



Weather Outlook – Summer 2022

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ATMOSPHERIC SCIENCE

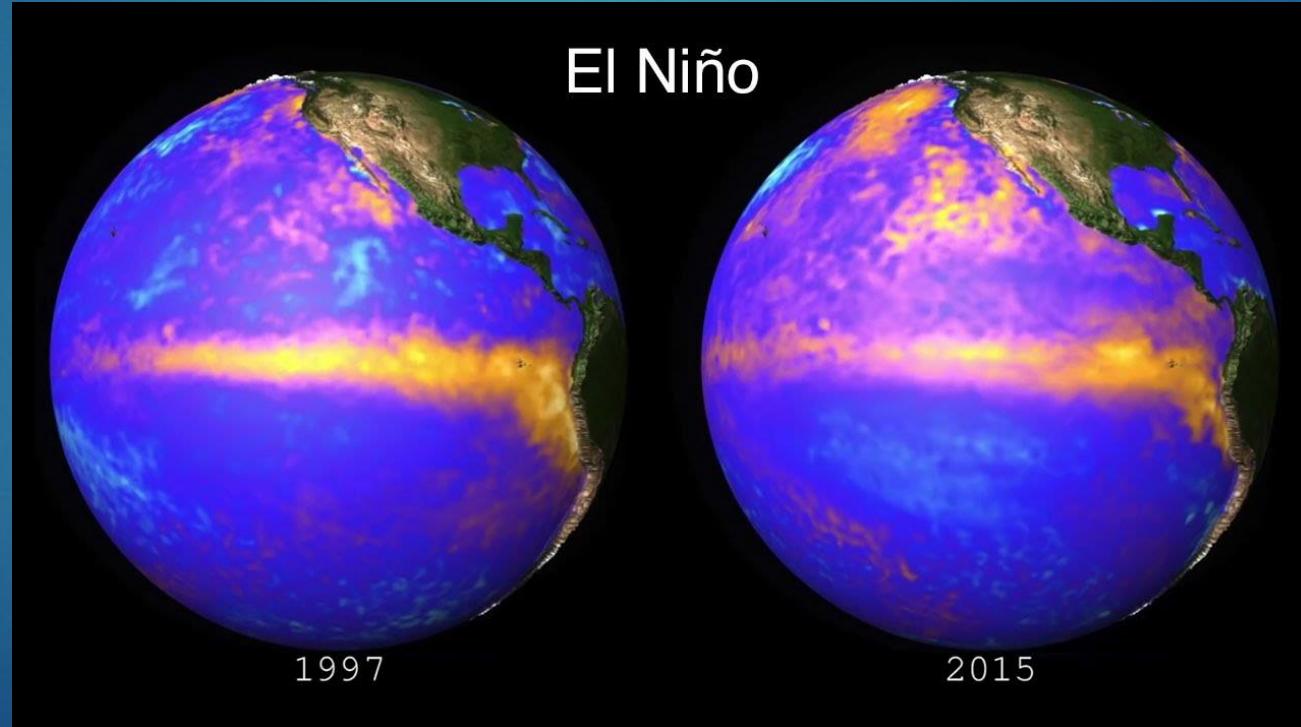
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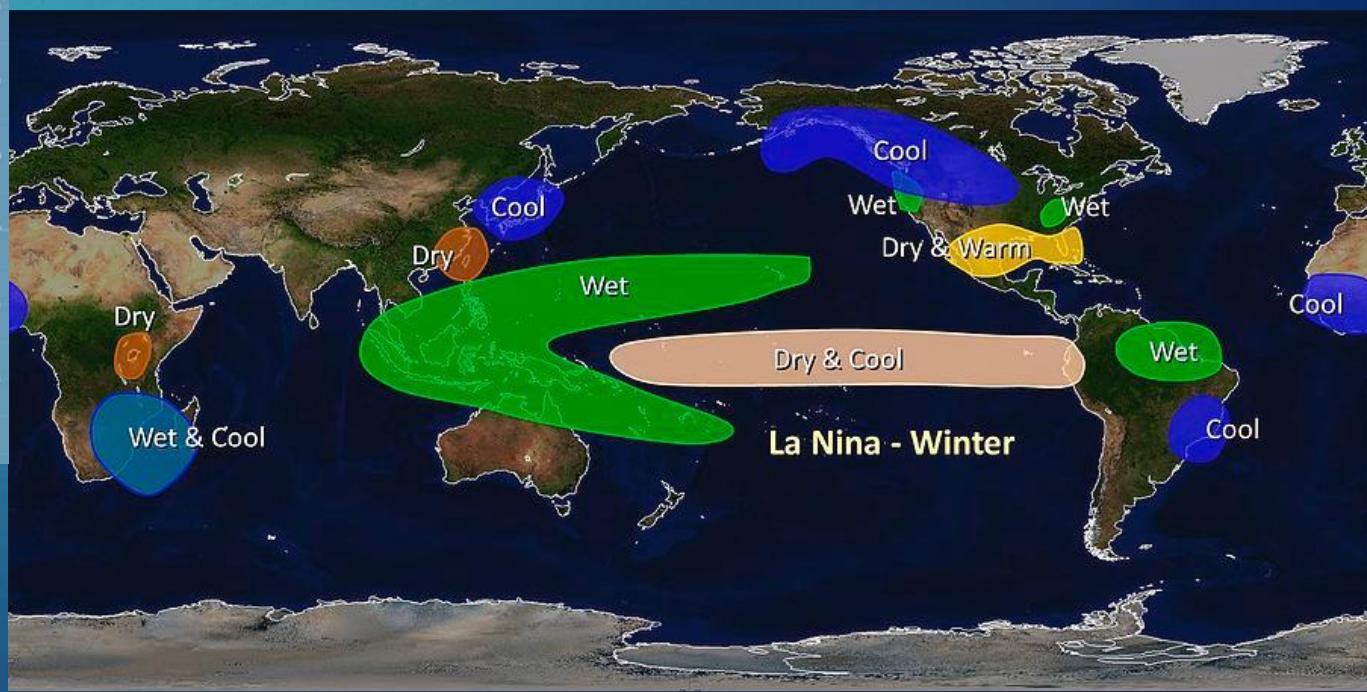
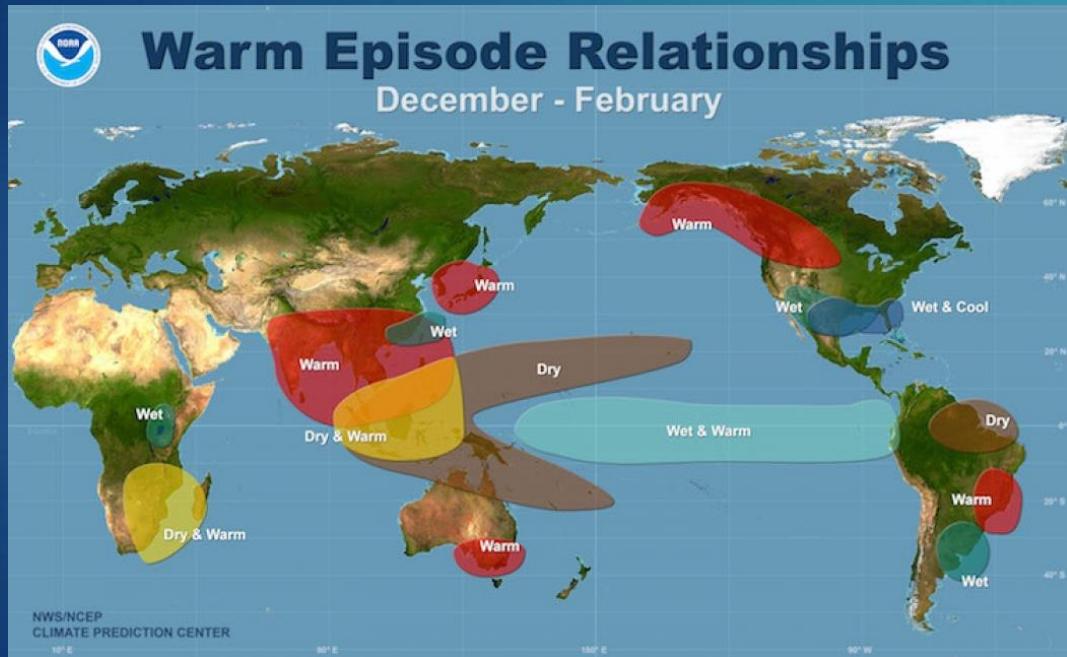
El Niño and Southern Oscillation (ENSO)

