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Providing Information on Climate Variability for the U.S.-Affiliated Pacific Islands

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CURRENT CONDITIONS

The tropical Pacific climate system persisted in a status of ENSO-neutral during the 1st half of 2013. At the time of this writing (late-July), the climate indices remain ENSO-neutral, but many of the climatic elements (e.g., the low level wind, the position of the monsoon trough, the pattern of the sea surface temperature (SST) and the distribution of typhoons) are behaving in a way more typical of La Niña. For most of the past decade, and ongoing again this year, the climate and weather of the Pacific basin has been dominated by La Niña, or by weather patterns typical of La Niña even when ENSO indices are in the neutral range. Sometime during the late 1990s, the Pacific basin climate appears to have transitioned into a positive phase of the Pacific Decadal Oscillation (PDO). The positive phase of the PDO is a long-lasting (~50 years) period in which the weather and climate of the Pacific basin are dominated by anomalies that are typical of La Niña. The negative phase of the PDO also lasts several decades and features persistent climate anomalies that are typical of El Niño. During the 1980s and most of the 1990s when the PDO was still negative, many hurricane remnants passed near or over Hawaii, enhancing summer rainfall. Two destructive hurricanes, Iwa (1982) and Iniki (1992), severely impacted Hawaii. The monsoon trough of the western North Pacific was very active, with many typhoons tracking within the boundaries of Micronesia, including Typhoon Paka (1997), which was the last typhoon to pass through the Marshall Islands.

Trade-winds have been unusually persistent across the western North Pacific through July, with the summer monsoon weak or absent. Tropical cyclone activity has been shifted to the west, with half of the 2013 tropical cyclones forming or moving into the South China Sea (see pg. 3 for discussion). At some islands (e.g., Palau and Yap), typical summer rains have commenced, while at other islands (e.g., Guam, the CNMI, and at Kwajalein), the rainy season has been lackluster, with persistently below-normal rainfall during the 1st half of 2013 (Figs. 1a and 1b) continuing through July (see local summaries).

During the 1st half of 2013, there were five notable climate anomalies with significant impacts in the region:

- Extreme drought occurred for several months across the northern-most atolls of the Republic of the Marshall Islands (RMI), while moderate drought conditions occurred for a short period across the northern atolls of Chuuk State and the eastern atolls of Yap State;
- persistently higher than average mean sea level was observed at all Micronesia sites and in American Samoa, likely contributing to inundation at several locations, such as the Marshall Islands and the east shores of Kosrae;
- destructive sea inundation occurred on the south shores of some atolls of the RMI during a period of astronomically accentuated King tides at the timing of the full moon (a "supermoon") in June 2013;
- landslides and flooding affected the Compact Rd on the island of Babeldaob in the Republic of Palau when heavy rains fell as Tropical Storm (TS) Leepi formed to the northwest of the region during the last week of June; and
- NOAA issued coral bleaching watches and warnings in an extensive area across the western Pacific Ocean, extending from the Philippines northeastward across all the Mariana Islands.

Special Topic: The King Tide and the Supermoon

On 25 June (the day of that month's full moon), and for a day or two before and after, the high tides were unusually high across Micronesia. On Majuro, they contributed to damaging inundation. Elsewhere, abnormally high tides were observed but did not cause any significant inundation or damage. These highest of high tides of the year are locally referred to as King tides. "King tide" is not a scientific term, nor is it used in a scientific context. Use of the term originated in Australia, New Zealand and other Pacific nations to refer to an especially high tide that occurs only a few times per year. Throughout Micronesia, the highest, and lowest tides of the year occur in June and again in December, based on the axial tilt of the earth. Another factor that can cause the highest of high tides to be even higher is the varying distance of the moon from Earth. When the moon is closest to the earth in its elliptical orbit (perigee) at the timing of the full or the new moon (syzygy), it can add about 15% to the height of the high tide. This phenomenon, resulting in a so-called "supermoon", occurred during the full moon of 25 June 2013. The technical name is the perigee-syzygy of the Earth-Moon-Sun system. The term "supermoon" is not astronomical. It originated in modern astrology. The combined effect of the Sun and Moon on Earth's oceans and tides, is greatest when the moon is either new or full. On 25 June 2013, everything came together to produce King tides in Micronesia: the moon was full, it was a "supermoon", the tides were at their seasonal peak, and the mean sea level was elevated by about half-a-foot by persistently strong trade winds.

SEA SURFACE TEMPERATURES

ENSO neutral conditions have persisted over the past few months with sea surface temperatures (SST) resting near average in April and May. In June, below-average SSTs prevailed in the eastern Pacific, while near-average SSTs persisted across the rest of the equatorial Pacific. The oceanic heat content (average temperature in the upper 300m of the ocean) was near average in May, decreased slightly by the emergence of below-average subsurface temperatures in the eastern Pacific. In April, the oceanic heat content stayed near average, reflecting near average subsurface temperatures across the central and eastern equatorial Pacific. The oceanic heat content anomalies then increased in June, due to the emergence of above-average subsurface temperatures in the eastern half of the Pacific. The atmospheric and oceanic conditions remain consistent with ENSO-neutral.

SOUTHERN OSCILLATION INDEX

The 3-month average of the Southern Oscillation Index for the second quarter of this year was 0.7, with monthly values of 0.2, 0.8, and 1.2 for the months of April, May, and June (AMJ) 2013, respectively. Over the last few months, SOI observations have been trending from a smaller positive value to a positive value over 1. This shift of SOI values from 0.2 to 0.8 to 1.2 over the AMJ months of 2013, although neutral, indicate a hovering near the threshold of La Niña.

