



# National Weather Service Overview

And

# Climate Information and Communication

Sarah Spiegler and Erik Heden

Climate Section Credit:

Barb Mayes Boustead, Ph.D.

NWS/OCLO/Warning Decision Training Division



## **Erik Heden NWS Morehead City**

Warning Coordination Meteorologist  
Liaison between the community and the local  
National Weather Service office. Conduct  
community outreach and preparedness  
activities.



**Morehead City**  
Sarah Spiegler  
N.C. Sentinel Site Coop. Coordinator &  
Marine Education Specialist

**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.







# Our Mission



## The National Weather Service (NWS)

[Weather.gov](http://Weather.gov) > About the NWS

### About the NWS

National Program

#### About

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](#)

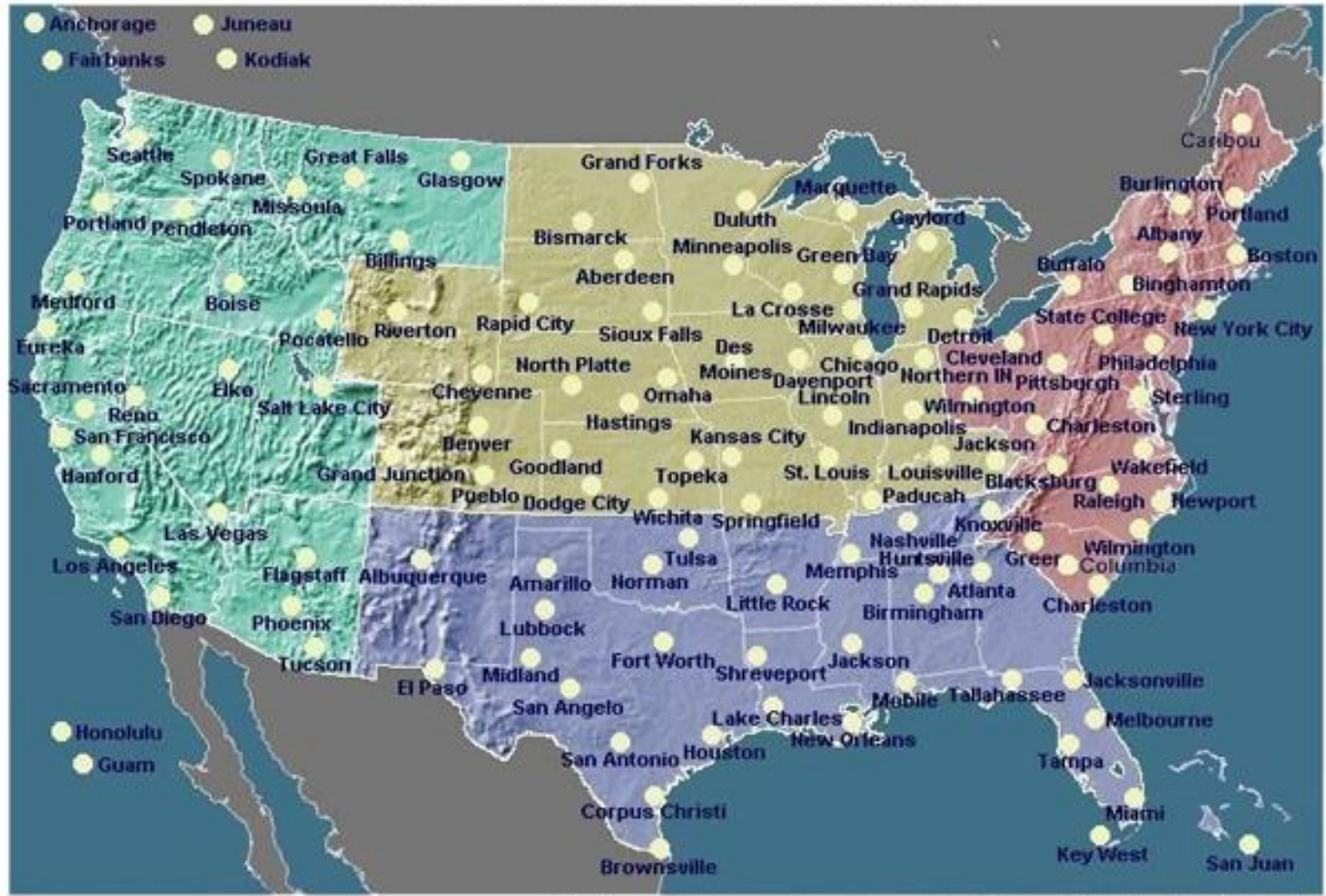




# Office Locations



National Weather Service Office Locations



Background topography courtesy Ray Stemer, Johns Hopkins University





# 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

**NATIONAL WEATHER SERVICE**  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION


HOME FORECAST PAST WEATHER SAFETY INFORMATION EDUCATION NEWS SEARCH ABOUT

Local forecast by "City, St" or ZIP code  
Enter location ...   
[Location Help](#)

**News Headlines**


- [The Fall 2019 Edition Of Our Newsletter, Carolina Skywatcher, Is Now Online!](#)

**MY FORECAST**  
Morehead City NC




Overcast  
**49°F**  
9°C [Get Detailed info](#)

**Today**



Partly Sunny  
High: 55°F

**Tonight**




Mostly Cloudy  
Low: 43°F  
[change location](#)

**NWS Forecast Office Newport/Morehead City, Newport/Morehead City, NC**  
Weather Forecast Office

[Weather.gov](#) > Newport/Morehead City, NC

[Current Hazards](#) [Current Conditions](#) [Radar](#) [Forecasts](#) [Rivers and Lakes](#) [Climate and Past Weather](#) [Local Programs](#)

Click a location below for detailed forecast.






Watches, Warnings & Advisories

- [Coastal Flood Advisory](#)
- [High Surf Advisory](#)
- [Small Craft Advisory](#)
- [Hazardous Weather Outlook](#)

Last Map Update: Tue, Nov. 19, 2019 at 11:58:19 am EST

**Tropical** **Local Radar** **Satellite**

NOAA/NWS 11/19/19 16:46Z GOES-East





# 7- Day Forecast

weather.gov/newport



Sky cover



High/low temperatures



Winds



Chance of precipitation

### Detailed Forecast

Today	Mostly cloudy, with a high near 54. Light northwest wind.
Tonight	Mostly cloudy, with a low around 38. West wind 5 to 7 mph.
Wednesday	Sunny, with a high near 60. Northwest wind 7 to 9 mph.
Wednesday Night	Mostly clear, with a low around 38. Light north wind.
Thursday	Sunny, with a high near 60. Light and variable wind becoming northwest around 5 mph.
Thursday Night	Partly cloudy, with a low around 44.
Friday	Mostly sunny, with a high near 67.
Friday Night	Mostly cloudy, with a low around 48.
Saturday	A chance of showers. Mostly cloudy, with a high near 64. Chance of precipitation is 50%.
Saturday Night	A chance of showers. Mostly cloudy, with a low around 44. Chance of precipitation is 50%.
Sunday	Partly sunny, with a high near 58.
Sunday Night	Mostly clear, with a low around 39.
Monday	Sunny, with a high near 60.

### Extended Forecast for New Bern NC

Today	Tonight	Wednesday	Wednesday Night	Thursday	Thursday Night	Friday	Friday Night	Saturday
Mostly Cloudy	Mostly Cloudy	Sunny	Mostly Clear	Sunny	Partly Cloudy	Mostly Sunny	Mostly Cloudy	Chance Showers
High: 54 °F	Low: 38 °F	High: 60 °F	Low: 38 °F	High: 60 °F	Low: 44 °F	High: 67 °F	Low: 48 °F	High: 64 °F



# Weather Briefings

weather.gov/newport



Local forecast by "City, ST" or ZIP code  
 Enter location ...   
[Location Help](#)

**News Headlines**

- Here's the Updated Skywarn Training Schedule!
- Here's a Summary on the March 2-5, 2018 Wind/Coastal Flood/Low Water Event.
- Summary on the Minor Winter Weather Event, March 12-13, 2018

**Customize Your Weather.gov**

City, ST

Enter Your City, ST or ZIP Code

Remember Me

[Privacy Policy](#)

**NWS Forecast Office Newport/Morehead City, Newport/Morehead City, NC**  
 Weather Forecast Office

[Weather.gov](#) > Newport/Morehead City, NC

[Current Hazards](#) [Current Conditions](#) [Radar](#) [Forecasts](#) [Rivers and Lakes](#) [Climate and Past Weather](#) [Local Programs](#)

Click a location below for detailed forecast.

Last Map Update: Thu, Mar. 22, 2018 at 11:05:21 am EDT

[Watches, Warnings & Advisories](#)

<a href="#">Radar</a>	<a href="#">Current Weather</a>	<a href="#">Rivers &amp; Lakes</a>	<a href="#">Satellite</a>	<a href="#">Weather Inform Disp</a>	<a href="#">Forecast Maps</a>
<a href="#">Hour by Hour Forecast</a>	<a href="#">Winter Weather</a>	<a href="#">Map View</a>	<a href="#">Surf Forecast/Rip Currents</a>	<a href="#">Weather Hazard Briefing (when applicable)</a>	<a href="#">Local Self-Briefing Pages</a>
<a href="#">Forecaster Discussion</a>	<a href="#">Marine</a>	<a href="#">Text Products</a>	<a href="#">Tropical</a>	<a href="#">Skywarn</a>	<a href="#">Submit Storm Reports</a>

Created prior to bigger events of severe weather



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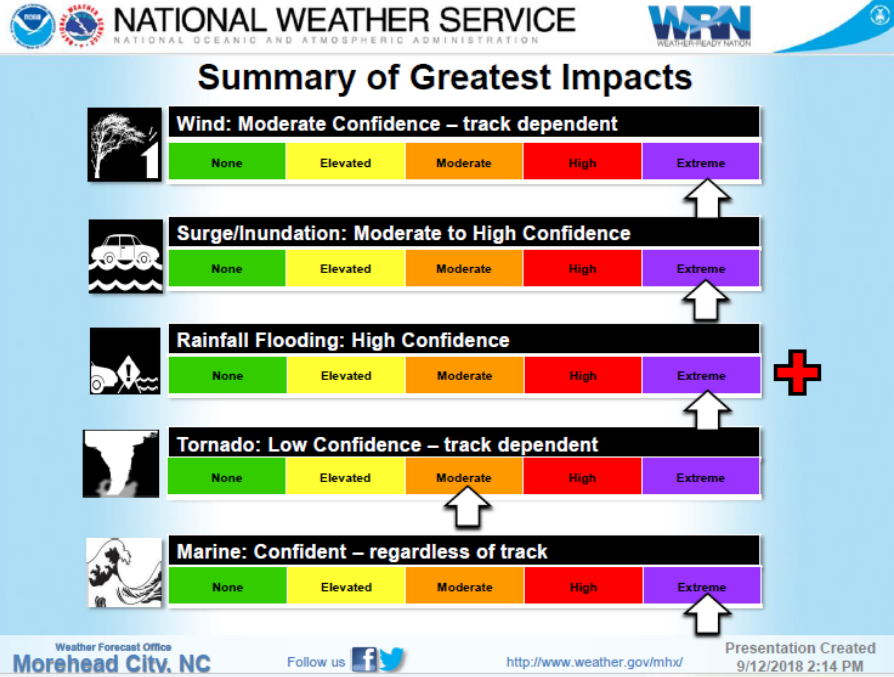
MHX RSS Feed



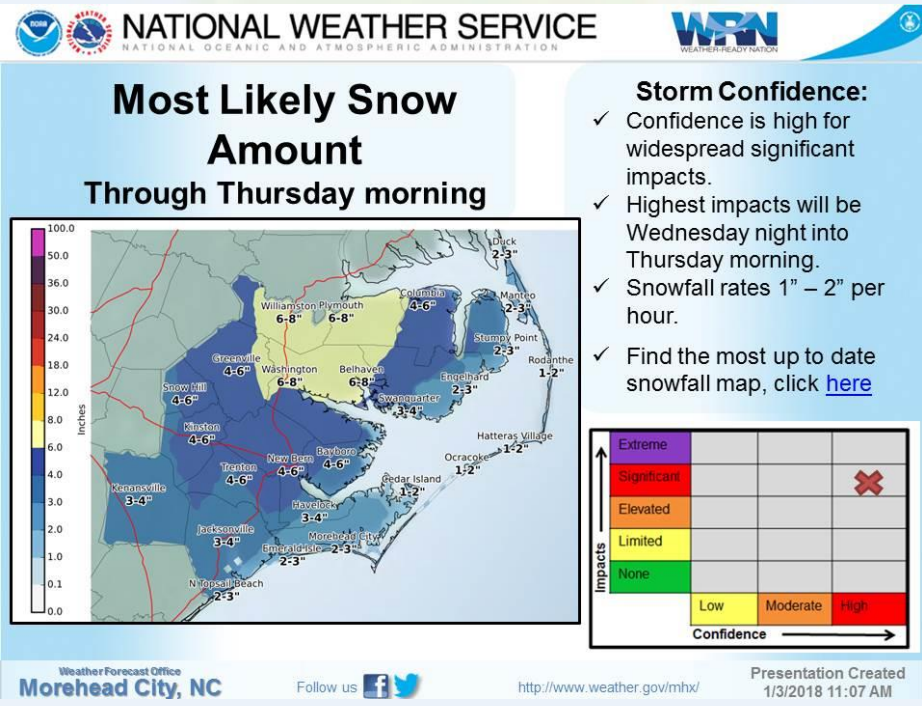


# Weather Briefings

weather.gov/newport



## January 2018 Winter Storm



## Hurricane Florence Impacts



# Social Media

## Search NWS Morehead City



**NWS Newport/Morehead** @NWSMoreheadCity

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...](http://weather.gov/media/mhx/Late...)

**NATIONAL WEATHER SERVICE**

### Summary of Greatest Impacts

<b>Wind: Moderate Confidence – track dependent</b>	None	Elevated	Moderate	High	Extreme
<b>Surge/Inundation: Moderate to High Confidence</b>	None	Elevated	Moderate	High	Extreme
<b>Rainfall Flooding: High Confidence</b>	None	Elevated	Moderate	High	Extreme
<b>Tornado: Moderate Confidence</b>	None	Elevated	Moderate	High	Extreme
<b>Marine: Confident – regardless of track</b>	None	Elevated	Moderate	High	Extreme

Weather Forecast Office  
**Morehead City, NC**

Follow us <http://www.weather.gov/mhx/>

Presentation Created 9/13/2018 8:39 AM

8:44 AM - 13 Sep 2018

765 Retweets 1,078 Likes

40 765 1.1K

**NATIONAL WEATHER SERVICE**

### Hurricane Florence Briefing #15

As of: 630 AM  
Wednesday, September 12<sup>th</sup> 2018

**What has Changed?**

- Track has shifted a bit further south and west, and has slowed significantly near the coast
- Extreme rainfall amounts now are expected across southern coastal counties
- Major River Flooding Likely

Disclaimer: Do not use after 5 PM Wednesday 9/12/18

Next Briefing: By 600 PM Wednesday (9/12/18)

Hurricane Florence NWS Morehead City Wednesday 900 AM Briefing

2,895 views 13 0 SHARE SAVE

**NWSMoreheadCity**  
Published on Sep 12, 2018

**SUBSCRIBE 199**

# Hurricane Florence Lead Up





# Mobile Forecasts

mobile.weather.gov



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

**National Weather Service**

Morehead City NC

**Current Conditions**

Beaufort Smith Field  
Updated: 19 Nov 09:58 am EST

**48 °F**  
Wind NE 3 MPH  
Dew Point 46 °F (93% RH)

Overcast

**Forecast**  
19 Nov 09:58 am EST

<b>Today</b>  Partly Sunny Hi <b>55°F</b>	<b>Tonight</b>  Mostly Cloudy Lo <b>45°F</b>	<b>Wednesday</b>  Sunny Hi <b>58°F</b>
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Verizon 3:42 PM 50%

mobile.weather.gov

**Hourly Forecast**

Topeka KS

**Tonight** **Sunday Night**

**SUN, FEB 26**

6 am <b>30%</b> Chance Snow Temp: 34°F Wind: SSW @ 6 mph
7 am <b>30%</b> Chance Rain And Snow Temp: 35°F Wind: SSW @ 5 mph
8 am <b>30%</b> Chance Rain And Snow Temp: 36°F Wind: S @ 5 mph
9 am <b>30%</b> Chance Rain Temp: 37°F Wind: S @ 5 mph



