Pacific Region
ENSO UPDATE AND SEASONAL CLIMATE OUTLOOK

June 26 2018

PREPARED BY THE PEAC CENTER

Principal Scientist:
Dr. Rashed Chowdhury

Pacific Region Climate Officer:
LTJG Joseph Brinkley

Acknowledgements:
Dr. Mark Lander, Chip Guard, and Alejandro Ludert

PACIFIC ENSO APPLICATIONS CLIMATE CENTER

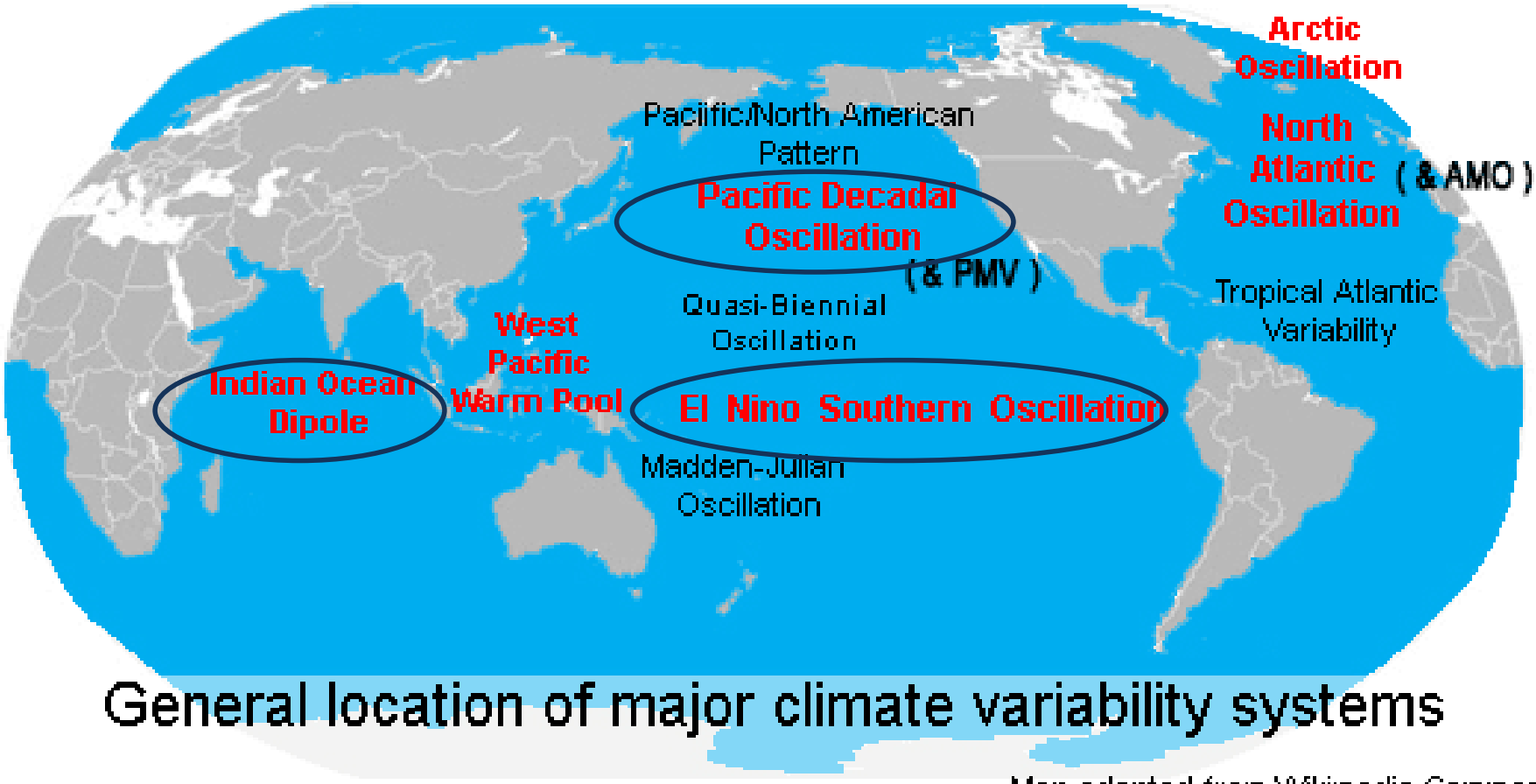
NOAA UOG/WERI UH/SOEST

(I) What Is El Niño and La Niña

A general description of ENSO and their global impacts

General Location of Major Climate Variability System

IOD: 201805: neutral, 1997: +ve,1998: -ve



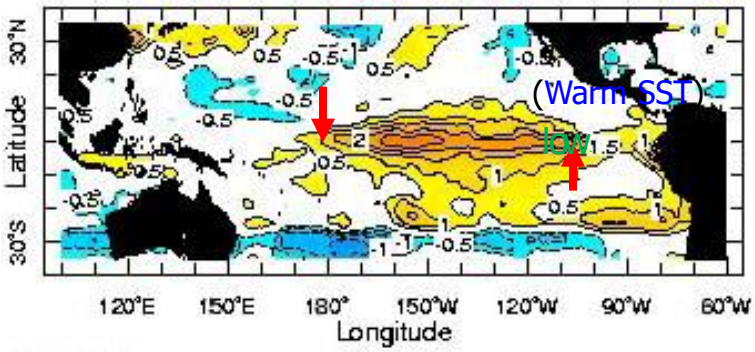
Map adapted from Wikimedia Commons

PDO: 201805: -0.61, 199710: +1.72,199810: -2.23

COLD: 1890-1924;1947-76….WARM: 1925-46; 1977-97

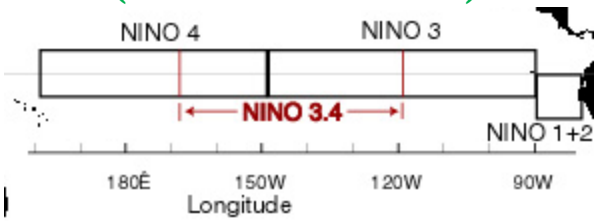
El Niño/La Niña -Southern Oscillation (ENSO)

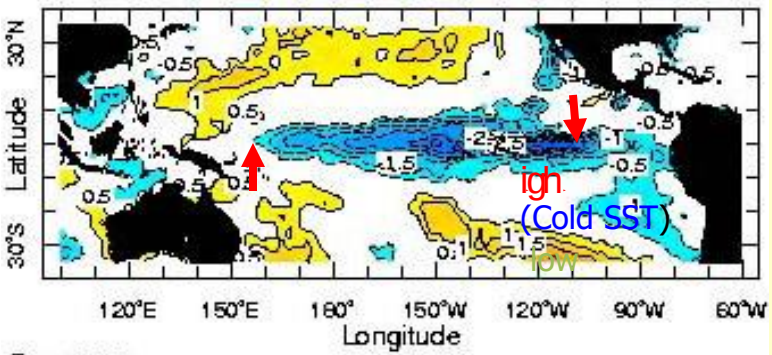
(Develops in JAS, strengthen through OND, and weakens in JFM)



Dec 1991

(5S-5N and 170-120W)

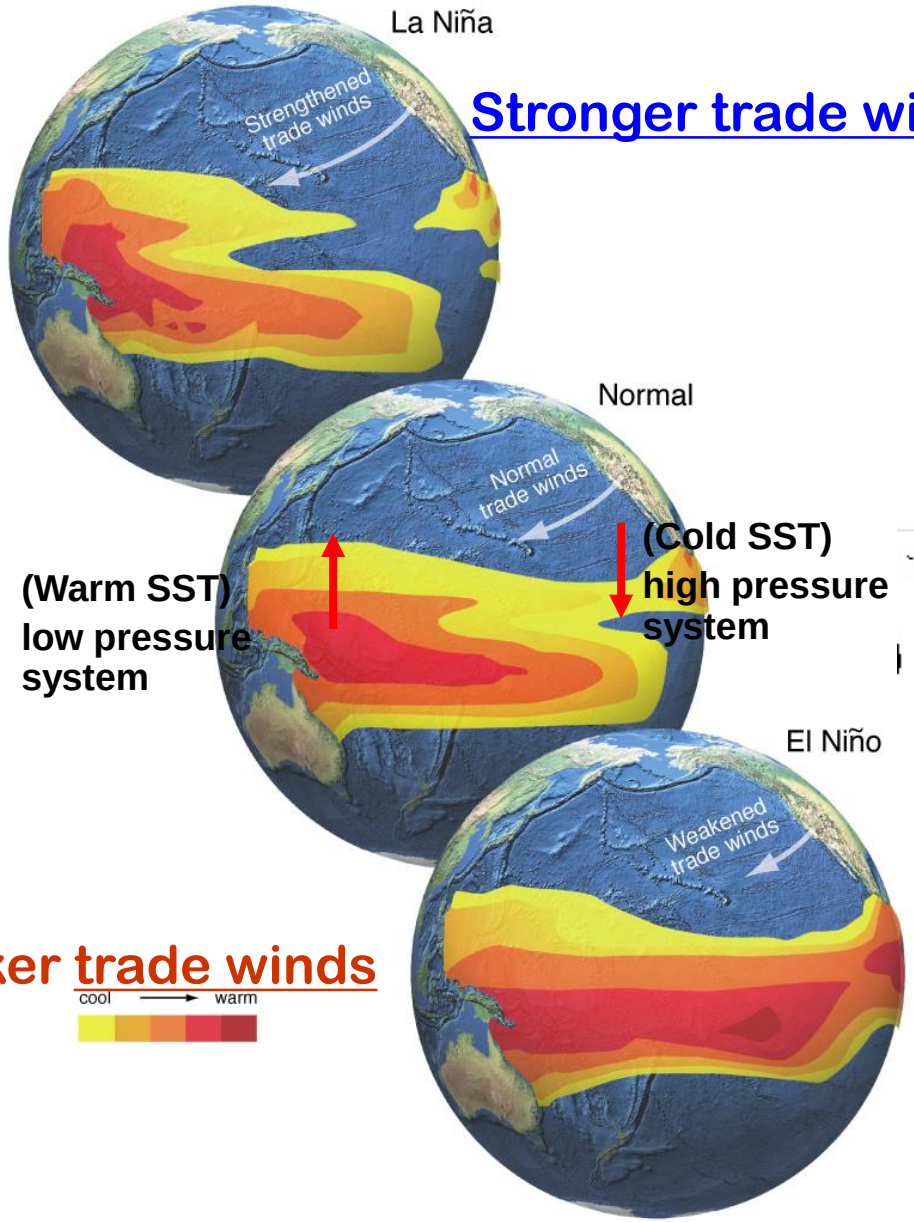




Dec 1988

- **El Nino—major warming of the equatorial waters in the Pacific Ocean**
  - **The anomaly of the SST in the tropical Pacific increases (+0.5 to +1.5 deg. C in NINO 3.4 area) from its long-term average;**
  - **A high pressure region is formed in the western Pacific and low-pressure region is formed in the eastern Pacific—this produces a negative ENSO index (SOI negative).**
- **La Nina—major cooling of the equatorial waters in the Pacific Ocean**
  - **The anomaly of the SST in the tropical Pacific decreases (-0.5 to -1.5 deg. C in NINO 3.4 area) from its long-term average;**
  - **A high pressure region is formed in the eastern Pacific and low-pressure region is formed in the western Pacific—this produces a positive ENSO index (SOI positive).**

El Niño and La Niña

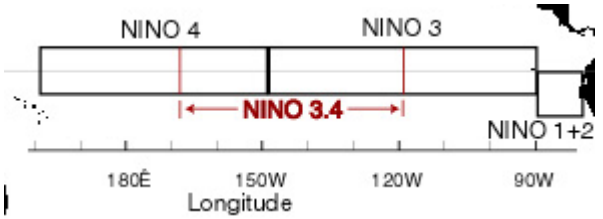


Stronger trade winds)

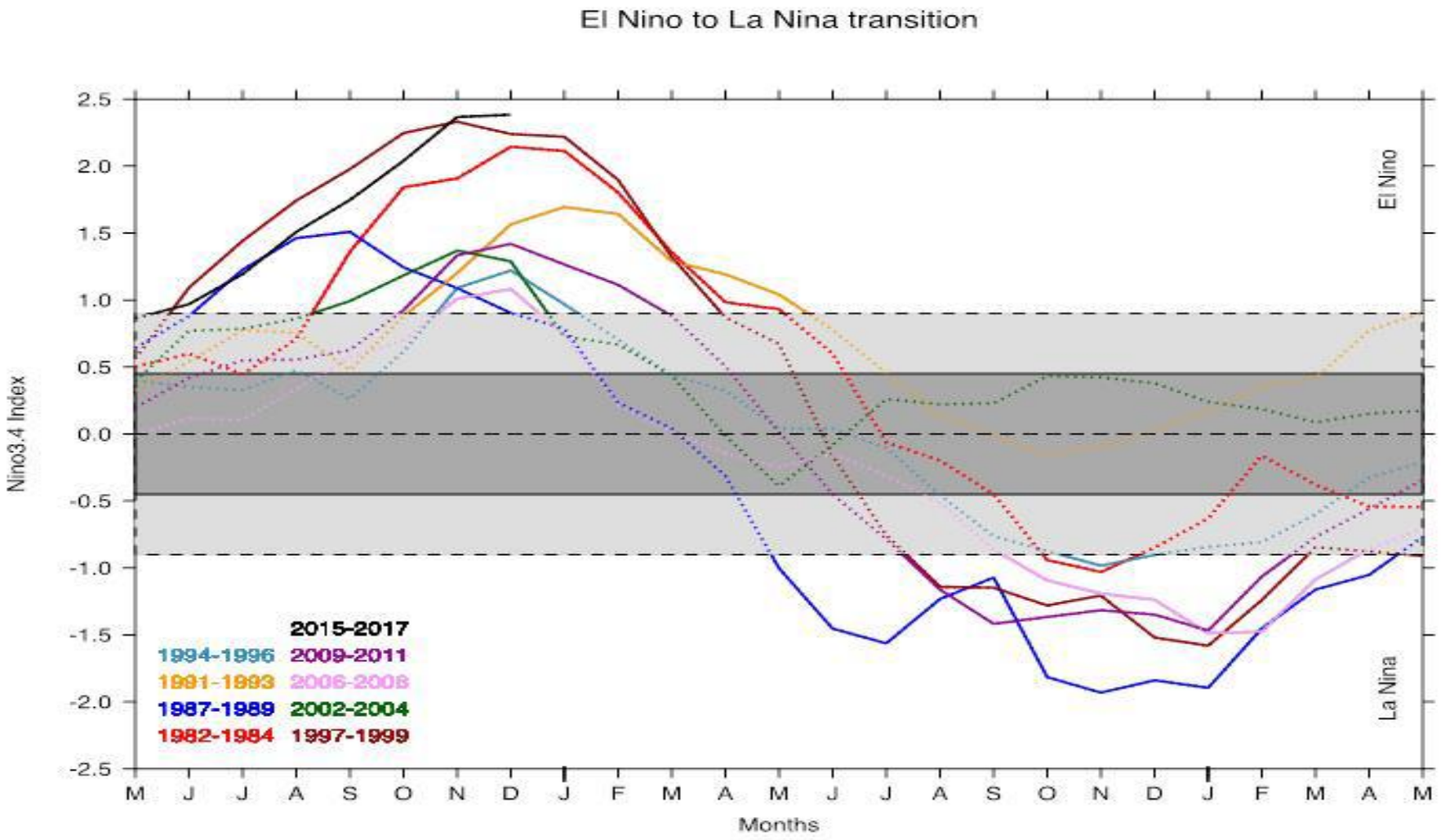
(Warm SST)
low pressure system

(Cold SST)
high pressure system

Weaker trade winds



6 out of the 8 El Niño events since 1979 have transitioned to La Niña conditions.