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



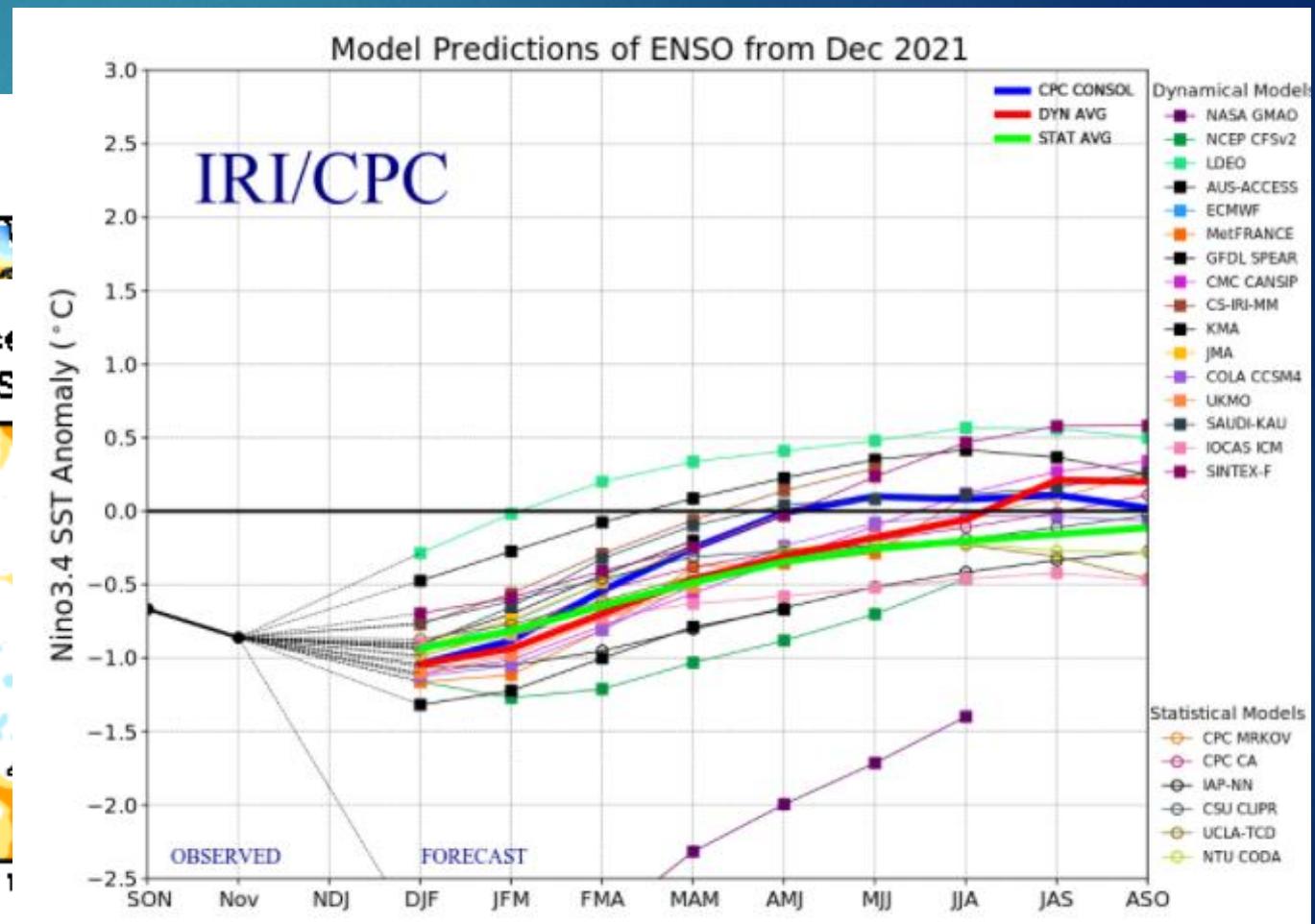
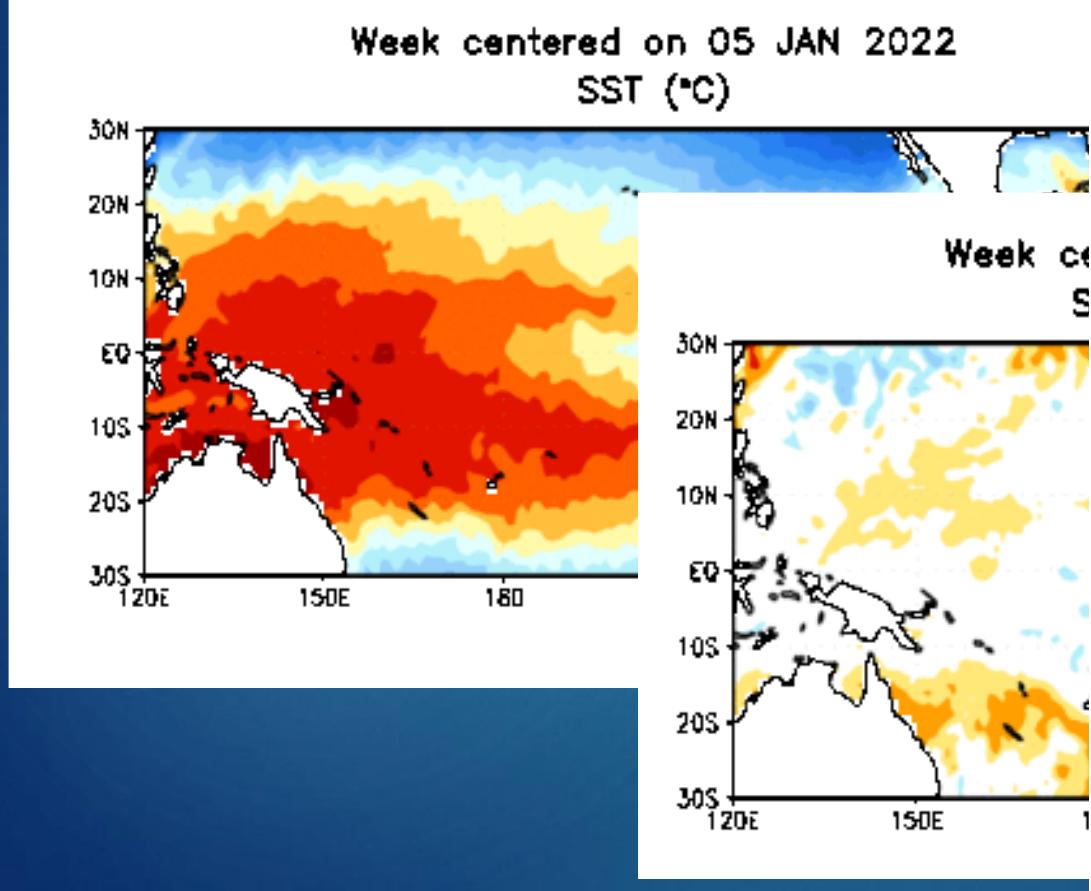
ENSO Impacts

