

# Pacific Region ENSO UPDATE AND SEASONAL OUTLOOK

Aug 15 2016

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PREPARED BY THE PEAC CENTER

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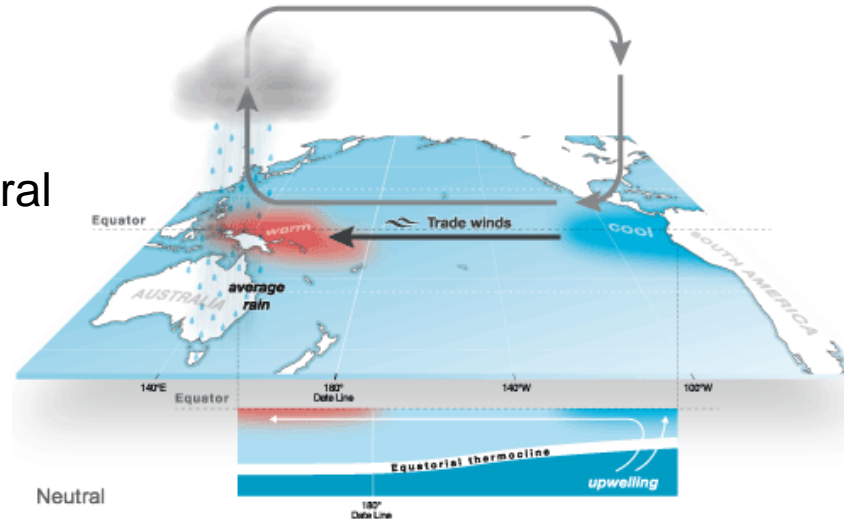
# What Is El Niño and La Niña

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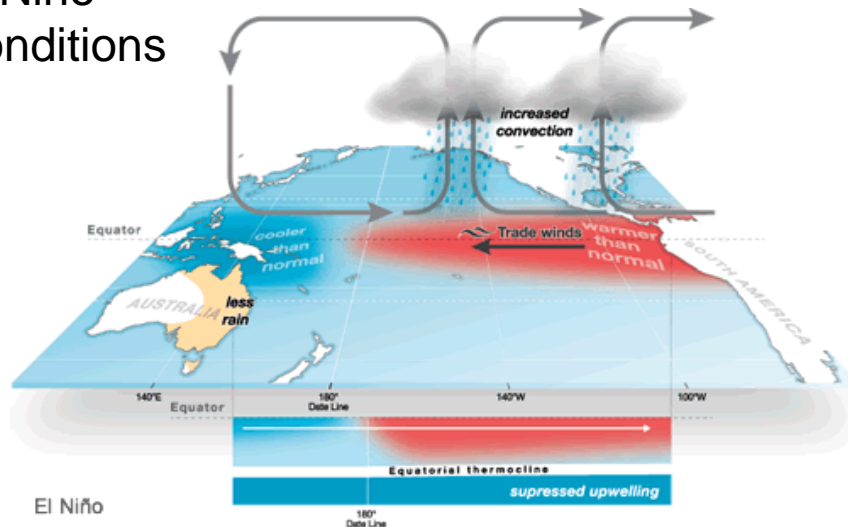
A general description of their global impacts

# El Niño-Southern Oscillation (ENSO)

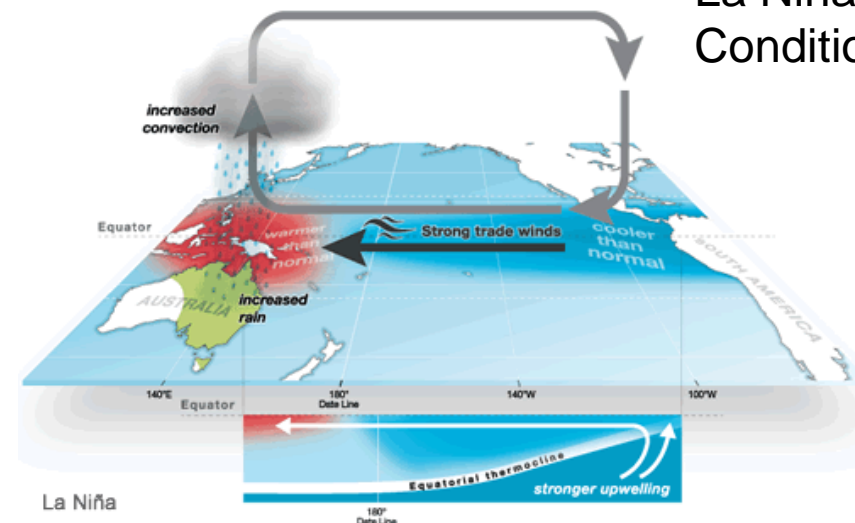
ENSO Neutral Conditions



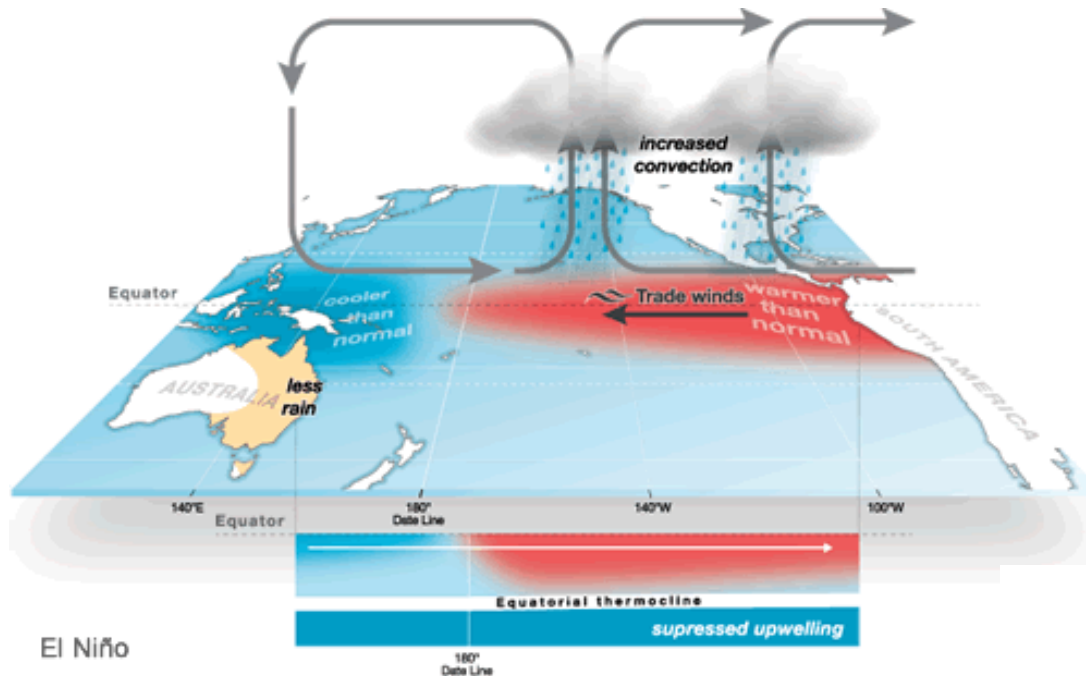
El Niño Conditions



La Niña Conditions



# El Niño in a nutshell

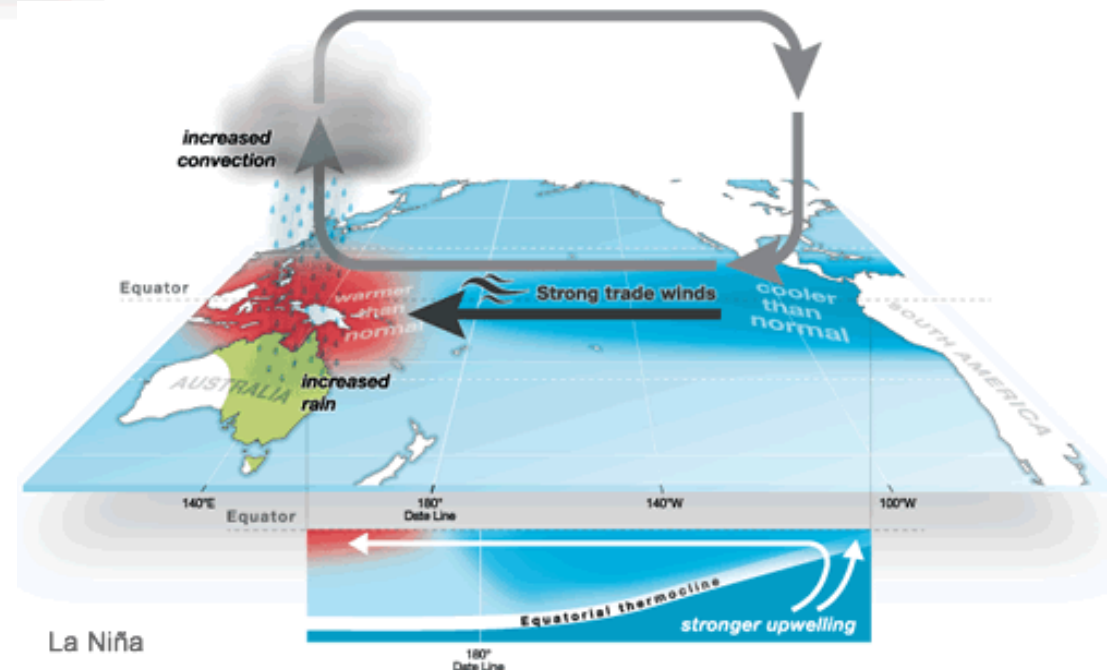


## El Niño Conditions:

- Warm sea surface temperatures to the east and cold to the west
- Weakened trade winds, westerly winds over east Pacific
- Rainfall over the Central and East Pacific
- Lower than normal sea levels over the western Pacific

## La Niña Conditions:

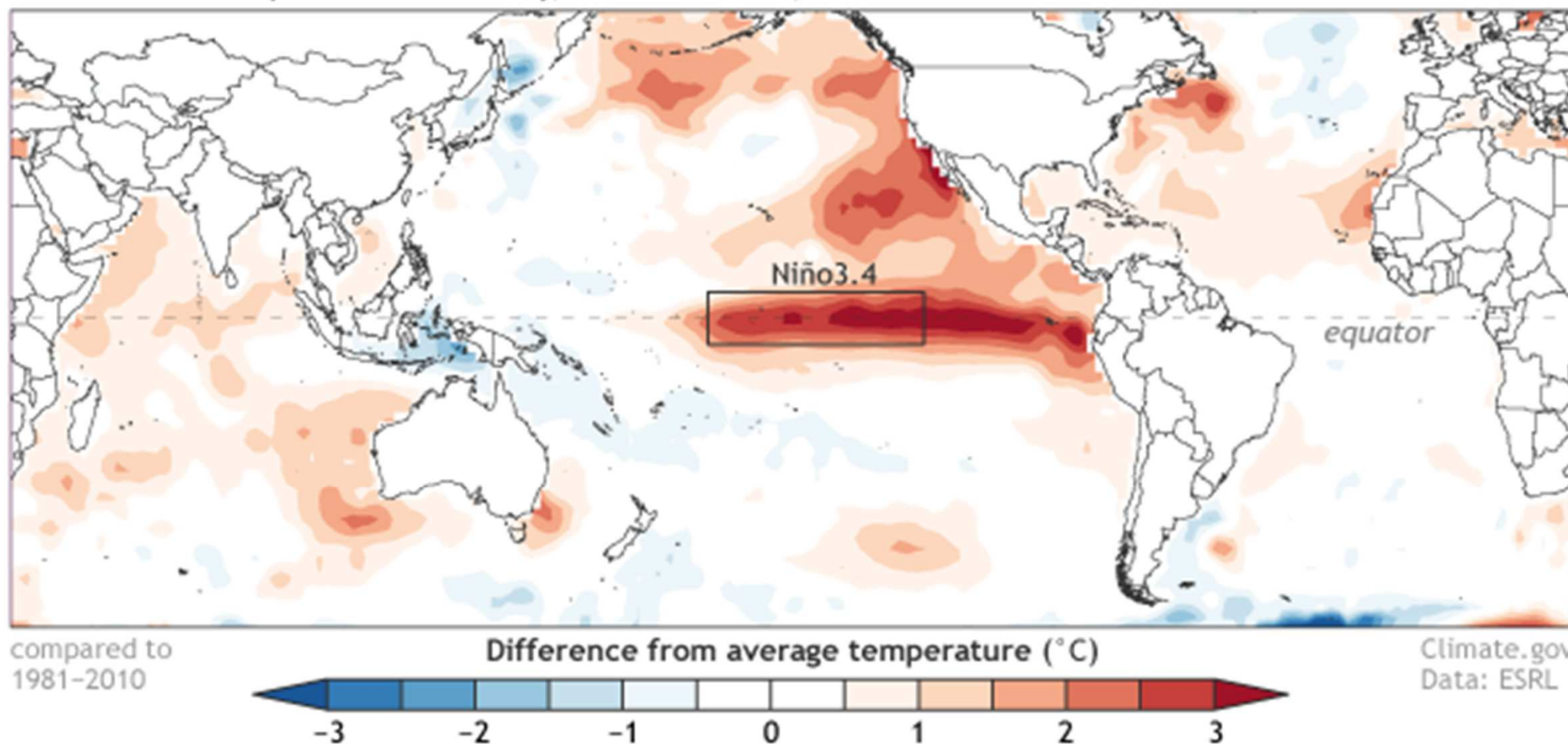
- Cooler than normal sea surface temperatures to the east and warmer to the west
- Stronger trade winds
- Enhanced rainfall over the Western Pacific
- Higher than normal sea levels over the Western Pacific



# El Niño development, peak and decay

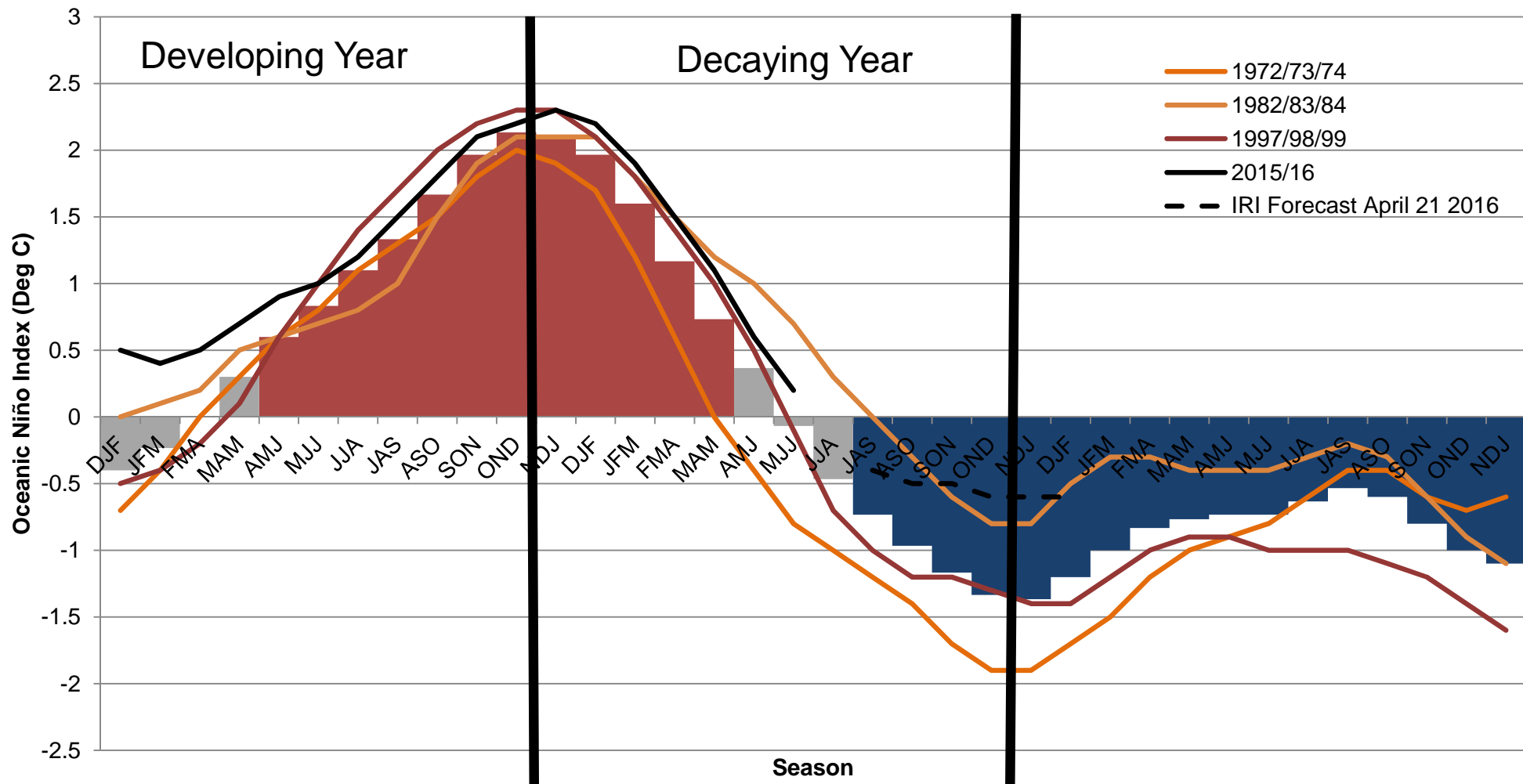
- Oceanic Niño index averaged for 5 recent El Niño events
  - 1963/64, 1972/73, 1982/83, 1997/98, 2009/2010

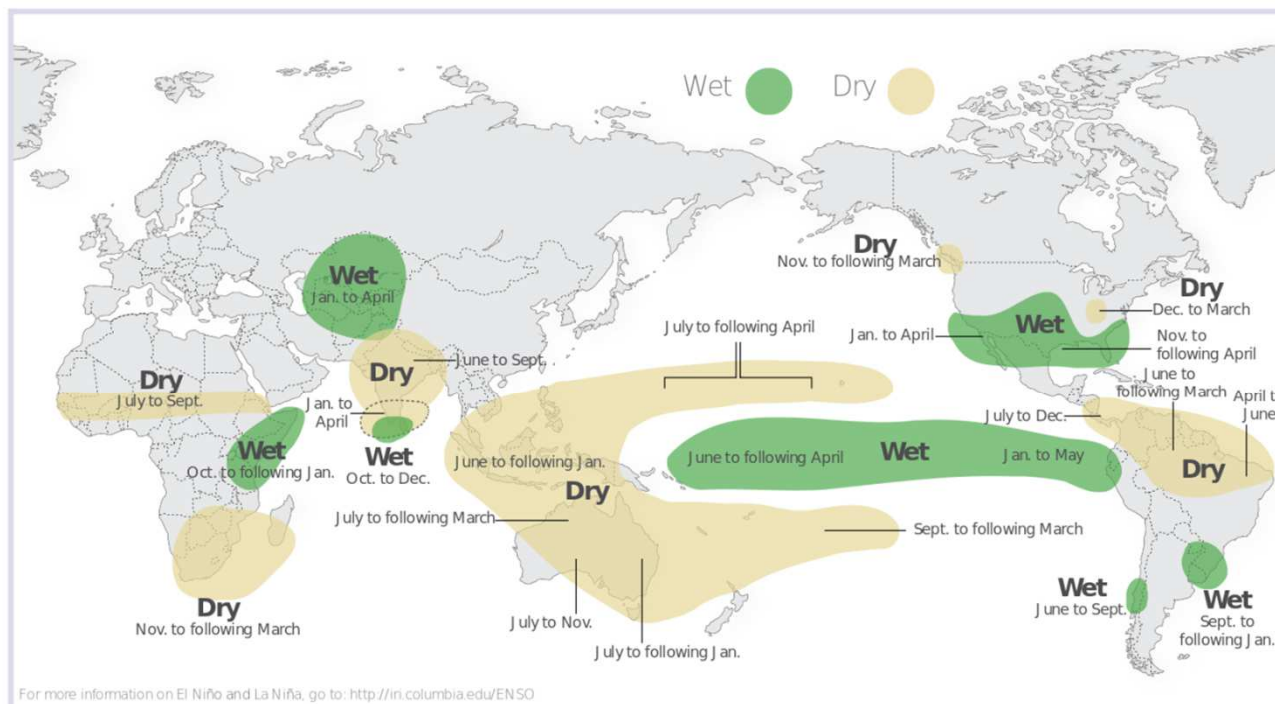
Sea surface temperature anomaly, Oct 11–Nov 7, 2015



