

# Tools for Exploring Exposure

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|----------------------|---|
| WHO                  | This guidance is for the practitioner and planning team in Step 1.  |
| WHAT                 | Exposure is the presence of people and community assets and ecosystems in places where they could be adversely affected by hazards. When one of these is exposed to a hazard, it is called an <i>impact pair</i> . This resource provides information for various tools and information that can be used to understand exposure and help inform the potential impacts matrix later in Step 1.   |
| SUPPORTING RESOURCES | These tools can be used to help fill in <a href="#">Resource 1.2b   Potential Impacts Matrix</a>  |
| INSTRUCTIONS         | To determine exposure: <ol style="list-style-type: none"><li>1. Use the conceptual understanding of exposure that was discussed earlier as a first pass. For each community asset, ask: Does this hazard have the potential to impact the asset?</li><li>2. For spatially explicit asset/threat combinations, consider them as having potential exposure. Again, the detailed levels of exposure and vulnerability and risk can be determined in the next step.</li><li>3. Consider the scale or resolution of the hazard and asset. For example, flooding may be more localized as a result of the data that is available, compared to extreme heat.</li></ol> |

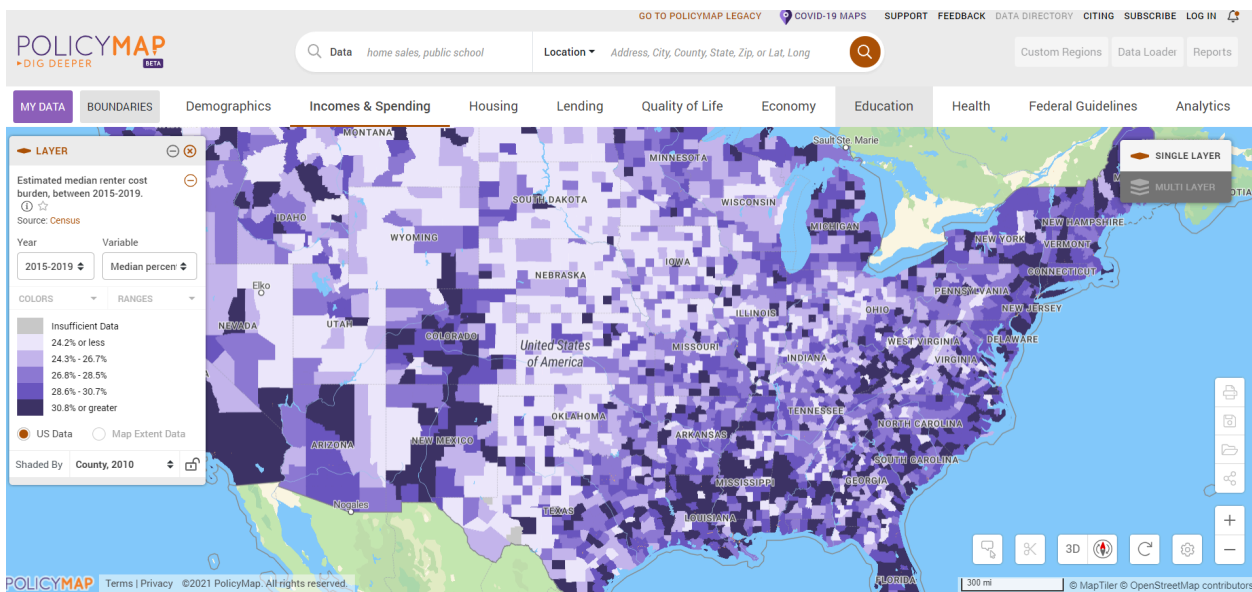
## Tools Overview

Many websites and applications bring datasets together to support decision makers. Some applications display raw data, while others allow the user to overlay datasets to see how they relate to one another. Other applications display an “index” that is created by combining multiple datasets to give an idea of which geographic areas have the greatest number of overlapping datasets.

