CLIMATE CENTRAL

Sea level rise and coastal flood risk:
Summary for Glen Burnie, MD

This document is meant as a one-stop summary and brief guide that integrates key findings, methods, interpretation and links from Climate Central's Surging Seas Risk Finder into one narrative. It stands alone or as a jumping-off point.

Sea level rise and flood forecast

Even small amounts of sea level rise make rare floods more common by adding to tides and storm surge. Climate Central has estimated risk by combining local sea level rise projections with historic flood statistics from the NOAA water level station at Baltimore, MD, 8 miles from the center of Glen Burnie. For reference, our extreme values analysis indicates that the "100-year" flood height, is 5.3 feet above local Mean Higher High Water (high tide line)[1]. The highest observed flood at this location, in records from 1902 to 2015, reached 6.49 feet MHHW in 2003. Taken all together, these values suggest that floods above 6 feet likely pose significant concerns.

Based on the National Climate Assessment intermediate high sea level rise scenario, we project 4.2 feet of rise locally by 2100, from a 1992 baseline. Our analysis translates this to 12 percent multi-year risk of at least one flood exceeding 6 feet from 2016 to 2030, a 33 percent risk by from 2016 to midcentury, and a 100 percent risk by 2100. Under the Assessment's highest scenario, these chances increase to 13, 42, and 100 percent, respectively, and we compute a 88 percent risk of at least one flood exceeding 9 feet by the end of the century.

Risk Finder's forecast tool allows exploration of a wide range of other flood heights (1-10ft), risk statistics (e.g., annual flood risk), and localized sea level projections (with choice of scientific models and climate pollution scenarios). See Methods section below for more discussion of the research approach used and important guidance on how to interpret results.

Map and exposure analysis

Understanding exposure to sea level rise and floods requires a good map. Climate Central combined tidal elevation models and lidar-based (laser-based) elevation data supplied by NOAA, plus levee location data from FEMA, to identify both fully exposed and potentially protected land less than 1-10 feet above the local high tide line.

Climate Central's interactive, embeddable online Risk Zone Map shows exposed areas and how they intersect with population density, social vulnerability, property value, and more.

Risk Finder also shows exposure at each water level for dozens of variables, based on data from over ten federal agencies. Here are a few values for Glen Burnie on land below 6 feet MHHW, in total and excluding land that may be protected by levees or isolation:

Variable	Total Exposure	Excluding isolated areas
Acres of land	167	123
Population	387	274
High social vulnerability pop.	38	33
Housing units	173	130
Property ($ billions)	0.1	0.1
Road miles	1	1
EPA-listed sites	0	0
Schools	0	0

At 9 feet, 657 people (1.0 percent of the total population in Glen Burnie) and $174 million are exposed in total.

Risk Finder offers comprehensive downloads of exposure tables as well as lists of facilities that may be affected, and data sources and methods descriptions for each variable. See Methods section below for more discussion of the general research approach used and important guidance on how to interpret results.

Comparison

Threats vary from place to place. With heat maps and rankings, Risk Finder's comparison module supplies wider regional context for exposure of each variable analyzed, and at any water level.

For example, Glen Burnie is in the top half of Cities in MD for total exposure of homes on land below 6 feet for cities under 100,000 in population. Glen Burnie is if ranked by its *percentage* of homes exposed, and it is in the top half if all Cities are ranked by exposure after excluding areas that appear isolated or protected.

The comparison tool simply offers a different presentation of exposure analysis. Therefore the same methods and interpretative notes apply.

Methods and interpretation

Sea level rise and flood forecast

The projections described here and in Surging Seas Risk Finder are based on analysis specific to a selected water level station site. They may or may not indicate nearby area risks, such as a specific location in Glen Burnie. Local sea level rise projections are generally similar across neighboring areas. Flood risks can more easily vary across short distances, due to details of local topography and bathymetry and typical storm paths. Tool settings (under "When are the Risks?") allow comparison of results across multiple regional water level stations, to check for general consistency or differences.

The basic methods for this analysis follow Tebaldi et al (2012), plus simple extensions for computing cumulative flood risk. Furthermore, the current analysis improves local accuracy by employing all verified historic hourly water level data available at each NOAA water level station through 2015, instead of limiting inputs to a standard 30-year period as in Tebaldi et al.