# El Niño development, peak and decay

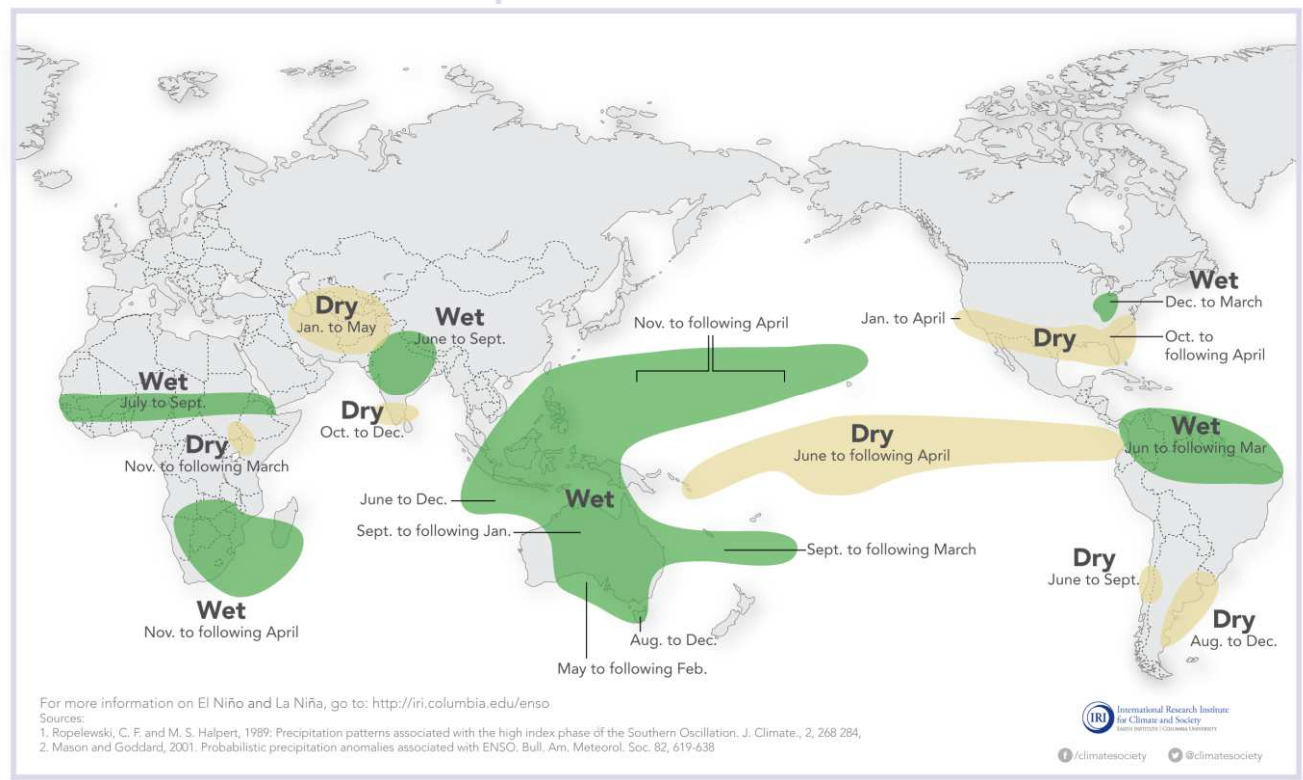
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# El Niño and Rainfall

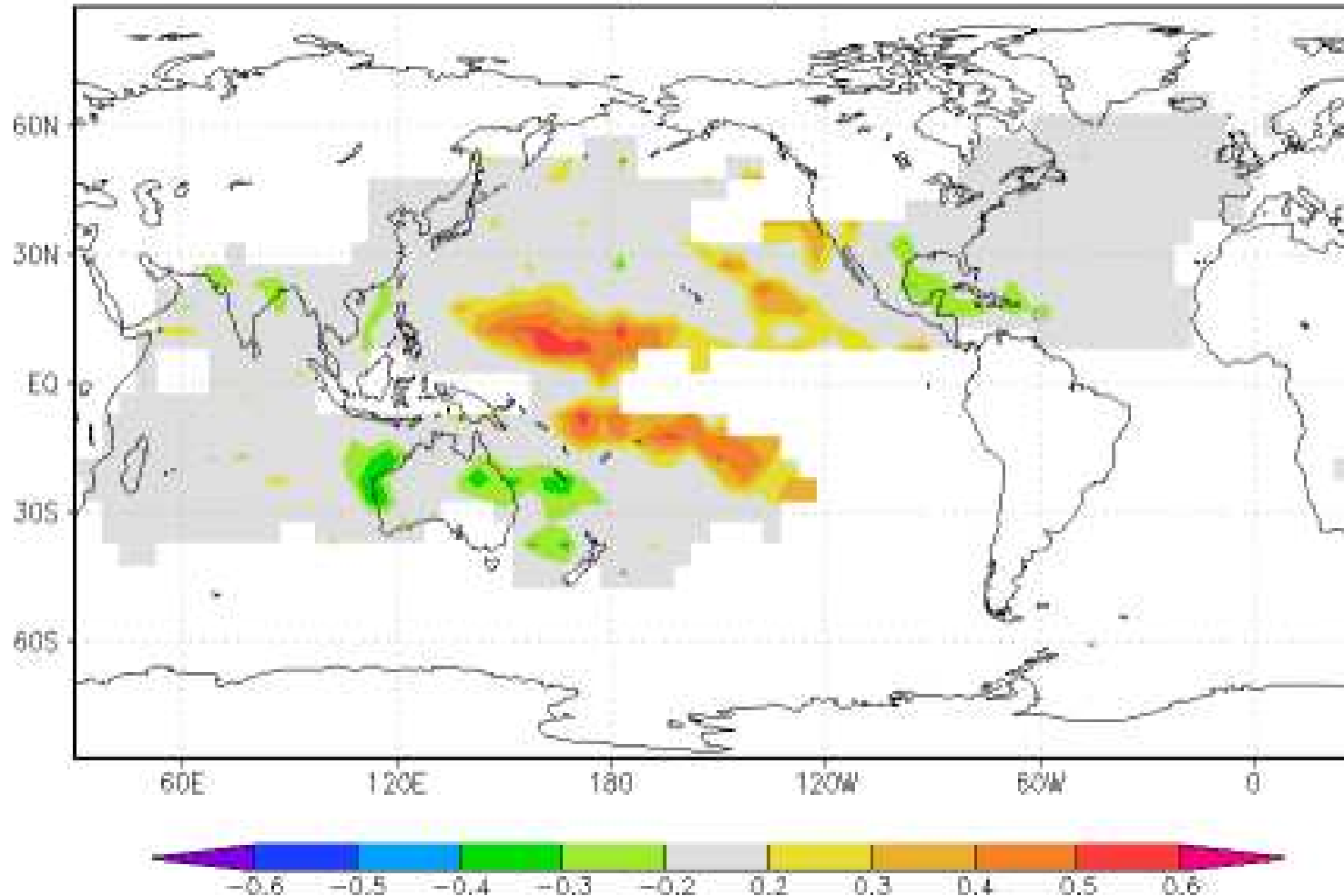
# La Niña and Rainfall



<http://www.climate.gov/news-features/department/8443/all>

# ENSO and Tropical Cyclones

corr Jul–Jun averaged NINO3.4 index  
with Jul–Jun averaged MIT #TS tracks 1856:2004



El Niño shifts TC genesis  
Eastward over the North  
and South Western Pacific

- Less TC activity
  - Australia
  - Philippines
- More TC activity
  - Tropical Pacific
  - Hawaii
  - American Samoa



# GENERAL SYNOPSIS

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This section will give a quick overview of the coming topics

# Synopsis

## ENSO Alert System Status: **La Niña Watch**

### Current Conditions

- Current ENSO status is **Neutral**
- Sea Surface Temperature slightly cooler than normal over the Eastern Pacific
- Atmospheric conditions consistent with Neutral ENSO conditions

### Observed Impacts

- Expected El Niño impacts
  - Severe drought conditions across the globe
  - Shifted Tropical Cyclone Activity in the Western Pacific
  - Below average sea levels over the Western Pacific
- Are all returning to neutral conditions or shifting towards La Niña conditions

### General ENSO Forecast

- Onset of **La Niña** is expected during the August to October season
- Peak during the December to January season
- **La Niña** is expected to be weak

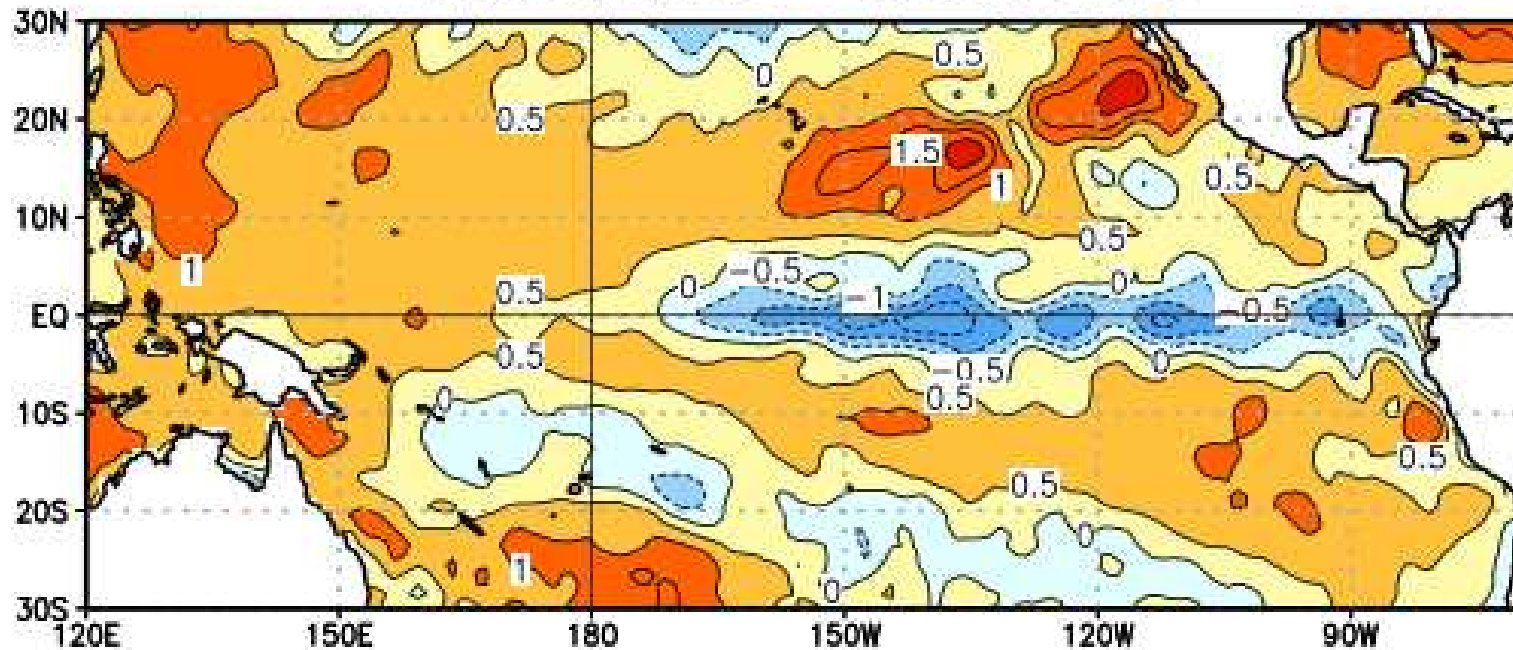
# Current Conditions

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General State of the Ocean and Atmosphere

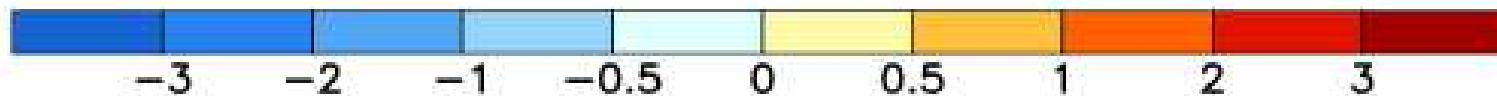
During the last 4 months, equatorial SSTs transitioned from above average to slightly below across the Eastern Pacific Ocean

**Average SST Anomalies**  
**10 JUL 2016 – 6 AUG 2016**



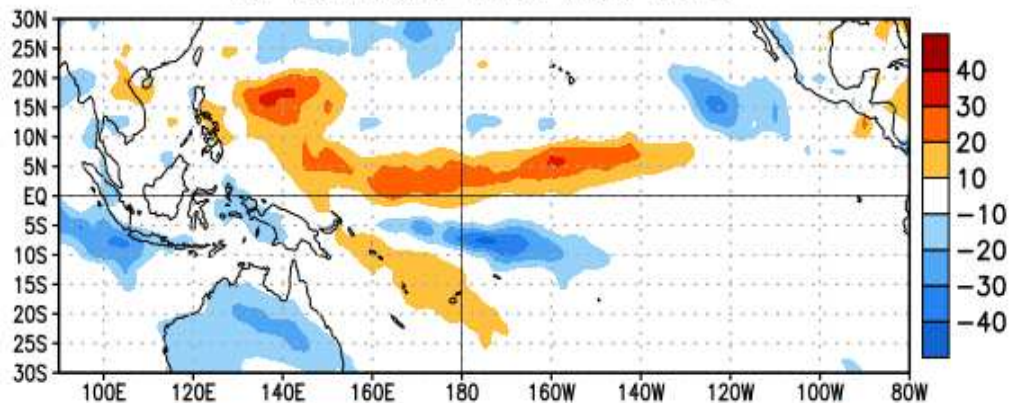
Average sea surface temperature (SST) anomalies ( $^{\circ}$  C).

Slightly below average sea surface temperatures close to the equator across the eastern tropical Pacific Ocean



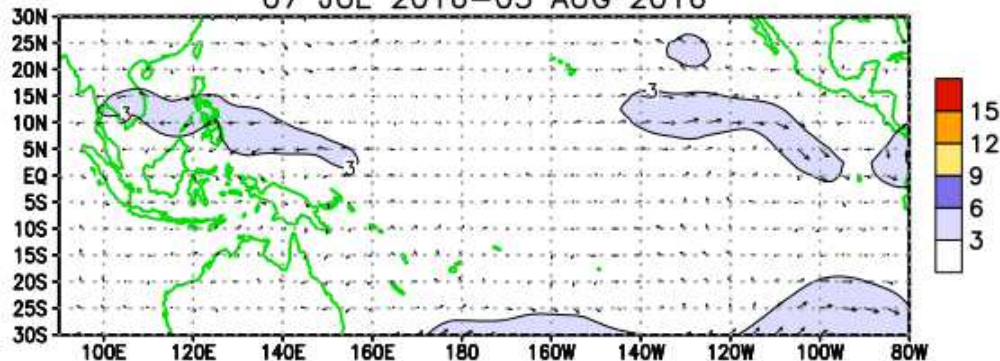
# OLR and Wind Anomalies for Past 30 Days

OLR Anomalies  
07 JUL 2016 to 01 AUG 2016



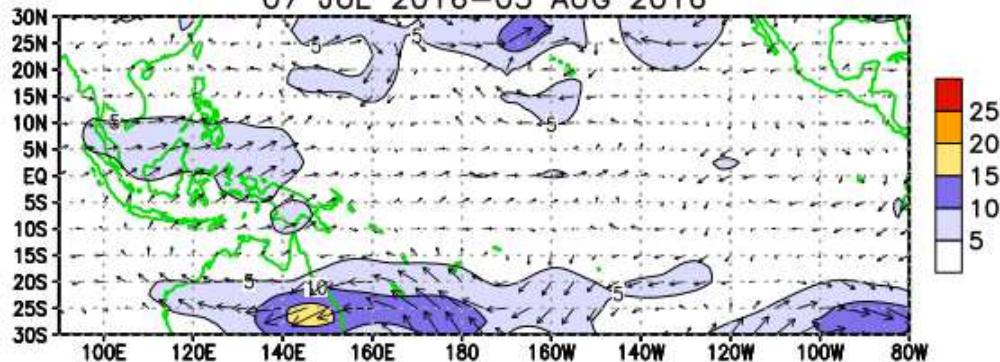
- Above average deep convection (- OLR anomalies) over part of Indonesia
- Below average precipitation (+ OLR anomalies) over portions of the western and central tropical Pacific

CDAS 850-hPa Wind Anoms  
07 JUL 2016-05 AUG 2016



Low level winds over the Equatorial Central Pacific are close to normal

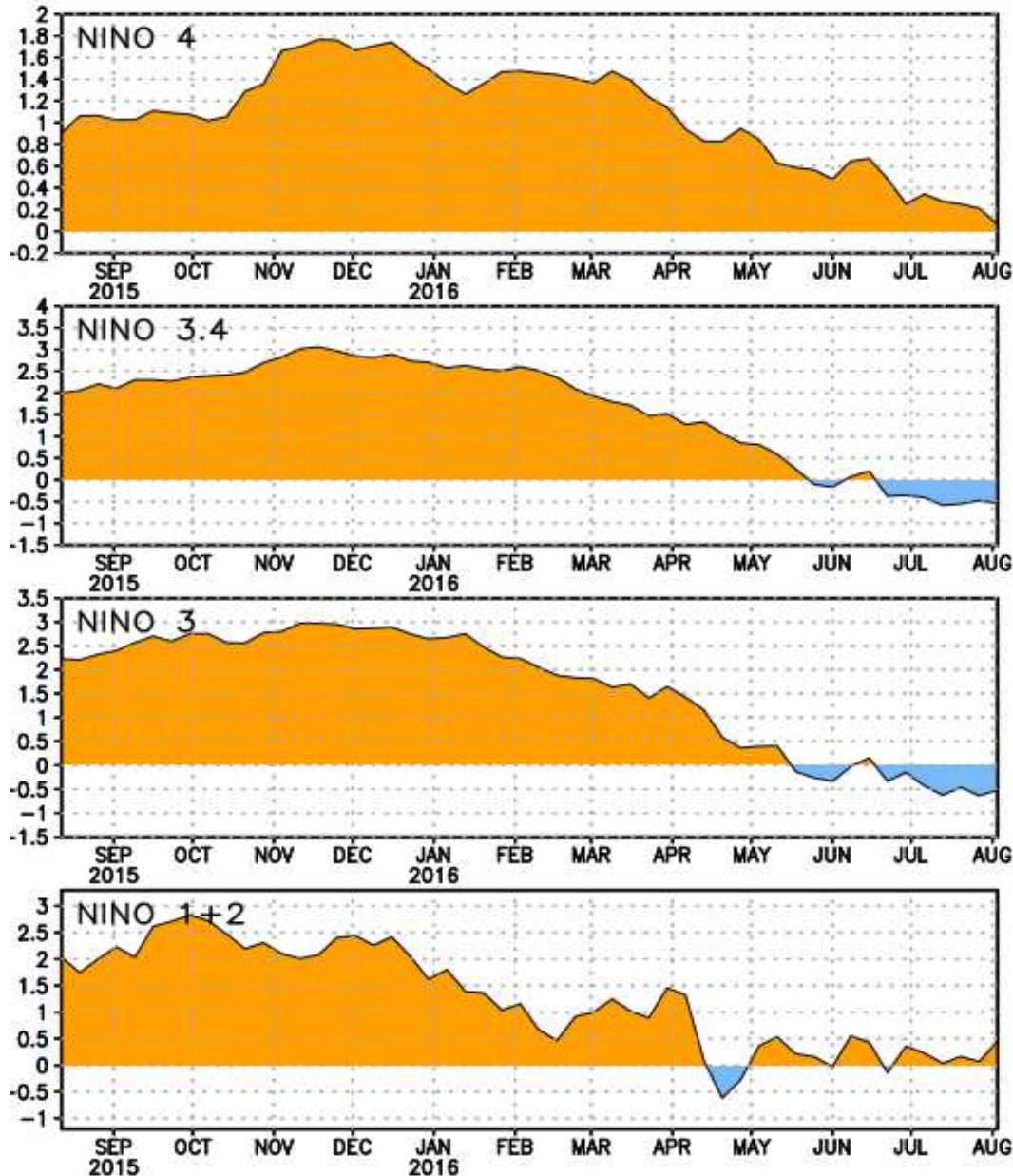
CDAS 200-hPa Wind Anoms  
07 JUL 2016-05 AUG 2016



Upper level winds show predominant westerly winds over the maritime continent and near average across the rest of the Pacific

# SST DEPARTURES AND UPPER OCEAN (0 - 300m) HEAT CONTENT ANOMOLY

SST Anomalies



The latest weekly SST departures are:

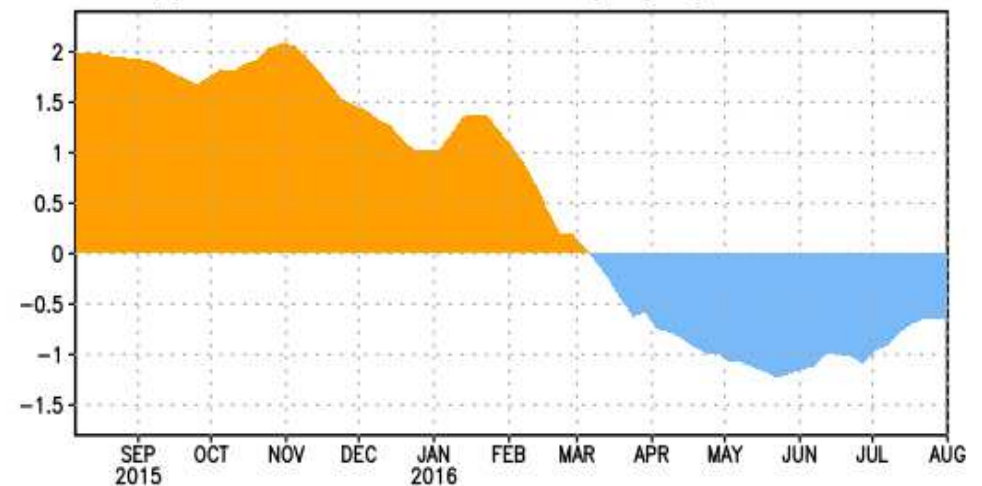
Niño 4      0.1°C

Niño 3.4    -0.5°C

Niño 3      -0.5°C

Niño 1+2    0.5°C

EQ. Upper-Ocean Heat Anoms. (deg C) for 180–100W



# EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

## ENSO Alert System Status: **La Niña Watch**

### Synopsis:

- Slightly below average sea surface temperatures close to the equator across the eastern tropical Pacific Ocean
- Weekly Niño-1+2 and Niño-4 regions were near average, the Niño-3 and Niño-3.4 indices were slightly below average during July
- Below-average subsurface temperatures continued
- Upper and lower-level winds also were near average across most of the tropical Pacific
- Southern Oscillation index and the equatorial Southern Oscillation index were near average during July Convection was suppressed over portions of the western and central tropical Pacific and enhanced over part of Indonesia
- the combined ocean and atmosphere system is reflective of ENSO-neutral

