



2021 SUMMER OUTLOOK

PRESENTED BY SENIOR METEOROLOGIST CHAD MERRILL
AND METEOROLOGIST ANDREW ROSENTHAL

BEFORE WE GET STARTED...

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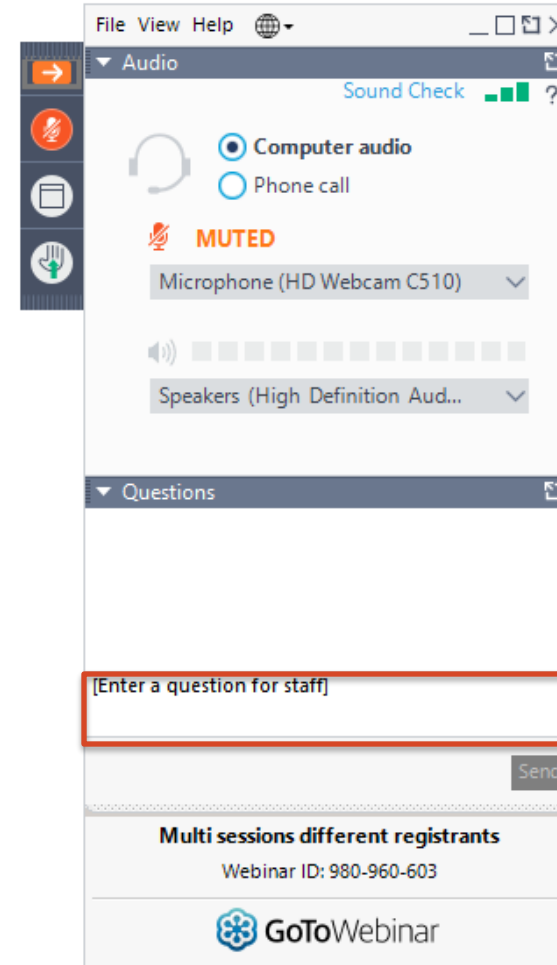
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← Question Box

2021 SUMMER OUTLOOK METEOROLOGICAL TEAM



**CHAD
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Sr. Meteorologist



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**MATTHEW
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RUPP**

Meteorologist



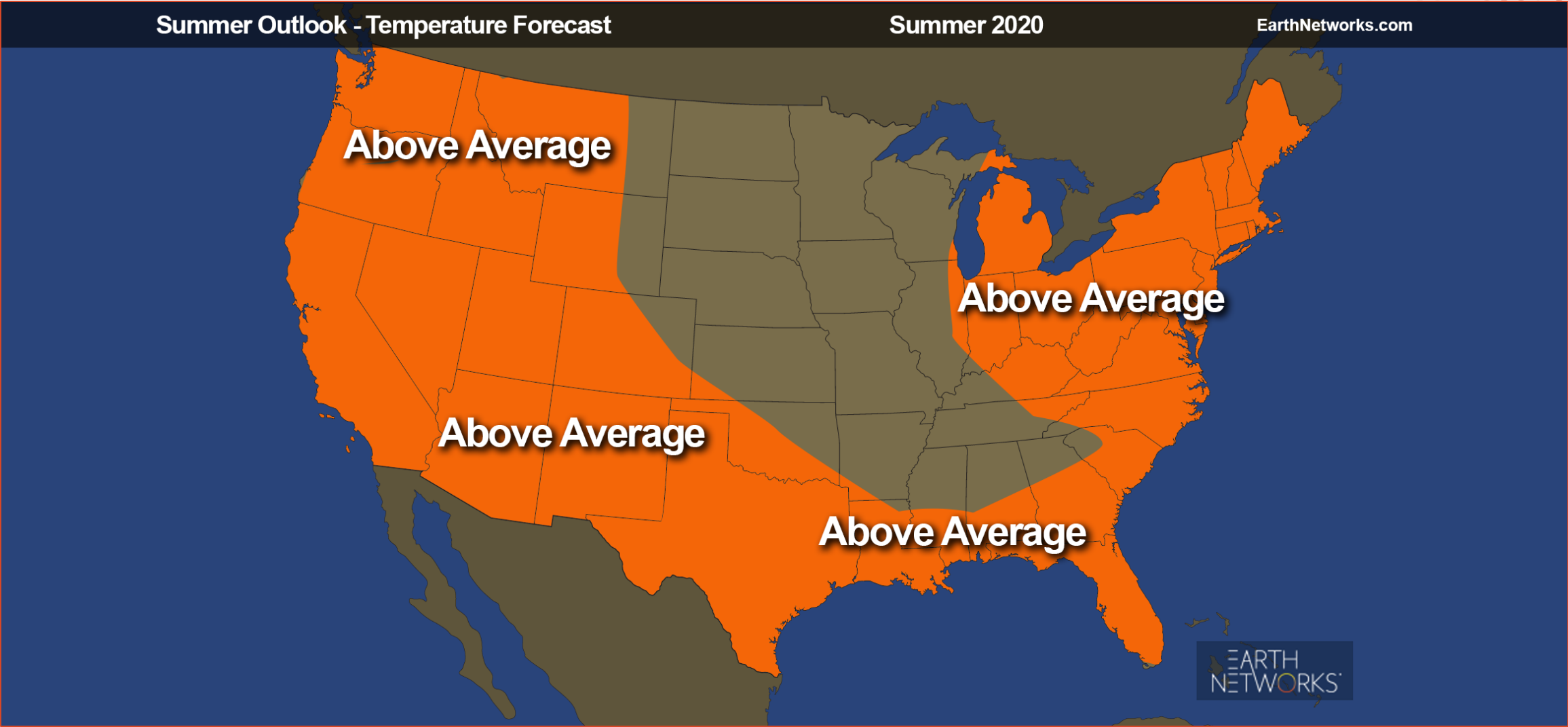
**JULIE
GADDY**

Sr. Meteorologist

SUMMER 2020 RECAP

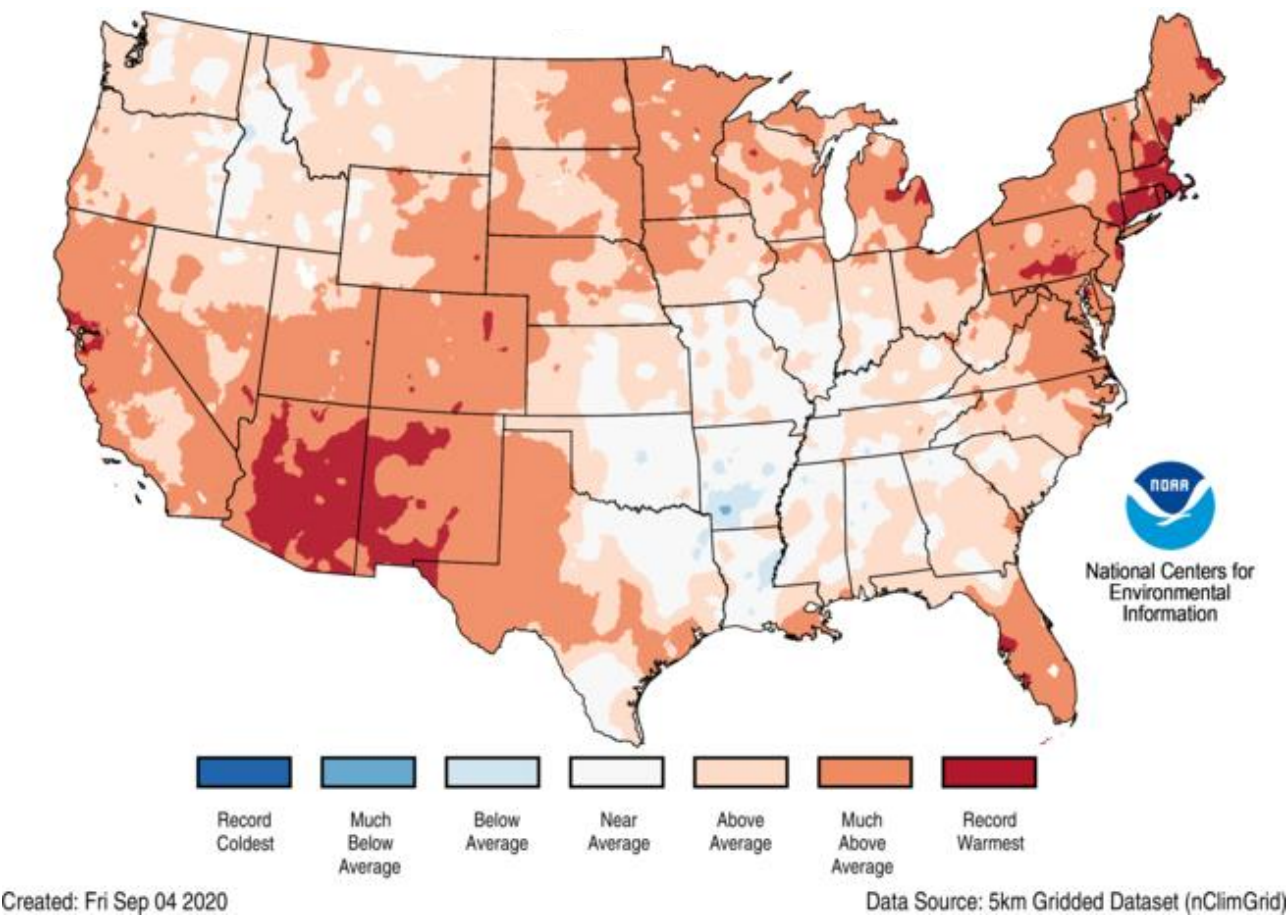


EARTH NETWORKS 2020 SUMMER TEMPERATURE OUTLOOK



2020 SUMMER TEMPERATURE OUTLOOK VERIFICATION

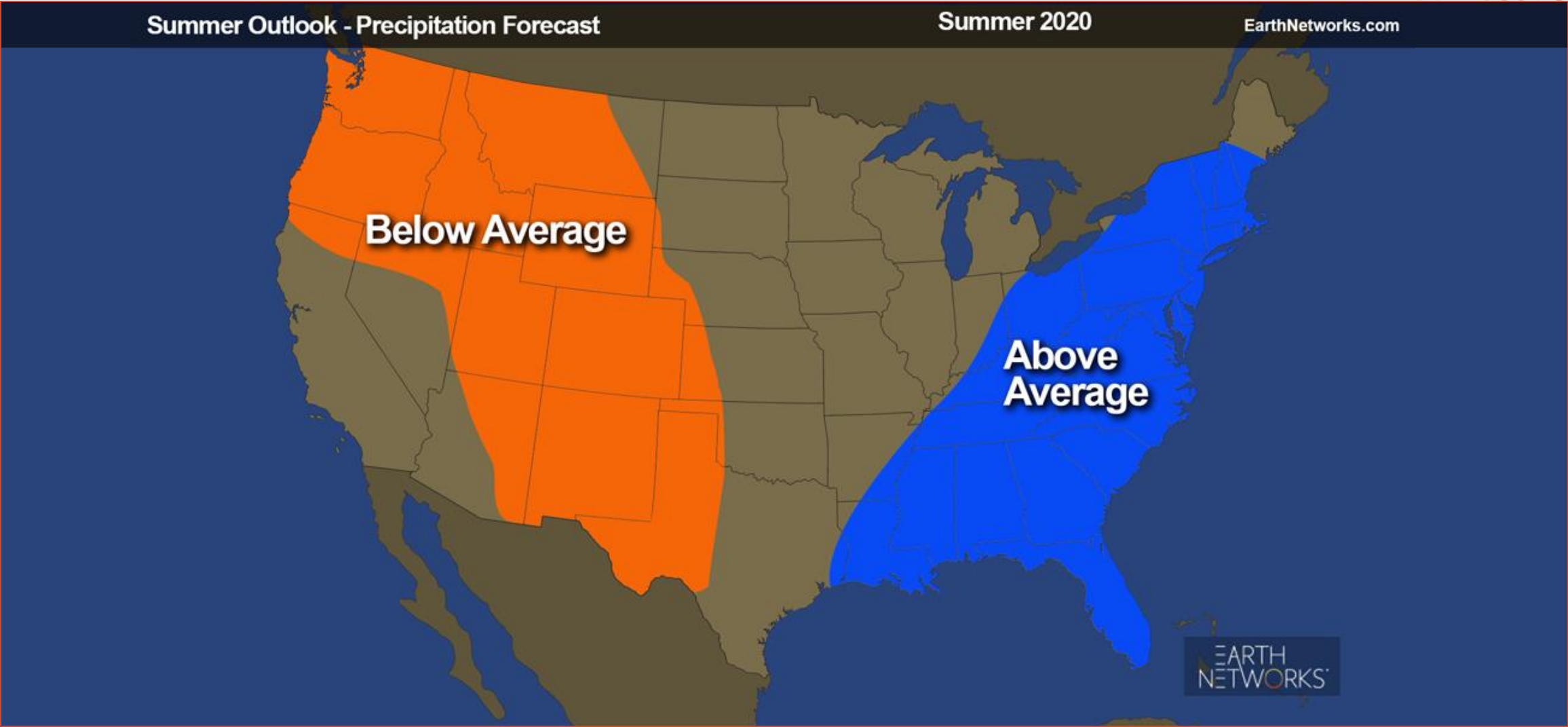
MEAN TEMPERATURE PERCENTILES | JUNE–AUGUST 2020 | RANKING PERIOD: 1895–2020



HOW OFTEN DID LOWS STAY ABOVE 70 DEGREES LAST SUMMER?

