Response to Anonymous Referee #1 for HESS Discussion Article

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Sulistioadi, et al., 2014

Satellite Radar Altimetry for Monitoring Small River and Lakes in Indonesia

1. General Comments

The authors gratefully thank the 1st anonymous referee for his/her critical comments. These comments and suggestions are vital in improving the quality of this manuscript, as the authors desired. In the following sections, each comments and corrections are addressed. The final version of the article will reflect the changes listed here.

2. Specific Comments

Issues	Solutions/Explanations
Retrieval of water level fluctuation of a river as narrow as ~54 m without validation	This issue is also raised by the anonymous referee #2. The authors will carefully reviewed the manuscript and revise any statement that imply "successful altimetry measurement (including validation) of the small river (width 54 m)". It will be emphasized in the text that the water level fluctuation was rather "indicated" than actually "measured and validated". In addition, in the conclusion section, it has been mentioned as "potentially observable".
Delineating the boundary for the 54 m width river	It has been explained that measurements of the river and lake width are carried out through (1) visual interpretation of Landsat-7 and Landsat-8, or (2) medium-scale (1:50,000) topographic maps released by the Indonesian Geospatial Agency. That being said, when Landsat imagery could not provide detail boundaries between water bodies and land surface, the authors determine such boundaries along with the buffer based on the topographic maps.
Process of selecting the waveform shapes for different water bodies and if the approach can be automated	The process was manual. The standard waveform shapes (Brown-like, specular, flat-patch) were displayed along with another window showing waveform shapes from each measurements along with their ID. The IDs of measurements with matched waveform shapes were noted down then processed further. It is planned to automate this process, such as the one done by Dabo-Niang (2006), through pattern recognition and waveform shape geometry.
Why need to prove the merit of Ice-1	The main argument is that all four standard re-trackers were not intended to measure inland water. They range from ocean, ice sheet and sea ice studies. In addition, satellite altimetry processing might be different from one region into another. So far, only Frappart et al (2006) evaluated the performance of those four re-trackers for monitoring inland water, thus need evaluation in other region.

3. Technical Corrections

Page	Line	Issues	Solutions in the revised version of manuscript
		Abstract	
2826	12	"Over-water" radar waveform	"Over-water" term might be removed without changing the original meaning of the sentence. Re-phrased into: "… using satellite altimetry through careful selection of waveform shapes that correspond to the re-tracked water level."
	19	Reasonable accuracy	Will be replaced with "similar accuracy as shown by other studies"
	1-25	Minor changes suggested to explicitly expressing major challenge addressed in this study. Also need to pose research question related to inter re-trackers comparison	Will consider to include brief summary on the major challenge addressed by this study, as well as present the research question related to re-trackers comparison
		Introduction	
2827	5-10	"less important"	The authors reflected the situation in the most *developing countries*, where environmental monitoring is rather seen as expenses instead of needs. The authors realized that the manuscript did not specify the context of this section, though. It is possible to narrow the context by adding a sentence like "This is particularly true for developing countries, where this study is setup"
	10-15	Reliable water level	Again, this statement is in the context of developing countries, where a lot of rivers are not gaged at all. Additional sentence as proposed above should help the reader to get into the context.
2828	15	Legresy and Remy (1997)	Will be added in the Bibliography
	20	ntil	Will be replaced with until
	29	Not clear why incorporate RS & GIS	Rephrased into: "This situation motivates the authors to integrate geospatial information, remote sensing and satellite altimetry measurement to monitor important water bodies."
2829	5		Further explanation on how RS/GIS help satellite altimetry measurement of river and lake is given here