# Impacts

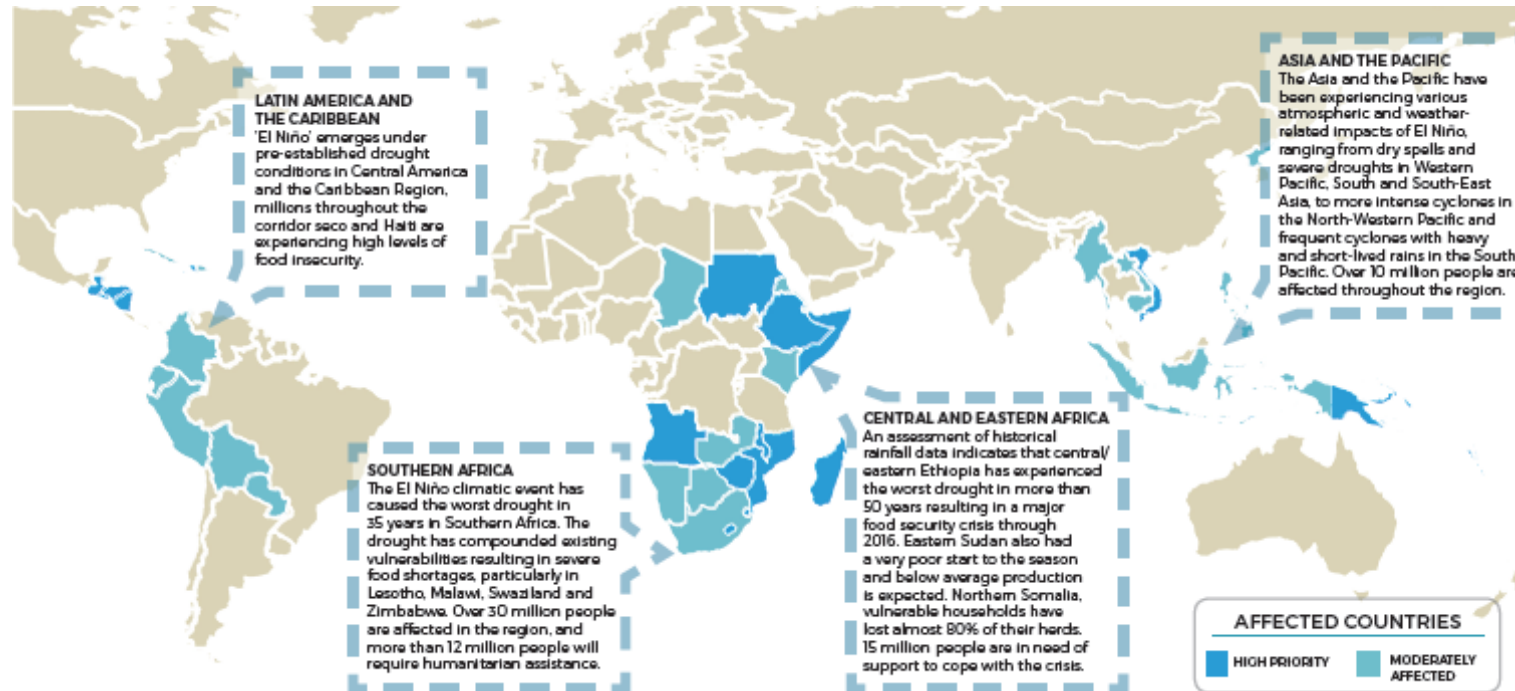
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Rainfall, Sea Level, Tropical Cyclones and  
Societal Impacts

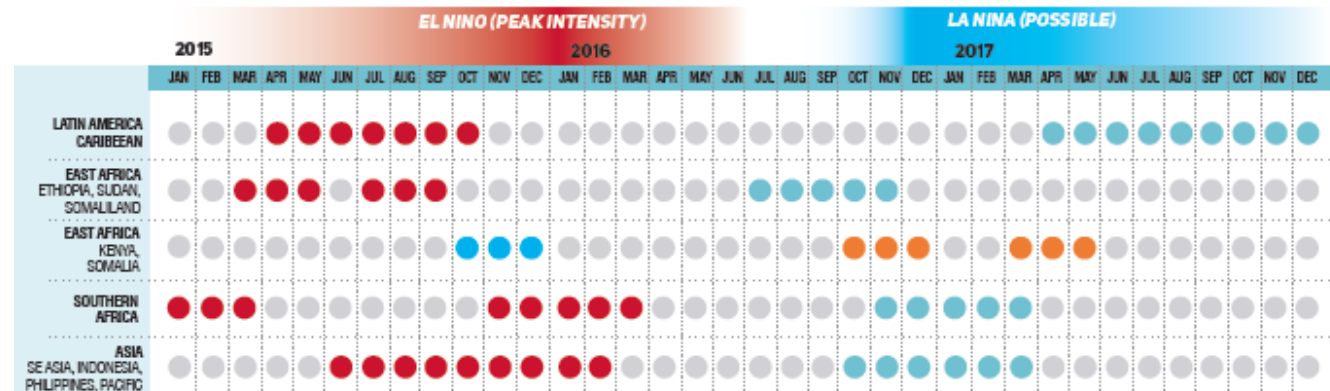


# Summary of the 2015-2016 El Niño impacts

(WFP/FAO 13 July 2016)



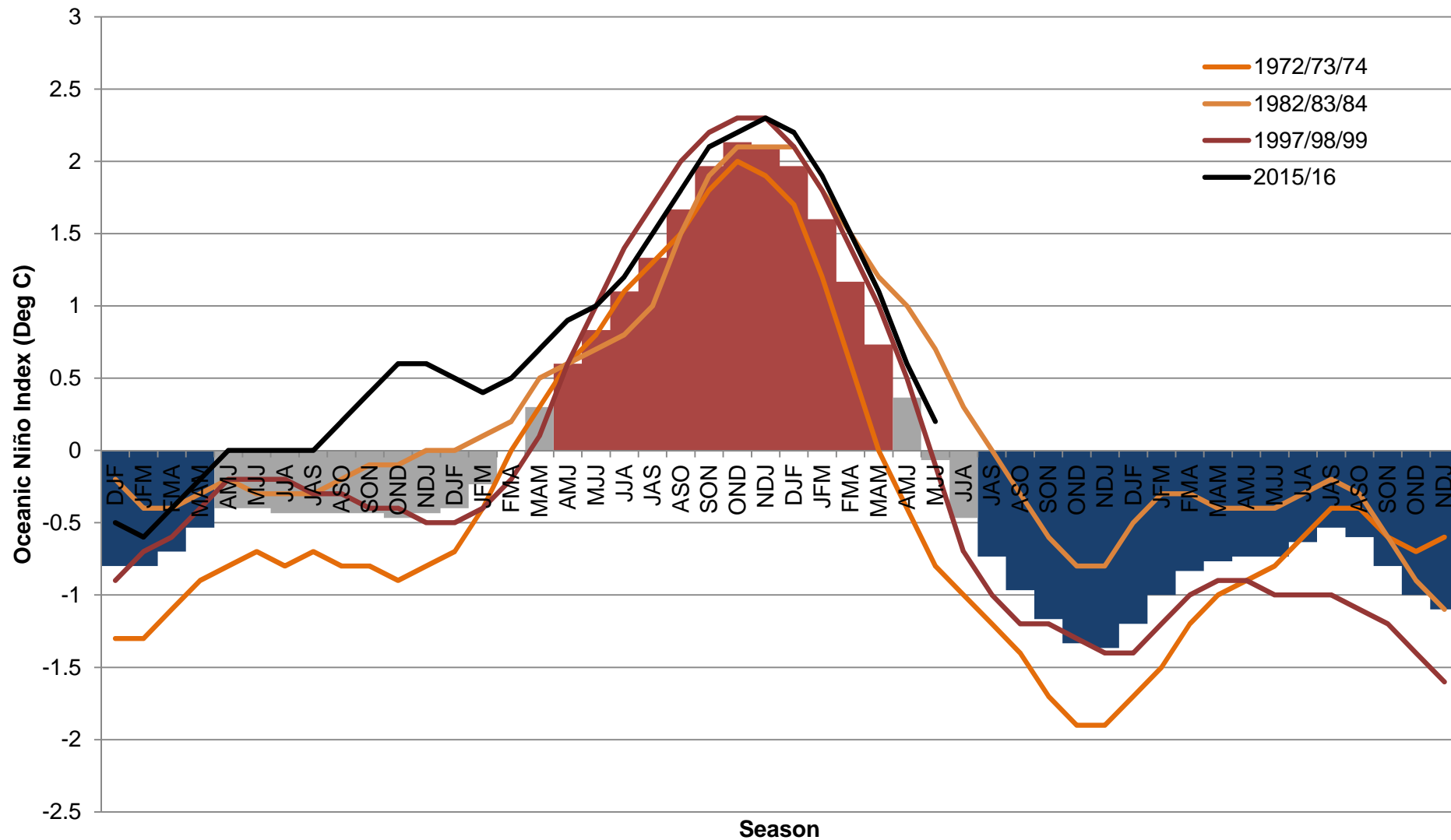
## EL NIÑO SEASONAL CALENDAR\*\*



Retrieved from:  
[http://reliefweb.int/sites/reliefweb.int/files/resources/wfp\\_fao\\_el\\_nino\\_overview\\_by\\_fsc\\_1.pdf](http://reliefweb.int/sites/reliefweb.int/files/resources/wfp_fao_el_nino_overview_by_fsc_1.pdf)

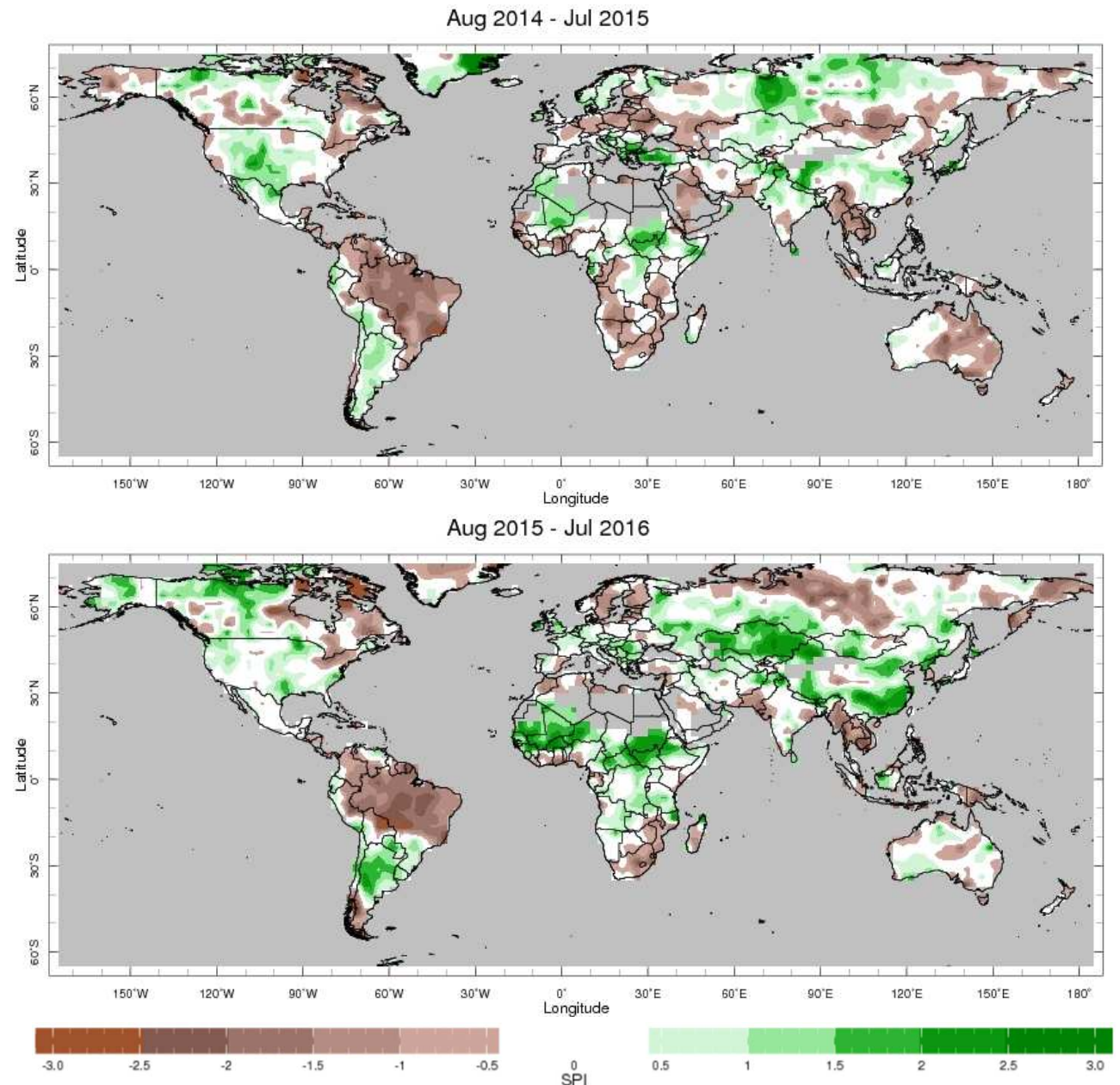
CHART LEGEND: ● DROUGHT ● FLOOD ● DROUGHT RISK ● FLOOD RISK

# El Niño “like” conditions during 2014



# Rainfall impacts: Drought

- The impacts of the 2015/2016 El Niño were compounded with those from El Niño “like conditions during the year before
- Extremely dry conditions over two years (two growing seasons) were present in many areas of the globe
  - Northern South America
  - Africa
  - South East Asia
  - Pacific Islands
  - Australia



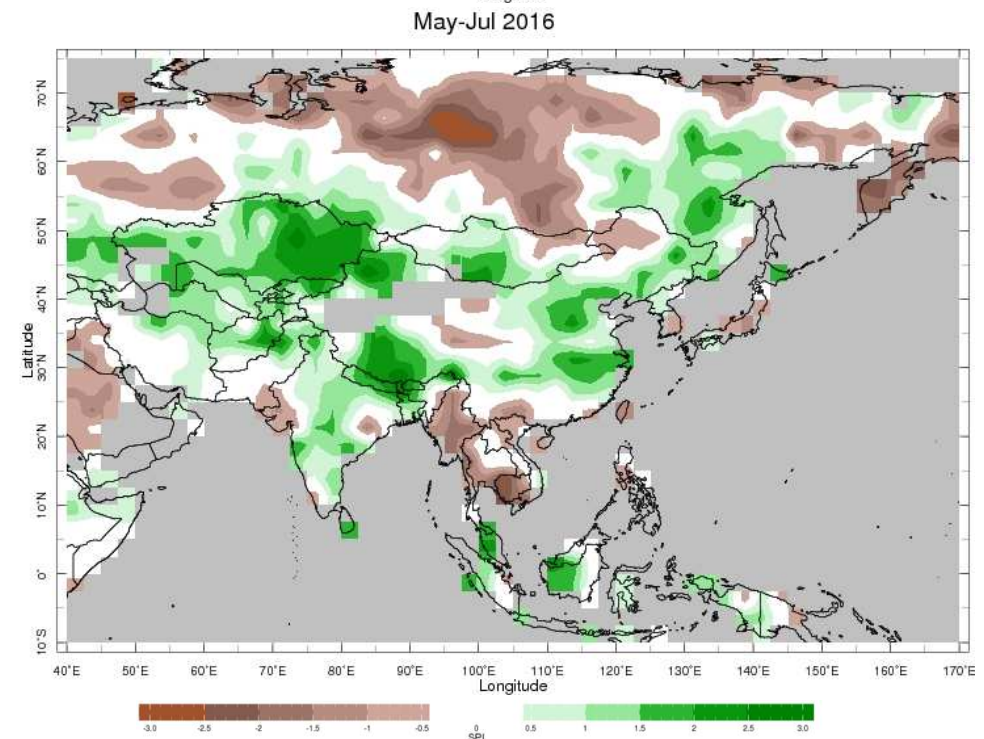
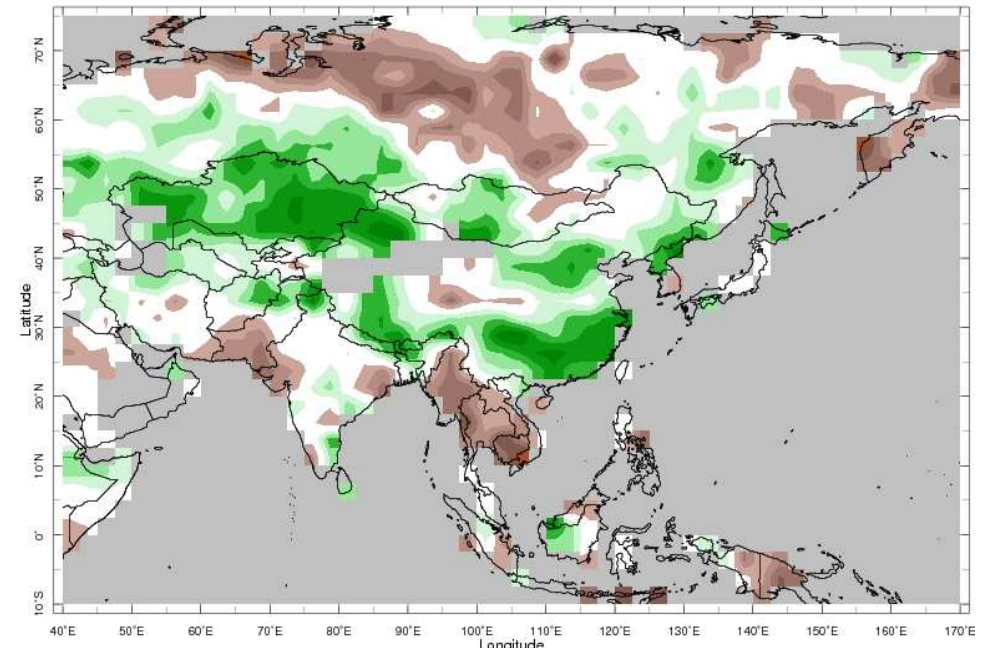
Figures made using the IRI Map Room  
<https://iridl.ldeo.columbia.edu/maproom/>

