



# Climate and Weather Threats in Florida

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# Climate/Weather Threats



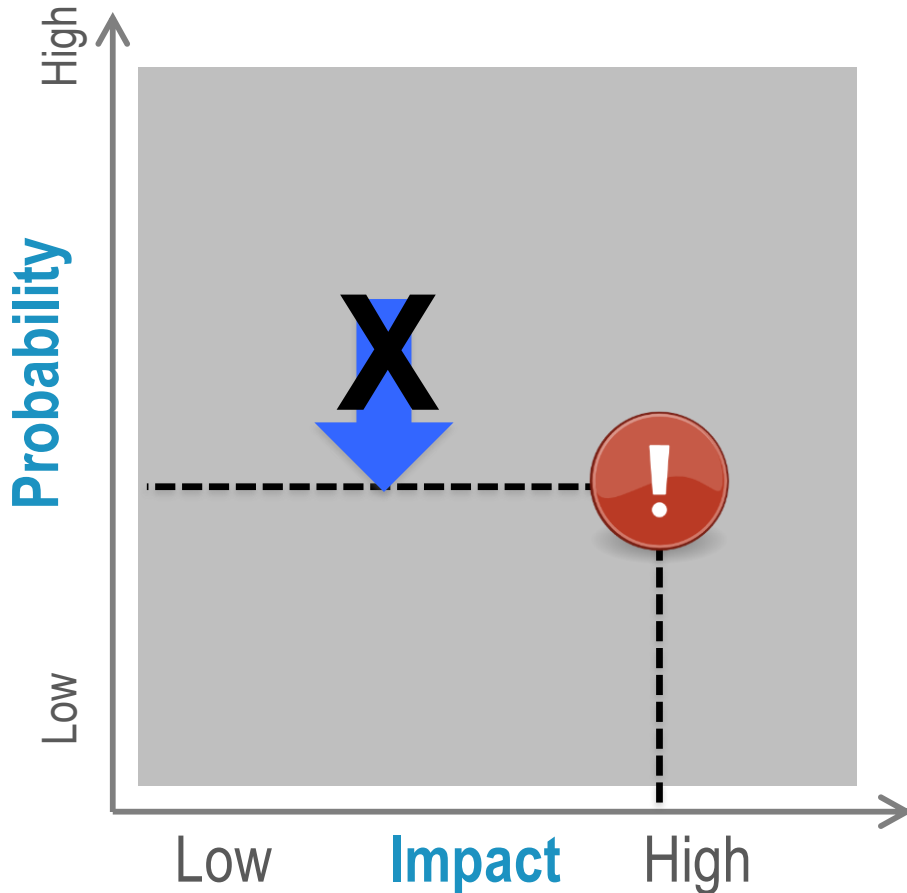
- **Sea level rise**
- Extreme rainfall and flooding
- Hurricanes - wind damage, storm surge
- Severe weather – wind, hail, lightning
- **Extreme temperatures – heat waves, severe freezes, prolonged heat or cold**
- Drought



# Defining Risk

$$\text{Risk} = \text{Threat} \times \text{Exposure}$$

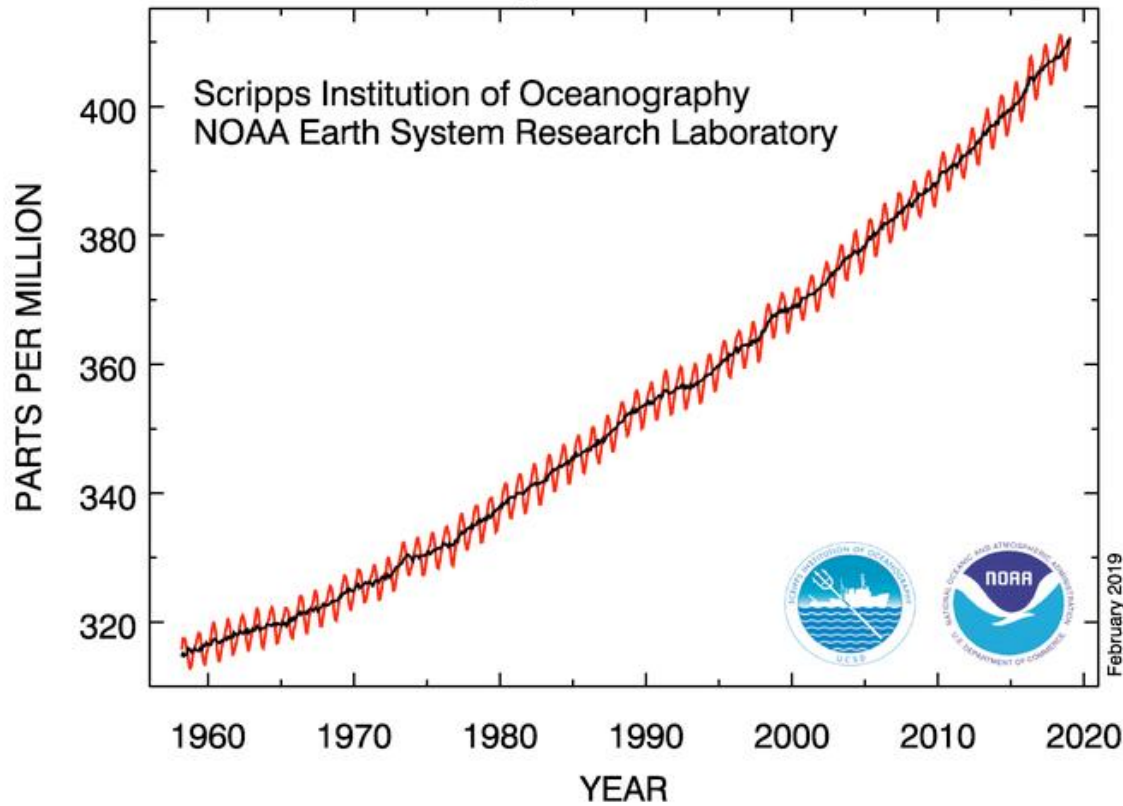
(Probability) (Impact, vulnerability)





# Carbon Dioxide Concentrations

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



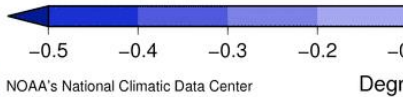
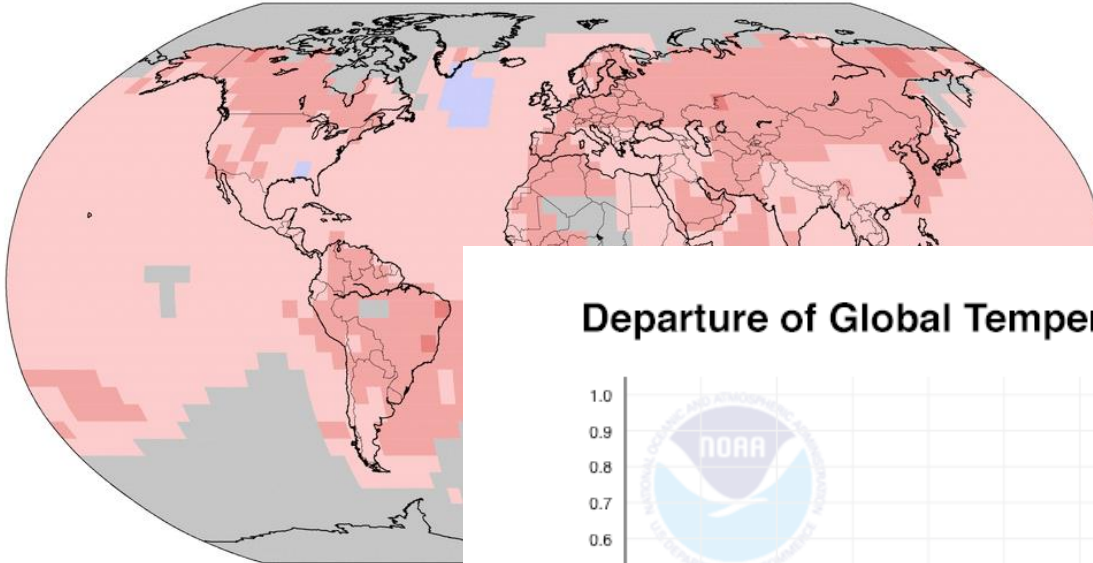


