

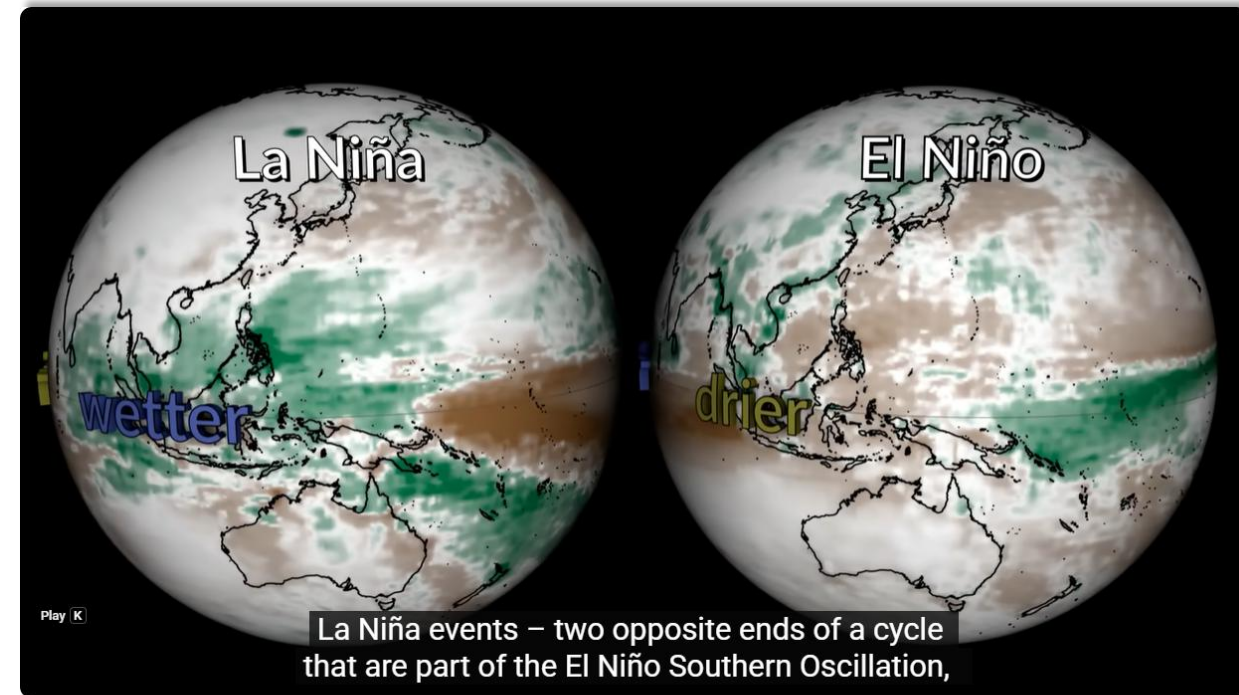


# Sept 30 Southern Oscillation (ENSO)

## Foci of the Day

- What are El Niño and La Niña?
- How often does ENSO occur?
- How long does ENSO last?
- How will ENSO impact a particular region?
- What is the Southern Oscillation Index (SOI)?
- El Niño/La Niña Update (August 2026) -- WMO

<https://www.youtube.com/watch?v=sabLh0F0rzA>



Climate change

United Nations • Climate change refers to long-term shifts in temperatures and weather patterns. Human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal, oil and gas.

## Reading

NOAA, El Niño Southern Oscillation (ENSO); [https://psl.noaa.gov/enso/?utm\\_source=chatgpt.com](https://psl.noaa.gov/enso/?utm_source=chatgpt.com)

WMO on El Niño (9/3/2026); <https://wmo.int/resources/publication-series/el-ninola-nina-updates/august-2026>

ENSO (<https://www.climate.gov/news-features/blogs/enso/what-el-nino-southern-oscillation-enso-nutshell>)

**El Niño:** A warming of the ocean surface, or above-average sea surface temperatures (SST), in the central and eastern tropical Pacific Ocean. Over Indonesia, rainfall tends to become reduced while rainfall increases over the tropical Pacific Ocean. The low-level surface winds, which normally blow from east to west along the equator (“easterly winds”), instead weaken or, in some cases, start blowing the other direction (from west to east or “westerly winds”).

**La Niña:** A cooling of the ocean surface, or below-average sea surface temperatures (SST), in the central and eastern tropical Pacific Ocean. Over Indonesia, rainfall tends to increase while rainfall decreases over the central tropical Pacific Ocean. The normal easterly winds along the equator become even stronger.

**Neutral:** Neither El Niño or La Niña. Often tropical Pacific SSTs are generally close to average. However, there are some instances when the *ocean* can look like it is in an El Niño or La Niña state, but the atmosphere is not playing along (or vice versa).

## Brief History

- Before La Niña was even recognized, South American fisherman noticed the warmup of coastal waters occurred every so often around Christmas. They referred to the warming as “El Niño,”
- **Sir Gilbert Walker** discovered the “Southern Oscillation,” or large-scale changes in sea level pressure across Indonesia and the tropical Pacific. However, he did not recognize that it was linked to changes in the Pacific Ocean or El Niño.
- It wasn’t until the late 1960s that **Jacob Bjerknes** and others realized changes in the ocean and the atmosphere were connected and the “ENSO” was born.
- It wasn’t until the 1980s or later that the terms ***La Niña*** and ***Neutral*** prominence.