## Assets & Social Vulnerability

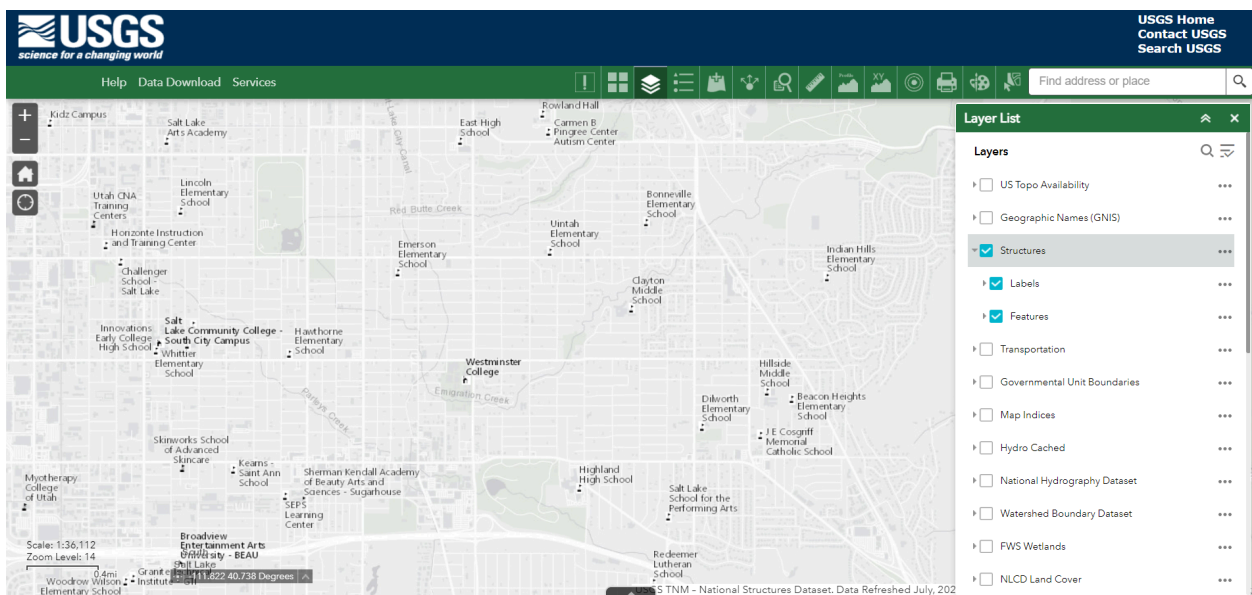
### PolicyMap

Many companies and groups are now providing some really good GIS links for datasets. One of the primary ones to check out for the Human and Economic themes is [PolicyMap](#). There is both a free part of this database and an expanded subscription service. The data is provided under several themes: Demographics, Incomes and Spending, Housing, Lending Activity, Quality of Life, Economy, Education, Health, Federal Guidelines, and Analytics.



