Climate Trends, Normals and Extremes In Kansas

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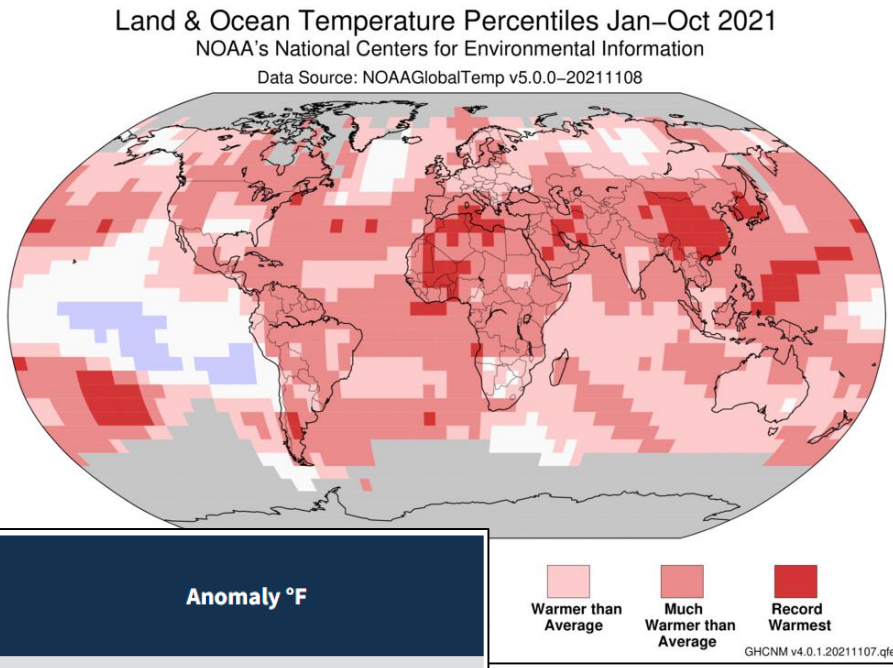
Agenda

* Precipitation & Temperature Trends
  * Global to Kansas
* 30 Year Normals
* Kansas Extremes
* Winter Outlook?

Main Take Aways

* Precipitation trends show increases across the state
* Temperature trends are increasing
  * Minimum temperature increasing more rapidly
* New 30-Year Normals Comparisons (1991-2020)
* Billion $ Disaster Trends
  * Becoming more costly
  * Increasing frequency?

Global Temperature Trends



Rank 1 = Warmest Period of Record: 1880–2020	Year	Anomaly °C	Anomaly °F
1	2016	1.00	1.80
2	2020	0.98	1.76
3	2019	0.95	1.71
4	2015	0.93	1.67
5	2017	0.91	1.64
6	2018	0.83	1.49
7	2014	0.74	1.33
8	2010	0.72	1.30
9	2013	0.68	1.22
10	2005	0.67	1.21

99% chance 2021 will be top 10

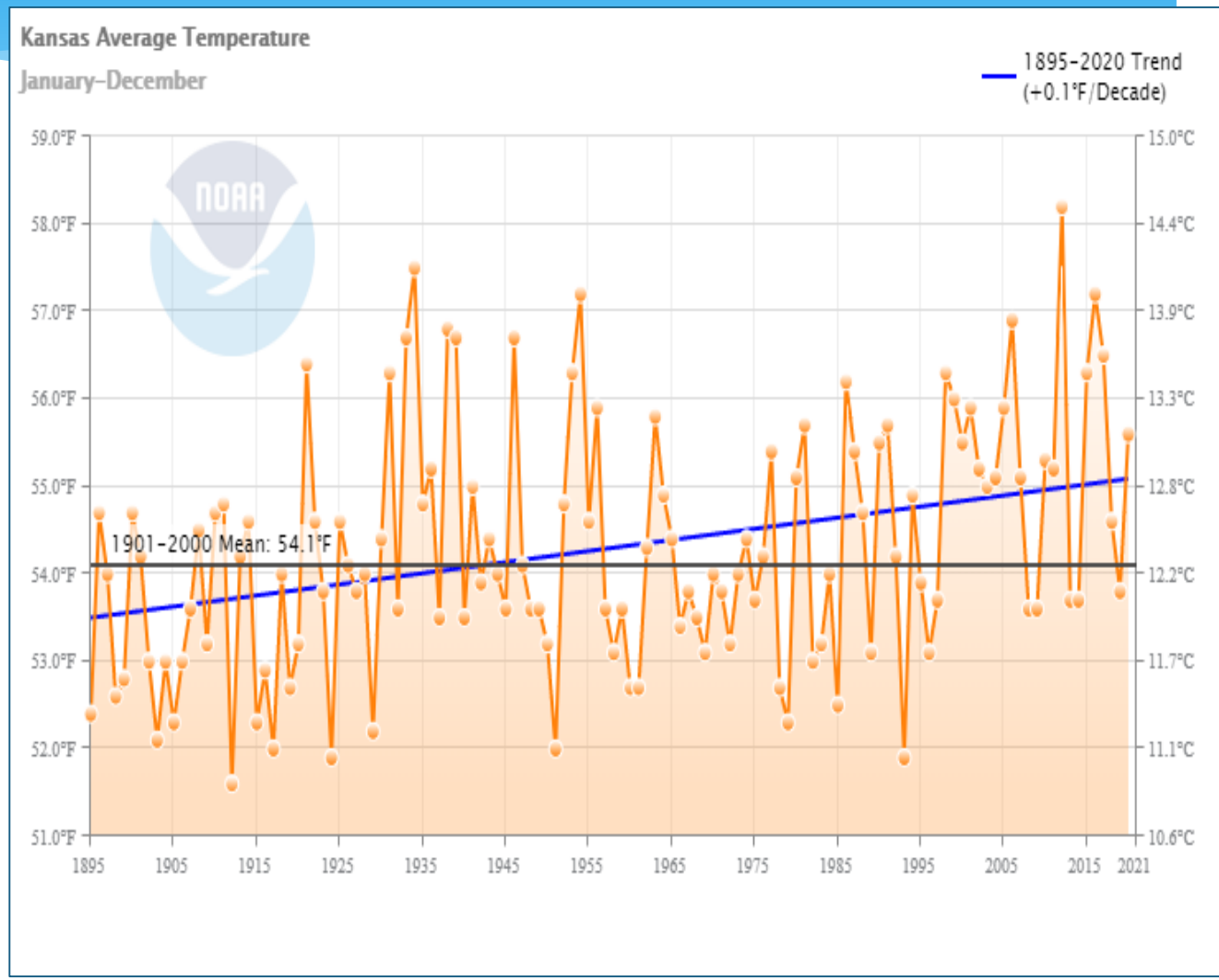
So far it is 6th warmest

https://www.ncdc.noaa.gov/sotc/

Kansas Climate Trends

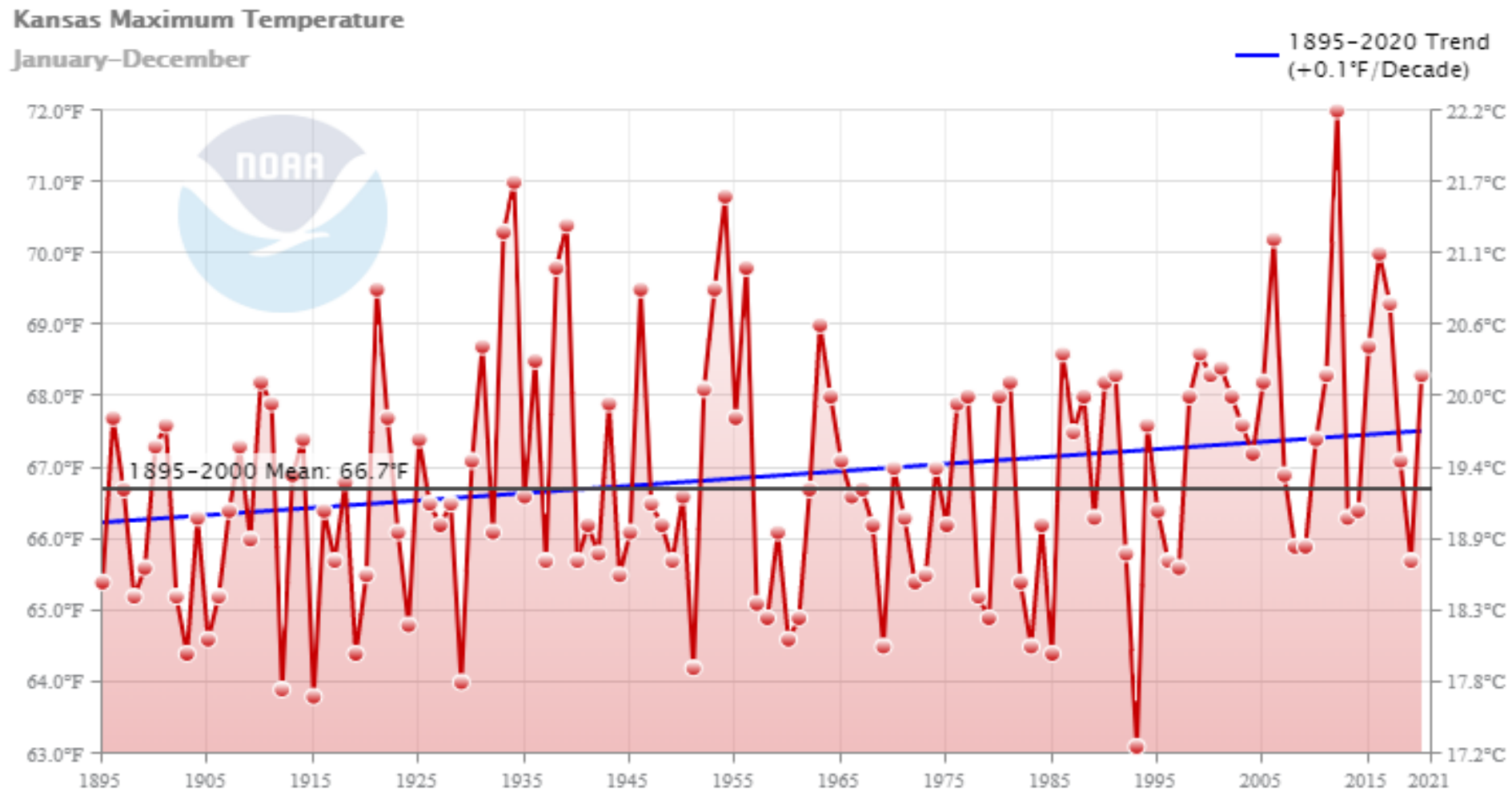
Kansas Temperature Trends

- **Key Points**
  - General upward trend
  - Largest seasonal trend - winter
  - Minimums rising faster than maximums
  - Using "Climate At A Glance" tool
  - County & City too



