



# Trends in Extreme Heat

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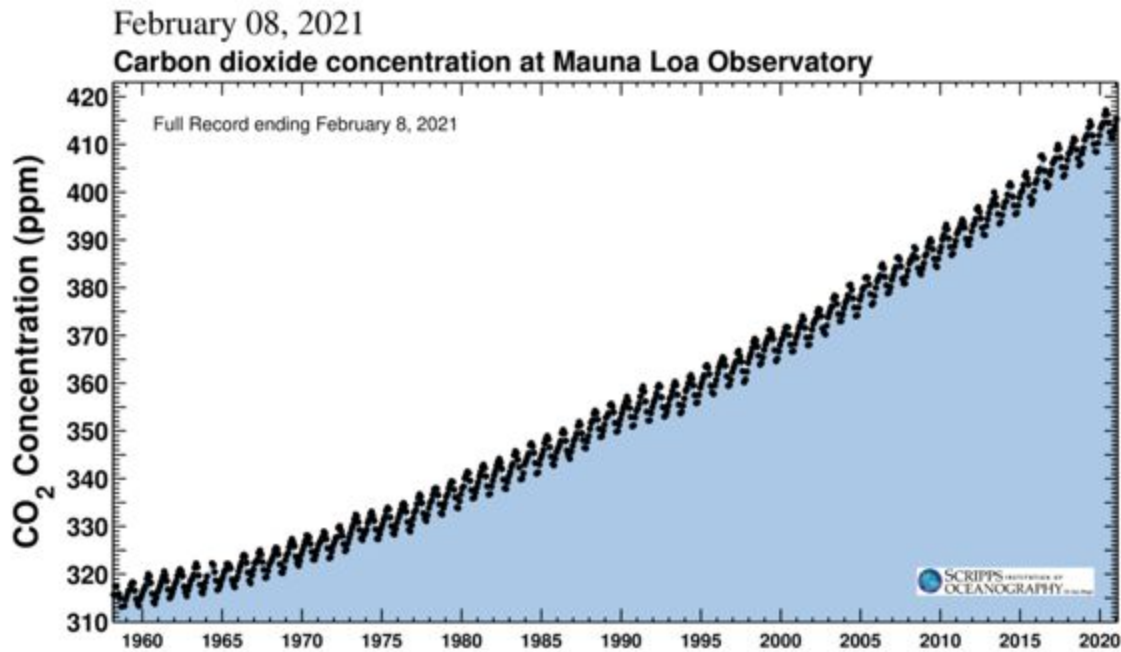
*RCAP Workshop*

