PACIFIC ENSO UPDATE

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

3rd Quarter, 2015 Vol. 21, No. 3 **ISSUED: July 30th, 2015**

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

http://www.prh.noaa.gov/peac

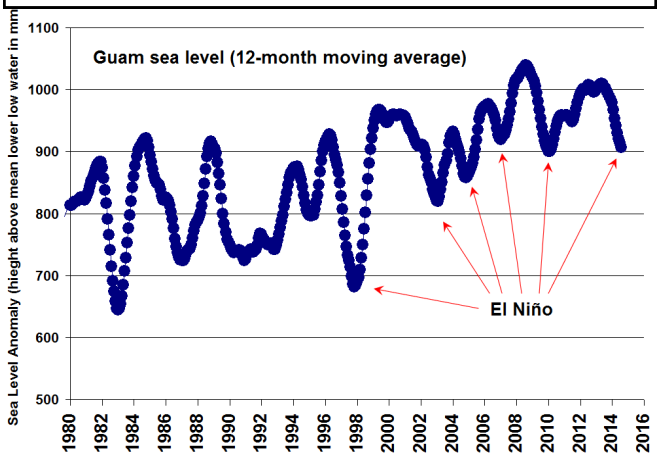
CURRENT CONDITIONS

During the first half of 2015, substantial warming of the equatorial Pacific sea surface and sub-surface waters clearly and unambiguously signaled the arrival of El Niño. Wild weather patterns typical of El Niño onset were observed across the region. These included noteworthy extremes of rainfall and an abundance of early-season tropical cyclones. Strong oceanic responses included the aforementioned oceanic warming and dramatic lowering of the sea level across much of Micronesia. Strong westerly wind bursts accompanied by twin (northern hemisphere-southern hemisphere) tropical cyclone formation were noted at roughly 30-day intervals, with quiet periods in between. This is the hallmark signature of the Madden Julian Oscillation (MJO) amplified by the background El Niño climate state. Through mid-July, twelve named topical cyclones were observed in the western North Pacific basin (see the tropical cyclone discussion). One of these -- Typhoon Halola -- entered from the central Pacific. All but one of the 12 (TS Kujira formed and stayed in the South China Sea) tracked within the bounds of Micronesia, where many islands took a beating. The most damaging of the early season typhoons was super typhoon Maysak, which (at the end of March 2015) left a trail of destruction from Chuuk State westward through Yap State. There was considerable damage and four deaths in Chuuk State, and Ulithi Atoll experienced a devastating direct strike by this super typhoon. During mid-May 2015, Typhoon Dolphin passed between Guam and Rota with typhoon force winds and very high surf observed on portions of both islands. This was the first time since 2002 (during the passage of Pongsona) that typhoon-force sustained wind was observed on Guam, and the first time since 2004 (during the passage of Chaba) that typhoon-force sustained wind was observed on Rota and the northern part of Guam

From January through mid-July 2015, adverse weather across Micronesia included several occurrences of damaging wind, very heavy rainfall and damaging high surf. The wild weather of the first half of 2015, which featured many high rainfall extremes throughout the region, managed even to include a prolonged localized drought across Palau. A selection of extraordinary weather and climate highlights from January through mid-July of 2015 includes:

(1) RMI -- record-setting heavy daily and monthly rainfall on some atolls; (2) RMI – damaging sea inundation on more than one occasion; (3) RMI – unusual tropical cyclone activity; (4) western North Pacific -- abundant early season tropical cyclones (12 through mid-July); (5) Pohnpei Island – record May rainfall; (6) FSM – damaging typhoons (Maysak, Noul, and Dolphin); (7) western Pacific -- two occurrences of named twin tropical cyclones (Bavi and Pam; Chan-hom and Raquel); (8) western Pacific -- several major westerly wind bursts; (9) Guam – February 2015 was the driest month of record; (10) Guam – large waves (20-25 feet) on the east and northeast coasts during the passage of TS Bavi and again during the passage of TY Dolphin; (11) Guam and CNMI – damaging wind from tropical cyclones (Bavi, Dolphin, Chan-hom and Nangka); (12) Pacific Basin – major oceanic surface and subsurface warming signaling the onset of a potentially strong El Niño!

Figure 1. A time series of the sea level anomaly at Guam (which is representative of all of Micronesia). Raw monthly data has been smoothed with a 12-month moving average. Note the lower sea level during El Niño.



Rainfall totals during the first half of 2015 were above average at most locations, with prolonged regional dryness noted only at Palau in the far west of Micronesia, and a month or two of abnormally dry conditions also noted at Utirik, the northern-most island of the Marshall Islands (Fig. 1 and Fig. 2, Page 18). At locations in eastern Micronesia, rainfall was abundant, with extraordinary amounts occurring during March and again in April. Wetter than average rainfall (and in some cases, much wetter than average rainfall) was observed at many islands during January through June. A tropical cyclone was observed within the bounds of Micronesia in every month of 2015 through July (see the typhoon discussion).

The sea level throughout Micronesia has been very high over the past decade, with some small dips during times of weak to moderate El Niño events. As a sure sign of El Niño, sea level continued to fall across most of Micronesia during late 2014 and the first half of 2015 (Fig. 1). The lowest anomaly of sea level tends to occur in December of a typical El Niño year. See the discussion of sea level for more details.

SEA SURFACE TEMPERATURES

For the past Quarter (April, May, and June), ENSO conditions remained in an El Niño Advisory. Overall, across the Pacific representative conditions of El Niño were present with consistent enhanced convection over the central and eastern equatorial Pacific and suppressed convection over Indonesia. Above-average SSTs remained across the equatorial Pacific with anomalies exceeding 1 degree Celsius. The subsurface heat content was slightly reduced as a result of an upwelling oceanic Kelvin wave in the month of June. Consistent with ocean-atmosphere coupling significant low level westerly winds and upper level easterly winds persisted for the past three months. The combined atmospheric and oceanic state are indicative of a strengthening El Niño.

SOUTHERN OSCILLATION INDEX

The 3-month average of the Southern Oscillation Index for the 3rd Quarter of 2015 including April, May, and June remained negative at –0.7. The respective monthly values were –0.1, -1.2, and –0.9. Consecutive periods of negative SOI values and warm ocean waters across the eastern tropical Pacific are indicative of El Niño.

Normally, positive SOI values in excess of +1.0 are associated with La Niña conditions, and negative SOI values below -1.0 are associated with El Niño conditions. Low SOI values suggest a weak coupling between the ocean and the atmosphere. The SOI is an index representing the normalized sea level pressure difference between Darwin, Australia and Tahiti.

TROPICAL CYCLONE ACTIVITY

The PEAC archives western North Pacific tropical cyclone 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 tropical cyclone 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. There are sometimes differences in the statistics (e.g., storm maximum intensity) for a given tropical cyclone among the agencies that are noted in this summary.

Tropical Cyclone Summary

Four typhoons and one tropical storm (all the early season output of the basin) formed within the boundaries of Micronesia during the first four months of 2015. All of these generated heavy rainfall, large waves and high winds somewhere within Micronesia. The eye of Super Typhoon Maysak passed over Ulithi Atoll (10.0°N; 139.7E) on the night of 31 March, with major damage reported. Other islands in Chuuk and Yap State were also adversely affected by the passage of Maysak. (See the tropical cyclone summary and the individual local variability summaries for more details.)

During January through mid-July of 2015, the JTWC numbered eleven significant tropical cyclones (Fig. 2). Each of these was named by the Japan Meteorological Agency (JMA). Eight of these eleven became typhoons as per estimates by the JTWC. The other three (Bavi, Haishen and Kujira) reached only to tropical storm intensity. One additional tropical cyclone (Halola) moved into the western North Pacific from the central Pacific. Halola passed south of Wake Island (19.3°N; 166.7° E) on the 16th of July and remains active well north of Guam and the CNMI at the time of this writing.

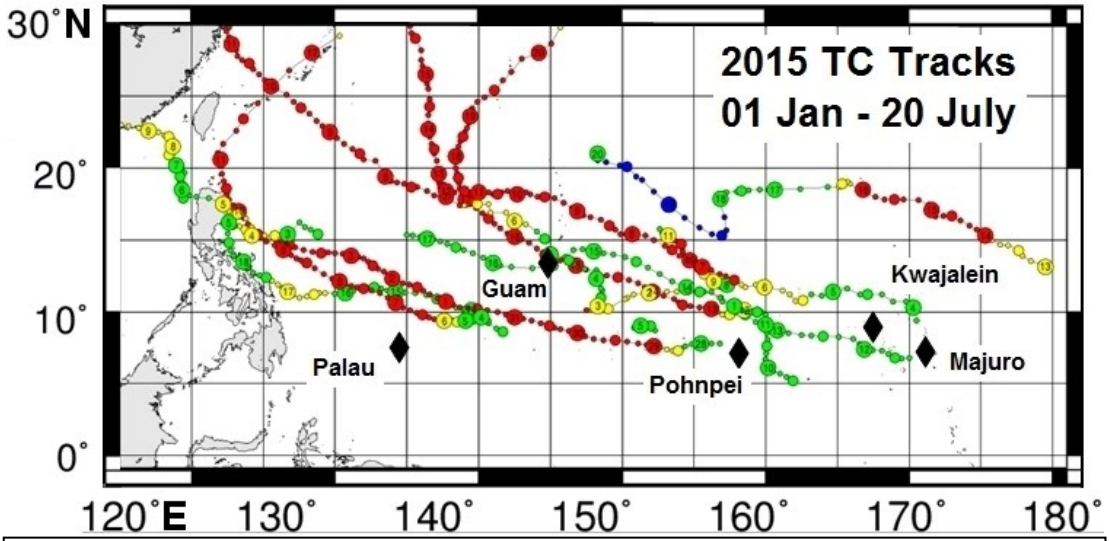
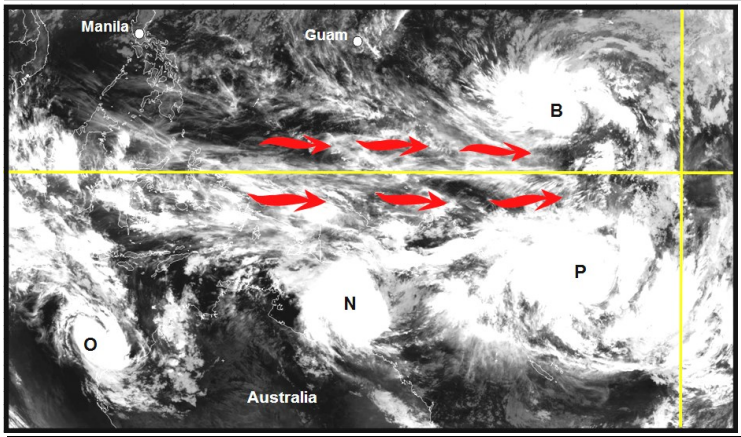


Figure 2. WestPAC tropical cyclones during Jan-Jul 2015. Note that all tracks shown (the track of Kujira is out-of-sight in the South China Sea) pass somewhere within the boundaries of Micronesia, with two of them (Bavi and Nangka) becoming tropical storms while passing Kwajalein. This early season distribution of tropical cyclones is strongly indicative of El Niño to the point where it may be considered diagnostic of El Niño.

A very similar suite of climate indicators that had predicted El Niño in the first few months of 2014 was once again present in even greater force in early 2015. This includes heavy rainfall in the RMI, abundant early season typhoons, major westerly wind bursts (WWBs) along the equator, and falling sea level. During early March, early May, and early July, major WWBs occurred, with each leading to the formation of tropical cyclones. Two cases of named twins occurred in association with the March and July bursts: Bavi and Pam; then Chan-hom and Raquel (Fig. 3). Chan-hom and Raquel represented the first historical case of named twin cyclones during July. Continual low-latitude westerly winds and the WWBs forced an oceanic response to the east: a deepening of the thermocline that yielded a major surface and subsurface warm anomaly that tipped the climate system into relatively strong El Niño for this time of year, with a high likelihood of a continuation of moderate or strong El Niño for the rest of the year.

TROPICAL CYCLONE ACTIVITY



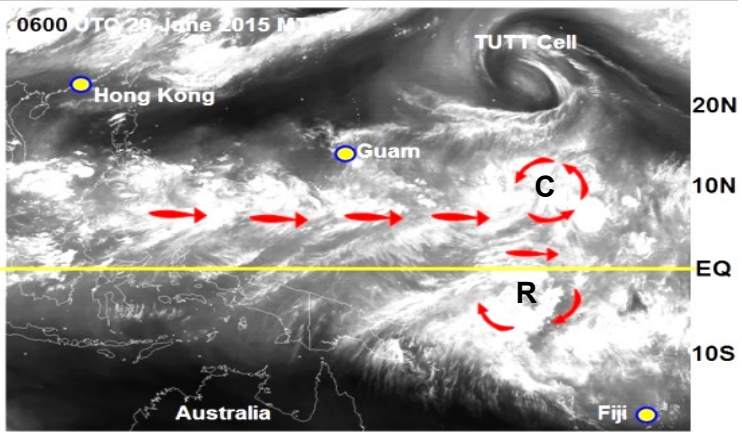


Figure 3a & 3b. 3a (Left). Tropical Cyclone Twins symmetrical with respect to the equator (B = Bavi and P = Pam) developed from a major westerly wind burst that occurred in early March 2015. Two other tropical cyclones (O = Olwyn and N = Nate) also formed along the monsoon trough in the Southern Hemisphere. MTSAT infrared satellite image time is 1800 UTC 11 March 2015**. 3b (Right).** The precursor disturbances that became the tropical cyclone twins Chan-hom (C) and Raquel (R). Strong monsoonal westerlies were found just north of the equator in late June, with the cyclones forming at the eastern reach of the westerlies, acquiring their names in early July.

