PACIFIC ENSO UPDATE

A Quarterly Bulletin of the Pacific El Niño-Southern Oscillation Applications Climate (PEAC) Center

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Providing Information on Climate Variability in the U.S.-Affiliated Pacific Islands for the Past 20 Years.

http://www.weather.gov/peac

CURRENT CONDITIONS

The CPC's Oceanic Niño Index is now at the threshold of La Niña, as the index continues its dramatic decline from its high-stand at strong El Niño in the first three months of the year (Fig. 1). Indeed, the falling values of the ONI and other recent behaviors of the atmosphere and ocean indicate that the climate system has entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO diagnostics discussion that is appended below.

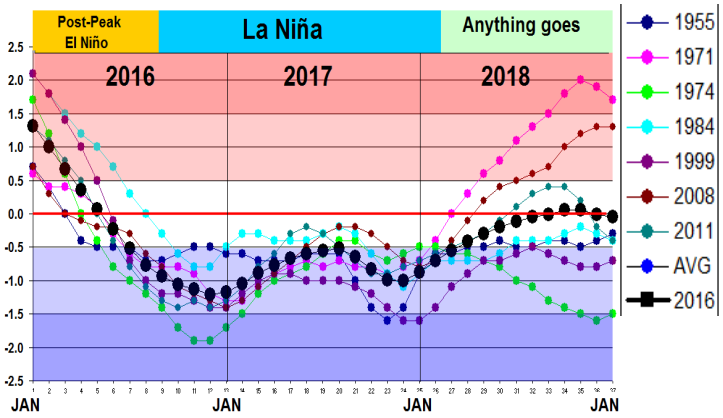

Figure 1. A composite of the Oceanic Niño Index (ONI) for the post-Peak phase of seven strong El Niño events, all carried forward through the subsequent year (colored lines). The progress of the ONI during 2016 is shown by the large black squares. All strong El Niño events in the composite transitioned to at least weak La Niña by the end of the post-Peak year. The behavior of 2016 to-date is similar to the other years, with perhaps a noticeable slight delay in the timing of the cross-over to the La Niña threshold, and a bias to the warm side of the envelope. Individual years used in the composite are color-coded in accordance with the key on the right side of the chart

During the 3rd Quarter, rainfall continued below average at a majority of reporting sites across the USAPI (Figs 2 and 3). High rainfall amounts at reporting sites on the island of Saipan were a notable exception. Several daily extreme rainfall events, and persistent wet conditions associated with the western Pacific monsoon trough helped to push the 3rd Quarter rainfall at Saipan locations to the top of the list for the entire region! Utirik Atoll, located in the northern RMI, was also very wet, at least in terms of its long-term average. Utirik's 3rd Quarter total of 29.43 inches gave it a region-leading 154% of average. Heavy 3rd Quarter rainfall at some of the more northerly located islands was an artifact of a developing La Niña climate pattern that saw deep convection and the ITCZ/monsoon trough migrate northward of average. See the local variability summaries for more details.

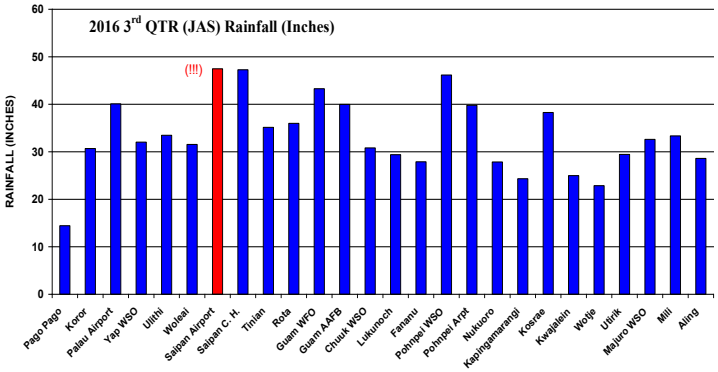

Figure 2. 2016 3rd Quarter rainfall amounts in inches at the indicated locations. Note the regional top-most value of the rainfall at Saipan (red bar is the reading at the Saipan International Airport).

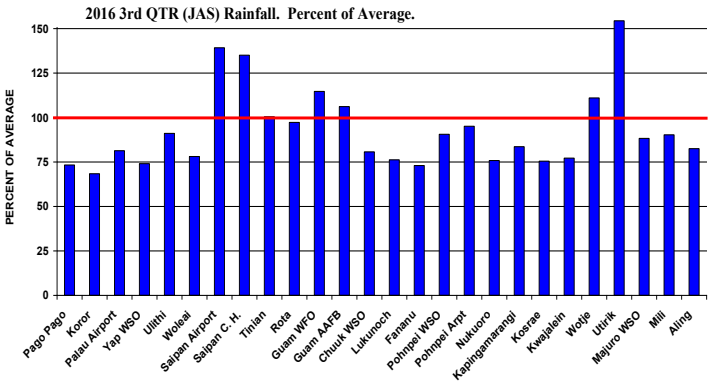

Figure 3. 2016 3rd Quarter rainfall as a percent of average at the indicated locations. Note that most locations in Micronesia were below average, with the notable exceptions of Saipan, Guam and the northern RMI atolls of Utirik and Wotje..

Sea Level

The sea level has rebounded sharply from its low stands at the peak of El Niño in late 2015/early 2016 (Fig. 4). A sharp rise of sea level typically occurs in the first few months of the post -peak year of an El Niño event. As anticipated by the PEAC, the sea level across Micronesia returned to above average values during the 3rd Quarter of 2016. Note that the rise and fall of sea level closely tracks the strength of the low-latitude trade winds. See the sea level discussion for more details and specific forecasts.

CURRENT CONDITIONS

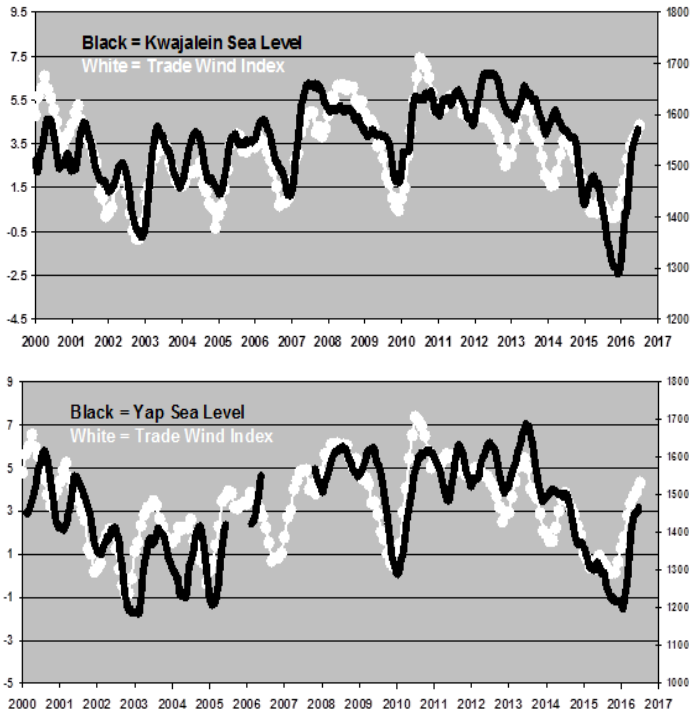

Figure 4. Time series of sea level at Yap and Kwajalein from January 2000 through July 2016. Note the steady decline that reaches a low point at the end of 2015, and the subsequent sharp rise during 2016 (also see Fig. 6)

CURRENT STATE OF ENSO

ENSO Alert System Status: La Niña Advisory

Synopsis: La Niña conditions are present and slightly favored to persist (~55% chance) through winter 2016-17.

Current Situation and Outlook Summary

- **La Niña Advisory is currently active now;**
- **Negative SST expanded across most of eastern and central equatorial Pacific Ocean (Fig. 5).**
- **Atmosphere is also supportive to La Niña;**
- **The consensus favors the continuation of weak and short-lived La Niña conditions through DJF 2016-17.**
- **ENSO-neutral condition is again favored beyond DJF**

"La Niña conditions were observed during October, with negative sea surface temperature (SST) anomalies in early November stretching across most of the eastern and central equatorial Pacific Ocean. With the exception of the Niño1+2 region, the Niño region indices remained negative over the last month, with the latest weekly value of the Niño-3.4 index at -0.8°C. The upper-ocean heat content also remained below average during October, reflecting below-average temperatures at depth. Convection was suppressed over the central tropical Pacific and enhanced over Indonesia. The lower-level easterly winds were weakly enhanced near and west of the International Date Line, and anomalously westerly upper-level winds were mainly west of the International Date Line. Overall, the ocean and atmosphere system reflected weak La Niña conditions."

CURRENT STATE OF ENSO

"The multi-model averages favor La Niña conditions (3-month average Niño-3.4 index less than or equal to -0.5°C) continuing through the winter. Given the current atmospheric and oceanic conditions, along with model forecasts, the forecaster consensus favors the continuation of weak La Niña conditions through December-February (DJF) 2016-17. At this time, the consensus favors La Niña to be short-lived, with ENSO-neutral favored beyond DJF. La Niña conditions are present and slightly favored to persist (~55% chance) through winter 2016-17

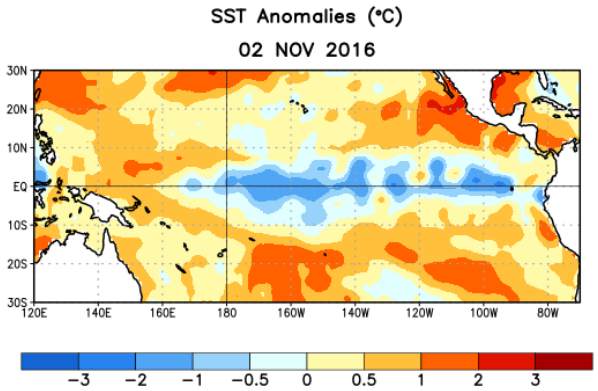

Figure 5. Average sea surface temperature (SST) anomalies (°C) for the week centered on 2 November 2016. Anomalies are computed with respect to the 1981-2010 base period weekly means.

Also see: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.pdf

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

The PEAC archives western North Pacific tropical cyclone (TC) numbers, track coordinates, and 1-minute average maximum sustained wind taken from operational warnings issued by the Joint Typhoon Warning Center (JTWC) of the U. S. Air Force and Navy, located at Pearl Harbor, Hawaii. Western North Pacific tropical cyclone names are obtained from warnings issued by the Japan Meteorological Agency (JMA), which is the World Meteorological Organization's Regional Specialized Meteorological Center (RSMC) for the western North Pacific basin. The PEAC archives South Pacific TC names, track coordinates, central pressures, and 10-minute average maximum sustained wind estimates from advisories issued by the Tropical Cyclone Warning Centers at Brisbane, Nadi, and Wellington. The numbering scheme and the 1-minute average maximum sustained wind estimates are taken from warnings issued by the JTWC.

