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Deep uncertainty about the modes and tails of sea-level projections

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Sea-levels are generally rising around the world, posing nontrivial risks. Managing these risks hinges on sea-level rise projections and their associated uncertainties. Deriving sea-level projections presents nontrivial methodological challenges. Previous studies projecting sea-level rise have broken new ground, but typically adopt a single calibration method. Here we use a simple sea-level rise model to analyze and quantify the structural uncertainties driven by the choice of calibration method. In particular, we analyze a frequentist bootstrap method and a Bayesian approach (one with and one without the consideration of heteroskedastic errors). We show that the Bayesian approach with a heteroskedastic likelihood function performs best in hindcast experiments with respect to producing credible intervals with appropriate coverage. The choice of calibration method has considerable impacts on the modes and tails of the projections. Specifically, the modes vary across methods by more than 0.5 meters, in the year 2100. Arguably more important, the projected sea-levels with 1 in 100 and 1 in 10,000 exceedance probabilities vary by 2.5 and 3.5 meters. This structural uncertainty introduced by the choice of the statistical method has considerable implications for the design of sea-level rise adaptation strategies.