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Modeling monetary damages due to floods and the impact of hydrologic uncertainty

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Flood damage assessment is of increasing importance in this era of hydrologic non-stationarity and climate change. Estimating the monetary damages associated with floods requires the specification of a flood damage model and a design peak flow within a catchment. However prediction or modeling of peak flows is subject to significant uncertainty associated with the selection and optimization of any hydrologic model and the lack of observations for rare events.

In this study, we make use of a recently developed uncertainty metric to evaluate the impact of hydrologic model uncertainty on economic flood damages. The metric, known as the Quantile Flow Deviation (QFD), expresses uncertainty in modeled flows as a function of flow quantiles. As such, the metric may be extrapolated to understand how uncertainty manifests in extreme events. We demonstrate the QFD metric for a given catchment and evaluate the potential impact of uncertainty on modeled peak flows. We examine this uncertainty as it is propagated through a flood damage model to estimate expected monetary damages. Overall, we demonstrate that an appropriate framework for estimating damage uncertainty is necessary in water resources planning for improved understanding of the economic impacts of extreme hydrologic events.