# What Is Climate?

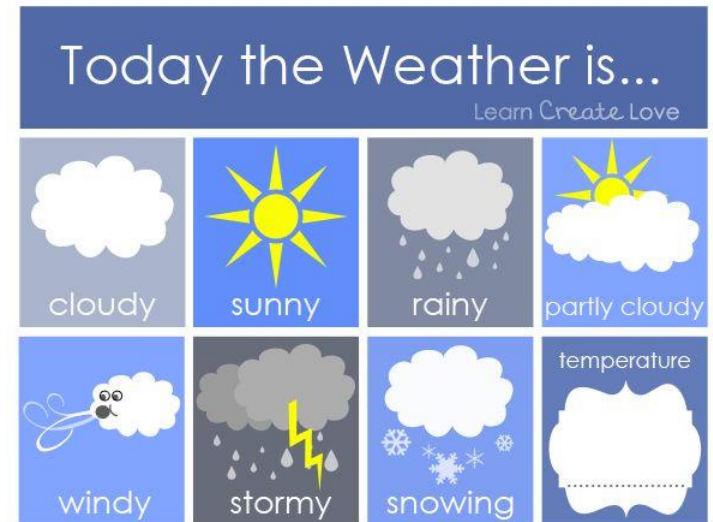


# Weather vs. Climate

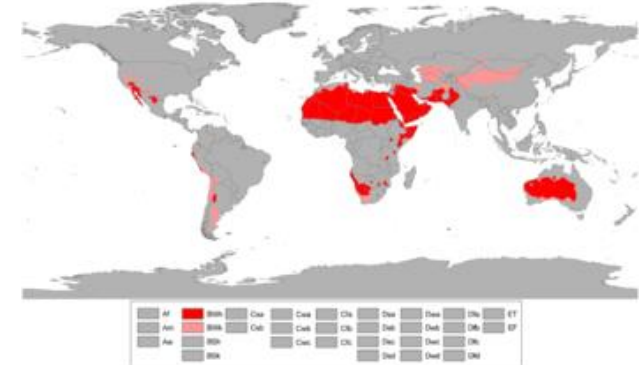
- **Weather**: temperature, wind, clouds, precipitation; what's happening outside right now
- **Climate**: average of weather conditions over a long time period



<https://www.worldatlas.com/articles/what-is-a-desert-climate.html>



<https://speechfoodie.com/weather-definition-for-kids/>



[https://en.wikipedia.org/wiki/Desert\\_climate](https://en.wikipedia.org/wiki/Desert_climate)

# 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

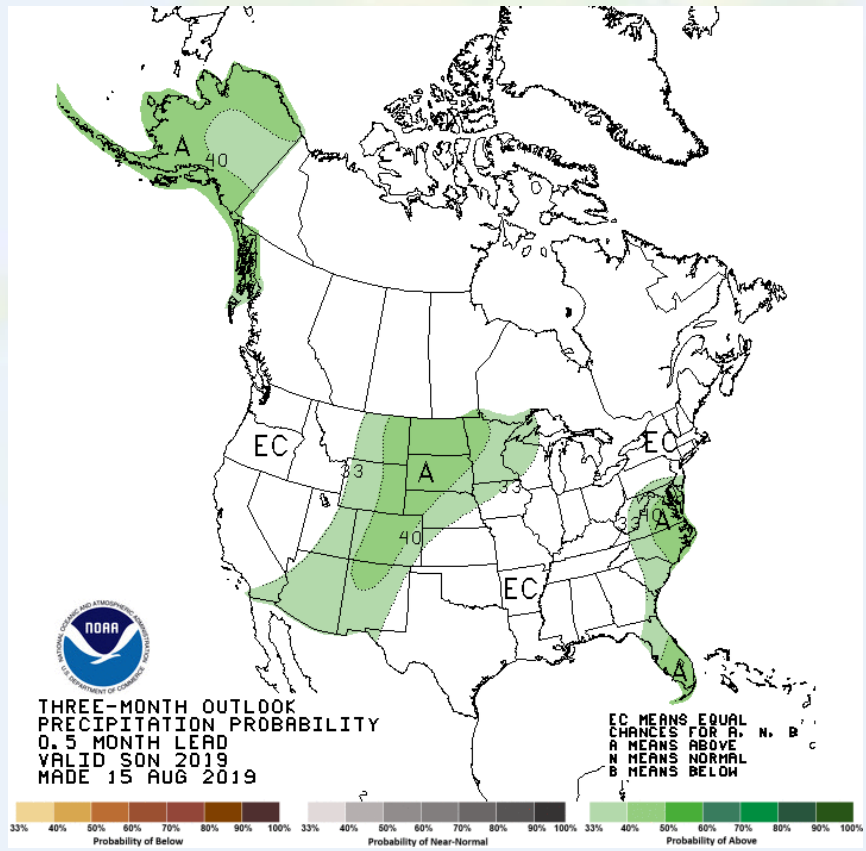
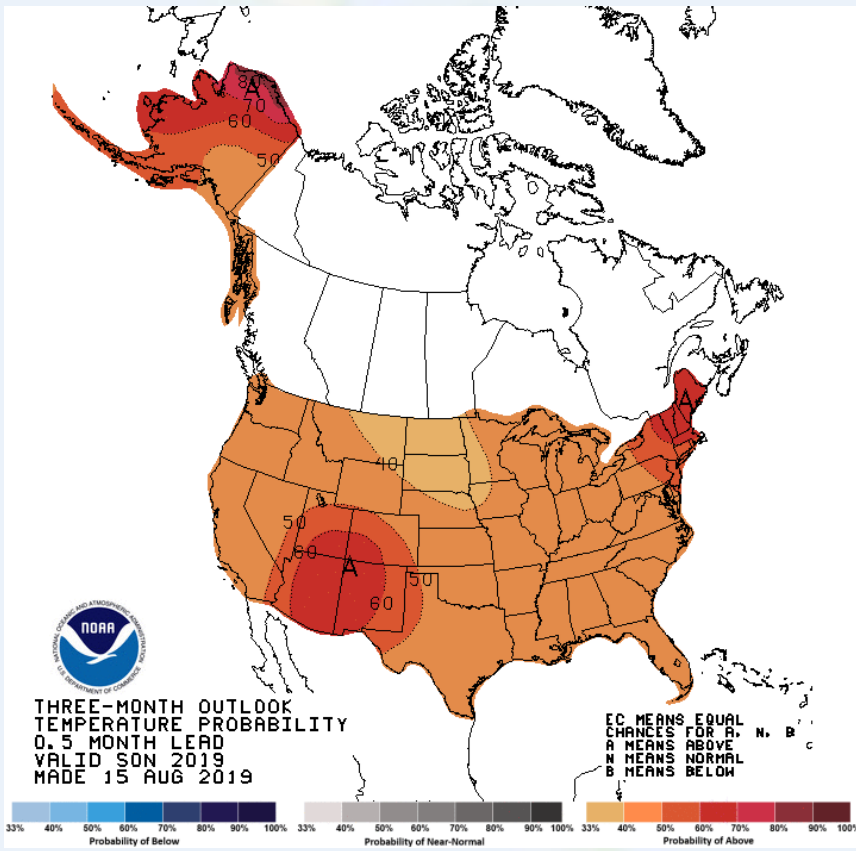




# Climate Prediction



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

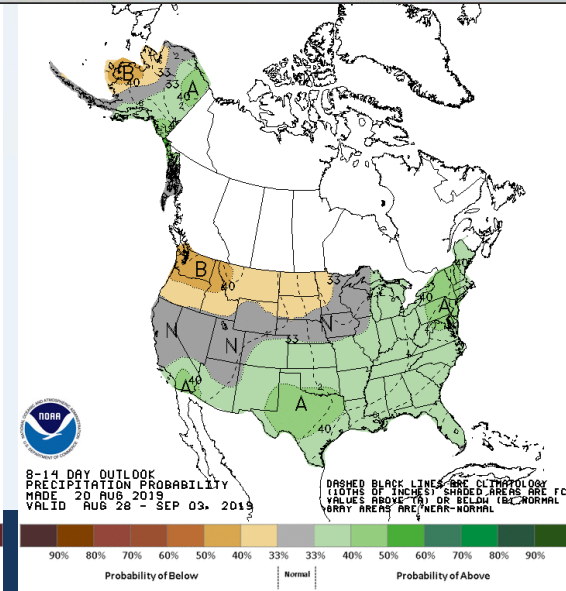
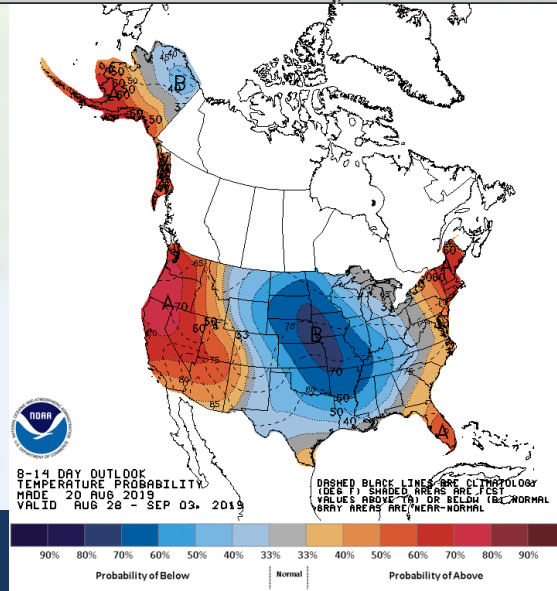
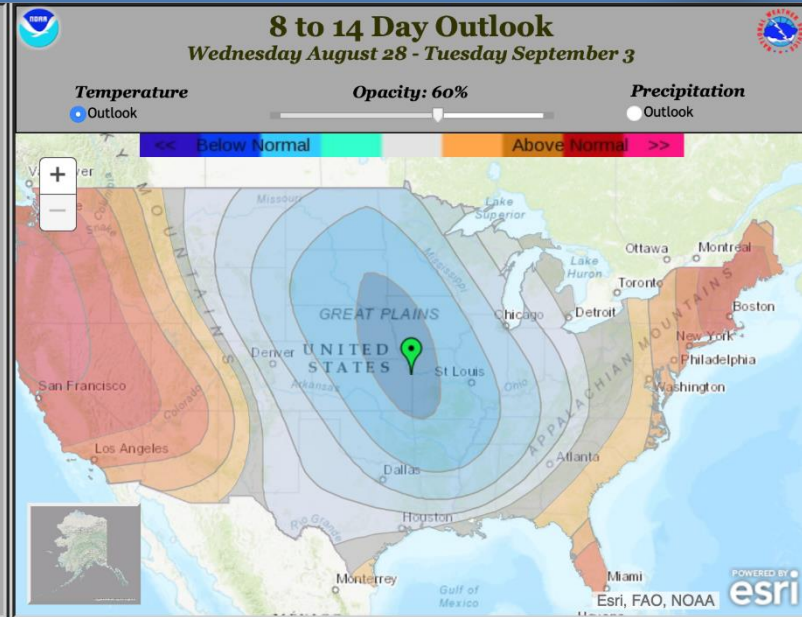
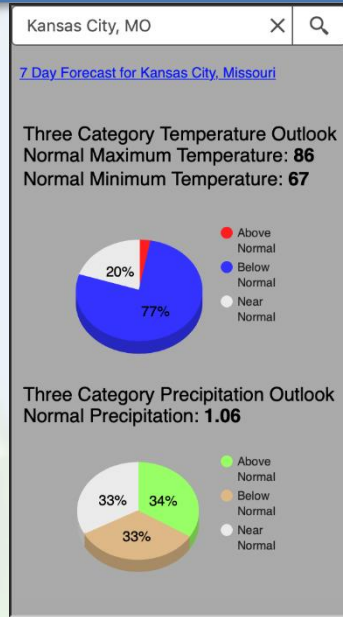




# CPC Outlooks: 6- to 10-Day and 8- to 14-Day

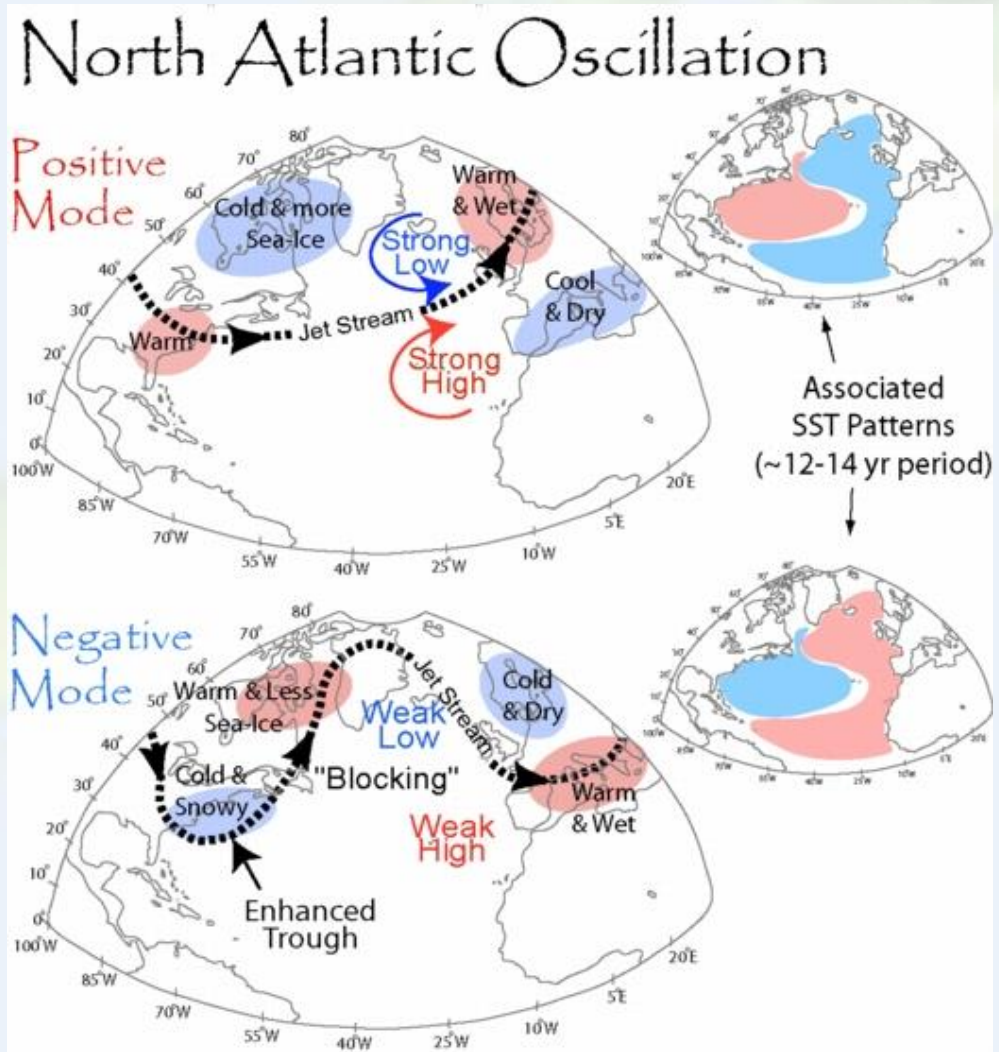
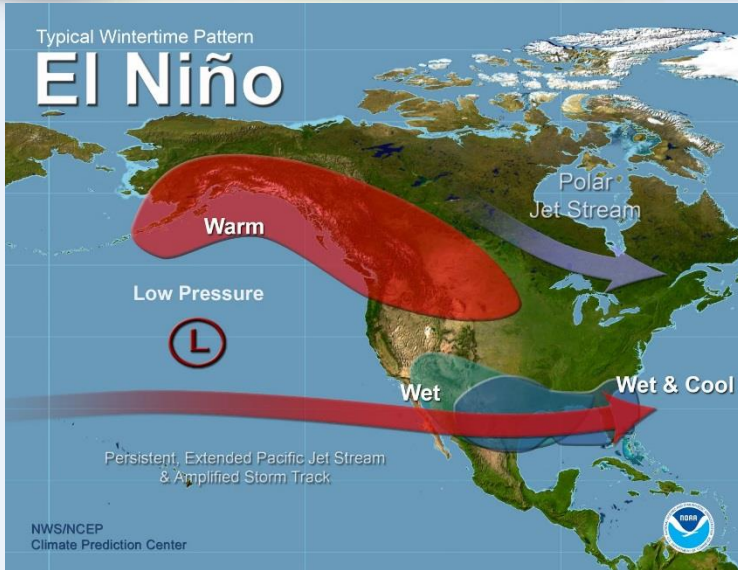


- Predicting chances for *temperatures* and *precipitation* to fall in the *upper, middle, and lowest thirds*.
  - ◆ “40%” = 40-50% chance of that category (instead of the usual 33%)
- Issued every afternoon
  - ◆ Automated on weekends
- Mainly based on weather and climate models
- Interactive and static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





# Climate Variability: Influencing Seasons







# 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?

~ UTOPIA THEORY ~



"Yeah, I see him too...But nobody wants to talk about it!"