The calendar year 2015 began with the dying remnants of Tropical Storm Jiangmi still present at low latitudes between the Philippines and Borneo. Not soon after the demise of Jiangmi, a tropical disturbance originating to the southwest of Pohnpei on the 9th of January moved quickly westward (passing to the south of Guam) and was named Mekkhala on the 14th of January. It became the first numbered and named tropical cyclone of the 2015 season. The PEAC had earlier predicted (based on the presence of borderline or weak El Niño during 2014) that the month of January 2015 would likely see the formation of a typhoon with an origin in Micronesia. Less than a month later, a monsoon depression in the far east of Micronesia (i.e., near Kosrae) evolved to become the season's 2nd typhoon. Higos underwent a period of rapid deepening when located to the northeast of Guam and reached its 105 kt peak intensity on the 10th of February (according to the JTWC). At its peak, Higos achieved the status of the strongest February typhoon since Typhoon Nancy in 1970. In less than 24 hours after reaching its peak, Higos rapidly weakened and fell below typhoon intensity on the afternoon of the 11th. During early March 2015, a major westerly wind burst (WWB) began to take shape along the equator in the western Pacific, and by the 10th of March, four named tropical cyclones were active in the western Pacific: Pam, Olwyn and Nate in the Southern Hemisphere, and Bavi in the Northern Hemisphere (see Fig. 5 top). Bavi and Pam were a textbook case of the formation of tropical cyclone twins symmetrical with respect to the equator as the product of an intense WWB. Bavi was a large tropical cyclone, but not of high intensity. Its expansive wind field allowed it to generate large waves that were problematic in the Marshall Islands and later on Guam (see the local variability summaries for more details). Bavi's twin, Pam, was a very intense typhoon that severely affected the South Pacific island nation of Vanuatu. Next up in the chain of early season tropical cyclones of 2015 was Super Typhoon Maysak. This typhoon also formed in the far eastern reaches of Micronesia (southwest of the RMI). It moved westward to become a typhoon a day or so prior to moving directly over Chuuk Lagoon. After leaving Chuuk behind, it intensified even further to become a super typhoon before making a devastating pass over Ulithi Atoll in Yap State. Maysak was perhaps the earliest Category 5 super typhoon recorded in the western North Pacific. Tropical Storm Haishen was a weak storm that had a brief life within Chuuk State. In early May, another major WWB began in the western Pacific. Typhoons Noul and Dolphin evolved from this WWB. On the night of 05 May, Noul (having just reached typhoon intensity) passed nearly over Yap Island. Wind gusted to 68 mph at the Yap Airport, and 24-hour rainfall totals were near 10 inches (see the Yap LVS). Moving westward on the heels of Noul, Dolphin dumped heavy rainfall on Pohnpei Island. Continuing on its west-northwestward track, Dolphin passed between Guam and Rota on the night of 15 May. Sustained winds reached 75 mph with a gust to 106 mph at Andersen AFB. Damage was modest, but a disaster declaration by the U.S. federal government allowed US $10 million recovery funds for Guam following the typhoon (see the Guam and CNMI LVS). The next cluster of tropical cyclones was generated by a strong WWB that started in late June. Typhoon Chan-hom was the first named cyclone of this cluster, and it had a complex track that eventually saw it pass between Guam and Rota of the 5th of July. It had not reached typhoon intensity at that time, but rainfall was heavy (see the Guam and CNMI LVS). Chan-hom had a Southern Hemisphere twin, Raquel. Chan-hom and Raquel were the first documented case of tropical cyclone twins in the month of July. Typhoon Linfa formed next. It brought rainfall to Yap and Palau, but impacts were minimal. The final cyclone of this cluster (Nangka) formed in the RMI. Gusty westerly winds across the Majuro lagoon resulted in a major inundation event on the lagoon side of the heavily populated eastern side of the atoll (see the RMI LVS for more details). Moving west-northwest and becoming a super typhoon, Nangka passed directly over the CNMI island of Alamagan (17.6° N; 145.8° E) just a few hours before attaining super typhoon intensity. After Nangka moved out of the region, a quiet spell ensued across most of Micronesia, with light winds and very hot, mostly sunny days. A tropical cyclone passed from the central Pacific into the western Pacific during this quiet spell, but passed too far to the north to have any appreciable affects in Micronesia, except perhaps to contribute to the stifling light winds and clear skies further to the south.

An abundance of early season tropical cyclones as seen during the first half of 2015 (and also during the early months of 2014) is a typical response to El Niño onset in the western North Pacific. In fact, abundant early season typhoons in the western North Pacific may be used as a condition to diagnose the onset of El Niño. Used as such, the PEAC anticipated the meteorological onset of El Niño in the spring of 2014; however, the necessary oceanic response was delayed until later in the year. The ongoing abundance of 2015 early season typhoon activity in the western North Pacific was/is even more pronounced than it was at the beginning of 2014. Indeed, the Pacific

TROPICAL CYCLONE ACTIVITY

basin is unambiguously in the climate state of El Niño (see CPC discussion on pages 17 to 18), with the meteorological and oceanic components of El Niño clearly and strongly established.

PEAC Center Tropical Cyclone Assessment

Western North Pacific and American Samoa

Three organizations typically produce seasonal outlooks for tropical cyclone activity in the western North Pacific that are routinely used by the PEAC Center for guidance on the upcoming typhoon season: (1) The Guam Weather Forecast Office (WFO), (2) The City University of Hong Kong Laboratory for Atmospheric Research, and (3) The Benfield Hazard Research Centre Tropical Storm Risk (TSR) research group.

On 06 May, 2015, the TSR group issued a forecast for western North Pacific typhoon activity. They predict that the 2015 western North Pacific typhoon season will be the most active since 2004, with activity one standard deviation above the 1965 – 2014 climatic norms. Furthermore, the prediction includes high probability (81%) of a greater-than-average number of very intense typhoons. The PEAC believes that a very high danger remains across Micronesia (and Hawaii) for enhanced tropical cyclone activity. The risk of a damaging tropical cyclone in Micronesia is greatly enhanced by El Niño, even weak or moderate ones. Indeed, the US-Affiliated Pacific Islands (US-API) of the western Pacific have already this year suffered great damage from tropical cyclones associated with El Niño. This damage has been widespread (though not everywhere severe) from the Marshall Islands and westward across Chuuk State, Guam, the CNMI and Yap State. This is likely to continue through 2015 and into January 2016. The risk of a damaging tropical cyclone will be especially high from September 2015 through January 2016) across Micronesia from Guam all the way eastward to the RMI. Most Micronesia islands will have about a 1-in-3 chance of serious effects from some combination of high winds, large waves, and/or extreme rainfall associated with a typhoon during 2015, with a near 100% chance of additional severe effects from a typhoon somewhere generically within Micronesia during the remainder of 2015.

American Samoa passed its 2014-2015 cyclone season without major problems, and now enters its dry season with no serious tropical cyclone threats anticipated. If a moderate or strong El Niño develops during 2015, American Samoa may face a busy 2015-2016 cyclone season, but there is still ample time to consider this.

SEASONAL SEA LEVEL OUTLOOK FOR THE US-AFFILIATED PACFIC ISLANDS

The following sections describe: the Canonical Correlation Analysis (CCA) forecasts for seasonal (mean and maxima) sea level anomalies (seasonal cycle removed) for the forthcoming seasons July-August-September (JAS), August-September-October (ASO), and September-October-November (SON) of 2015,; JAS return values at 20 and 100-yr period; the observed monthly mean and maximum sea-level anomalies for the previous season AMJ of 2015, and; Seasonal sea level variability: Island Summary. *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 such as tropical cyclones, storm surges or tsunamis.*

Seasonal sea level forecast (anomalies with respect to climatology) for JAS, ASO, and SON of 2015

Forecasts of the sea-level anomalies in the USAPI (see http://www.prn.noaa.gov/peac/map.php) are presented using CCA statistical model. Based on the independent SST and zonal wind (U) (SST-U) values in AMJ of 2015, the resulting CCA model has been used to forecast the sea level of three consecutive seasons: JAS, ASO, and SON (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) provide skillful forecasts for three consecutive seasons.

The current sea level forecasts indicate that most of north Pacific stations are likely to be below normal (normal and average are synonymously used throughout the sea level section) in the forthcoming JAS, ASO, and SON seasons. Palau, Yap, and Chuuk are expected to be well below normal. Guam, Pohnpei, is expected to be marginally below normal (+ 0 to 1 inches below) and Majuro, and Kwajalein are expected to be normal during JAS season, but runs below normal in ASO and SON. The lone south Pacific Island Pago Pago is also expected to be normal (this station has been above normal for a long time). In Hawaii, both Honolulu and Hilo are likely to be slightly elevated, but still close to normal. This current trend is very supportive to the on-going moderate strength El Ninõ state; several features across the tropical Pacific are characteristic of moderate-to-strong El Niño conditions. The current forecasts show a further marginal fall when compared to the previous quarter; however, it is still very significant fall (i.e., 4-6 inches) when compared to the forecasts of JAS, ASO, and SON of 2014. It may be mentioned here that Oceanographers note that this El Niño has just completed a classic "double peak" pattern in the eastern Pacific with the first peak in sea level occurring in July and the second peak in October. This pattern is very similar to what was observed during the 1982-83 El Niño, although at that time the double peaks occurred in January and April 1983. This "double peak" means that we may see a considerable fall of sea level in the vicinity of the USAPI region in July and October of 2015.

Table 1: Forecasts of sea level anomalies in inches (JAS, ASO, and SON)

Table 1 Note: (-) 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. All information is based on 1983-2001 epoch. *** There was a level shift (approximately 2-4 inches) in American Samoa at the time of September 2009 earthquake. So, -3 inches needs to be adjusted to the current tide-gauge values of Pago Pago. 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.

SEASONAL SEA LEVEL OUTLOOK FOR THE US-AFFILIATED PACFIC ISLANDS

	Seasonal Mean Deviations [1]				Seasonal Max Deviations [2]					
Tide Gauge Station	**JAS**	**ASO**	**SON**	**Seasonal Outlook[3]**	**JAS**	**ASO**	**SON**	**Seasonal Outlook[3]**	**JAS: Return Period[4]**	
Lead Time [5]	**0M**	**1M**	**2M**	**Seasonal Outlook[3]**	**0**	**1M**	**2M**	**Seasonal Outlook[3]**	**20- YR**	**100-YR**
Marianas, Guam	-1	-2	-2	Marginal Below	+17	+15	+15	Marginal Below	6.3	10.9
Malakal, Palau	-5	-4	-4	Below	+32	+33	+33	Below	8.1	10.2
Yap, FSM	-4	-4	-4	Below	+24	+24	+24	Below	8.4	11.3
Chuuk, FSM**	-4	-4	-4	Below	+27	+27	+27	Below	n/a	n/a
Pohnpei, FSM	-1	-2	-2	Marginal Below	+27	+27	+27	Marginal Below	5.8	7.0
Majuro, RMI	0	-1	-2	Normal	+41	+40	+39	Normal	3.5	4.2
Kwajalein, RMI	0	-1	-2	Normal	+38	+37	+36	Normal	5.2	6.8
Pago Pago, Am. Samoa***	0	0	0	Normal	+28	+27	+27	Normal	4.1	5.2
Honolulu, Hawaii	+2	+2	+2	Marginal Above	+21	+20	+20	Marginal Above	4.1	5.4
Hilo, Hawaii	+2	+2	+1	Marginal Above	+24	+23	+23	Marginal Above	3.4	5.7

Observed monthly sea level anomalies in AMJ 2015

The monthly time series (April to June) 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 as compared to previous months, the monthly mean sea level in June 2015 recorded further fall in most of the stations. Currently, most of the stations are below normal. Among others, Palau is running 7 inches below normal; Yap is also 4.5 below normal. Pago Pago is stable which is expected. Honolulu and Hilo recorded slight fall. The monthly maximum values also displayed some fall in most of the stations.

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

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. * In Pago Pago, there was a level shift (approximately 2-4 inches) at the time of September 2009 earthquake.

Tide Gauge Station	Monthly Mean Deviations[1]					Monthly Max Deviations[2]			
	Apr	**May**	**Jun**	**Standard Deviations**	**Sea level Trend**	**Apr**	**May**	**Jun**	**Standard Deviations**
Marianas, Guam	-2	+0.8	+2	3.7	Stable	+13	+22	+17	3.7
Malakal, Palau	-5.5	-7	-7	4.2	Falling	+31	+29	+26	4.2
Yap, FSM	-1.5	-4.5	-4.5	4.3	Falling	+27	+27	+23	4.3
Chuuk, FSM***	**	**	**	*	**	**	**	**	*
Pohnpei, FSM	**	**	**	2.8	**	**	**	**	2.8
Kapingamarangi	+3	+3	+3	**	Stable	+27	+31	+29	**
Majuro, RMI	+0.5	-1	**	2.2	Falling	+41	+38	**	2.2
Kwajalein, RMI	-0.2	-1.5	-1	2.8	Falling	+37	+33	+33	2.8
Pago Pago*	+10.5	+10.5	+10	4.3	Stable	+36	+35	+33	4.3
Honolulu	+2.2	+4	+3	1.6	Stable	+19	+21	+21	1.6
Hilo	+4.2	+1	+1.5	2.0	Stable	+24	+21	+23	2.0

SEASONAL SEA LEVEL OUTLOOK FOR THE US-AFFILIATED PACIFIC ISLANDS

Seasonal Sea Level Variability: Island Summary

Starting from JFM 2014, a comparative perspective of seasonal sea level variations is given below (Fig. 4). In JFM 2015, most of the island recorded considerable fall (4 to 6 inches), as compared to the sea level of JFM 2014. This fall is even more significant when compared to last 10 years.