*November 8, 2021*





# Carbon Dioxide Concentrations

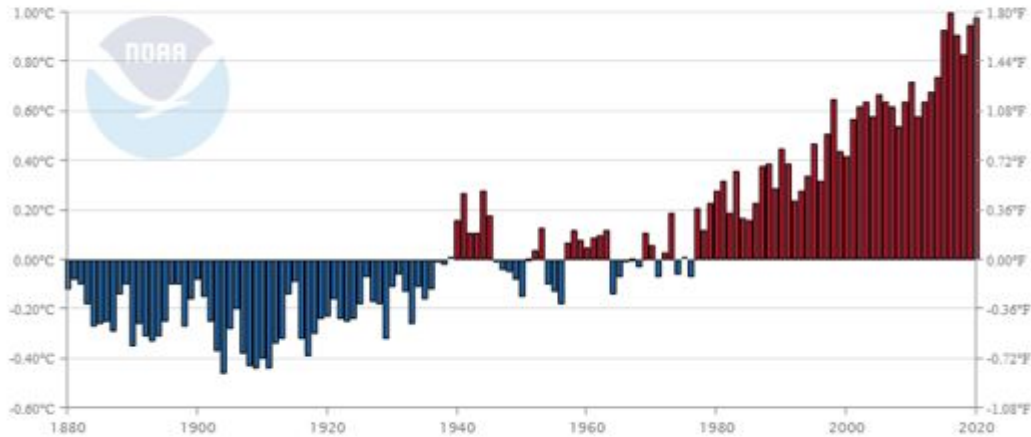




# Global Average Temperatures

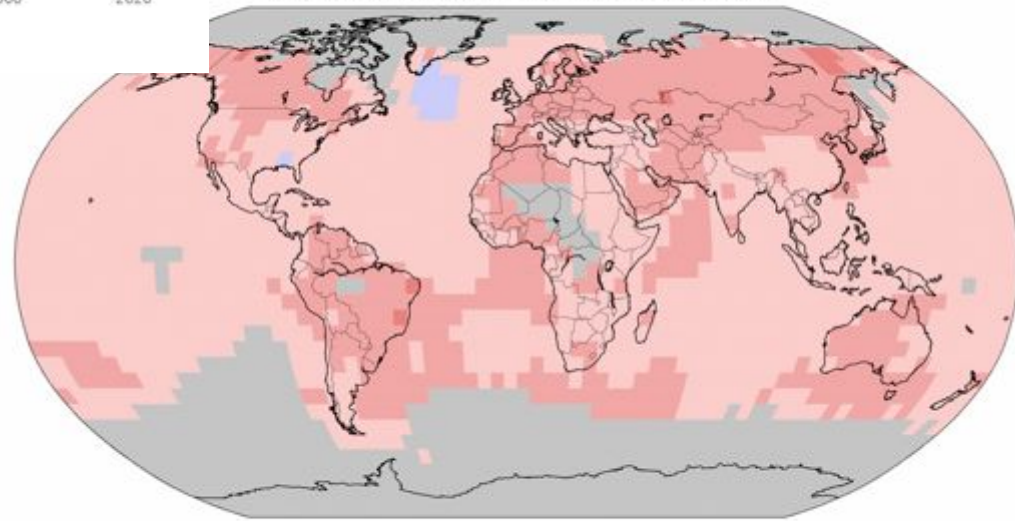
## Global Land and Ocean

### January-December Temperature Anomalies



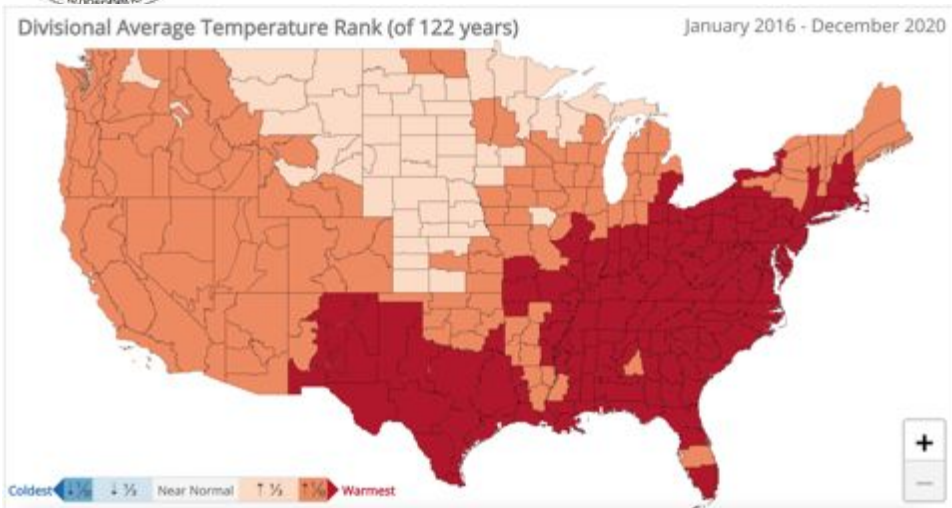
## Jan-Dec Land & Ocean Temperature Trends Period: 1901-2014

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





# U.S. and Florida Temperatures



- 65 out of the last 69 months have been warmer than average
- Includes 31 months in a row
- Includes 8 months of record warm
- Overnight temperatures affected most

Florida Average Temperature  
60-Month Period Ending in January

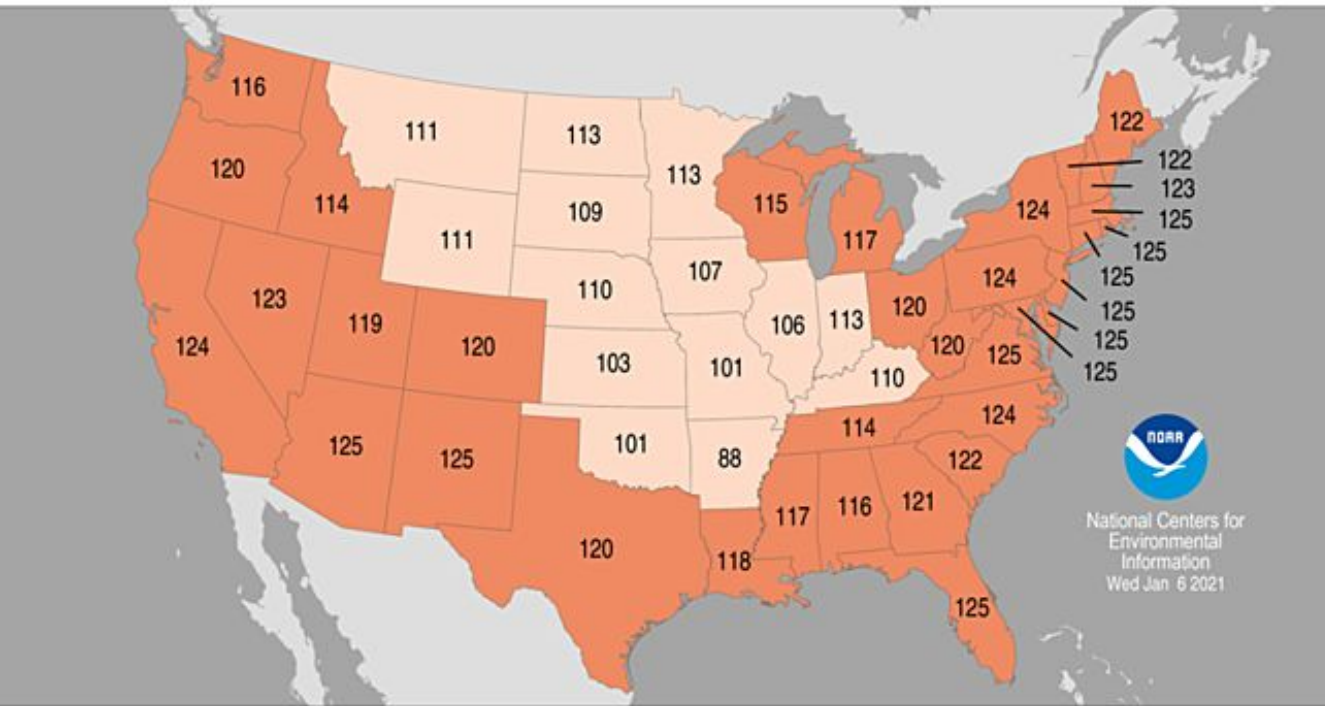






# 2020 U.S. Temperatures

Statewide Average Temperature Ranks  
January – December 2020  
Period: 1895–2020

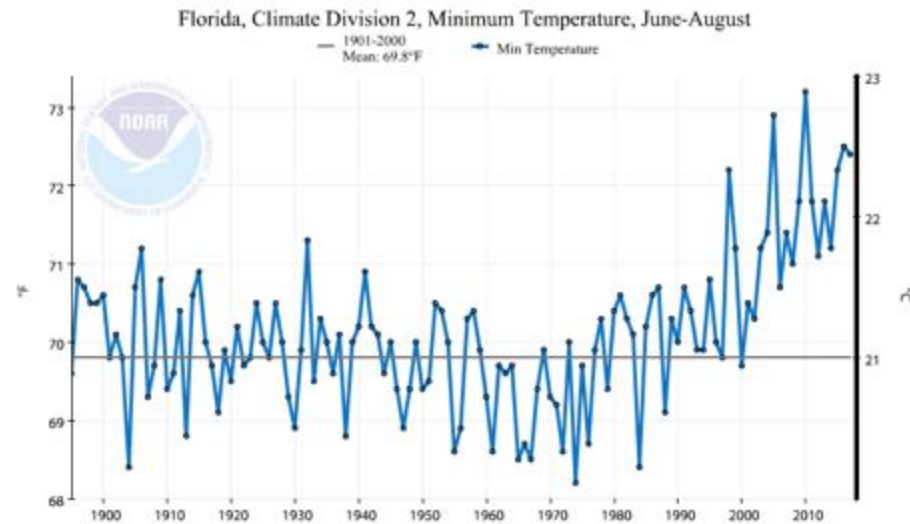


- 5<sup>th</sup> warmest year for U.S. as a whole
- No State with record warm temperatures
- 10 States with 2<sup>nd</sup> warmest calendar year





