Three Years of La Niña:

Expectations During a Transition to El Niño

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USDA Office of the Chief Economist / World Agricultural Outlook Board

Presented to

2023 USDA Agricultural Outlook Forum

Grain and Oilseeds Outlook

February 24, 2023

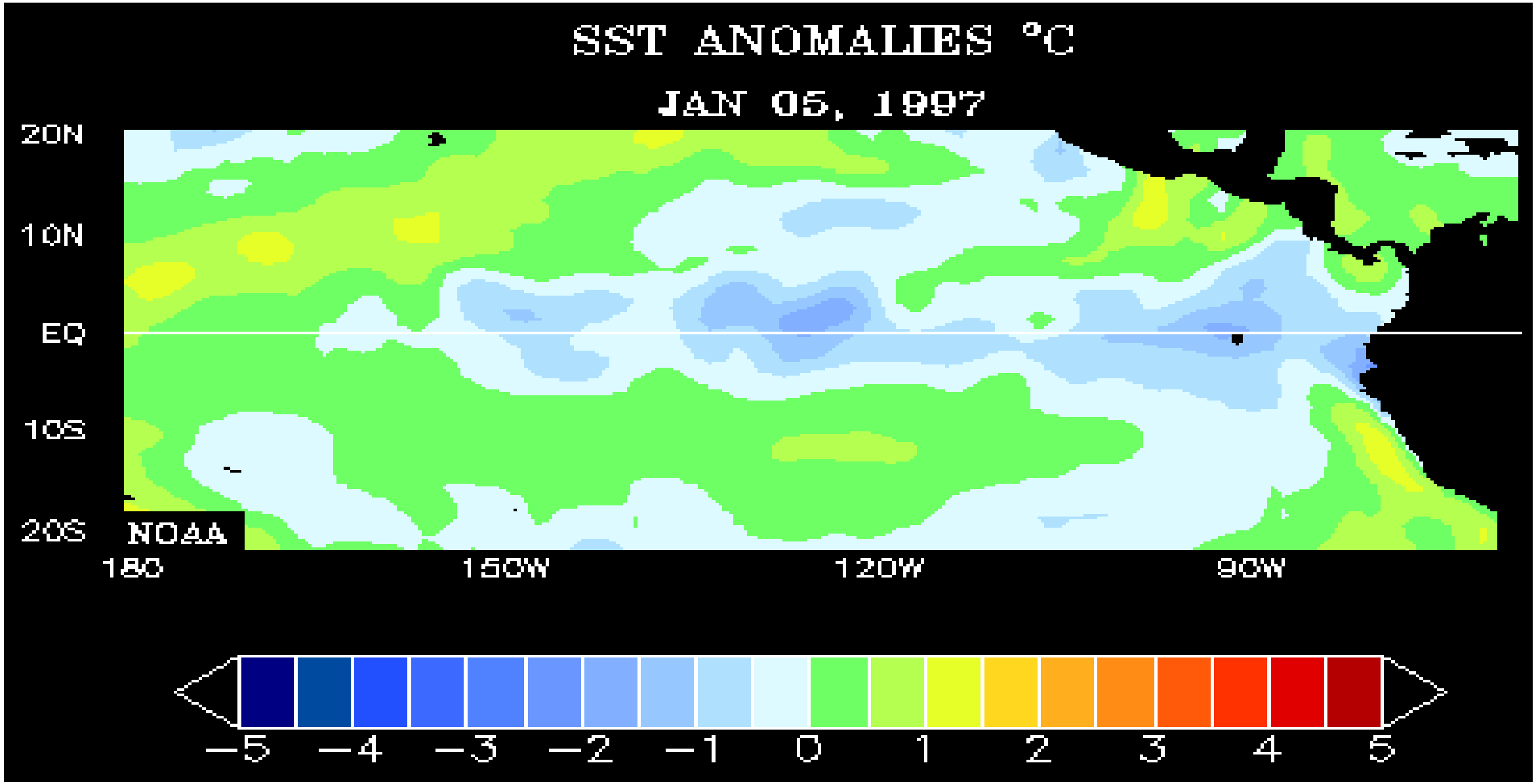
* **El Niño** means *The Little Boy*, or *Christ Child* in Spanish. El Niño was originally recognized by fishermen off the coast of South America in the 1600s, with the appearance of unusually warm water in the Pacific Ocean. The name was chosen based on the time of year (around December) during which these warm waters events tended to occur.

* **La Niña** means *The Little Girl* in Spanish. La Niña is also sometimes called *El Viejo*, *anti-El Niño*, or simply "*a cold event.*" La Niña episodes represent periods of below-average sea surface temperatures across the east-central Equatorial Pacific. Global climate La Niña impacts tend to be opposite those of El Niño impacts. In the tropics, ocean temperature variations in La Niña also tend to be opposite those of El Niño.

ANCHORED: A file photo of fishing boats anchored in Paita, Peru. The warmer waters last year ensured a huge drop in the volume of cold-water anchovies that were caught by the coast. Peru is the world's top producer of animal feed made of ground-up anchovy, known as fishmeal, and the lack of anchovies is one of the reasons that economic growth slowed to its weakest pace in five years. (Steff Gaulter – Gulf Times, July 26, 2015)

Photo: US Navy/Wikipedia

* NOAA. What are El Niño and La Niña. National Ocean Service website, https://oceanservice.noaa.gov/facts/ninonina.html (accessed on 2/20/18)


SST ANOMALIES °C
JAN 05, 1997
20N
10N
EQ
10S
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NOAA
180
150W
120W
90W
−5
−4
−3
−2
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1
2
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SOURCE: NOAA

ENSO:

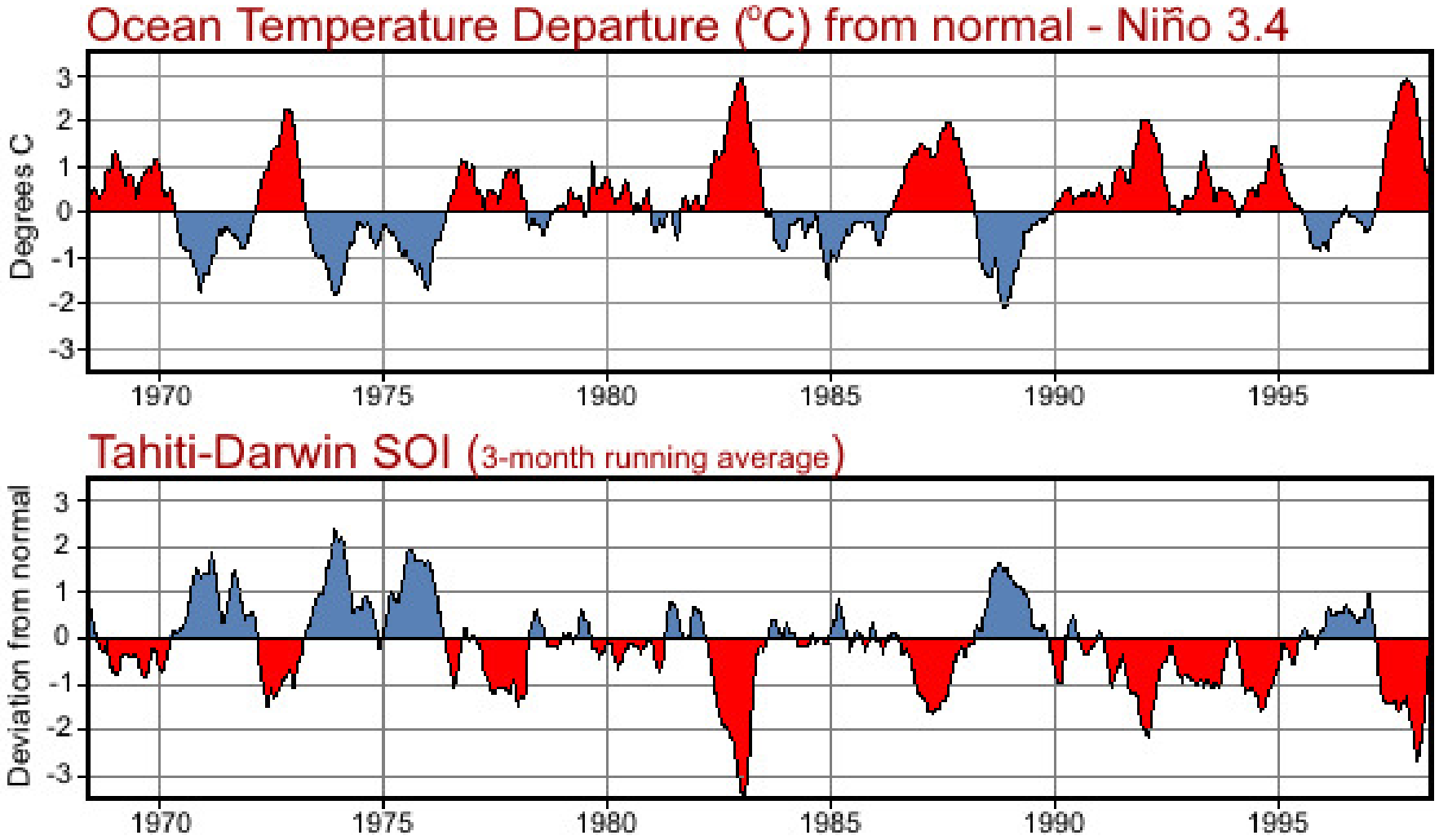
El Niño

(Peruvian Fishers)

+

Southern Oscillation

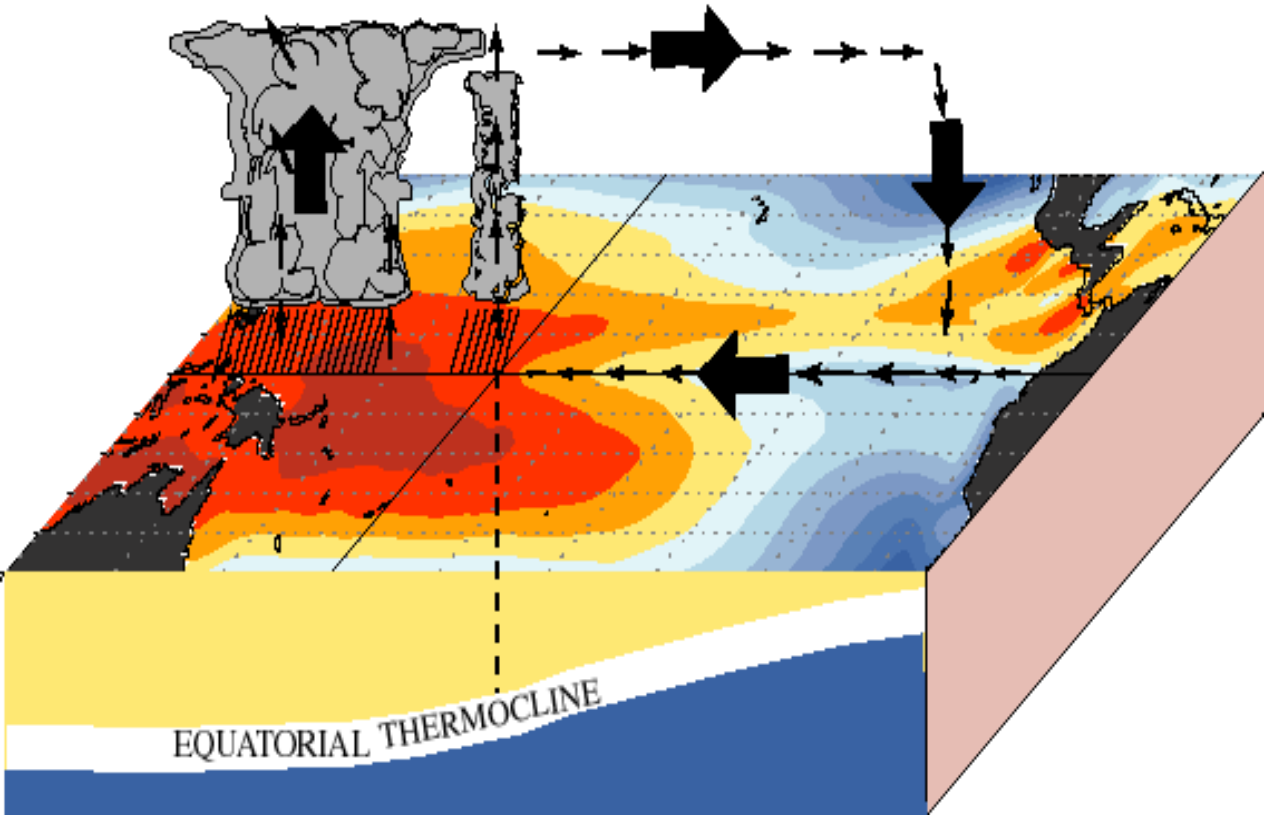
(Sir Gilbert Walker)



"During El Niño conditions, the average air pressure is higher in Darwin than in Tahiti. Therefore, the change in air pressures in the South Pacific and water temperature in the East Pacific Ocean, 8,000 miles (13,000 km) away, are related."

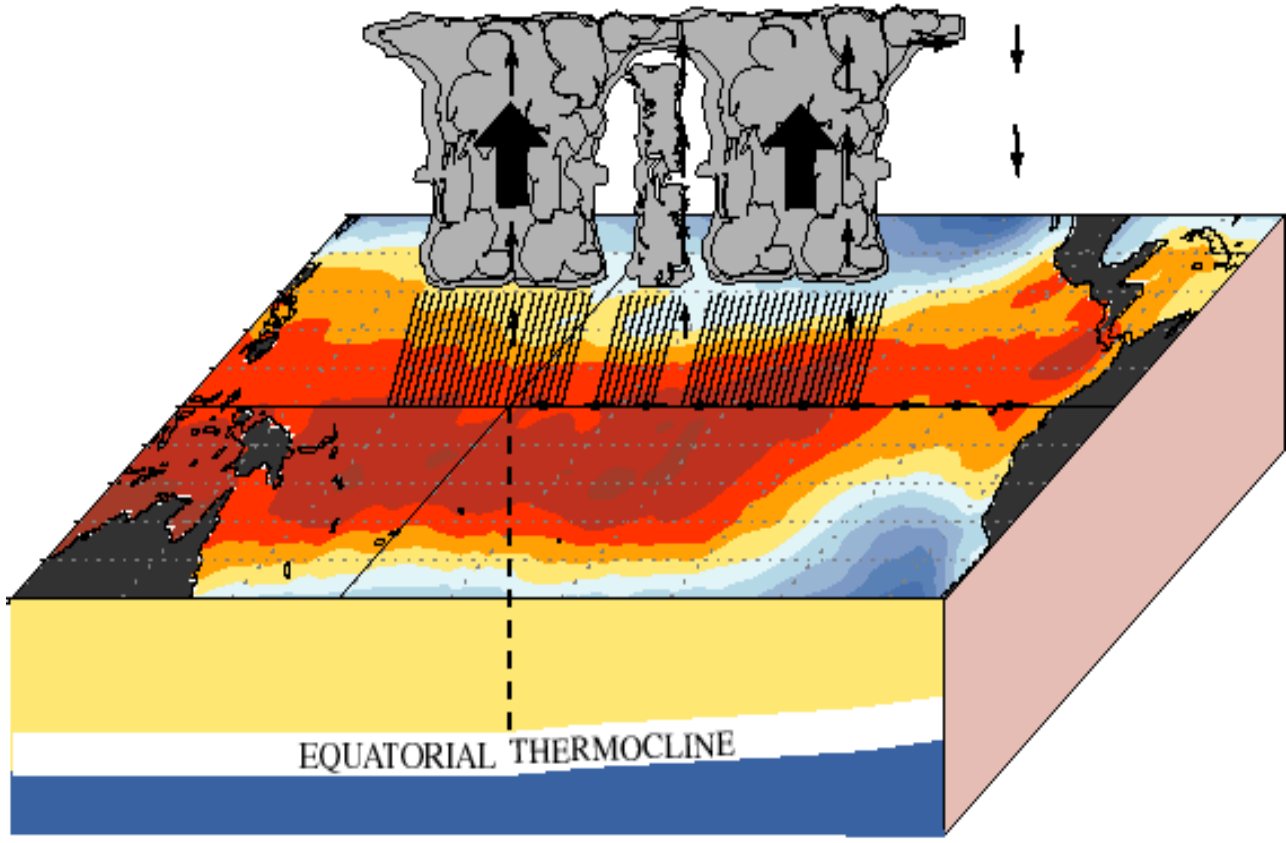
https://www.weather.gov/jetstream/enso

December - February Normal Conditions



- Easterly winds at surface in eastern Pacific (upwelling of nutrient rich water)
- Increased convection in western Pacific

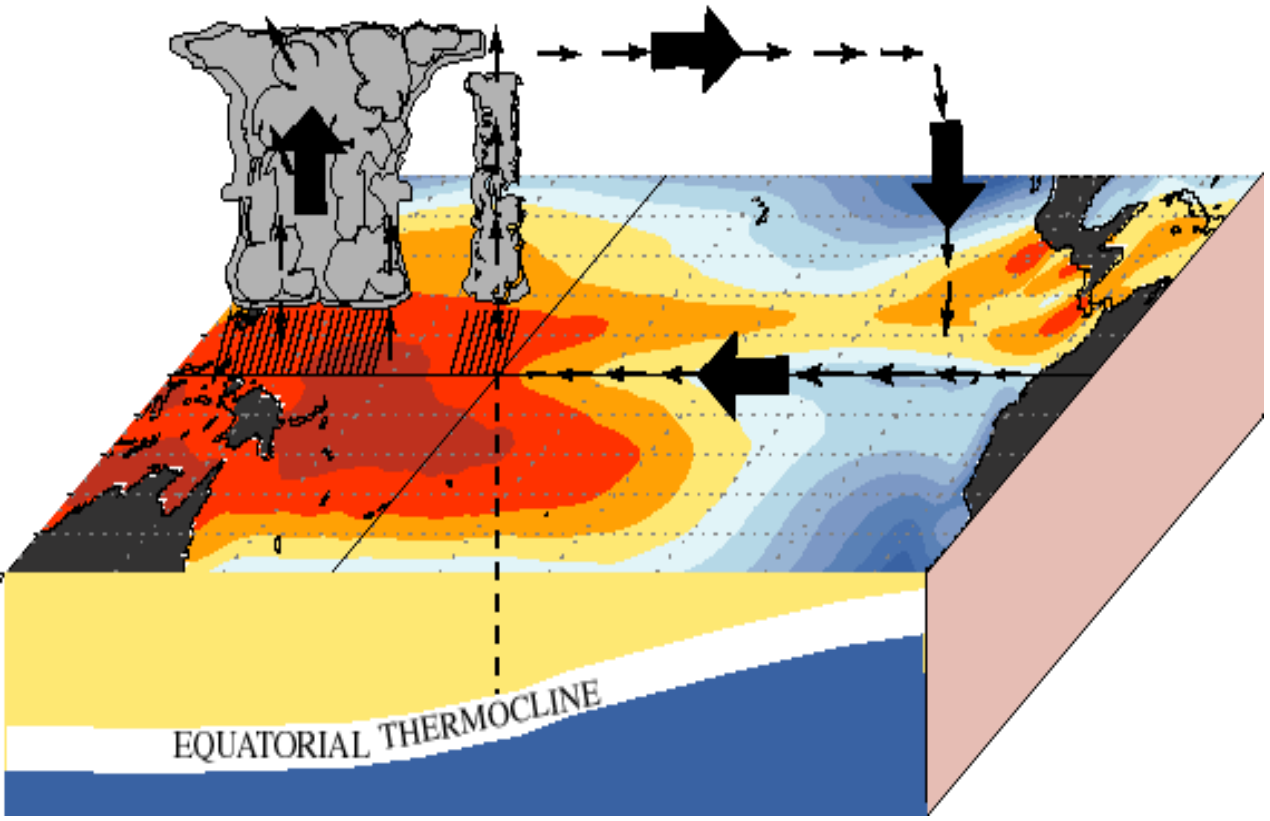
December - February El Niño Conditions



- Weak easterly or reversal of eastern easterlies (impedes upwelling / deeper thermocline)
- Increased convection in central Pacific

