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How much expert knowledge is it worth to put in conceptual hydrological models?

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Both modellers and experimentalists agree on using expert knowledge to improve our conceptual hydrological simulations on ungauged basins. However, they use expert knowledge differently for both hydrologically mapping the landscape and parameterising a given hydrological model. Modellers use generally very simplified (e.g. topography-based) mapping approaches and put most of the knowledge for constraining the model by defining parameter and process relational rules. In contrast, experimentalists tend to invest all their detailed and qualitative knowledge about processes to obtain a spatial distribution of areas with different dominant runoff generation processes (DRPs) as realistic as possible, and for defining plausible narrow value ranges for each model parameter. Since, most of the times, the modelling goal is exclusively to simulate runoff at a specific site, even strongly simplified hydrological classifications can lead to satisfying results due to equifinality of hydrological models, overfitting problems and the numerous uncertainty sources affecting runoff simulations. Therefore, to test to which extent expert knowledge can improve simulation results under uncertainty, we applied a typical modellers' modelling framework relying on parameter and process constraints defined based on expert knowledge to several catchments on the Swiss Plateau. To map the spatial distribution of the DRPs, mapping approaches with increasing involvement of expert knowledge were used.
Simulation results highlighted the potential added value of using all the expert knowledge available on a catchment. Also, combinations of event types and landscapes, where even a simplified mapping approach can lead to satisfying results, were identified. Finally, the uncertainty originated by the different mapping approaches was compared with the one linked to meteorological input data and catchment initial conditions.