'", which resonates more with "global scale" and is probably clearer for the reader than "local scale". The term "regional scales" has also been explicitly defined when first used in the paper to avoid ambiguity. And then, we've implemented your suggestions of speaking

about “spatial variability of sea level drifts”. We’ve also specified more explicitly what was the spatial scale each time that we were using “local scale”.

Lines 73-74: Again, it is not quite clear what the authors mean by “local scales”. I would suggest to change this to say something like “…we assess spatial variability in the drift in sea level estimates” As explained just before, we have improved this sentence to say that we extend the detection of the global sea level drift to different regional scales, i.e. assess spatial variability in the drift in sea level estimates.

Line 109: It is not clear why a resolution of 1 degree latitudinally and 3 degrees longitudinally are selected for this method. Could the authors clarify this choice of resolution, and comment on the potential influence of grid resolution and spatial collocation of altimetry tracks to the reference grid on the resulting analysis and MSL drift estimates? The resolution of 1 degree latitudinally and 3 degrees longitudinally applied in this study is coming from the GMSL AVISO calculation method (https://www.aviso.altimetry.fr/en/data/products/ocean-indicators-products/mean-sea-level/processing-and-corrections.html ). Henry et al. (2014) showed this resolution is the most adapted for the historical orbit of the TOPEX/Jason altimeter missions in order to calculate the GMSL time series and well represent its inter-annual variations (e.g. during ENSO events for instance) . We have decided in this study to keep this resolution to detect the relative GMSL drift between Sentinel-3 (A and B), SARAL-Altika, and Jason-3 first because we wanted to stay in line with the GMSL AVISO method. We have included more information in the updated paper to better justify the spatial resolution applied for this study.

Line 321: Clarify the reference time period used to determine trends in Section 4.4. Yes, added in the paper.

Lines 354-358: Do these findings suggest that some spatial averaging/smoothing is generally needed or recommended to obtain robust sea-level estimates? Indeed, spatial smoothing/averaging reduces the impact of ocean variability, which is the limiting factor for detecting relative sea level drift between these same two missions. As shown in the paper, taking into account large regional areas (e.g. 2400 km) reduces the uncertainties in the relative sea level trend. However, this smoothing/averaging approach is done at the expense of small spatial scales. Our recommendation would be to find a method where the effect of oceanic variability should be reduced (e.g. by removing as much as possible the mesoscale signal) before comparing sea level estimates between two missions.

Line 380: Clarify what is meant by local scales here. Corrected by removing “local scale” and directly giving the spatial scale to which the values correspond.

Technical corrections:

Line 9: “It could have an impact on sea level rise of a few tenths of mm yr-1.” This seems to imply the drift impacts the actual sea levels, which of course is not the case. I suggest changing to something like: “It will affect the accuracy of sea level sensing, which could result in errors in sea-level change estimates of a few tenths of mm yr-1” Yes. Corrected in the paper.

Line 12: Global Mean Sea Level should be written in full here, since it is the first time the GMSL acronym is used. Yes. Corrected in the paper.

Line 25: Suggest to insert the word “lagging” before “indicator” in the statement “GMSL rise is a widely accepted indicator for the rate at which the climate is changing”. Your comment suggests that the characteristic response time of the ocean to global warming is long enough for the GMSL rise to be defined as a "lagging Indicator of climate change". After discussing with Benoit Meyssignac, expert of this topic, "Lagging indicator of climate change" is not adapted because it suggests that physical climate change should be reduced to the forcing applied to the climate system but not to the response of the climate system which develops over thousands of years. Benoit Meyssignac has also suggested us to change this sentence by "The GMSL rise is a widely accepted indicator of the current climate state (Meyssignac et al., 2019) and the GMSL acceleration for the rate at which the climate is changing" which is more exact.

Lines 34-45: The statement “…sea level is rising everywhere over the globe” is not necessarily true depending on the reference frame and location. For example, at coastal locations experiencing post-glacial rebound (e.g. the Canadian High Arctic), sea levels are actually falling relative to the land. Some clarification is probably needed. Prandi et al, (2021) shows that 98% of the ocean surface experiences a significant sea level rise (Fig. 5 of this study). The few regions where sea level trends are not significant are located in the Southern Ocean, Baffin Bay and in the north Atlantic Ocean, south of Iceland. In all areas where sea level is falling (see Fig. 5) the rate of sea level fall is not significant at the 90% confidence level, except in the Caspian Sea. We have modified the text in the paper adding “sea level is rising almost everywhere over the globe”.

Line 56: Suggest to insert the word “inferred” before “GMSL” in the statement “…with a direct impact on the GMSL trend of about 0.3 mm yr-1.” Yes. Corrected in the paper.

Line 109: There appears to be too many “)” in this sentence. Yes. Corrected in the paper.

Lines 152 and 153: Insert space after GMSL (two instances) Yes. Corrected in the paper.

Table 1: GIA errors are canceled out Yes. Corrected in the paper.

Table 1 footnote: All uncertainties reported are based on Gaussian distributions Yes. Corrected in the paper.

Table 2: see comments on Table 1 – same apply here. Yes. Corrected in the paper.

Line 243: I think this line should be altered to state “These results highlight a significant difference in GMSL trends estimated from S3A and Jason-3…” Yes. Corrected in the paper.

Line 373: I did not find the cited Poisson et al. (2018) reference in the bibliography. Perhaps this should be Poisson et al. (2019)? Yes, it is 2019. Corrected in the paper.

Lines 409-468: Several of the references appear to be incomplete, lacking information needed to locate the publication. Yes, the other reviewer pointed this out as well. Those references are not articles but presentations or project reports. We’ve added more details and links to the presentations.