The 2023/2024 El Niño: Monitoring Global Impacts on Agriculture

Mark D. Brusberg
Chief Meteorologist
USDA Office of the Chief Economist / World Agricultural Outlook Board

Presented to
2024 USDA Agricultural Outlook Forum
Grain and Oilseeds Outlook
February 16, 2024
Normal Conditions

La Niña

Enhanced Circulation

Redirected Circulation

La Niña conditions

From: The Walker Circulation: ENSO's atmospheric buddy (Tom Di Liberto, August 1, 2014)
La Niña and Rainfall

La Niña conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one La Niña to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on the map below.

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

Sources:
Normal Conditions

El Niño

From: The Walker Circulation: ENSO's atmospheric buddy (Tom Di Liberto, August 1, 2014)
El Niño and Rainfall

El Niño conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one El Niño to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on the map below.

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

El Niño and His Friends
The North Atlantic Oscillation

Official NOAA CPC ENSO Probabilities (issued Feb. 2023)

based on -0.5°/+0.5°C thresholds in ERSSTv5 Niño-3.4 index

La Nina
Neutral
El Nino

Percent Chance (%)

Season
JFM FMA MAM AMJ MJJ JJA JAS ASO SON

https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/
Intensity of +1.5°C Considered a Strong El Niño

https://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/
IRI Multi-Model Probability Forecast for Precipitation for October–November–December 2023, Issued September 2023

https://iri.columbia.edu/our-expertise/climate/forecasts/#Seasonal_Climate_Forecasts
# Agricultural Weather Assessments

**OCE/World Agricultural Outlook Board**

## Sea Surface Temperature Anomalies (°C)

### Current Event

<table>
<thead>
<tr>
<th>Year</th>
<th>DJF</th>
<th>JFM</th>
<th>FMA</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
<td>0.2</td>
<td>-0.1</td>
<td>-0.3</td>
<td>-0.4</td>
<td>-0.6</td>
<td>-0.9</td>
<td>-1.2</td>
<td>-1.3</td>
<td>-1.2</td>
<td></td>
</tr>
<tr>
<td>2021</td>
<td>-1.0</td>
<td>-0.9</td>
<td>-0.8</td>
<td>-0.7</td>
<td>-0.5</td>
<td>-0.4</td>
<td>-0.4</td>
<td>-0.5</td>
<td>-0.7</td>
<td>-0.8</td>
<td>-1.0</td>
<td>-1.0</td>
<td></td>
</tr>
<tr>
<td>2022</td>
<td>-1.0</td>
<td>-0.9</td>
<td>-1.0</td>
<td>-1.1</td>
<td>-1.0</td>
<td>-0.9</td>
<td>-0.8</td>
<td>-0.9</td>
<td>-1.0</td>
<td>-1.0</td>
<td>-0.9</td>
<td>-0.8</td>
<td></td>
</tr>
<tr>
<td>2023</td>
<td>-0.7</td>
<td>-0.4</td>
<td>-0.1</td>
<td>0.2</td>
<td>0.5</td>
<td>0.8</td>
<td>1.1</td>
<td>1.3</td>
<td>1.6</td>
<td>1.8</td>
<td>1.9</td>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

### El Niño Event

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

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

### Strong El Niño (>= 1.5)

- 1991-92
- 1994-95
- 1997-98
- 2002-03
- 2004-05
- 2006-07
- 2009-10
- 2014-16
- 2015-16
- 2018-19
- 2023-24

### Strong (1991-92)

### Strong (1997-98)

### Strong (2009-10)

### Strong (2015-16)

### Strong (2023-24)

---

https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php
Java, Indonesia
Cumulative Precipitation (mm)
(Source: World Meteorological Organization)
“Because of this close connection, it becomes challenging to determine how much IOD variability is separate from ENSO variability

... A few studies even suggest that the IOD may influence the evolution of ENSO (citation), and so the ENSO/IOD connection might be a two-way street.”
Panama
Cumulative Precipitation (mm)
(Source: Climate Prediction Center/CMORPH)
To Mitigate Effects of "El Niño" Phenomenon, the Panama Canal Announces Draft Restrictions to Transiting Vessels
Northwestern Victoria
Cumulative Precipitation (mm)
(Source: World Meteorological Organization)

2002: +1.3
2015: +2.6
1997: +2.4
2023: +2.0 (°C)

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

Mato Grosso, Brazil
Total Precipitation (mm): November 1 - January 31
(Source: World Meteorological Organization)
Mato Grosso, Brazil

Number of Days Max T >= 35°C: November 1 - January 31
(Source: World Meteorological Organization)
Mato Grosso Soybean Yields (kg/ha)

Source for yield data: CONAB
2015/16 Soybean Crop Forecast Increased to 100 Million Metric Tons
Post increased its forecast for Brazil’s 2015/16 soybean production to a record **100 million metric tons (mmt)**. The higher production is a result of an increase (by 200,000 hectares) in Post’s estimate for planted area, to a total of 33.2 million hectares (ha). The higher planted area is based on the latest estimate by the Brazilian Food Supply Company (CONAB). The higher production forecast is also supported by the good rains through February in the Center-West, which is expected to help yields.