# Global Average Temperatures

## Jan–Dec Land & Ocean Temperature Trends

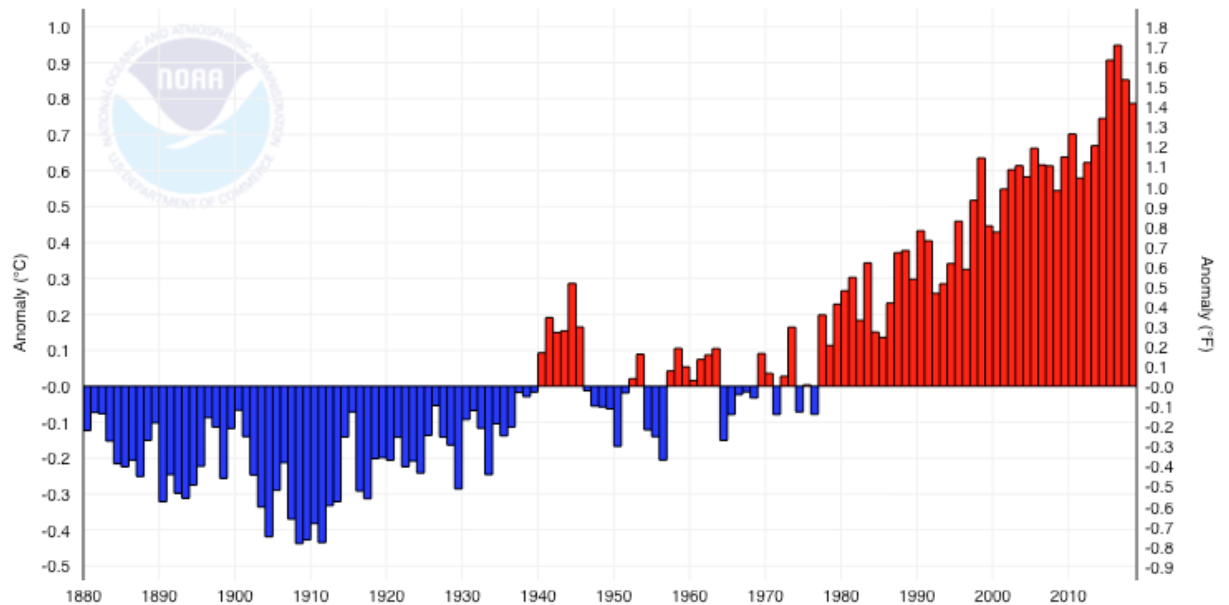
Period: 1901–2014

Data Source: GHCN–M version 3.2.2 & ERSST version 3b



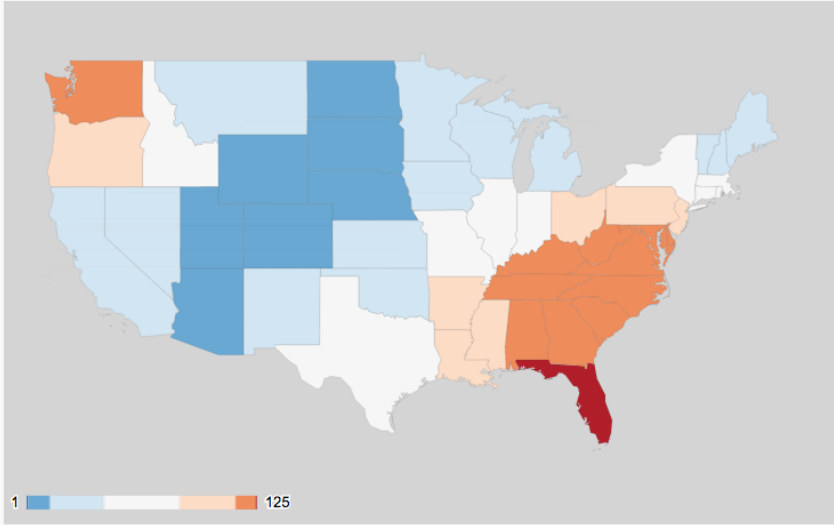
NOAA's National Climatic Data Center  
Mon Jan 12 19:35:06 EST 2015

## Departure of Global Temperature From Average, 1880 - 2018



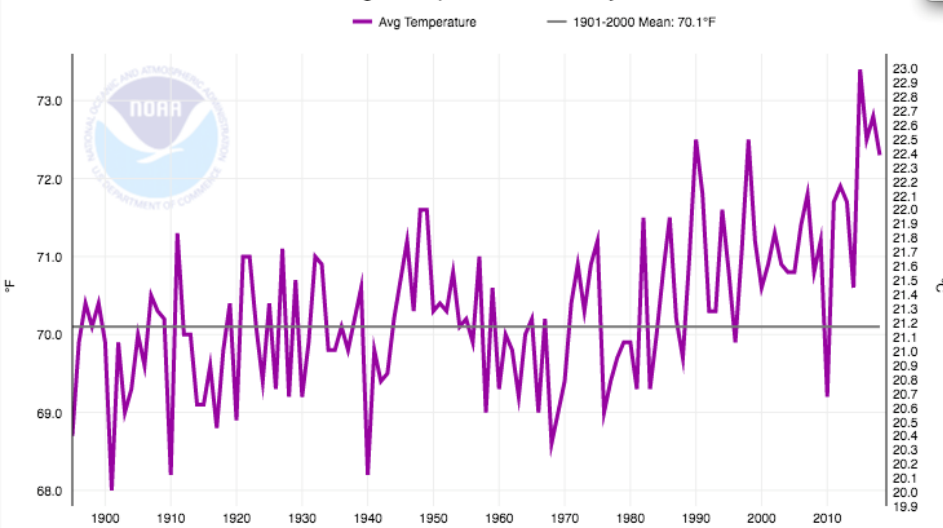
# Florida Temperatures

Statewide Average Temperature Ranks, May 2019



- 49 out of the last 52 months in Florida have been warmer than average
- Includes last 15 months in a row
- Includes 6 months of record warm
- Overnight temperatures affected most