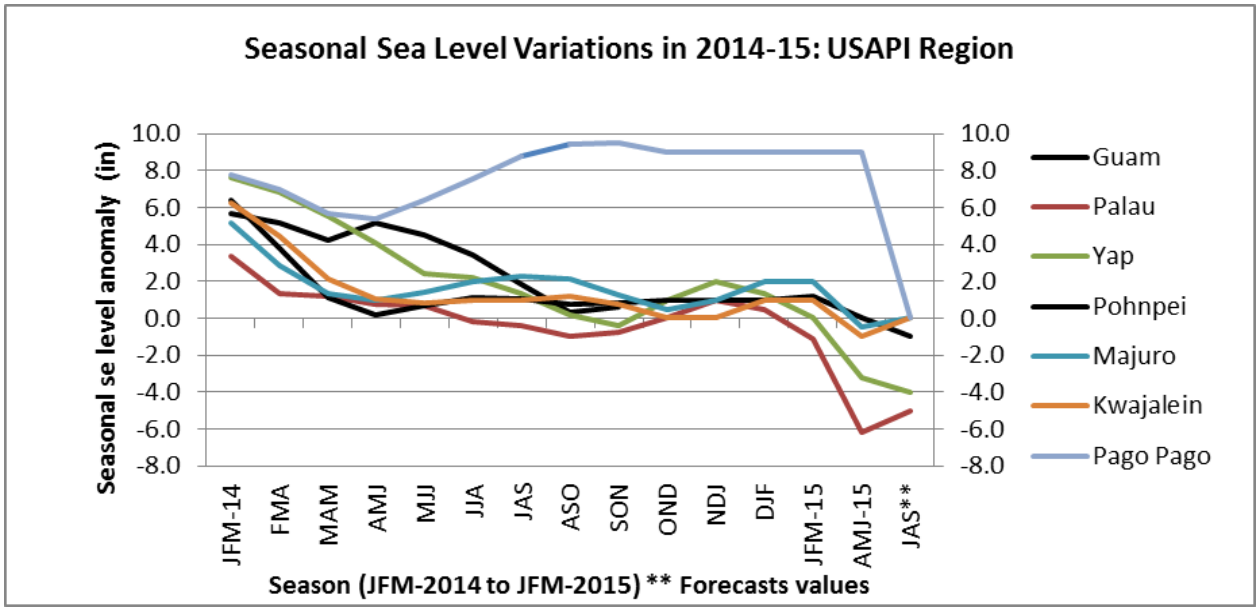


Fig.24 A comparative perspective of Island-wise seasonal sea level variations (JFM 2014 to AMJ 2015; Forecasts for JAS are denoted by **)

(*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

NOTE: *All Predictions[1] listed in the rainfall summaries represent BEST ESTIMATES given the probabilistic forecast for each particular season and station.*

American Samoa: There was high variability in the monthly rainfall at American Samoa during the first half of 2015. January and May were particularly wet, with March the only month that was substantially below average. No widespread damage due to inclement weather was reported. Some minor stream flooding occurred during two heavy rain events in the latter half January and again during heavy rain on the 22nd of April. During a high -surf event on the 23rd of January, a 17-year-old girl lost her life when she was swept out to sea. The south shore of Tutuila experienced some exceptionally high surf with waves 10-13 feet most of that day.

No tropical storms or hurricanes adversely affected American Samoa over the course of the 2014-2015 South Pacific hurricane season that ended on 30 June 2015.

American Samoa Rainfall Summary: 2015 2nd Quarter and 2015 First Half

Station		Apr	May	Jun	2nd Qtr	1st Half
Yap State						
Pago Pago	Inches	14.34	16.59	9.07	40.00	85.97
	% Avg	119%	167%	123%	136%	130%
Siufaga Ridge	Inches	10.74	17.96	18.50	47.20	77.71
	% Avg*	83%	163%	206%	143%	101%

*Used Pago Pago averages.

Pago Pago data needs to be adjusted (approximately 2-4 inches) with respect to the new sea level datum. In order to generate a seal level outlook for Pago Pago, we are subjectively

LOCAL SUMMARY AND FORECAST

deducting 3 inches from the tide-gauge values received from the UHSLC. Since January 2014, the monthly mean sea level in Pago Pago remained above normal and in May it was reading + 4.5 (or +1.5) inch above normal. Currently, it is +10 (or 7 in) inches above normal. This rise is expected, as the sea level fall in American Samoa displays a couple of months delay with respect to the north Pacific Islands.

Climate Outlook: The Pacific basin is in an El Niño climate state, and it is strong at this time. Indices of El Niño typically reach peak late in the El Niño year, and the ultimate strength of El Niño is usually pegged to its condition at its peak. For this reason, the strength of the current El Niño, while strong for this time of year, is not yet established, and won't be known until the end of the year. In any case, the PEAC will issue forecasts based on the occurrence of strong El Niño conditions.

American Samoa lies in an area of the Pacific where the relationships between rainfall and ENSO are weak, with few consistent anomalies that can be used to make a reliable long-range forecast.

During the very strong El Niño's of 1982-83 and 1997-98 (Fig. 5), American Samoa experienced continual dryness punctuated by a few wet months (Fig. 5). The rainfall in the dry season of the year following both these El Niño events (e.g., May through August 1983, and May through August 1998) was especially low. For all lesser El Niño events, there is no consistent pattern to the rainfall behavior. The rainfall outlooks for American Samoa will assume that 2015 will be a strong El Niño comparable to 1982-83 and 1997-98.

During a strong El Niño, tropical cyclone activity in the South Pacific shifts so far to the east that the threat of a damaging tropical cyclone in American Samoa may actually be slightly reduced. Hurricane Val (December 1991) is the only example in the modern record since 1970 of an intense tropical cyclone affecting American Samoa during a moderate or strong El Niño.

LOCAL SUMMARY AND FORECAST

Forecasts for the next three seasons (JAS, ASO, and SON) indicate normal sea level and, when compared to the forecasts of first quarter 2015; this is in fact a marginal fall.

Predicted rainfall for American Samoa from July 2015 through June 2016 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]
July - September 2015 (Heart of Dry Season)	95% (18.7 inches - Pago Pago)
October - December 2015 (Onset of next Rainy Season)	75%
January - March 2016 (Heart of next Rainy Season)	80%
April– June 2016 (Onset of Next Dry Season)	50%

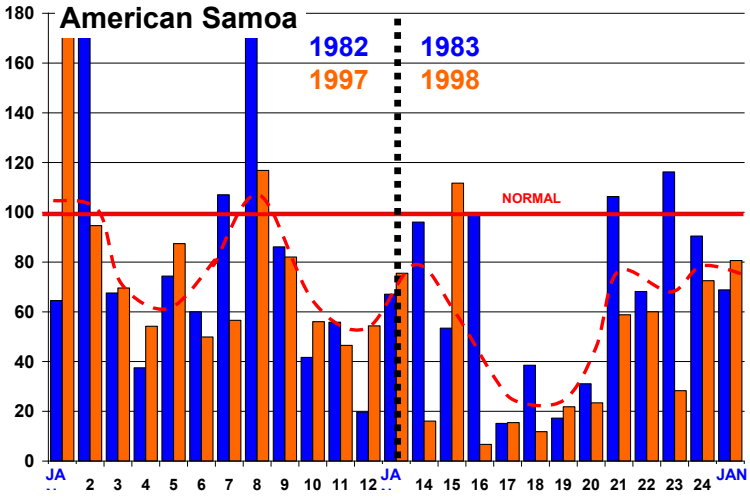


Figure 5. Monthly rainfall distribution (in percent) during two strong El Niño events: 1982-83 (blue) and 1997-98 (orange). Note the similar seasonal variability and the occurrence of the driest anomaly during the dry season months of the year that follows both these El Niño events. This behavior is how the PEAC long-range rainfall forecasts for American Samoa have been tailored. The orange dashed line shows the short-term rainfall trends for the two events.

Guam/CNMI: The weather during the first half of 2015 was wet and wild on Guam and in the CNMI. Several very heavy daily rainfall extreme events during tropical cyclone passages were balanced by long dry spells to yield quarterly and 2015 first-half totals that, by themselves, do not seem too extraordinarily wet. During the 1st half of 2015, the region was a nexus for tropical cyclone tracks (see earlier Fig. 2), with two radar-observed eye passages – Typhoon Dolphin and Tropical Storm Chan-hom -- through the Rota Chanel (between Guam and Rota) and a direct strike of Alamagan Island by intense Typhoon Nangka. Tropical cyclones that adversely affecting the region during the 1st half of 2015 include: (1) Tropical Storm Bavi (March); (2) Typhoon Dolphin (May); (3) Tropical Storm Chan-hom (July); and (4) Super Typhoon Nangka (July). The center of Tropical Storm Bavi passed directly over Guam on the night of 15 March. The highest winds associated with Bavi were on its north side, which placed Saipan in a band of 55-60 mph sustained winds with gusts to near typhoon force. These high winds toppled some trees and knocked out electrical power on many areas of the island. Farther south on Guam, the winds reached minimal gale force, but the waves on the northeast and east coasts reached 20-25 feet.

Typhoon Dolphin possessed Category 2 typhoon wind speeds when it passed between Guam and Rota on the night of 15 May. When the eye of Typhoon Dolphin passed through the Rota Chanel, its eyewall scraped northern Guam and the southwestern tip of Rota, giving these locations full typhoon conditions. Observed wind at Andersen Air Force Base (AAFB) peaked at 75 mph sustained with a gust to 106 mph. Minimum seal level pressure bottomed out there at 973 mb, with a reading of 969 mb recorded by a University of Guam pressure gauge near Ritidian Point on the far northern tip of Guam. Extensive damage to vegetation was noted on northern Guam, and widespread power outages lasting up to a few days were experienced across the island. Rainfall during Dolphin was very high in the far north of Guam, with AAFB recording over 18 inches in 24 hours. Further south on Guam, rainfall amounts diminished rapidly and peak 24-hour rainfall was only 6.69 inches at a gauge in Guam's southern Mountains. Damage from Dolphin, while not catastrophic, earned the island of Guam a Presidential Disaster Declaration that allowed U.S. $10 million to be used for recovery efforts.

On the night of 05 July, Tropical Storm Chan-hom passed through the Rota Chanel. A brief period of gales was noted at AAFB with a peak gust to 63 kt. Rainfall from Chan-hom was heavy on the northern half of Guam with 12 inches or more observed from the University of Guam (UOG) in central Guam, northward to AAFB. Guam's Doppler weather radar (known colloquially as Guam's "NEXRAD") nicely showed the concentrated band of heavy rainfall across northern Guam during Chan-hom's passage (Fig. 6).

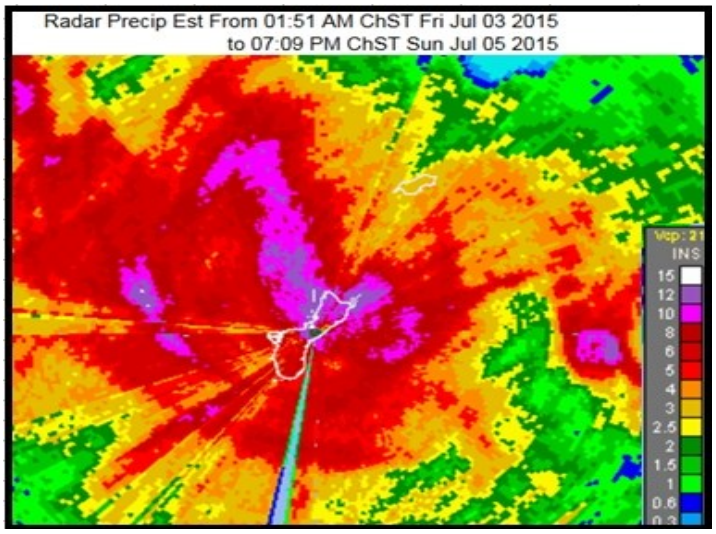


Figure 6. NEXRAD storm-total precipitation (STP) for Tropical Storm Chan-hom for the period 2 AM 03 July to 7 PM 05 July 2015. Pink shading indicates rainfall amounts of 10 inches or more, while the purple embedded in the pink represents rainfall of 12 inches or more.

During the evening hours of 09 July, Typhoon Nangka passed directly over the island of Alamagan in the CNMI. The intensity of Nangka at this time was just below the super typhoon threshold, but would cross that threshold 12 hours later. Alamagan is one of several small high islands that comprise the northern Mariana chain to the north of Saipan. They are all

LOCAL SUMMARY AND FORECAST

volcanoes, and several have had substantial eruptions in recent decades (e.g., Pagan and Anatahan). Very few people live on these islands. During the passage of Nangka across Alamagan, the 6 people on-island at the time successfully weathered this very severe storm without injury in a concrete bunker. Sea level in Guam remained slightly elevated throughout the end of 2014 and part of 2015. It fell to below normal (-2 in) in April 2014. Both May and June recorded a slight rise. Currently, it is still slightly elevated (+2 in), but close to normal.