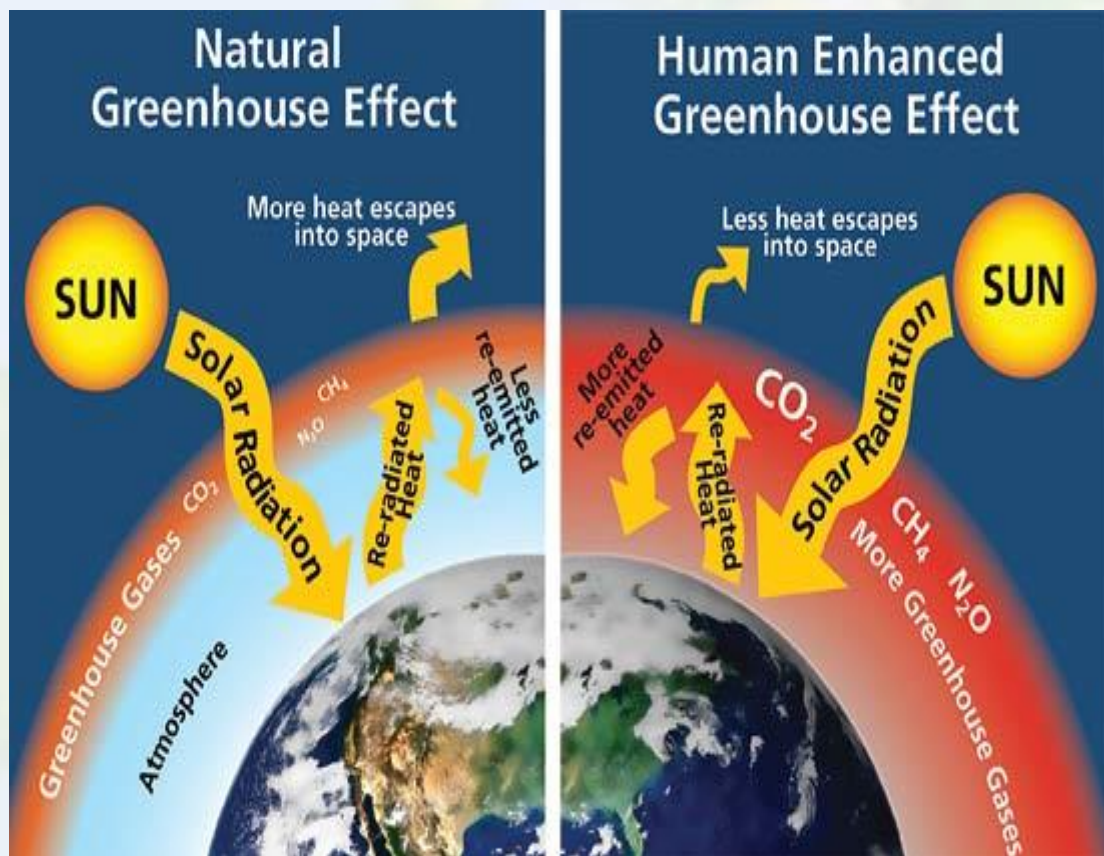




# **Climate and the Greenhouse Gases**



- Greenhouse gases absorb heat (solar radiation)
  - ◆ Radiate heat back to Earth's surface
  - ◆ Major greenhouse gases include carbon dioxide ( $\text{CO}_2$ ) and water vapor ( $\text{H}_2\text{O}$ )
  - ◆ 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.

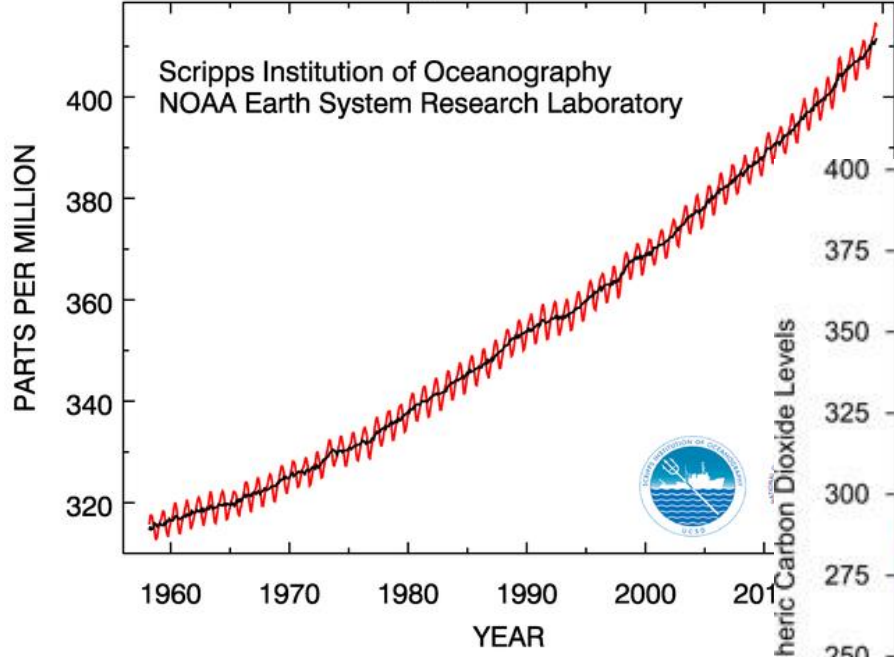




# Carbon Dioxide Increasing Due to Human Activity

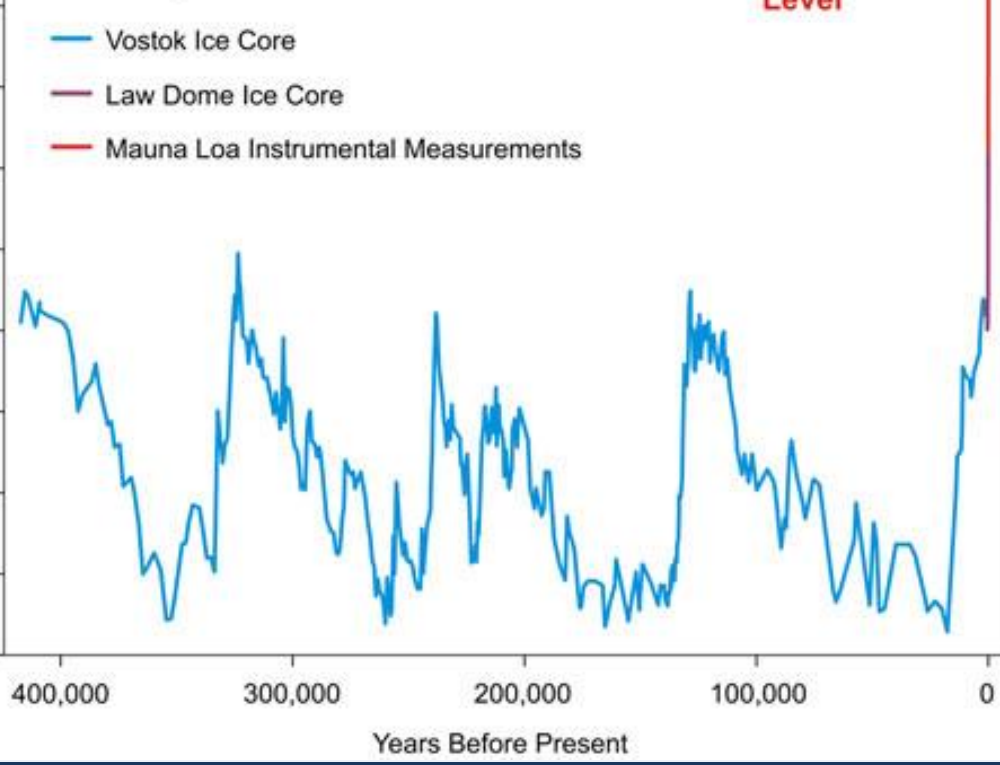


### Atmospheric CO<sub>2</sub> at Mauna Loa Observatory



2019 peak: 411.6 PPM ★

### Atmospheric Carbon Dioxide

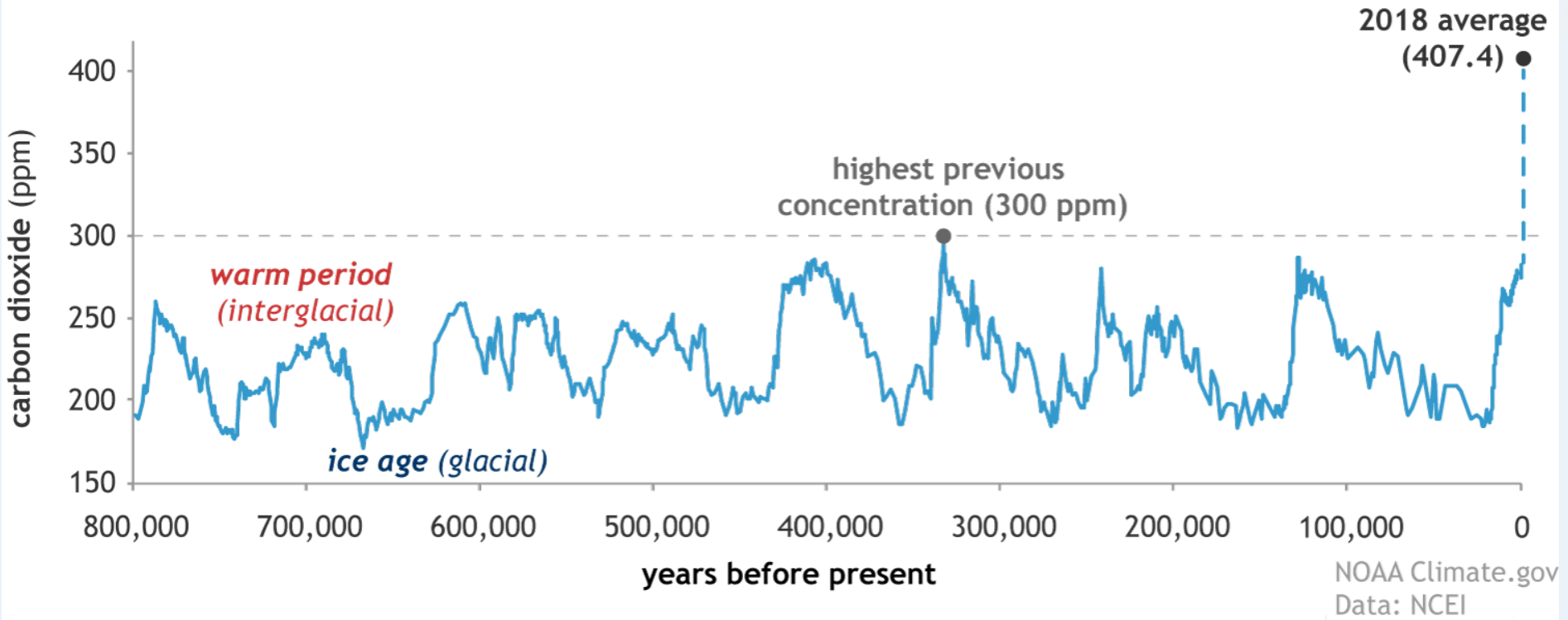




# Carbon Dioxide Increasing



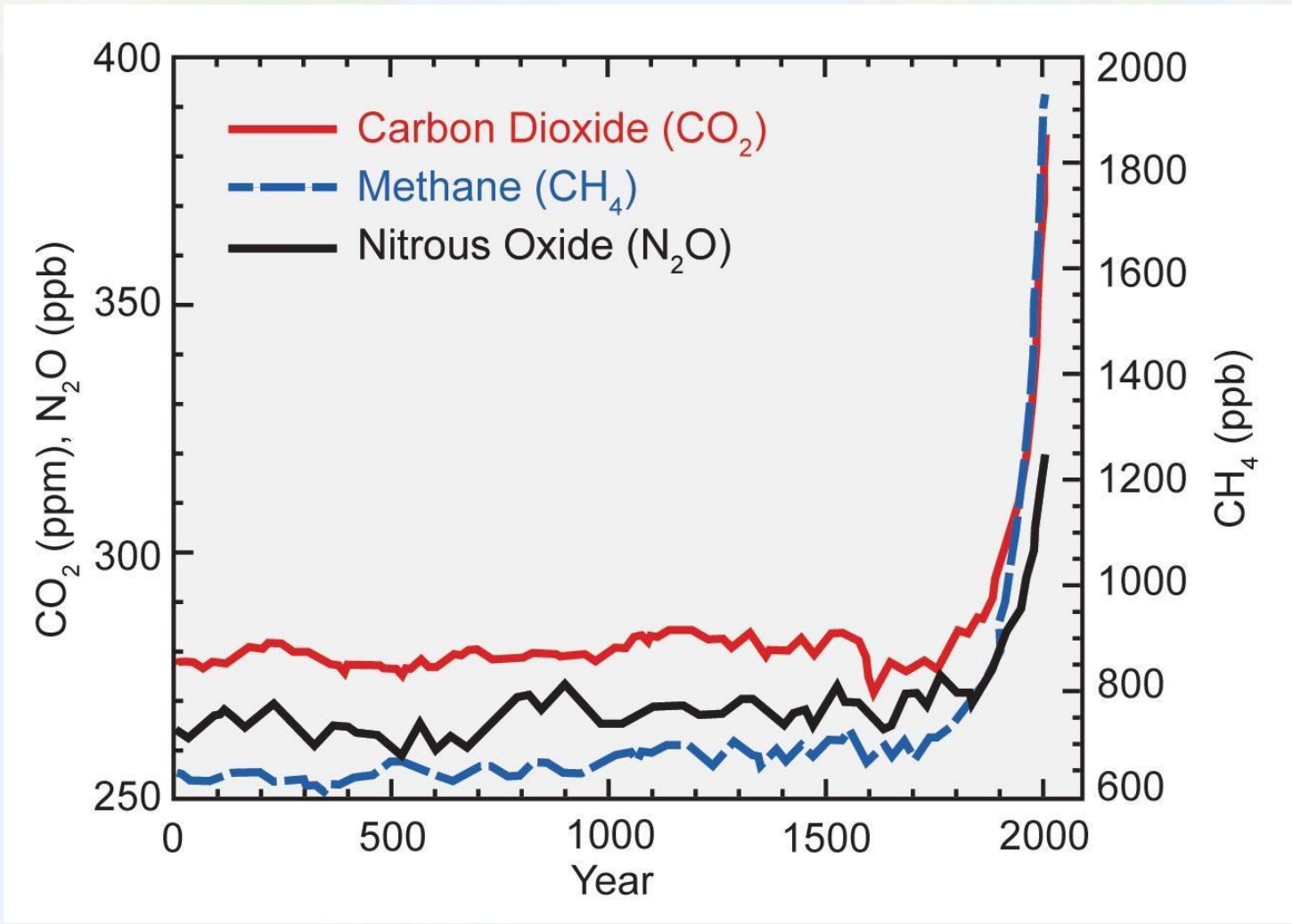
CO<sub>2</sub> during ice ages and warm periods for the past 800,000 years





