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Bayesian conditioning of a rainfall-runoff model for predicting flows in ungauged catchments and under land use changes

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Land use and land management changes usually occur at relatively localised scales (e.g. fields), and therefore to model the catchment scale hydrological implications a distributed model is generally used. A physics based distributed model needs a large number of parameters to be specified and this may result in non-identifiability and insufficient prediction accuracy. Moreover, the land use change effects on physical properties are not generally well understood. Alternatively, a conceptual model has more parsimonious structure, but it is harder to parameterize, since the parameters correspond less directly to physical properties, and so regionalisation must be relied upon.
In our research, we use readily available indices that summarize hydrological system behavior depending on catchment geology, soils, land use and management, and therefore can be used to constrain a hydrological model for application to ungauged catchments or scenarios of change. We integrate information on Base Flow Index and Curve Number using a novel Bayesian conditioning scheme so that the overall response of the conditioned model is consistent with the information in the aforementioned indices. The approach is assessed on British catchments and used to predict effects of different land use scenarios on flood flow responses.