National Weather Service Overview

And

Climate Information and Communication

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Climate Section Credit:

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Warning Coordination Meteorologist
Liaison between the community and the local National Weather Service office. Conduct community outreach and preparedness activities.
Morehead City
Sarah Spiegler
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Focus Areas:
Leverages resources and provides information related to the impacts of sea level rise on coastal habitats and communities in North Carolina; Hosts trainings, workshops and partner meetings.
The National Weather Service (NWS)

Serving you in every community in the U.S. Check out who we are and what we do!

NWS Mission
Provide weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy.

NWS Vision
A Weather-Ready Nation: Society is prepared for and responds to weather, water, and climate-dependent events.

Weather-Ready Nation Story
Accurate weather forecasts do not always result in a good outcome. The National Weather Service (NWS) learned this difficult... 
Read more

Begin Your NWS journey
Our Local Office

Eastern part of North Carolina

Includes: Land areas, inland rivers, sounds, and adjacent ocean

Other parts of the state covered by other local offices (Raleigh, Wilmington, etc)
Open 24/7/365

Hurricane Florence

Staff here for 3 to 7 days

Our building is designed to withstand storms

We stay when the weather is bad
Our Website

weather.gov/newport

Weather information from past events, current weather, and forecast

Explore the website and bookmark or save what you like

Go in depth as much as you need
Sky cover
High/low temperatures
Winds
Chance of precipitation
Created prior to bigger events of severe weather
Weather Briefings
weather.gov/newport

January 2018
Winter Storm

Summary of Greatest Impacts

- **Wind: Moderate Confidence – track dependent**
  - None
  - Elevated
  - Moderate
  - High
  - Extreme

- **Surge/Inundation: Moderate to High Confidence**
  - None
  - Elevated
  - Moderate
  - High
  - Extreme

- **Rainfall Flooding: High Confidence**
  - None
  - Elevated
  - Moderate
  - High
  - Extreme

- **Tornado: Low Confidence – track dependent**
  - None
  - Elevated
  - Moderate
  - High
  - Extreme

- **Marine: Confident – regardless of track**
  - None
  - Elevated
  - Moderate
  - High
  - Extreme

Hurricane Florence Impacts

Most Likely Snow Amount
Through Thursday morning

Storm Confidence:
- Confidence is high for widespread significant impacts.
- Highest impacts will be Wednesday night into Thursday morning.
- Snowfall rates 1” – 2” per hour.
- Find the most up to date snowfall map, click [here](http://www.weather.gov/newport)
Category of the storm is only related to wind, it does not tell you about all of the impacts with a #hurricane like #florence. Our impacts have not changed with storm surge and catastrophic flooding. Do not let your guard down. weather.gov/media/mhx/Late...
Quickly access hourly forecasts, radar, and more from your local office, ANYWHERE in the country.

Can work like a weather “APP” by adding it to home screen.

Also works on PCs.
What Is Climate?
Weather vs. Climate

- **Weather**: temperature, wind, clouds, precipitation; what’s happening outside right now

- **Climate**: average of weather conditions over a long time period

https://www.worldatlas.com/articles/what-is-a-desert-climate.html
Weather vs. Climate

**Weather** happens at a particular time and place.

**Climate** is regional and long-term.

*Is it news (weather) or history (climate)?
Climate Outlooks
Climate Prediction

- Not quite like weather prediction
  - In terms of odds (probabilities)
  - Averaged over longer periods of time (weeks to months)

http://www.cpc.ncep.noaa.gov/
CPC Outlooks: 6- to 10-Day and 8- to 14-Day

- Predicting chances for *temperatures* and *precipitation* to fall in the upper, middle, and lowest thirds.
  - “40%” = 40-50% chance of that category (instead of the usual 33%)
- Issued every afternoon
  - Automated on weekends
- Mainly based on weather and climate models
- Interactive and static displays
Climate Variability: Influencing Seasons

El Niño
- Warm
- Low Pressure
- Wet & Cool
- Persistent, extended Pacific Jet Stream & amplified storm track

La Niña
- Cool
- Wet & Cool
- Pacific Jet Stream
- Dry & Warm

North Atlantic Oscillation
- Positive Mode:
  - Warm & more sea-ice
  - Cold & dry
  - Strong Low