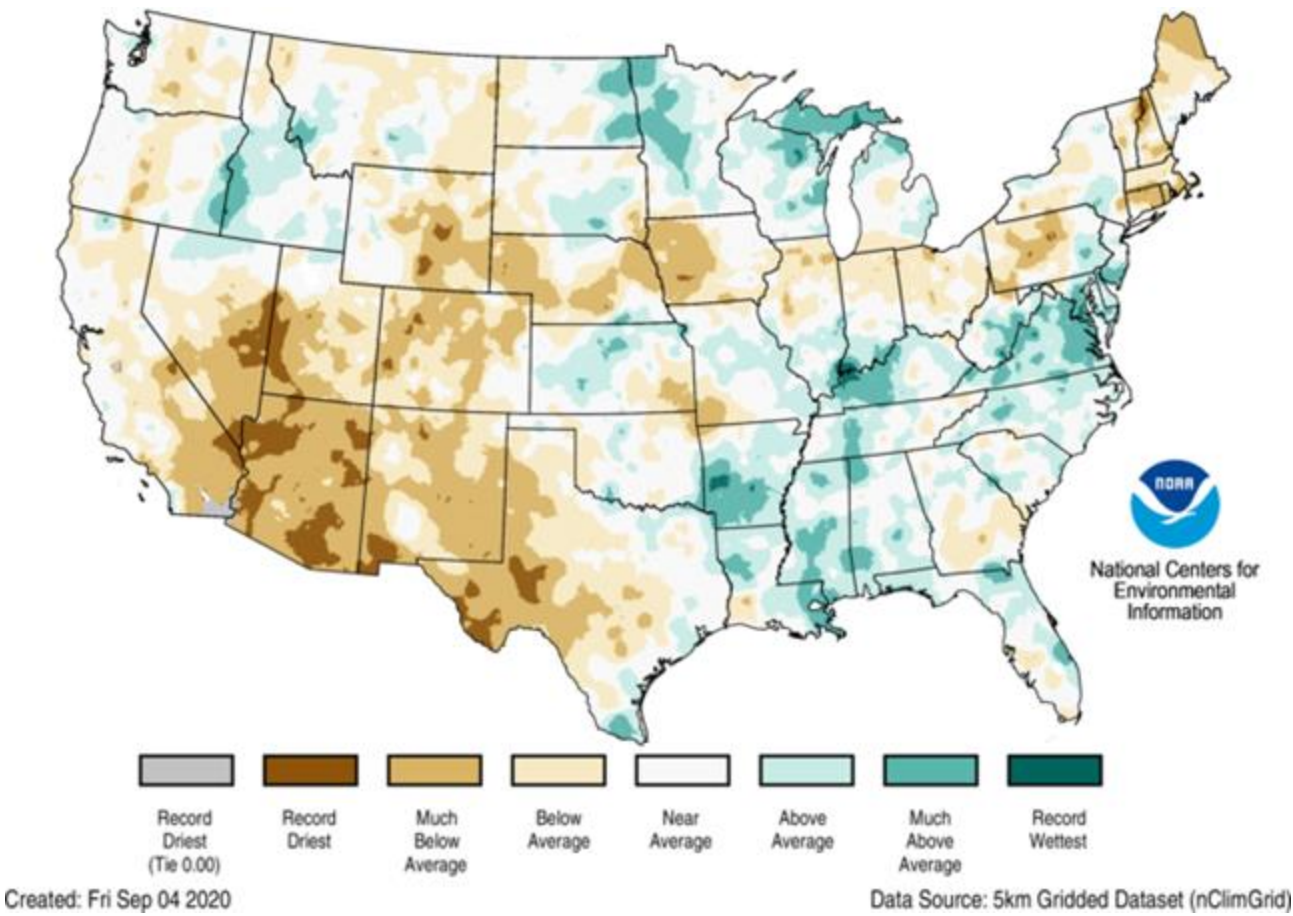


EARTH NETWORKS 2020 OUTLOOK SUMMER PRECIPITATION

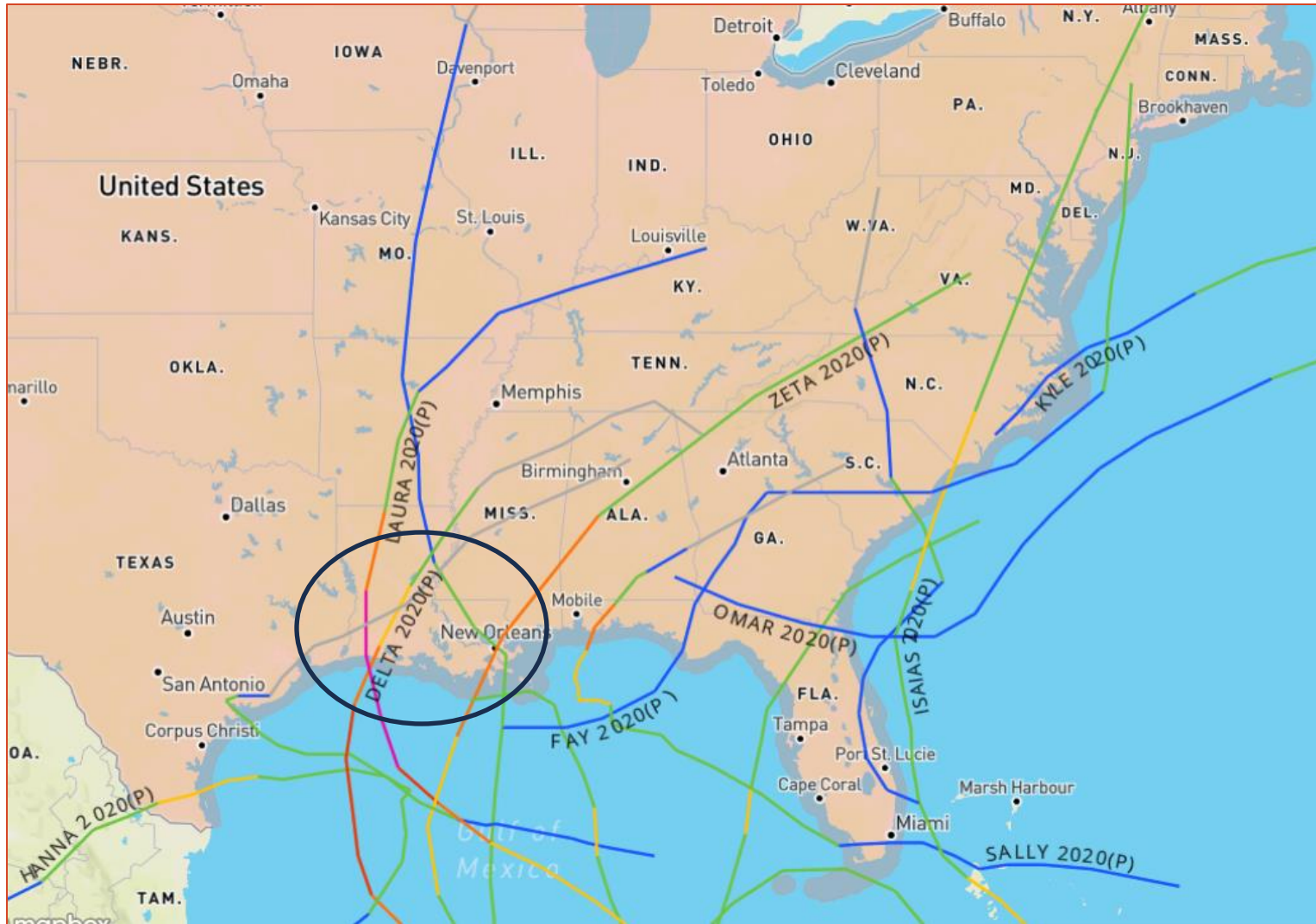


2020 SUMMER PRECIPITATION VERIFICATION

TOTAL PRECIPITATION PERCENTILES | JUNE–AUGUST 2020 | RANKING PERIOD: 1895–2020



2020 TROPICAL LANDFALLS IN CONTINENTAL U.S.



RECORDS:

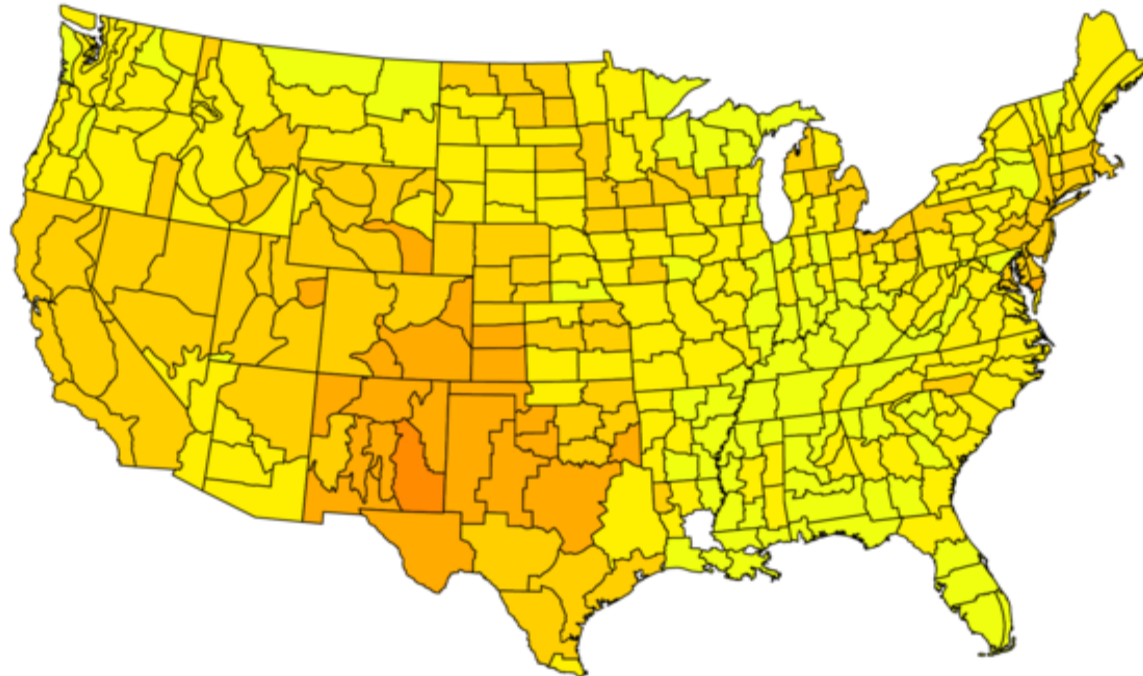
- 30 Storms Across Atlantic Basin
- 11 Landfalls in Continental U.S.
- 4 Landfalls on Louisiana coast

2021 WEATHER NORMALS UPDATE



SUMMER CHANGES IN NORMALS

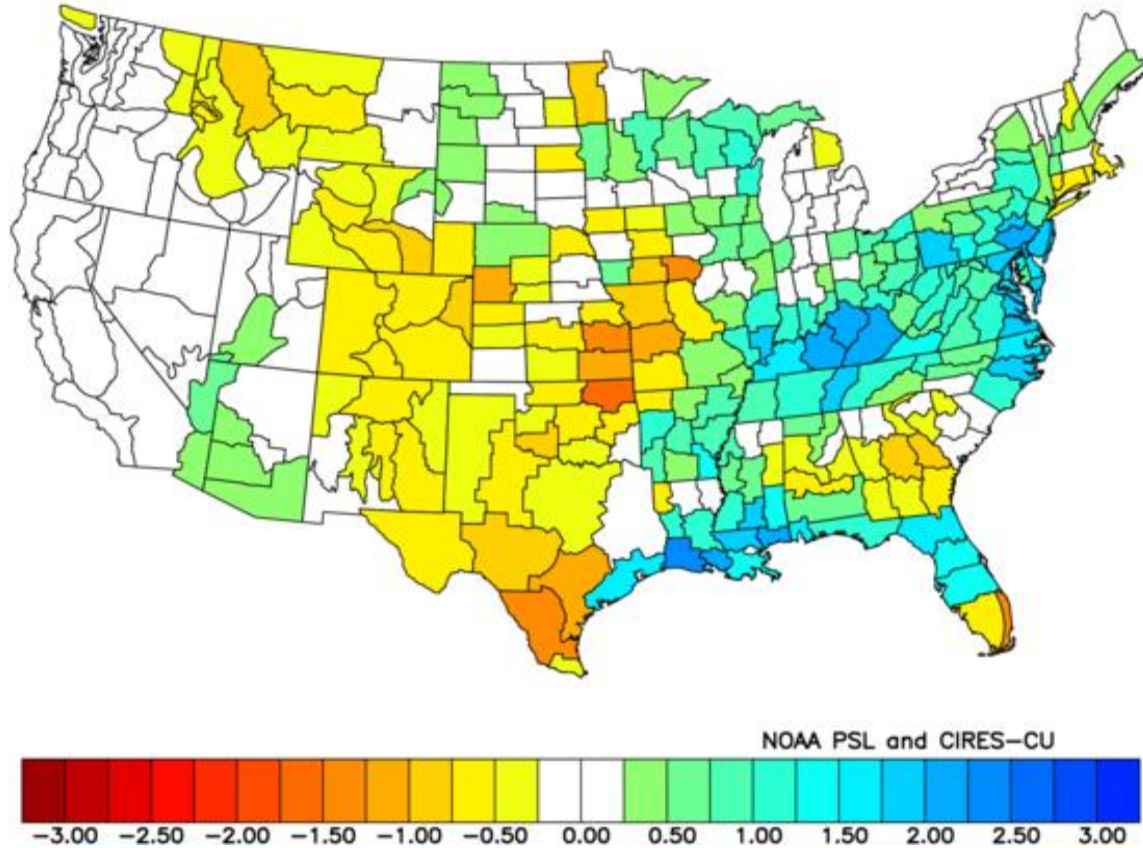
NOAA/NCEI Climate Division Composite Temperature Anomalies (F)
Jun to Sep 2020,2019,2018,2017,2016,2015,2014,2013,2012,2011
Versus 1991–2020 Longterm Average



- All areas of the country experienced warming
- Largest warming found across Southwest
- Some warming across coastal Northeast and Mid-Atlantic
- Least warming occurred across Southeast and Gulf Coast

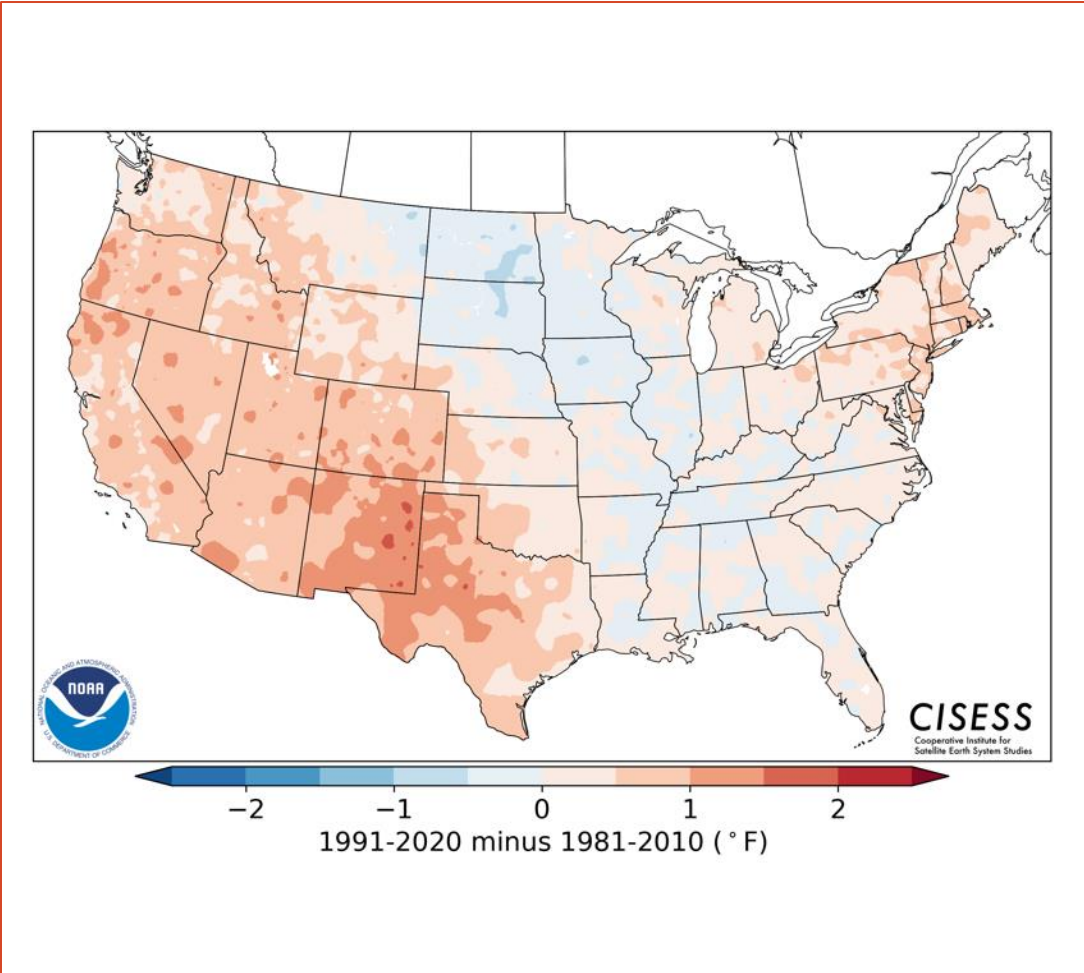
SUMMER CHANGES IN NORMALS

NOAA/NCEI Climate Division Composite Precipitation Anomalies (in)
Jun to Sep 2020,2019,2018,2017,2016,2015,2014,2013,2012,2011
Versus 1991–2020 Longterm Average