TROPICAL CYCLONE ACTIVITY

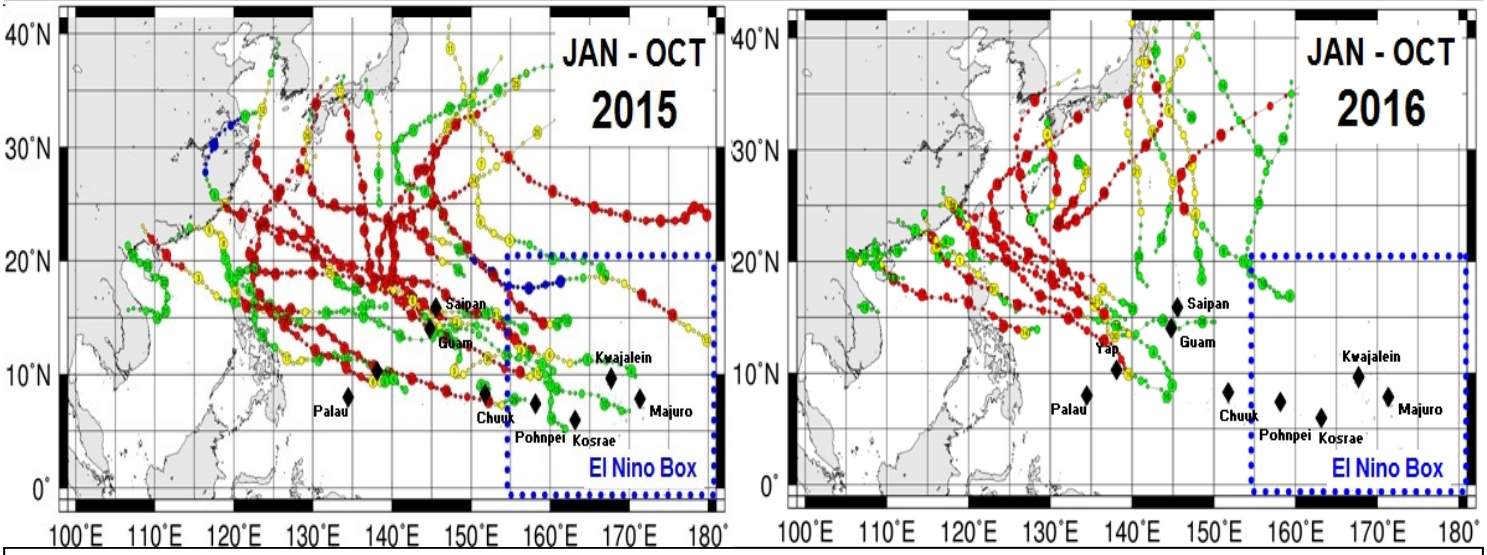

Figure 6. The stark contrast of Western North Pacific Tropical Cyclone activity during 2015 versus 2016 for the period January through October. A cluster of TCs in the subtropics to the north of Guam and Saipan formed during a strong far northward displaced monsoon trough during August. During September and October, a persistent focus of TC development was seen to the west of Guam. Clustering of TC activity and persistence of general track behavior are noted in most typhoon seasons, with each year possessing its own unique suite of characteristics.

Western North Pacific

As anticipated by the PEAC, the 2016 typhoon season of the western North Pacific had a very late start, with the first named storm (Super Typhoon Nepartak) reaching tropical storm intensity on the 3rd of July. Through the remainder of July, the basin was quiet. There was a burst of TC activity during August when a very active monsoon system formed in the subtropics of the western North Pacific. The TCs of August form the wide cluster of tracks northward of Guam and Saipan (Fig. 6). During September, the monsoon trough collapsed to the west and south, and was the site of a highly concentrated cluster of TC formations to the west of Guam. These TCs had very severe effects in the Philippines, Taiwan, Mainland China and parts of Japan. In stark contrast to the activity during 2015, which was unusually abundant and displaced eastward in to Micronesia, the TCs of 2016 were displaced westward and northward away from most of Micronesia; although one of the TCs of October (Typhoon Haima) affected portions of Yap State on its way to a severe strike of northern Luzon (see the Yap State LVS).

Particularly because of the unusual TC behavior in the subtropics during August, the number counts and behavior of TCs of 2016 as described by the JMA versus the JTWC is quite different. As per the JTWC, there were 25 numbered TCs from January through October 2016, with a distribution of 11 typhoons, 10 tropical storms and 5 tropical depressions. Five of the JTWC typhoons achieved super typhoon status (i.e., maximum one-minute sustained wind at-or-above 130 kt). As per the JMA there were 22 numbered TCs during January through October 2016, with a distribution of 11 typhoons and 11 tropical storms.

Southern Hemisphere

The 2016-17 Southern Hemisphere (SH) TC season is only just beginning. So far only one TC has been numbered there: TC 01S was a weak tropical storm that formed during July in the western portion of the South Indian Ocean. It moved westward and dissipated to the east of Madagascar. No TCs have yet occurred in the South Pacific.

PEAC Tropical Cyclone Assessment

Western North Pacific and American Samoa

The PEAC anticipates that TC activity will be near average to below average in the western North Pacific basin for the remainder of 2016 in most categories of activity, and that any late-season TC activity will primarily occur in the far western side of the basin (e.g., across the Philippine Archipelago into the South China Sea). The PEAC further believes that it will also remain relatively inactive throughout most of Micronesia, a result of both the low basin count and the westward shift to the activity. During the remainder of 2016, (November and December), the risk of a tropical storm or typhoon should increase to near average only across western Micronesia (Yap State and the Republic of Palau), but remain low (but not zero!) at locations eastward of Guam.

The new 2016-17 South Pacific cyclone season officially began 01 July 2016. No activity has occurred so-far near American Samoa. Early indications are that the severity of the next cyclone season (i.e., 2016-17) in American Samoa will be near average to slightly below average. The Australian Bureau of Meteorology has called for above average TC activity in the Australian region (see: water http://www.bom.gov.au/cyclone/outlooks/seasonal/qld.shtml), while in the South Pacific, eastward of the International Date Line, TC activity is likely to be reduced. The 30-year average indicates one named TC near American Samoa during the early season (October through December). No further TC activity is anticipated for the Hawaiian Islands until the summer of 2017.

SEASONAL SEA LEVEL OUTLOOK FOR THE US-AFFILIATED PACFIC ISLANDS

The following sections describe: (i) the Canonical Correlation Analysis (CCA) forecasts for seasonal (mean and maxima) sea level anomalies (seasonal cycle removed) for the forthcoming seasons October-November-December (OND), November-December-January (NDJ), and December-January-February (DJF) of 2016, (ii) OND return values at 20 and 100-yr period, (iii) the observed monthly mean and maximum sea-level anomalies for the previous season July-August-September (JAS) of 2016, and (iv) synopsis of 2-years Sea Level variability and forecasts. *Note that, seasonal cycles have been removed for the data anomalies that are defined as 'deviations or departures from the normal' using the 1983 through 2001 mean sea level value computed at each station. Also note that CCA-forecasting technique adopted here does not account for sea level deviations created by other atmospheric or geological factors.*

Seasonal Sea Level Forecast (anomalies with respect to climatology) for OND, NDJ, and DJF of 2016

Forecasts of the sea-level anomalies in the USAPI (see http://www.weather.gov/peac/sealevel) are presented using CCA statistical model. Based on the independent SST and zonal wind (U) (SST-U) values in JAS of 2016, the resulting CCA model has been used to forecast the sea level of three consecutive seasons: OND, NDJ, and DJF (see Table 1: left panel shows values for seasonal mean while the right panel shows the seasonal maxima). All the tide gauge stations (at 0 to 2-months lead time) provided skillful forecasts for these three consecutive seasons.

Table 1: Forecasts of sea level anomalies in inches (OND, NDJ, and DJF

	Seasonal Mean Deviations [1]				Seasonal Max Deviations [2]				
Tide Gauge Station	**OND**	**NDJ**	**DJF**	**Seasonal Outlook[3]**	**OND**	**NDJ**	**DJF**	**OND: Return Period[4]**	
Lead Time [5]	**0-M**	**1M**	**2M**	**Seasonal Outlook[3]**	**0-M**	**1M**	**2M**	**20- YR**	**100-YR**
Marianas, Guam	+2	+2	+5	**Above**	+19	+20	+20	6.5	9.1
Malakal, Palau	+3	+4	+5	**Above**	+38	+38	+38	6.1	6.4
Yap, FSM	+4	+5	+5	**Above**	+32	+32	+32	8.2	11.0
Chuuk, FSM**	+5	+5	+5	**Above**	+32	+32	+32	n/a	n/a
Pohnpei, FSM	+5	+4	+4	**Above**	+32	+34	+34	9.1	11.8
Majuro, RMI	+5	+4	+4	**Above**	+41	+43	+44	5.7	6.4
Kwajalein, RMI	+4	+4	+4	**Above**	+40	+42	+42	6.6	8.4
Pago Pago, Am. Samoa***	+2 (-2)	+4 (-1)	+4 (-1)	**Normal**	+29 (+24)	+29 (+25)	+29 (+25)	4.9	6.1
Honolulu, Hawaii	+2	+2	+2	**Normal**	+21	+22	+22	3.0	3.7
Hilo, Hawaii	+2	+2	+2	**Normal**	+25	+26	+26	3.2	5.2

Table 1 and Supporting Statistics: : (-) indicate negative anomalies (fall of sea level from the mean), and (+) indicate positive anomalies (rise of sea level from the mean), n/a: data not available. Anomalies from -1 to +1 inches are considered negligible and anomalies from -2 to +2 inches are unlikely to cause any adverse climatic impact. Forecasts for Chuuk (**) are estimated subjectively based on information from WSO Chuuk and observations from neighboring stations of Pohnpei and Yap. *** There was a level shift (approximately 2-4 inches) in American Samoa at the time of September 2009 earthquake. So, -2 inches needs to adjust to the current tide-gauge values of Pago Pago. See PEAC website for the explanations of footnote (1 to 5). Also note that all information is based upon the 1983-2001 epoch.

The current sea level forecasts indicate that most of north Pacific stations are likely to be above-normal (normal and average are synonymously used throughout the sea level section) in the forthcoming OND, NDJ, and DJF seasons. The lone south Pacific Island (American Samoa) is expected to be normal to slightly above-normal during the same time-period. In Hawaii, both Honolulu and Hilo are likely to be slightly elevated, but still close to normal. Despite some rise, current observations revealed that all the stations are stable now. This rise is somewhat expected and the stable condition also corresponds very well with the current developing phase of ENSO-neutral or weak La Niña condition. As the most likely strength of a La Niña, should it develop, is weak (according to WMO), so we may not see any significant rise of sea level in the near future.

SEASONAL SEA LEVEL OUTLOOK FOR THE US-AFFILIATED PACFIC ISLANDS

Observed Monthly Mean Sea Level Anomalies (with respect to climatology) for Jul-Aug-Sep (JAS) of 2016

The monthly time series (January to March) for sea level anomalies have been taken from the UH Sea Level Center. The full time series (in mm) for monthly mean is available at: ftp://ilikai.soest.hawaii.edu/islp/slpp.anomaliess. Locations of all these stations can be found at http://www.prn.noaa.gov/peac/map.php.

