Climate Variability, Climate Change in MO, and an Early Weather Outlook – Winter 2025-2026

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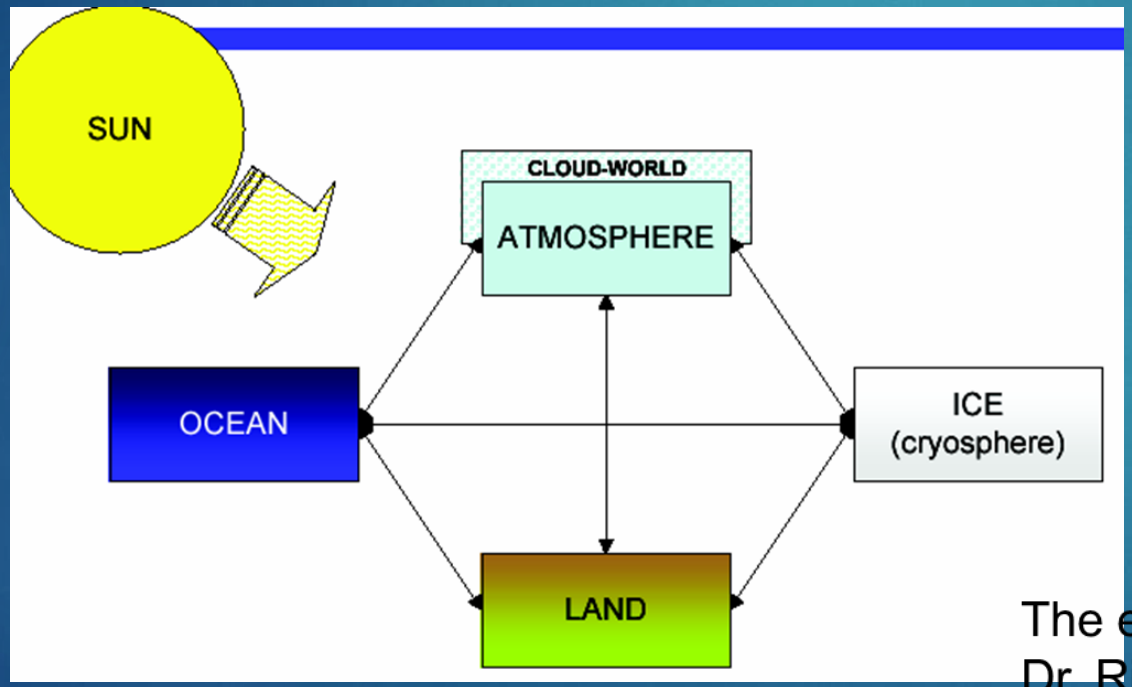
Definitions

- Weather – instantaneous conditions which can be measured using state variables.

- Climate - Is the long-term or time mean state of the earth-atmosphere system and the state variables along with higher order statistics. Also, we must describe extremes and recurrence frequencies

The Climate System – What is it?

- **The Earth-Atmosphere system is an integrated system of which the atmosphere is only one part!**



The earth-atmosphere system, courtesy of Dr. Richard Rood. (http://aoss.engin.umich.edu/class/aoss605/lectures/)

The Climate System

- The other parts of the climate system are:

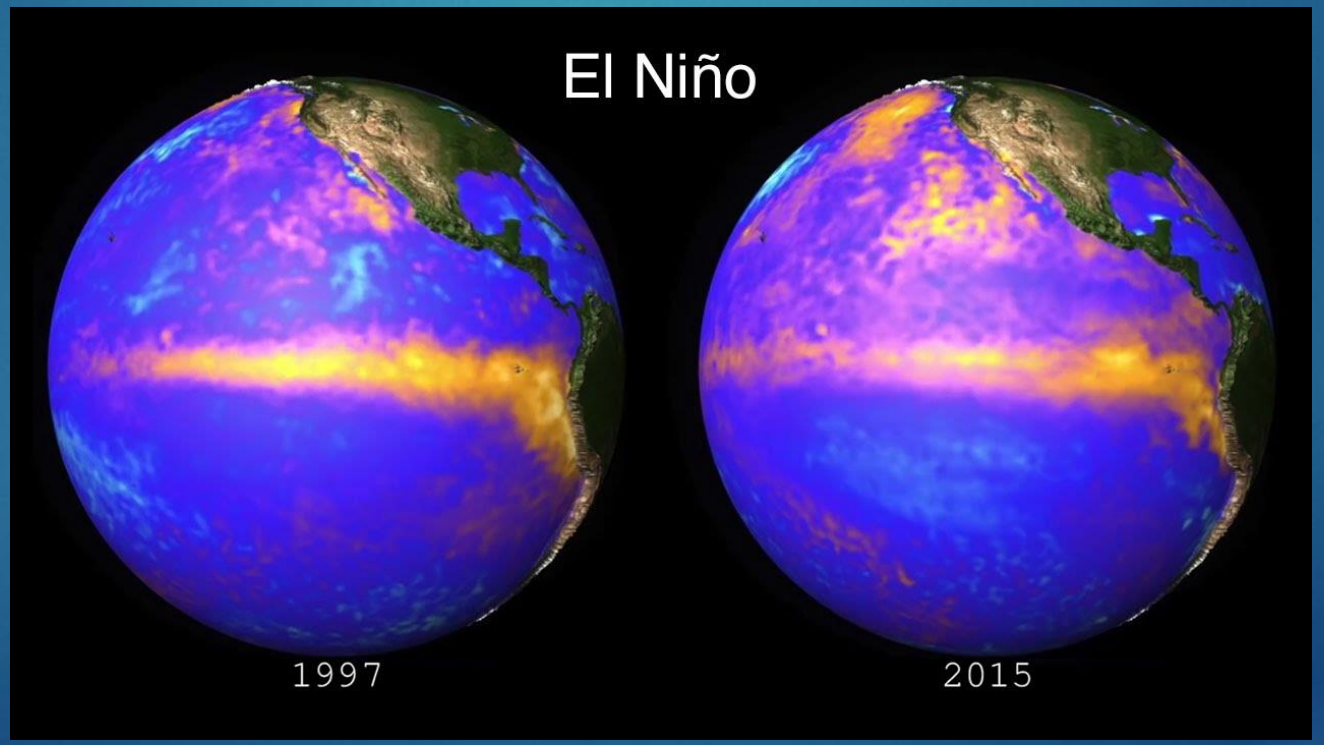
  - Cryosphere (Glaciers, Antarctica)
  - Oceans (and freshwater too)
  - Lithosphere (dirt, continents)
  - Biosphere (life → Plants and Animals)

Sub-seasonal and Seasonal Forecasting

- In this part of the world – there are three basic phenomena which drive sub-seasonal (one to four weeks) and seasonal range forecasting:
- El Niño and Southern Oscillation
- Atmospheric Blocking
- Teleconnections