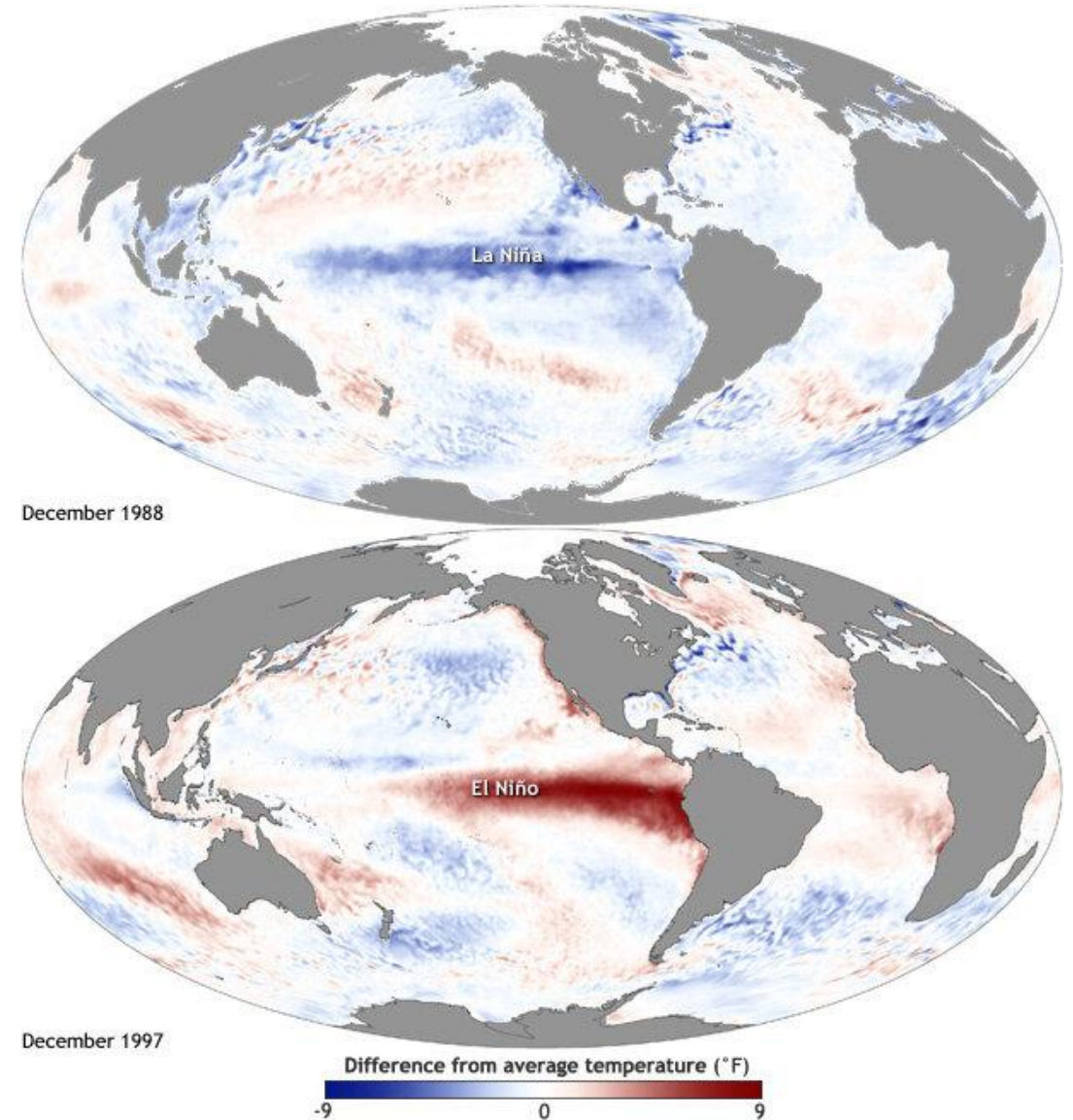


## El Niño/Southern Oscillation (ENSO)

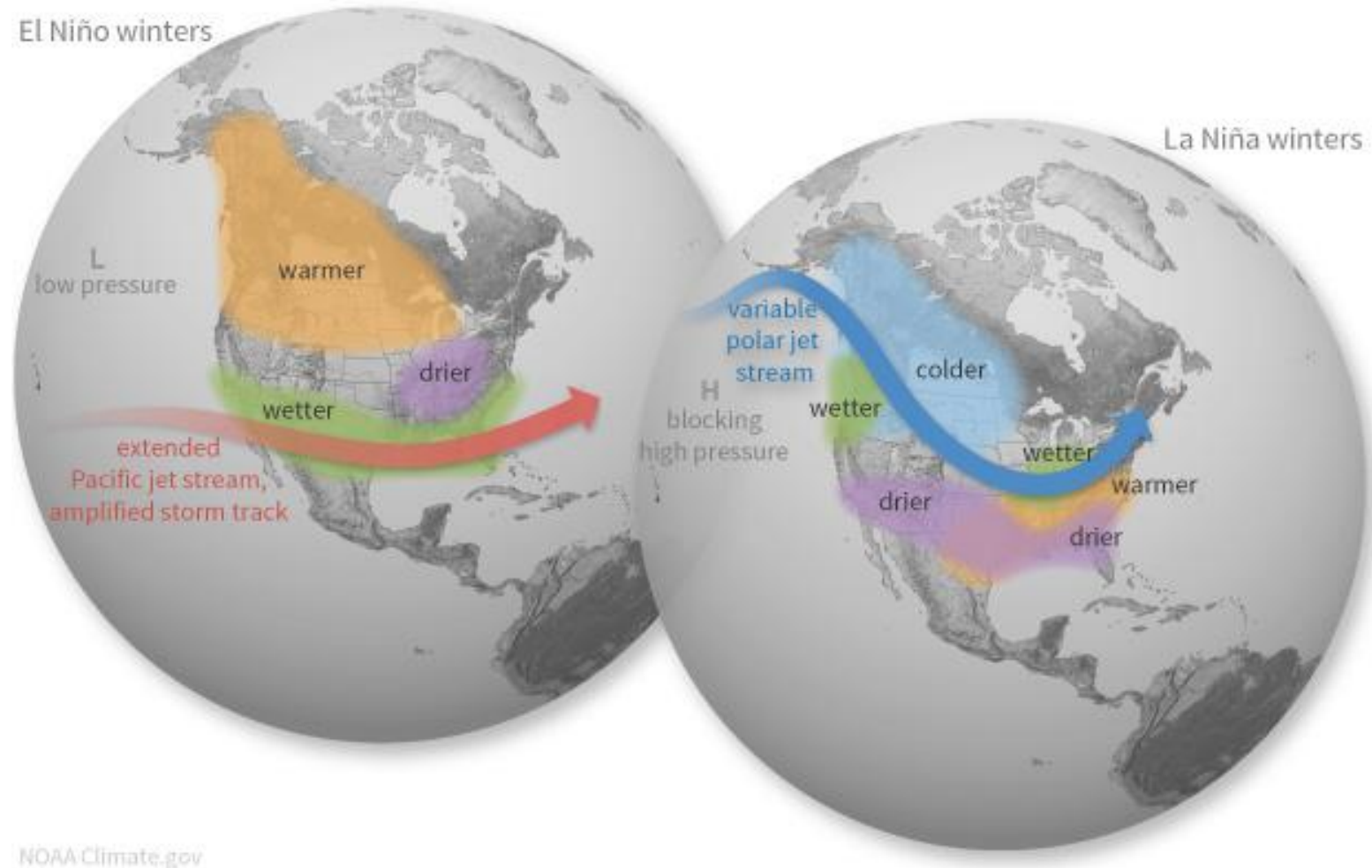
- ENSO is a naturally occurring anomalous state of tropical Pacific coupled ocean-atmosphere conditions
- It is made up of two states, or phases: “[El Niño](#),” and “[La Niña](#).”
- When the planet is not in either phase, it is said to be “ENSO-[Neutral](#)”
- On average, El Niño and La Niña occur every 3-7 years and each phase lasts about 9-12 months.

<https://research.noaa.gov/50-years-of-getting-enso-predictions-mostly-correct/>

Sea surface temperatures in the Pacific Ocean during a strong *La Niña* (top, 12/988) & *El Niño* (bottom, 12/1997).