Page	Line	Issues	Solutions in the revised version of manuscript
		Study Area	
2830	1	And therefore, and …	This sentence has been revised along when revising previous page (starting from line 26)
	3,6	are	Will be replaced with "were"
	9	This study takes place…	Will be replaced with "This study was conducted…"
	11	Short distance	Will be replaced with "close proximity"
		Materials and Methods	
2831	17/20	Define RA2/MWR SGDR	Definition will be added at the first instance. Radar Altimeter-2 (RA-2)/Microwave Radiometer (MWR) Sensor Geophysical Data Record (SGDR) (hereafter, RA-2/MWR SGDR)
2832	5-10	Need to re-arrange the placement of the hypotheses to be tested, e.g. into introduction	Hypotheses regarding comparison of standard re-trackers will be posed in the end of introduction section
	21-24	The text that explains color composite is confusing	The same concern is raised by referee #2 This paragraph will be rewritten into: "…, i.e. through dark-blue color reflected by the water bodies in the pseudo-natural color composite of Landsat imagery, or (2) …."
	26-27	To avoid repetitive information	Line 25 to next page line 1 will be replaced with: "… development and contrast adjustment of pseudo-natural color composite from red-green-blue combination of bands 5, 4 and 3 of Landsat 5 and Landsat 7 or bands 6, 5 and 4 for the recently launched Landsat 8".
2833	3	Choice of buffer values and how the buffers used Also raised by referee #2	From previous research, it is known that the presence of variable land cover (e.g. vegetation in the riverbank, lakeshore or coastline, as well as islands or sandbanks within the river or lake) affect the returned radar signal in altimetry measurement (e.g. Deng and Featherstone, 2006; Berry et al, 2005). Specifically, Sarmiento and Khan (2010) found that altimetry-measured water level from lake area closer to the lakeshore shown lower performance compared to those with further distance. This study tries to see if there is any different effect caused by different distance from the satellite footprint center to the lakeshore. There was no specific consideration in determining the buffer distances other than to see any difference should the distance is greater.

Page	Line	Issues	Solutions in the revised version of manuscript
			Neither this nor other studies exclude data points near the lakeshore. Instead, this study compares data points based on gradual distance increment.
	18-21	Un-clear sentence	Revised into: "influenced by other surface within the projected radar footprint."
	21-22	Check the grammar	Will be revised into "…lakeshore should be enough considering that…"
2834	2	Specular shape needs explanation	As the definition of specular "characteristics" was also questioned by the referee #2, The authors will add the following sentence into page 2828 line 10. "Specular refers to a reflection characteristic where a signal is reflected into one direction, thus match the reflection by a mirror (e.g. Torrance and Sparrow, 1967). In the context of radar signal processing, this is the mechanism when the radar signal hits very calm/smooth water surface, thus presenting a peak in a return signal power, as represented by the shape of the waveform."
	11	Further explain why complex and non-classified waveforms were disqualified	Will consider to add the explanation like the following: "Range measurements that carry complex and non-classified shapes were disqualified considering that the mixture of water and vegetation (i.e. that produces complex and non-classified waveform shapes) may lead to in-accurate elevation measurement compared to the radar signal returned by water-dominated surface."
	11	Categorized or qualified	Will be revised into "Some examples of actual waveform that classified into "Brown-like", specular, flat-patch, as well as complex and non-classified shapes are presented in Fig. 3."
	15	Most value range	The whole sentence will be revised into "Although the altimetry measurements that carry non-qualified waveform shapes had been excluded, some measurements are still far beyond the mean and median value."
	20/25	Definition of WSE	Will be added right after the equation
		Results and Discussion	
2836	7-8 9-12	Claims on water level retrieval of small river	Will consider to: • Remove "regardless the width of the river" on line 7-8 • Mention a clear "cutoff" on the river width, e.g. successful on river width 200-800 m and possible or

Page	Line	Issues	Solutions in the revised version of manuscript
			potential on river width < 200 m
	14-20	Claims on water level retrieval of small river	This issue is also raised by the referee #2 The paragraph at line 13-22 will be revised. The authors realized that the measurement of very small rivers in this study **indicates** the potential of satellite altimetry to monitor such small rivers. The two paragraphs (line 3 to 22) will be revised accordingly and specifically discuss the results from each classes of rivers (i.e. small (< 200 m width) and medium sized (200-800 m width)).
	14-20	Delineating river boundary for the narrow channel (~54 m width)	This issue has been addressed in "Specific Comments" at the beginning of this response.
2837	29	"actually" is redundant	Will be removed in the revised version of this article
2839	15-16	Add legend to Fig 12	Will add TRMM Precipitation and WLA into the legend of Fig 12
	16-19	Modify the TRMM data in Fig 12	Will consider to bin the data and visually evaluate the linearity
2840	4-6	Rewrite the sentence	Will be replaced with "Up to now, a systematic and verified classification of waveform shapes especially for inland waters does not exist, except the early development such as presented by Dabo-Niang et al. (2007). Hence, a further study in this field might worth to consider in the future."
	8	Table 6, determine buffer	Buffer development was described in page 2833 line 3. However, explicitly mention the number of buffers and distance range will surely help the reader so it will be added into page 2833 line 3. "Once the lake boundaries are identified, two buffers and three distance ranges (i.e. 0-500 m, 500-1000 m, and >1000 m) are created for the lakes
		Figures	
Fig	8	Legend blocks the WLA	Will revise the plot accordingly
Fig	12	No legend	Legends will be added