Geophysical Research Abstracts
Vol. 20, EGU2018-10210, 2018
EGU General Assembly 2018

Representative computation: How to make use of hydrological similarity?

Rik van Pruijssen (1), Elnaz Azmi (2), Erwin Zehe (1), and Uwe Ehret (1)

(1) Karlsruhe Institute of Technology, Institute for Water and River Basin Management (IWG), Hydrology, Karlsruhe, Germany , (2) Karlsruhe Institute of Technology, Steinbuch Centre for Computing (SCC), Karlsruhe, Germany

Hydrological modelling is, besides the struggle to obtain the best modelling results, also a continuous fight with computational resources. Highly resolved models operate on such a fine grid that they require considerable computational resources. However, satisfactory modelling results can also be obtained by using only a subset of the model structure, which indicates that hydrological similarity can be exploited to simplify the model used and thus to reduce computational demand. This has for example been done in TOPMODEL, where different points in the catchment are grouped based on their topographic index. The question remains which catchment characteristics can be used to identify and categorize hydrologically similarly functioning areas.

The paradigm of hydrological similarity we follow in our work is that structurally similar model units (here: hillslopes) behave similarly when starting from similar initial states and being exposed to similar forcing. We express hillslope structure via drainage tests using a distributed hydrological model based on the principles suggested by Zehe et al (2014) in their HESS opinion paper. It is set up and applied in the Attert catchment, a densely measured lower meso-scale size catchment in Luxembourg, which is subdivided in approximately 13500 hillslopes.

The drainage curves are an integral signature reflecting not only hillslope extend and slope, but also soil properties and preferential drainage structures. From the drainage curves we derive the properties 'total storage', 'active storage', 'time to equilibrium' and 'curve shape'. These descriptors are used to apply a time-invariant clustering or grouping of hillslopes using different clustering methods such as K-means and DBSCAN. Being work in progress, at this point similarity is only a function of hillslope structure, while similarity of dynamical forcing and initial states are still ignored. Hydrological model runs are executed for both non-grouped (individual) and grouped hillslopes, and simulated catchment runoff responses are compared to assess the effect of grouping. Further, we apply measures from information theory (conditional entropy) to assess the connection of individual hillslope properties such as catena-type, geology, soil type, soil profile, flow length, slope, aspect and the hillslope groups derived from the drainage tests. We also discuss the spatial patterns of these groups.

The next steps will be to include initial state and dynamical forcing into the grouping, which will then become time-variant, and to apply hillslope wetting tests, which, together with the drainage tests, will yield a more complete picture of hillslope behaviour and thus a better basis to explore similarity.