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Temporal resolution of precipitation as a control of runoff model performance

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In most cases the choice of the temporal resolution of the data used for model calibration is driven by the data availability. Yet, a carefully chosen resolution could greatly improve the identifiability of catchment processes and enhance the model predictability, while saving costs and time for too detailed measurement protocols or simulations. In this work we formulate this issue as an inverse problem and investigate how data of different temporal resolutions, ranging from one hour to two days, affects the predictability of a precipitation-runoff model (HBV) for both high and low flow conditions. We employ a Bayesian inference with a formal likelihood function, which enables a quantitative comparison. Our study is based on the sample of five heterogeneous Swiss meso-scale catchments with two different datasets of precipitation fields: radar-based (RB) and ground station network (GSN).

Our results showed that a high data resolution was preferable in small and medium size catchments, with catchments smaller than 60 km^2 having a stronger tendency towards an hourly resolution. As opposed, a high data resolution was not so important in catchments larger than 200 km^2 and daily data seemed to be detailed enough. A similar effect was observed for predictive uncertainty bands, which were significantly reduced with finer data in small and medium size catchments, whereas they remained similar in larger catchments despite increasing the temporal resolution. Moreover, RB resulted in a better model performance for both high and low flows in small and medium size catchments, whereas a similarly good model performance was obtained with GSN in the larger catchments.