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, respectively.

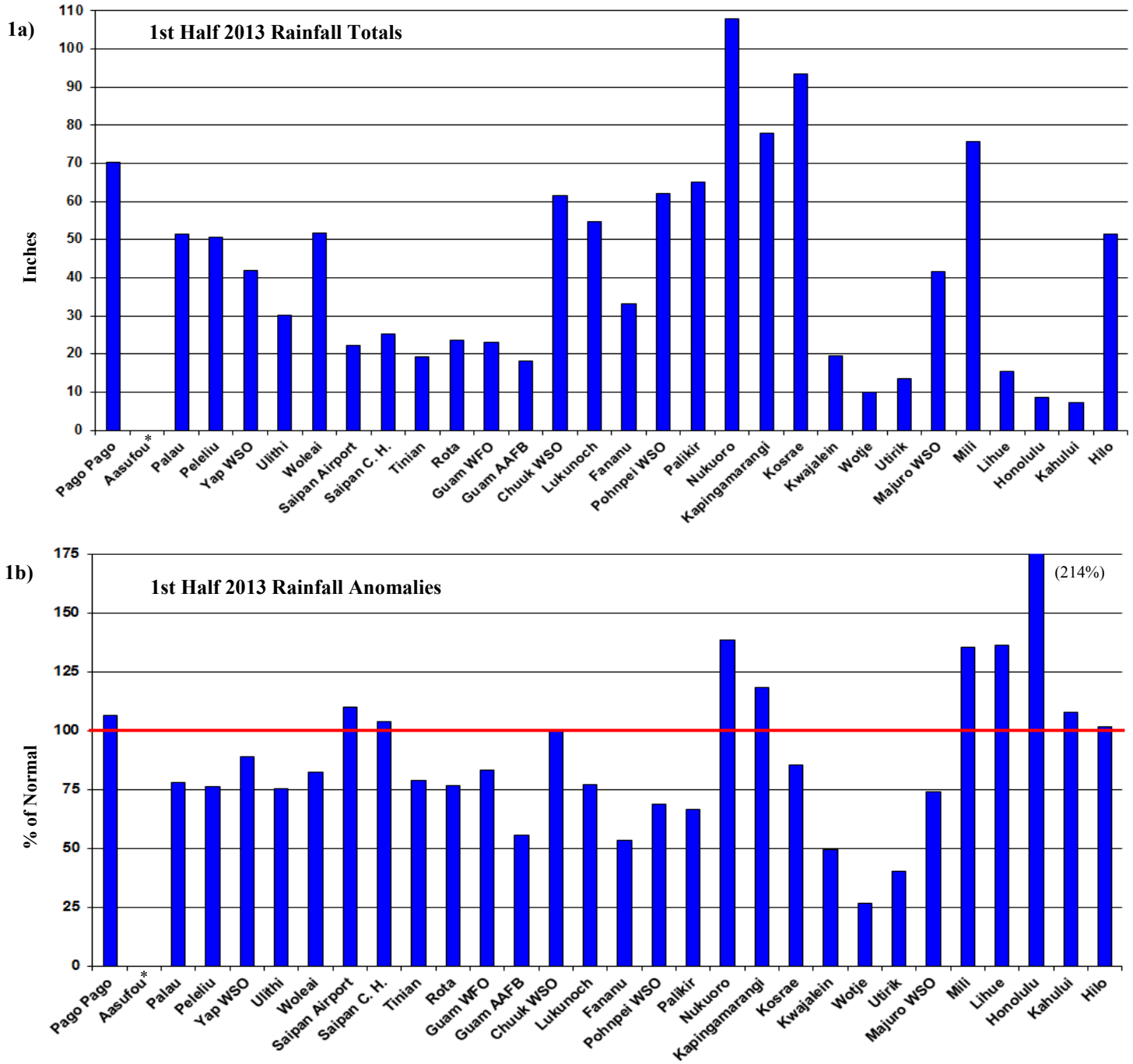

Figure 1. 1st Half 2013 rainfall totals (a) in inches and (b) anomalies (expressed as % of normal). In 1b, solid line indicates normal rainfall (100%). * Missing data.

TROPICAL CYCLONE

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, Darwin, Port Moresby, Jakarta, Nadi, and Wellington. The numbering scheme for Southern Hemisphere tropical cyclones and the 1-minute average maximum sustained wind estimates are taken from warnings issued by the JTWC, which has a warning responsibility to its constituency across the South Pacific and South Indian oceans that overlaps the local centers. Tropical cyclone advisories for eastern North Pacific tropical cyclones are provided by RSMC Miami, and tropical cyclone advisories for the central North Pacific (140° W to the 180° meridian) are provided by RSMC Honolulu. There are sometime differences in the statistics (e.g., storm maximum intensity) for a given tropical cyclone between the JTWC and the local centers that are noted in this summary.

Tropical Cyclone Summary

During the 1st half of 2013, the JTWC numbered six significant tropical cyclones that were also provided names by the JMA: one in early January—Sonamu (01W), one in Feburary—Shanshan (02W), and four during June—Yagi (03W), Leepi (04W), Bebinca (05W), and Rumbia (06W). Four of these six cyclones formed within, or moved into, the South China Sea. Tropical Storm (TS) Leepi (04W) formed near Palau, and contributed to heavy rains over Palau during the three-day period from 25-27 June. During July 2013, there were two additional tropical cyclones in the western North Pacific basin: Typhoon Soulik (07W) and TS Cimaron (08W). TS Cimaron was another cyclone that formed far to the west and affected northern parts of the Philippines, Taiwan and southeastern China. Soulik was an unusual typhoon that formed northeast of Guam in association with an upper-level cyclone, or TUTT cell. This cyclone began to intensify rapidly just as it was passing through the northern Mariana Islands (north of Pagan Island and near or over Agrihan Island).

