Metadata for: Sea Level Rise

Sectors
Agriculture,Forestry,Coastal Zone,Economy,Local Government,Natural Resources/Habitats,Public Health,Public Safety/Emergency Response,Recreation,Infrastructure,Water Resources

Source
University of Massachusetts – Amherst

Data Description
Future sea level projections are provided for the Massachusetts coastline at established tide gauge stations with long-term records at Boston Harbor, MA; Nantucket, MA; Woods Hole, MA; and Newport, RI. The projections shown in this map layer are adjusted to each station's mean sea level and converted to the North American Vertical Datum of 1988 (NAVD88).

The sea level projections are based on a methodology which provides complete probability distributions for different greenhouse gas concentration trajectories (referred to as representative concentration pathways, or RCPs)[1]. This approach was utilized for the recent City of Boston's sea level rise projections in 2016[2] and similar analyses done for the states of California (2017)[3] and New Jersey (2016)[4].

The analysis for Massachusetts (DeConto and Kopp, 2017)[5] consisted of a probabilistic assessment of future relative sea level rise at each tide gauge location given two future atmospheric greenhouse gas concentration pathways, medium (RCP4.5) and high (RCP8.5)[6], and for two methods of accounting for Antarctic ice sheet contributions to sea level rise: one based on expert elicitation (Kopp, 2014[1]) and one where Antarctic ice sheet projections are driven by new, process-based numerical ice sheet model simulations (DeConto and Pollard, 2016[7]; Kopp, 2017[8]). Relative sea level is the local difference in elevation between the sea surface and land surface. A multi-year reference time period for relative sea level was used to minimize biases caused by tidal, seasonal, and inter-annual climate variability, following the accepted practice of using a 19-year tidal datum epoch[9] centered on the year 2000 as the 'zero' reference for changes in relative sea level rise. To account for the 'zero' reference point utilized for the models and to provide elevations on a common geodetic datum, sea level rise model projection values at each tidal station were adjusted to the station's mean sea level as computed for the 19 year tidal datum epoch of 1999-2009 and converted to NAVD88.

Following the approach in the 2017 National Climate Assessment (NCA)[10] and the Global and Regional Sea Level Rise Scenarios for The United States[11], conditional probability distributions for sea level rise projections can be integrated into different scenarios to support planning and decision-making, given uncertainty and future risks. This approach allows for the many different

probabilistic projections (i.e., two models each using two greenhouse gas concentration pathways for multiple time series and several probabilities groups) to be filtered into four scenarios. Under this approach, each of the scenarios—Intermediate, Intermediate-High, High, and Extreme—is cross-walked with two or three probabilistic model outputs *(see Table 1 for definition of scenarios and projections shown in this map layer)*. These values are consistent with the 2017 NCA global mean sea level values.

Collectively, these sea level rise projections provide the background sea level estimates that can be used for detailed, site specific hydrodynamic modeling[12] to map storm surge impacts and influences of localized processes along the coast. On their own, while they are not site-specific projections of mean higher high water levels, these projections provide insight to overall trends in rising sea levels along the Commonwealth coastline, to help coastal municipal officials and workshop participants identify future hazards exacerbated by rising seas.

Relative mean sea level (feet NAVD88)	
Scenario	**Cross-walked probabilistic projections**
Intermediate	Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5)
	• Extremely unlikely to exceed (95% probability) given a medium emissions pathway (RCP 4.5) • Unlikely to exceed (83% probability) given a medium emissions pathway (RCP 4.5) • About as likely as not to exceed (50% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible ice sheet instabilities
Intermediate - High	Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP 8.5)
	• Unlikely to exceed (83% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible ice sheet instabilities • About as likely as not to exceed (50% probability) given a high emissions pathway (RCP 8.5) when accounting for possible ice sheet instabilities
High	Extremely unlikely to exceed (99.5% probability) given a high emissions pathway (RCP 8.5)
	• Unlikely to exceed (83% probability) given a high emissions pathway (RCP 8.5) when accounting for possible ice sheet instabilities • Extremely unlikely to exceed (95% probability) given a medium emissions pathway (RCP 4.5) when accounting for possible ice sheet instabilities
Extreme (Maximum physically plausible)	Exceptionally unlikely to exceed (99.9% probability) given a high emissions pathway (RCP 8.5)
	• Extremely unlikely to exceed (95% probability) given a high emissions pathway (RCP8.5) when accounting for possible ice sheet instabilities

Table 1: Definitions of relative (or local) mean sea level projections based on four National Climate Assessment global scenarios with associated probabilistic model outputs from the Northeast Climate Science Center. Each of the scenarios—Intermediate, Intermediate-High, High, and Extreme—is cross-walked with two to three probabilistic model outputs. The shaded probabilistic output for each scenario (e.g., Unlikely to exceed [83% probability] given a high emissions pathway [RCP 8.5] for the Intermediate scenario) is reflected in the projection tables and visualizations for this map layer. Sea level projections at each tide station in this map layer are referenced to the North American Vertical Datum of 1988 (NAVD88).

References

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[9] A tidal datum epoch is a 19-year astronomical cycle over which tidal height observations are taken and reduced to obtain mean values in order to establish the various datums (e.g., mean sea level, mean higher high water, etc.)(NOAA Tides and Currents).

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