Schematic diagram showing the physical mechanisms by which the SST (shaded), OLR (contours), surface zonal and meridional winds (vectors), and sea level pressure (represented by "H" and "L" which indicate the high and low pressure center, respectively) determine the wintertime Multivariate ENSO Index (MEI) during (a) El Niño and (b) La Niña events. The schematic is based on the composite anomalies for November-December (ND) drawn from 11 warm events and 11 cold events during 1980-2016.

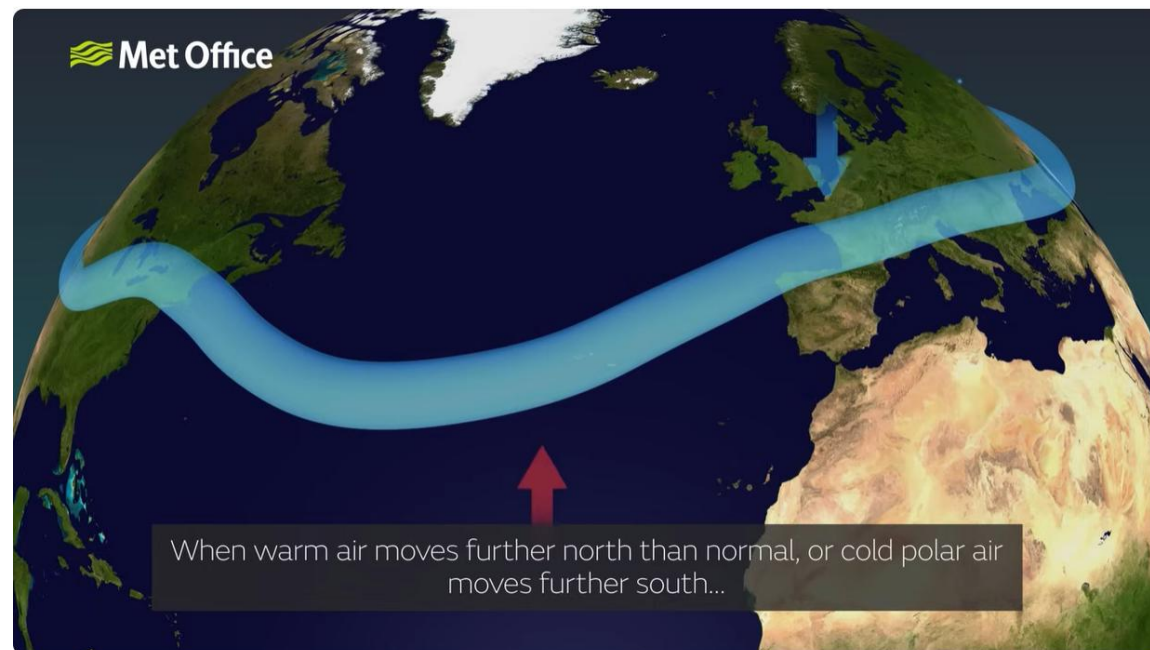


Typical winter impacts of La Niña (top) and El Niño (bottom) and how the jet stream is affected.