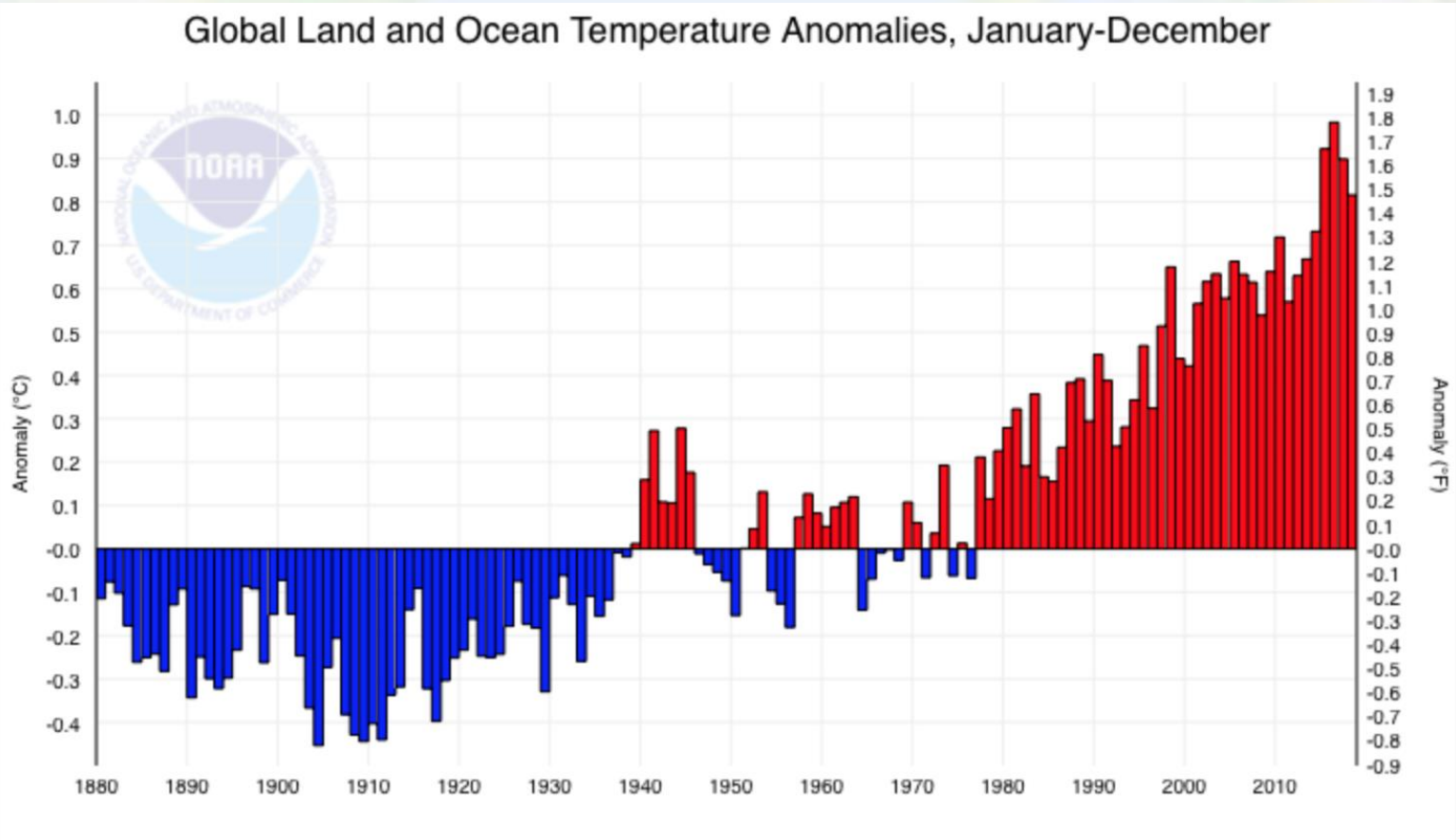


# ...And So Are Other Greenhouse Gases





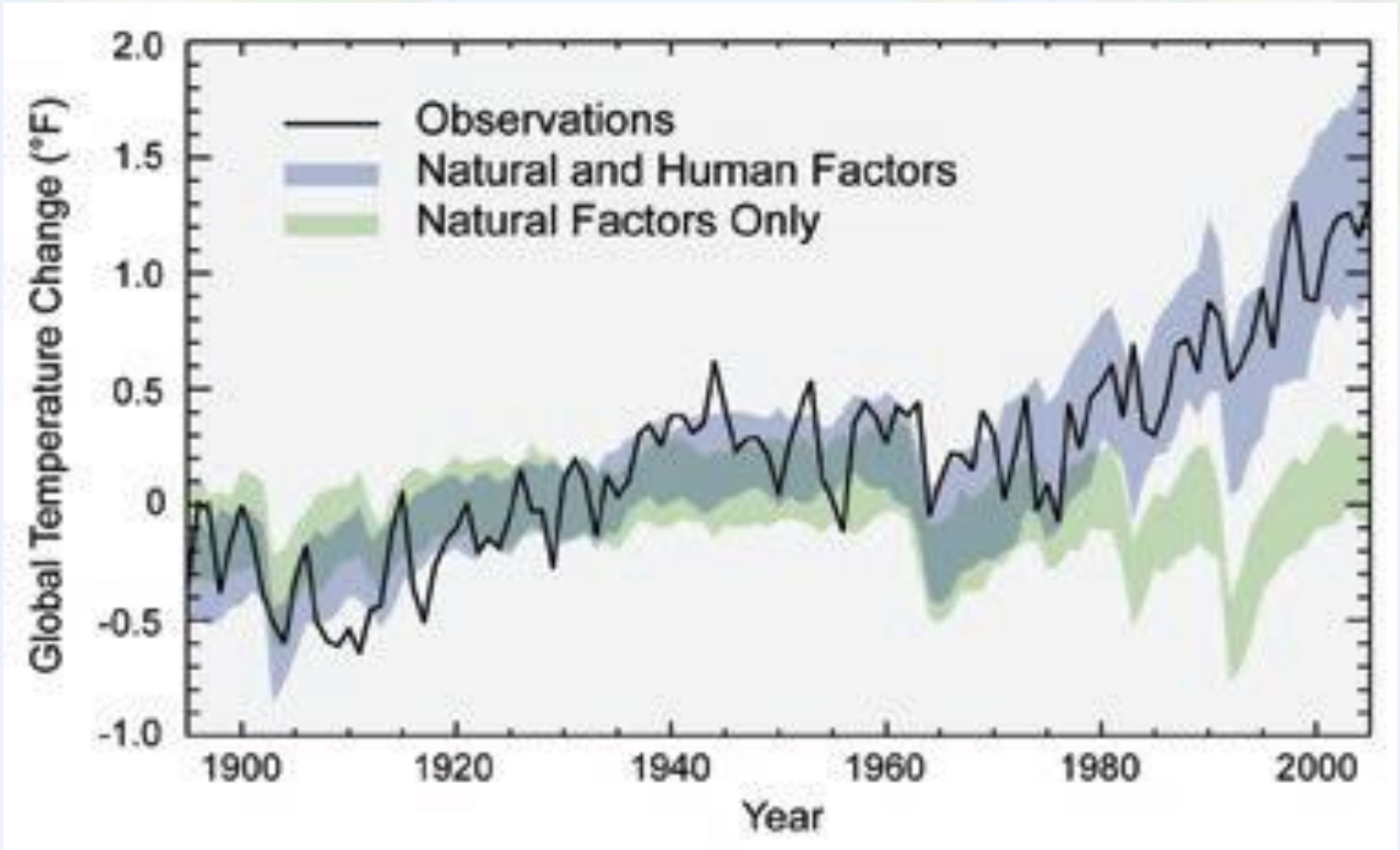
# Global Temperatures Are Increasing



Most obvious and most discussed impact of climate change



# ...And Are Explained Only When Including Increased Greenhouse Gases



Source: IPCC

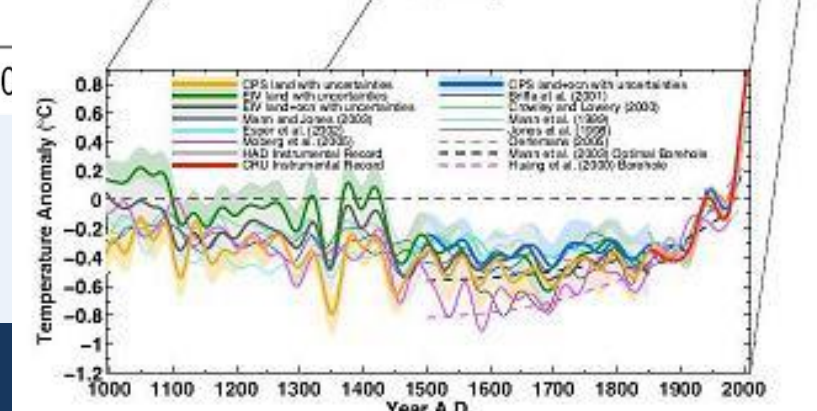
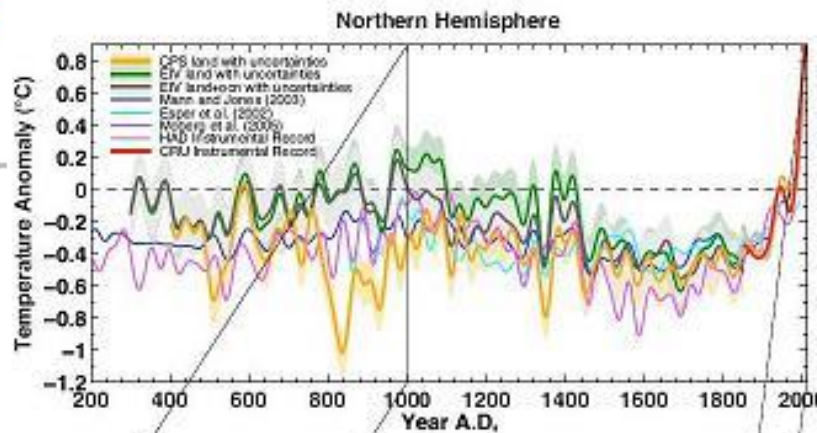
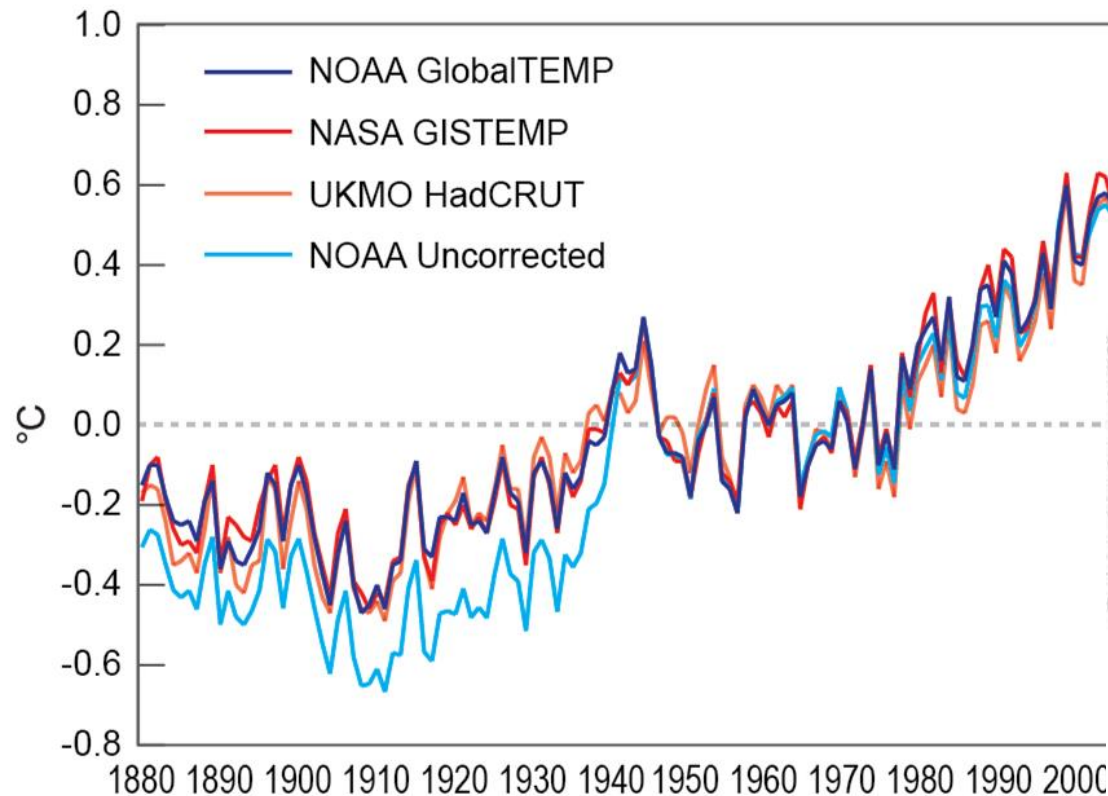




# Global Temperature Analyses Agree



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

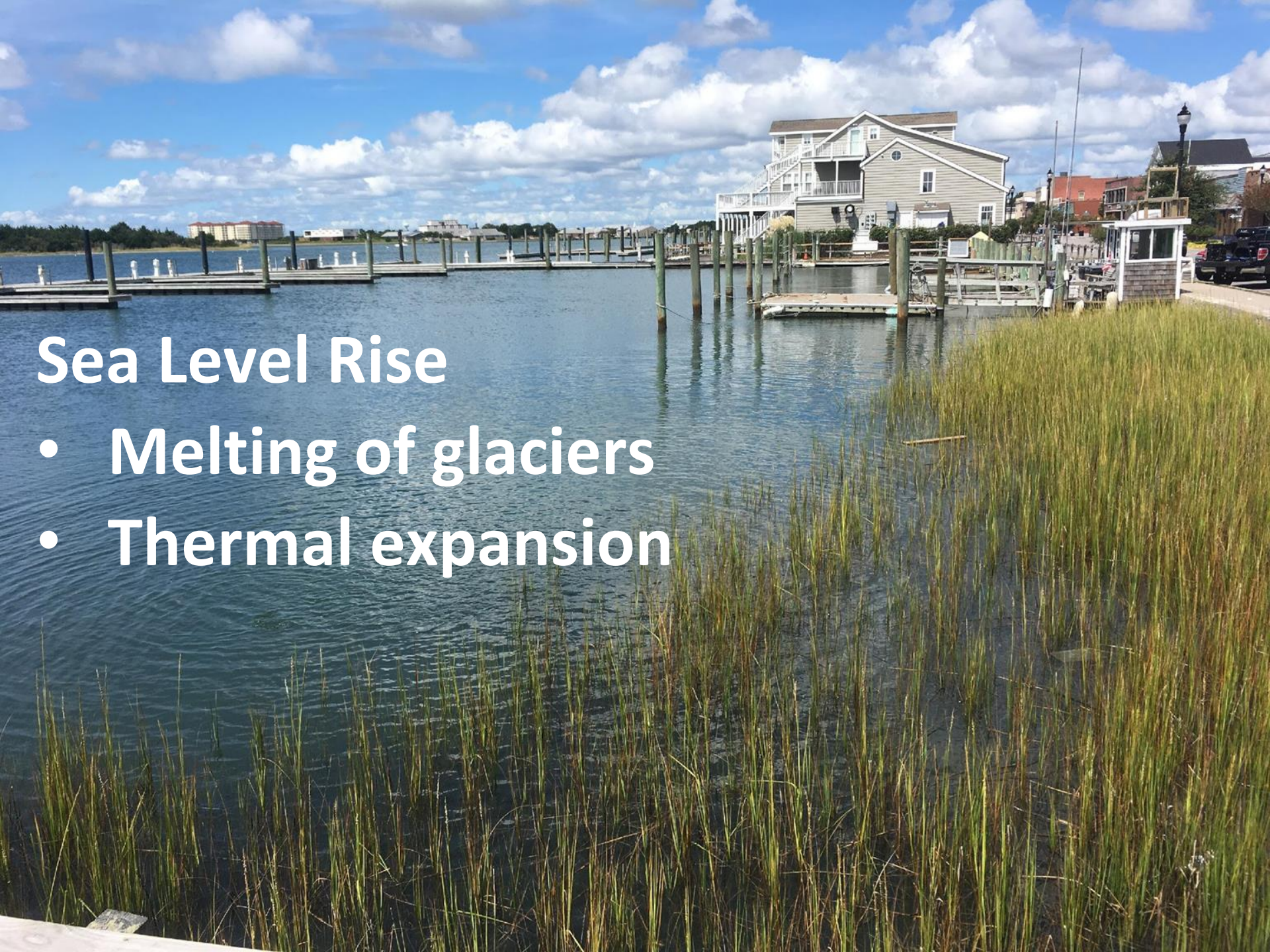


**Right:** Temperature over the past 1000-2000 years. Uncertainty increases farther back in time, when temperature reconstructions are based on “proxy” data (ice cores, tree rings, corals, lake sediments, glaciers, boreholes, stalagmites, etc.). Agreement improves with the instrumental records, beginning around 1850 A.D.



