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The impact of prior parameter ranges on model behaviour using Global Sensitivity Analysis

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Hydrological models are typically calibrated on available streamflow data or, more rarely on other hydrologic variables (i.e. soil moisture, groundwater dynamics, etc.). Whilst the literature is increasingly extensive on the value of different hydrologic variables in constraining model predictions, less attention has been given on how to define plausible parameter prior distributions or how much such priors impact the range of model behaviour before further conditioning. This can be relevant to the uncertainty bounds of any model prediction or in regard to the amount of sensitivity of the model parameters to the chosen model outputs.
In this study, we combine four different conceptual hydrological models (HYPE, HYMOD, TUW, FLEX) with Global Sensitivity Analysis techniques to explore what are the most influential parameters and how the parameter priors impact model predictions. Our analysis focuses on 27 catchments across Europe, capturing a wide range of climates, vegetation and landscapes typologies in order to explore the effects of these physical and climatic properties on parameter prior distributions. Our findings provide new insights in the value of different sources of information for constraining hydrological model inputs, and for predicting water resource conditions in catchments worldwide.