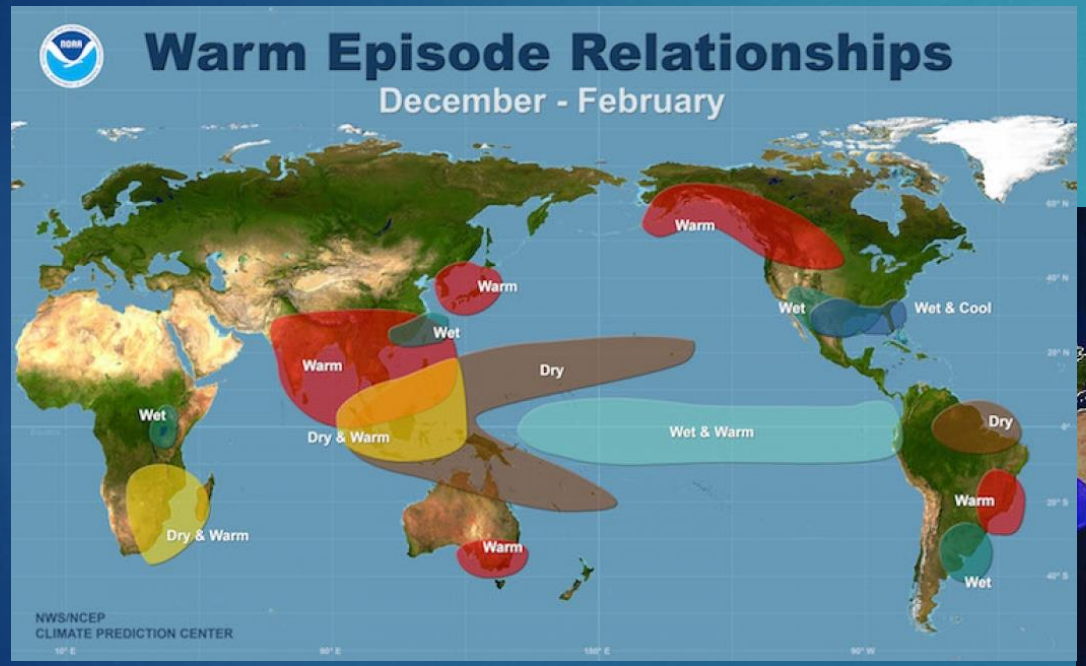
El Niño and Southern Oscillation (ENSO)

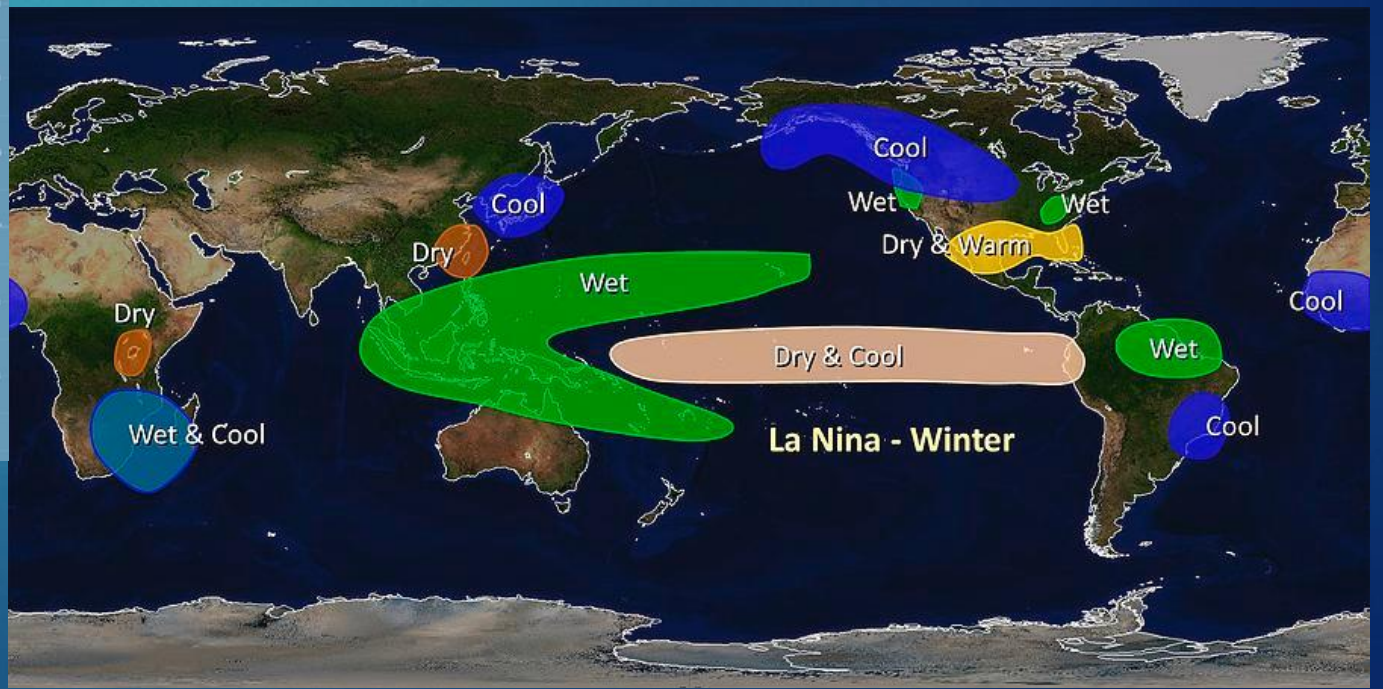
- is a two-to-seven year warming of water in the Eastern Tropical Pacific that impacts weather and climate world-wide.