- ▶ Influences weather worldwide



ENSO – Current State – Where are we going?

► January 2022

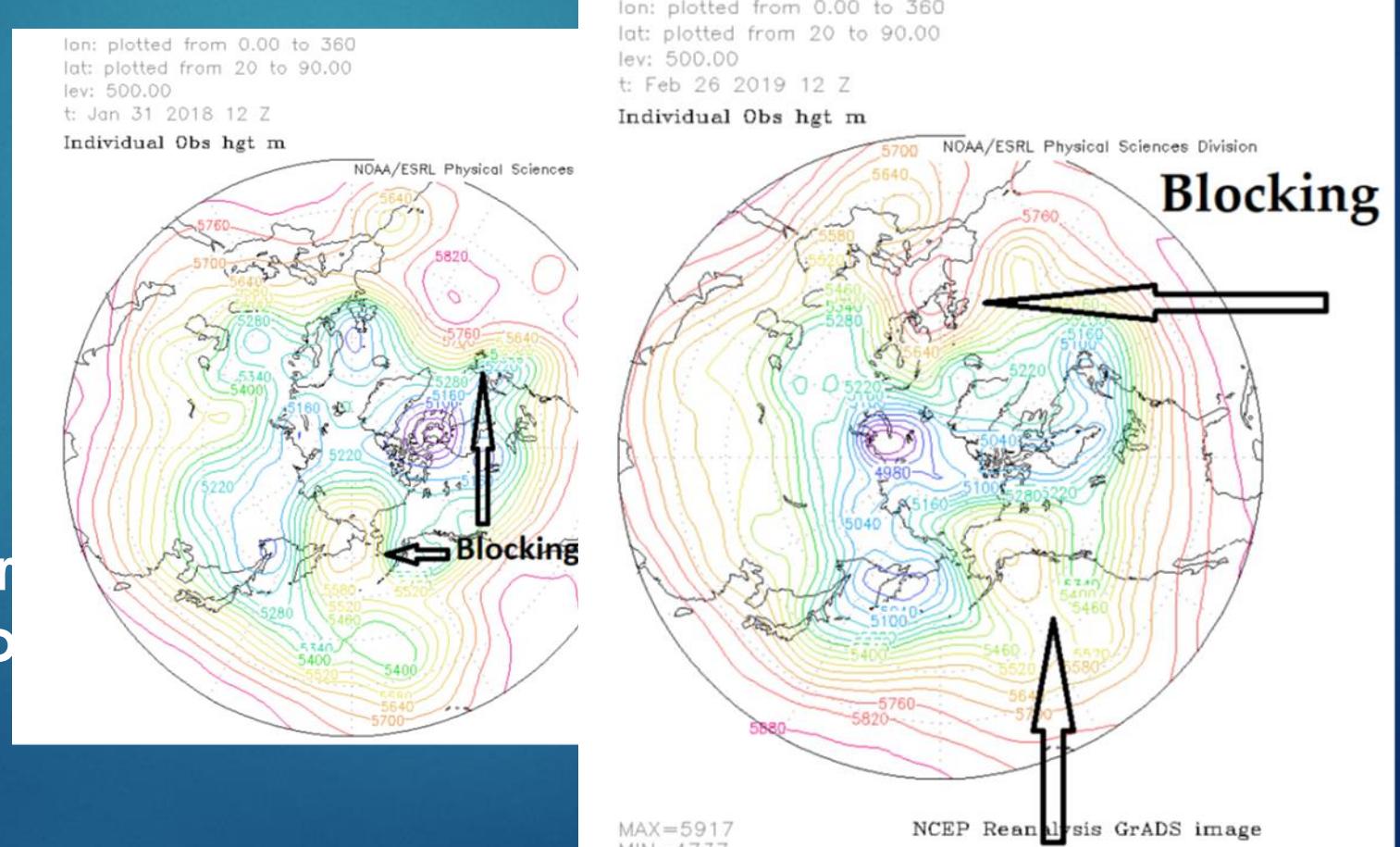


Atmospheric Blocking