# North Florida Summer Nighttime Temperature

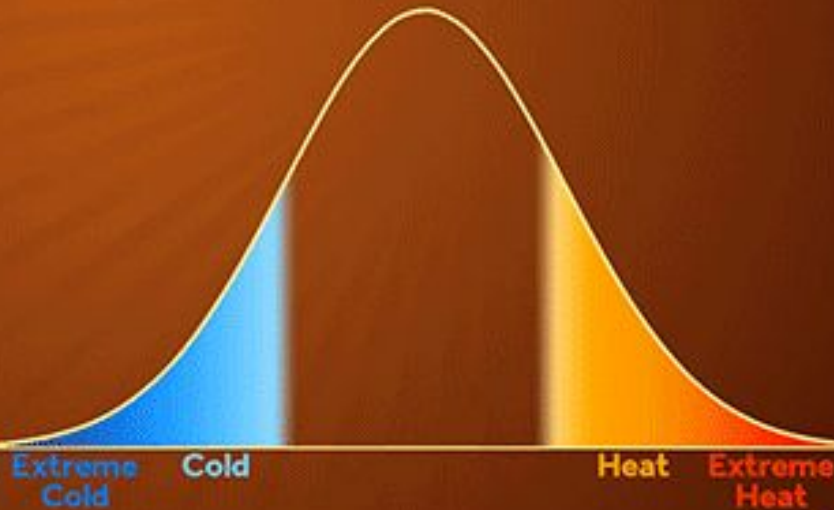


- Elevated soil temperature
- Cumulative stress on livestock
- Heat related illness and stroke



# Why Do Changes in the Average Matter?

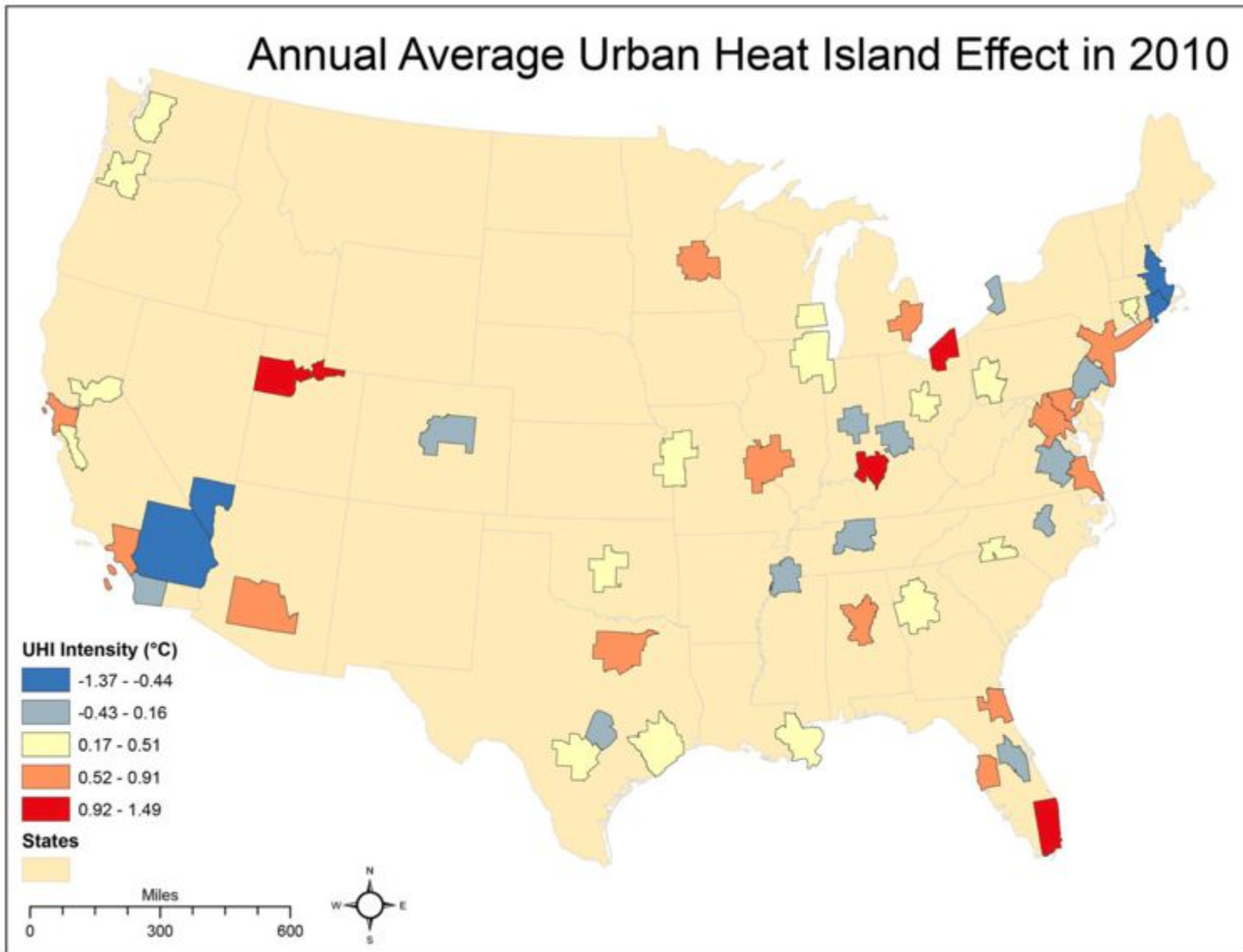
**SMALL CHANGE IN AVERAGE  
BIG CHANGE IN EXTREMES**