https://www.ncdc.noaa.gov/cag/statewide/time-series

Kansas Maximum Temperature Trend



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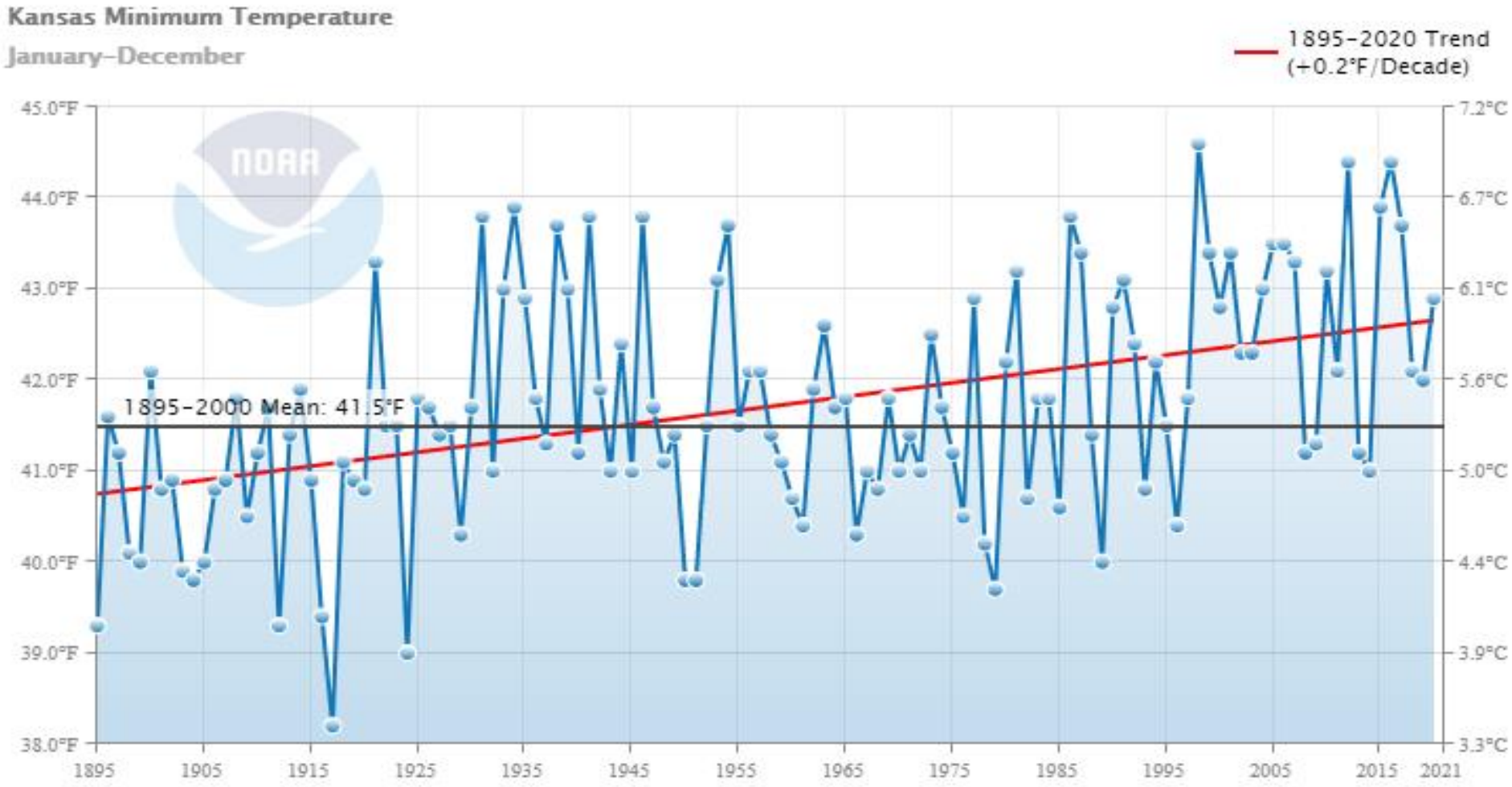
Kansas Minimum Temperature Trend



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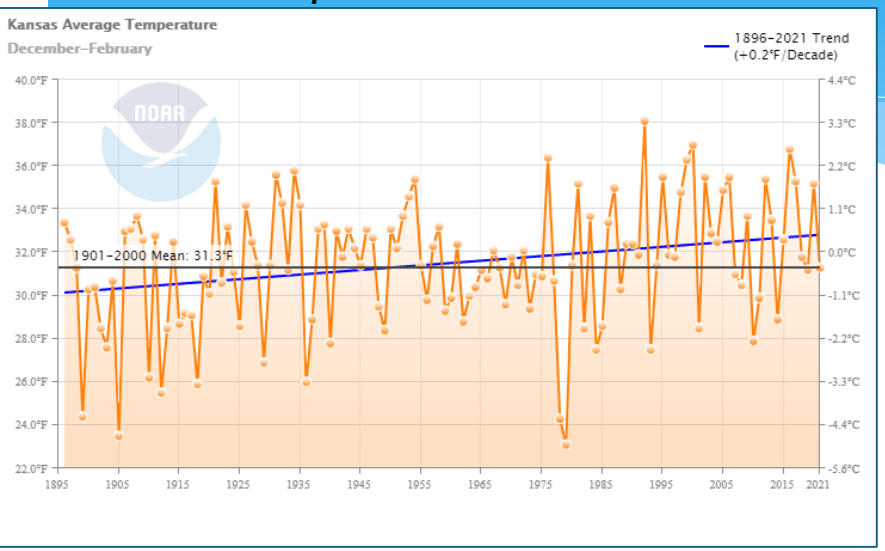
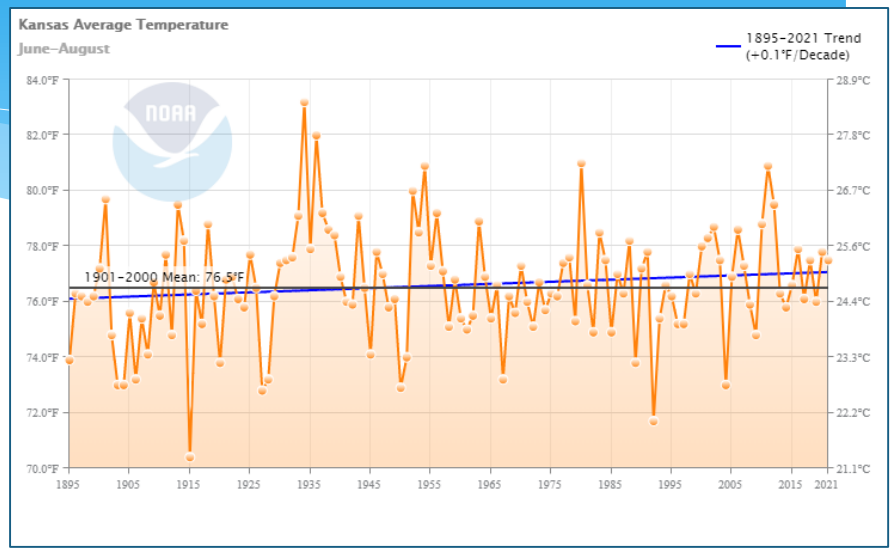
Seasonal Trends

(Average Temperatures)