- ▶ Atmospheric jet stream behavior is complicated

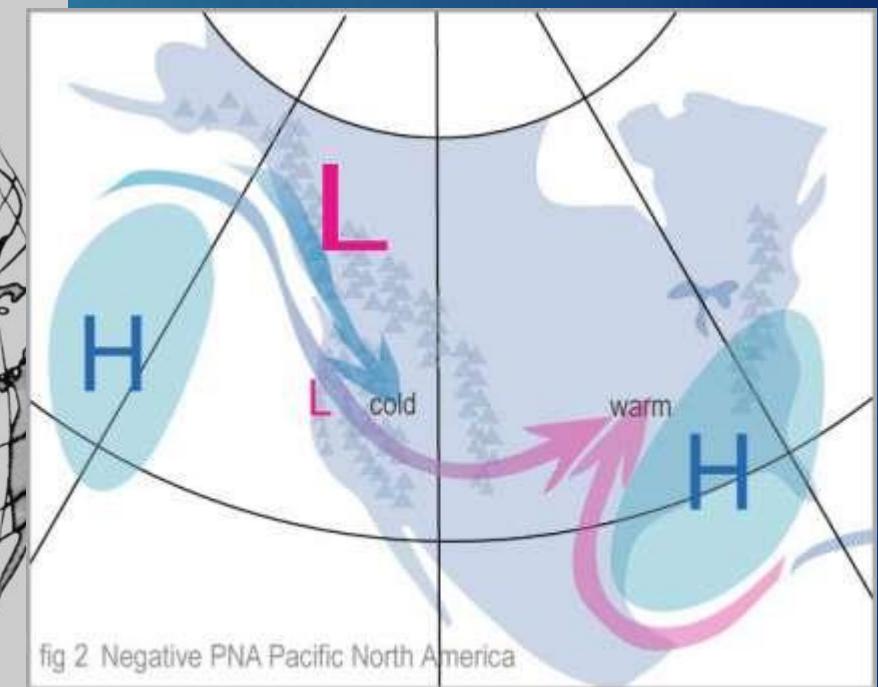
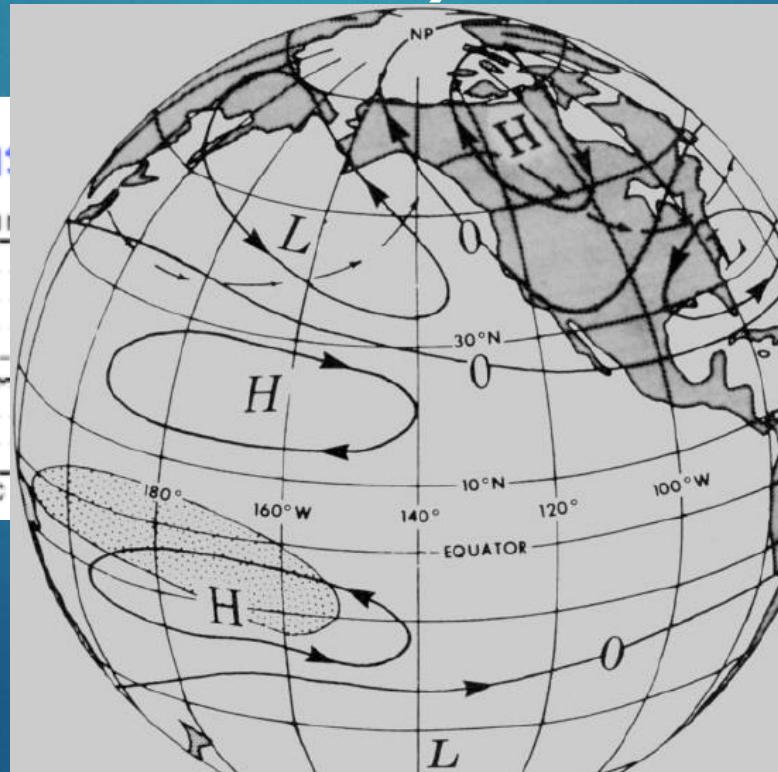
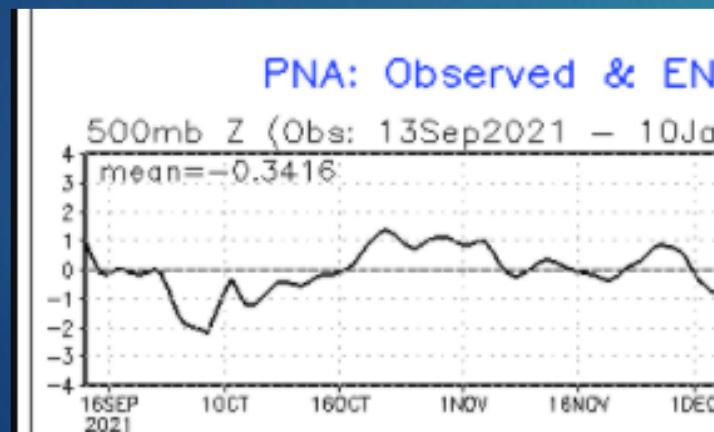