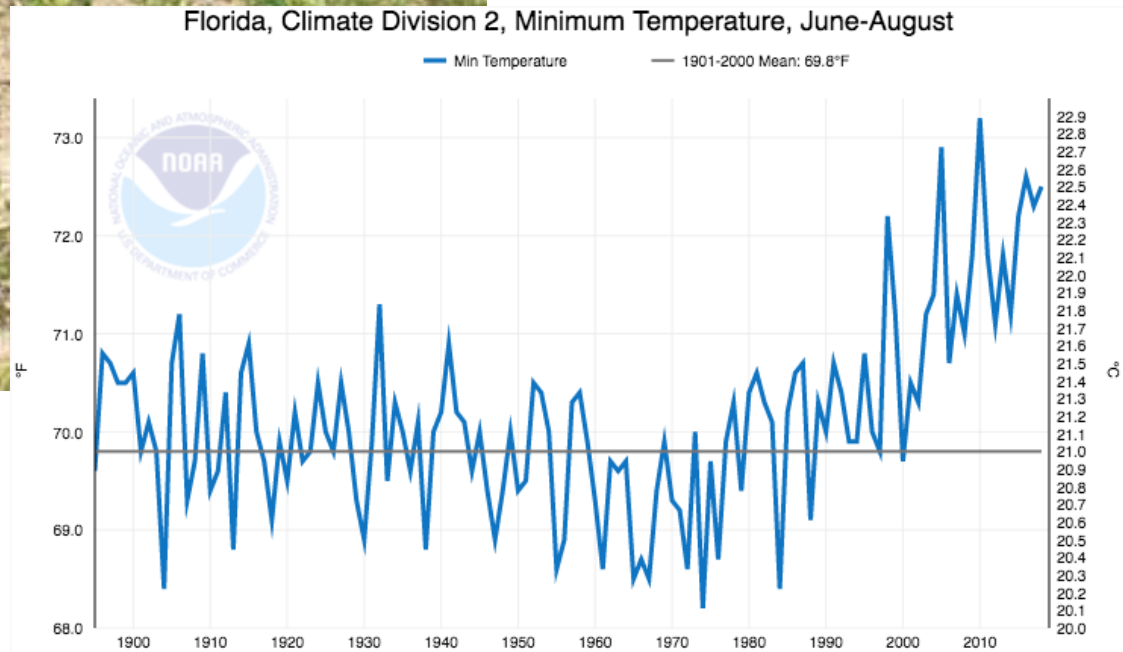
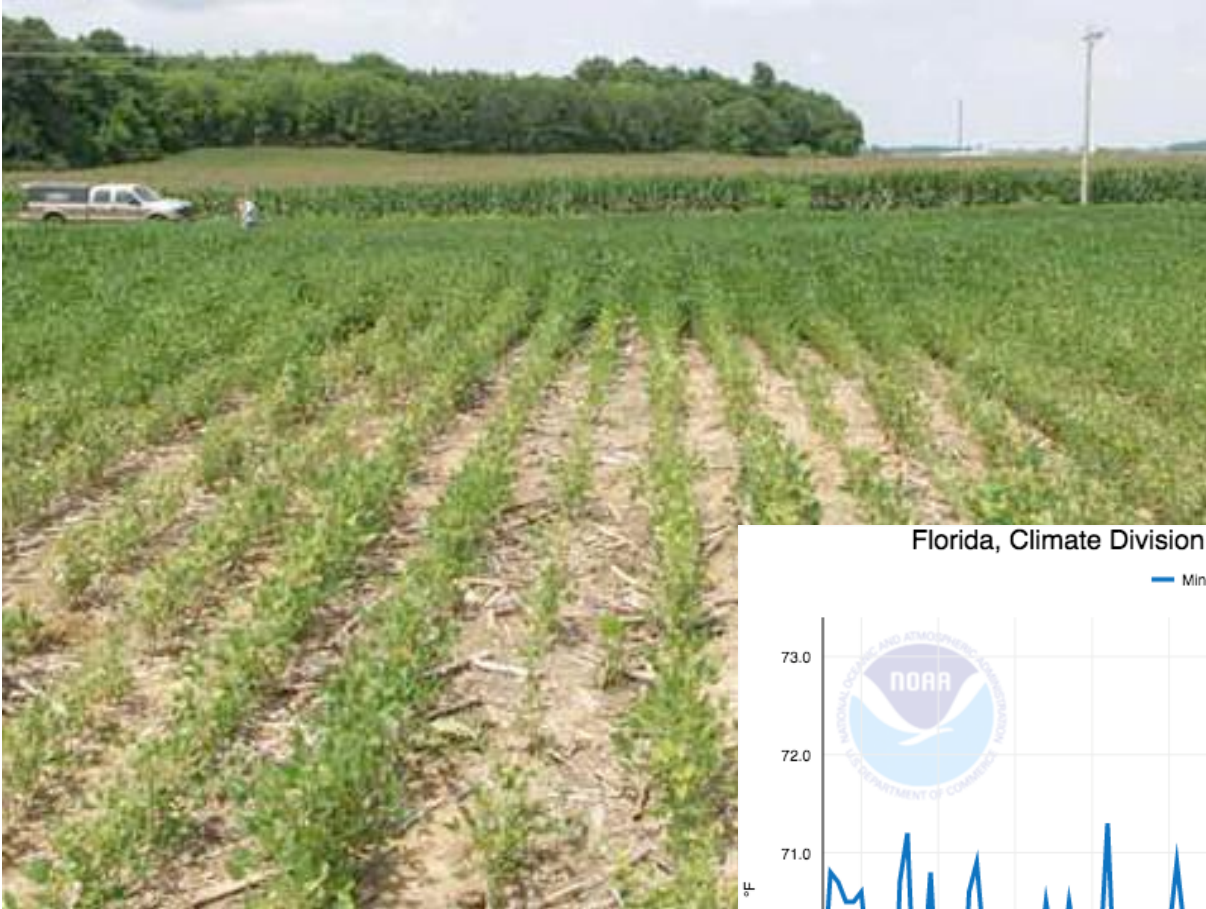
Florida, Average Temperature, January-December







