

# Our Changing World

## The New Normals of Weather and Climate in Kentucky

Governor's Local Issues Conference

August 25, 2021

Joe Sullivan

KYEM



# Change

- Many people don't like it
- Inevitable
- *Always* occurring
- Not necessarily even or consistent
- More noticeable when it happens quickly



# “Normal”

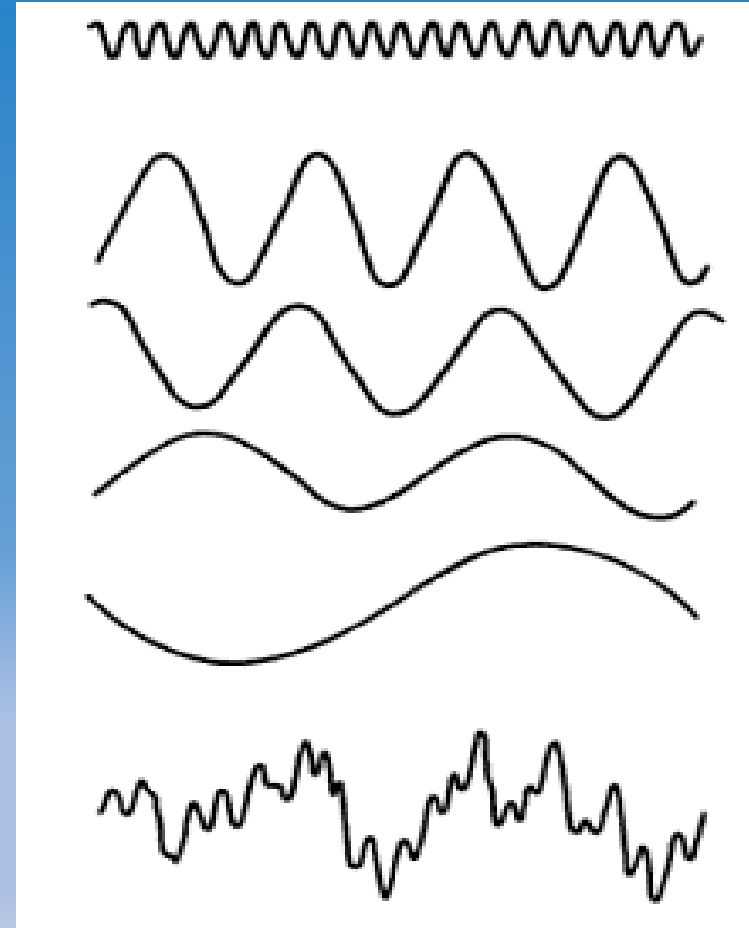
- In weather/climate, a 30-year numerical average (mean)
- Based on decade years 1-0, e.g., 1981-1990
- Recalculated every 10 years (in “1” year – e.g., 2021)



# Weather and Climate

## Contributing Cycles and Elements

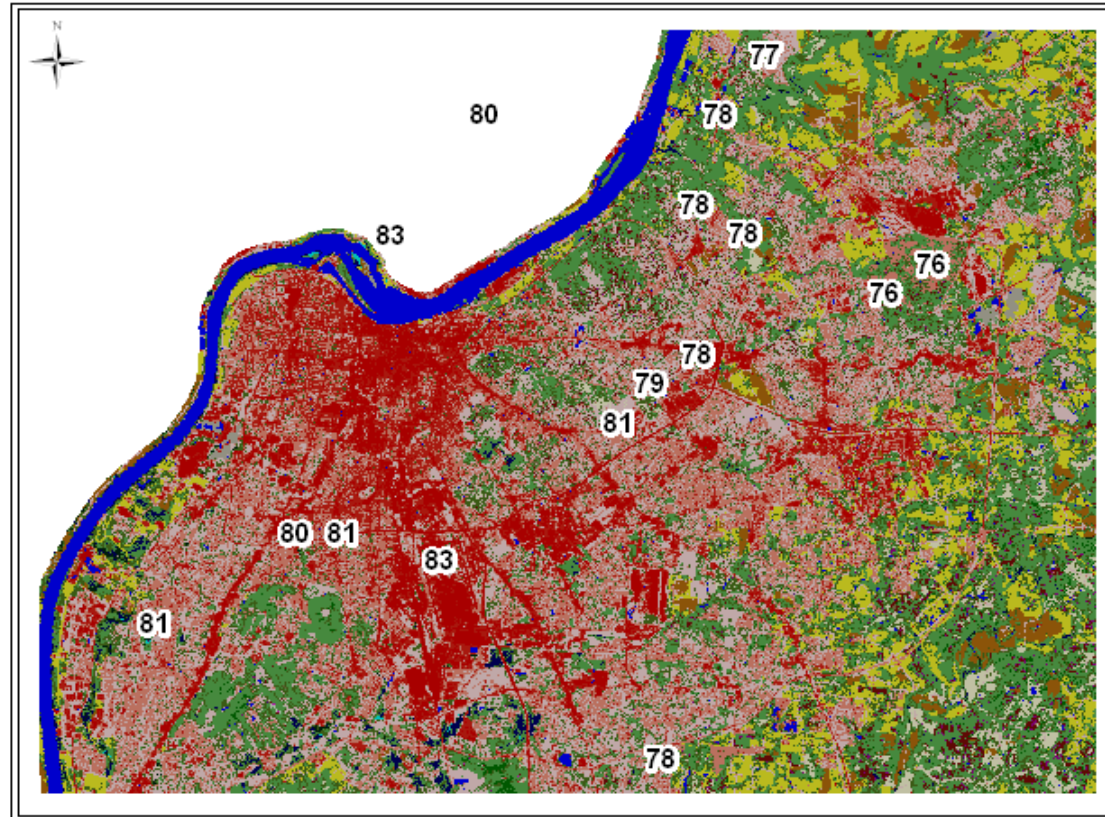
- Diurnal (daily)
- Lunar (28 days)
- Annual (365 days)
- ENSO (3-7 years)
- Other:
  - Madden-Julian Oscillation
  - North Atlantic Oscillation
  - Etc...





# Urban Heat Islands

**Louisville Metro Landcover**  
**Minimum Temperatures August 4th, 2010**



Low temperatures this morning clearly demonstrate the "urban heat island" effect. Temperatures increase with proximity to the more densely developed areas of the city. Louisville International Airport has some of the highest concentration of unnatural landcover in the city and recorded the highest minimum temperature of 83 degrees. Areas farther out of the city near forest and cropland reports temperatures as low as 76 degrees.