## The National Map

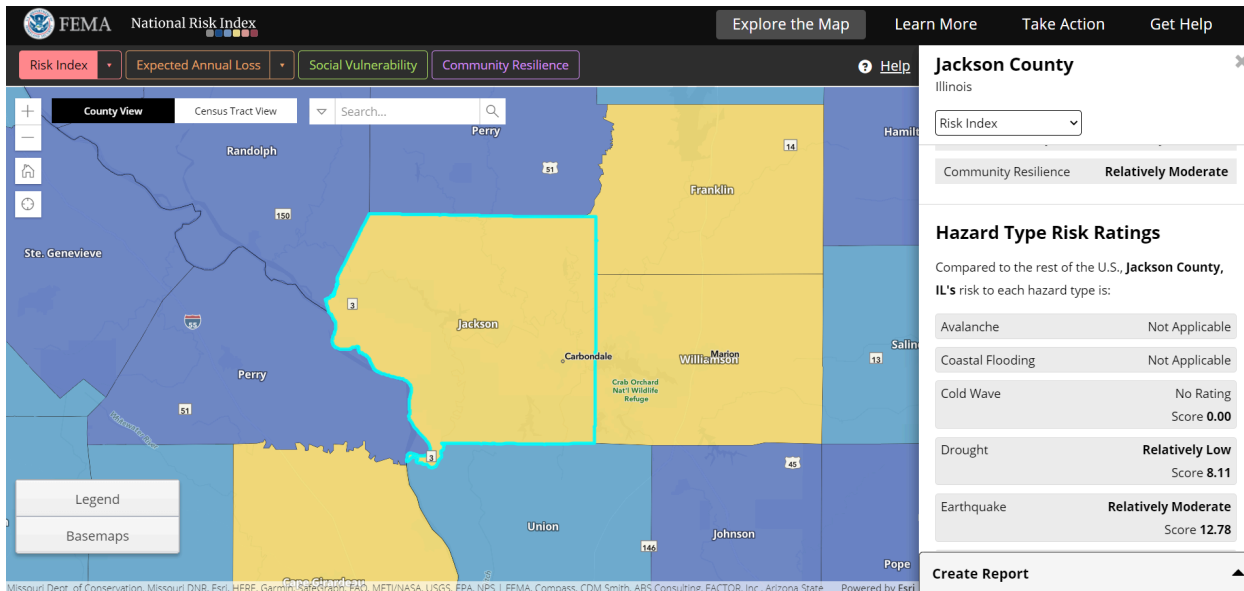
The [USGS National Map](#) provides a go-to source for viewing and downloading many datasets such as NLCD land cover types (forested, wetlands, impervious surfaces), transportation, and watersheds. One important dataset for Step 1 is the National Structures Dataset (shown below), which provides point locations for federal and state landmarks, medical facilities, education, public safety, and more. Datasets shown on The National Map are available for download.



## National Risk Index

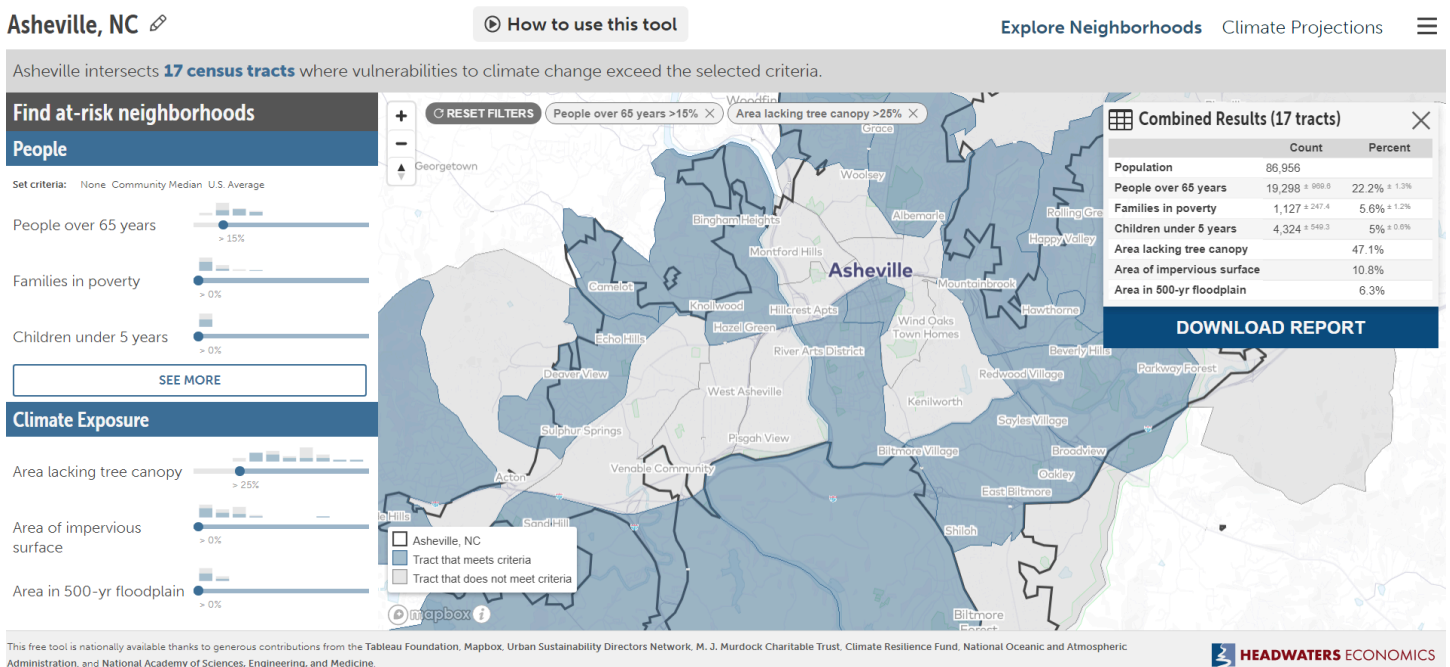
The [FEMA National Risk Index](#) combines several pieces of information into an overall risk index provided by the county or census tract level for the continental U.S. This tool looks at several hazards, including flooding, heat waves, hurricanes, ice storms, landslides, and wildfire. If needed, the data are available for download.