Summary of historical global impact of La Niña and El Niño

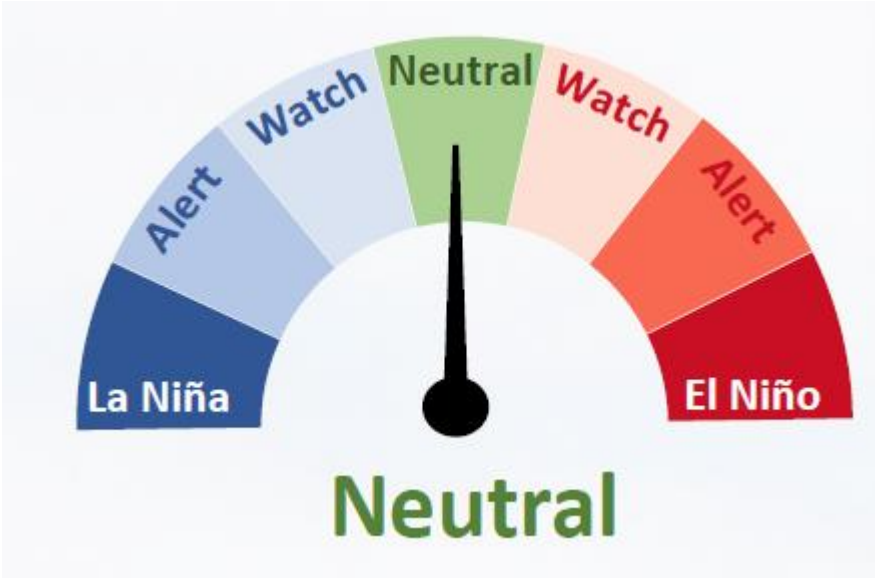
	Summary of Historical Impacts			
	La Niña		El Niño	
	Jun-Aug	Dec-Feb	Jun-Aug	Dec-Feb
Wetter	India, Malaysia, Indonesia, Central America, Sahel, southern Australia	Indonesia, Malaysia, Australia, northern South America, southern Africa	central Pacific, central Chile, western United States (US)	South America (Ecuador, northwestern Peru, southern Brazil, central Argentina, Uruguay), equatorial East Africa, northern Mexico/southern
Drier	central Pacific, Uruaguay, eastern Argentina, central Chile	central Pacific, Ecuador, East Africa, southern India	India, Indonesia, Malaysia, eastern Australia, Sahel, southern Africa, northern South America	Australia, Indonesia, the Philippines, northern South America, southern Africa
Warmer	Papua New Guinea, eastern Indonesia	southern US	west coast of South America, southern Brazil, Central America	South East Asia, southern Africa, Japan, southern Alaska and western/ central Canada, southeastern Brazil and southeastern Australia
Colder	West Africa, southeast Asia, western South America	West Africa, Japan, eastern Brazil, southern Alaska and western/ central Canada	southern Pacific, New Zealand	Gulf coast of US

ENSO Alert System: El Niño Watch

(II) Current Conditions

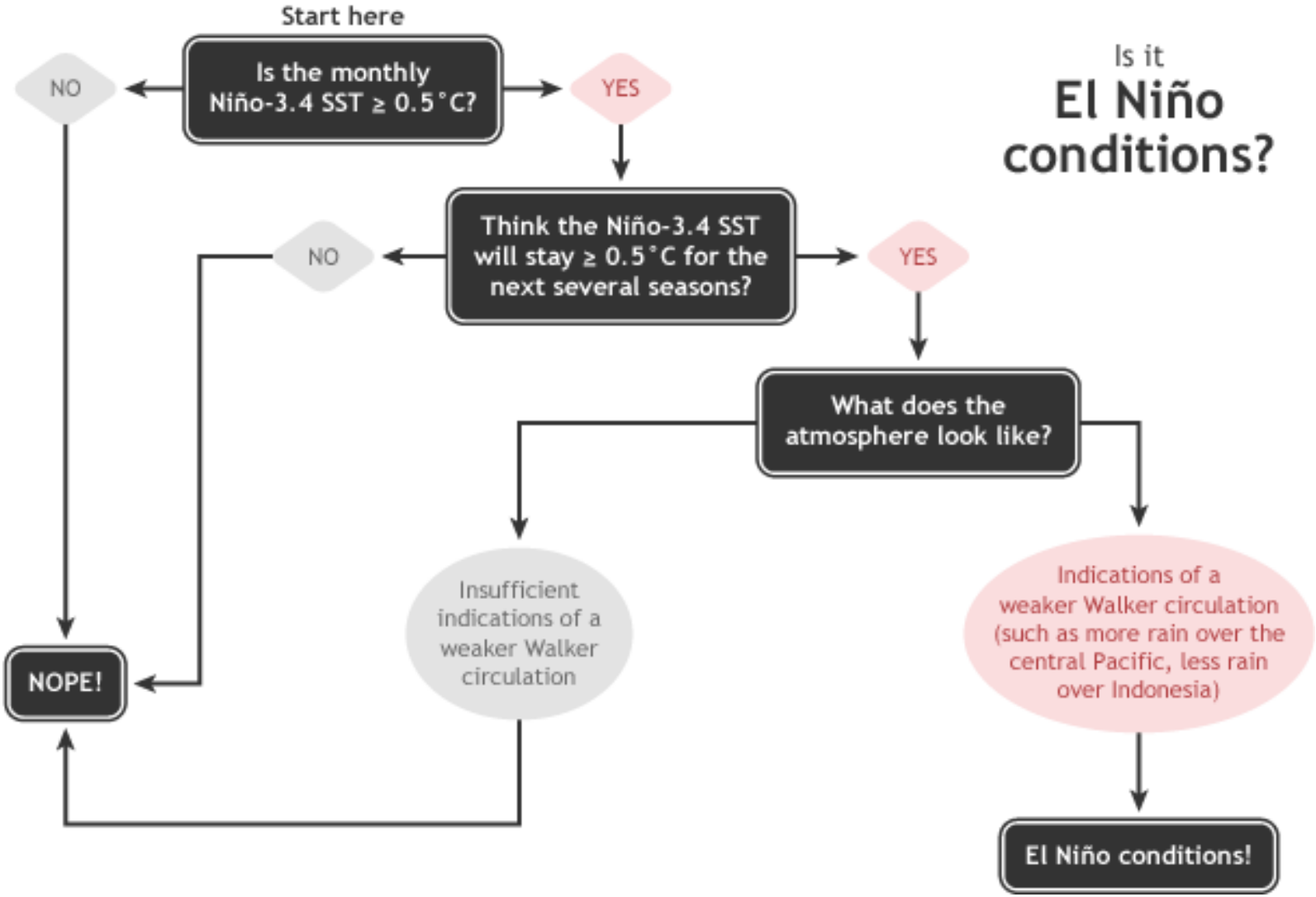
General State of the Ocean and Atmosphere

- ENSO neutral in May
- SOI is neutral (+0.3)



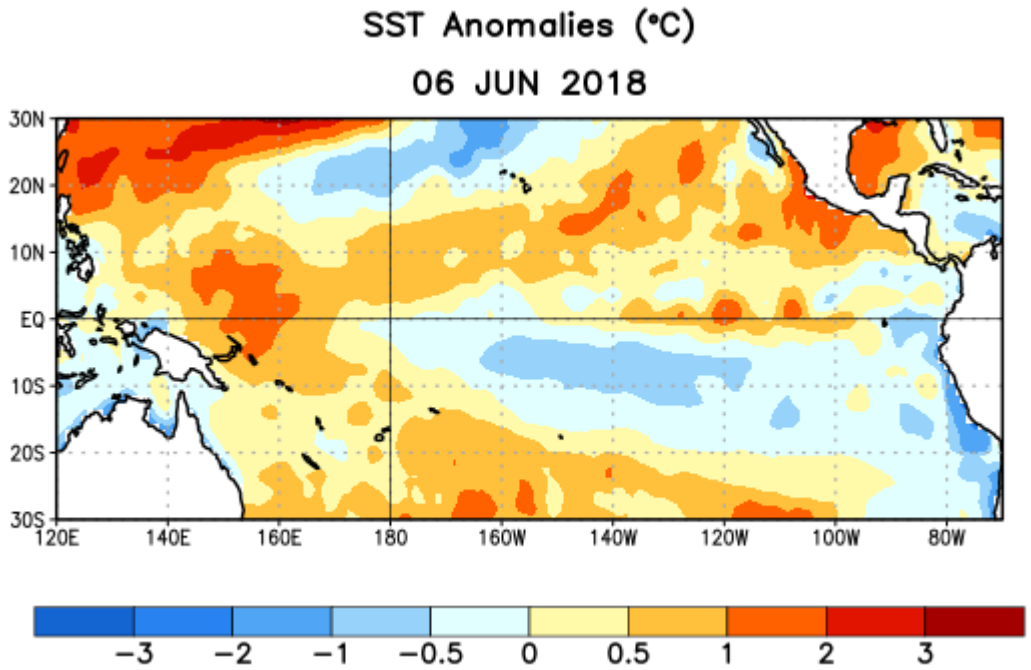
- SST in the central/ eastern Pacific are near average

NOAA's CPC has issued an El Nino Watch on 6/14, putting us all on notice that the climate pattern could take hold in the coming six months.



Current State of ENSO (SST)

ENSO Alert System Status: El Niño Watch



- **ENSO neutral along with its climate impacts around the world.** *SST at NINO3.4 region is +0.2°C*
- The chance for El Niño increasing to 50% during fall, and ~65% during winter) (45% by NIWA)

CPC/IRI ENSO Forecast

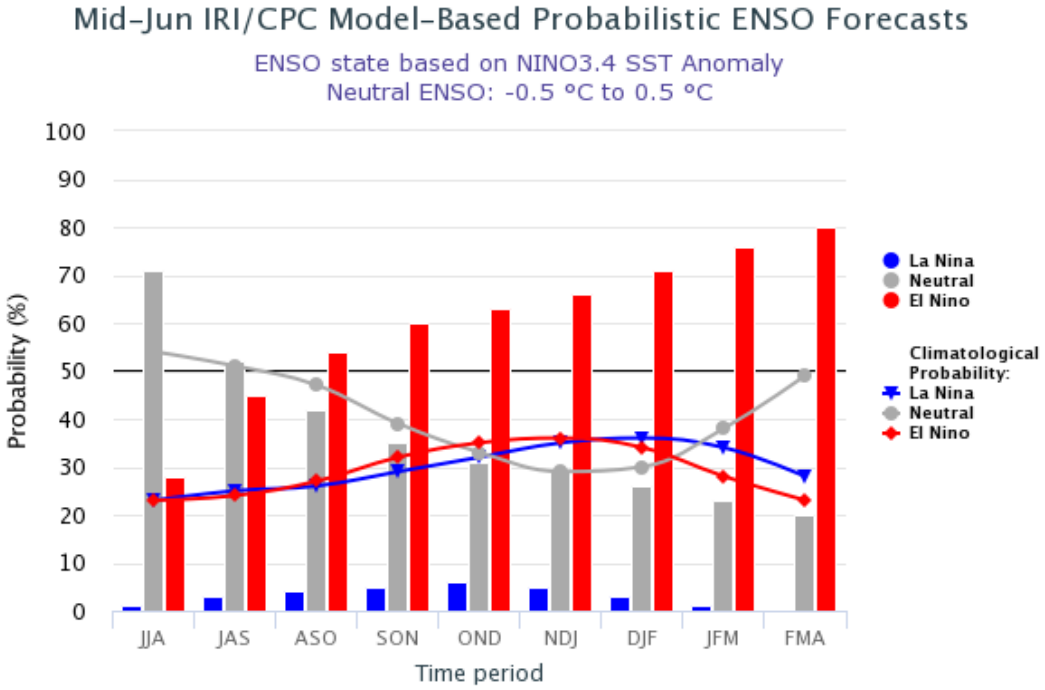
CPC/IRI EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

Expected Conditions

- The forecaster consensus favors ENSO neutral continuing through summer 2018

- Rapidly returning to weak El Niño

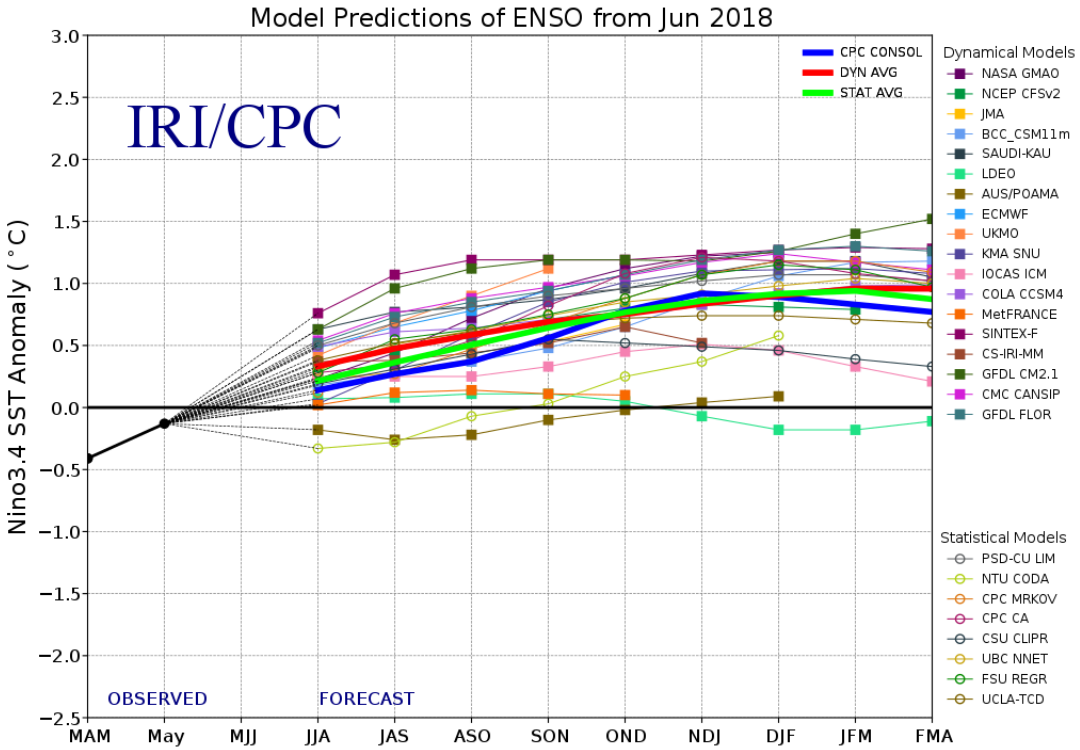
Climate Prediction Center
NOAA/National Weather Service
College Park, MD 20740