Current Conditions: The monthly mean sea level in most of the stations recorded rise in September and remained well above normal. Slight and intermittent rise is always expected after any strong El Ninõ year, which results due to rapid backflow of a bulk quantity of water from the east to the western part of the Pacific. Therefore, the higher sea level which is observed now in the western Pacific is not expected to last long. If ENSO neutral condition continues to stay, sea level will get back to normal soon. The current sea level forecasts indicate that all the north Pacific stations are likely to be above normal (3-5 inches above) in the forthcoming OND season. Pago Pago is expected to be slightly above normal (2 inches above) in OND. In Hawaii, both Honolulu and Hilo are likely to be elevated (2 inches above)

Table 2: Monthly observed mean/maximum sea-level anomalies in inches

Tide Gauge Station	Monthly Mean Deviations[1]				Monthly Max Deviations[2]			
	Jul	Aug	Sep	Standard Deviations	Jul	Aug	Sep	Sea level Trend
Marianas, Guam	+1	+3	+2	3.6	+15	+19	+18(2)	Below-Rising
Malakal, Palau	+5	+5	+6	4.5	+43	+43	+43(3)	Below-Rising
Yap, FSM	0	**+6**	**+6**	4.8	+27	+33	+33(3)	Below-Rising
Chuuk, FSM*	**+5**	**+7**	**+7**	*	**	**	**	**
Pohnpei, FSM	+6	+7	+7	3.4	+34	+35	+33(5)	Below-Rising
Majuro, RMI	**+7**	**+7**	**+10**	2.5	+46	+45	+50(8)	Normal-Rising
Kwajalein, RMI	+4	+4	+6	3.0	+39	+40	+43(7)	Below-Rising
Pago Pago, American Samoa* **	+6 (+1)	+7 (+2)	+8 (+3)	3.4	+29	+30	+31(1)	Normal-Falling
Honolulu, Hawaii	+4	+3	+3	1.8	+25	+21	+20(0)	Above-Stable
Hilo, Hawaii	+2	+4	+4	1.8	+25	24	+24(1)	Normal-Stable

Table 2. +/- 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. Red: Falling trend, Black: Stable SL, and Blue: Rising trend. * In Pago Pago, there was a level shift (approximately 2-4 inches) at the time of September 2009 earthquake.

Synopsis of 2-years Sea Level Variability and Forecasts

Starting from JAS of 2014, a comparative perspective of two years of seasonal sea level variations is given below (Fig. 6). The sea lever in the western Pacific started to fall from JFM of 2015. This falling trend continued up to JAS of 2015. Again it started to rise from OND of 2015 and, starting from JFM of 2016, sea level recorded an abrupt rise and remained high until JAS of 2016. The month of August-September also remained high. It is likely to stay elevated during the remainder of 2016.

See page 15 for sea level observations from Jason-2 satellite picture (Fig. 22).

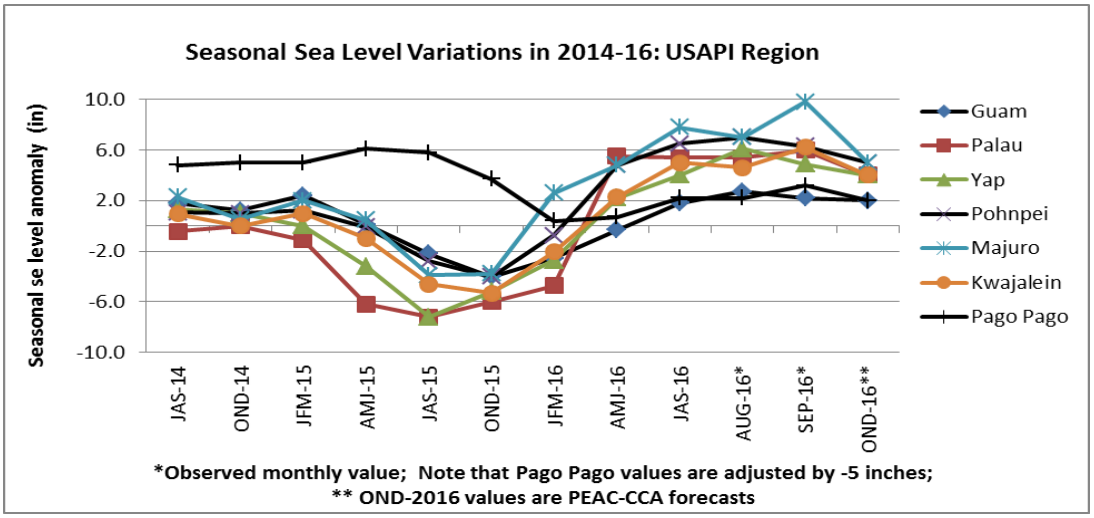

Figure 7. A comparative perspective of Island-wise seasonal sea level variations (JAS 2014 to JAS 2016) (*Note that Pago Pago data needs correction because of level shift after 2009 earthquake. ,There was a level shift (approximately 2-4 inches) at that time which has not been adjusted).

LOCAL SUMMARY AND FORECAST

American Samoa: Monthly rainfall amounts at American Samoa were below average for all but one of the months during January through October 2016 (Fig. AS-1). During April 2016, an enormous amount of rain (30.34 inches) was experienced at the WSO Pago Pago, which was by far the highest April rainfall and the 2nd highest rainfall total of any month in the historical record. If April is assigned its average value (~12 inches), then the period January to October of 2016 would have been the 3rd driest such period in Pago Pago's 50-year climate record.

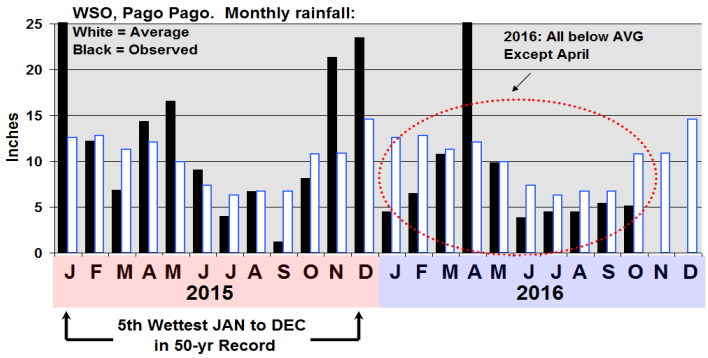

Figure AS-1. A time series of the monthly rainfall recorded at the Pago Pago WSO during 2015 through October 2016.

In collaboration with Richard Heim of NOAA's NCEI, PEAC scientists and WFO Guam personnel have established the following rough monthly rainfall thresholds for drought impacts at tropical islands throughout the USAPI:

(1) 8 inches per month to sustain an adequate quantity of drinking water; and,

(2) 4 inches per month to keep forests, lawns and roadsides green.

Pago Pago has been just above the 4-inch threshold for the past 4 months. It is certain that the mountainous interior of Tutuila (the location of the capital city of Pago Pago) and the other islands of American Samoa remain above one or both of these drought thresholds. Indeed, no adverse affects of prolonged dryness have recently been reported from the WSO Pago Pago.

The mean sea level in American Samoa fell during the first half of 2016 to a low level that has not been recorded since the first half of 2010 (see Fig. AS-2). Lowered sea level is a typical response to El Niño in American Samoa. However, the sea level recorded sharp rise again in the last quarter (ASO), which is typical in any La Niña year.

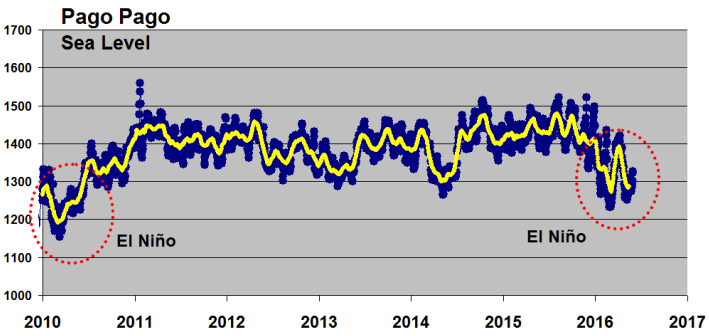

Figure AS-2. A time series of the monthly sea level recorded at the Pago Pago tide gauge during January 2010 through July 2016. Note the lowered sea level in response to the El Niño events of 2009-10 (dark blue) and 2015-16 (dark red). Sea level units are in meters above gauge benchmark.

LOCAL SUMMARY AND FORECAST

American Samoa Rainfall Summary: JASO & 3rd Qtr 2016						
Station		Jul	AUG	SEP	OCT	3rd Qtr
Pago Pago WSO	Rain (in)	4.48	4.49	5.45	5.12	14.42
	% Avg.	71%	67%	81%	47%	73%
Siufaga Ridge*	Rain (in)	.	.	.	.	.
	% Avg.	%	%	%	%	%

Climate Outlook:

During October 2016, the CPC's Oceanic Niño Index (ONI) and other behaviors of the atmosphere and ocean indicated that the climate system had entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO diagnostics discussion (see Current Conditions section). Rainfall in American Samoa is only weakly related to the state of ENSO, with dryness immediately following strong El Niño the most consistent relationship. With La Niña now in-place and anticipated to continue for the next several months, there are no compelling reasons at this time to bias the forecast to the wet or dry side of average.

Tropical cyclone activity during the upcoming 2016-17 cyclone season is anticipated to be shifted westward. Highest TC activity will be in Australian waters eastward into the Coral Sea. The Australian Bureau of Meteorology has called for above average TC activity in the Australian region (see: water http://www.bom.gov.au/cyclone/outlooks/seasonal/qld.shtml). In the South Pacific, eastward of the International Date Line, TC activity is likely to be reduced, with American Samoa seeing a slight reduction to its risk of damaging effects from cyclones.

The sea level at American Samoa is now undergoing the rise that typically occurs in the latter half of the post-Peak year of El Niño. With the recent onset of La Niña, the sea level should continue its upward trend over the next few months (see the sea level section for details).

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]
October - December 2016 (Onset of Next Rainy Season)	100%
January - March 2017 (Heart of Rainy Season)	100%
April - June 2017 (Onset of Next Dry Season)	100%
Jul - Sep 2017 (Heart of Next Dry Season)	100%

[1] Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.

Guam/CNMI: In the very first few days of August, a monsoon depression moved to the north of Guam and Saipan. The southwest monsoon swept in with the year's first widespread and prolonged episode of cool rainy weather. This monsoon trough (Fig. G1) would dominate the weather of Micronesia and the entire western North Pacific basin for the whole month of August. A spate of tropical cyclones formed in this trough with unusual tracks northward through the sub-tropics. The monsoon and its associated developing tropical cyclones kept Guam and the islands of the CNMI wet and windy

LOCAL SUMMARY AND FORECAST

throughout August. Southwesterly winds gusting to 40 mph, or more, were experienced several times on Guam and Saipan (Fig. G2).

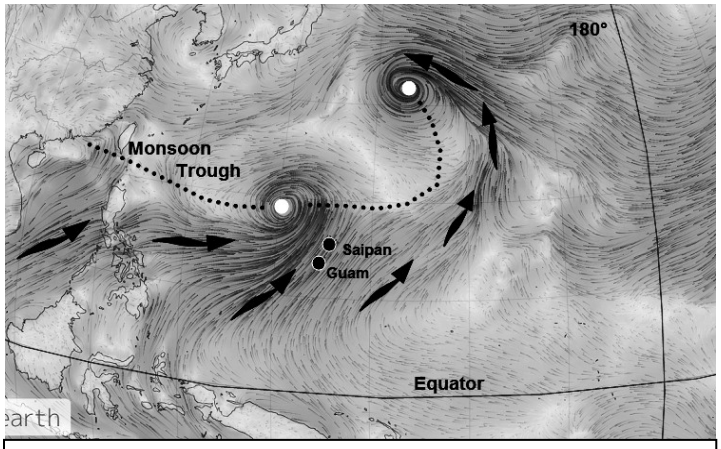

Figure G1. Streamlines of the low-level winds across the western North Pacific on 13 August 2016. A strong monsoon trough stretches across the basin in sub-tropical latitudes bringing gusty southwest winds to Guam and Saipan. Several TCs developed along the trough axis and moved on unusual north-oriented tracks. Black arrows show monsoonal flow, dotted line shows the axis of the monsoon trough, and the two TCs are Conson (well north) and Chanthu (closer to Guam and the CNMI). Chart is derived from NULLSCHOOL web based utility.