This tool allows the user to generate a PDF summary report for the selected area (or compared to another area).



## Neighborhoods at Risk

The Neighborhoods at Risk tool has several functionalities at the census tract level. This tool helps provide context through an interactive map with filters for areas that may have a greater social vulnerability to hazards. Choose a place and set the criteria for people by moving the sliders on the pre-selected criteria or clicking "See More" to add or remove criteria. Set the criteria for the percent area lacking tree canopy, percent area that is impervious surface, and percent area within the 500-year floodplain. As you set the criteria, the map automatically updates. This information can be downloaded in a summarized PDF format from this interface.



By choosing Climate Projections in the top right corner, graphs show future heat and precipitation projections:

Asheville is expected to experience a 270% increase in extremely hot days and a 9% increase in days with heavy precipitation within 25 years.

Explore climate projections

Select time range: 25 Years

Select an emissions scenario:

Higher Emissions (RCP8.5) Lower Emissions (RCP4.5)

HEAT

Days per year above: 90°F 95°F 100°F

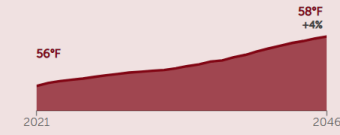
By 2046, Asheville is expected to experience 5 more days that reach above 95°F (from 2 days to 7 days per year).



Extremely hot days are the leading cause of weather-related fatalities in the U.S. and contribute to economic stress as the need for (and cost of) air conditioning rises.

Average annual temperature

By 2046, Asheville is expected to have a 2°F increase (from 56°F to 58°F) in average annual temperatures.



Increasing annual temperatures contribute to droughts, longer and more catastrophic wildfire seasons, and warmer oceans that fuel hurricanes and offshore storms.

PRECIPITATION

Days per year with precip. above: 1" 2" 4"

By 2046, Asheville is expected to experience 0.7 more days of heavy precipitation per year (from 7.6 days to 8.2 days per year).



Heavy precipitation leads to both riverine flooding and flash floods as the ground fails to absorb the high volume of precipitation that falls in a short period.

Average annual precipitation

By 2046, Asheville is expected to have a 1.1" increase (from 48.4" to 49.5") in average annual precipitation.



Increasing annual precipitation contributes to sustained flooding. For example, in 2019 areas along the Mississippi remained above flood stage for at least three months.