# Symptoms of Climate Change



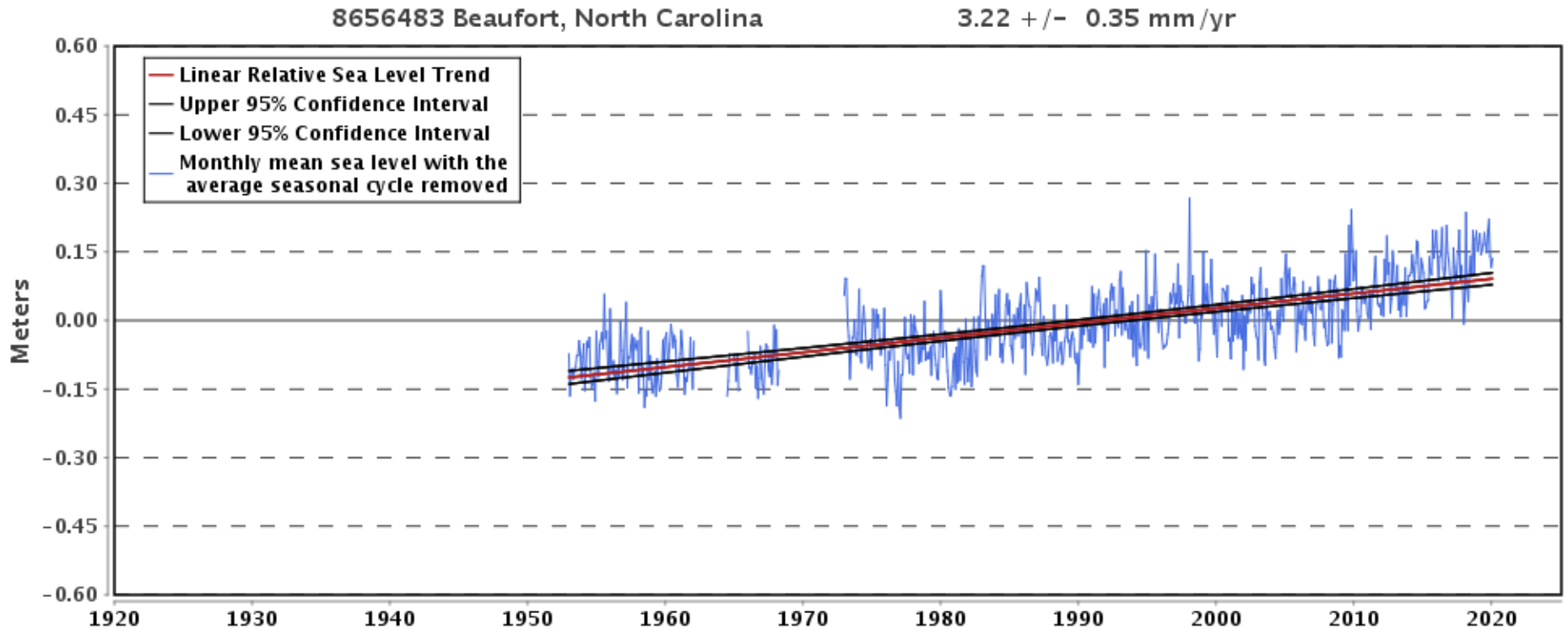


# Sea Level Rise

- Melting of glaciers
- Thermal expansion



# Sea Levels are Rising



## Relative Sea Level Trend: Beaufort, North Carolina

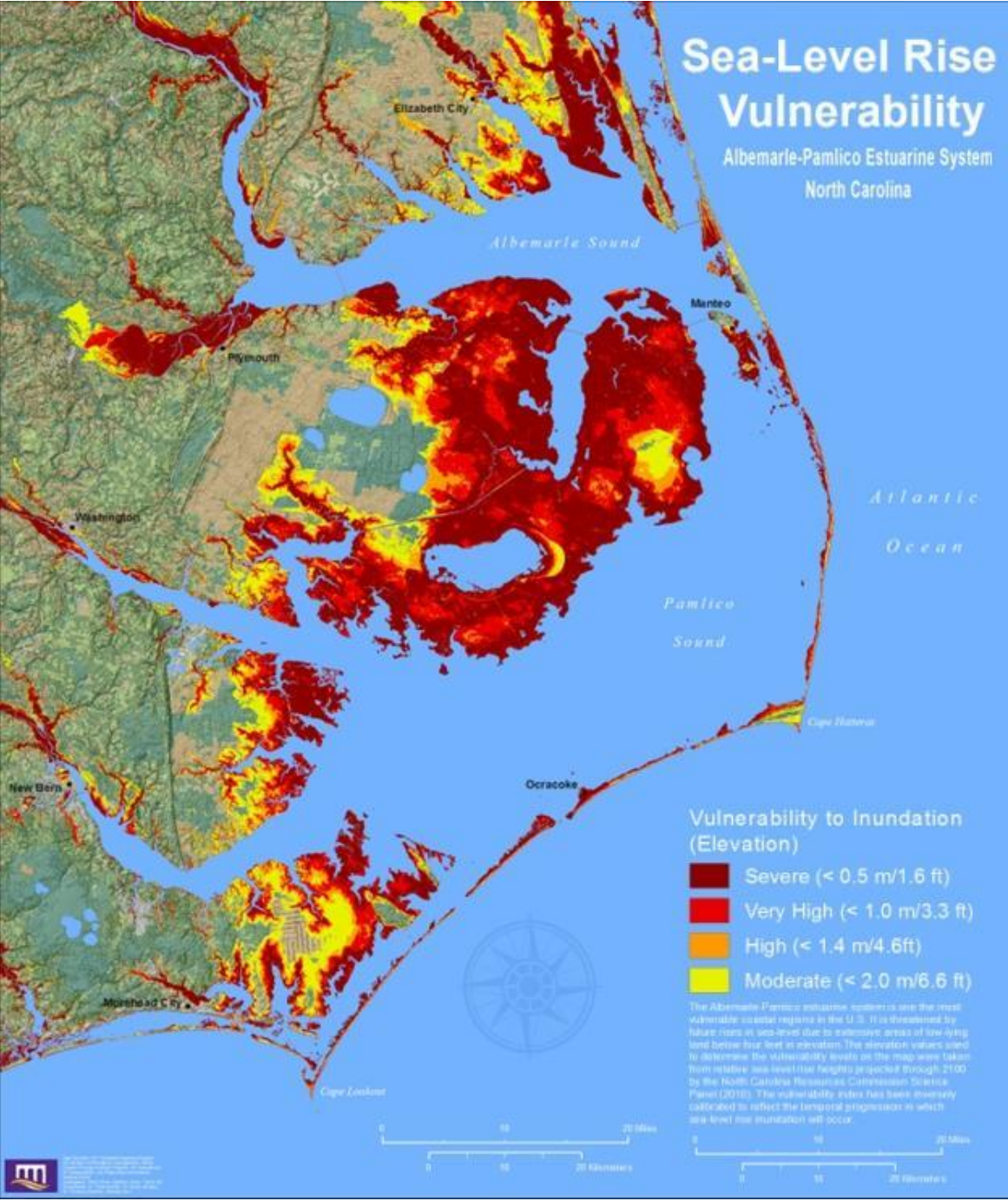
The relative sea level trend is **3.22 millimeters/year** with a 95% confidence interval of +/- 0.35 mm/yr based on monthly mean sea level data from **1953 to 2019** which is equivalent to a change of 1.06 feet in 100 years.

[https://tidesandcurrents.noaa.gov/sltrends/sltrends\\_station.shtml?id=8656483](https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8656483)



# Sea-Level Rise Vulnerability

Albemarle-Pamlico Estuarine System  
North Carolina

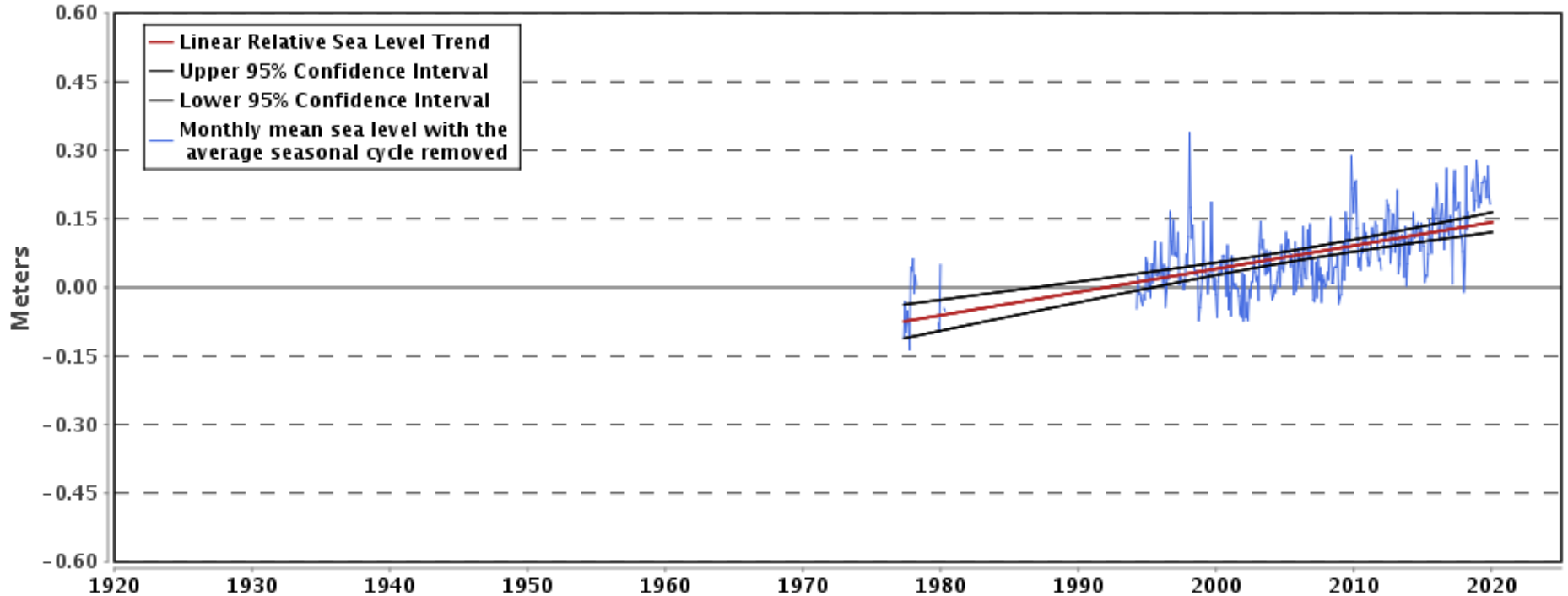




# Sea Levels are Rising

8652587 Oregon Inlet Marina, North Carolina

5.08 +/- 1.16 mm/yr

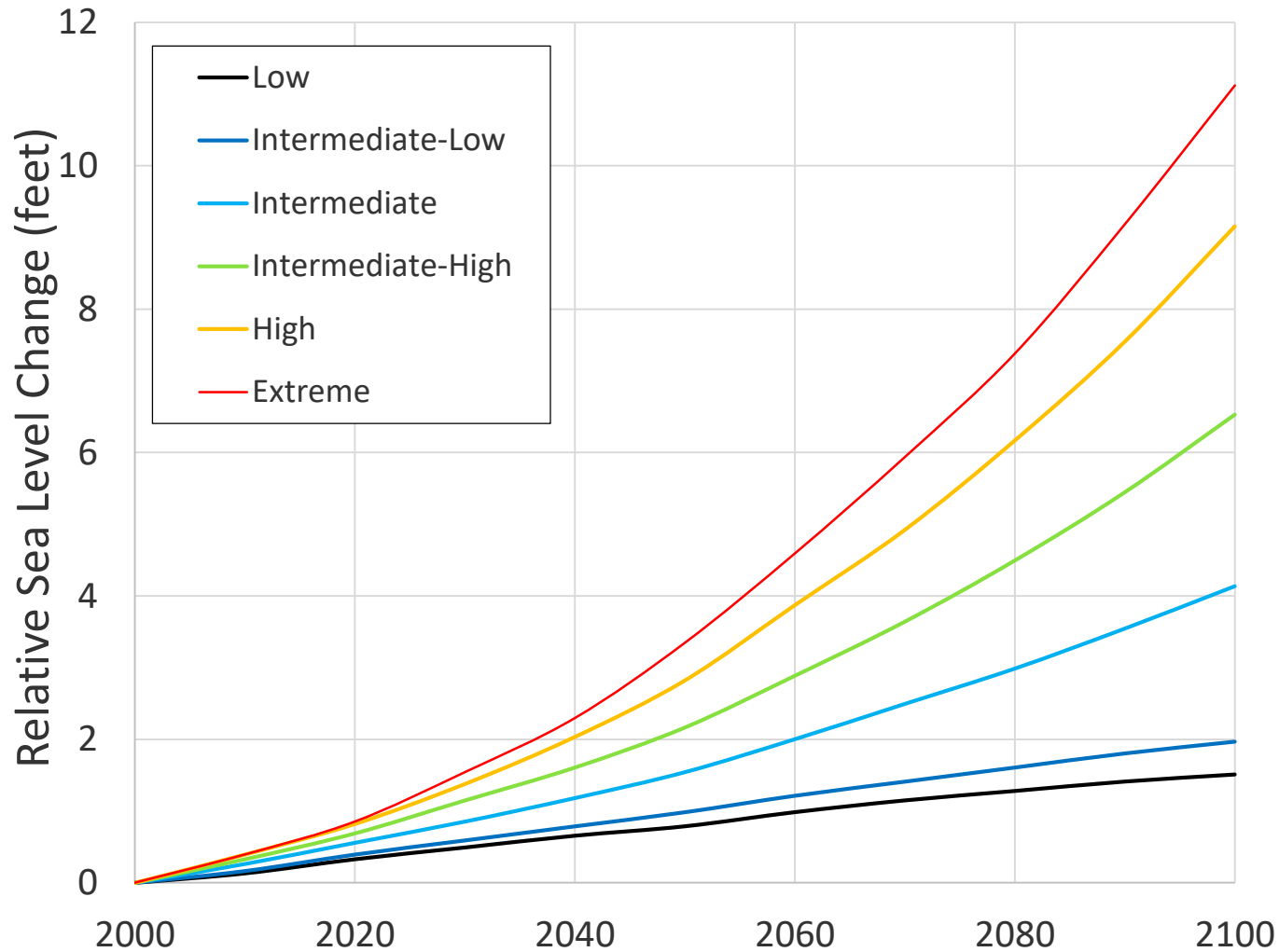


## Relative Sea Level Trend: Oregon Inlet, NC

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](https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8652587)

# Projected Increase in Mean Sea Level

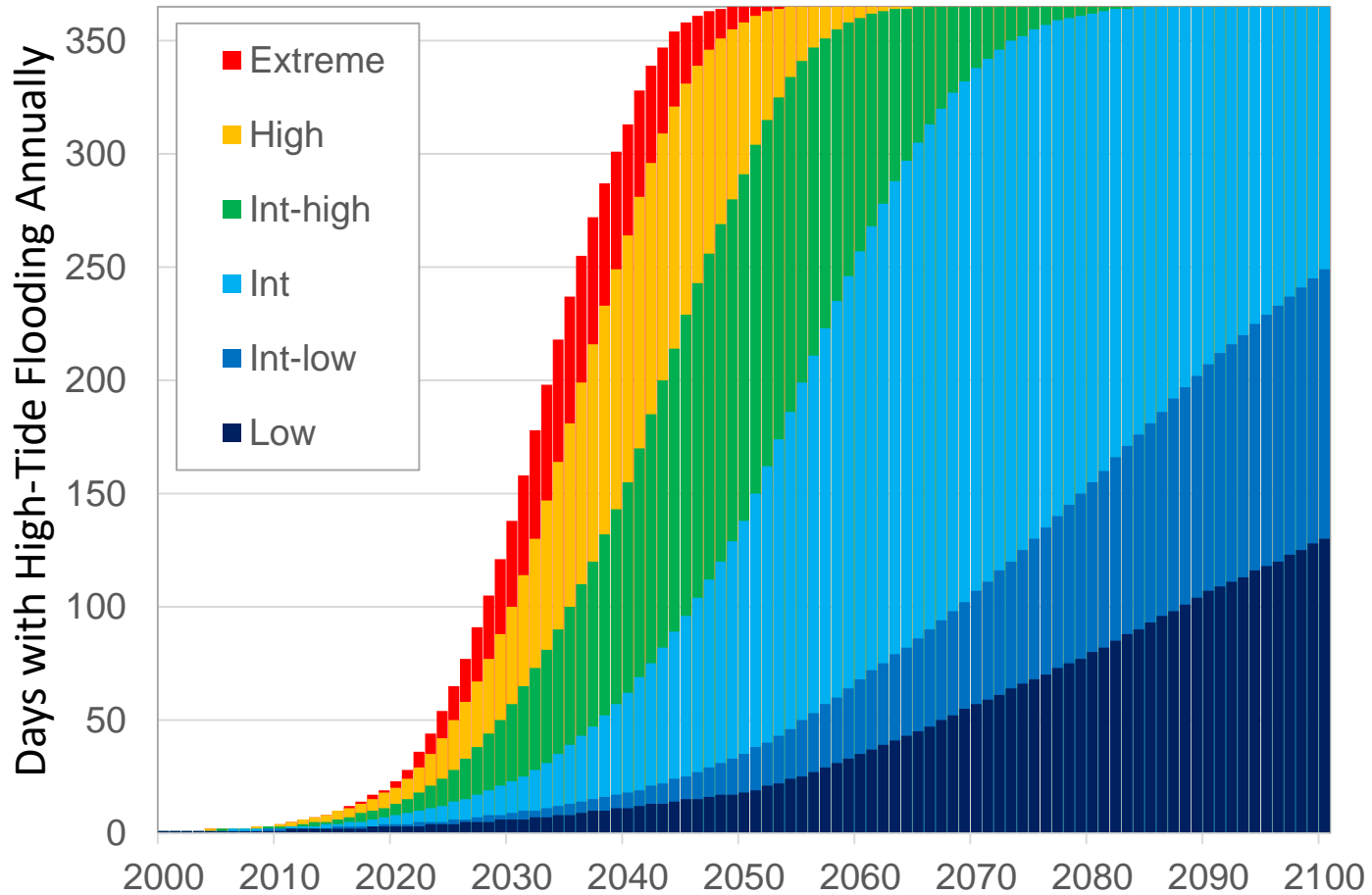


Relative sea level change scenarios for **Beaufort, NC** associated with 6 different sea level rise scenarios. The low and extreme scenarios represent the minimum and maximum of plausible future sea level rise.