CLIMATE  CENTRAL

# Urban Heat Island

Annual Average Urban Heat Island Effect in 2010







# Days of Extreme Heat (Miami)

Number of Days Max Temperature  $\geq 95$  - Jan through Dec - MIAMI INTERNATIONAL AP, FL

Use navigation tools above and below chart to change displayed range



2019  
Number of Days Max Temperature  $\geq 95$  : 15

Number of Days Max Temperature  $\geq 100$  - Jan through Dec - MIAMI INTERNATIONAL AP, FL

Use navigation tools above and below chart to change displayed range



1942  
Number of Days Max Temperature  $\geq 100$  : 1





# Heat Index

## NWS Heat Index

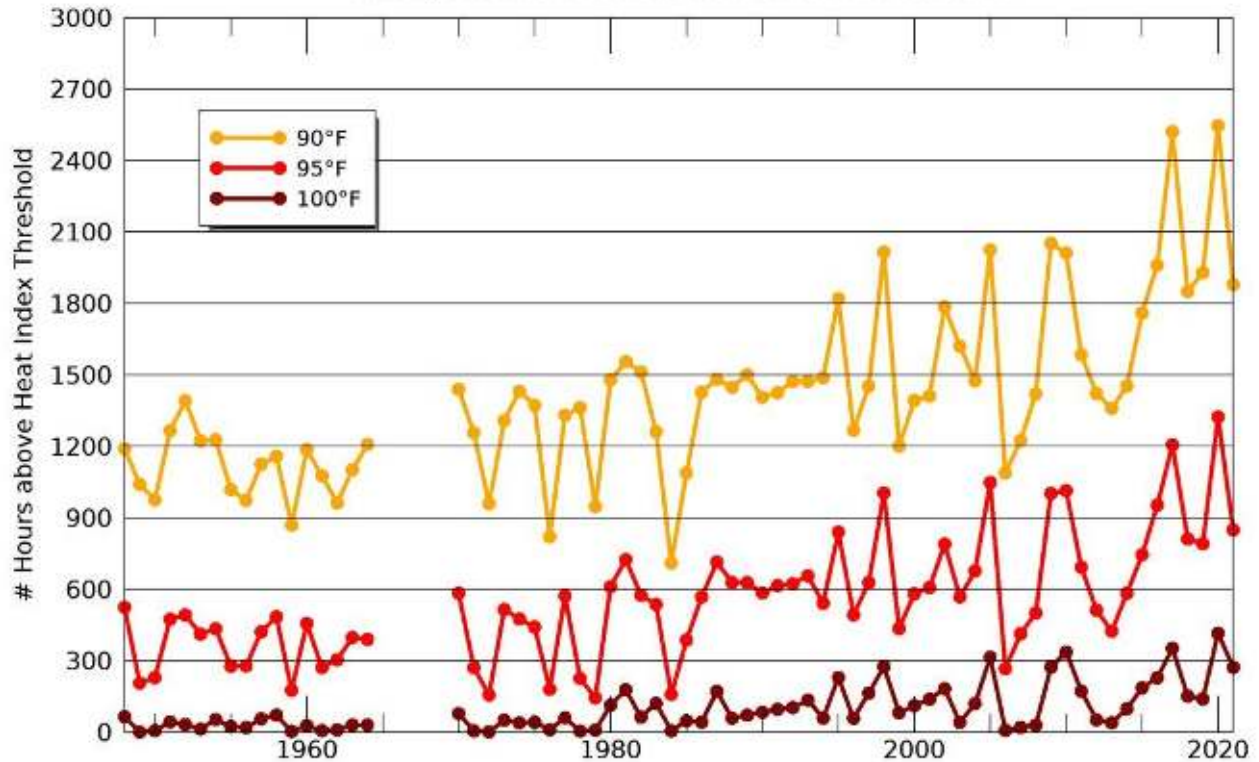
Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prob