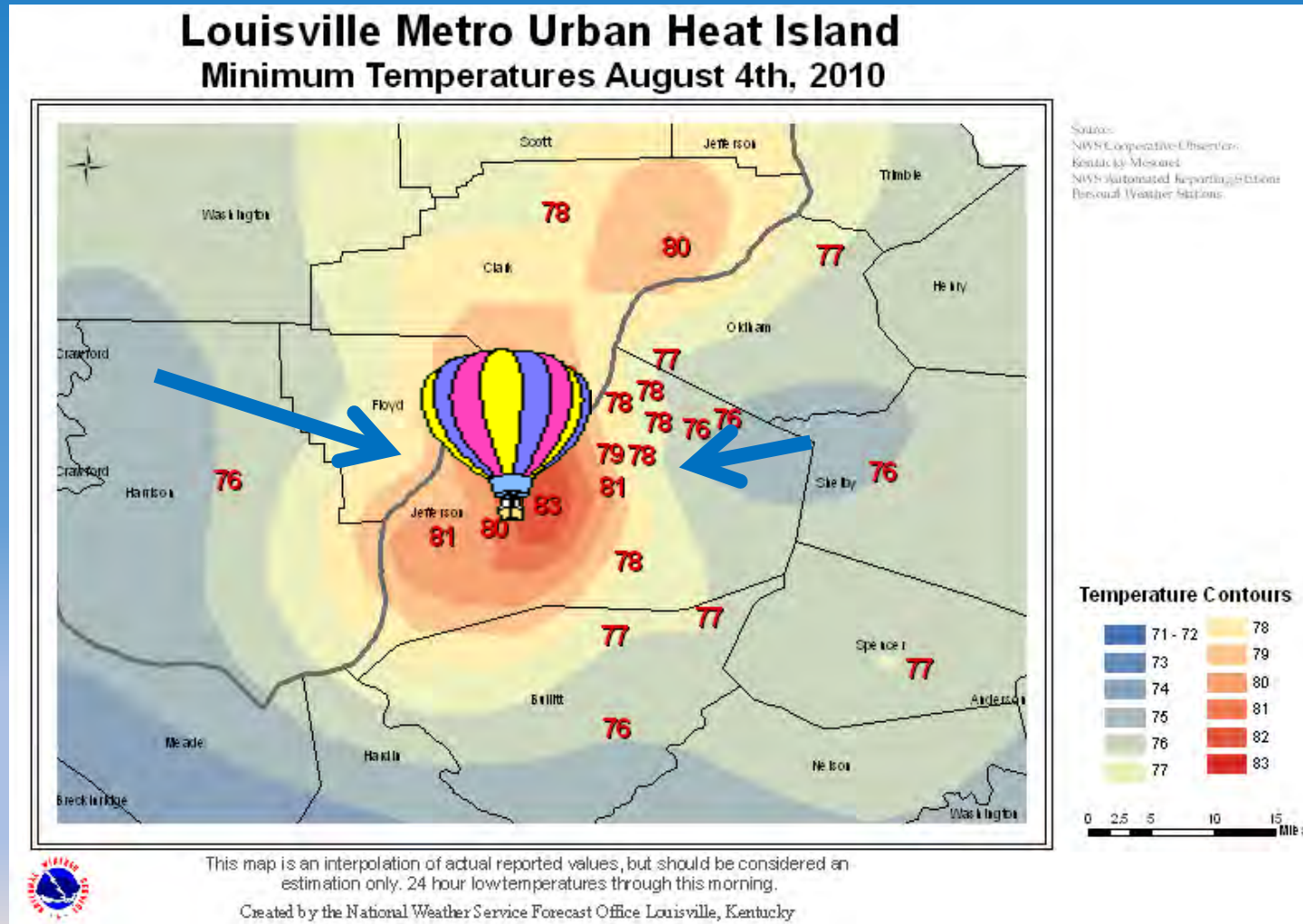


Created by the National Weather Service Forecast Office Louisville, Kentucky

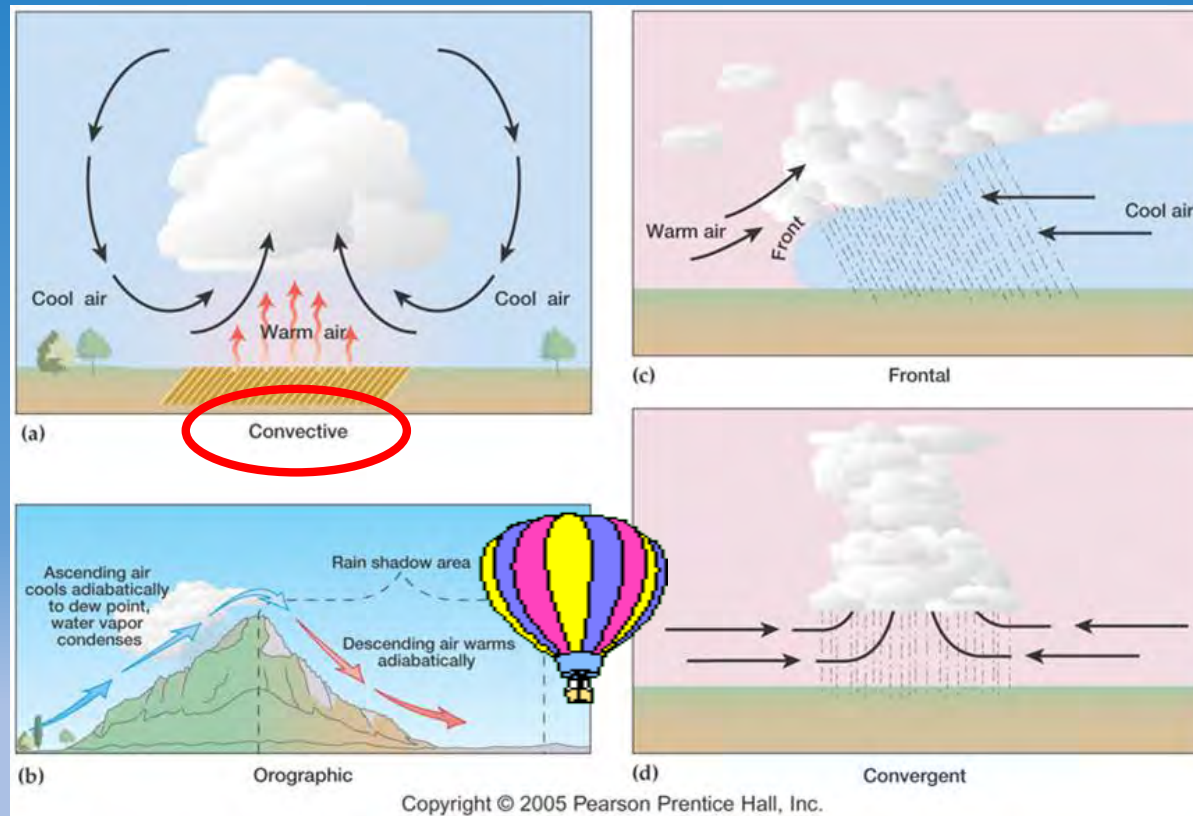
0 2.5 5 Miles



# Urban Heat Islands



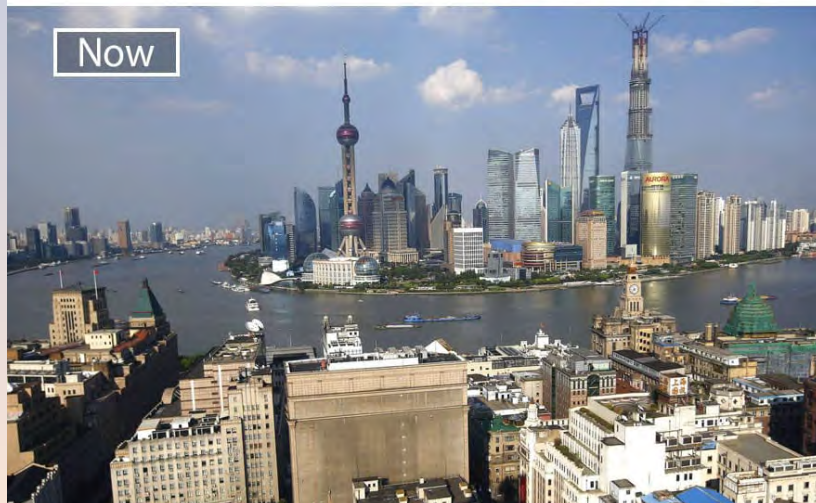
# Urban Heat Islands



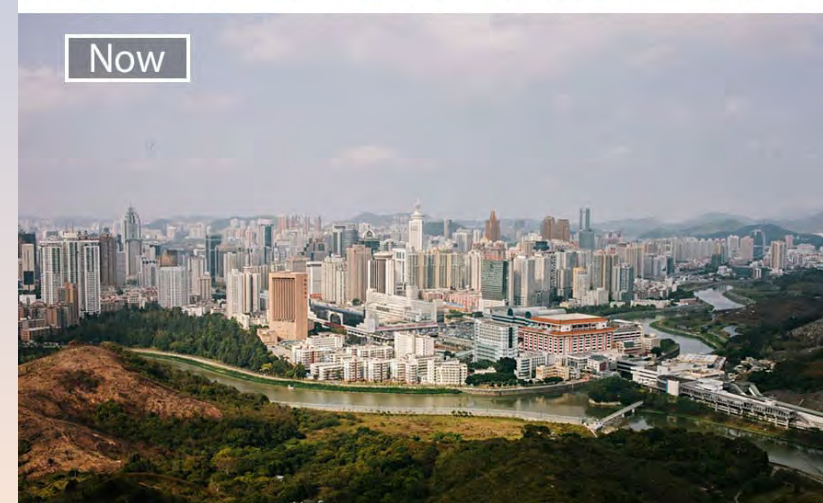


# Our Changing Planet

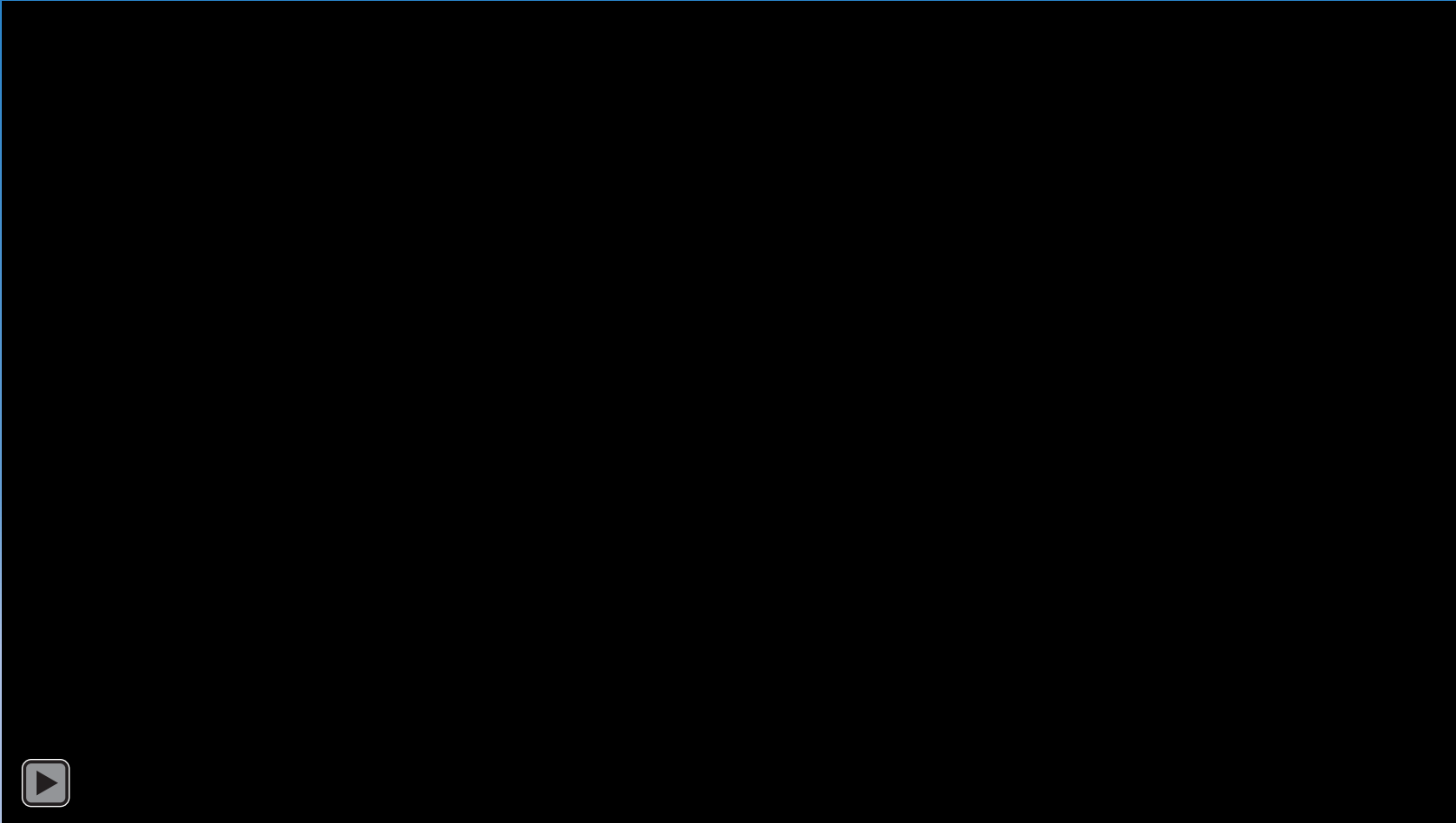
Shanghai



Shenzen, China



# Increased heat alters motion in a fluid





# Our Changing Planet

Muir Glacier, Alaska



Olivares Alfa glacier, Chili

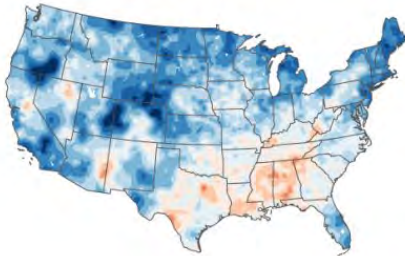




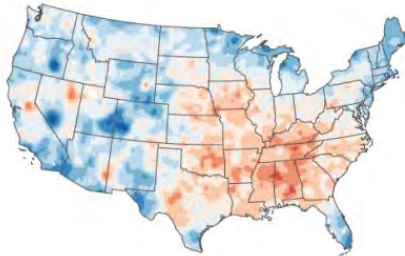
# “Normal” vs. 20<sup>th</sup> Century **Temperatures**

## U.S. ANNUAL TEMPERATURE COMPARED TO 20<sup>th</sup>-CENTURY AVERAGE

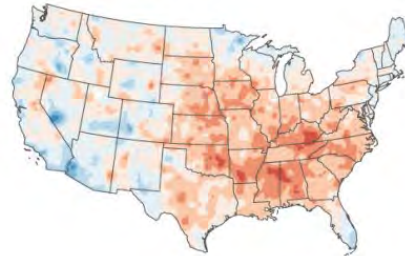
1901–1930



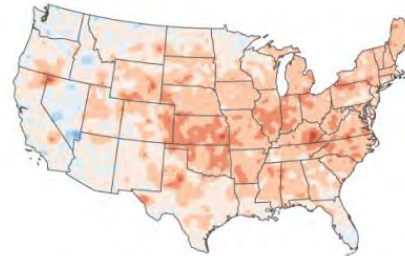
1911–1940



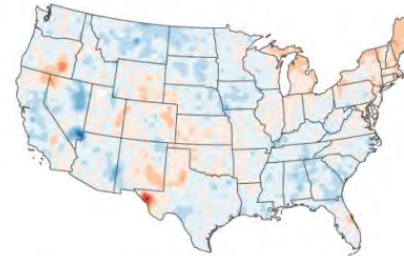
1921–1950



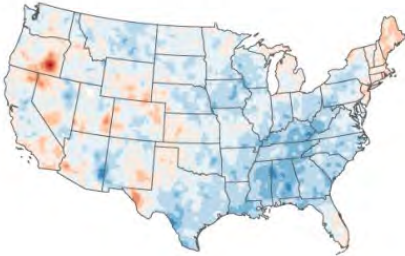
1931–1960



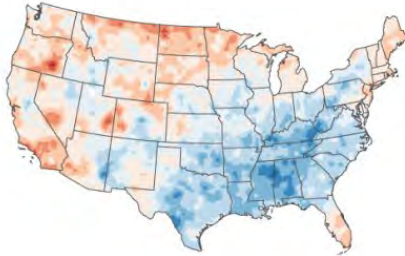
1941–1970



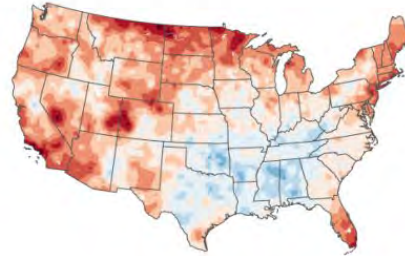
1951–1980



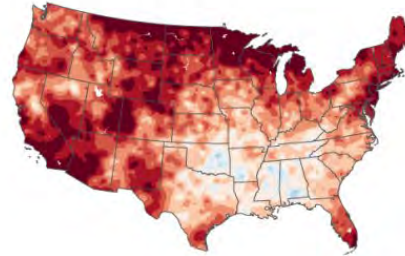
1961–1990



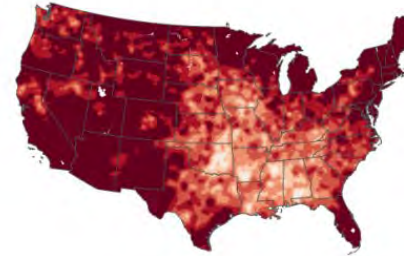
1971–2000



1981–2010

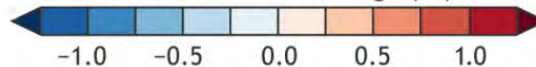


1991–2020



30-year Normal  
compared to 1901–2000

Difference from average (°F)



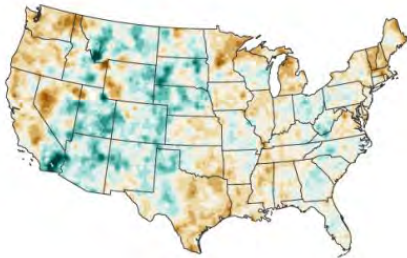
NOAA Climate.gov  
Data: NCEI



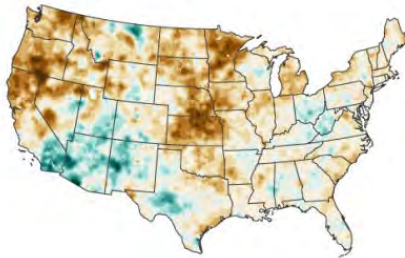
# “Normal” vs. 20<sup>th</sup> Century Precipitation