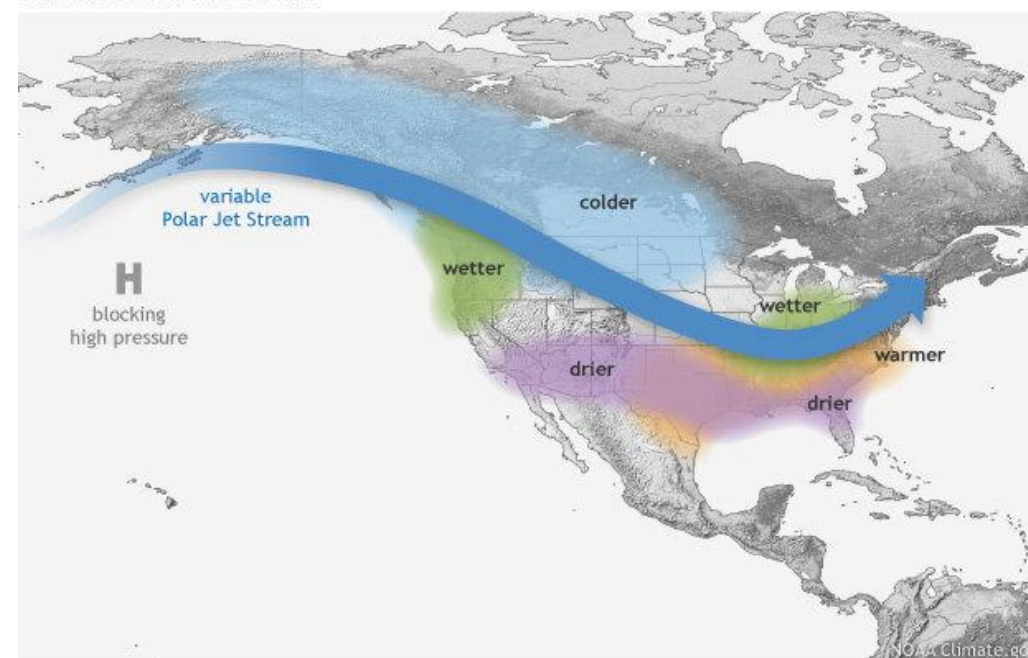
## Jet Stream

The jet stream is a core of strong winds around 5 to 7 miles above the Earth's surface, blowing from west to east.

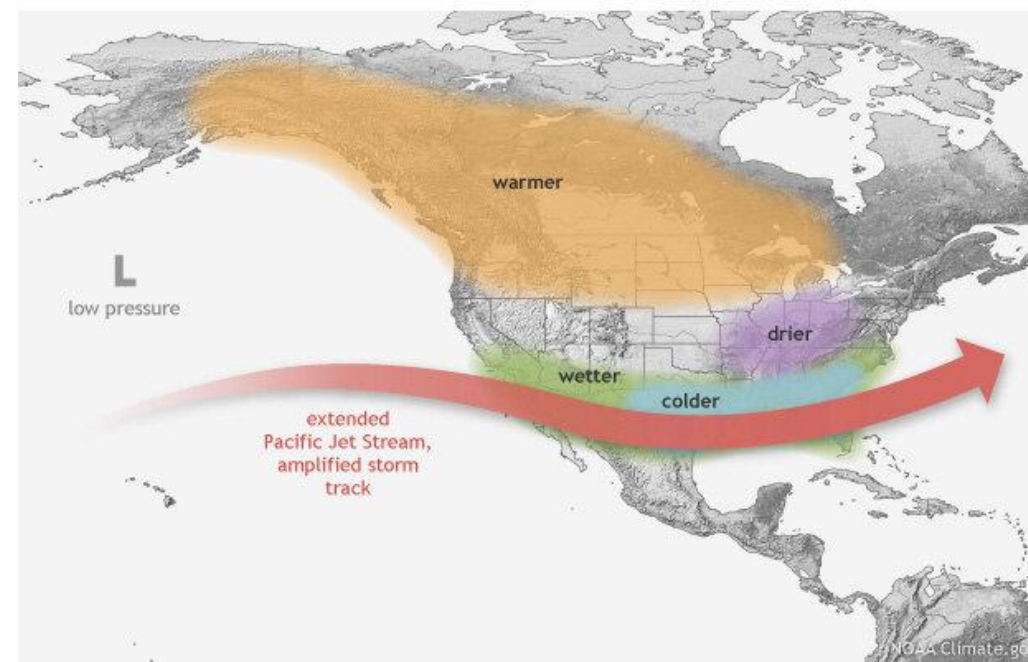
Explanation: <https://www.youtube.com/watch?v=Lg91eowtfbw>



