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A Simple Model Framework to Explore the Deeply Uncertain, Local Sea Level Response to Climate Change. A Case Study on New Orleans, Louisiana

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Sea-level rise threatens many coastal areas around the world. The integrated assessment of potential adaptation and mitigation strategies requires a sound understanding of the upper tails and the major drivers of the uncertainties.

Global warming causes sea-level to rise, primarily due to thermal expansion of the oceans and mass loss of the major ice sheets, smaller ice caps and glaciers. These components show distinctly different responses to temperature changes with respect to response time, threshold behavior, and local fingerprints.

Projections of these different components are deeply uncertain. Projected uncertainty ranges strongly depend on (necessary) pragmatic choices and assumptions; e.g. on the applied climate scenarios, which processes to include and how to parameterize them, and on error structure of the observations. Competing assumptions are very hard to objectively weigh. Hence, uncertainties of sea-level response are hard to grasp in a single distribution function.

The deep uncertainty can be better understood by making clear the key assumptions. Here we demonstrate this approach using a relatively simple model framework. We present a mechanistically motivated, but simple model framework that is intended to efficiently explore the deeply uncertain sea-level response to anthropogenic climate change. The model consists of 'building blocks' that represent the major components of sea-level response and its uncertainties, including threshold behavior.

The framework's simplicity enables the simulation of large ensembles allowing for an efficient exploration of parameter uncertainty and for the simulation of multiple combined adaptation and mitigation strategies. The model framework can skilfully reproduce earlier major sea level assessments, but due to the modular setup it can also be easily utilized to explore high-end scenarios and the effect of competing assumptions and parameterizations.