## U.S. ANNUAL PRECIPITATION COMPARED TO 20<sup>th</sup>-CENTURY AVERAGE

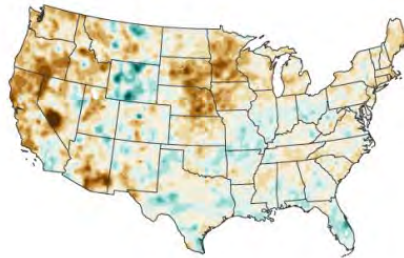
1901–1930



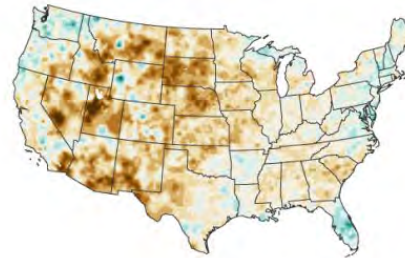
1911–1940



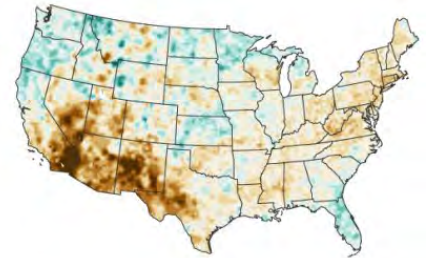
1921–1950



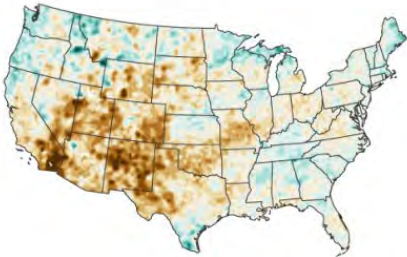
1931–1960



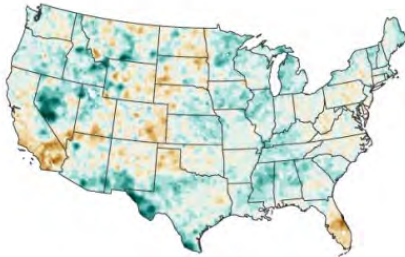
1941–1970



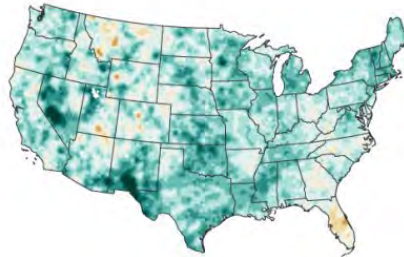
1951–1980



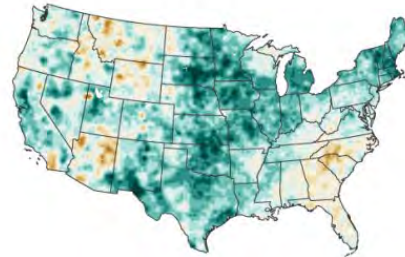
1961–1990



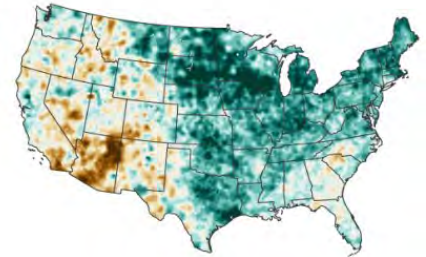
1971–2000



1981–2010

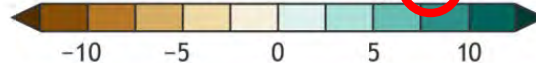


1991–2020



30-year Normal  
compared to 1901–2000

Difference from average (%)



NOAA Climate.gov  
Data: NCEI



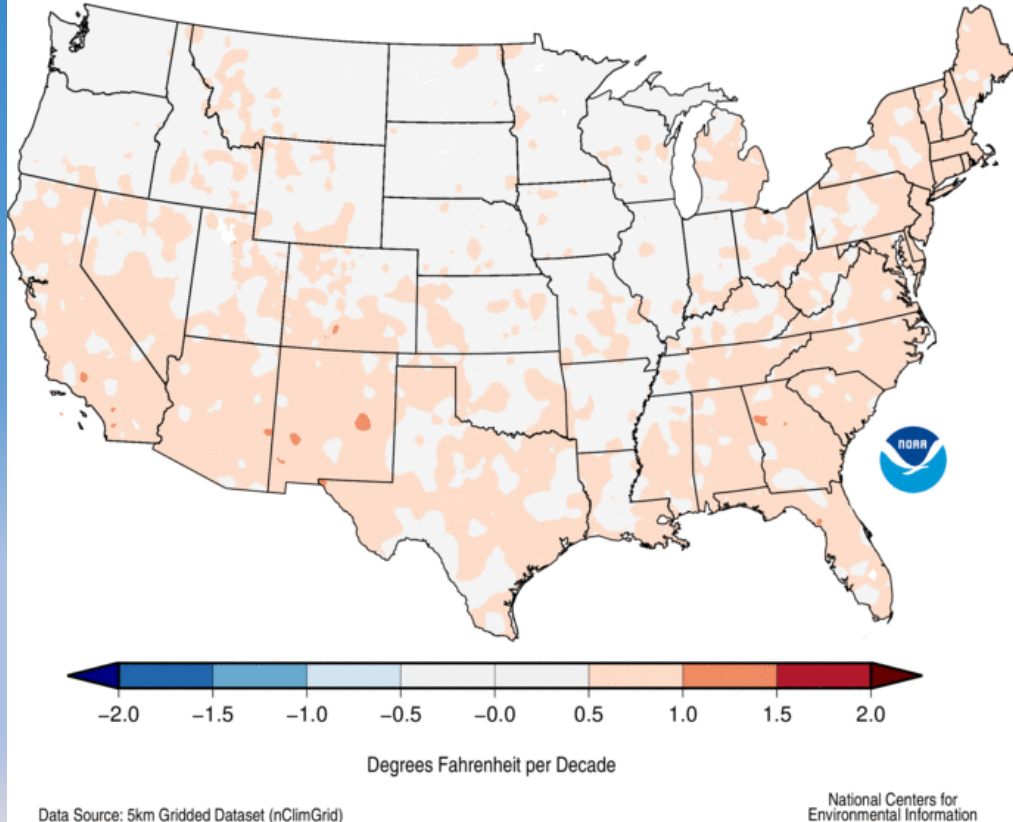


# Old vs. New Normals

## *Mean* Temperature

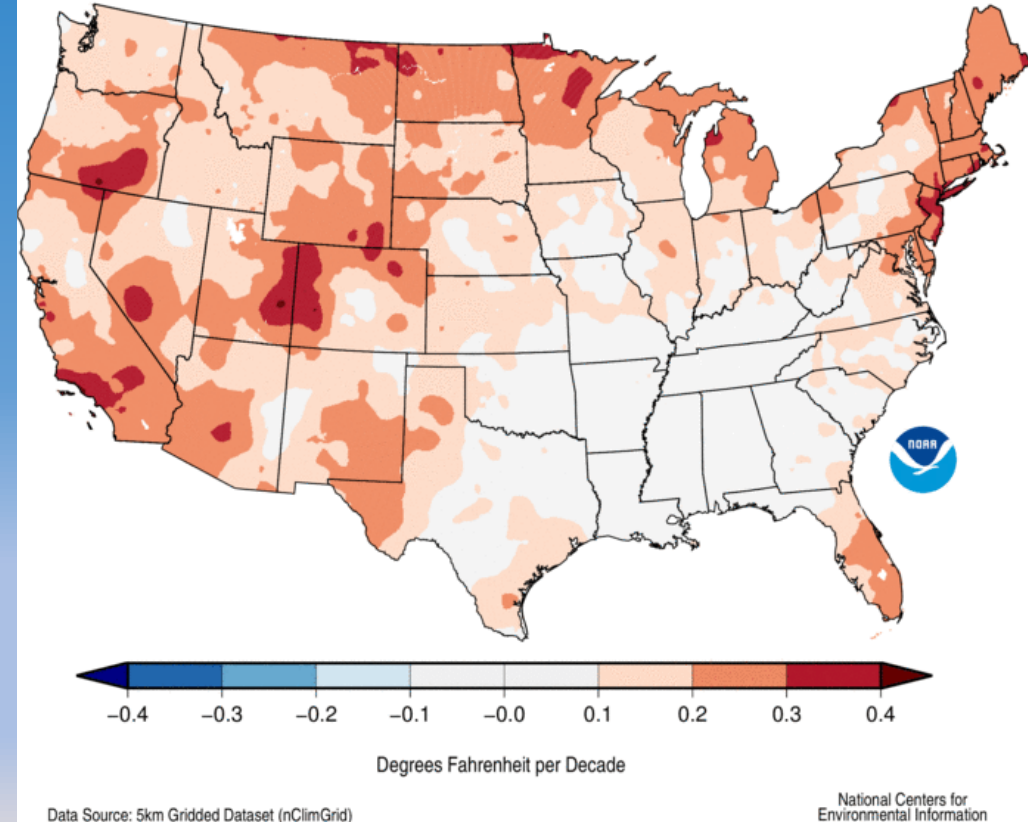
vs. 1980-2010

Average Temperature Trends  
Annual 1991–2020 (30 years)



Trend since 1895

Average Temperature Trends  
Annual 1895–2020

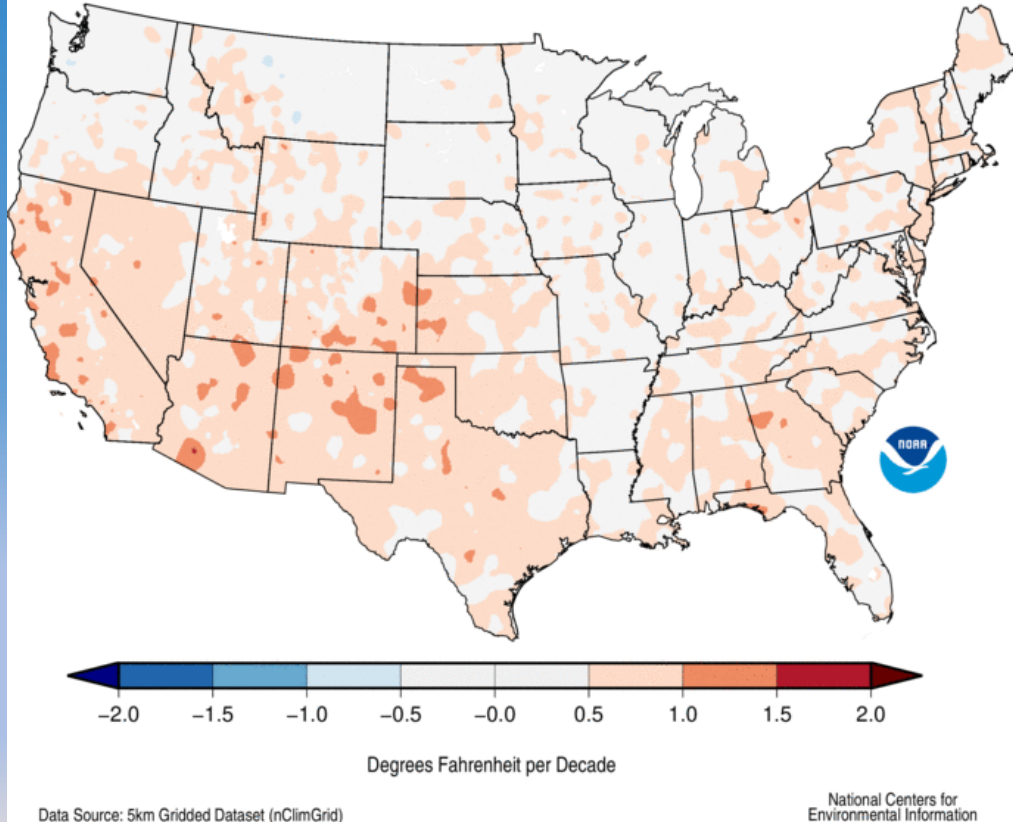


# Old vs. New Normals

## *Maximum* Temperature

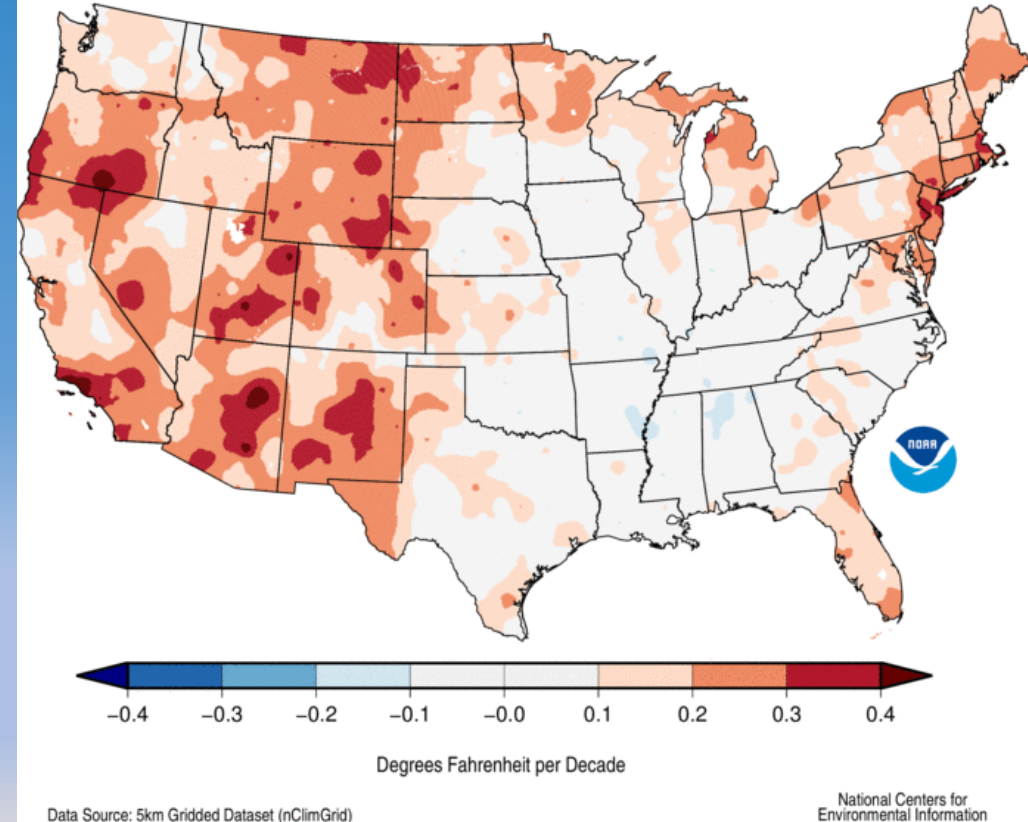
vs. 1980-2010

Average Maximum Temperature Trends  
Annual 1991–2020 (30 years)



