Neglecting model parametric uncertainty can drastically underestimate flood risks

Objective

Current approaches to estimate flood hazards often sample only a relatively small subset of the known unknowns such as model parameters. This neglects the impacts of key uncertainties on hazards and system dynamics. Here we mainstream a particle-based approach, previously developed with DOE support, to calibrate a computationally expensive distributed hydrologic model. We demonstrate some practical implications of neglecting key uncertainties on flood hazard and risk estimates.

Approach

We use FaMoS (Fast Model Calibrations), a sequential Monte Carlo particle-based approach, to improve the characterization of distributed hydrologic model parameters. We compare the results of this Bayesian approach to two simpler methods: stepwise line search and precalibration.

Impact

We quantify how neglecting model parametric uncertainty can drastically underestimate extreme flood events and risks. Applying state-of-the-art statistical methods can help to refine uncertainty characterization of flood damage projections.

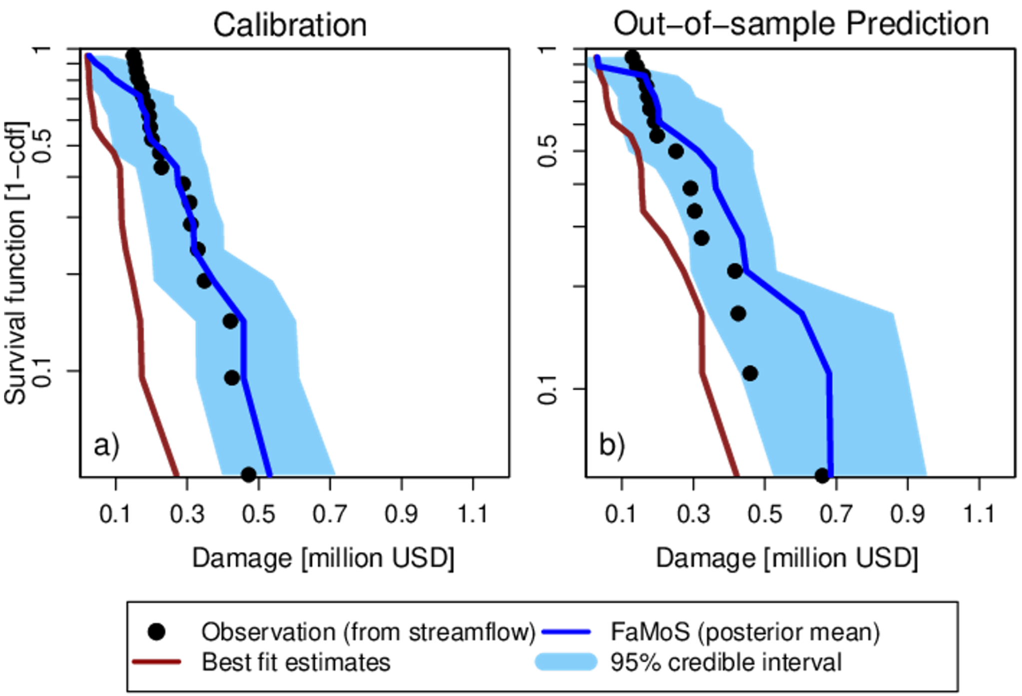

Figure: Survival function (one minus the cumulative frequency) for damage estimates using streamflow obtained using the best-fit parameter set (stepwise line search, dark red) and parameter distribution (FaMoS, blue). We show damage estimates for a) calibration and b) out-of-sample prediction. "cdf" is the cumulative distribution function.

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