- ▶ Blocking - generates mid-latitude anomalies



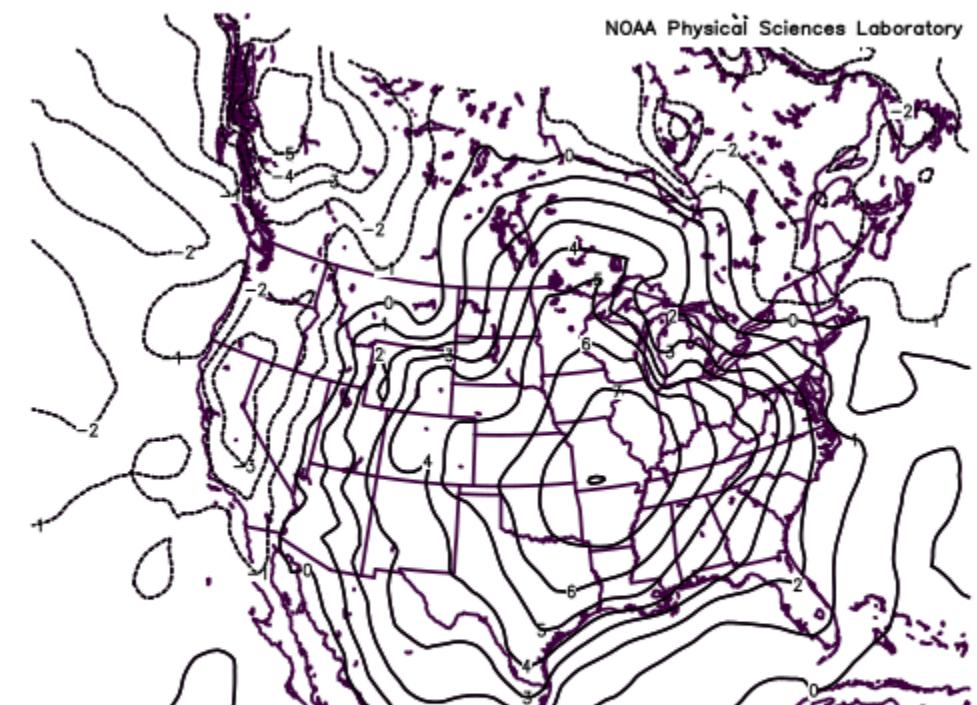
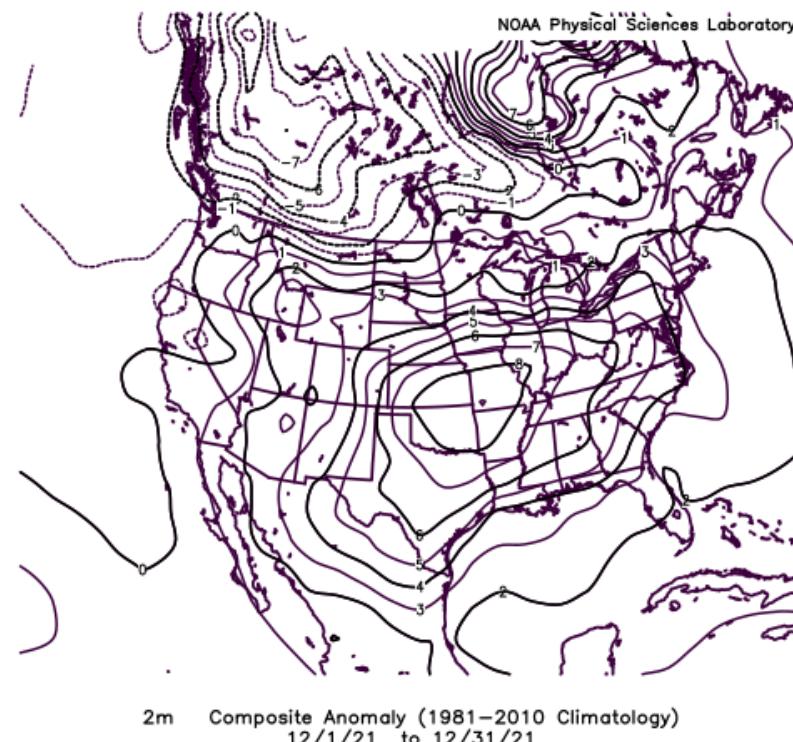
Teleconnections

- ▶ 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.

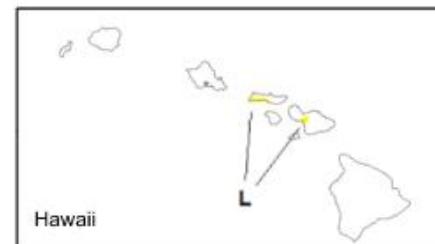
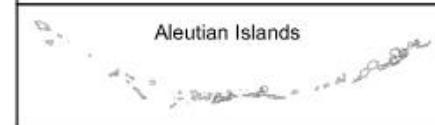
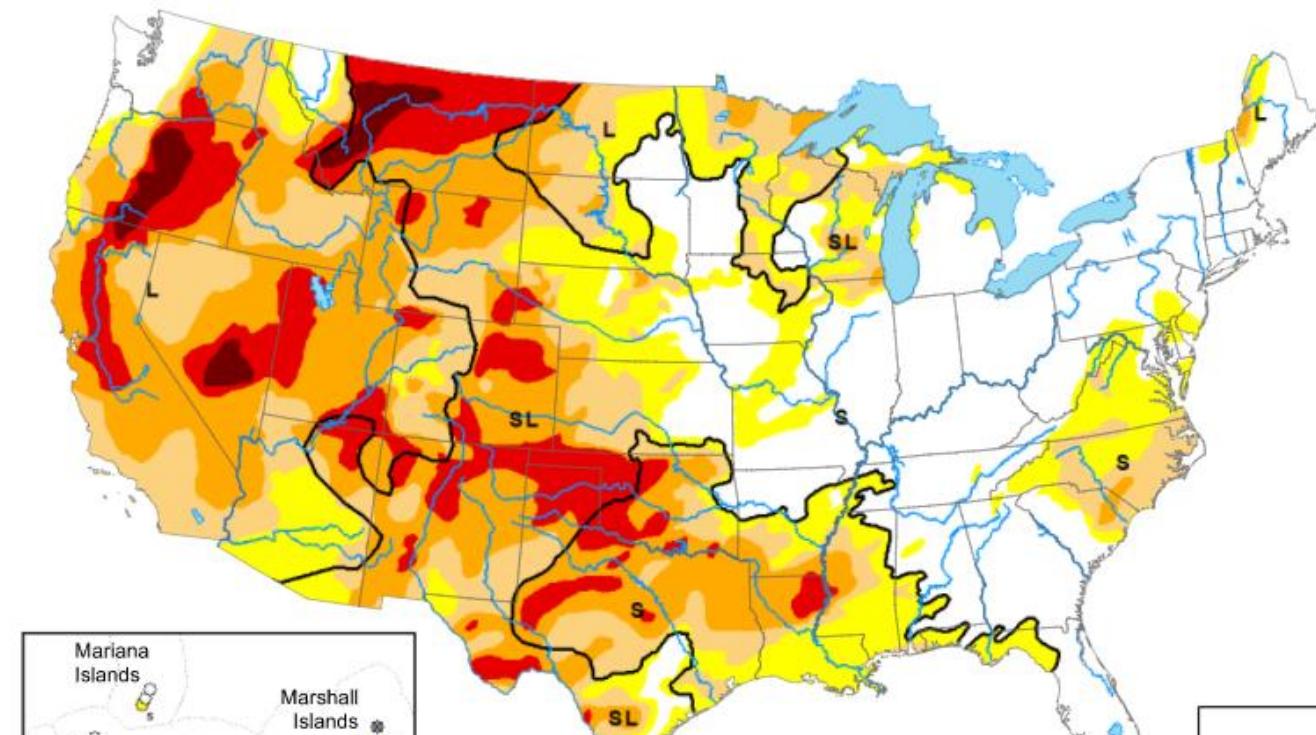