Trend since 1895

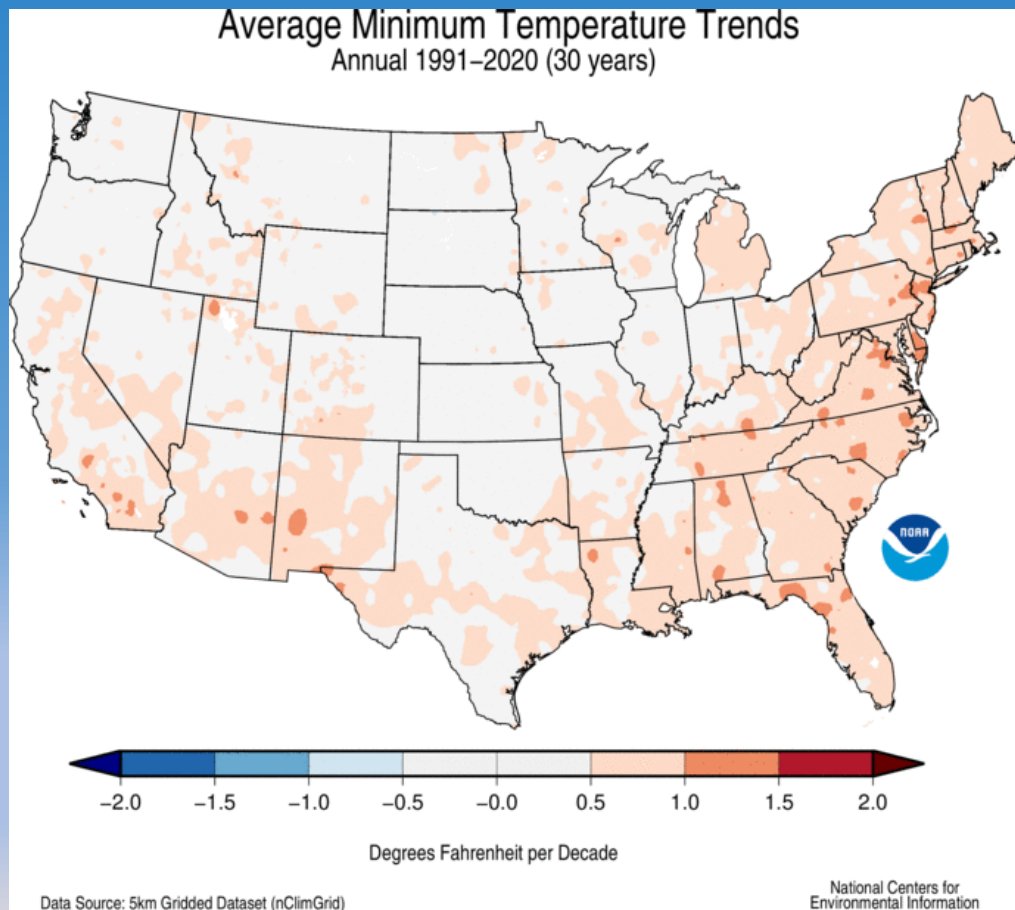
Average Maximum Temperature Trends  
Annual 1895–2020



