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Uncertainty guided discharge sampling in ungauged basins: an active-learning approach

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Obtaining discharge predictions in ungauged catchments remains to be challenging. This study addresses this challenge by assuming that it would be possible to take a limited number of discharge measurements in an ungauged catchment. More specifically, it is assumed that a water level sensor is installed during a first field visit and that discharge measurements are occasionally performed during follow-up visits. Here we present a novel approach to decide at which points in time these discharge measurements would be most informative for model calibration. First, a hydrological model is calibrated for the (almost) ungauged catchment using only the continuous water level information. Iteratively, the timing of the next discharge measurements is then chosen using the concept of active learning. Thereby, simulation uncertainty resulting from multiple model parameterizations indicates when additional discharge information is needed most to improve model predictions. We tested this approach for 100 catchments in the United States covering a wide range of hydroclimatic conditions. Results indicate that the prediction of discharge using solely water level information leads to a varying model performance. Including discharge information, which could be collected during a few strategically selected field visits, to the model calibration, can considerably improve the prediction accuracy. Overall, this study demonstrates the combined value of water level information and a few discharge measurements at strategically chosen points in time for discharge predictions in (almost) ungauged basins.