Outlook for El Niño and its Impact on Global Crop Weather

Image source – https://www.climate.gov/enso

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USDA Agricultural Outlook Forum 2016
Water shortages in South Africa

Drought in Papua New Guinea

Flooding in Paraguay

Source - http://www.ibtimes.co.uk/el-nino-photos-show-widespread-flooding-worse-weather-come-1536302
Hurricane Patricia – 200 mph sustained winds

Source - http://earthobservatory.nasa.gov/IOTD/view.php?id=86882
Deadly December tornadoes

Excessive rains

Welcome mountain snows

What is El Niño?

- **El Niño** was first recognized by fishermen off the coast of South America in the 1600’s, with the appearance of unusually warm waters in the Pacific Ocean.

- This phenomenon was referred to as **El Niño** (i.e., *Little Boy* or *Christ Child* in Spanish) because of the tendency for the warm waters to arrive around Christmas.

- In the mid 1900’s, scientists discovered that the anomalous warming in the central & eastern Pacific Ocean was linked to periodic variability (i.e., oscillations) in regional atmospheric patterns.

- The phenomenon is now referred to as **ENSO** (*El Niño* / *Southern Oscillation*), in an acknowledgement that there are both ocean and atmospheric components.
At the surface, trade winds blow from east to west across the Pacific Ocean.
The winds blow water westward, helping pool the warmest water in the west Pacific.
The warmer waters in the west promote convection, which drives the Walker Circulation.
**ENSO Warm Phase (El Niño)**

- About every 2-7 years, the easterly trade winds weaken (or become westerly).
- SST rise above normal in the central & eastern Pacific; convection shifts eastward.
- This displacement in convective activity disrupts the Walker Circulation, leading to anomalous temperature & precipitation patterns on local & regional levels.

Source - [Australian Bureau of Meteorology](https://www.bom.gov.au)
How is the strength of an El Niño measured?

- The current state of the ENSO is often measured by sea surface temperature anomalies in parts of the equatorial Pacific Ocean.

- NOAA/NWS/CPC declares the onset of an El Niño when 3-month average SST departures exceed 0.5°C in Nino region 3.4 [5°N-5°S, 120°W-170°W]

- El Niño intensity classifications:

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Source - NOAA/NWS/CPC
ONI = 3-month running mean of SST anomalies in Nino region 3.4 [5°N-5°S, 120°W-170°W], based on centered 30-year base periods updated every 5 years.

Source - NOAA/NWS/CPC
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.

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Source - http://iridl.ldeo.columbia.edu/maproom/IFRC/FIC/EINinoandRainfall.png
Western Pacific Tropical Cyclone Tracks - 2014

Western Pacific Tropical Cyclone Tracks - 2015

The shift in tropical cyclone activity and a suppressed monsoon led to *below-normal rainfall*...
which contributed to a reduction in rice production.
Current production estimate...which contributed to a reduction in rice production. 

Textbook example of El Niño dominating throughout growing season.
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SPOTTING AN EL NIÑO

TEMPERATURES in the tropical Pacific Ocean warm, both at the surface and below.

SURFACE PRESSURE changes across the Pacific; higher in the west, lower in the east.

TRADE WINDS weaken, and sometimes reverse.

CLOUD increases near the Date Line.

TYPICAL IMPACTS ON OUR CLIMATE

RAINFALL DECREASES IN EASTERN AUSTRALIA.

TEMPERATURE INCREASES IN SOUTHERN AUSTRALIA (DAYTIME TEMPERATURES).

OTHER IMPACTS

INCREASED BUSHFIRE RISK

FEWER TROPICAL CYCLONES

LATER START TO NORTHERN WET SEASON

MORE HEATWAVES

LONGER FROST RISK SEASON

REDUCED CHANCE OF WIDESPREAD FLOODS

LESS CHANCE OF INDIAN OCEAN HEATWAVES

STRONGER SEABREEZES

WHEN DO THEY OCCUR?

USUALLY EL NIÑO DEVELOPS IN AUTUMN TO WINTER AND STARTS TO DECAY IN SUMMER.

EL NIÑO EVENTS CAN LAST FOR AS LITTLE AS 6 MONTHS OR AS LONG AS 2 YEARS.

