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Hydrology and Earth System Sciences Discussions

Interactive comment on "Comparison of predictions of rainfall-runoff models for changes in rainfall in the Murray-Darling Basin" *by* J. M. Whyte et al.

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We consider that the reviewer's implication that our argument is circular obscures the detail. In general terms it is unequivocal that one should check that a model fits data before using it for predictions. But, this avoids the issues of what should be checked and how it should be checked.

Researchers typically fit a model to a calibration data set aiming to maximise the Nash-Sutcliffe coefficient, and further assess its performance by making predictions for a validation data set and comparing these with data. If the calibration and validation series are stochastically equivalent, models are likely to perform well for the validation

set, and if so are then usually refitted using all the data.

It is generally accepted that it is unwise to extrapolate models fitted to a specific data set beyond the range of that data, even if such models are conceptual in nature. However, a reduction in rainfall, at least, does not require extrapolation, and a model chosen on the basis of a highest Nash-Sutcliffe coefficient might be used for predicting changes in runoff for climate change scenarios.

We demonstrate that models which have similar, and reasonably high, Nash-Sutcliffe coefficients, can give very different results in terms of rainfall-runoff elasticity.

In response to this referee's second criticism, we have already given quotes from several authors who see value in model comparison, as part of our response to the first referee. Rather than reiterate these, we provide additional material to emphasize that for some time modellers have advocated for model comparison and advised against trusting the output of a single model. From "Prediction uncertainty of conceptual rainfall-runoff models caused by problems in identifying model parameters and structure", S. Uhlenbrook, J. Seibert, C. Leibundgut and A. Rohde, Hydrological Sciences Journal **44**(5), October 1999, Page 793,
"Zhang & Lindström (1996) compared the HBV model in detail with another conceptual model, namely the Chinese Xinanjiang model (Zhao, 1992). They found that both models performed well and it was difficult to see any great quality difference in the runoff simulations. They recommended to be cautious when interpreting conceptual models as actual physical descriptions of basin hydrology, and when using one model for studying the impact studies of climate or land-use change. The results obtained in this study support these results and recommendations."

Exploring the response of competing rainfall-runoff models to changed rainfall inputs on a catchment of interest may assist discrimination between candidate models, if it were possible to determine the actual effect on runoff caused by a given change in precipitation. Such values are often determined through the use of ..... hydrological

models!

Taking a particular model as the source of “truth" and then rewarding or penalizing alternative models in a selection process based on their agreement with the preferenced model is unsatisfactory as it ignores two problems:

- “Essentially, all models are wrong, but some are useful", statistician G. E. P. Box.
- The result obtained is model dependent.

Awareness of this has lead to a determination of catchment precipitation elasticity of streamflow derived from the time series in a systematic model free manner (see the reference to Whyte, (2011) in our paper). We contend that examination of the behaviour of hydrological models under changed rainfall inputs and comparison of the output with precipitation elasticity of streamflow obtained in a manner similar to that proposed in Whyte (2011) provides a useful check on the suitability of hydrological models. This applies whether or not they are intended for use in climate change studies, and whether or not they are conceptual, time series based, or other.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 917, 2011.