Data Documentation

Dataset Information
Dataset Title:

NCCOS Assessment: Community Assessment to Flood Hazard in the United States Virgin Islands, 2023-01-01 to 2024-08-30

Description:

This dataset includes estate level component scores of various indices from the National Centers for Coastal Ocean Science (NCCOS) Community Assessment to Flood Hazard in the United States Virgin Islands (USVI). Indices include social vulnerability, structural vulnerability (and sub-indices), structural exposure (and sub-indices), nearshore environment protection benefits, compounded flood hazard, waterborne toxins and contaminants, vegetation, and potential walkability. Each component score is aggregated to the estate level geography provided by the U.S. Census Bureau. Additionally, intermediary raster-based datasets on stormwater flooding potential, compounded flooding (both near-term-moderate and projected-high), orbital velocity data, a Shannon land use diversity index, and a Visible Atmospherically Resistant Index (VARI) are included.

For full dataset methods please see the NOAA Technical Memorandum NOS NCCOS 334 at https://repository.library.noaa.gov/view/noaa/66566.

Purpose:

The U.S. Virgin Islands (USVI) are particularly vulnerable to natural hazards such as erosion, hurricanes, and flooding. These risks are exacerbated by climatic events that contribute to increased storm intensity and extreme weather patterns, including droughts and heavy rainfall. While climate change is a global crisis, its impacts on the USVI are especially severe due to the territory's small size, geographic isolation, and reliance on imported goods. Social determinants of vulnerability—such as economic disparities, limited access to resources, and historical inequities—further compound these challenges. Underserved and historically marginalized communities across the territory often face heightened risks and reduced capacity to prepare for or recover from such hazards. To address these critical issues, the National Centers for Coastal Ocean Science (NCCOS) conducted a place-based, integrated community vulnerability assessment at the estate level to support communities in the USVI.

Project Page:
https://coastalscience.noaa.gov/project/assessing-community-vulnerability-to-flood-hazard-in-the-u-s-virgin-islands/

Methods:

This assessment used a geospatial, indicator-driven approach to integrate data from a variety of sources related to community vulnerability in the USVI. These data included measures of social and structural vulnerability and exposure, the nearshore environment, flood hazards, waterborne toxins and contaminants, vegetation, and potential walkability. These indicators were based on territorial needs, existing research, local stakeholder feedback, and data feasibility checks. Each component was analyzed using publicly available data, renormalized using a min-max normalization method, and aggregated to

estate-level geographies. These were then categorized into statistical quantile breaks to show relative rankings across the territory. This integrative approach supports bivariate choropleth mapping for highlighting areas of co-occurrence and prioritization and also highlights estate-level hazard and vulnerability. Additionally, several raster based indices were created in this assessment.

Stormwater flooding potential was calculated using an application of the "FIGUSED" methodology (Kazakis et al., 2015) based on locally relevant datasets. This methodology incorporates seven indicators frequently used to identify areas of high flooding potential, These indicators are: "F" – flow accumulation, "I"– rainfall intensity, "G" – geology (hydrologic soil groups), "U" –land use, "S" – slope, "E" – elevation, and "D" – distance from the drainage network. For each of these indicators, a value of 1 corresponds to higher flood potential, while values closer to zero (or null) correspond to lower flood potential. The final raster dataset ranges from 0-7 and all data were resampled to a 10 meter resolution grid.

Two compounded flooding scenarios were developed in this assessment (1, flood_nm_n.tiff) near-term-moderate compounded flooding (current sea level with additive stormwater flooding potential and Category 3 storm surge) and (2, flood_h_n.tiff) projected-high compounded flooding (additive projected sea level rise, stormwater flooding potential, Category 5 storm surge). Data inputs come from the FIGUSED stormwater potential (figused.tiff), NOAA Office for Coastal Management, and the Category 3 and 5 storm surge models from the NOAA National Hurricane Center. Final values were normalized 0-1 and resamples to a 10 meter resolution grid.

Significant wave height and wave period were obtained from Caribbean Coastal Ocean Observing System (CARICOOS) Simulating Waves Nearshore (SWAN) simulations for 2012–2021 at 0.01° spatial resolution and 3-hr temporal resolution. Model output was averaged by calendar day, then by calendar month, and then across months. The resulting annual mean values were reprojected with linear interpolation to match high-resolution (approximately 10 m) bathymetry grids for St. Thomas/St. John and St Croix. Wavelength was calculated using Hunt's approximation (Coastal Engineering Research Center, 1985), and representative (i.e., root mean square) orbital bottom velocity was calculated with significant wave height limited to 0.78 x bottom depth (due to wave breaking), following Wiberg and Sherwood (2008). Final values were normalized 0-1 and resamples to a 10 meter resolution grid.

