Projected Coastal Flooding

Indicator Names

- *% Projected Coastal Flooding in Watershed (WS), 2-Foot Sea Level Rise*
- *% Projected Coastal Flooding in Watershed (WS), 10-Foot Sea Level Rise*

Indicator Category | **Stressor**

Subcategory | *Flood Inundation Risk*

Available in RPS Tool files for all lower 48 states

Indicator Description

Background

Sea level rise (SLR) refers to an increase in average ocean depth over time. SLR is primarily driven by the melting of sea ice and thermal expansion of water due to warming conditions.[1] The Fourth National Climate Assessment, completed by the US Global Change Research Program, reports that the global average sea level could rise by approximately eight feet by the year 2100.[1] Global SLR projections can translate to higher or lower local SLR projects due to location-specific conditions.[2] Local SLR along the Chesapeake Bay, for example, has been estimated to occur at roughly twice the global average.[2]

As ocean levels rise, *coastal flooding* occurs when areas that were previously above water become periodically flooded during high tides or permanently submerged. Projections of coastal flooding provide an understanding of the area potentially impacted by SLR.

What the Indicators Measure

These indicators measure the projected extent of coastal flooding in a HUC12 subwatershed* due to SLR:

- ***% Projected Coastal Flooding in Watershed (WS), 2-Foot Sea Level Rise*** – area that is projected to be inundated with water due to a 2-foot rise in local sea level in the HUC12 (Figure 1). Reported as a percentage of the total HUC12 area.
- ***% Projected Coastal Flooding in WS, 10-Foot Sea Level Rise*** – area that is projected to be inundated with water due to a 10-foot rise in local sea level in the HUC12. Reported as a percentage of the total HUC12 area.

Relevance to Water Quality Restoration and Protection

Climate scientists expect that SLR may continue throughout the 21st century due to global warming.[3] Watersheds that are projected to have rising sea levels are likely to experience more frequent and severe tidal flooding events.[1] During floods, water picks up chemical contaminants, soil particles, and other debris from the landscape and transports them into nearby waterbodies where they can be harmful to the health of humans and aquatic organisms.[4] Coastal flooding may also disrupt operations at sewage treatment plants and related facilities,[5] leading to the discharge of inadequately treated wastewater into surface waters. Such SLR impacts can be compounded by other flood-related hazards such as hurricanes, tropical storms, and riverine flooding.[6,7]

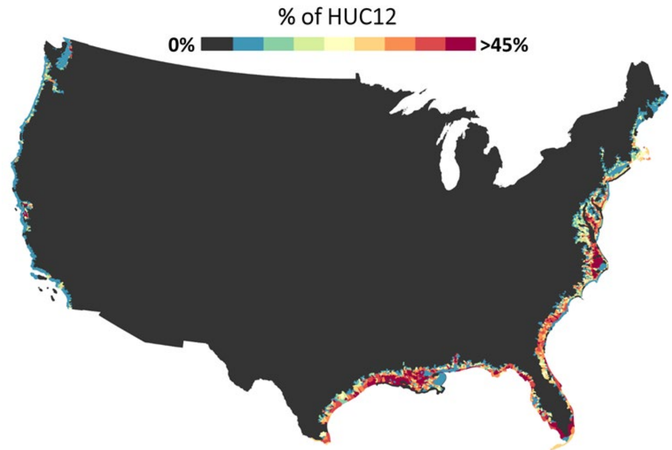

*Figure 1. Map of **% Projected Coastal Flooding in Watershed, 10-Foot Sea Level Rise** for HUC12s in the contiguous US.*

SLR can negatively affect fish and other aquatic species as sea water moves inland.[8] Freshwater species that are acclimated to low salinity levels may encounter shrinking habitats with SLR and may need to migrate upstream to avoid encroaching sea water.[8] Saltwater intrusion into coastal rivers and groundwater can also affect drinking water supplies and potentially require increased treatment to address excess salinity.[8]

Rising water levels are also expected to drive a loss in coastal wetlands. Coastal wetlands have an important role in storing floodwaters and breaking down pollutants[9-11], and their loss could contribute to the degradation of adjacent ocean environments.[12]

These indicators can be used to identify HUC12s that are projected to experience coastal flooding due to SLR and to assess the vulnerability of HUC12s to future degradation due to climate change. An assessment of watershed vulnerability may incorporate additional indicators, such as the percentage of impervious cover or recent trends in developed land uses, that characterize the sensitivity of watershed processes and aquatic ecosystems to SLR to gain a more complete picture of the likelihood of climate change impacts on watersheds.

