Response to Anonymous Referee #2 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 2nd 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
Some additional background or references are needed to justify some assumptions investigated relative to the "buffers" of the lake	It is realized that the **hypothesis** on the influence of distance between satellite altimetry footprint center and the lakeshore **was not well-posed** in the introduction part and only mentioned briefly in the method section (p. 2833). A paragraph that discusses this matter, along with some background references will be added into the introduction section of the revised version of the manuscript. References: Sarmiento and Khan (2010) studied the Great Slave Lake (GSL) and found that Jason-1 performed worse measurement over areas within 20 km "buffer" distance to the coastline, as compared to Topex/Poseidon measurement within 10 km distance to the coastline.
Interpretation of results with conclusions being drawn from insufficient data, in particular the case of narrow river where no validation data available	The same concern was posed by the first referee. The offered solutions are to re-phrase all related statements regarding the altimetry measurement on virtual station UM03 that has 54 m river width. Emphasize in the text that the water level fluctuation was only "indicated" rather than actually "measured". In the conclusion section, it has been mentioned using "potentially observable" term. The same situation happens to the measurement of Karangmumus River.
Need more detail in determining the water level anomaly when more than one point is available during a satellite pass	The most critical process was outlier removal, which then followed by averaging. Will explain explicitly in method section of the revised version of the manuscript.

3. Technical Corrections

Page	Line	Issues	Solutions in the revised version of manuscript
		Abstract	
2826	4	"e.g." is not appropriate	Correction accepted. The sentence will be revised into: "(i.e. satellite revisit period)
	6	For river	Will be replaced with "to rivers"
	11	Indicate the size of lakes	Herdendorf (1982) and Chang (1987) defined the large lakes as those with surface area greater than 500 km^2. In addition, Berry et al. (2005) also limited their study to lakes with extent greater than 500 km^2.
	12	Confusing sentence	Re-phrased into: "… using satellite altimetry through careful selection of waveform shapes that correspond to the retracked water level."
	18-19	Do not repeat the river size	Size definition will not be repeated
	20	What is "reasonable accuracy"?	Will be replaced with "similar accuracy as shown by other studies"
	20	"the procedure"	Will be replaced with "a procedure"
	20	Identification or selection	Will be replaced with "identification and selection"
		Introduction	
		More background regarding different re-trackers	E.g. cases they tend to (or are expected to) produce similar/different results. Specific literature summary will be added for this matter
2827	6	"for various reasons"	Will be deleted
	7-9	"In contrast, despite …"	Sentence will be re-phrased into "The installation and operation of in-situ measurement such as permanent gauging is often considered costly and less important. However, the need for continuous hydrological monitoring of small rivers is increasing"
	12	Space geodetic	Will be replaced with "space geodesy"
	17-18	"very limited if not none of them"	Will be replaced with "most of them"
	21	Earlier references for altimetry for inland waters	Will re-arrange line 21-23 into one compact sentence
2828	1	"Even"	Will be replaced with "While"
	1-2	Contradictory sentences. Consider re-phrasing	Will be revised
	4	Therefore	Will be replaced with "At present, … "

Page	Line	Issues	Solutions in the revised version of manuscript
	9	Describe “specular characteristics”	Add this sentence into 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.
	18	“hence, it is later called”	Replaced with “It is called model-free re-tracker”
	19	“This algorithm…”	Simplified into “The Ice-1 re-tracker was …”
	20	“ntil”	Replaced with until
	21	“claimed”	Replaced with “was found to be”
	21	Frappart et al (2006)	Yes. They compared the four re-trackers as this study
	26	After all	Replaced with “So far”
2829	29/1	“This led to…”	Rephrased into: “This situation motivates the authors to integrate geospatial information, remote sensing and satellite altimetry measurement to monitor important water bodies.”
	9	Rephrase	Replaced into: “This study focuses on …”
	12	“oriented”	Replaced into: “These regions, shown in Figs 1 and 2, represent different geomorphology, climate and anthropogenic situations, which described as follow”
	15	Missing “The”	Will be added
	17	… declares…	Will be replaced with “makes”
	21-23	Grammar check	Will be revised
	23-24	“the”	Will be removed
2830	2-8	rewrite	Will be rewritten
	9	Missing “The”	Will be added
	18	Counts as	Will be replaced with “is”
	19	i.e.	Will be removed
	23	Included as	Will be removed
2831	13-16	Explain how to get 18Hz data	Will elaborate more details on this matter based on Envisat RA-2 Product Handbook
	17	Explain MWR/SGDR	Will be added
	20	In addition	Will be removed
	22	cycles	Will be replaced with cycle
	22-23	The Envisat and sites	Will be revised
	24	geocentric	Will be removed
	25	the	Will be added