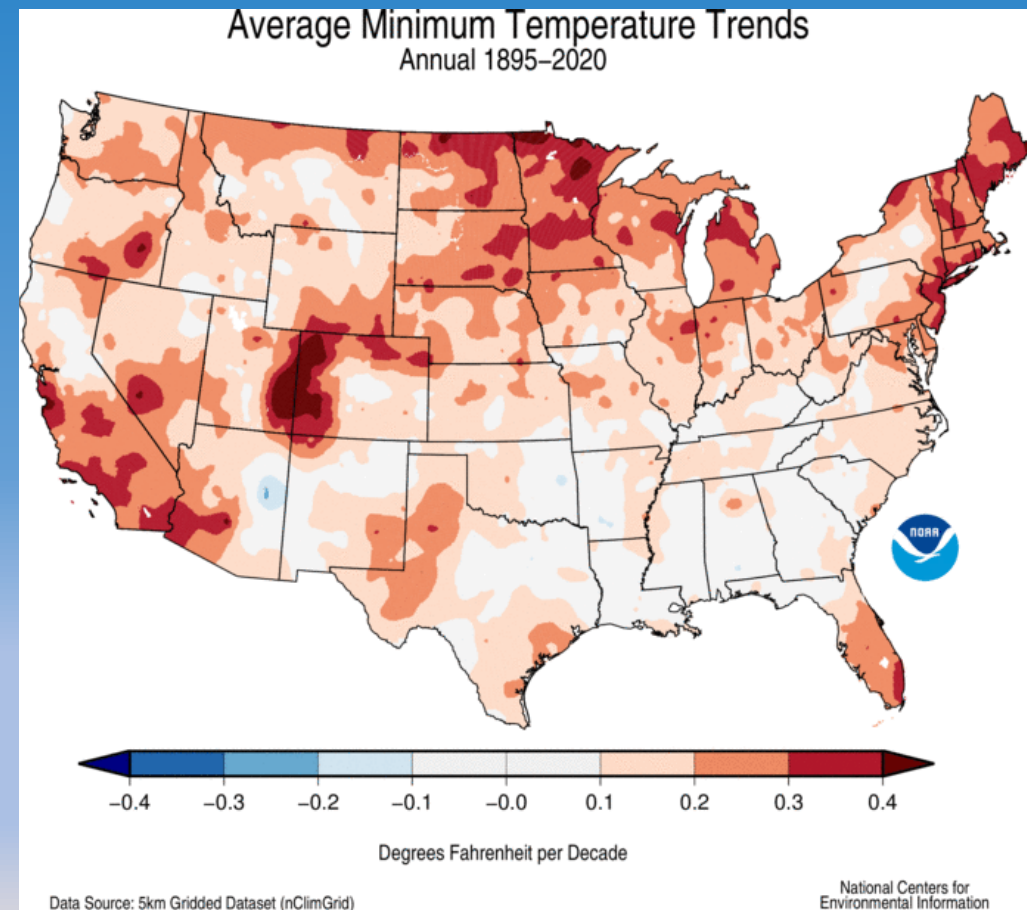
# Old vs. New Normals

## *Minimum* Temperature

vs. 1980-2010



Trend since 1895

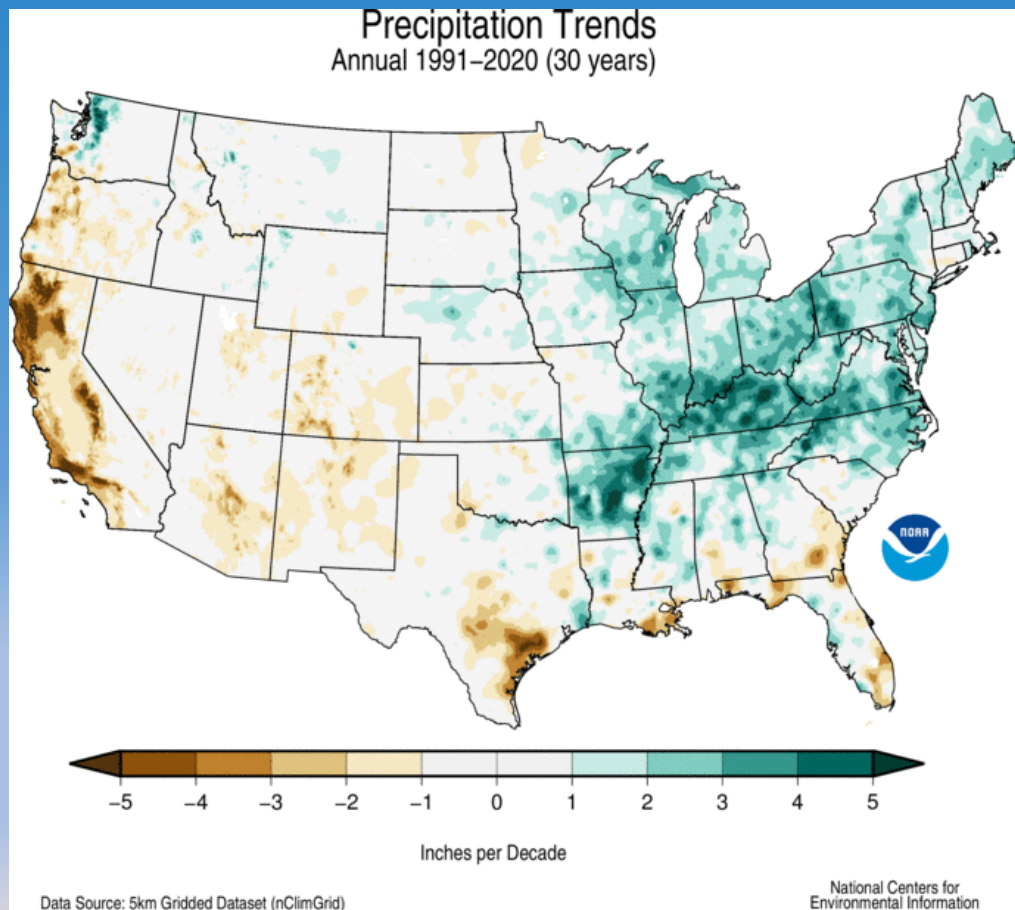




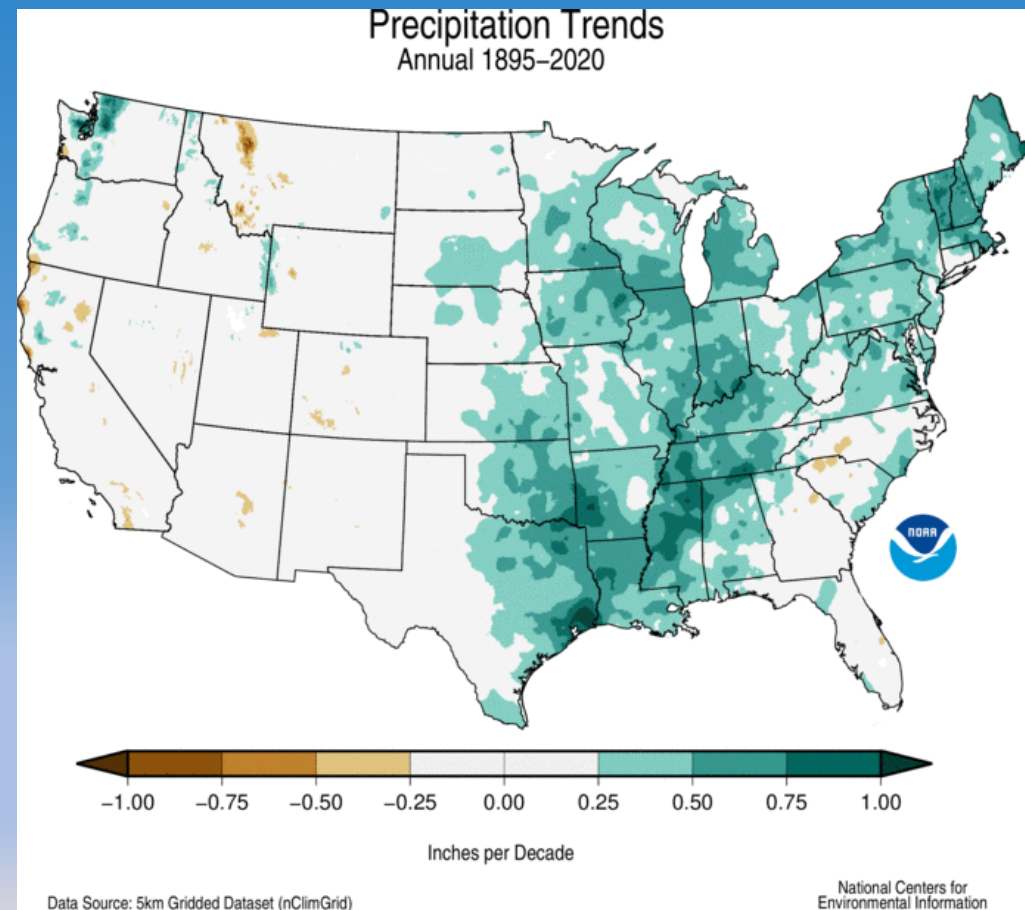
# Old vs. New Normals

## Precipitation

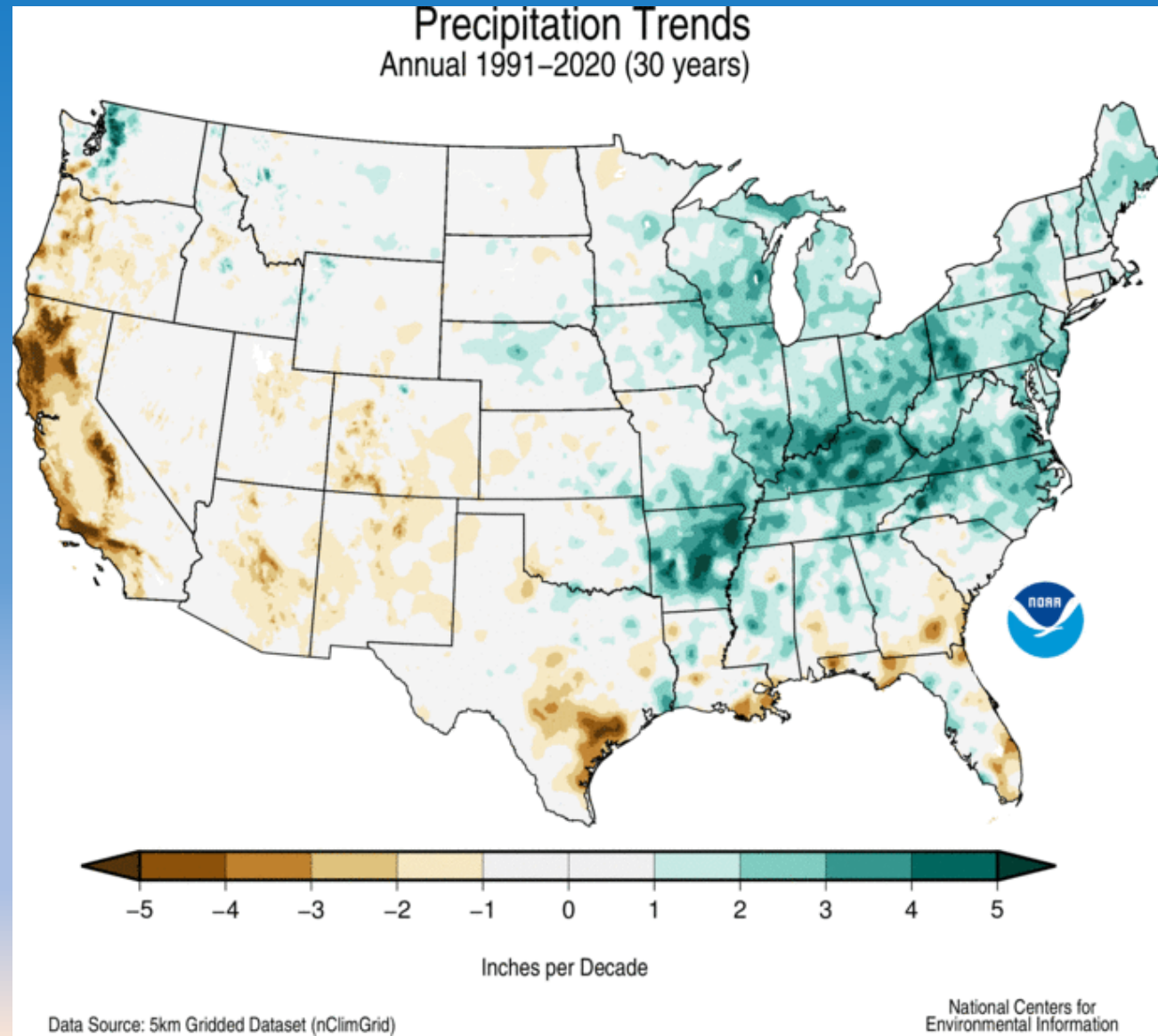
vs. 1980-2010



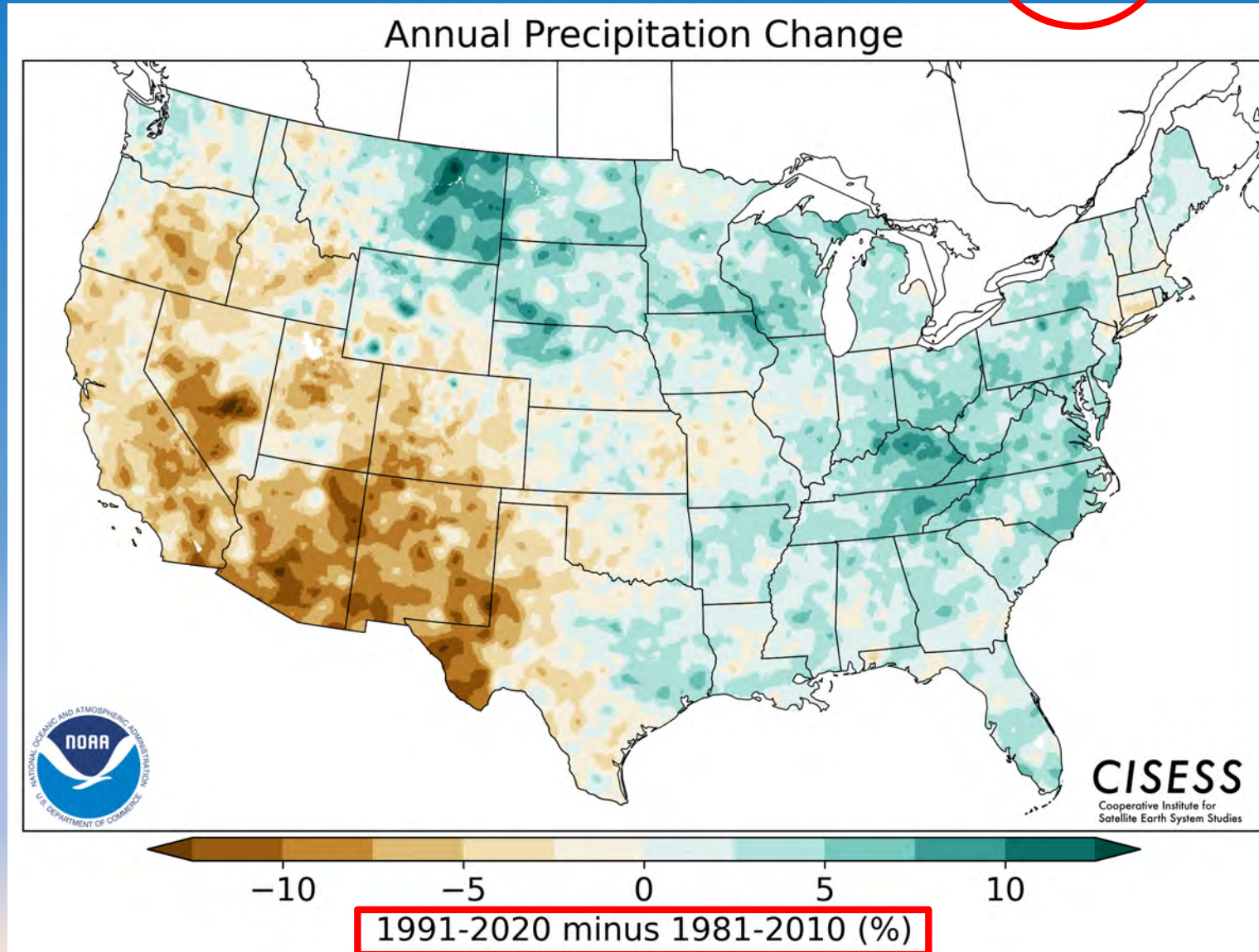
Trend since 1895



# Old vs. New Normals (inches)



# Old vs. New Normals (%)



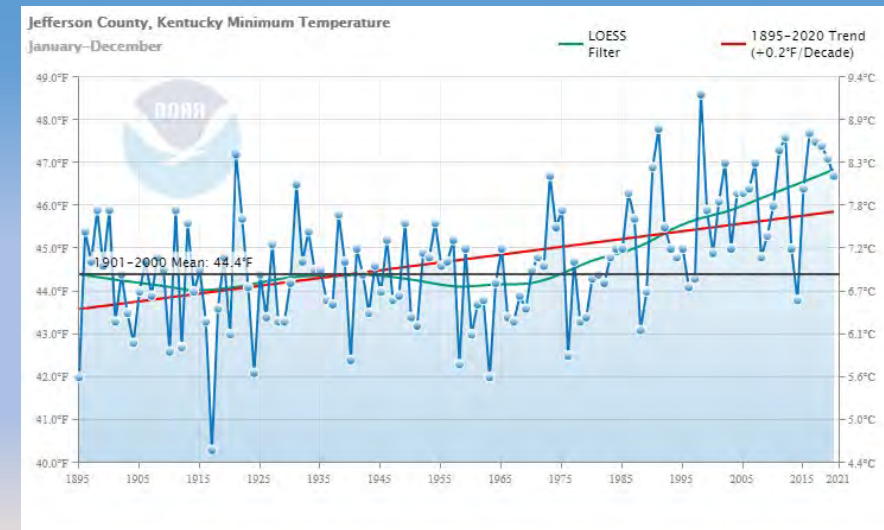
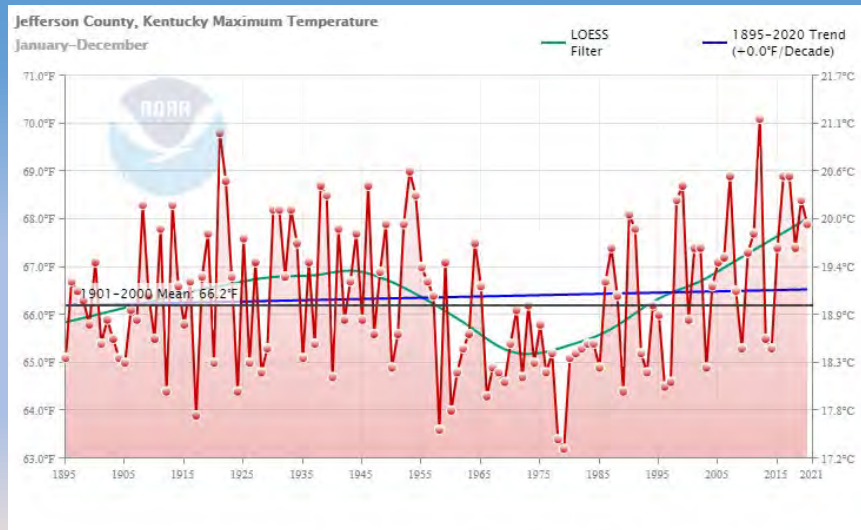
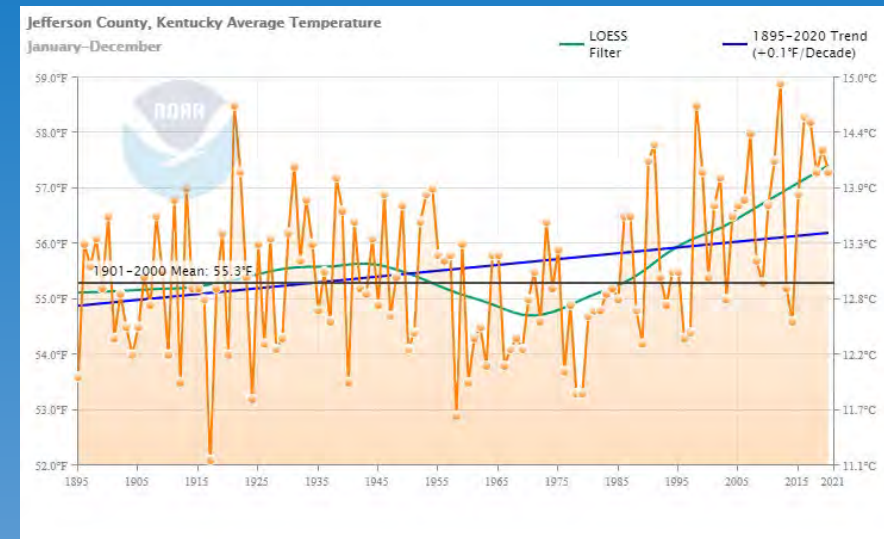
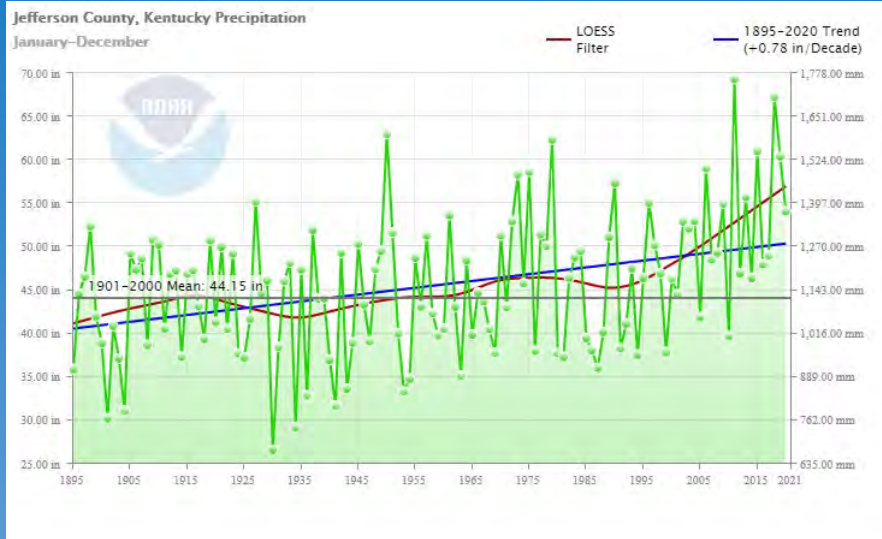


