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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Using modelled discharge to develop satellite-based river gauging: a case study for the Amazon Basin" *by* Jiawei Hou et al.

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We thank the reviewer for the time and effort spent on the review of our manuscript. The reviewer provided us with helpful comments, which will greatly improve our manuscript. Below please find our response to reviewer's comments in detail.

Comment #1

"Page 3 Section 2: "The fundamental assumption in our methodology is that there exist strong, monotonic relationships between remote sensing signal, surface water extent, river channel storage, and river discharge." This assumption is the basis of the whole

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study while it may not be true for many cases due to low-quality inundation observations caused by cloud (for optical sensors) or dense vegetation (for both optical and microwave), reservoir regulations, hilly terrain and inhomogeneity of the study region. The approach developed under this assumption will inevitably find difficulties for global applications."

Response #1

Our assumption really combines two hypotheses. One is that surface water extent is monotonically related to river channel storage and discharge. Another is that the remote sensing signal monotonically relates to surface water extent. It is true that the second hypothesis can be affected by cloud and dense vegetation, which was discussed in P12L16-24. It is also correct that reservoirs can affect the first hypothesis, but we are not sure that influence of hilly terrain and inhomogeneity of the study region on either hypothesis is to be expected.

Comment #2

"Section 2.3.2 "A Spearman correlation > 0.6 in a grid cell (0.05 °×0.05 °) was used to identify a potential river reach for developing SGR". It seems a paradox to me. If the high correlation implies the good quality of model and satellite results, why not use model simulations alone? In other words, under such high correlations, satellite retrievals do not provide much support on improving the model predictions."

Response #2

We appreciate the reviewer's comment. We do not believe this is a paradox as the high correlation here only implies the relationship between water extent and discharge is robust enough to develop SGRs in a certain river reach. In addition, our results in Section 3.2 indeed show the model outperforms SGRs in most cases. Thus, instead of using model, we consider SGRs as an alternative, simple and automated approach for river discharge prediction using satellite observation only. For example, SGR would be

useful as an alternative if the model was unable to provide real-time estimations due to delayed rainfall estimates. We will add these points to the discussion.

Comment #3

“Why not use assimilation techniques and refine the model predictions by incorporating the satellite-derived inundation data?”

Response #3

We agree that data assimilation is a promising way to refine model prediction, though it is not a solution without challenges of its own. It, too, requires a reasonable model in the first place, and then requires that satellite observations are even better than model simulations. Our study helps assess where this is the case. We intend to look at data assimilation in the future, but it is beyond the scope of this study.

Comment #4

“Overall the gauge readings are well correlated with satellite inundation data for the Amazon region (Pham-Duc et al., 2017). It will be interesting to check one more major river basin for evaluating the method.”

Response #4

In response to the reviewer, we have evaluated SGRs elsewhere. For example, a SGR in the lower channel of the Niger Basin is shown in Figure A below. This is one example for another major river basin, but we do not propose to include it in the paper as it could be construed as selective. However, we do hope to undertake a global scale analysis of SGRs along the ones of this manuscript in future research.

Comment #5

“There are several satellite inundation data sets (e.g. long-term record described in Pham-Duc et al., 2017). What about the alternative choices of using these data sets?”

Response #5

The reason we chose MODIS and GFDS water extent data sets is primarily that they were used in a previous paper with good success. We thank the reviewer for suggesting these alternative data sets and had a look at them. However, as we found they are much coarser, we suspect they will not be more useful.

Comment #6

“Page 12 “A likely reason for this is that MODIS optical remote sensing is limited to clear-sky conditions and requires surface water to be unobscured by a dense vegetation canopy while GFDS passive microwave remote sensing is not affected by either of these factors”. This statement is not accurate since passive microwave also has its limitations when sensing land surface over severer weather or dense vegetation conditions.”

Response #6

Agreed. We will change P12L17-19 from “is not affected” to “is much less affected”.

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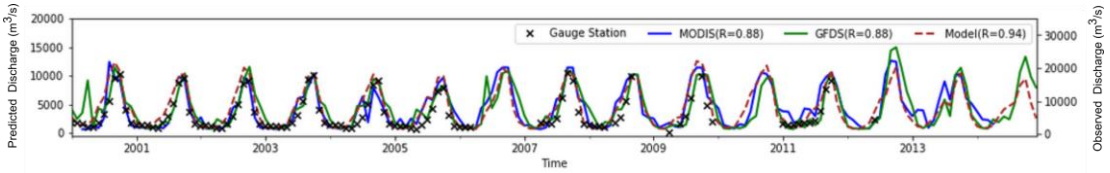

Figure A Comparison between observations (right axis) from gauging station (black x) and river discharge estimates (left axis) derived using MODIS SGR (blue line), GFDS SGR (green line) and the W3 model (brown dash) in the lower channel of the Niger Basin.