This free tool is nationally available thanks to generous contributions from the Tableau Foundation, Mapbox, Urban Sustainability Directors Network, M. J. Murdock Charitable Trust, Climate Resilience Fund, National Oceanic and Atmospheric Administration, and National Academy of Sciences, Engineering, and Medicine. Climate data accessed via Applied Climate Information System (ACIS) managed by the Northeast Regional Climate Center, Cornell University.



# Flood Hazards

## Coastal Flood Exposure Mapper

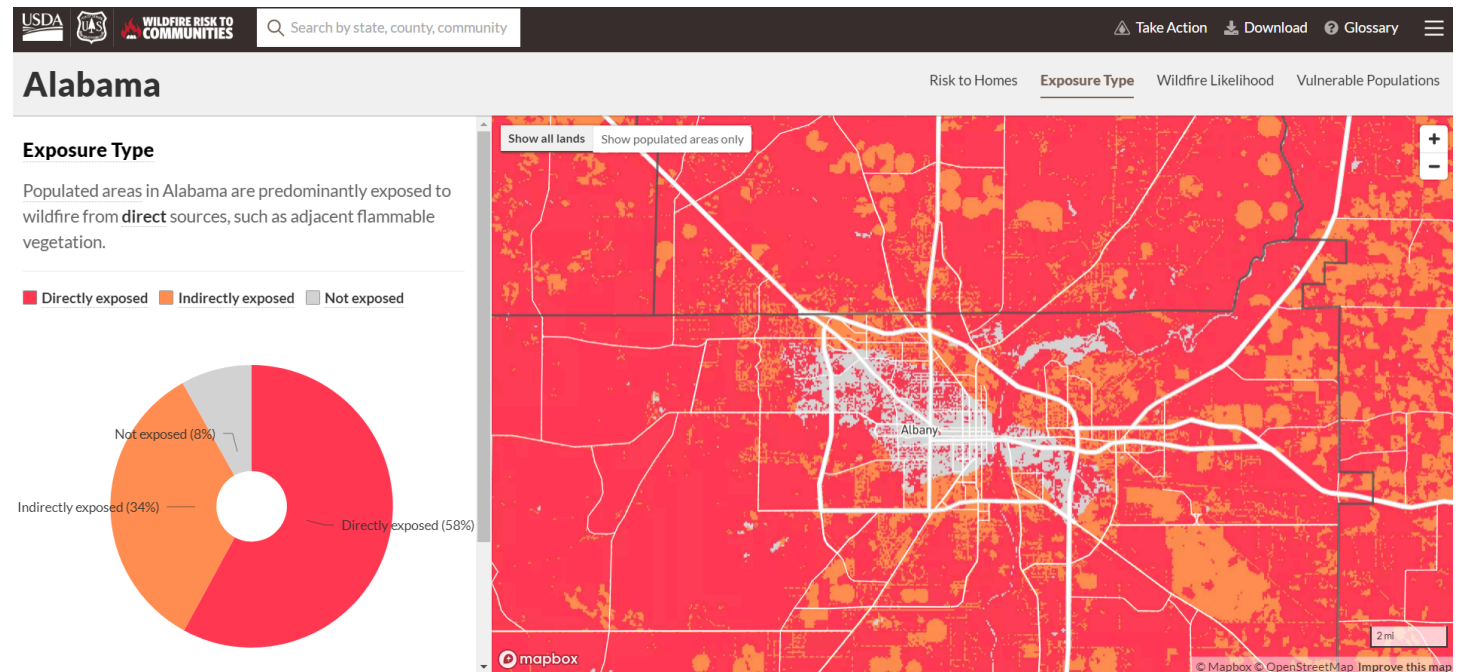
NOAA's Coastal Flood Exposure Mapper displays coastal flooding across the nation. In contrast, though, this map includes location data for three additional categories: people, infrastructure, and ecosystem; as well as a larger variety of flood types: high tide flooding, FEMA flood zones, tsunami, storm surge, sea level rise, and a flood composite layer.