Aug 2015 - Jul 2016

# Rainfall impacts:

## Drought in Asia and the Pacific

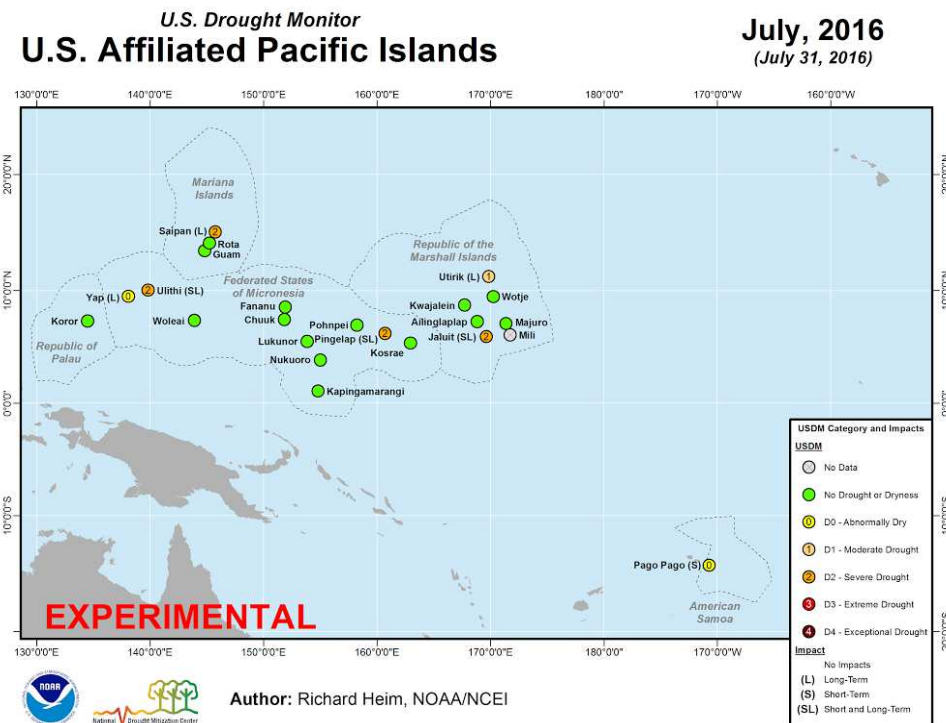
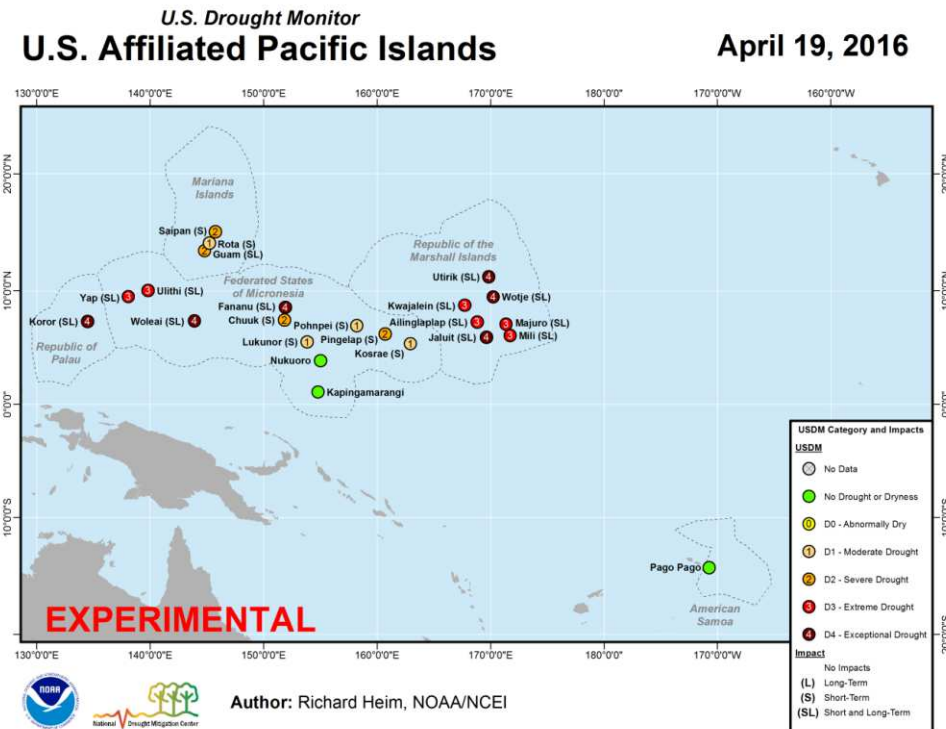
- Rainfall deficits for
  - Last 12 months (top)
  - Last 3 months (bottom)
- Dry conditions have eased over
  - The Indian Subcontinent
  - The Maritime Continent
  - The Arabian Peninsula
- Continental South East Asia, while still dry, has seen some modest improvement



# Drought impacts to the USAPIs

- State of Emergency due to drought declared for
  - Republic of Palau
  - Federated States of Micronesia
    - Federal and State levels
  - Republic of the Marshall Islands
- Water Rationing Implemented on bigger islands
- Drinking water became a serious issues for smaller islands
- Damage to food crops in smaller islands
- Drought conditions have eased in the last month
  - Water supply is less of a concern
  - Food security will take more time to recuperate

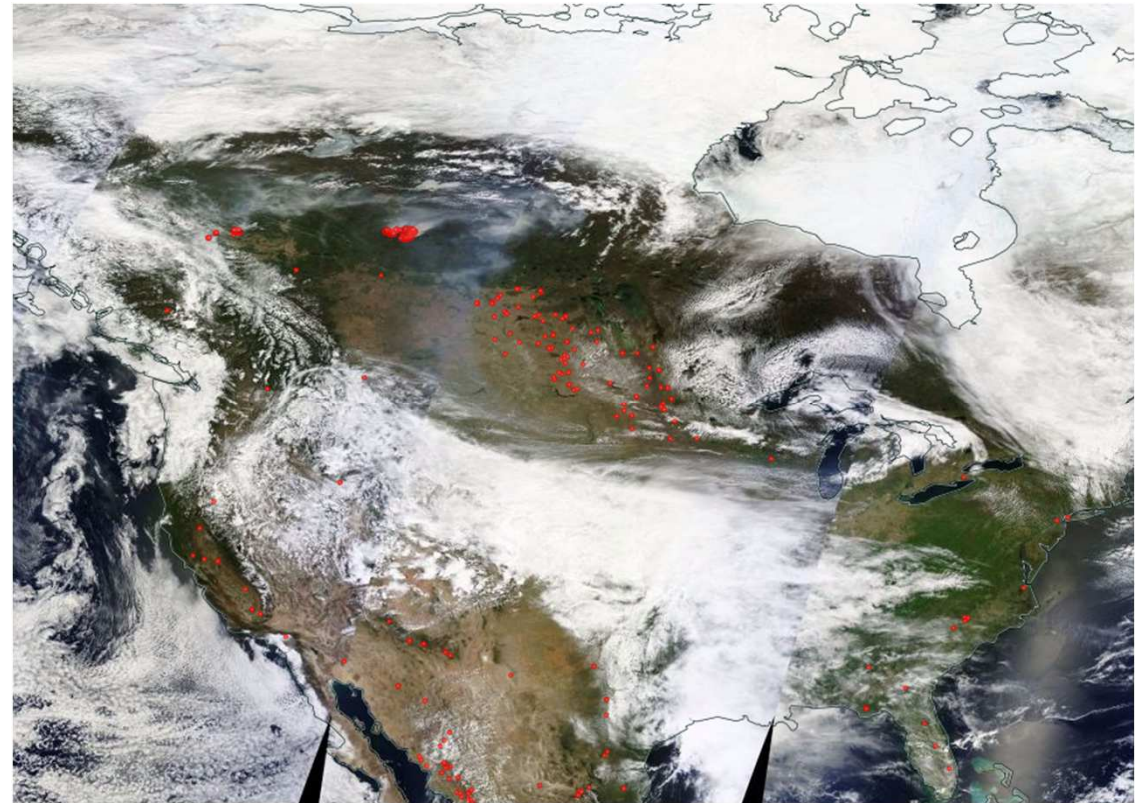
Special acknowledgement to  
Richard Heim NOAA/NCEI  
Chip Guard NWS WFO Guam  
WSO personnel throughout the USAPI



# Fort McMurray Fires

- El Nino in the Pacific disrupted weather patterns to bring northern Alberta a dry fall and very little snow throughout the winter
- Similar conditions were observed in 1998

*According to Daniel Thompson from Natural Resources Canada in Edmonton to Bloomberg News*



MODIS True Color Image from May 16<sup>th</sup> 2016

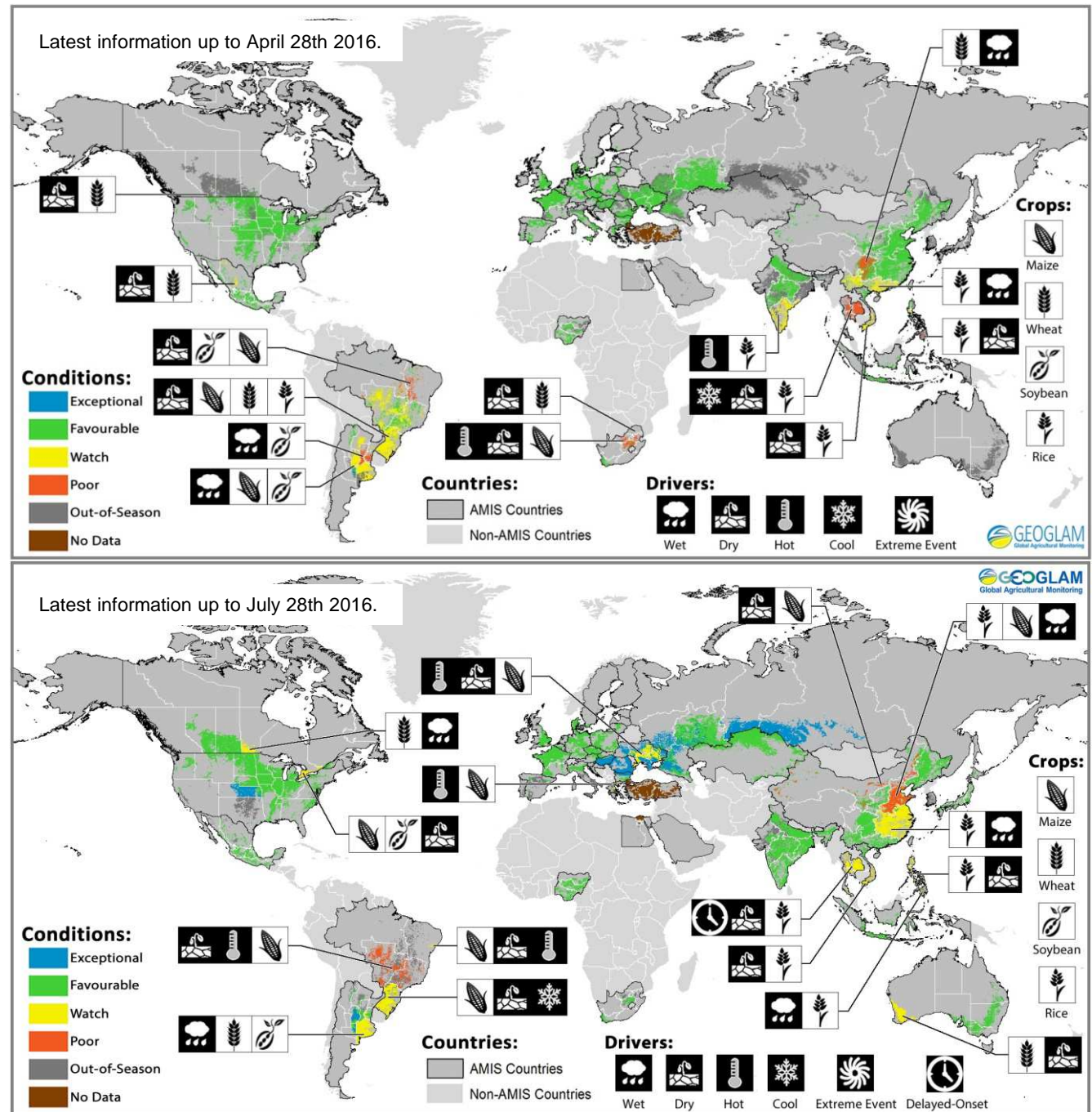
Source:  
AON Benfield  
2016 Global Catastrophe  
Recap: First Half of 2016

Date	Event	Location	Deaths	Insured Loss <sup>1</sup> (USD)
April 14 & 16, 2016	Earthquake(s)	Japan	75	5.0 billion
May/June 2016	Flooding	France, Germany, Belgium, Austria	17	3.4 billion
May 2016	Wildfire	Canada	0	3.2 billion
April 10-15, 2016	Severe Weather	United States	1	3.2 billion
March 22-25, 2016	Severe Weather	United States	0	1.5 billion
April 15-19, 2016	SCSI/Flood	United States	9	1.0 billion

<sup>1</sup>Totals subject to change

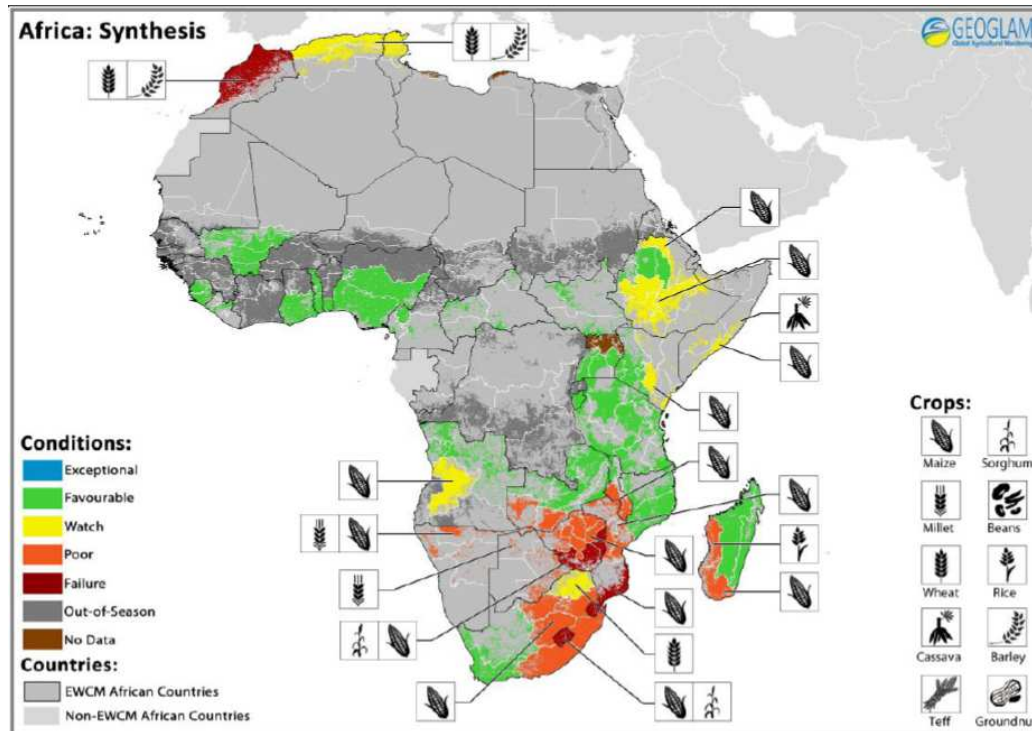
## Global crops

- Conditions have improved for many places across the globe
  - Europe
  - South America
  - Australia
- Deteriorated over Western China

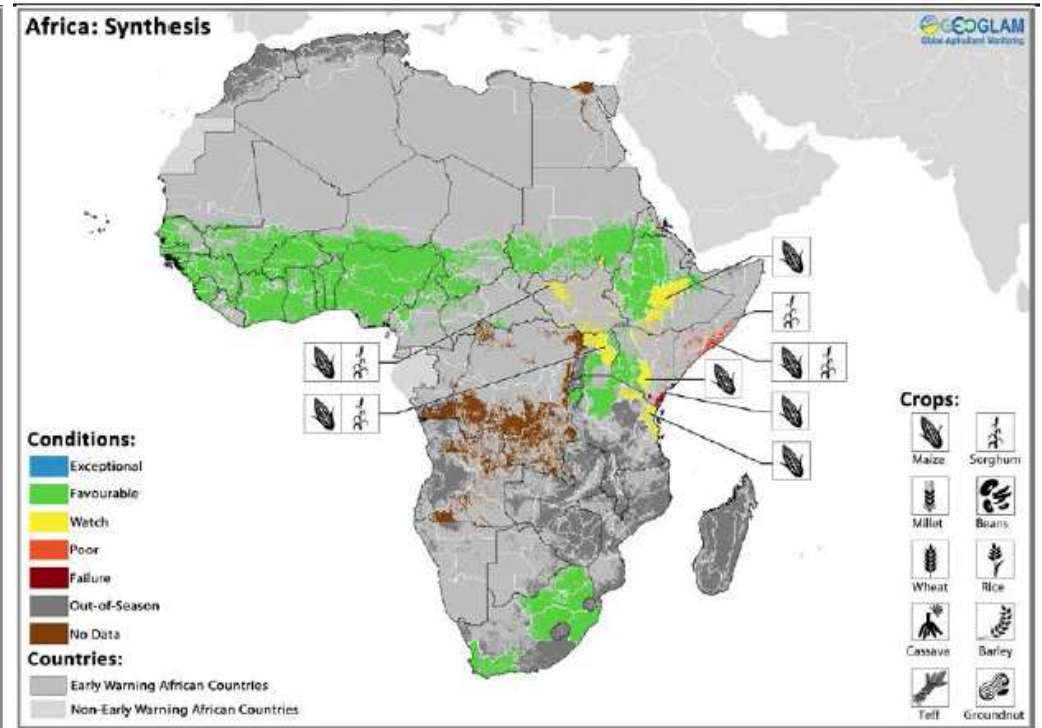


# Crops in Africa

Latest information up to April 28th 2016.



Latest information up to July 28th 2016.



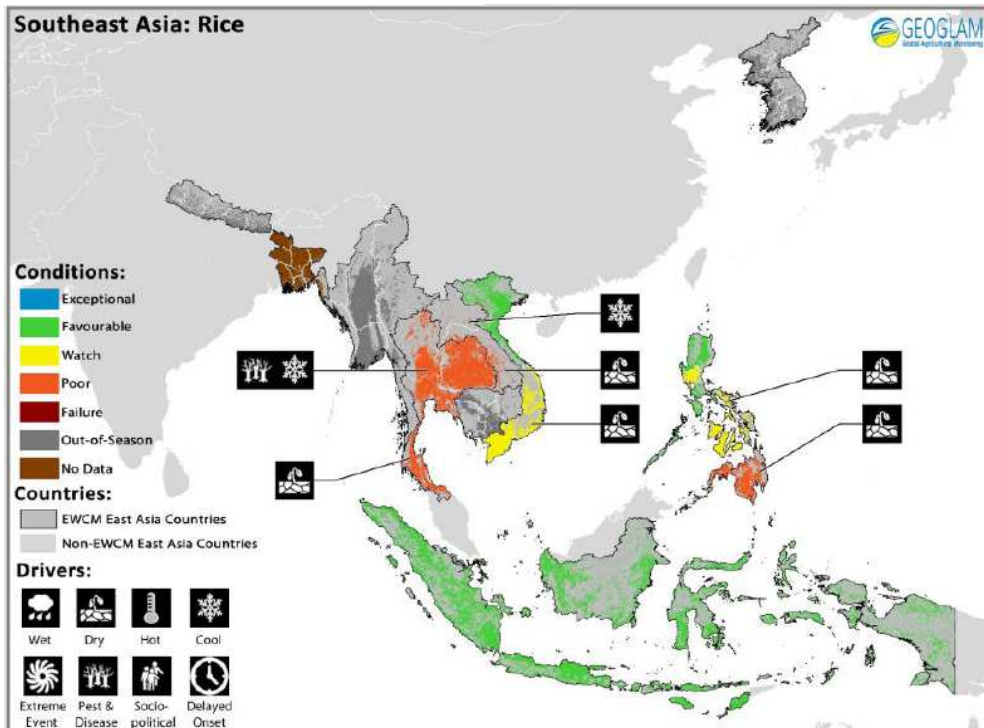
From GEOGLAM Early Warning Crop Monitor  
<http://www.geoglam-crop-monitor.org/>

- Severe drought over the southern portion of the continent has been ameliorated
- Watch conditions over Ethiopia have improved

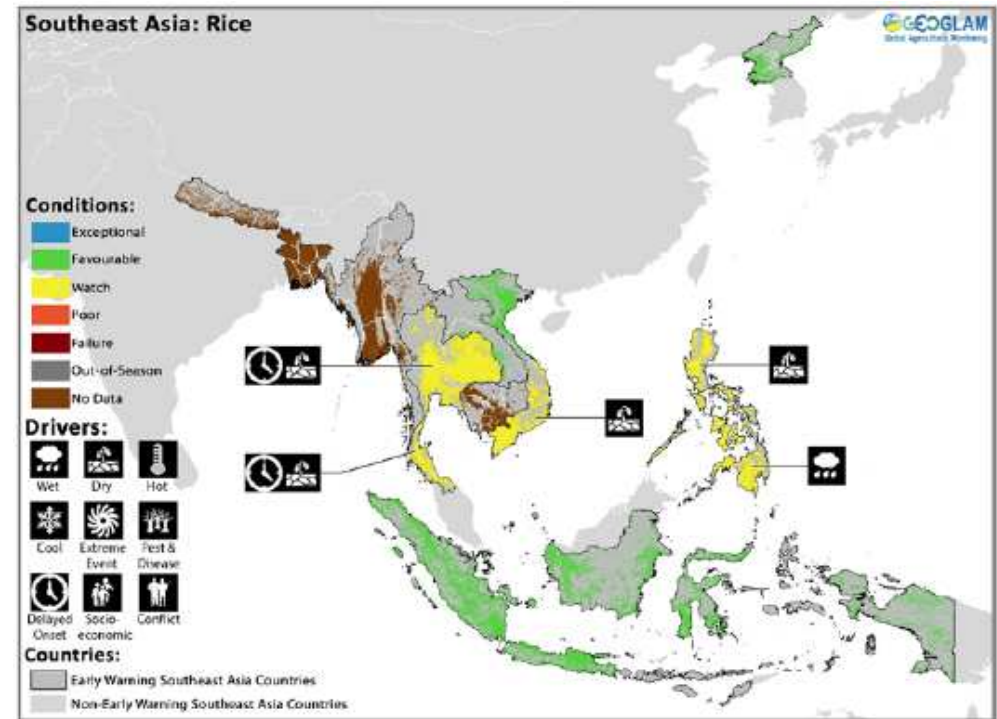


# Rice Crops in South East Asia

Latest information up to April 28th 2016.



Latest information up to July 28th 2016.