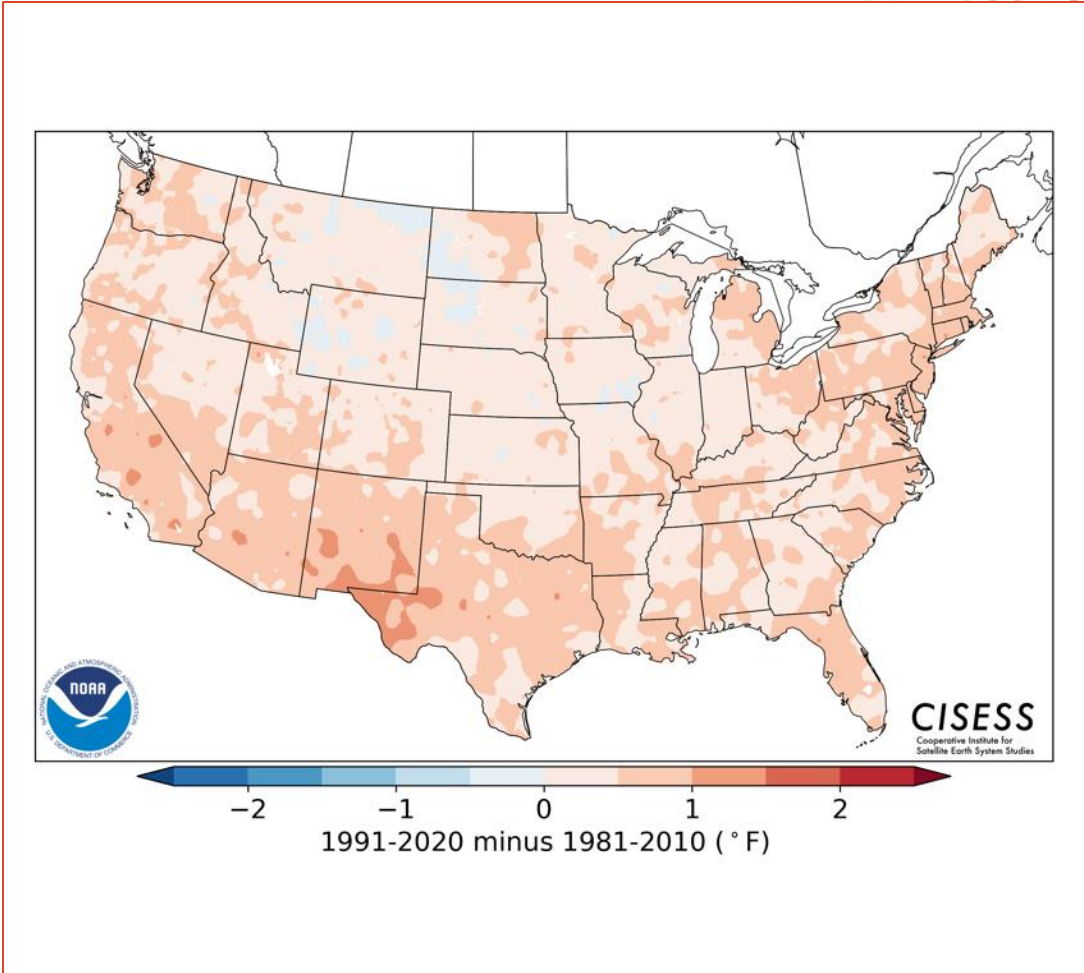


- Much drier across Rockies into Texas
- West was also drier, wet anomaly in the Colorado Basin
- This is a result of wet summers in 2013, 2014, 2015 and 2017
- Gulf Coast to Northeast have seen wet anomaly in the last 10 years

CHANGES IN NORMAL — DAY VS. NIGHT



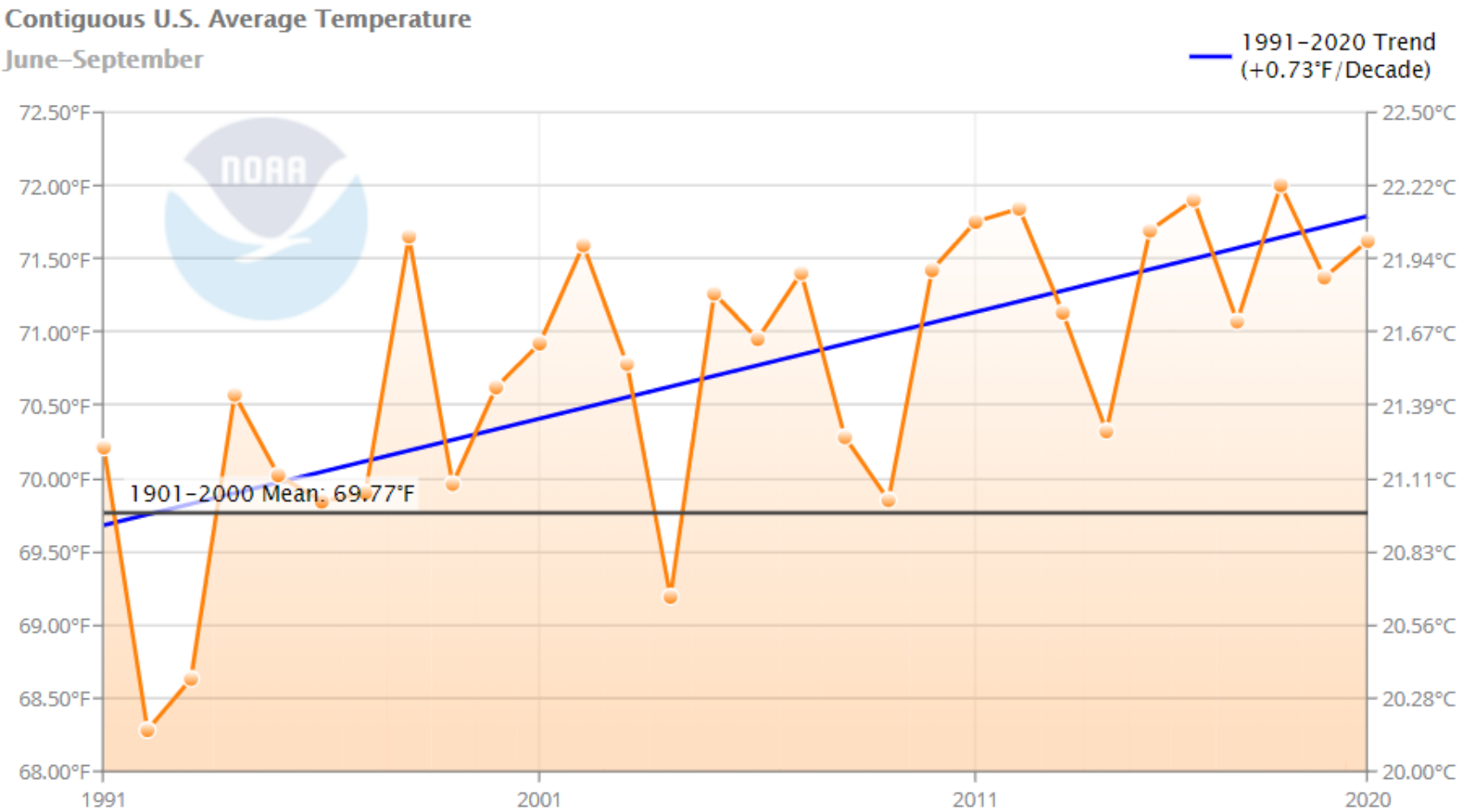
Summer (JJA) Maximum Temperature Change



Summer (JJA) Minimum Temperature Change

U.S. SUMMER TEMPERATURE TRENDS

JUNE–SEPTEMBER



SUMMER 2021 OUTLOOK

We are forecasting the overall
rainfall and temperature trends
expected for the months of:

JUNE, JULY, AUGUST
& SEPTEMBER



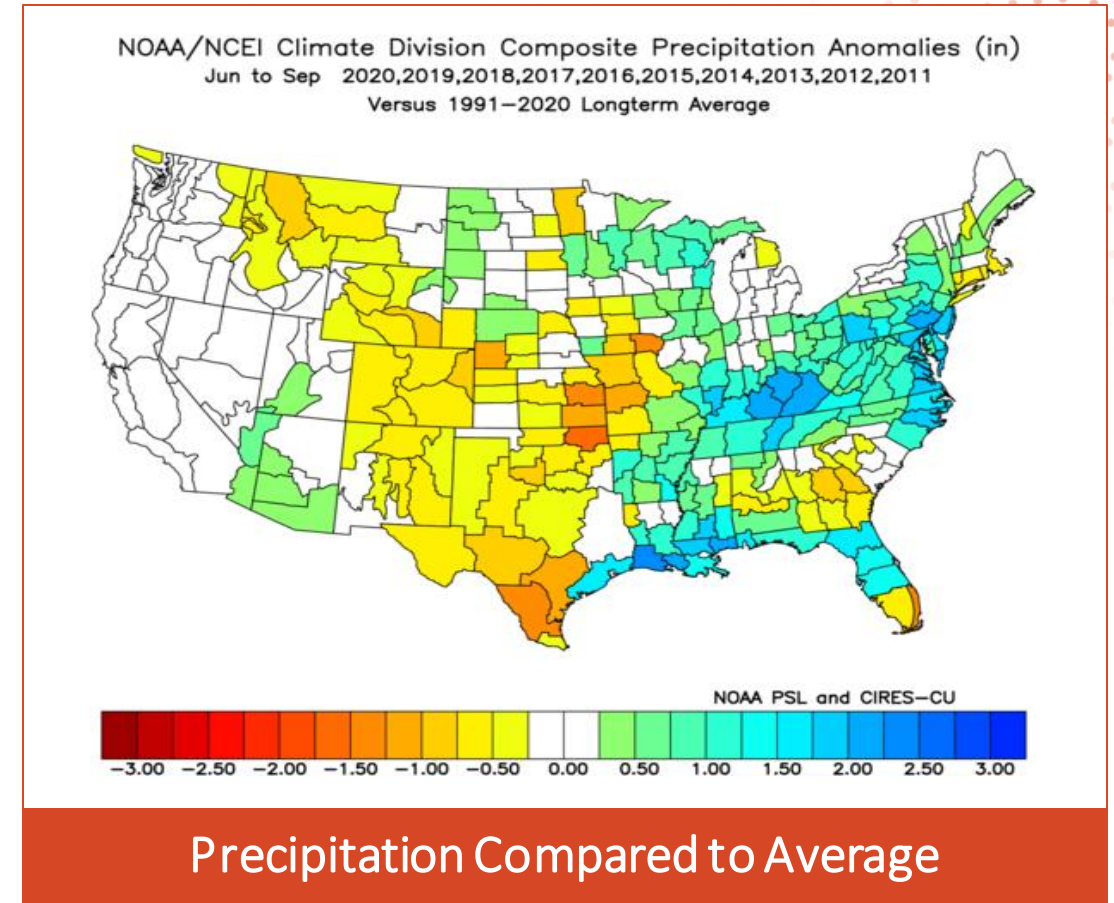
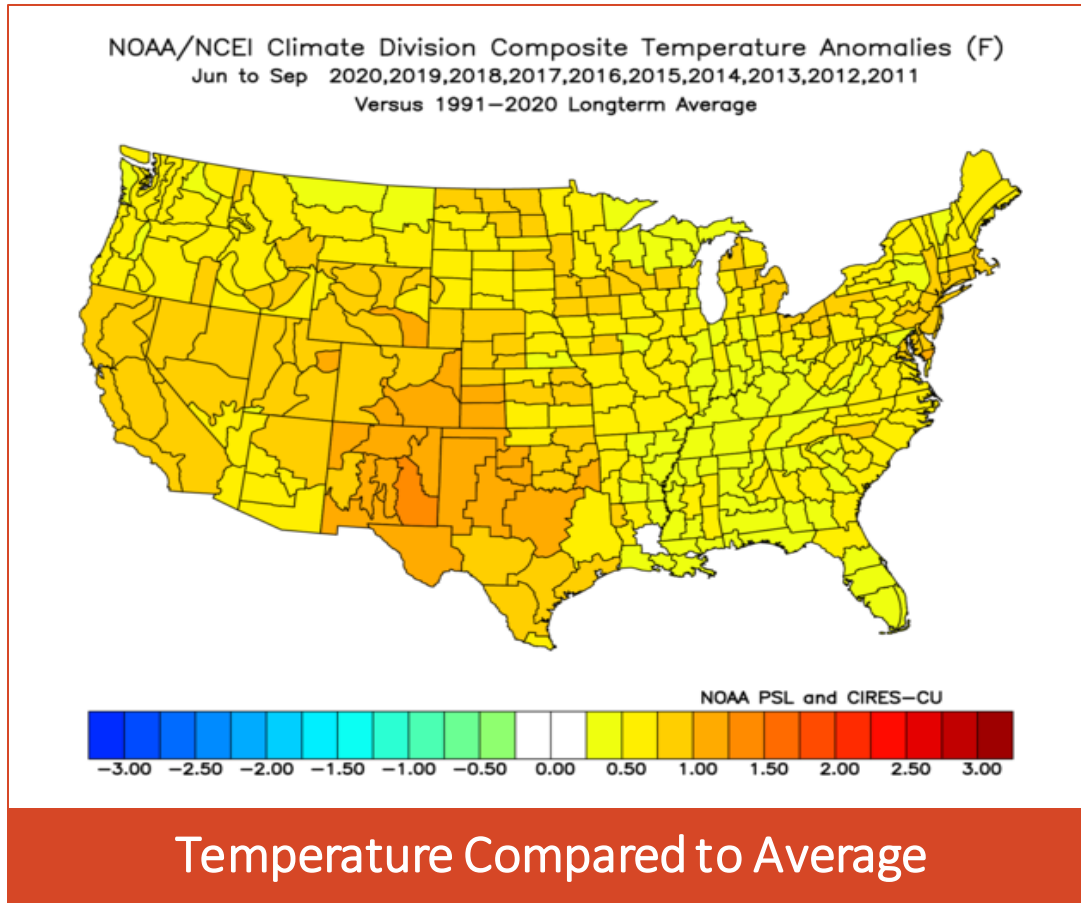
HOW THESE FACTORS RANKED IN OUR SUMMER 2021 OUTLOOK

STRONGEST SIGNALS NOTED IN ORDER OF IMPORTANCE

- **40%:** Recent Temperature & Rainfall Trends
- **40%:** Current and forecast drought conditions
- **10%: Expected Similar ENSO Summers**
(El Niño (Warm Phase), Neutral (Neither cold or warm), La Niña (Cold Phase))
- **10%:** Climate model outlook



TEMPERATURE/RAINFALL TRENDS THE PAST 10 SUMMERS



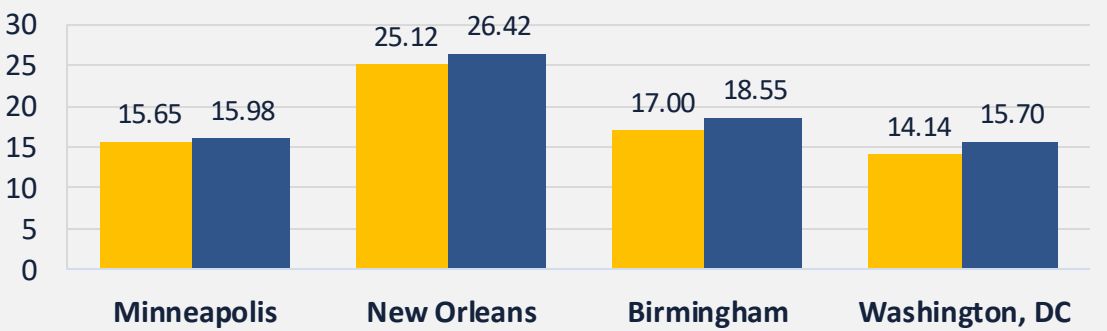
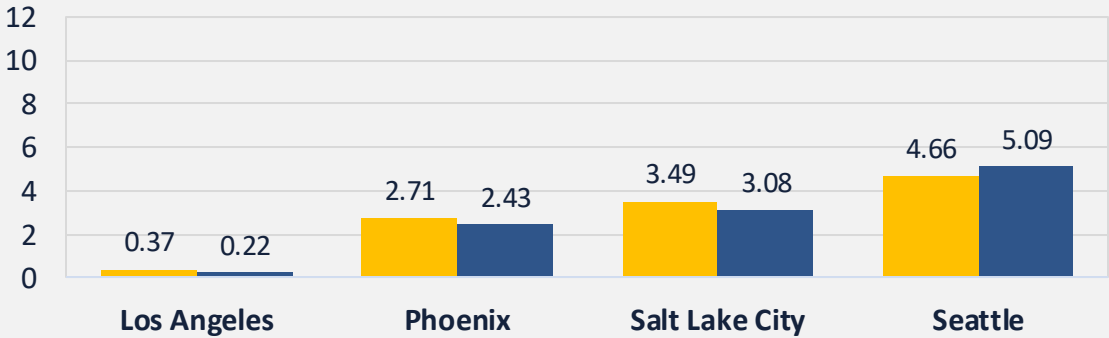
- * **Warm signal** evident across the entire US, most notably in the West and Midwest
- * **Wet signal** in the Midwest, western Gulf Coast and East
- * **Dry signal** from Texas into the Northwest

U.S. SUMMER RAINFALL TRENDS

CHANGE IN 30-YEAR AMOUNTS (JUNE-SEPTEMBER)

STRONGEST SIGNALS NOTED IN ORDER OF IMPORTANCE

City	1981-2010 Rainfall Avg. (in.)	1991-2020 Rainfall Avg. (in.)	% Change	City	1981-2010 Rainfall Avg. (in.)	1991-2020 Rainfall Avg. (in.)	% Change
Los Angeles	0.37	0.22	41% ↓	Minneapolis	15.65	15.98	2% ↑
Phoenix	2.71	2.43	10% ↓	New Orleans	25.12	26.42	11% ↑
Salt Lake City	3.49	3.08	12% ↓	Birmingham	17.00	18.55	8% ↑
Seattle	4.66	5.09	8% ↑	Washington, DC	14.14	15.70	10% ↑