Guam and CNMI Rainfall Summary: 2ndQtr and First Half

Station		Apr	May	Jun	2nd Qtr	1st Half
GUAM						
GIA (WFO)	Inches	6.65	9.91	5.32	21.88	34.71
	% Avg	170%	164%	82%	133%	126%
AAFB	Inches	6.70	21.33	3.35	31.28	48.81
	% Avg	138%	322%	53%	176%	149%
Southern Mountains	Inches	4.62	10.79	3.93	19.34	34.68
	% Avg	95%	163%	62%	109%	106%
CNMI						
Saipan Int'l Airport	Inches	5.34	8.11	4.15	17.60	28.56
	% Avg	191%	184%	89%	149%	147%
Tinian Airport	Inches	4.43	8.26	4.32	17.01	28.24
	% Avg	127%	150%	74%	115%	116%
Rota Airport	Inches	7.03	11.67	6.24	24.94	39.87
	% Avg	155%	184%	100%	146%	130%

Climate Outlook: The Pacific basin climate is currently in a state classified as El Niño, and it is strong at this time. Indices of El Niño typically peak late in the El Niño year, and the ultimate strength of El Niño is usually pegged to its condition at its peak. For this reason, the strength of the current El Niño, while strong for this time of year, is not yet established, and won't be known until the end of the year. In any case, the PEAC will issue forecasts based on the occurrence of a strong El Niño. This includes the continued high risk of a typhoon on Guam and on all islands of the CNMI. The typhoon threat will persist through January of 2016. Notorious El Niño-related typhoons tend to occur late in the year; examples include: Typhoon Karen (November 1962), Typhoon Roy (January 1988); Typhoon Yuri (November 1991); Typhoon Paka (December 1997), and Typhoon Pongsona (December 2002). The other threat posed by El Niño is major drought. Drought related to El Niño becomes severe early in the year that follows El Niño (e.g., 1983 and 1998). In a typical moderate or strong El Niño, rainfall begins to fall below normal as early as September, and then is drastically reduced in the period of January through May of the following year (Fig. 7). Note that in Figure G2, December is wet. This is an artifact of Typhoons Pongsona and Paka occurring in that month and providing enormous rainfall over a 1 to 2 day at a time that otherwise would have been very dry. Also note that the whole year following El Niño tends to be dry – Guam and the CNMI do not

LOCAL SUMMARY AND FORECAST

return to normal rainfall for over a full year following a strong El Niño. Consistent to the current moderate El Ninõ state, forecasts are slightly below normal for the next seasons (JAS, ASO, and SON) with possibility of a marginal below sea level (-1 to -2 in).

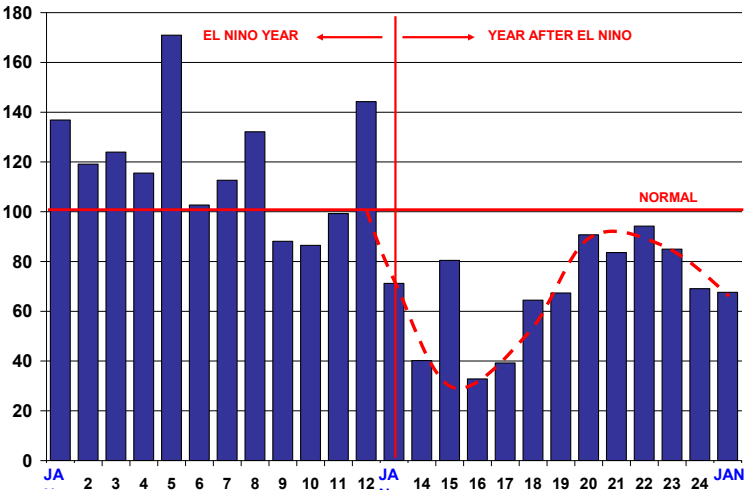


Figure 7. Rainfall at Guam for a composite of five El Nino events. Note the wet conditions in the first half of the El Nino year, with a gradual drying that begins in September. Drying is substantial in the first half of the year that follows El Nino, and does not recover for the whole year. Note the spike in December in what otherwise should be in a drying trend. This is an artifact of typhoon strikes late in the El Nino year.

Predicted rainfall for the Mariana Islands from July 2015 through June 2016:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]	
	Guam/Rota	Saipan/Tinian
July – September 2015 (Heart of Rainy Season)	120% (45.3 inches)	120% (40.92 inches)
October – December 2015 (Transition to Dry Season)	90%	85%
January – March 2016 (1st Half of Dry Season)	50%	50%
April– June 2016 (2nd Half of Dry Seson)	65%	65%

* could be higher if a typhoon strikes!

Federated States of Micronesia

Yap State: Yap State was pounded relentlessly by tropical cyclones during the first half of 2015. From December 2014 through July 2015, five tropical cyclones adversely affected Yap Island or other islands and atolls of Yap State: (1) Typhoon Hagupit (December 2014); (2) Tropical Storm Jangmi (December 2014); (3) Tropical Storm Mekkhala (January 2015); (4)Super Typhoon Maysak (March 2015); and, (5) Typhoon Noul (May 2015). Two of these tropical cyclones – Hagupit and Maysak -- were devastating for some islands.

During the local evening of 03 December 2014, Typhoon Hagupit (TC22W, 2014) passed about 60 miles to the south of Yap Island, and near or over Ngulu Atoll (8.4N 137.5 E). There were reports there of significant damage, but no deaths

LOCAL SUMMARY AND FORECAST

or injuries among the six people on-island at the time. On the day before Christmas 2014, the tropical depression that would later become tropical storm Jangmi (TC23W, 2014) passed to the south of Yap Island and caused only a period of unremarkable rain showers with typical (20-30 kt) gusty winds in the showers. During the night of 14 January 2015, Tropical Storm Mekkhala passed approximately 50 n mi to the north of Yap island, and less than 25 n mi to the south of Ulithi Atoll (10.0 N 139.7 E). The peak wind gust on Yap Island was 36 mph (31 kt) accompanied by about 0.5 inches of rainfall. Ulithi Atoll reported over 4 inches of rainfall during the passage of this tropical cyclone; however, there were no reports of significant damage or injuries there or anywhere in Yap State associated with this storm. On the night of 31 March 2015, Super Typhoon Maysak passed very close to Ulithi Atoll, causing catastrophic damage. The center of the well-defined eye of this powerful super typhoon passed about 20 miles to the north of Ulithi Atoll bringing winds on the northern part of the atoll to at least 125mph sustained with gusts up to 150. The island of Fais (9.8° N 140.5°E) was also adversely affected by Maysak with destructive winds likely reaching 100 mph sustained gusting to up to 125mph. There were no known deaths or serious injuries in Yap State from Maysak. On 05 May, Noul passed over Yap Island just as it was becoming a typhoon. Winds gusted to 68 mph at the airport Weather Service Office (WSO) on Yap Island, accompanied by very heavy rainfall (over 10 inches in 24 hours). No severe damage or injuries were reported. Subsequent typhoons in the western North Pacific basin (Dolphin, Linfa, Chan-hom and Nangka) traveled on more northerly tracks and spared the islands of Yap State. Ulithi and Fais are still recovering from the severe impacts of Super Typhoon Maysak.

Sea level for Yap has been considerably below normal since February 2015. As compared to AMJ of 2014, it fell about 8 inches in AMJ of 2015. Currently it is about 5 inches below normal.

Yap State Rainfall Summary: 2015 2nd Qtr and First Half

Station		Apr	May	Jun	2nd Qtr	1st Half
Yap State						
Yap WSO	Inches	7.80	18.41	11.07	37.28	51.96
	% Norm	135%	203%	87%	136%	111%
Ulithi	Inches	4.01	14.09	12.18	30.28	50.78
	% Norm	82%	183%	113%	129%	128%
Woleai	Inches	6.03	5.42	17.88	29.33	56.19
	% Norm	55%	44%	138%	81%	90%

Climate Outlook: The Pacific basin climate is in an El Niño climate state, and it is strong at this time. Indices of El Niño typically reach peak late in the El Niño year, and the ultimate strength of El Niño is usually pegged to its condition at its peak. For this reason, the strength of the current El Niño, while strong for this time of year, is not yet established, and won't be known until the end of the year. In any case, the PEAC will issue forecasts based on the occurrence of strong El Niño conditions.

LOCAL SUMMARY AND FORECAST

The threat of a damaging typhoon within Yap State is very high in the first half of an El Niño year – as was the case during the first half of 2015. As time progresses, typhoon activity shifts ever more exclusively to the east, and typhoons tend to lift north and/or east of Yap State. In the late fall of an El Niño year when Guam and the CNMI are under enhanced threat by typhoons, Yap State is often just out of range of the damaging effects of these storms. Good examples include typhoons Yuri (NOV 1991), Paka (NOV 1997), Roy (JAN 1988), Nida (NOV 2009) and Pongsona (DEC 2002).

Another upcoming threat posed by El Niño is major drought. Drought related to El Niño becomes severe early in the year that follows El Niño (e.g., 1983 and 1998). In a typical moderate or strong El Niño, rainfall begins to fall substantially below normal by October, and then is drastically reduced in the period of December through May (Fig. 8). Monthly rainfall returns to near normal by August of the year following El Niño. Forecasts for the next seasons (JAS, ASO, and SON) indicate below normal sea level (-4 inches) and, when compared to the forecasts of the previous quarter, this is about an additional 2 inch fall.

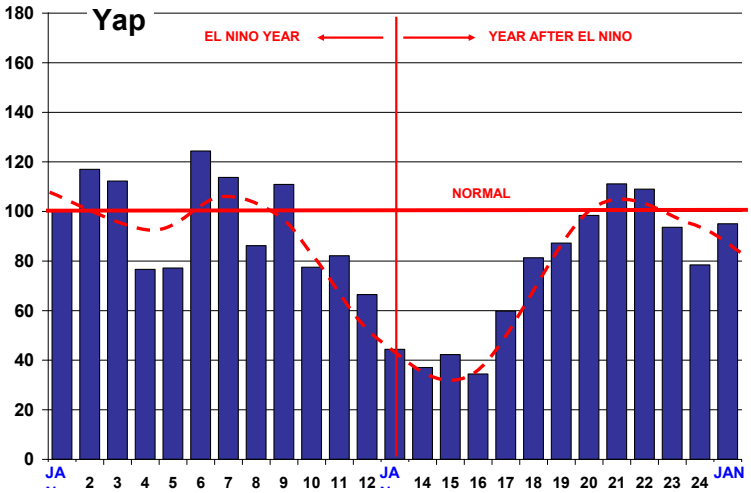


Figure 8. Rainfall at the WSO Yap for a composite of five El Nino events. Note the near-average conditions in the first half of the El Nino year, with a gradual drying that begins by August or September. Significant drying occurs in the latter 3 months of the El Niño year and is severe in the first half of the year that follows El Nino. Full recovery occurs by about August of the year following El Niño.

Predicted rainfall for Yap State from July 2015 through June 2016 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]	
	Woleai	Yap & Ulithi
July – September 2015 (Heart of Rainy Season)	85% (34.26 inches)	90% (38.93 inches)
October – December 2015 (End of Rainy Season)	70%	75%
January – March 2016 (Heart of Next Dry Season)	40%	50%
April– June 2016 (End of Next Dry Season)	75%	70%

LOCAL SUMMARY AND FORECAST

Chuuk State: During the first half of 2015, most of the islands of Chuuk State were drenched with above normal rainfall. The high rainfall included several "big days" (i.e., extreme 24-hour rainfall at-or-above 5 inches). Month-to-month variation was high, and variation of rainfall among the islands and atolls of Chuuk State was also very high. This high spatial and temporal variability of rainfall observed over the first half of 2015 was derived in large measure by a continual parade of tropical disturbances and named tropical cyclones passing through regional waters. The most serious of the tropical cyclones affecting Chuuk State during the first half of 2015 was Typhoon Maysak. The eye of Maysak passed directly over Chuuk Lagoon during the morning hours of 29 March as a strong Category 1 typhoon with sustained one-minute winds of 75 to 90 mph over open water with gusts as high as 110 mph. Damage was severe on many of the islands that dot the lagoon, and recovery efforts are still underway.

An unusual persistence of westerly wind was noted across Chuuk State throughout the first half of 2015 accompanied by high surf. Episodic periods of minor sea inundation occurred in some locations (e.g. Onoun) from this high surf.

Chuuk State Rainfall Summary: 2015 2nd Qtr and First Half

Station		AprJan	May	Jun	2nd Qtr	1st Half
Chuuk Lagoon						
Chuuk WSO	Inches	13.03	10.08	20.08	43.19	84.56
	% Avg	105%	82%	171%	119%	137%
Southern Mortlocks						
Ta	Inches	11.23	8.10	19.57	38.90	90.02
	% Avg	85%	61%	160%	100%	127%
Northern Mortlocks						
Nama	Inches	7.60	5.57	24.20	37.37	75.84
	% Avg	62%	46%	206%	103%	123%
Northern Atolls						
Onoun	Inches	17.61	11.52	9.60	38.73	74.37
	% Avg	143%	94%	82%	107%	121%
Western Atolls						
Polowat	Inches	8.88	4.22	8.77	21.87	41.92
	% Avg	148%	47%	70%	80%	87%

Climate Outlook: The Pacific basin climate is in an El Niño climate state, and it is strong at this time. Indices of El Niño typically reach peak late in the El Niño year, and the ultimate strength of El Niño is usually pegged to its condition at its peak. For this reason, the strength of the current El Niño, while strong for this time of year, is not yet established, and won't be known until the end of the year. In any case, the PEAC will issue forecasts based on the occurrence of strong El Niño conditions.

The threat of a damaging typhoon within Chuuk State is high throughout an El Niño year – as the activity in the first half of 2015 has already shown. As time progresses during an El Niño year, typhoon activity shifts ever more exclusively to

LOCAL SUMMARY AND FORECAST

the east. This progression, however, is not enough to move the cyclones safely away from the islands and atolls of Chuuk State, except maybe at Polowat in the far west of the State. We anticipate two or three typhoons to form in eastern Micronesia from October 2015 through January 2016. These late-season typhoons will be serious threats to Guam and the CNMI, but could also pass close enough to the northern islands of Chuuk State to bring a risk of damaging wind, heavy rainfall and high surf. Good examples include typhoons Yuri (NOV 1991), Paka (NOV 1997), Nida (NOV 2009) and Pongsona (DEC 2002).