From GEOGLAM Early Warning Crop Monitor  
<http://www.geoglam-crop-monitor.org/>

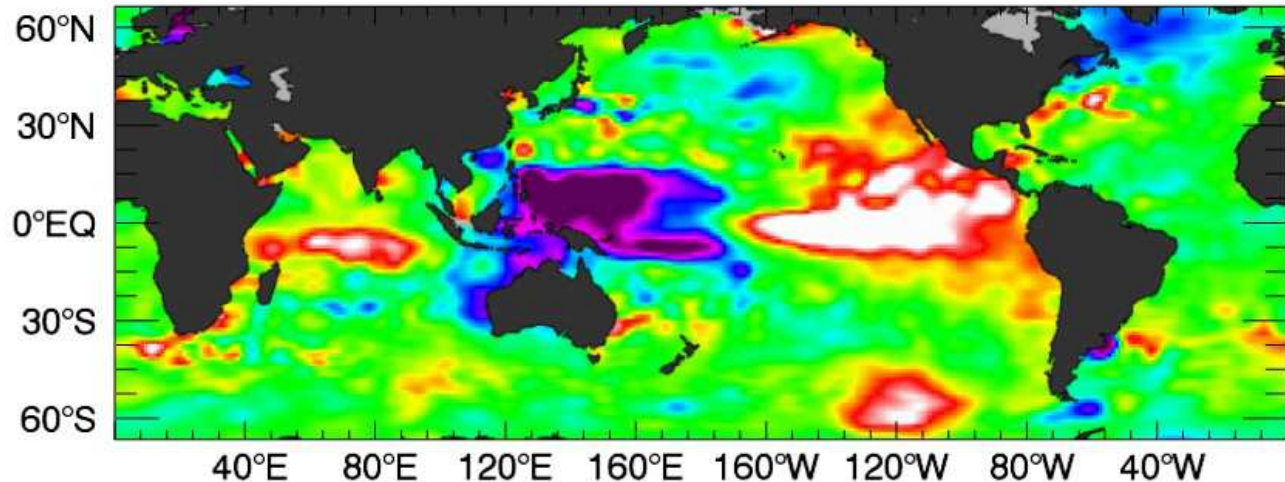
- Thailand and Cambodia have seen greatly improved conditions
- The Philippines has seen some improvement from drought
- Myanmar and Bangladesh may see poor growing conditions

# Sea Level Observation

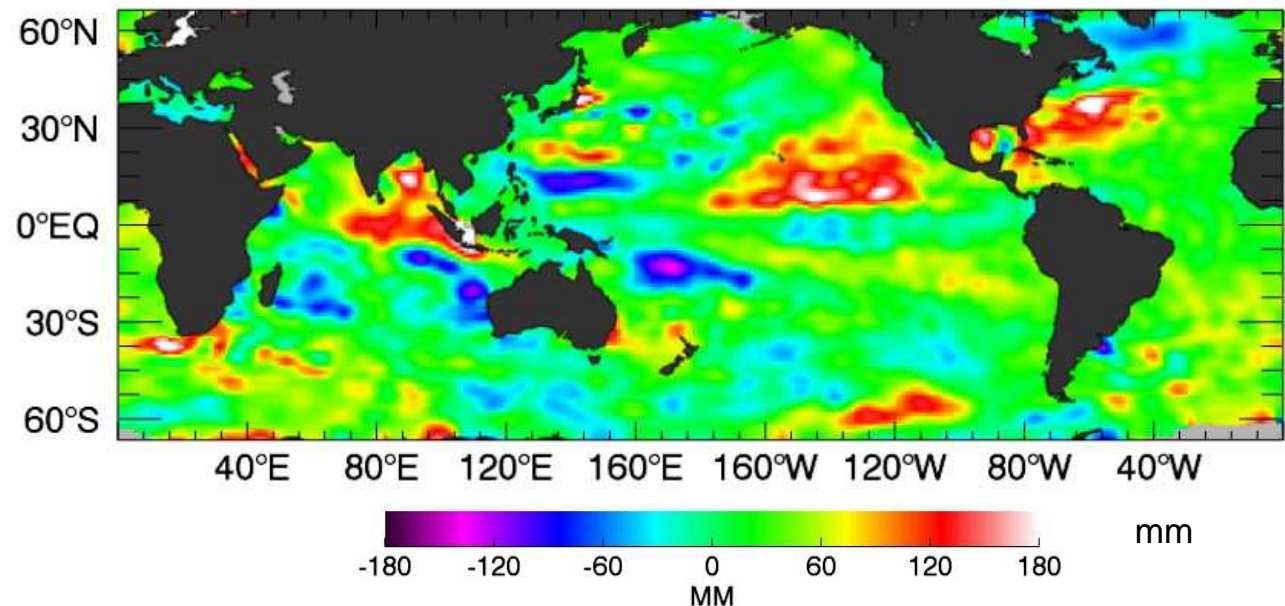
Sea Levels have been

- Below average over Western Pacific Basin since March 2015
- Returned to near average by March 2016
- Quickly transitioned to above average by May 2016
- PEAC Center sea level data monitoring indicates clear trend towards La Niña

Jason-2 Sea Level Residuals JAN 23 2016



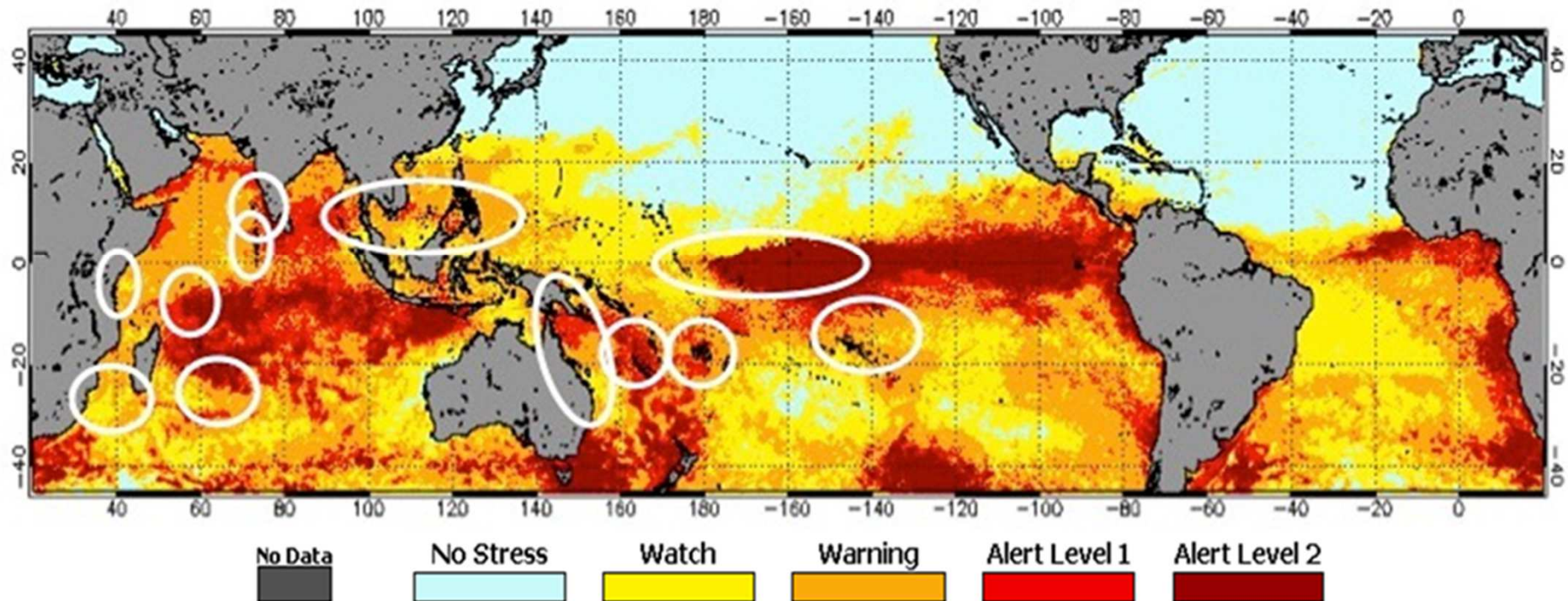
Jason-2 Sea Level Residuals JUL 21 2016



# Coral Bleaching

## Sever bleaching events

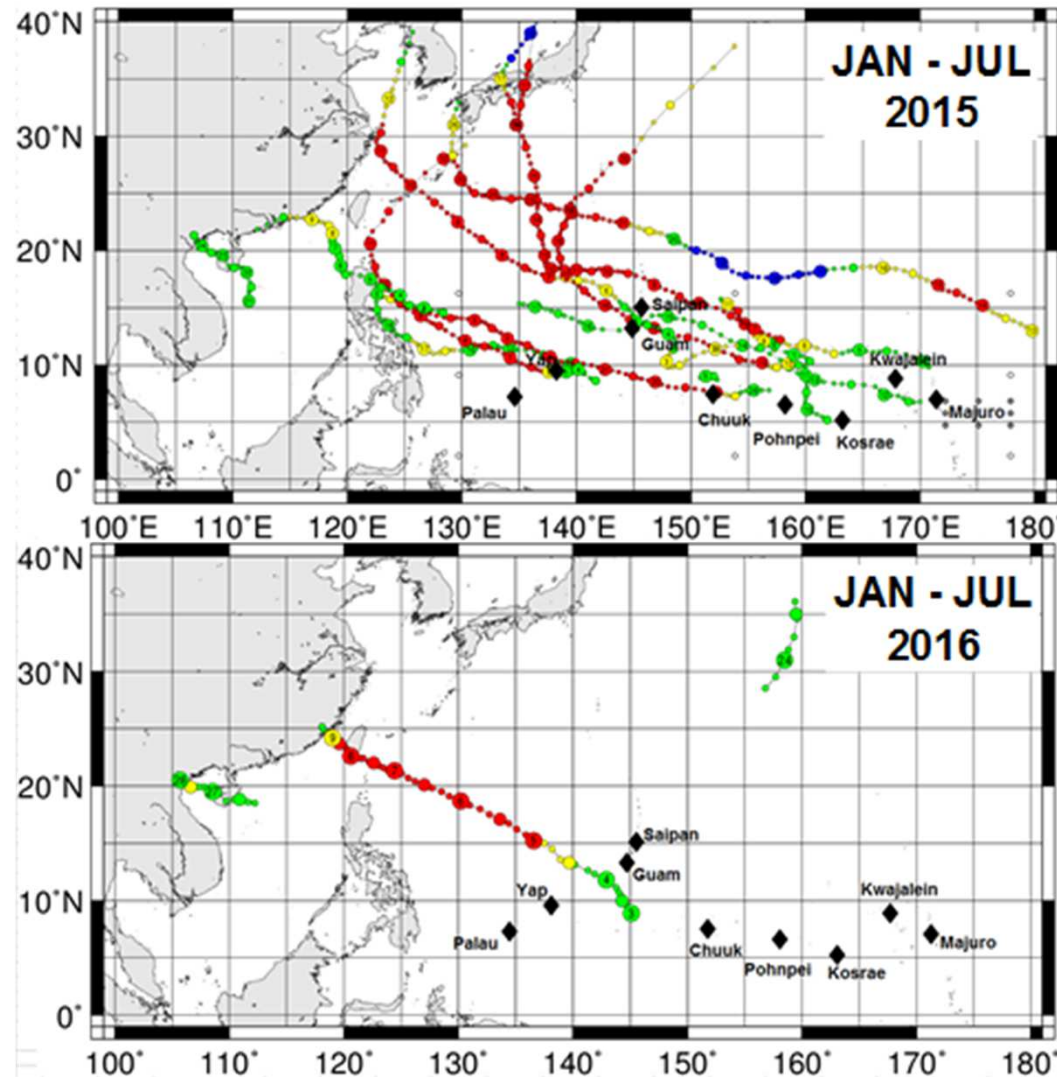
NOAA Coral Reef Watch Maximum Satellite Coral Bleaching Alert Area Jan.-May 2016



Oman	W. India	Thailand	Kiribati
Western India	Maldives	Indonesia	French Polynesia
Seychelles	Réunion	Great Barrier Reef	
Kenya/Tanzania	Mauritius	New Caledonia	
Mozambique	Madagascar	Fiji	

## Tropical cyclone activity

- TC activity was very low during the first half of 2016
- The season had a very late start,
  - first named storm (Super Typhoon Nepartak) reaching tropical storm intensity on the 3<sup>rd</sup> of July
- TC activity during the first half of 2016 was displaced to the west and north of average, in stark contrast to the activity during the first half of 2015



# How ENSO affects global health

THE LANCET • Published online May 20, 2003 • <http://image.thelancet.com/extras/02art5336web.pdf>

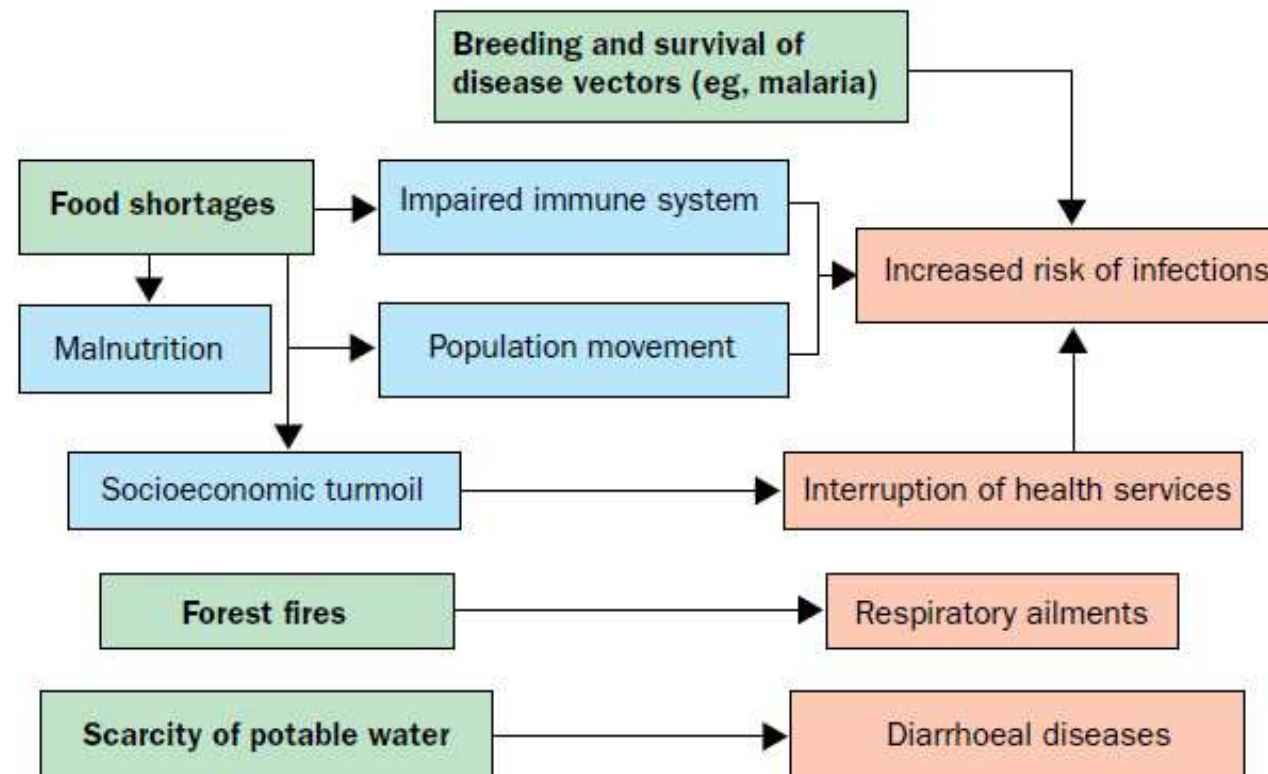
REVIEW

## Review

### El Niño and health

R Sari Kovats, M

El Niño Southern  
consequences of  
occurrence of El  
disasters increa  
South Asia and  
disease is provid  
on other mosqui  
to dealing with  
climate forecast



wide-ranging  
The irregular  
ect of natural  
s in parts of  
en ENSO and  
ENSO's effect  
ers are used  
and seasonal  
paredness.

Figure 2: Potential health effects of drought in developing countries

# Observed Health impacts during 2015-16

## • Tanzania

- Cholera epidemic of more than 12 000 reported is likely to spread to other countries
- This Tanzanian cholera outbreak is the largest since 1997-1998, which had over 40 000 reported cases

## • In Ethiopia

- Number of people in need of emergency health interventions nearly doubled in three months

## • In southern Africa

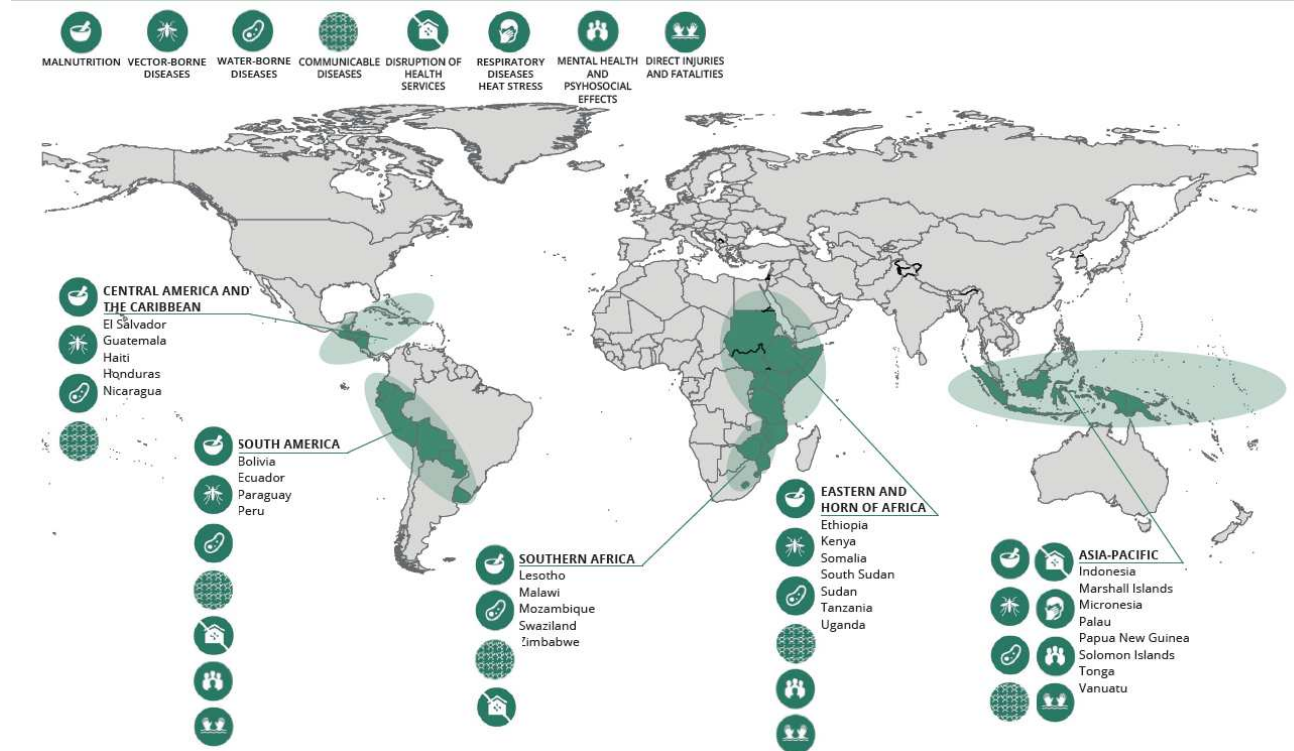
- Increasing malnutrition and disease risks
- Growing concerns about the interruption to anti-retroviral therapy

## • South America

- Above-average rainfall
- Floods and increased diseases spread by mosquitoes

## • In Guatemala and Honduras,

- 2 years of drought and El Niño
- 2.8 million people in need of humanitarian assistance
- 1-5 households will face critical food consumption gaps and acute malnutrition



[http://www.who.int/hac/crises/el-nino/who\\_el\\_nino\\_and\\_health\\_global\\_report\\_21jan2016.pdf](http://www.who.int/hac/crises/el-nino/who_el_nino_and_health_global_report_21jan2016.pdf)

## • Papua New Guinea

- Drought
- Major immediate public health threats include the interruption of critical infrastructure

## • Vanuatu, Fiji, Solomon Islands

- Water shortages
- Increased incidence of diarrheal diseases

## • Indonesia

- Fires
- Likely cause respiratory disease, food insecurity

## Global Response

- The 2015–16 El Niño has now dissipated, but its devastating impacts will be felt well into 2017
- As a result of droughts caused or exacerbated by El Niño, 60 million people across four continents, require immediate assistance
- This was a well forecast event.
- Both governments and international stakeholders have responded, but not at the scale and speed to preserve livelihoods, hope and dignity.
- This El Niño was a broadly preventable crisis, and as such, is a modern day tragedy.

