Satellite radar altimetry for monitoring small river and lakes in Indonesia

By

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Anonymous (Reviewer)

General comments

A better quantification of discharge and water levels in rivers and lakes (water bodies) are primarily hindered by both the limited temporal resolution (< 1 week) and limited spatial footprint (< 1 km) of radar altimetry satellites. The current state-of-the-art radar altimetry processing technology limits accurate retrievals of water levels in small-size rivers of width 40-200 m and medium size-rivers of width of width 200-800 m, as well as for small lakes of extent < 1000 km^2 due to this resolution effect. This manuscript uses level 2 radar altimetry (RA-2) measurements acquired from European Space Agency's Envisat satellite to measure water levels of medium size river (width, 200-800 m) and small lakes (extent<1000 km^2) in a tropical humid region in Southeast Asia. Authors proposed to use carefully chosen retracked waveforms (by removing non-qualified waveforms and outliers) to retrieve the radar altimetry over water bodies because over topographic surfaces radar altimetry tracking system is unable to maintain the nominal tracking positions (due to rapid range variations). From their experiment, authors found that water levels in medium size rivers and small water bodies can be retrieved with reasonable accuracy. They also test the performances of four retracking algorithms (i.e., Ocean, Ice-1, Ice-2, and Sea Ice-2) and no merits were found in ice-1 retracker as documented by previous research.

Once non-qualified waveform and outliers were removed, the method proposed in this manuscript seems works for rivers of widths larger than 200-800 m. The method proposed by the authors is useful specifically for data poor region in the world for estimation of discharge and water level fluctuations.

Specific comments:

Having motioned above, there are some issues with the manuscript that need to be addressed. Please see my specific comments and technical corrections.

It seems the Author's approach can retrieve the water level fluctuations of a narrow river of width ~54 m. However, this finding is not validated. All other validated cases in this study for river widths that were greater than 240 m. I openly question that is it appropriate to claim the water level fluctuations that you obtained to be accurate without properly validating the satellite based retrievals. It is also possible to agree with your non-validated water levels if the width of the river is in the order of 200 m.

It is my opinion that this claim is unsupported with proper validation data. Furthermore, Authors also accept that river width limits the ability of Envisat RA-2 radar altimetry to measure water levels. Where could be the cutoff point? There are some other challenges also associated with this claim. It would be appropriate to remove unsupported context in this manuscript.

How did authors delineate the boundary of the 54 m channel? As of Landsat 30 m resolution data, channel width is larger than just one pixel and smaller than 2 pixels even after Authors adding the buffer

distances. There may be some other questions as well related to absolute accuracy between altimetry data and Landsat data.

Further details are requested on how authors select the wave from shapes for different inland water bodies and if their approach can be automated.

It is requested to provide the proper context that why Authors want to prove if the ice-1 is the best retracking algorithm or not for the inland waters. Some explanation is needed than just proving a reference as the reason for this research question.

Technical corrections

Page 2826

Abstract

L 12: "Over-water" radar waveform. I am not sure if the word "over-water" is appropriate in this context.

L 19: Suggest to mention what authors mean by "reasonable accuracy"

L 1-25: I suggest doing some minor changes to the abstract. Authors introduced both spatial and temporal challenges in the abstract. They have not explicitly expressed that which major challenge they addressed in this work. Furthermore, one of the research questions in this manuscript is to show that ice-1 retracker is not necessarily the best retracker. However, what could be the significance of this research question is not given.

Introduction

Page 2827

Obtaining in-situ water level or stage and discharge measurements are costly and installing instrumentation and maintaining it for long-term hydrological measurements are difficult, necessitating remote sensing methods for continuous estimations of reliable measurements.

L 5-10: "Less important" is not well supported- Would Authors please explain why it is less important.

L 10-15: "reliable water level", Is it really the RS measurements reliable than the in-situ measurements. Need some clarification.

Page 2828

L 15: Legresy and Remy, 1997. This reference is not given in the reference list.

L 20-25: Typo "ntil" please correct it "until"?

L 25: It is not clear for the readership that why you need to incorporate remote sensing, geospatial information. If these data are used for boundary demarcation and area computation, please specify it.

Study area:

Page no 2829

L 1: Please correct “and therefore, and”

L 5-10: Grammar: I suggest writing it in the past tense, unless this experiment is still going on: “This study takes place…” (Your dataset covered the period from 2002 to 2010)

Material and methods

Page 2830

L 11: Please replace “short distance” with “proximity” or “closeness”.