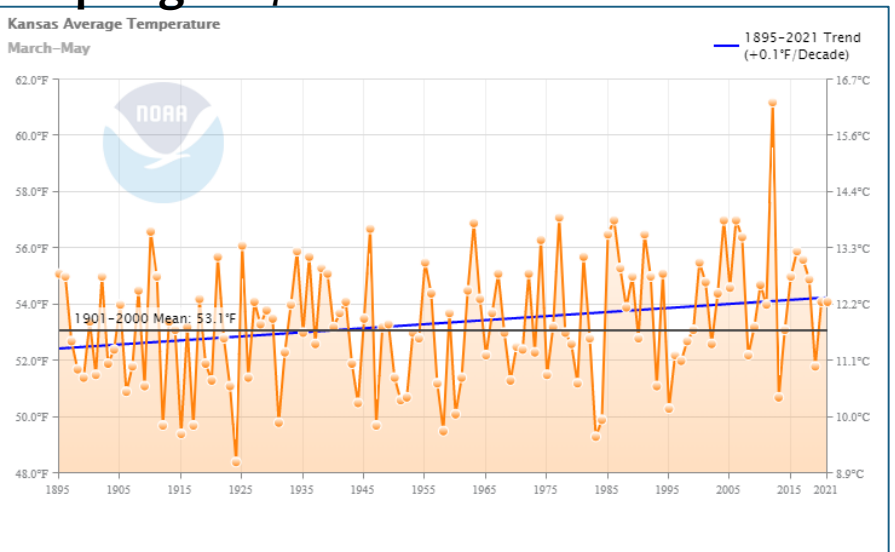
Winter +0.2F/decade



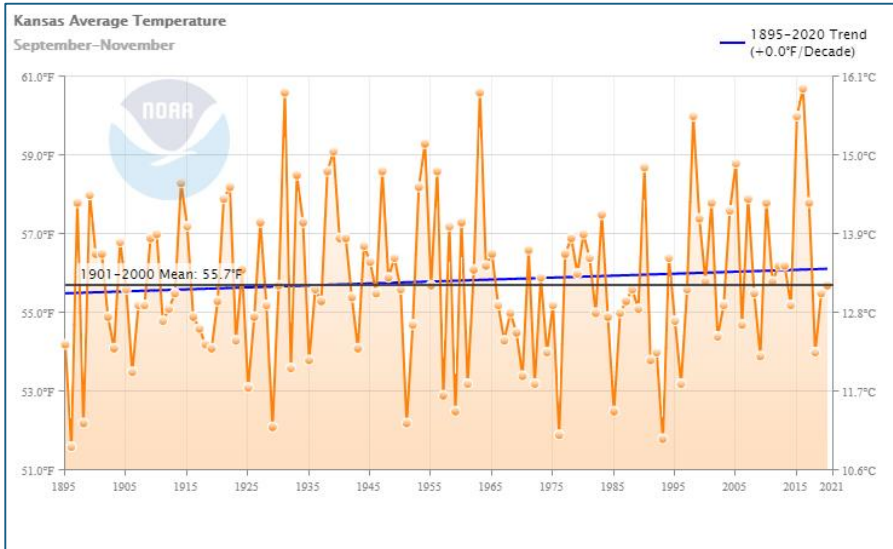
Summer +0.1F/decade



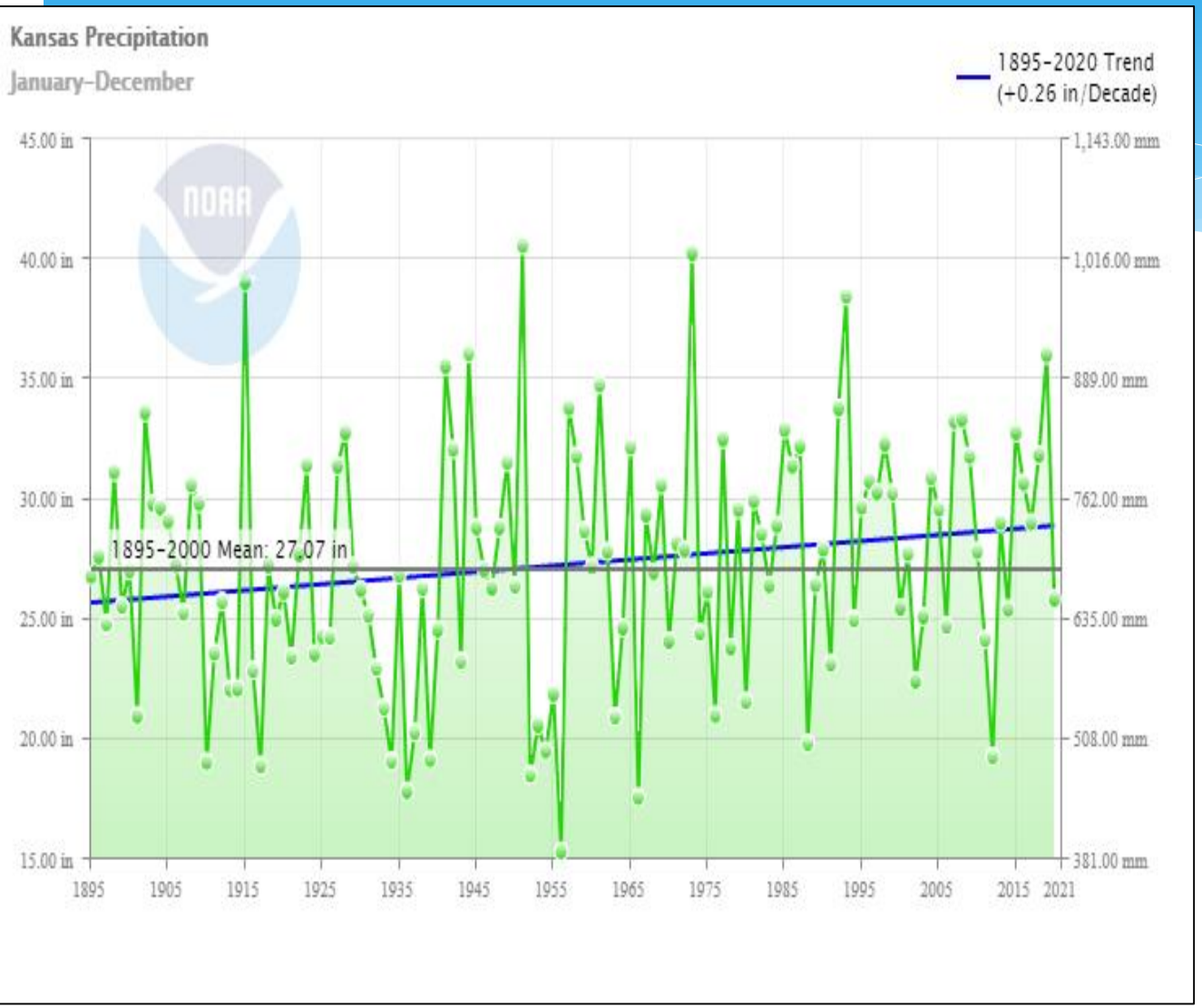
Spring 0.1F/decade



Fall +0.0F/decade



Kansas Precipitation Trend



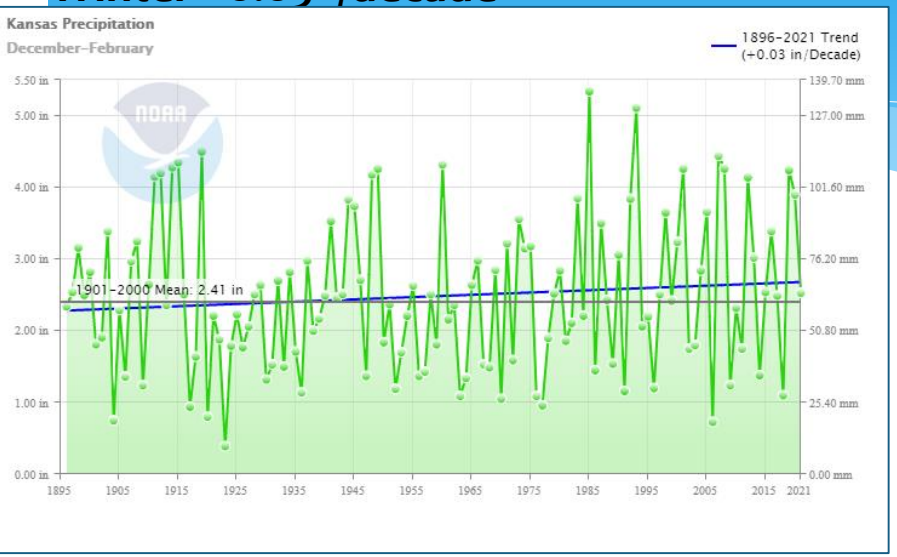
- **Key Points**
  - Upward trends annually (+0.26/decade)
  - Spring largest upward trend (0.14”/decade)
  - Fall/winter slower increase

https://www.ncdc.noaa.gov/cag/

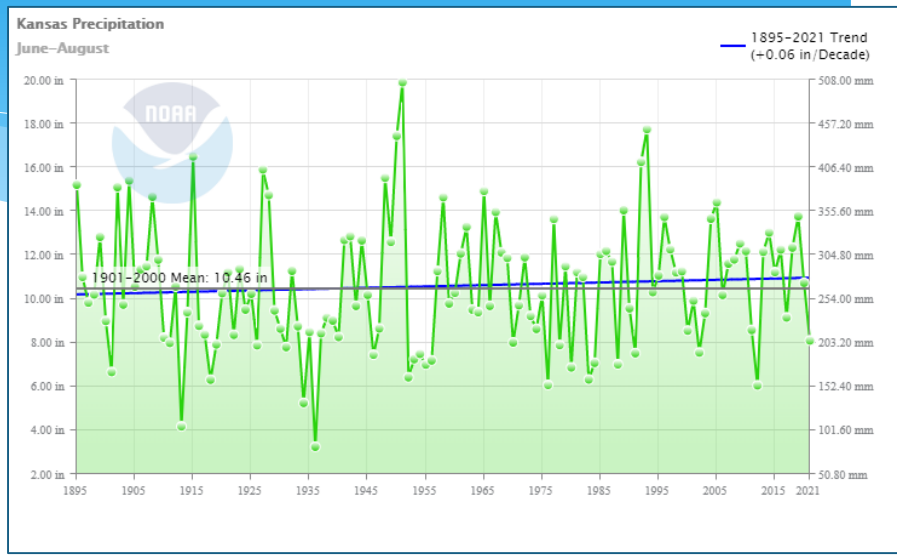
Seasonal Trends

(Precipitation)