OXFAM BRIEFING NOTE

18 JULY 2016

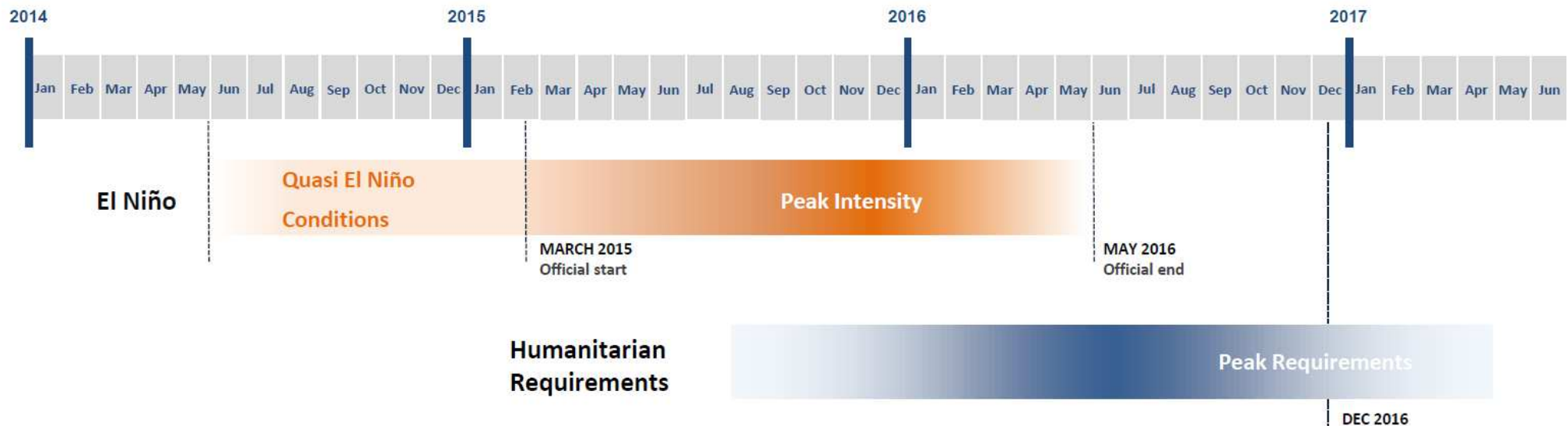


Nalukul, from Nalwel, Western Province, Zambia, only harvested 10kg of maize after El Niño-induced drought destroyed her crops. Her children have dropped out of school for the first time and they now weed other people's farms or sell charcoal. Photo: Misozzi Tembo/Oxfam

## A PREVENTABLE CRISIS

El Niño and La Niña events need earlier responses and a renewed focus on prevention

# Even with El Niño ending, the challenges remain:



- Effects on food security and nutrition from this El Niño event are time delayed
  - Harvest and national stocks will supply populations for a period of time, food insecurity tends to happen later
  - Levels of humanitarian assistance are expected to peak by late 2016 early 2017



# Forecast

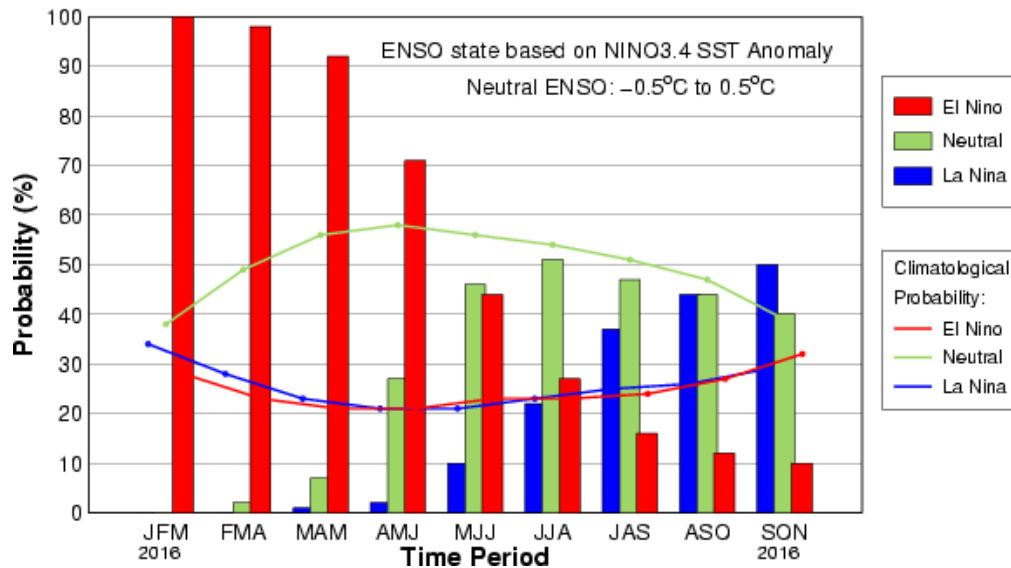
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ENSO forecasts

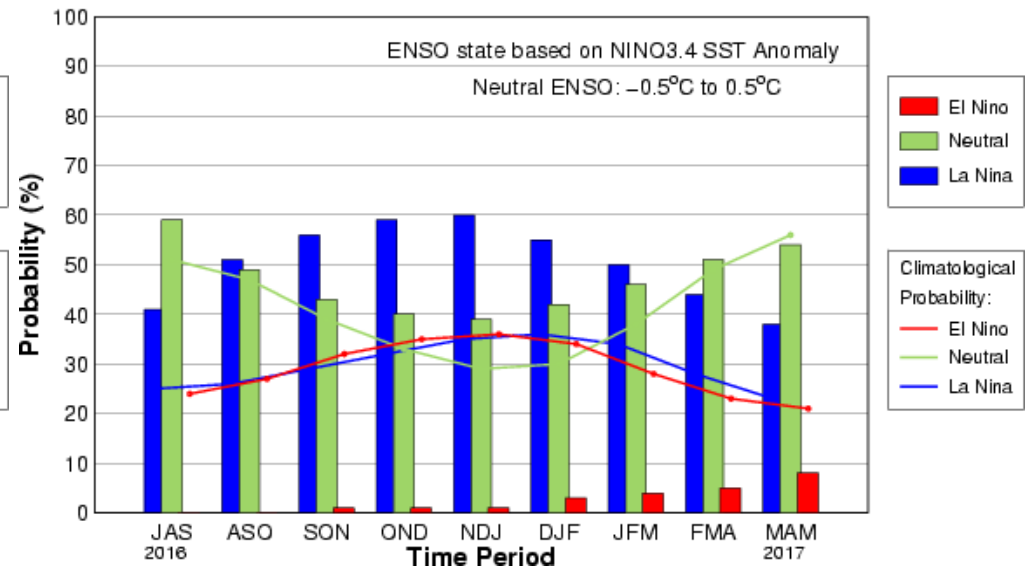
Rainfall, Sea level, Tropical Cyclones and  
Coral Bleaching

# CPC/IRI ENSO Forecast

Early–Feb CPC/IRI Consensus Probabilistic ENSO Forecast



Early–Aug CPC/IRI Official Probabilistic ENSO Forecast



## CPC/IRI EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

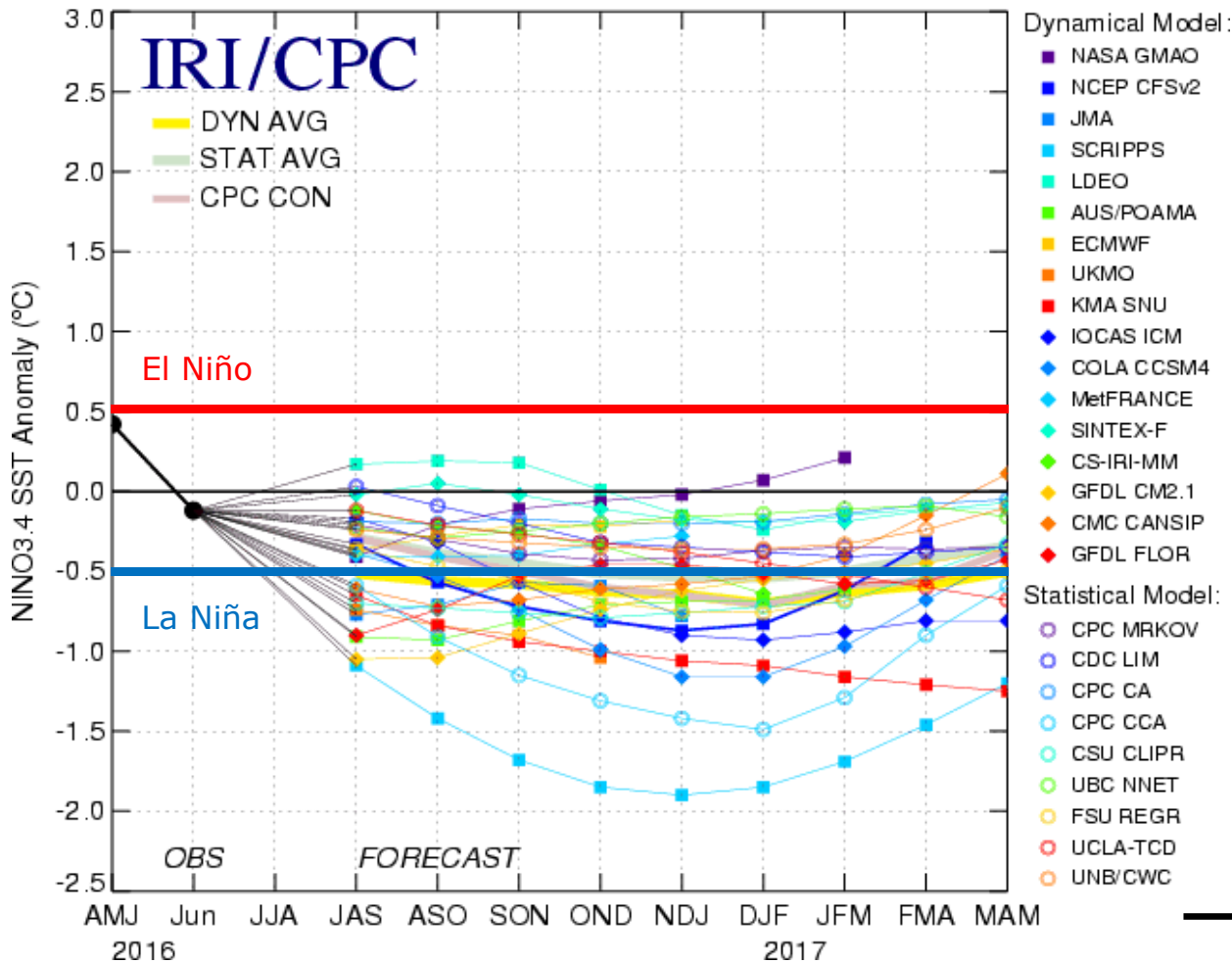
### Expected Conditions

- The forecaster consensus favors La Niña onset during the August-October season
- 55-60% chance of La Niña during the fall and winter 2016-17

Season	La Niña (early June forecast)	Neutral	El Niño
JAS 2016	41% (64%)	59%	0%
ASO 2016	51% (70%)	49%	0%
SON 2016	56% (72%)	43%	1%
OND 2016	59% (74%)	40%	1%
NDJ 2016	60% (76%)	39%	1%
DJF 2016	55% (75%)	42%	3%
JFM 2017	50% (73%)	46%	4%
FMA 2017	44%	51%	5%
MAM 2017	38%	54%	8%

# CPC/IRI ENSO Forecast

Mid-Jul 2016 Plume of Model ENSO Predictions



## CPC/IRI EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

### Expected Conditions

- Many models favor La Niña by the beginning of the Northern Hemisphere fall,
- Continuing into winter
- Statistical models predict a slightly later onset time (i.e., mid- to late fall) than dynamical models, and also predict a slightly weaker event.
- The forecaster consensus favors La Niña onset during the August-October season
- Predictions are for a **weak event**

Climate Prediction Center  
National Centers for Environmental Prediction  
NOAA/National Weather Service  
College Park, MD 20740

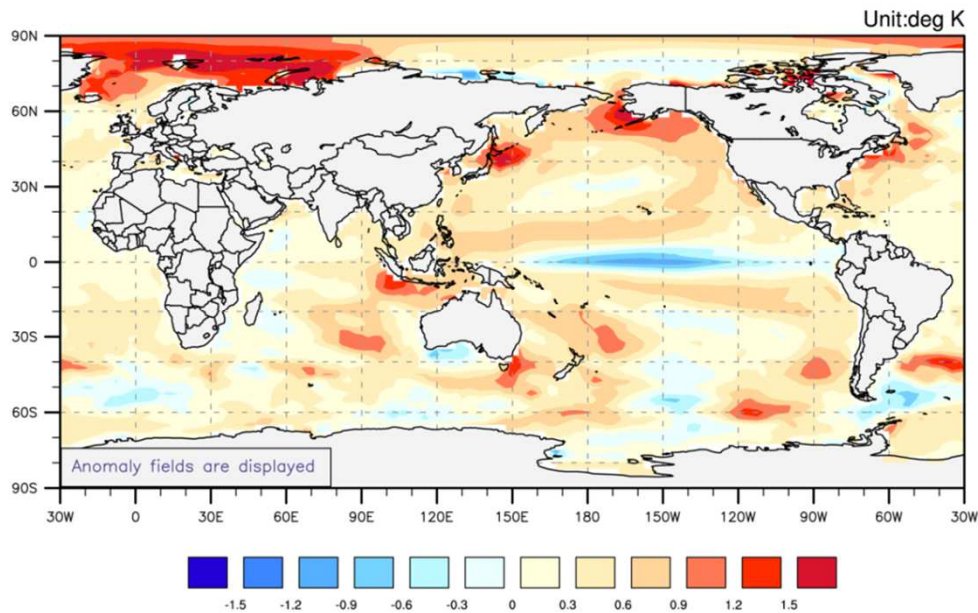
### Average Niño 3.4 SST Anomaly Forecast

	JAS	OND	JFM
Dynamical	-0.5	-0.6	-0.6
Statistical	-0.3	-0.5	-0.5
All Models	-0.4	-0.6	-0.5

[http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso\\_tab=enso-cpc\\_update](http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-cpc_update)  
[http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso\\_tab=enso-sst\\_table](http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-sst_table)  
[http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso\\_tab=enso-iri\\_update](http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-iri_update)  
[http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso\\_tab=enso-sst\\_table](http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-sst_table)

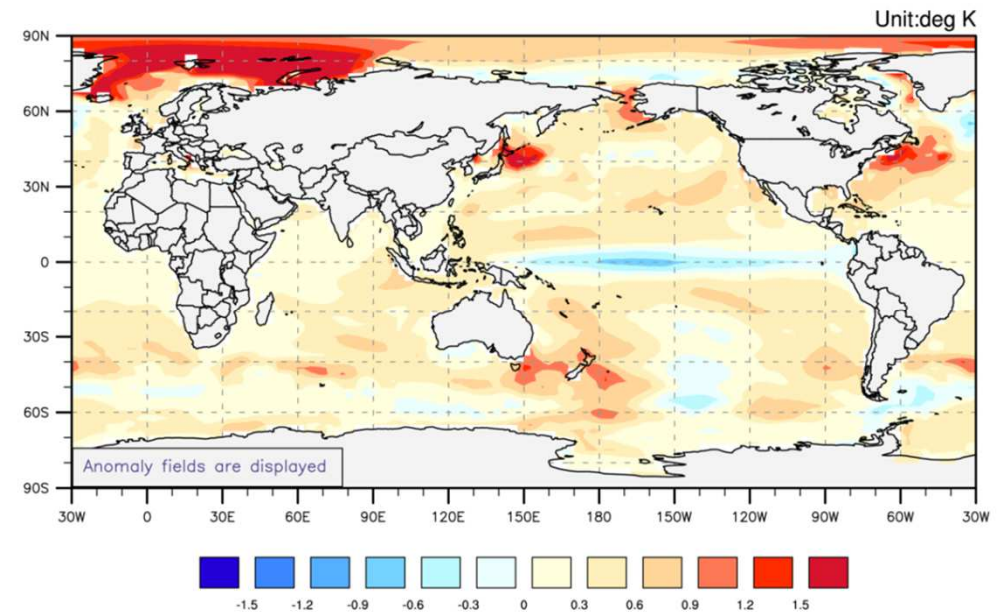
# Tropical SST Forecasts (May 2016-Oct 2016)

Sea Surface temperature for August-October 2016



© APEC Climate Center

Sea Surface temperature for November 2016-January 2017



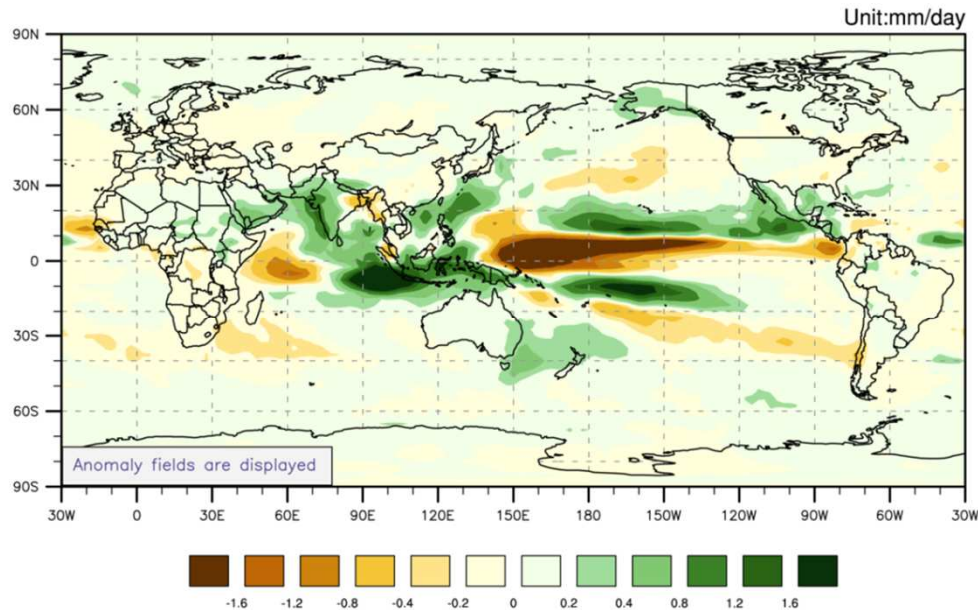
© APEC Climate Center

From: <http://www.apcc21.org/ser/outlook.do?lang=en>

- This particular model ensemble
  - Produces a reasonable La Niña “horse shoe” spatial pattern
  - Develops La Niña conditions by August 2016
  - Ensemble predictions for NINO3.4 index are around -0.6C (weak La Niña)

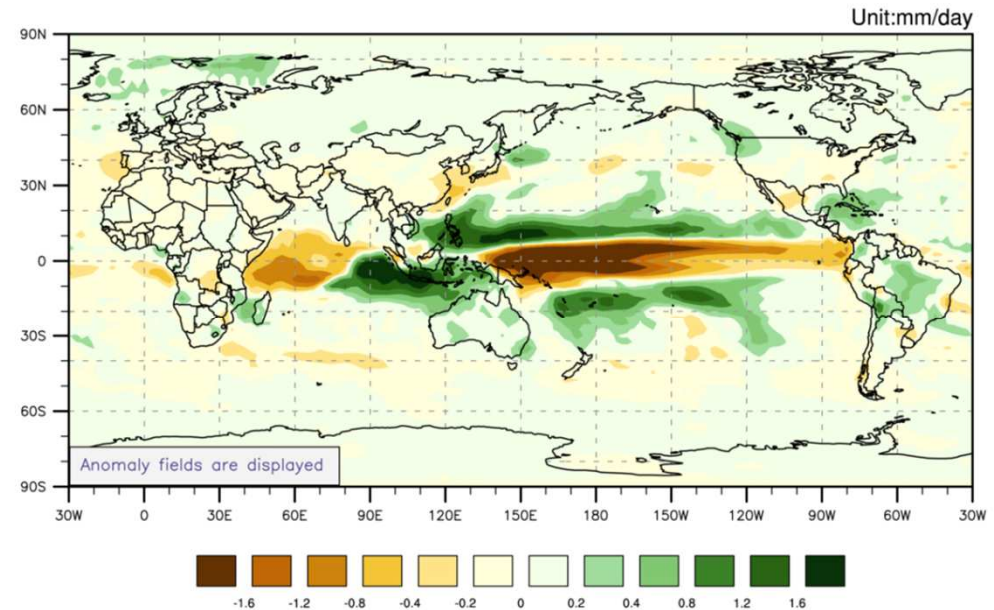
# Tropical Rainfall Forecasts (May 2016-Oct 2016)

Precipitation for August-October 2016



© APEC Climate Center

Precipitation for November 2016-January 2017



© APEC Climate Center

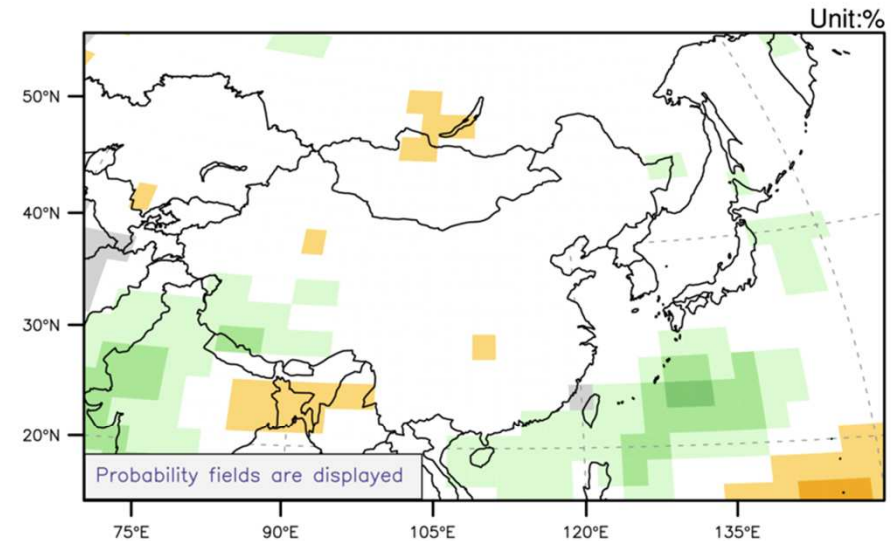
- August-October
  - Current dry conditions over the Equatorial Pacific start to extend east past the dateline
  - Near normal rainfall over South America
  - Strong wet conditions over the Maritime Continent
- November-January
  - Wet conditions over the Indian Ocean intensify
  - Dry conditions over the equatorial tropical Pacific extend to far along equator
  - Wet conditions over South America