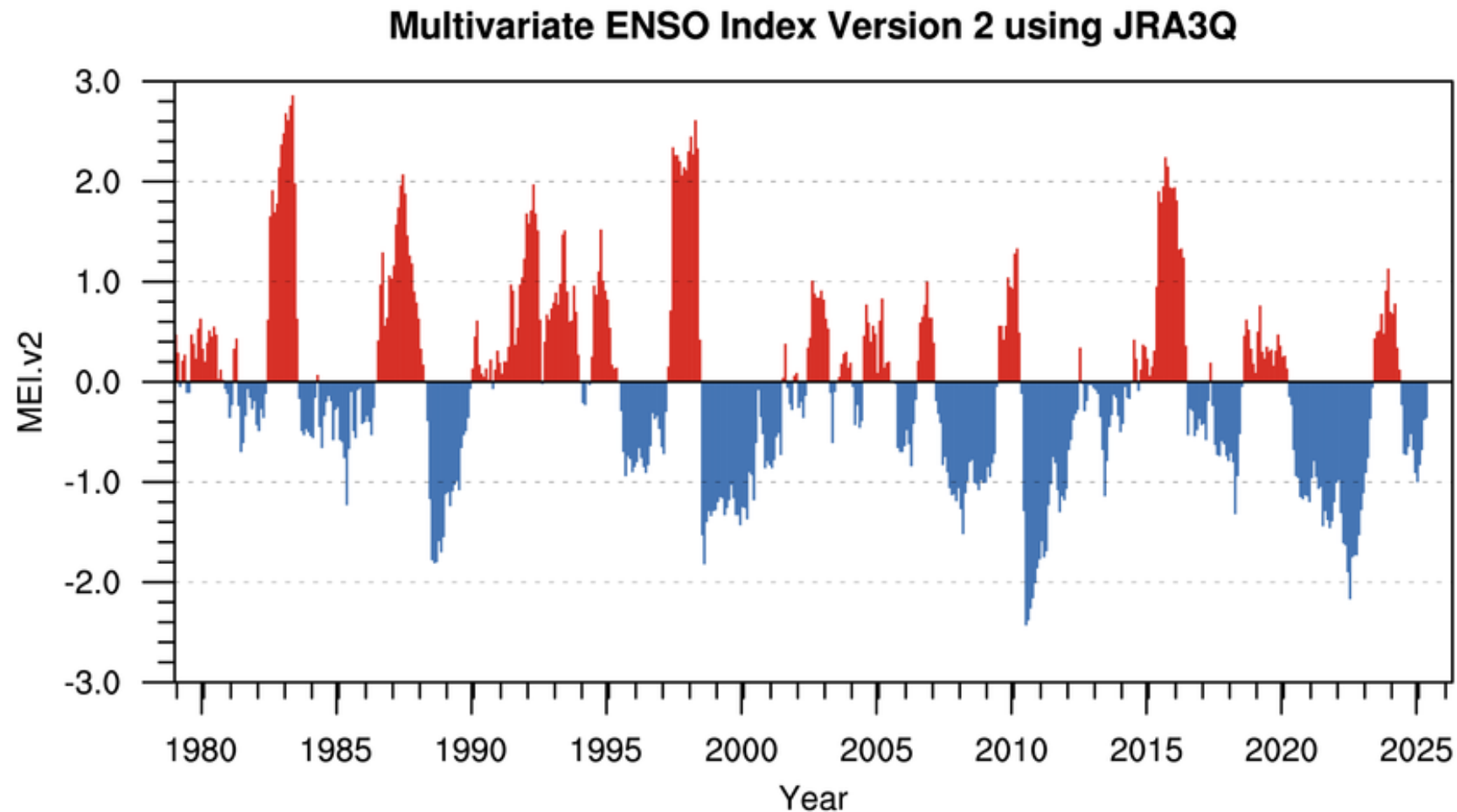
WINTER LA NIÑA PATTERN



WINTER EL NIÑO PATTERN

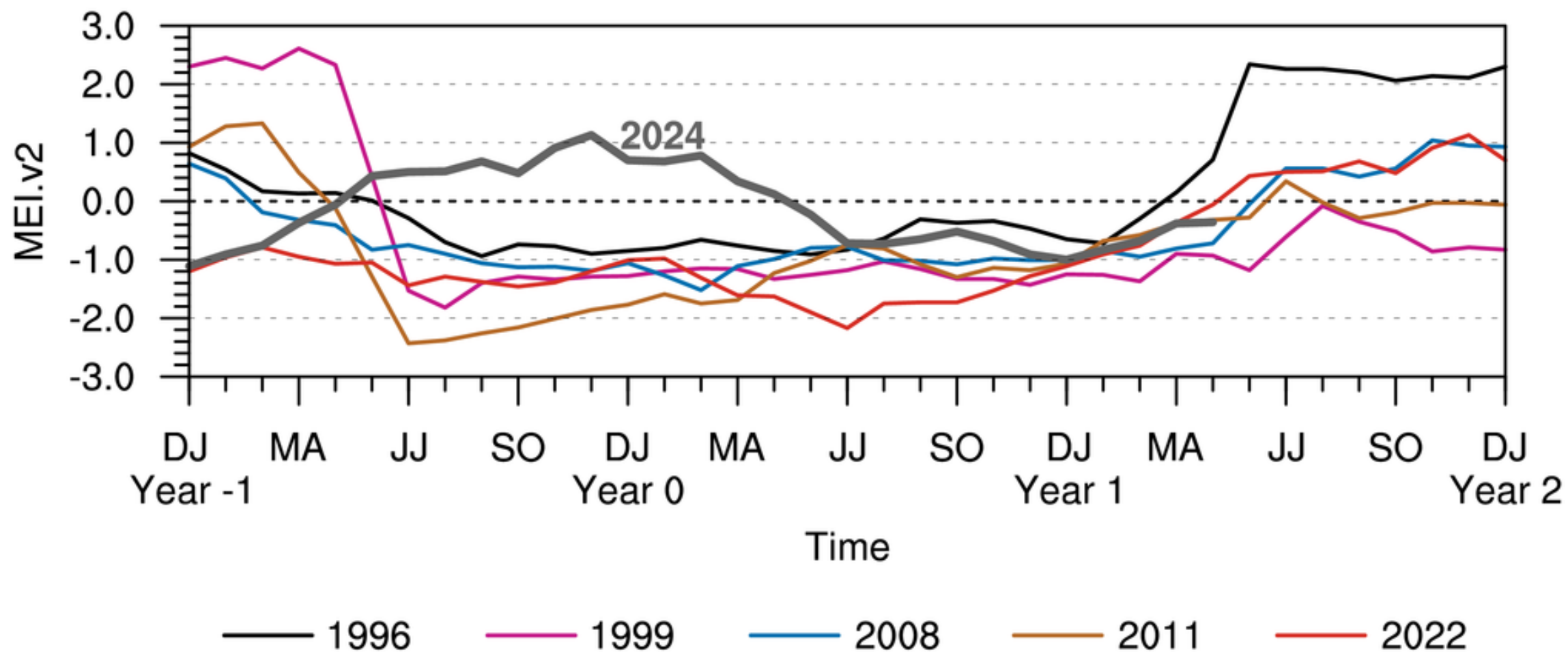


Bi-monthly **M**ultivariate **E**l Niño/Southern Oscillation (ENSO) Index (**MEI**) is the time series of the leading combined Empirical Orthogonal Function (EOF) of five variables: sea level pressure (SLP), sea surface temperature (SST), zonal and meridional components of the surface wind, and outgoing longwave radiation (OLR)) over the