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Comment on hess-2022-111

Anonymous Referee #1

Referee comment on "A graph neural network (GNN) approach to basin-scale river network learning: the role of physics-based connectivity and data fusion" by Alexander Y. Sun et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-111-RC1, 2022

This work presents a multistage, physics-guided, graph neural network (GNNs) approach for basin-scale river network learning and stream forecasting. This approach is computationally less demanding than vector-based river network models.

I am a hydraulic engineer with some expertise in the modelling of river reaches, including under flood conditions. I have accepted the invitation to review this paper in the hope to be able to provide constructive and useful comments and suggestions to the authors, and in the hope to expand my own knowledge base.

I have enjoyed reading the paper and I have understood the concept of the method, which I find very interesting. I have the impression that the authors master the theme and have made a worthwhile contribution. But I have to admit that I am not sufficiently familiar with the topic to make an authoritative assessment of the quality and originality of the contribution.

I hope that the following suggestions will be helpful to the authors:

- The paper is very technical and probably not very appealing to non-experts in the field of neural network approaches. The authors may want to make an effort to make the paper more appealing to a broader readership.
- The authors highlight that a major advantage of the graph-neural-network approach over a vector-based river model is the much lower computational demand. I suggest substantiating/quantifying this lower computational demand.
- The model is only demonstrated for one relatively small snow-dominated watershed in the western US. Is this a sufficient basis for claiming general validity of the model in watersheds in other geographical settings.

I suppose these suggestions amount for a moderate revision (something in between a minor and a major revision).