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensocycle/enso_cycle.shtml

December - February Normal Conditions



- Easterly winds at surface in eastern Pacific (upwelling of nutrient rich water)
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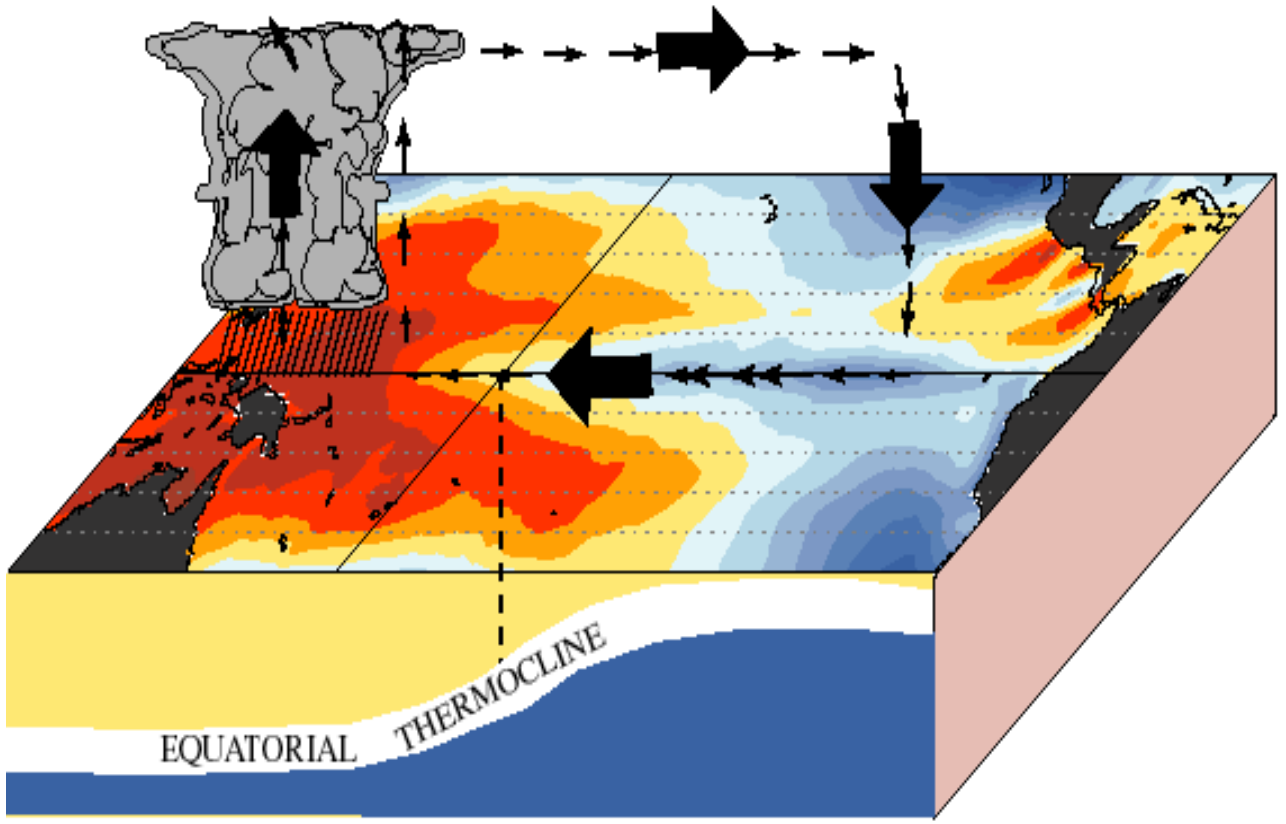
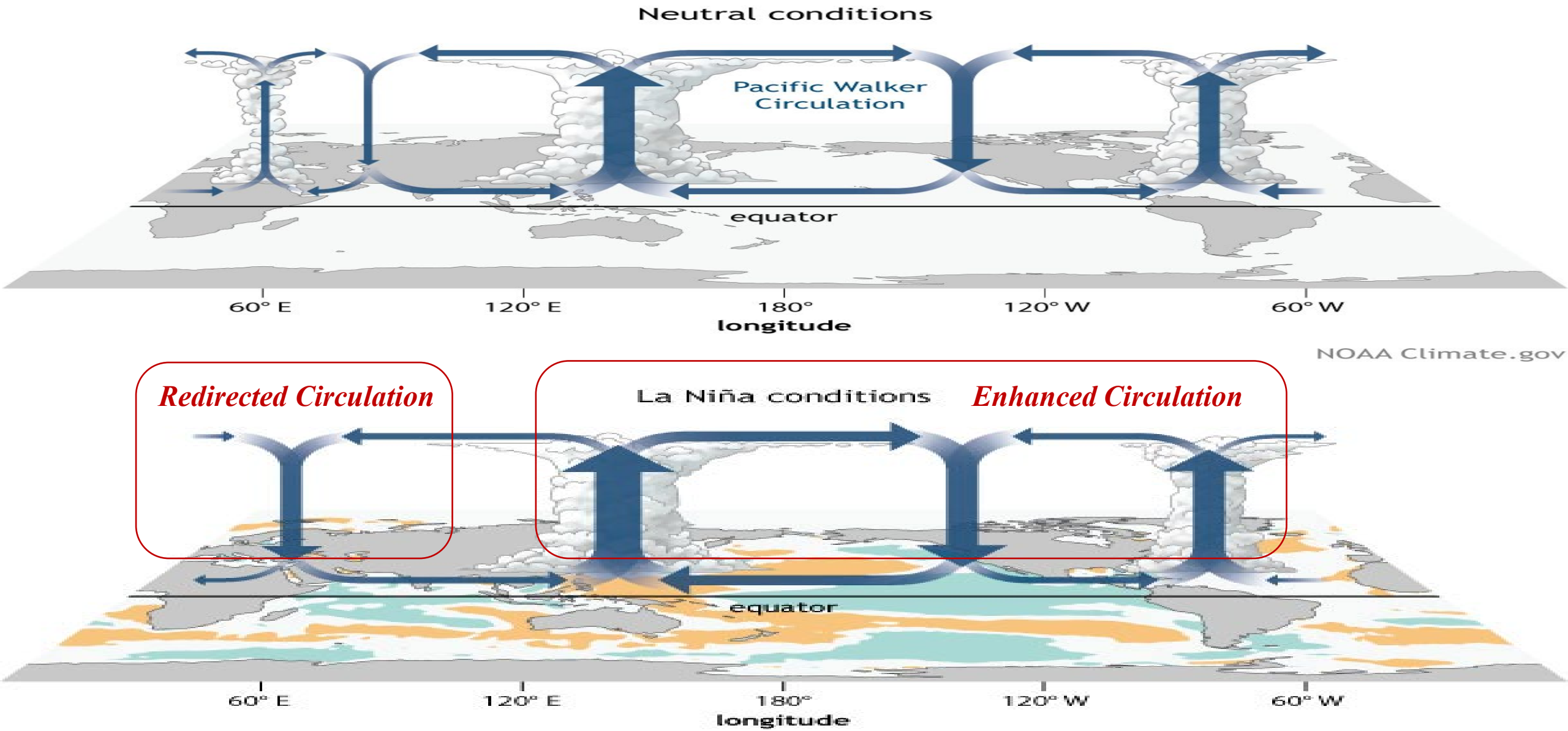
December - February La Niña Conditions

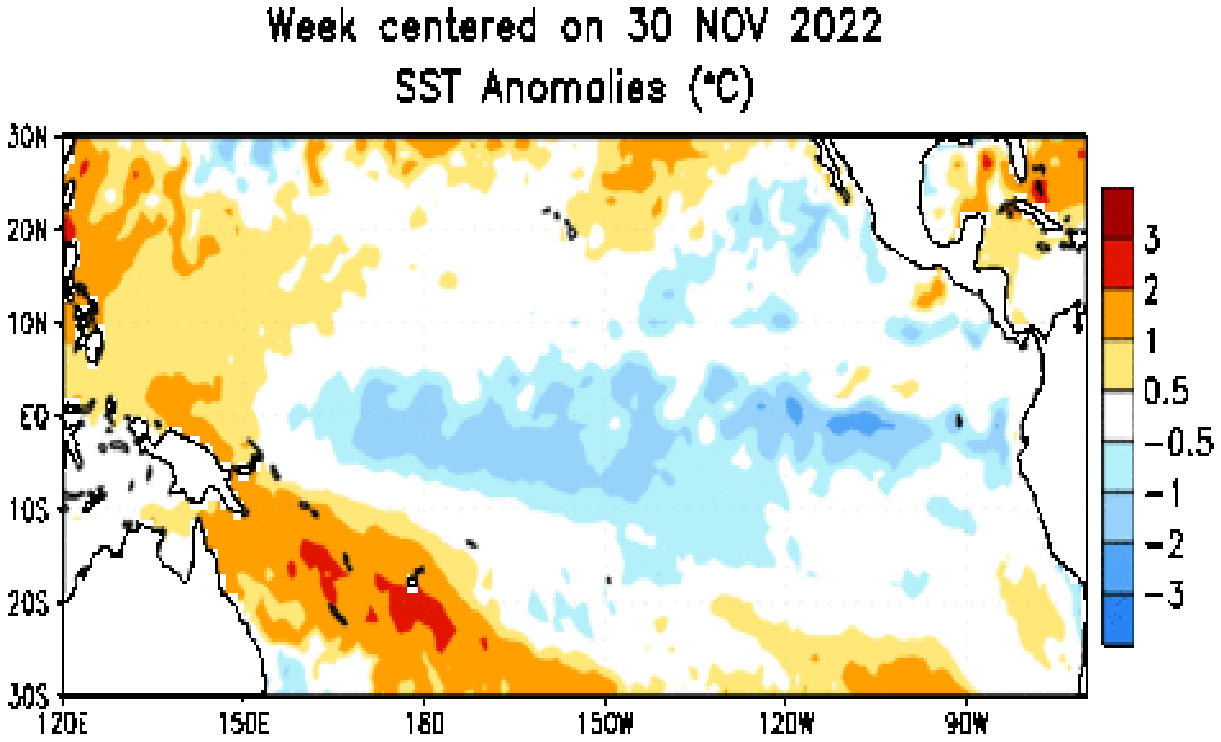


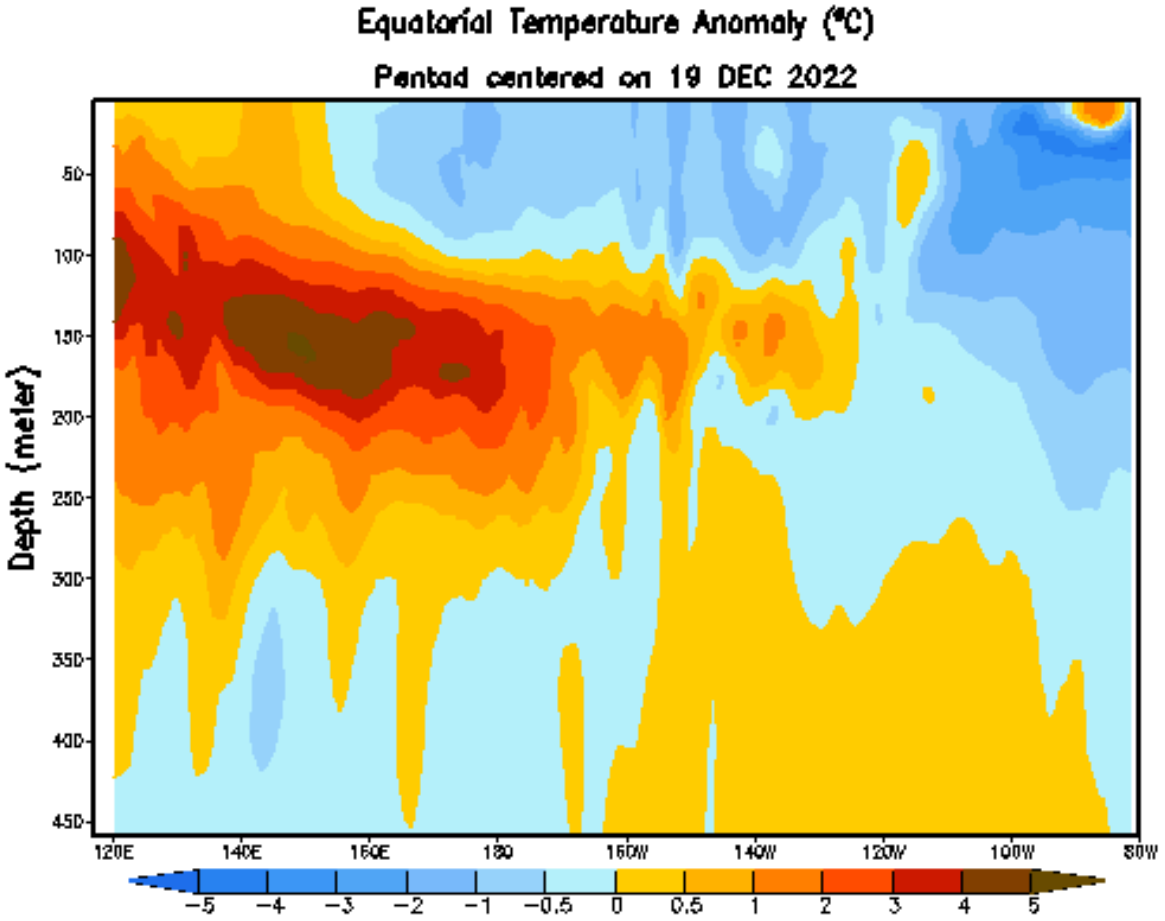
- Stronger surface easterlies in eastern Pacific (accentuates upwelling / thermocline closer to surface)
- Increased convection in western Pacific

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensocycle/enso_cycle.shtml



From: The Walker Circulation: ENSO's atmospheric buddy (Tom Di Liberto, August 1, 2014)
https://www.climate.gov/news-features/blogs/enso/walker-circulation-ensos-atmospheric-buddy





https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml

La Niña and Rainfall

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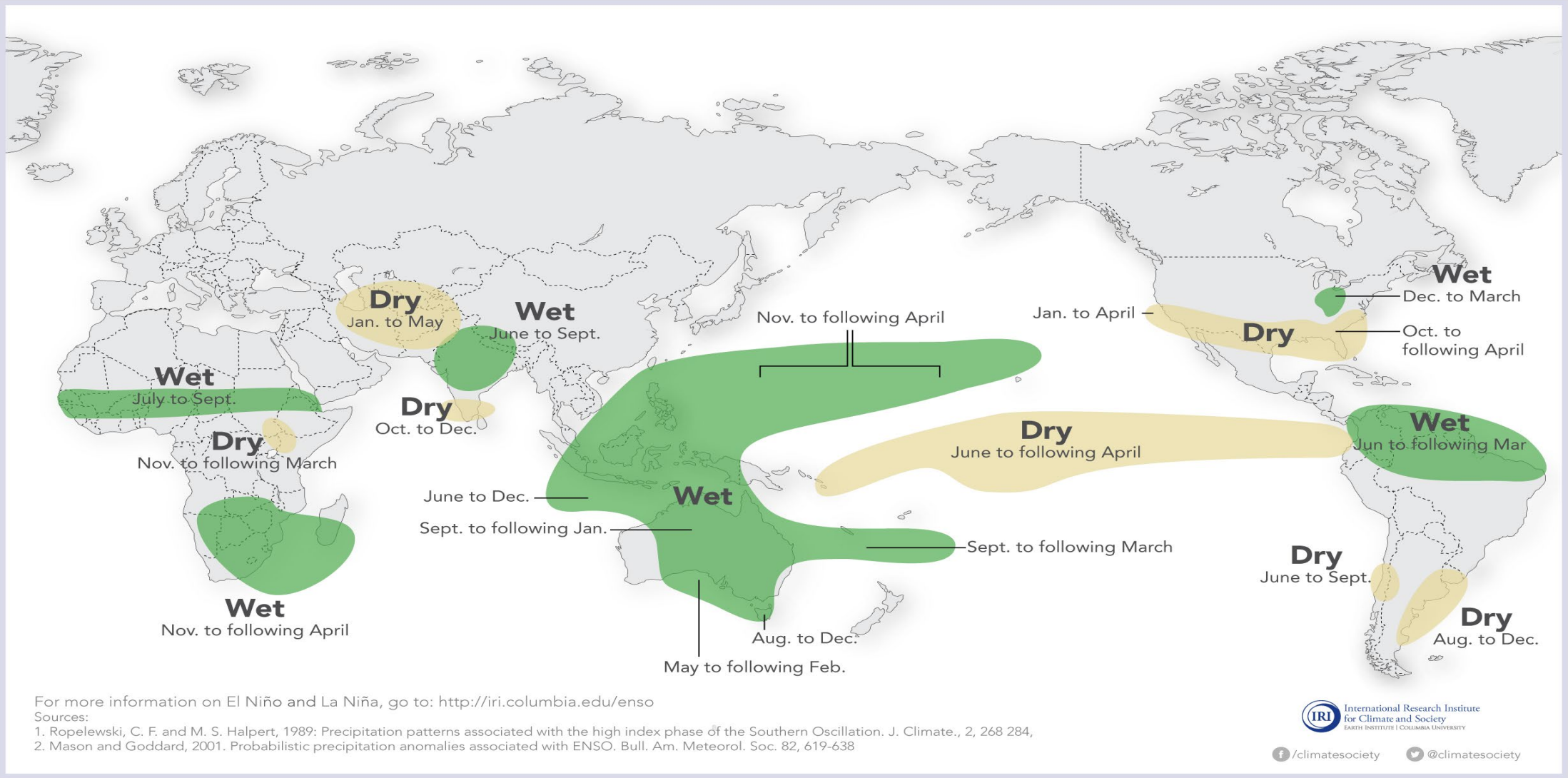

For more information on El Niño and La Niña, go to: http://iri.columbia.edu/enso

Sources:

1. Ropelewski, C. F. and M. S. Halpert, 1989: Precipitation patterns associated with the high index phase of the Southern Oscillation. J. Climate., 2, 268 284,
2. Mason and Goddard, 2001. Probabilistic precipitation anomalies associated with ENSO. Bull. Am. Meteorol. Soc. 82, 619-638

International Research Institute for Climate and Society
Earth Institute | Columbia University

/climatesociety @climatesociety

Current Event

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2020	0.5	0.5	0.4	0.2	-0.1	-0.3	-0.4	-0.6	-0.9	-1.2	-1.3	-1.2
2021	-1.0	-0.9	-0.8	-0.7	-0.5	-0.4	-0.4	-0.5	-0.7	-0.8	-1.0	-1.0
2022	-1.0	-0.9	-1.0	-1.1	-1.0	-0.9	-0.8	-0.9	-1.0	-1.0	-0.9	-0.8

Red Value: Departure >= +0.5°C (6 months or longer)

Blue Value: Departure <= -0.5°C (6 months or longer)

Consecutive-Year La Niña Event

Sea Surface Temperature Anomalies (°C)