IRI/CPC Mid-Month Model-Based ENSO Forecast Probabilities

Season	La Niña	Neutral	El Niño
JJA 2018	1%	71%	28%
JAS 2018	3%	52%	45%
ASO 2018	4%	42%	54%
SON 2018	5%	35%	60%
OND 2018	6%	31%	63%
NDJ 2018	5%	29%	66%
DJF 2019	3%	26%	71%
JFM 2011	1%	23%	76%
FMA 2019	0%	20%	80%

CPC/IRI ENSO Forecast



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

Expected Conditions

- Models favor **neutral ENSO** condition through **summer of 2018**;
- Quickly shifting to **weak El Niño** from **August 2018;**
- Predictions are for a **weak-to-moderate event** throughout

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

Average Niño 3.4 SST Anomaly Forecast

	JJA	ASO	OND
Dynamical	0.3	0.6	0.8
Statistical	0.6	0.6	0.8
All Models	**0.3**	**0.6**	**0.8**

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/ourexpertise/climate/forecasts/enso/current/?enso_tab=enso-iri_update
http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-sst_table

IRI ENSO Briefing on May 28, 2018

https://iri.columbia.edu/news/may-climate-briefing-enso-neutral-but-other-climate-impacts-in-forecast/

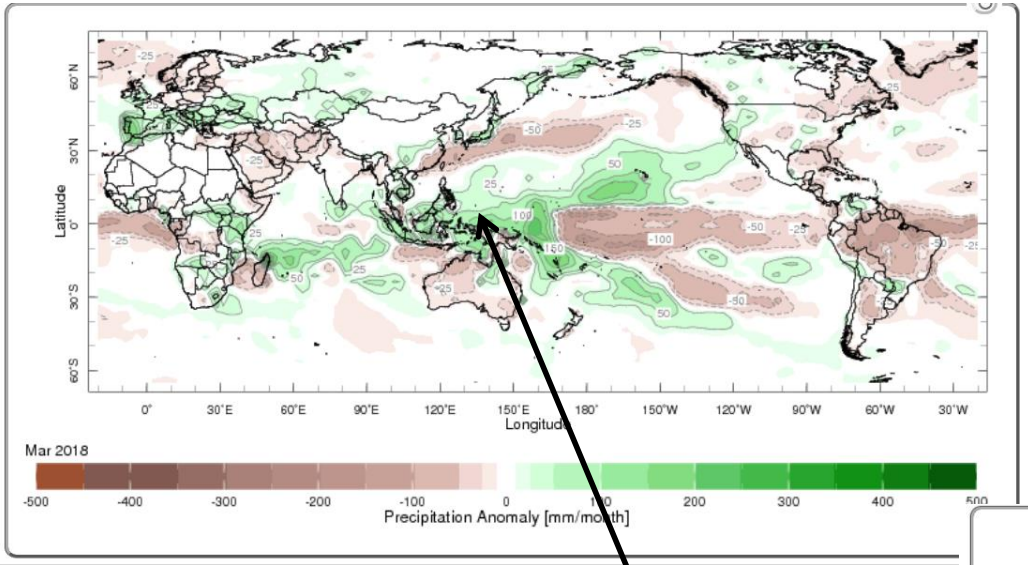
https://www.facebook.com/climatesociety/videos/1210653932403827/UzpfSTEwMDAwNDkzNzk3NTgzOTo5NzA3OTMxMjk3NjE5NDQ/

Climate models are predicting a greater likelihood for El Niño later this year. But! ENSO forecasts at this time of year are notoriously hard to get right.

(III) Impacts

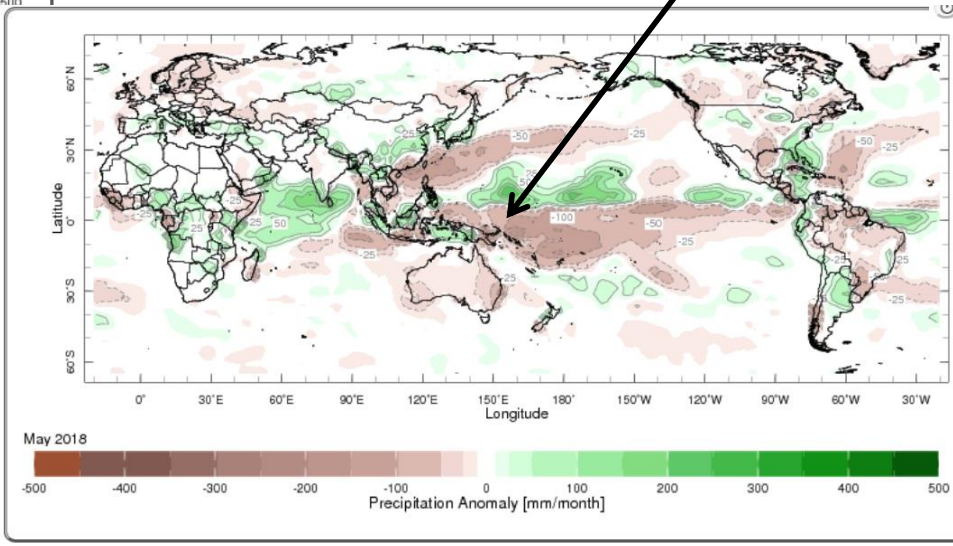
- Quick recap of the 2018-19 ENSO neutral and El Niño
- Current conditions for
  - Rainfall
  - Sea Level
  - Tropical Cyclones
  - Societal Impacts

Global Monthly Precipitation Anomaly



March 2018

May 2018



The satellite precipitation estimates are based on emitted longwave radiation observed by polar-orbiting satellite.

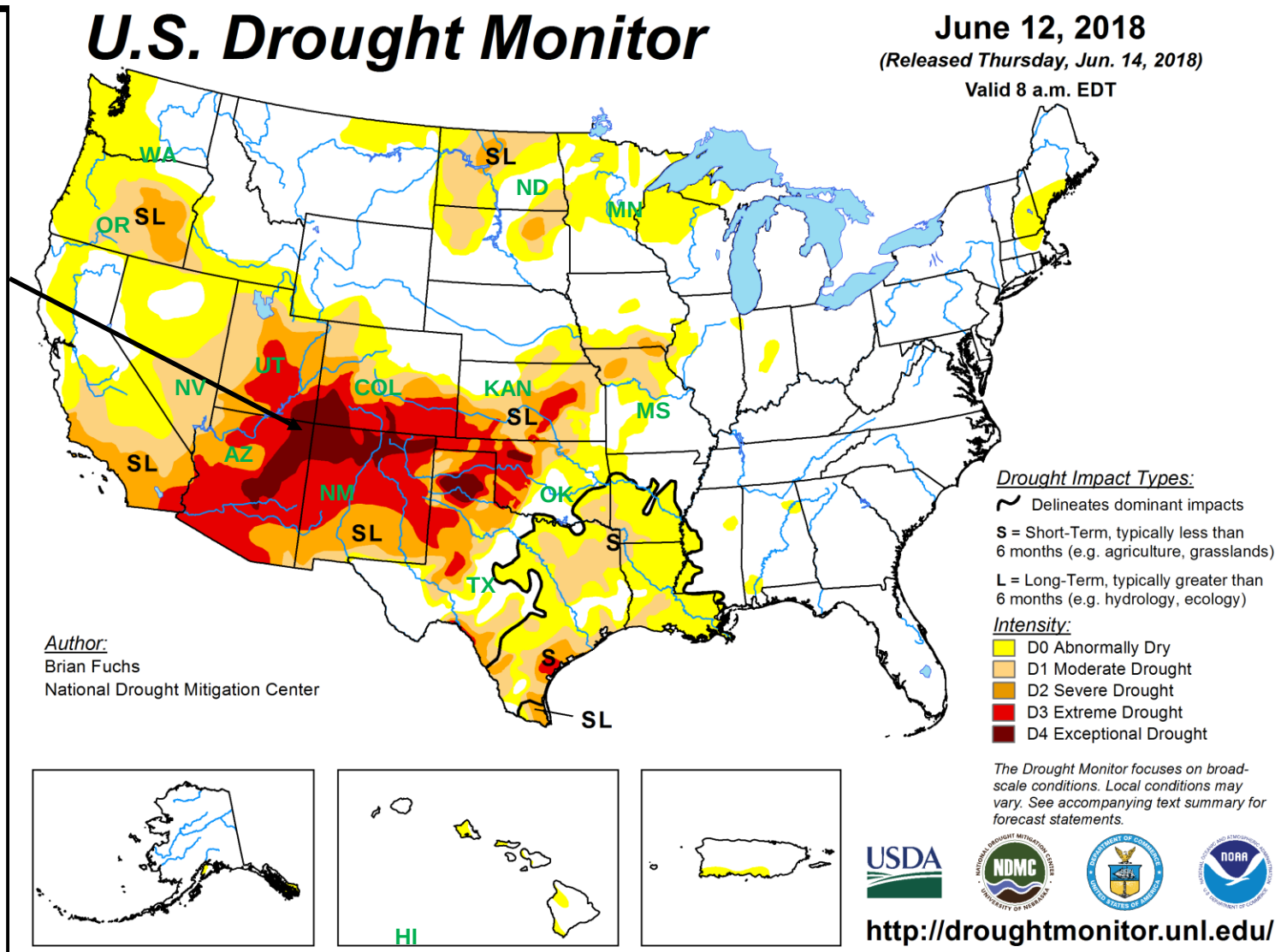
These data are from the NOAA Climate Prediction Center's CAMS_OPI data set. "OPI" stands for "*Outgoing longwave radiation Precipitation Index*"

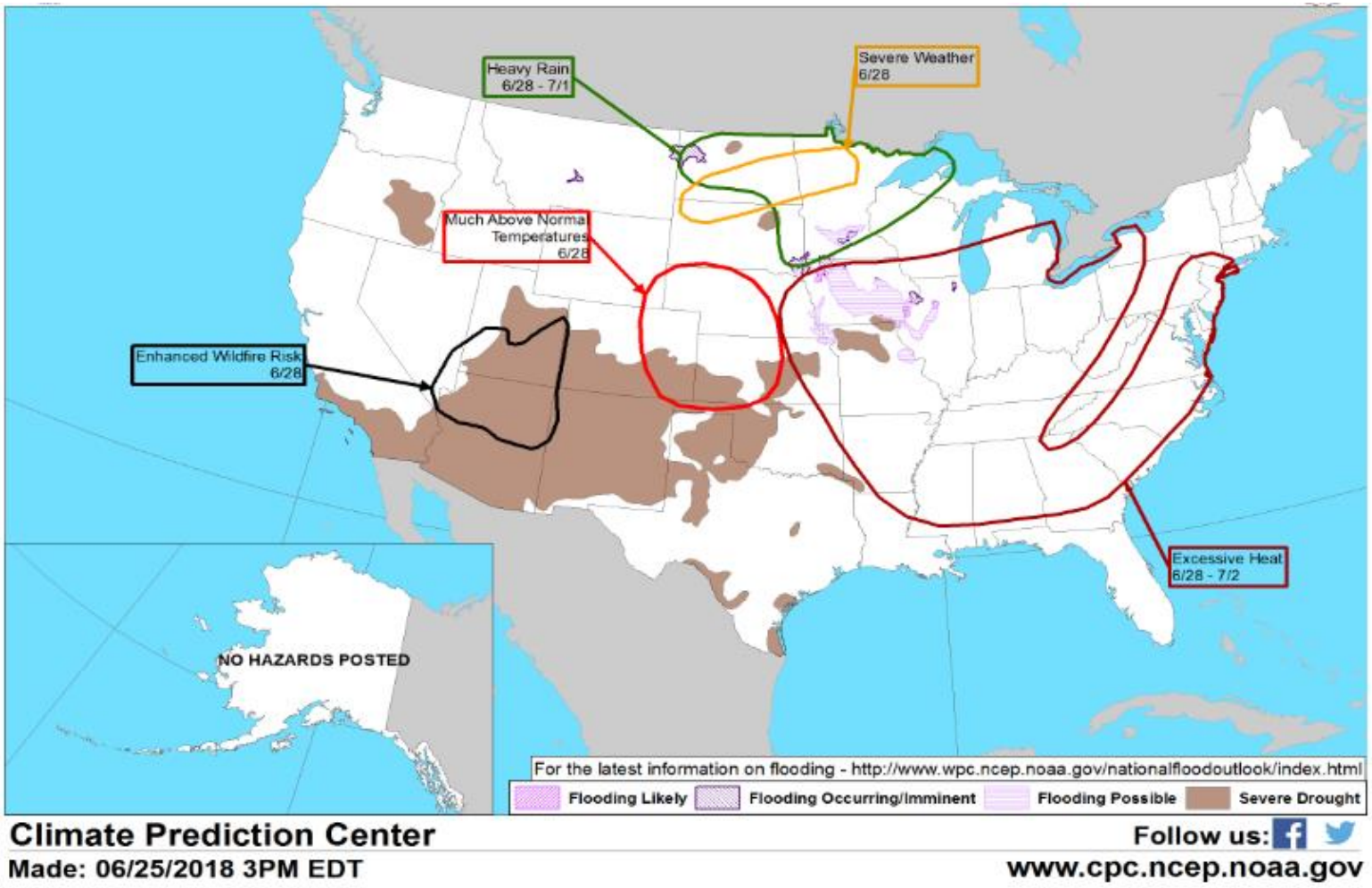
Drought Condition

South Western USA region continued to be dry over the last several months.

High Plains: Western Dakota is bit dry too.