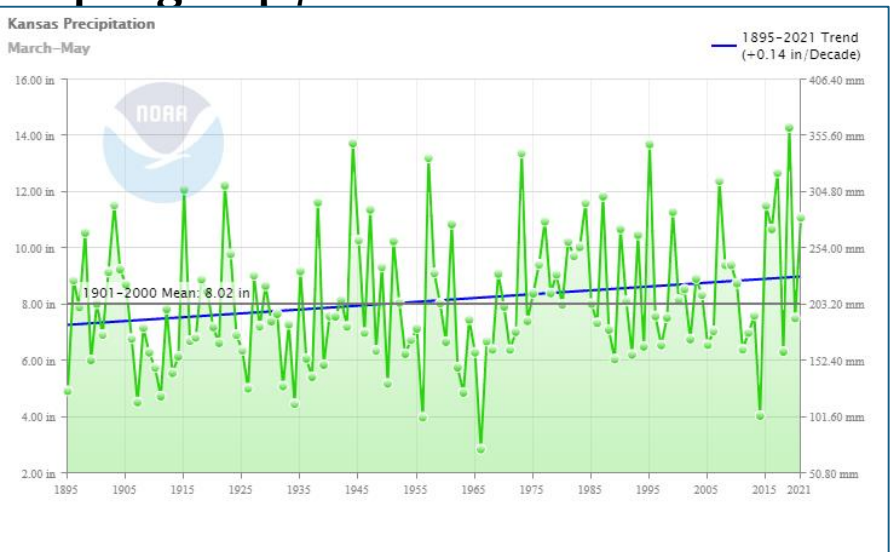
Winter +0.03”/decade



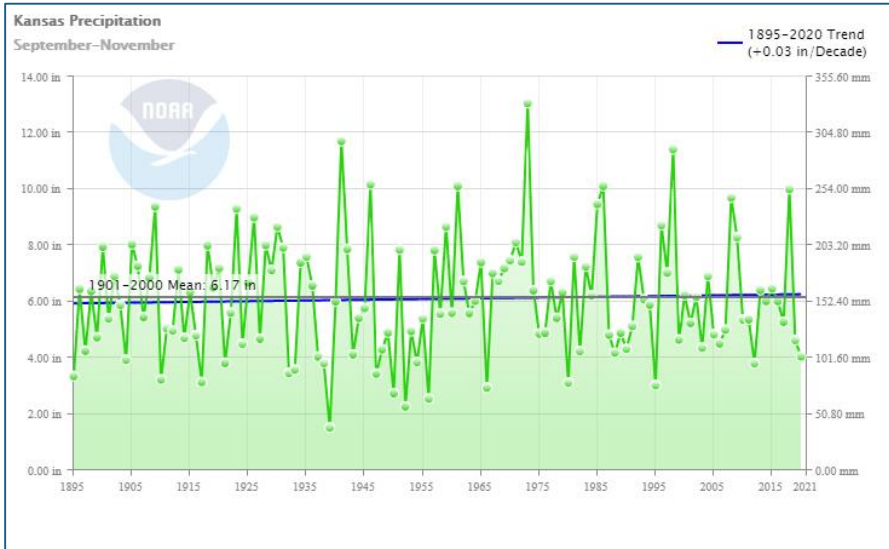
Summer +0.06”/decade



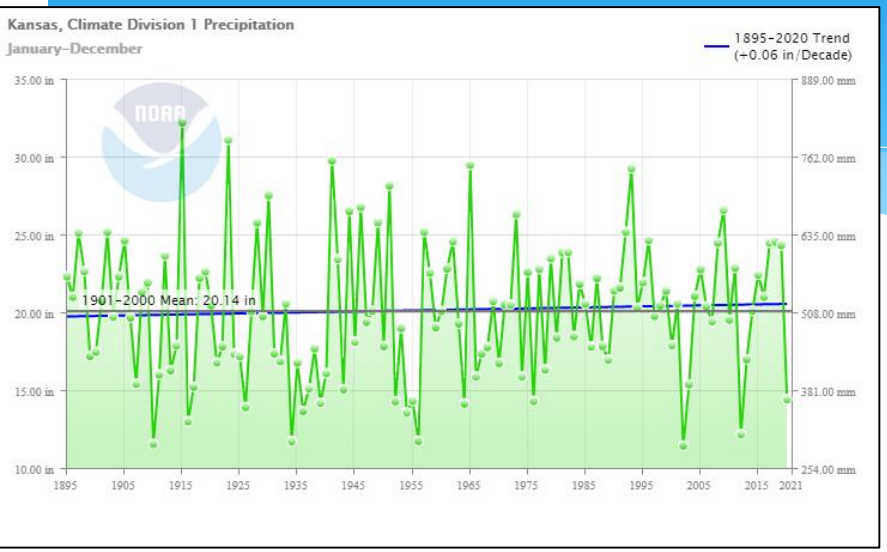
Spring 0.14”/decade

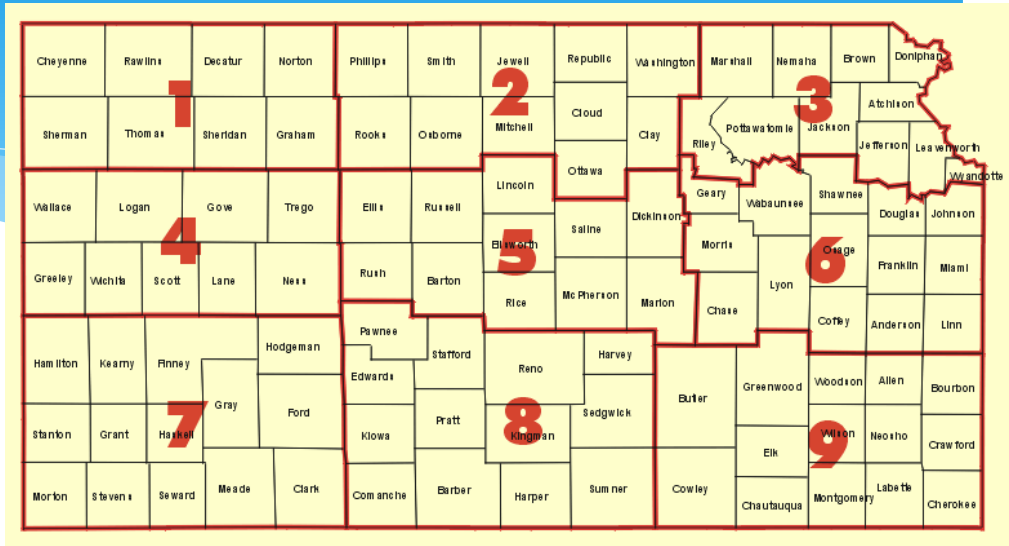


Fall +0.03”/decade

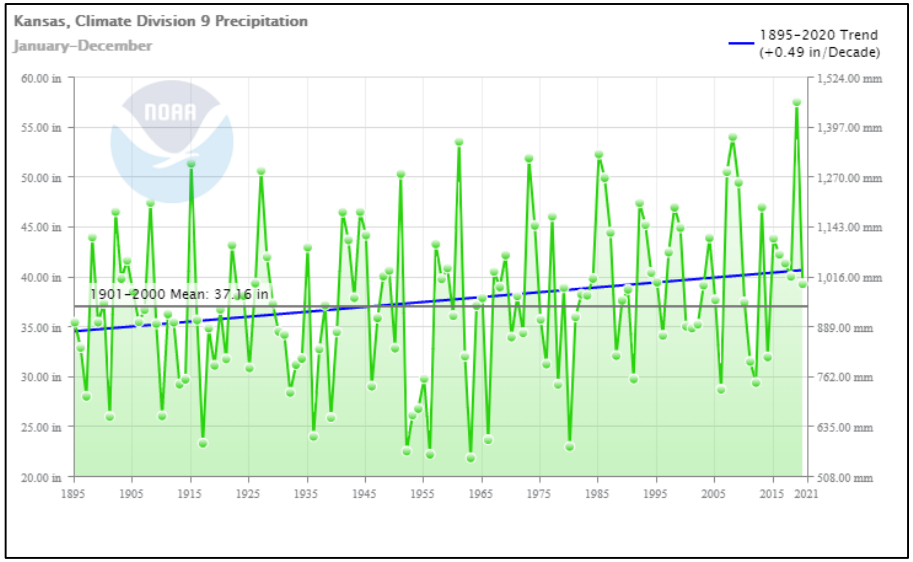


Precipitation Trends by Climate Division



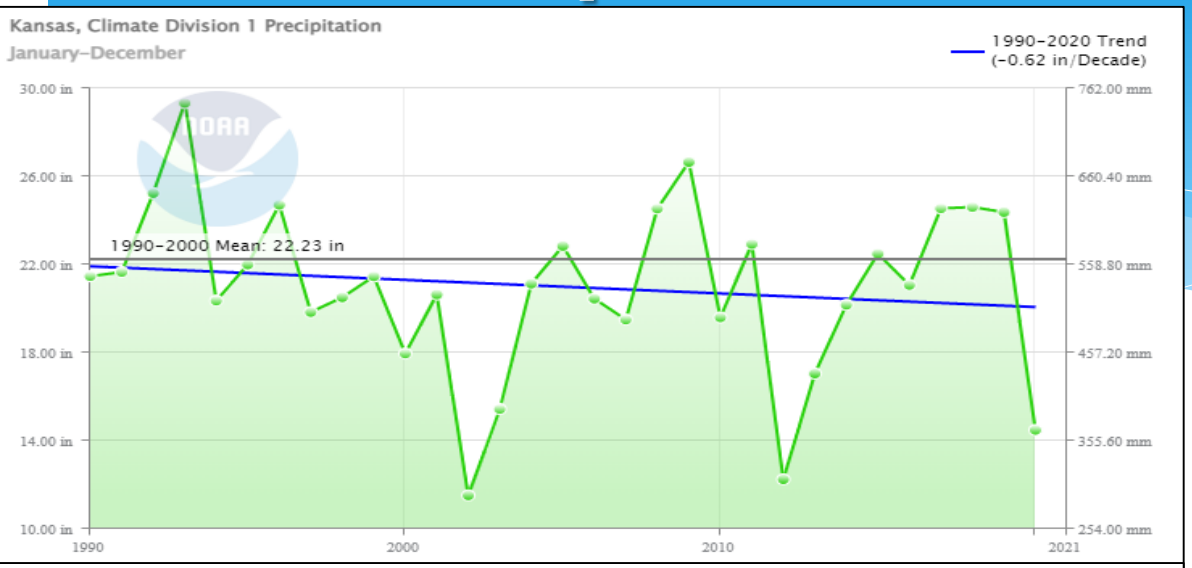


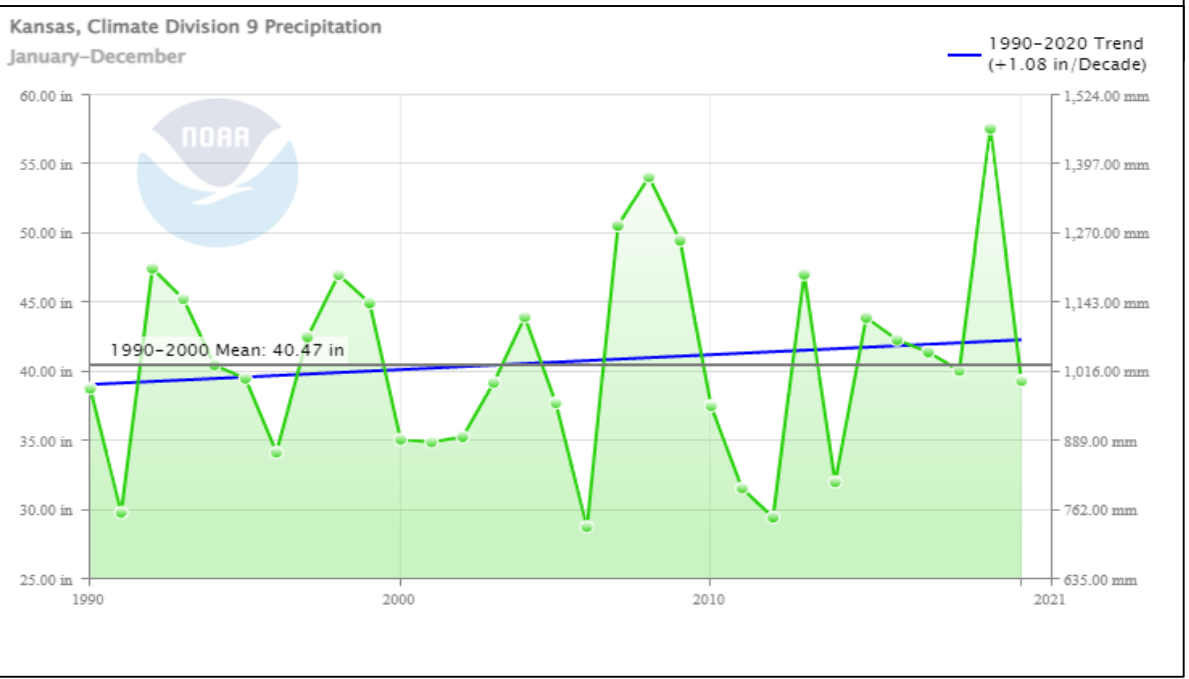
- 1) Northwest: 0.06”/dec
- 2) North Central: 0.26”/dec
- 3) Northeast: 0.22”/dec
- 4) West Central: 0.10”/dec
- 5) Central: 0.28”/dec
- 6) East Central: 0.30”/dec
- 7) Southwest: 0.15”/dec
- 8) South Central : 0.37”/dec
- 9) Southeast: 0.49”/dec