ENSO Impacts

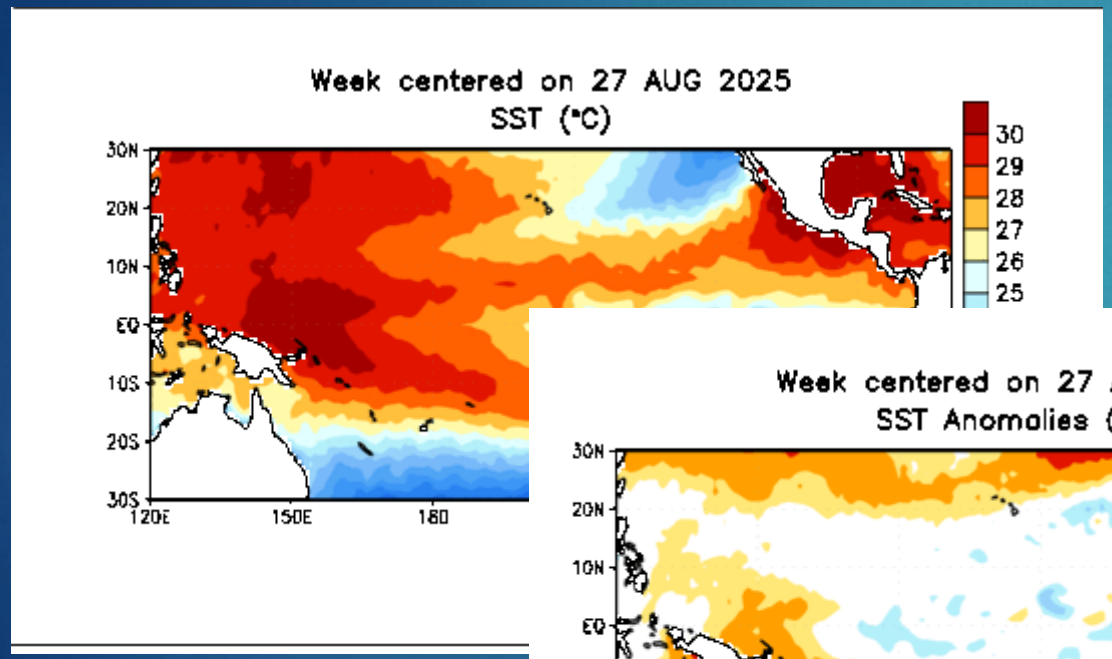
- Influences weather worldwide

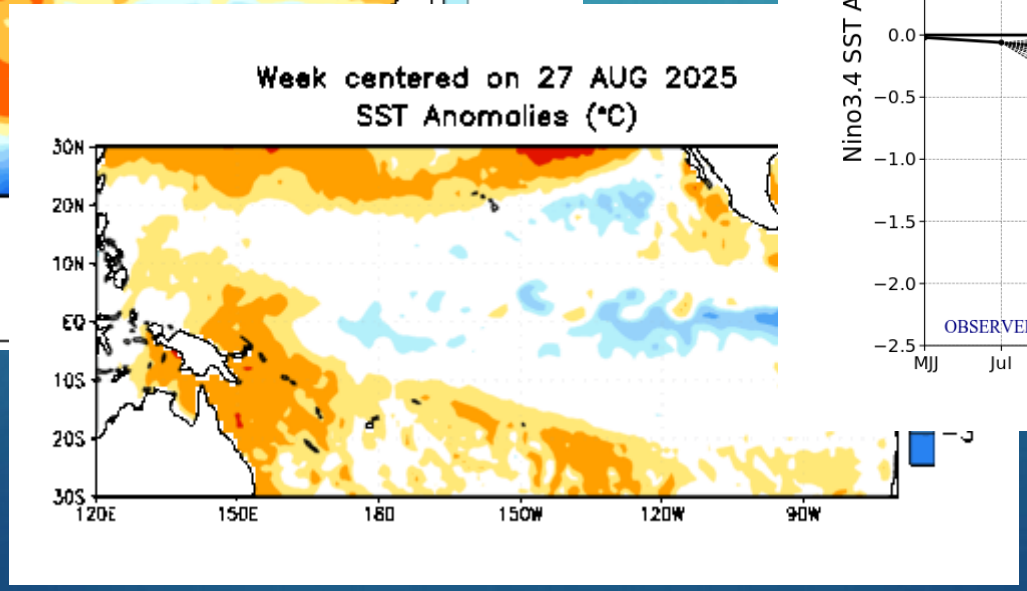


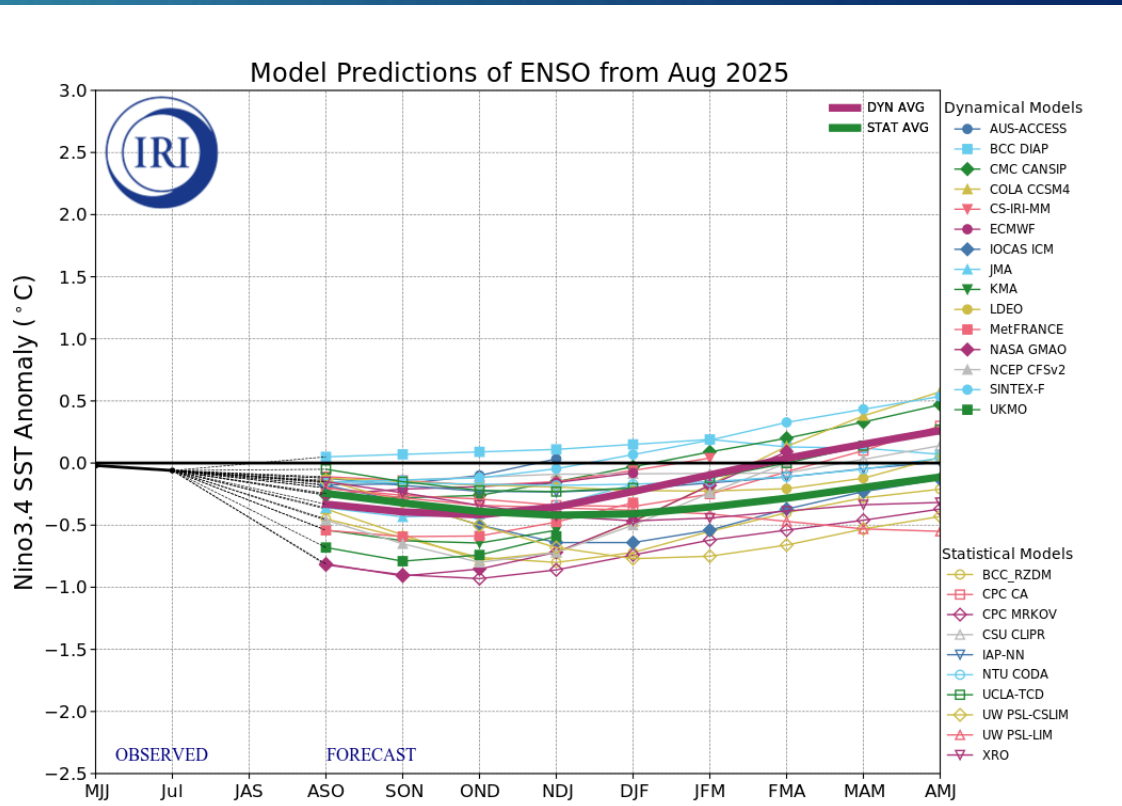


ENSO – Current State – Where are we going?