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1990	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.4	0.4
1991	0.4	0.3	0.2	0.3	0.5	0.6	0.7	0.6	0.6	0.8	1.2	1.5
1992	1.7	1.6	1.5	1.3	1.1	0.7	0.4	0.1	-0.1	-0.2	-0.3	-0.1
1993	0.1	0.3	0.5	0.7	0.7	0.6	0.3	0.3	0.2	0.1	0.0	0.1
1994	0.1	0.1	0.2	0.3	0.4	0.4	0.4	0.4	0.6	0.7	1.0	1.1
1995	1.0	0.7	0.5	0.3	0.1	0.0	-0.2	-0.5	-0.8	-1.0	-1.0	-1.0
1996	-0.9	-0.8	-0.6	-0.4	-0.3	-0.3	-0.3	-0.3	-0.4	-0.4	-0.4	-0.5
1997	-0.5	-0.4	-0.1	0.3	0.8	1.2	1.6	1.9	2.1	2.3	2.4	2.4
1998	2.2	1.9	1.4	1.0	0.5	-0.1	-0.8	-1.1	-1.3	-1.4	-1.5	-1.6
1999	-1.5	-1.3	-1.1	-1.0	-1.0	-1.0	-1.1	-1.1	-1.2	-1.3	-1.5	-1.7
2000	-1.7	-1.4	-1.1	-0.8	-0.7	-0.6	-0.6	-0.5	-0.5	-0.6	-0.7	-0.7
2001	-0.7	-0.5	-0.4	-0.3	-0.3	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3
2002	-0.1	0.0	0.1	0.2	0.4	0.7	0.8	0.9	1.0	1.2	1.3	1.1
2003	0.9	0.6	0.4	0.0	-0.3	-0.2	0.1	0.2	0.3	0.3	0.4	0.4
2004	0.4	0.3	0.2	0.2	0.2	0.3	0.5	0.6	0.7	0.7	0.7	0.7
2005	0.6	0.6	0.4	0.4	0.3	0.1	-0.1	-0.1	-0.1	-0.3	-0.6	-0.8
2006	-0.9	-0.8	-0.6	-0.4	-0.1	0.0	0.1	0.3	0.5	0.8	0.9	0.9
2007	0.7	0.2	-0.1	-0.3	-0.4	-0.5	-0.6	-0.8	-1.1	-1.3	-1.5	-1.6
2008	-1.6	-1.5	-1.3	-1.0	-0.8	-0.6	-0.4	-0.2	-0.2	-0.4	-0.6	-0.7
2009	-0.8	-0.8	-0.6	-0.3	0.0	0.3	0.5	0.6	0.7	1.0	1.4	1.6
2010	1.5	1.2	0.8	0.4	-0.2	-0.7	-1.0	-1.3	-1.6	-1.6	-1.6	-1.6
2011	-1.4	-1.2	-0.9	-0.7	-0.6	-0.4	-0.5	-0.6	-0.8	-1.0	-1.1	-1.0
2012	-0.9	-0.7	-0.6	-0.5	-0.3	0.0	0.2	0.4	0.4	0.3	0.1	-0.2
2013	-0.4	-0.4	-0.3	-0.3	-0.4	-0.4	-0.4	-0.3	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.5	-0.3	0.0	0.2	0.2	0.0	0.1	0.2	0.5	0.6	0.7
2015	0.5	0.5	0.5	0.7	0.9	1.2	1.5	1.9	2.2	2.4	2.6	2.6
2016	2.5	2.1	1.6	0.9	0.4	-0.1	-0.4	-0.5	-0.6	-0.7	-0.7	-0.6
2017	-0.3	-0.2	0.1	0.2	0.3	0.3	0.1	-0.1	-0.4	-0.7	-0.8	-1.0
2018	-0.9	-0.9	-0.7	-0.5	-0.2	0.0	0.1	0.2	0.5	0.8	0.9	0.8
2019	0.7	0.7	0.7	0.7	0.5	0.5	0.3	0.1	0.2	0.3	0.5	0.5
2020	0.5	0.5	0.4	0.2	-0.1	-0.3	-0.4	-0.6	-0.9	-1.2	-1.3	-1.2
2021	-1.0	-0.9	-0.8	-0.7	-0.5	-0.4	-0.4	-0.5	-0.7	-0.8	-1.0	-1.0
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1998-2001

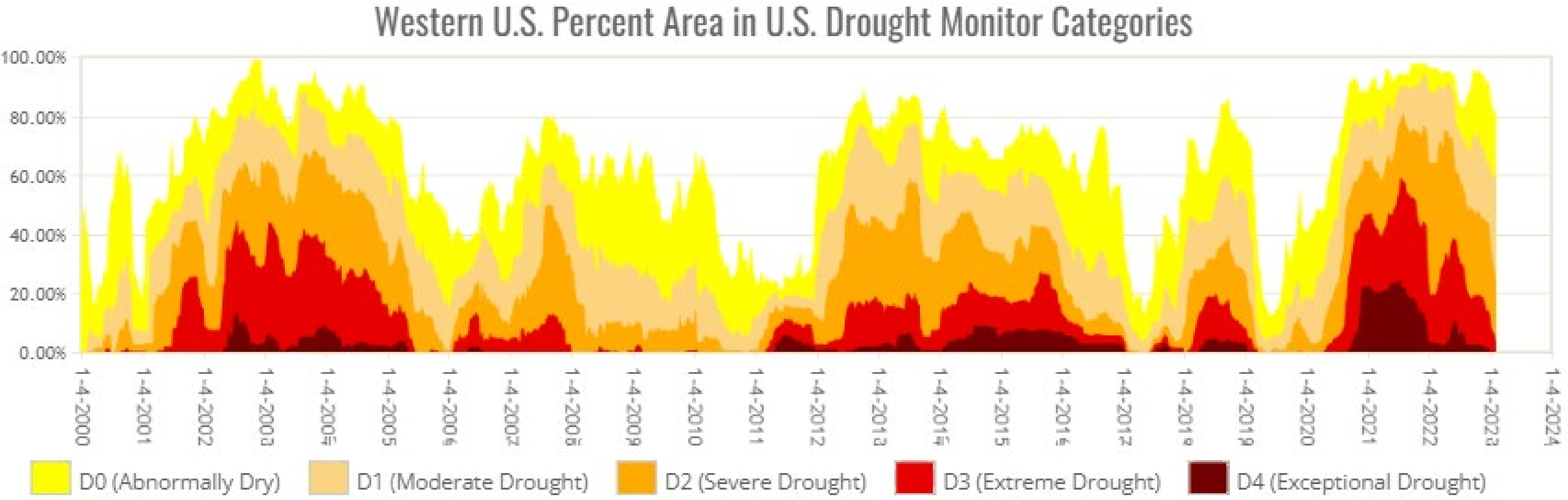
2007-2009

2010-2012

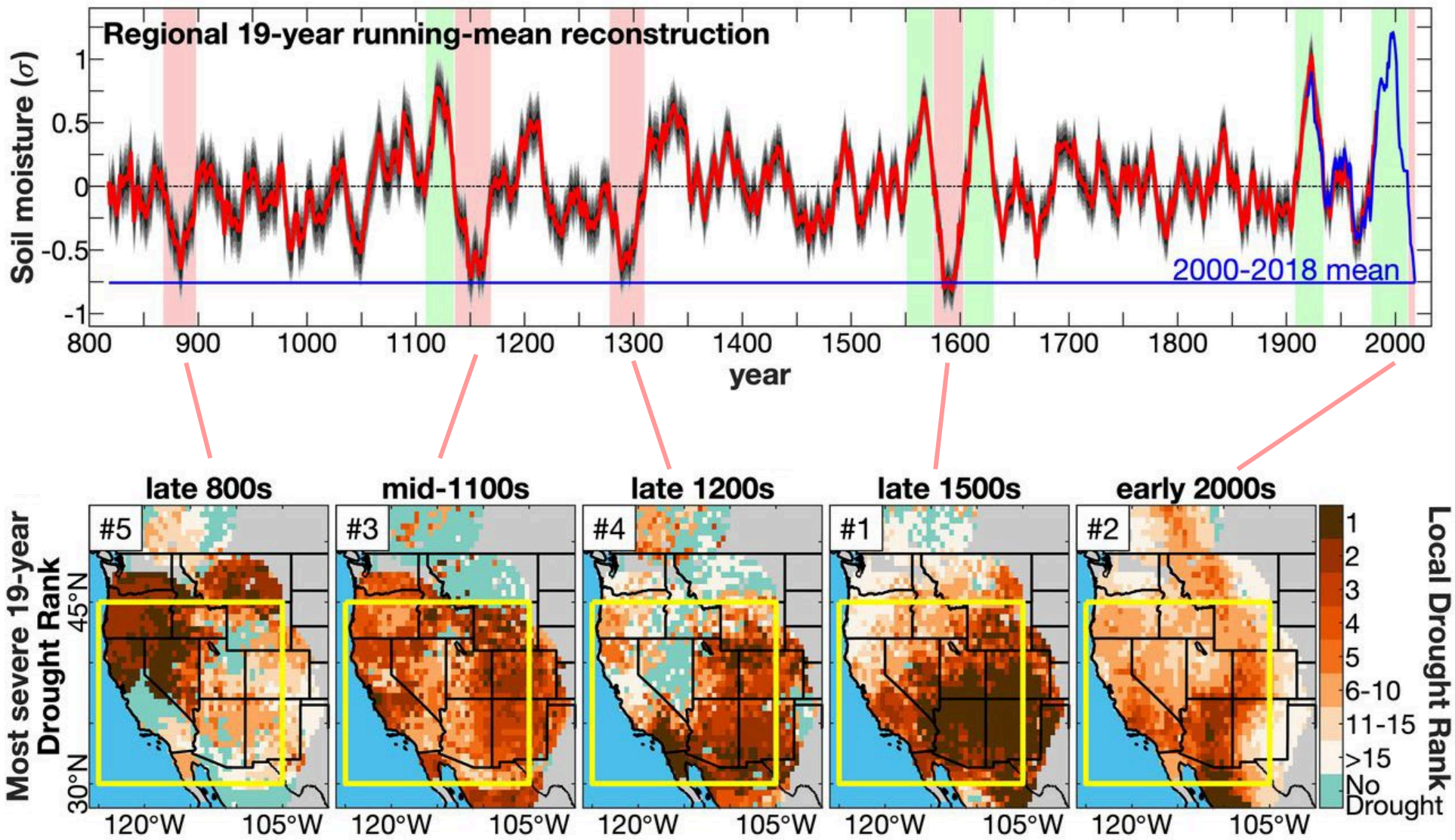
2016-2018

2020-2023

https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php



https://droughtmonitor.unl.edu/



From Williams, et. al. Science 17 Apr 2020: Vol. 368, Issue 6488, pp. 314-318

Fall 2009

Climate Change and Cultural Response In The Prehistoric American Southwest

Larry Benson
U.S. Geological Survey, great.basin666@gmail.com

Michael S. Berry
Bureau of Reclamation

'Most of the Anasazi great houses were vacated during the ***middle-twelfth-century megadrought*** *(designated "D3" in this study) (Marshall et al. 1979). In the northern San Juan Basin, Brown et al. (2008) have attributed the slow and intermittent construction of the Aztec East great house during D3 to "a sustained period of hardship associated with epic drought." '*

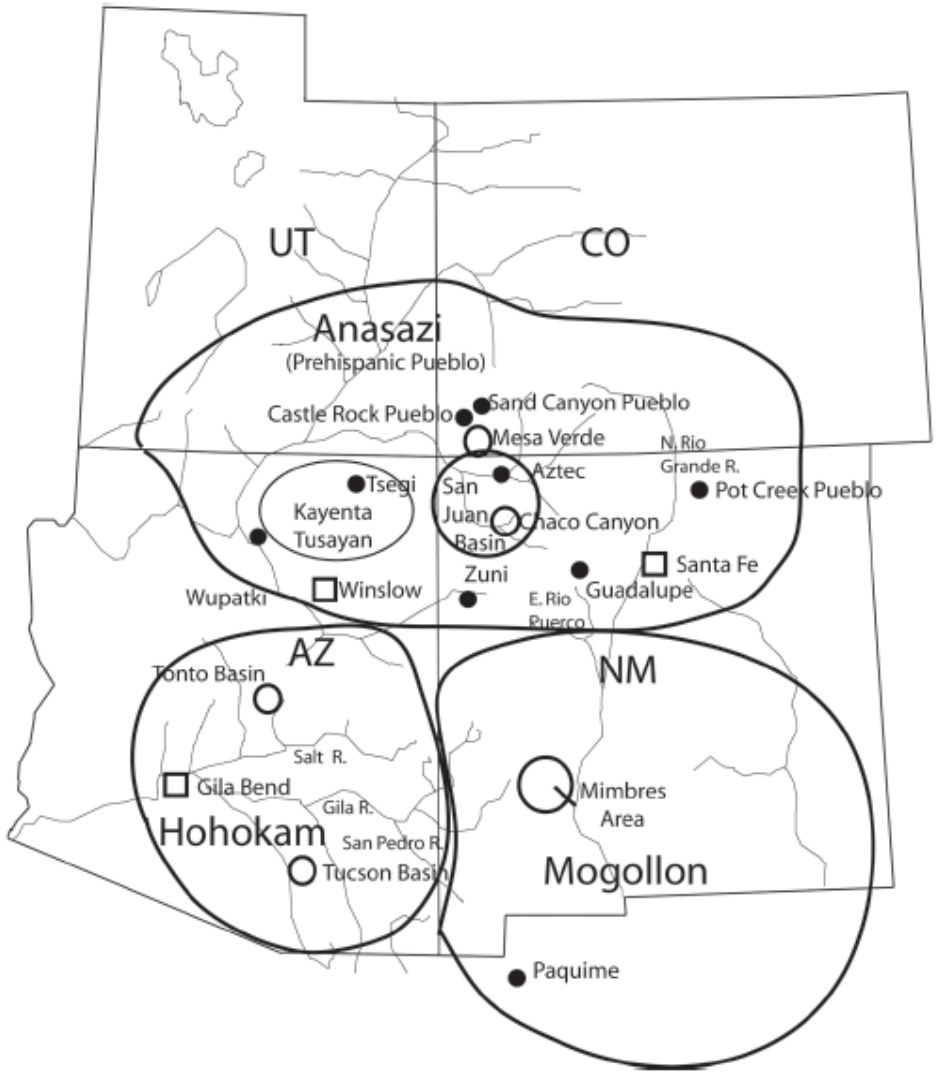
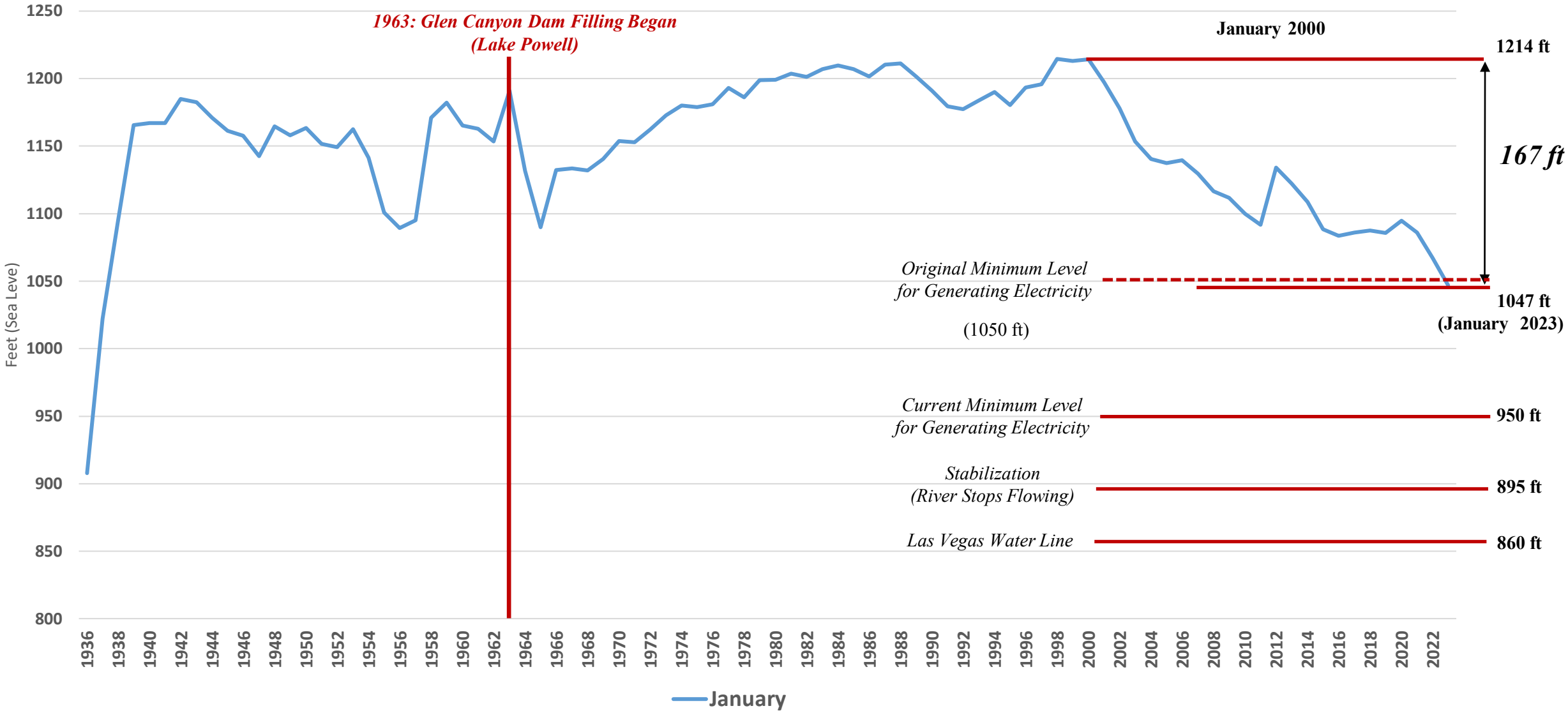


FIGURE 3. Locations of cultural traditions (Anasazi, Hohokam, and Mogollon), archaeological areas (empty circles), archaeological sites (small filled circles) and present-day cities (empty squares) mentioned in the text.

Lake Mead Water Levels



Source: Bureau of Reclamation, Other

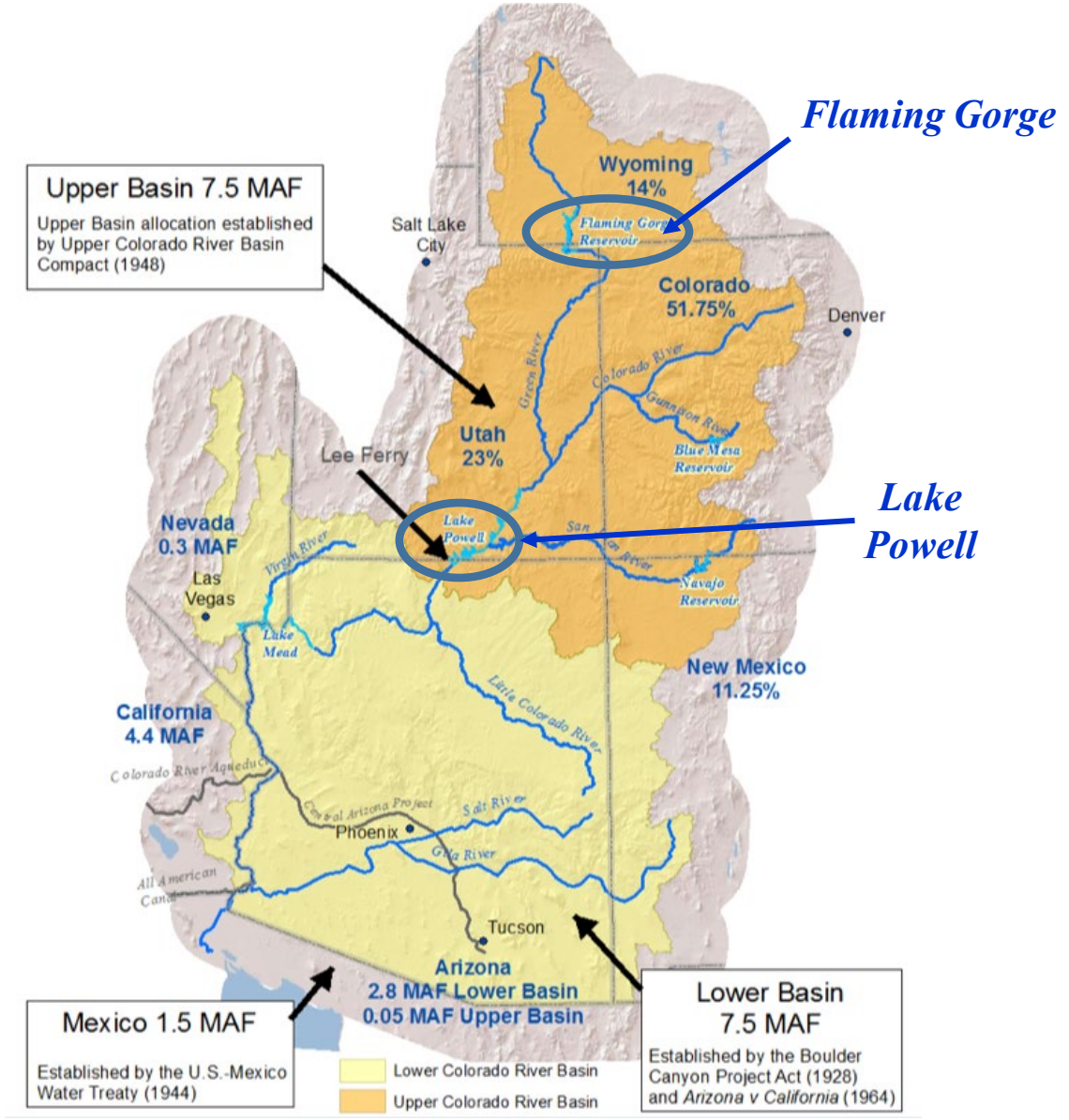
Current Lake Powell Water Level (February 22, 2023)