https://www.ncdc.noaa.gov/cag/

Precip Trends Last 30 years

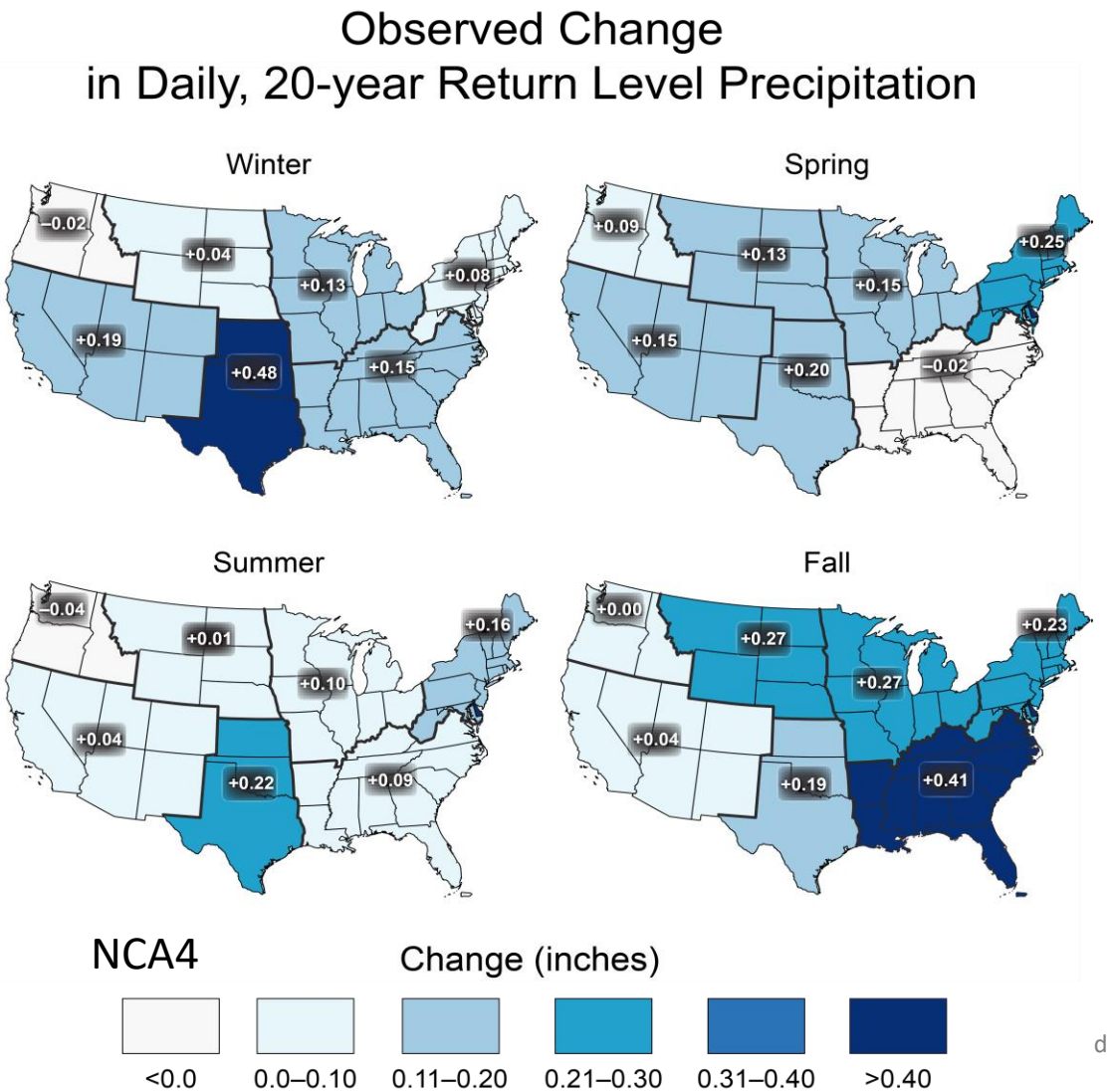




Northwest KS -0.62”/decade

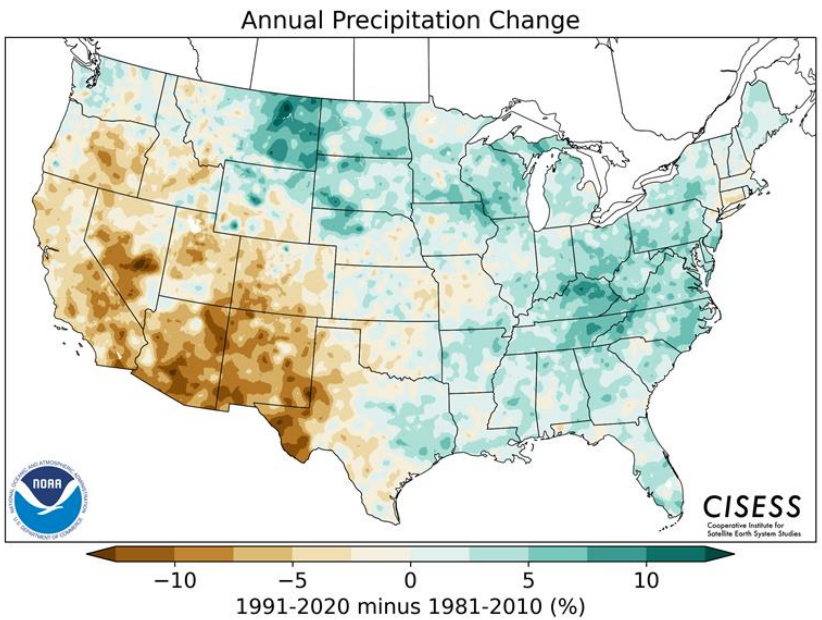
Southeast KS +1.08”/decade

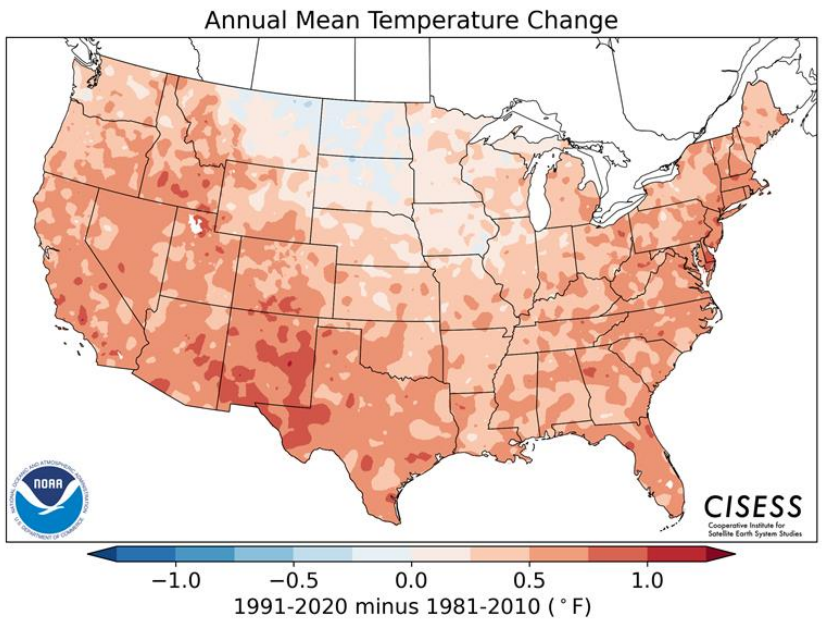
Heavy Rainfall



- Daily 20-year Return means amount of rainfall expected to occur, on average, once every 20 years
- Amounts have increased more than 0.4 inch in places (slight decrease in some places)
- Varies geographically by season

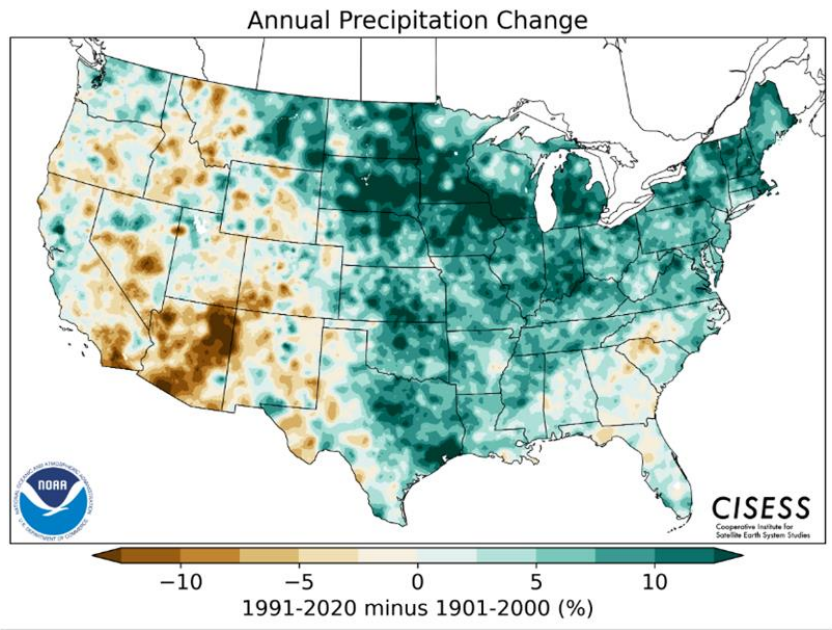
10-Year Annual Normals Change

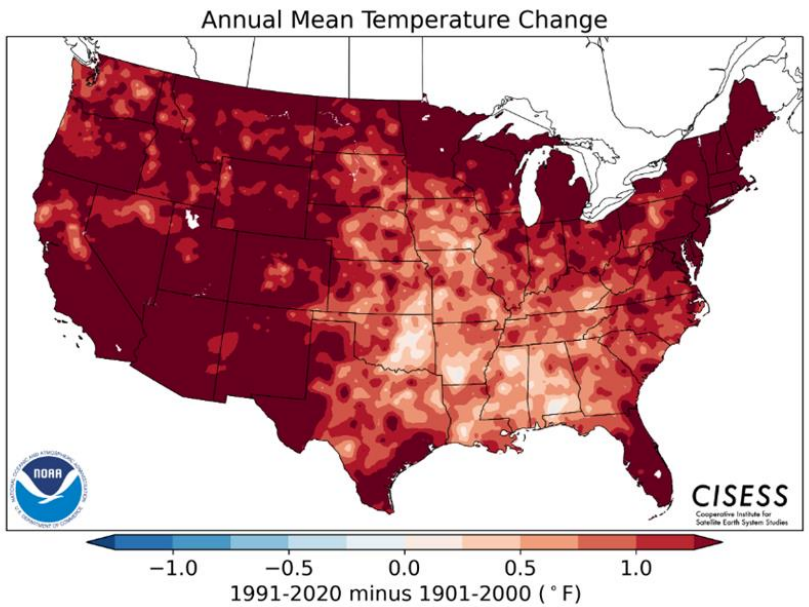




- Wetter in the central and eastern U.S., drier in the Southwest
- Warmer everywhere except the north central U.S.

