

Interactive comment on “On the choice of calibration metrics for “high flow” estimation using hydrologic models” by Naoki Mizukami et al.

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Received and published: 16 August 2018

The NSE criterion

Having had taken a postgraduate-level course from Nash (1968-69) when he was a visiting professor at my alma mater, the University of Guelph in Ontario, Canada, I believe I was privy to his thinking behind the development of the NSE criterion, a variant of the sum of squared error measure (Nash and Sutcliffe, 1970).

I could be wrong because of the passage of time, but his thinking was that in the absence of a model, the best estimate of the future flows was the average or mean

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observed flow value \bar{O} , thus its appearance in the denominator of the criterion below (e.g., Ding, 1974, Equation 47):

$$R^2 = 1 - F/F_0, \quad (1)$$

$$F_0 = \sum_{t=0}^{L-1} (Q_{t+1} - \bar{O})^2, \quad (2)$$

$$F = \sum_{t=0}^{L-1} (Q_{t+1} - O_{t+1})^2, \quad (3)$$

in which R^2 is the model efficiency; F_0 and F are the initial variance from the mean value and the residual variance from the observed values, respectively; O and Q are the observed and simulated flow series, respectively; t is the index of timestep Δt ; and L is the length, or number of ordinates, of the observed hydrograph.

To my way of thinking then, a better estimator would instead be based on a one-step-ahead forecast, $\hat{O}_{t+1} = O_t + (O_t - O_{t-1})$. Replacing the \bar{O} term in Equation (2) by \hat{O}_{t+1} produces Equations (4) and (5):

$$F_1 = \sum_{t=0}^{L-1} (Q_{t+1} - \hat{O}_{t+1})^2, \quad (4)$$

$$R_1^2 = 1 - F/F_1, \quad (5)$$

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This would make F_1 smaller in value than F_0 , and the modified NSE criterion, R_1^2 , a lower score one. The drawback was to always overshoot, by one timestep, the turning points, the peaks and troughs of an observed hydrograph.

References

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2018-391>, 2018.