tropical Pacific basin (30°S-30°N, 100°E-70°W). (<https://psl.noaa.gov/enso/mei/>)



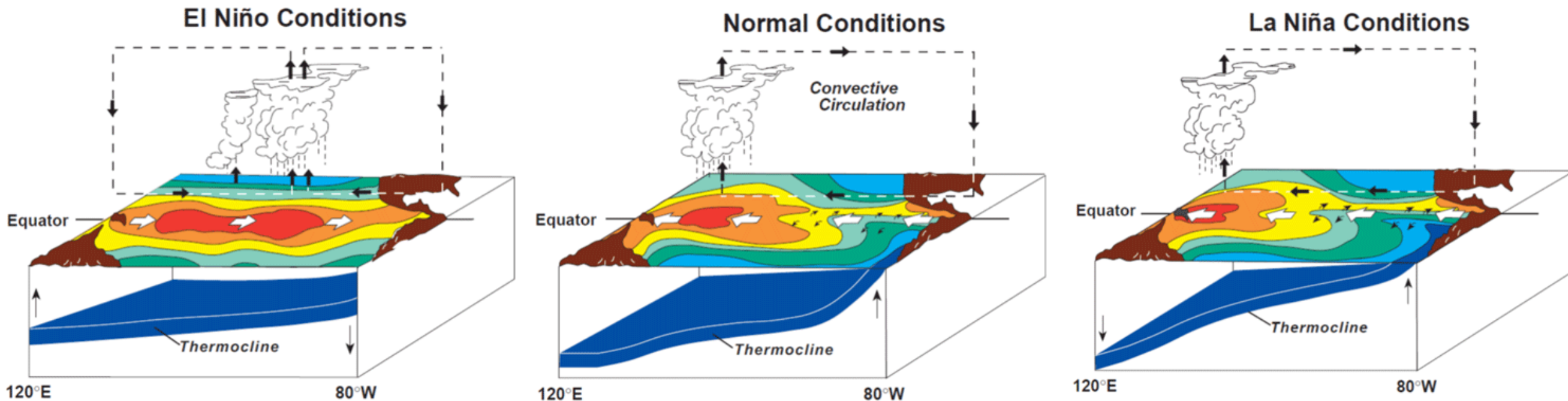


## MEI.v2 Evolution of Current ENSO Event in Historical Context



Surface temperatures, winds, areas of rising air, and the thermocline (blue surface) in the tropical Pacific during El Niño, normal, and La Niña conditions.

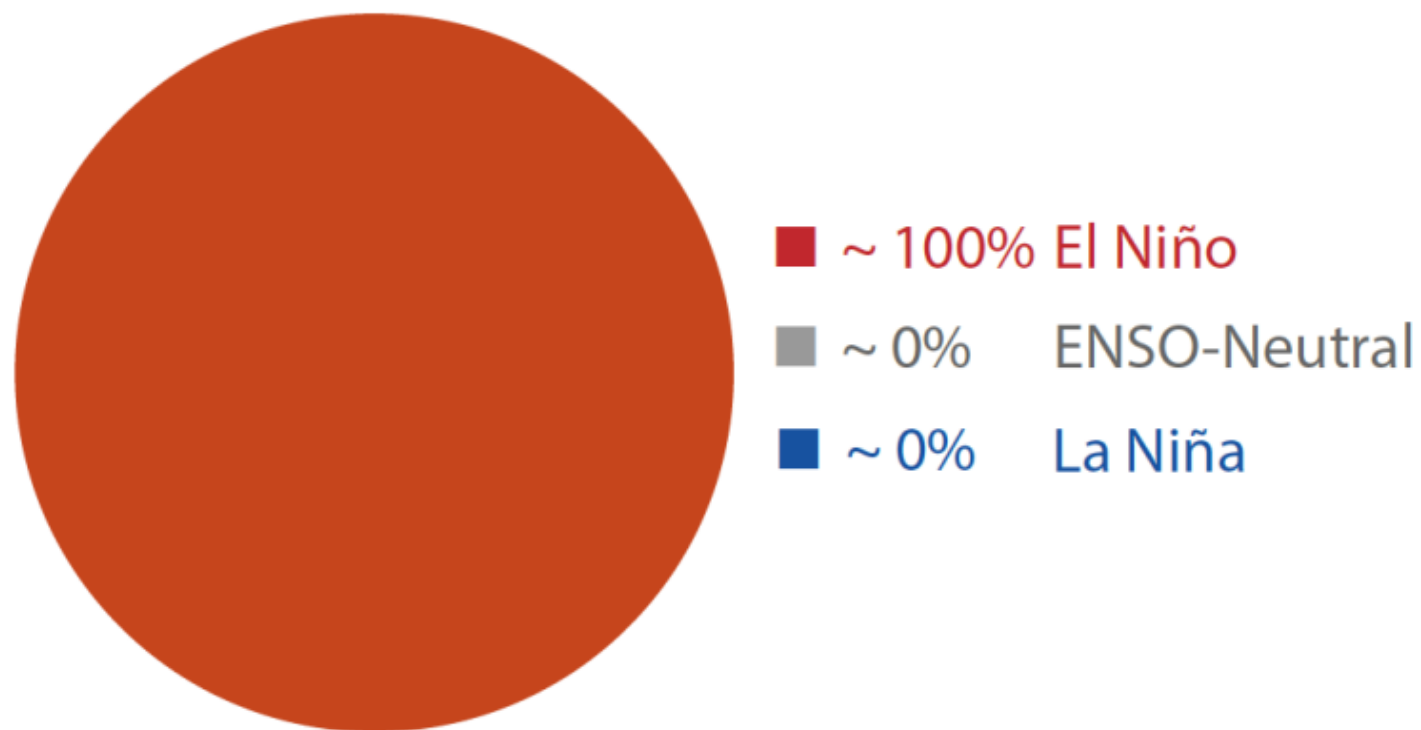
<https://reefresilience.org/climate-and-ocean-change/el-nino-southern-oscillation/>