Page	Line	Issues	Solutions in the revised version of manuscript
2832	5	prove	Will be replaced with “test”
	6	On the Ice-1 as	Will be replaced with “that Ice-1 is”
	13-14	corrections	Indicate that the authors did not perform all of these corrections (i.e. corrections have been completed beforehand as part of Level-2 product development)
	21	image	Will be replaced with “imagery”
	21-24	Repetitive description on Landsat color composite	Related to the next paragraph (line 21-24). 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 p2833 line 1	Repetitive description on Landsat color composite	“… 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 background studies or references to justify this test	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. Neither this nor other studies exclude data points near the lakeshore. Instead, this study compares data points based on gradual distance increment.
	6	The use of river buffer	The river buffer determined in this study was not used to test the effect of different buffer distances as those in the lake areas. The buffer was developed to accommodate any errors related to geo-referencing and projection in the preparation of satellite imagery and topographic maps. The authors realized that the buffer magnitude (5 m) is not relevant with the 350 m satellite ground track

Page	Line	Issues	Solutions in the revised version of manuscript
			interval
	20-21	Unclear sentence	Revised into: “influenced by other surface within the projected radar footprint.”
2834	14-15	Need to rephrase	Although the altimetry measurements that carry non-qualified waveform shapes had been excluded, some measurements are still far beyond the mean and median value.
	16	Mild outlier	Mild outlier or minor outlier refers to data value beyond the 1.5 quartile away from the nearest quartile
	Eq 1	1.5(IQR)	Will be replaced with “1.5*IQR
	21-23	Definitions of equation	Will re-arrange the sentences and define the variables of the equation immediately after the equation. A note describing how IQR determined will also be added.
2836	7	Trend	Will be replaced with “fluctuation”
	8-19		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)).
	15	River width in (Michailovsky, 2012)	Will be revised into “40 m”
	16	“…without validation”	Will remove “, also without validation”
	19	remarkable accuracy	Will be replaced with quantities revealed by the original article
2837	2	Why Figure 6 & 7 only show Ice-1 retracker?	Will add SeaIce re-tracker and in-situ data (even with limited in temporal coverage, i.e. 2002-2004) in the revised version of this paper
	3-6	Figures 6 & 7 do not directly correlated with the statement	Will consider to remove the first sentence since it is well known, has been mentioned in the beginning of the paper and not directly represented by the figures
	6-10	Need to re-arrange the sequence of this section	Will be re-arranged accordingly
	10-15	Need to re-arrange the sequence of this section	Will be re-arranged accordingly
	16-20	Need more specific when discussing results	The idea to expose the longest gap between satellite measurements is greatly appreciated since it is well correlated with the applications of this research