# North Florida Summer Nighttime Temperature

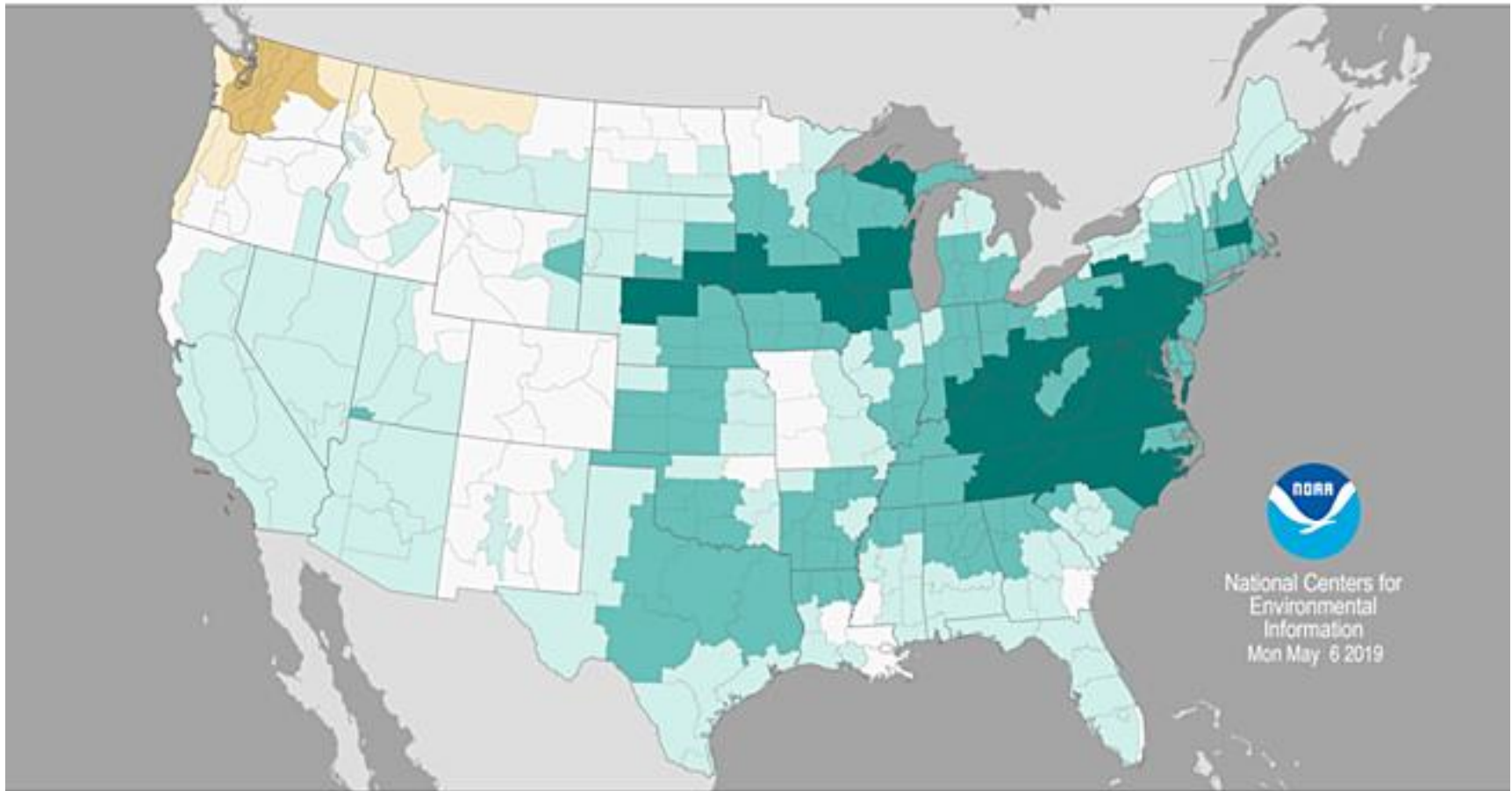


# Wettest 12-month period in U.S. History

## Divisional Precipitation Ranks

May 2018–April 2019

Period: 1895–2019



National Centers for  
Environmental  
Information  
Mon May 6 2019



Record  
Driest



Much  
Below  
Average



Below  
Average



Near  
Average



Above  
Average



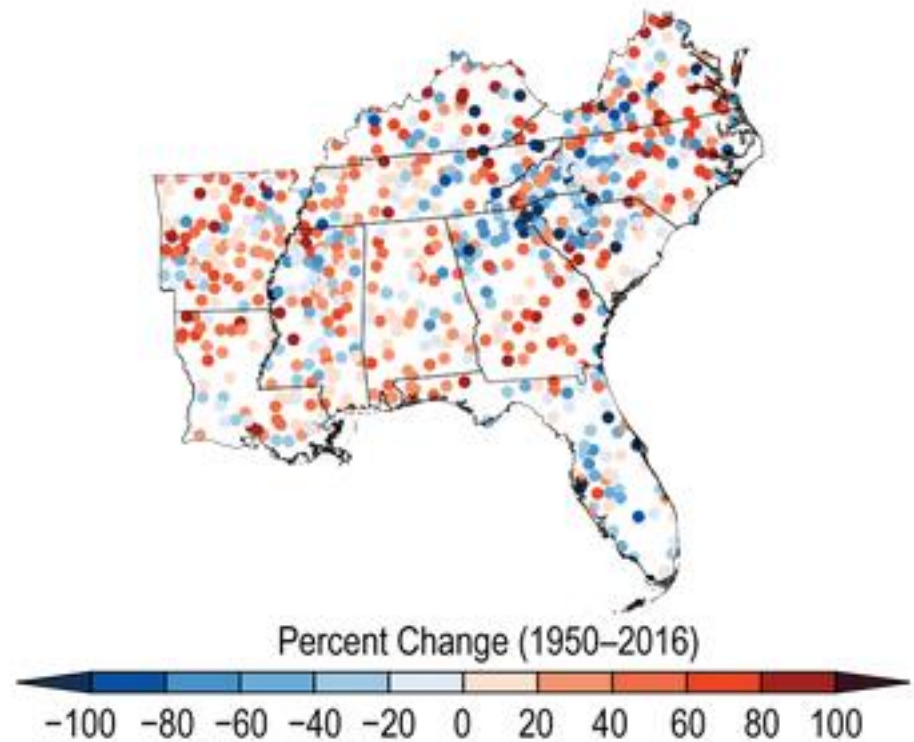
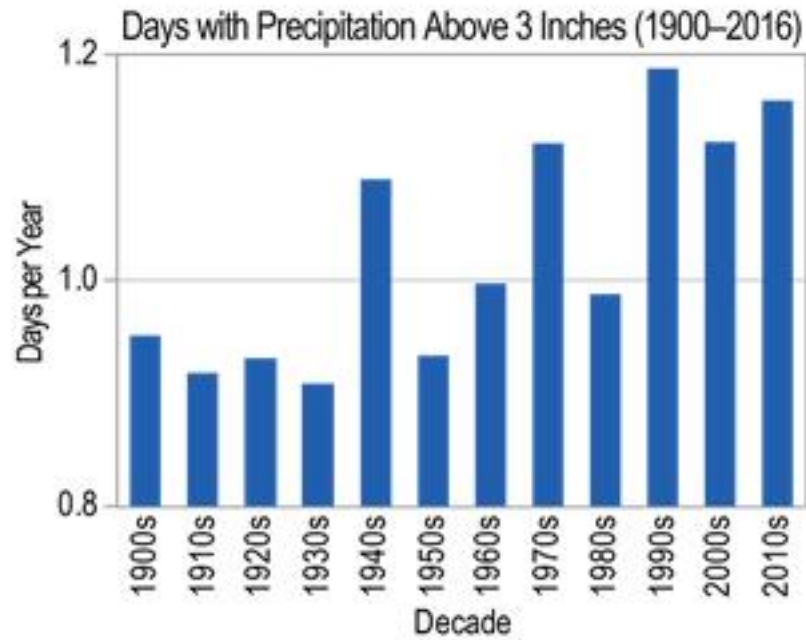
Much  
Above  
Average