3,522 ft: 178 below "Full Pool"

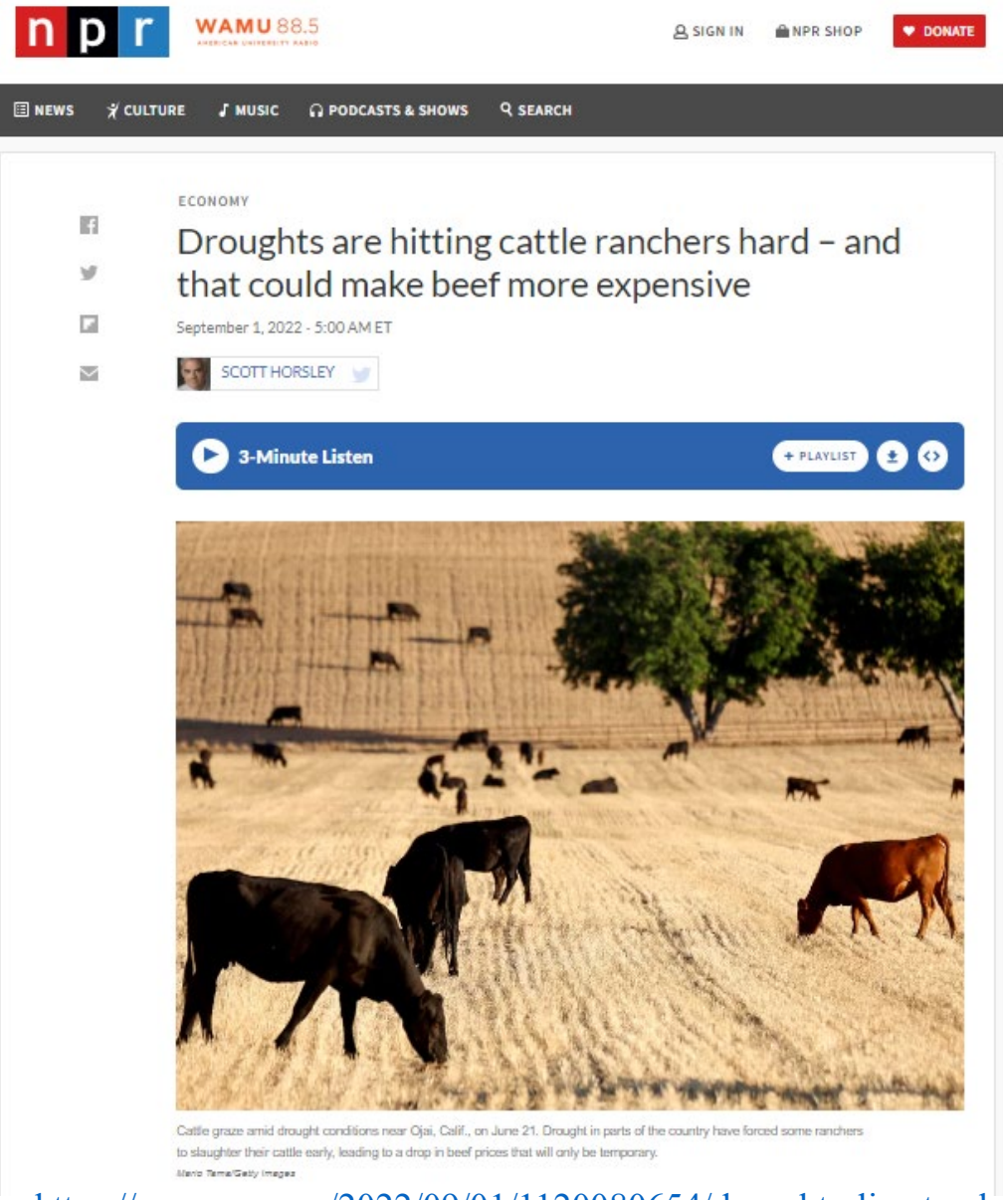
https://lakepowell.water-data.com/

"The Bureau of Reclamation announced on May 3, 2022, two separate urgent drought response actions that will help prop up Lake Powell by nearly 1 million acre-feet (maf) of water over the next 12 months (May 2022 through April 2023):

- *Approximately 500 thousand acre-feet (kaf) of water will come from Flaming Gorge Reservoir.*
- *Another 480 kaf will be left in Lake Powell by reducing Glen Canyon Dam's annual release volume from 7.48 maf to 7.0 maf."*



https://www.usbr.gov/uc/water/crsp/cs/gcd.html



From the Story:

Sending cattle to slaughter early

Without enough feed to get cattle through the winter, ranchers have been forced to send some of their animals to slaughter prematurely.

"We've liquidated a lot of our cows and a lot of neighbors have liquidated anywhere from 20 to 60% of their cow herds," O'Dea says.

That's resulted in more steaks on supermarket shelves, and a temporary drop in prices. But the savings for consumers are likely to be short-lived.

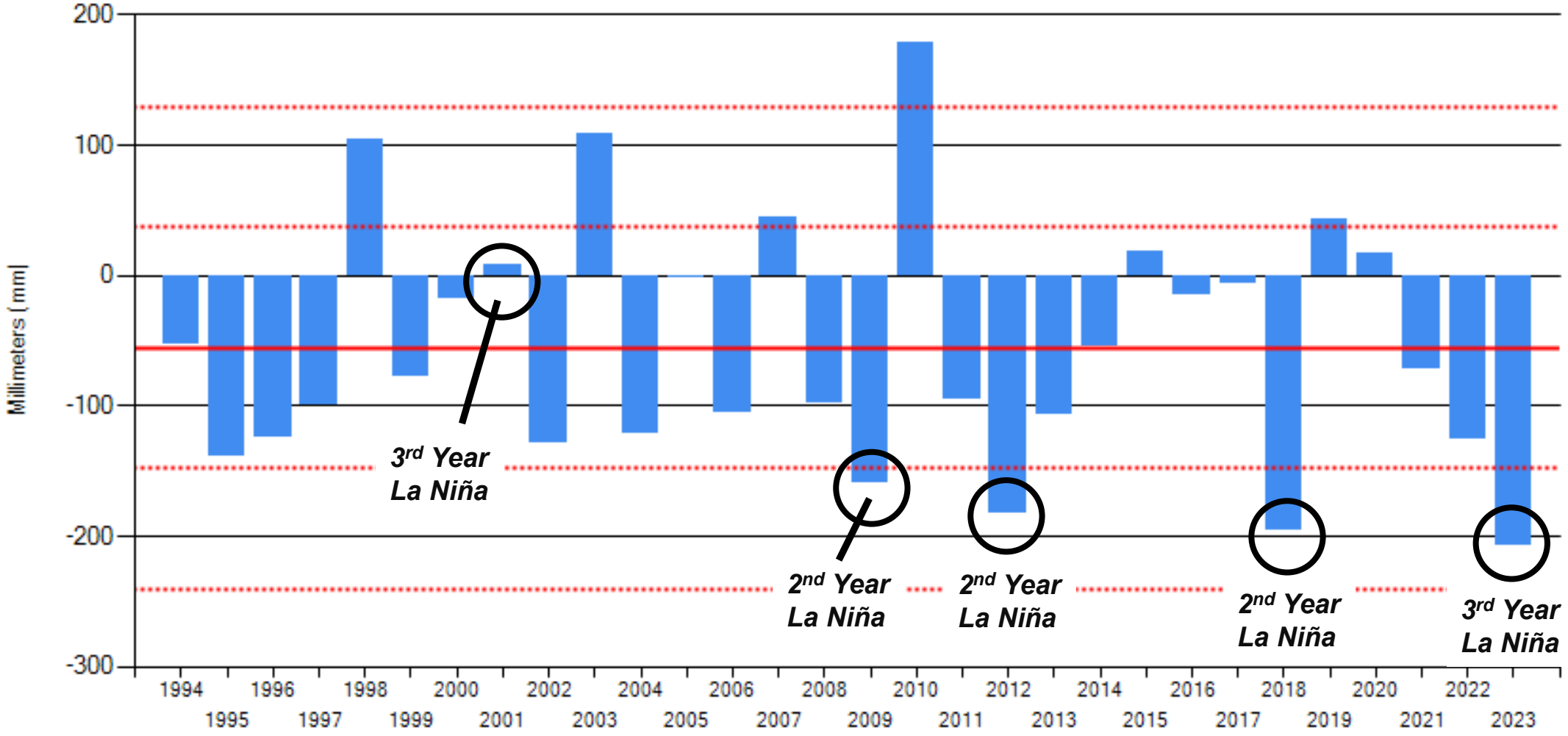
In a sign of ranchers' desperation, many of the slaughtered animals are breeding females — cows and heifers — so the next generation of cattle will be smaller.

The USDA reported more beef cows slaughtered in July than any month since recordkeeping began in 1986.

https://www.npr.org/2022/09/01/1120080654/drought-climate-change-ranchers-cattle-beef-steaks-inflation-food-prices#:~:text=Ranchers%20also%20face%20rising%20costs&text=A%20severe%20drought%20a%20decade,some%20of%20their%20cattle%20now

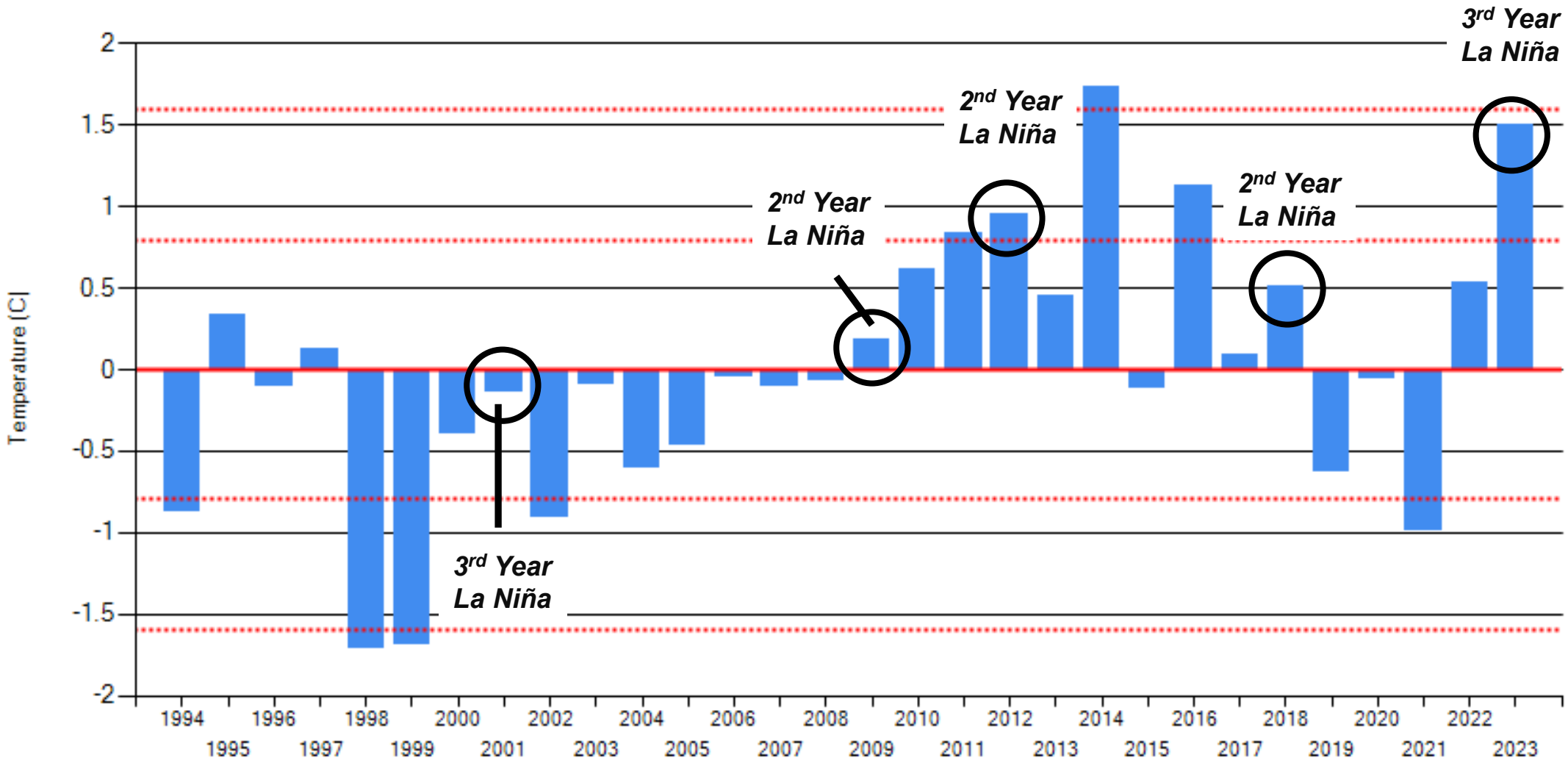
Central Argentina

Precipitation – Potential ET: December 1 to February 14



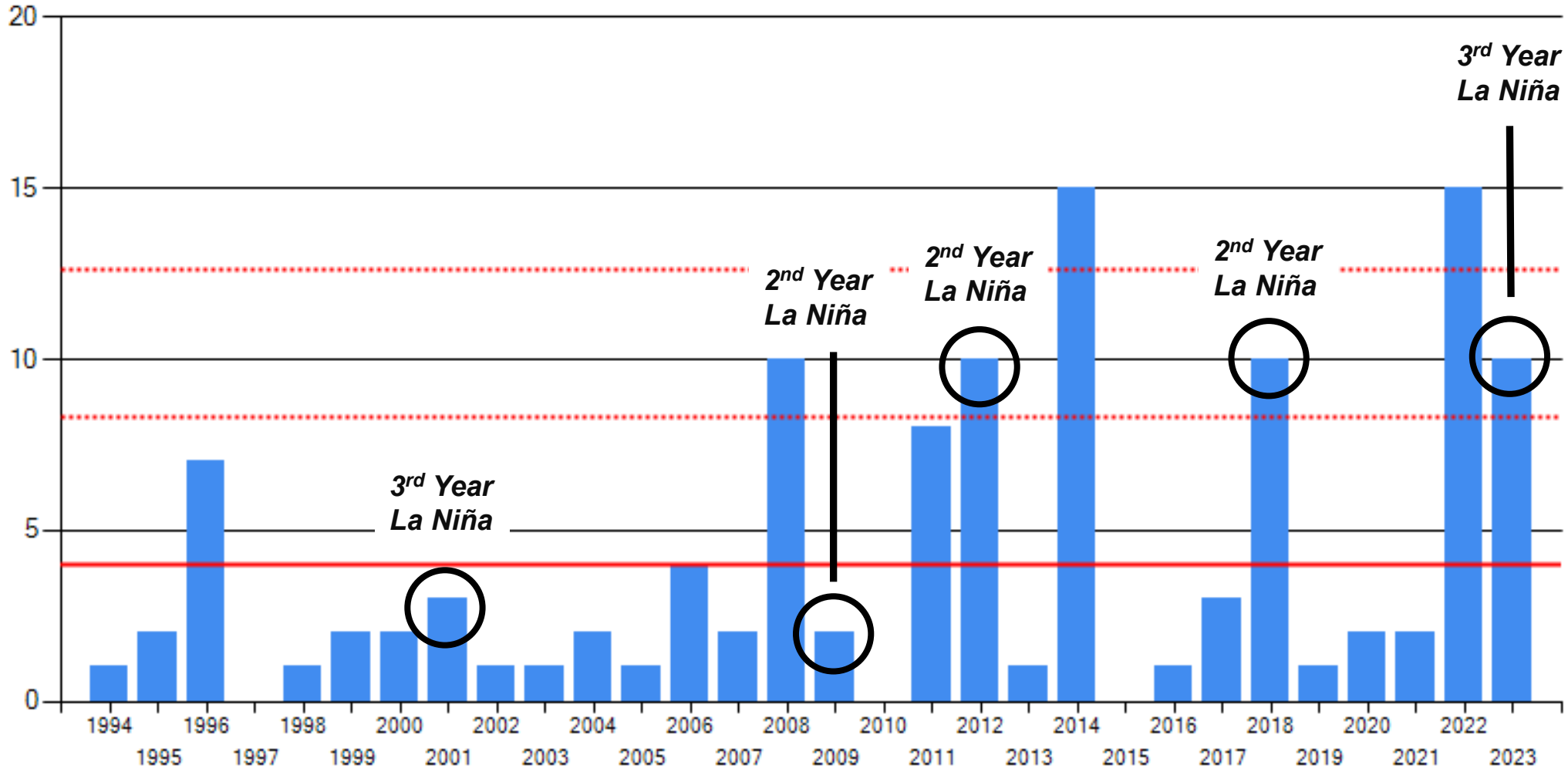
Central Argentina

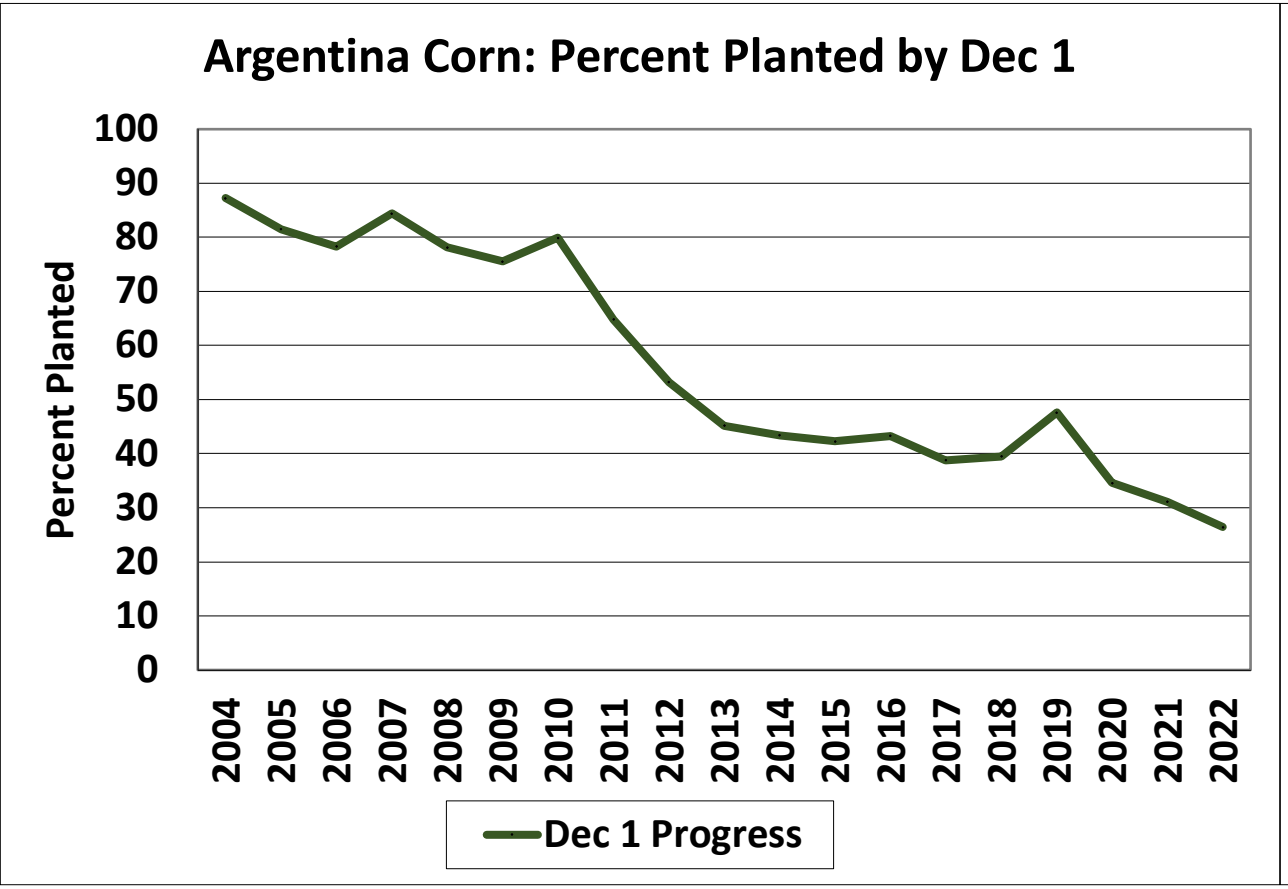
Temperature Departure from Average (°C): December 1 to February 14