- August 2025 – Weak La Niña again



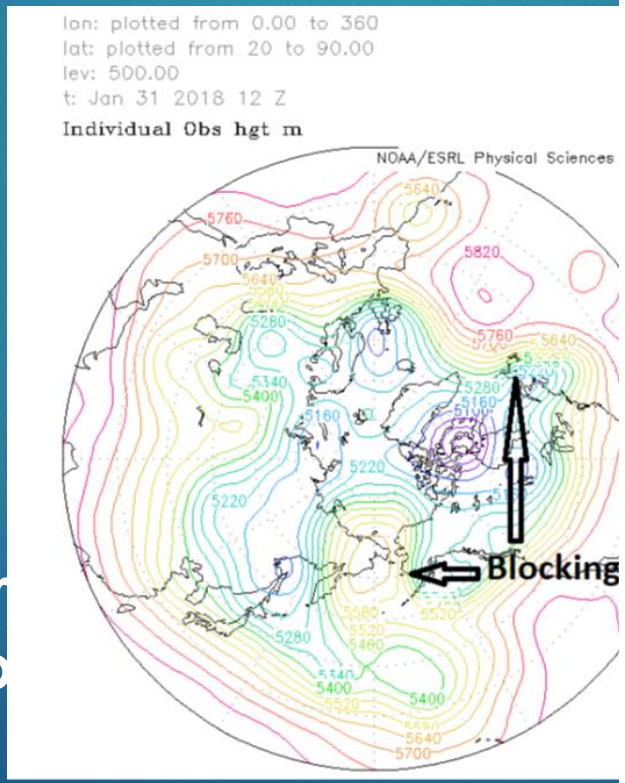


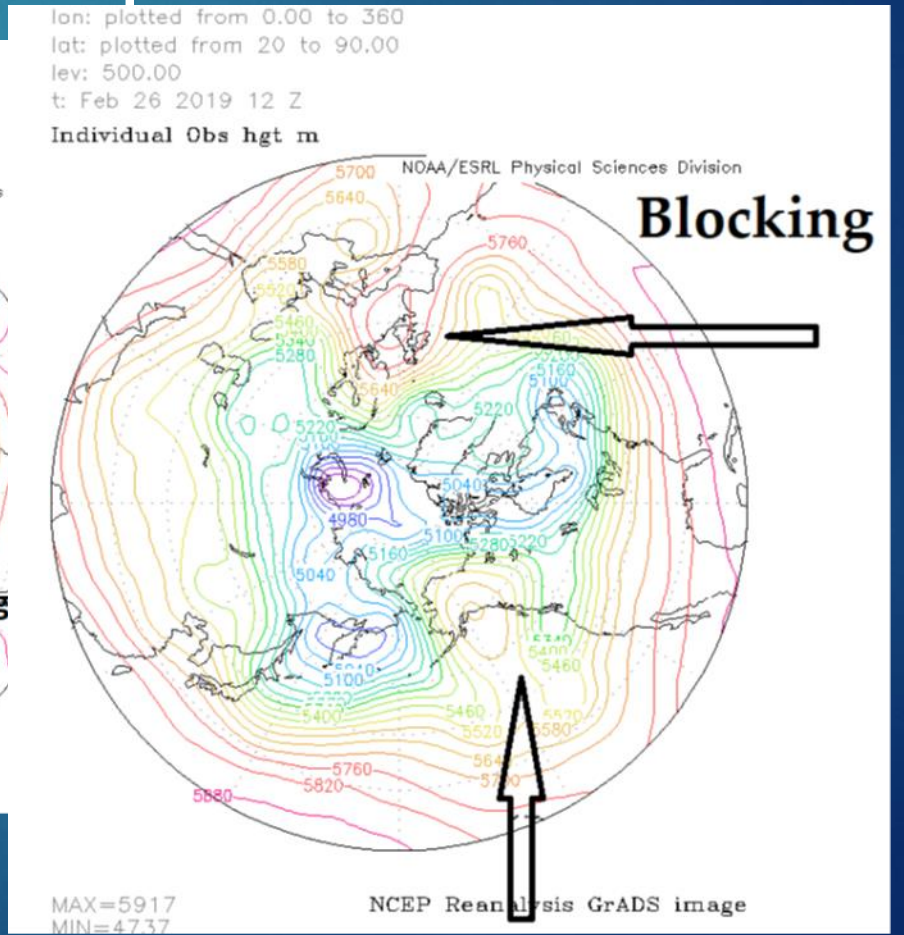


Atmospheric Blocking

- Atmospheric jet stream behavior is complicated

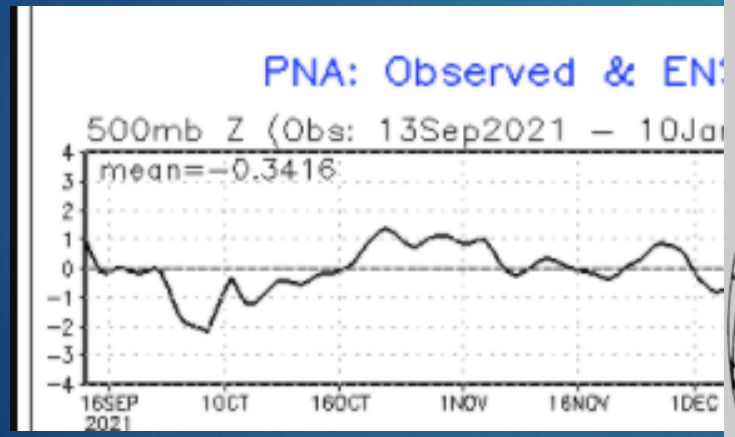
- Blocking - gener
  mid-latitude ano

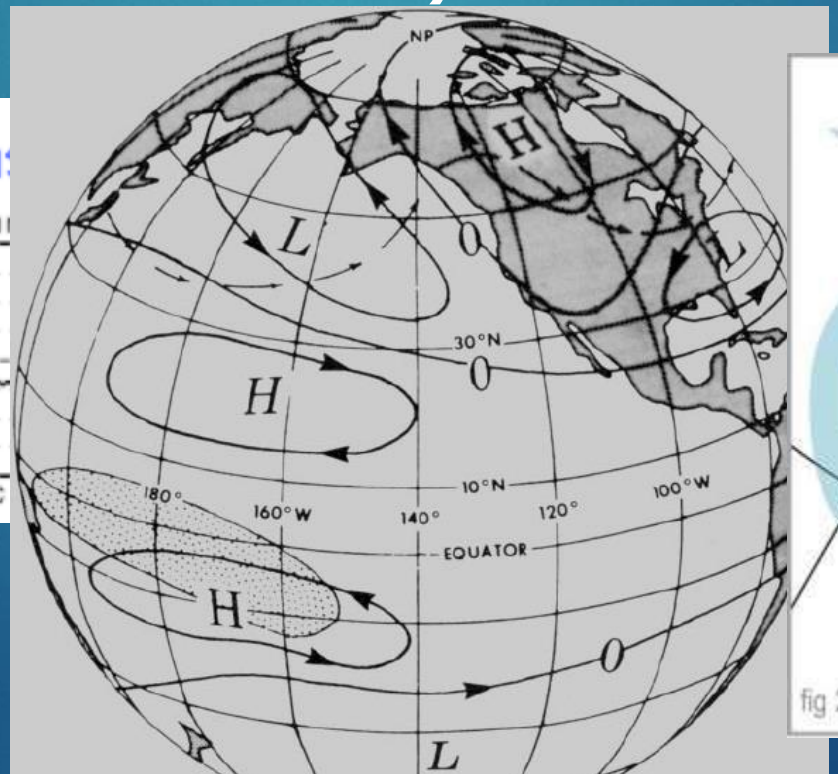


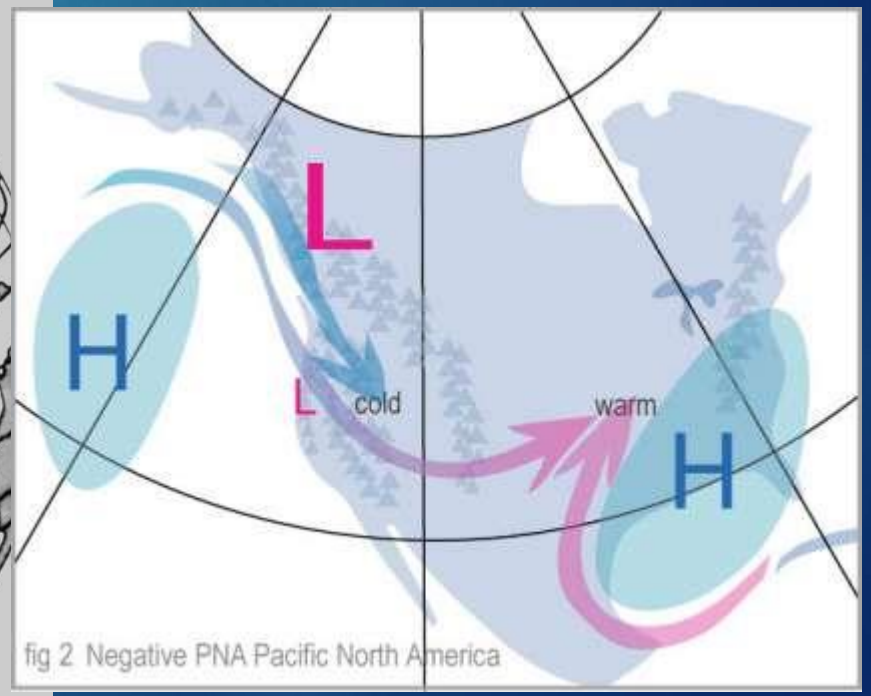


Teleconnections

- Teleconnections – are typical jet stream wave patterns that impact certain large-scale areas of the world (6,000 – 10,000 km, one to two weeks).

