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

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

Sources:

Western Pacific Tropical Cyclone Tracks - 2014

Western Pacific Tropical Cyclone Tracks - 2014

Tropical Storm Tracks

Year 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 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

THE LAST EL NIÑO WAS IN 2009–10

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

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**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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**When do they occur?**

Usualy 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.**

**The last El Niño was in 2009-10.**

**Globally**

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

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**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.

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Australian Government
Bureau of Meteorology

www.bom.gov.au
SPOTTING AN EL NIÑO

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www.bom.gov.au

Australian Government
Bureau of Meteorology
Winter-spring mean rainfall deciles
12 moderate-strong classical El Niños

Distribution based on gridded data
Australian Bureau of Meteorology

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

Source - Australian Bureau of Meteorology
Sea surface temperature anomalies – August 5, 2006

Source - Australian Bureau of Meteorology

Source - NOAA NESDIS
Indian Ocean – Neutral IOD

Pacific Ocean – El Niño

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.

Source - Australian Bureau of Meteorology
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.
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.

Source - http://iridl.ldeo.columbia.edu/maproom(IFRC/FIC/ElNinoAndRainfall.png)
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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.
AHPS 90-Day Precip Departure
As of: Tuesday, February 23, 2016
AHPS 90-Day Precip Departure
As of: Tuesday, February 23, 2016
IRI/CPC Pacific Nino 3.4 SST Model Outlook

Updated – February 18, 2016

Mid-Feb 2016 Plume of Model ENSO Predictions

Dynamical Model:
- NASA GMAO
- NCEP CFVSv2
- JMA
- SCRIPPS
- LDEO
- AUS/POAMA
- ECMWF
- UKMO
- KMA SNU
- IOCAS ICM
- COLA CCSM4
- MeFRANCE
- SINTEX-F
- CS-IRI-MM
- GFDL CM2.1
- CMC CANSIP
- GFDL FLOR

Statistical Model:
- CPC MRKOV
- CDC IIM
- CPC CA
- CPC CCA
- CSJ CLIPR
- UBC NNET
- FSU REGR
- UCLA-TCD

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Mid-Feb 2016 Plume of Model ENSO Predictions

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


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 in the United States during La Niña summers. The map highlights areas with above-normal, normal, and below-normal precipitation anomalies.]
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)
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Precipitation Anomalies (in)
Climate patterns associated with developing La Niña – Summer

Composites based on 11 distinct events

Maximum Temperature Anomalies (F)

Jun – Aug

[Map showing temperature anomalies with regions marked as warmer than normal, cooler than normal, and normal.]

Scale:
-8.0  -7.0  -6.0  -5.0  -4.0  -3.0  -2.0  -1.0  0.0  1.0  2.0  3.0  4.0  5.0  6.0  7.0  8.0
Climate patterns associated with developing La Niña – Summer

June – July – August

Temperature Anomalies (F)
Climate patterns associated with developing La Niña – Summer

*June – July – August*

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Climate patterns associated with developing La Niña – Summer

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Temperature Anomalies (F)
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Source - http://iridl.ldeo.columbia.edu/maproom/IFRC/FIC/LaNinaandRainfall.png
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
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)

1998  1983  1973

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

Maximum Temperature Anomalies (F)

1998  1983  1973

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

*June – July – August*

**Precipitation Anomalies (in)**

- **1998**: Map showing precipitation anomalies with areas marked as above normal (A) or below normal (B).
- **1983**: Similar map with precipitation anomalies.
- **1973**: Similar map with precipitation anomalies.

Legend:
- **(A)** = above normal
- **(B)** = below normal

**Maximum Temperature Anomalies (F)**

- **1998**: Map showing temperature anomalies with areas marked as warmer than normal (W) or cooler than normal (C).
- **1983**: Similar map with temperature anomalies.
- **1973**: Similar map with temperature anomalies.

Legend:
- **(W)** = warmer than normal
- **(C)** = cooler than normal
CPC/IRI Consensus Probabilistic ENSO Forecast

*Updated – February 18, 2016*

Autumn probabilities – **51% La Niña, 32% Neutral, 17% El Niño**

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

- Severe droughts
- Excessive rainfall
- Drought episodes
- Increase in surface ocean temperature during the 1998 El Niño event
- Pelagic fish catch in southeast Pacific
- Scarce precipitation, soil moisture deficit
- Severe droughts, increased forest fires
- Scarce precipitation in rainy season
- Intense rains in summer, dryness in the Andean region
- High temperature episodes
- Plentiful rains in spring and summer

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