EGU21-3446
https://doi.org/10.5194/egusphere-egu21-3446
EGU General Assembly 2021

Identification of dominant hydrological mechanisms using Bayesian inference, multiple statistical hypothesis testing and flexible models

Cristina Prieto[1,2,3], Dmitri Kavetski[4], Nataliya Nataliya Le Vine[3], César Álvarez[1], and Raúl Medina[1]
[1]IHCantabria – Instituto de Hidráulica Ambiental de la Universidad de Cantabria, Santander, Spain
(cristina.prieto@unican.es)
[2]Eawag, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland
[3]Department of Civil and Environmental Engineering, Imperial College London, London, UK
[4]School of Civil, Environmental and Mining Engineering, University of Adelaide, Adelaide, South Australia, Australia

In hydrological modelling, the identification of hydrological model mechanisms best suited for representing individual hydrological (physical) processes is a major research and operational challenge. We present a statistical hypothesis-testing perspective to identify dominant hydrological mechanism. The method combines: (i) Bayesian estimation of posterior probabilities of individual mechanisms from a given ensemble of model structures; (ii) a test statistic that defines a "dominant" mechanism as a mechanism more probable than all its alternatives given observed data; (iii) a flexible modelling framework to generate model structures using combinations of available mechanisms. The uncertainty in the test statistic is approximated via bootstrap from the ensemble of model structures. Synthetic and real data experiments are conducted using 624 model structures from the hydrological modelling system FUSE and data from the Leizarán catchment in northern Spain. The findings show that the mechanism identification method is reliable: it identifies the correct mechanism as dominant in all synthetic trials where an identification is made. As data/model errors increase, statistical power (identifiability) decreases, manifesting as trials where no mechanism is identified as dominant. The real data case study results are broadly consistent with the synthetic analysis, with dominant mechanisms identified for 4 of 7 processes. Insights on which processes are most/least identifiable are also reported. The mechanism identification method is expected to contribute to broader community efforts on improving model identification and process representation in hydrology.