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Ranking streamflow model performance based on Information theory metrics

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The accuracy-based model performance metrics not necessarily reflect the qualitative correspondence between simulated and measured streamflow time series. The objective of this work was to use the information theory-based metrics to see whether they can be used as complementary tool for hydrologic model evaluation and selection. We simulated 10-year streamflow time series in five watersheds located in Texas, North Carolina, Mississippi, and West Virginia. Eight model of different complexity were applied. The information-theory based metrics were obtained after representing the time series as strings of symbols where different symbols corresponded to different quantiles of the probability distribution of streamflow. The symbol alphabet was used. Three metrics were computed for those strings – mean information gain that measures the randomness of the signal, effective measure complexity that characterizes predictability and fluctuation complexity that characterizes the presence of a pattern in the signal. The observed streamflow time series has smaller information content and larger complexity metrics than the precipitation time series. Watersheds served as information filters and and streamflow time series were less random and more complex than the ones of precipitation. This is reflected the fact that the watershed acts as the information filter in the hydrologic conversion process from precipitation to streamflow. The Nash Sutcliffe efficiency metric increased as the complexity of models increased, but in many cases several model had this efficiency values not statistically significant from each other. In such cases, ranking models by the closeness of the information-theory based parameters in simulated and measured streamflow time series can provide an additional criterion for the evaluation of hydrologic model performance.