

## ***Interactive comment on “HESS Opinions: Deep learning as a promising avenue toward knowledge discovery in water sciences” by Chaopeng Shen et al.***

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Thanks for the online comment. Here, due to time constraint, I can make a quick personal reply. Dr. Sawicz mentioned two themes: 1. "how deep learning has been integral in other fields to increase knowledge discovery of other fields of science". 2. "the presentation of a general framework of how to apply the techniques of deep learning to open or poorly understood problems within the hydrologic sciences." Both are good points and would be useful for the community. As our reply to the other reviewers, a review of how DL is applied in other sciences is provided in our companion review paper. However, it is indeed a good idea to present a good summary here in the revision,

C1

and perhaps a couple of illuminating examples.

"The manuscript is generally well written, but I would recommend more attention to simplifying the verbiage and clarify the message of the paper. To help communicate this further, I included examples within the specific comments below as a guide. With thoughtful revision, I believe that this paper can serve the community well to help show the utility of deep learning techniques. I also think that the inclusion of a companion paper to explain the more technical aspects of deep learning was a very good decision"

Agreed. We shall make some drastic effort to simplify the paper in terms of terminology. Many hydrologists would not be able to interpret some of the language. We shall use simpler terms or make some clear definitions.

"I have included some specific comments that should be revised and used as examples to help guide the authors in their overall revision. Page 2 Line 19: "deep networks are differentiable from outputs to inputs, giving them practical advantages in efficient parameter optimization via backpropagation (training)." It is not clear to me what is meant by differentiable from outputs to inputs. I believe that the concept the authors are trying to communicate here is simple, but it is not done so effectively."

Yes this is mostly DL jargon. DL models essentially accept some inputs and propagate through a chain of matrix multiplications and nonlinear transformations. Unlike classification trees which may be discontinuous, DL models produce a mapping that is differentiable, except at final decision stage for a discrete classification problem, so a small change in inputs normally results in a small change in output. Nevertheless, we shall revise these sentences to be more interpretable.

Page 10 Line 20: "Observations in hydrology and water sciences. . ." Some would consider hydrology to be a subset of water science and others may say that hydrology and water sciences are the same field named differently. While cleaning up the language used in the manuscript, I would also suggest using either hydrology or water science. This may be a small point but is one that should be echoed through the paper."

C2

We will stick to hydrologists for our revision.

"In addition to these specific comments, I would also encourage the authors to include the various references listed by reviewers 1 and 2. I do not personally have anything to add to these references, but they would serve to present a fuller picture of machine learning applications within hydrology"

will do. thanks.

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