Caution      Extreme Caution

Time Spent Above Heat Index Thresholds at Miami FL

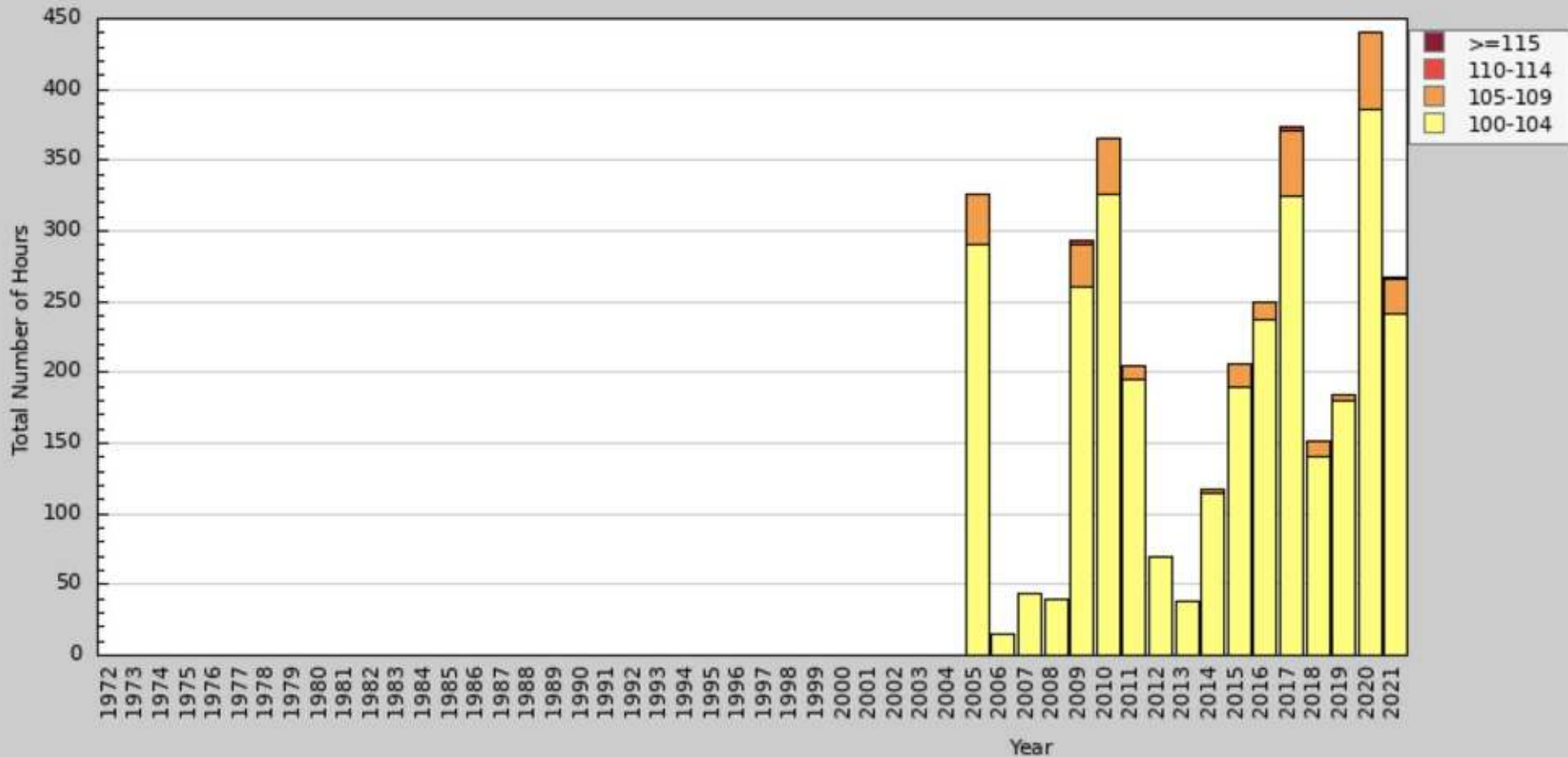




# Heat Index

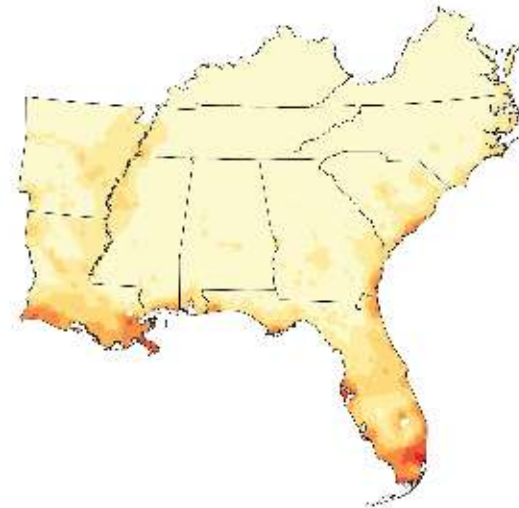


MIAMI INTL AP (KMIA)  
Heat Index Counts





# Warm Nights



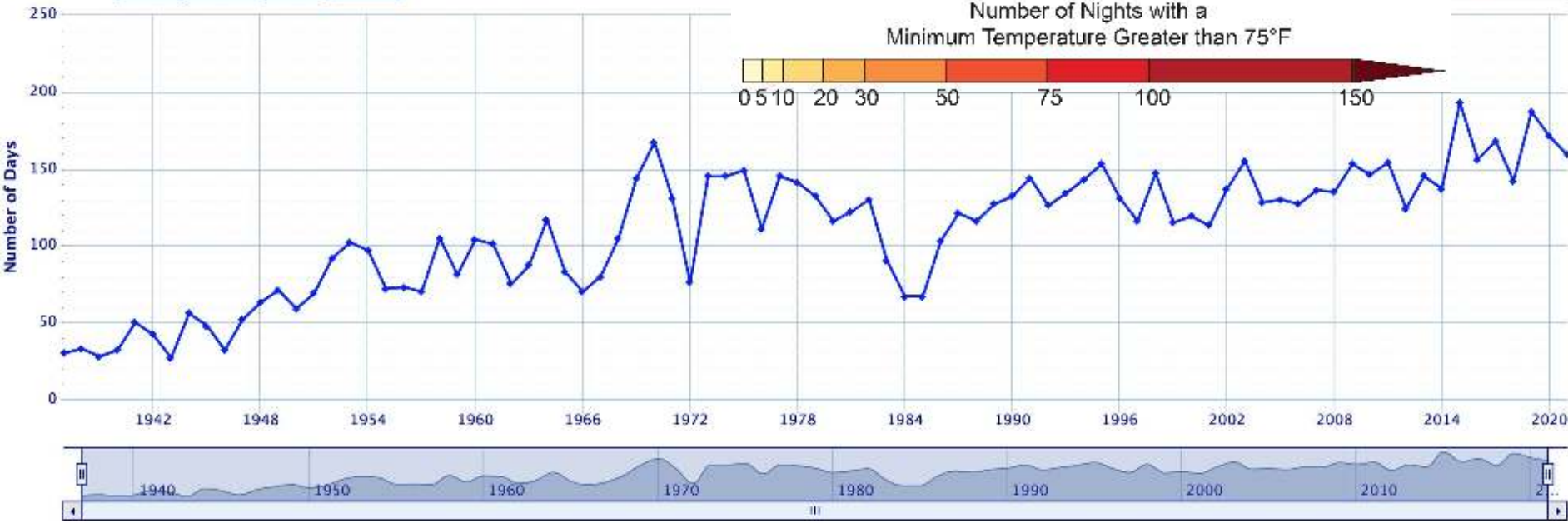
Number of Days Min Temperature  $\geq 75$