From: <http://www.apcc21.org/ser/outlook.do?lang=en>

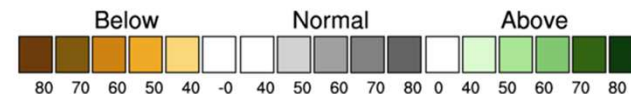
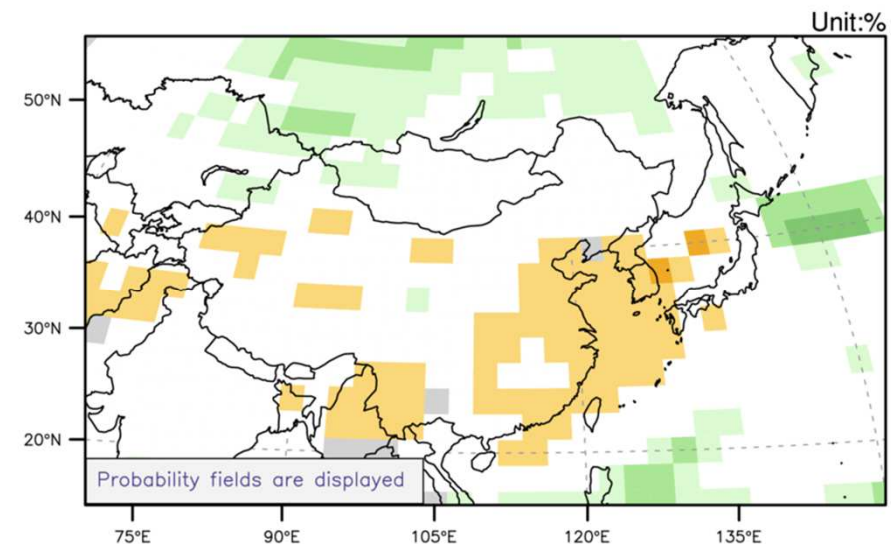
# Continental Asia

- August-October
  - Rainfall near normal over Mainland China, the Korean peninsula and Japan
  - Mild wet conditions for Taiwan
  
- November-January
  - Dry conditions develop over Eastern China and the Korean Peninsula

Precipitation for August-October 2016



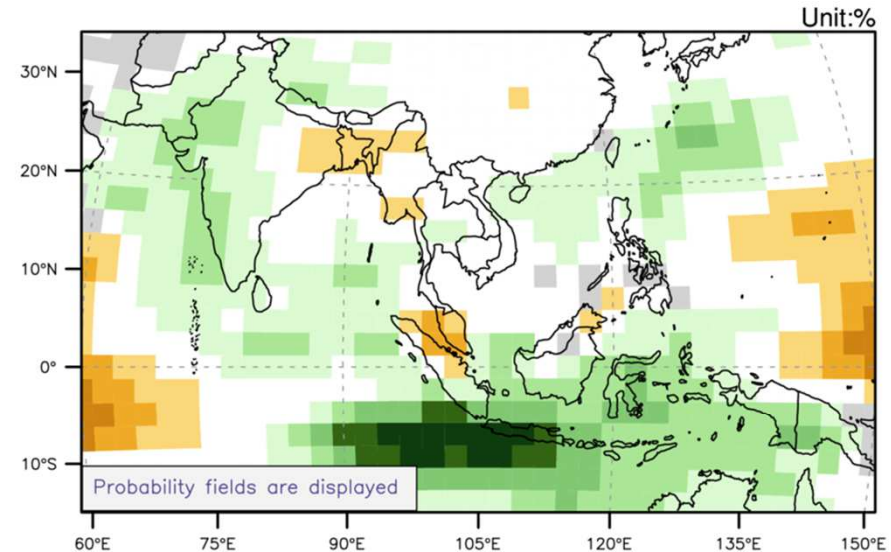
Precipitation for November 2016-January 2017



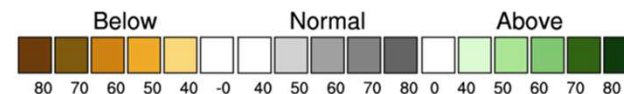
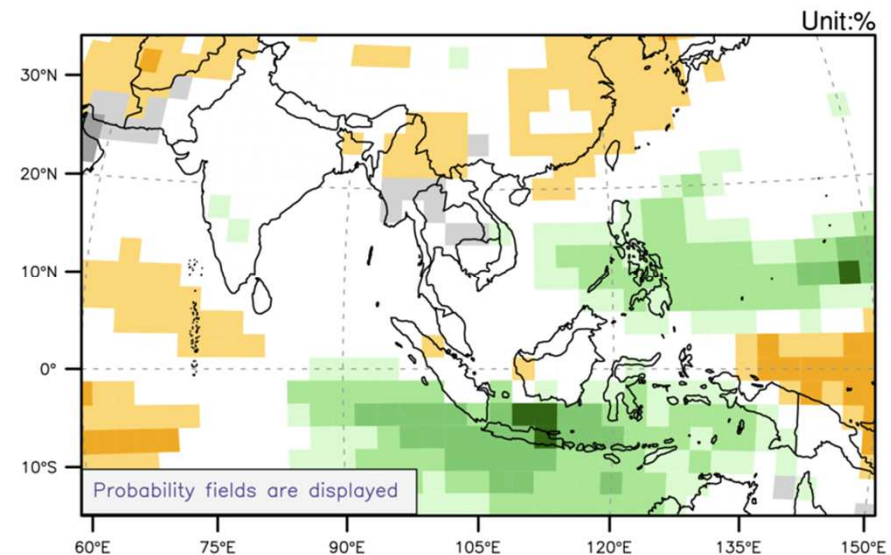
# Asia Pacific

- Western North Pacific
  - Dryer than conditions likely to continue over the tropical and give way to wet conditions by the end of the year
- Western Pacific Islands are coming out of severe drought
- India
  - Above average rainfall over most of the Indian subcontinent returning to near normal by the end of the year
- Continental South East Asia
  - Mixed rainfall conditions
- Philippines
  - Increasing rainfall as the year progresses
- Maritime Continent
  - Likely to see wet conditions for the rest of the year

Precipitation for August-October 2016



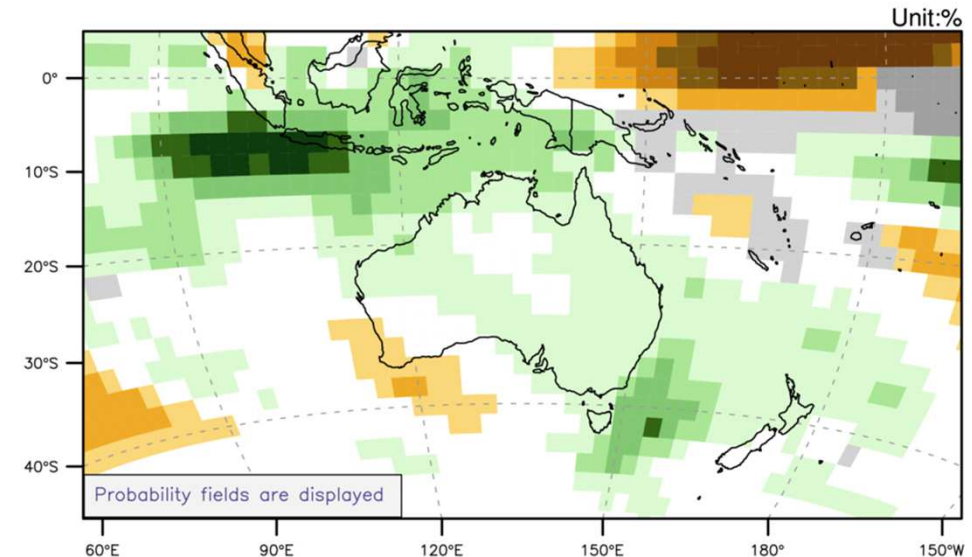
Precipitation for November 2016-January 2017



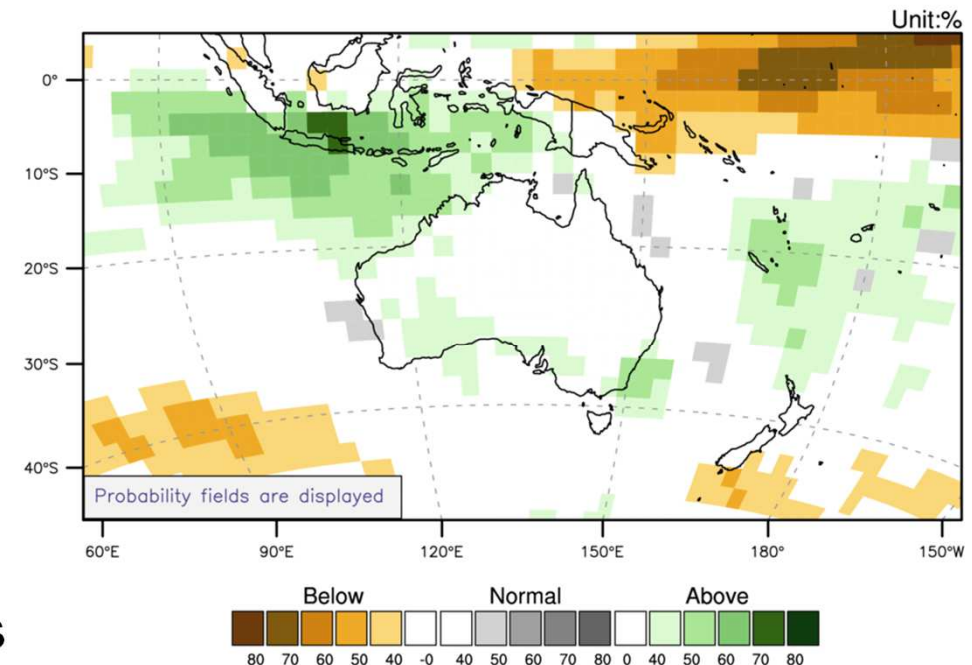
# Australia - Pacific

- Maritime Southeast Asia will see more rain and relief from severe drought
- South Pacific Islands
  - Many recovering from severe drought
  - likely to see some relief
  - May be short lived
- Australia
  - Likely above average rainfall for the next 3 months
  - Could make for severe floods
  - 2010-2011 Queensland floods
    - TC + Enhanced wet conditions
    - Produced ~2.4 Billion in damages

Precipitation for August-October 2016



Precipitation for November 2016-January 2017





# US Affiliated Pacific Islands

## Rainfall

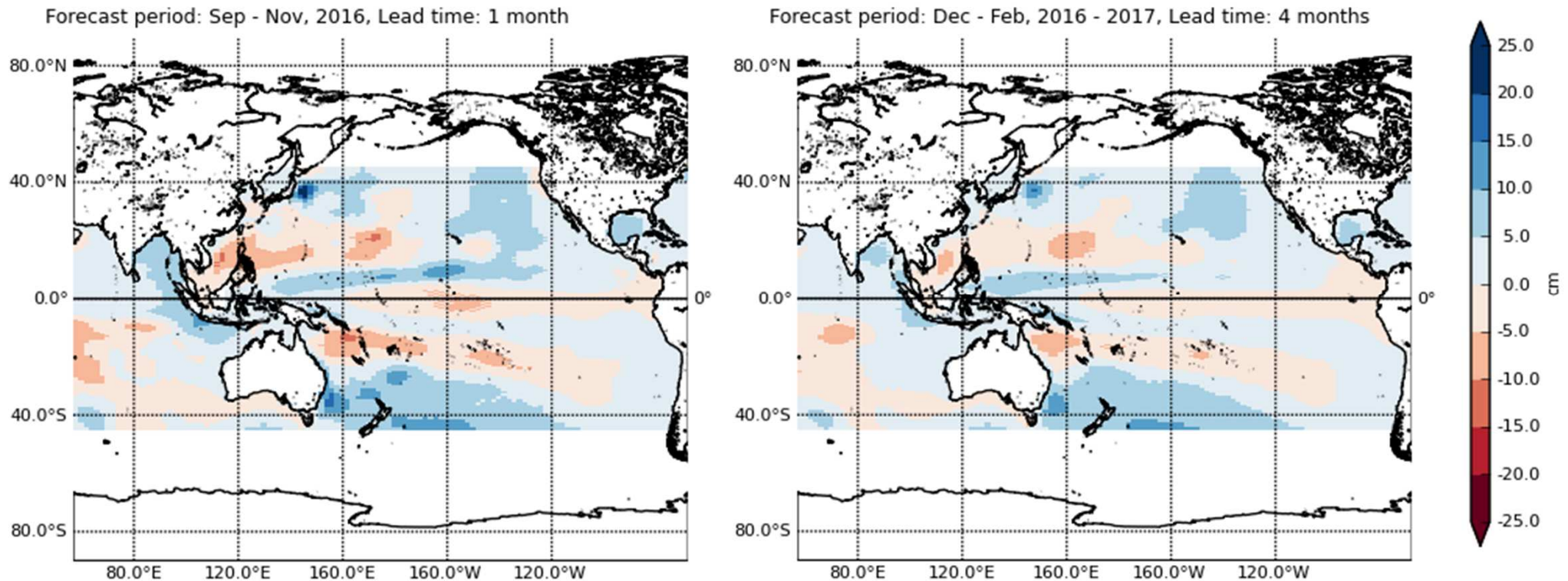
July - August - September (JAS) 2016

Model:	UKMO	ECMWF	NCEP_CA	NASA_GMAO	NCEP_Coupled	IRI	APCC	PEAC_CCA	Final Outlook	Final Probabilities	
Republic of Palau											
Koror	L 7° 22' N, λ 134° 32' E	Avg-Above	Below	Above	Avg-Above	Avg	Clim	Below	Clim	Average	30:40:30
Federated States of Micronesia											
Yap	L 9° 29' N, λ 138° 05' E	Avg-Below	Below	Above	Below	Below	Below	Below	Avg-Below	Avg-Below	35:35:30
Chuuk	L 7° 28' N, λ 151° 51' E	Below	Below	Above	Below	Below	Below	Below	Avg-Below	Average	30:40:30
Pohnpei	L 6° 59' N, λ 158° 12' E	Below	Below	Avg-Above	Below	Below	Below	Below	Avg-Above	Avg-Below	35:35:30
Kosrae	L 5° 21' N, λ 162° 57' E	Below	Below	Avg	Below	Below	Below	Below	Below	Avg-Below	35:35:30
Republic of the Marshall Islands											
Kwajalein	L 8° 43' N, λ 167° 44' E	Avg	Below	Avg-Above	Below	Below	Below	Below	Clim	Average	30:40:30
Majuro	L 7° 04' N, λ 171° 17' E	Avg-Below	Below	Avg-Above	Below	Below	Below	Below	Avg-Above	Avg-Below	35:35:30
Guam and CNMI											
Guam	L 13° 29' N, λ 144° 48' E	Below	Below	Below	Below	Avg-Below	Below	Below	Avg-Below	Below	40:35:25
Saipan	L 15° 06' N, λ 145° 48' E	Below	Below	Below	Below	Avg-Below	Below	Below	Clim	Below	45:30:25
American Samoa											
Pago Pago	L 14° 20' S, λ 170° 43' E	Above	Above	Below	Above	Avg-Above	Clim	Above	Avg-Below	Above	30:30:40
State of Hawaii											
Lihue	L 21° 59' N, λ 159° 20' E	Above	Below	Below	Avg	Avg	Clim	Avg	Avg-Below	Avg-Below	35:35:30
Honolulu	L 21° 19' N, λ 157° 56' W	Above	Below	Below	Avg	Avg-Above	Clim	Avg	Avg-Below	Avg-Below	35:35:30
Kahului	L 20° 54' N, λ 156° 26' E	Above	Below	Below	Avg-Above	Avg-Above	Clim	Avg	Avg-Above	Avg-Above	30:35:35
Hilo	L 19° 43' N, λ 155° 03' E	Above	Below	Below	Avg-Above	Avg-Above	Clim	Avg	Avg-Above	Avg-Above	30:35:35



People line up for water in the Marshall Islands in early 1998 to receive a ration once every 14 days. (Photo courtesy of Federal Emergency Management Agency)

# Sea Level Forecasts



- Sea Level across the Western Pacific Basin was well below average since early 2015
- Sharply transitioned to above average in early 2016
- Will likely remain above normal until 2017

# US Affiliated Pacific Islands

## Sea level forecast

**Table 1 : Forecasts of MEAN and MAX sea level anomaly in inches for JJA 2016**

Tide Gauge Station	Forecast Anomaly for JJA 2016 (in inches)			
	MEAN Deviation(1)	Standard Deviation MJJ season	MAX Deviation (2)	Standard Deviation of MJJ season
Marianas, Guam	+2	3.5	+18	4.6
Malakal, Palau	+3	4.4	+38	4.4
Yap, FSM1	+2	3.9	+30	3.9
Chuuk, FSM**	+2	*	+30	*
Pohnpei, FSM	+4	3.1	+33	3.3
Kapingamarangi, FSM	*	*	*	*
Majuro, RMI	+3	2.4	+41	2.6
Kwajalein, RMI	+4	2.8	+41	3.0
Pago Pago, American Samoa	+1 (-4)	3.6	+26 (-3)	3.7
Honolulu, Hawaii	+2	1.7	+21	2.3
Hilo, Hawaii	+1	2.0	+25	2.6

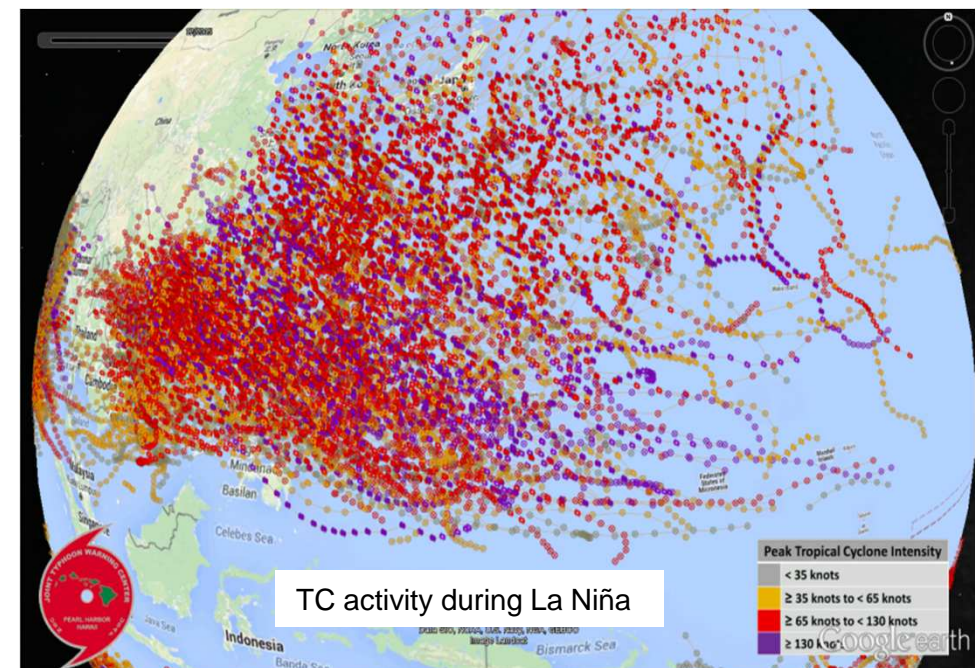
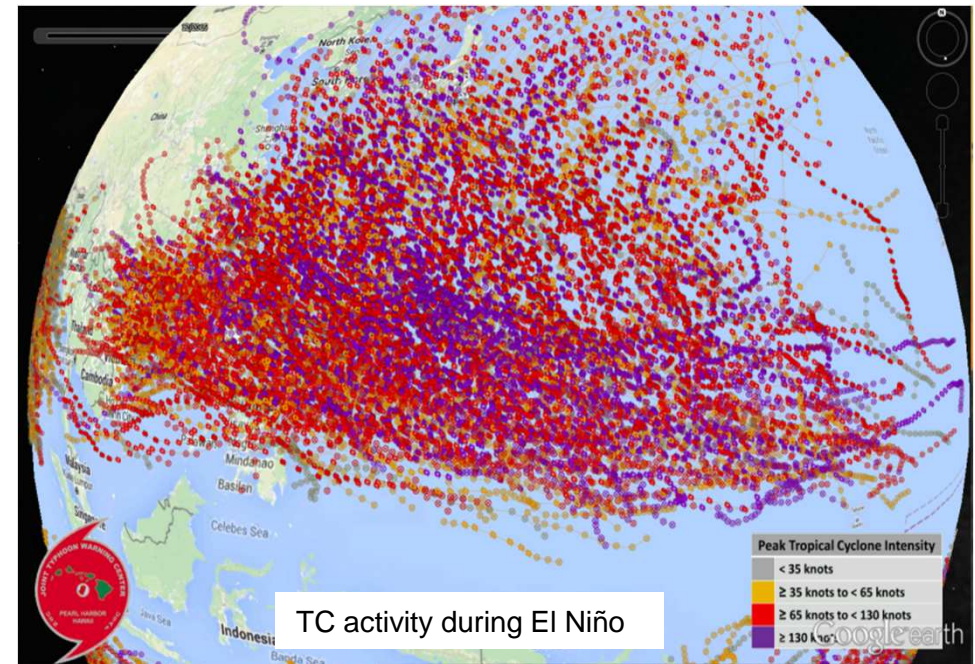
+/- indicate positive anomaly (rise) and negative anomaly (fall) respectively. Note that any changes between (0~±1) inch is considered to be negligible. Also note that changes within the range of (+/-) 2 inches are unlikely to cause any adverse climatic impact. \*\*\* Guesstimated values, \*\* Data currently unavailable; Figures in parenthesis are year-to-year seasonal anomaly.

