Bringing order to the chaos of sea level projections

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In their effort to provide decisionmakers with insight into the consequences of climate change, climate researchers at NIOZ, Deltares and UU are bringing order to the large number of sea level projections, translating climate models to expected sea level rise. Their new overview study was published in the journal *Earth's Future*. These results offer tools for decision making on the shorter and longer term.

Aimée Slangen is a climate scientist at NIOZ and co-author of the IPCC climate report. Together with climate adaptation experts Marjolijn Haasnoot and Gundula Winter from Deltares and Utrecht University, both also IPCC authors, Slangen investigated the similarities and differences between the many sea level projections published in recent years.

Eight families

"We found that the set of more than 80 different projections can be reduced to eight 'families'," says Slangen. "Within each of the families of projections that we identified, researchers have often used similar data, but they have for instance used different model approaches. As a result, every new publication resulted in different amounts of projected sea level rise, depending on whether the publication focused on the shorter term or the longer term, or depending on the models used to estimate the processes causing a potentially large contribution of accelerated melting of the Antarctic ice sheet."

These details are interesting for scientists, but make it more difficult for users to maintain overview. Slangen says that "this can be an issue when you have to decide as a government what you are going to do to protect your coasts from rising sea levels. Decision makers can't adjust their policies with every new publication."

Half a meter rise before the end of the century

The researchers hope to dispel this doubt, as all families paint a similar picture for the first 50 cm of sea level rise. Slangen says that "we will see the first half-meter rise before the end of this century, even if we start reducing greenhouse gas emissions on a large scale. For this period, it therefore makes little difference which family you use for sea level

projections."

According to adaptation expert Haasnoot, this therefore means that we can already start adapting to the consequences of sea level rise now. "Those who have to make the climate-proof decisions can already get started. However, it is important to take into account the uncertainty of the future. If you plan cleverly, you make sure that what you are doing now for a half meter sea level rise can be adjusted later for one meter. That will save a lot of money and effort."

Models and emission scenarios

The larger the sea level rise, the more diverse the eight families become. Slangen says that "from 75 cm to one meter sea level rise, it matters more which model approach you use and which climate scenario you follow. While such larger values are only exceeded in the long term, they can inform adaptation decision making already for the medium term. Each family is valuable for a specific situation and at what point certain threshold values are exceeded."

Haasnoot adds that "in a vulnerable area, for example, you might choose a family with a large acceleration in the contribution of Antarctic melt. Many major world cities, such as London, New Orleans and Rotterdam, are in vulnerable areas. In such mega-deltas, relative sea level rise is even faster because of the land subsidence caused for instance by groundwater extraction."

Flowchart

In their publication, the authors present a flow chart that policymakers can use when deciding when and how to adjust, while taking into account the range of uncertainty in sea level projections. "For example,

the timing of these sea level values can be used to estimate until when a measure will remain effective," says Haasnoot. But vice versa as well: given a desired lifespan, you can use these values to design a protective measure.

Slangen concludes that "for the first 25 centimeters of sea level rise, the bandwidth of the timing is small: the projections show that this will happen before 2060. Half a meter rise will be reached before the end of the century. The larger the sea level rise, the larger the uncertainty. Depending on the family, 1.5 to 2 meter rise can be reached by the year 2100, but it could also be 2200 or later."

More information: A. B. A. Slangen et al, Rethinking Sea-Level Projections Using Families and Timing Differences, *Earth's Future* (2022). DOI: 10.1029/2021EF002576

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