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* HUC12s are subwatershed delineations in the National Watershed Boundary Dataset. HUC12s are referenced by their 12-digit Hydrologic Unit Code.

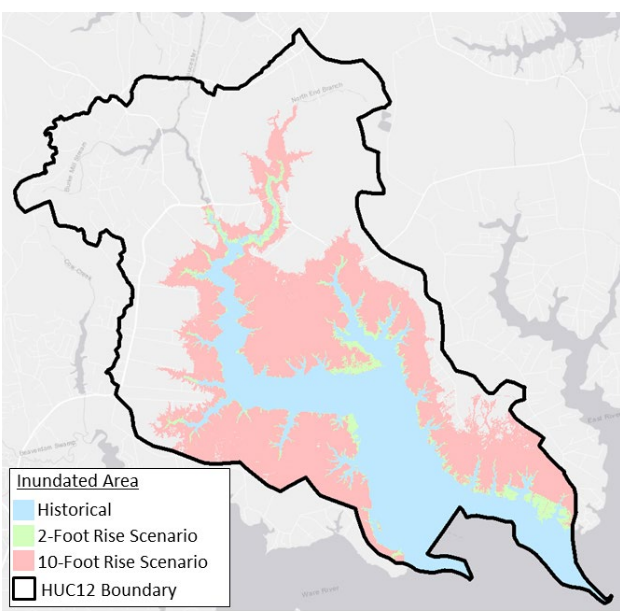
Processing Method

These indicators are derived from projections developed by the National Oceanic and Atmospheric Association (NOAA) of future coastal inundation due to SLR. The projections consist of map layers that depict the extent of coastal inundation during historical sea levels (circa-2000) and at various depths of local SLR. The maps of coastal inundation are based on the historical sea surface and coastal topography.[13]

Coastal water levels vary continuously with daily tides, and scientists have developed a variety of benchmarks that account for this variation to allow for analysis of sea level changes over time. The NOAA projections describe SLR relative to a benchmark known as the Mean Higher High Water (MHHW) mark. The MHHW is the average depth of the highest water level recorded each day at a tidal station over time. Thus, a 2-foot SLR would be indicative of a 2-foot increase in the average daily high tide water level.

Map layers of historical coastal inundation and inundation under the 2-foot SLR scenario and the 10-foot SLR scenario were acquired from NOAA in March 2021. Each map layer was overlaid with HUC12 boundaries to calculate inundated areas per HUC12 for the historical and SLR scenarios (Figure 2). Indicator values were then calculated as the change in inundated area for each SLR scenario relative to historical conditions, expressed as a percentage of total HUC12 area. For example, *% Projected Coastal Flooding in WS, 2-Foot Sea Level Rise*, was calculated for each HUC12 as:

$$\frac{\text{2-Foot SLR Inundated Area - Historical Inundated Area}}{\text{HUC12 Area}} \times 100$$



Limitations

- NOAA projections of coastal inundation incorporate available data on levee locations and heights but do not reflect a detailed accounting of drainage and flood protection systems in a given area. The projections also do not consider future shoreline changes that can occur with rising sea levels, which may affect inundation patterns. The projections are therefore intended to be used for planning and awareness rather than site-specific applications, such as engineering designs or navigation.
- Portions of Florida, Maryland, Texas, and Washington lacked sufficient coastal elevation data for inundation mapping by NOAA. Inundation mapping was also not completed beyond an inland boundary established by NOAA. HUC12s were assigned blank values of these indicators if coastal inundation was unmapped for more than 50% of the HUC12 area.
- The 2-foot and 10-foot SLR scenarios selected for these indicators correspond to high-end projections of potential global SLR by 2050 and 2100, respectively.[3] Readers can explore the NOAA Sea Level Rise Viewer (https://coast.noaa.gov/slr) to better understand the timing and likelihood of 2-foot and 10-foot SLR in their area of interest.

Links to Access Data and Additional Information

HUC12 indicator data can be accessed within the EPA Restoration and Protection Screening (RPS) Tool, in downloadable data files, or as a web service. Visit the EPA RPS website for links to access the RPS Tool, HUC12 indicator database, and web service.

The projections of coastal flooding used to calculate these indicators can be accessed from the NOAA Sea Level Rise Viewer.

References

[1]USGCRP. 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II.

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[9]Fisher, J. et al. 2004. Wetland nutrient removal: a review of the evidence. *Hydrol. Earth Syst. Sci*. 8(4): 673-685.

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[12]Raposa, K., et al. 2016. Assessing tidal marsh resilience to sea-level rise at broad geographic scales with multi-metric indices. *Biological Conservation*. 204: 263-275.

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