Page 2831

L 20: I strongly suggest authors to define the following terms in the manuscript: RA2/MWR SGDR and RA2/MWR SGDR (RA-2 (this is defined in the text) Radar Altimeter-2 and the MWR Microwave Radiometer AND GDR Geophysical Data Record).

Page no 2832

L 5 - 10: Would Authors please explain the proper context that why Authors want to prove the ice-1 is the best retracking algorithm or not for the inland waters. Some explanation is needed than just proving a reference as the reason for this research question.

I also see that some content of the manuscript needs to be rearranged. It seems part of the hypothesis of the study is given in the mid of methodology section. What could be the complete hypothesis of this study? Is this a one of the hypotheses: “To prove the current assumption on the Ice-1 as the best retracking algorithm for inland waters (Frappart et al., 2006), this study compares the water level anomaly obtained from the water surface elevation measured by the Ocean, Ice-1, Ice-2 and Sea Ice retrackers with the water level anomaly obtained from the in-situ gage measurement.”

If this is the one of the hypotheses, I suggest authors need to specify it at the end of the introduction section as well. Please also lay down you complete hypotheses at the end of the introduction section.

Optical remote sensing and geospatial dataset

L 23: I suggest spelling out the band number rather than using # symbol. I also suggest specifying the spectral bandwidth that authors used for r-g-b representation. Now it seems the text is somewhat confusing.

L 23: Please use “pseudo color combination” instead of “red-green-blue” because you specify the bands that go with color composite.

Page 2833

L 3: Please provide, in which conditions, authors used 500 m buffer and in which conditions they used 1000 m buffer. Again, it is not clear a single buffer with 500 m or 1000 m generated or two buffers with 500 m and 1000 m are generated for each lake. What would be the rationality to take these two values?

L 18-21: The sentence that starts from “Therefore it is …” note clear. Would you please rewrite it?

L 21-22: Please correct for the grammar: “.. shore should be enough “consider”….”

L 19-21: Please rewrite.

Waveform Shape Analysis

Page 2834

L 2: What is the meaning of "specular shape"- please provide some context.

L 9-11: I would suggest telling the reason to the readership why the complex and non-classified waveforms were considered as non-qualified waveforms.

L 11: I suggest authors to explain in the caption that which wave forms are considered and which wave forms are not considered as qualified candidates for this study.

L 11: Is it the "categorized" waveform or "qualified" waveforms. Please change accordingly.

L 15: Would Authors please explain what they mean by the "most value range"

L 19-20: Please define the term WSE. I see now the WSE term in Line Number 25. Please define it either before the equations or just after the equations.

Page 2836

L 9-12: It seems the Author's approach retrieve the water level fluctuations of a narrow river of width ~54 m. However, this finding is not validated. All other validated cases in this study were for river widths that were greater than 240 m. I openly question that is it appropriate to claim the water level fluctuations that you obtained is accurate without properly validating the satellite based retrievals. It is also possible to agree with your non-validated water levels if the width of the river is in the order of 200 m.

L 14-20: It is my opinion that this claim is unsupported with proper validation data. Furthermore, Authors also accept that river width limits the ability of Envisat RA-2 radar altimetry to measure water levels. Where could be the cutoff point? There are some other challenges also associated with this claim. How did authors delineate the boundary of the 54 m channel? As of Landsat 30 m resolution data, it is larger than one pixel and smaller than 2 pixels even after you adding the buffer distances. There may be some other questions as well related to absolute accuracy between altimetry data and Landsat data.

Page 2837

L 29: The word "actually" is redundant.

Page 2839

L 15-16: Please provide this information in the legend of the Figure 12.

L 16-19: I suggest to bin the TRMM dataset and plot the sum or maximum value of each bin to show the linear relationship between the water level fluctuation anomaly and precipitation (TRMM).

Page 2840

L 4-5: Please rewrite the sentence that is starting from "With the absence of ....."

L 8: It is bit confusing the way that the authors describe the details about buffers. From Table 6, it is clear that authors demarcated two buffers and then three distance ranges are considered (i.e., buffer <500, 500 < buffer<1000, buffer>1000). In the text in page 2833, L 3-4 it says a buffer with different distances are considered. Why not authors explicitly express that they have created two buffers and three distance ranges (i.e., buffer <500, 500 < buffer<1000, buffer>1000) are created for the lakes. Readers have to wait until they read figure 6, to clarify their doubt.

Figures:

Figures 8: I suggest either to make the figure legend transparent or to move the legend to another location where it does not obscure the water level anomaly time series.

Figure 12: There is no legend for this Figure. Which values that you are representing from black color line and ash color lines are not clear.