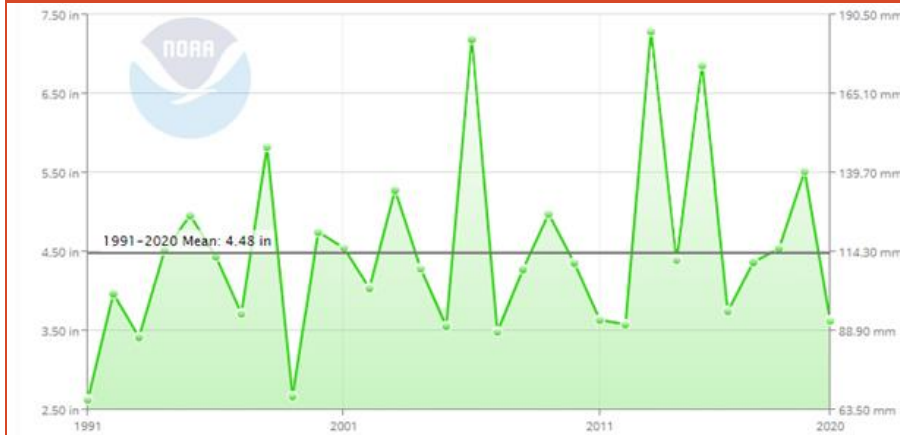
1981-2010 Rainfall Average (inches)



1991-2020 Rainfall Average (inches)

EASTERN U.S. RAINFALL TRENDS

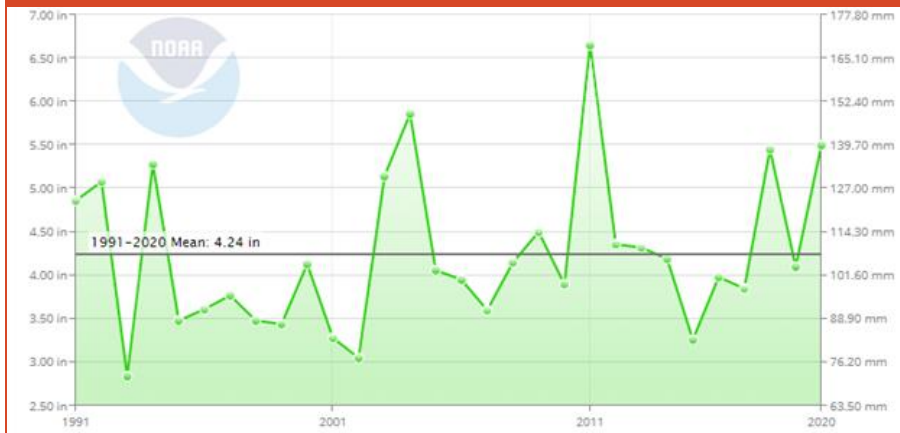
June



July



August



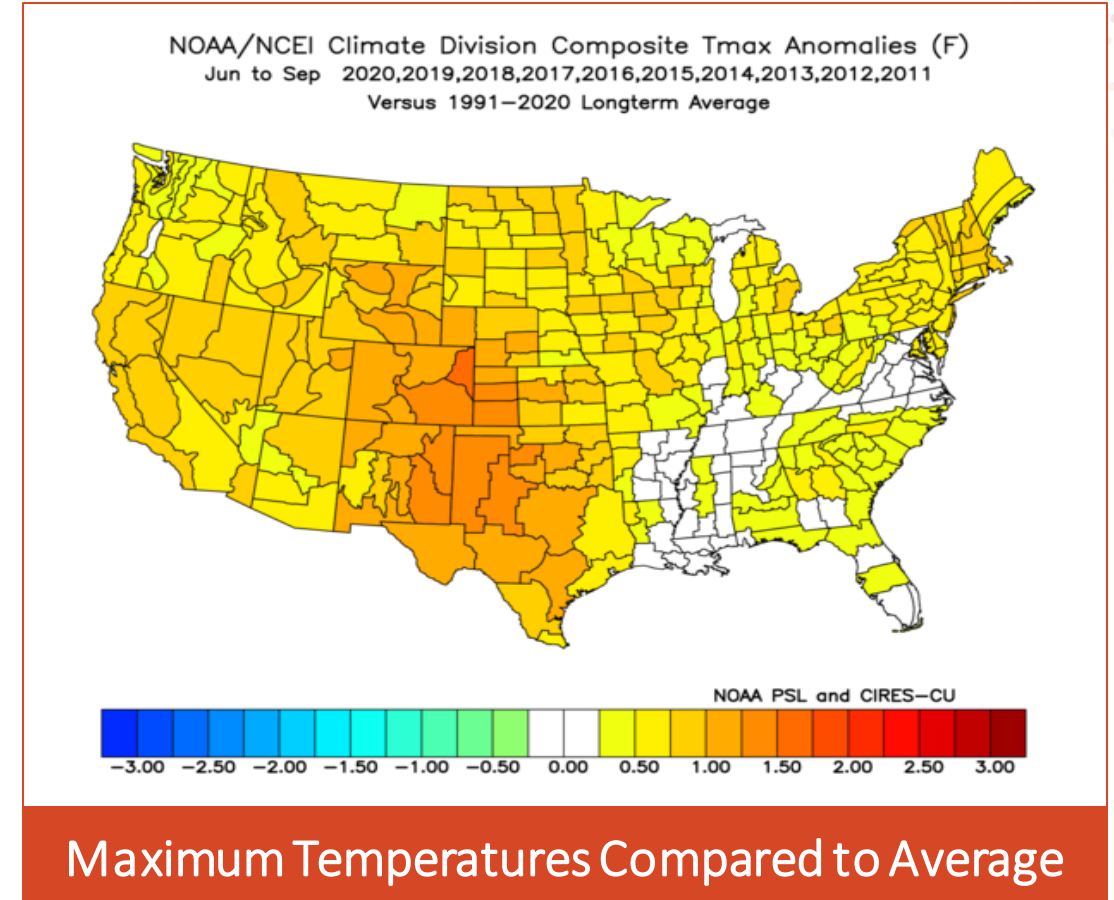
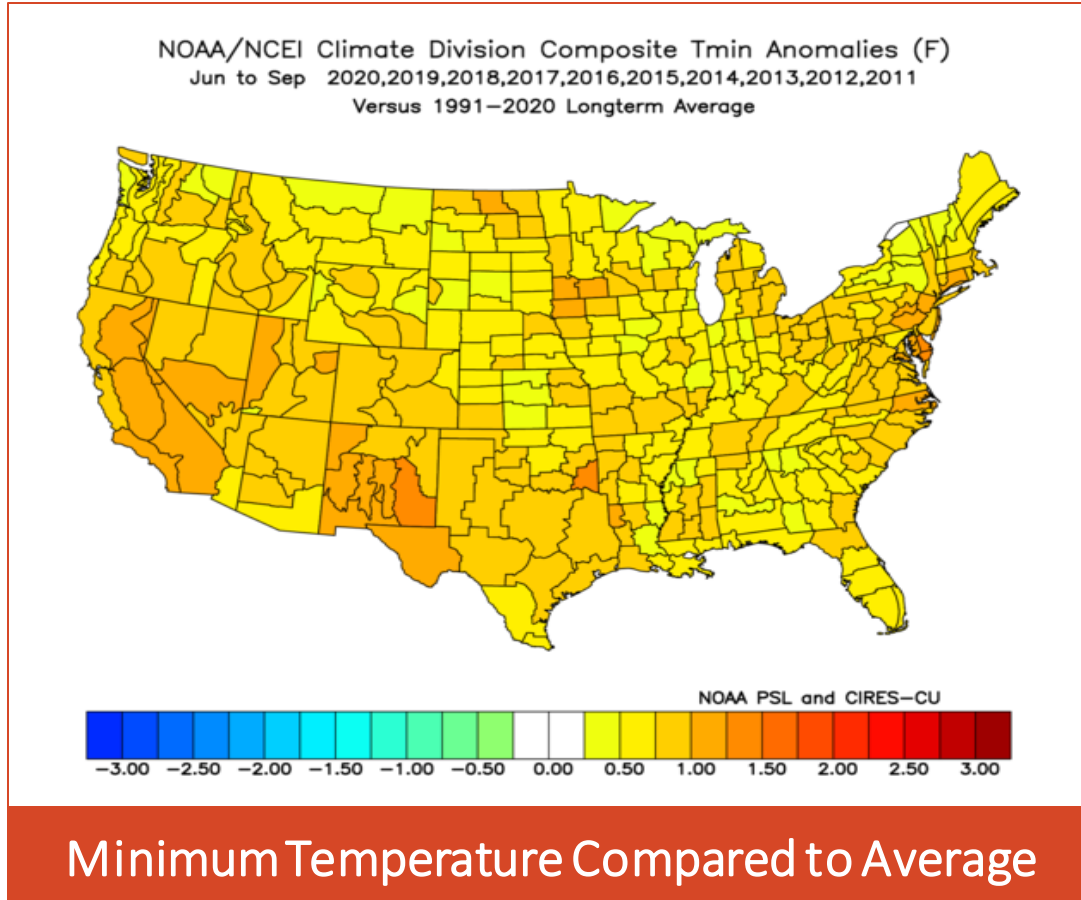
September



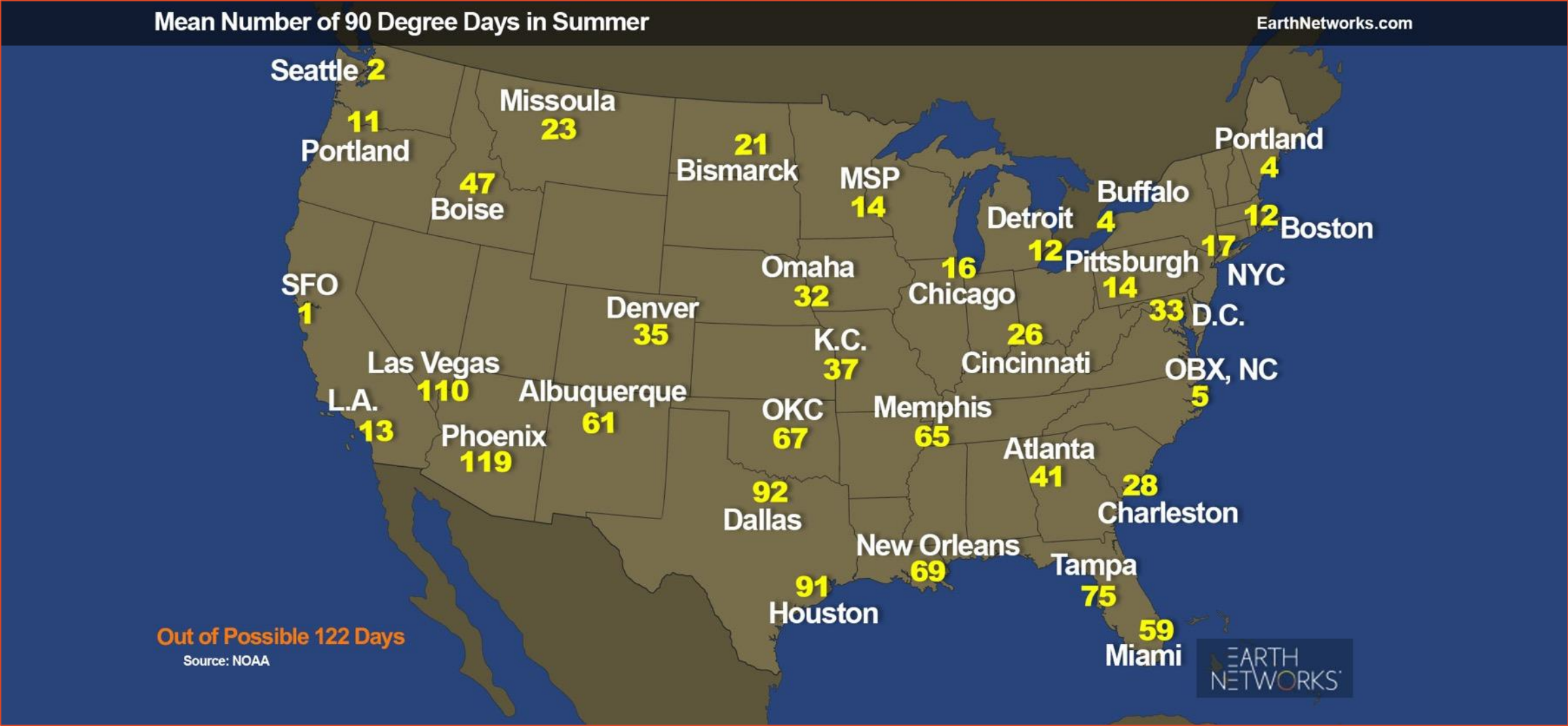
- On average, June and July are the wettest months.
- September is the driest month but shows the highest variability due to influence of an Atlantic or Gulf tropical system.

A CLOSER LOOK AT THE DECADAL TEMPERATURE TRENDS

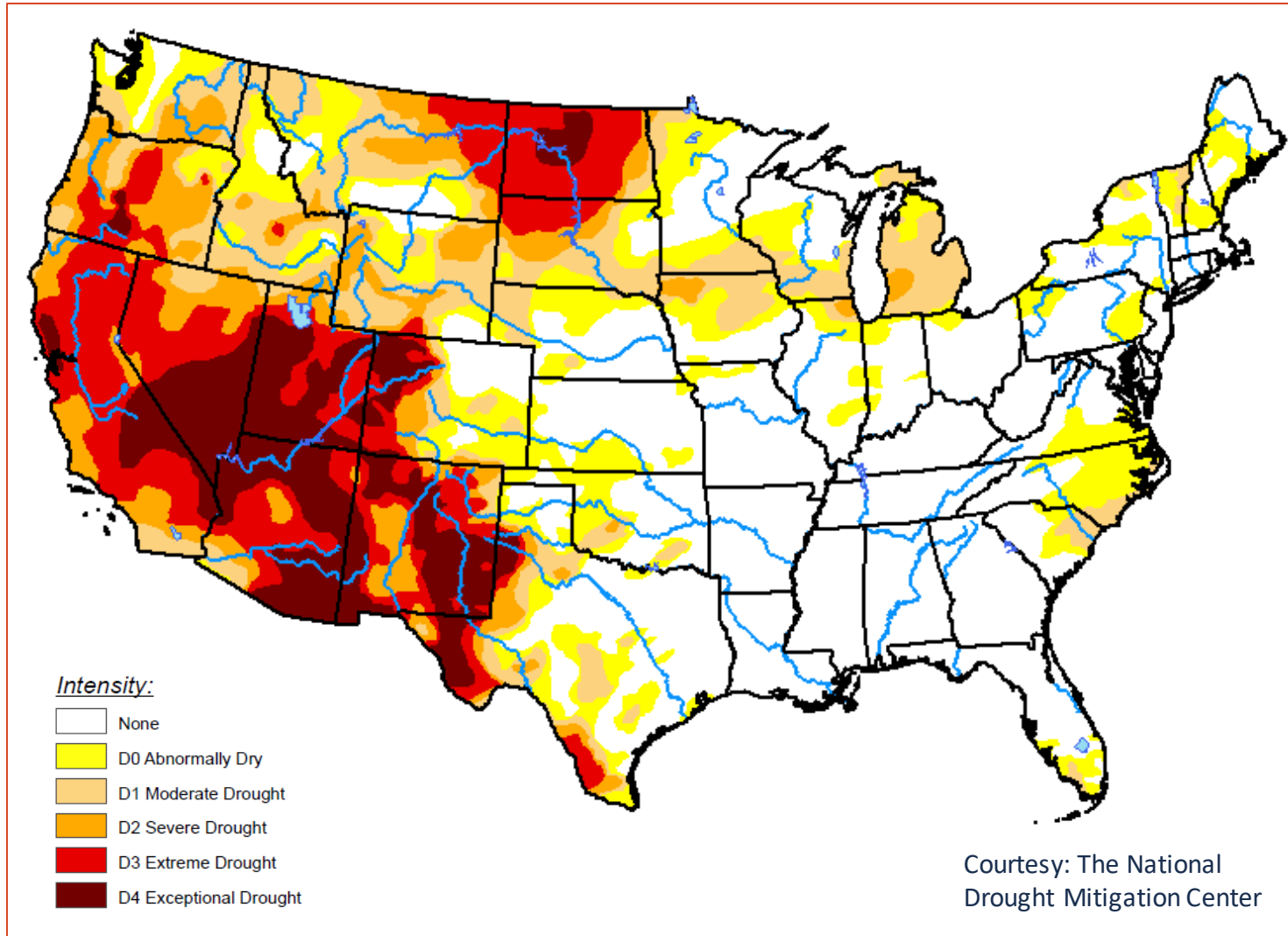
Morning lows trended warmer, particularly in the Southwest and I-95 corridor
Afternoon highs have trended warmer in the West, S. Plains and Midwest



HOW COMMON ARE 90 DEGREE DAYS IN THE SUMMER?



