Reply on CC1

Richard Arsenault et al.

Author comment on "Continuous streamflow prediction in ungauged basins: long short-term memory neural networks clearly outperform traditional hydrological models" by Richard Arsenault et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-295-AC1, 2022

Thank you for this excellent comment. It is actually quite philosophical in nature and we have been debating internally if a LSTM should be considered a hydrological model.

On one hand, in our view, hydrological models represent the processes in a (albeit sometimes inexact or imprecise) concrete, process-based manner, where hydrological processes are represented by estimations of the real-world physics governing the movement of water, etc. In this view, it is pretty clear that LSTMs are not hydrological models, but rather complex regression models that happen to be able to find patterns from the data. They are not aware that they are modelling streamflow. Likewise, one would hardly consider a linear regression model that predicts tomorrow's streamflow based on today's streamflow a hydrological model.

On the other hand, LSTMs do manage to train and develop internal structures and weights that seem to represent the hydrological processes. Once trained, they could probably indeed be considered hydrological models, although not in the same category as traditional, physically based hydrological models. In our view, these should be considered separately within the family of "hydrological models".

Since this issue will not be resolved entierly within this discussion, we suggest adding a precision in the title to the effect that the models used here are traditional hydrological models, without stating (or not) if the LSTM is a hydrological model (or not): Continuous streamflow prediction in ungauged basins: Long Short-Term Memory Neural Networks clearly outperform **traditional** hydrological models.

Thank you once again for this interesting comment!