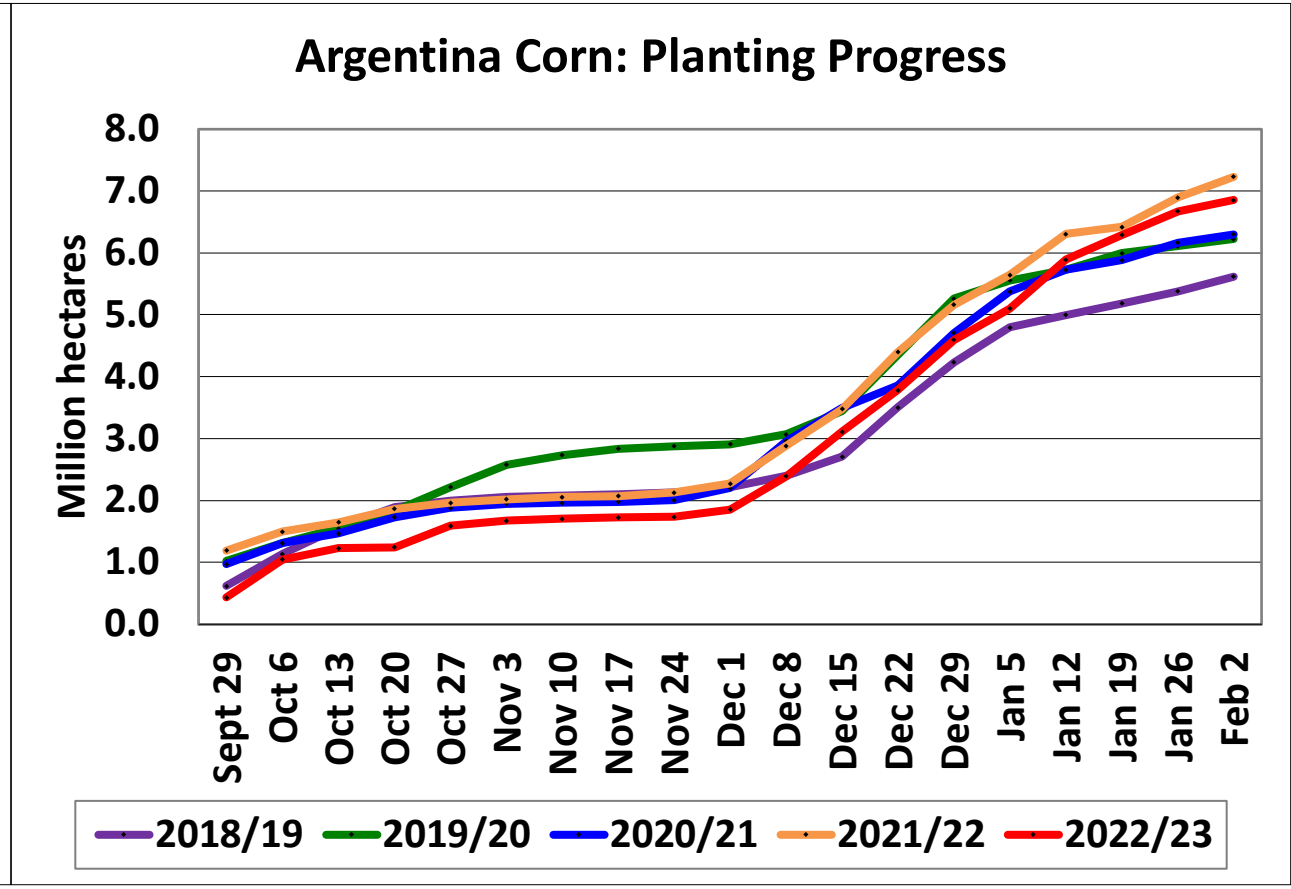


Central Argentina

Number of Days with Average Max Temperature Above 34°C: December 15 to January 15



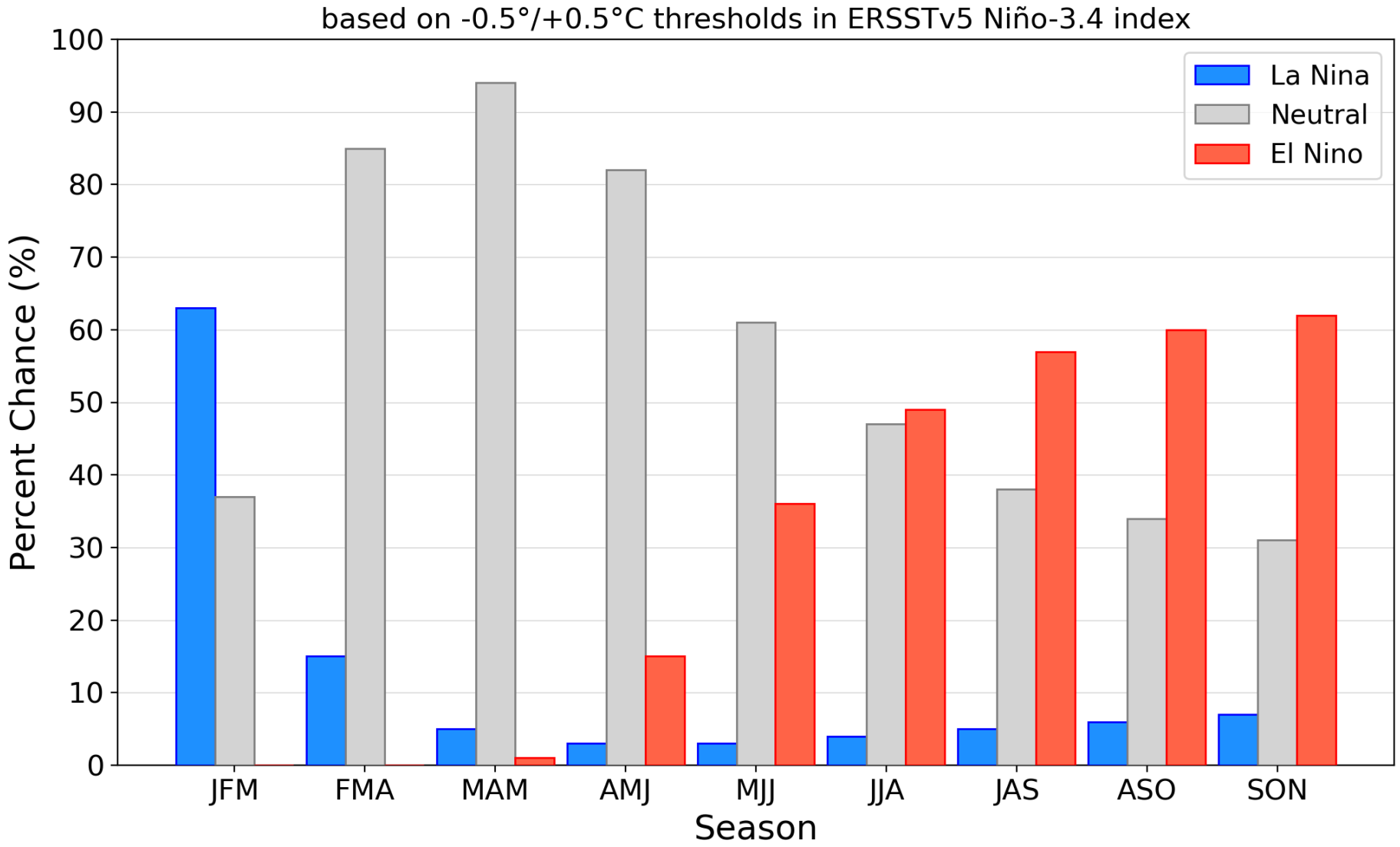




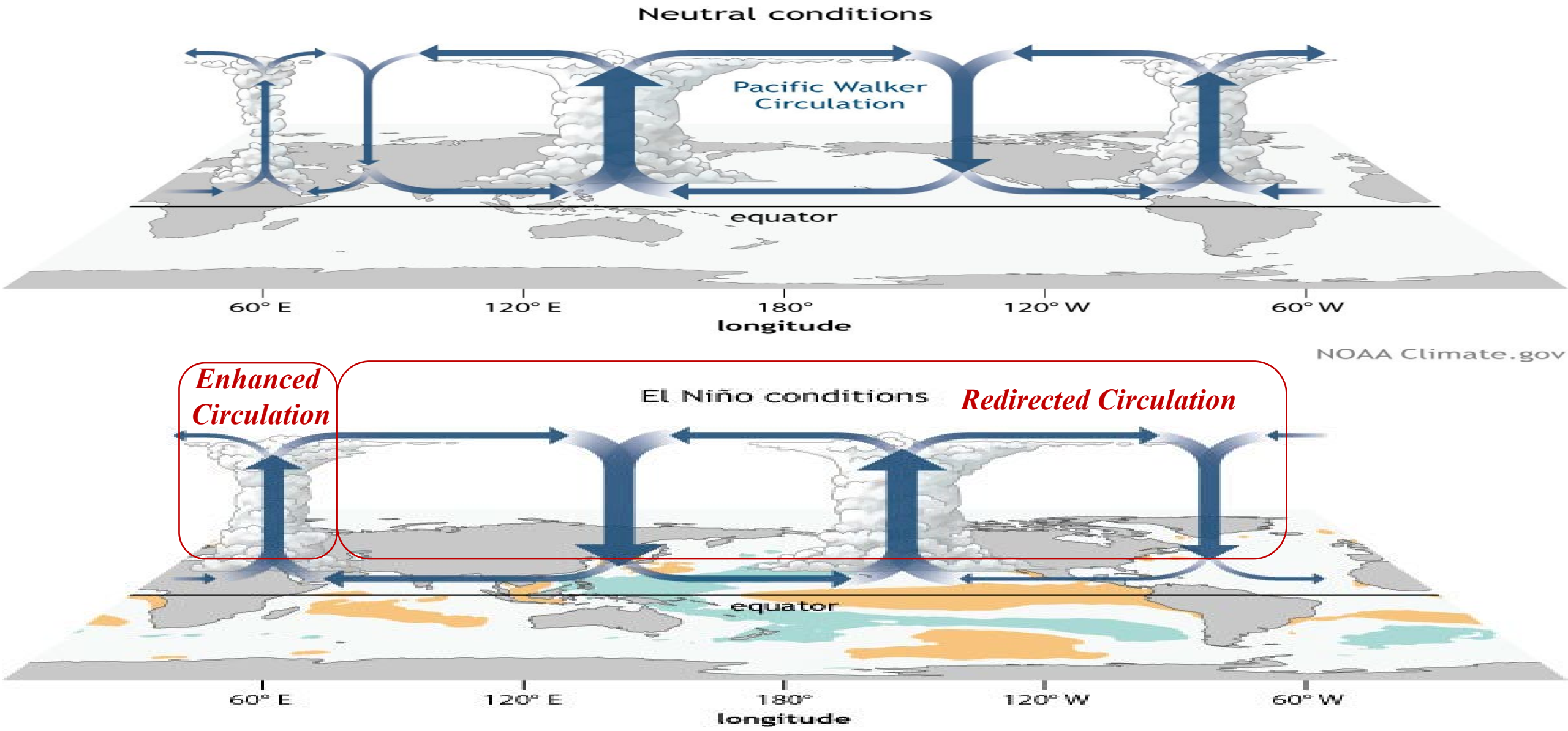
Farmers planting a more distinct second corn crop to take advantage of later-arriving moisture.

Data Source: Argentina Bolsa de Cereales Buenos Aires
Maps compiled by Katie McGaughey (USDA/FAS/TFAA) and Mike Jewison (USDA/OCE/WAOB)

Official NOAA CPC ENSO Probabilities (issued Feb. 2023)



https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/



From: The Walker Circulation: ENSO's atmospheric buddy (Tom Di Liberto, August 1, 2014)
https://www.climate.gov/news-features/blogs/enso/walker-circulation-ensos-atmospheric-buddy

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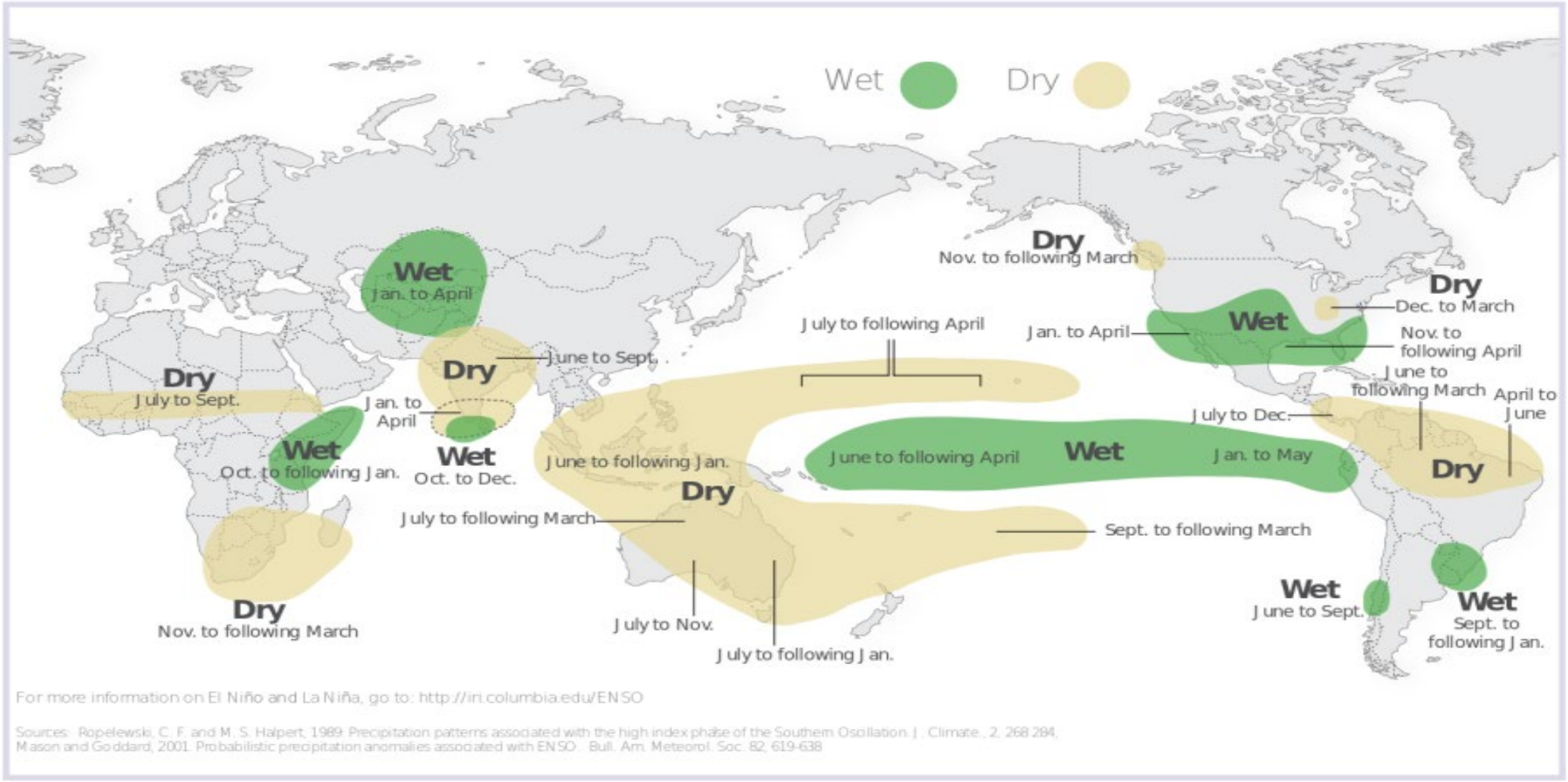

