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Interactive comment on "Technical note: "Bit by bit": A practical and general approach for evaluating model computational complexity vs. model performance" *by* Elnaz Azmi et al.

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Suggestions to expand the list of candidate models

I enjoy reading this Discussion paper from a hydrologic model performance perspective, and suggest the authors consider expanding the list of candidate models (Table 1) and their training methodology as follows:

1. A second–order autoregressive process as a baseline model

The (almost) ignorant model (Model-00) is a baseline model in the popular Nash–Sutcliffe model efficiency (NSE) criterion (e.g., Knoben et al., 2019, and SC1 therein for my comment).

As an alternative to it, I've suggested a simple(st) autoregressive model of order 2, AR(2):

$$Q(t) = Q(t-1) + [Q(t-1) - Q(t-2)] = 2Q(t-1) - Q(t-2), \qquad (1)$$

This and their top–rated Model-07 (AR(3)) belong to the class of autoregressive processes. Their Equation (1) reads, omitting the subscript HOST to the discharge variable Q:

$$Q(t) = 0.0549 + 1.9266Q(t-1) - 1.2071Q(t-2) + 0.2685Q(t-3), \qquad (2)$$

Similarity in terms of the coefficient between the two is striking. In an integer form, both are identical.

It would be instructive to score the performance of all the candidate models by the NSE criterion, both in its original and the newly suggested AR(2) form.

The AR(2)–based NSE will score Model-07 (AR(3)) again as a best performing model. It may differentiate more clearly the one–bucket (Model-02) and the two–buckets (Model-05) one. As expected, the latter performs better than the former (Lines 273-278), but the two are indistinguishable from each other on the authors' proposed model performance scale (Figure 3).

2. Catchments as a quadratic reservoir

The linear storage–discharge equation, $Q = S/K$ (Figure 1a) can be extended to a quadratic one below:

$$Q = (CS)^2, \tag{3}$$

In the absence of precipitation, $P(t) = 0$ for Δt >>1 d, the recession hydrograph is linearized below:

$$-1/\sqrt{Q_t} = -1/\sqrt{Q_0} - C(t - t_0), \tag{4}$$

This has been called a negative inverse square root (NISR)–transformed recession flow model (Pelletier and Andreássian, 2020, and SC3 therein for my comment). This is in contrast to the universal logarithmic transformed one,

$$\log Q_t = \log Q_0 - (1/K)(t - t_0), \tag{5}$$

both having a single scale parameter K or C.

3. Training on transformed streamflow space

As a consequence of data linearization described above, some prior transformation of the observed streamflow time series data may help reducing the model computational complexity (i.e. number of computing steps) as opposed to improving model performance (i.e. a consequence of applying hydrologic law, formulas, and equations)

(Lines 167-171).

As the case maybe, this can be the log or the NISR transformation of both a single reservoir (Figure 1a) and a two-parallel-reservoirs (Figure 1b) model, linear (Model-02 and 05) or quadratic as in Equation (3) above.

References

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