# 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.

Data source: NOAA Technical Report NOS CO-OPS 086.







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

<https://sph.unc.edu/sph-news/north-carolina-tropical-cyclone-driven-coastal-flooding-is-worsening-with-climate-change-population-growth/>

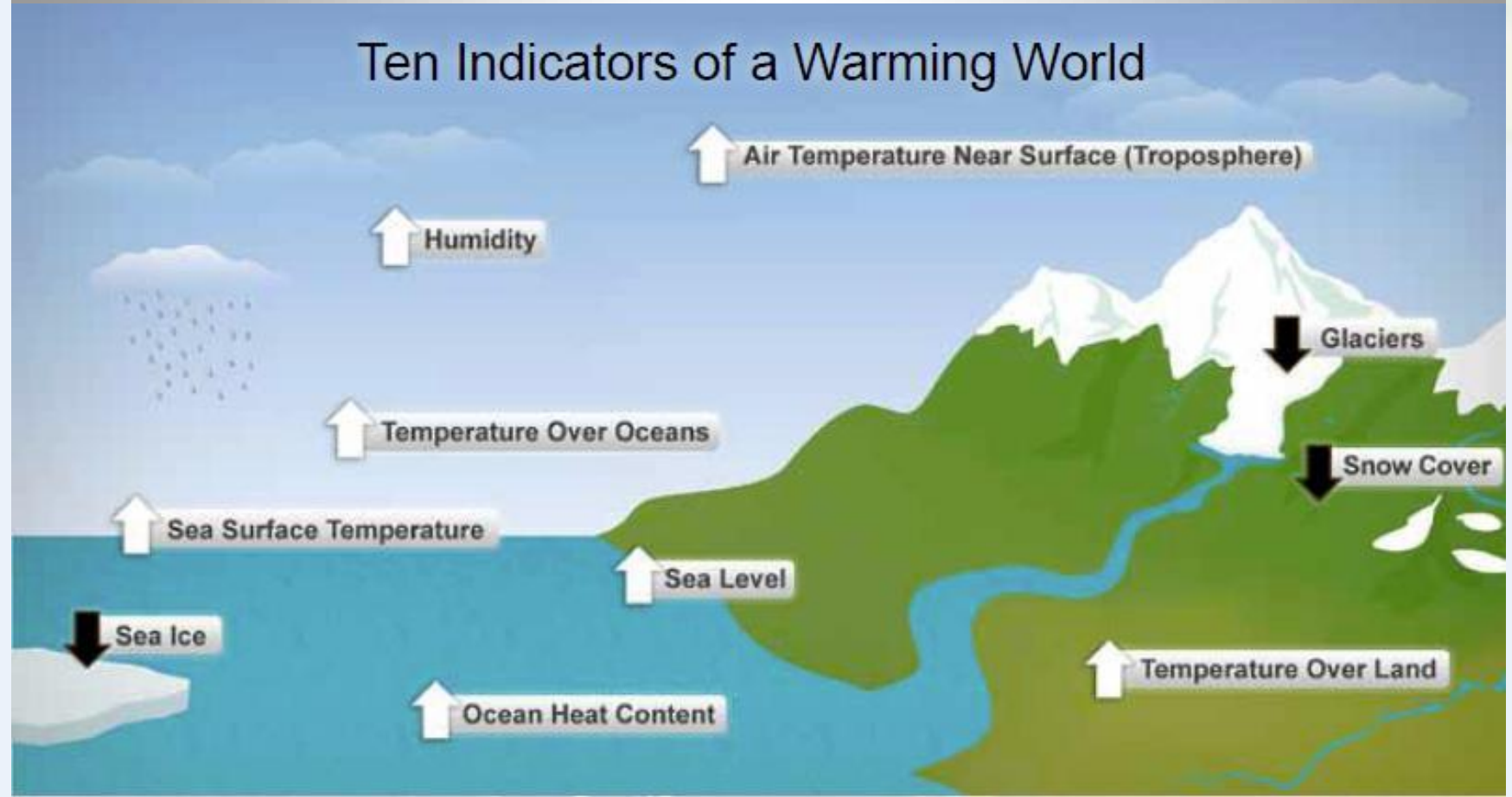




# ⊕ || Indicators of a Warming World

**The stratosphere (up here!) is cooling**

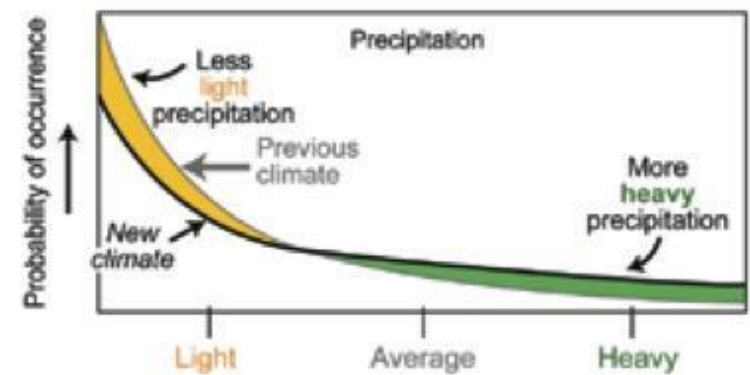
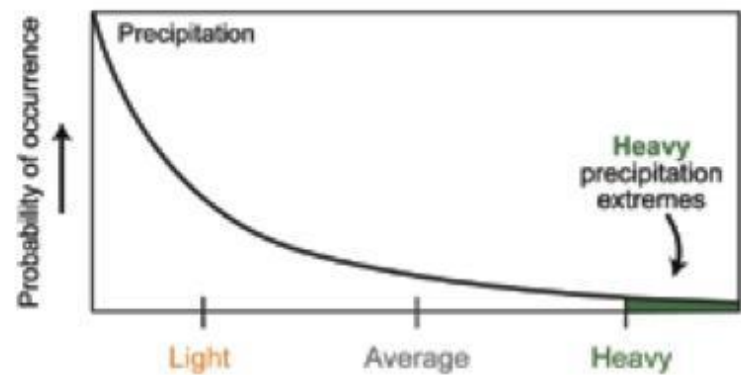
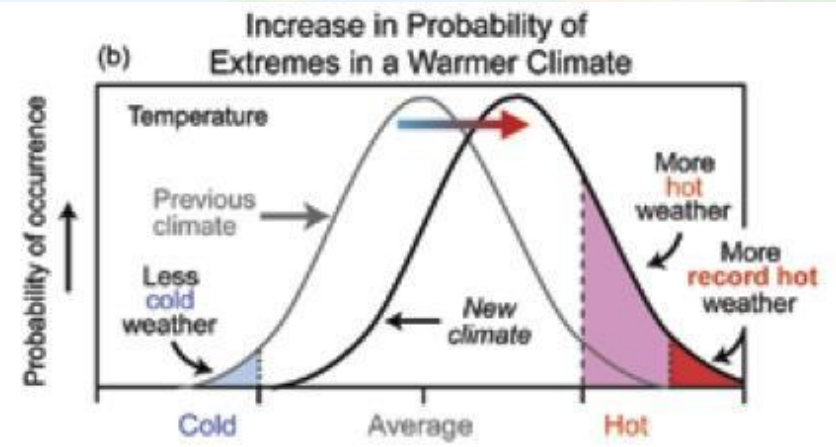
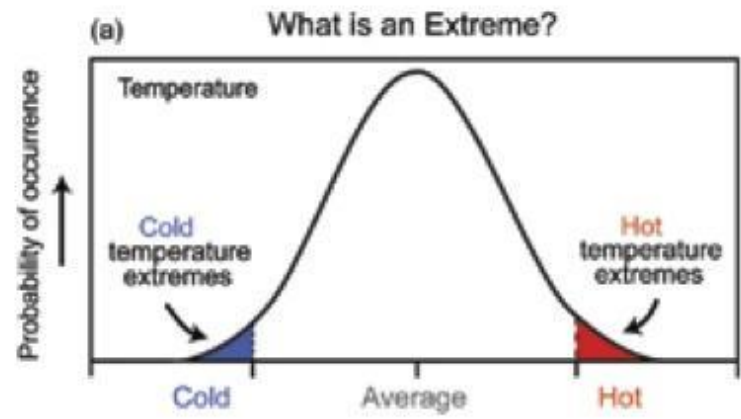
## Ten Indicators of a Warming World



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



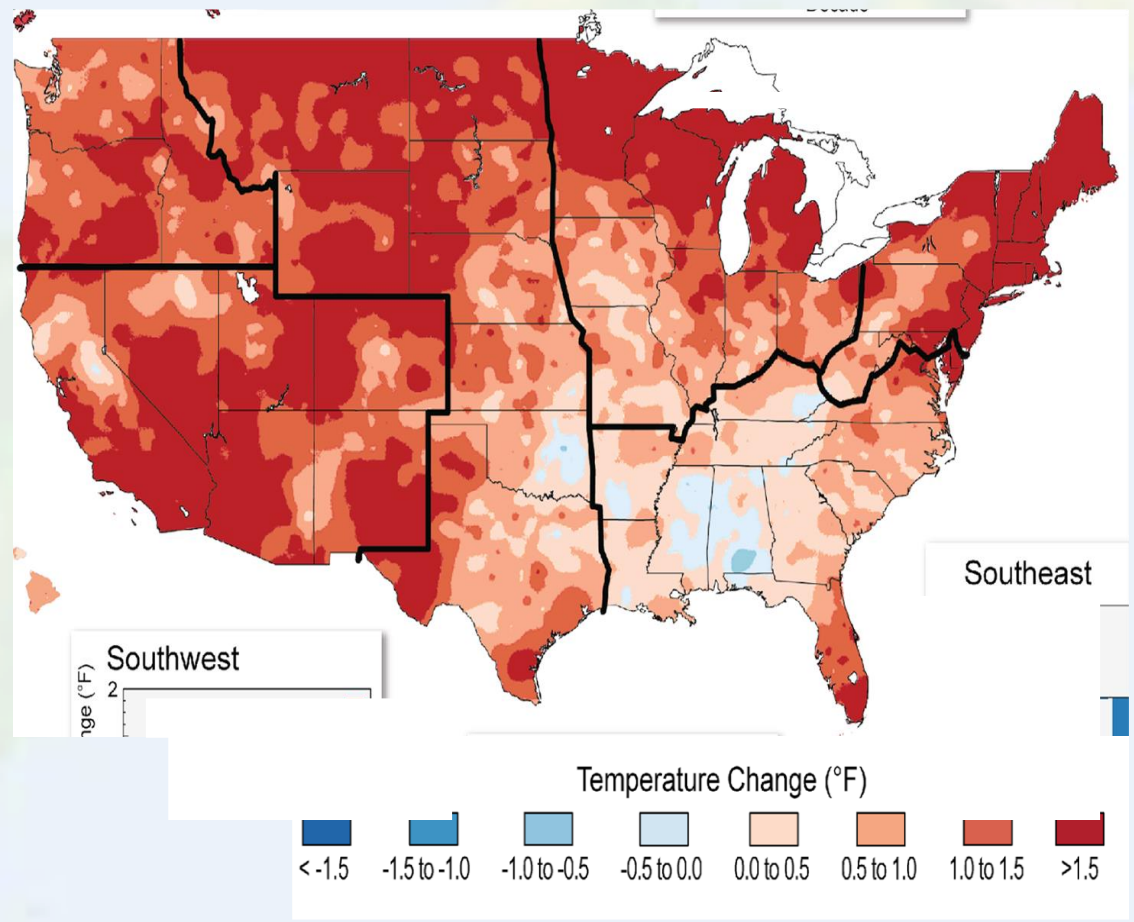


# Recent Temperature Trends



- Temperatures have warmed over the last century across the region.
- The warming is strongest during winter and for northern tier states.

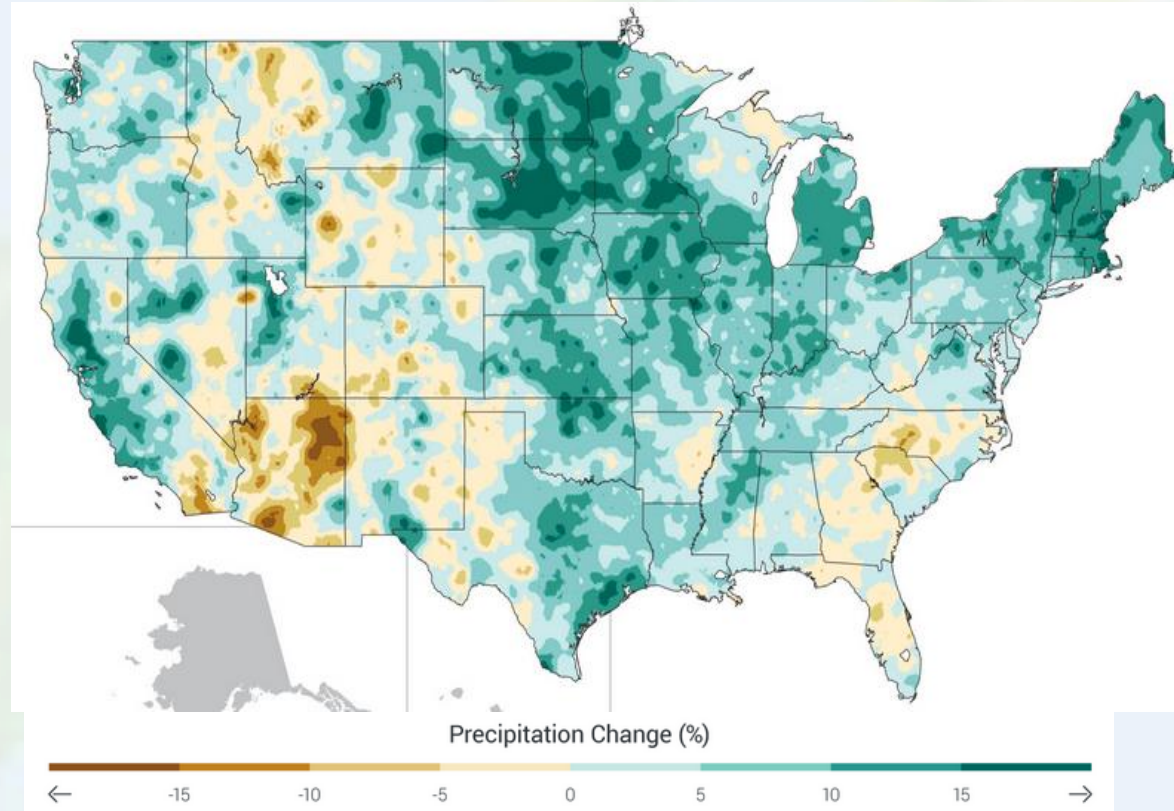
Recent temperatures (1991-2012) compared to 1901-1960