Another upcoming threat posed by El Niño is major drought. Drought related to El Niño becomes severe early in the year that follows El Niño (e.g., 1983 and 1998). In a typical moderate or strong El Niño, rainfall begins to fall substantially below normal by October, and then is drastically reduced in the period of December through May (Fig. 9). Monthly rainfall returns to near normal by August of the year following El Niño.

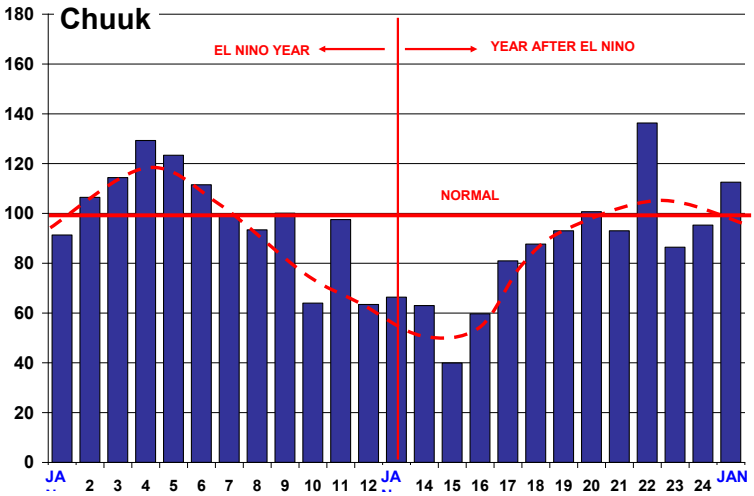


Figure 9. Rainfall at the WSO Chuuk for a composite of five El Nino events. Note the wet conditions in the first half of the El Nino year, with a gradual drying that begins by August or September. Drying is substantial in the first half of the year that follows El Nino, but recovers by July or August of the year following El Niño. Note the spike in November in what otherwise should be in a drying trend. This is an artifact of typhoon passages late in the El Niño year.

Predictions for Chuuk State for July 2015 through June 2016:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]			
	Chuuk Lagoon, and Nama	Polowat	Northern Atolls	Mortlocks
Jul – Sep 2015	90% (34.39 in)	80% (28.95 in)	90% (34.38 in)	90% (34.38 in)
Oct – Dec 2015	75%	70%	75%	75%
Jan – Mar 2016	50%	50%	50%	50%
Apr – Jan 2016	75%	70%	70%	75%

Pohnpei State: During the first half of 2015, all recording locations on Pohnpei Island and most of the atolls of Pohnpei State recorded above average rainfall. The Weather Service Office (WSO) located in Kolonia, Pohnpei Island, recorded its

LOCAL SUMMARY AND FORECAST

all-time record monthly rainfall (for any month) in May 2015, with 43.68 inches (228%). The previous top-three monthly rainfall amounts at the WSO are 38.81 inches (Sep 1991), 38.65 inches (Apr 1959) and 38.43 inches (May 1980). May is typically the wettest month of the year at this location, with an average just under 20 inches. A large portion of May's rainfall (10 inches) occurred while Typhoon Dolphin (then gathering strength as a tropical storm) meandered slowly northward between Pohnpei Island and Kosrae (Fig. 10).

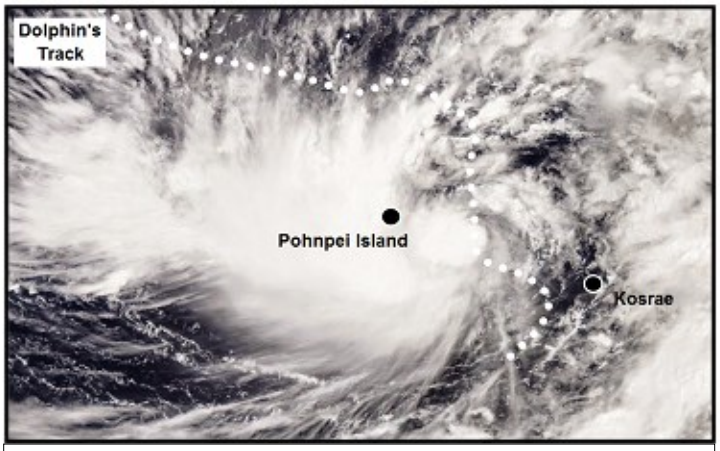


Figure 10. While gathering strength as a tropical storm, Typhoon Dolphin moved slowly northward between Pohnpei Island and Kosrae. Seen here on the afternoon of the 10th of May, Dolphin's core and peripheral rainbands bring high wind and gusty rain to Pohnpei Island.

Dolphin's high winds and heavy rain caused damage on Pohnpei Isalnd and on the atolls of Pingelap and Mwokilloa. The following is a description of the effects of Dolphin as described in the 21 May 2015 edition of the Kaselehlia Press:

"Sustained winds up to 45 miles per hour and stronger gusts struck the main island of Pohnpei in the middle of the night on May 10. ... There was widespread flooding and power and water outages, roofs were blown off, and hundreds of trees were damaged, some falling on vehicles and homes."

"Even as The Kaselehlie Press went to press, some people on the island were still without power or water nearly two weeks after the storm. Damaged and weakened trees continued to fall well after the storm had passed. A falling tree killed one pre-teenager in Pohnpei. Storm related injuries were difficult to quantify but there were many. One entire family was admitted to hospital after a tree fell on their home in Palikir. Patrick Carl, Pohnpei's Emergency Assistance Officer said that most if not all of the homes on the shorelines of Mwokil and Pingelap were completely destroyed. His office also received reports of salt water intrusion into taro patches and water catchment systems. He said that he sent a preliminary damage assessment to President Christian. In it he reported damage or complete destruction of at least 200 homes on Pohnpei's main island that had been reported. That number is probably higher," Carl said. He put the damage assessment for homes alone at approximately a million dollars. Crops in Pohnpei were also hit hard."

"Carl estimates that probably more than a million dollars in crops were damaged. In Pohnpei, Pohnpei Utilities Company crews struggled to restore power and water services and PUC was inundated with phone calls. Crews are still working diligently and in a prioritized manner restoring power just as quickly as they can despite the frustration of many of its customers. After Tropical Storm Dolphin passed Pohnpei it intensified into a full-fledged typhoon and headed towards Guam which also suffered heavy damage."

LOCAL SUMMARY AND FORECAST

Pohnpei State Rainfall Summary: 2015 2nd Qtr and 2015 First Half.						
Station		**Apr**	**May**	**Jun**	**2nd Qtr**	**1st Half**
Pohnpei Island						
Pohnpei WSO	**Inches**	**21.94**	**43.68**	**15.86**	**81.48**	**119.44**
	% Norm	**133%**	**228%**	**93%**	**155%**	**133%**
Atolls of Pohnpei State						
Nukuoro	**Inches**	**10.07**	**27.49**	**14.42**	**51.98**	**100.05**
	% Avg	**67%**	**186%**	**118%**	**124%**	**129%**
Pingelap	**Inches**	**11.45**	**23.16**	**6.47**	**41.08**	**77.00**
	% Avg	**67%**	**136%**	**40%**	**81%**	**86%**
Kapinga.	**Inches**	**11.82**	**20.84**	**22.14**	**54.80**	**94.95**
	% Avg	**87%**	**202%**	**305%**	**176%**	**144%**

Climate Outlook: The Pacific basin climate is in an El Niño climate state, and it is strong at this time. Indices of El Niño typically reach peak late in the El Niño year, and the ultimate strength of El Niño is usually pegged to its condition at its peak. For this reason, the strength of the current El Niño, while strong for this time of year, is not yet established, and won't be known until the end of the year. In any case, the PEAC will issue forecasts based on the occurrence of strong El Niño conditions.

The threat of a damaging tropical cyclone within Pohnpei State is high throughout an El Niño year – as the passage of Dolphin and other cyclones near Pohnpei Island in the first half of 2015 has already shown. As time progresses during an El Niño year, typhoon activity shifts ever more exclusively to the east. We anticipate two or three typhoons to form in eastern Micronesia from October 2015 through January 2016. These late-season typhoons will be serious threats to Guam and the CNMI, but could also pass close to Pohnpei Island and the atolls of Mwokilloa and Pingelap to bring a risk of damaging wind, heavy rainfall and high surf.

Another upcoming threat posed by El Niño is major drought. Drought related to El Niño becomes severe early in the year that follows El Niño (e.g., 1983 and 1998). In a typical moderate or strong El Niño, rainfall is heavy through August or September of the El Niño year, and then begins to fall below normal by October. Rainfall is substantially reduced in the period of December through May (Fig. 11, page 12). Monthly rainfall returns to near average by June of the year following El Niño. Sea level forecasts for the next three seasons (JAS, ASO, and SON) indicate a slight fall in sea level (-2 in) and when compared to the forecasts of second quarter of 2014, there was a 5 inch fall.

Predicted rainfall for Pohnpei State from April 2015 through March 2016:

LOCAL SUMMARY AND FORECAST

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]	
	Pohnpei Is. And Atolls	Kapingamarangi
Jul - Sep 2015	120% (61.17 inches)	140% (31.48 inches)
Oct - Dec 2015	75%	120%
Jan - Mar 2016	50%	100%
Apr—June 2016	75%	100%

* 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 El Niño year, and may stay wet into the year following El Niño. Major drought at Kapingamarani is often associated with strong La Niña events.

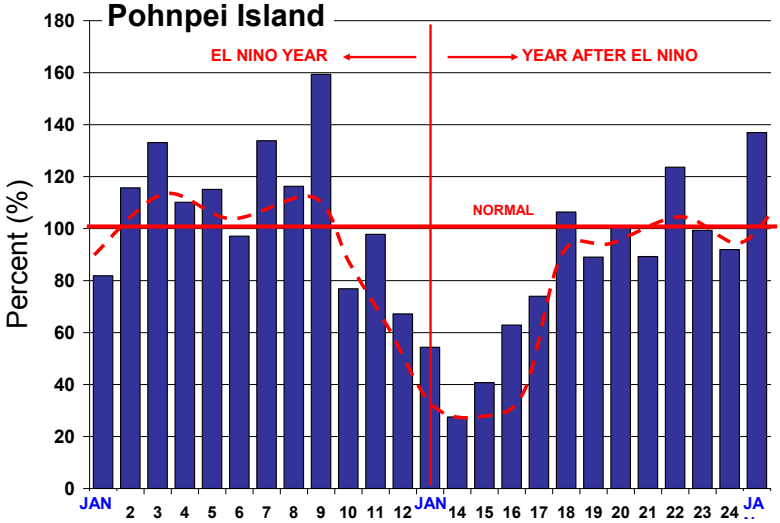


Figure 11. Percent of average rainfall at the WSO Pohnpei for a composite of five El Nino events. Note the wet conditions through September of a typical El Niño year, with a gradual drying that begins by October. Drying is substantial from December of the El Niño year through May of the year that follows El Niño. Rainfall recovers to near average by June or July of the year following El Niño. Note: the spike in September is not just an artifact of a single big month; all five September members of the composite were well above average.

Kosrae State: During the first half of 2015, all recording locations on the island of Kosrae had near average rainfall, with small month-to-month variability. The big weather story of the first half of 2015 was not the amount of rainfall, but the very unusual prevalence of gusty westerly wind, and the passage near Kosrae of two named tropical cyclones (Bavi and Dolphin) and the pre-named beginning stages of several other tropical cyclones. These tropical cyclones had only modest effects at Kosrae (e.g., gusty westerly wind and high surf on the west side of the island). In March, during the developing phase of Typhoon Maysak, persistent westerly winds blew down a few trees, damaged or destroyed some light structures, and caused significant coastal erosion. Strong and persistent westerly winds during the first half of the year are a sure sign of El Niño!

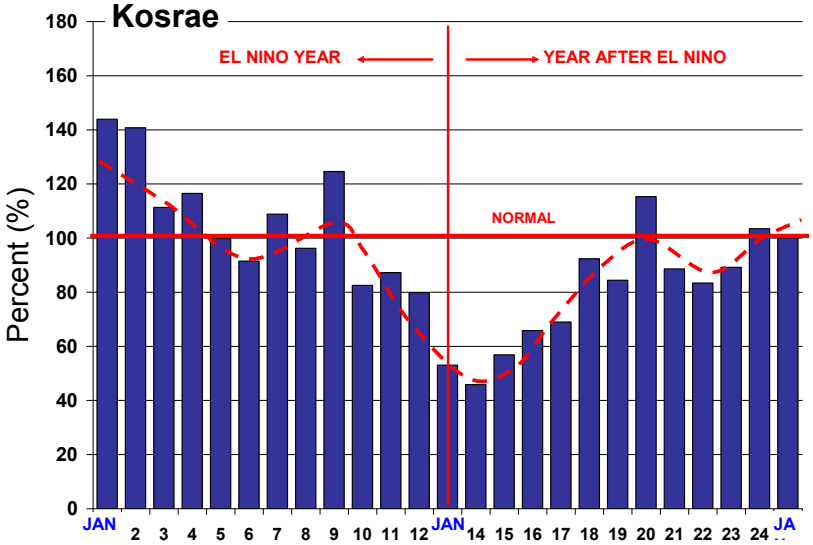
LOCAL SUMMARY AND FORECAST

Kosrae State Rainfall Summary: 2nd Qtr 2015 and 2015 First Half						
Station		Apr	May	Jun	2nd Qtr	1st Half
Kosrae State						
Airport (SAWRS)	Inches	16.12	14.89	20.90	51.91	101.32
	% Avg	74%	79%	110%	87%	93%
Nautilus	Inches	15.66	17.15	22.72	55.53	109.09
	% Avg	72%	91%	120%	93%	100%

Climate Outlook: The Pacific basin climate is in an El Niño climate state, and it is strong at this time. Indices of El Niño typically reach peak late in the El Niño year, and the ultimate strength of El Niño is usually pegged to its condition at its peak. For this reason, the strength of the current El Niño, while strong for this time of year, is not yet established, and won't be known until the end of the year. In any case, the PEAC will issue forecasts based on the occurrence of strong El Niño conditions.