Record  
Wettest



# Heavy Precipitation



# Causes of Sea Level Rise

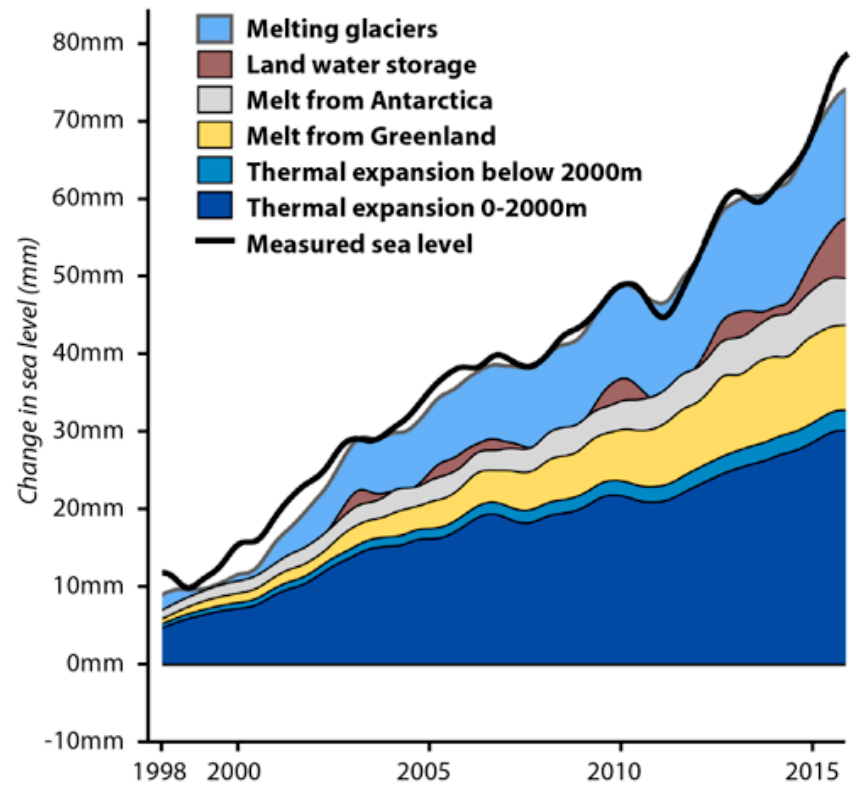
## Oceans Warm and Expand— and the Seas Rise

The increase in ocean heat causes seawater to expand, raising sea level. In 2015, roughly half of global sea level rise was caused by ocean warming.



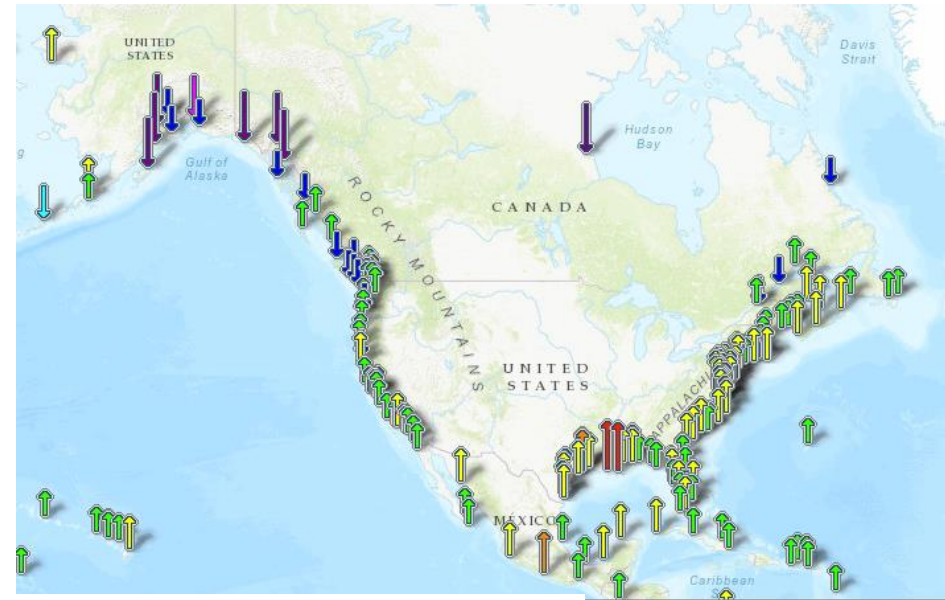
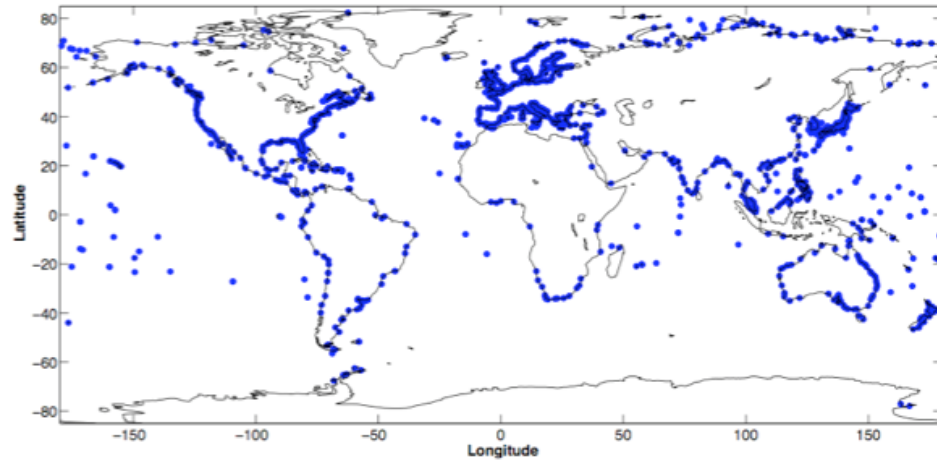
### SEA LEVEL RISE AND CAUSES

In millimeters, 1998-present

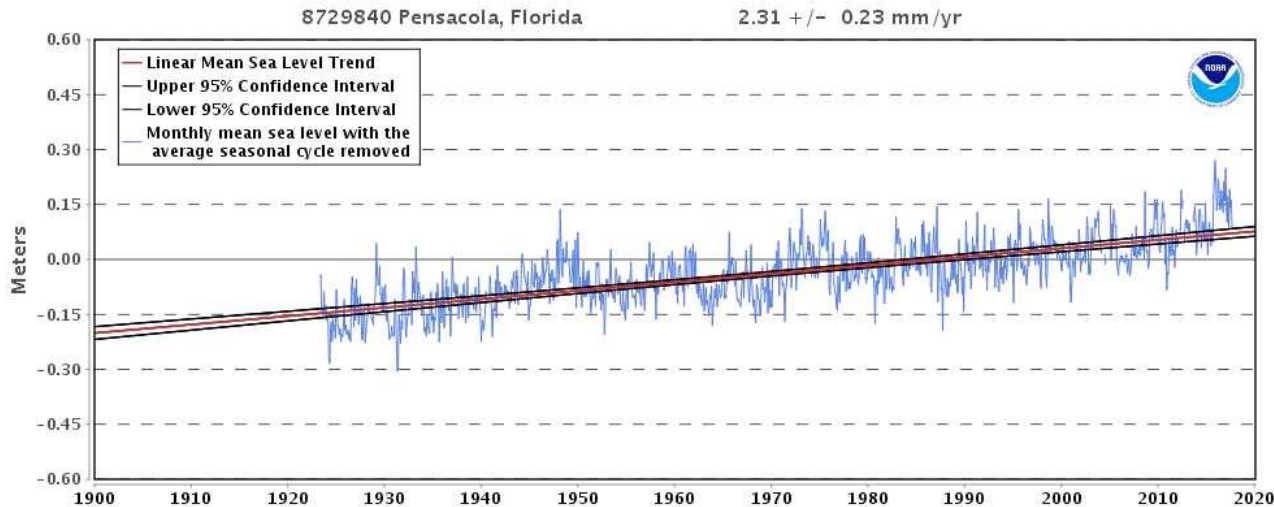


- Thermal expansion of ocean water (steric)
- Melting of glaciers and continental ice sheets
- NOT from melting sea ice