National Drought Monitor

► Current Drought Conditions – short-term no improvement

Map released: January 6, 2022

Data valid: January 4, 2022

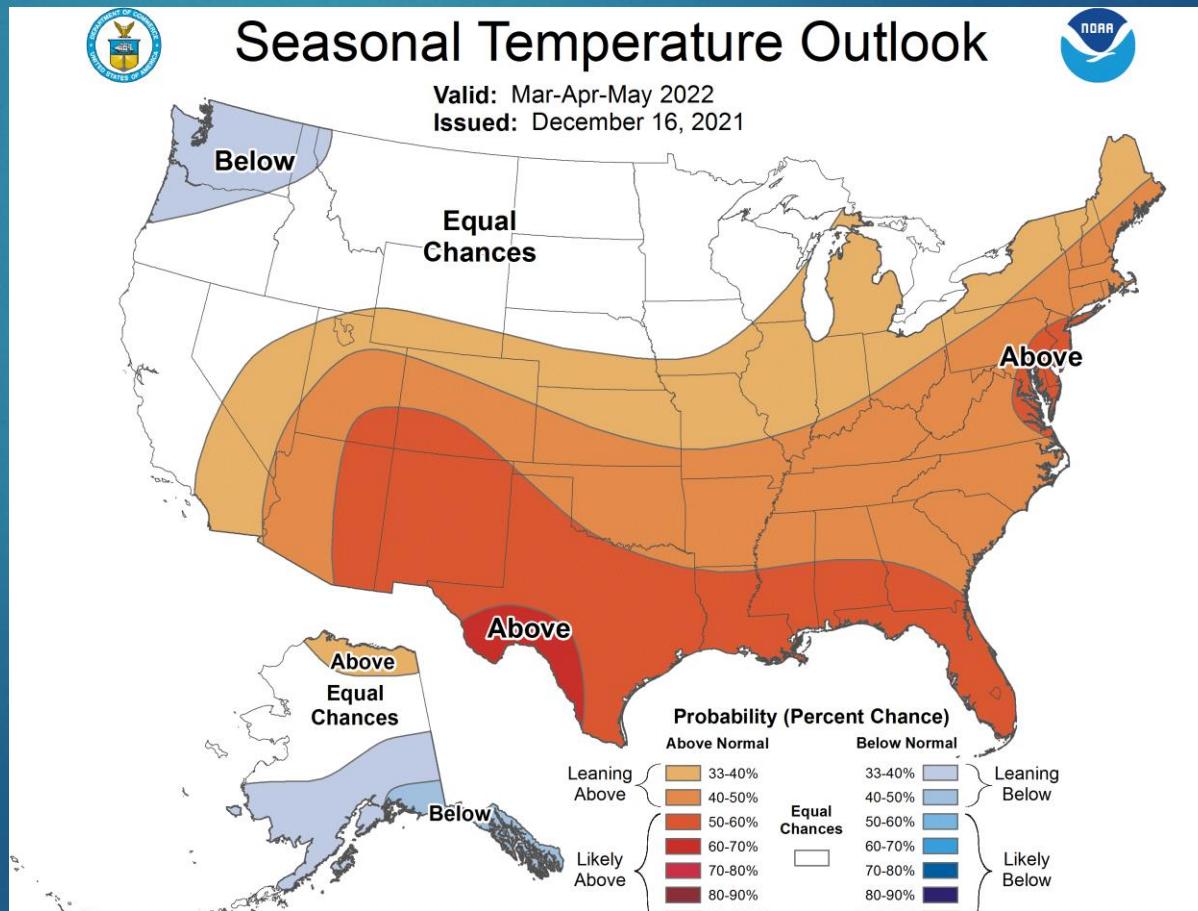


How'd our 2021 forecast turn out?

- ▶ Our temperature forecast so far is kind of good. We said about 1.0 sigma above normal ($+2.0^{\circ}$ F) for summer. We were at 2.2 F above normal – good forecast – score! June was usually warm. Let's go +2 points!
- ▶ As for precipitation, we projected near normal. We were dry in August, but June was so wet across mid- MO (July across northern MO), we are nearly +1.5 sigma (+7.19 inches). So, we can't get any points. June beat us.

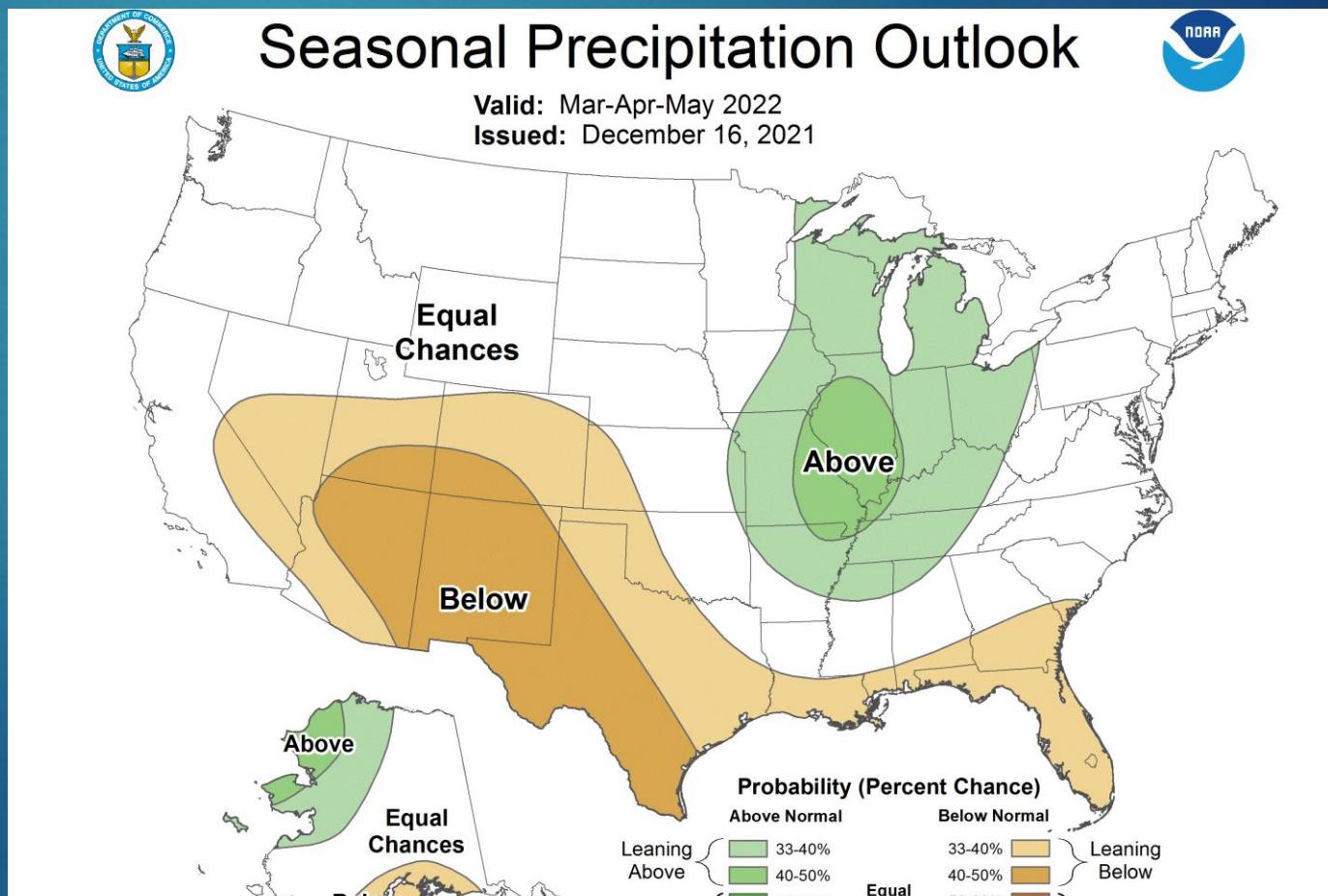
Spring 2022 – CPC outlooks

- ▶ Temperature – projections are for above average temperature across the southern USA