The screenshot shows the NOAA Coastal Flood Exposure Mapper interface. On the left, there are controls for 'CREATE My Map', including 'ACTIVE LAYERS' and 'SAVED MAPS'. Under 'ACTIVE LAYERS', 'Sea Level Rise' is selected. Under 'SOCIAL EXPOSURE', 'Population Density', 'Poverty', 'Elderly', and 'Employees' are listed with toggle switches. Under 'INFRASTRUCTURE EXPOSURE', 'Development' and 'Critical Facilities' are listed with toggle switches. A 'SAVE MAP' button is at the bottom left. The main map area shows a coastal region with color-coded flood exposure zones. A legend on the right is titled 'Storm Surge - Category 2 Hurricane' and includes categories: 'Up to 3 feet above ground' (blue), 'Greater than 3 feet above ground' (yellow), 'Greater than 6 feet above ground' (orange), and 'Greater than 9 feet above ground' (red). It also lists 'Levee Areas - Consult Local Officials for flood risk', 'Areas Not Mapped', and 'Critical Facilities' including 'Fire Station/EMS Station', 'Hospital/Medical Center', 'Law Enforcement', and 'School'. A search bar at the top right says 'Search By Address'. At the bottom, there are 'LEGEND' and 'BASEMAPS' buttons, and a scale bar showing 5 miles.

# Wildfire Hazards

## Wildfire Risk to Communities

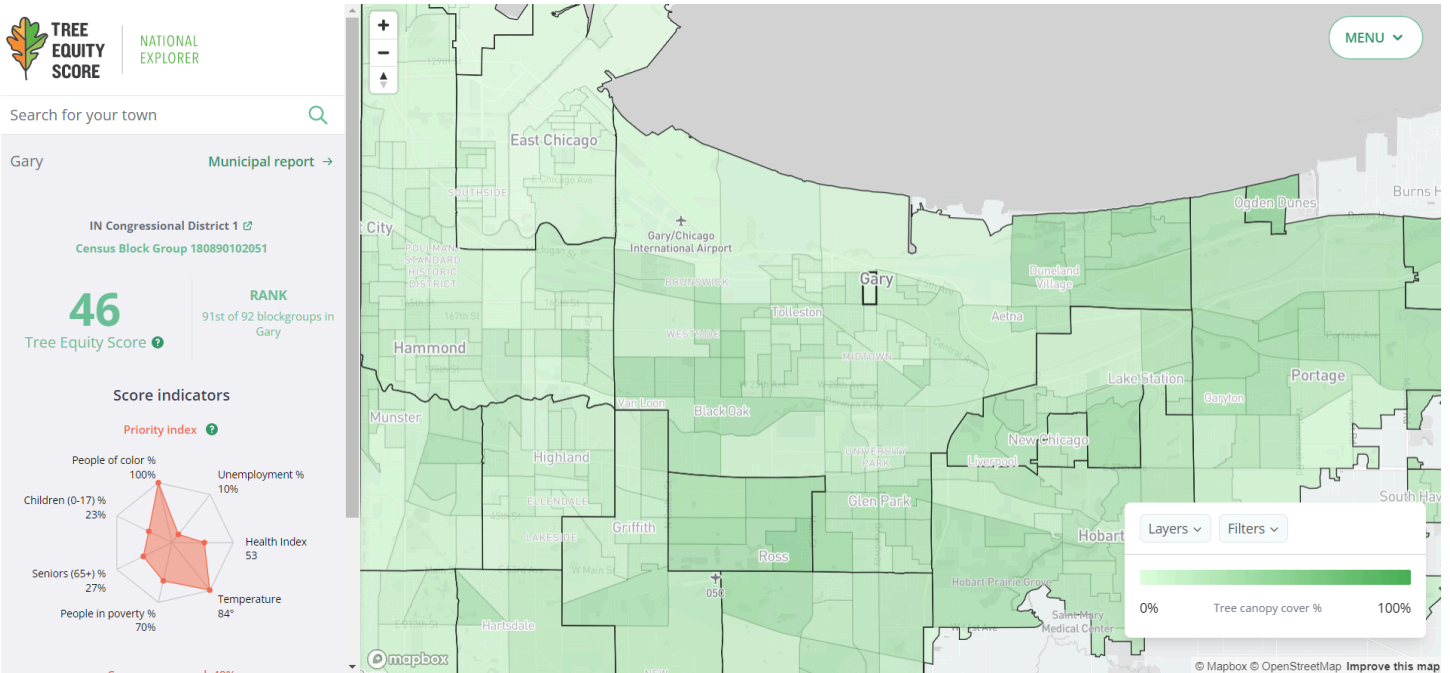
The [USDA USFS Wildfire Risk to Communities](#) tool provides several ways for examining wildfire potential in your community. While this tool can be used to understand risk and probability as defined by USDA, direct and indirect exposure is also considered. In lieu of local data, this may help understand what parts of your community might be within the Wildland Urban Interface (WUI).