Hawaii: PCP has been near normal

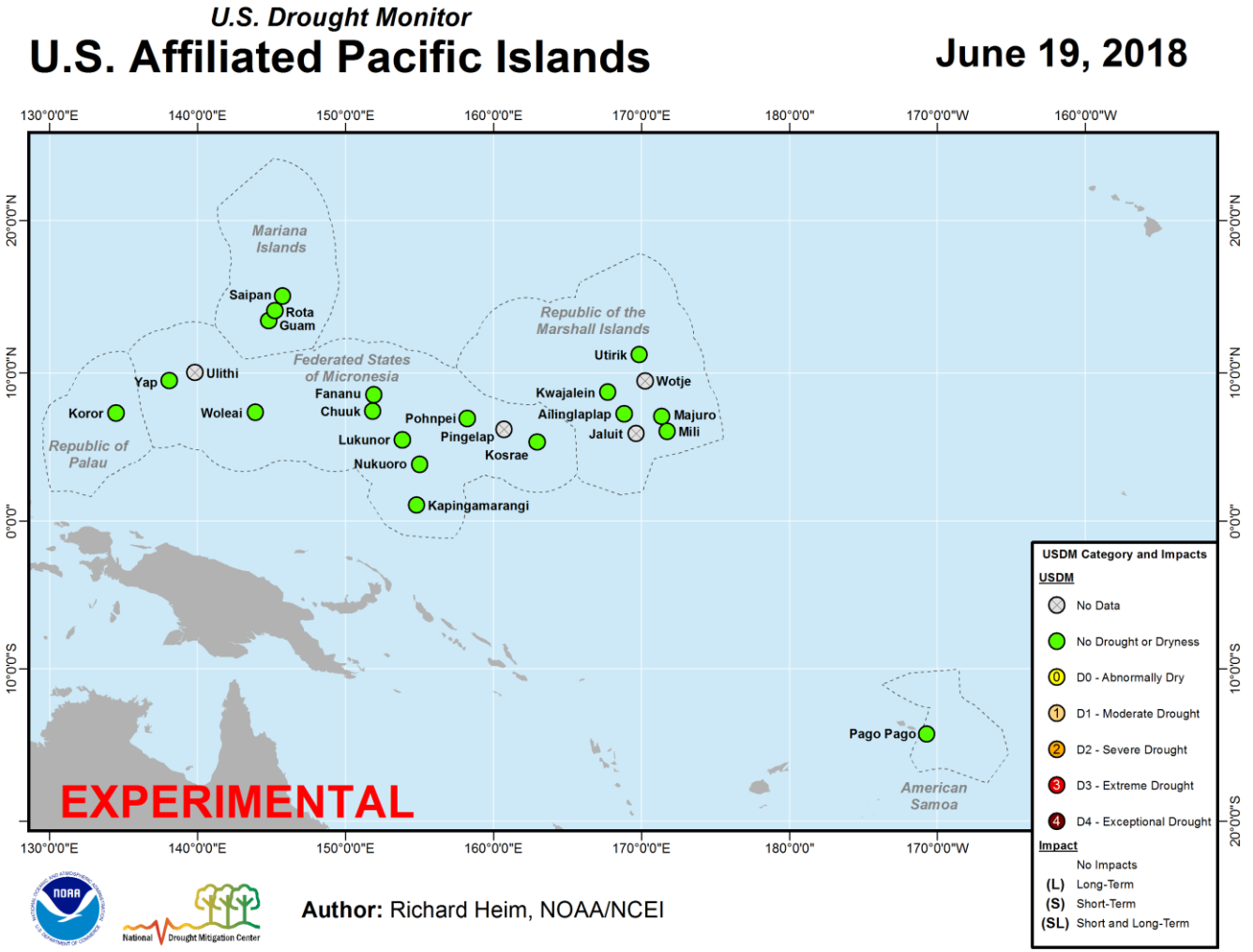




- **Mid to late this week, temperatures are going to heat up to excessive levels across much of the eastern third of the country, and much above normal for the portions of the Plains.**
- **A trough in the west will bring enhanced wildfire risk to the desert southwest.**

Drought impacts to the USAPIs

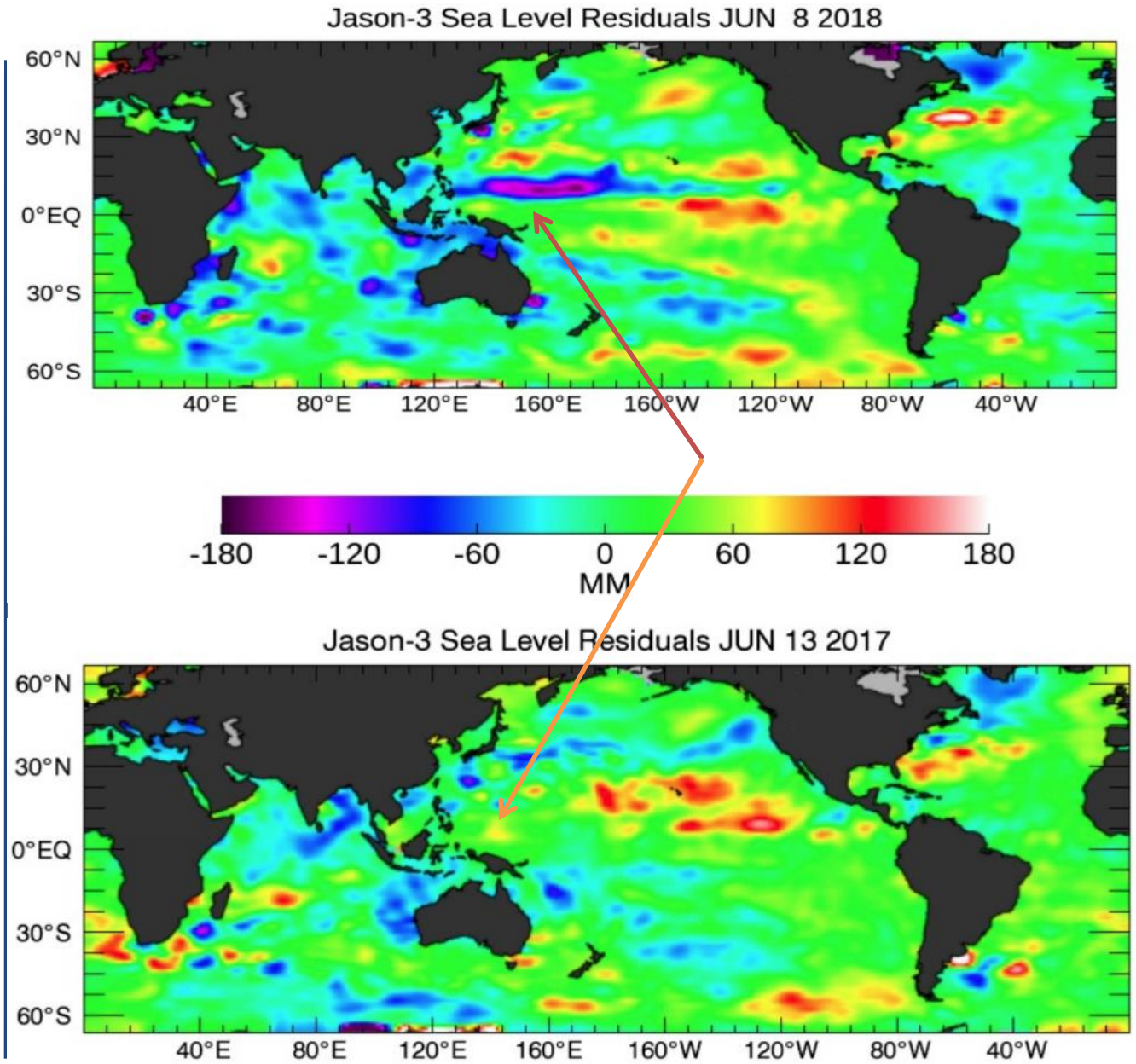
- **Hydrological drought conditions have ended**
- **Water supply no longer a concern**
  - **Food security will take more time to recuperate**



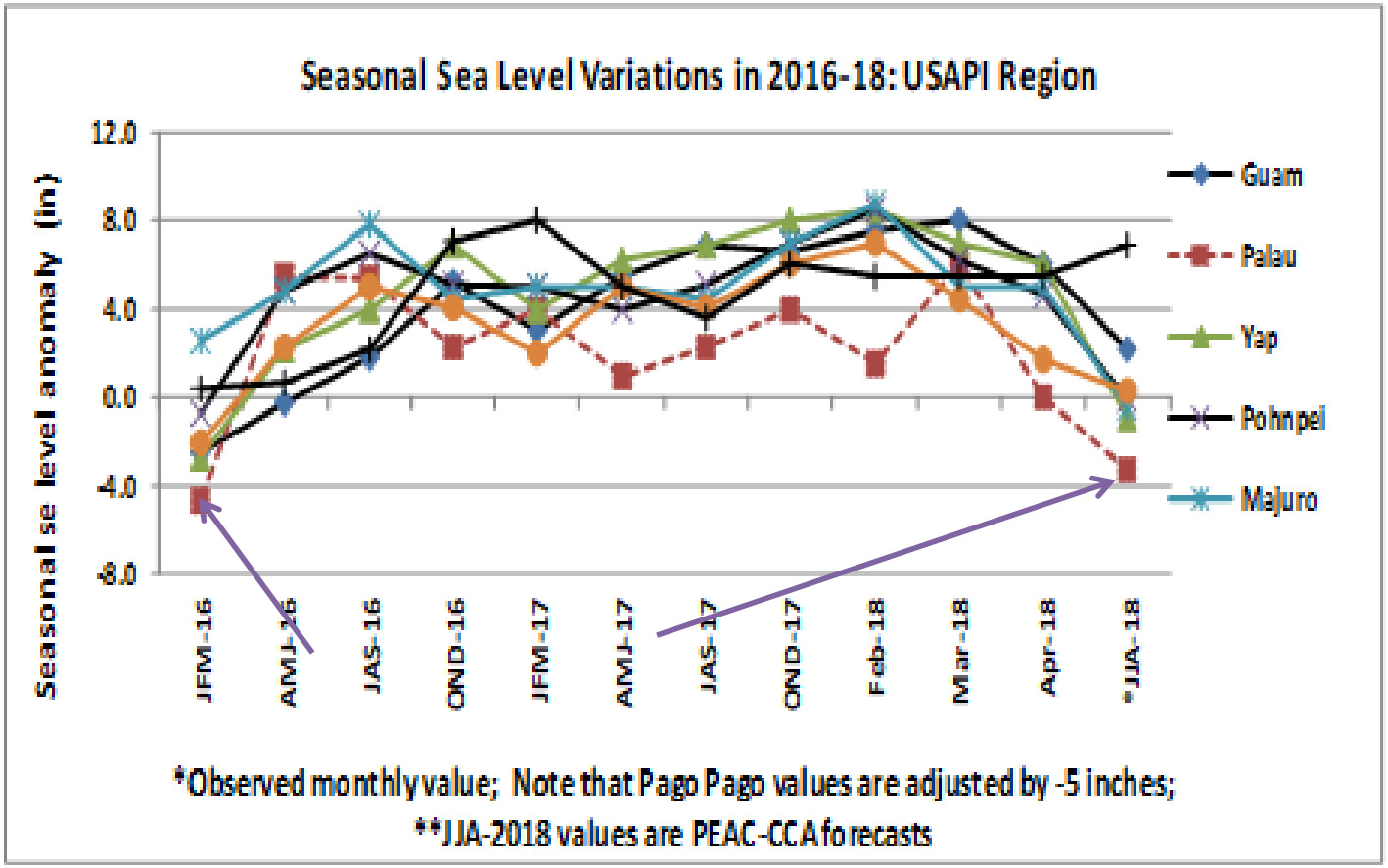
Sea Level Observation

Sea Levels have been

- **Average over Western Pacific Basin since June 2018**



Synopsis of 2-years of SLV and Forecasts



- **RISE from JFM of 2016 and stayed elevated until February 2018;**
- **Started to FALL from March 2018;**
- **The current forecasts JJA-JAS-ASO also signals a significant fall.**

La Niña Impacts (Jan-April 2018) in FSM

a) Wave-driven flooding in Majuro (3-4 Feb 2018)

PC. C Guard, Guam

b) Rain/Inundation (17-Mar 2018) in Pohnpei

PC. Wallace and Wilfred, WSO, Pohnpei

c) Land/Mudslides 17-18 Mar, 2018

d) Damaged road, Madolenihmw

2017 Atlantic hurricane season

(Preliminary damage is over $369.86 billion)

- The 2017 Atlantic hurricane season was a hyperactive, deadly, and extremely destructive season, featuring 16/17 named storms, ranking alongside 1936 as the fifth-most active season since records began in 1851.
-
- The season also featured both the highest total accumulated cyclone energy (ACE) and the highest number of major hurricanes since 2005 with major hurricanes — Harvey, Irma, and Maria.

Why was so Intense?

- **ENSO neutral—improving Atlantic Hurricane prospects**
- **Tropical Atlantic was exhibiting high "thermal potential"—meaning water can rapidly evaporate to atmosphere**
- **SST was warmer than *average***

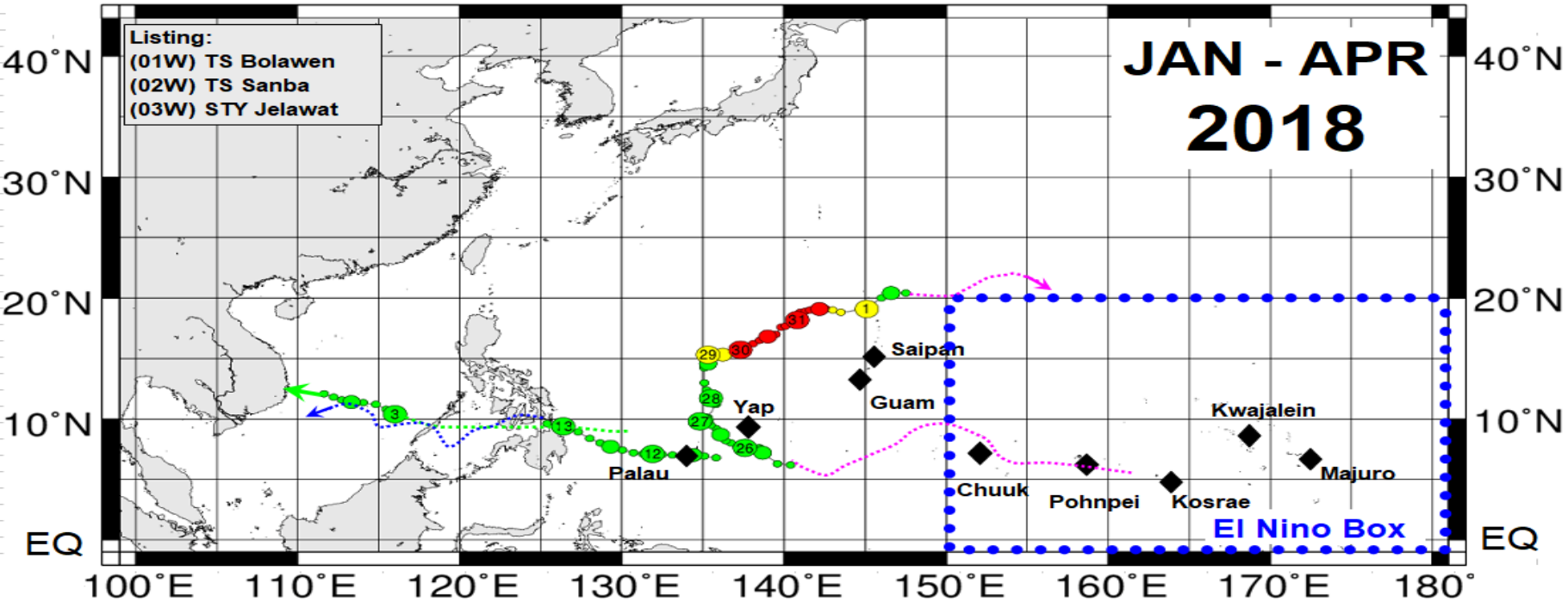
2018 Northern Hemisphere Tropical Cyclone Activity (through May 15), by basin and with hemisphere totals

Basin	Named Storms	Days	Hurri/ Typh	Days	Major Hurri	Days	ACE**
Natl	**0 (0.1)**	**0 (0.4)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0)**	**0 (0.4)**
ENP	0 (0.2)	0 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0.5)
WNP	**3 (2.1)**	**7.5 (9.4)**	**1 (1.1)**	**2 (3.6)**	**1(0.6)**	**1 (1.6)**	**12(18.2)**
NIO	**0 (0.7)**	**0 (2.2)**	**0 (0.2)**	**0 (0.6)**	**0 (0.2)**	**0 (0.3)**	**0 (3.4)**
NHem	**8 (10)**	**37.7 (42)**	**4 (5.1)**	**13.2(15)**	**1 (2.5)**	**4 (4.4)**	**63.5 (72)**