# El Niño Update (August 2026), WMO

As of mid-August 2026, [El Niño](#) has become firmly established, marked by persistent and intensifying positive sea surface temperature anomalies across the central-eastern equatorial Pacific. The latest seasonal forecasts from WMO Global Producing Centres indicate [an exceptionally high likelihood \(nearly 100% probability\) that El Niño will persist through September–November 2026 and December 2026–February 2027.](#)

## ESTIMATED ENSO PROBABILITIES FOR SEPTEMBER-OCTOBER-NOVEMBER 2026





## El Niño Update (August 2026), WMO

- Forecasts indicate further strengthening of El Niño in the coming months, with the event forecast to reach very strong intensity before peaking towards the end of the year.
- ENSO-neutral conditions or a return to La Niña are not anticipated during the outlook period.
- A very strong El Niño increases the likelihood of significant shifts in temperature and rainfall patterns in many parts of the world.
- However, the strength of an El Niño event does not translate directly into the magnitude of impacts in any region.

# El Niño/La Niña Update (August 2026), WMO

## Key messages

- El Niño is firmly established and is expected to strengthen further
- WMO Forecasts show near 100% likelihood that it will persist through February 2027
- Exceptionally warm tropical Pacific Ocean conditions support further intensification
- A very strong El Niño can significantly shift rainfall and temperature patterns worldwide and fuel extreme weather

More YouTube Presentations on ENSO

<https://www.youtube.com/watch?v=wVlfyhs64IY>

<https://www.youtube.com/watch?v=EjlleQFxdIE&list=PL8A83633F8E268752&index=1>

<https://www.youtube.com/watch?v=hbeWmP0FQOg&list=PL8A83633F8E268752&index=2>



# OFFICIAL Forecasts: Dec-Jan-Feb 2025-26

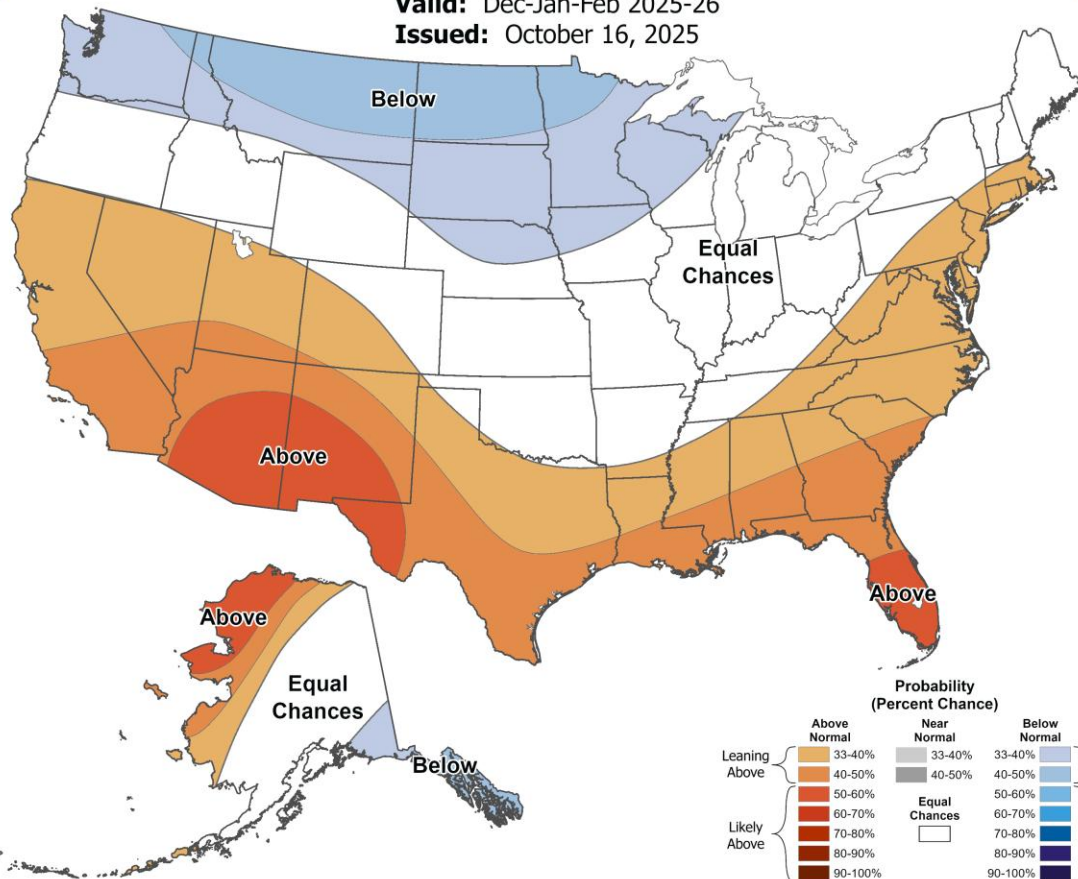
NOAA Prediction Center ([https://www.cpc.ncep.noaa.gov/products/predictions/long\\_range/seasonal.php?lead=2](https://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=2))