The threat of adverse effects from a tropical cyclone on the island of Kosrae is high throughout an El Niño year – as the passages of Bavi (March) and Dolphin (May) and other cyclones (e.g., pre-named (Maysak, March; Chan-hom, July) near or northeast of Kosrae in the first half of 2015 have already shown. As time progresses during an El Niño year, typhoon activity shifts ever more exclusively to the east. We anticipate two or three typhoons to form in eastern Micronesia from October 2015 through January 2016. These late-season typhoons will be serious threats to Guam and the CNMI, but could also pass close to the island of Kosrae with the primary risks being damaging wind, heavy rainfall and high surf.

Another upcoming threat posed by El Niño is major drought. Drought related to El Niño becomes severe early in the year that follows El Niño, especially a strong one (e.g., 1983 and 1998). In a typical moderate or strong El Niño, rainfall is at-or-above average through September of the El Niño year, and then begins to fall below normal by October. Rainfall is substantially reduced (<70% of average) during the period of January through May (Fig. 12). Monthly rainfall returns to near average by June of the year following El Niño.

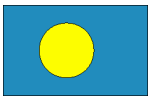


LOCAL SUMMARY AND FORECAST

Figure 12. Percent of average rainfall on the island of Kosrae for a composite of five El Niño events. Note the relatively wet conditions through September of a typical El Niño year, with a gradual drying that begins by October. Drying is substantial from January of through May of the year that follows El Niño. Rainfall recovers to near average by June or July of the year following El Niño. The red dashed line shows the short-term rainfall trends during the El Niño and El Niño + 1 years.

Predicted rainfall for Kosrae State from July 2015 through June 2016 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]
July - September 2015	100% (50.71 inches)
October - December 2015	80%
January – March 2016	50%
April– June 2016	75%



Republic of Palau: The Republic of Palau was one of the few island groups of the western North Pacific where the first half of 2015 was persistently dry. Every month from January through May 2015 had below average rainfall at Koror and other recording locations. By the end of May, the cumulative rainfall at Koror for the first 5 months of the year was 28.04 inches, which was 20.64 inches short (or only 58%) of the 48.68 inches of rainfall that typically falls during that period (Fig. 13).

In collaboration with Mr. Richard Heim of NOAA's Climate Prediction Center, the PEAC is establishing criteria for the severity of drought in the U.S.-Affiliated Pacific islands for inclusion of the islands in the U.S. Drought Monitor (USDM). The USDM is produced through a partnership between the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration. The USDM is updated weekly and is released each Thursday at 8:30 a.m. Eastern Time. In order for a municipality to receive federal aid for impacts of drought, there is a requirement for the drought conditions of that municipality to appear in the USDM. In small tropical island locations, rainfall deficits can have serious drought impacts in two to three months versus many months or years of deficient rainfall for the impacts of drought to become severe in places such as California. Although research is on-going, some rough threshold amounts for drought impact include: (1) at least 8 inches of rain per month is needed to sustain and/or replenish municipal and home rain catchment systems, sustain and/or replenish municipal surface and groundwater supplies, provide for adequate stream flow on high islands, and greatly reduce the risk of wildfire; and, (2) threats to agriculture, the occurrence of wildfires and unacceptable drawdown of rain catchments and shallow dug wells rise sharply with monthly rainfall less than 4 inches.

For each of the three months March, April and May, Koror and the Palau International Airport recorded about 5 inches of rainfall. In May, Koror fell below 4 inches. This prompted the Weather Forecast Office, Guam to issue a drought advisory statement for the Republic of Palau, citing ongoing dryness and likely impacts to agriculture and water supplies. Palau also appeared in an experimental addition to the U.S. drought monitor, with a category of D2-L (D2 = severe drought intensity; L = long term). The Statement did indicate that the best chances to get rain would be later in June and in July.

LOCAL SUMMARY AND FORECAST

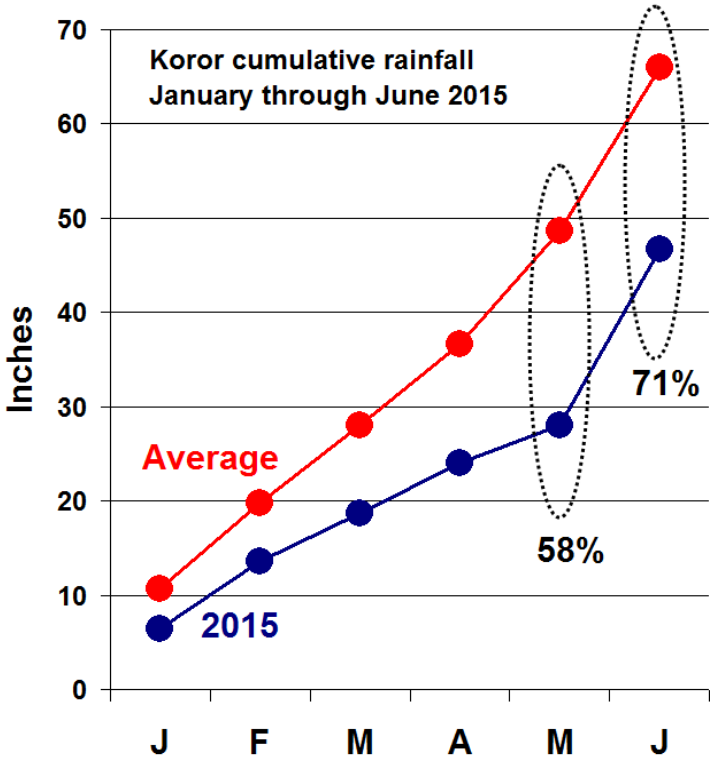


Figure 13. Cumulative rainfall at Koror. Red line shows the normal accumulated rainfall over the first 6 months of the year, and the dark blue line shows the accumulated rainfall over the first 6 months of 2015. By May 2015, only 58% of average rainfall had fallen at Koror. Heavy rainfall in June brought the accumulated total closer to average, but it still fell short at 71%.

Abundant rainfall finally arrived at Palau in June when the monsoon trough lifted across the island nation and brought a 2-week period of heavy showers. Koror received 18.66 (108%) inches of rainfall during June 2015. This was actually only slightly above average, but was a vast improvement over the previous conditions. It was more rain than measured in the previous 3 months combined! At the end of June, the drought advisory was lifted, and Palau was placed in a probationary category of D0-L in the USDM (D0-L = abnormally dry, long-term).

With dryness anticipated to gradually worsen over the next few months, and especially early in 2016, Palau could quickly and easily slip back into severe drought conditions. Indeed, this is the PEAC outlook. Another drought advisory will likely be issued for Palau by WFO Guam later in the summer.

Palau sea level has been below normal since March 2015. Currently it is considerably below normal (-7 in). This fall is supportive of the on-going El Ninõ state, as Palau displayed a similar fall in 1997.

LOCAL SUMMARY AND FORECAST

Republic of Palau Rainfall Summary: 2015 2nd Quarter and 2015 First Half						
Station		Apr	May	Jun	2nd Qtr	1st Half
Palau						
Koror WSO	Inches	5.42	3.96	18.66	28.04	46.70
	% Avg	63%	33%	108%	74%	71%
Intl. Airport	Inches	5.71	4.47	19.50*	29.68	51.52
	% Avg	166%	37%	113%	78%	78%

* Estimated.

Climate Outlook: The Pacific basin climate is in an El Niño climate state, and it is strong at this time. Indices of El Niño typically reach peak late in the El Niño year, and the ultimate strength of El Niño is usually pegged to its condition at its peak. For this reason, the strength of the current El Niño, while strong for this time of year, is not yet established, and won't be known until the end of the year. In any case, the PEAC will issue forecasts based on the occurrence of a strong El Niño.

History has shown that El Niño does play some role in damaging typhoons at Palau. Three major historical typhoons have occurred with a plausible association with El Niño; these include: Typhoon Marie (April 1976), Typhoon Owen (December 1990), and Typhoon Mike (November 1991). Four major historical typhoons affected Palau outside of El Niño; these include: Sally (March 1967), Kate (October 1970); Bopha (2012); and Haiyan (2013). Although three of seven major typhoons affecting Palau have an association with El Niño, history reveals that only one typhoon (Mike – Nov 1991) severely affected Palau in the fall of an El Niño year. Thus, for the rest of 2015 and early 2016, it is thought that the threat of a damaging typhoon at Palau is near average (~5-10%). It is not zero, and nervousness certainly remains after the back-to-back late season strikes of typhoons Bopha and Haiyan!

Another upcoming threat posed by El Niño is major drought. Drought related to El Niño becomes severe early in the year that follows a strong El Niño (e.g., 1983 and 1998). Rainfall during El Niño is greater than average very early in the year, and then gradually drops farther below normal as the year progresses (Fig. 14). Rainfall sinks to well below average during the first few months (January through May) of the year following El Niño. Recovery to near-average rainfall is delayed until July or August.

Forecasts for the next three seasons (JAS, ASO, and SON) indicate about 4-5 inches below normal sea level at Malakal; when compared to the forecasts of the previous quarter (AMJ) of 2015, this is still considered to a be an additional fall.

Predicted rainfall for Palau from July 2015 through June 2016 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]
July – September 2015	85% (38.12 in)
October – December 2015	75%
January – March 2016	40%
April - June 2016	65%

LOCAL SUMMARY AND FORECAST

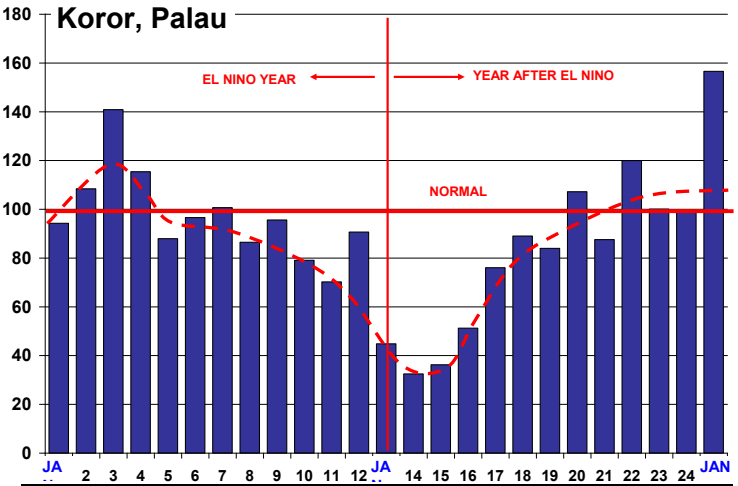


Figure 14. Composite monthly rainfall for 5 strong El Niño events at Palau for the two-year period that covers the El Niño year and the year that follows El Niño. Values plotted are monthly percent of average rainfall. Red dashed line shows smoothed rainfall trend.

Republic of the Marshall Islands: The RMI experienced some wild weather during the first half of 2015, including heavy rainfall, tropical cyclone passages and sea inundations. January and February passed rather uneventfully, with some very low rainfall totals reported at Utirik and Wotje in the northern RMI. Rainfall throughout the RMI had a dramatic rebound to very wet conditions during March, April and May of 2015. Even at the usual driest of the atolls in the north (e.g., Kwajalein, Utirik and Wotje), enormous amounts of rainfall were experienced. The spatial and temporal variability of the heavy rainfall was high. This might be expected considering that much of the rainfall derived from an unusual spate of tropical cyclones and an unusual eastward extension of the monsoon trough into the RMI. Three separate instances of damaging sea inundation occurred on some of the atolls of the RMI. Each of the damaging sea inundations was associated with a tropical cyclone in the region: (Bavi, March 2015); Dolphin (May 2015); and, Nangka (July 2015).

(Bavi, March 2015): The wind and swell of Bavi caused over $1 million in damages on the main islet of the Kwajalein atoll. Damages were also substantial on Ebeye where high surf caused damaging inundation and gales damaged structures with weaker tin roofs and plywood walls. At other locations in the RMI, Bavi's large waves coupled with high-tide caused flooding across the expansive Majuro Atoll. A yacht struck a reef within the atoll due to the rough seas, though no injuries resulted. Gusty winds and heavy rain impacted much of the Marshall Islands. At the missile test range on Kwajalein, there was 10.65 inches of rain during the 3-day passage of Bavi, with an extreme of 6.35 inches on the 10th of March. A peak wind gust to 51 mph was recorded on the 11th. The lowest sea level pressure during the event of 997.2 mb was the 3rd lowest pressure recorded at Kwajalein, with only two other tropical cyclones bringing lower pressure: Roy (1988) and Zelda (1991) with minimum SLP of 991.5 and 990.1, respectively.

(Dolphin, May 2015) Typhoon Dolphin did not pass through the RMI, but while it was moving northward between Pohnpei and Kosrae, westerly winds to its south generated a swell that man-

aged to enter the Kwajalein Lagoon through passes on the west side, which then propagated across the lagoon (Fig. 15) to end up as high surf on the lagoon side of Ebeye! (Fig. 16). Twitter exchanges from area residents indicated that some small boats were sunk. While not a catastrophic inundation, it was a rather unusual occurrence, and demonstrates a vulnerability from westerly swells that must be considered.