1: Difference between the mean sea level for the given month and the 1983 through 2001 mean sea level value at each station (seasonal cycle removed); 2: Same as 1 except for maxima; SD stands for standard deviations.

\* **In Pago Pago**, There was a level shift (approximately 5 inches) in American Samoa at the time of September 2009 earthquake. So, -5 inches has been adjusted (shown in parenthesis) to the current tide-gauge values of Pago Pago.

# Tropical Cyclone Forecast

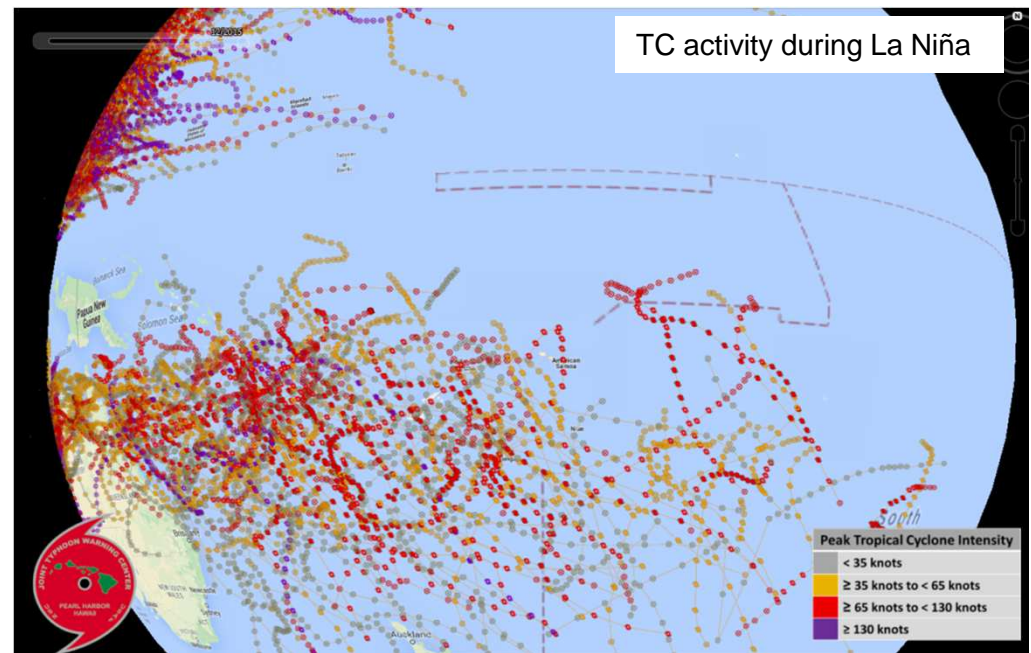
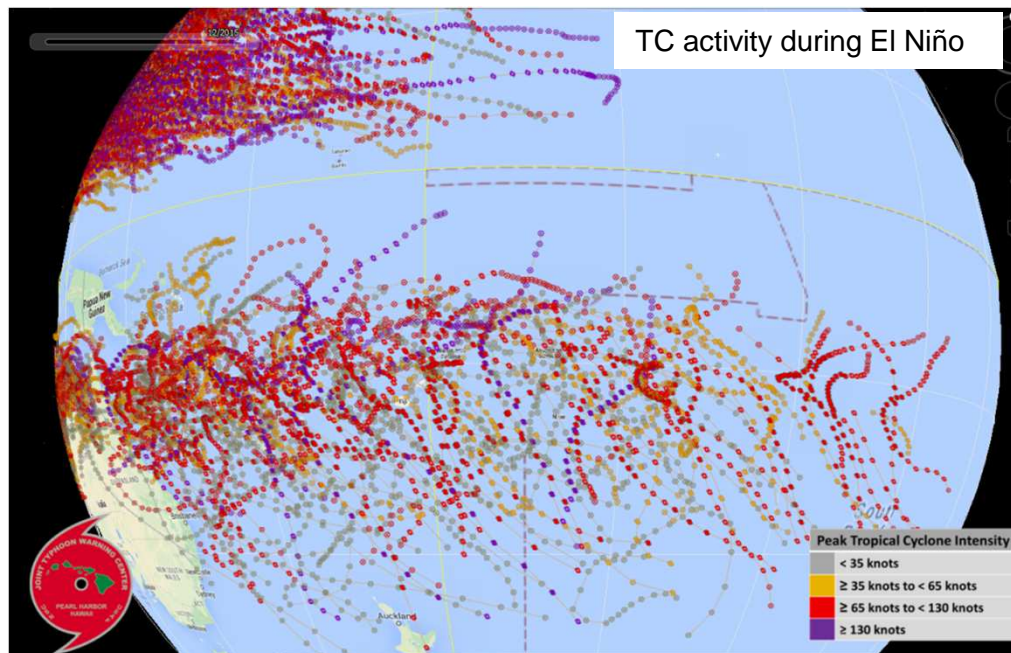
- US Affiliated Pacific Islands (PEAC Center Forecast)
  - Tropical cyclone activity will be below average in the western North Pacific basin
  - Relatively inactive year within the bounds of Micronesia
  - October through December, the risk of a tropical storm or typhoon should increase to near average across western Micronesia and remain low (but not zero!) at locations eastward of Guam.
- Central Pacific Basin (CPHC, May 26<sup>th</sup> 2016)
  - (TC season June 1 to November 30 )
  - Average to Above Average season with 4 to 7 tropical cyclones likely
  - La Niña tends to suppress TC activity in the region but decadal variability shifting towards more active mode
- Philippines (PAGASA, July 15<sup>th</sup> 2016)
  - July to September 5 to 11 TCs likely
  - October to December 4 to 9 TCs likely



Images from JTWC, Courtesy of Robert Falvey.

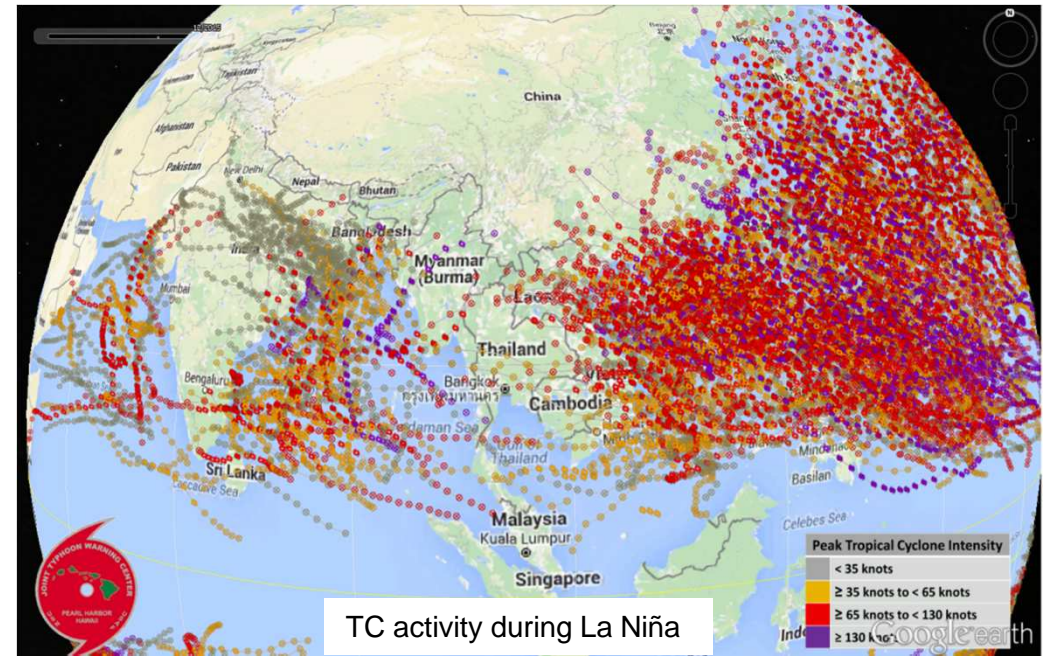
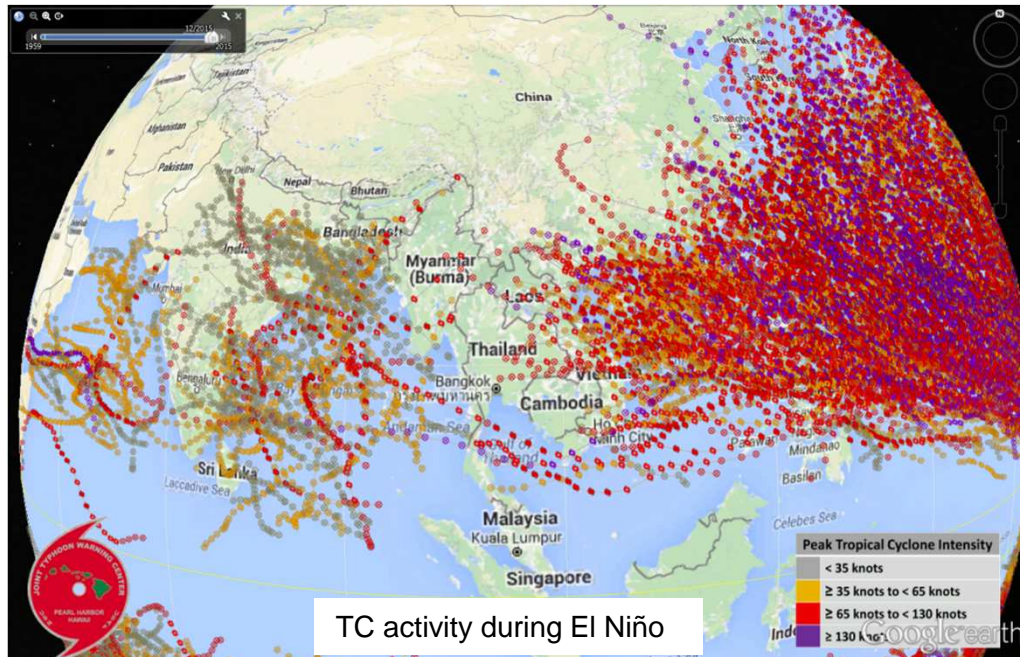
# Tropical Cyclone Forecast

- American Samoa TC (PEAC Center)
  - November to April
  - No activity is anticipated near American Samoa in the new season until November or December of 2016.
- Australia (Australian BOM Forecast)
  - TC season from Nov 1 to Apr 30, forecasts issued in October
  - Based on the BOM 2010-2011 forecast
    - Australian region likely to get above average TC activity during the 2016-2017 season



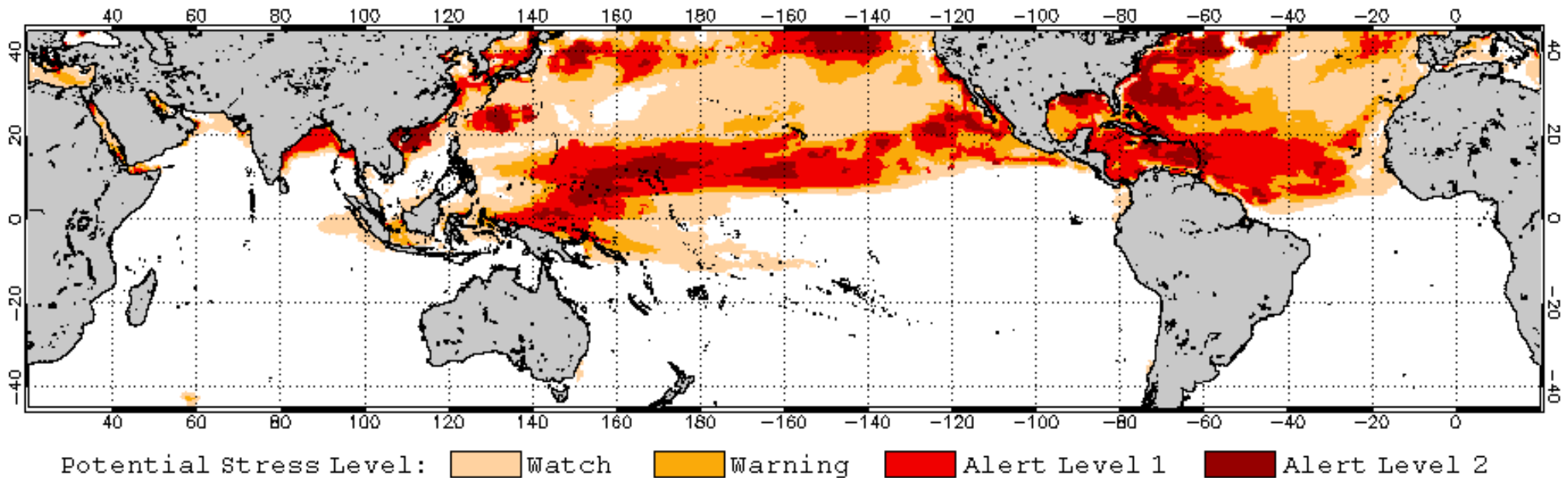
# Tropical Cyclone Forecast

- Western Pacific (City University of Hong Kong, July 2016)
  - TCs year round, minimum of activity in February and March
  - Years post strong El Niño events tend to have below normal TC activity
  - Downward trend in total number of TCs in the region
  - Below average formation (18/22) and landfalls (10/16) are expected
- Indian Ocean
  - From climatology
  - Enhanced activity in the Bay of Bengal during La Niña



# Coral Bleaching Outlook

2016 Aug 9 NOAA Coral Reef Watch 60% Probability Coral Bleaching Thermal Stress for Aug–Nov 2016  
Experimental, v3.0, CFSv2–based, 28–member Ensemble Forecast



- High probability of Coral Bleaching across Western Pacific
- Western Pacific Islands may see bleaching in the coming months
- Caribbean Islands are at high risk of bleaching events

# Synopsis

## ENSO Alert System Status: **La Niña Watch**

### Current Conditions

- Current ENSO status is **Neutral**
- Sea Surface Temperature slightly cooler than normal over the Eastern Pacific
- Atmospheric conditions consistent with Neutral ENSO conditions

### Observed Impacts

- Expected El Niño impacts
  - Severe drought conditions across the globe
  - Shifted Tropical Cyclone Activity in the Western Pacific
  - Below average sea levels over the Western Pacific
- Are all returning to neutral conditions or shifting towards La Niña conditions

### General ENSO Forecast

- Onset of **La Niña** is expected during the August to October season
- Peak during the December to January season
- **La Niña** is expected to be weak



# Forecast Summary

- Rainfall
  - Dry conditions over the tropical Western North Pacific likely to continue to improve
  - Eastern China and Korean Peninsula
    - likely to receive near average rainfall for the next 3 months
    - Dry conditions from November to January
  - India
    - Above average rainfall over most of the Indian subcontinent returning to near normal by the end of the year
  - Continental South East Asia
    - Mixed rainfall conditions
  - Philippines
    - Increasing rainfall as the year progresses
  - Maritime Continent
    - Likely to see wet conditions for the rest of the year
  - South Pacific Islands
    - Many recovering from severe drought
    - likely to see some relief
    - May be short lived
  - Australia
    - Likely above average rainfall for the next 3 months

# Forecast Summary

- Sea Level
  - Likely to remain above normal over the Western Tropical Pacific until the end of the year
- TCs
  - US Affiliated Pacific Islands
    - US Affiliated Pacific Islands likely below normal activity
  - Western Pacific
    - Below average formation and landfalls are expected
  - Central Pacific Basin
    - Average to Above Average season with 4 to 7 tropical cyclones likely
  - Philippines
    - July to September 5 to 11 TCs likely
    - October to December 4 to 9 TCs likely
  - Australia
    - Likely above average cyclone season, Nov 1 2016 – Apr 30 2017
  - Indian Ocean
    - Above average activity in the Bay of Bengal

## Global impacts of La Niña

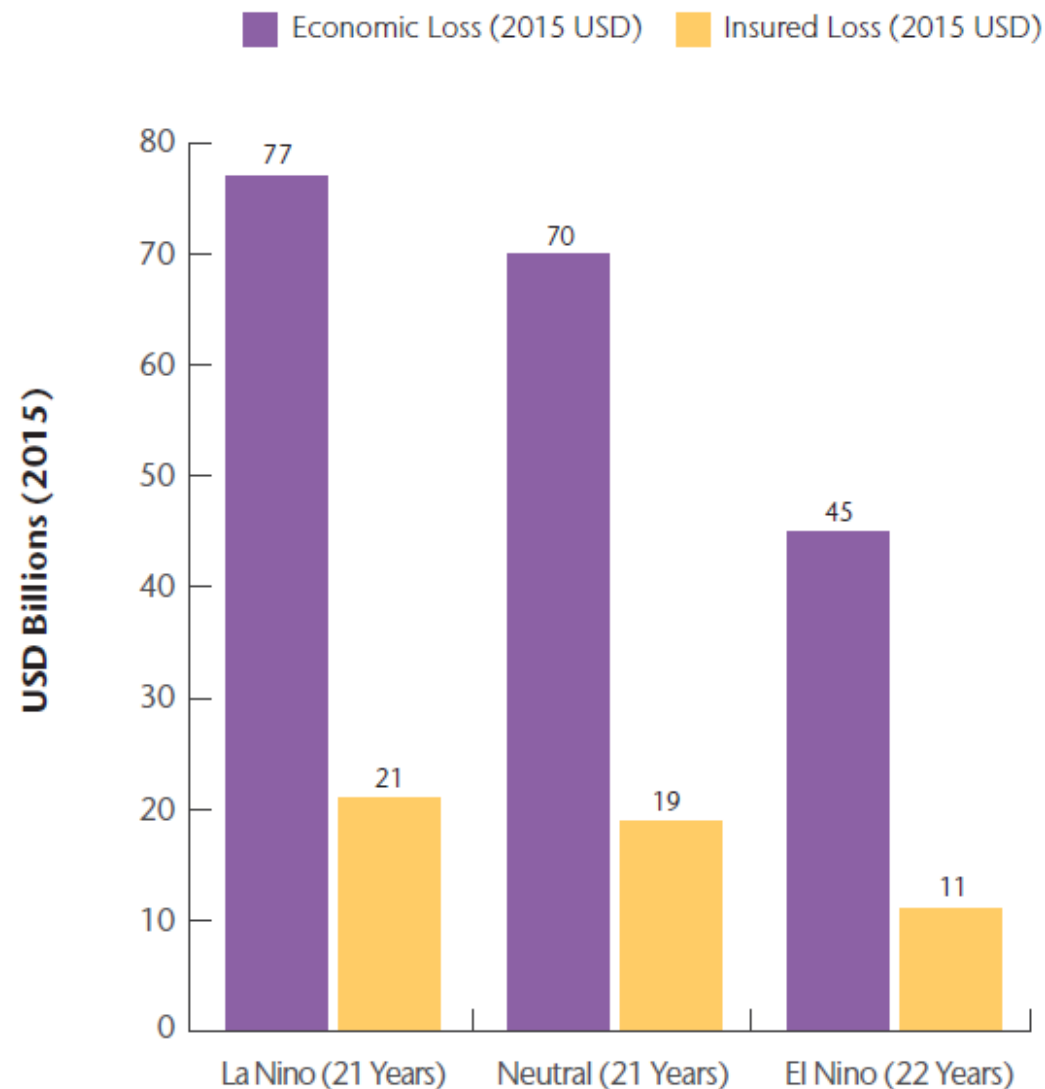
La Niña years have clearly shown greater average annual losses in comparison to El Niño and Neutral phases.

- La Niña USD77 billion
- El Niño USD45 billion

Much of the increase in losses during a La Niña year surrounds

- Increased frequency of costly landfalling tropical cyclone events in the Atlantic Ocean basin
- Increased flooding events across Asia Pacific

Exhibit 13: Global Weather Catastrophe Losses (Annual Average)



Source: Aon Benfield 2015 Annual Climate and Catastrophe report.

# La Niña can linger on...

- While El Niño conditions rarely persist more than one year La Niña conditions can persist many years
  - 1953/1954 El Niño followed by La Niña conditions from AMJ1954 trough AMJ 1956
  - 1969/1970 El Niño followed by La Niña conditions from JJA1970 trough DJF 1972
  - 1972/1973 El Niño followed by La Niña conditions from MJJ1973 trough FMA 1976
  - 1997/1998 El Niño followed by La Niña conditions from JJA1998 trough FMA 2001
- This makes it so that La Niña type impacts can be present for many years.



# The PEAC Center

The Pacific ENSO Applications Climate  
Center



Photo courtesy of  
Lt. Charlene Felkley