Three organizations 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[1]. The TSR research group and the WFO Guam have released tropical cyclone outlooks at the time of this writing. The Guam WFO forecast calls for slightly below normal basin activity and the TSR forecast calls for near normal basin activity. The Hong Kong group has not released a forecast for typhoon activity for 2013, and their stated reason for not doing so is relevant to our discussion:

> *"The Tropical Cyclone (TC) activity over the western North Pacific has a significant decreasing trend in recent years. Our prediction scheme, which was first developed in 1997, with an improvement in 2001, however does not incorporate this trend and therefore overestimated the TC activity during the last few years. The prediction scheme is currently under revision and we will not issue the forecasts for the TC activity over the western North Pacific in 2012 [and also not for 2013]."*

The Southern Hemisphere cyclone season of 2012-2013 ended with 24 cyclones numbered by the JTWC, which was below normal. The season began early with an intense cyclone (TC Anais) in the South Indian Ocean during October 2012, and an intense and destructive cyclone (TC Evan) in December 2012 that affected Samoa and Fiji. Though there have been some notable destructive storms, both the western North Pacific and the Southern Hemisphere have seen relatively quiet seasons for the past several years. No tropical cyclone activity is anticipated for American Samoa through November 2013, after which time the new Southern Hemisphere cyclone season (2013-2014) will commence, with the season's first cyclones appearing in the South Indian Ocean and in the Coral Sea.

The Hawaiian Islands were impacted during the last part of the month of July by TS Flossie. Flossie formed in the West Pacific on 24 July and was upgraded to a tropical storm less than 24 hours later, making it the sixth named storm in the eastern Pacific so far this season. Flossie reached maximum intensity over the ocean on 27 July with estimated maximum winds of 70mph. TS Flossie tracked east-northeast crossing the 140°W on the 27th and prompting the Central Pacific Hurricane Center to issue Tropical Storm watches for the Hawaiian islands, later to be upgraded to warnings during the 28. Convection from the Tropical storm began to affect the Hawaii Island on the evening of 29 July with rain rates of 3-4 in/hour (recorded at Haleakala). On Maui 5.3 inches of rain was recorded at Kaup Gap. The damage from the storm was minimal with some power lines and trees downed by the winds. No fatalities or serious injuries were reported as a result of TS Flossie.

PEAC Center Tropical Cyclone Assessment

Based on available guidance[1] and the forecast behavior of ENSO, the PEAC tropical cyclone outlook for the upcoming western North Pacific typhoon season of 2013 is for slightly below normal activity, considering: (1) the relative quiescence of the season to-date; (2) the recent widespread trend toward reduced numbers of TCs; and, (3) the available guidance noted above. There may be a continuation of the notable westward shift of TC activity observed during the 1st half of 2013, and also the decadal trend. If the current ENSO-neutral conditions were to evolve toward El Niño in the latter half of 2013, then there may be near normal to slightly above normal activity within Micronesia in September through December. Otherwise, another quiet typhoon season appears to be in store for Micronesia. Please see the local variability summaries for the anticipated typhoon risk for each island group.

[1] The PEAC tropical cyclone forecasts for 2013 are based on forecasts of the status of ENSO and input from three seasonal outlooks for tropical cyclone activity in the western North Pacific basin: (1) The Guam Weather Forecast Office (WFO), (2) The City University of Hong Kong Laboratory for Atmospheric Research, under the direction of Dr. J. C-L. Chan, and (3) The Benfield Hazard Research Centre, University College London, TSR research group, UK, led by Dr. Adam Lea and Professor Mark Saunders.

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: For the 1st half of 2013, there was a very noisy pattern of rainfall with high month-to-month variability. January was particularly wet, with an active monsoon and some tropical cyclones in the region. May was very dry, but rainfall increased again in June, going against the typical pattern of decreasing rainfall as American Samoa enters the heart of its dry season (July through Sept.). The rainfall at Pago Pago was slightly above average during the 2nd quarter and the 1st half of 2013. The mean sea level at Pago Pago was above average for the entire 1st half of the year, and reached a high stand of +9 inches during June, which was the highest recent monthly anomaly noted among the USAPI sea level stations (see sea level discussion pg. 10-11).

American Samoa Rainfall Summary 2nd Quarter and 1st Half of 2013						
Station		**Apr.**	**May**	**Jun.**	**2nd Qtr**	**1st Half**
Pago Pago WSO	**Inches**	13.52	6.35	11.75	**31.62**	**70.34**
	% Norm	112%	64%	159%	**108%**	**107%**

Climate Outlook: American Samoa is now in the heart of its dry season. Conditions during the start of the current dry season were near normal. Climate models and simple persistence of current conditions favor a continuation of near normal rainfall over the next three-month period. The next rainy season (Oct. 2013- April 2014) is anticipated to have a normal onset with near-average rainfall. ENSO-neutral conditions persisting through the latter half of 2013 should favor tropical cyclone activity in the Coral Sea from northeast Australia across to Fiji, with a near normal risk of tropical cyclone development near, or south of, American Samoa beginning in late November 2013. If ENSO-neutral conditions trend toward El Niño in the final months of 2013, then the heart of the next rainy season (December through February) in American Samoa could be wetter than average, with above average tropical cyclone activity.