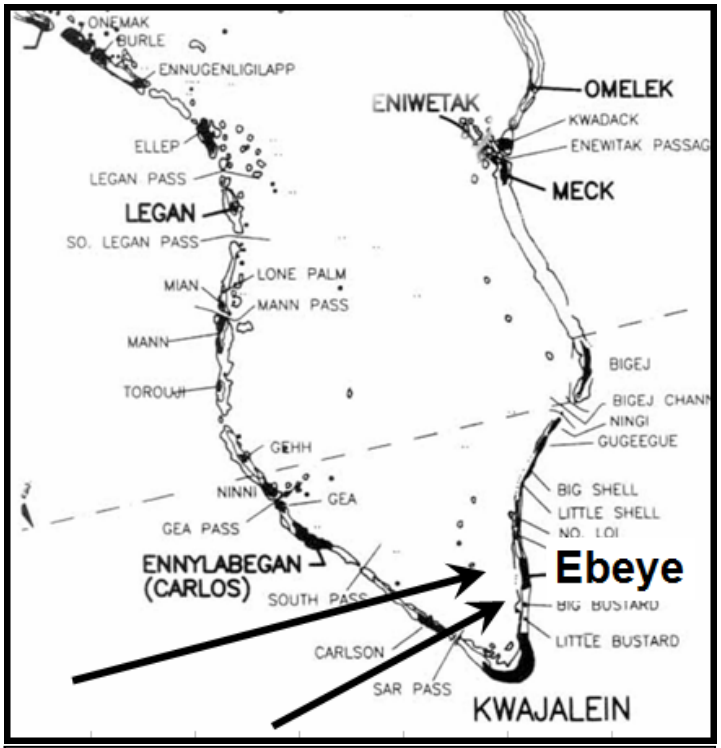


Figure 15. A map of the southern half of the Kwajalein Atoll showing the location of the Ebeye islet. Swell from Tropical Storm Dolphin managed to enter the passes on the southwest side to cross the lagoon and generate high surf on the lagoon side of Ebeye.

Figure 16. (Photo from https://www.facebook.com/pacioos/posts/902923986430958) Tropical storm Dolphin generated high swells that reached the lagoon-side of Ebeye Islet, Kwajalein Atoll, Marshall Islands. Several boats were reported sunk; Picture of the week submitted to the US Embassy, Majuro, by Love Diaz, 21 May 2015; "… wave action this week on Ebeye."

(Nangka, July 2015). According to the JTWC, Nangka became a tropical storm on the morning of Saturday, 04 July. A day earlier on Friday, 03 July, near-gale force westerly winds blew across the Majuro Lagoon causing a major inundation event on the lagoon-side of the most populated islets on the east side of the atoll (see Fig. 17). Damage was extensive, and included ships sunk or driven ashore, power outages, coastal destruction (particularly severe at the site of Robert Reimer's Hotel). A news summary from the Autralian Broadcasting Corporation nicely summarizes the effects of the storm at Majuro Atoll:

Figure 17. Gusty westerly wind drives high waves onto the lagoon side of the Darrit-Uliga-Delap (D-U-D) shoreline of Majuro Atoll. Photo posted on the Twitter account of RMI foreign minister Tony de Brum: https://twitter.com/MinisterTdB/status/617100637671698432/photo/1.

Majuro Atoll's normally calm lagoon was turned into a cauldron of high waves on Friday, ripping fishing vessels and yachts from their moorings and smashing them on to reefs.

High winds tore roofs from houses, knocked down trees and caused a power outage affecting half the city which is home to about 25,000 people.

Marshall Islands foreign minister Tony de Brum had just returned from a United Nations climate conference in New York when he faced the damaging, unseasonal storm.

"My family home battered by the beginnings of yet another cyclone. Climate change has arrived," he tweeted.

"Just landed home. Majuro like a war zone. Roofs torn off, huge blackout, ships ashore. On alert for more tonight."

Local officials said the severity of the storm was unusual because July is not typically in typhoon season for the western Pacific nation.

"We've been here through many westerlies, but I have never seen anything quite so ferocious," said Cary Evarts, an American who has lived aboard his yacht in Majuro for more than 15 years.

LOCAL SUMMARY AND FORECAST

He estimated 25 vessels in the lagoon either broke loose or dragged their moorings.

Majuro's five-kilometre eastern lagoon coastline was littered with debris from boats and damaged houses.

"We've seen inundation and damage all along the shoreline," longtime local fisherman and Sea Patrol officer Kyle Aliven said."

"This is the worst I've seen."

The United States Joint Typhoon Warning Centre issued a typhoon formation alert for the Marshall Islands, saying Nangka was building between Majuro and Kwajalein, the two most populated Marshall Islands atolls.

The monthly mean sea level in Majuro recorded a fall during the last couple of months. It levelled the mark at below normal in May 2015. Currently, it is marginally below normal (-1 in); but this indicates a 5 inch fall in AMJ when compared to JFM of 2015. Despite a gradual fall, the monthly mean sea level in Kwajalein was slightly elevated. It started to fall since March 2015 and, currently, it is marginally below normal (-1 in); this indicates a further 2 inch fall with respect to AMJ of 2014.

RMI Rainfall Summary: 2015 2nd Quarter and 1st Half

Station		Apr	May	Jun	2nd Qtr	1st Half
RMI Central and Southern Atolls						
Majuro WSO	Inches	15.23	17.27	6.31	38.81	73.02
	% Avg	148%	154%	54%	117%	131%
Aling...	Inches	10.28	16.09	8.44	34.81	50.93
	% Avg*	115%	152%	80%	116%	107%
Jaluit...	Inches	8.42	6.66	8.84	23.92	39.64
	% Avg*	82%	60%	76%	72%	71%
Mili	Inches	13.69	13.72	7.44	34.85	69.37
	% Avg*	133%	123%	64%	105%	124%
RMI Northern Atolls						
Kwajalein	Inches	16.94	13.69	8.12	38.75	68.39
	% Avg	224%	137%	84%	143%	175%
Wotje	Inches	6.69	7.71	4.83	19.23	44.22
	% Avg	172%	168%	93%	140%	213%
Utirik	Inches	19.89	4.08	2.07	26.04	31.79
	% Avg	551%	96%	43%	205%	165%

Climate Outlook: The Pacific basin climate is in an El Niño climate state, and it is strong at this time. Indices of El Niño typically reach peak late in the El Niño year, and the ultimate strength of El Niño is usually pegged to its condition at its peak. For this reason, the strength of the current El Niño, while strong for this time of year, is not yet established, and won't be known until the end of the year. In any case, the PEAC will issue forecasts based on the occurrence of strong El Niño conditions.

El Niño has large effects on the climate of the RMI. Rainfall, sea level and the typhoon distribution are substantially altered. Assuming 2015 to be an El Niño year of moderate to strong intensity, fairly reliable long-term outlooks for the climate can be made.

The threat of a damaging tropical cyclone within the RMI is high throughout an El Niño year – as the passage of

LOCAL SUMMARY AND FORECAST

Bavi, Dolphin, Nangka and other developing cyclones through the region during the first half of 2015 has already shown. As time progresses during an El Niño year, typhoon activity shifts ever more exclusively to the east. We anticipate two or three typhoons to form in eastern Micronesia from October 2015 through January 2016. These late-season typhoons could be serious threats to some of the atolls of the RMI. The chances are estimated at least 50-50 for another tropical cyclone to bring damaging wind, heavy rainfall and/or high surf to one or more of the atolls of the RMI.

Another upcoming threat posed by El Niño is major drought. Drought related to El Niño becomes severe early in the year that follows a strong El Niño (e.g., 1983 and 1998). Rainfall during El Niño is greater than average during the first half of the year. After September, the monthly rainfall begins a steady decline, sinking to well below average during the first few months (January through May) of the year following El Niño (see Fig. 18). Recovery to average rainfall is delayed until June for the southern atolls and until July for the northern atolls. Majuro forecasts for the next three seasons (JAS, ASO, and SON) indicate marginally below normal sea level (-1 in) and, when compared to the forecasts of first quarter 2015, this is a marginal decline of sea level. Kwajalein forecasts for the next seasons (JAS, ASO, and SON) indicate marginally below normal sea level (-1 to -2 in) and, when compared to the forecasts of first quarter 2014, this is about a 2-3 inch fall.

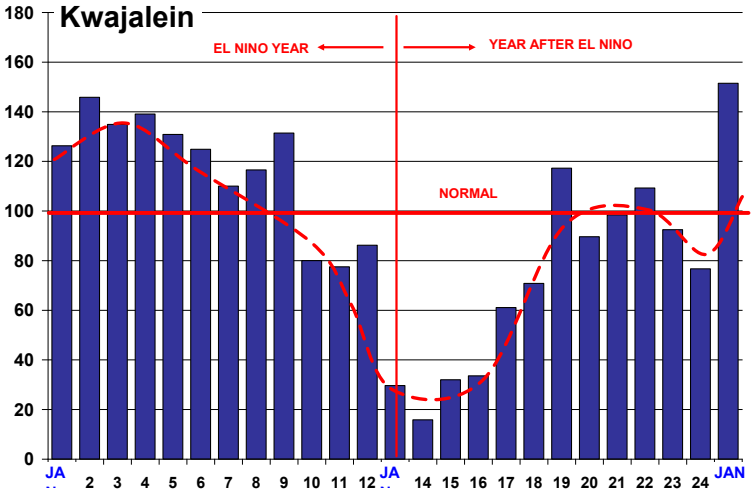
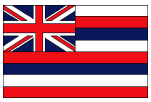


Figure 18. The typical response during El Niño of monthly rainfall (% of average in the RMI. The data plotted are for Kwajalein.

Predicted rainfall for the RMI from July 2015 through June 2016 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]		
	South of 6°N	6°N to 8°N	North of 8°N
Jul - Sep 2015	120% (44.33 inches)	120% (44.33 inches)	120% (47.53 inches)
Oct - Dec 2015	90%	90%	85%
Jan – Mar 2016	50%	40%	40%
April– June 2016	70%	60%	50%

LOCAL SUMMARY AND FORECAST



Hawaii: Even though NOAA officially declared ongoing conditions as an El Niño event only in April 2015, some aspects of North Pacific weather patterns resembled conditions typical of El Niño years as early as January 2015 including persistent high pressure ridging over or near the state, a strong east-west-oriented jet stream extending across much of the North Pacific, and stable atmospheric conditions producing below average rainfall across the main Hawaiian Islands.

January through April represents for Hawaii the latter half of the wet season and was dominated by variable weather patterns and the passage of cold fronts through the islands late into the season, with a cold front passing even as late as May. Lihue, Honolulu and Hilo all received below or near average rainfall during these 4 months. This deficient rainfall during the end of the wet season made it so that drought conditions over the state deteriorated rapidly during the first half of the year as compared to 2014. As the state transitioned to its dry and warm season during May and June, rainfall has been near average for most stations bringing some relief to drought conditions. This improvement unfortunately will likely not last as the dry season progresses.

In comparison to the other island regions mentioned earlier, the following two stations (Honolulu and Hilo) are less sensitive to ENSO with regards to sea level. Therefore, in addition to ENSO, other local oceanic and atmospheric factors are equally important. Never the less current conditions are as follows: Since January 2015, the monthly mean sea level in Honolulu remained close to normal. Currently, it is staying slightly above normal (+3 in). Since January 2015, the monthly mean sea level in Hilo also remained close to normal. Currently, it is staying 1.5 inches above normal.

Hawaii Rainfall Summary: 2015 2nd Quarter and 1st Half

Station		Apr	May	Jun	2nd Qtr	1st Half
Lihue Airport	Inches	1.48	0.86	0.98	3.32	6.87
	%Avg	76%	58%	77%	70%	286%
Honolulu Airport	Inches	0.37	0.20	0.23	0.8	3.23
	%Avg	71%	50%	128%	73%	87%
Kahului Airport	Inches	2.81	2.23	0.1	5.14	19.24
	%Avg	316%	455%	111%	350%	80%
Hilo Airport	Inches	14.31	7.75	5.23	27.29	44.30
	%Avg	160%	105%	83%	121%	60%

Climate Outlook: As discussed in other island sections, the ongoing El Niño event will continue to develop and reach maximum strength during December 2015 to January 2016. The event is forecasted to reach the strong intensity category and the PEAC Center will issue forecasts based on conditions associated with this level of intensity.

NOAA's Central Pacific Hurricane Center predicted above-normal activity in the Central Pacific basin during the 2015 hurricane season which extends from June 1st to November 30th. Their statement, issued on May 26, 2015, was based on the expectation of strengthening El Niño conditions

LOCAL SUMMARY AND FORECAST

throughout the rest of 2015. El Niño usually the favors the development of tropical cyclones in the Central Pacific as well as the westward tracking of storms from the Eastern Pacific, allowing them to reach the Central Pacific. These compounded effects make for an above average chance of Tropical Cyclone activity in the Central Pacific Basin and an increased risk for Hawaii.

As for rainfall, the Hawaiian Islands are expected to have a wet dry season (April through August) during the development of an El Niño event and a dry wet season (October through April) during the peak and decay phase of the El Niño.

Forecasts for the next three seasons (JAS, ASO, and SON) indicate a slightly elevated sea level of plus to inches for both Honolulu and Hilo.

Predicted rainfall for the State of Hawaii from July 2015 through June 2016 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]			
	Honolulu	Lihue	Kahului	Hilo
Aug- Oct 2015	150% (1.05 in)	120% (2.81 in)	200% (0.82 in)	125% (11.10 in)
Nov- Jan 2016	100%	95%	75%	85%
Feb-Apr 2016	80%	90%	85%	85%

The U.S. Climate Prediction Center's Seasonal Outlook Discussion, posted on January 15, 2015, can be obtained from the following website: http://www.cpc.ncep.noaa.gov/products/predictions/90day/hw40.html.