For more information on El Niño and La Niña, go to: http://iri.columbia.edu/ENSO

Sources: Ropelewski, C. F. and M. S. Halpert, 1989: Precipitation patterns associated with the high index phase of the Southern Oscillation. J. Climate., 2, 268-284.
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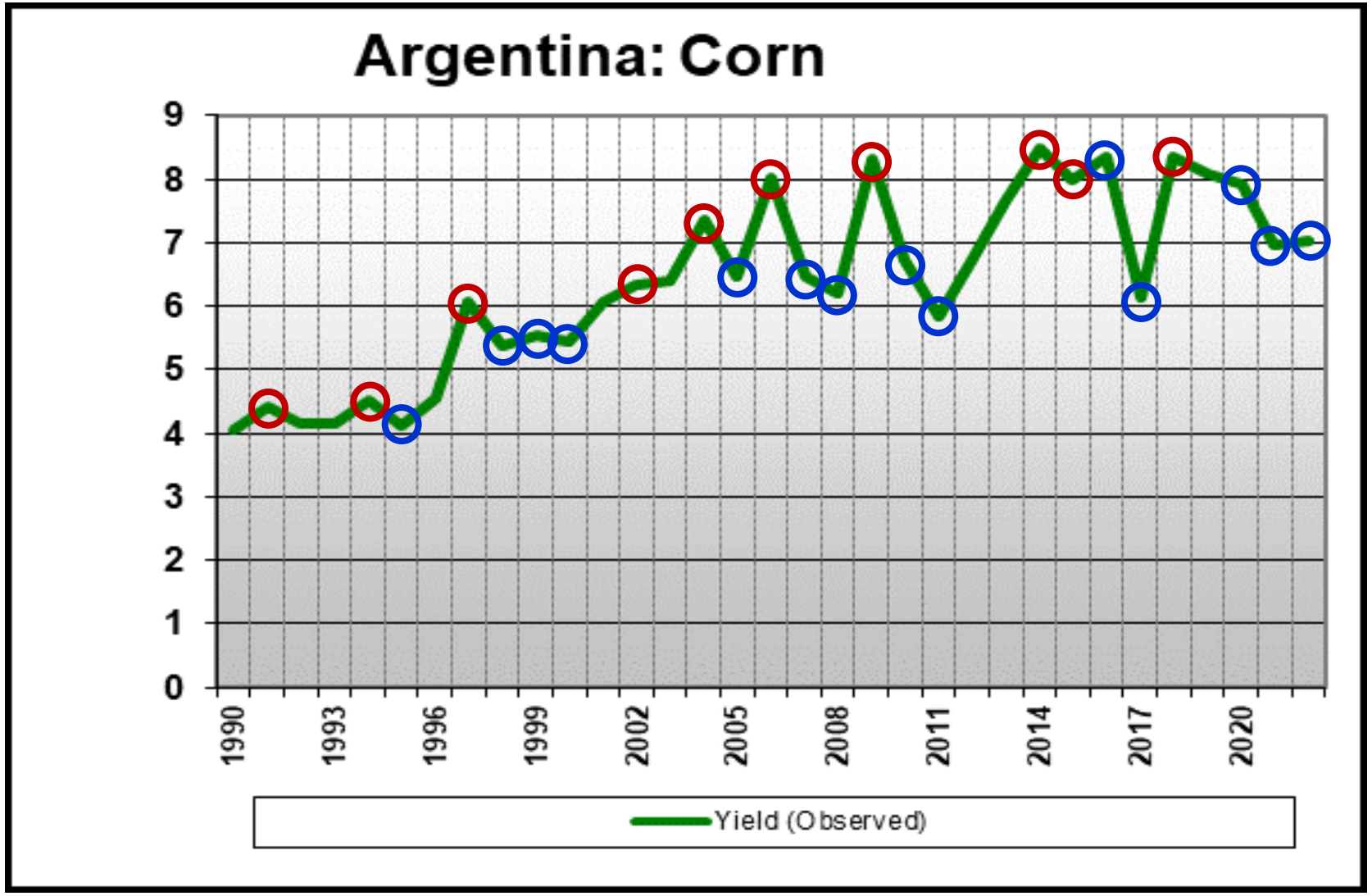
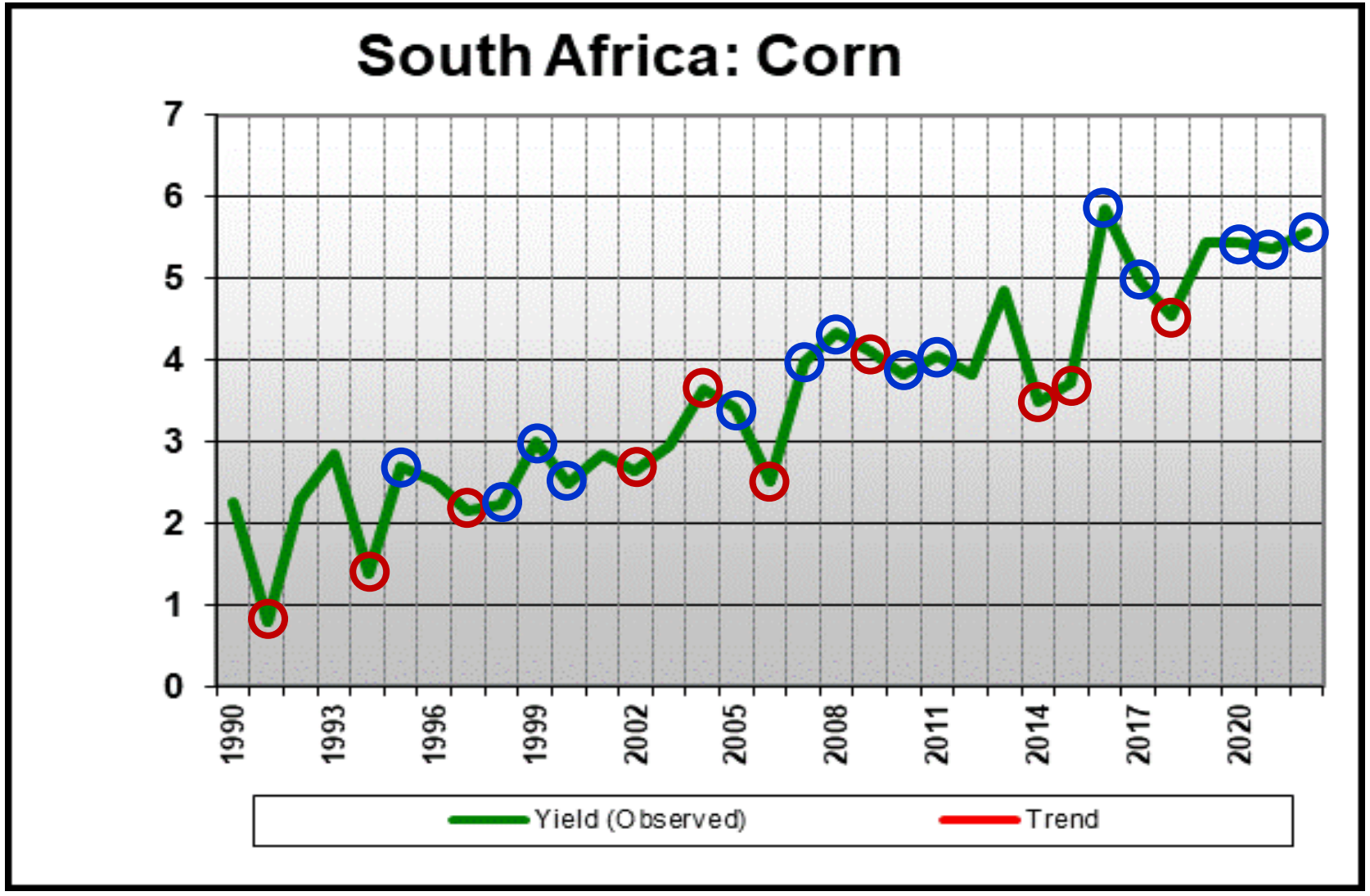


El Niño

La Niña

Yields typically rebound following La Niña growing season!

Source: PSD-Online (https://apps.fas.usda.gov/psdonline/app/index.html#/app/downloads)

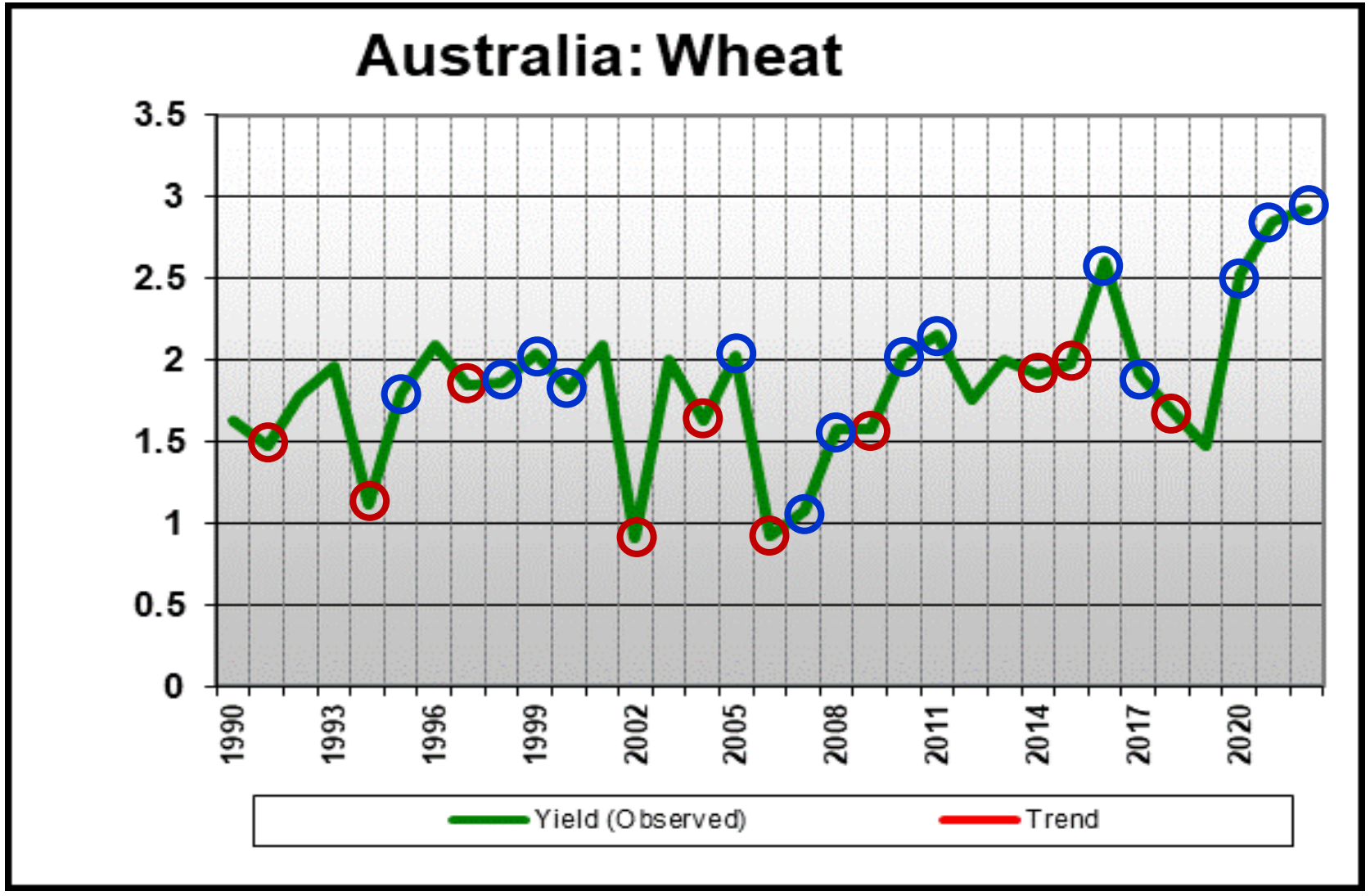


El Niño

La Niña

Droughts are common during El Niño years, with some notable exceptions.

Source: PSD-Online (https://apps.fas.usda.gov/psdonline/app/index.html#/app/downloads)

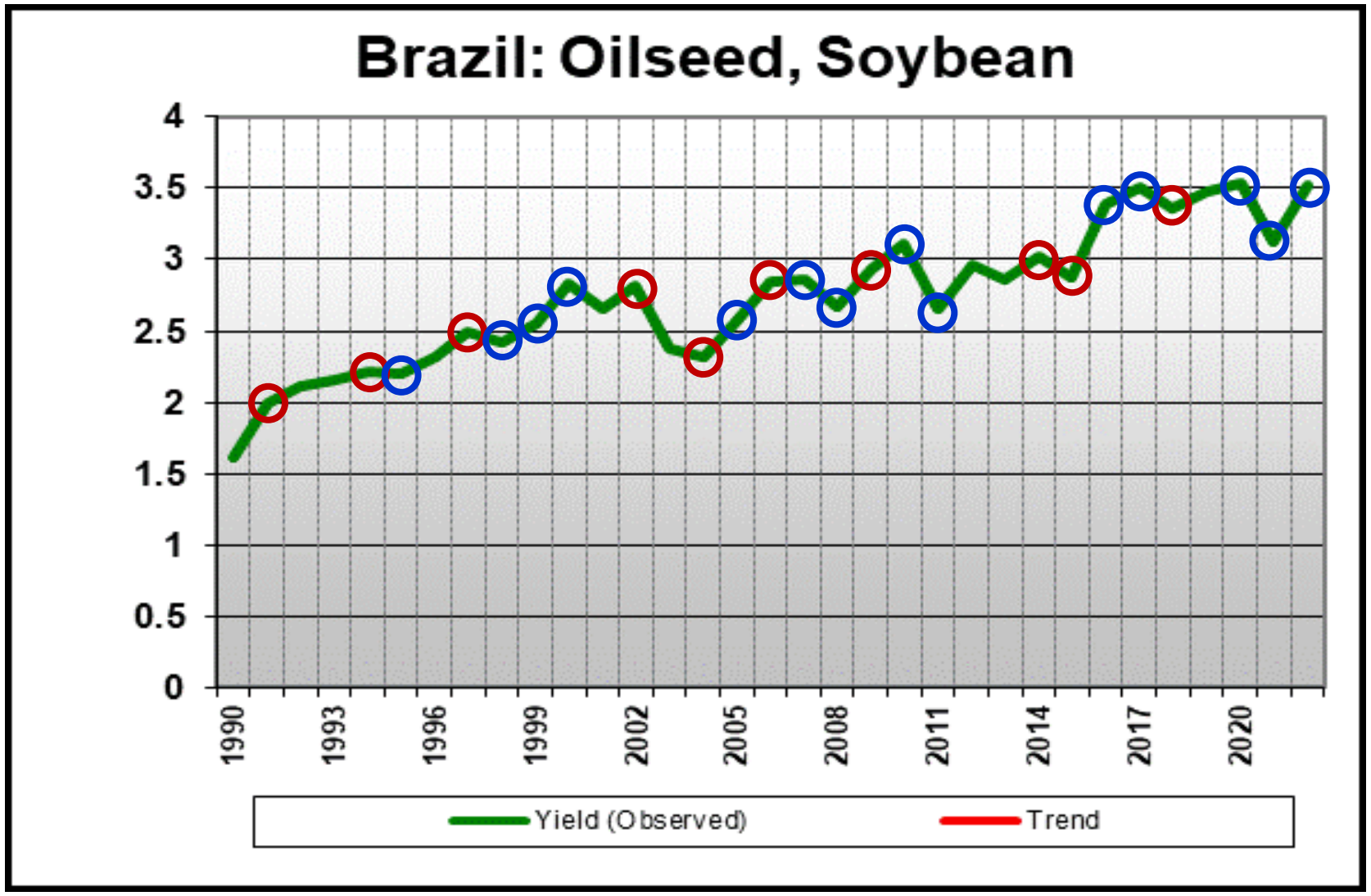


El Niño

La Niña

More variability in yields, though many El Niño seasons have been marked by drought.

Source: PSD-Online (https://apps.fas.usda.gov/psdonline/app/index.html#/app/downloads)



El Niño

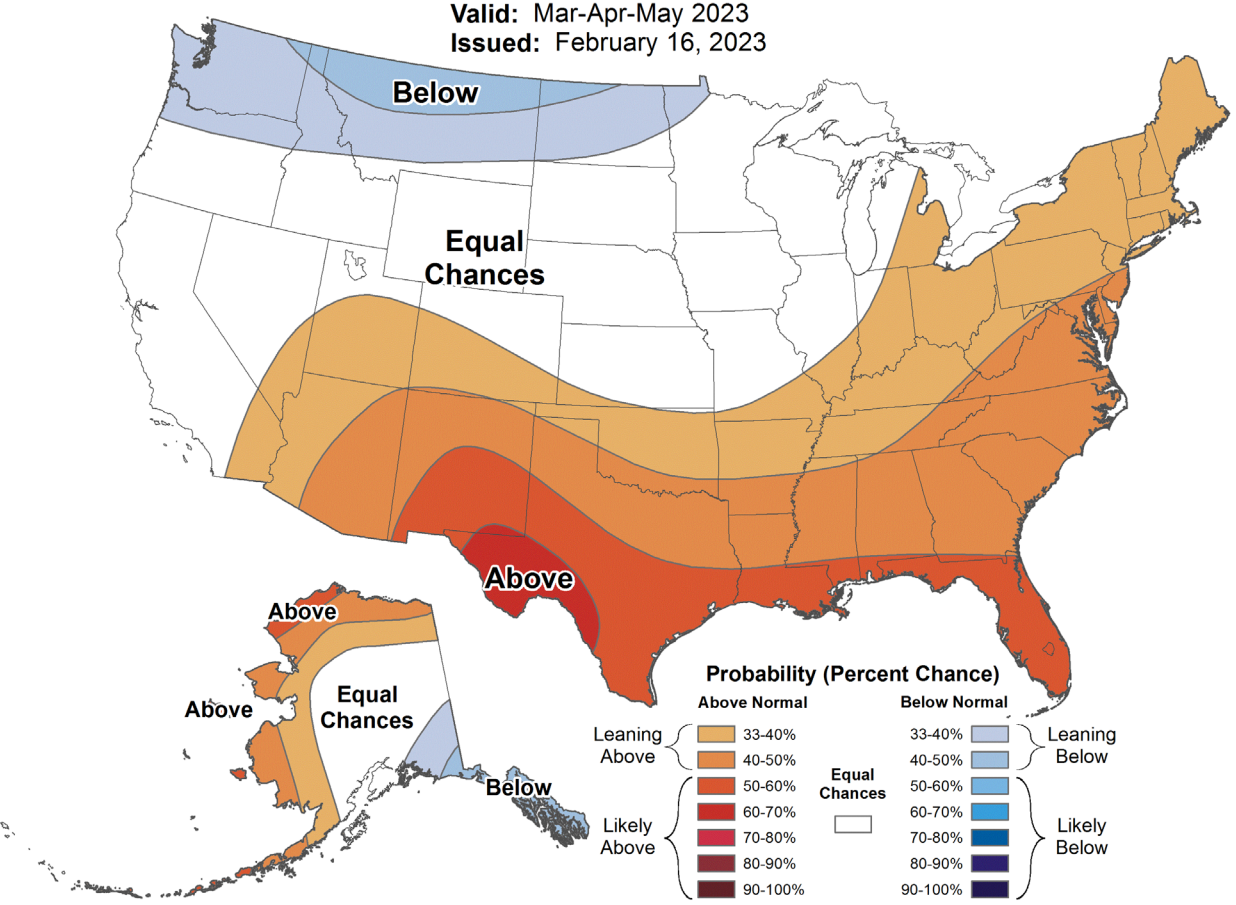
La Niña

No clear pattern.

Source: PSD-Online (https://apps.fas.usda.gov/psdonline/app/index.html#/app/downloads)