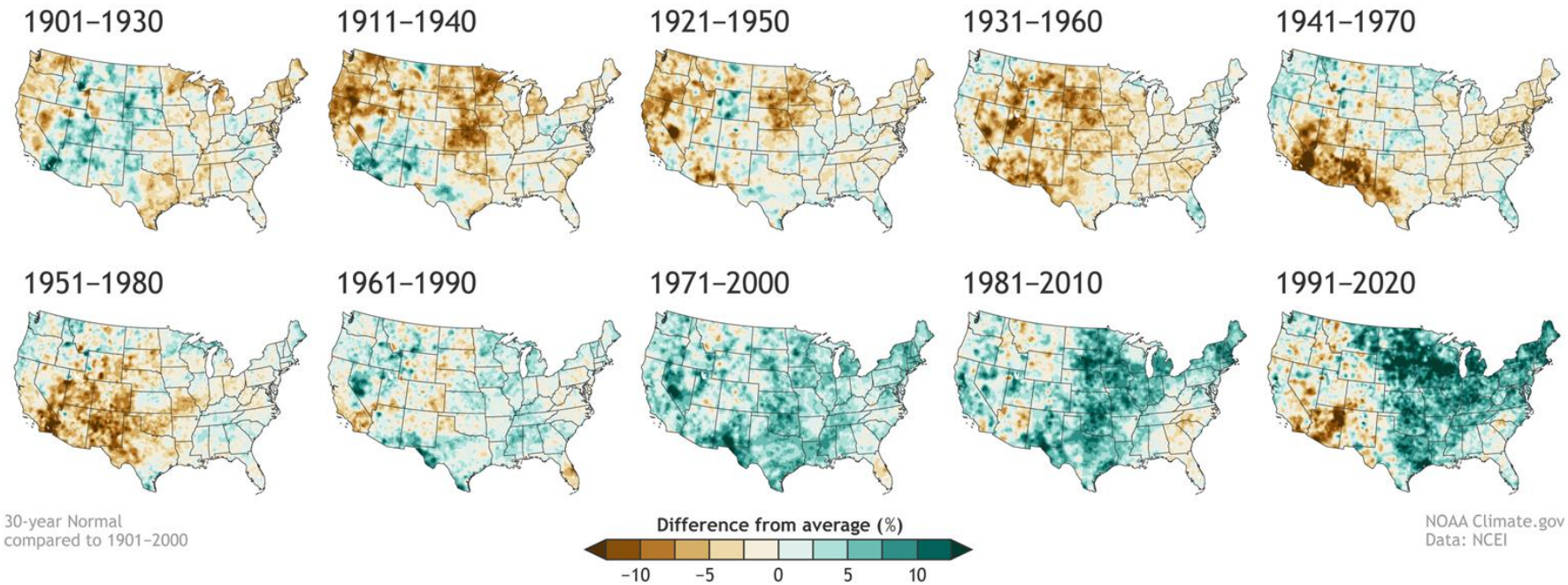
Comparing 1991-2020 to 1901-2000





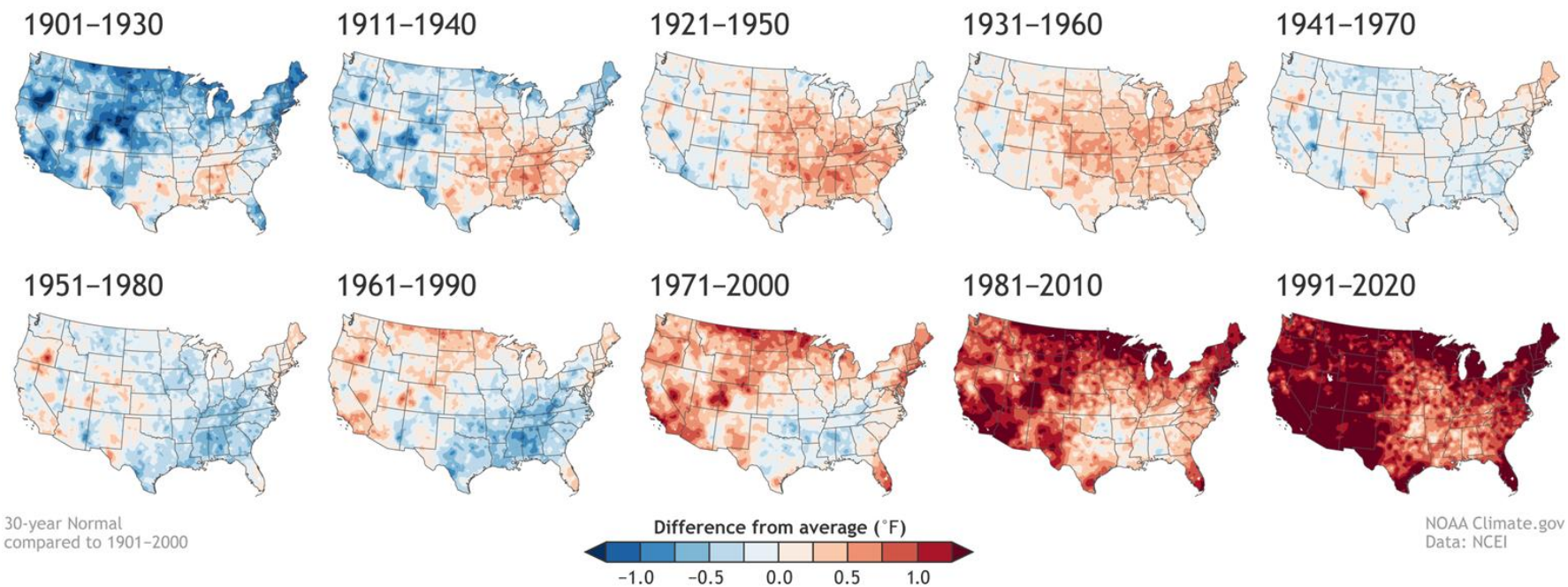
- Climate change is clearly seen in comparing the new normals to the Twentieth Century averages

Annual Precipitation Normals since 1901 compared to the 20th Century Average



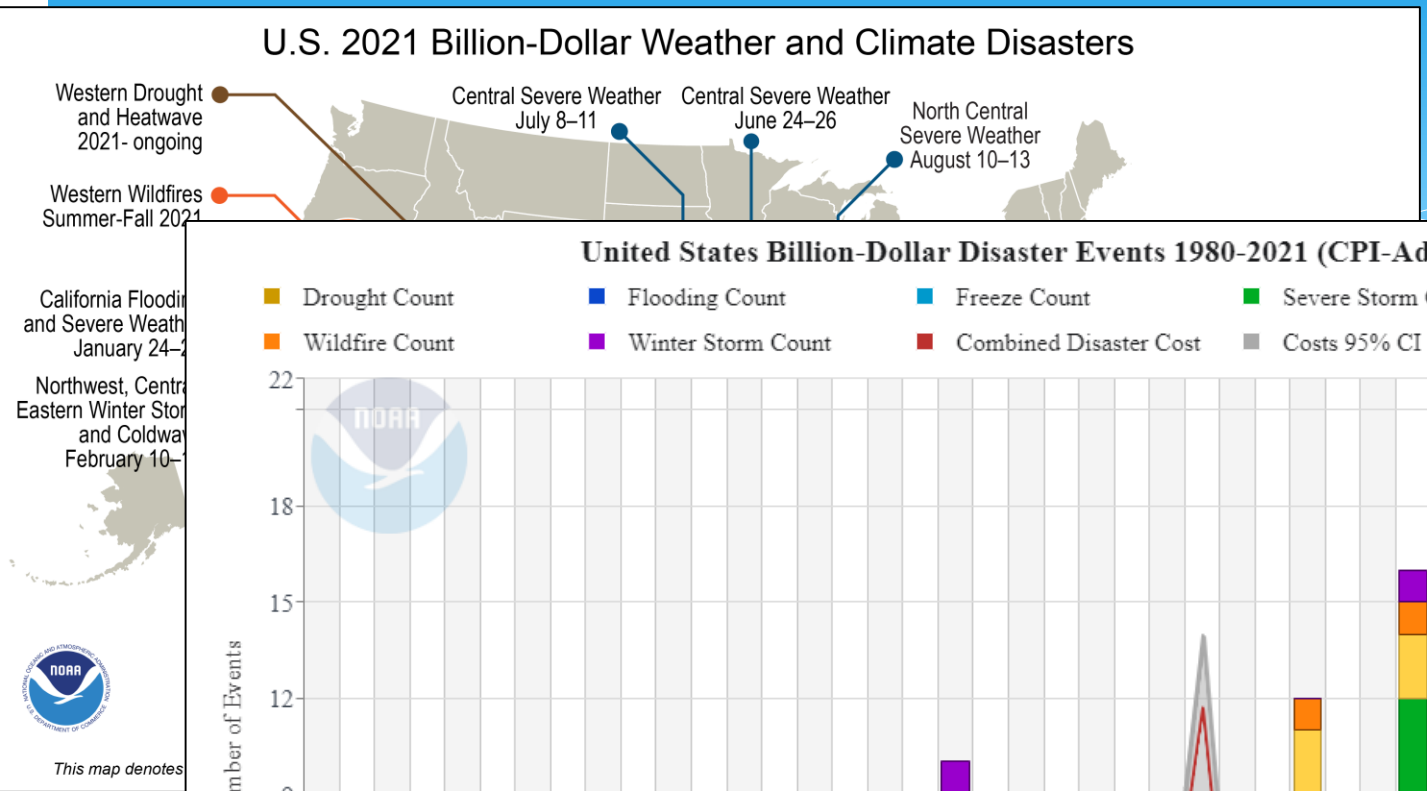
- Climate change is coming into focus in recent normals.

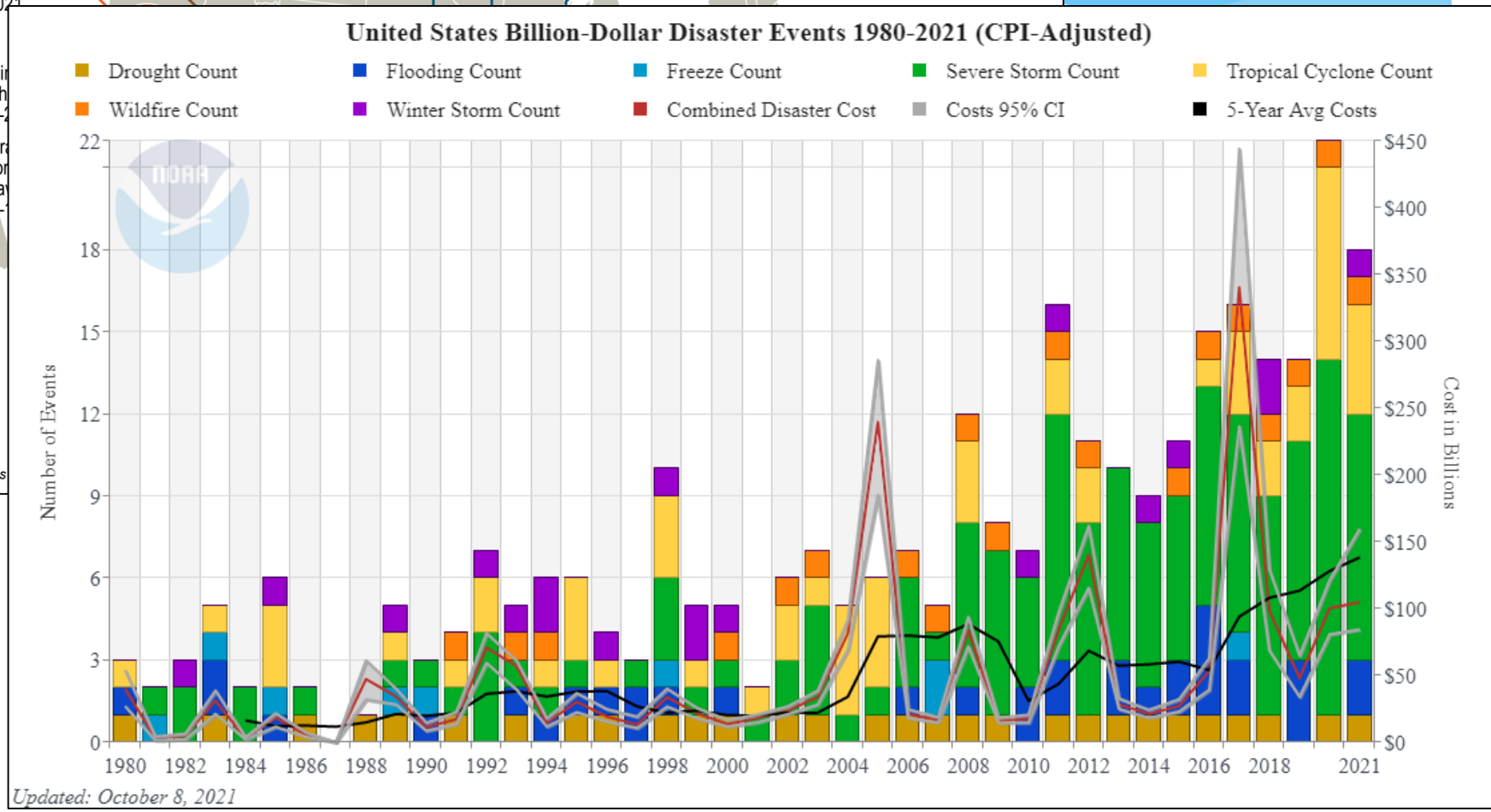
Annual Temperature Normals since 1901 Compared to the 20th Century Average