Predicted rainfall for American Samoa from July 2013 through June 2014 is:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]
July - September 2013 (Heart of Dry Season)	**100% (19.68 inches - Pago Pago)**
October - December 2013 (Onset of next Rainy Season)	**100%**
January - March 2014 (Heart of next Rainy Season)	**120%**
April - June 2014 (Onset of next Dry Season)	**100%**

Guam/CNMI: Throughout Guam and the CNMI, the rainfall during the 1st half of 2013 was generally below average, with most locations throughout the region experiencing 75% to 85% of average rainfall. Only on the island of Saipan did some locations report above-normal rainfall, thanks to a few relatively heavy 24-hour events: 5.37 inches (24%) of the 2013 1st half total of 22.31 inches at the Saipan International Airport (SIA) was derived from four days (11 May, 30 January, 03 June and 13 June). The first 6-months of the year are the dry season on Guam and in the CNMI, with average 6-month totals ranging from approximately 20 inches at the SIA to about 30 inches at locations on Guam and Rota further to the south. During the first six months of 2013, there were no daily rainfall totals in excess of 2 inches on Guam and only one such day on Saipan (11 May) when the Saipan International Airport (SIA) recorded 2.18 inches of rain. The rainy season typically begins in July, with monthly totals jumping to near 10 inches on Guam and to 8 inches on Saipan. The rainy season is now late on Guam and in the CNMI, with most days during July being dry, very warm, and mostly sunny with persistent trade winds. The southwest monsoon has been late and/or conspicuously weak or absent during the rainy seasons of recent years. Beginning in April, temperatures at the Guam Weather Forecast Office (WFO) have been very high under conditions of bright sun and light winds. During the 115 days from 01 April through 24 July there were 94 days with a maximum temperature of 90°F or above. At the SIA, where ocean breezes flow more directly across the runway, there were no days during which the maximum temperature reached 90°F or above. The WFO Guam is investigating the temperature sensors however, as the daily maximum temperatures seem excessive.

During the dry season of 2013, there were several wildfires on Guam and on Saipan. Guam's southern mountain area had some fairly large burns, but this is typical during most dry seasons when large tracts of tall sword grass become dry and are taken out by brushfires. These savannah grasses will regrow to head-high by year's end: A bane to hunters and hikers. To reduce upland erosion and sedimentation of reefs, there has been a push by authorities on Guam to convince people not to start brushfires. Stream flow on Guam remained very low through July, with some popular waterfalls running very low, and two running out of water. The region awaits the proper onset of its rainy season.

Guam and CNMI Rainfall Summary 2nd Quarter and 1st Half of 2013						
Station		**Apr.**	**May**	**Jun.**	**2nd Qtr**	**1st Half**
Guam						
GIA (WFO)	**Inches**	1.14	3.51	6.32	**10.97**	**22.99**
	% Norm	29%	58%	98%	**67%**	**83%**
AAFB	**Inches**	3.05	3.18	3.76	**9.99**	**18.28**
	% Norm	63%	48%	59%	**56%**	**56%**
Dededo (Ypapao)	**Inches**	1.89	5.55	6.04	**13.48**	**28.36**
	% Norm	39%	84%	95%	**76%**	**86%**
Ugum Watershed	**Inches**	2.50	4.98	5.52	**13.00**	**25.44**
	% Norm	51%	75%	87%	**73%**	**78%**
Sinajaña	**Inches**	1.74	5.78	5.38	**12.90**	**23.23**
	% Norm	45%	96%	83%	**79%**	**84%**

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Guam and CNMI Rainfall Summary 2nd Quarter and 1st Half of 2013						
Station		**Apr.**	**May**	**Jun.**	**2nd Qtr**	**1st Half**
CNMI						
Saipan Intl. Airport	**Inches**	1.65	4.82	5.83	**12.30**	**22.31**
	% Norm	59%	110%	125%	**104%**	**115%**
Capitol Hill	**Inches**	2.12	7.29	5.32	**14.73**	**25.31**
	% Norm	61%	133%	92%	**108%**	**104%**
Tinian Airport	**Inches**	0.60	5.36	3.05	**9.01**	**19.23**
	% Norm	17%	97%	53%	**61%**	**79%**
Rota Airport	**Inches**	1.74	3.81	3.92	**9.47**	**23.67**
	% Norm	38%	60%	63%	**55%**	**77%**

Climate Outlook: Chronologically, the rainy season has begun on Guam and in the CNMI, but heavy rains have yet to arrive. For several years, unusually persistent light easterly winds, a weak or absent monsoon and a notable lack of tropical cyclone systems have accompanied relatively dry conditions. Guam and the CNMI depend on tropical cyclone activity and the southwest monsoon for much of their rainy season rainfall. Normally at least three or four week-long episodes of the southwest monsoon sweep across Guam and the CNMI sometime during July through October with three or four tropical storms and at least one typhoon passing within 180 nmi of Guam and/or Saipan. There is no indication of a shift or easing of the factors suppressing the monsoon and reducing tropical cyclone activity in the western North Pacific basin and across Micronesia. Thus, the rainfall for the remainder of the year should be near or below average, with a reduced number (half of average) of tropical cyclones affecting Guam and the CNMI.

