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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Hydrologically Informed Machine Learning for Rainfall-Runoff Modelling: Towards Distributed Modelling" *by* Herath Mudiyanselage Viraj Vidura Herath et al.

Anonymous Referee #1

Received and published: 11 November 2020

The paper addresses the problem of coupling traditional hydrological models with machine learning techniques. The problem addressed is relevant and a current topic of interest in the hydrological community and this paper potentially represents a valuable contribution.

However, I see some deficiencies in the paper organization and in the clarity of the content that make difficult to fully exploit the potential of the work. Therefore I believe that a major revision, mainly addressed to the form rather than to the content, is needed.

GENERAL COMMENT

There are many extremely long paragraphs (e.g. lines 70 to 90) that express multiple

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concepts. I would make paragraphs shorter, creating a paragraph per concept. This should help the readability of the paper.

There are several statements without a reference justifying them.

OVERALL STRUCTURE

I do not like the structure of the paper and the amount of content given to each paragraph. Your main message is to present MIKA-SHA but this is left to section 4, which is barely 1 page out of 42. If that was the main concept of the paper, I would give it more space.

I like the material in sections 1 to 3 (included) but they are basically a mix of introduction and a "methods" section. I would move some content from section 2 and 3 to the introduction, which can be divided in subsections. A possible structure of the introduction can be:

- Quick introduction on hydrological modelling and TGDS

- On hydrological models

* Physics-based models vs. conceptual models vs. data science models (mix of 2.1 and 2.2)

* Focusing on conceptual models, difference between fix and flexible structure (some part of 2.2)

* Lumped vs. distributed (2.3)

- On ML models

* Some generalities (3)

* ANN (3.1, maybe reduce)

* GP (3.2)

- Physics informed ML (3.3)

I would then add a “methods” part where you write about what of sections 2 and 3 you actually use: SUPERFLEX, FUSE, GP. I would also add to this the metrics that you later use in section 5.

Section 5 and 6 are about the case study and I think this should represent a minor part of the paper (which objective is to present how MIKA-SHA works). To this end, I would more or less keep the same content and put it in a single section divided in:

- Presentation of the case study

- Settings

- Results that you get

- Meaningful discussion, potentially showing that MIKA-SHA works.

I would therefore move some aspects of this section elsewhere:

- Metrics to a “methods” section

- Further explanation of MIKA-SHA functioning to the section that presents the model

- General implications on the goodness of the approach to a general “discussion and conclusion” section

PAPER CONTENT

Keeping in mind that I do not have a deep knowledge of GP, I find quite difficult to understand what MIKA-SHA actually does and my difficulty can be motivated by the following reasons:

- Use of jargon from GP, that may be not common in the hydrological community (e.g. model induction vs. model selection)

- Assuming good familiarity of the reader with GP

- Assuming that the reader knows ML-RR-MI: you do not have to re-write here that paper but at least explain here the concepts that are necessary. I find it difficult to follow something that says that MIKA-SHA is basically ML-RR-MI plus something else.

DATA AND CODE AVAILABILITY

I do not know if HESS forces the sharing of the source code but I believe that, potentially, MIKA-SHA can be a valuable tool for the hydrological community and, therefore, I invite you to make it publically available.

FURTHER COMMENTS

See the attached PDF with the comments.

Please also note the supplement to this comment:
https://hess.copernicus.org/preprints/hess-2020-487/hess-2020-487-RC1-supplement.pdf

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