# Jefferson County

[ncdc.noaa.gov/cag](https://ncdc.noaa.gov/cag)

## Precipitation

## Mean (AVG) Temperature



MAX Temperature

MIN Temperature

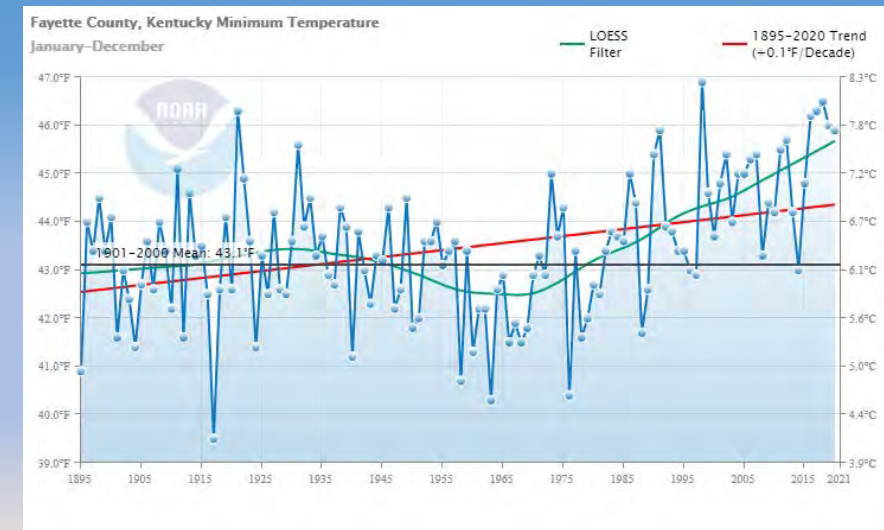
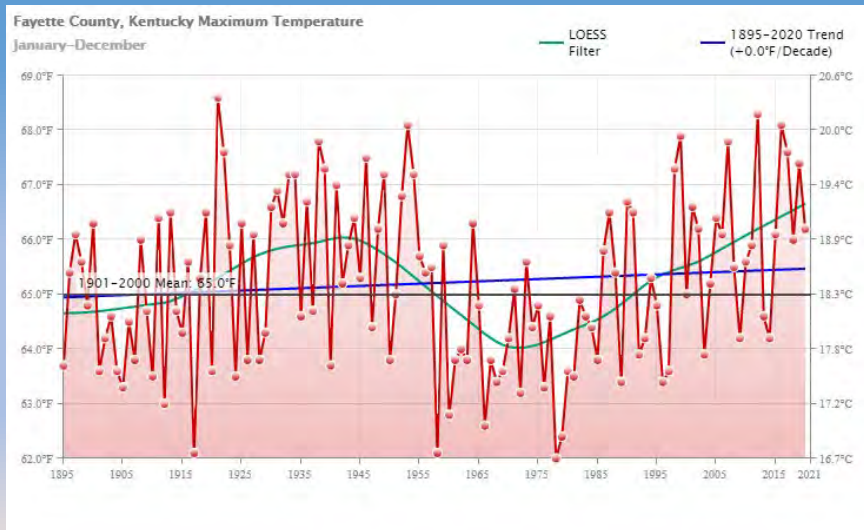
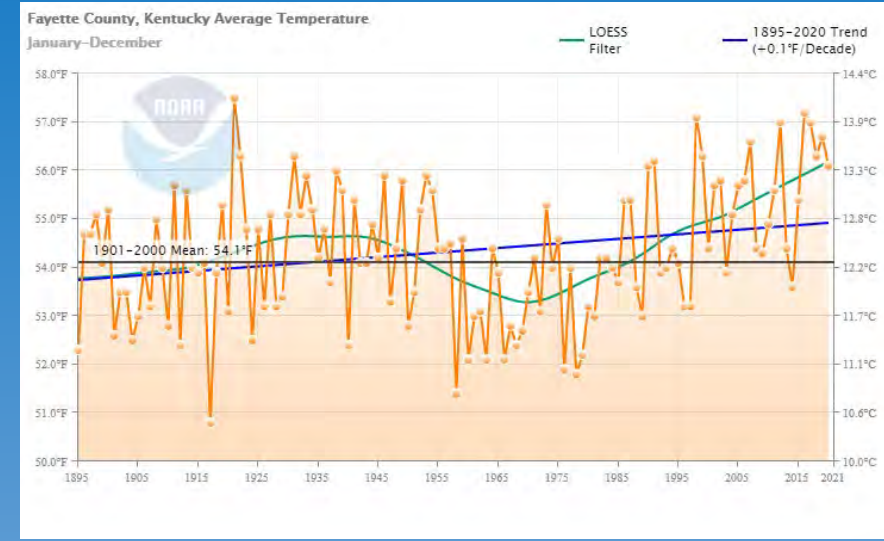
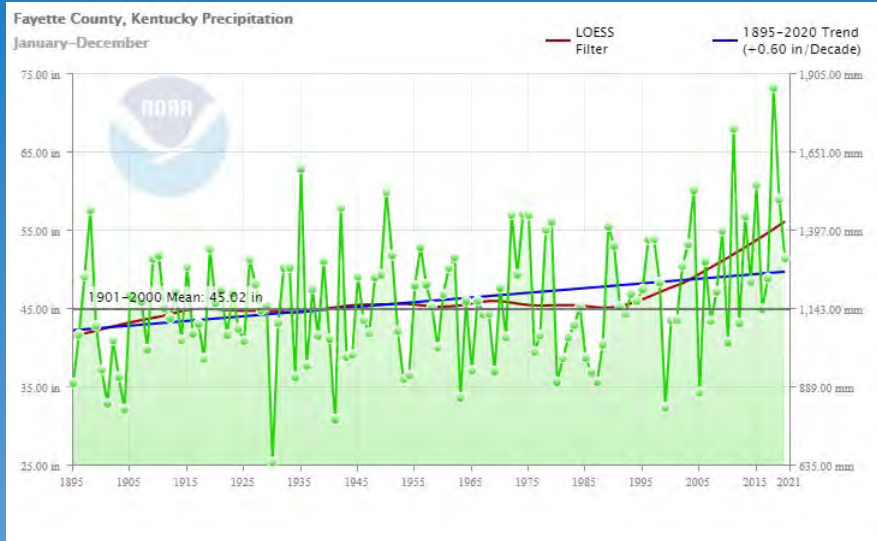


# Fayette County

[ncdc.noaa.gov/cag](https://ncdc.noaa.gov/cag)

## Precipitation

## Mean (AVG) Temperature



MAX Temperature

MIN Temperature

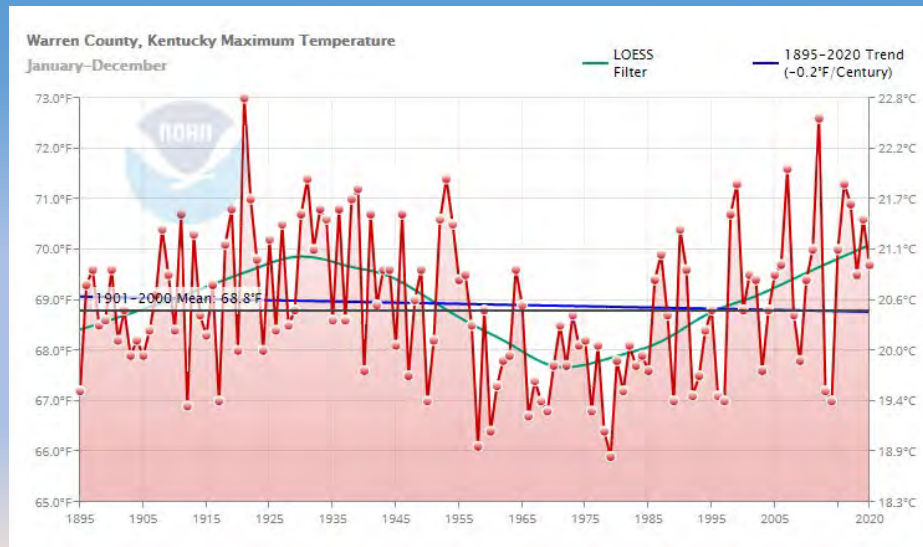
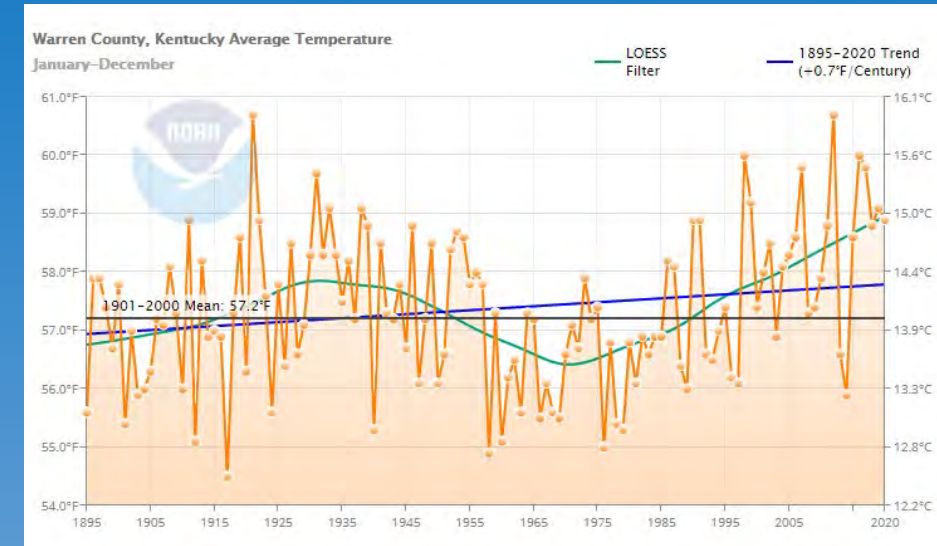
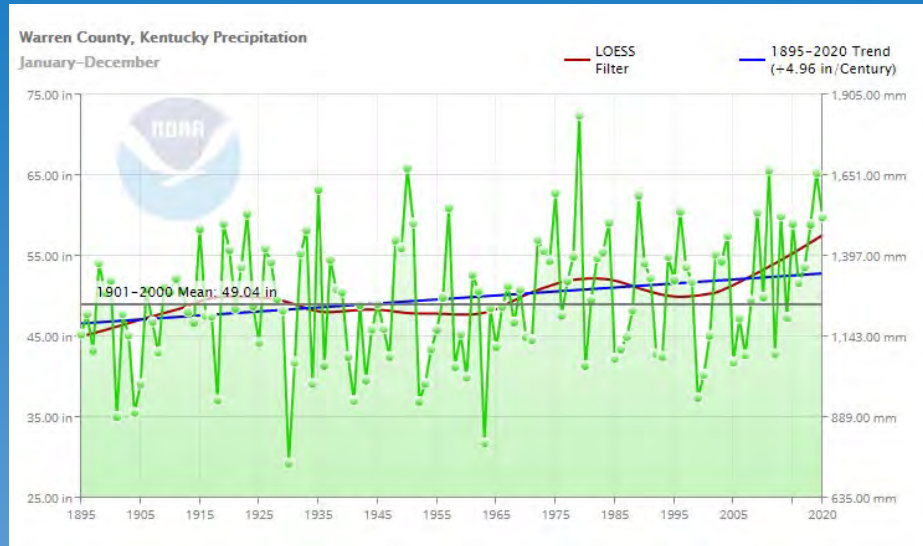