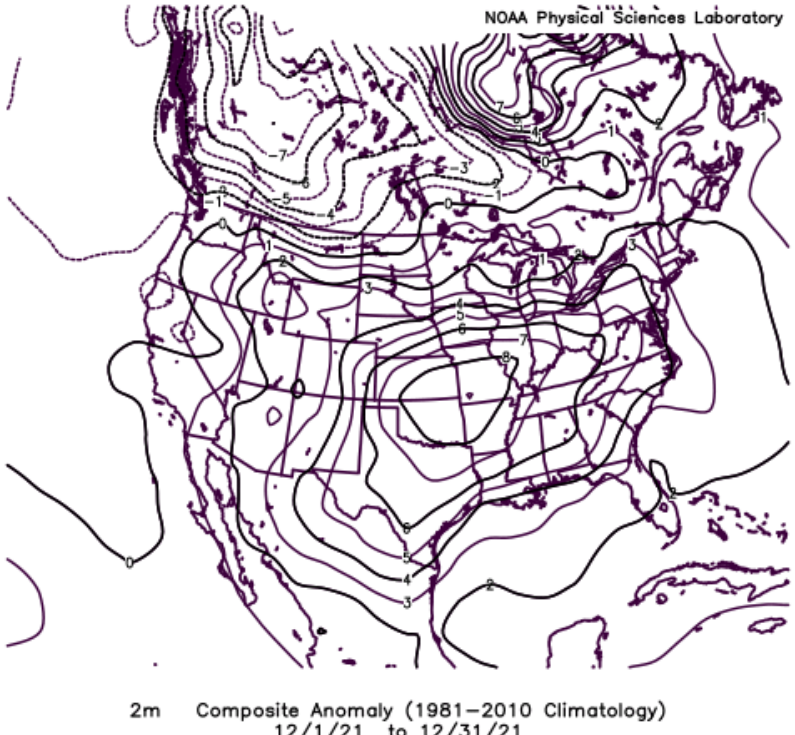


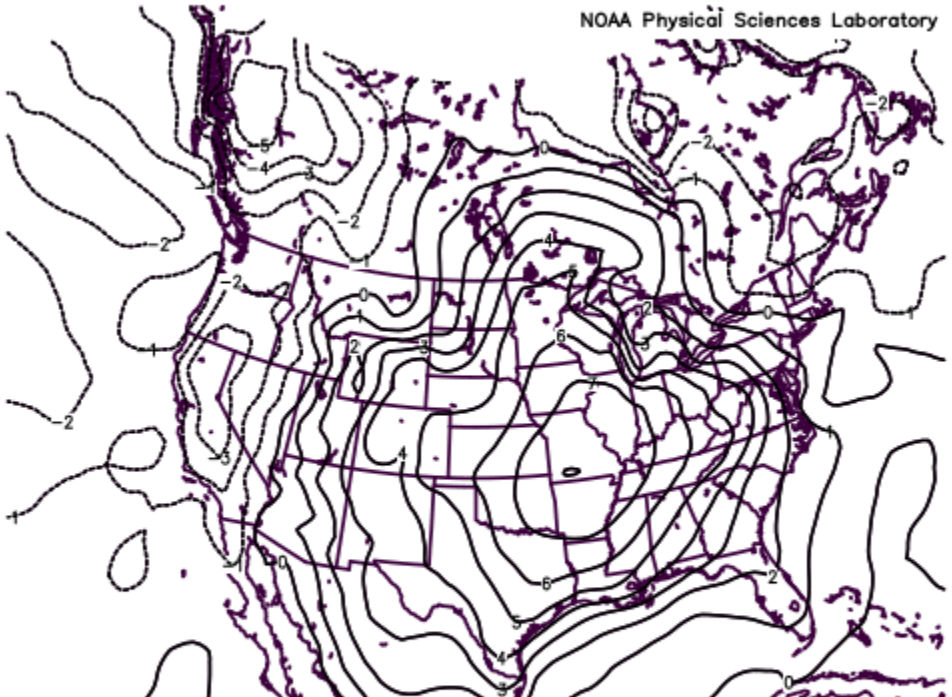




December 2021 versus 1889

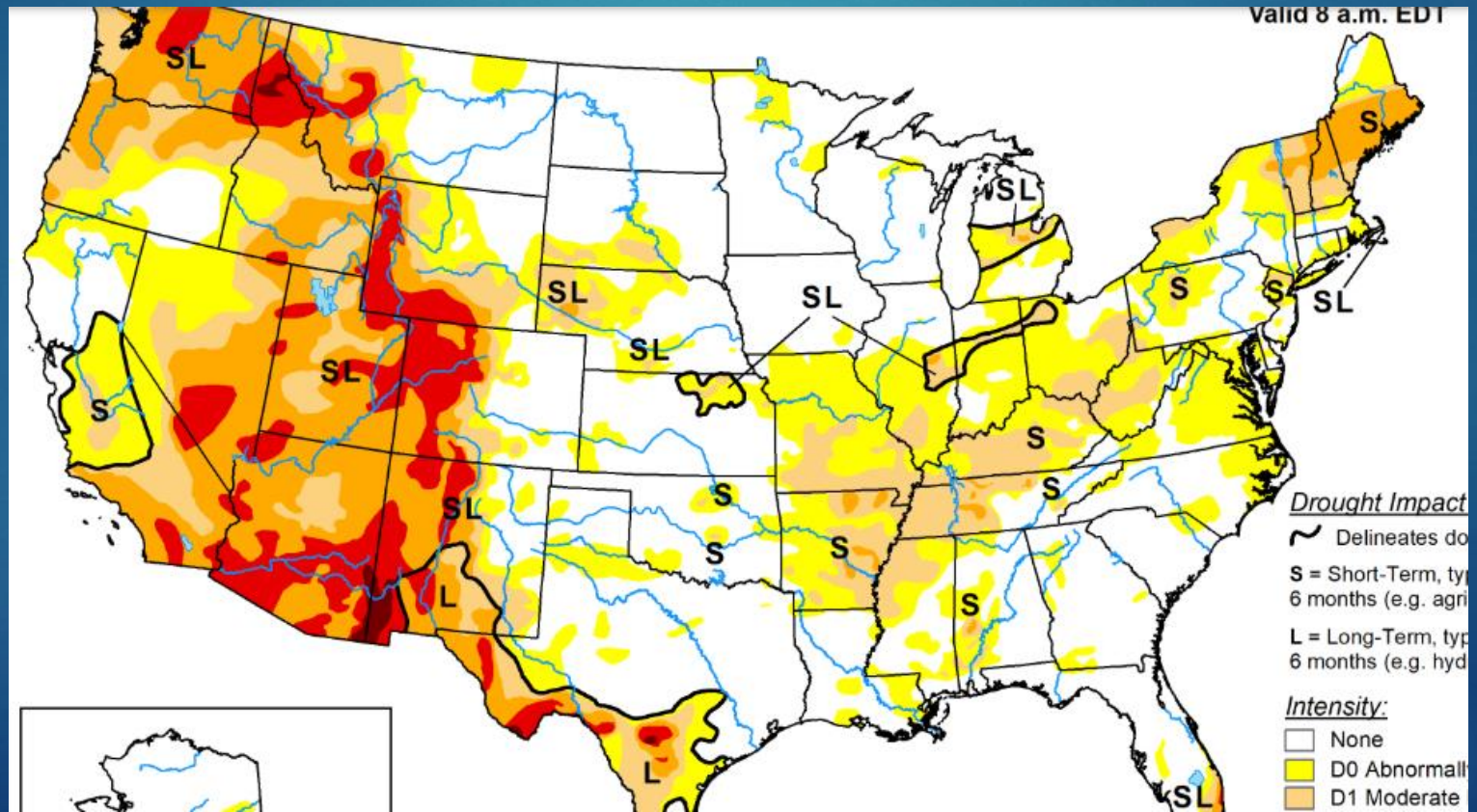
- December 2021 was anomalously warm – but we've seen it before.





