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Interactive comment on "Water levels of the Mekong River Basin based on CryoSat-2 SAR data classification" *by* Eva Boergens et al.

Anonymous Referee #1

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Summary

This paper presents a new method for classifying satellite SAR-altimetry returns over inland water targets. The conventional approach is to select inland water returns from the dataset using static or dynamic water-land masks. This paper presents an alternative methodology, in which properties of the signal itself are used to determine whether the signal is returned by inland water or not. Such a method is useful for the inland water altimetry community, because time-consuming water-land masking steps may be saved and because it may provide new ways of filtering outliers from the altimetric record. The study would benefit from a more systematic comparison of the new approach developed here and the conventional approach using land-water masks.

Review Comments

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Discussion paper

1. p. 2, line 10ff: The authors state that the/some land-water-masks are "constant over time" and therefore neglect seasonal variations of the water extent. Dynamic water masks can be derived fairly easy from, for example, Sentinel-1 SAR imagery or, cloud cover permitting, from Landsat or Sentinel-2 optical imagery (e.g. NDVI or NDWI). Furthermore (p. 2, line 21), the authors state that their method can "overcome the problems and limitations of land-water-masks". It seems, however, that especially highly variable seasonal water extents hinder the application of the developed classification in the downstream parts of the Mekong (p. 10, line 4 ff: "the width of the river feature larger seasonal changes than in the other regions. This can influence the waveform and RIP significantly") In this case, the introduction shouldn't mention this as an advantage of the developed method.

2. Validation of Water Levels: Besides using the differences between observations 369 days apart, which only provides an indirect way of validating the observed heights, a direct validation against in situ water levels still should be possible. At least for CryoSat-2 observations in proximity of in situ stations, where simple assumptions about river slope can hold true.

3. It would be interesting to compare results to the conventional approach of using a river mask, and simply filter points with that. This has been done by the authors, but only mentioned in the manuscript briefly for the validation. So how many water observations do you get from the river mask vs. the classification, how many outliers, how good is the fit for an actual validation against in situ data as suggested above? The question is whether there is a clear benefit of the classification approach over the conventional river masking.

4. P7L20ff: It appears that, for the validation of the classification, and also in order to find out which of the kmeans clusters represent water (P10L2ff), a water mask is still required. . . So maybe the selling point for this methodology is not so much that it can operate without land-water masks but rather that it can improve outlier filtering?

5. P7L24ff: Apparently, the region of interest has to be divided into subregions prior to the application of the method because it is “too diverse in the reflectivity properties of water bodies”. How would this play out for a routine application of this method in a new basin, what is the operational procedure to slice the region up into appropriate sub-regions?

6. P15L8ff: It is probably difficult to get to any general conclusion regarding the relative performance of the classification and the masking approaches, as, obviously, the performance of the masking approach will depend on the quality of the mask. Lower performance in the upstream region may simply indicate that the mask is less reliable there. One could even think of a reversed sales argument here, and argue that in regions with narrow rivers SAR altimetry offers a tool to map water surfaces that are too small to be reliably resolved by Landsat/Sentinel SAR imagery.

Details

1. p. 2, line 14 ff: Can we really say that a 30m resolution is insufficient? In the reviewer’s experience, such precise water masks often can be buffered (i.e. enlarged) to obtain a higher number of water level measurements. This is likely linked to the size of the footprint of the altimeter, which also in SAR mode is much larger than the resolution of the water mask.

2. The classification of rivers into large, smaller and small is inconvenient and easily misunderstood. It may be better to operate with classes A,B, and C or similar and just define breaks between the classes.

3. P1L14: “smaller upstream regions” should probably be “upstream regions with smaller water bodies”.

4. Some in-text citations are messed up (e.g. P1L17, P3L9)

5. P2L9: Please add a few arguments explaining why the dense spatial distribution is an advantage, esp. for rivers.

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6. P3L6: “gauges” should probably be “gorges”

7. P3L17-18: Sentence repeated from above.

8. Fig 1: Map legend entries have different symbology from shown layers

9. P7L15: delete “a” before “several”

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