# Warren County

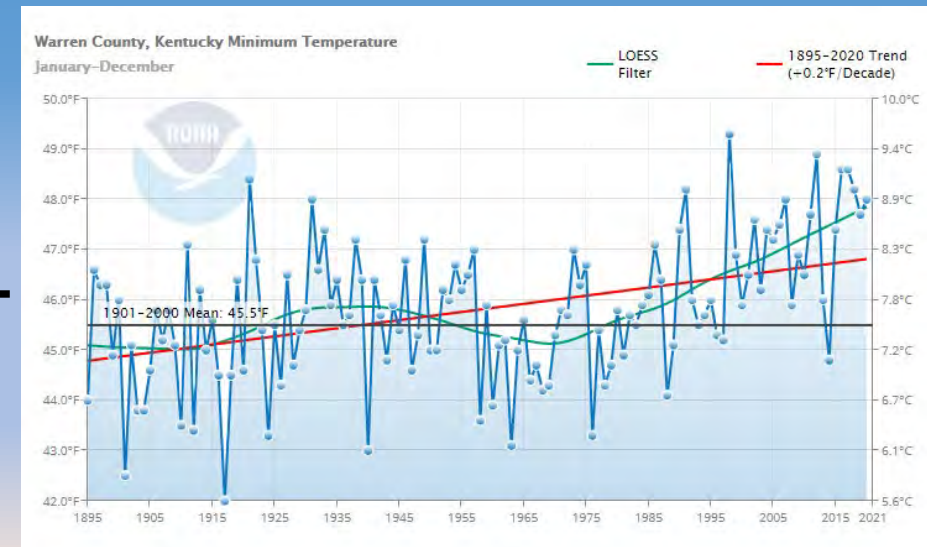
[ncdc.noaa.gov/cag](https://ncdc.noaa.gov/cag)

## Precipitation



MAX Temperature

MIN Temperature

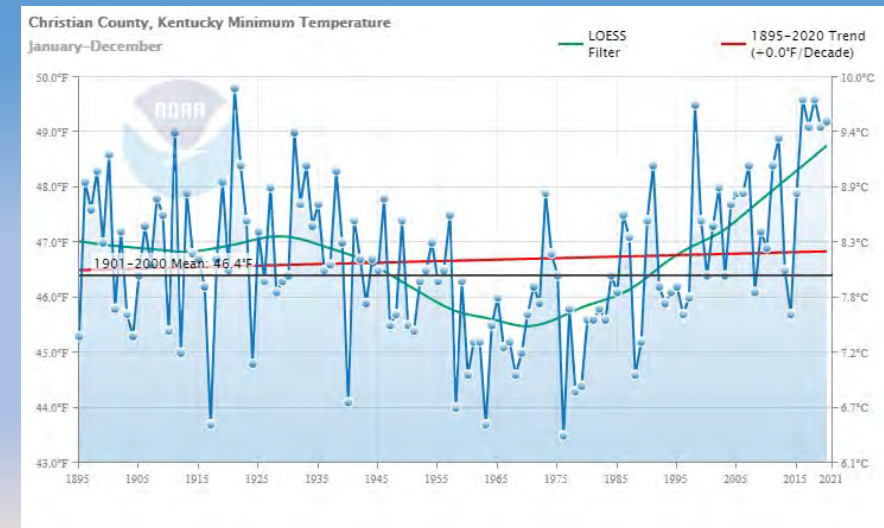
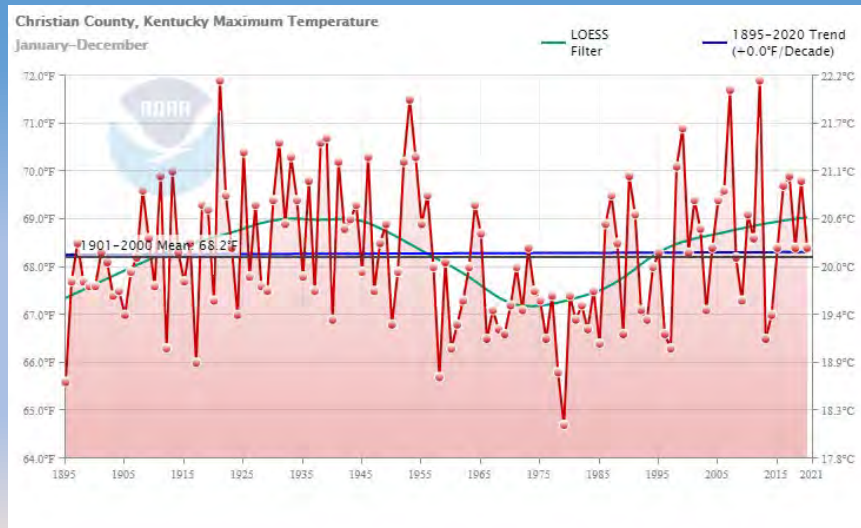
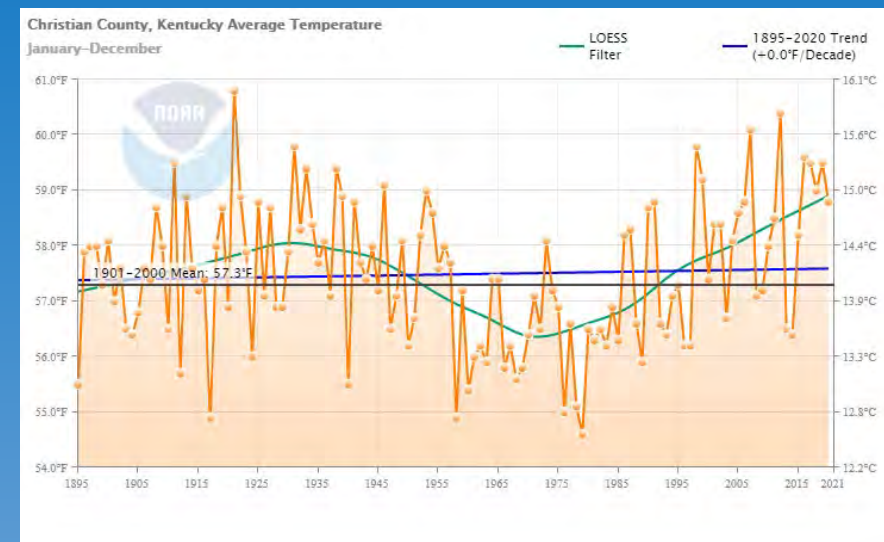
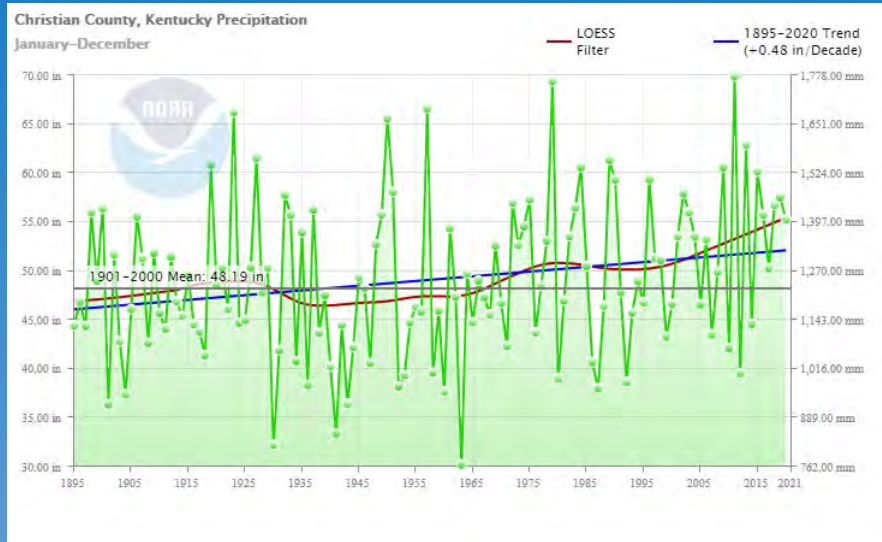


# Christian County

[ncdc.noaa.gov/cag](https://ncdc.noaa.gov/cag)

## Precipitation

## Mean (AVG) Temperature



MAX Temperature

MIN Temperature

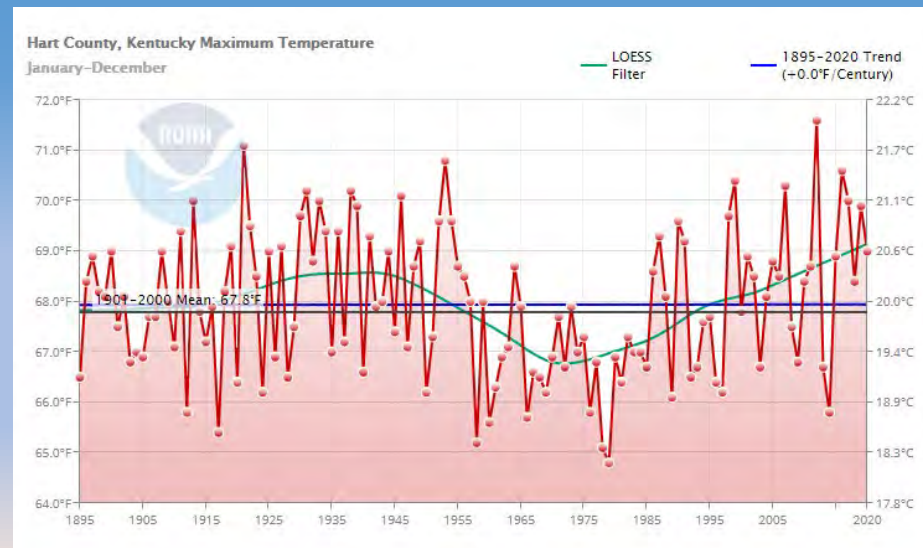
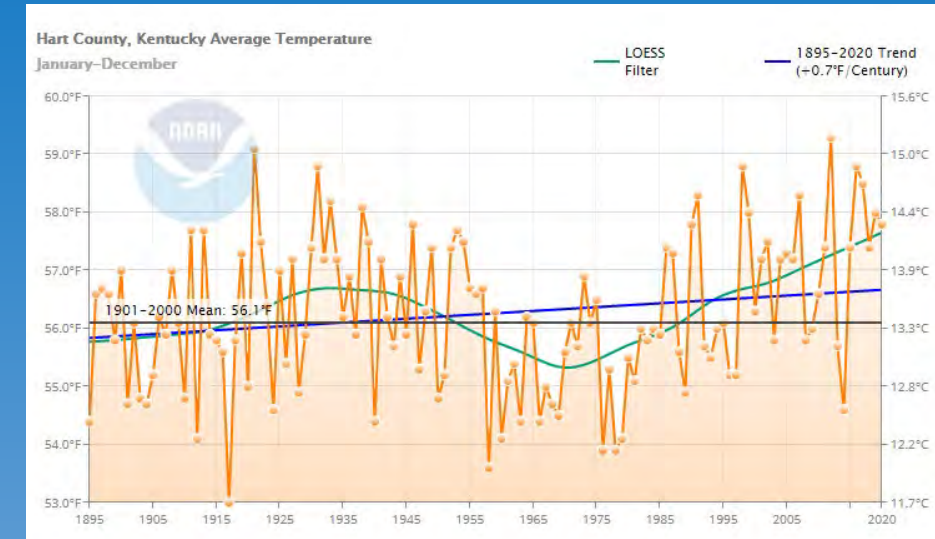
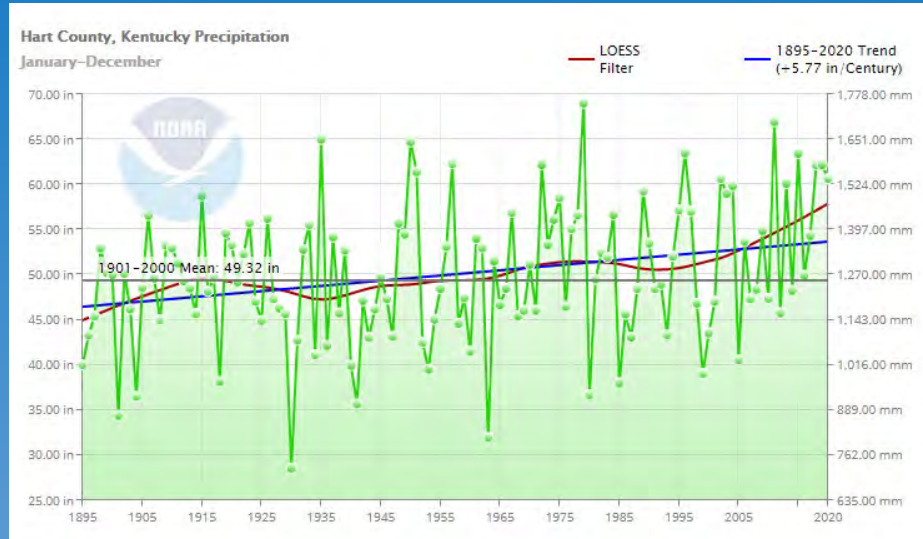