https://www.climate.gov/news-features/understanding-climate/climate-change-and-1991-2020-us-climate-normals

Billion Dollar Weather and Climate Events

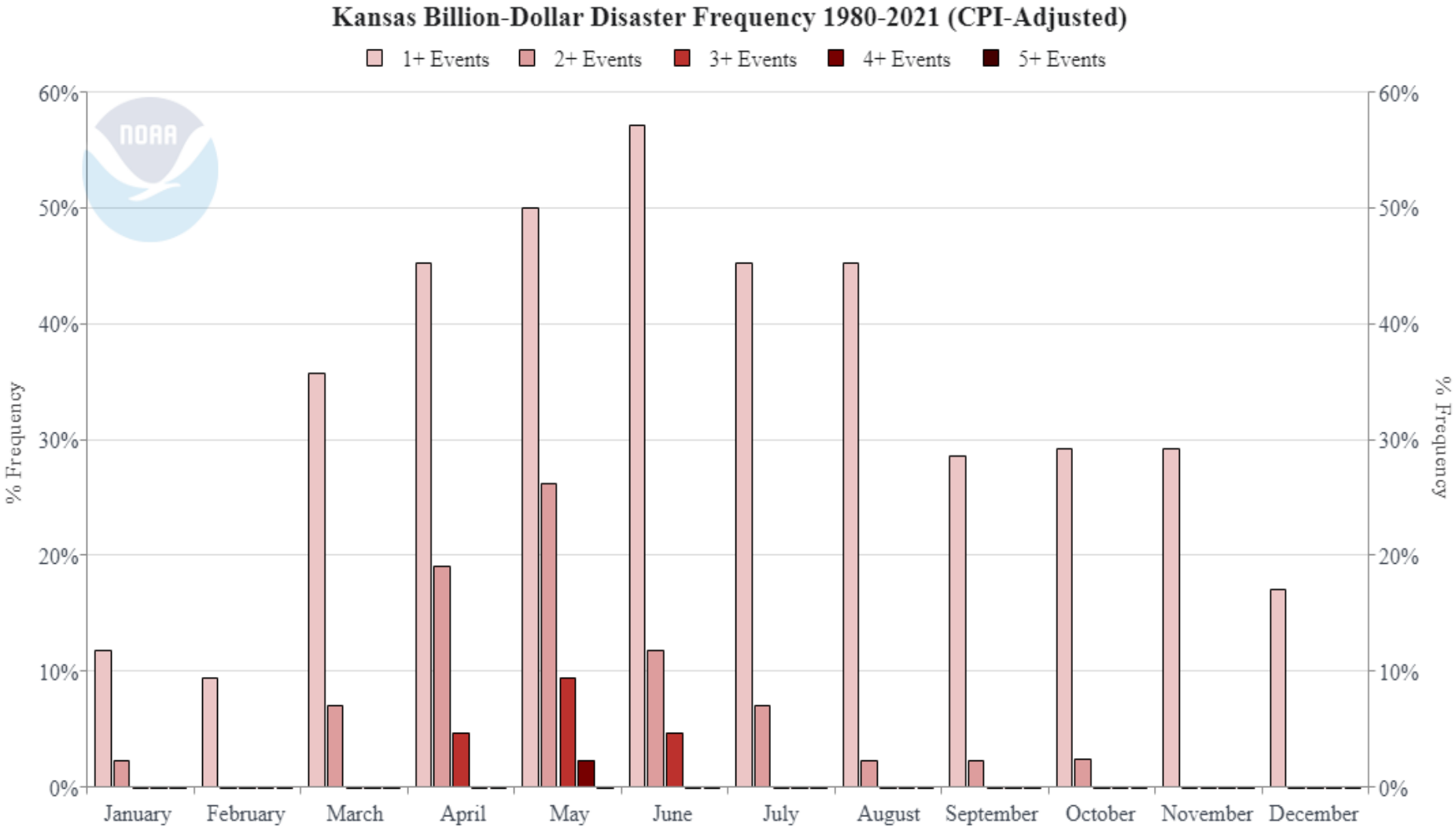




https://www.ncdc.noaa.gov/billions/time-series

Kansas Disasters

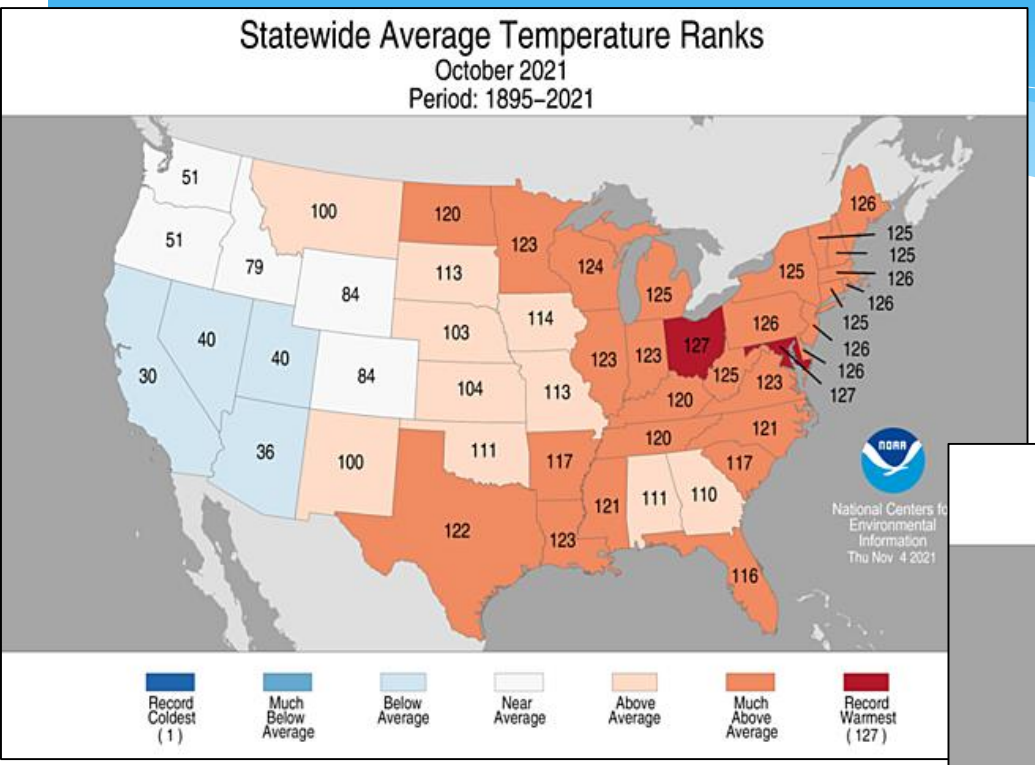
Seasonality & Frequency

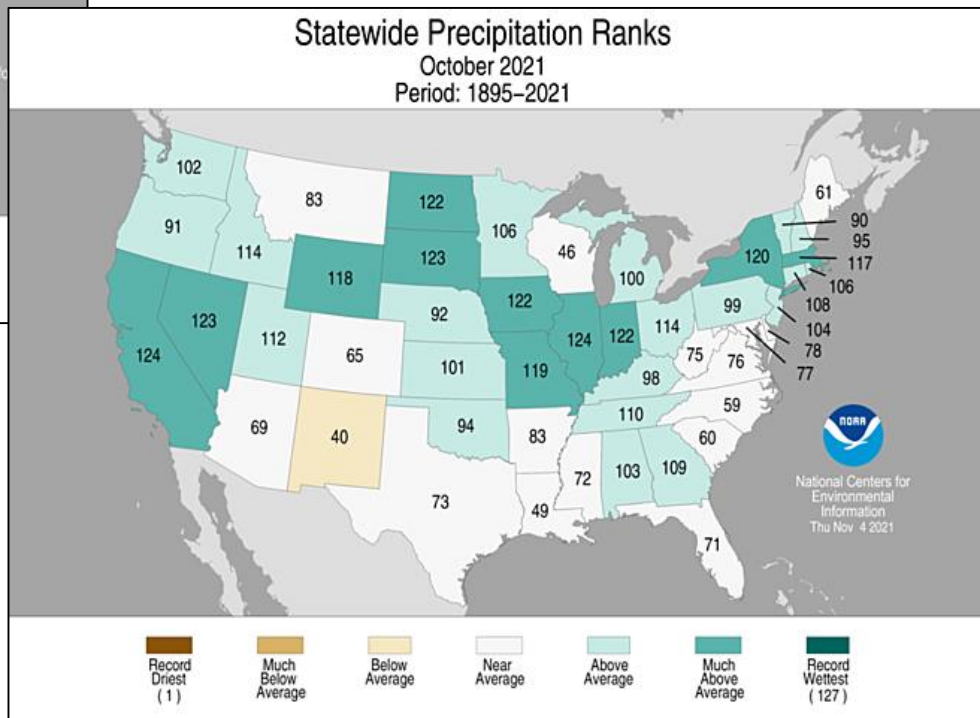


Updated: October 8, 2021

Monitoring the Climate

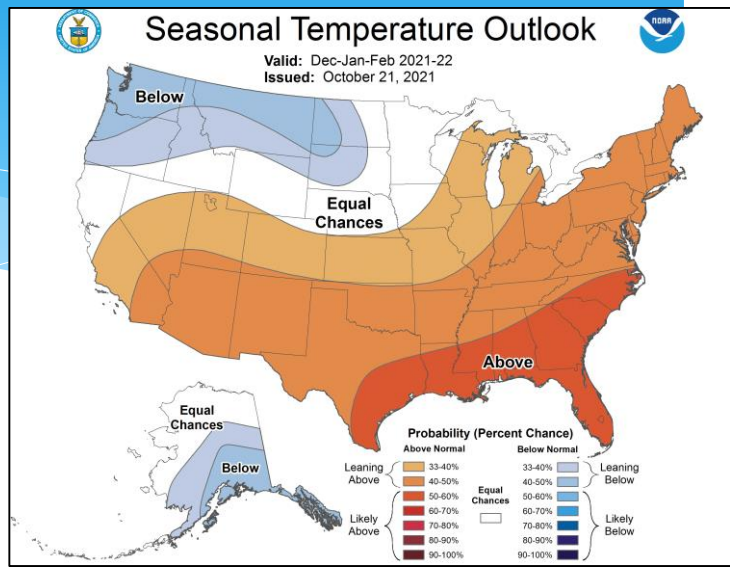
October

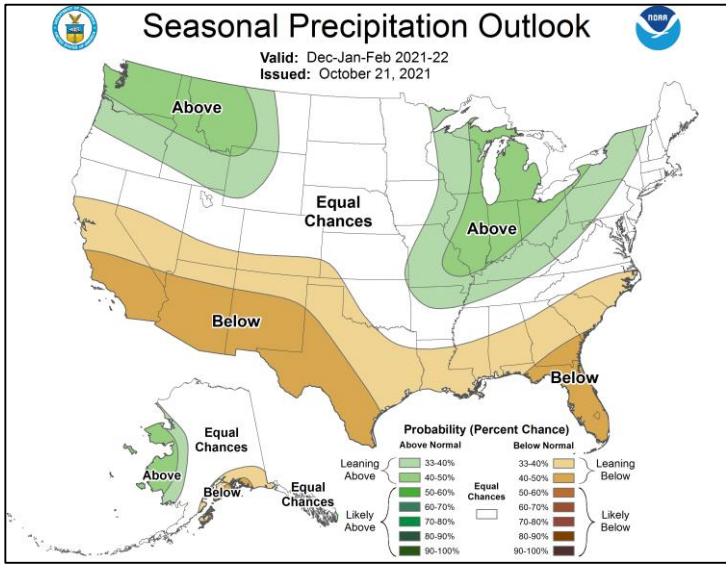




* Monthly to multi-monthly analysis

Winter Outlook





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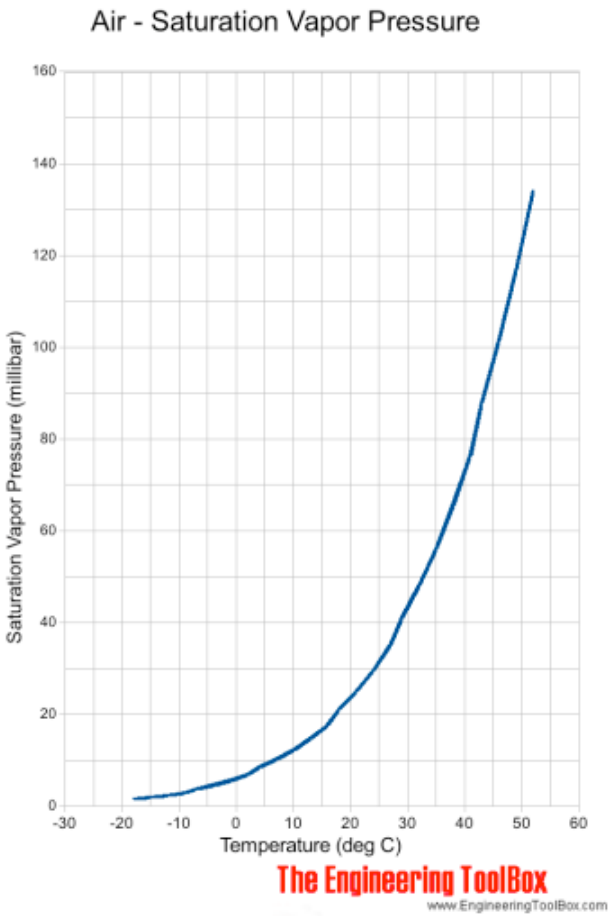