Use navigation tools above a

Zoom 1 yr 10 yrs 30 yrs All

2021

Number of Nights with a Minimum Temperature Greater than 75°F



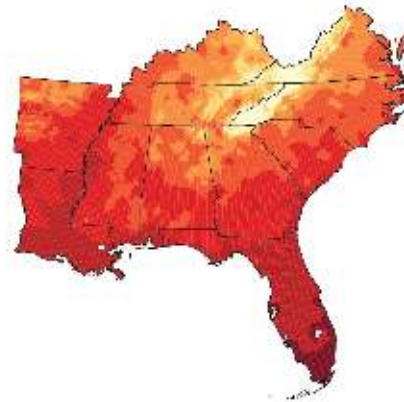
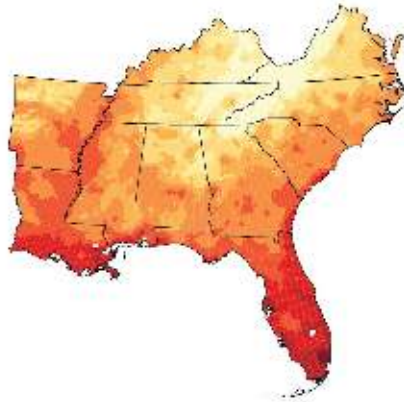


# Future Changes in Warm Nights

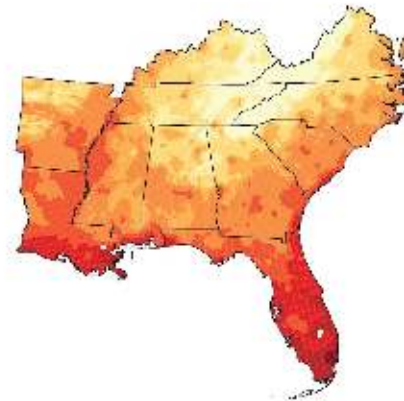
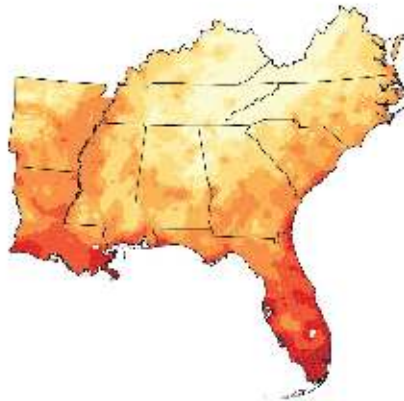
Mid-21st Century

Late 21st Century

Higher Scenario (RCP8.5)



Lower Scenario (RCP4.5)



Number of Nights with a  
Minimum Temperature Greater than 75°F





# Climate and Florida Citrus

Adapted from: John Attaway, "A History of Florida Citrus Freezes"



Mature orange grove outside of St. Augustine, FL in the early 1890's. Trees have obviously grown for decades without major freeze damage.

- from Buel, 1893

## Impact Freezes:

February 7-9, 1835

December 29, 1894

February 8, 1895

February 13-14, 1899

December 12-13, 1934

January 27-19, 1940

December 12-13, 1962

January 18-20, 1977

January 12-14, 1981

December 24-25, 1983

January 20-22, 1985

December 24-25, 1989

January 19, 1997



# February 13<sup>th</sup>, 1899



*Snowballing on Capitol Steps—  
Feb. 13<sup>th</sup> 1899. Tallahassee, Florida.*

- - 2 degrees F in Tallahassee (State Record)
- Measurable snow from the Panhandle to Tampa and Jacksonville
- Key West and Jupiter the only cities east of the Rockies without freezing temperatures
- Is this still possible?





# Extreme Cold Temperatures

Number of Days Min Temperature  $\leq 40$  - Jan through Dec - MIAMI INTERNATIONAL AP, FL

