**Hydrology and
Earth System
Sciences
Discussions**

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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We are grateful to Dr. de Vos for this comment and his agreement on the importance of the subject that this paper addresses. We accept that it is possible for the reader to interpret the text on page 147 (line 16) in a manner that was not originally intended. However, we would suggest that, rather than being actively misleading, the text at this point lacks clarity about the specific findings presented in de Vos (2013). We, therefore, suggest the following revision to the text to ensure greater clarity:

"Consequently, NNRFs have the potential to deliver river forecasts with reduced error. In addition, recent work (de Vos, 2013) has highlighted how the application of echo

state networks within NNRF studies may extend the horizon of NN-based forecasts."

We agree with de Vos that understanding WHY or HOW neural network river forecast (NNRF) models are able to achieve their performance benefits is critical to justifying and legitimising their use - a view that forms the central argument in our paper. The method we present represents an essential first step to achieving this. However, the application of our data-driven mechanistic modelling (DDMM) framework to the complex, echo state network (ESN) techniques employed in de Vos (2013), would be reliant on the development of direct numerical methods that quantify their internal mechanisms. We acknowledge that, at present, such methods may not exist. Indeed, in the summary of our paper we state:

"Consequently, the relative ease with which we have been able to quantify and interpret input relative sensitivity in this study may not be mirrored in more complex studies that use an increased number and diversity of inputs and/or variants of the standard back-propagation algorithm."

In this context, ESNs are an additional, variant of standard neural network (NN) algorithms that have considerable additional complexity and that require further research effort to develop methods for their mechanistic elucidation. Indeed, it is our hope that, in response to the arguments presented in our paper, the wider NNRF research community will be encouraged to research and develop new methods (including but not restricted to sensitivity-based approaches) by which data-driven modelling mechanisms can be elucidated and interpreted, even in the context of the most complex NN algorithms.

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