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Parameter regionalization for a flexible modeling framework based on a large sample of catchments

Nans Addor
Climatic Research Unit, University of East Anglia, Norwich, UK

Flexible modeling frameworks enable hydrologists to generate a large number of hydrological modeling structures. This means that model performance and structural uncertainty can be assessed in a more systematic way than when standard off-the-shelf models are used. Yet, to benefit from these advantages, flexible modeling frameworks require new parameter estimation schemes to be developed. These schemes should fulfill three main objectives. Firstly, they should be fully automated, so that a large number of structures (possibly hundreds) can be setup on the fly without requiring much human attention. Secondly, parameter values should not simply be the result of an optimization algorithm, but they should reflect the landscape that the model aims to simulate. Thirdly, parameter estimation should be applicable in ungauged locations, and in particular on a grid used for continental-scale simulations.

This presentation will introduce a parameter estimation scheme which fulfills these three objectives. It is designed for the flexible modeling framework FUSE (Framework for Understanding Structural Errors) and relies on the recently-released CAMELS (Catchment Attributes and MEteorology for Large-sample Studies) data set, which provides hydrometeorological time series and landscape attributes for 671 US catchments. The shuffled complex evolution (SCE) algorithm was used to calibrate each catchment, resulting in a large pool of calibrated parameter sets. The landscape of the catchments was then accounted for by comparing different definitions of hydrological similarity, which rely on different sets of landscape attributes. The definition of hydrological similarity was optimized by assessing the realism of the hydrological simulations obtained by transferring parameter sets from donor catchments selected based on their hydrological proximity. Regionalized FUSE matches or exceeds the performance of 4 commonly-used conceptual models over the CAMELS catchments. Further, since FUSE code was optimized for speed and parallel computing, this regionalization scheme enables the simultaneously setup of diverse hydrological modeling structures.