Use navigation tools above and below chart to change displayed range



Zoom 1 yr 10 yrs 30 yrs All

From 1937 To 2021



Powered by ACIS

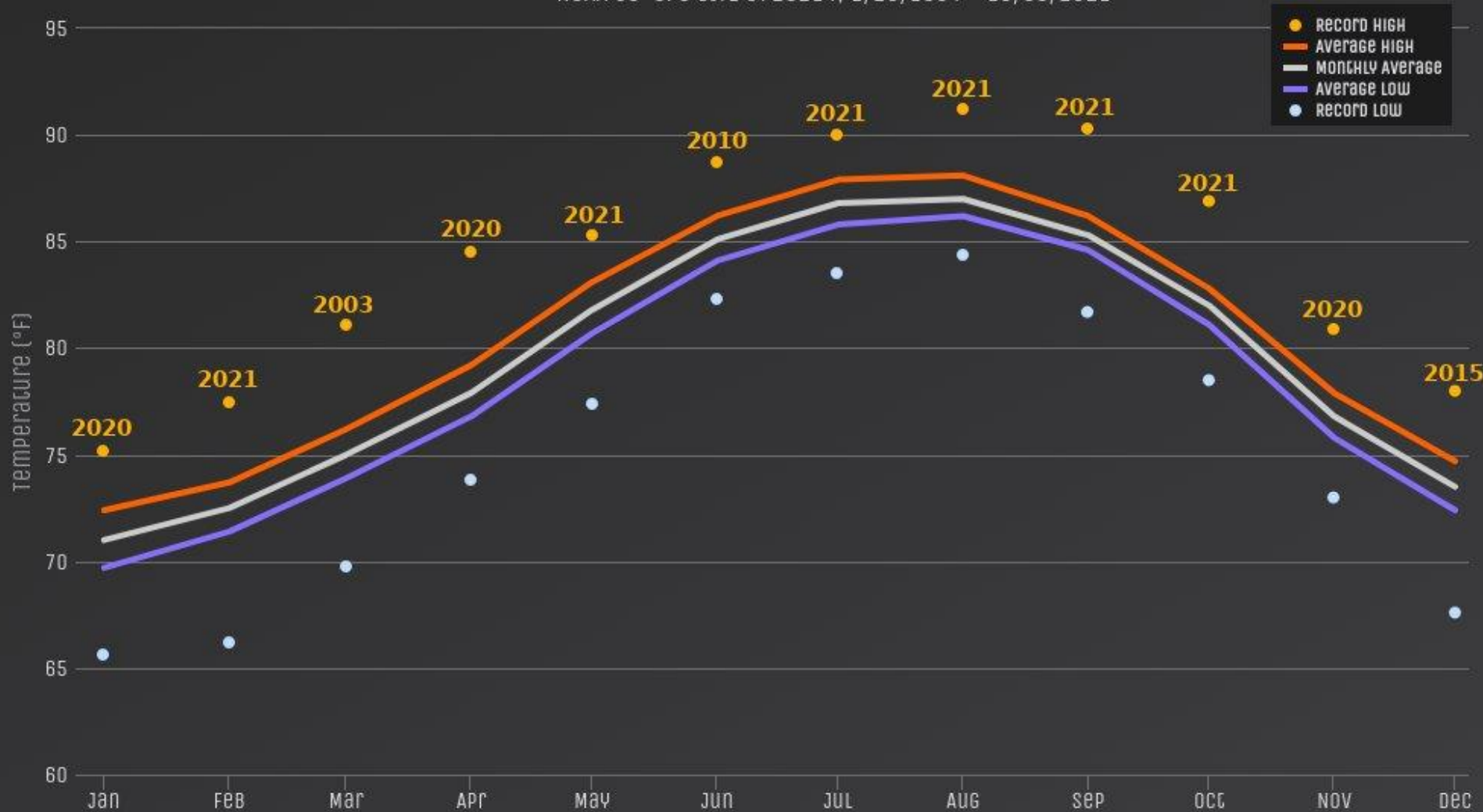






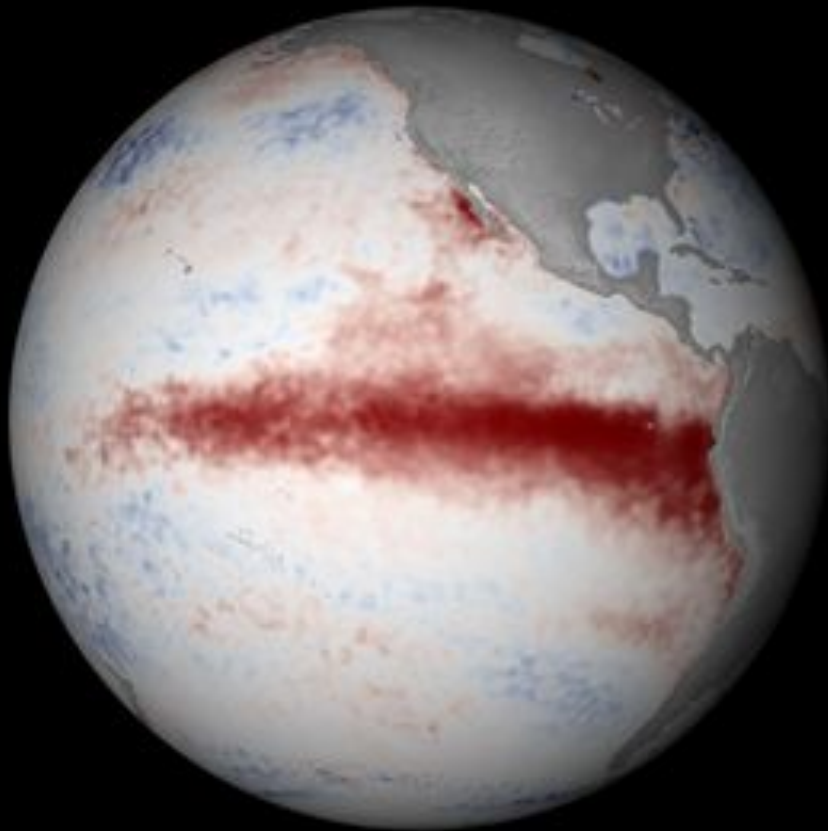
# Coastal Water Temperatures

MONTHLY WATER TEMPERATURE CLIMATOLOGY FOR VIRGINIA KEY, FL  
NOAA CO-OPS SITE 8723214, 1/29/1994 - 10/30/2021



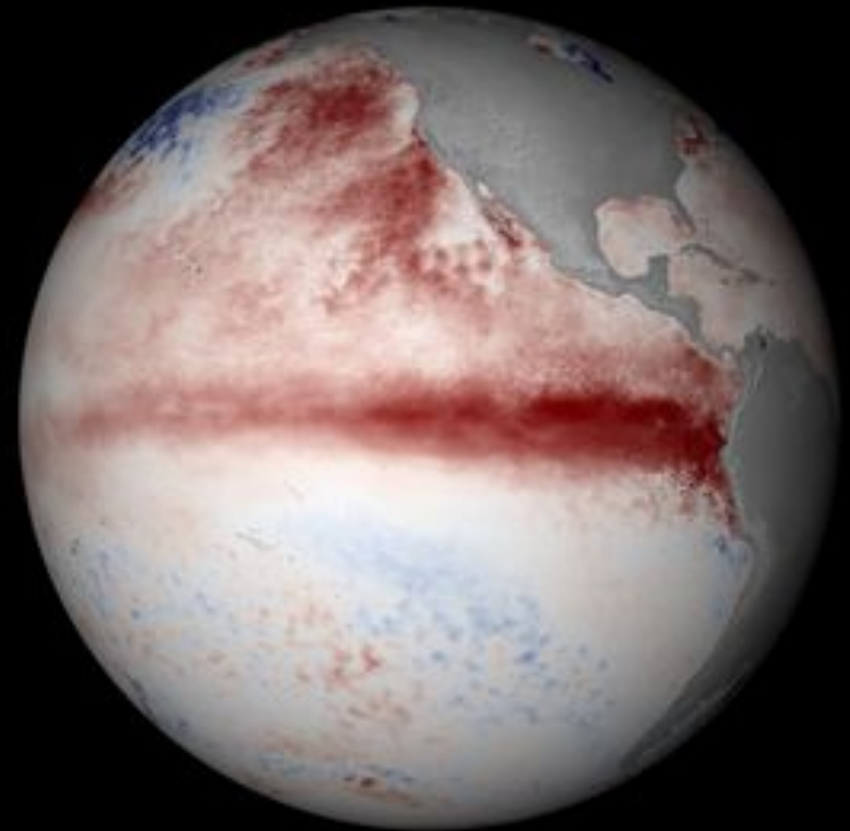
# El Nino/La Nina Cycle

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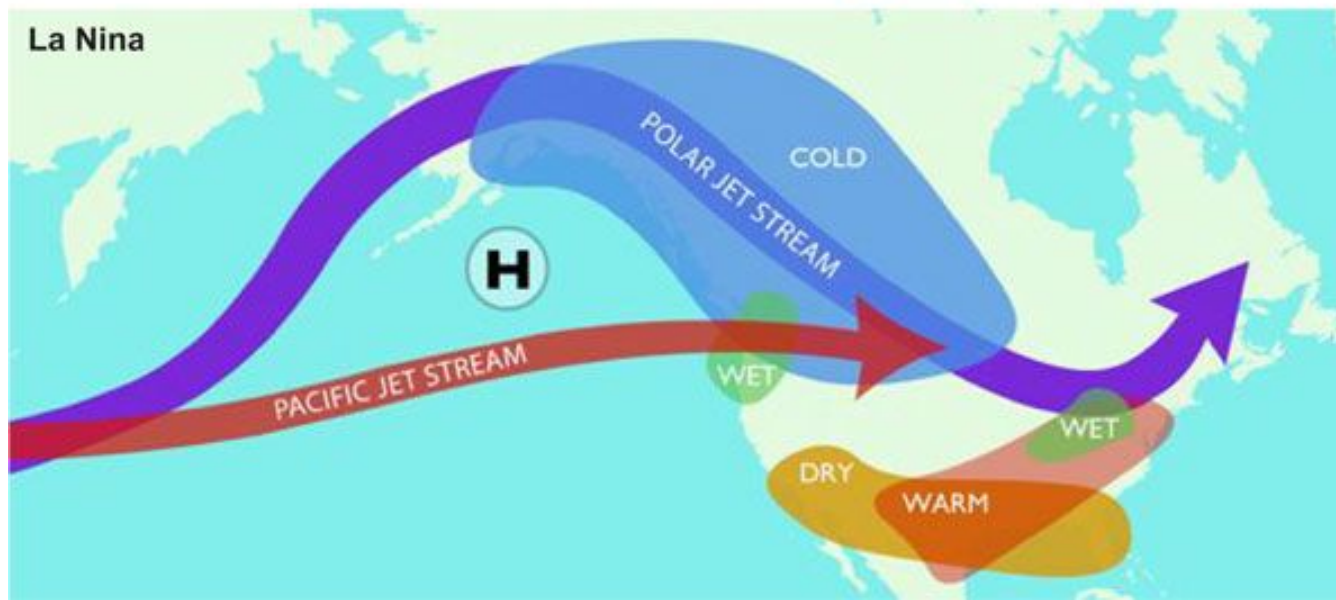