- Negative Mode:
  - Warm & less sea-ice
  - Cold & snowy
  - Weak High

Associated SST Patterns (~12-14yr period)
Climate Change
Climate Change

• Get comfortable with terminology
  ♦ The terms “climate change” and “global warming” are often used interchangeably
  ♦ Scientists prefer “climate change” because it describes the changes to the whole system, not just temperatures
  ♦ Many people still say “global warming”

• Be careful about your information sources!
  ♦ Blogs, news commentators, politicians often (usually) not trained in climate
  ♦ Would you go to a dentist to get heart surgery?
Climate and the Greenhouse Gases
Greenhouse Effect

- Greenhouse gases absorb heat (solar radiation)
  - Radiate heat back to Earth’s surface
  - Major greenhouse gases include carbon dioxide (CO\textsubscript{2}) and water vapor (H\textsubscript{2}O)
  - Trace gases include methane, ozone, nitrous oxide, and CFCs
- Natural greenhouse effect is necessary for life on Earth
- Concern: Human activities are enhancing the greenhouse effect.
Carbon Dioxide Increasing Due to Human Activity

Atmospheric CO$_2$ at Mauna Loa Observatory

Scripps Institution of Oceanography
NOAA Earth System Research Laboratory

http://www.esrl.noaa.gov/gmd/ccgg/trends/
Carbon Dioxide Increasing

CO₂ during ice ages and warm periods for the past 800,000 years

- **Warm period (interglacial)**
- **Ice age (glacial)**

2018 average (407.4)

Highest previous concentration (300 ppm)

Years before present

Climate.gov [https://www.climate.gov/sites/default/files/paleo_CO2_2018_1500.gif](https://www.climate.gov/sites/default/files/paleo_CO2_2018_1500.gif)
...And So Are Other Greenhouse Gases
Global Temperatures Are Increasing

Most obvious **and most discussed** impact of climate change

http://www.ncdc.noaa.gov/sotc/global/2015/13
...And Are Explained Only When Including Increased Greenhouse Gases

Source: IPCC
**Global Temperature Analyses Agree**

**NASA, NOAA, MetOffice: relative to a common 1951 – 1980 base period**

| Temperature over the past 1000-2000 years. Uncertainty increases farther back in time, when temperature reconstructions are based on “proxy” data (ice cores, tree rings, corals, lake sediments, glaciers, boreholes, stalagmites, etc.). Agreement improves with the instrumental records, beginning around 1850 A.D. |
Symptoms of Climate Change
Sea Level Rise
• Melting of glaciers
• Thermal expansion
Sea Levels are Rising

Relative Sea Level Trend: Beaufort, North Carolina

The relative sea level trend is **3.22 millimeters/year** with a 95% confidence interval of +/- 0.35 mm/yr based on monthly mean sea level data from **1953 to 2019** which is equivalent to a change of 1.06 feet in 100 years.

https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8656483
Sea-Level Rise Vulnerability
Albemarle-Pamlico Estuarine System
North Carolina

Vulnerability to Inundation (Elevation)
- Severe (< 0.5 m/1.6 ft)
- Very High (< 1.0 m/3.3 ft)
- High (< 1.4 m/4.6 ft)
- Moderate (< 2.0 m/6.6 ft)

The Albemarle-Pamlico estuarine system is one of the most vulnerable coastal regions in the U.S. It is threatened by future rises in sea-level due to extensive areas of low-lying land below four feet in elevation. The elevation values used to determine the vulnerability levels on the map were taken from national and local land elevation projects through 2050 by the North Carolina Resilience Commission Science Plan (2015). The vulnerability index has been developed to reflect the temporal progression in which sea-level rise inundation will occur.
Sea Levels are Rising

Relative Sea Level Trend: Oregon Inlet, NC

The relative sea level trend is **5.08 millimeters/year** with a 95% confidence interval of +/- 0.35 mm/yr based on monthly mean sea level data from **1977 to 2019** which is equivalent to a change of 1.67 feet in 100 years.

https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8652587
Projected Increase in Mean Sea Level

Relative sea level change scenarios for **Beaufort, NC** associated with 6 different sea level rise scenarios. The low and extreme scenarios represent the minimum and maximum of plausible future sea level rise.

Projected Days of Future Flooding with Sea Level Rise in Beaufort, NC

Projected future days of minor flooding based on derived levels at Beaufort, NC under different sea level-rise scenarios.

Six of the seven highest precipitation events on record in North Carolina have occurred within the last 20 years.