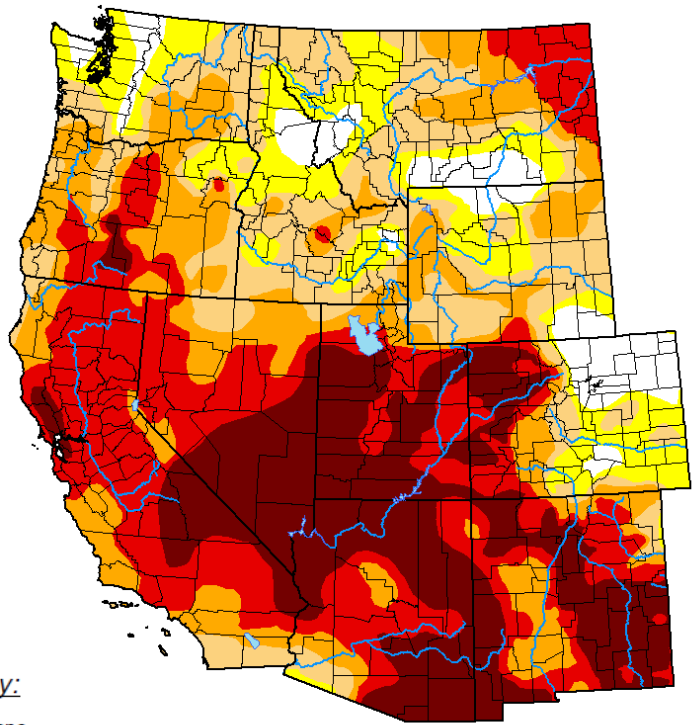
CURRENT DROUGHT CONDITIONS



- Much of the West in a record drought
- Moderate to severe drought stretches across the northern Plains
- Moderate drought noted from the Upper Midwest and Great Lakes into interior New England
- Only patchy dry spots in the Ohio Valley, northern Mid-Atlantic and Southeast Atlantic Coast

WESTERN U.S.: SIGNIFICANT DROUGHT DEVELOPED OVER THE LAST YEAR

Latest Drought Conditions



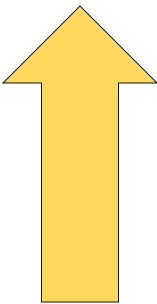
Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Courtesy: The National
Drought Mitigation Center

Western Drought Coverage Compared to Last Year

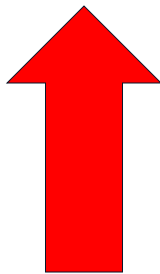
NOW: 83%



May 2020: 39%

Drought

NOW: 46%



May 2020: 3%

Extreme drought

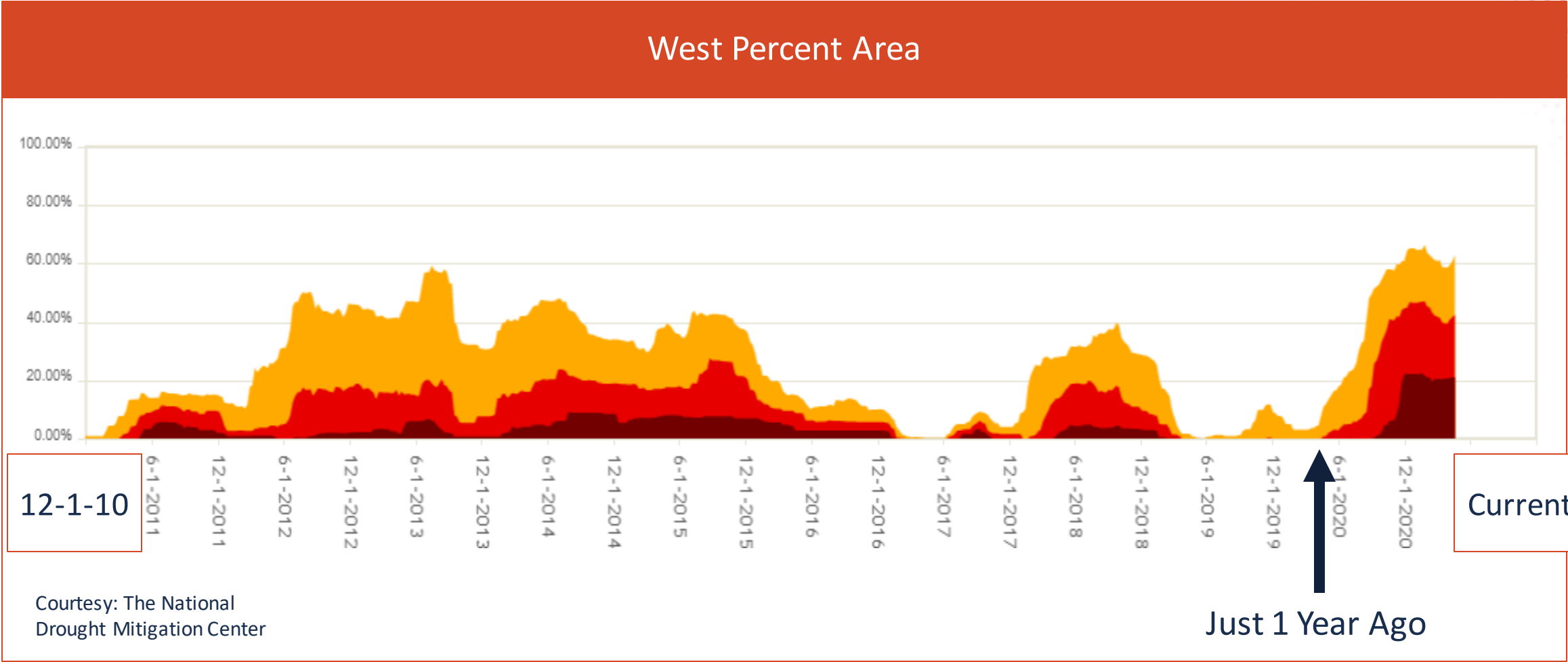
NOW: 22%



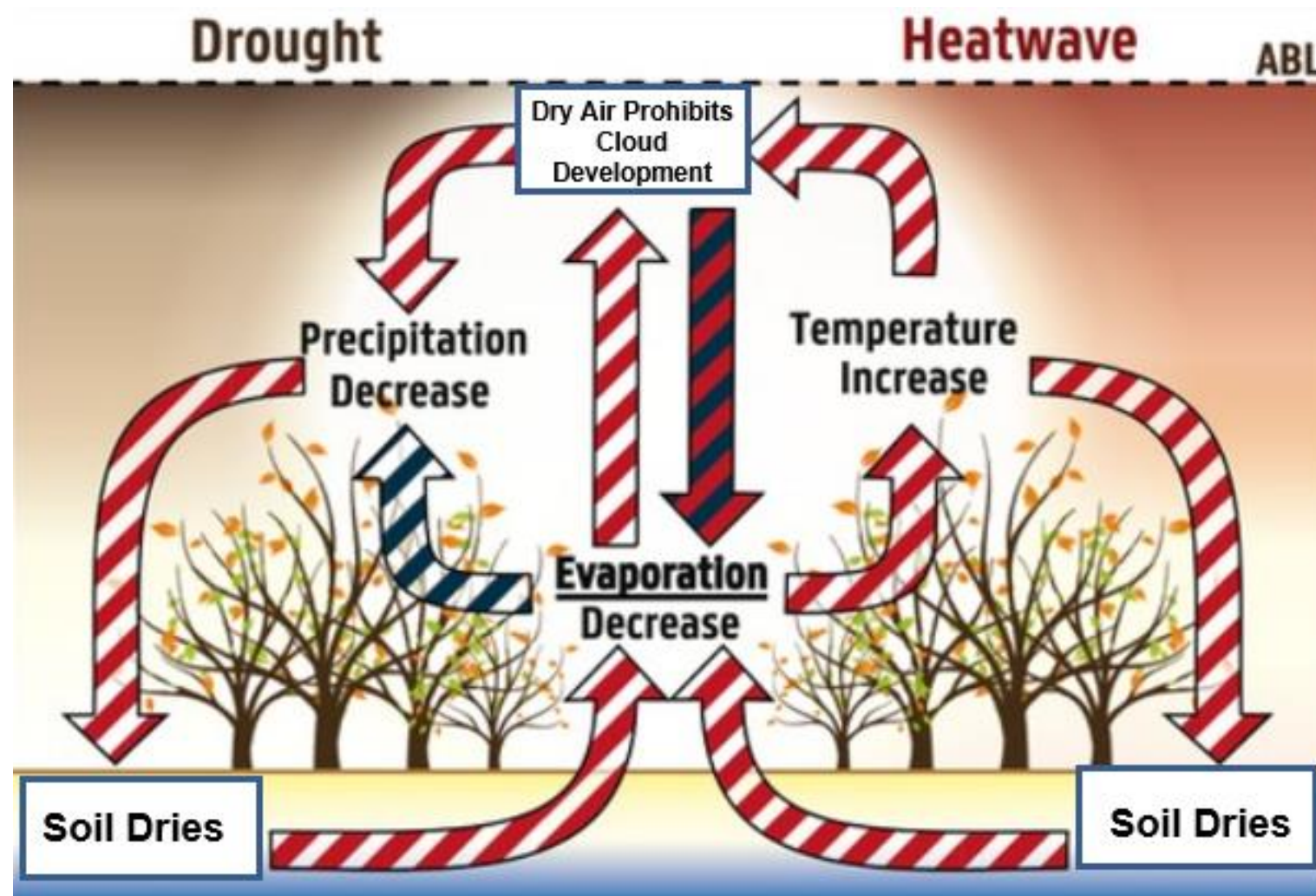
May 2020: 0%

Exceptional drought

WESTERN U.S. EXCEPTIONAL DROUGHT COVERAGE AT ITS HIGHEST COMPARED TO LAST 10 YEARS

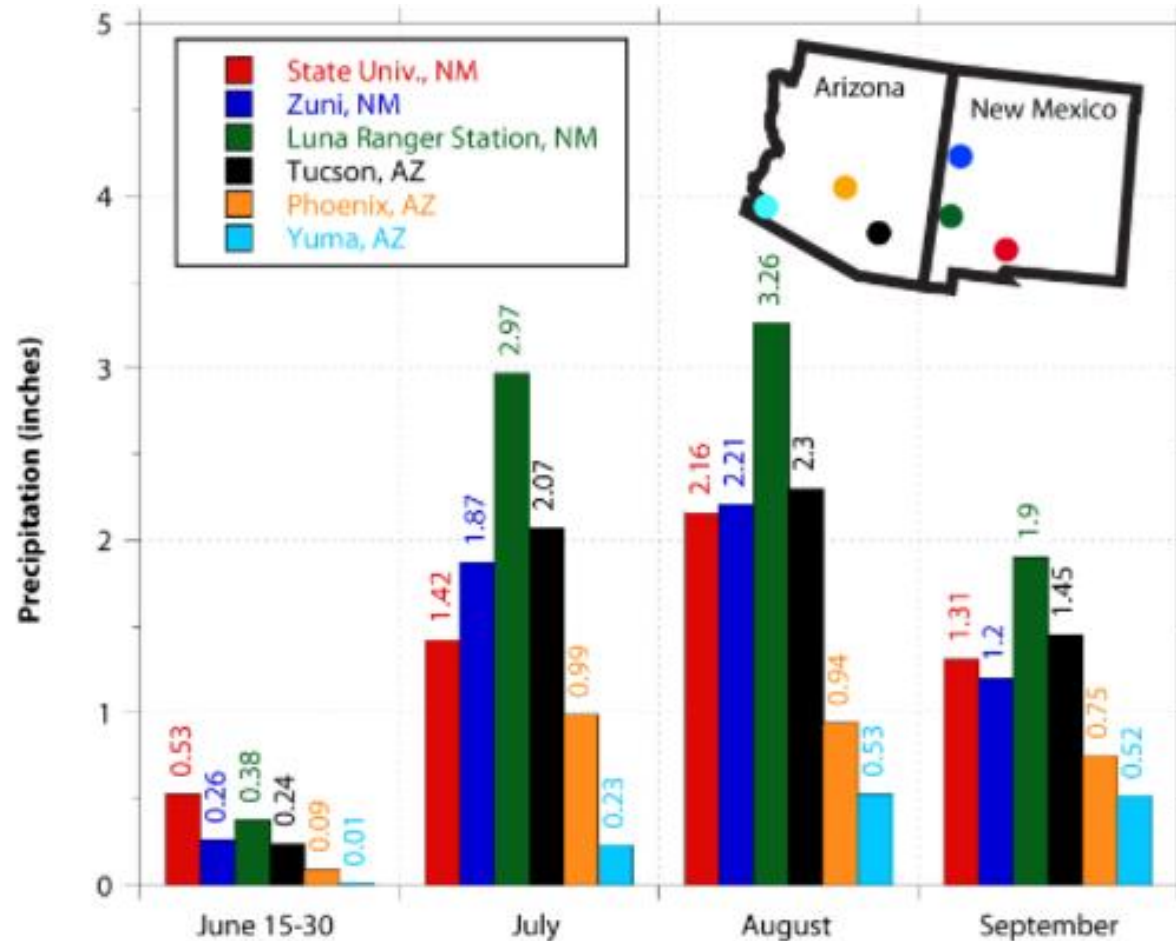


DROUGHT FEEDBACK: LESS RAINFALL AND WARMER TEMPERATURES



Courtesy: Annals
of the New York
Academy of Sciences

SOUTHWEST MONSOON SUMMER RAINFALL CLIMATOLOGY



Courtesy: The University of Arizona

- Afternoon showers and storms are triggered by difference in air temperature between the desert and adjacent Gulf of California and Pacific Ocean
- Most of the monsoon rain occurs in July and August
- Monsoon season rain accounts for 35-45% of Arizona and New Mexico's annual precipitation

DROUGHT: PRECURSOR TO DRY SOUTHWEST MONSOON SEASON

Figure 1

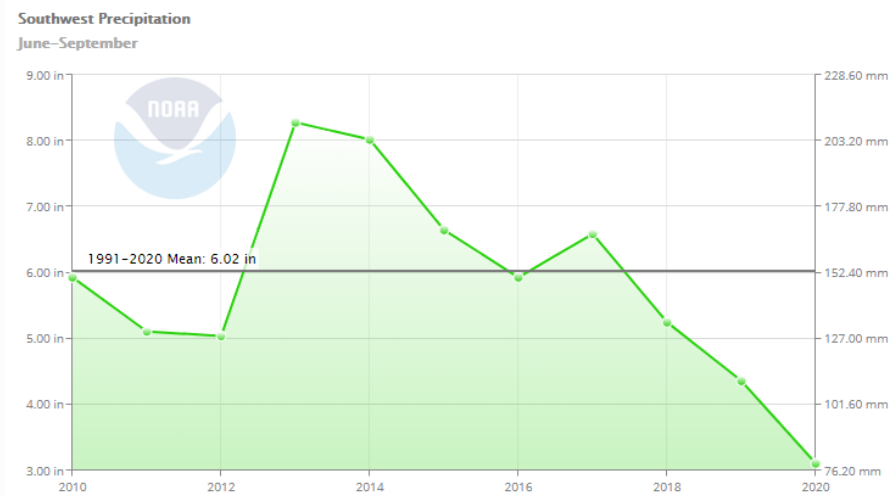
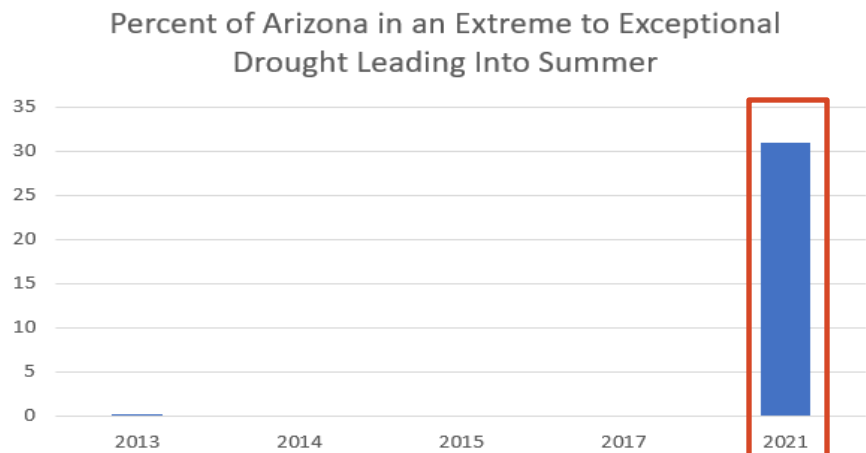