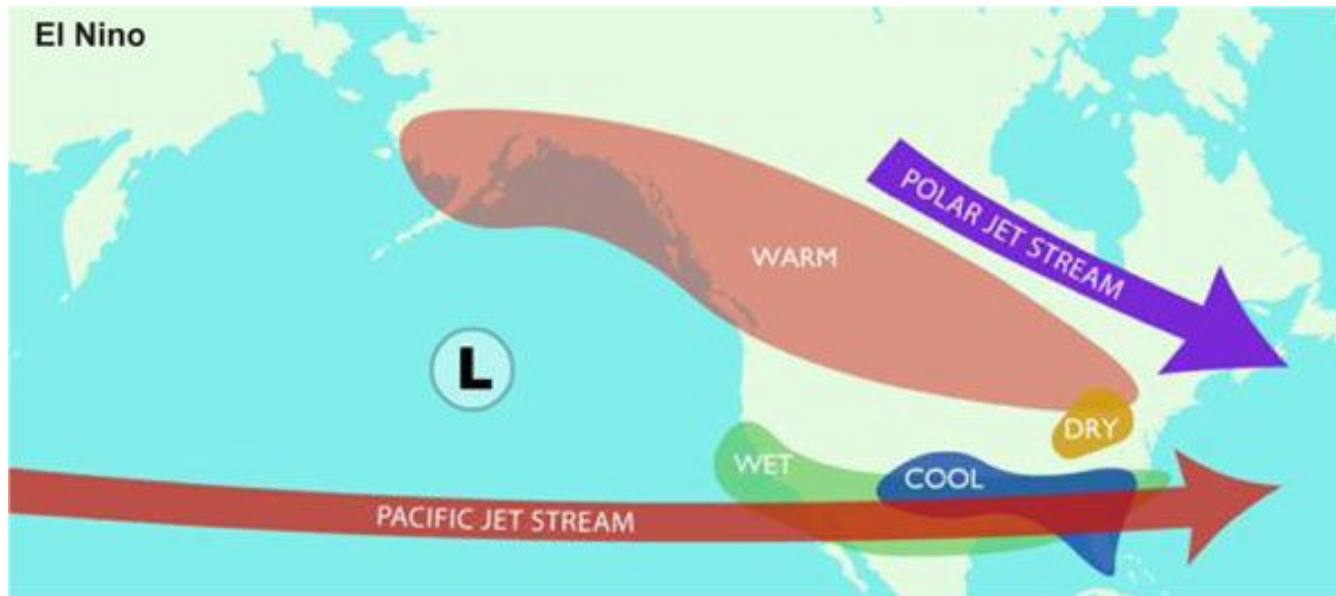
NOAA

November 1997



July 2015

# El Niño/La Niña Jet Stream Patterns





# Take Home Messages

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- Global, national, and statewide temperatures continue to rise with increasing GHG concentrations
- Land use/land cover also contributes to rising temperatures
- Changes in averages lead to amplified changes in the extremes
- Overnight minimum temperatures warming more than daytime highs
- Milder winters leading to more pests/disease and spread of invasive species