****ACE is proportional to the square of the wind speed**. (): Long-term avg

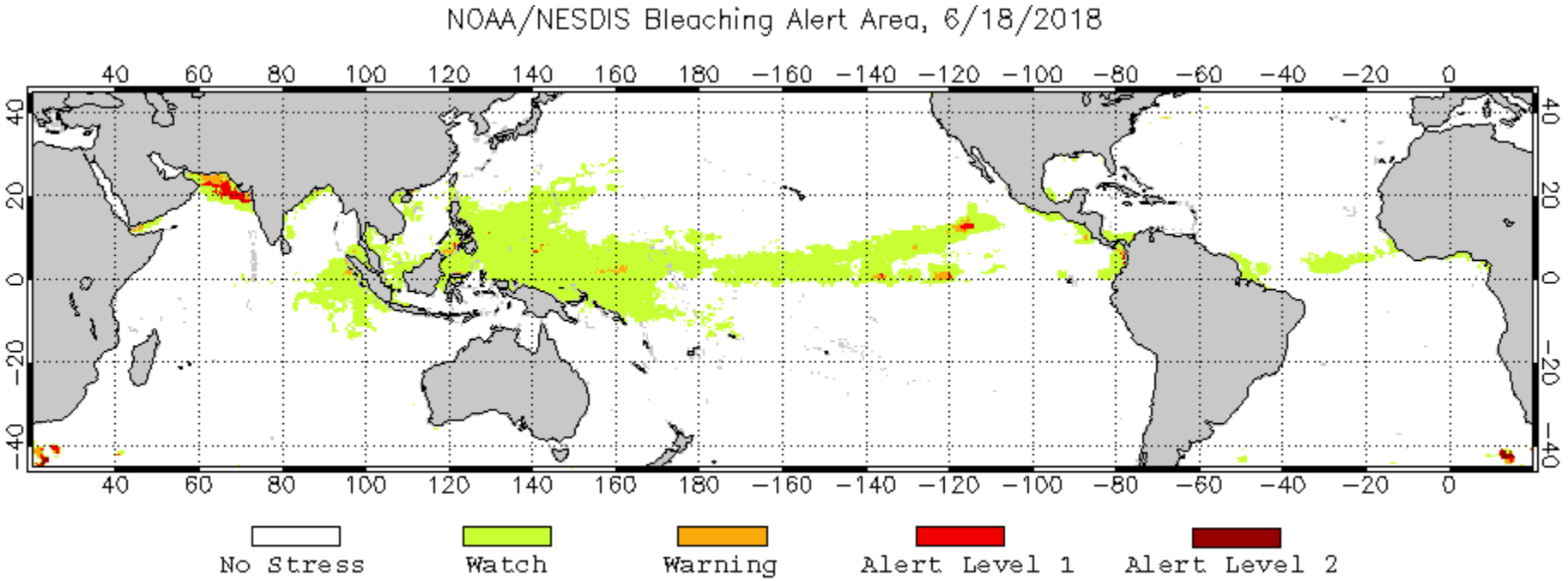
- **During the 1st Q of 2018, the TC activity in WNP was inactive or near average.**
- ***Super Typhoon (Cat 4) Jelawat (NW of Guam/ N of Yap) suddenly lost strength and drifted slowly to NE CNMI)***

TC tracks during JFMA 2018: Inactive



- **Three systems were numbered by the JTWC;**
- **Dotted lines show disturbance stages tracked by the JTWC in the pre- and post-storm stages;**
- **Dotted-line box encloses the region where TCs occur almost exclusively during El Niño.**

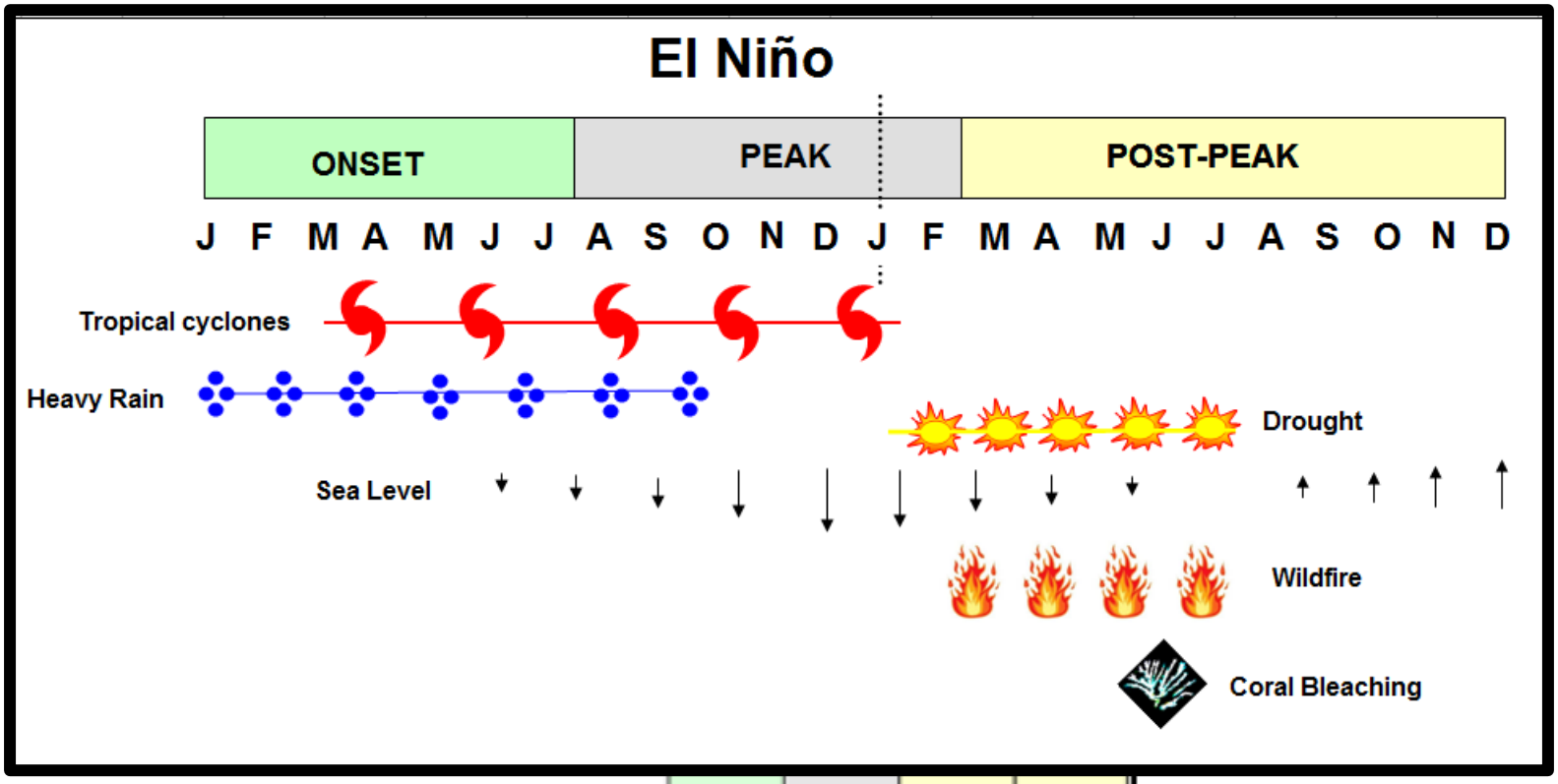
Coral Reef Watch
(50-km Satellite Monitoring)



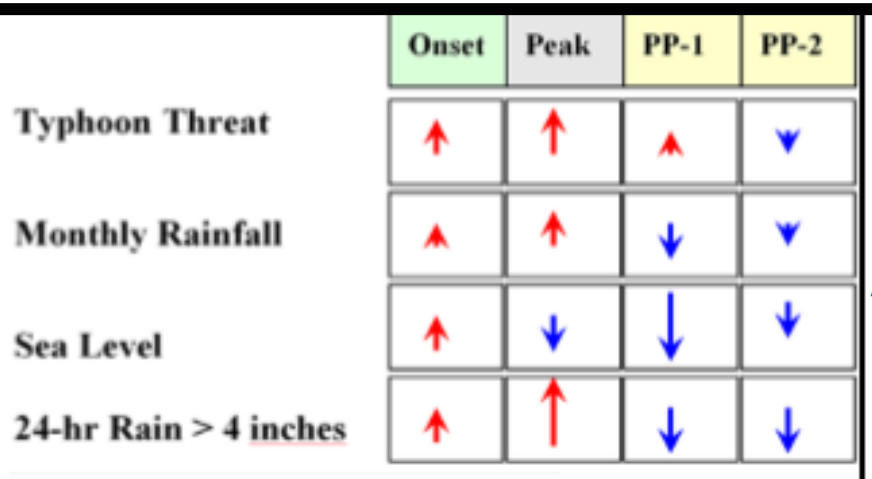
- Coral Bleaching across the Pacific Islands is under watch
- Indonesia/Islands of Sumatra are at watch for bleaching event

Timing of climatic hazards associated with El Niño.

FSM



Onset = Jan – Jun;
Peak = Jul- – Feb;
PP 1 = Mar – Jun 2016;
PP2 = Jul – Dec 2016.



American Samoa

Global impacts of El Niño/La Niña

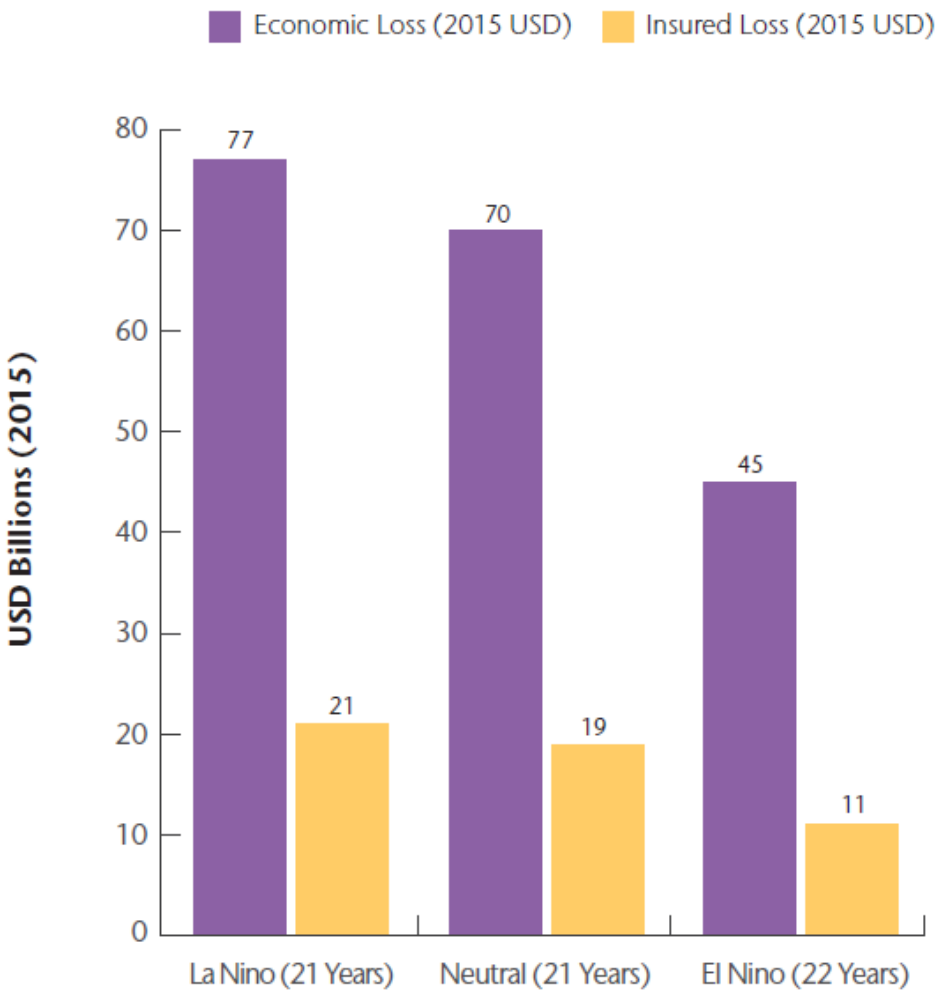
La Niña years have clearly shown greater average annual losses in comparison to El Niño and Neutral phases.

- **La Niña USD77 billion**
- **El Niño USD45 billion**

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

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

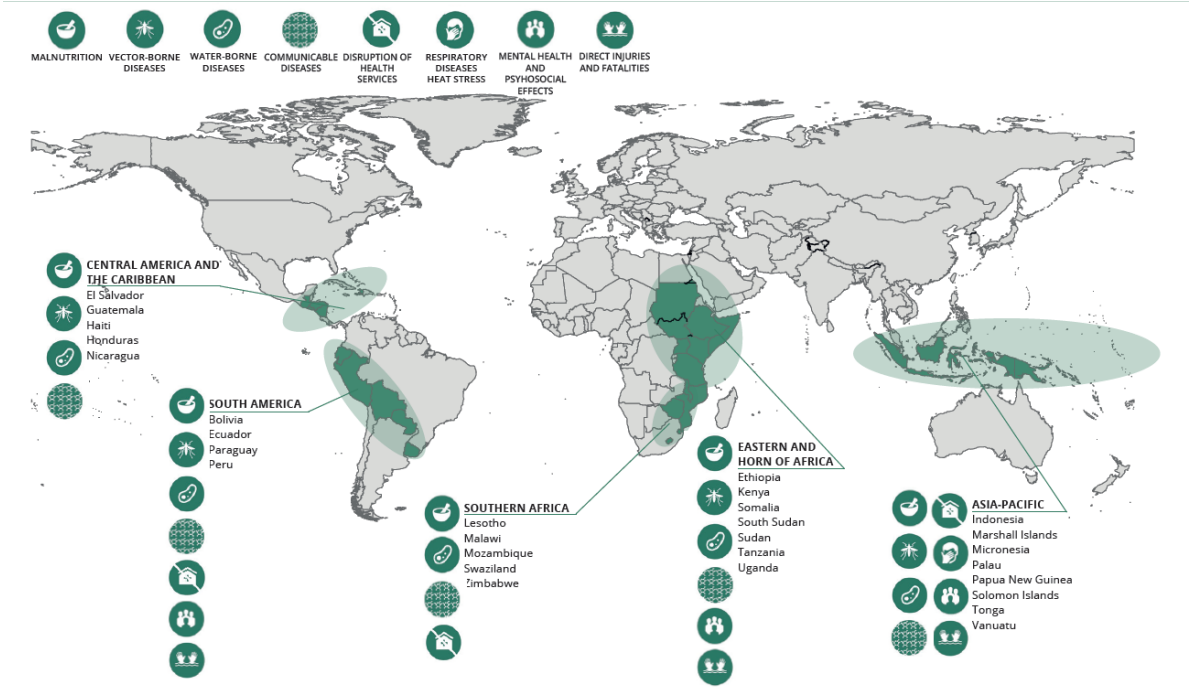
Exhibit 13: Global Weather Catastrophe Losses (Annual Average)



Source: Aon Benfield 2015 Annual Climate and Catastrophe report.