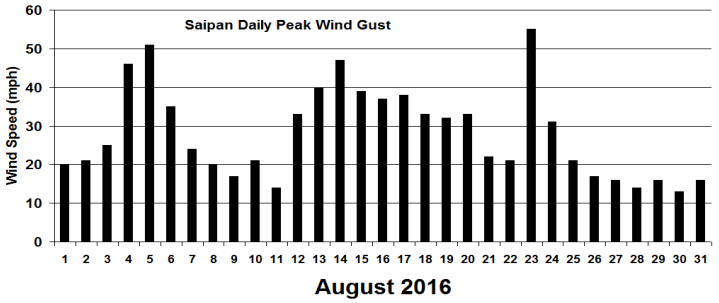

Figure G2. Daily peak wind gusts at the Saipan International Airport show the effects of a persistent monsoonal flow, and the passage of several developing TCs to the north and west.

While July was yet another dry month in a long series of dry months occurring over the first half of 2016, August was very wet from the persistent influence of the monsoon trough and developing TCs. During the first week of August, very heavy rainfall was experienced throughout Guam and the CNMI, with Saipan experiencing a very high extreme rainfall of 9.34 inches over a 24-hour period spanning the 3rd and 4th. Rainfall totals during the 1st week of August were 13.82 inches and 10.84 inches at Saipan and Guam, respectively, constituting over half the August monthly total at each location. The August monthly total of 24.40 inches at the Saipan International Airport placed at number 4 in the ranking of recorded monthly rainfall, behind August 1981 (24.80 inches), August 1960 (28.94 inches) and August 2004 (34.15 inches – the all time high!).

The month of September continued to be wet at most locations on Guam and in the CNMI. The monsoon trough shifted to the south and west during September from its unusual sub-tropical location during August, to place Guam and the CNMI at the eastern reaches of the monsoon circulation. Winds during September were still brisk, but not as strong as during August. The direction of the wind was more southerly reflecting the westward shift of the monsoon trough. Several TCs

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developed in a focused region just to the west-northwest of Guam and the CNMI, resulting in an unusual cluster of TC tracks originating in this region (see TC section). Rainfall was abundant in September, associated with the passage of several tropical disturbances and convection related to TUTT cells.

Guam and CNMI Rainfall Summary: JASO & 2016 3rd Qtr.

Station		Jul	Aug	Sep	Oct	3rd Qtr
GUAM						
GIA (WFO)	Inches	6.77	20.85	15.65	13.14	43.27
	% Avg	64%	152%	116%	109%	115%
AAFB	Inches	6.95	17.42	15.59	12.35	39.96
	% Avg	64%	130%	117%	96%	106%
Southern Mountain	Inches	7.10	20.84	12.40	14.46	40.34
	% Avg	65%	155%	93%	112%	107%
CNMI						
Saipan Intl. Airport	Inches	3.76	24.40	19.31	4.26	47.47
	% Avg	46%	195%	143%	38%	139%
Capitol Hill	Inches	5.22	25.44	16.59	7.44	47.25
	% Avg	58%	204%	123%	62%	135%
Tinian Airport	Inches	3.80	21.72	9.62	4.07	35.14
	% Avg	42%	174%	71%	34%	100%
Rota Airport	Inches	8.10	13.10	14.78	7.38	35.98
	% Avg	78%	99%	111%	58%	97%

Climate Outlook:

During October 2016, the CPC's Oceanic Niño Index (ONI) and other behaviors of the atmosphere and ocean indicated that the climate system had entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO diagnostics discussion (see Current Conditions section). Computer model forecasts are now indicating average to above average rainfall over the next three months, and the PEAC concurs with these projections. With La Niña now in-place and expected to continue at last through early 2017, rainfall amounts should be average to slightly above average over the next several months. Enhanced convection in shear lines or from a convective cloud cluster extending beyond 10°N could result in a wet January or February.

The TC threat on Guam and in the CNMI is usually greatly reduced during the year of the post-Peak of a strong El Niño event. It is tempting to declare that no direct strikes of any tropical storm or typhoon will occur on Guam or in the CNMI during the remainder of 2016 (and through at least April 2017), but the odds do not fall to zero. The basin TC activity should continue to exhibit a westward shift, with a near average count (3 or 4 more named cyclones) for the remainder of the year. The year-ending TCs will likely be in early developmental stages near Guam and Saipan, bringing some heavy rains, but sparing the region the damaging effects of a strong tropical storm or typhoon.

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Predicted rainfall for the Mariana Islands from October 2016 through September 2017:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]	
	Guam/Rota	Saipan/Tinian
Oct-Dec 2016 (End of rainy season)	110%	100%
Jan-Mar 2017 (1st half of next dry season)	110%	100%
Apr-Jun 2017 (2nd half of next dry season)	100%	95%
Jul-Sep 2017 (Onset of next rainy season)	100%	100%

Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.

Federated States of Micronesia

Yap State: Every month from September 2015 through September 2016 had below average rainfall at the Yap Island WSO (Fig. Y1). The 6 months of OND (2015) + JFM (2016) were particularly dry with only 39% of average, and by March 2016, the Yap Island reservoir was nearly depleted. In addition, several wild fires had scorched portions of the island. Despite the depletion of the reservoir, other sources of water (e.g., wells), and water in storage precluded both mandatory conservation measures and water rationing. Uninterrupted 24-hour water service was largely maintained across most of the island. High rainfall during May 2016 averted any further deterioration in water resources. Full water service was available when PEAC scientists visited Yap Island in late June, although the level of the reservoir was still very low. Rainfall was below average across Yap Island during subsequent months, but amounts were enough to eventually refill the reservoir. Rainfall at the outer islands and atolls of Yap State also continued to be mostly below average, but in recent months has been of sufficient magnitude to alleviate severe shortages earlier in the year. October 2016 was a very wet month throughout most of Yap State as a named typhoon (Haima) and some other tropical disturbances passed through the region.

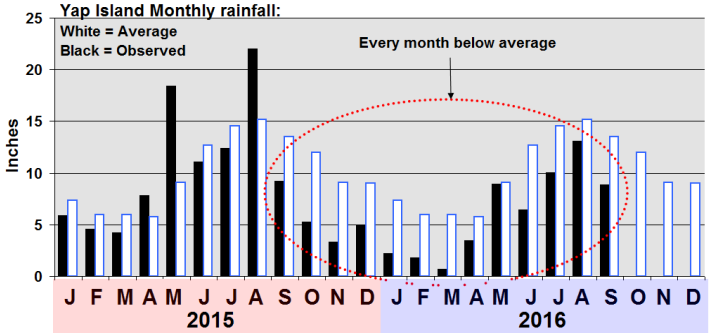

Figure Y1. Time series of monthly rainfall at the Yap Island WSO for all of 2015 through September 2016. The continuous dryness at the end of 2015 into JFM of 2016 set a new historical record. Below average rainfall continued through September.

The northeastern atolls of Yap State (Ulith and Fais) were affected by Typhoon Haima on the night of 15 October through the morning of 16 October. Haima was a tropical storm as it passed over Fais and became a Category 1 typhoon as it moved toward Ulithi Atoll. On the 16th of October, the Yap Island WSO reported 1.39 inches of rain and a peak wind gust to 34 mph as Haima passed safely by to the north. There were no deaths or injuries on Fais or Ulithi, but food sources were partially destroyed. Residents of Ulithi were still recovering from Typhoon Maysak, and recovery efforts were hampered by Haima. After exiting Yap State, Haima became a very intense typhoon that had severe effects in the Philippines and later caused nearly $1 Billion (US) of damage in Hong Kong.

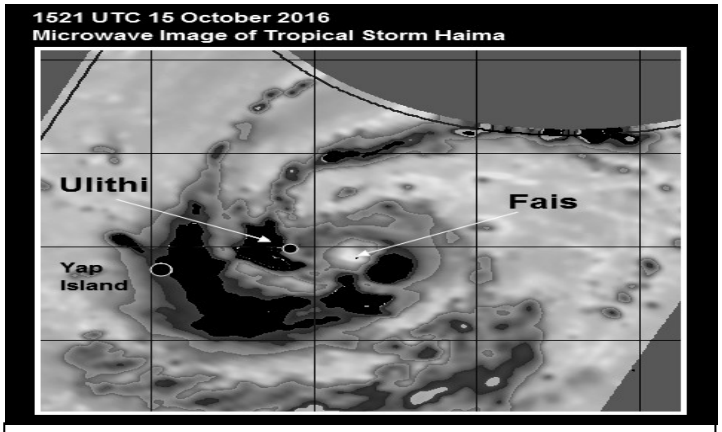

Figure Y2. A microwave image of Haima at 1521 UTC 15 October (121 AM 16 October Yap local time) shows the island of Fais inside the broad consolidating eye of Tropical Storm Haima soon to be a typhoon. (Image courtesy of NRL Monterey)

Yap State Rainfall Summary: JASO 2016 & 3rd Quarter

Station		Jul	Aug	Sep	Oct	3rd Qtr
Yap State						
Yap WSO	Inches	10.03	13.10	8.89	20.00	32.02
	% Norm	69%	86%	66%	167%	74%
Ulithi	Inches	6.08	16.86	10.53	18.51	33.47
	% Norm	49%	130%	92%	182%	91%
Woleai	Inches	14.85	6.67	10.01	18.39	31.53
	% Norm	106%	45%	86%	135%	78%

Climate Outlook:

During October 2016, the CPC's Oceanic Niño Index (ONI) and other behaviors of the atmosphere and ocean indicated that the climate system had entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO diagnostics discussion (see Current Conditions section). The rainfall for the remainder of the year should be close to average throughout Yap State, with average to slightly above average rainfall during the upcoming dry season.

The general reduction of Pacific basin typhoons and the westward and northward displacement of the basin's TCs during a post-Peak El Niño year helps to reduce the local typhoon risk to islands and atolls of Yap State. Late in such a year (i.e., OND 2016), Yap State will be among the first locations in Micronesia where the risk of impacts from TCs returns to near normal. Indeed, Typhoon Haima affected portions of Yap State right on cue in mid-October. One or two more TCs may pass near enough to Yap State over the next two months to be of concern. The PEAC assesses the risk of some damaging effects, such as high waves, gales or very heavy rainfall at 15-20% (a 1-in-7 to 1-in-5 chance).

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Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]	
	Woleai	Yap & Ulithi
October-December 2016 (End of Rainy Season)	100%	100%
January-March 2017 (Heart of next Dry Season)	100%[1]	95%
April-June 2017 (End of Dry Season)	110%[1]	100%
July-September 2017 (Heart of next Dry Season)	100%	100%

[1][Trade wind trough becomes strong at Woleai latitude in La Niña and values can increase to 120%.]

Predicted rainfall for Yap State from October 2016 through September 2017 is:

Chuuk State: Surprising levels of dryness continued at some locations in Chuuk State through the 3rd Quarter of 2016. Looking back, the period October 2015 through March 2016 was particularly dry throughout Chuuk State, which caused some problems with potable water supplies. Then, during the months of April through July of 2016, higher (but still slightly below average) rainfall amounts returned to central and southern islands and atolls. By May 2016, the perceptible impacts of dry weather had ended at all but the atolls in the far north and west of Chuuk State (e.g., Fananu, Onoun and Polowat) where dry conditions were more pronounced. During the 3rd Quarter of 2016, most islands and atolls of Chuuk State continued to receive below average rainfall, with some of the available readings for October 2016 showing below average rainfall in that month as well (Fig. CH-1). Some noteworthy extremes of dryness continue, such as: (1) 7th driest October to July, and (2) 3rd driest October to October. The dryness at the Chuuk WSO during the 13-month period October 2015 through October 2016 was exceeded only by the October-to-October periods of 82-83 and 97-98. All the monthly rainfall totals at the Chuuk WSO have been below average since October 2015!