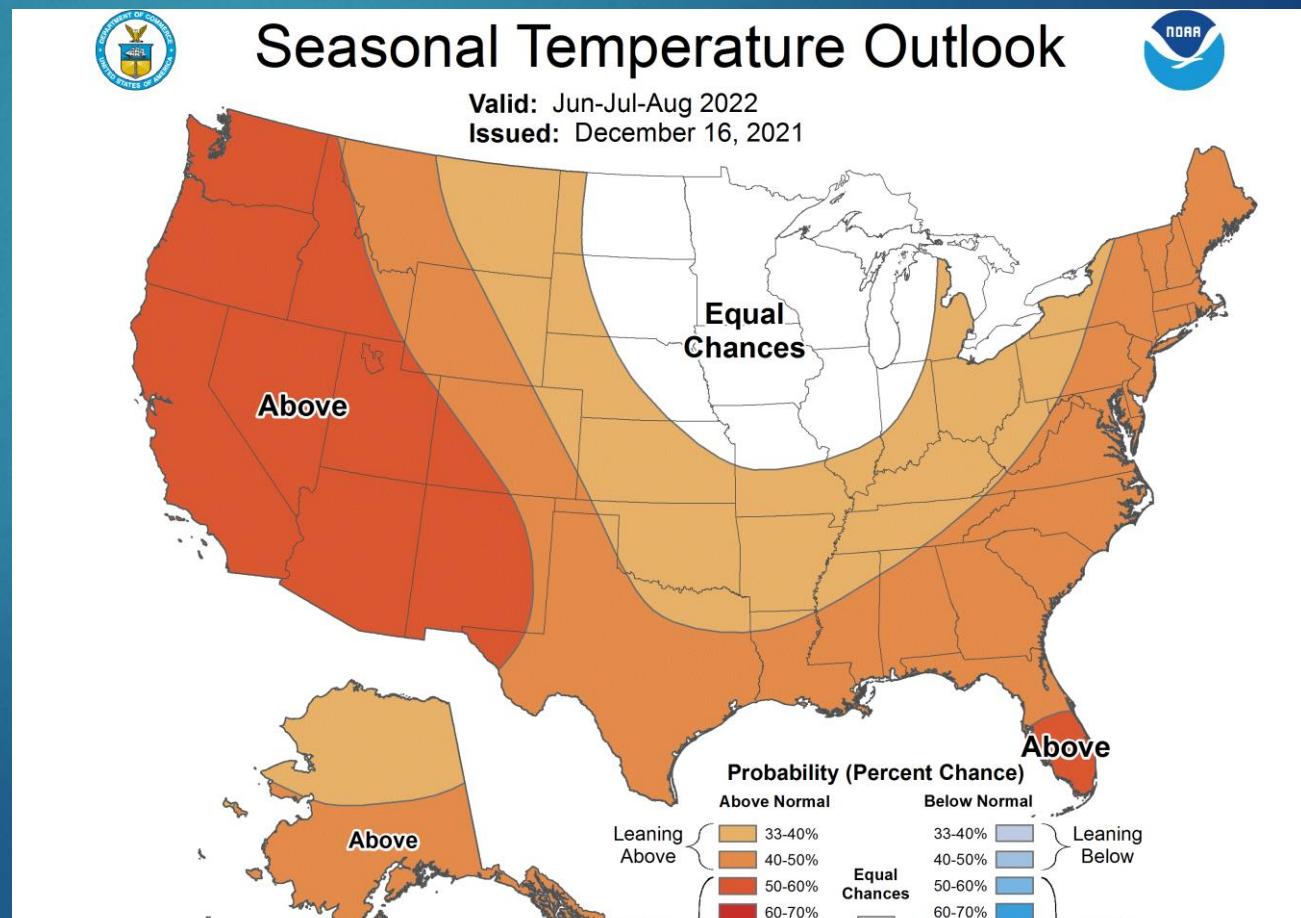
Spring 2022 – CPC Outlooks

- ▶ Precipitation – above normal in the Great Lakes and Midwest?



