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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 her detailed comments and suggestions, which will greatly help us to improve our manuscript. Below please find our response to reviewer's comments in detail.

Comment #1

"Overall, the methods description is clear, and results show promising potential. However, I would have liked to see a commentary on the limitations of the method, in particular related to the use of hydrological model simulations to train the derivation

of 'Satellite Gauging Reaches' SRGs. This is particular important in regions with no river gauged observations, as lack of observations can dramatically reduce hydrological modelling performance as no calibration can be undertaken."

Response #1

We certainly agree with the reviewer that a poor model imposes its limitations on SGRs as we used a model to train SGRs. We will add further discussion of the limitations of SGRs caused by the model in the revised manuscript.

Comment #2

"I believe the authors should also clarify their comment line 334-335 as this seams a circular argument, with hydrological simulations used to derive SGRs, and then SGRs used to calibrate hydrological models."

Response #2

We agree that the reviewer is essentially correct that this is a circular argument. We will delete this sentence.

Comment #3

"Another point of clarification regards the justification of the optimisation/ training strategy: SGRs discharge estimates are based on a built relationship between water extent and modelled channel storage, and then another transformation from water extent to river discharge. I am not sure I follow why they are two independent methods, and why the water extent cannot be directly trained using simulated river discharge."

Response #3

Thank you for your comment. As there is a linear and direct relationship between river channel storage and discharge within the W3 model structure, water extent can be related to either river channel storage or discharge (see P5L8-9) with identical results. We chose storage for conceptual reasons.

Comment #4

“Whilst promising, the authors only found that the methods could be applied and evaluated over less than 1/3 of gauged rivers (and 1/6 for the GFDS method). It would be insightful to have a commentary on the overall applicability of the method, and ways of improvement.”

Response #4

Agreed. The overall applicability of the method was described in P12L5-10, but we will add more discussion on the importance of river size, which appears the main determinant.

Some ways for improvement were described in the last paragraph of discussion section, which emphasized the use of much higher resolution satellite imagery, e.g. from Sentinel-1 and Sentinel-2.

Comment #5

“The Data and methods section does not contain information on the data used for the hydrological mode, in particular the source of rainfall and potential evaporation time series. A commentary on the calibration of the model, especially if it used any of the 31 river gauges considered in the study, would be an important addition.”

Response #5

The model was not calibrated against the 31 river gauges. We will add further details on model inputs and calibration in the revised manuscript.

Comment #6

“The description of the GFDS dataset is not very clear, in particular regarding the time step of the time series (4days or 1 day?).”

Response #6

We apologise for the confusion, and will change these sentences to clarify the description of the GFDS dataset.

Comment #7

“line 143: change ‘resampled to 8-day averages’ to ‘averaged to 8 days’.”

Response #7

Agreed. We will change this sentence as suggested.

Comment #8

“Section 3.1: it would be useful to know on how many points the evaluation is conducted over (for fig 2 and 3).”

Response #8

Thank you for your suggestion. We calculated Spearman correlations between modelled river channel storage and MODIS and GFDS water extent for 11752 grid cells across the Amazon Basin. We will add a sentence about the number of points at which the evaluation was conducted.

Comment #9

“Lines 222-225. Can you please provide a more quantified metrics, for example the number of false attributions in relation with the window size?”

Response #9

Thank you for your suggestion. We will provide quantified metrics related to comment #8. Our results suggest there are 3427 potential grid cells (ca. 17,135 km river reaches) to construct MODIS SGRs, and 1447 grid cells (ca. 7,235 km river reaches) to develop GFDS SGRs.

Comment #10

"lines 231-232: The last sentence is presumably referring to GFDS: please clarify."

Response #10

Agreed. We will rephrase this.

Comment #11

"Section 3.2: can you justify the use of a correlation threshold of 0.6? Please also remind the reader that the vertical axes in fig 5 are not the same for observations and simulations. It would also be important to comment on the relatively low number of sites where the method is judged 'applicable (about 1/3 for MODIS, and only 1/6 for GFDS). As GFDS shows a relatively better performance in reproducing river discharge time series than channel storage (fig 5), it might be useful to consider a slightly lower threshold for the overall performance analysis."

Response #11

Thank you for these suggestions. In the caption of Figure 5, we mentioned that observations from gauging stations are shown on the right axis and river discharge estimates derived using remote sensing and model on the left axis. We will try to explain this better.

Gauging stations are usually located in single, narrow and stable river reaches, while SGRs can be constructed in multiple, broad, and unstable river reaches provided variations can be detected by remote sensing. With that caveat, there were less than 1/3 of gauged river reaches that were feasible to develop MODIS SGRs and 1/6 to construct GFDS SGRs. Limited validation reaches with gauging stations does imply an underestimate of the percentage of successful SGRs. We will add sentences to explain the relatively low number of sites where the method was judged applicable.

The correlation threshold of 0.6 is an empirical threshold we used to distinguish potential river reaches to develop SGRs. If we develop SGRs where correlations are below 0.6, the overall performance would worsen accordingly. For example, the corre-

lation between modelled storage and remote sensing water extent at gauging station G10 was 0.48 for MODIS and 0.58 for GFDS. When we constructed SGRs, the performance of MODIS and GFDS SGRs reached low values of 0.33 and 0.36, respectively. Thus, we propose to keep 0.6 as the threshold.

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