In general, yields for 2015/16 are expected to be better than what was anticipated back in December 2015. The states of Parana, Rio Grande do Sul, Bahia, Goais, and Mato Grosso do Sul are all expected to have better yields compared to the 2014/15 season. In contrast, Mato Grosso and states in the northeast (Piaui, Maranho, and Tocantins) are expected to have lower yields compared to last year due to the dry and hot conditions early in the season. However, the national yield is forecast to better than last year and reach 3.01 metric tons per ha.

---

2015/16 Soybean Crop Lowered to 98 Million Metric Tons
Post lowered its forecast for Brazil’s 2015/16 soybean production to a record **98 million metric tons (mmt)**. Area planted for soybeans is estimated at 33 million hectares (ha). The dry and hot conditions in Mato Grosso and other states in central and northeast Brazil are expected to impact yields.

- 
- 
- 

The southern states of Brazil, mainly Parana and Rio Grande do Sul, have experienced too much rain due to the weather phenomenon El Niño. The result has been some planting delays and has created concerns about potential yield losses. However, officials in both states have reported that most of the crop is in good conditions and it is too early to assess potential yield problems.
IRI Multi-Model Probability Forecast for Precipitation for October–November–December 2023, Issued September 2023

IRI Multi-Model Probability Forecast for Temperature for October–November–December 2023, Issued September 2023

https://iri.columbia.edu/our-expertise/climate/forecasts/#Seasonal_Climatic_Forecasts
*Vegetative Health Index
Week 52 Difference (2023 versus 2022)

*Source: NESDIS
Paraná, Brazil
Cumulative Precipitation (mm)
(Source: World Meteorological Organization)
Paraná VHI
Week 1 (1996 to 2024)

Average ~55

Source: NESDIS
Paraná VHI
Diff Week 1 - Week 48

Source: NESDIS
Paraná Soybean Yields (kg/ha)

Year + VHI (Week 1): Adj $r^2 \sim 0.65$

Source for yield data: CONAB
Paraná Soybean Yields (kg/ha)

Other Strong El Niños

Year + VHI (Week 1): Adj $r^2 \sim 0.65$

Source for yield data: CONAB
Multivariate ENSO Index (MEI)

Estimates level of “coupling” between ENSO events with atmosphere.

Considers the Following:

- Sea Surface Temperatures;
- Sea Level Pressure;
- Surface Zonal Winds
- Surface Meridional Winds; and
- Outgoing Longwave Radiation

[https://www.psl.noaa.gov/enso/mei/](https://www.psl.noaa.gov/enso/mei/)
Multivariate ENSO Index Version 2

https://www.psl.noaa.gov/enso/mei/
MEI.v2 Evolution of Current ENSO Event in Historical Context

![Graph showing MEI.v2 values over time for different years. The graph includes lines for 1983, 1987, 1992, 1998, and 2016, with a note that 2023 is highlighted.](https://www.psl.noaa.gov/enso/mei/)
Sea Surface Temperature Anomalies (°C)
September 1997

Sea Surface Temperature Anomalies (°C)
September 2023

https://climatereanalyzer.org/
Monthly SST Anomaly (°C), World (60°S–60°N, 0–360°E)

Dataset: NOAA OSI SST V2.1 | Image Credit: ClimateReanalyzer.org, Climate Change Institute, University of Maine

https://climatereanalyzer.org/
**Agricultural Weather Assessments**
OCE/World Agricultural Outlook Board

**El Niño Winter**
- Increased risk of wet or dry extremes
- SOURCE: NOAA

**La Niña Winter**
- SOURCE: NOAA
The science behind atmospheric rivers

An atmospheric river (AR) is a flowing column of condensed water vapor in the atmosphere responsible for producing significant levels of rain and snow, especially in the Western United States. When ARs move inland and sweep over the mountains, the water vapor rises and cools to create heavy precipitation. Though many ARs are weak systems that simply provide beneficial rain or snow, some of the larger, more powerful ARs can create extreme rainfall and floods capable of disrupting travel, inducing mudslides, and causing catastrophic damage to life and property. Visit [research.noaa.gov](https://research.noaa.gov/article/ArtMID/587/ArticleID/2926/Atmospheric-Rivers-What-are-they-and-how-does-NOAA-study-them) to learn more.

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

[California Snow Water Content, February 14, 2024, Percent of April 1 Average](https://cdec.water.ca.gov/reportapp/javareports?name=PLOT_SWC)
Seasonal Outlooks: March, April, May 2024
Issued February 15, 2024

https://www.cpc.ncep.noaa.gov/
**U.S. Seasonal Drought Outlook**

Drought Tendency During the Valid Period

Valid for February 15 - May 31, 2024  
Released February 15, 2024

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).

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

https://www.cpc.ncep.noaa.gov/

https://go.usa.gov/3eZ73
Thanks!

mark.brusberg@usda.gov

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