Predicted rainfall for the Mariana Islands from July 2013 through June 2014 is as follows:

Inclusive Period	**% of long-term average / Forecast rainfall (inches)** [1]	
	Guam/Rota	**Saipan/Tinian**
July - September 2013 (Heart of Rainy Season)	**95% (35.86 inches)**	**100% (34.10 inches)**
October - December 2013 (End of Rainy Season)	**95%**	**95%**
January - March 2014 (Onset of Next Dry Season)	**995%**	**90%**
April - June 2014 (2nd Half of Next Dry Season)	**100%**	**100%**

Federated States of Micronesia

Yap State: The months of February through April are typically the heart of the dry season for Yap Island and the atolls of Yap State. Monthly rainfall totals drop to approximately 6 inches across Yap Island and to about 5 inches at Ulithi. At Woleai, further to the south and east, there is a shorter and less pronounced dry season, with average monthly rainfall dropping below 10 inches during February and March. During the 1st half of 2013, rainfall was below normal at every Yap State recording location. It was particularly dry during

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April at most locations on Yap Island, where several sites recorded less than two inches of rain. The northern and western atolls of Yap State were included in the drought information statements issued by the Guam WFO. A wet June at most Yap State locations prevented any serious impacts arising from the rainfall deficits earlier in the year, and as of the beginning of July, the perception on Yap Island was that there was sufficient rain to cover agricultural and personal water needs. Satellite imagery showed that Yap State was overspread by the peripheral rain bands of TS's Yagi and Leepi (two of the four tropical cyclones that formed in the western North Pacific basin during June). Typical rainy season heavy showers have continued during July throughout Yap State.

Yap State Rainfall Summary 2nd Quarter and 1st Half of 2013						
Station		**Apr.**	**May**	**June**	**2nd Qtr**	**1st Half**
Yap Island						
Yap WSO	**Inches**	2.81	5.41	16.16	**24.38**	**41.81**
	% Norm	49%	60%	127%	**89%**	**89%**
Dugor	**Inches**	1.99	5.23	12.62	**19.84**	**36.59**
	% WSO	35%	58%	99%	**72%**	**78%**
Gilman	**Inches**	0.83	3.88	5.94	**10.65**	**23.62**
	% WSO	14%	43%	47%	**39%**	**50%**
Luweech	**Inches**	2.24	3.52	15.84	**21.60**	**32.66**
	% WSO	39%	39%	125%	**79%**	**70%**
Maap	**Inches**	1.25	5.12	5.94	**12.31**	**25.14**
	% WSO	22%	57%	47%	**45%**	**54%**
North Fanif	**Inches**	3.22	5.85	14.85	**23.92**	**43.72**
	% WSO	56%	65%	117%	**87%**	**93%**
Rumung	**Inches**	1.31	7.32	9.47	**18.10**	**34.11**
	% WSO	23%	81%	75%	**66%**	**73%**
Tamil	**Inches**	1.76	6.63	15.24	**23.63**	**37.24**
	% WSO	31%	73%	120%	**86%**	**80%**
Outer Islands						
Ulithi	**Inches**	4.05	3.78	10.93	**18.76**	**30.04**
	% Norm	83%	49%	101%	**80%**	**76%**
Woleai	**Inches**	9.19	10.03	13.15	**32.37**	**51.70**
	% Norm	84%	82%	101%	**89%**	**82%**

Climate Outlook: Near average to above average rainfall is anticipated for all islands of Yap State for at least the next three months and probably through the end of the year. The monsoon

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trough of the western North Pacific has been weak or absent so far during the early part of the rainy season. The trough has, at times, penetrated at least to the longitudes of Yap State and the Republic of Palau, bringing monsoon showers and occasionally some rain bands from tropical cyclones developing northwest of the State. We are more confident of abundant rainfall throughout Yap State and Palau than elsewhere in Micronesia. The chances for gale-force winds or greater from a tropical cyclone near Yap Island or any of the northern outer islands will be near normal for the remainder of the year (roughly 10-15%, or 1 in 6 years).

Predicted rainfall for Yap State from July 2013 through June 2014 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]	
	Yap and Ulithi	Woleai
July - September 2013 (Heart of Rainy Season)	**120% (51.90 inches)**	**95% (38.29 inches)**
October - December 2013 (End of Rainy Season)	**110%**	**95%**
January - March 2014 (Heart of Next Dry Season)	**100%**	**90%**
April - June 2014 (Onset of next Rainy Season)	**110%**	**90%**

Chuuk State: Rainfall was below average throughout most of Chuuk State during the 1st half of 2013, with some of the northern atolls (e.g., Namonuito and the Hall Islands) dry enough to cause concerns for water supplies. The northern and western atolls of Chuuk State were included in the early drought information statements issued by the WFO Guam. Abundant rainfall returned to these problem areas in June, and no serious drought impacts were reported. In the Mortlock Island groups, some of the atolls (e.g., Ta and Nama) received above average rainfall during the first 6 months of 2013. The 71.71 inches observed at Ta Atoll in the southern Mortlocks was the highest observed 2013 first-half rainfall total within Chuuk State. The 33.13 inches observed at Fananu in the north was the lowest observed 2013 first-half rainfall total in Chuuk State. A sharp north-south rainfall gradient is typical across Chuuk State during the 1st half of the year when the trade-wind trough is seasonally located farthest to the south.