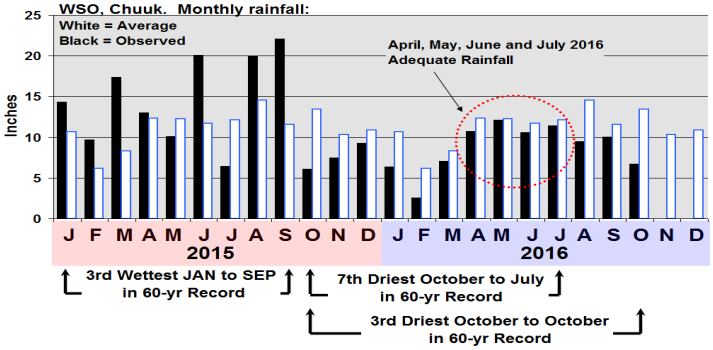

Figure CH-1. A time series of the monthly rainfall at the WSO Chuuk during the calendar year of 2015 and 2016 to-date through October (black bars) as compared to the monthly averages (white bars). Some period of wet and dry extremes are indicated.

Climate Outlook:

During October 2016, the CPC's Oceanic Niño Index (ONI) and other behaviors of the atmosphere and ocean indicated that the climate system had entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO diagnostics

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Chuuk State Rainfall Summary: JASO 2016 and 3rd QTR 2016 total						
Station		Jul	Aug	Sep	Oct	3nd Qtr
Chuuk Lagoon						
Chuuk WSO	Inches	11.27	9.50	10.04	6.74	30.81
	% Avg	93%	65%	87%	50%	81%
Southern Mortlocks						
Lukunoch	Inches	6.84	10.31	12.23	8.41	29.38
	% Avg	45%	79%	120%	81%	76%
Northern Mortlocks						
Losap	Inches	6.64	11.70	10.06	.**	28.40
	% Avg	55%	80%	87%	%	74%
Northern Atolls						
Fananu	Inches	10.54	12.08	5.26	5.39	27.88
	% Avg	87%	83%	46%	40%	73%
Western Atolls						
Polowat	Inches	2.75*	5.31*	3.51*	.**	11.57*
	% Avg	20%	35%	26%	%	27%

* It is possible that dryness at Polowat is caused by an exposure problem with the rain gauge.

discussion (see Current Conditions section). With weak La Niña conditions in-place, the rainfall over the next three months should be average to slightly above average throughout Chuuk State, with near average rainfall during the upcoming dry season.

The general reduction of Pacific basin typhoons and the westward and northward displacement of the basin's TCs during a post-Peak El Niño year helps to reduce the local typhoon risk to islands and atolls of Chuuk State. One or two more of the basin's TCs may pass through Chuuk State during the final 2 months of 2016, bringing heavy showers, but the risk of some damaging effects, such as high waves, gales or very heavy rainfall is small at 10% (a 1-in-10 chance). During the upcoming winter months, there is slight risk of damaging over-wash of atolls by large northerly swell generated far to the north by the winter storms of the mid-latitudes.

Lastly, the sea level was very low in Chuuk State during the latter half of 2015 and early 2016, but has risen rapidly to now stand above average (see the sea level section for details). Predicted rainfall for Chuuk State from October 2016 through September 2017 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]			
	Chuuk Lagoon, Losap, & Nama	Polowat	Northern Atolls	Mortlocks
Oct – Dec 2016	105%	90%	95%	110%
Jan – Mar 2017	100%	85%	95%	105%
Apr-Jun 2017	100%	95%	100%	110%
Jul - Sep 2017	100%	90%	95%	100%

[1] Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.

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Pohnpei State: Persistent dryness began on Pohnpei Island in the 2nd half of 2015 and continued through May of 2016. Although these dry conditions were not perceived to be severe by residents of Pohnpei Island, and there was no serious impact to municipal water quantity and quality, the 12-month period June 2015 through May 2016 was the 9th driest such period in the 63-year post-WWII historical record (Fig. PN-1). Rainfall returned

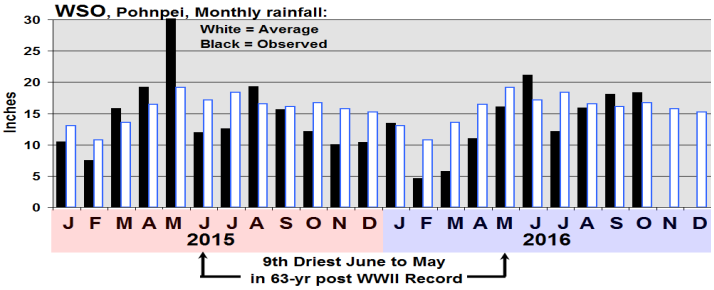

Figure PN-1. A time series of the monthly rainfall at WSO Pohnpei Island during the calendar year of 2015 and JAN – OCT of 2016. The total rainfall in the period June 2015 through May 2016 was the 9th driest such period in the post-WWII record. Rainfall returned to near average after May. Black bars are observed rainfall and white bars are the long-term average.

to near average over the subsequent months, with half the months from May through October 2016 above average and half below. By the time of an October visit to Pohnpei Island by UOG PEAC scientists, the roadside and mountain rain forest vegetation was richly thick and green; waterfalls were wide, post-card perfect, whitewater cascades; and streams were running high. During an evening meal, a typical Pohnpei downpour pounded on the roof to drown out conversation as over two inches of rainfall fell in an hour!

Pohnpei State Rainfall Summary JASO & 3rd Qtr 2016						
Station		**Jul**	**Aug**	**Sep**	**Oct**	**3rd Qtr**
Pohnpei WSO	**Rain (Inches)**	**12.12**	**15.91**	**18.13**	**18.39**	**46.16**
	% of Average	**66%**	**96%**	**113%**	**110%**	**91%**
PNI Airport	**Rain (Inches)**	**9.85**	**13.43**	**16.51**	**15.33**	**39.79**
	% of Average	**65%**	**99%**	**125%**	**112%**	**95%**
Atolls of Phonpei State						
Station		**Jul**	**Aug**	**Sep**	**Oct**	**3rd Qtr**
Nukuoro	**Rain (Inches)**	**13.06**	**6.77**	**8.02**	**7.61**	**27.85**
	% of Average	**91%**	**60%**	**73%**	**71%**	**76%**
Pingelap	**Rain (Inches)**	**4.53**	**4.60**	**3.30**	**5.98**	**12.43**
	% of Average	**28%**	**31%**	**22%**	**40%**	**27%**
Kapinga	**Rain (Inches)**	**9.33**	**7.38**	**7.61**	**2.14**	**24.32**
	% of Average	**78%**	**84%**	**92%**	**32%**	**84%**

On the atolls of Pohnpei State at lower latitude (e.g., Nukuoro and Kapingamarangi) rainfall amounts continued a trend toward below average amounts. This is typical during the onset of La Niña, as the equatorial SST begins to cool, winds become easterly, and convection is suppressed. The low amount

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of rainfall at Pingelap (further north) may not be representative of a true decline because the rain gauge there has an identified shortfall that will require the rain gauge to be moved to a location with a better exposure.

Climate Outlook:

During October 2016, the CPC's Oceanic Niño Index (ONI) and other behaviors of the atmosphere and ocean indicated that the climate system had entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO diagnostics discussion (see Current Conditions section). With the anticipation that weak La Niña will persist through the winter of 2017, the rainfall over the next three months should be average to slightly above average at Pohnpei Island and atolls north of 5° N (e.g., Pingelap, Sapwuahfik and Mwoakilloa), with average to slightly above average rainfall continuing through the winter months (DJF) of 2017. Atolls south of 5°N (especially Kapingamarangi) may now enter a prolonged period of mostly below average monthly rainfall. Note: the spring months (AMJ) of 2017 could see above average rainfall at Pohnpei Island as a persistent trade-wind trough is established between 5° and 8°N.

For the remainder of 2016, the threat of a damaging TC anywhere within Pohnpei State is very low (less than a 1-in-10 chance).

Lastly, the sea level was very low in Pohnpei during the latter half of 2015 and early 2016, but has risen rapidly to now stand above average (see the sea level section for details).

Breaking News

A Drought Information Statement was issued by the WFO Guam on 21 November to highlight emerging drought conditions at Kapingamarangi Atoll, and to focus attention on the possible later emergence of drought conditions at Nukuoro and at Kosrae. Excerpts follow:

"THE EXPERIMENTAL DROUGHT ASSESSMENT OF THE U.S. DROUGHT MONITOR INDICATES KAPINGAMARANGI IS ALREADY IN SEVERE DROUGHT (DROUGHTLEVEL 2 OF 4) AND THAT NUKUORO IS ABNORMALLY DRY AND MAY ALSO BE AFFECTED BY DROUGHT IN THE COMING WEEKS. KOSRAE MAY ALSO EXPERIENCE PERIODS OF DRY WEATHER IN THE COMING MONTHS.
SUMMARY OF IMPACTS....

POHNPEI STATE…

***KAPINGAMARANGI**: LOCAL AUTHORITIES HAVE REQUESTED ASSISTANCE AND POHNPEI STATE GOVERNMENT HAS PROVIDED BOTTLED WATER AND IS CONDUCTING FURTHER ASSESSMENTS.*

WEATHER CONDITIONS FOR KAPINGAMARANGI ARE BECOMING INCREASINGLY DRY AND BELOW NORMAL RAINFALL IS EXPECTED THROUGH THE NEXT FEW MONTHS. WATER SUPPLIES NEED TO BE MONITORED CLOSELY AND WATER CONSERVATION IS NEEDED. WELLS SHOULD BE MONITORED FOR EXCESSIVE SALINITY. DAMAGE TO FOOD CROPS IS LIKELY OVER THE NEXT FEW MONTHS AND THE HEALTH OF FOOD CROPS SHOULD BE CLOSELY MONITORED.

***NUKUORO**: RAINFALL HAS BEEN BELOW NORMAL AT NUKUORO THE PAST COUPLE OF MONTHS AND RELATIVELY DRY WEATHER IS EXPECTED IN THE COMING*

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MONTHS. WATER SUPPLIES SHOULD BE MONITORED AND WATER CONSERVATION IS ENCOURAGED. WELLS SHOULD BE MONITORED FOR EXCESSIVE SALINITY. SOME DAMAGE TO FOOD CROPS IS POSSIBLE OVER THE NEXT FEW MONTHS AND THE HEALTH OF FOOD CROPS SHOULD BE CLOSELY MONITORED."

Predicted rainfall for Pohnpei State from October 2016 through September 2017 is:

Inclusive Period	% of long-term average	
	Pohnpei Island/ atolls	Kapingamarangi
Oct – Dec 2016	100%	60%
Jan – Mar 2017	110%	50%
Apr – Jun 2017	120%	50%*
Jul – Sep 2017	110%	75%*

*Located near the equator, the rainfall pattern at Kapingamarangi is much different than at islands and atolls farther to the north. It remains wet through the onset and peak of El Niño, and typically stays wet through all of the post-Peak period El Niño. Drought at Kapingamarangi is often associated with strong La Niña events, and dry conditions could become persistent at Kapingamarangi by late spring or summer of 2017 if the climate system breaks the threshold toward La Niña late in 2016.