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

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



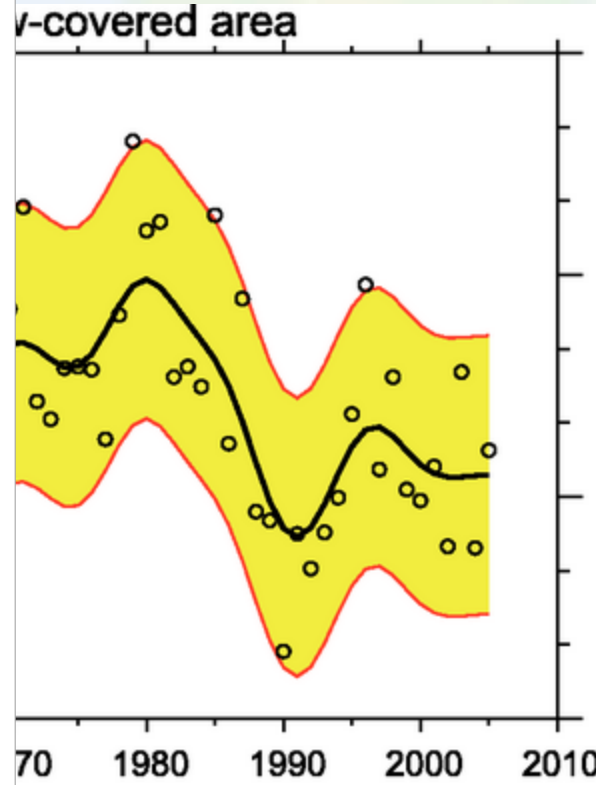
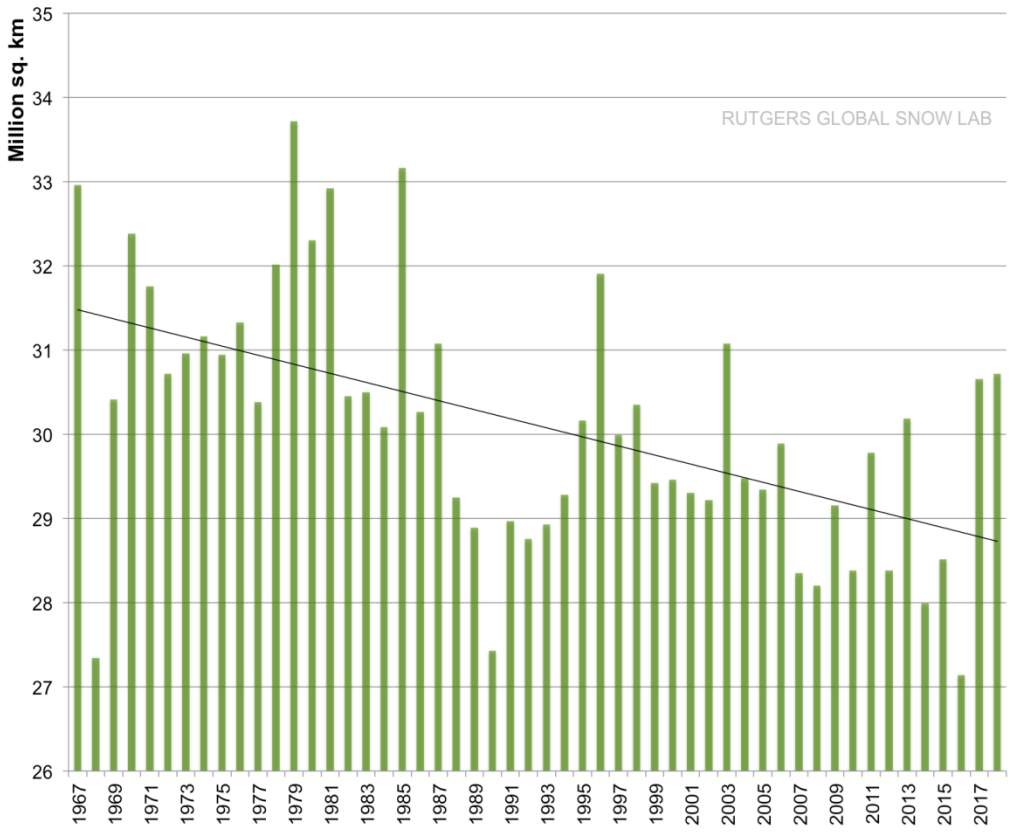


# Snow Is Melting Early



- In 2014, snow melt occurred 20–30 days earlier over North America than the 1998–2010 average.

Spring Northern Hemisphere Snow Extent

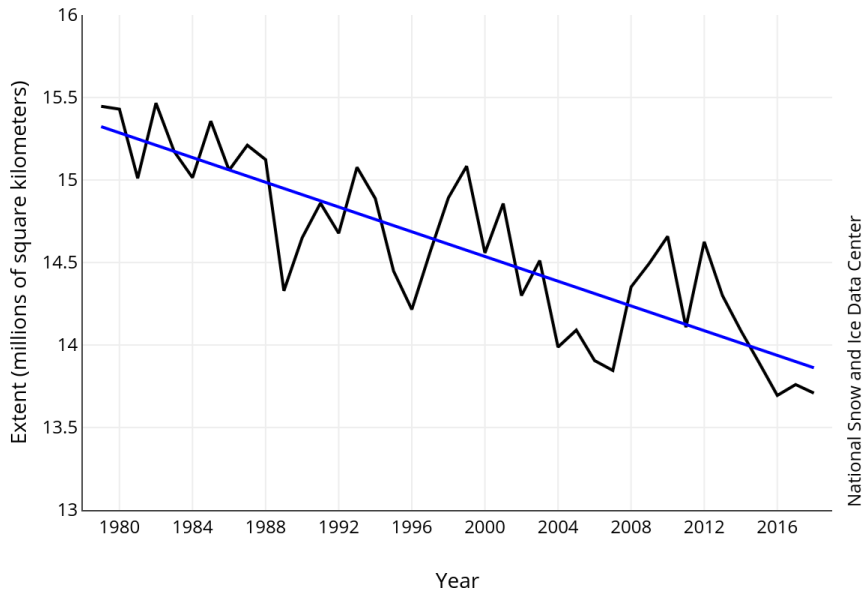




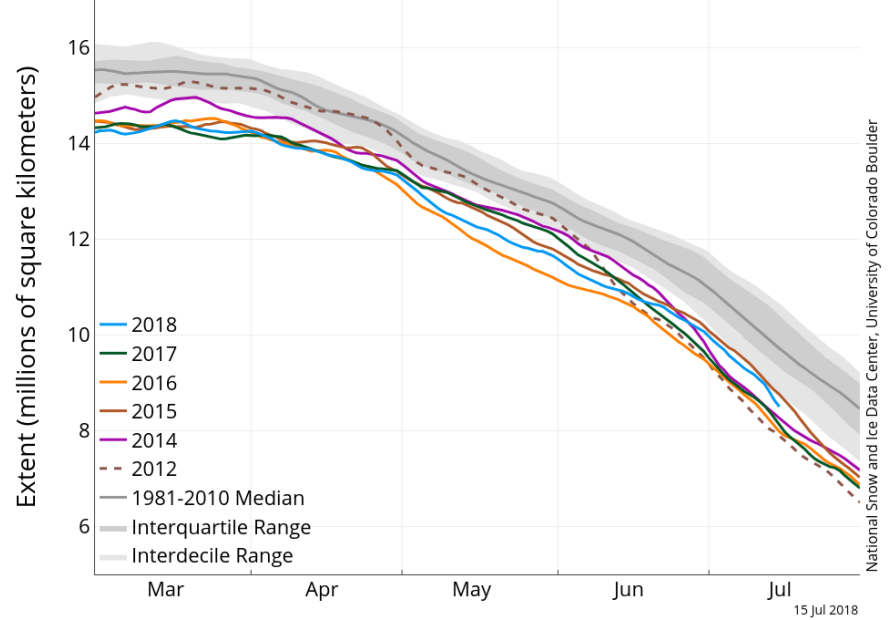
# Arctic Sea Ice Is Melting



Average Monthly Arctic Sea Ice Extent  
April 1979 - 2018



Arctic Sea Ice Extent  
(Area of ocean with at least 15% sea ice)

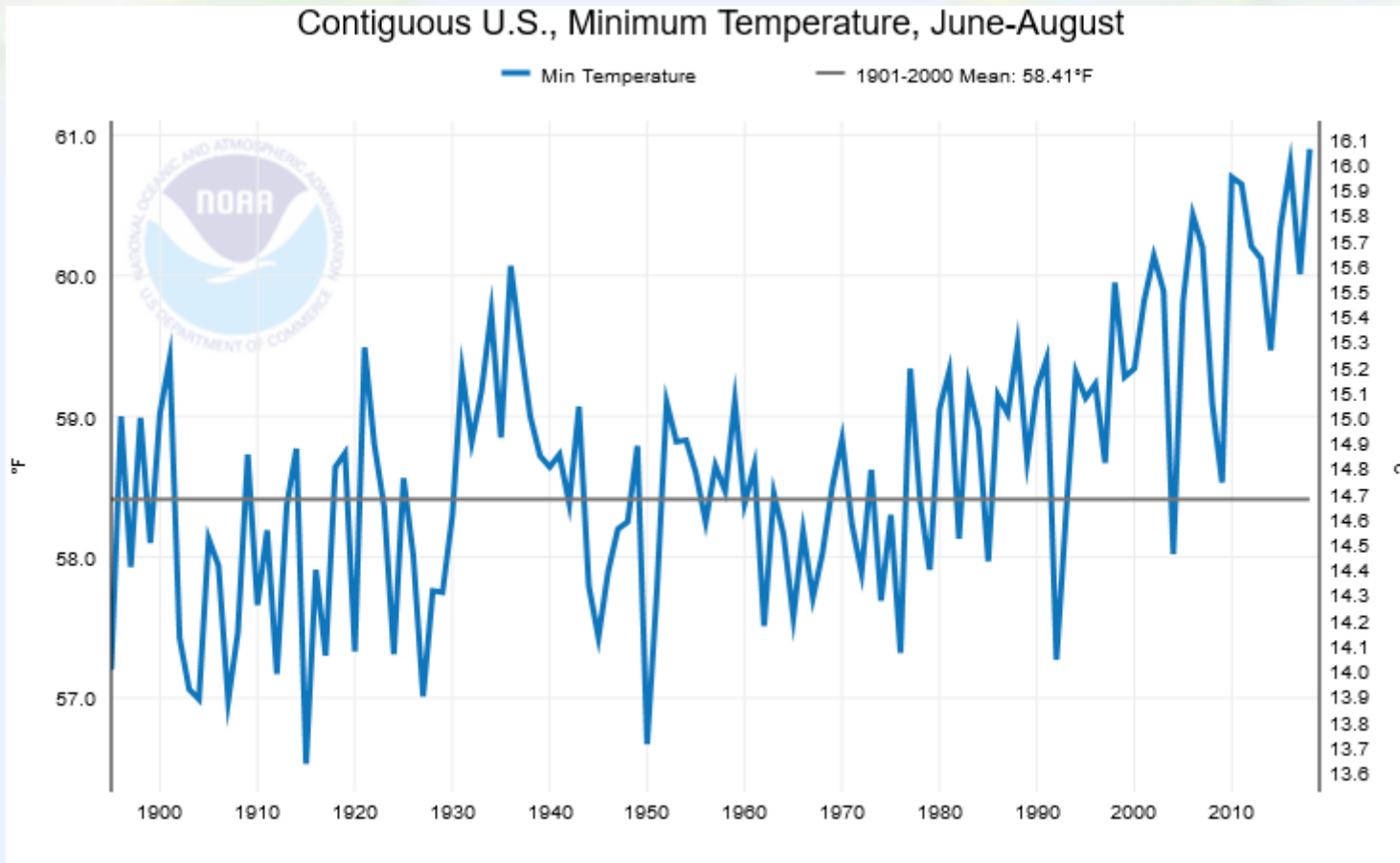


- 10 lowest minimum sea ice extents are the last 10 years.
- Multi-year ice is decreasing (ice is thinning).
- September Arctic sea ice extent is declining at a rate of -13.3% per decade.





# Big Heat Is Increasing



*(Big Cold is generally decreasing)*



# Frost-Free Season Is Lengthening



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

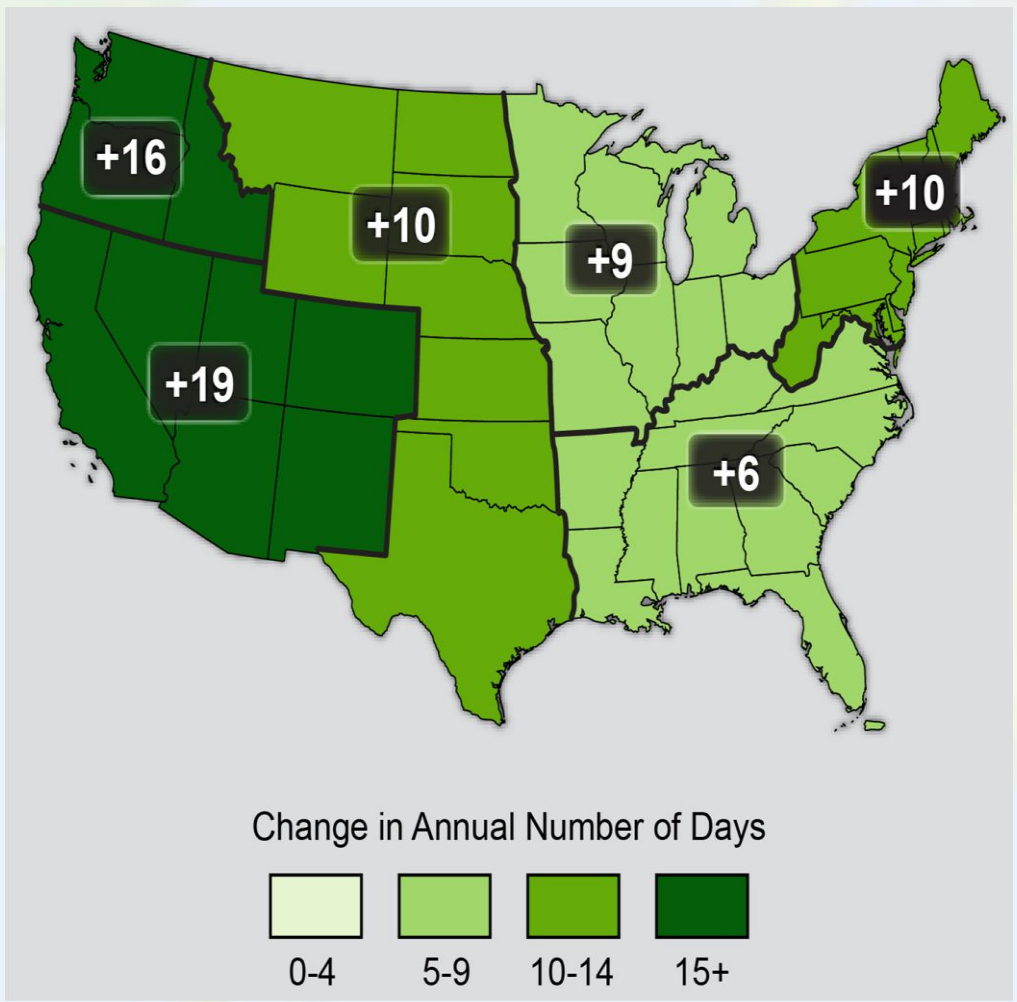


Figure 2.10 Our Changing Climate, National Climate Assessment. <http://nca2014.globalchange.gov>

