Climate Change
Projections & Vulnerability

SALISBURY, MARYLAND
☆ Climate Projections

What future changes do scientists expect to occur?

☆ Community Vulnerability

How susceptible to harm is the community as a result of those changes?
Likely Climate Stressors

- Higher average temperatures and more extreme heat
- Increased precipitation, particularly in the winter and spring
- Increased frequency/intensity of extreme precipitation and flooding
- Possible increases in hurricane frequency and intensity
- Sea level rise and increase in storm surge and coastal flooding

Icons courtesy of Tracey Saxby, Diana Kleine, and Jane Hawkey, Integration and Application Network (ian.umces.edu/media-library)
THE CLIMATE EXPLORER

Explore how climate is projected to change in any county in the United States.

To get started, enter a city or county

or click one of these cities:

New York City, NY
Los Angeles, CA
Anchorage, AK
Phoenix, AZ
Houston, TX
Honolulu, HI

New! Climate projection charts are now available for Hawaii and U.S. territories.
Important Considerations

• Trend direction
• Magnitude of change
• Shifts in timing and/or variability
• Scientific uncertainty

Projected Trends  % CHANGE BY 2100  • Models vary

![Maximum temperature graph]

![Total precipitation graph]
Important Considerations

- Trend direction
- Magnitude of change
- Shifts in timing and/or variability
- Scientific uncertainty

Observed historical 1961–1990

Mid-Century 2040–2049

Late-Century 2070–2099
Higher Average Temps

▲ Minimum temperature
+4.3°F by 2050; +9.7°F by 2100
(historical: 46.2°F)

▲ Maximum temperature
+4.5°F by 2050; +9.6°F by 2100
(historical: 66.9°F)

Source: Climate Explorer
Air Temperature

MORE EXTREME HEAT

▲▲ Days over 90°F
59.6 days by 2050;
105.6 days by 2100
(historical: 20.2 days)

Source: Climate Explorer
SHIFTS IN TIMING/AMOUNT OF RAINFALL

▲ Annual precipitation
+6.5% by 2050; +12.9% by 2100
(historical: 43.0 in)

Source: Climate Explorer
Precipitation

SHIFTS IN TIMING/AMOUNT OF RAINFALL

▲▼ Changes in seasonality

Significant increase in winter (+13.6% by 2100) and spring rainfall (+8.1%)

Slight increases in summer (1.8%) and fall (3.8%) precipitation

Source: USGS National Climate Change Viewer
MORE EXTREME PRECIPITATION

▲▲ Precipitation total for 20-year storm event
+22% in the Northeast US by 2100

▲▲ Days with at least 2 inches of rain in 24 hours
+33% by 2050; +89% by 2100
(historical: 0.9 days per year)

Source: Climate Explorer; Easterling et al. 2017
HIGHER SEA LEVELS

▲ ▲ 50% probability of 1.4 ft by 2050
   (5% probability of exceeding 2.1 ft)

50% probability of 3.0 ft by 2100
   (5% probability of exceeding 5.4 ft)

(Compared to sea levels in 2000)

Source: Boesch et al. 2018
INCREASED HURRICANE IMPACTS

▲ +8% per decade in global hurricane intensity from 1979–2017

▲ -16% rate of forward motion for Atlantic hurricanes from 1949–2016

▲ +100% probability of an active hurricane season from 1982–2020

▲ Likely increase in the U.S. landfall frequency of Category 4/5

Source: Kossin 2018; Kossin et al. 2020; Pfleiderer et al. 2022; Knutson et al. 2022
Storm Surge

STORM SURGE

▲▲ 100-year coastal flooding event will occur every 7 years by 2100

Source: Sweet et al. 2018
Questions?

NEXT UP: What kind of impacts will these climate changes have on Salisbury?
VULNERABILITY is the degree to which natural, built, and human systems are susceptible to harm.
Community Vulnerability

- **Likelihood** is the degree to which a community is exposed to significant climate changes.
- **Consequence** is the degree to which a community is affected by exposure to changes.
- **Adaptive Capacity** is the community’s ability to adjust to climate change to minimize potential damages, take advantage of opportunities, or cope with consequences.

**Risk** is the combination of Likelihood and Consequence, leading to Vulnerability.

**Likelihood** and **Consequence** lead to **Risk**, which in turn leads to **Vulnerability**.
Climate change vulnerability is not evenly distributed across communities!

Understanding disproportionate impacts is critical to ensuring just distribution of adaptation benefits
Community Vulnerability

- People of Color
- Low-Income Residents
- Children under 5
- Seniors over 65
- Individuals with Disabilities
- Individuals with Limited English Skills
- At-Risk Workers
- Individuals with No Vehicle Access

EPA EJ Screen  https://ejscreen.epa.gov/mapper/
Community Vulnerability

Examples:

- **Low-income individuals**: Lack of financial resources/insurance to respond to extreme events
- **Children, elderly, people with chronic health conditions**: Difficulty regulating body temp; increased vulnerability to severe illness/disease
- **Individuals with limited mobility**: Reduced ability to evacuate during emergencies or access shelters
Community Vulnerability

Examples:

• **People with limited English:** Less able to benefit from resources or access information and receive alerts.

• **People of color, individuals with disabilities:** Less able to utilize emergency shelters or other community spaces.