Figure 2

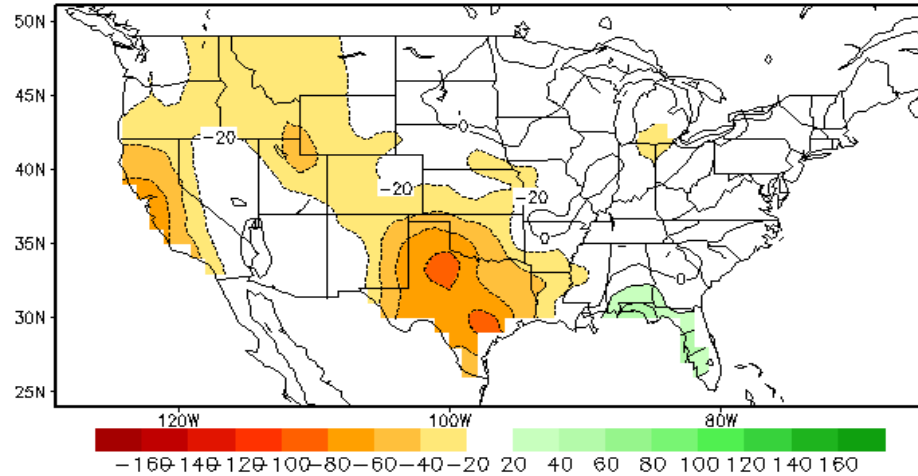


Current

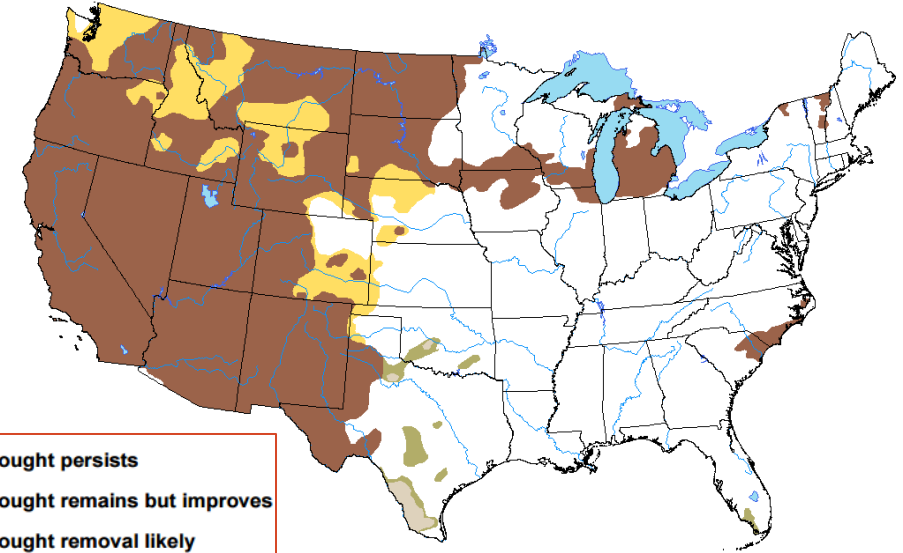
- Over the last 10 summers, 2013, 2014, 2015 and 2017 had above-average rainfall in Arizona. (Figure 1)
- In the May preceding each summer, only 2013 saw extreme to exceptional drought coverage (0.27% of Arizona was in an extreme or exceptional drought). (Figure 2)
- Extreme to exceptional drought as of early May 2021 covers 31% of Arizona! (Figure 2)
- This is a good indication that drought will lead to below-average summer monsoon rain.

SOIL MOISTURE/DROUGHT OUTLOOK

Lagged Averaged Soil Moisture Outlook for End of AUG2021
units:anomaly (mm), SM data ending at 20210427



Soil Moisture Outlook

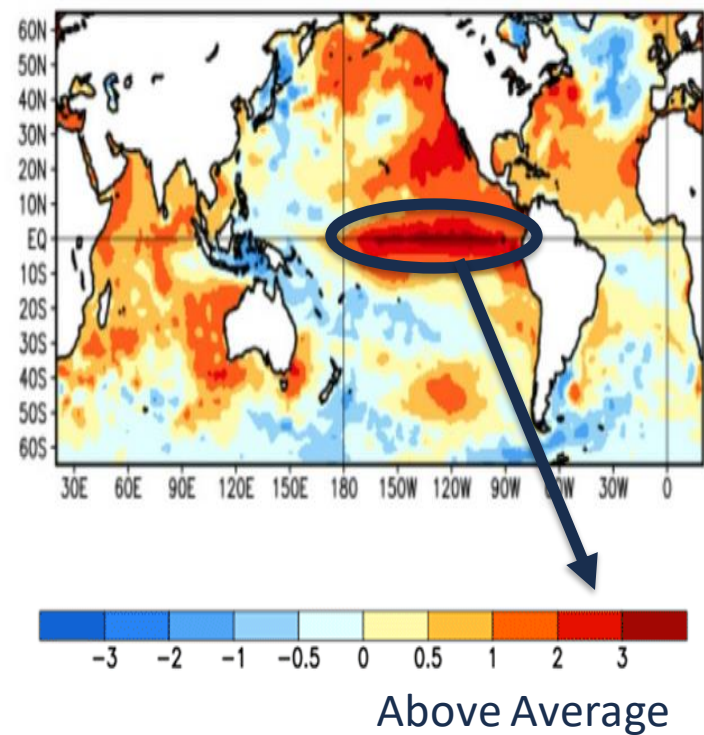


Drought Outlook: Valid Through August 31, 2021

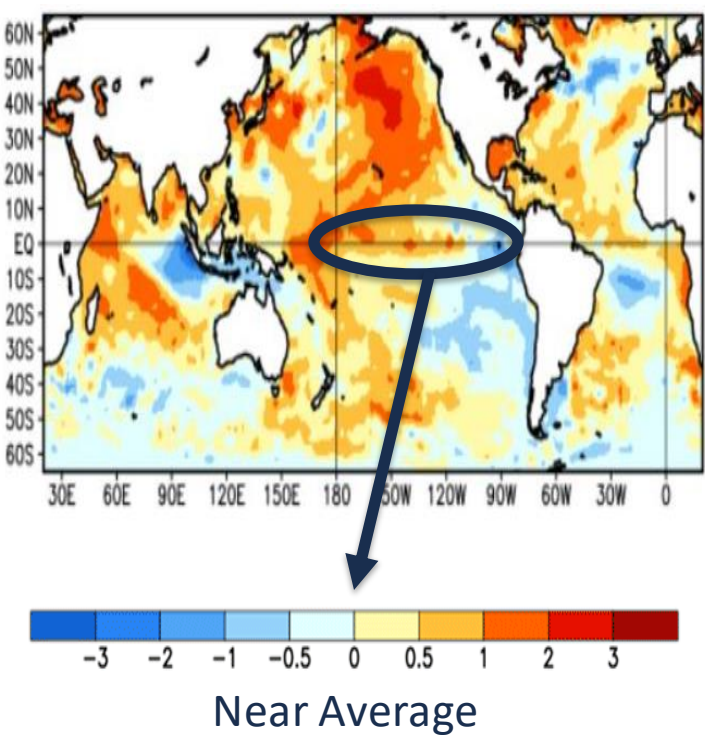
- Drier than average soil will lead to persistent drought in the West
- Drought will expand into the northern Rockies and Texas this summer
- Drought development is not expected in the Great Lakes to interior New England

ENSO: CYCLICAL WARMING AND COOLING CYCLE OF THE EQUATORIAL PACIFIC

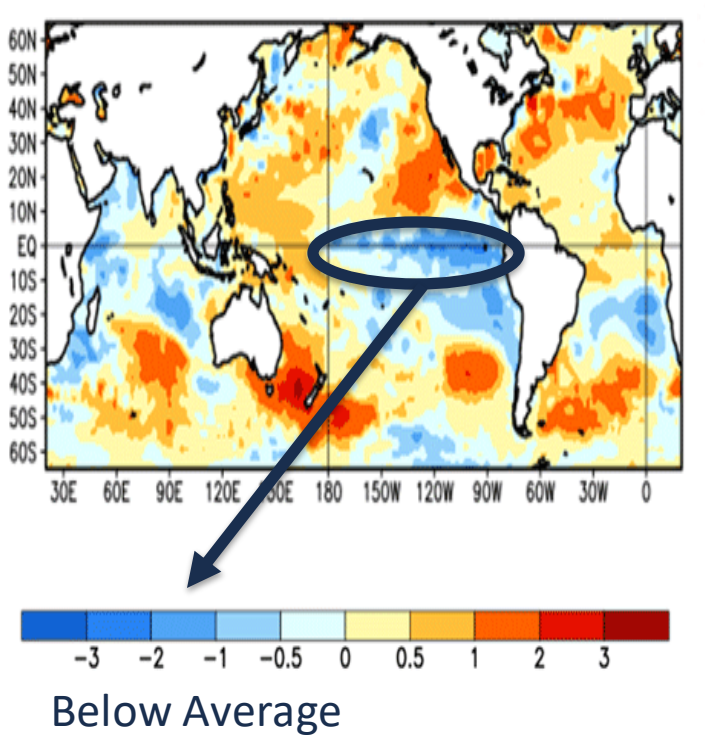
El Niño



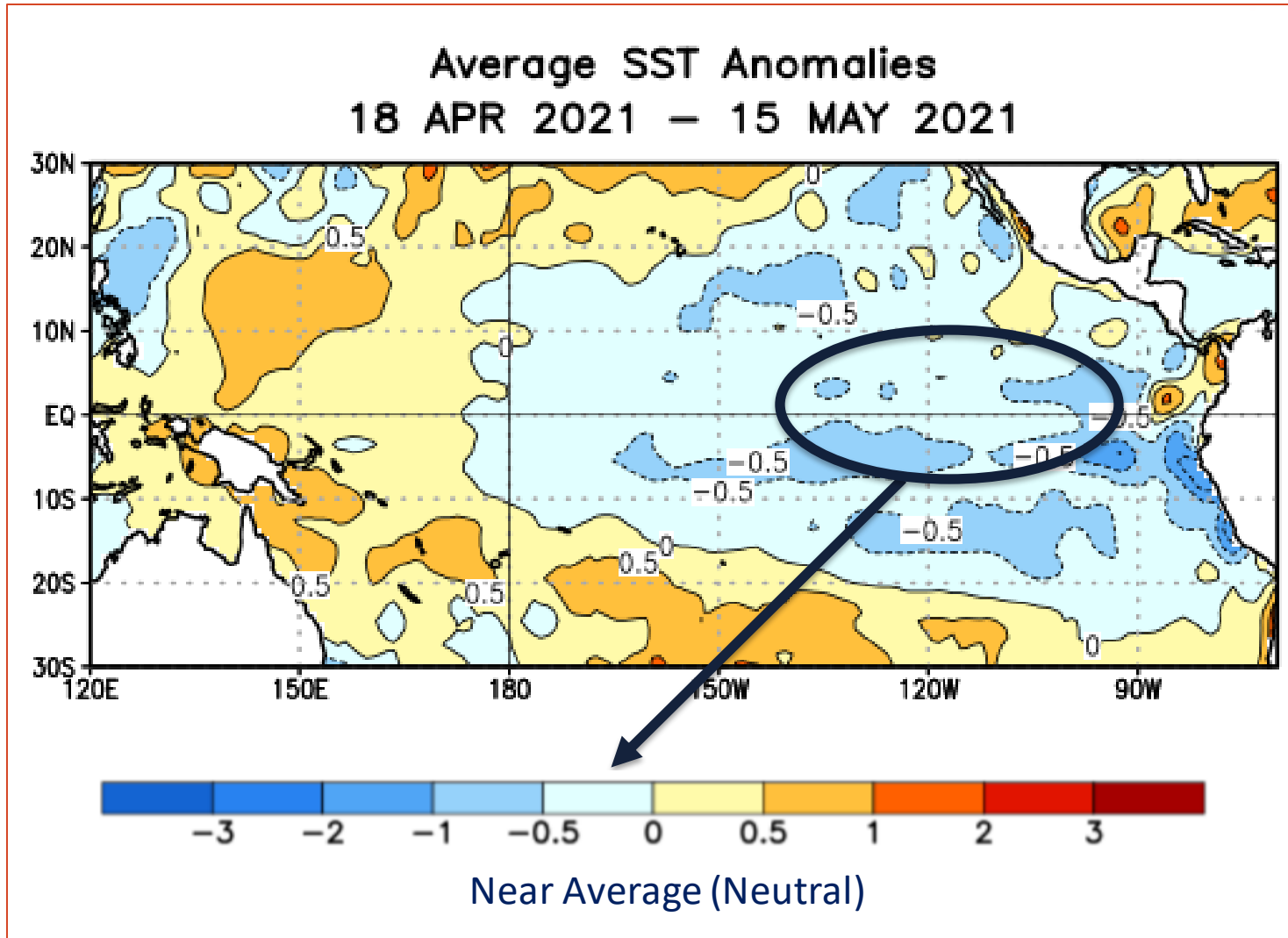
Neutral



La Niña

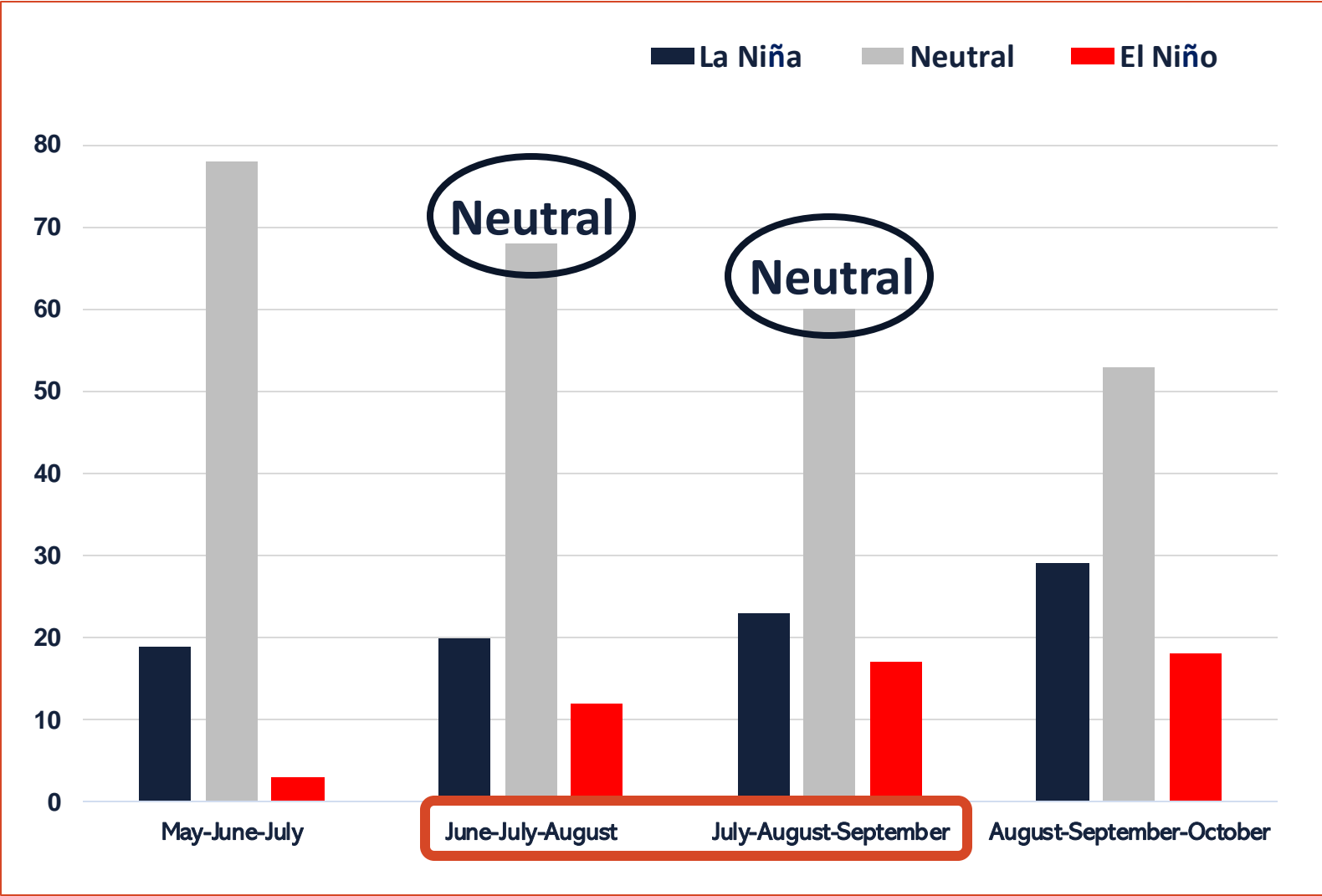


WHICH PHASE IS EXPECTED THIS SUMMER?



