

Preparing for Local Sea-Level Rise: How Likely Are Surprises

Hans-Peter Plag, Climate Change and Sea Level Rise Initiative, Old Dominion University, Norfolk, VA, USA, hpplag@odu.edu

Stakeholders in the coastal zone, particularly the urban coasts, are turning to science to get information on the range of plausible 21st Century trajectories for Local Sea Level (LSL) rise. Many scientists and scientific committees respond to this knowledge need with a range of plausible trajectories (RPT) defined by a number of possible trajectories each corresponding to a certain scenario. Most often, these assessments take a starting point in the small number of trajectories provided by the IPCC for 21st Century Global Sea Level (GSL) rise. This approach uses an inherently deterministic thinking process. The resulting RPT, which can be quite large, is considered as reflecting “uncertainty in LSL projections.” Non-scientists often use the RPT to select a preferred and much narrower sub-RPT, for which they plan, or they use the “large uncertainty” to justify not taking measures to prepare coastal communities and infrastructure for a rising LSL. Often, science is asked to focus on a reduction of the uncertainties.

This approach has a number of problems: (1) The complexity of LSL as the outcome of many local, regional and global earth system processes, including anthropogenic processes, renders a deterministic approach to prediction invalid. (2) Most assessments of the RPT account for an incomplete set of relevant earth system processes, and for each processes make assumptions that (often arbitrarily) constrain the contribution from this process. (3) LSL is an inherently probabilistic variable that has a broad probability density function (PDF), with a complex dependency of this PDF on the PDFs of the many contributing processes. Selecting a narrow sub-RPT as a planning basis ignores the probability of the neglected tails of the PDF. In the case of LSL, the risk associated with these tails can be considerable.

In particular, the contribution from the large ice sheets has a PDF with low-probability high-impact tails that are generally neglected in deterministic LSL projections and in the sub-RPT used for coastal planning. Comparing the common LSL risk assessments to risk assessments for seismic and volcanic hazards, impacts of asteroids, or other natural and anthropogenic hazards indicates that the standard assessment not only neglect most of the low-probability, high-impact part of the PDF but also medium-probability, high-impact parts. This creates a high potential for “black swans” in the near future. These low or medium-probability events would challenge a global civilization depending on crucial coastal infrastructure with growing urban coasts built under the principle assumption that LSL will not change in the future much more than what this civilization experienced during the (geologically short) past.