National Drought Monitor

- Current Drought Conditions – same as last year – much worse than the start of August



Our Forecast – Winter Recap 2024 - 2025

- We went with a cooler winter than normal. We looked at the recent "classic" La Niñas of 2007, 2010, 2017, 2020, and 2021. We liked -1.5 to 0.0 F.
- Winter 2024-2025 was -0.3 F from the 1889 – 2024 average and -1.9 F from the 30 year mean. Score a hit!
- We leaned toward precipitation being above normal which tends to associate with recent La Ninas. We also forecast snow to be around 15 – 20 inches a little more than the last few years, but not horrible. We forecast a few moderate snowfall, probably not one big one.
- Winter 2024-2025 came in at 4.25 inches which is 0.5 – 1.0 sigma below normal. Gotta count that as a miss. But 18.4 inches of snow is a homerun.

Our Forecast – Recap Summer 2025

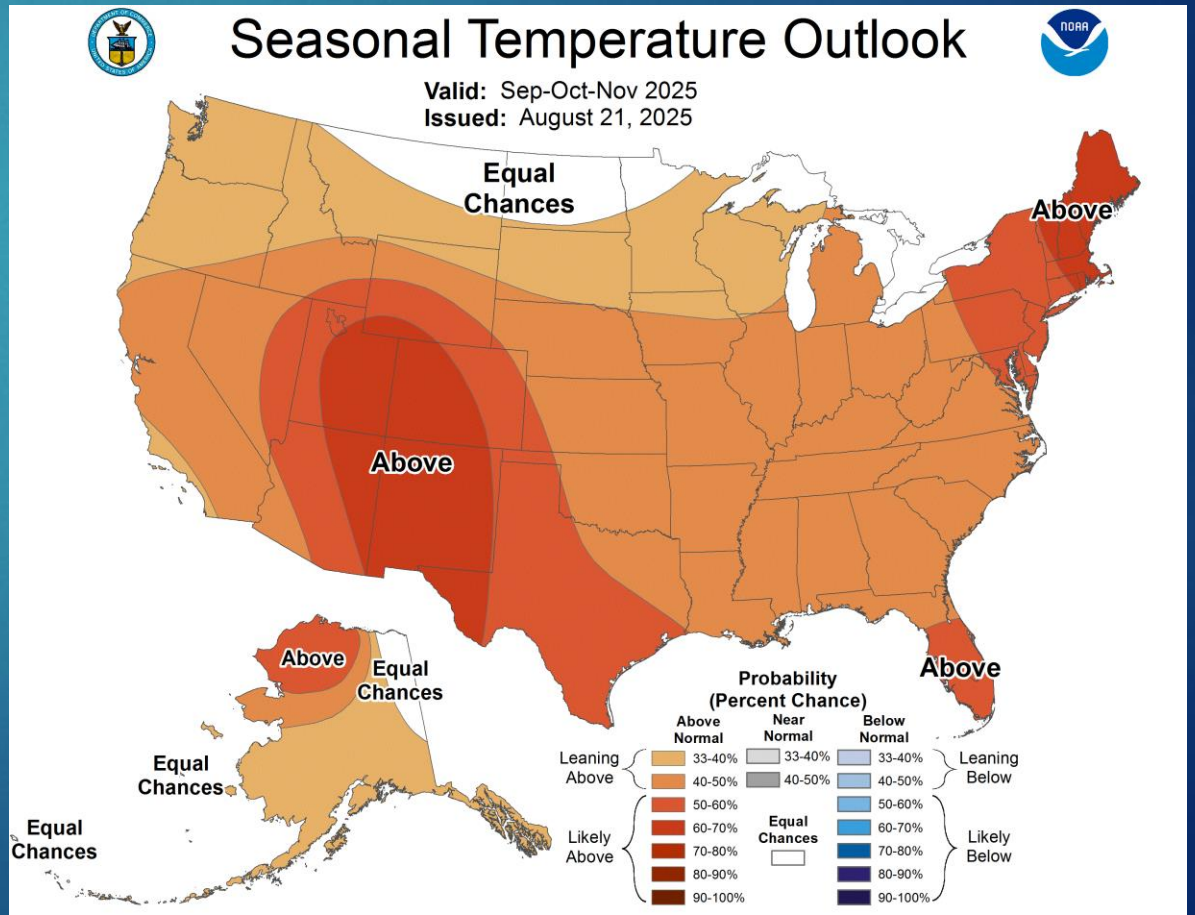
- Reasoning:

- We thought that the current weak La Niña would fade somewhat but slowly. We did move toward Neutral Conditions but cold neutral.

- So we said that summer would be on the warm side of normal (one half to one sigma of normal or +1.2 – 2.4 F and the precipitation within the range of normal (+/- 2.5 inches above normal). Summer was 0.3 F above normal – a partial win. On the "strength" of a brutally dry August we ended up -0.23 inches from the long term mean, and -1.19 from the 30 year mean. A hit!