ON AVERAGE THEY OCCUR EVERY 3 TO 5 YEARS.


GLOBALLY 7 OUT OF 10 OF THE HOTTEST YEARS ON RECORD WERE IN AN EL NIÑO YEAR OR THE YEAR FOLLOWING.

EVERY EL NIÑO IS DIFFERENT

EL NIÑO WINTER AND SPRING RAINFALL

1982 1997

RED = DRIER THAN NORMAL BLUE = WETTER THAN NORMAL

THERE HAVE BEEN 26 EL NIÑO EVENTS SINCE 1900 17 HAVE BROUGHT WIDESPREAD DROUGHT

7 OF AUSTRALIA'S 10 DRIEST YEARS ON RECORD WERE DURING EL NIÑO

www.bom.gov.au
**SPOTTING AN EL NIÑO**

**TEMPERATURES**
in the tropical Pacific Ocean warm, both at the surface and below

**SURFACE PRESSURE**
changes across the Pacific; higher in the west, lower in the east

**TRADE WINDS**
weaken, and sometimes reverse

**CLOUD**
increases near the Date Line

---

**TYPICAL IMPACTS ON OUR CLIMATE**

**RAINFALL**
decreases in eastern Australia

**TEMPERATURE**
increases in southern Australia (daytime temperatures)

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**OTHER IMPACTS**

- Increased bushfire risk
- Fewer tropical cyclones
- Later start to northern wet season
- More heatwaves
- Longer frost risk season
- Reduced chance of widespread floods
- Less chance of Indian Ocean heatwaves
- Stronger seabreezes

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**EL NIÑO IN AUSTRALIA**

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**EL NIÑO EVENTS CAN LAST FOR AS LITTLE AS 6 MONTHS OR AS LONG AS 2 YEARS**

**ON AVERAGE**

**THE LAST EL NIÑO WAS IN 2009–10**

---

**EVERY EL NIÑO IS DIFFERENT**

**EL NIÑO WINTER AND SPRING RAINFALL**

- 1982
- 1997

**GLOBALLY**

7 out of 10 of the hottest years on record were in an El Niño year or the year following

**THERE HAVE BEEN**

26 El Niño events since 1900

17 have brought widespread drought

---

7 of Australia's 10 driest years on record were during El Niño

---

www.bom.gov.au
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26 EL NIÑO EVENTS SINCE 1900
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7 OF AUSTRALIA'S 10 DRIEST YEARS ON RECORD WERE DURING EL NIÑO

www.bom.gov.au
Winter-spring mean rainfall deciles
12 moderate-strong classical El Niños

Distribution based on gridded data
Australian Bureau of Meteorology

http://www.bom.gov.au

© Commonwealth of Australia 2015, Australian Bureau of Meteorology
ID code: Analyser
Issued: 25/05/2015
New South Wales

In contrast to a typical El Niño, near- to above-normal rainfall maintained good to excellent yield prospects throughout most of the growing season.
Why didn’t El Niño have more of an impact?
Indian Ocean – Positive IOD

Pacific Ocean – El Niño

Sea surface temperature anomalies – August 5, 2006

Source - Australian Bureau of Meteorology

Source - NOAA NESDIS
Sea surface temperature anomalies – August 3, 2015

Source - Australian Bureau of Meteorology

Source - NOAA NESDIS
Why didn’t El Niño have more of an impact?

Competing climate patterns impacted the weather in Australia.
Why didn’t El Niño have more of an impact?

Indian Ocean – Neutral IOD

Pacific Ocean – El Niño

Competing climate patterns impacted the weather in Australia.

Warmer-than-normal Indian Ocean fueled rains, leading to better than expected crop production.

Source - Australian Bureau of Meteorology
El Niño and Rainfall

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Sources:

Winter Precipitation Anomalies (in)

December – January – February

Analyses illustrate typical precipitation patterns, but also local variability among El Niño events.

