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Conditioning rainfall-runoff model parameter space to reduce prediction uncertainty in ungauged basins

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Prediction of streamflow for ungauged basins is associated with large uncertainty arising from input data, model structure, and parameter values. This paper investigates how conditioning the prior parameter space using regionalised indices of streamflow affects the prediction uncertainty for ungauged basins.
The main concept used is filtering out the rainfall-runoff model parameter sets that do not give estimates of streamflow indices close to the regionalised values. These values are calculated based on regression equations, and associated Gaussian error distributions, constructed from the relationship between physical catchment properties and streamflow indices at gauged sites. The performance of the model is measured by 1-NSE and 1-log(NSE) for high and low flow fitting accordingly, calculated on daily and on monthly intervals. Ability to capture streamflow and reduction in prediction uncertainty is judged by reliability and sharpness. The case study is the upper Ping River in Thailand and the spatially lumped IHACRES model is used.
Using the range defined by the regression at 95% confidence level of rainfall-runoff elasticity and base flow index to condition the prior parameter space is useful for reducing streamflow prediction uncertainty. The reliability obtained from conditioned parameter space is high, 73-99%, but the sharpness is low, 7-31%. It is suggested in this study that concurrently reaching the high sharpness and reliability is difficult, maybe due to poor data quality and high spatial variability of daily rainfall in this tropical region. The model usually overestimates peak flow throughout the period of simulation. The prior range of parameter values also contributes to the performance of the model but in this case rather wide prior parameter ranges are needed to accommodate all possible parameter values for all subcatchments which have various physical characteristics. The use of runoff coefficient to reduce uncertainty in streamflow prediction is considered not very useful because it usually yields very low reliability. The potential for improving quality of predictions through using satellite observatiions of rainfall, a more complex rainfall-runoff model, and using more streamflow indices is discussed.
However, this study is being continued with an attempt to reach higher reliability and sharpness. Performing the analysis based on coarser scale i.e. weekly or monthly can improve the reliability and sharpness.