Chuuk State Rainfall Summary 2nd Quarter and 1st Half of 2013						
Station		**Apr.**	**May**	**June**	**2nd Qtr**	**1st Half**
Southern Mortlocks						
Lukunoch	**Inches**	8.06	10.77	7.51	**26.34**	**54.66**
	% WSO	61%	81%	61%	**68%**	**77%**
Ettal	**Inches**	9.42	11.69	12.45	**33.56**	**61.81**
	% Luk	72%	88%	102%	**87%**	**87%**
Ta	**Inches**	14.98	13.40	8.57	**36.95**	**71.71**
	% Luk	114%	100%	70%	**95%**	**101%**
Namoluk	**Inches**	9.05	14.27	11.56	**34.88**	**61.46**
	% Luk	69%	107%	94%	**90%**	**87%**

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Chuuk State Rainfall Summary 2nd Quarter and 1st Half of 2013						
Station		**Apr.**	**May**	**June**	**2nd Qtr**	**1st Half**
Chuuk Lagoon						
Chuuk WSO	**Inches**	6.13	8.93	9.85	**24.91**	**61.51**
	% Norm	50%	73%	84%	**69%**	**100%**
Piis Panew	**Inches**	5.60	4.98	9.78	**20.36**	**47.35**
	% WSO	45%	41%	83%	**56%**	**77%**
Northern Atolls						
Fananu	**Inches**	3.93	6.03	12.79	**22.75**	**33.13**
	% WSO	32%	49%	109%	**63%**	**54%**
Onoun	**Inches**	4.18	4.20	10.53	**18.91**	**36.36**
	% WSO	34%	34%	90%	**52%**	**59%**
Northern Mortlocks						
Losap	**Inches**	5.10	7.19	10.31	**22.60**	**53.48**
	% WSO	41%	59%	86%	**62%**	**87%**
Nama	**Inches**	11.78	7.16	13.19	**32.13**	**67.27**
	% WSO	95%	59%	113%	**89%**	**109%**
Western Atolls						
Polowat	**Inches**	3.63	6.00	11.47	**21.10**	**41.37**
	% Norm	61%	67%	92%	**77%**	**86%**

Climate Outlook: With the Pacific basin climate remaining in ENSO-neutral, and the pattern of wind, rainfall and typhoon distribution of the western North Pacific still exhibiting some characteristics of La Niña, near average to slightly below average rainfall is anticipated throughout Chuuk State for at least the next several months. Light easterly winds should prevail across the state until late August through early October when the monsoon trough should finally push across Chuuk State, with its embedded tropical disturbances and monsoon depression stages of developing tropical cyclones. Thus the weather for the next few months in Chuuk State will feature typical seasonal heavy showers with some breaks of hot dry weather. Odds are below average for a tropical storm or typhoon to pass through any part of Chuuk State during the remainder of the year. One or two occurrences of gale-force wind associated with a developing tropical cyclone may affect Chuuk Lagoon or atolls to the north, especially in the fall of 2013.

Predictions for Chuuk State from July 2013 through June 2014 are as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]			
	Chuuk Lagoon, Losap, and Nama	Polowat	Northern Islands	Southern Mortlocks
Jul-Sep 2013	**95% (36.29 inches)**	**90% (32.57 in)**	**95% (36.29 in)**	**100% (38.2 in)**
Oct-Dec 2013	**100%**	**95%**	**100%**	**100%**
Jan-Mar 2014	**100%**	**90%**	**100%**	**100%**
Apr-Jun 2014	**100%**	**90%**	**95%**	**100%**

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Pohnpei State: During the 1st half of 2013, rainfall was below average at most locations throughout Pohnpei State, with the exception of the atolls near the equator (e.g., Nukuoro and Kapingamarangi) where above average rainfall was observed. It has been continually very wet at Nukuoro and at Kapingamarangi since a major drought ceased there in June 2011. Kapingamarangi has high inter-annual rainfall variability related to ENSO. It is typically very dry there during La Niña, especially if a pronounced La Niña-related cold tongue of SST extends considerably to the west of the 180° meridian. Very wet years can occur there during El Niño or during ENSO-neutral. As an example of the extreme variations of rainfall at Kapingamarangi, consider the annual totals from May 2010 to April 2011 versus May 2012 to April 2013: 52.04 inches versus 192.62, respectively. Dryness across Pohnpei Island and other atolls, apart from those near the equator, has not resulted in any reported problems with water supply. Higher than normal tides were observed at the time of the full Moon during June, but there were no reports of any damaging inundation.

Pohnpei State Rainfall Summary 2nd Quarter and 1st Half of 2013

Station		Apr.	May	June	2nd Qtr	1st Half
Pohnpei WSO	Inches	10.00	10.44	16.79	**37.23**	**62.03**
	% Norm	61%	55%	98%	**71%**	**69%**
Palikir	Inches	13.51	11.49	12.05	**37.05**	**65.04**
	% Norm	76%	56%	65%	**65%**	**67%**
Kolonia Airport	Inches	11.70	9.80	13.68	**35.18**	**60.71**
	% Norm	87%	62%	97%	**81%**	**82%**
Nukuoro	Inches	16.09	17.08	16.63	**49.80**	**108.00**
	% Norm	107%	116%	136%	**119%**	**139%**
Pingelap	Inches	9.95	7.37	12.66	**29.98**	**57.16**
	% Norm	58%	43%	78%	**59%**	**64%**
Mwoakilloa	Inches	6.17	9.72	13.01	**28.90**	**62.92**
	% Norm	46%	62%	92%	**67%**	**85%**
Kapingamarangi	Inches	10.51	5.84	6.45	**22.80**	**77.86**
	% Norm	77%	56%	89%	**73%**	**118%**

Climate Outlook: Based on a persistence of recent dryness and computer guidance, near normal to slightly below normal rainfall is anticipated on Pohnpei Island and the atolls of Pohnpei State for the next several months. Unless it is El Niño, tropical storms and typhoons do not typically affect Pohnpei State. With ENSO-neutral conditions prevailing for the remainder of 2013, and with an ongoing multi-year shift of typhoon activity to the west, it is unlikely that a tropical storm or typhoon will adversely affect any portion of Pohnpei State during the remainder of 2013. However, it is likely that a few tropical disturbances and perhaps a monsoon depression or two will pass through the State, helping to push the rainfall to near normal values.