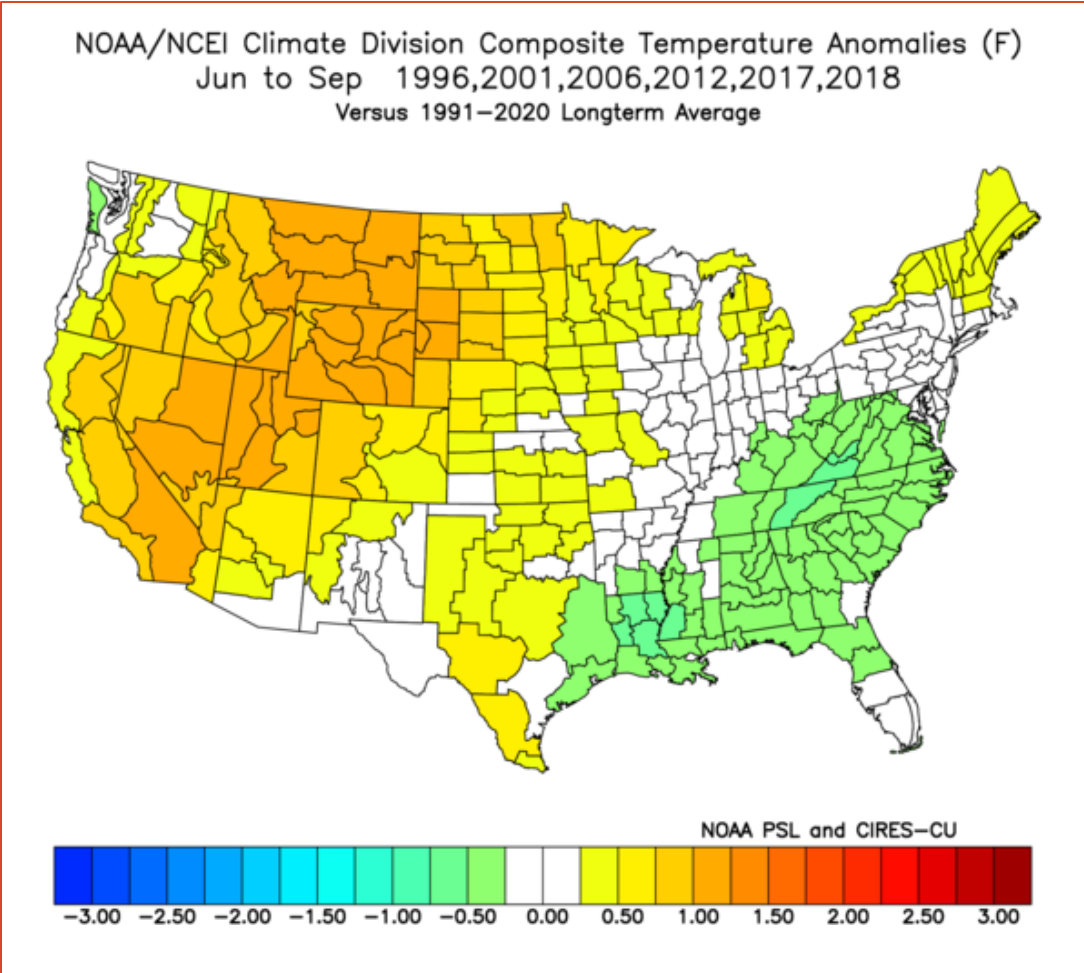
The equatorial
Pacific sea surface
temperatures are
NEAR average.

FORECAST MODEL PROBABILITIES FOR ENSO

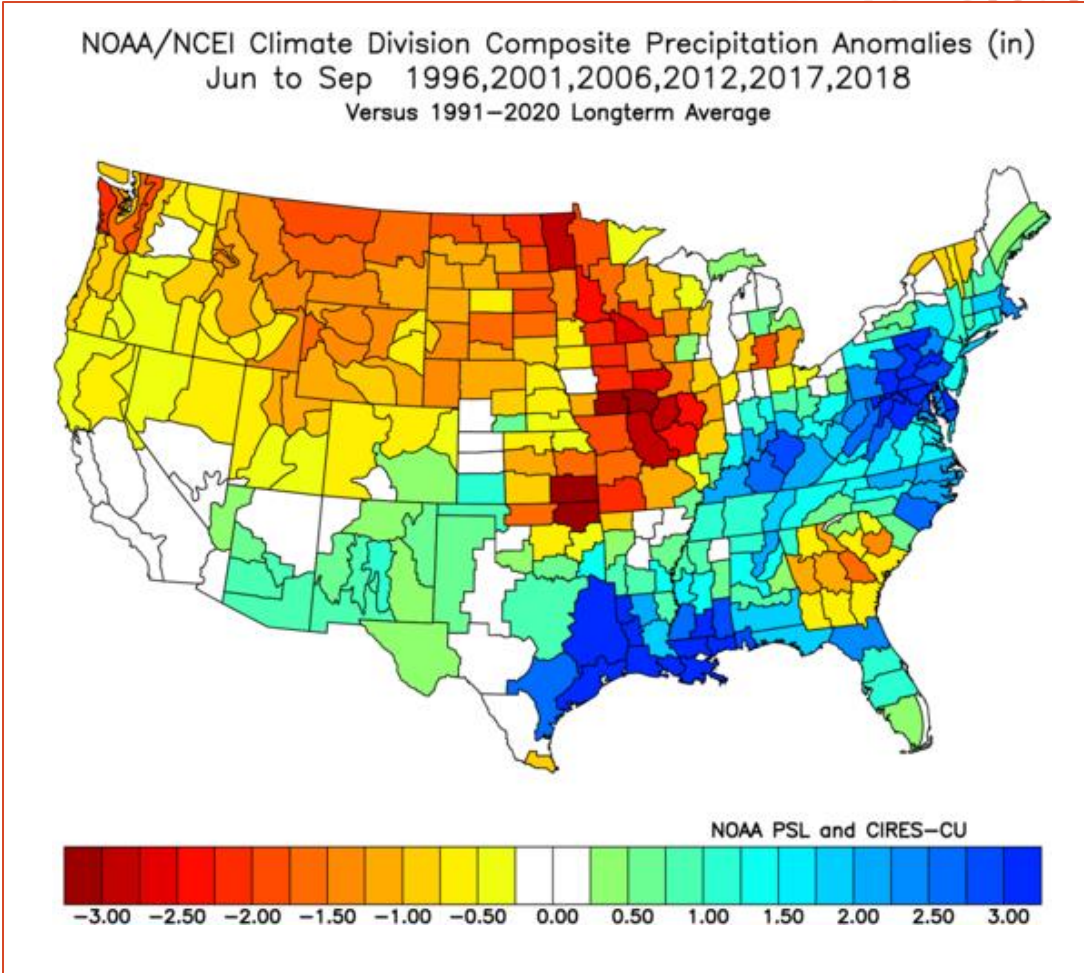


The equatorial Pacific sea surface temperatures are expected to remain NEAR average through September.

BEST MATCHED PREVIOUS ENSO SUMMERS TO 2021

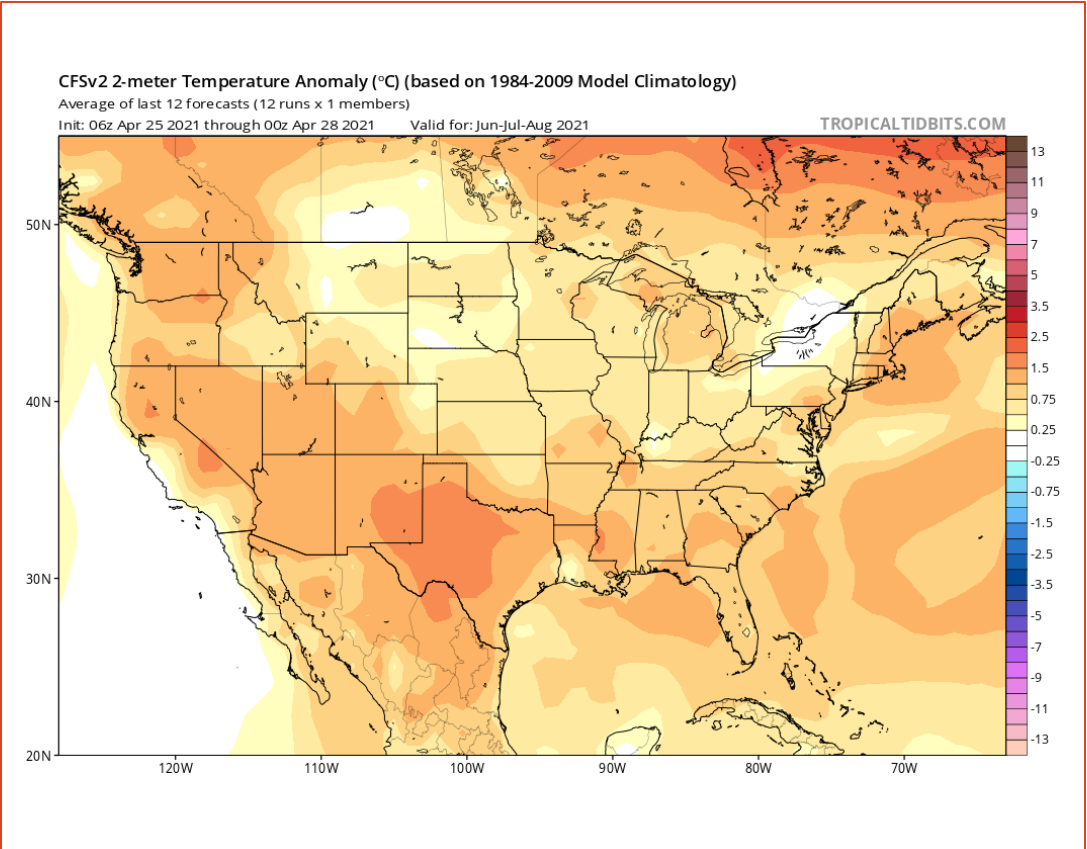


Overall Temperature Departure from Average

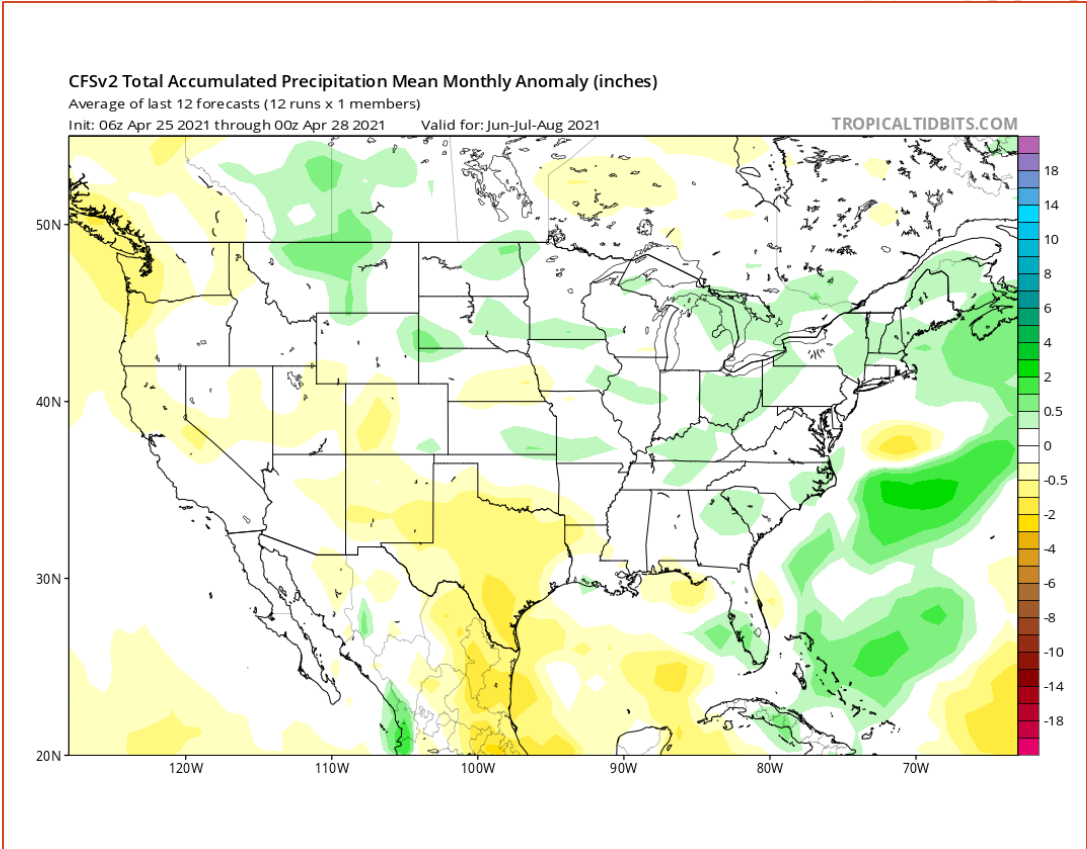


Precipitation Departure from Average

CLIMATE MODEL FORECASTS – TEMPERATURE/RAINFALL



CFS Model Temperature Departure
Forecast for JJA 2021

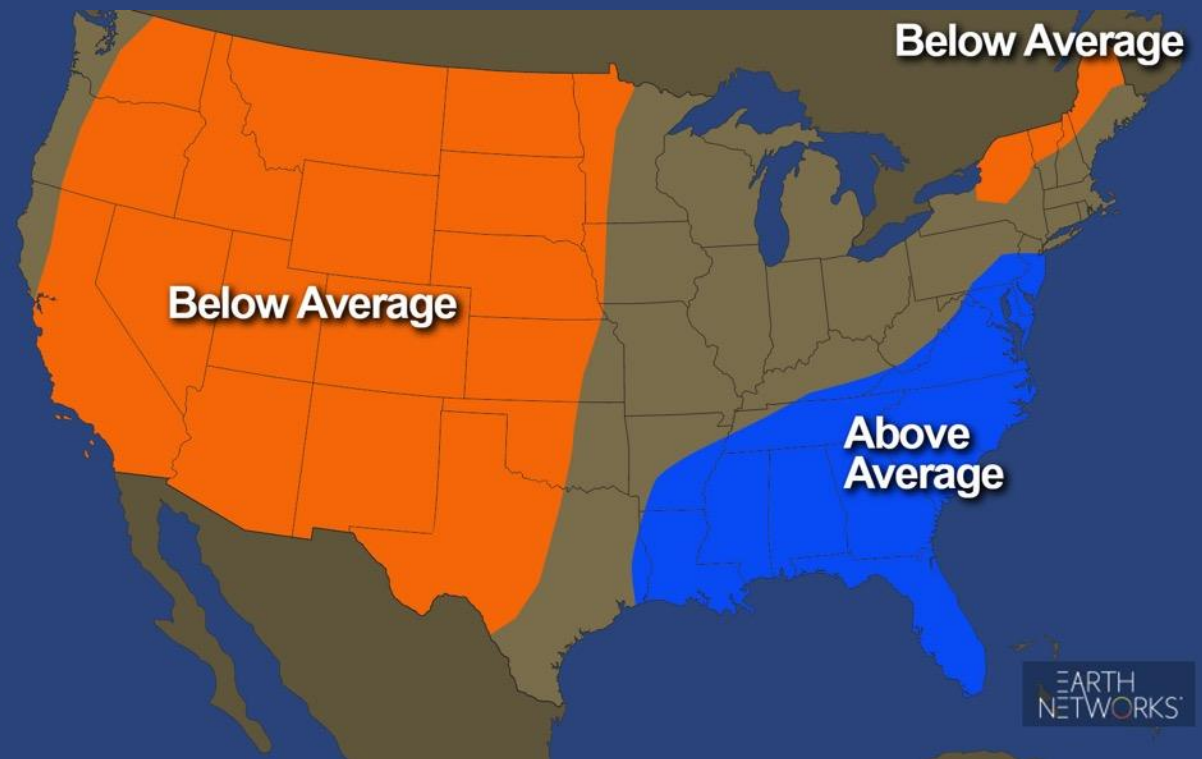


CFS Model Rainfall Departure
Forecast for JJA 2021

EARTH NETWORKS 2021 SUMMER RAINFALL OUTLOOK

REGIONAL HIGHLIGHTS

- Western drought will lead to an active fire season
- Southwest monsoon season will produce less rainfall than average
- Thunderstorms and tropical moisture will likely contribute to above-average rainfall in Southeast and Mid-Atlantic
- Abnormally dry conditions will persist across interior New England
- Mixed signals for rainfall in Midwest, Ohio Valley and eastern New England