Note that our analytic approach assumes that the storms of the future will resemble the storms of the past. However, research suggests that intense storms and surge will become more severe, possibly rendering the flood risk estimates here too low.

Map and exposure analysis

The basic methods for this analysis follow Strauss et al (2012), but using updated elevation data and incorporating levees. Flood maps are based on NOAA-supplied lidar elevation data and achieve near-perfect consistency with NOAA's Sea Level Rise and Coastal Flooding Impacts Viewer over the two products' shared elevation range (1-6 feet MHHW). Climate Central's analysis adds elevation data from USGS to fill rare gaps or to make rare updates after newer lidar data become available. We also supplement FEMA's Midterm Levee Inventory, the best available national dataset but known to be partial.

Exposure values indicate what sits on land below the selected water level (elevation), computed both with and without accounting for potential protection. They aim to illustrate general exposure to future sea level rise and coastal flooding -- not specify actual impacts or damages, or precisely "what will flood." Complicating factors include:

Protection. Levees, walls, dams, ridges, or other features may protect or isolate some areas, e.g. block hydrologic connectivity, especially at lower elevations, e.g. 10-year flood heights. Data limitations, such as incomplete levee data, and elevation data too coarse to capture narrow seawalls, make assessing protection difficult. However, the online tool allows toggling between including or excluding potentially protected areas from analysis. In assessing protection, we assumed levees are always sufficiently tall and strong, because data on height and condition were not available. Unmapped culverts, sewer lines, other connectivity, or rainwater unable to drain during coastal storm events, may also compromise apparently protected areas. Total and unprotected exposure values likely bracket the actual exposure from sea level rise and coastal flooding at any given water level.

Bathtub method. Employing elevation relative to local high tide lines (MHHW), this analysis uses near-flat water surfaces statewide to compare exposure. Actual storms create uneven flooding in limited areas.

Elevation error. The laser-based "lidar" elevation data used in this tool includes error. In rare cases, localized error may make large low-lying areas appear mistakenly connected to -- or isolated from -- the ocean at a particular water level.

Dynamics. This analysis does not account for future erosion, marsh migration, coastal development, coastal defense, or other dynamic factors that may affect exposure.

Feature representations. Available data represent most features (e.g. schools, roads) using simple point or line coordinates. Most exposure assessments thus cannot account for full structure or site footprints. Available data represent density variables (e.g. population) as totals within minimum Census units (e.g. blocks). The analysis treats each unit's total as spread out evenly within the unit's dry land area. Methods notes for each potential impact category listed in the online analysis tool provide further detail.

Citation

Climate Central (2016). Sea level rise and coastal flood exposure: Summary for Glen Burnie, MD. Surging Seas Risk Finder file created July 21, 2016. Retrieved from http://ssrf.climatecentral.org.s3-website-us-east-1.amazonaws.com/Buffer2/states/MD/downloads/pdf_reports/Town/MD_Glen_Burnie-report.pdf

File details

- Creation date: July 21, 2016
- Name: Summary for Glen Burnie, MD
- File URL: http://ssrf.climatecentral.org.s3-website-us-east-1.amazonaws.com/Buffer2/states/MD/downloads/pdf_reports/Town/MD_Glen_Burnie-report.pdf
- Download from: ssrf.climatecentral.org/#p=L&state=Maryland&location=MD_Town_2432650

Footnotes

1. All elevation and flood height values in this document and the tool are given in reference to Mean Higher High Water (informally, the "high tide line") -- the average of each day's higher high tide over the most recent national "tidal epoch," 1983-2001.

Main references

Strauss, B. H., Ziemlinski, R., Weiss, J. L., & Overpeck, J. T. (2012). "Tidally adjusted estimates of topographic vulnerability to sea level rise and flooding for the contiguous United States." *Environmental Research Letters*, 7(1), 014033. Link

Tebaldi, C., Strauss, B. H., & Zervas, C. E. (2012). "Modelling sea level rise impacts on storm surges along US coasts." *Environmental Research Letters*,7(1), 014032. Link

Disclaimer

All content found herein is provided solely for personal informational purposes and is provided "AS-IS." You acknowledge and agree that your use and possession of this content is subject to, and you agree to the provisions set forth in, Climate Central's Terms of Use and Privacy Policy (both at http://www.climatecentral.org/about/legal) and Surging Seas Disclaimer (http://sealevel.climatecentral.org/about/disclaimer).