Predicted rainfall for Pohnpei State from July 2013 through June 2014 is as follows:

LOCAL SUMMARY AND FORECAST

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]	
	Pohnpei Island and Atolls	Kapingamarangi
Jul - Sep 2013	**90% (45.88 inches)**	**95% (21.36 inches)**
Oct - Dec 2013	**95%**	**95%**
Jan - Mar 2014	**100%**	**100%**
Apr - Jun 2014	**110%**	**100%**

Kosrae State: At most locations on Kosrae, it was relatively dry during the first six months of 2013, with the month of May particularly dry. A notable exception to the dryness on Kosrae occurred at the Utwa recording site on the southwest side of the island. At this site, all the monthly rainfall amounts were higher than at the other three recording sites on the island, with the June total of 32.21 inches roughly twice as high as the readings elsewhere. A preliminary investigation of this high reading did not uncover any problems, so the readings will be accepted for now. The dryness during the 1st half of 2013 can not be completely attributed to the status of ENSO. Kosrae, along with other locations in the eastern portion of Micronesia, has a statistically significant long-term trend of decreasing rainfall. No reports of damaging sea inundation were received from Kosrae.

Kosrae State Rainfall Summary 2nd Quarter and 1st Half of 2013

Station		Apr.	May	June	2nd Qtr	1st Half
Airport (SAWRS)	Inches	16.71	13.41	17.89	**48.01**	**93.37**
	% Norm	77%	71%	94%	**81%**	**86%**
Utwa	Inches	18.00	16.70	32.21	**66.91**	**122.79**
	% Norm	83%	89%	170%	**113%**	**113%**
Tofol	Inches	15.80	16.07	16.80	**48.67**	**85.17**
	% Norm	73%	85%	88%	**82%**	**78%**
Nautilus Hotel	Inches	14.91	15.44	14.92	**45.27**	**91.45**
	% Norm	69%	82%	79%	**76%**	**84%**

Climate Outlook: For the next several months, weak easterly winds should dominate in Kosrae State. Areas of disturbed weather should episodically affect Kosrae during the remainder of the year, with monthly rainfall totals running near average. No adverse tropical cyclone activity is expected for Kosrae State during the remaining months of 2013. Any development should be well north of the island.

Predicted rainfall for Kosrae State from July 2013 through June 2014 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]
July - September 2013	**100% (50.71 inches)**
October - December 2013	**100%**
January - March 2014	**90%**
April - June 2014	**100%**

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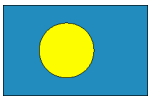

Republic of Palau: Most recording locations throughout the Republic of Palau were drier than average during the 1st half of 2013. The International Airport was the wettest location (99% norm). Despite normal monthly rainfall totals, there was an episode of heavy rainfall during 25-27 June, which caused flooding in parts of the main island of Babeldaob and landslides along the Compact Rd that rings the island. This heavy rainfall occurred when TS Leepi was forming to the northwest of the region. The damage from flooding was isolated in scale: a family in Ngerikiil, Airai, was forced from their home, and a nearby piggery down the street was also flooded. Taro patches, farms and other areas around the Ngerikiil area experienced some flooding. For more info on the flooding and landslides, see Oceania Television Network, Palau, video on Youtube: http://www.youtube.com/watch?v=NI93zdF3EJg. Rainfall at the airport was 5.47 inches during those three days.

As at many other locations around Micronesia, very high tides were observed during the time of the full moon in late June. Reports and pictures of high tide flooding were made available to PEAC by UOG-based energy and communications consultant, Bruce Best. In addition, the following info was obtained from the Oceania Television Network (OTV) website: *"On the morning of June 25, ocean water seeped into coastal houses damaging property during the peak of the high tide. OTV crew who were dispatched to document the high tide and any potential damage it had on property learned that although the tide schedule indicated the peak at 8:02 am at about 6.7 feet, residents reported an earlier peak at sometime between 6:30 to 7:00 am and possibly higher than 6.7 feet. Some homes in the Airai and Koror area sustained water damage. …".*

Republic of Palau Rainfall Summary 2nd Quarter and 1st Half of 2013

Station		Apr.	May	June	2nd Qtr	1st Half
WSO Koror	Inches	7.57	12.87	11.70	**32.14**	**51.47**
	% Norm	87%	107%	68%	**85%**	**78%**
Nekken	Inches	8.37	15.78	13.05	**37.20**	**55.58**
	% Norm	97%	132%	76%	**98%**	**84%**
Intl. Airport	Inches	10.63	18.70	17.09	**46.42**	**64.97**
	% Norm	123%	156%	99%	**122%**	**99%**
Peleliu	Inches	7.85	4.35	12.22	**24.42**	**50.51**
	% Norm	91%	36%	71%	**64%**	**77%**

Climate Outlook: Although it was fairly dry across most of Palau during the 1st half of 2013, by July, the monsoon became established across the region, and abundant rainfall is now occurring. Located on the western boundary of Micronesia, Palau has been less affected by persistent easterly wind flow and the weakening of the western North Pacific monsoon system. Near average to above average rainfall is expected to occur over the next few months. In the anticipated continuation of the ENSO-neutral state of the climate, many of the western North Pacific basin's tropical cyclones will form and/or move close enough to Palau to keep rainfall abundant there. Usually, tropical cyclones pass well to the north of Palau, and combined with the usual monsoon, generate gusty southwest winds that sweep across the region with hazy skies and very choppy seas in coastal waters

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and in the open waters of Rock Islands. One or two episodes of very gusty (25 to 35 kt) sustained southwest winds are anticipated in the coming months, with the greatest risk of these events occurring late August through November. No direct strike on Palau by a tropical cyclone is expected, although if it were to occur, it would likely take place November through December, as was the case last year when Typhoon Bopha came very close to the islands on 02 December.

