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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Assimilation of satellite data to optimize large scale hydrological model parameters: a case study for the SWOT mission" *by* V. Pedinotti et al.

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Review comment on "Assimilation of satellite data to optimize large scale hydrological model parameters: a case study for the SWOT mission" by Pedinotti et al.

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[General Comments]

This manuscript discusses a possibility of estimating large-scale river model parameters by satellite data assimilation. The experiment is well designed, and the results show the possibility of using SWOT water elevation observation to estimate Manning's

coefficient. Even though the developed method based on synthetic observation has a limitation when applying the same method to real-case observation, this work is considered to include enough contribution to hydrology community. I suggest this manuscript to be published after minor revisions suggested below.

[Specific Comments]

Abstract

> The abstract is too long and has many unnecessary information. For example, I think the following parts can be removed:

- which are typically employed in Land Surface Models (LSM) for global scale applications.

- a trans-boundary river, which is the main source of fresh water for all the riparian countries. In addition, geopolitical issues in this region can restrict the exchange of hydrological data, so that SWOT should help improve this situation by making hydrological data freely available. In a previous study, the model was ïňĄrst evaluated against in-situ and satellite derived data sets within the framework of the international African Monsoon Multi-disciplinary Analysis (AMMA) project.

P4478.L13: the word "indeed"

> The word "indeed" appears repeatedly (16 times in the manuscript), and sometimes it is not necessary. Please remove the word when not needed.

P4478.L15: "which might have locally significant errors."

The term "locally significant errors" is ambiguous. It's better to say "significant errors at local scale".

> Furthermore, the scale indicated by "local" may be different for different researchers. Please clarify what the "local" mean in this study. It can be read as "basin-scale" or "reach-scale".

P4479.L8 & Section 5.4: Continental reservoir

It's not clear what the "continental reservoir" means. It might be misunderstood as large lakes or any kind of large water bodies.

P4479.L9: "Results obtained in this preliminary study demonstrate SWOT potential for global hydrologic modeling, especially to improve model parameters."

> This statement is generally true, but I think it's too optimistic given that this manuscript only performs Observing System Simulation Experiment. It's better to say that further studies (e.g. considering multiple error sources and difference between synthetic and real observations) are obviously needed to achieve the SWOT's application stated in the abstract.

P4480.L8: "1-dimensional"

What the 1-dimensional means here? Is it 1-spatial-dimentsion along river stream, or a point data with a time-series dimension?

P4480.L9: "but such data do not give any information about runoff and lateral inflow."

> It's better to say "any DIRECT information" because we can guess the amount of runoff or lateral inflow from gauged discharge.

P4480.L19: "current remote sensing technology spatial resolution does not resolve small scale land water dynamics"

> It's better to say "current satellite altimetry" because high-resolution observations of water area are already available (i.e. LANDSAT, Synthetic Aperture Radars, etc).

4480.L29: "Several studies are thus currently being performed over geographically diverse basins"

> Please put references for the "several studies".

P4481.L26 "the Brahmaputra river" and related parts

> Please use large capital for an individual river name (i.e. the Brahmaputra River, the Niger River).

P4482.L12 qmodelling.

> Please correct the typo.

P4483.L15: might not give the best results locally (for a particular basin).

> This is true, but some studies showed that empirical equation does not work well even within one basin and significant error can be found at sub-basin scale or reach scale (e.g. Miller et al., 2014, Yamazaki et al., 2014).

P4483.L29: "the reason will be explained"

> Please clarify in which section "the reasons are explained".

P4485.L5: The modelling of the Niger basin by CHSs thus requires a good description of climate conditions, especially of rainfall, and . . .

> It is stated in the previous sentence that the modelling complexity comes from different climate zones existing in the Niger Basin, therefore I think it's better to write that infiltration and evaporation from floodplain is also very important in addition to rainfall for modelling the Niger River.

P4485.L18: a saturated fraction "fsat"

P4485.L26: a simple groundwater reservoir "G (kg)"

P4486.L3: a prognostic flood reservoir, F (kg),

> If the symbols for variables (e.g. fsat and G, F) are not used in other parts of the manuscript, these symbols don't have to be shown. Same correction may be needed for other variables.

P4486.L2: TRIP RIM

> Does this mean “TRIP RRM”?

P4486.L13: The TRIP schematic concept is presented on Fig. 2 and more details can befound in Pedinotti et al. (2012).

> It’s better to move this sentence at the start of the explanation of TRIM RRM in ISBA. Readers may understand the model easier by reading sentences with the Provided Figure.

