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Utilizing signatures of hydrologic function in hydrological model identification and evaluation

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The use of mathematical models to reflect the functional behavior of hydrological systems from soil core to global scale is fundamental to most research and operational aspects of hydrology. Despite decades of research into optimal strategies for model identification and evaluation, we have still not achieved our ultimate aim, i.e. to develop models that reflect the (relevant) functional behavior of the hydrological system under study and can be applied everywhere. Most strategies currently applied are still rooted in the tradition of statistical regression with little to no integration of hydrological understanding into the modeling process, ultimately leading to statistically optimal, but hydrologically dissatisfying models. In this talk I will outline how the use of signatures constitutes a new framework for hydrological modeling across scales for gauged and ungauged systems as well as for those that experience(d) environmental change. Examples at the watershed scale will be used to demonstrate model identification, diagnostic model evaluation and operational predictions in gauged and in ungauged watersheds, as well as in those that might be impacted by climate change.