## Extreme Heat

### Tree Equity Score

The [Tree Equity Score viewer](#) by American Forests provides useful insight into the amount of tree canopy cover in an area, as well as social indicators that may aid in a community's adaptive capacity for extreme heat. The viewer defaults to the Tree Equity Score layer, but can easily be changed to view the percent canopy cover or any other metric provided. Choose a census block group for a summary of the information. The Municipal report option will provide even more insight and download options.



## Tools for Natural Assets

The following tools are focused on aspects of natural systems and have been incorporated from *Incorporating Nature-based Solutions into Community Climate Adaptation Planning*.

[Habitat Climate Change Vulnerability Index.](#) NatureServe has developed a tool called the Habitat Climate Change Vulnerability Index (HCCVI), which provides a framework to help conservation practitioners determine the vulnerability of various natural communities or habitat types based on their potential exposure to changing climatic conditions, their sensitivity to those conditions, and their adaptive capacity (NatureServe n.d.). The climate change exposure elements include identification of baseline climate conditions, including historical climatic variability, future climate projections, and their departure from historical conditions. Where possible, changing climate variables are connected to dynamic processes, such as wildfire, hydrology, and sea-level rise. For example, Comer et al. (2019) applied the framework to assess the vulnerability of 52 major vegetation types in the Western United States, including an assessment of natural wildfire regime departure. Results suggest that, as of 2014, more than 50% of the area of 50 of the 52 vegetation types were moderately vulnerable to climate change. By the mid-21<sup>st</sup> century, all but 19 types were shown to face high or very high vulnerability due to elevated exposure.

[Sea Level Affecting Marshes Model.](#) Ecological response models provide a variety of ways to assess the vulnerability of wildlife species, habitats, and ecosystems to climate change (Glick et al. 2011). One such model is the Sea Level Affecting Marshes Model (SLAMM), which was designed to simulate the dominant processes involved in wetland conversions and shoreline modifications among a multitude of different coastal habitat types under various scenarios of sea-level rise. The model provides an accessible, middle-of-the-road tool that allows for fairly detailed, scientifically sound regional assessments within the constraints of relatively limited data availability, budgets, and time, and it has been applied in a variety of coastal studies across the country (e.g., Glick et al. 2007, 2008, 2013). The SLAMM model addresses the relative sensitivity of habitat types (e.g., saltmarsh, mangroves) to sea-level rise based on known ecological traits such as the tolerance for

salinity of associated plant species. Elements of exposure to sea-level rise are based on land elevation as well as the scenarios of sea-level rise modeled. Adaptive capacity is addressed in terms of both intrinsic and extrinsic factors (e.g., marsh accretion rates and presence of hard shoreline armoring). Model results can help coastal managers identify where marshes are likely to persist and where they may be converted to other habitat types, such as mudflats or open water. Further, the model can help inform strategies such as the removal of dikes to facilitate inland habitat migration.