P4487.L25: Remote sensing opens the possibility of estimating the river width by direct measurements and the critical bankfull height by indirect algorithms.

> Better to provide references such as [Pavelski and Smith, 2008; Yamazaki et al., 2014; Durand et al., 2010].

P4488.L23: wider than 100 m (requirement)

> Better to say “(mission requirement)” instead of “(requirement)” for non-expert.

P4489.L11: in needed

> Should it be “is needed”?

P4490.L9: absolute water level

> It’s difficult to guess the difference between “absolute water level” and “free surface water elevation”. May be it’s better to say “water depth”.

P4490.L9: Thus, in real-time DA applications, the direct comparison between SWOT and ISBA-TRIP water levels will not be straightforward and will need further investigation.

> Please make a discussion about the impact of this assumption. It can be a limitation of applying the method developed in this study to a real-observation case.

P4491.L18: has a signiïňĄcant impact on the hydrological variables over the Niger basin.

> It’s better to clarify “impact on SIMULATED hydrological variable” given the impact assessment on actual hydrodynamics is still difficult due to uncertainties in model physics and parameters.

P4492.L25: requires a bigger storage capacity

> It’s better to say “disc (or memory, or computational) storage capacity”. River model also has storage component, thus storage capacity might be misunderstood as model variable.

P4493.L11: a Gaussian distribution, centered in 0 with a standard deviation, σbt of 20% of the average value of the Manning coefficient over the river.

> I’m not sure whether this assumption for the initial prior Manning’s coefficient is feasible. Because there is no ground-truth for Manning’s value, the initial value may be totally different (can be biased globally and/or locally) in the real situation. Please at least discuss the possible impact of the initial Manning’s value estimation, and if possible please do additional experiment to check its impact on assimilation results.

P4493.L19: H = SoM

> What is “o” between S and M?

P4496.L5: the Manning coe ïňČ cient relative error (averaged over the river)

> Is it reasonable to average relative errors over the basin? Is some point has positive relative error and another point has negative ones, they are cancelled out.

P4496.L25: a noise with a frequency of about 20 days

> This is obviously the signal from orbit cycle, thus it’s strange to call it “noise”. It’s better to use another word (such as jump?)

P4497.L12: reaching up to 9 m at Lokoja (for an 8 m averaged river depth).

> I cannot get this message. It seems two gauges are lacking in Figure 11.

P4499.L15: the model simulates ïňĆoodplains (25%)

> It's difficult to guess that the sentence means. Please say, for example, "flooding in 25% of the grid area".

P4501.L15: This study is promising since, to our knowledge, no large scale assimilation applications exist

> This statement is generally true, but please note that further studies on model physics and parameter retrieval are needed to apply the developed method to "real-observation" further than OSSE.

Figure 2 Caption:

> The figure shows "water flux calculation in TRIP RRM in ISBA", but not for "The TRIP model" itself.

Figure 4

> Can you also show the prior Manning's value before assimilation and posterior Manning's value as well as the true value?

Figure 7: Caption

> Please describe what the colored line (black and blue) represent.

Figure 11:

> Two gauges are missing.

Figure 16b

> Please clarify that the blue and red lines are not shown because flooded fraction is zero.

Figure 18 Caption

> Please use "floodplain" instead of "flood". Flood is too ambiguous.

Tables 2 and 3.

> Please use the consistent effective digits.

[References]

Durand, M., E. Rodrigues, D. E. Alsdorf, and M. Trigg (2010), Estimating river depth from remote sensing swath interferometry measurements of river height, slope, and width, IEEE Geosci. Remote Sens. Lett., 3(1), 20–31, doi:10.1109/JSTARS.2009.2033453.

Miller, F. M., T. M. Pavelsky, and G. H. Allen (2014), Quantifying river form variations in the Mississippi Basin using remotely sensed imagery, Hydrol. Earth Syst. Sci. Discuss., 11, 3599–3636.

Pavelsky, T. M., and L. C. Smith (2008), RivWidth: A software tool for the calculation of river widths from remotely sensed imagery, IEEE Geo-sci. Remote Sens. Lett., 5(1), 70–73, doi:10.1109/lgrs.2007.908305.

Yamazaki, D., F. O ' Loughlin, M. A. Trigg, Z. F. Miller, T. M. Pavelsky, and P. D. Bates (2014), Development of the global width database for large rivers, Water Resour. Res., 50, doi:10.1002/2013WR014664.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 4477, 2014.