

## ***Interactive comment on “Legitimising neural network river forecasting models: a new data-driven mechanistic modelling framework” by N. J. Mount et al.***

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The authors have undertaken an important step in the direction which many proponents of data-driven modelling (DDM) were not able to move far. It concerns improving procedures of DDM (in river forecasting) so that they become more understandable and hence more widely usable by practitioners of hydrological forecasting. In brief, and in my own interpretation, their approach is to use sensitivity analysis to show the relative importance (sensitivity calculated for each time step) of various inputs of the ANN on the resulting flow. The considered models are not rainfall- runoff models: Model A considered is purely autoregressive flow forecasting model (with three terms), and

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model B is a routing model that has three upstream lagged (each by 1 day) flow inputs.

In my view the considered example is too simple to demonstrate the full potential of the methodology. Considering a hydrological RR model would introduce much more underlying physics in the whole picture. The Model Selection phase is in fact in the choice of the number of hidden neurons, whereas in a RR model (especially in its semi-distributed form) it could be been much richer. It would be great if the proposed method can be also demonstrated on more complex models.

In my view if we talk about the "mechanisms" that the proposed DDMM claim to reveal, many practitioners may think further than only sensitivity analysis (even such a nice twist of it presented here), and expect more from a technology that wishes to be more "legitimate". For the specialists in operational hydrological forecasting I was talking to, "legitimacy" would possibly mean "revealing the physics better", with sensible interpretation of the internals of an ANN. However, for others, who like new technologies more (and who are less nervous about black-box regression models), using ANN for hydrological forecasting is just a normal thing to do, especially if it ensures higher profits (e.g. using ANNs for reservoir inflow forecasting by hydropower companies).

Reviewers suggested a number of reasonable things of which authors accepted most, as I can see.

In general, I think this paper is an excellent contribution to extending our arsenal of modelling, and to the discussion about the types of models to be used in hydrological forecasting. Some want them white (=physically-based, or at least conceptual), some claim black boxes are legitimate enough if they are more accurate than white ones. This paper contributes to this move from "dark ages" (when the principle "through all data indiscriminately on some new regression model like ANN and publish" was sometimes adopted) to "unbearable lightness of being" (or whiteness of modelling) (when we have so much physical data that it is easy to build distributed hydrological models of everything). (By the way, the authors were never in the first camp always trying to find

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physics and common sense in ANN modelling (or what some called neural hydrology.)

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