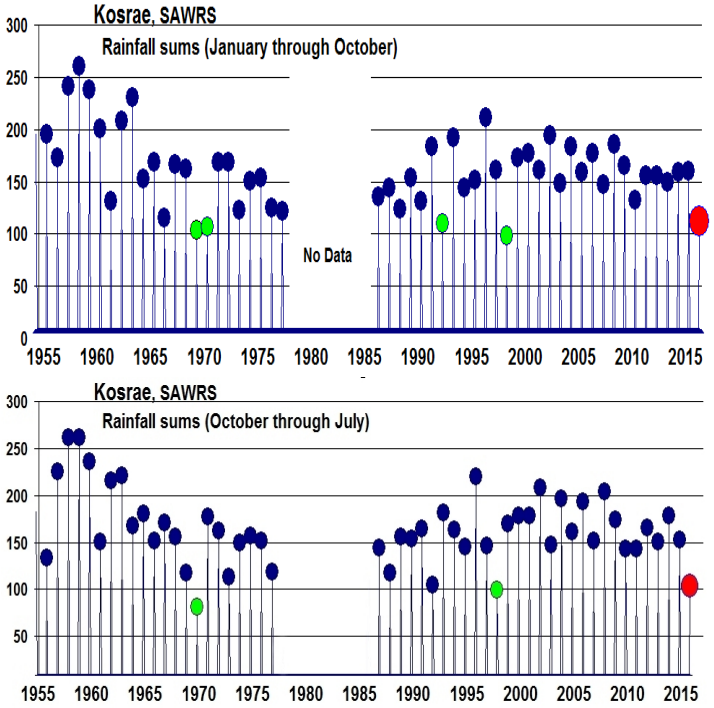

Figure KS-1. Time series of 10-month Oct-Jul rainfall totals (top) and 10-month Jan-Oct rainfall totals (bottom) at Kosrae SAWRS (Airport) observing site during the period of historical record 1954-2016 (with no data during 1978-1985). The period Oct 2015 to July 2016 was the 3rd driest such period in the time series (red dot) behind only 1970 and 1998 (green dots), and the period January 2016 to October 2015 the 5th driest such period in the time series (red dot) behind only 1969, 1970, 1992 and 1998 (green dots).

LOCAL SUMMARY AND FORECAST

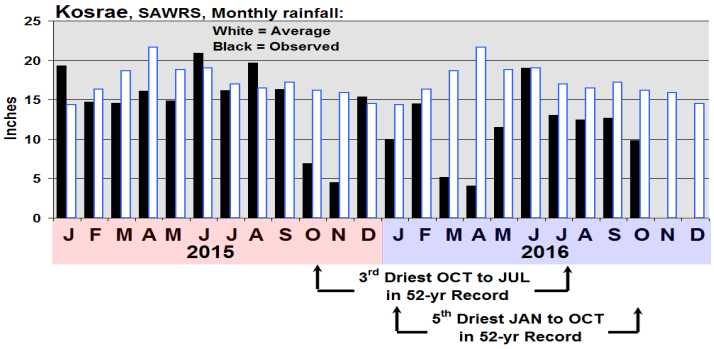

Figure KS-2. A time series of the monthly rainfall at Kosrae Supplemental Aviation Weather Reporting Station (SAWRS) for the calendar year of 2015 and January through October of 2016.

Kosrae State: Kosrae was very dry over the course of the Peak and Post-Peak phases of the 2015/16 El Niño event. Tabulations of rainfall over a variety of multi-month time periods reveal rainfall amounts in the lowest 10% of historical values. For example, the period from October 2015 through July 2016 was the 3rd-driest such period in the 52-year time series of rainfall at Kosrae Supplemental Aviation Weather Reporting Station (SAWRS) (See Fig. KS-1 top). The period from January 2016 through October 2016 was the 5th-driest such period (See Fig. KS-1 bottom). Despite the low rainfall totals, the PEAC received no reports of any serious problems related to dry conditions on Kosrae. This may be an artifact of the observed sequence of drier and wetter months, Kosrae's small population,

Kosrae State Rainfall Summary: JASO 2016 and 3rd QTR 2016 total

Station		Jul	Aug	Sep	Oct	3rd Qtr
Airport (SAWRS)	Rain (Inches)	13.07	12.48	12.71	9.87	38.26
	% of Average	77%	76%	74%	61%	75%
Nautilus Hotel	Rain (Inches)	10.60	15.75	12.23	21.65	38.58
	% of Average	62%	95%	71%	%	76%

and the fact that even with near-record dryness, several of the months had over 10 inches of rainfall (Fig. KS-2). Only two months during 2016 to-date fell below the PEAC/NCEI threshold of 8-inches per month for drought impacts to begin affecting drinking water quantity. With all years of Kosrae's historical record having a tally of over 100 inches of annual rainfall and the total rainfall of 2016 to-date already at 112.28 inches, "dryness" on Kosrae is a relative term! Perhaps, as at Palau (where historically low rainfall had ecological impacts such as the death of the jellyfish in Jellyfish Lake), prolonged relatively low rainfall on Kosrae may induce subtle ecological damages.

Climate Outlook:

During October 2016, the CPC's Oceanic Niño Index (ONI) and other behaviors of the atmosphere and ocean indicated that the climate system had entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO Diagnostics Discussion (see Current Conditions section). Computer model forecasts for the total rainfall at Kosrae over the next three months indicate equal

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probabilities (33%) for each of the three categories: below average, average, or above average. Note that equal chances for each of the rainfall terciles does not mean the forecast is for "near average"; that would require a higher weighting for the "average" tercile. In view of the persistent ongoing dryness, PEAC scientists and WFO Guam forecasters manually intervened to add a small weight to the chances for average or below average rainfall and reduce the odds for above average rainfall over the next 3 months. During the spring of 2017, a strong trade wind trough could bring wetter than average conditions.

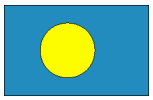
Tropical cyclones occur at Kosrae almost exclusively during the months of El Niño Onset through the El Niño Peak phase. During the El Niño post-Peak months, and indeed all the way through to the end of 2016, the threat of a damaging tropical cyclone at Kosrae is very low.

Lastly, the sea level typically begins a rapid rise throughout all of Micronesia in the post-Peak months of an El Niño event. The sea level all across all of Micronesia increased rapidly over the past few months, and is now above average at all tide-gauge sites in the region. Sea level throughout Micronesia is highly correlated, and it is very likely that the sea level at Kosrae has risen substantially since earlier in the year to now stand above average (see the sea level section for details).

Predicted rainfall for Kosrae State from October 2016 through September 2017 is:

Inclusive Period (Kosrae)	% of long-term average / Forecast rainfall (inches) [1]
Oct – Dec 2016	85%
Jan – Mar 2017	90%
Apr – Jun 2017	110%
Jul – Sep 2017	100%

[1] Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.



Republic of Palau: During the 3rd Quarter of 2016 (Fig. PL1), Palau continued to accrue additional losses to its substantial reduction of rainfall (Fig. PL2). By August 2016, the accumulated deficit of rainfall (starting the tabulation in January 2015) reached its lowest point of 85.73 inches! Wet weather during September and October helped to ease the long-term deficit by a small amount, but many months of above-average rainfall will be needed to fully erase the long-term rainfall accumulated deficit of the El Niño drought of 2015-2016.

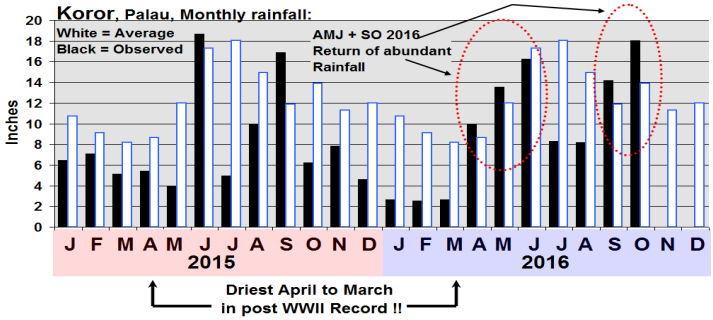


Figure PL-1. Observed rainfall (black bars) versus average rainfall (white bars) at Koror, Palau, for calendar year 2015 through October 2016.

LOCAL SUMMARY AND FORECAST

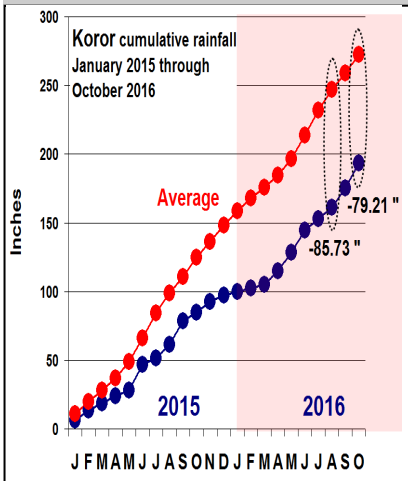


Figure PL-2. Cumulative rainfall at Koror. Red line shows the normal accumulated rainfall from JAN 2015 through OCT 2016, and the dark blue line shows the measured accumulated rainfall over the same time period. The accumulated deficit reached its extreme low of -85.73 inches in August 2016. Above average rainfall during September and October 2016 improved the deficit by a small amount, but there is still a long way to go for full recovery from the record-breaking long El Niño drought of 2015-2016.

As reported in the last newsletter, the substantial prolonged reduction of Palau's rainfall caused major disruptions to the municipal water supply. Ecological impacts of dryness included brush fires, reduced stream flow, yellowing of vegetation, and the death of millions of jellyfish in Palau's world-famous Jellyfish Lake. Whereas 24-hour municipal water service is now fully restored in Koror (and other local Palau communities), the recovery from the ecological damage may yet take several more months of abundant rainfall. During the strong 1997/98 El Niño event, the golden jellyfish (Mastigias sp.) medusa of Jellyfish Lake underwent a total collapse, and none were observed until January 2000. It was not until May 2012 that the population returned to pre-decline levels of many millions of adult golden medusa.

Republic of Palau Rainfall summary
JASO & 3rd Quarter 2016 total.

Station		Jul	Aug	Sep	Oct	3rd Qtr
Koror WSO	Rain (Inches)	8.28	8.20	14.19	18.06	30.67
	% of avg.	46%	55%	120%	130%	68%
Intl. Airport	Rain (Inches)	11.01	14.69	14.39	19.77	40.09
	% of avg.	55%	89%	110%	130%	81%
Nekken	Rain (Inches)	15.30	17.53	21.37	17.55.	54.20
	% of avg.	85%	117%	180%	127%	121%
Intl. Airport	Rain (Inches)	11.32	8.14	9.25	9.72	28.71
	% of avg.	63%	54%	78%	70%	64%

Climate Outlook:

During October 2016, the CPC's Oceanic Niño Index (ONI) and other behaviors of the atmosphere and ocean indicated that the climate system had entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO diagnostics discussion (see Current Conditions section). The rainfall over the next three months should be average to slightly above average, with average to slightly above average rainfall during the upcoming 2017

LOCAL SUMMARY AND FORECAST

dry season. The occurrence and near passage of a TC could produce a much wetter than normal month.

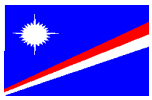
The general reduction of Pacific basin typhoons and the westward and northward displacement of the basin's TCs during a post-Peak El Niño year helps to reduce the local typhoon risk to islands and atolls of Palau. However, late in such a year (e.g., OND 2016), the Republic of Palau will be among the first locations in Micronesia where the risk of impacts from TCs returns to near normal. Indeed, several TCs have recently passed well to the north of Palau, but over the next two months, one or two named TCs may pass near enough to Palau to be of concern. The PEAC assesses the risk of some damaging effects, such as high waves, gales or very heavy rainfall at 15% (a 1-in-7 chance). Palau is not immune from very strong, late season typhoons, such as Supertyphoon Bopha in December 2012 and Supertyphoon Haiyan in November 2013.

Lastly, the sea level was very low in Palau during 2015, but has risen rapidly to now stand above its average height (see the sea level section for details).