ENSO UPDATE

All of the weather patterns occurring in the USAPI during 2015, as discussed throughout, typically occur during El Niño, and some (such as the very abundant early season tropical cyclone activity) occur usually during a moderate or strong El Niño. Indeed, the climate system has already been declared El Niño and shows signs that it may become strong, as the latest discussion from the U.S. Climate prediction Center (CPC) indicates below.

EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION posted on the U.S. Climate Prediction Center/NCEP1 and the International Research Institute for Climate and Society web site on 09 July, 2015:

ENSO Alert System Status: El Niño Advisory

Synopsis: There is a greater than 90% chance that El Niño will continue through Northern Hemisphere winter 2015-16, and around an 80% chance it will last into early spring 2016.

"During June, sea surface temperatures (SST) anomalies exceeded +1.0°C across the central and eastern equatorial Pacific Ocean. The largest SST anomaly increases occurred in the Niño-3 and Niño-3.4 regions, while the Niño-4

ENSO UPDATE

and Niño-1+2 indices remained more constant through the month. Positive subsurface temperature anomalies weakened due to the eastward shift of an upwelling oceanic Kelvin wave, which reduced above-average temperatures at depth in the central and east-central equatorial Pacific. In many respects, the atmospheric anomalies remained firmly coupled to the oceanic warming. Significant westerly winds were apparent in the western equatorial Pacific and anomalous upper-level easterly winds continued. The traditional and equatorial Southern Oscillation Index (SOI) were both negative, which are consistent with enhanced convection over the central and eastern equatorial Pacific and suppressed convection over Indonesia. Collectively, these atmospheric and oceanic features reflect an ongoing and strengthening El Niño.

Nearly all models predict El Niño to continue into the Northern Hemisphere winter 2015-16, with many multi-model averages predicting a strong event at its peak strength (3-month values of the Niño-3.4 index of +1.5°C or greater). At this time, the forecaster consensus is in favor of a significant El Niño in excess of +1.5°C in the Niño-3.4 region. Overall, there is a greater than 90% chance that El Niño will continue through Northern Hemisphere winter 2015-16, and around an 80% chance it will last into early spring 2016.

El Niño will likely contribute to a below normal Atlantic hurricane season, and to above-normal hurricane seasons in both the central and eastern Pacific hurricane basins."

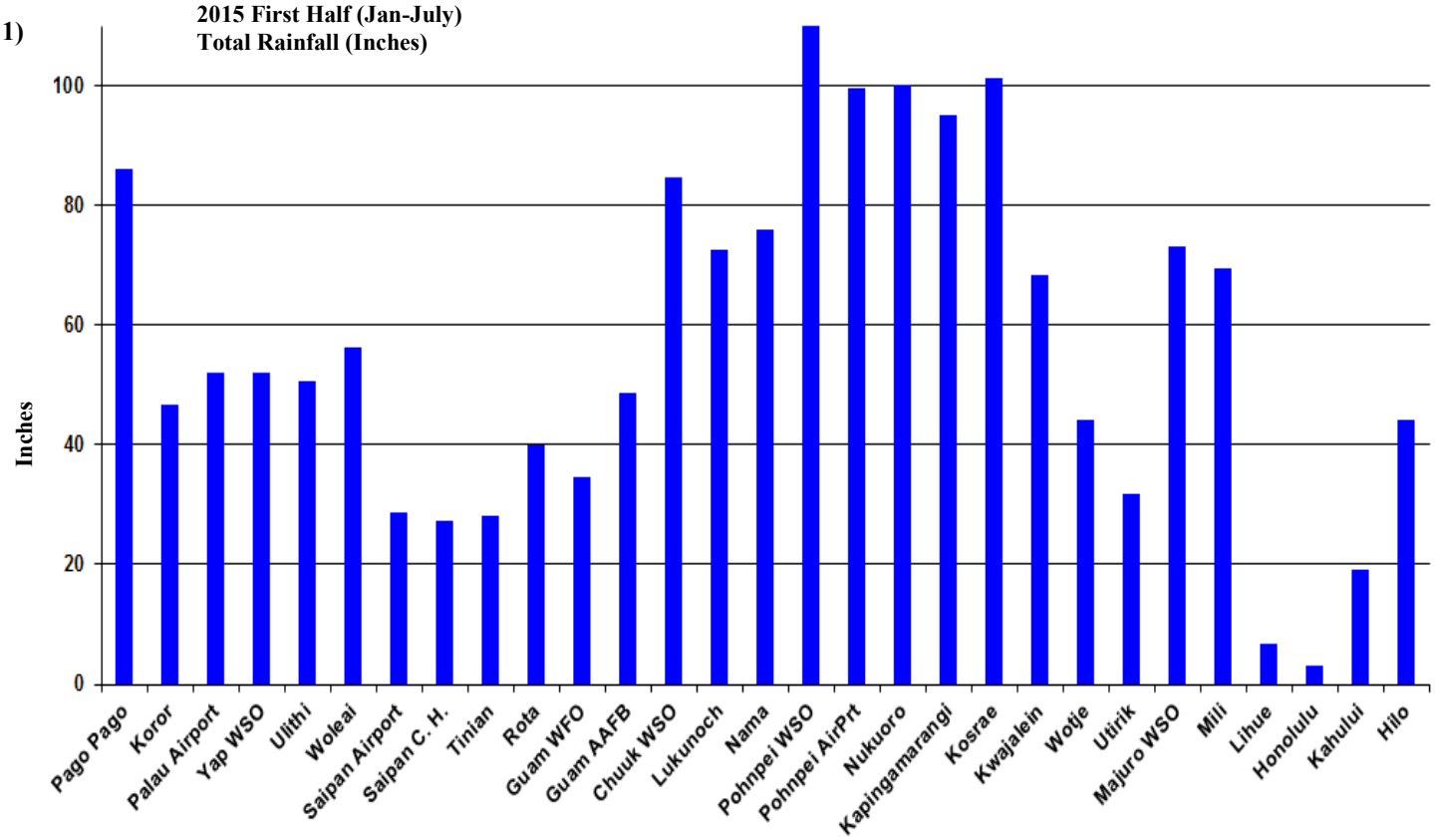
[1]Climate Prediction Center National Centers for Environmental Prediction. NOAA/National Weather Service. College Park, MD 20740

TROPICAL CYCLONE/ POST SCRIPT

Post Script: A just released statistical forecast of tropical cyclone activity for the remainder of the year in the western North Pacific basin has been supplied to the PEAC from Mr. Paul Stanko, lead forecaster at the Guam Weather Service Forecast Office. His forecast calls for the annual totals of nearly all categories of TC activity (e.g., number of typhoons, number of major typhoons, number of typhoons in Micronesia, etc) to be above normal, and in some cases at record highs. The anticipated record highs include: (1) the number of major typhoon in the western North Pacific basin; (2) the number of TS+TY within the bounds of Micronesia; (3) the number of TY within the bounds of Micronesia; and, (4) the number of major typhoons within the bounds of Micronesia. His statistics indicate that all but one (TC 01W in early January) of the tropical cyclones to-date during 2015 occurred in the very-early quintile for the arrival time of its designated JTWC number (e.g., 01W, 02W, 03W, etc.)

SEASONAL RAINFALL OUTLOOK FOR THE US-AFFILIATED PACFIC ISLANDS

1)



SEASONAL RAINFALL OUTLOOK FOR THE US-AFFILIATED PACFIC ISLANDS

2)

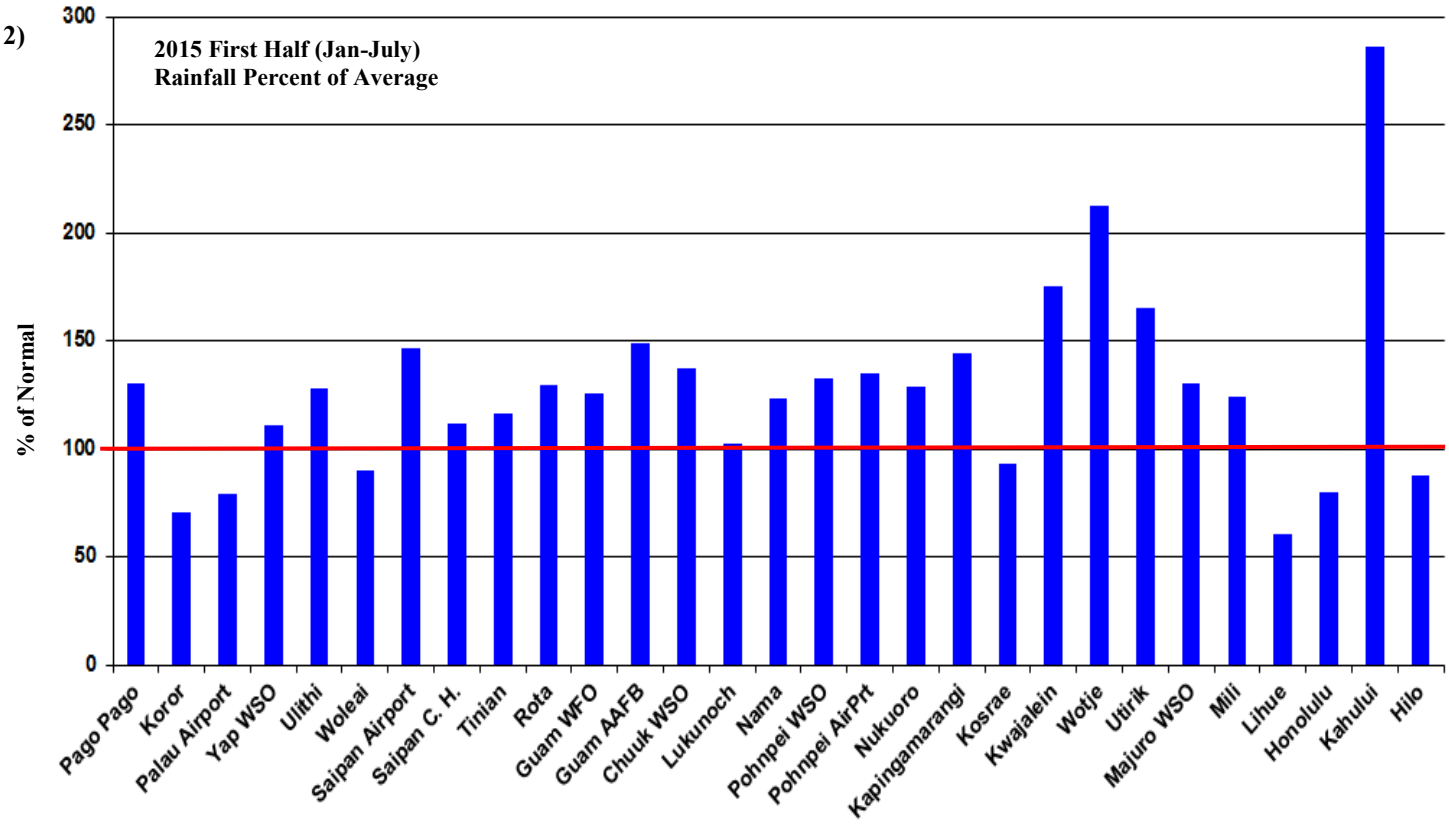


Figure 1 and 2, **(1)** 2015 First Half (JFMAMJ) rainfall amounts in inches at the indicated locations. **(2)** 2015 First Half (JFMAMJ) rainfall percent of average at the indicated locations.

ADDITIONAL INFORMATION

For more information on weather and climate in American Samoa go to
http://www.prh.noaa.gov/samoa/.

For more information on Guam's weather and climate go to
http://www.prh.noaa.gov/guam

For more information on weather and climate in Yap go to
http://www.prh.noaa.gov/yap/

For more information on weather and climate in Chuuk go to
http://www.prh.noaa.gov/chuuk/

For more information on weather and climate in Phonpei go to
http://www.prh.noaa.gov/phonpei/

For more information on weather and climate in Mauro go to
http://www.prh.noaa.gov/majuro/

ADDITIONAL INFORMATION

For more information on weather and climate in Hawaii go to
http://www.prh.noaa.gov/pr/hnl/ or
www.cpc.noaa.gov/products/predictions/long_range/fxhw40.html

***Pacific ENSO Update* is Now Available Online:**
To receive notification when the newsletter is available online visit:
http://www.prh.noaa.gov/peac/update.php

DISCLAIMER STATEMENT

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 editor, LTJG G. Carl Noblitt IV, 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.

CONTRIBUTORS

NOAA National Weather Service
Pacific ENSO Applications Climate (PEAC) Center:
HIG #340, 2525 Correa Road, Honolulu, Hawai'i 96822
LTJG G. Carl Noblitt IV, NOAA Corps, Pacific Region Climate Officer, at
808-956-2324: for information on PEAC, the Pacific ENSO Update and ENSO-related climate data for the Pacific Islands.

University of Hawai'i - Joint Institute of Marine and Atmospheric Research (JIMAR),
Pacific ENSO Applications Climate (PEAC) Center:
HIG #340, 2525 Correa Road, Honolulu, Hawai'i 96822
Dr. Rashed Chowdhury, Principal Research Scientist, at
808-956-2324: for information on ENSO and sea level variability in the USAPI.

University of Hawai'i - Joint Institute of Marine and Atmospheric Research (JIMAR),
Pacific ENSO Applications Climate (PEAC) Center:
HIG #340, 2525 Correa Road, Honolulu, Hawai'i 96822
Alejandro Ludert, Graduate Research Assistant and Webmaster.

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.
808-956-2324 for: information related to the PEAC website.

CONTRIBUTORS

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.

NOAA National Weather Service
Weather Forecast Office (WFO) Guam:
Clint Simpson, Meteorologist, at
671-472-0950 for: information on tropical cyclones and climate in the USAPI.

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.