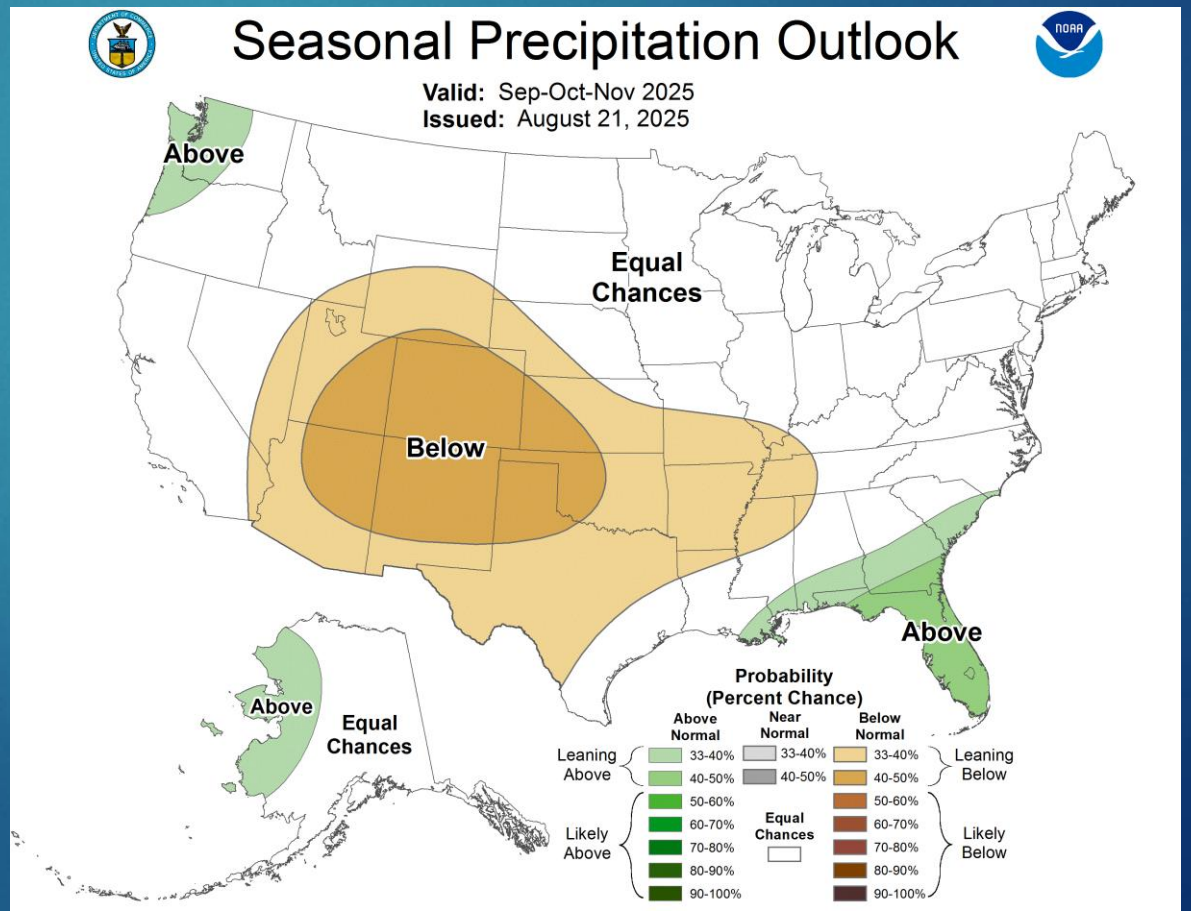
Fall 2025 – CPC outlooks

- Temperature – projections are for above average temperature across most of the USA with the least confidence in the Midwest.
- Similar to last year!



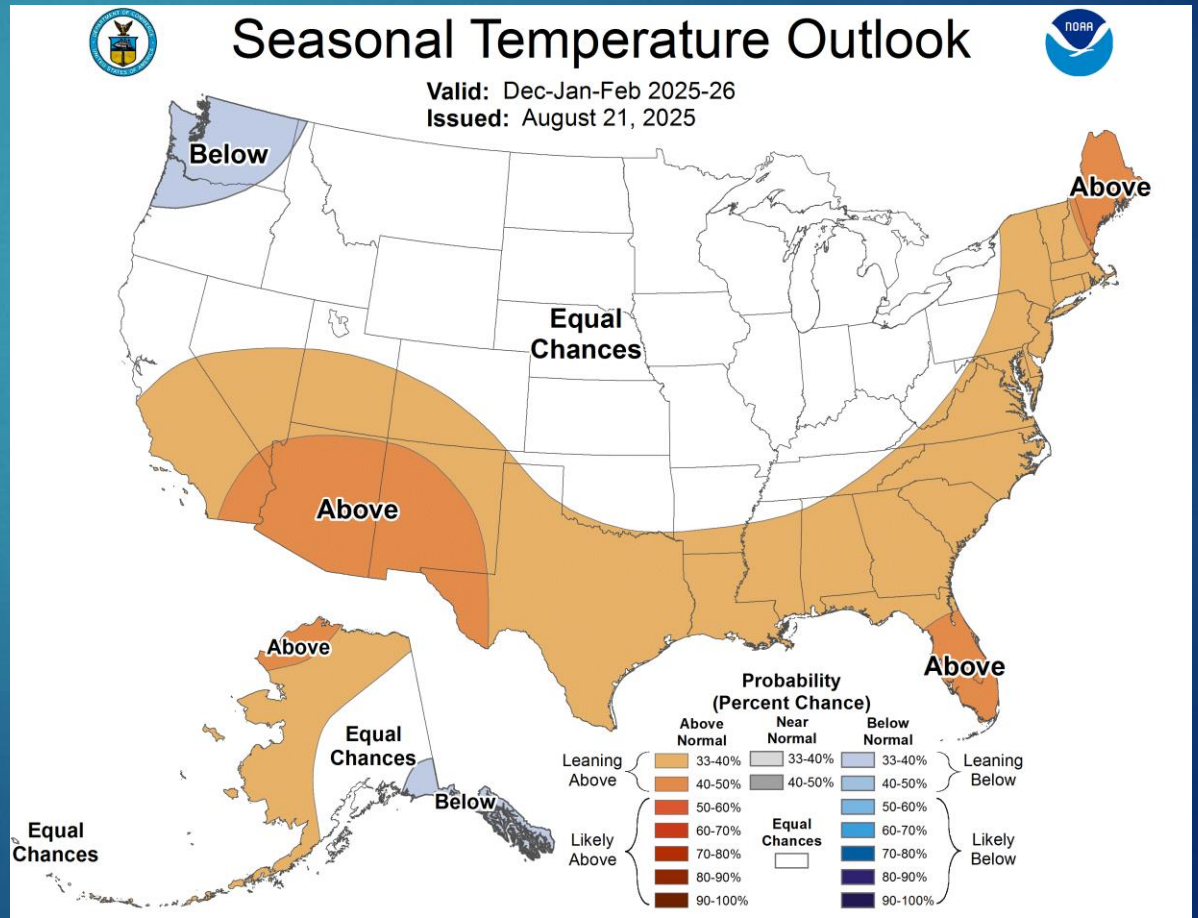
Fall 2025 – CPC Outlooks

- Precipitation – look for dry conditions to worsen mildly. Similar to last year.