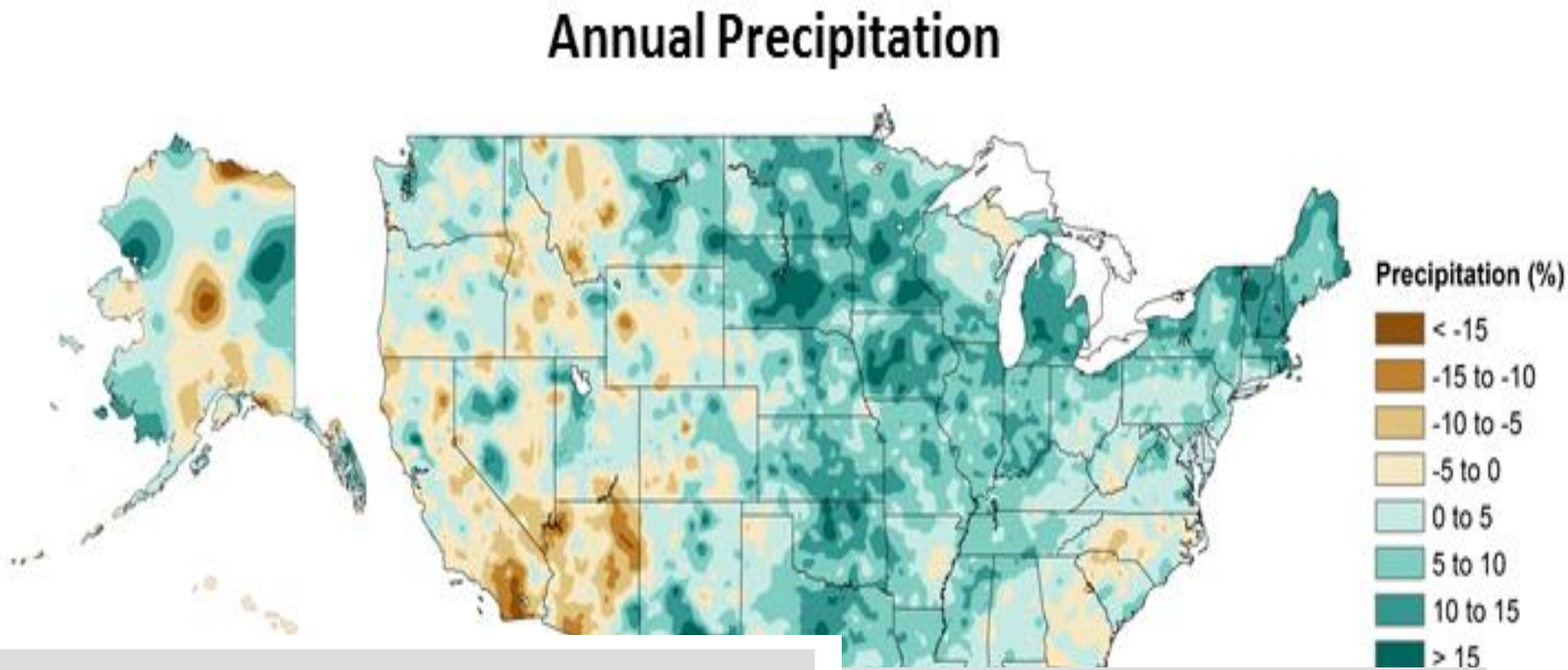
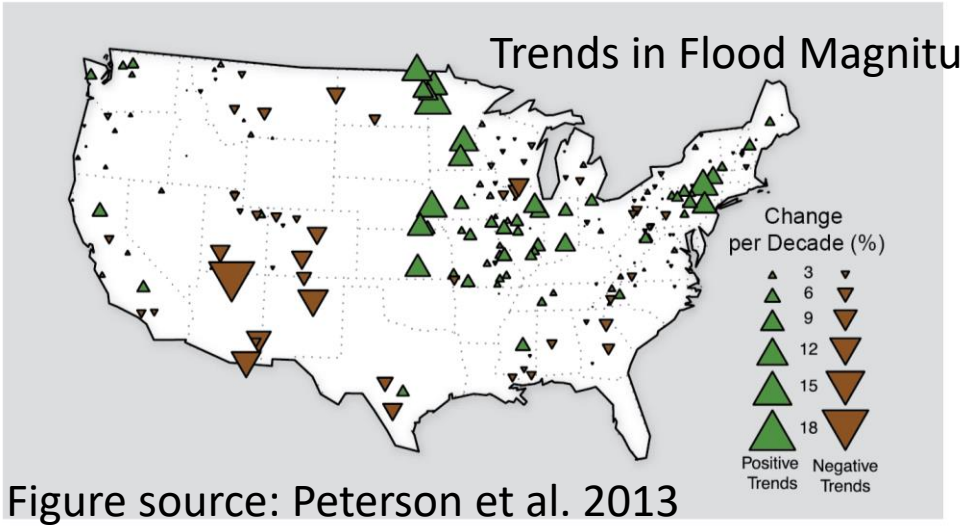
Warm Air Holds More Water Vapor

- Saturation vapor pressure is the total amount of pressure exerted if the air were saturated (relative humidity 100%)
  - Nearly doubles for every 10 deg C increase in temperature
  - Warm tropical air can hold 4-10 times as much vapor as cold, dry air
  - Consequently more latent heat release in storms, more precipitation



Recent 30 years (1986-2015) compared to the past (1901-1960)





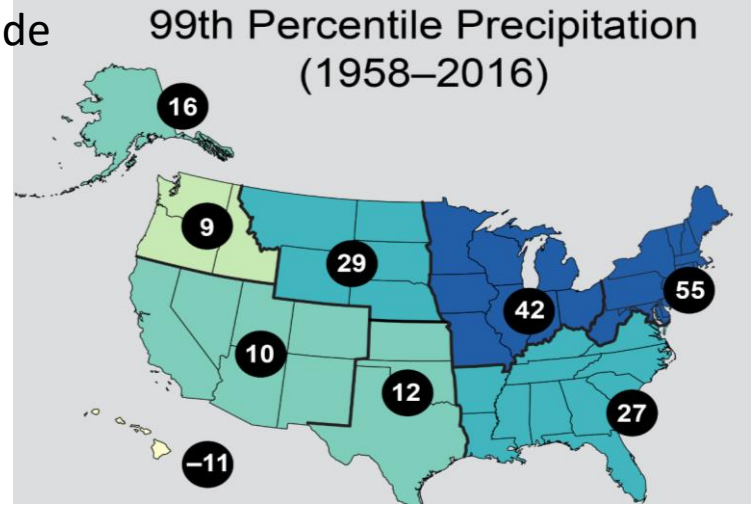


Figure source: Peterson et al. 2013