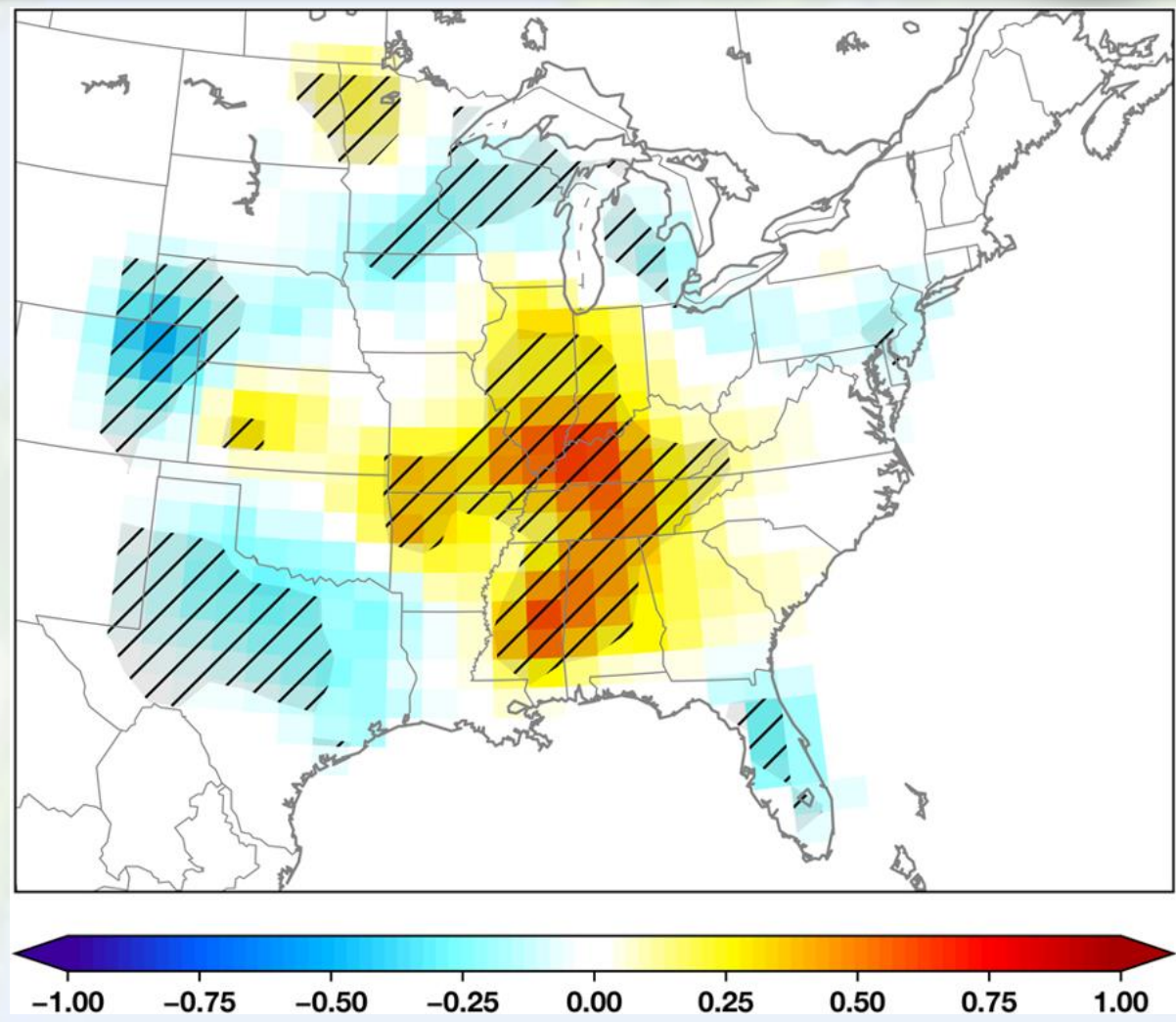


# Tornado Trends



1979-2017

- Shifts in where tornadoes occur



Gensini and Brooks 2018

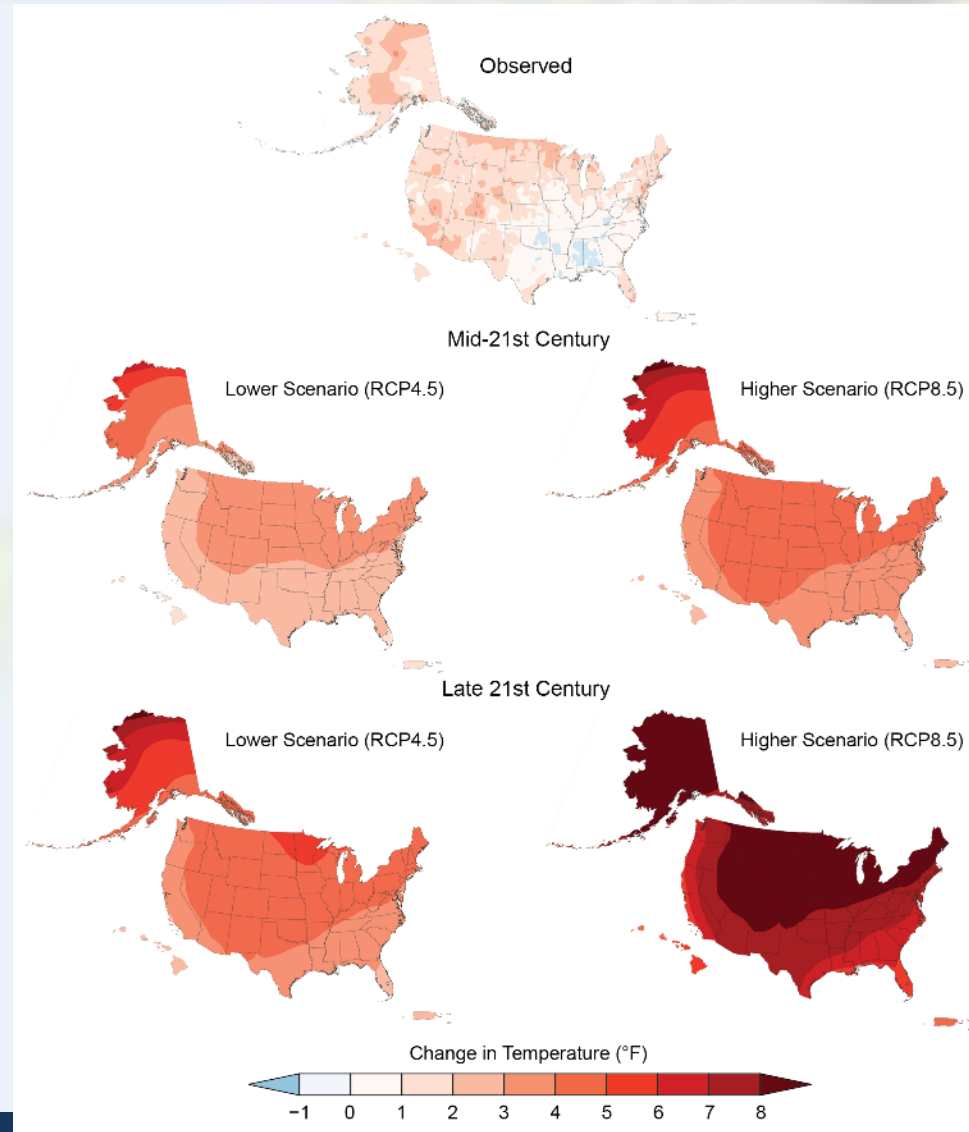




# Projected Temperature Change



- 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



# 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

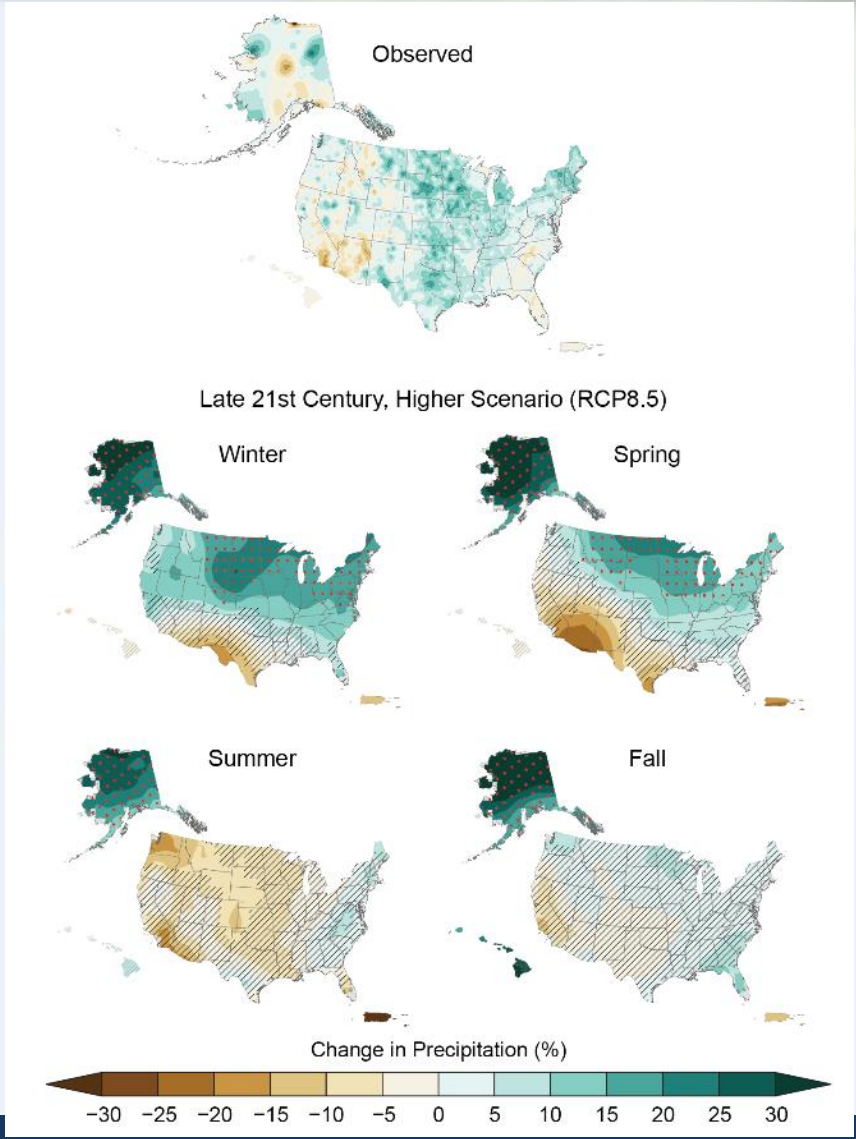


Figure 2.5, Our Changing Climate  
National Climate Assessment: <https://nca2018.globalchange.gov/>



# 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



# Climate.gov Global Climate Dashboard



## Global Climate Dashboard

▼ Climate Change

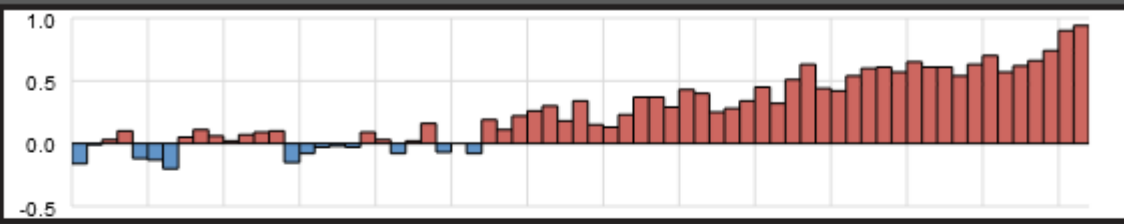
▶ Climate Variability

▶ Climate Projections

### 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.

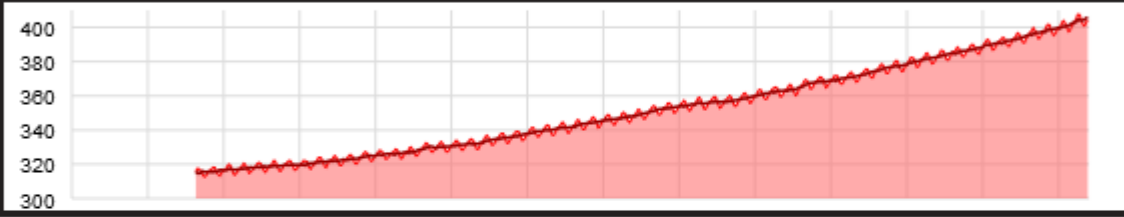
[learn more >>](#)



### 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.

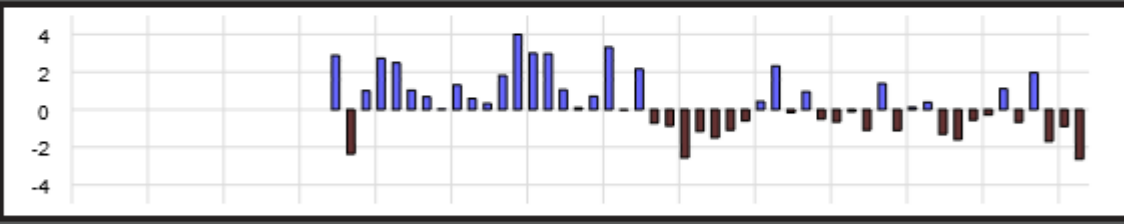
[learn more >>](#)



### Spring Snow Cover (million km<sup>2</sup>)

Snow is melting earlier: each bar shows spring snow cover in the Northern Hemisphere compared to the long-term average.

[learn more >>](#)



- ▲ Temperature
- ▶ Sea Level
- ▶ Sun's Energy

- ▲ Carbon Dioxide
- ▶ Arctic Sea Ice
- ▶ Glaciers

- ▲ Snow
- ▶ Ocean Heat
- ▶ Heat-Trapping Gases



# Climate Resilience Toolkit



U.S. Climate  
Resilience  
Toolkit

Steps to Resilience

Case Studies

Tools

Expertise

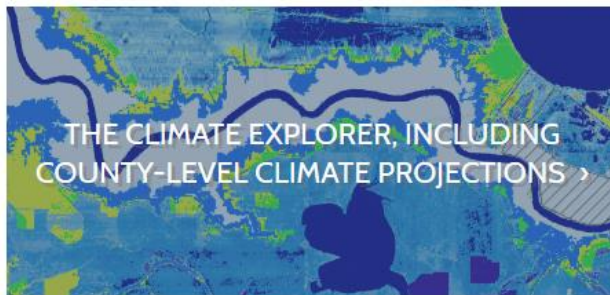
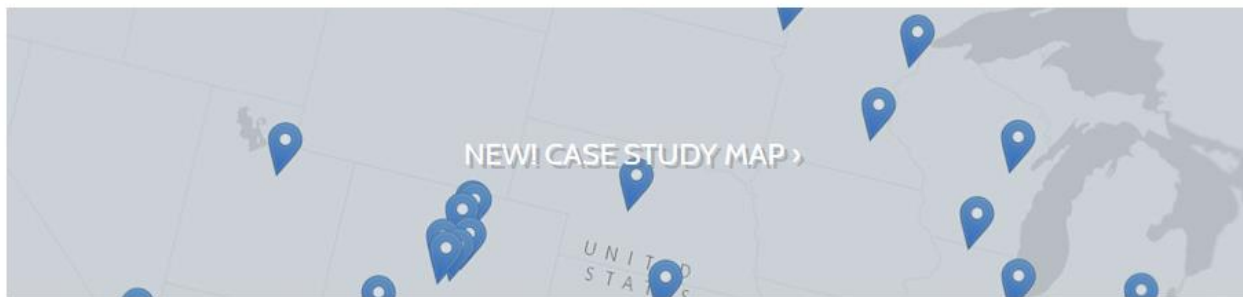
Regions

Topics

Search



## FEATURED







# Nags Head Case Study



**U.S. Climate Resilience Toolkit** Steps to Resilience Case Studies Tools Expertise Regions Topics Search

## Building Resilience in the OBX


In North Carolina's Outer Banks, the coastal Town of Nags Head is vulnerable to flooding from heavy rain events, hurricanes, tropical storms, nor'easters, and storm surge. To add insult to injury, vulnerability is increasing with sea level rise. Town managers and residents recognized the need to build the town's resilience and moved forward to prioritize and plan.

Case Studies > Building Resilience in the OBX >

### Nags Head can't ignore the rising sea

Dare County, in North Carolina's Outer Banks—known colloquially as "the OBX"—is a dynamic barrier island chain that juts out into the Atlantic Ocean. The Town of Nags Head, located in the northern portion of the Outer Banks, is a unique coastal community steeped in culture, history, and rich in natural resources. Residents are resilient: they enjoy the setting, and they've become accustomed to the winds, storms, and other coastal hazards that shape their environment.

More than 11 miles long, Nags Head boasts the longest



**Steps to Resilience**  
This content supports the highlighted step:

- 1 Explore Hazards
- 2 Assess Vulnerability & Risks
- 3 Investigate Options
- 4 **Prioritize & Plan**
- 5 Take Action

**Tools**  
[Vulnerability, Consequences, and Adaptation Planning Scenarios \(VCAPS\)](#) >  
[NOAA Tides & Currents](#) >

## 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

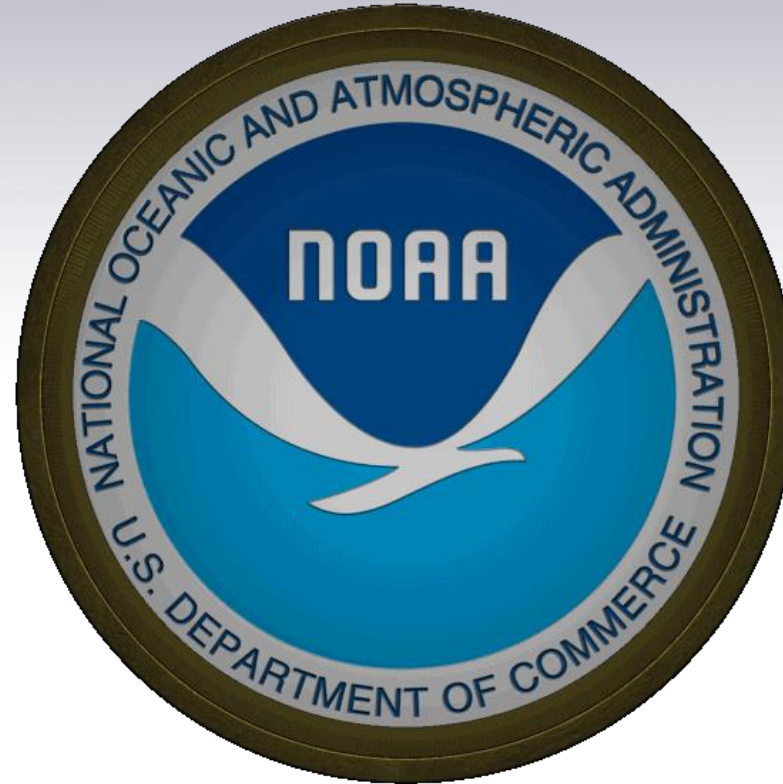


**Snap the shore** *See the future*





# Thanks for Your Interest!



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