Health impacts during 2015-16 El Niño

- **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**
  - **Acute malnutrition**



http://www.who.int/hac/crises/el-nino/who_el_nino_and_health_global_report_21jan2016.pdf

- **Papua New Guinea**
  - **Drought**
  - **Immediate public health threats, interruption of infrastructures**
- **Vanuatu, Fiji, Solomon Islands**
  - **Water shortages**
  - **Increased incidence of diarrheal diseases**
- **Indonesia**
  - **Fires**
  - **Likely cause respiratory disease, food insecurity**

(IV) Forecast

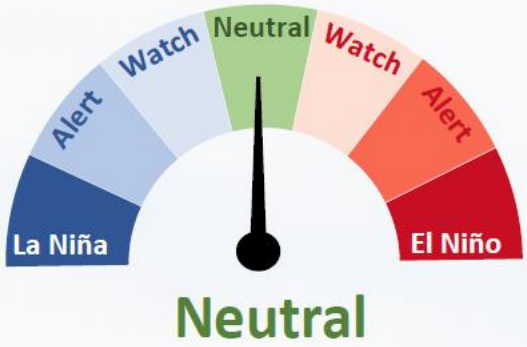
ENSO forecasts

Rainfall, Sea level, Tropical Cyclones and Coral Bleaching

ENSO Situation Summary

67% chance for **ENSO-neutral** conditions to continue during **June – August 2018.**

Chance for **El Niño** conditions to emerge during **August – October 2018** **45%**

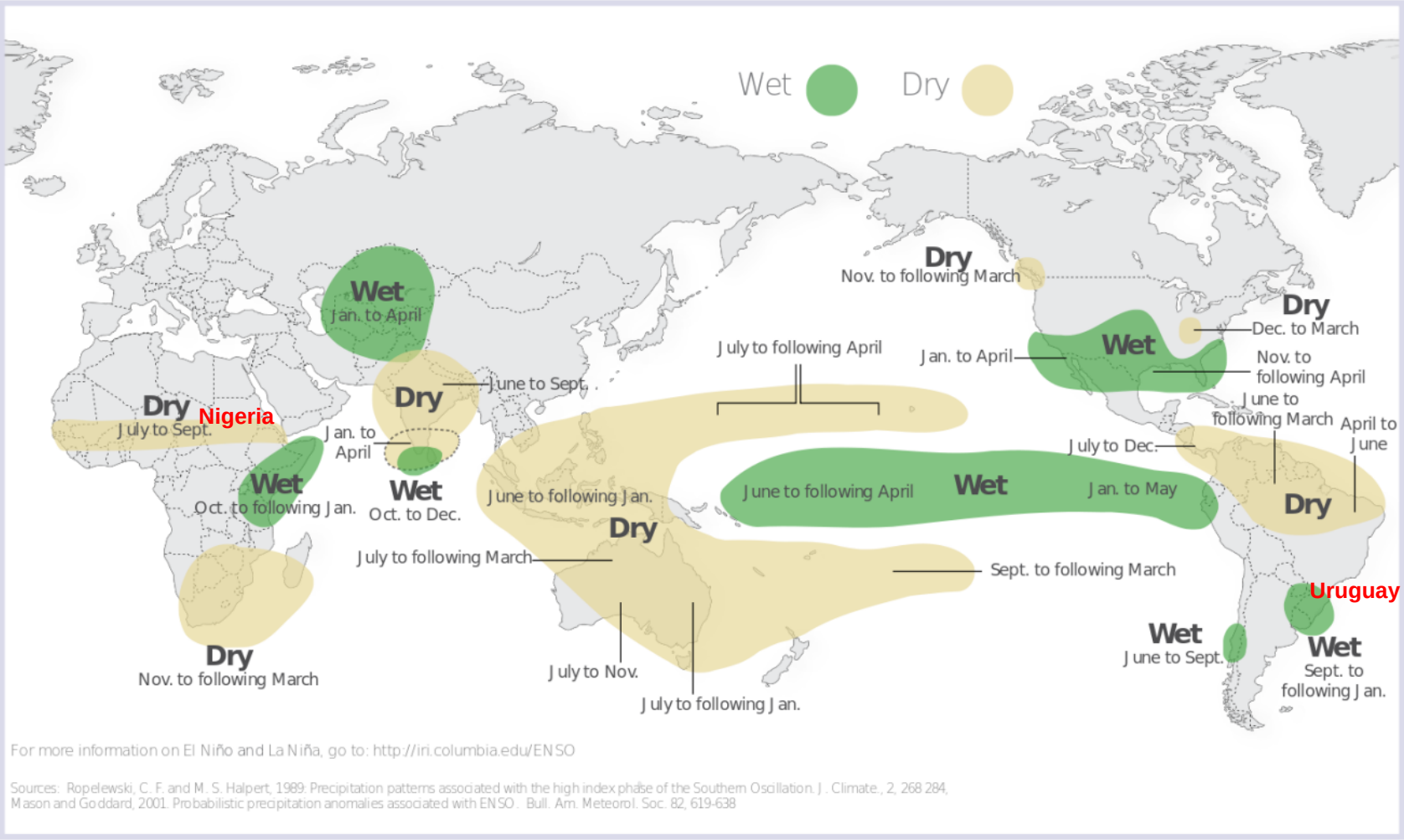


Forecast

- **CPC: EL Niño conditions are likely (50% during fall), and 65% during winter of 2018-19;**

El Niño and Rainfall

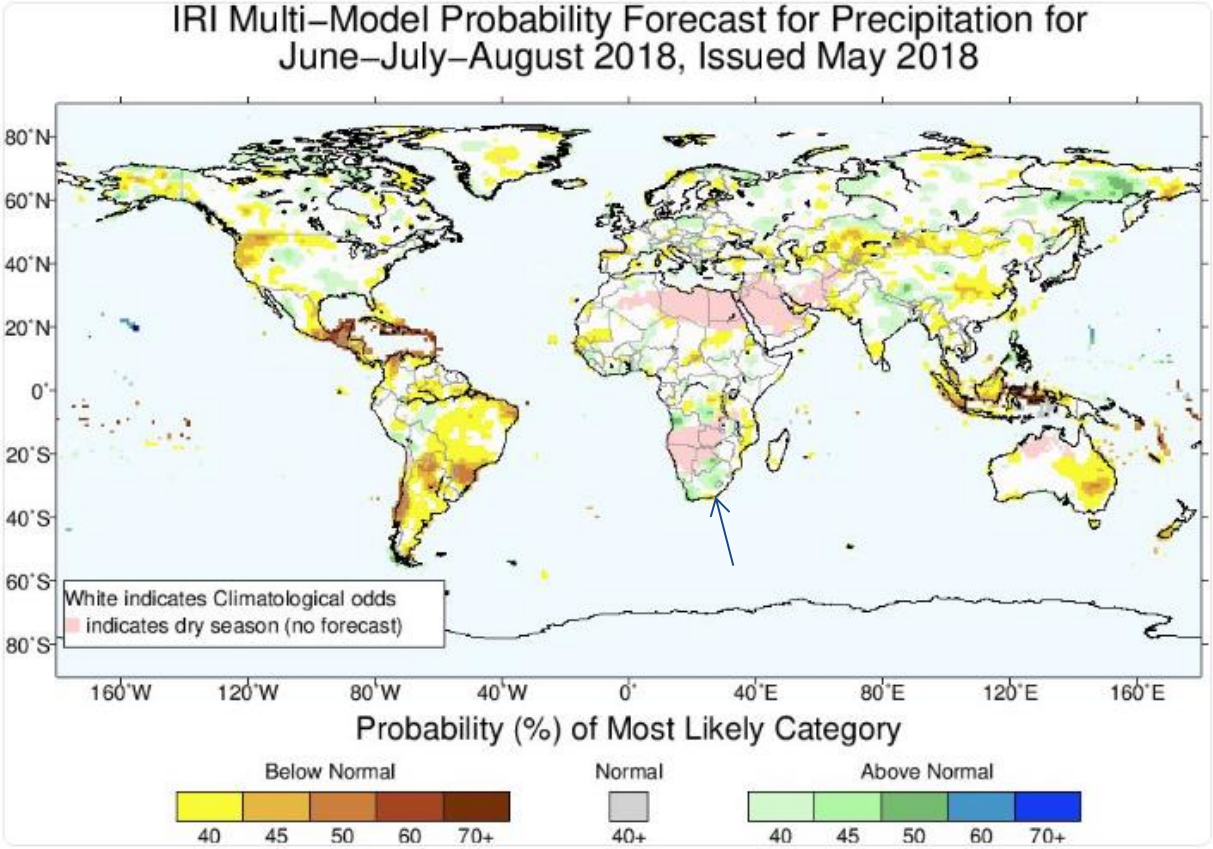
El Niño conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one El Niño to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on the map below.



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

precipitation in the upcoming months.

Some strong sea surface temperature anomalies NOT related to ENSO are influencing this forecast, says IRI's Tony Barnston.



1:48 PM - 18 May 2018

Favor of below-normal rainfall across Indonesia, Central Asia, eastern Australia, the northwestern U.S., Central America, the Caribbean and portions of South America.

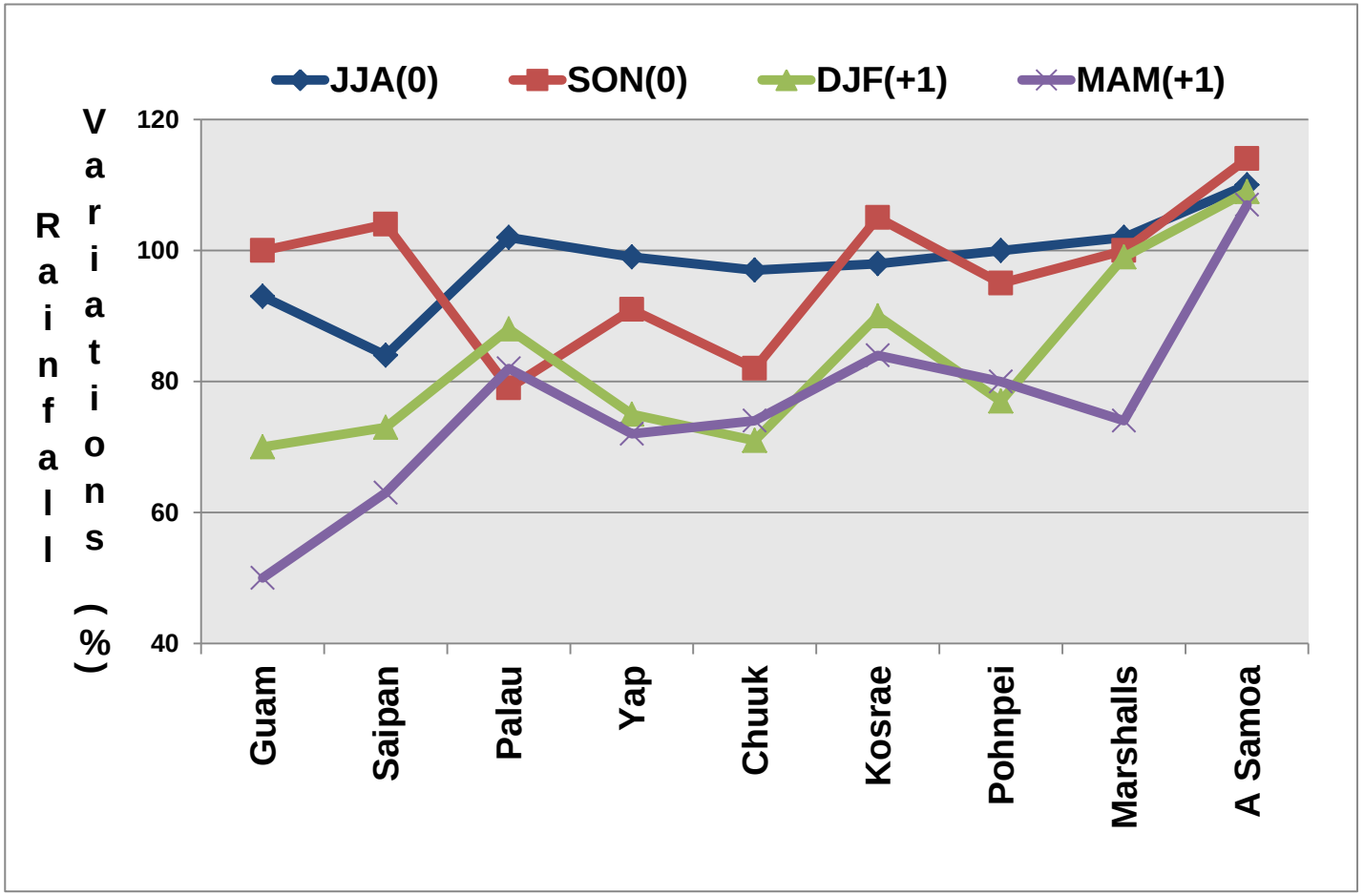
Favor above normal rainfall in southern Africa, eastern Russia, eastern India and the Himalayas.

