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Improving hydrologic model realism by using environmental tracers – a case for isotope enabled hydrologic modeling

Harsh Beria (1), Natalie Ceperley (1), Anthony Michelon (1), Josh Larsen (1,2), and Bettina Schaefli (1)

(1) University of Lausanne, Institute of Earth Surface Dynamics, Lausanne, Switzerland (harsh.beria@unil.ch), (2) School of Geography, Earth and Environmental Sciences, University of Birmingham

The last century of hydrological research has led to significant improvements in rainfall-runoff modeling with improved representation of the different hydrological processes occurring within a catchment. However, there has not been a significant rise in the number of hydrometeorological variables monitored within a catchment. Consequently, hydrological models are calibrated only against the runoff data which may limit the predictive power of such models. One option to improve the realism of hydrologic prediction models is through the use of environmental tracers like stable isotopes of water, water temperature, etc. Conventionally, stable water isotopes have been used to learn more about the dominant hydrological processes in headwater catchments, thereby improving the hydrologic model structure. In this study, we develop a framework to incorporate stable water isotopes in continuous hydrologic modeling with the aim of improving the realism of rainfall-runoff modeling, without significantly increasing the model complexity. We couple a conceptual hydrologic model with a newly developed Bayesian mixing model to provide additional constraints during the model calibration. We test this framework in Vallon de Nant experimental catchment, located in the South-western Swiss Alps. We will discuss the advantages and limitations of such a modeling approach and how it can be extended to other catchments globally.