Land use data from the NOAA Coastal Change Analysis Program (NOAA Office for Coastal Management, 2015) were used to calculate a Shannon diversity index as follows: $H = -\Sigma (pi * \ln(pi))$. The final raster dataset was resampled to a 10 meter resolution grid resulting in a final Shannon diversity index with normalized values from 0-1.

Orthographic Imagery from 2020 with sub-meter precision (USVI Hazard Mitigation and Resilience Plan, 2023) were used to calculate a Visible Atmospherically Resistant Index (VARI) equation as follows: (Green-Red)/(Green+Red-Blue). The final raster dataset was normalized 0-1 and resampled to a 10 meter resolution grid resulting in a final vegetation index.

For a full methodological write-up, please see the NOAA Technical Memorandum NOS NCCOS 334 at https://repository.library.noaa.gov/view/noaa/66566.

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- U.S. Virgin Islands Lieutenant Governor's Office
- U.S. Virgin Islands National Park Service
- U.S. Fish and Wildlife
- U.S. Geological Survey
- National Sea Grant Program
- NOAA's Office for Coastal Management
- NOAA's Southeast Fisheries Science Center

Funding:
- U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, National Centers for Coastal Ocean Science

Extents:

Start Date:	2023-01-01
End Date:	2024-08-30

Northern Boundary: 18.4419148°N

Southern Boundary: 17.6507787°N
Western Boundary: 65.4089351°W
Eastern Boundary: 64.2196511°W

Data Sources:

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Associated Online Resources:

- https://coastalscience.noaa.gov/project/assessing-community-vulnerability-to-flood-hazard-in-the-u-s-virgin-islands/

Keywords:
Sea Areas, Water Bodies, Marine Protected Areas:

- USVI, Climate Vulnerability, Caribbean

NOAA Ships, Other Ships, Platforms:

- n/a

NCCOS Keywords: *(see Appendix for NCCOS Keywords)*

- Social Science
- Assessing Vulnerability and Resilience
- Caribbean Sea
- U.S. Virgin Islands
- Geospatial

File Information
Total File Size: 1.24GB, 28 files, 2 folders; 125MB zipped
Data File Format(s):

- GeoTiff .TIF
- Comma-separated value (.CSV)
- ShapeFile .SHP (and ancillary files .CPG, .DBF, .PRJ, .SBN, .SBX, .SHX)

Data File Compression: winzip
Data File Resolution: estate level, 10x10m raster grid
GIS Projection: NAD 1983 UTM Zone 20N

Data Files:

- Archived_Data_VA1_USVI.zip

Documentation Files:

- BrowseGraphic.JPEG
- VA1_USVI_Data_Dictionary_Archived_Data.csv
- VA1_USVI_Data_Dictionary_Archived_Data_Raster_Data.csv
- VA1_USVI_Archive Package_Dec 2024.docx.pdf
- VA1_USVI_ESTATES.xml

Table 1: Data Dictionary for VA1_USVI_ESTATES

Column	Variable	Field Name	Definition	Units	Range
1	OBJECTID	OBJECTID	Object ID	n/a	Object ID
2	Shape	Shape	Geometry	n/a	Geometry
3	County	COUNTYFP	County Identifier (U.S. Census)	n/a	text
4	GEOID	GEOID	Geographic Identifier (U.S. Census)	n/a	text
5	Estate name	estate_name	Estate Name (from USVI Partners shapefile)	n/a	text

6	Potential walkability index	walkability_MIN_MAX	Final potential walkability aggregated index incorporating slope, street connectivity, land use mix, building density, sidewalks, road quality, and public transportation access (Min-max normalization)	index score	0-1
7	Compounded flooding aggregated index	comp_flooding_MIN_MAX	Final compounded flooding aggregated index incorporating stormwater flood hazard potential (flow accumulation, rainfall intensity, hydrologic soil groups, land use-landcover, slope, elevation, and drainage density), projected 2 ft sea level rise, and Category 5 storm surge (Min-max normalization)	index score	0-1
8	Toxins and contaminants aggregated index	contaminants_MIN_MAX	Final waterborne toxins and contaminants aggregated index incorporating bin sites, landfills, drinking water contaminants, wastewater, water sources, and industrial zones (Min-max normalization)	index score	0-1
9	Structural vulnerability aggregated index	structural_v_MIN_MAX	Final structural vulnerability aggregated index incorporating communications infrastructure, utilities infrastructure, and transportation infrastructure sub-indices (Min-max normalization)	index score	0-1
10	Communications infrastructure sub-index	communications_MIN_MAX	Structural vulnerability sub-index of communications infrastructure incorporating number of cell service	sub index score	0-1