(A) = above normal
(B) = below normal
IRI/CPC Pacific Nino 3.4 SST Model Outlook

*Updated – February 18, 2016*

Mid-Feb 2016 Plume of Model ENSO Predictions

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Mid-Feb 2016 Plume of Model ENSO Predictions

**Dynamical Model:**
- NASA GMAO
- NCEP CFVS2
- JMA
- SCRIPPS
- LDEO
- AUS/POAMA
- ECMWF
- UKHO
- KMA SNU
- IOCAS ICM
- COLA CCSM4
- MeFRANCE
- SINTEX-F
- CS-IRI-MM
- GFDL CM2.1
- CMC CANSIIP
- GFDL FLOR

**Statistical Model:**
- CPC MIRKOV
- CDC LIM
- CPC CA
- CPC CCA
- CSU CLIFR
- UBC NNET
- FSU REGR
- UCLA-TCD

Autumn probabilities – 51% La Niña, 32% Neutral, 17% El Niño
Climate patterns associated with El Niño – Spring (following peak)

*Composites based on data from 1998, 1983, 1973*

Precipitation Anomalies (in)
Mar – May

Maximum Temperature Anomalies (F)
Mar – May

(A) = above normal
(B) = below normal
(W) = warmer than normal
(C) = cooler than normal
Climate patterns associated with El Niño – Summer (following peak)


Precipitation Anomalies (in)  
Jun – Aug

Maximum Temperature Anomalies (F)  
Jun – Aug

(A) = above normal  
(B) = below normal  
(W) = warmer than normal  
(C) = cooler than normal
Climate patterns associated with developing La Niña – Summer

*Composites based on 11 distinct events*

Precipitation Anomalies (in)
Jun – Aug

[Map showing precipitation anomalies across the United States with color-coded areas indicating above normal, normal, and below normal precipitation. The scale ranges from -8.0 to 8.0 inches.]
Climate patterns associated with developing La Niña – Summer

*June – July – August*

Precipitation Anomalies (in)
Climate patterns associated with developing La Niña – Summer

*June – July – August*

Precipitation Anomalies (in)
Climate patterns associated with developing La Niña – Summer

*June – July – August*

Precipitation Anomalies (in)

1954

1964

1967

1970

1973

1984

1988

1995

1998

2007

2010
Climate patterns associated with developing La Niña – Summer

*June – July – August*

Precipitation Anomalies (in)

1954

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Outlook for *El Niño* and its Impact on Global Crop Weather

**Summary**

*What we know:*

- The 2015/16 *El Niño* is still going strong, but it appears to have peaked in intensity.

*What is likely:*

- The *El Niño* is forecast to weaken through the spring, with a return to neutral ENSO conditions likely by this summer.

*What is possible:*

- About 50% of the time, a weakening moderate to strong *El Niño* is followed by *La Niña* development by the end of the calendar year (*i.e.*, 2016).
- About 70-80% of the time, *La Niña* development occurs by the end of the *NEXT* calendar year (*i.e.*, 2017).
- Should a *La Niña* develop, the impact on crops is often opposite that typically observed during *El Niño* events.

Image source – [https://www.climate.gov/enso](https://www.climate.gov/enso)
El Niño – Dec/Jan/Feb

El Niño – Jun/Jul/Aug
La Niña – Dec/Jan/Feb

La Niña – Jun/Jul/Aug
Climate patterns associated with El Niño – Spring (following peak)

March – April – May

Precipitation Anomalies (in)

(A) = above normal
(B) = below normal

Maximum Temperature Anomalies (F)

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Climate patterns associated with El Niño – Summer (following peak)

June – July – August

Precipitation Anomalies (in)

1998

1983

1973

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ENSO Predictions from Apr 14 to Jan 16

IRI

Dyn. model:
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- SCRIPPS
- LDEO
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CPC/IRI Consensus Probabilistic ENSO Forecast

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Climate impacts of El Niño Phenomenon in Latin America and the Caribbean

Severe droughts

Excessive rainfall

Drought episodes

Pacific Ocean

Atlantic Ocean

Increase in surface ocean temperature during the 1998 El Niño event

+0.5+2.5°C

+2.5+5.0°C

Severe droughts, increased forest fires

Scarce precipitation, soil moisture deficit

Scarce precipitation in rainy season

High temperature episodes

Pelagic fish catch in southeast Pacific

Million tonnes

20

16

12

8

4

0

1980

1986

1992

1998

Very strong El Niño

In Peru, the 1997-1998 El Niño caused US$ 3.5 billion economic losses. Fishery exports dropped by 76 percent.

United Nations Environment Programme / GRID-Arendal