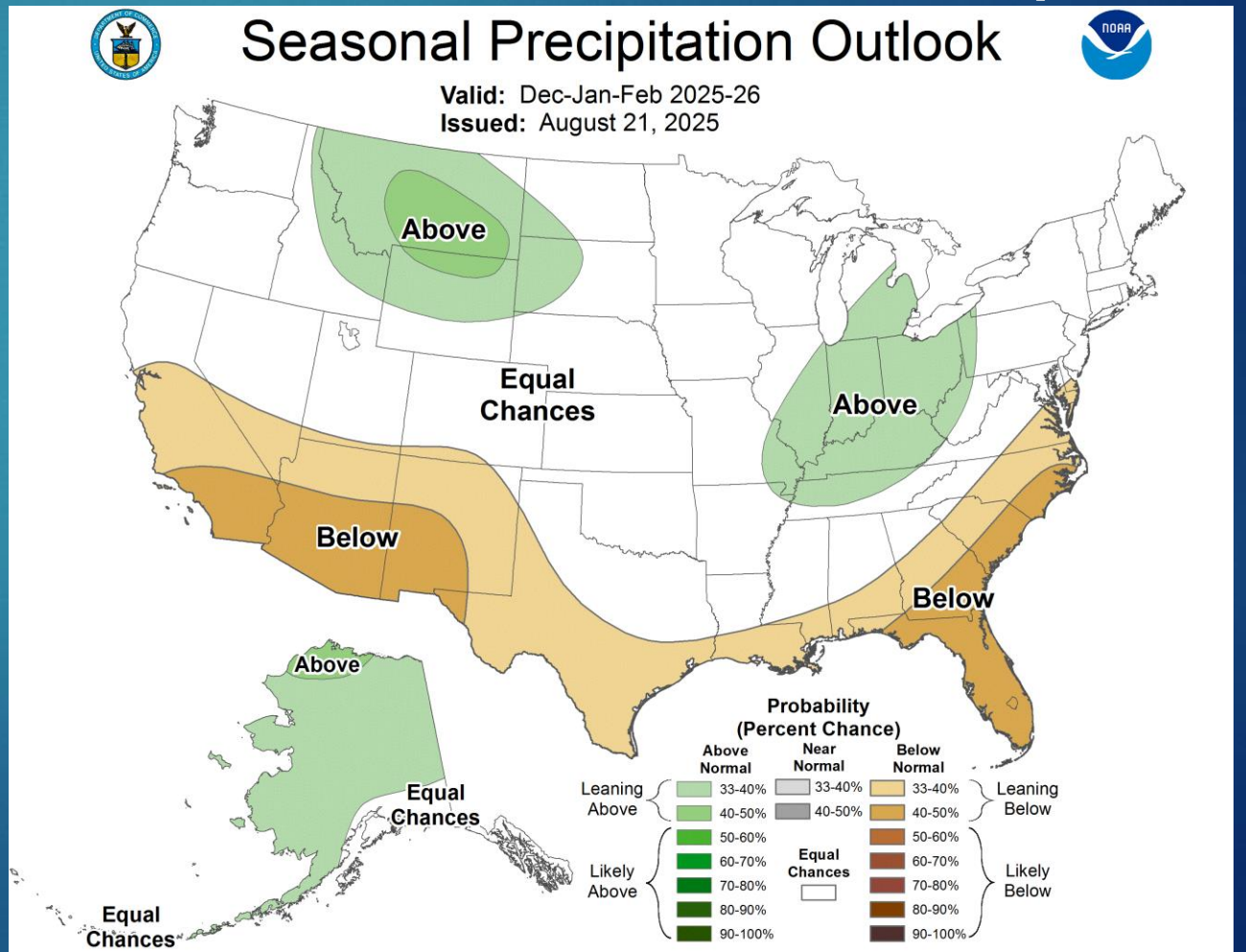
CPC Winter Outlook – 2025 - 2026

- Temperature – “Classic” La Niña. But milder than last year.



CPC Winter Outlook 2025 - 2026

- **Precipitation – again consistent with La Niña? Just like last year but weaker?**



Winter 2025 - 2026 Outlook

- Like last year - CPC forecast is for warm conditions for the fall, but “trending” toward cooler by late winter. Moisture, we’re looking at some improvement on dry conditions. The last few weeks have seen us “flip” from zonal to strong meridional flow with a nigh amplitude ridge / trough over North America. We’ve also seen some unusual summer blocking in our neighborhood. Also, recent La Ninas tend to give us more snow on the back half of winter.

- Weak La Niña conditions were in place this time last year.

Our Forecast – Winter 2025 - 2026

- We're going to go with a winter very close to normal. We're looking at the recent "classic" La Ninas of 2007, 2010, 2017, 2020, and 2021. And last year! This seems to be a strong indicator. Temperature will be within 0.5 sigma of normal which is -1.5 to +1.5F, I like the middle of the range. And colder on the back end.

- We're going to lean toward precipitation being below normal which will track with last year. We'll also forecast snow to be around 15 – 20 inches again this winter a little more than the last few years, but not horrible. We forecast a few moderate snowfall, probably not one big one.

Our Forecast – Winter 2025 - 2026

- Reasoning: “Persistence” is the name of the game.

- Weak La Niña is coming in slowly again. The dynamic and statistic models track similarly this year and make it weak. Everything we’re describing here is similar to last year. I see fall starting warm and dry but trending toward a cooler second half of winter with close to normal precipitation. Early 2021 and 2022 showed similar conditions. Remember Winter 2021 was the Great Polar Vortex of February. Last year was brutally cold in late February as well. But, the cold January was also an issue. The last few weeks have seen the emergence of strongly meridional patterns and blocking. I think this continues. I see a winter with alternating warm and cool conditions as we’ll be on the “node” of the waves. The wild card in all of this is blocking. We’ve seen some this summer. If blocking happens frequently in the east Pacific / West North America, those periods will be cooler. The more blocking the colder it will be.

Community Collaborative Rain, Hail, and Snow Network

- Please consider joining CoCoRaHS. This data is used by agencies to decide crop loss information. It's worth it to you to join Missouri CoCoRaHS. (State Climatologist Zach Leasor). MO has been a CoCoRaHS state since 2006.

- http://cocorahs.org

- Email: lupoa@missouri.edu

Missouri Climate Center

- Missouri Climate Center
- http://climate.missouri.e

Climate Change

- **U.S Global Change Research Program:** http://www.globalchange.gov/
- **2018 National Climate Assessment:** https://nca2018.globalchange.gov/
- **2014 National Climate Assessment:** http://nca2014.globalchange.gov/
- **National Oceanic and Atmospheric Administration (NOAA):** http://www.noaa.gov/climate
- **NOAA Climate Portal:** https://www.climate.gov
- **NOAA U.S. Climate Resilience Toolkit:** https://toolkit.climate.gov
- **Midwestern Regional Climate Center﷯s Climate Trends Tool:** http://mrcc.isws.illinois.edu/mw_climate/climateTrends.jsp
- **USDA Midwest Regional Climate Hub:** https://www.climatehubs.oce.usda.gov/hubs/midwest
- **National Centers for Environmental Information State Climate Summaries:** https://statesummaries.ncics.org
- **NASA Global Climate Change:** http://climate.nasa.gov/
- **US EPA Climate Change:** https://19january2017snapshot.epa.gov/climate-impacts/climate-change-impacts-state_.html
- **Real Climate:** http://www.realclimate.org/
- **Climate Science Centers:** http://www.doi.gov/csc/index.cfm