# Measuring Sea Level – Tide Gauges



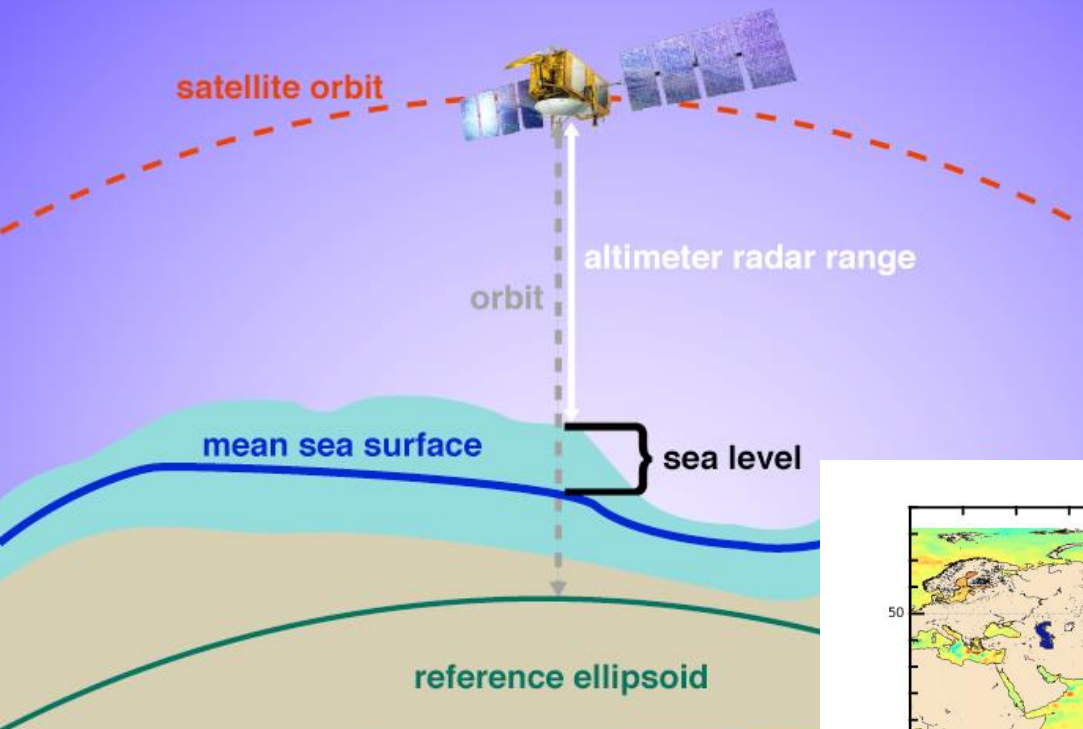
Mean Sea Level Trend  
8729840 Pensacola, Florida



