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Modelling a model?!! Prediction of observed and calculated daily pan evaporation in New Mexico, U.S.A.

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Data-driven modelling is most commonly used to develop predictive models that will simulate natural processes. This paper, in contrast, uses Gene Expression Programming (GEP) to construct two alternative models of different pan evaporation estimations by means of symbolic regression: a simulator, a model of a real-world process developed on observed records, and an emulator, an imitator of some other model developed on predicted outputs calculated by that source model. The solutions are compared and contrasted for the purposes of determining whether any substantial differences exist between either option. This analysis will address recent arguments over the impact of using downloaded hydrological modelling datasets originating from different initial sources i.e. observed or calculated. These differences can be easily be overlooked by modellers, resulting in a model of a model developed on estimations derived from deterministic empirical equations and producing exceptionally high goodness-of-fit. This paper uses different lines-of-evidence to evaluate model output and in so doing paves the way for a new protocol in machine learning applications. Transparent modelling tools such as symbolic regression offer huge potential for explaining stochastic processes, however, the basic tenets of data quality and recourse to first principles with regard to problem understanding should not be trivialised. GEP is found to be an effective tool for the prediction of observed and calculated pan evaporation, with results supported by an understanding of the records, and of the natural processes concerned, evaluated using one-at-a-time response function sensitivity analysis. The results show that both architectures and response functions are very similar, implying that previously observed differences in goodness-of-fit can be explained by whether models are applied to observed or calculated data.