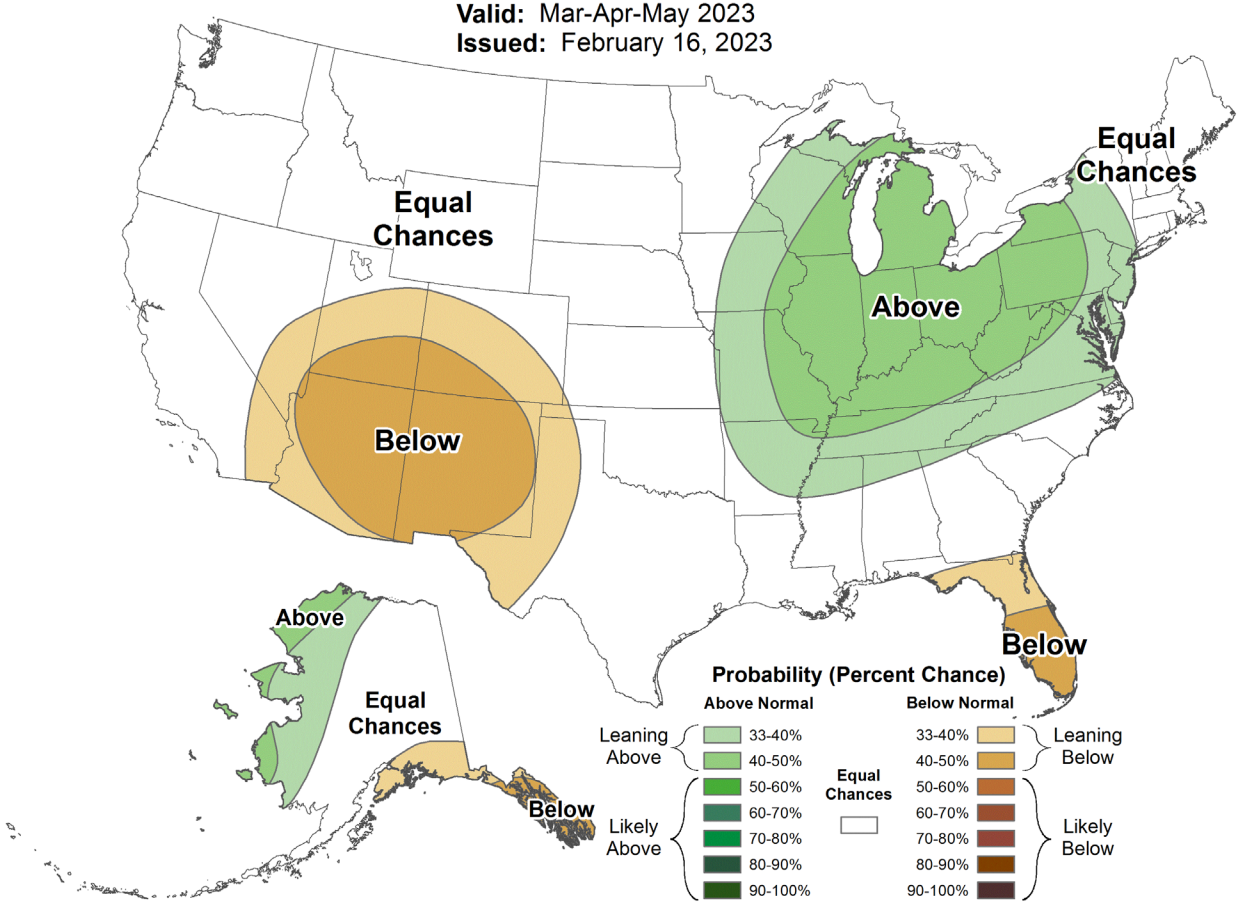
Seasonal Temperature Outlook

Valid: Mar-Apr-May 2023
Issued: February 16, 2023



Seasonal Precipitation Outlook

Valid: Mar-Apr-May 2023
Issued: February 16, 2023

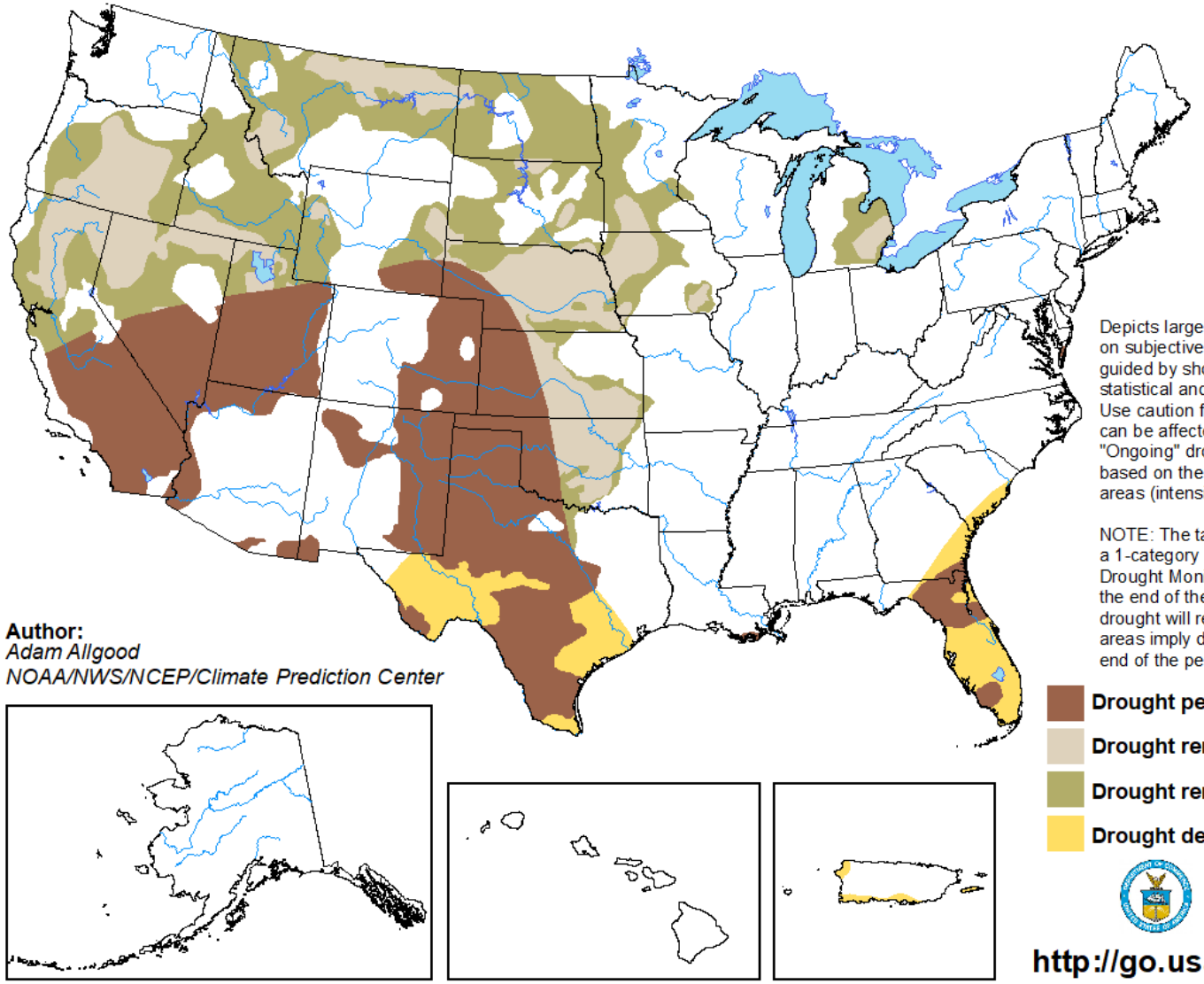


https://www.cpc.ncep.noaa.gov/products/predictions/long_range/

U.S. Seasonal Drought Outlook

Drought Tendency During the Valid Period

Valid for February 16 - May 31, 2023
Released February 16



Author:
Adam Allgood
NOAA/NWS/NCEP/Climate Prediction Center

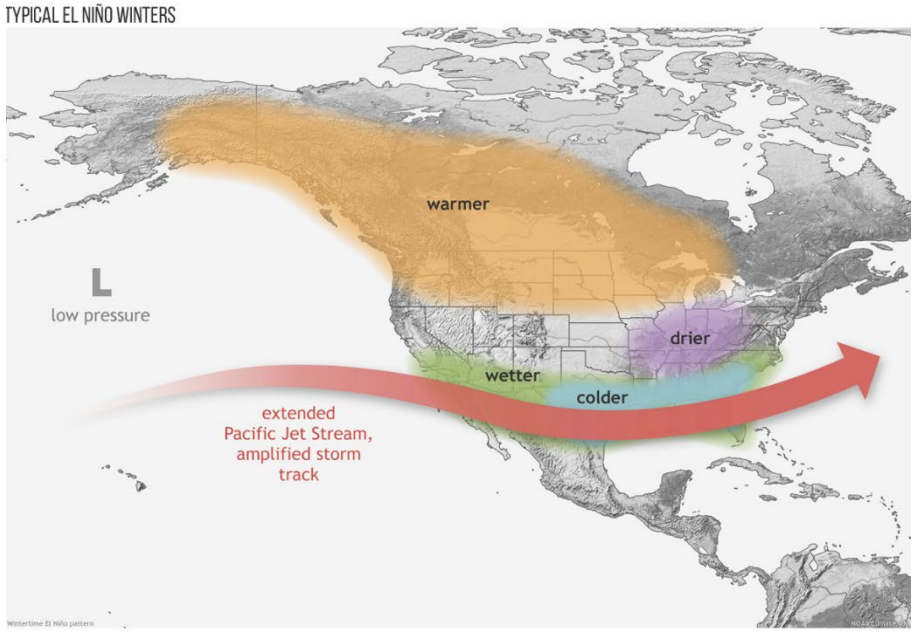
Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

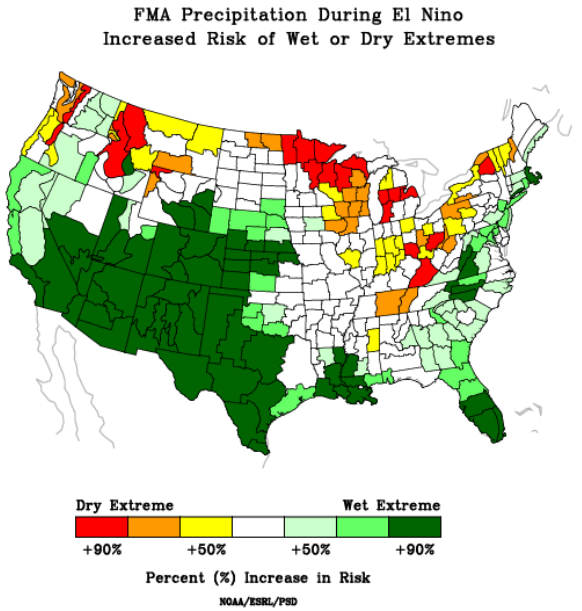
- **Drought persists**
- **Drought remains but improves**
- **Drought removal likely**
- **Drought development likely**