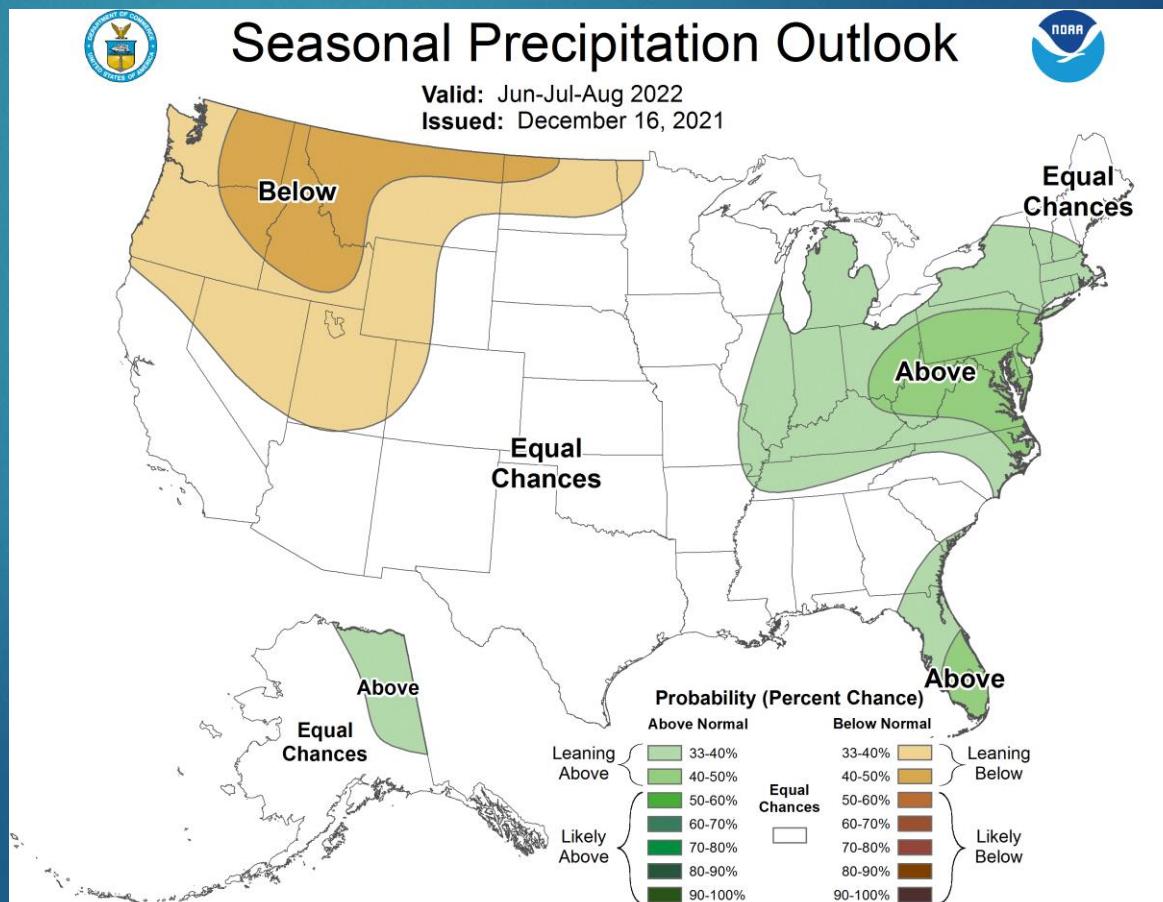
CPC Summer Outlook - 2022

- ▶ Temperature – consistent with drought in the west and looks like last year.



CPC Summer Outlook 2022

- ▶ Precipitation – again consistent with dry conditions out west and looks like last year.



Summer 2022 Outlook

- ▶ CPC forecast is for a warm summer in the west and equal chances for the upper midwest. They are going for continued drought in the west and northwest USA and wet in the east. But, we're in a slowly fading La Nina, and 2011 and 2021 are two analogs (hot, but moist). The last 20 years have seen some back and forth between hot and cool summers.
- ▶ In the Spring and Summer 2021 La Nina conditions were in place and were projected to drift toward cool/neutral. The last 5 analogues are two warm and drier summers (including 2011, 2017), normal and dry (1999), and cool and wet (2000, 2008).

Our Forecast – Summer 2022

- ▶ We're going to go with a repeat of 2021, toward the warm side but maybe not as strongly as last year. Temperature will be about +0.5 to +1.0 sigma above normal – which is about 1 – 2 F, with more humid conditions.
- ▶ We're going to lean toward precipitation being above normal following last year. This is the closest analogue. (about +0.5 sigma to +1.0 sigma: about +2.6 inches to +5.2 inches), this is somewhat good news for agriculture, depending on how spring goes. The winter has been somewhat dry across MO.

Our Forecast – Summer 2022

- ▶ Reasoning:
- ▶ We think that with similar conditions in place to last year, that is a good start. Also, La Nina conditions have persisted since Fall 2020. Two straight La Nina years is unusual, three would even be more so. The best models project us to go back toward warmer sea surface temperature in the tropical Pacific. However, when ENSO goes back toward neutral, our summers are more moderate.

Missouri Crop Forecast – Summer 2022 Henson et al. (2017)

- ▶ Summer 2022 – Crop Yield Projections – Missouri Climate Divisions



Missouri Crop Forecast – Summer 2022

► http://weather.missouri.edu/gcc/10.1007_s00484-016-1263-3.pdf

Table 4 Departure from average (standard deviation) calculated from detrended crop yields in kilograms per hectare, for each crop in each climate region of Missouri, for the years associated with each El Niño Southern Oscillation-Pacific Decadal Oscillation (ENSO-PDO) phase combination (Table 1)

| | Positive PDO (1) | | | Negative PDO (2) | | |
|-----------|------------------|-----------------|----------------------|------------------|----------------|-----------------------|
| | La Niña | Neutral | El Niño | La Niña | Neutral | El Niño |
| Corn 1 | -360.0 (894.3) | -137.0 (1144.5) | 442.8 (631.3) | -321.4 (976.7) | 230.1 (1247.5) | 131.5 (1138.4) |
| Corn 2 | -495.3 (966.3) | -92.8 (992.6) | 455.1 (650.0) | -191.1 (925.7) | 140.3 (1496.8) | 71.6 (1037.2) |
| Corn 3 | -50.1 (258.1) | 22.4 (1127.7) | 213.3 (743.3) | -236.7 (1063.5) | 74.2 (1399.8) | -40.8 (980.4) |
| Corn 4 | -175.7 (274.7) | -35.1 (985.6) | 389.5 (636.7) | -194.3 (1015.4) | 18.3 (1326.5) | 107.7 (1017.3) |
| Corn 5 | -309.7 (290.3) | -1.2 (863.8) | 137.6 (515.2) | -212.0 (830.4) | 113.0 (1174.5) | 91.4 (838.7) |
| Corn 6 | -573.1 (522.6) | 129.2 (891.9) | 429.0 (686.8) | -293.1 (1045.8) | 56.3 (1160.9) | -158.9 (817.1) |
| Soybean 1 | -135.3 (283.2) | -33.6 (398.1) | 92.5 (186.0) | -43.1 (200.5) | -1.6 (350.5) | 115.2 (246.1) |
| Soybean 2 | -107.0 (300.9) | -14.4 (339.1) | 100.9 (66.5) | -39.6 (264.6) | -2.2 (359.1) | 66.0 (226.8) |
| Soybean 3 | 78.9 (69.6) | 39.8 (403.7) | 174.3 (263.1) | -55.9 (235.7) | -25.3 (385.3) | -47.2 (356.5) |
| Soybean 4 | 14.2 (127.7) | -80.3 (374.5) | 90.5 (394.8) | 22.6 (239.3) | 12.8 (368.7) | 28.5 (330.7) |
| Soybean 5 | -83.3 (154.9) | -10.1 (280.3) | 91.5 (96.8) | -44.5 (286.2) | 29.5 (237.8) | -3.3 (188.8) |
| Soybean 6 | -145.8 (318.3) | -15.5 (292.0) | -56.6 (124.4) | -111.8 (242.1) | 95.0 (239.3) | 55.4 (263.7) |

Bold values represent significant differences (p value of 0.10 or less) in yield for El Niño years of different PDO phases, with both data sets involved containing at least five samples (yield per phase year combination)

Missouri Summer Crop Forecast 2022

- ▶ For Summer 2022: Northeast and north central Missouri corn and soybean yields are projected to be near average to above average, generally.

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 Patrick Guinan). MO has been a CoCoRaHS state since 2006.
- ▶ <http://cocorahs.org>
- ▶ Email: lupoa@missouri.edu



Missouri Climate Center

- ▶ Missouri Climate Center
- ▶ <http://climate.missouri.edu>

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>