# Hart County

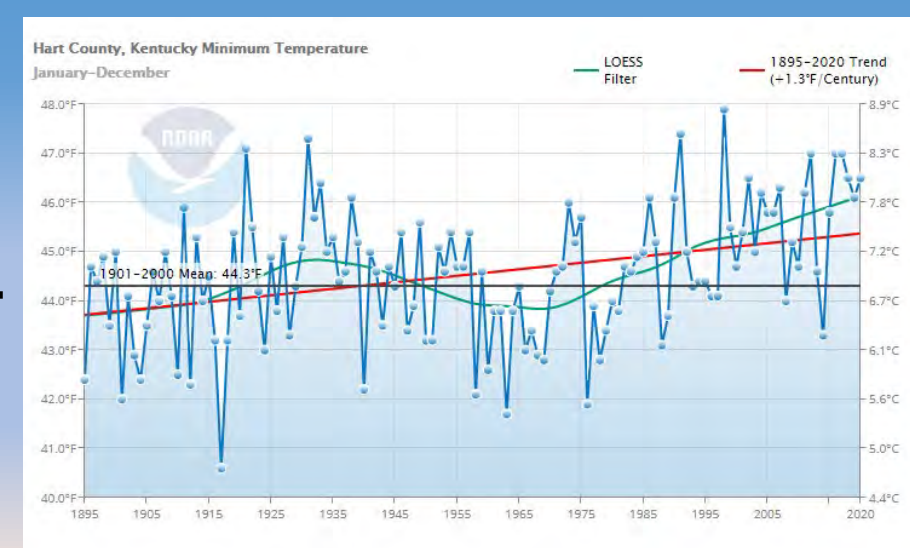
[ncdc.noaa.gov/cag](https://ncdc.noaa.gov/cag)

## Precipitation



MAX Temperature

MIN Temperature

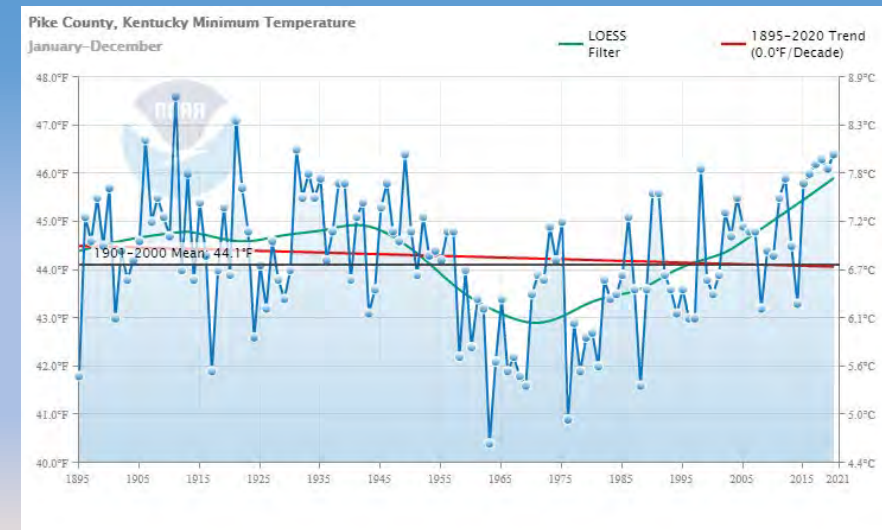
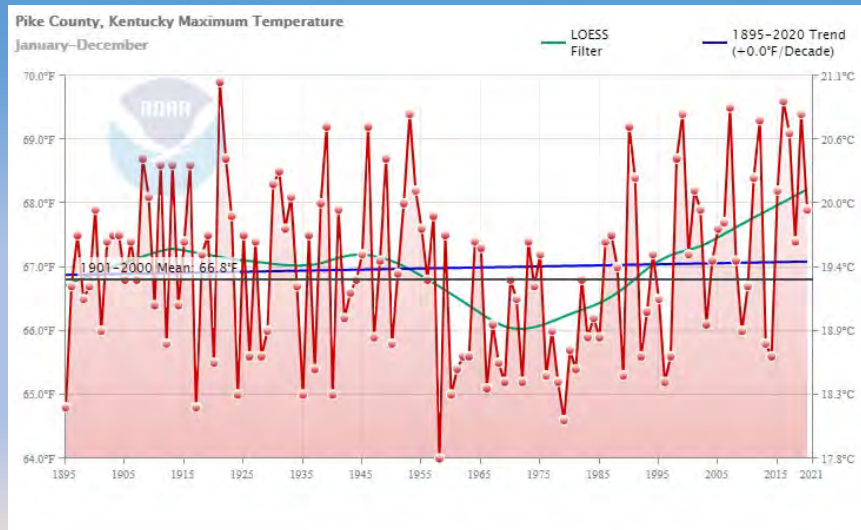
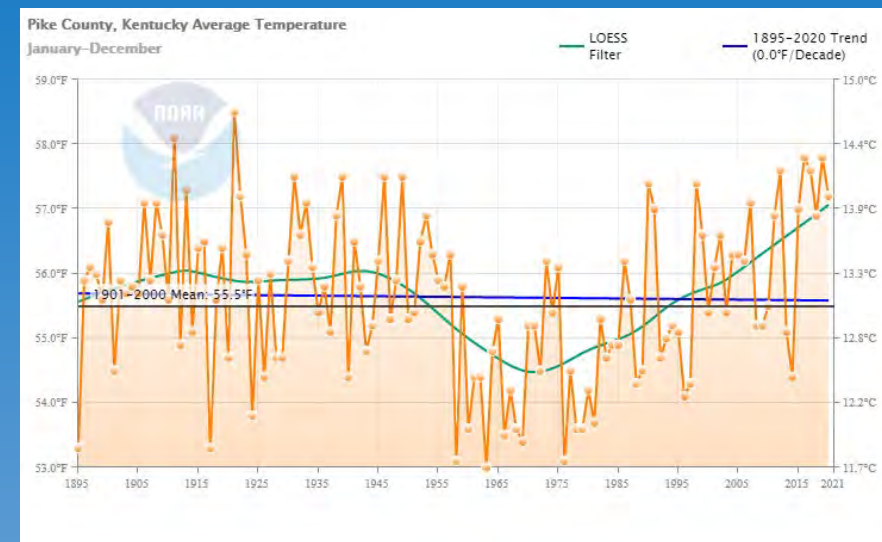
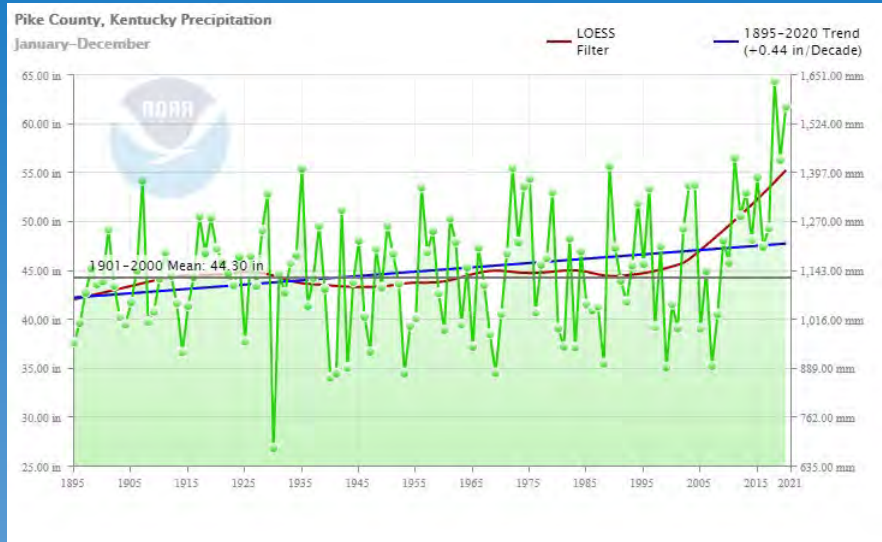


# Pike County

[ncdc.noaa.gov/cag](https://ncdc.noaa.gov/cag)

## Precipitation

## Mean (AVG) Temperature

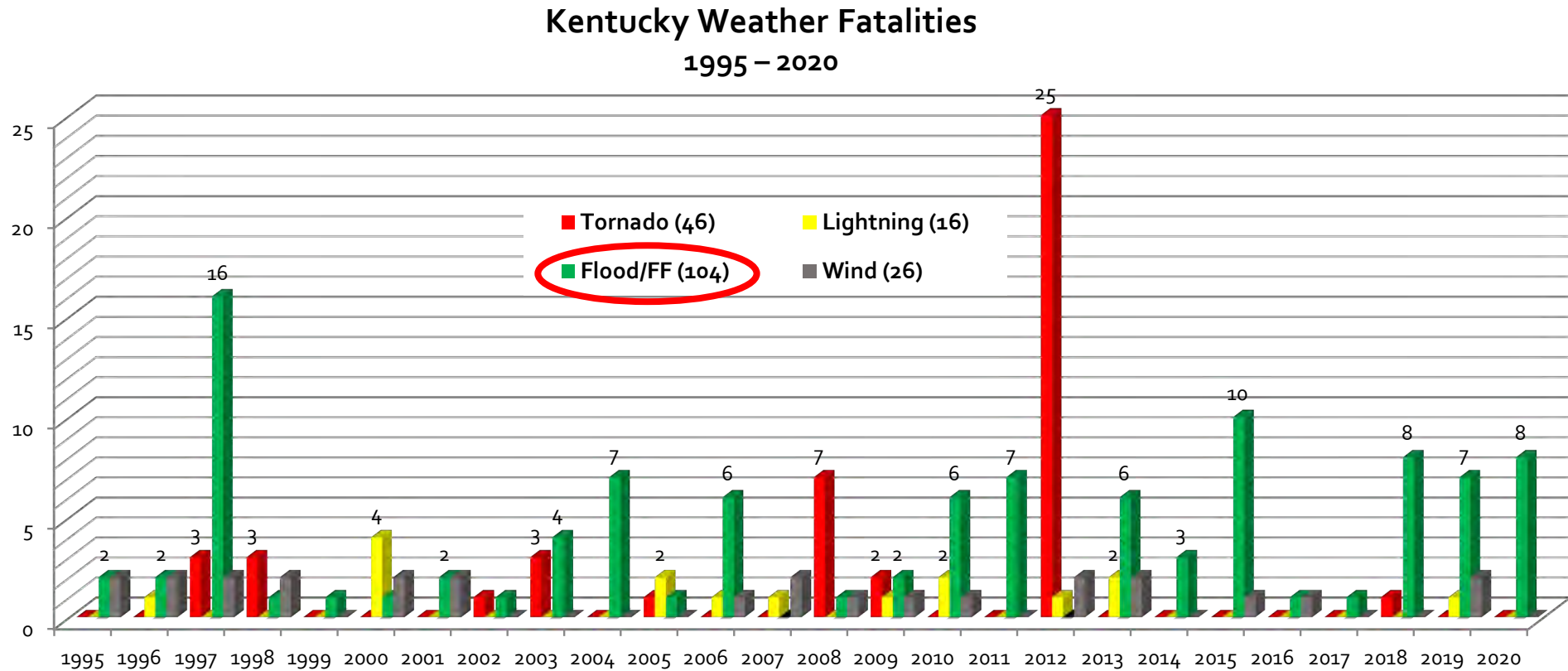


MAX Temperature

MIN Temperature



# Kentucky Weather Killers





# Solutions (???)



**DO** try to impact the environment *as little as possible*

### Cub Scout Leave No Trace Pledge

I promise to apply the Leave No Trace frontcountry principles wherever I go:

1. Know Before You Go
2. Choose The Right Path
3. Trash Your Trash
4. Leave What You Find
5. Be Careful With Fire
6. Respect Wildlife
7. Be Kind to Other Visitors



Signature \_\_\_\_\_



**DO** try to impact the environment *as little as possible*



Mitigation Matters!





# Questions?



[JSullivan.weather@gmail.com](mailto:JSullivan.weather@gmail.com)