U.S. State, Territories, and Affiliated Countries - Rainfall Forecast - JJA 2018

Location	UKMO	ECMWF	CA	NASA	NCEP	IRI	APCC	PEAC CCA	Outlook	Final
Palau										
Koror 7° 22' N, 134° 32' E	Avg.	Avg-above	Avg.	Avg-below	Avg-above	Clim.	Avg.	Avg-below	Avg-above	**30:35:35**
FSM										
Yap 9° 29' N, 138° 05' E	Avg.	Avg.	Avg-above	**Below**	Avg-above	**Above**	Avg.	Avg-above	Avg-above	**30:35:35**
Chuuk 7° 28'N, 151° 51'E	Avg-above	**Above**	Avg-above	**Below**	Avg.	Clim.	Avg.	Avg-above	Avg-above	**30:35:35**
Pohnpei 6° 59'N, 158° 12'E	**Above**	**Above**	Avg-above	Avg.	Avg-above	**Below**	Avg.	Avg-above	Avg-above	**30:35:35**
Kosrae 5° 21'N, 162° 57'E	**Above**	Avg.	Avg.	Avg-above	Avg-above	Clim.	Avg.	Avg-below	Avg.	**25:40:35**
RMI										
Kwajalein 8° 43'N, 167° 44'E	**Above**	**Above**	Avg-above	Avg.	Avg.	**Above**	**Above**	Avg.	**Above**	**25:30:45**
Majuro 7° 04' N, 171° 17'E	**Above**	**Above**	Avg.	Avg-above	Avg.	**Above**	**Above**	Avg.	**Above**	**25:35:40**
Guam and CNMI										
Guam 13° 29'N, 144° 48' E	Avg.	Avg-above	**Above**	Avg.	Avg.	**Above**	Avg.	Avg-above	Avg-above	**30:35:35**
Saipan 15° 06'N, 145° 48' E	**Above**	**Above**	**Above**	Avg.	Avg.	**Above**	Avg.	Avg-above	Avg-above	**30:35:35**
American Samoa										
Pago Pago 14° 20'S, 170° 43'W	Avg.	Avg.	Avg-below	Avg.	Avg-below	**Above**	**Below**	Avg-above	Avg.	**25:40:35**
State of Hawaii										
19.7° - 21.0' N, 155.0° - 159.5' W										
Lihue	**Above**	**Above**	Avg-above	Avg.	**Above**	**Above**	**Above**	**Above**	**Above**	**25:30:45**
Honolulu	**Above**	**Above**	Avg-above	Avg.	**Above**	**Above**	**Above**	**Above**	**Above**	**25:30:45**
Kahului	**Above**	**Above**	**Above**	Avg.	**Above**	**Above**	**Above**	**Above**	**Above**	**20:30:50**
Hilo	**Above**	**Above**	**Above**	Avg.	**Above**	**Above**	**Above**	**Above**	**Above**	**20:30:50**

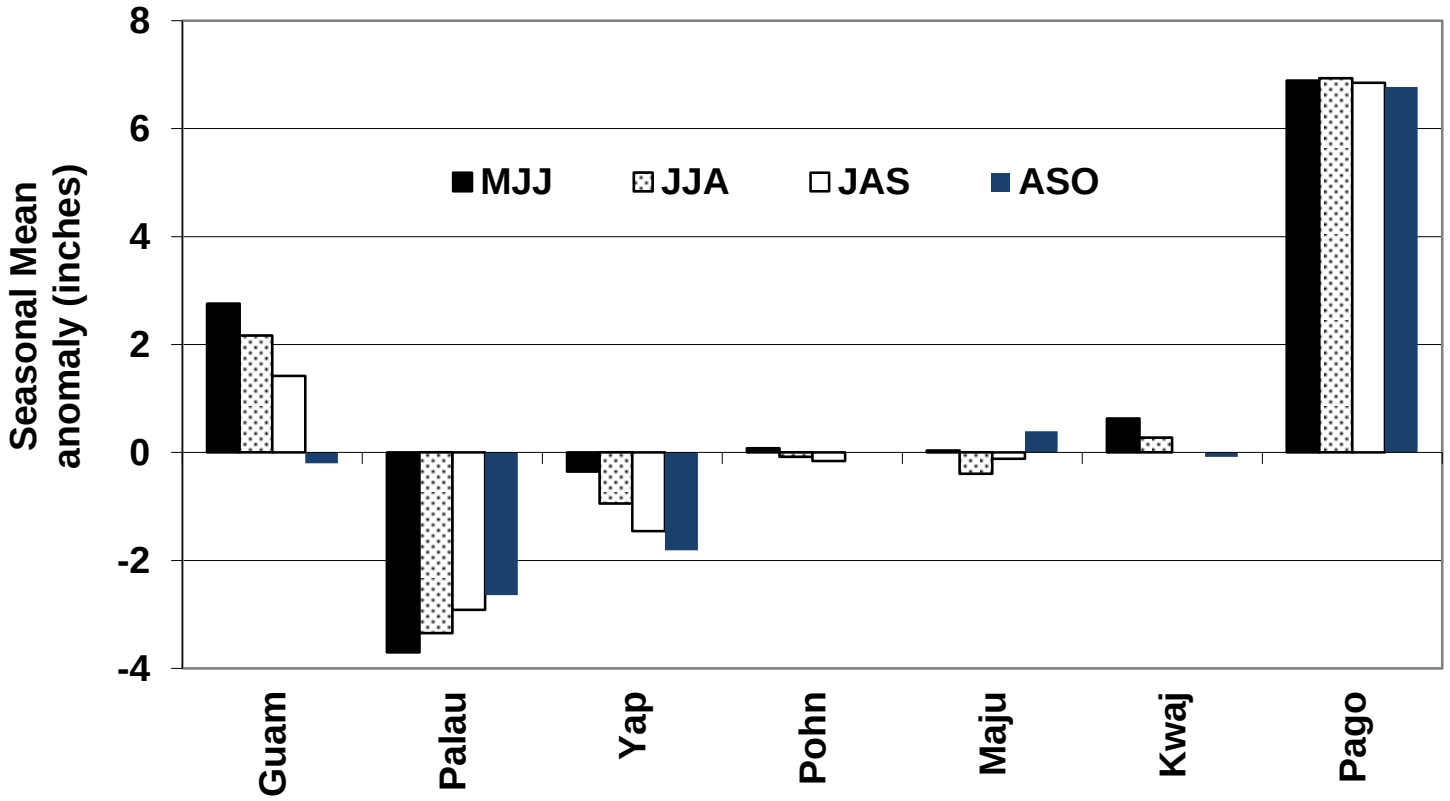
Clim. indicates equal chances of below normal rainfall-average rainfall-and above average rainfall.

EL Niño Impacts on Rainfall: USAPI Region



El Niño (0): the year of onset of El Niño. El Niño (+1): the following year of El Niño;

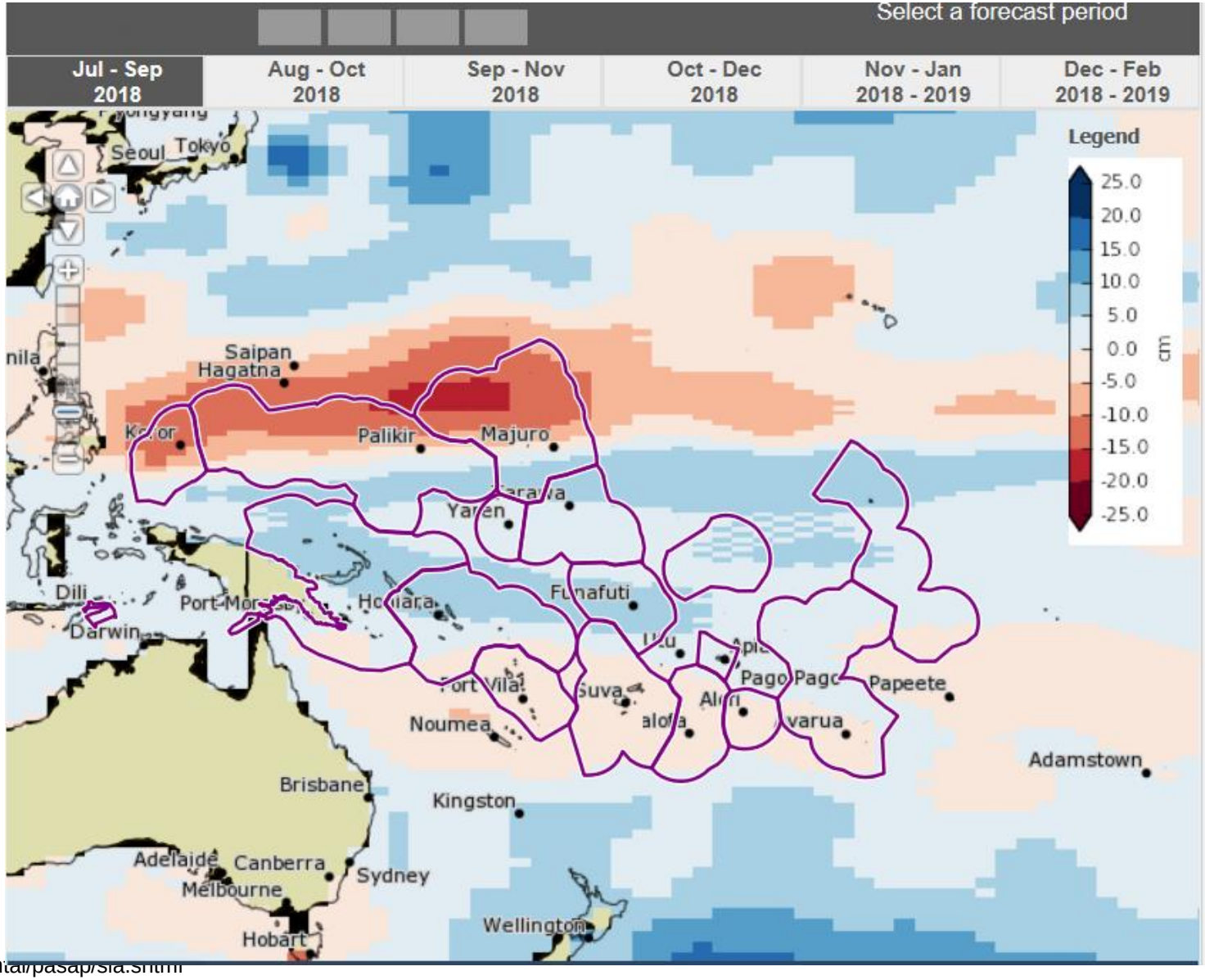
Sea level Forecasts: USAPI Region



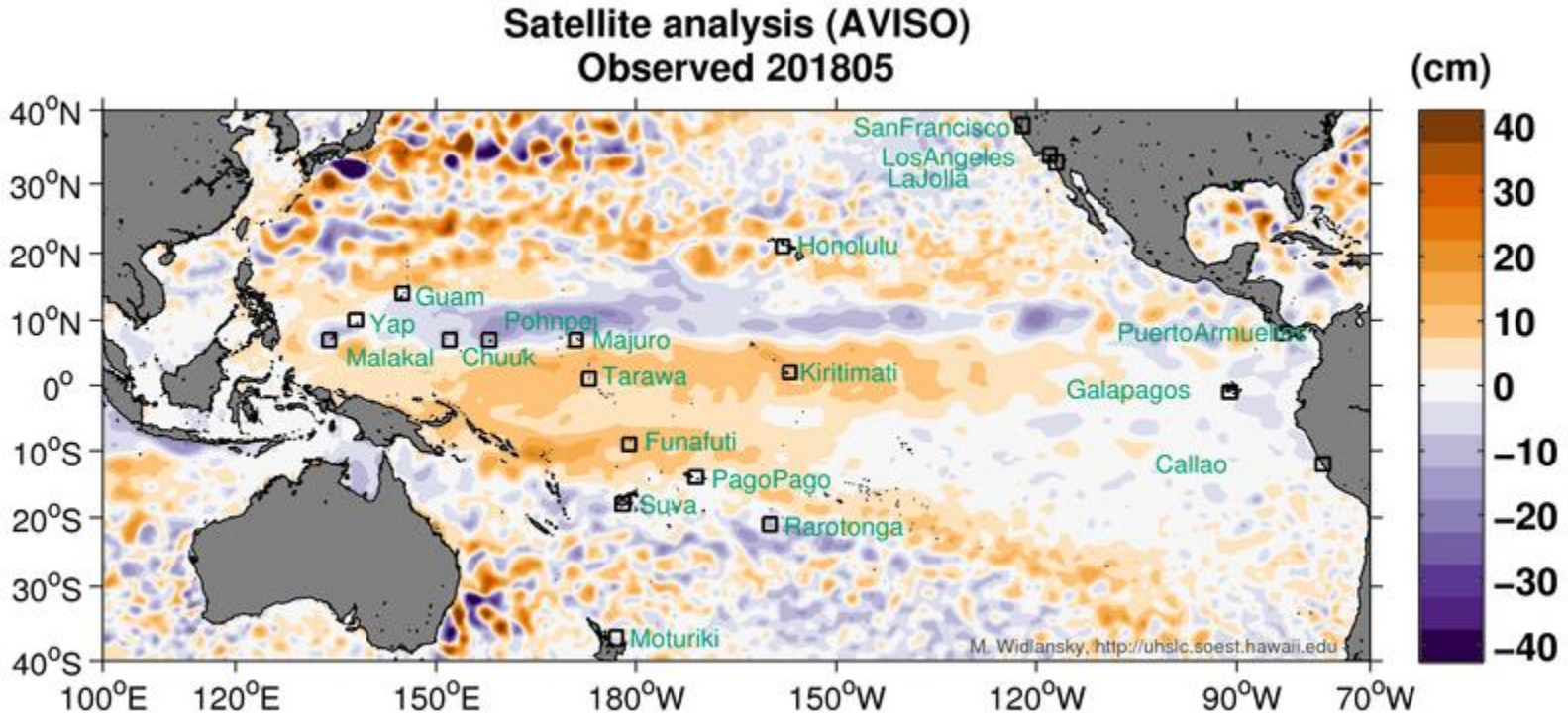
- **The FALL is due to lagged response to the easing of trade-wind forcing /westward Rossby wave;**
- **Palau: This is a typical picture in any El Nino year as *Palau tracks ENSO so well that it makes a good ENSO index in its own right!***

Sea Level Forecasts @ Western Pacific (Jul-Sep 2018)

- **Sea Level across the Western Pacific Basin will be near normal during JAS 2018**



http://poama.bom.gov.au/experimental/pasap/sla.shtml



https://uhslc.soest.hawaii.edu/sea-level-forecasts/

2018 Atlantic Hurricane: quieter than expected

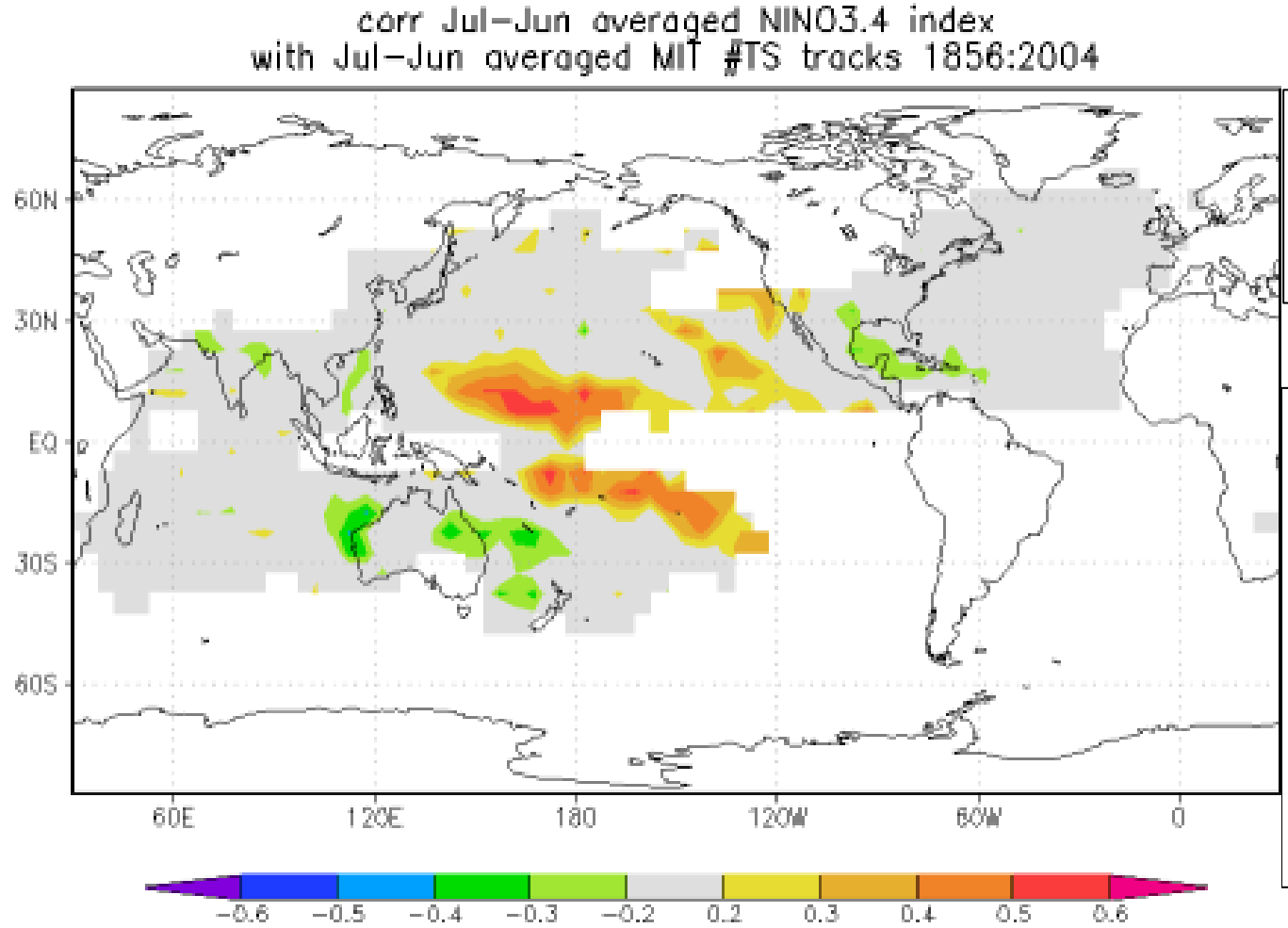
A new analysis of global hurricane data since 1980 shows the number of storms with winds over 124 mph has doubled, and those with winds over 155 mph has tripled.