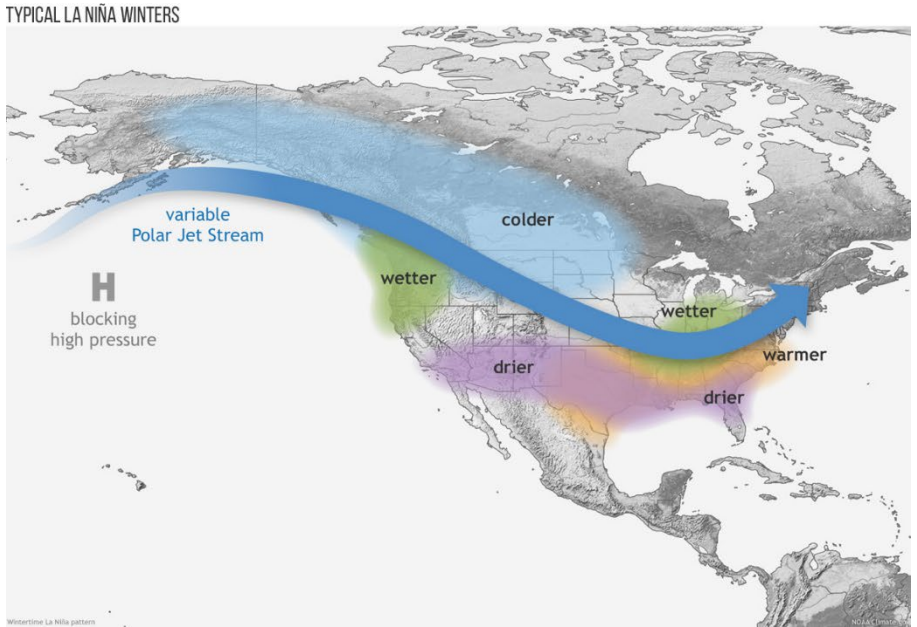
http://go.usa.gov/3eZ73

https://www.cpc.ncep.noaa.gov/products/expert_assessment/season_drought.png

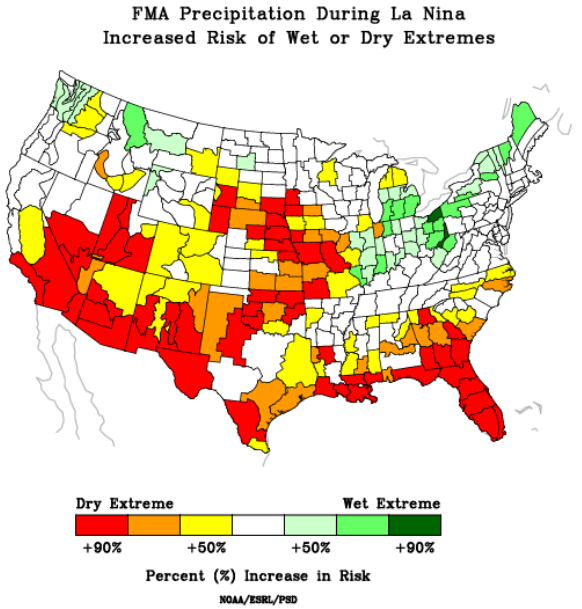


El Niño Winter

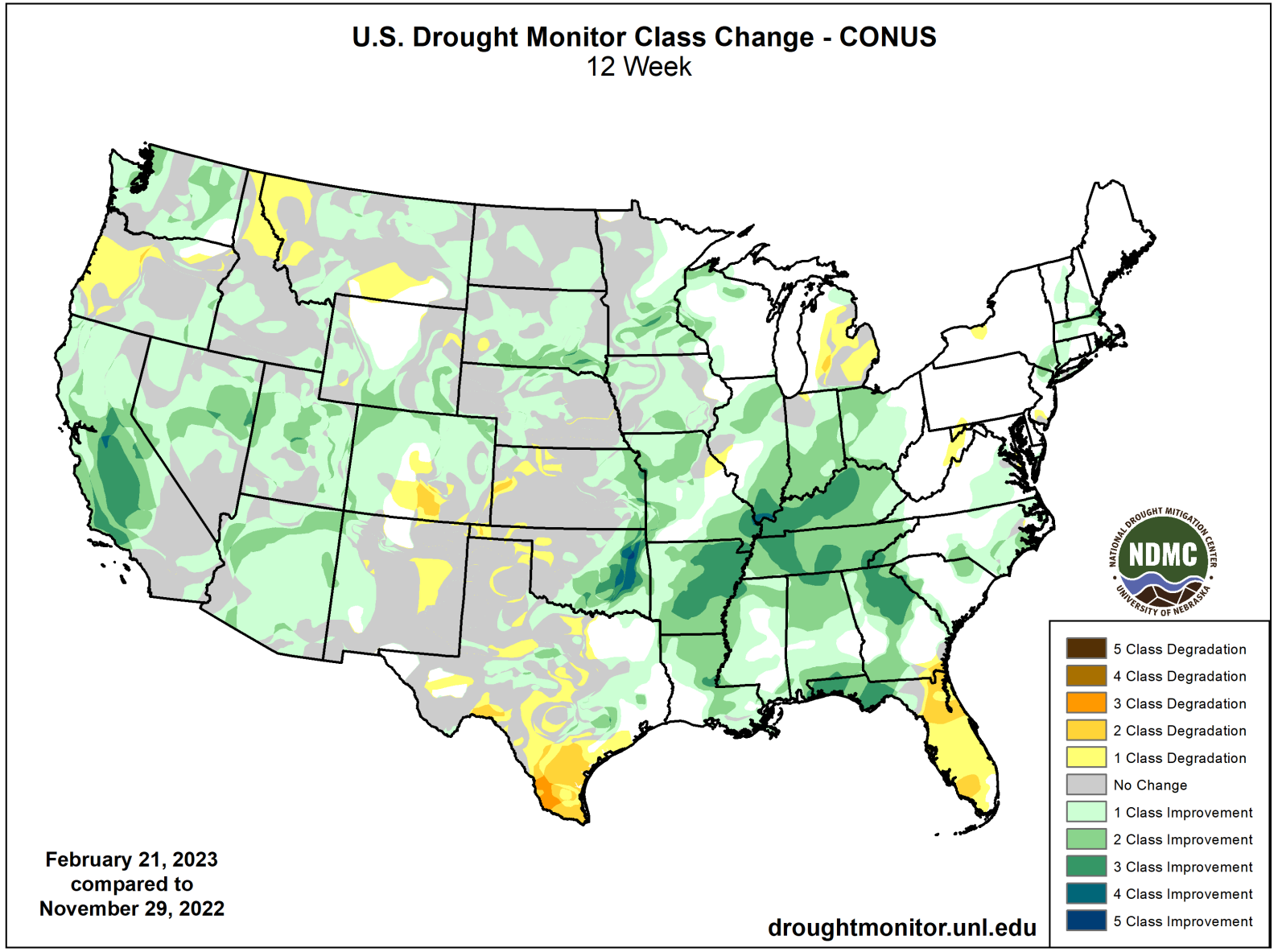




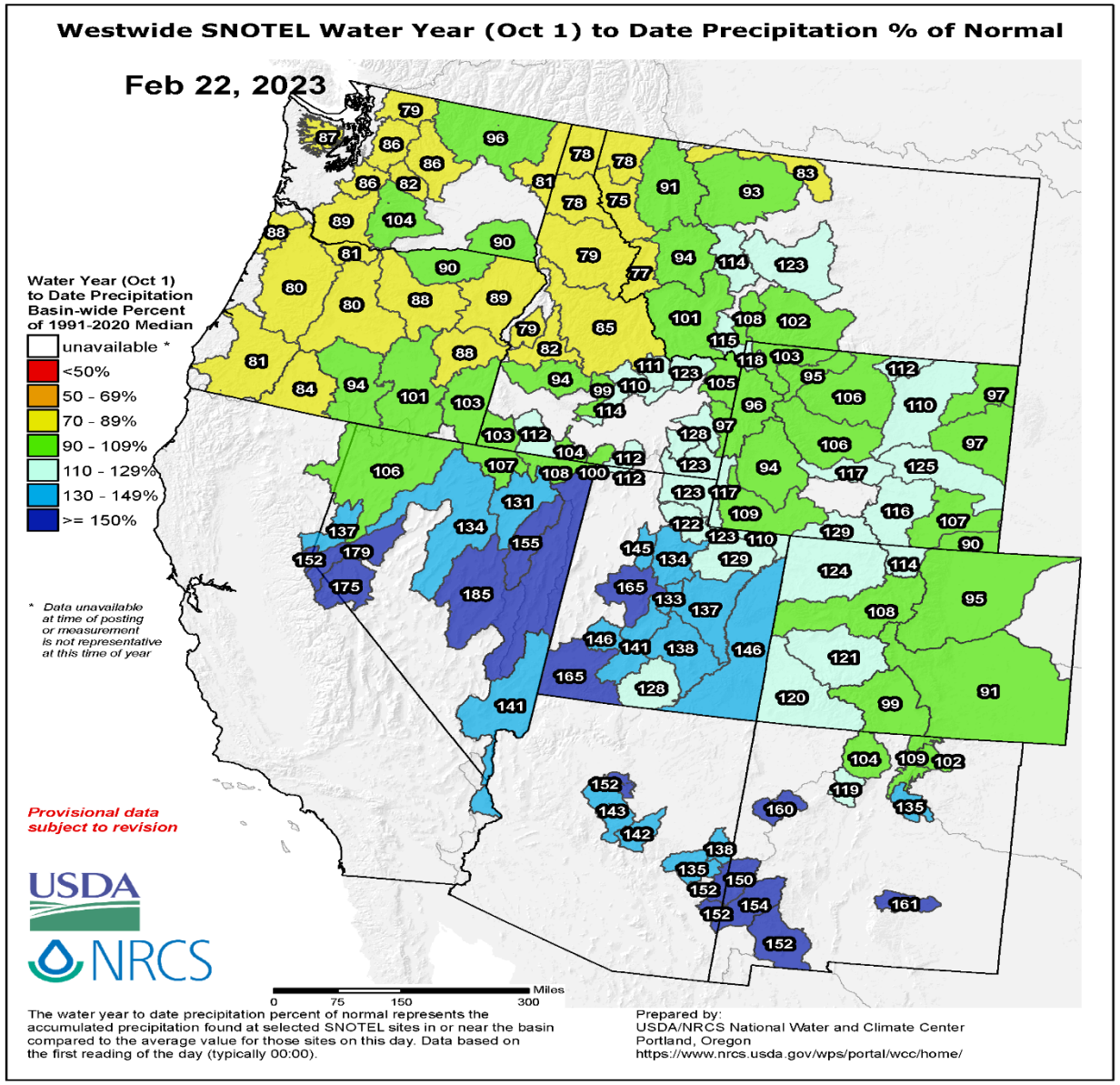
La Niña Winter

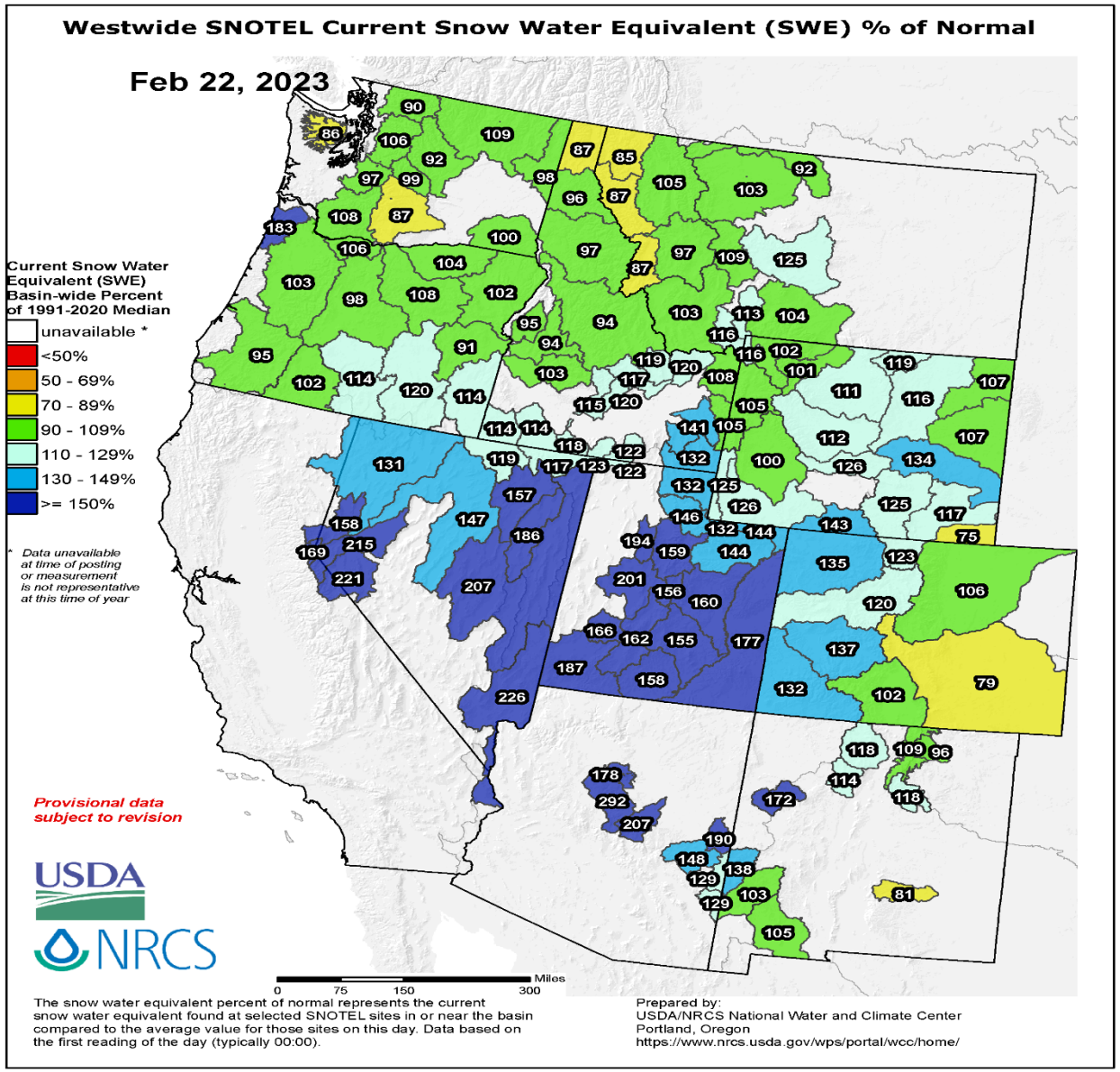


SOURCE: NOAA



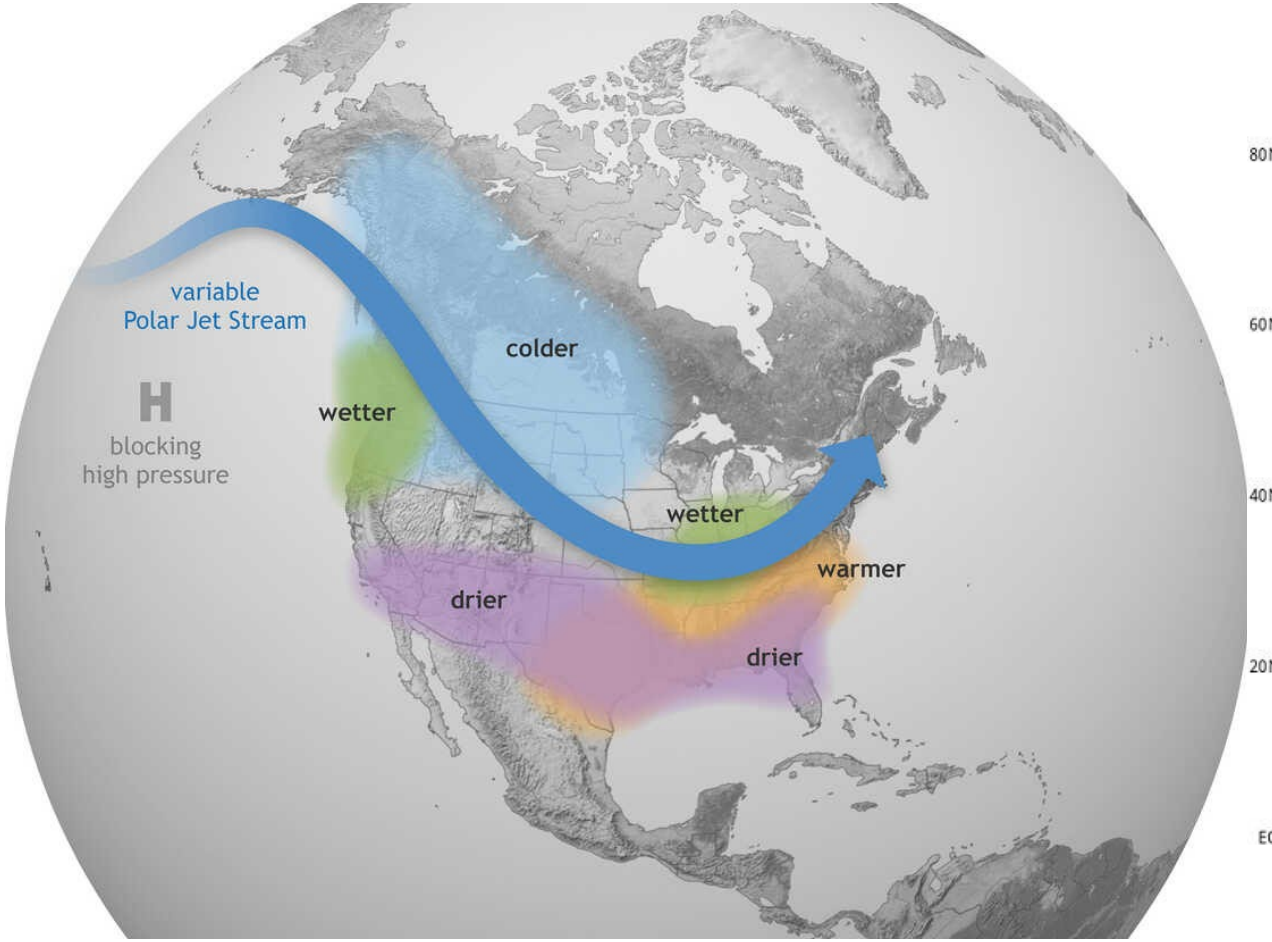
https://droughtmonitor.unl.edu/Maps/ChangeMaps.aspx



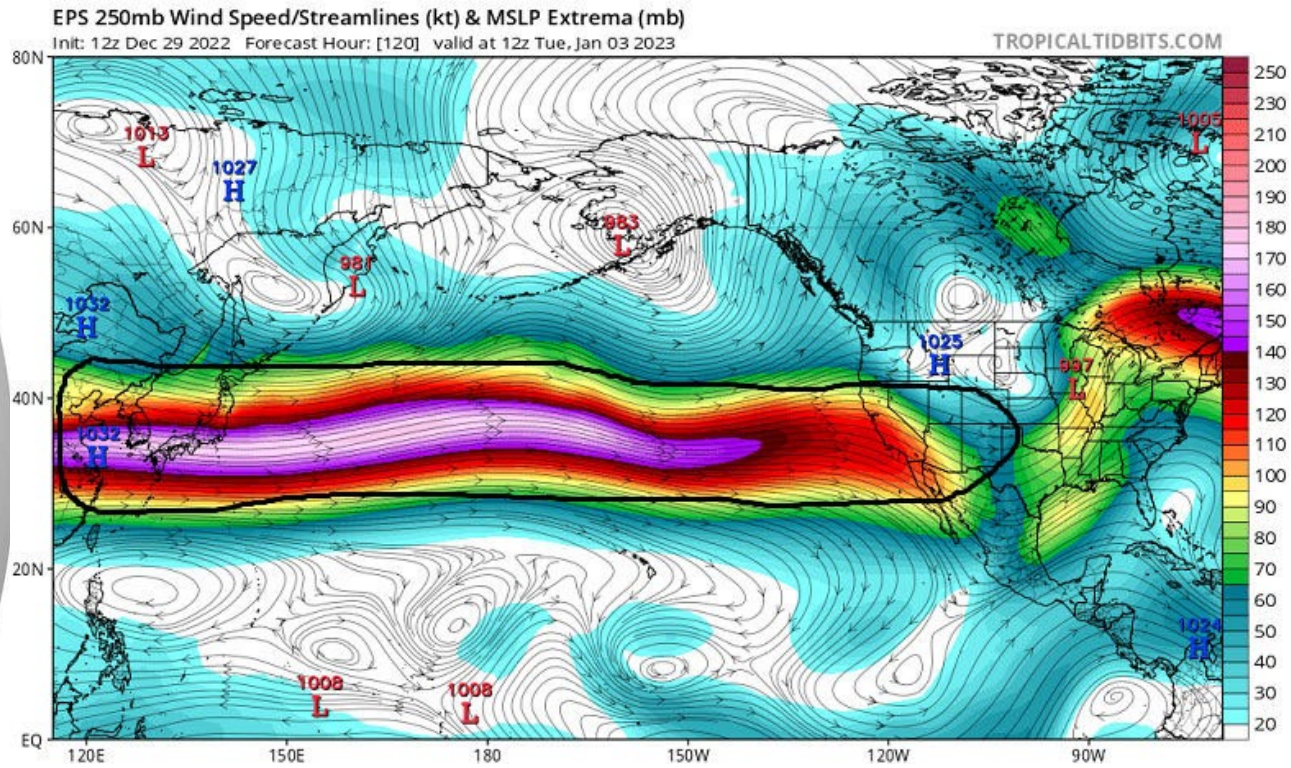


https://www.nrcs.usda.gov/wps/portal/wcc/home/

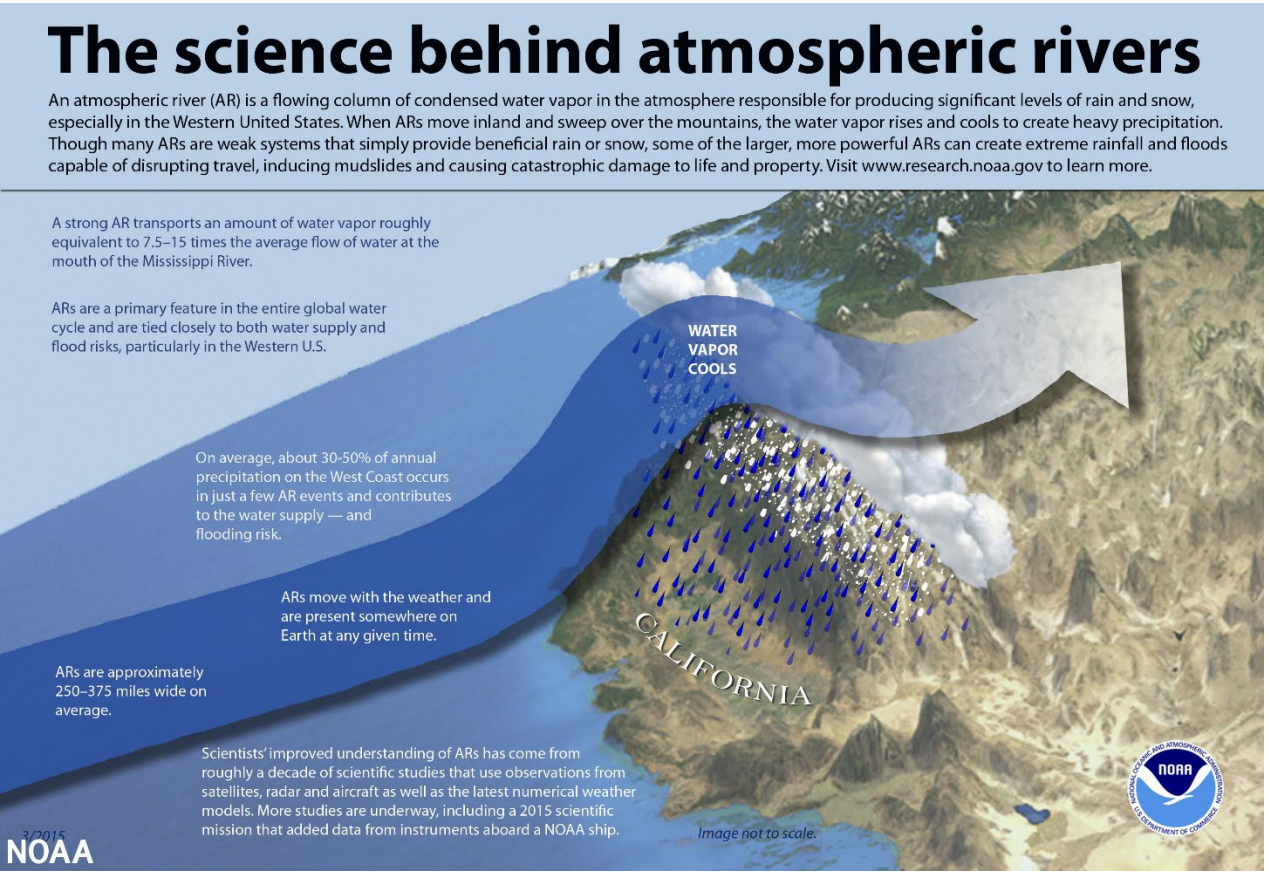
Typical La Niña Pattern

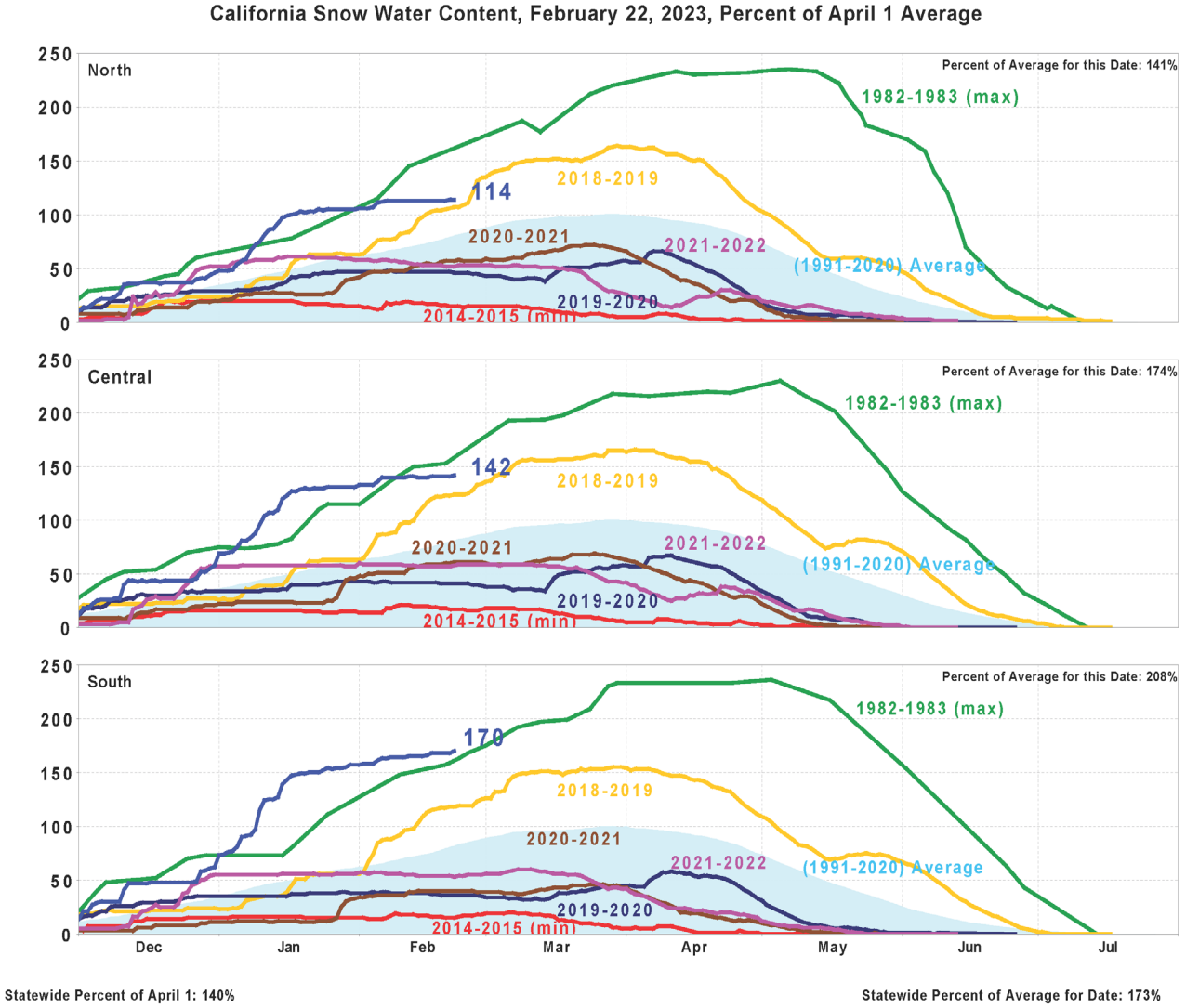


Actual Observed Pattern



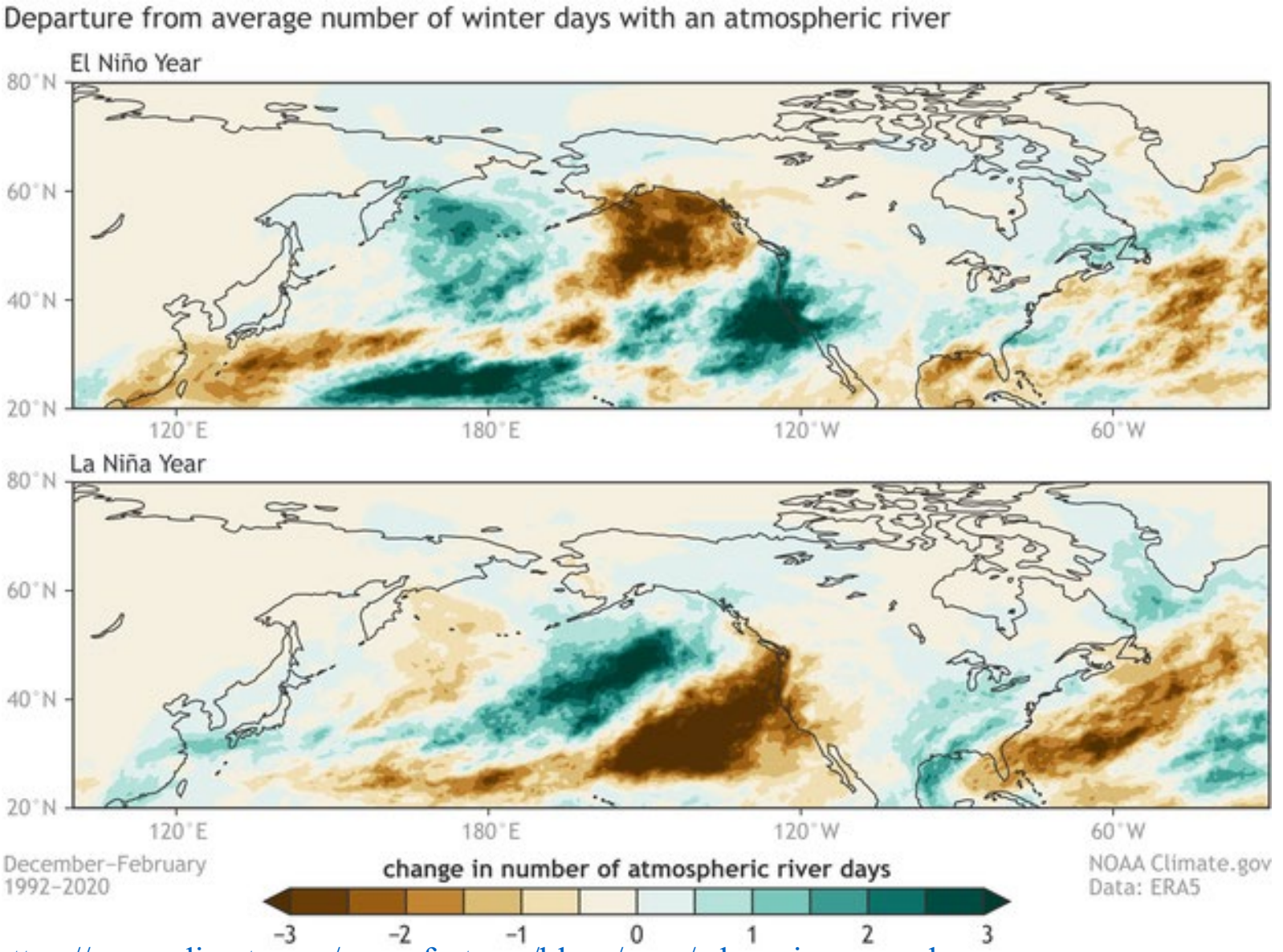
SOURCE: NOAA





https://research.noaa.gov/article/ArtMID/587/ArticleID/2926/Atmospheric-Rivers-What-are-they-and-how-does-NOAA-study-them

https://cdec.water.ca.gov/reportapp/javareports?name=PLOT_SWC



https://www.climate.gov/news-features/blogs/enso/when-rivers-reach-sky?fbclid=IwAR22aqVTHPekncvju3YEFL7MSlhVT8ytvWKr2lxOhNxWOSdR2NVhHbhmPao

Thanks!

mark.brusberg@usda.gov

https://www.markethallfoods.com/products/anchovy-fillets-iasa