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Can citizens observe what models need? - Evaluation of the potential value of crowd-based hydrological observations

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The CrowdWater project explores opportunities for citizen science approaches in hydrology. Here, we present first results on one aspect of the project, namely the potential value of crowd-based stream level observations for model calibration. Hydrological models with a low number of parameters are often able to simulate streamflow reasonably well but rely on model calibration, which makes their use in ungauged basins challenging. Stream levels are easier to measure than streamflow and can be observed by citizen scientists. We recently demonstrated that stream level data, instead of streamflow data, are useful for constraining a simple runoff model. This suggests that if stream level observations are available for otherwise ungauged catchments, these data can be used to constrain a runoff model and to generate simulated discharge time series from the level observations. However, the challenge with crowd-based stream level data is that observations are taken at irregular time intervals and with a limited vertical resolution. The latter is especially the case at sites where no staff gauge is available and relative stream levels are observed based on (in)visible features in the stream, such as rocks. Here, we pretend that stream level observations are available at a limited vertical resolution by transferring the data into stream level classes. The model was calibrated with these hypothetical data sets and subsequently evaluated on the observed streamflow record. Our results indicate that stream level data can result in good streamflow simulations, even with a reduced vertical and temporal resolution of the level observations. Time series of only two stream level classes, e.g. above or below a rock in the stream, were already informative, especially when the class boundary was chosen towards the highest levels. There was some added value in using up to five stream level classes but hardly any improvement in model performance when using more classes. These results are encouraging for citizen science projects and provide a basis for designing observation systems that collect data that are as informative as possible for deriving model-based discharge time series for previously ungauged basins.