(Credit: NASA)

- Cooler ocean temperatures in the tropical Atlantic;
- Nascent El Niño pattern;
- This year's forecast is about average;
  - **10.1** named storms, with an average of **5.9** becoming hurricanes and 2.5 becoming major hurricanes (Cat **3** or greater).

https://insideclimatenews.org/news/02062018/hurricane-season-2018-noaa-storm-forecast-global-warming-atlantic-ocean-temperature-new-category-6

ENSO and Tropical Cyclones: WNP



During El Niño there are on average fewer hurricanes over the Atlantic Ocean

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

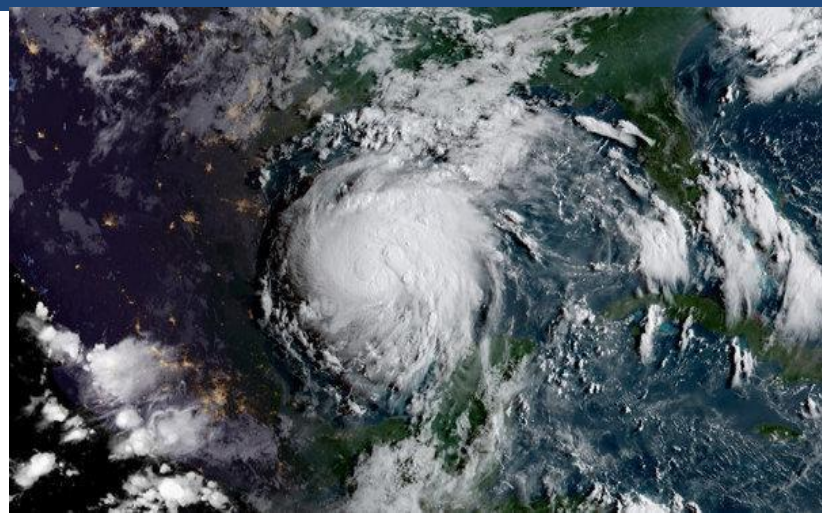
- **Less TC activity**
  - **Australia**
  - **Philippines**
- **More TC activity**
  - **Tropical Pacific**
  - **Hawaii**
  - **American Samoa**

From the Royal Netherlands Meteorological Institute
http://www.knmi.nl/research/global_climate/enso/effects/

2018 TC Activity: WNP/ A Samoa (PEAC Assessment)

- **Guam/Saipan: TS is given as 50% (about average);**
  - **The odds of a CAT 1 typhoon is set at 25% (above average);**
  - **The odds for a major typhoon (CAT 3 or higher) is set at 15% (slightly above average).**
-
- **Micronesia: the odds for damaging TC strikes are set to slightly above average;**
-
- **A Samoa: The 2017-18 South Pacific cyclone season soon ends (June 30, 2018), with no further activity.**

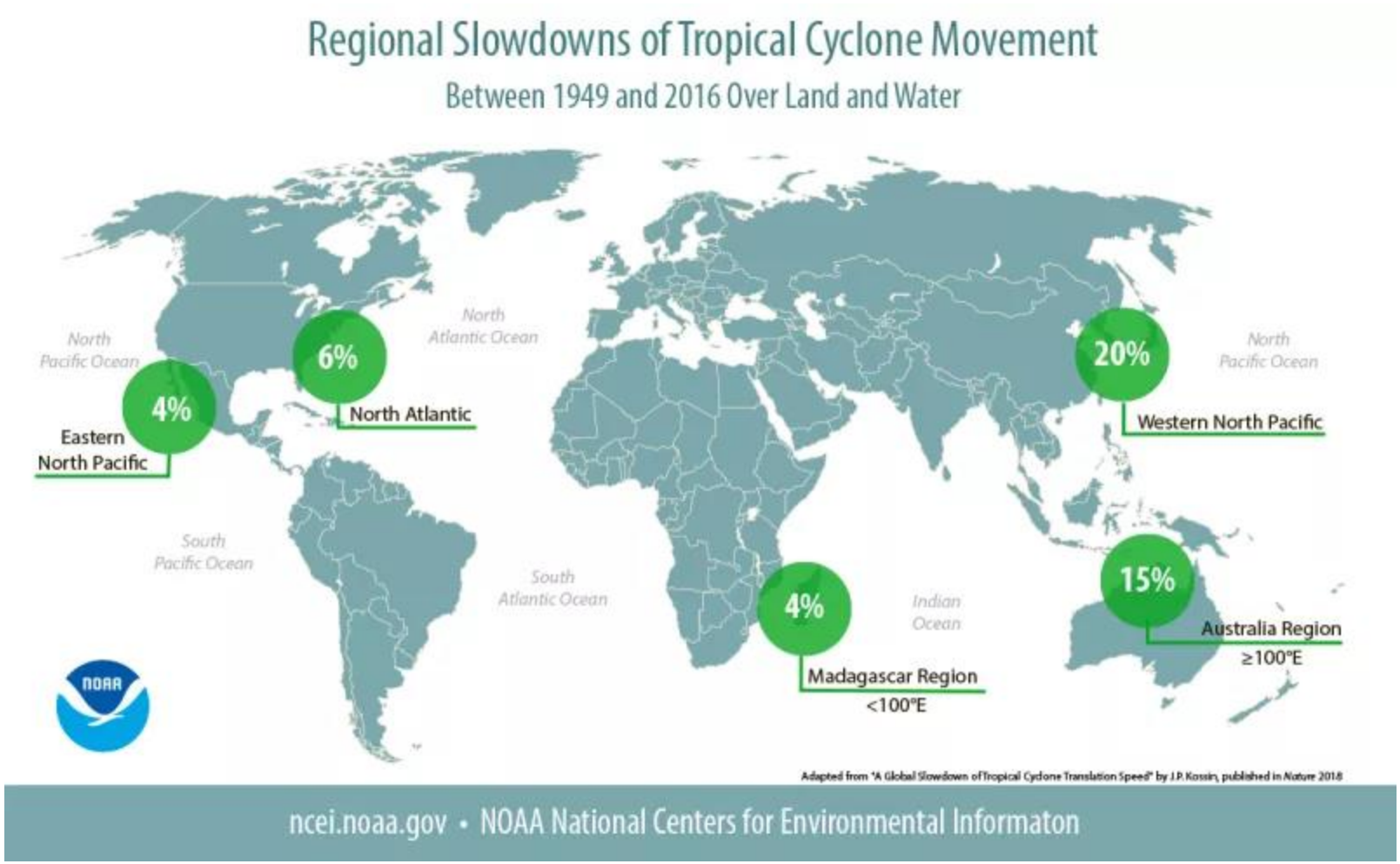
Hurricanes Are Lingering Longer : That Makes Them More Dangerous



Nature **volume 558**, pages104–107 (2018)

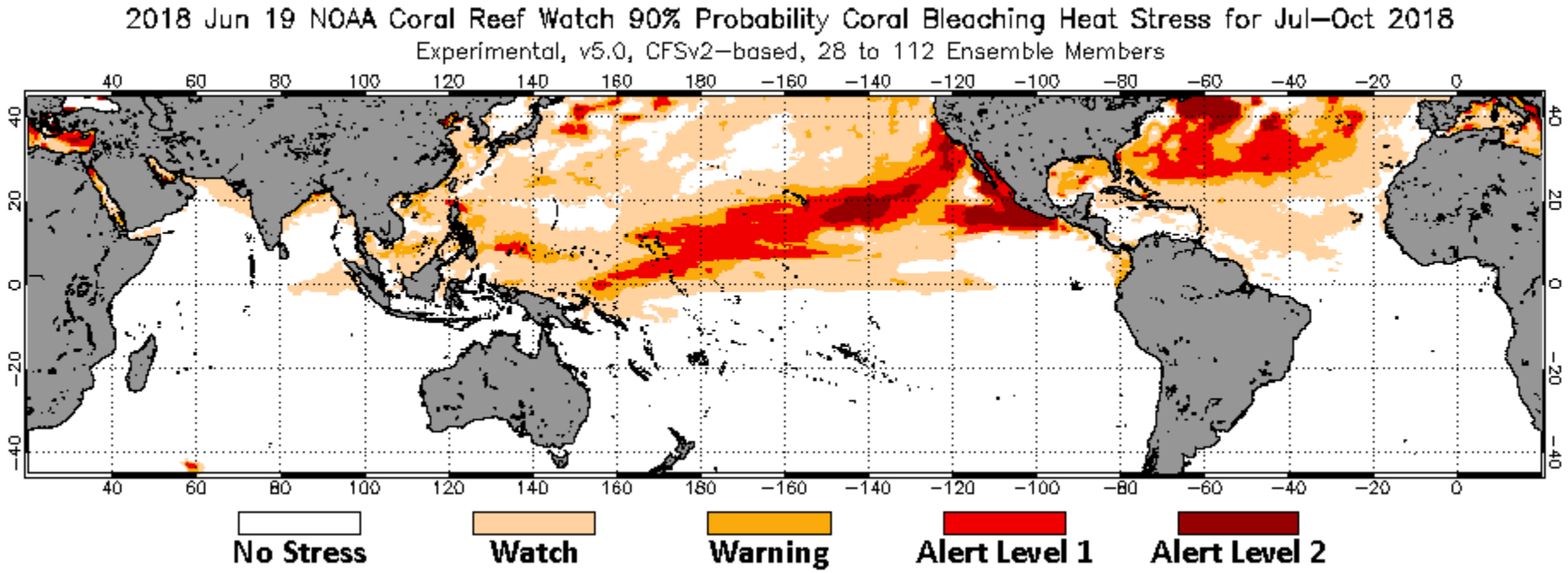
- **Storms are staying in one place longer, much like Hurricane Harvey did last year;**
- **Between 1949 and 2016, tropical cyclone translation speeds declined 10 percent worldwide;**
- **The storms, in effect, are sticking around places for a longer period of time;**
- **Lingering hurricanes is a problem, as Texans learned last year. The really, really high rainfall totals were because the storm moved so slowly,"**

Hurricanes Aren't Moving as Fast as They Used to, Translation Speed is Slowing



https://gizmodo.com/hurricanes-aren-t-moving-as-fast-as-they-used-to-and-t-1826606601

Four-Month Coral Bleaching Outlook



- **High probability of Coral Bleaching across the Pacific and North Atlantic Islands;**
- **The Famous Jellyfish Lake Is Running Out of Jellyfish in Palau.**

From Coral Reef Watch http://coralreefwatch.noaa.gov/satellite/baa.php

Drought and Conflict: Afghanistan

(June 9, 2018)

- **Approximately 20,000 Afghans displaced from their drought-ravaged farms in Ghor, Baghis and Faryab provinces fled to camps;**
- **This is a situation that could benefit the other group (Taliban) if Kabul is seen as failing to care for its people;**
- **There are studies the links between drought and conflict in Syria;**
- **Severe droughts can cause displacement and potentially conflict, particularly in agrarian societies strongly dependent on rainfall…..**

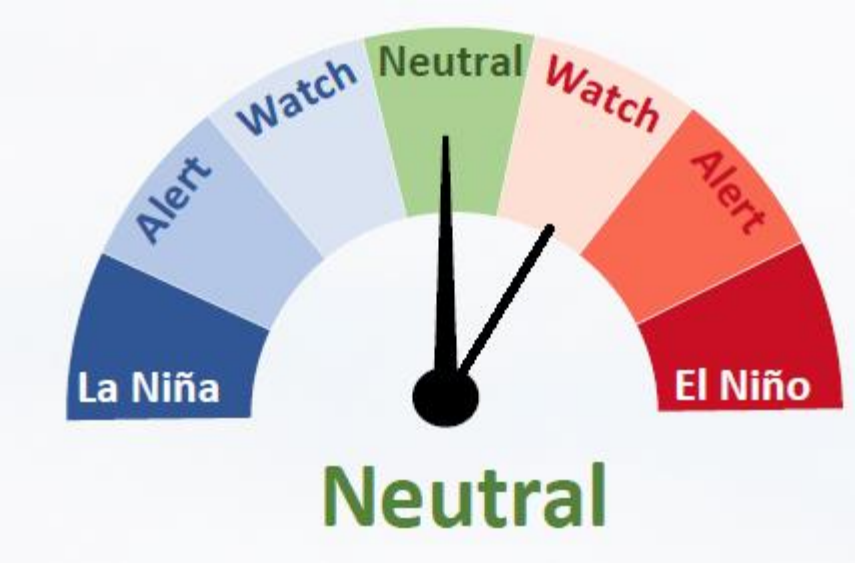
ENSO Poses Threat to Rohingya Refugees in Bangladesh

- **Over 700,000 Rohingyas escaped the violent military crackdown against them in Myanmar's Rakhine and have fled to Bangladesh;**
- **According the UN this is a "textbook ethnic cleansing";**

Barren hills Cox's Bazar

- **Faces a looming disaster when the first storms of the monsoon hit;**
- **"It's going to be drought…and health problem during El Niño…**

Summary



- **ENSO neutral conditions persisted in the tropical Pacific during May 2018;**
- **Convective activity is now centred over the WIO and Africa—a stark change from La Niña pattern;**
- **SST in the central/eastern Pacific are near normal;**
- **The SOI was in the neutral range (+0.3);**
- **67% chance for ENSO-neutral: Jun-Aug 2018;**
- **50% chance for El Niño: SON 2018; 65% in DJF;**
- **PEAC's observations are consistent to this finding!**

The PEAC Center

The Pacific ENSO Applications Climate Center

Mahalo

Mahalo

Photo courtesy of
Lt. Charlene Felkley