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Analysing the temporal dynamics of model performance for hydrological models

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Abstract. The temporal dynamics of hydrological model performance gives insights into errors that cannot be obtained from global performance measures assigning a single number to the fit of a simulated time series to an observed reference series. These errors can include errors in data, model parameters, or model structure. Dealing with a set of performance measures evaluated at a high temporal resolution implies analyzing and interpreting a high dimensional data set. This paper presents a method for such a hydrological model performance assessment with a high temporal resolution and illustrates its application for two very different rainfall-runoff modeling case studies. The first is the Wilde Weisseritz case study, a headwater catchment in the eastern Ore Mountains, simulated with the conceptual model WaSiM-ETH. The second is the Malalcahuello case study, a headwater catchment in the Chilean Andes, simulated with the physics-based model Catflow. The proposed time-resolved performance assessment starts with the computation of a large set of classically used performance measures for a moving window. The key of the developed approach is a data-reduction method based on self-organizing maps (SOMs) and cluster analysis to classify the high-dimensional performance matrix. Synthetic peak errors are used to interpret the resulting error classes. The final outcome of the proposed method is a time series of the occurrence of dominant error types. For the two case studies analyzed here, 6 such error types have been identified. They show clear temporal patterns, which can lead to the identification of model structural errors.

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