A flexible, web-based tool for assessing changes in the frequency of high-tide flooding events during the 21st century

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1. Probabilistic projections of high tide flooding frequency

Probabilistic projections of high tide flooding days per year were produced from joint analysis of:

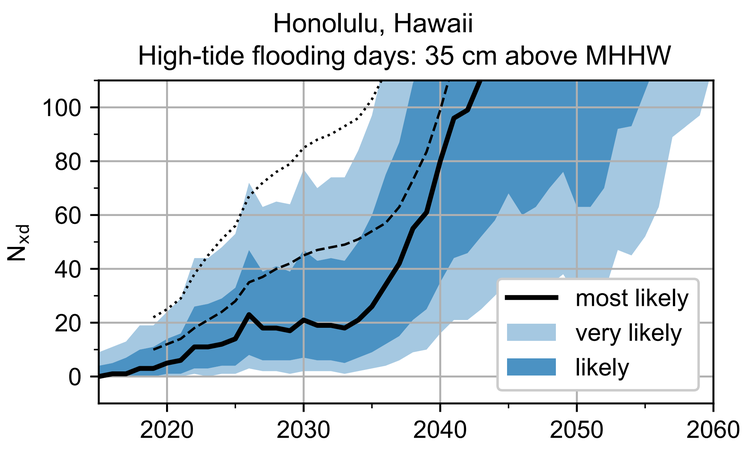
- Projections of local mean sea level (Kopp et al. 2014; Sweet et al., 2017)
- Deterministic tidal predictions including long-period modulations of tidal amplitude (e.g., 18.6-year nodal cycle)
- Gaussian process representations of annual and longer periodicities of sea level variability
- A statistical model that better accounts for overdispersion of events/year compared to Poisson

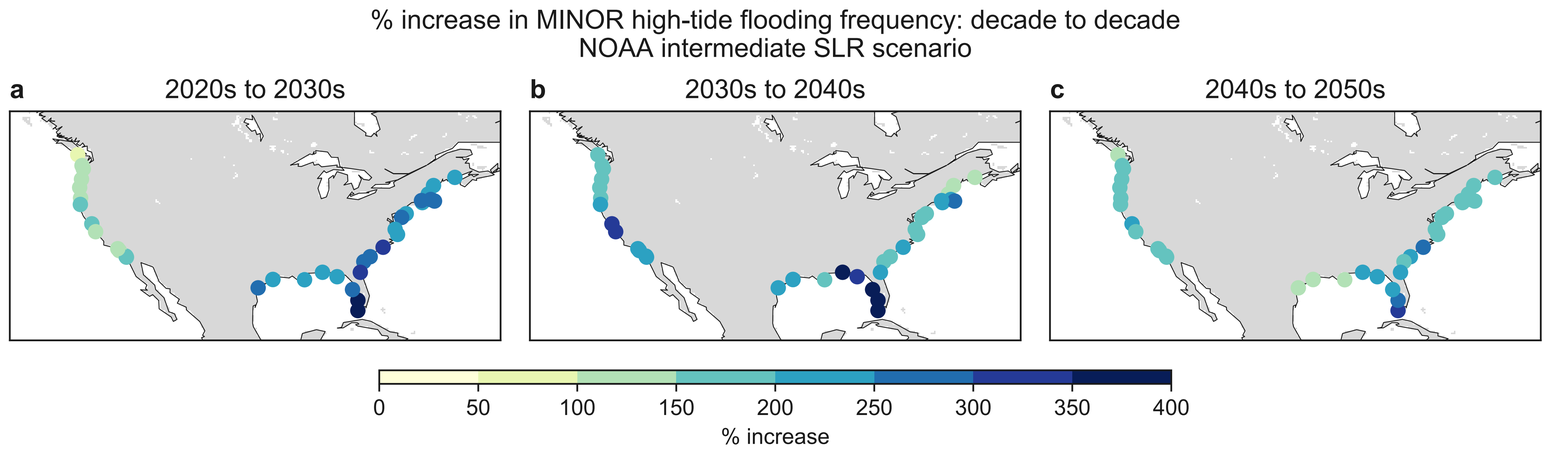
The projection framework was developed for Honolulu, Hawaii (Thompson et al., 2019). Decadal inflections in the number of high-tide flooding days above the threshold are due to the interaction between sea level rise and long-period tidal modulations.

For complete methodological details see: Thompson, P.R., Widlansky, M.J., Merrifield, M.A., Becker, J.M., and Marra, J.J. (2019), A statistical model for frequency of coastal flooding in Honolulu, Hawai'i during the 21st century, J. Geophys. Res. Oceans, 124, https://doi.org/10.1029/2018JC014741

The analysis has been extended to a subset of U.S. tide gauge locations:

- The frequency of minor high-tide flooding over the contiguous U.S. as a whole will roughly double during each of the next three decades (not shown). The doubling from one decade to the next is independent of sea level rise (SLR) scenario.
- Some areas—in particular those affected by long period tidal modulation—will experience more rapid increases in the near future. The frequency of minor high-tide flooding in central California will increase by more than 300% from the 2030s to the 2040s, while the frequency in the eastern Gulf of Mexico will increase by more than 400% during the same period.





2. Web-based analysis tool

Annual projections. Results for a subset of U.S. locations have been aggregated into prototype web tool. The tool was developed as part of a project for the NASA Sea Level Change Team. The final product will be hosted on https://sealevel.nasa.gov.

- Select from locations along U.S. coastlines
- Flooding threshold is flexible and can be adjusted to reflect locally relevant elevations
- Threshold in this example is set to 53 cm above MHHW, which is the derived NOAA minor flooding threshold for St. Petersburg, FL (Sweet et al., 2017).

Decadal projections. Decadal projections provide estimates of number of days per year experiencing high-tide flooding for (1) the average year in each decade and (2) the maximum year in each decade.

- Planning for the average year may severely underestimate the number of high tide flooding days experienced in any given year.
- For example, under the NOAA intermediate SLR scenario, the average year in St. Petersburg, FL during the 2030s will experience about 20 days of minor high-tide flooding. The worst year, however, will experience around 40.

Ancillary calculations. The probabilistic nature of the projections allows for ancillary calculations that help interpret the results.

- The tool provides the ability to estimate the first year that N days experience high tide flooding above the chosen threshold.
- The tool also provides estimates for the transition period from occasional to chronic flooding above the chosen threshold.
- Such transitions typically occur over 10–15 years, suggesting that planning for chronic flooding above a relevant threshold must begin decades before chronic flooding becomes reality.