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Comment on egusphere-2022-377

Anonymous Referee #2

Referee comment on "River hydraulic modeling with ICESat-2 land and water surface elevation" by Monica Coppo Frias et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-377-RC2, 2022

This work presents the calibration of a 1D hydraulic model on ICEsat-2 altimetric data, for a river portion with unknown bathymetry-friction and given discharge upstream and downstream, which is an interesting topic. The calibrated parameters lead to fair performances in terms of fit to observed water surface elevations (WSE). The parameter space representation and sensitivity analysis are pertinent.
However the scientific novelty of the study and scientific positioning is not sufficiently clear, the authors omit lots of recent works about inverse hydraulic-hydrological modeling with current altimetric and water extent data, and forthcoming SWOT data.
I recommend the authors thoroughly rework the manuscript, rewrite the introduction and sharpen the analysis of results, reoganize some parts to ease the reading. I provide some elements below.

This work relies on :
- ICEsat-2 data, preprocessed using water masks and an effective parameterization (from Dingman) for unobserved low flow cross section bathymetry. (which has been used with altimetry and hydraulic modeling in Bjerklie et al. 2018).
- a 1D steady state Saint-Venant shallow water model with 3 spatially uniform parameters (Manning friction, low flow depth, power shape) used in the calibration process. Rerun with calibrated parameters and unsteady solver in the MIKE platform. (Other 1D hydraulic models are used with altimetric data and effective bathymetry parameterization in references provided bellow).
- a global calibration algorithm and a global sensitivity analysis algorithm, both from literature are used.

I require clarifications and improvements on these points :

- No real analysis about the hydraulic inverse problem from satellite data, and of the scientfic difficulties related to it as the "bathymetry-fricion" equifinality (Garambois and Monnier 2015), existing elaborate algorithms including variational data assimilation used for high dimensional calibrations and adapted to satellite hydraulics (cf. Larnier et al. 2020, Garambois et al. 2020 and references therein).

- Model derived rating curves (and even stage fall discharge relationships, with WS slope...) have already been presented and thoroughly analyzed in Malou et al. with a hydraulic model calibrated on altimetry and water extents.

- It is not clear to me how much snapshots of WS are used, what about temporal variability ? Is there any nadir altimetric time series available on this study zone? The only validation regarding temporal variability is thus at gauging stations used as boundary conditions for the hydraulic models?

- Hydraulic analysis are not deep enough, regarding forward-inverse hypothesis and resulting misfit wrt observations and river morphological features, regarding also "WS interpolation at any river point" as mentioned in the flowchart of Fig 1. Detailed discussions about hydraulic extrapolation in altimetry context can be found in Pujol et al. 2020, Malou et al. 2021.

- An algorithm enabling Bayesian uncertainty analysis is used "To study the uncertainty of the model", the uncertainty is provided on infered parameters but not on other estimates in the rest of the paper ; analysis are not deep. What is the sensitivity of the parameter inference to first guess, to pdf choices and other calibration algorithm parameters?

- Is "80-180 meter in low flow season" corresponding to a narrow river ? This corresponds to rivers visible with current nadir altimeters and by the future swot mission, which should be properly discussed with a litterature review.

- Clarify UPA_{x} in Eq. 7.

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