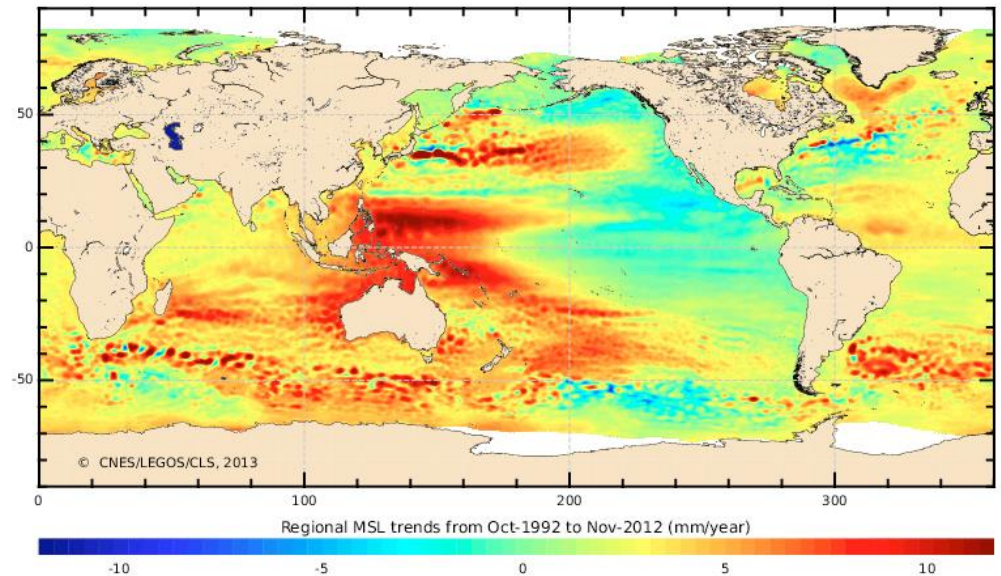


# Measuring Sea Level - Altimeters

Radar altimetry measurement system

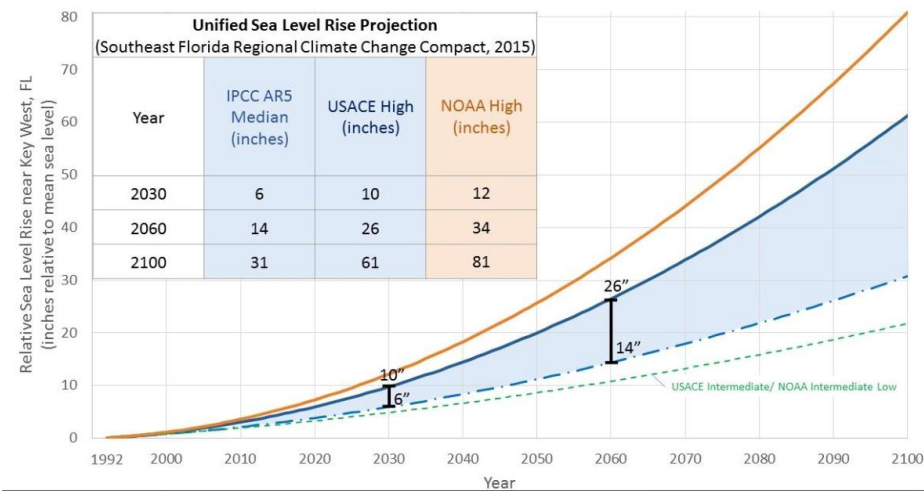
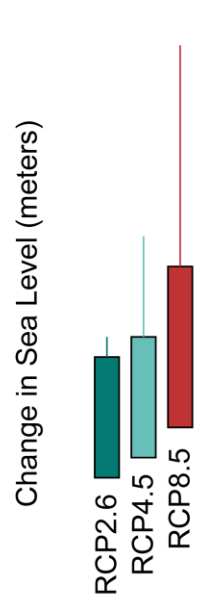
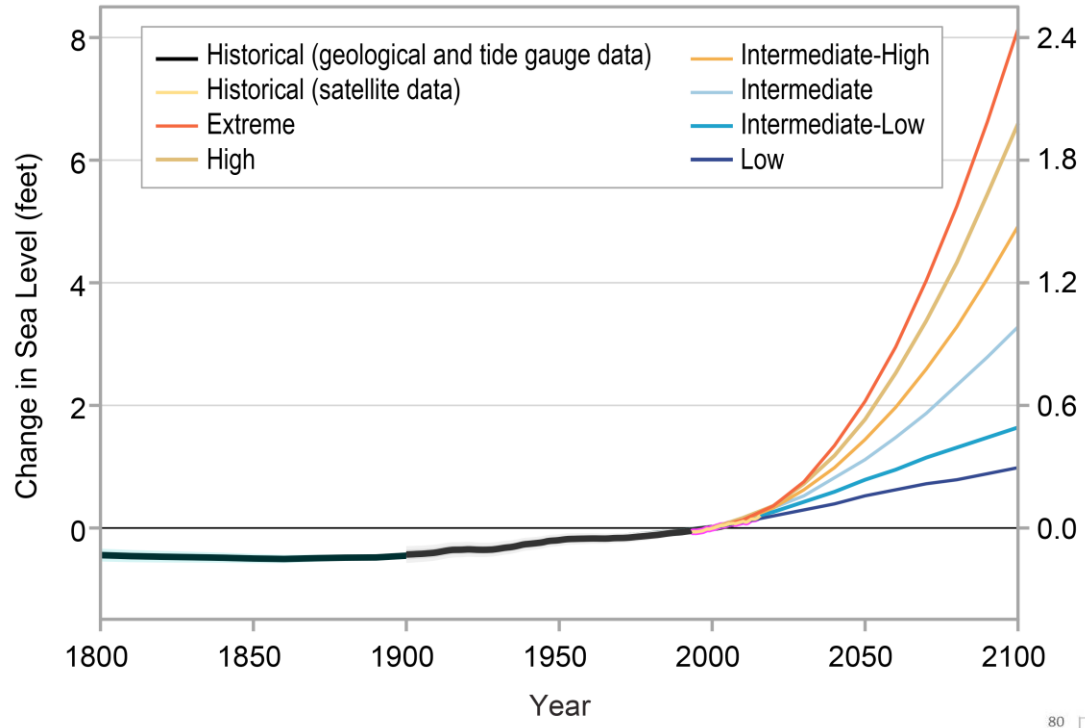