Page	Line	Issues	Solutions in the revised version of manuscript
	20-25	Averaging the water level on the same cycle done and consider the spread of water level in each cycle	The slope of the river was checked through SRTM elevation data (described at p 2838 line 2-3), so that the authors decided that its effect is negligible. However it is worth to have a closer look at the spread of water level in the same cycle and evaluate above assumption.
2838	16	Double-check all values. Keep all river width and ranges in the table. Add Birkinshaw et al. (2010)	Will be done in the revised version of this article.
	20	Mention if outlier was removed by in-situ data	The outlier removal did not use in-situ data
	24	Mention possible improvement	Will include the following text into the revised version of this article: "Among the improvements are using other altimetry missions (e.g. Jason-1, ICESat), detailed evaluation of retracked water elevation within a cycle and compare them with actual river slope."
	26	Need to highlight the observation about river orientation relative to satellite ground tracks	Might include additional note about this in the conclusion section
2839	5	The ground track does not intersect with the river	The satellite ground track may deviate up to 1 km at both directions (east and west). That explains why the data point in the Karangmumus River (which significantly zoomed in the IKONOS imagery) looks far away from its "theoretical ground tracks". In this research, the authors only consider altimetry measurements with center-of-projected-footprint that fall within the water body. Thus, no off-nadir data involved. That being said, the qualified measurement should not fall in the floodplain that might be dry during non-flood situation.
	7	WSE instead of WLA	Will be replaced with WLA in the revised version of this article
	11	Reference to Fig 12	Will be added at the end of the sentence
	8-18	Interpreting the plot, linear relation	Will be re-evaluated and revised accordingly
	18-20	Should not conclude with very limited data	"conclude" will be replaced by "indicates", while the rest of the sentence will be revised accordingly
	26	Sampled waveforms in Fig 13 representative?	Fig 13 shows some examples of waveform shapes that are different with those retrieved from river. We are

Page	Line	Issues	Solutions in the revised version of manuscript
			trying to say that these shapes are only present in the lakes and were not found in the river. In addition, these shapes are not the majority of the returned signal from the lakes, thus excluded from further processing due to our "qualification system"
	26	clearly	Will be replaced with "It seems like" since we did not do any quantification about this "distinguished waveform shapes"
2840	21	Reasoning for complex result on different buffer distance	Might consider to remove the sentence due to absence of supporting data and background studies
	27	"best match…"	It was a typo, therefore will be removed in the revised version of this article
2841	1-12	The two paragraphs do not describe the results	The two paragraphs indeed do not describe the results, but they provide background information related to the magnitude of water level fluctuation as presented by Figure 14 & 15.
	20	Double check the RMS Error value, especially for Lake Matano. Seems like the RMS Error is much higher than 0.33 m	Will do thorough double-check and revise accordingly
	25	In-consistent	Will be replaced by "cannot be verified"
	29	Un-necessary sentence	The last sentence in line 29 will be removed while adding " (see Figs. 18 & 19) at the end of the previous sentence ends at line 29.
2842	2	complicated	Will be replaced with "ambiguous"
	12	Geographic location	Geographic location may be omitted in the sentence
	12	Discuss the magnitude of difference between re-trackers	Will consider to discuss this matter specifically in the revised version of the article
	22	Include RMS values	RMS value will be mentioned in line 23 at the end of the sentence
2843	1	Reasonably good	Will be replaced with "…, as indicated by altimetry-derived water level anomaly for a river with 54 m width with a good temporal coverage, …"
	6	reliability	Will be replaced with "potential"
	12	It is obvious though	Will be replaced with "This study also indicates …"
	21	On the other hand	Will be removed
	22	Selection of waveform shapes allow the use of	The recommendation will be rephrased to reflect the statement

Page	Line	Issues	Solutions in the revised version of manuscript
		classic/available re-trackers	
		Tables and Figures	
Table	4 & 8	Sulistioadi (2013)	Will be replaced with “Current Study”
Figs	1 &2	Small writing, explanation of the number in the circles, highlight the label for measurement points	Will be improved
Figs	4	Split after geo-masking	Will be revised to reflect the process. Yes the detailed geographic masking is done after waveform selection
Figs	8,14,15	Re-arrange the legend not to block the data	Will be improved
Figs	11	Text not readable	Will be improved
Figs	12	Plot goes to 2010 but no data	Will be improved