**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.

Anonymous Referee #2

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This study tries to explore and evaluate neural networks' internal modelling mechanisms through the proposed DDMM framework. The global-local relative sensitivity method is the core element and was applied to two NNRF modelling scenarios. This is an interesting research and has the potential to make contribution to hydrological fields. After studying the manuscript, however, I have quite different opinions and would like to share my points shown below. (1)The manuscript repeatedly mentions the black-box character (four times!) of ANNs. It seems the authors put too much effort in emphasizing the weak points of ANNs and seems to ignore the fact that ANNs have been successfully and satisfactorily applied in various hydrosystem problems, as cited by the author's previous paper (Abrahart et al., 2012). (2)ANNs are a powerful tool for

solving complex and nonlinear problems; however this study restrict their modelling to simple and linear cases only, which I believe this less benefits those readers who are interested in the nonlinear learning capability of ANNs. (3)This study uses the back-propagation NN to construct the model, which is based solely on a nonlinear search algorithm and is not designed to obtain the input-output relation mechanism. Other types of ANNs, such SOM and neuro-fuzzy (ANFIS) networks, do have much more related studies in dealing with the internal modeling mechanism. (4)Introduction should be much shortened! After reading Introduction, I, however, have the feeling that it seems ANNs are neither useful nor a powerful nonlinear tool for solving complex hydrological problems! For those people who prefer to use ANNs, I think, they do not appreciate such kind of view, while for those people who are not familiar with ANNs, these statements might reinforce their disfavor and/or intimidation to learn or use ANNs! I am sure the authors do not expect to get this kind of feedback. (5)The authors used the proposed DDMM framework to explore the mechanisms in several candidate models with different numbers of nodes in hidden layers and select the proper model structures. However, I think the most important step before exploring the mechanisms in models is the determination of non-trivial input factors in a study area. It may involve a number of gauge stations that need to be used, the delay time and delay dimension for each gauge station, and so on. Different input factors will produce different mechanisms in a model. Can the proposed DDMM framework be further applied to the selection of inputs? (6)The relative sensitivity of each input in equation 2 should be clearly defined and explained. (7)The DDMM framework (Fig. 2) is very much similar to the pre-processing adopted in ANNs. (8)Can the global-local relative sensitivity plots for validation data also be presented to show the similar model mechanisms between calibration and validation stages? (9)Fig.8 and Fig.9 should be swapped.

Reference: Abrahart, R. J., Anctil, F., Coulibaly, P., Dawson, C. W., Mount, N. J., See, L. M., Shamseldin, A. Y., Solomatine, D. P., Toth, E., and Wilby, R. L.: Two decades of anarchy? Emerging themes and outstanding challenges for neural network modelling of surface hydrology, Prog. Phys. Geogr., 36, 480–513, 2012a.