- Reliable observations since 1992
- Precision to within a few millimeters



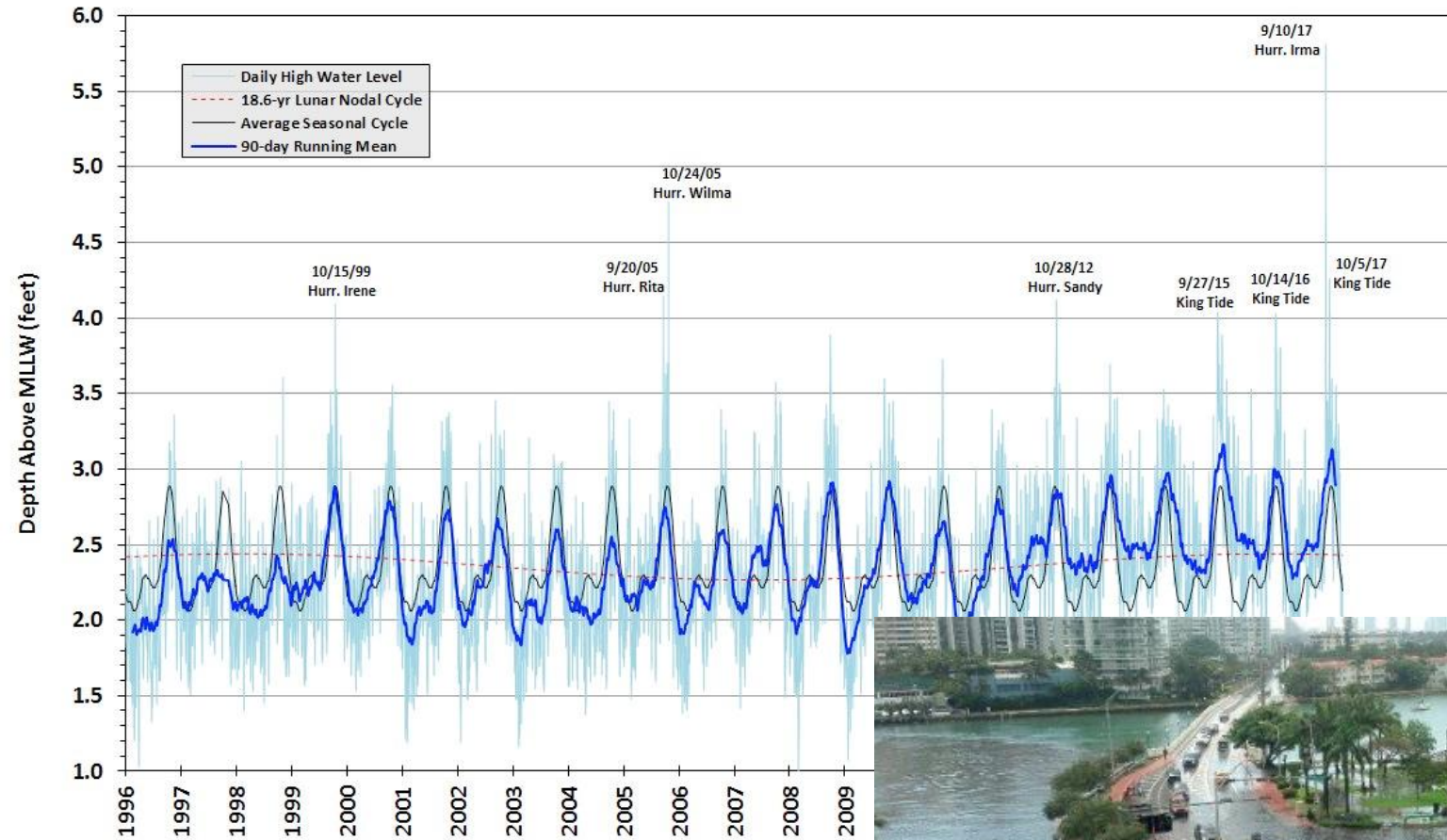


# Sea Level Rise



# Miami Sea Level Rise

Verified High Water Levels at Virginia Key, FL







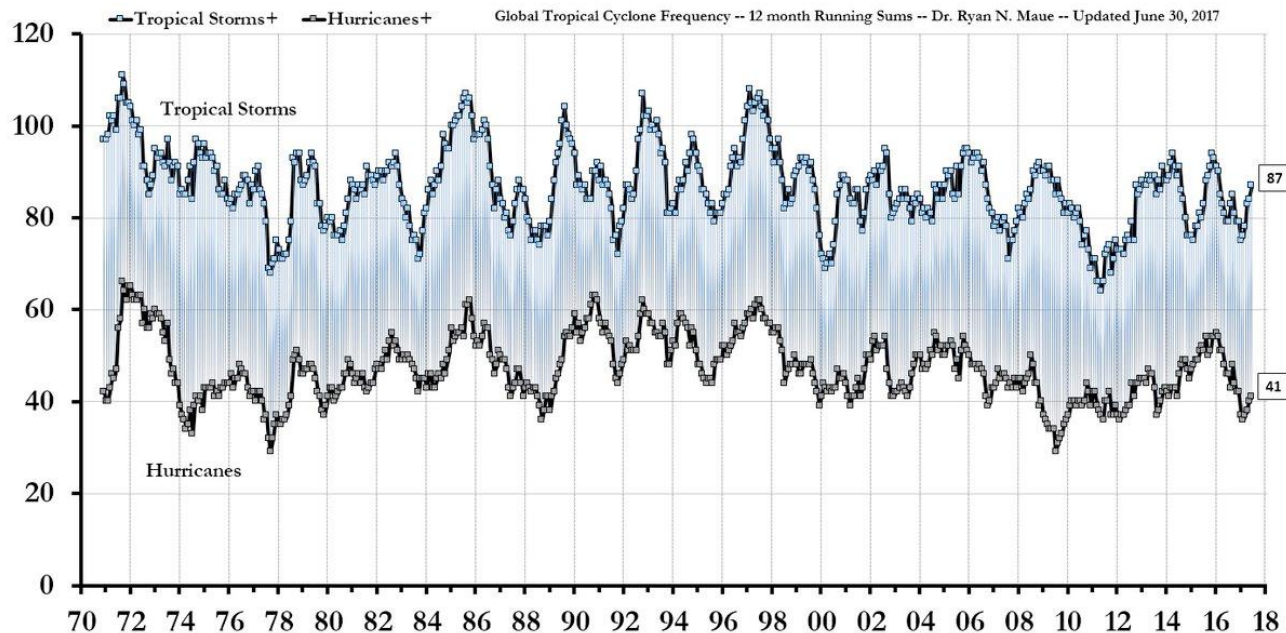
# Changes in Tropical Cyclones

**Most confident**

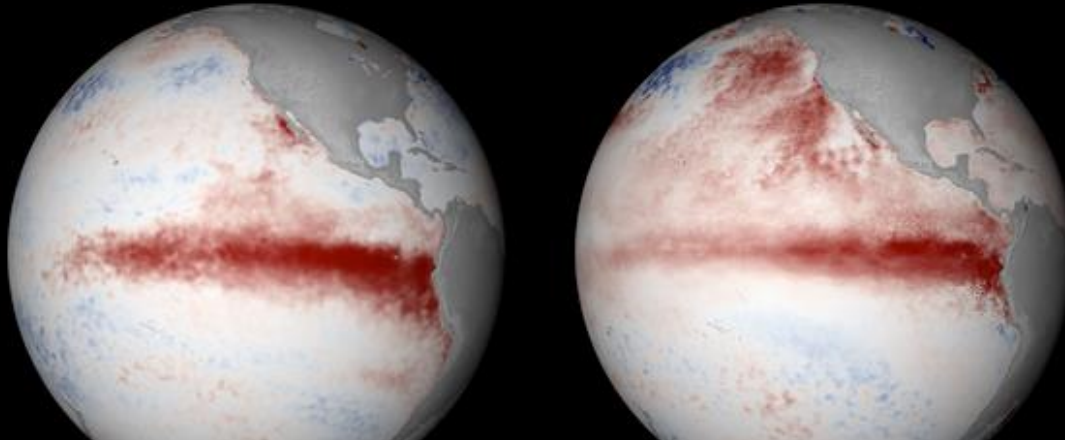


**Least confident**

- **Coastal flooding from storm surge will be worse because of sea level rise**
- TC rainfall likely to increase
- TC intensity likely to increase
- Number of TCs likely to change little or decrease

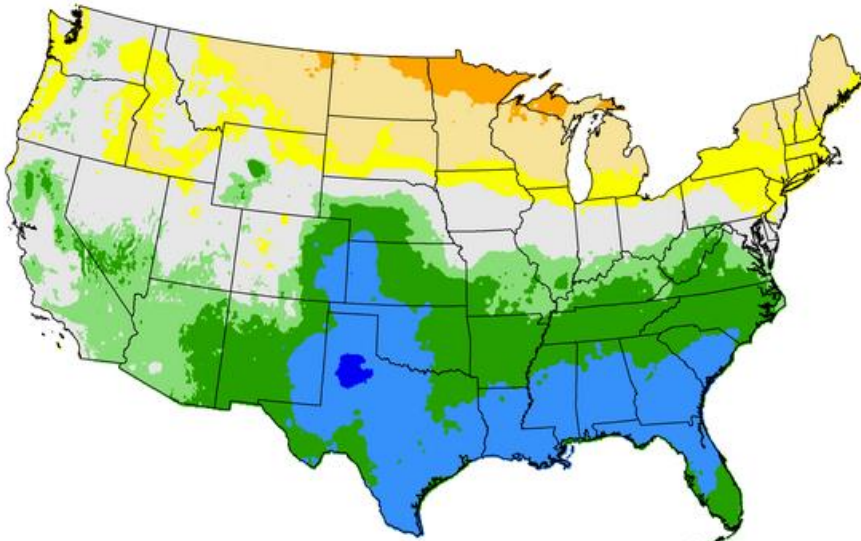


# Climate Variability



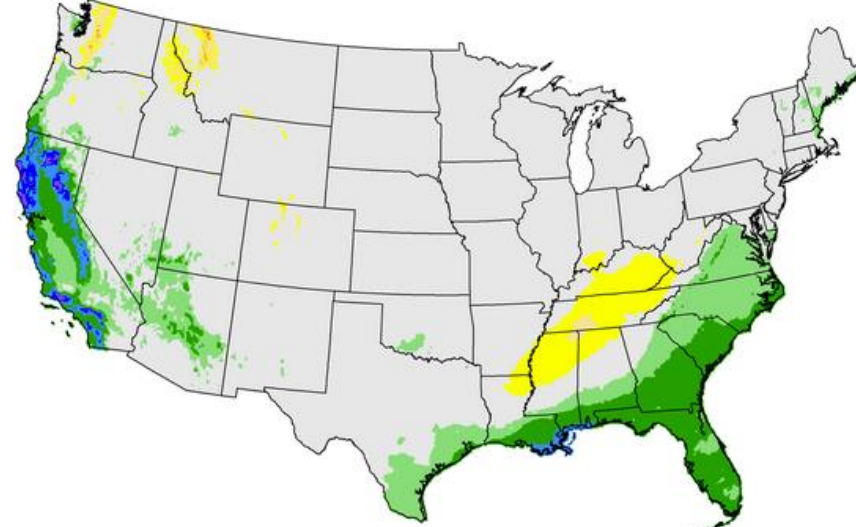
Deviation from Average - Max. Temperature (°F) - January

El Niño Years



Deviation from Average - Total Rainfall (Inch) - January

El Niño Years





# Potential Changes to Climate/Weather Threats

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Increasing  
confidence

**Sea level rise** – Global sea levels will continue to rise at a minimum the current rate, with the likely range of 1-4 ft. by 2100.

**Temperature** – very likely to continue rising with increasing CO<sub>2</sub>. Florida less than interior North America.

**Drought** – rising temperature alone could lead to more frequent/longer periods of drought. Rainfall changes uncertain.

**Rainfall** – some evidence of more extreme events, changing seasonal patterns uncertain.

**Hurricanes** – Uncertain in changes to the number or frequency, strength of strongest storms likely to increase

**Severe Weather** – difficult to discern past changes, difficult to model