Predicted rainfall for Palau from October 2016 through September 2017 is:

Palau Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]
Oct-Dec 2016	105%
Jan-Mar 2017	110%
Apr-Jun 2017	110%
Jul-Sep 2017	110%

[1] Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.



Republic of the Marshall Islands (RMI)

During September and October of 2016, the Majuro WSO experienced above average monthly rainfall for the first time in over one year! Most of the atolls of the RMI from Kwajalein and southward experienced a similar distribution of rainfall, with the prolonged El Niño-related dry spell finally broken by heavy rainfall in September and/or October (Fig. RMI-1). Oddly, it was at the northernmost atolls of the RMI (e.g., Wotje and Utirik) where substantially above average rainfall began two months earlier (i.e., July and August) than at atolls further to the south. A northward displacement of ITCZ convection may have been responsible. A general displacement of ITCZ convection was noted in the central Pacific for most of the summer months that was often broken into distinct cloud clusters and areas of thunderstorm activity accentuated by TUTT cells. October 2016 rainfall was particularly heavy in the northern RMI, with both Kwajalein and Utirik receiving over 18 inches! During October, Kwajalein atoll experienced three days with over 2 inches of rain, with an extreme event of 4.30 inches on 28 October that was its wettest day of 2016, and the wettest day since 17 November 2015 when 4.70 inches was recorded.

Sidebar[1]

On the afternoon of Tuesday, 18 October 2016, high astronomical tides combined with gusty south-southeasterly wind caused damaging inundation on the lagoon-side of the islets of Uliga, Rita, Ejit and other islets on Majuro's northern coastline. This event was generated by a 3-hour-long pulse of southerly winds of 25-30 mph (and perhaps locally higher) (Fig. RMI-2) .

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On the afternoon of Tuesday, 18 October 2016, high astronomical tides combined with gusty south-southeasterly wind caused damaging inundation on the lagoon-side of the islets of Uliga, Rita, Ejit and other islets on Majuro's northern coastline. This event was generated by a 3-hour-long pulse of southerly winds of 25-30 mph (and perhaps locally higher) (Fig. RMI-2) acting upon high water in the lagoon to produce 2-3 foot choppy lagoon-side wind waves with perhaps a small component of wind set-up of higher water on the north side of the lagoon. The gusty winds were likely the low-level outflow, with accompanying wind shift and pressure rise during the passage of a northward propagating area of convection located in the ITCZ initially near and to the south of Majuro. This area of convection was somewhat unremarkable on satellite imagery. In addition to the locally gusty winds on Majuro, the pulse also 12 hours later moved into Kwajalein in the very early morning hours of 19 October accompanied by a shift of the wind to a southerly direction, with a 5-hour period of higher gusts to 25-30 mph. A moderate total of 0.61 inches of rainfall was observed at the Kwajalein airfield during the event. No inundation was reported to upon high water in the lagoon to produce 2-3 foot choppy lagoon-side wind waves with perhaps a small component of wind set-up of higher water on the north side of the lagoon. Note that no inundation was reported to have occurred anywhere in the Kwajalein atoll during this event.

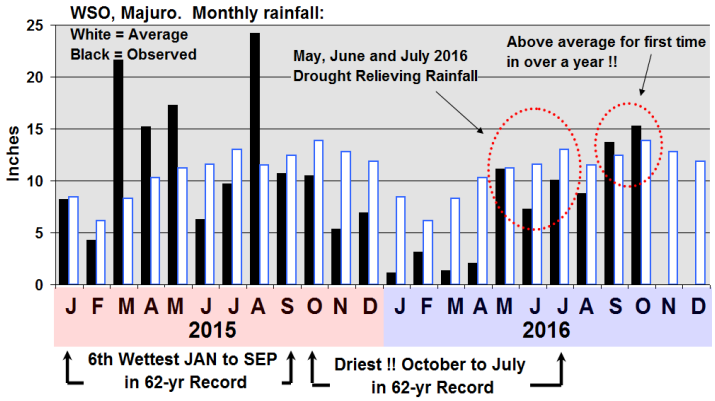


Figure RMI-1. A time series of rainfall at the WSO Majuro during 2015 and 2016 to-date. Note the evolution from extremely wet to extremely dry during the course of the 2015-16 El Niño event. Note also the long duration of below-average months, broken finally by above average rainfall during September and October 2016. The observed monthly values of rainfall at WSO Majuro are shown in black, and the monthly average rainfall is shown in white.

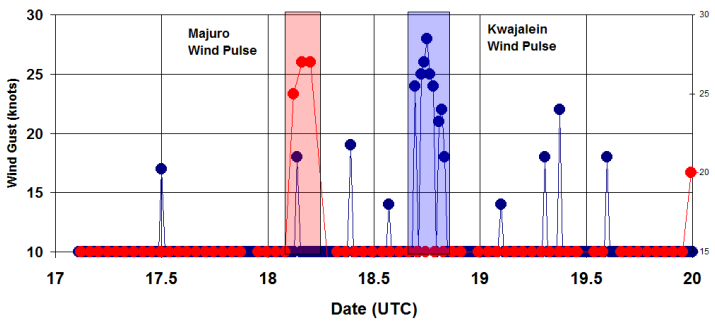


Figure RMI-2. Hourly wind gust reports from Majuro (lighter dots) and Kwajalein (darker dots) during the inundation event at Majuro on the 18th of October. Shaded regions show the period of highest gusts at the respective location.

LOCAL SUMMARY AND FORECAST

The following statements concerning the inundation on 18 October 2016 were excerpted from the 20 October 2016 issue of the Marshall Islands Journal[1]:

"A storm-driven high tide flooded the shoreline in Uliga and Rita as well as Ejit and other islands on Majuro's northern coastline Tuesday afternoon, causing damage to seawalls and structures along the lagoon."

"Waves pushed by storm winds Tuesday afternoon flooded parts of Majuro, damaging seawalls and structures located close to the lagoon shore. There were no reports of injuries, but a peak high tide for the month was driven over shorelines facing south by gusting winds of a storm that developed earlier in the day."

"Weather officials on Saturday predicted the likelihood of "some inundation" around times of high tides through Tuesday, and the forecast was correct as for several days at high tide, small inundations were seen at various locations around Majuro. But Tuesday's sudden storm multiplied the threat, causing waves kicked up inside the normally placid lagoon to roll several hundred feet into Ejit Island's interior and slam Uliga and Rita shorelines."

"Since Sunday, other parts of Majuro Atoll have experienced moderate ocean flooding that dumped garbage and rocks onto main roads, slowing or temporarily halting vehicular traffic".

[1] The Marshall Islands Journal: marshallislandsjournal.com http://marshallislandsjournal.com/Journal_WP/?p=3813

RMI Rainfall Summary: JASO 2016 and 3rd QTR 2016 total						
Station		**Jul**	**Aug**	**Sep**	**Oct**	**3rd Qtr**
RMI Central and Southern Atolls						
Majuro WSO	**Inches**	**10.09**	**8.78**	**13.73**	**15.28**	**32.60**
	% Avg	**78%**	**76%**	**111%**	**110%**	**88%**
Ailing	**Inches**	**12.53**	**9.42**	**6.64**	**13.28**	**28.59**
	% Avg	**107%**	**87%**	**55%**	**103%**	**82%**
Jaluit	**Inches**	**7.25**	**7.74**	**6.56**	**14.50**	**21.55**
	% Avg	**56%**	**67%**	**53%**	**105%**	**58%**
Arno	**Inches**	**13.15**	**8.97**	**14.89**	**19.54**	**37.01**
	% Avg	**101%**	**78%**	**120%**	**141%**	**100%**
RMI Northern Atolls						
Kwajalein	**Inches**	**9.96**	**8.12**	**6.90**	**18.73**	**24.98**
	% Avg	**95%**	**80%**	**58%**	**157%**	**77%**
Wotje	**Inches**	**10.00**	**9.92**	**2.94**	**13.83**	**22.86**
	% Avg	**167%**	**146%**	**38%**	**167%**	**111%**
Utirik	**Inches**	**9.60**	**10.83**	**9.00**	**18.47**	**29.43**
	% Avg	**173%**	**172%**	**125%**	**240%**	**154%**

Climate Outlook:

During October 2016, the CPC's Oceanic Niño Index (ONI) and other behaviors of the atmosphere and ocean indicated that the climate system had entered La Niña. For this reason, the CPC upgraded its La Niña Watch to a La Niña Advisory in its November 10th monthly ENSO diagnostics discussion (see Current Conditions section). The rainfall over the next three months should be average to slightly above average throughout the RMI. It should be very wet in Mili during the spring as the trade wind trough intensifies and sits over the atoll.

The general reduction of Pacific basin typhoons and the westward and northward displacement of the basin's TCs during a post-Peak El Niño year helps to reduce the local TC risk to atolls of the RMI. While no TCs are expected to adversely affect the RMI for the remainder of the year, gusty winds in the thunderstorm clusters of the ITCZ could yet again act to exacerbate minor lagoon-side inundation at Majuro and other atolls, especially at the times of peak astronomical tides of each month.

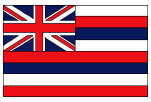
The atolls of the RMI are always at some risk of inundation by the arrival of large swell generated far to the north by the winter storms of the mid-latitudes. The risk of this source of damaging inundation is highest from December through March, with a 15-20% chance.

Lastly, the sea level typically begins a rapid rise in the El Niño post-Peak months, and sea level is now above average in the RMI, and may yet rise an inch or two more over the next two months (see the sea level section for details).

Predicted rainfall for the RMI from October 2016 through September 2017 is:

Inclusive Period	**% of long-term average**		
	South of 6ºN	**6ºN to 8ºN**	**North of 8ºN**
Oct—Dec 2016	**95%**	**110%**	**110%**
Jan—Mar 2017	**100%**	**100%**	**100%**
Apr –Jun 2017	**120%**	**110%**	**95%**
Jul –Sep 2017	**95%**	**100%**	**100%**

[1] Forecast rainfall quantities represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.



Hawaii: The following information was summarized from the NWS Honolulu Office Monthly Hydrology Precipitation Summaries and Drought Information Statements found at http://www.prh.noaa.gov/hnl/pages/hydrology.php. The start of the 2016 – 2017 Hawaiian Islands wet season featured trade winds during all of October, which were unseasonably persistent for this time of year. On average, trade winds occur on roughly two-thirds of the days in October across the island chain. Trade wind intensities were mainly in the moderate to fresh range, though stronger high pressure to the north of the state cranked up intensities into the fresh to strong range over the last 10 days of the month. The wet season runs through the end of April. During September abundant moisture from the deep tropics helped fuel another month of wet conditions for many areas of the state during what is normally part of the dry season. September started with the passage of Hurricane Lester to the north of the main Hawaiian Islands. Lester was the second of a tropical cyclone double feature, following the close passage of Hurricane Madeline just to the southeast of the Big Island in late August. While there were no reports of strong winds, the trailing rain band from Lester produced heavy showers and minor flooding over the leeward Kohala slopes of the Big Island and portions of east Maui on September 3.

During October ,while there were no direct hits by tropical cyclones, remnants of former tropical cyclones and a close pass by Hurricane Madeline brought abundant rainfall to many areas of the state. On days between the tropical weather systems, the

LOCAL SUMMARY AND FORECAST

trade winds, blowing mainly at moderate to fresh intensities, produced numerous showers along the windward slopes to further boost rainfall totals for the month.