			towers, number of radio broadcast transmission towers, number of paging transmission towers, number of TV station transmitters, number of microwave service towers, number of land mobile broadcast towers, and number of radio broadcast transmission towers (Min-max normalization)		
11	Utilities infrastructure sub-index	utilities_MIN_MAX	Structural vulnerability sub-index of utilities infrastructure incorporating public drinking water supply facilities, power generating facilities, wastewater treatment facilities, and wastewater management (landfills and bin sites) (Min-max normalization)	sub index score	0-1
12	Transportation infrastructure sub-index	transportation_MIN_MAX	Structural vulnerability sub-index of transportation infrastructure incorporating airports, helicopter transport, seaports, roadway bridge structural and functional assessment rating, roadway bridge structures, total miles of urban and rural arterial roads, boat ramps, marinas, and ports (Min-max normalization)	sub index score	0-1
13	Structural exposure aggregated index	structural_e_MIN_MAX	Final structural exposure aggregated index incorporating housing characteristics and vacant structures sub-indices (Min-max normalization)	index score	0-1
14	Housing characteristics sub-index	housing_MIN_MAX	Structural exposure sub-index of housing characteristics incorporating	sub index score	0-1

			home overcrowding, homes with inadequate plumbing and kitchen facilities, median age of residential housing, homes per square mile, non-permanent or mobile residential structures, and median housing value (Min-max normalization)		
15	Vacant structures sub-index	vacant_MIN_MAX	Structural exposure sub-index of housing characteristics incorporating vacant structures, vacant business structures, and vacant residential structures. (Min-max normalization)	sub index score	0-1
16	Social vulnerability aggregated index	social_v_MIN_MAX	Final social vulnerability aggregated index (Min-max normalization)	index score	0-1
17	Nearshore environment protection benefits aggregated index	nearshore_MIN_MAX	Final nearshore environment protection benefits aggregated index (Min-max normalization)	index score	0-1
18	Vegetation aggregated index	vari_MIN_MAX	Final vegetation aggregated index (Min-max normalization)	index score	0-1
19	Shape length	Shape_Length	Shape length	Meters	Geometry
20	Shape area	Shape_Area	Shape area	Meters squared	Geometry

Table 2: Data Dictionary for Raster Data

Variable	Filename	Definition	Units	Range	Resolution

Near-term-moderate compounded flooding index	flood_nm_n.tiff	Compounded flooding index (near-term-moderate) incorporating stormwater flood hazard potential FIGUSED index, incorporating flow accumulation, rainfall intensity, hydrologic soil groups, land use-landcover, slope, elevation, and drainage density), current sea levels, and Category 3 storm surge (normalized 0-1)	Normalized values/continuous raster	0-1	10m
Projected-high compounded flooding index	flood_h_n.tiff	Compounded flooding index (projected-high) incorporating stormwater flood hazard potential FIGUSED index, incorporating flow accumulation, rainfall intensity, hydrologic soil groups, land use-landcover, slope, elevation, and drainage density), projected 2 ft sea level rise, and Category 5 storm surge (normalized 0-1)	Normalized values/continuous raster	0-1	10m
Stormwater flooding potential index	figused.tiff	Stormwater potential flooding index from FIGUSED methodology incorporating flow accumulation, rainfall intensity, hydrologic soil groups, land use-landcover, slope, elevation, and drainage density (normalized 0-7)	Continuous raster	0-7	10m
Orbital bottom wave velocity	ov_n.tiff	Orbital bottom wave velocity (normalized 0-1)	Normalized values/continuous raster	0-1	10m
Shannon diversity index	div_n.tiff	Shannon diversity index raster incorporating slope, street connectivity, land use mix, building density, sidewalks,	Normalized value	0-1	10m

		road quality, and public transportation access (normalized 0-1)	s/continuous raster		
Visible Atmospherically Resistant Index (raster)	vari_n.tiff	Visible Atmospherically Resistant Index (VARI) (normalized 0-1)	Normalized values/continuous raster	0-1	10m

Data Types (Parameter Information)

List of major parameters included in this accession:

- Community Vulnerability

Parameter Description:

Parameters: Community Vulnerability
Property Type: calculated
Units: estates
Observation Category: modeled data
Sampling Instrument: secondary data analysis
Sampling and Analyzing Method:
This project involved secondary data analysis

Data Quality Method:
Data was accepted in “as is” condition from a variety of sources

Document Information

Date Last Updated: 2024-12-01
Resource Provider: NCCOS Data Manager, nccos.data@noaa.gov, US DOC; NOAA; NOS; National Centers for Coastal Ocean Science (NCCOS)
Comment: This data documentation describes data files archived as a NOAA NCEI data accession, and is intended to provide dataset-level metadata for the purposes of discovery, use, and understanding.
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