A Bayesian Framework for PUB

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In an ungauged catchment runoff records are not available to calibrate hydrological conceptual models. Predictions in such case are usually facilitated using one of two approaches: 1) a priori estimation of model parameters, or/and 2) regionalisation of model parameters. For the latter, hydrological information may be transferred from gauged to ungauged catchments by regression of model parameters or hydrological response indices against catchment physical properties, or by a direct transfer of parameter sets between donor (gauged) and ungauged catchments.

In this study, we consider a variety of hydrological response indices aiming to provide insights into various aspects of catchment functional behaviour that can be used to restrict hydrologic model parameters and predictions. Response indices – such as runoff ratio, base flow index, slope of flow duration curve, flow elasticity - are regressed on catchment physiographical and meteorological characteristics. The error resulting from discrepancies between the regression and the real system is analysed for the purpose of error structure identification and prediction uncertainty estimation. Approaches previously reported in the literature treat each index separately and hence do not take into account the error covariance structure. When multiple response indices are considered, we propose to explicitly account for inter-index error covariance structure, so that regional information is neither double-counted nor neglected and a more formal estimate of uncertainty can be obtained. A Bayesian framework is employed to examine how multiple regionalised indices can be used to classify a catchment and restrict the rainfall-runoff model parameter space, and hence reduce uncertainty in predictions; and how the inter-index error correlations affect the results.

Application to catchments chosen from the Model Parameter Estimation Experiment (MOPEX) project is used to test the proposed methodological development.