Indicators of a Warming World

The stratosphere (up here!) is cooling

Ten Indicators of a Warming World

- Air Temperature Near Surface (Troposphere)
- Humidity
- Temperature Over Oceans
- Sea Surface Temperature
- Sea Ice
- Sea Level
- Ocean Heat Content
- Temperature Over Land
- Glaciers
- Snow Cover

Seven of these indicators would be expected to increase in a warming world and observations show that they are, in fact, increasing. Three would be expected to decrease and they are, in fact, decreasing.
How the Averages Affect the Extremes

(a) What is an Extreme?
- Probability of occurrence
- Temperature
  - Cold temperature extremes
  - Hot temperature extremes
- Cold
- Average
- Hot

(b) Increase in Probability of Extremes in a Warmer Climate
- Temperature
  - Previous climate
  - New climate
- Less cold weather
- More hot weather
- Less light precipitation
- More heavy precipitation
- Light
- Average
- Heavy
Recent Temperature Trends

• Temperatures have warmed over the last century across the region.

• The warming is strongest during winter and for northern tier states.

Figure 2.7 *Our Changing Climate*, National Climate Assessment. [http://nca2014.globalchange.gov](http://nca2014.globalchange.gov)
Recent Precipitation Trends

- Wetting in the north.
- Drying in the west and south.

Recent precipitation (1991-2012) compared to 1901-1960

Figure 2.12 Our Changing Climate, National Climate Assessment. [http://nca2014.globalchange.gov](http://nca2014.globalchange.gov)
In 2014, snow melt occurred 20–30 days earlier over North America than the 1998–2010 average.
• 10 lowest minimum sea ice extents are the last 10 years.
• Multi-year ice is decreasing (ice is thinning).
• September Arctic sea ice extent is declining at a rate of -13.3% per decade.
Big Heat Is Increasing

Contiguous U.S., Minimum Temperature, June-August

Min Temperature
1901-2000 Mean: 58.41°F

(Big Cold is generally decreasing)

NOAA/NCEI Climate Extremes Index: http://www.ncdc.noaa.gov/extremes/cei
Frost-Free Season Is Lengthening

Recent length (1991-2012) compared to 1901-1960

Figure 2.10 Our Changing Climate, National Climate Assessment. http://nca2014.globalchange.gov
1979-2017

- Shifts in where tornadoes occur

Gensini and Brooks 2018
• Average temperatures will warm across the region, annually and for all seasons

• Warm temperature extremes will continue to occur more frequently than cold extremes

• Uncertainty lies in greenhouse gas emissions scenarios

Top: 1986-2016 temperatures, compared to 1901-1960
Middle: Projected annual average temperature change in 2036-2065, compared to 1986-2015
Bottom: Projected annual average temperature change in 2070-2099, compared to 1986-2015

Figure 2.4, Our Changing Climate
Projected Precipitation Change

- Wetting trend north, especially winter and spring.
- Drying trend south, especially winter and spring.
- Drying trend in the central US in the summer.

Top: 1986-2016 precipitation, compared to 1901-1960
Middle: Projected annual precipitation change in 2036-2065, compared to 1901-1960
Bottom: Projected annual precipitation change in 2070-2099, compared to 1901-1960
Red dots: changes large compared to natural variability
Hatched: changes are small and relatively insignificant

Figure 2.5, Our Changing Climate
National Climate Assessment: https://nca2018.globalchange.gov/
Takeaway Messages

• It’s real.
• It’s us.
• Experts agree.
• It’s mostly bad.
• It’s not too late to fix it.

Adapted from Ed Maibach, George Mason University’s Center for Climate Change Communication
Climate Tools
Global Climate Dashboard

Global Average Temperature (°C)
The temperature near Earth’s surface is rising: the bars show each year’s average temperature compared to the 20th century average.

Carbon Dioxide (ppm)
The amount of carbon dioxide in the atmosphere has risen by 25% since 1958, and by about 40% since the Industrial Revolution.

Spring Snow Cover (million km²)
Snow is melting earlier: each bar shows spring snow cover in the Northern Hemisphere compared to the long-term average.

https://www.climate.gov/
Nags Head can’t ignore the rising sea

- Adaptation to coastal hazards, including sea level rise, is an important step to becoming resilient
NC King Tides Project

Snap the shore See the future
CoCoRaHS!

- Volunteer precipitation observation network
- Use standard, low-cost tools
- Report observations online
- Data used by weather, water, and climate experts
- Provides access to educational webinars, materials

http://www.cocorahs.org/
Thanks for Your Interest!

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