EARTH NETWORKS 2021 SUMMER TEMPERATURE OUTLOOK

REGIONAL HIGHLIGHTS

- Much of the U.S. will see warmer than average temperatures
- High temperatures likely to be warmer than average in the West
- Warmer nights will contribute to above-average temperatures in the East
- Enhanced rainfall potential along Central Gulf Coast leads to mixed temperature signals
- No strong signals for warmth or cooling in the Upper Great Lakes



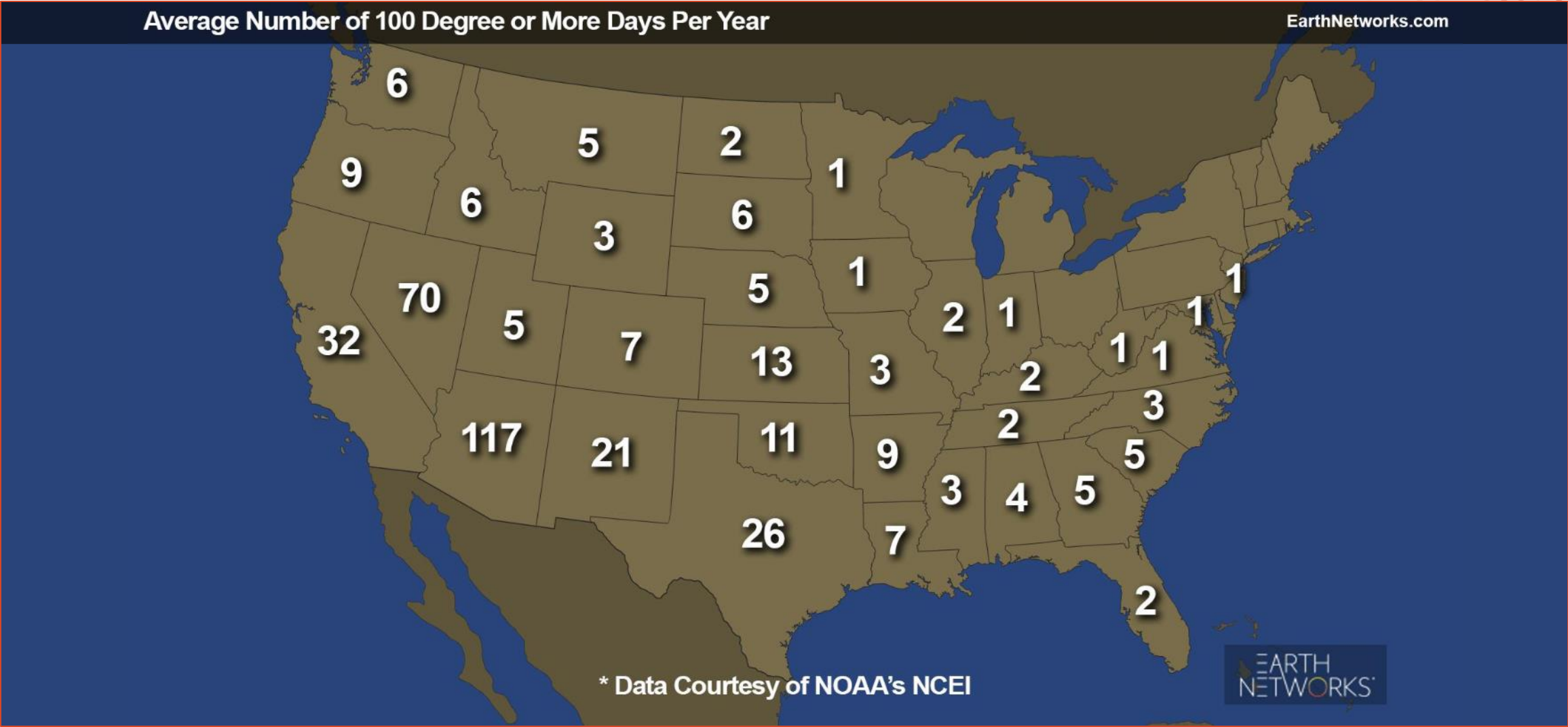


THANK YOU

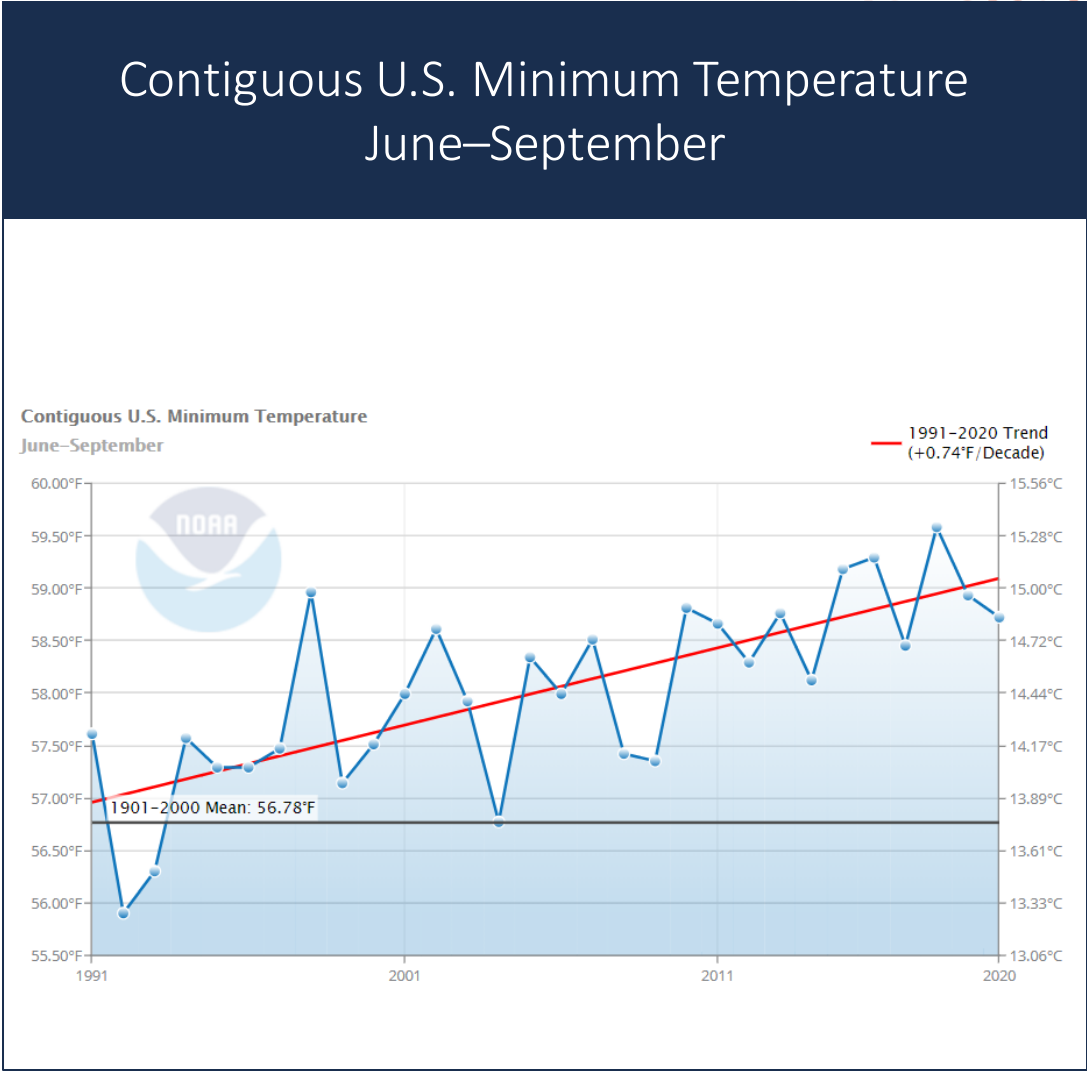
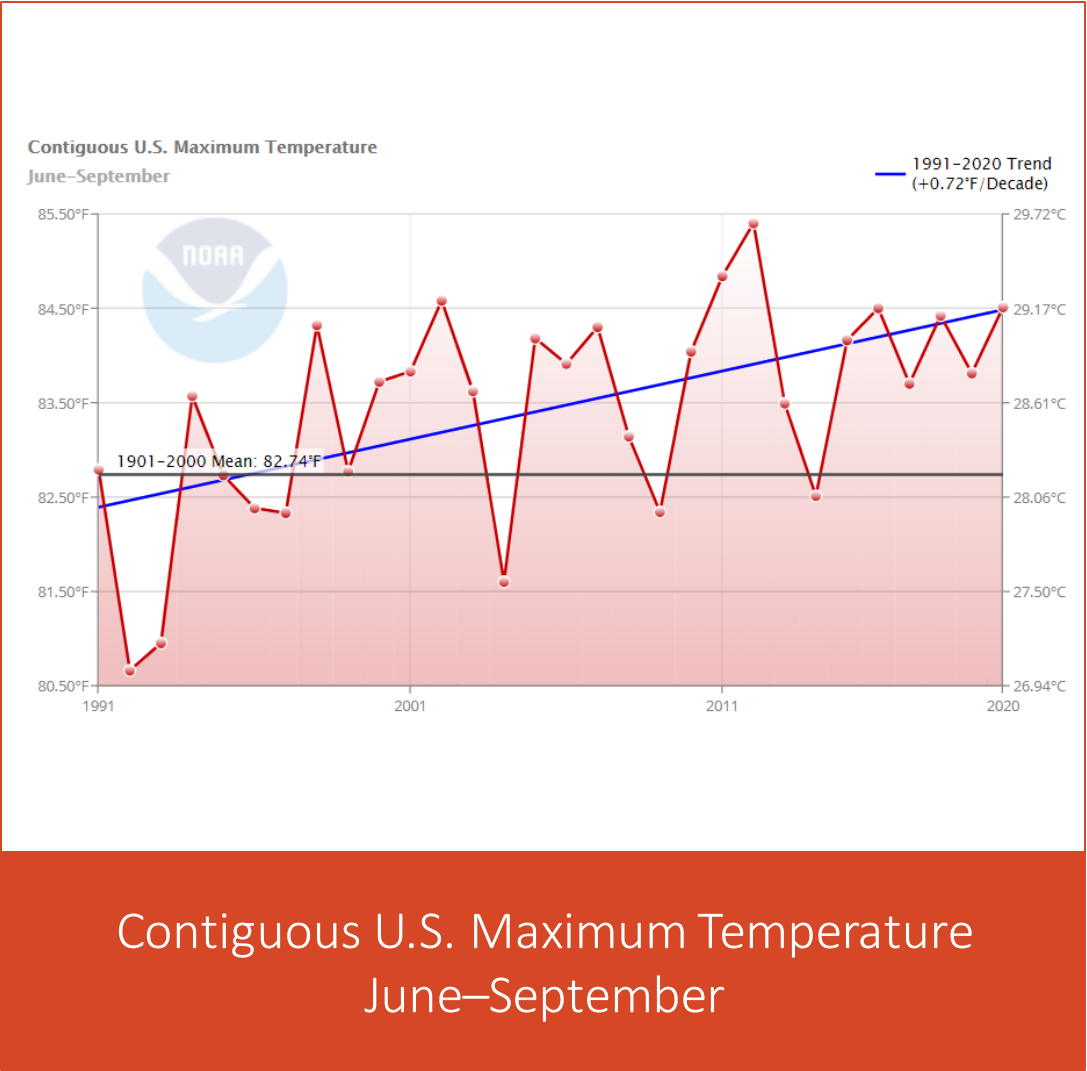
QUESTIONS AND COMMENTS?

Contact us at info@earthnetworks.com or **301-250-4000**

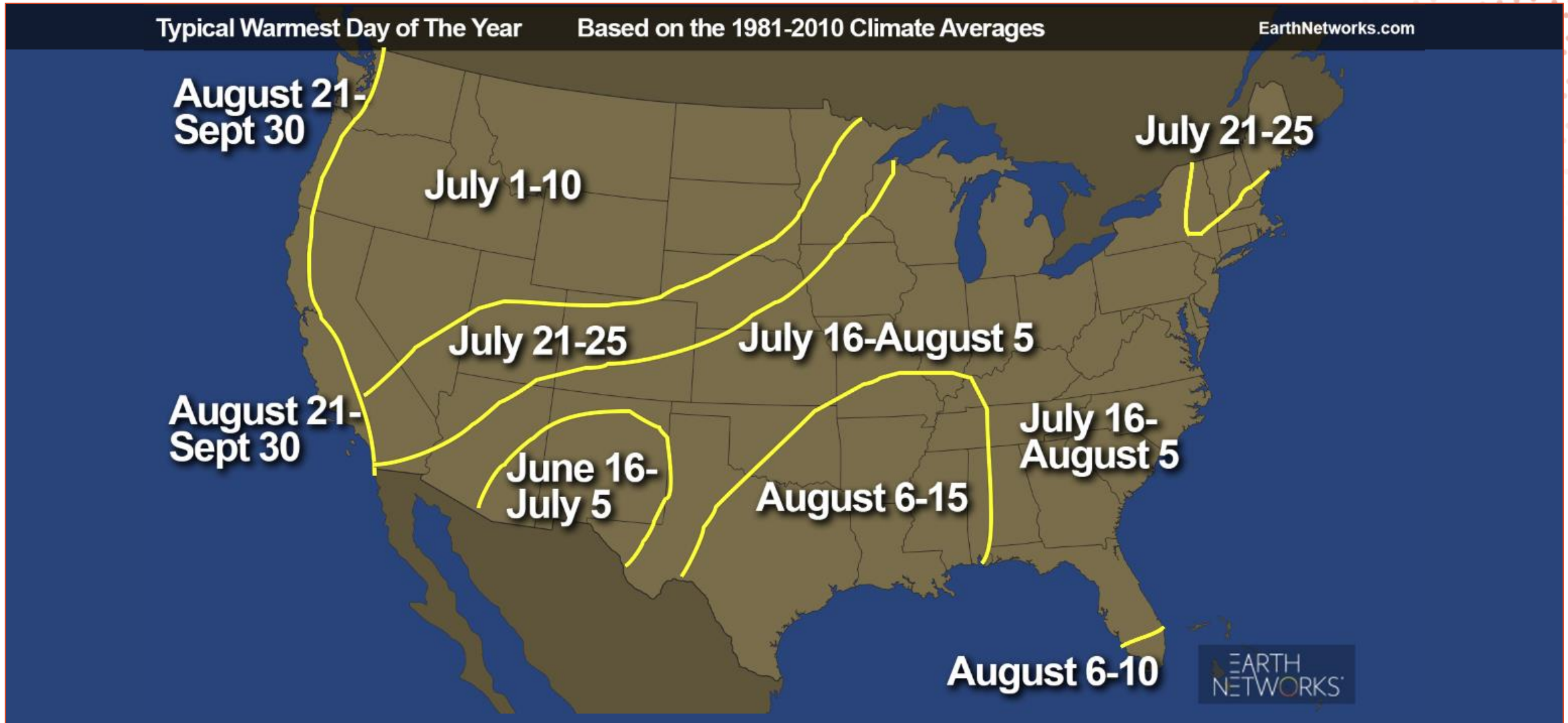
HOW COMMON ARE 100-DEGREE DAYS?



U.S. SUMMER MINIMUM & MAXIMUM TEMPERATURE TRENDS



WHEN IS THE WARMEST DAY OF THE YEAR MOST LIKELY TO OCCUR?



SUMMER TORNADO CLIMATOLOGY