The first couple of weeks in July featured typical summer trade wind conditions over the State of Hawaii. Showers produced over the slopes and also embedded within the trades brought daily rainfall to windward areas of the island chain. However, weather over the state during the rest of the month was significantly affected by an active period of tropical cyclone development in the eastern Pacific Ocean. The initial effects occurred in the form of low level moisture from the remnant of Hurricane Blas, which produced enhanced trade wind showers across portions of the state on July 13 and 14. Peak daily rainfall totals during this period were in the range of 1 to 2 inches and did not cause any flooding issues. Several days later, the remnant circulation of former Hurricane Celia passed north of the Hawaiian Islands and disrupted the trade wind flow, allowing land and sea breezes to become fully established within humid conditions. This resulted in briefly heavy showers over central Oahu and the windward slopes of Maui and the Big Island on July 18.

Hawaii Rainfall Summary: AMJ 2016 2nd Qtr & 1st Half						
Station		Jul	Aug	Sep	Oct	3rd Qtr
Lihue Airport	Inches	1.70	1.52	0.64	0.45	3.86
	%Norm	101%	83%	33%	14%	71%
Honolulu Airport	Inches	2.71	1.58	2.92	0.12	7.21
	%Norm	753%	832%	487%	10%	627%
Kahului Airport	Inches	1.16	0.56	1.24	0.65	2.96
	%Norm	305%	117%	653%	118%	282%
Hilo Airport	Inches	7.32	24.68	10.74	19.13	42.74
	%Norm	77%	295%	115%	222%	157%

Climate Outlook: From CPC Long-Lead Hawaii Outlooks. Dynamical tools favor above median precipitation for Hawaii from DJF 2016-17 to mam 2017 with higher probabilities for windward exposed locations (Lihue and Hilo) in the winter period. Equal chances for above, near, or below median precipitation are indicated for Hawaii in AMJ 2017 and longer leads.

Predicted rainfall for Hawaii State from December 2016 through August 2017 is:

	Station			
Inclusive Period	Hilo	Honolulu	Kahului	Lihue
Dec – Feb 2017	50% chance of Above Median rainfall	40% chance of Above Median rainfall	40% chance of Above Median rainfall	50% chance of Above Median rainfall
Mar – May 2017	40% chance of Above Median rainfall	40% chance of Above Median rainfall	40% chance of Above Median rainfall	40% chance of Above Median rainfall
Jun – Aug 2017	Equal probabilities of below, average or above average rainfall	Equal probabilities of below, average or above average rainfall	Equal probabilities of below, average or above average rainfall	Equal probabilities of below, average or above average rainfall

LOCAL SUMMARY AND FORECAST

Seasonal Drought Outlook for Hawaii:

The CPC U.S. Seasonal Drought Outlook released on Nov 17, 2016 (available at http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_summary.php) notes that small areas of remaining drought in Hawaii (leeward sides of Kauai and Maui) are expected to improve or be removed by the end of February, although conditions may somewhat degrade first. The Hawaiian precipitation forecast favors above-median precipitation across the archipelago, consistent with the tendency for wet conditions when ENSO is neutral (which is expected by early 2017)

SEASONAL SEA LEVEL OUTLOOK Cont.

Sea Level Observation from the Global Satellite Picture:

Observations from the recent global satellite picture (Fig. 22, below) revealed that the sea levels have been high over the western part of the Pacific Basin. ***The tropical Pacific atmosphere and ocean are currently at weak phase of La Niña.*** *This satellite data are supportive to tide-gauge observations, and revealed that some of the stations located in Micronesia and Marshalls Islands is rising, This is a turning point when sea level transitions to above normal stage from its year-long below normal.*

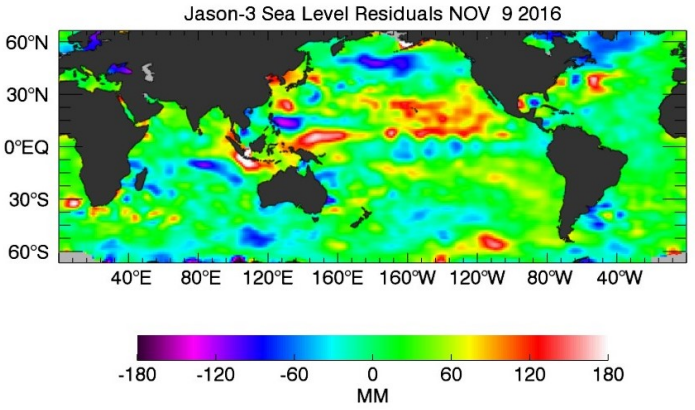


Figure 22. Jason-2 sea level residuals (November 9, 2016). (Source: https://sealevel.jpl.nasa.gov/images/latestdata/jason/2016/20160721G.jpg)

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SEASONAL RAINFALL OUTLOOK FOR THE US-AFFILIATED PACFIC ISLANDS

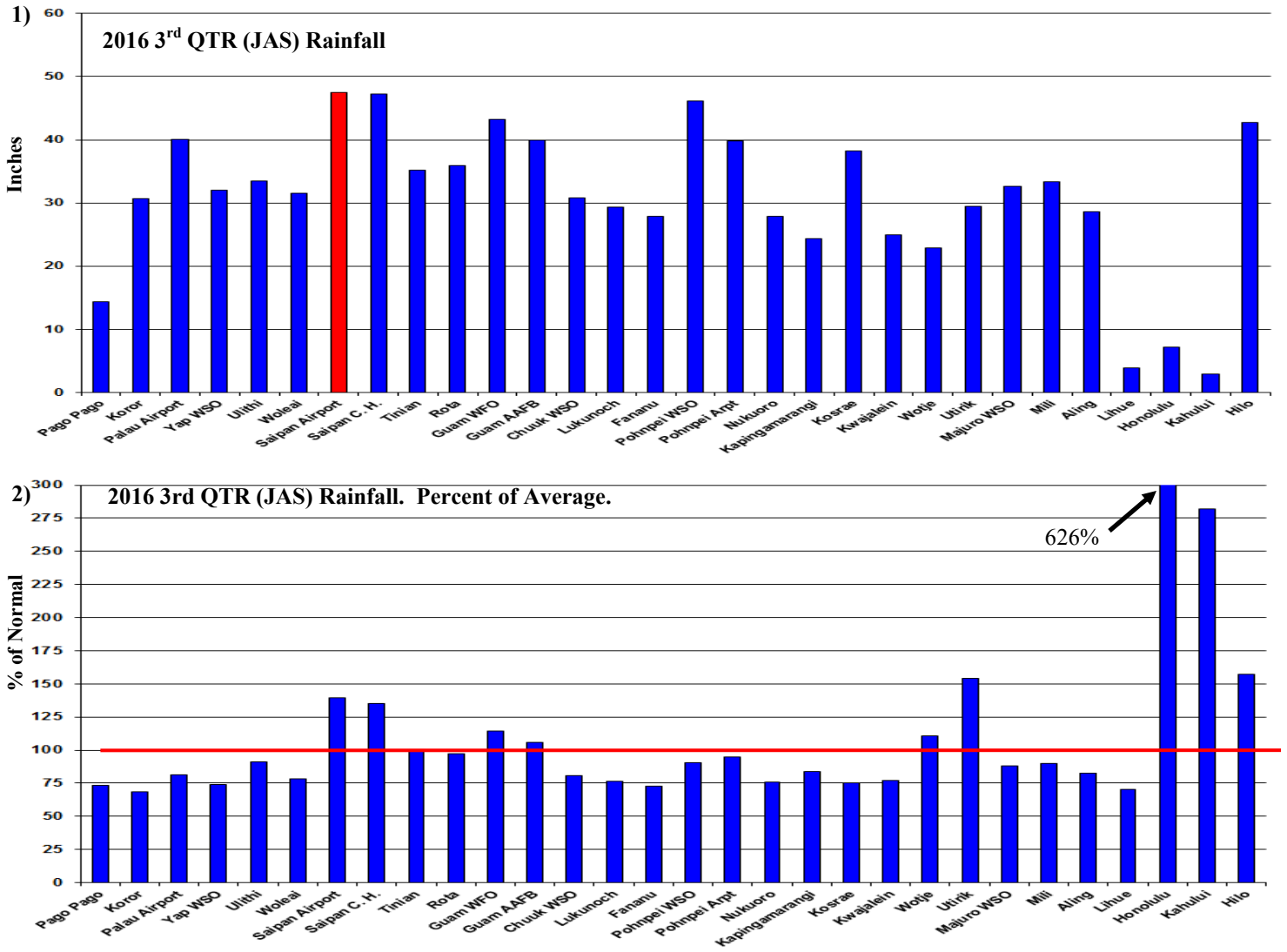

Figure 23 and 24, 2016 First Quarter Percent of Average rainfall amounts in inches at the indicated locations and rainfall departure from average (in percent) at the indicated locations.

ACKNOWLEDGEMENTS AND FURTHER INFORMATION

Pacific ENSO Applications Climate (PEAC) Center:
HIG #340, 2525 Correa Road, Honolulu, Hawai'i 96822
Contact at 808-956-2324: for information on PEAC, the Pacific ENSO Update and ENSO-related climate data for the Pacific Islands.

Dr. Rashed Chowdhury,
Principal Research Scientist, at 808-956-2324: for information on ENSO and sea level variability in the USAPI.
Alejandro Ludert, Graduate Research Assistant and Webmaster, at 808-956-2324 for: information related to the PEAC website.

University of Hawai'i - Joint Institute of Marine and Atmospheric Research (JIMAR), School of Ocean and Earth Science and Technology (SOEST), Department of Oceanography:
MSB #317, 1000 Pope Road, Honolulu, Hawai'i 96822
Dr. Mark Merrifield, PEAC Principal Investigator at 808-956-6161: for more information on sea level and climate in Hawai'i.

NOAA National Weather Service
Weather Forecast Office (WFO) Honolulu:
HIG #250, 2525 Correa Rd., Honolulu, HI, 96822
Tom Evans, PEAC Director, at 808-973-5270: for information related to NWS.

NOAA National Weather Service—Weather Forecast Office (WFO) Guam:
3232 Hueneme Road, Barrigada, Guam, 96913
Chip Guard, Warning Coordination Meteorologist, at 671-472-0900: for information on tropical cyclones and climate in the USAPI.

University of Guam - Water and Environmental Research Institute (WERI):
UOG Station, Mangilao, Guam 96913
Dr. Mark Lander, PEAC Meteorologist, at 671-735-2685 for: information on tropical cyclones and climate in the USAPI.

Pacific ENSO Update Editors:
Joseph Brinkley, Rashed Chowdhury, and Alejandro Ludert

The Pacific ENSO Update is a bulletin of the Pacific El Niño-Southern Oscillation (ENSO) Applications Climate (PEAC) Center. PEAC conducts research & produces information products on climate variability related to the ENSO climate cycle in the U.S. Affiliated Pacific Islands (USAPI). This bulletin is intended to supply information for the benefit of those involved in such climate-sensitive sectors as civil defense, resource management, and developmental planning in the various jurisdictions of the USAPI.

The Pacific ENSO Update is produced quarterly both online and in hard copy, with additional special reports on important changes in ENSO conditions as needed. For more information about this issue please contact the PEAC Center at peac@noaa.gov or at the address listed below.

PEAC is part of the Weather Forecast Office (WFO) Honolulu's mission and roles/responsibilities. All oversight and direction for PEAC is provided by the Weather Forecast Office Honolulu in collaboration with the Joint Institute for Marine and Atmospheric Research (JIMAR) at the University of Hawaii. Publication of the Pacific ENSO Update is supported by the National Oceanic and Atmospheric Administration (NOAA), National Weather Service-Pacific Region Climate Services. The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA, any of its sub-agencies, or cooperating organizations.