## Seasonal Temperature Outlook

**Valid:** Dec-Jan-Feb 2025-26

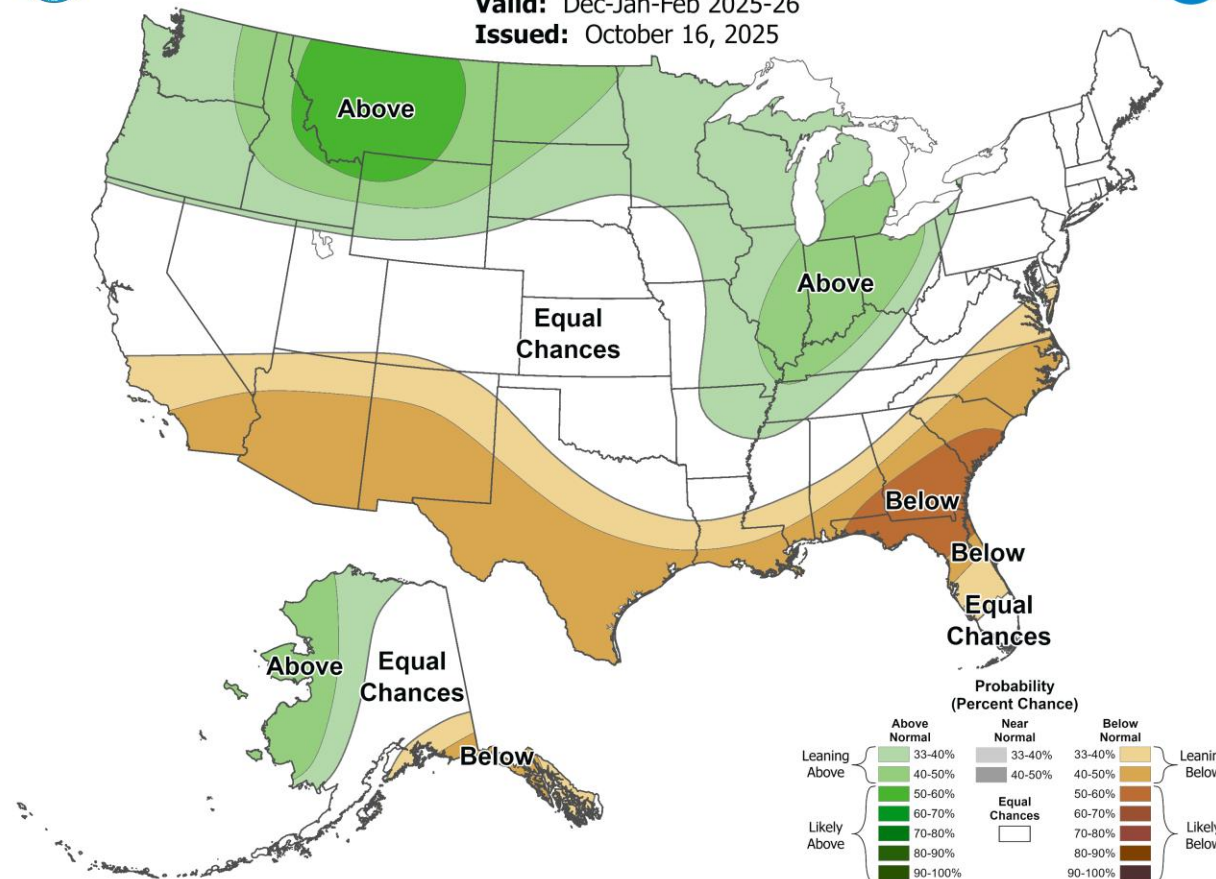
**Issued:** October 16, 2025



## Seasonal Precipitation Outlook

**Valid:** Dec-Jan-Feb 2025-26

**Issued:** October 16, 2025





- 1) ENSO includes three phases: El Niño, La Niña, and Neutral
- 2) El Niño and La Niña occur every 3-7 years and each phase lasts about 9-12 months
- 3) ENSO is a complex climate phenomenon arising from interactions between **ocean upwelling, surface wind patterns, and east–west atmospheric and oceanic circulation** in the tropical Pacific.



# Oct 5: Climate Extremes & Effects

## Foci of the Day

- Summary from IPCC (2021)
- Case studies (Gu et al. 2007; Grant et al. 2025)
- In class exercises
- Q&A on quizzes

## Reading:

- 1) U.S. Climate Extremes Index (CEI): <https://www.ncei.noaa.gov/access/monitoring/cei/>
- 2) Grant, L., Vanderkelen, I., Gudmundsson, L., Fischer, E., Seneviratne, S. I., & Thiery, W. (2025). Global emergence of unprecedented lifetime exposure to climate extremes. *Nature*, 641(8062), 374-379.