• **At-risk workers:** Increased exposure to hazards, often without adequate precautions or paid time off.
Impacts of Climate Change

DIRECT IMPACTS OF CLIMATE STRESSORS

- Housing
- Transportation
- Open Space

INTERACTIONS WITH PRE-EXISTING CONDITIONS
Impacts of Climate Change

Housing:

- Increased risk of damage to housing and critical infrastructure following storms, floods, and extreme heat
- Increased heat stress in developed areas, exacerbated by impervious surfaces and lack of vegetation
- Increased energy demand during heat waves, straining electrical grids
- Exacerbation of existing patterns of inequity for vulnerable communities
Impacts of Climate Change

Transportation:

- Damage to transportation infrastructure following storms, floods, and extreme heat events
- Road blockages & loss of access due to extreme events and sea level rise
- Slower travel or road closures due to melting asphalt overheating engines, and other extreme heat impacts
- Loss of electricity, limiting use of electric vehicles and public transit
Impacts of Climate Change

Open Space:

- Reduced growth and productivity of native vegetation due to heat stress and increases in evapotranspiration
- Expansion of non-native invasive plants, insect pests, and diseases
- Increased risk of harmful algal blooms, impacting water quality and survival of aquatic organisms
- Increased flooding/erosion, impacting native plants and access to open space
What additional climate change impacts are you concerned about?
**Important Tools and Resources**

**Observe/Projected Climate Changes and Associated Impacts for Salisbury, Maryland**

- **Air temperature**
- **Humidity**
- **Precipitation**
- **Sea level rise**
- **Storm surge**
- **Extreme events**
- **Housing**
- **Transportation**
- **Open Space**

**Likely Impacts Associated with Projected Climate Changes**

- Increased risk of damage to housing and critical infrastructure (e.g., utilities) following storms, floods, and extreme heat
- Increased heat stress in developed areas, exacerbated by large areas of impervious surfaces and lack of vegetation
- Increased energy demand during heat waves, straining electrical grids and potentially resulting in power outages and increased costs
- Escalation of existing patterns of inequity for low-income neighborhoods and other vulnerable communities who are more likely to experience heat island effects, poor drainage, etc.
- Damage to transportation infrastructure (e.g., roads, bridges, culverts) following storms, floods, and extreme heat events
- Road blockages and loss of access due to extreme events and sea level rise, impacting evacuation routes, emergency access, and other critical travel
- Slover travel or road closures due to melting asphalt, overheating engines, and other impacts of extreme heat
- Loss of electricity due to flooding or heat waves, limiting use of electric vehicles and impacting public transit
- Decreased use of non-motorized transit due to more frequent/severe inclement weather
- Reduced growth and productivity of native vegetation due to heat stress and increases in evapotranspiration
- Expansion of non-native invasive plants, insect pests, and diseases, with associated impacts to native plants and wildlife
- Increased risk of harmful algal blooms in freshwater, estuarine, and nearshore marine environments, impacting water quality and potentially causing widespread mortality of fish and other aquatic organisms
- Changes in plant survival due to more frequent coastal inundation and/or saltwater intrusion into freshwater habitats, likely altering the distribution of native plant communities (e.g., salt marsh vegetation)
- Increased flooding and erosion, impacting native plant communities as well as public and management access to greenspace
- Increased heat stress for people and wildlife using open space areas as well as changes in patterns of recreational use (e.g., heavier use of sites with water features, increases in maintenance costs)
- Alteration or decreased ecosystem functioning on conservation lands due to changes in hydrology, thermal regime, and plant species composition and distribution

**Resources:**

- U.S. Climate Resilience Toolkit Climate Explorer (https://catalog.climate.gov/tk)
- Chapter 4 of the Fourth National Climate Change Assessment (https://www.globalchange.gov/chapter/4)
- Coastal Inundation Predictions for Maryland (http://coast.noaa.gov/)
- NOAA Sea Level Rise Viewer (https://coast.noaa.gov/)

**Workshop Support Page**

- **Climate Change Adaptation and Certification (CCAC) Tool**
- **Rapid Vulnerability and Adaptation Tool (RVAT)**
- **Observe/Projected Climate Changes and Associated Impacts for Salisbury**

**About Upcoming Events**

- **Workshop Agenda**
- **Salisbury Climate Change Adaptation Workshop**
  - April 24th and 25th, 2023 - Salisbury University

**Overview**

This workshop focuses on understanding community vulnerabilities to climate change in Salisbury, MD, and developing adaptation strategies to address those vulnerabilities. Participants will also learn how to use tools that are available for communities to engage... [show full overview]

**Agenda & Speakers**

**Workshop Agenda**

**Reading & Resources**

- **Climate Change Adaptation and Certification (CCAC) Tool**
- **Rapid Vulnerability and Adaptation Tool (RVAT)**
- **Observe/Projected Climate Changes and Associated Impacts for Salisbury**

**Data sources and more information:**

- **U.S. Climate Resilience Toolkit Climate Explorer**
- **Northeast Chapter of the 4th National Climate Assessment**
- **FEMA’s National Flood Map Hazard Viewer**
- **Wicomico County Hazard Mitigation & Resilience Plan**
- **EPA’s Environmental Justice Screening and Mapping Tool**
- **What Will Climate Look Like in 60 Years?** (climate analogy tool)
- **Equity emphasis areas for transportation investments: Mapping traditionally underserved communities in the Chittanooga TPO area**
- **Climate Change and Social Vulnerability in the United States: A Focus on Site Impacts** (includes fact sheets that summarize impacts for specific communities)
- **Cleveland Racial Equity Tool** (an accessible screening tool to help people assess whether adaptation strategies they are considering are equitable)
CAN’T STAND THE HEAT

Winter 2014-2015 Temperature Percentiles

Record Warmest
Record Coldest

This winter was so cold!
Climate change is a MYTH!

Dude, that kiiinda makes you sound like a jerk.