Predicted rainfall for Palau from July 2013 through June 2014 is as follows:

Inclusive Period	% of long-term average / Forecast rainfall (inches) [1]
July - September 2013	**120% (53.82 inches)**
October - December 2013	**120%**
January - March 2014	**100%**
April - June 2014	**100%**

Republic of the Marshall Islands (RMI): The 1st half of 2013 was very dry at most atolls in the northern RMI. Some atolls had extraordinarily dry conditions that are rarely seen within Micronesia. During a 7-month period from November 2012 through May 2013 the atolls of Wotje and Utirik had rainfall totals of 7.47 and 7.55 inches, respectively. These low levels of rainfall created an emergency drought situation. For some perspective on the extraordinary dryness at Wotje and Utirik, the following rainfall totals during notable severe drought conditions on other islands are given: **1.** 1983 drought Pohnpei Island, January to May rainfall = 9.37 inches (13%), **2.** 1998 drought Pohnpei Island, January to April rainfall = 10.53 inches (20%), **3.** 1983 drought Guam, January to June rainfall = 7.66 inches (28%), **4.** 1998 drought Guam, January to June rainfall = 11.26 inches (41%), **5.** 1983 drought Majuro, January to May rainfall = 5.93 inches (17%), **6.** 1998 drought Majuro, January to April rainfall = 2.77 inches (11%).

The Guam WFO and the Majuro WFO issued continual drought information statements through the 1st half of 2013. The RMI Cabinet declared a state of disaster on 08 May for their northern atolls, which was elevated from the previous state of emergency declared on 19 February. The RMI Cabinet renewed the disaster declaration on 07 June. The severe drought affected over 6,300 people. On 14 June, U.S. President Obama declared a disaster for the RMI, authorizing additional U.S. Government (USG) funding for relief and reconstruction. Drought-relieving rains occurred during June and July: However, a full recovery from the severe drought will likely take several months.

On 23 July 2013, the following news report was posted at, http://reliefweb.int/report/marshall-islands/marshall-islands%E2%80%99-drought-operation-enters-second-phase: *"The response to a severe drought in the Marshall Islands is entering its second phase, as initial deliveries of emergency food supplies, principally funded by USAID, come to an end across the Pacific nation. The first rains have finally arrived but food is in short supply on the hardest-hit outer islands. IOM's rapidly-established air and sea bridges have delivered an estimated 45 metric tons (100,000 pounds) of food to 677 households on islands over 400 miles (640 km) from Majuro, one of the farthest-*

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flung capitals on the planet. USAID has also paid for transport costs, alongside the UN Central Emergency Response Fund (CERF), which financed water and sanitation assessments in the early stages of the operation. The shipments consisted of rice, flour, oil, tinned tuna, milk powder, canned fruit and vegetables, sugar, baking powder and high-protein biscuits. In addition to US-funded food, donations have come from local benefactors, the Marshall Islands Government, and the Government of Japan. All products were sourced locally, with care taken not to harm the local economy, and are intended to last for two weeks while more substantial supplies, designed to last for two months, arrive from the US Department of Agriculture. The emergency phase of the operation also included provision of drinking water and reverse osmosis units, which convert seawater to potable water. Other water/sanitation support has included an assessment of the state of rainwater storage tanks in the affected areas. Phase two of the sea bridge will run for at least another two months and will deliver a further 100 metric tons (220,000 pounds) of food to all the 13 affected atolls. This is a massively complex, yet essential relief operation,' said Ashley Carl, IOM's Chief of Mission for the Marshall Islands and Micronesia. 'Fortunately no one is starving, yet the level of nutrition – and water – dropped alarmingly during the drought, which is particularly dangerous for pregnant and nursing mothers, as well as children and the elderly. As food becomes scarcer and more expensive, costs associated with fishing and fruit gathering go up, which means even less to spend on feeding the family. The USAID food aid is intended to remove the worry about immediate food security and allow people to concentrate on longer-term recovery.' While imported foodstuffs are generally available on the main island, the outer islands depend on tree-based food staples like coconuts, pandanus, breadfruit and bananas. These have been severely depleted by the drought and it will take several years until damaged trees can be replaced and start bearing fruit."

The RMI was the site of another severe impact from unusual climatic conditions. On 25 June, and for a day or two before and after, the high tides were unusually high across Micronesia. On Majuro, they contributed to damaging inundation, particularly on the day of the full "Supermoon" on 25 June (see current conditions, pg. 1). On that day, the high tide was reportedly up to 1.5 feet higher than a typical astronomical high tide. These high tides, combined with a long-period 4-6 foot oceanic swell from the south, caused damaging sea inundation to occur on Majuro. There were reports of structure breaks to sea walls, damage to portions of the main road, and damage to 25 homes and businesses. 120 people were displaced to schools for several days. The airport was closed for all flights when rocks were strewn onto the runway by breaking waves.

The following news story was carried on the Pacific RISA website (http://www.pacificrisa.org/2013/06/26/coastal-inundation-in-the-marshall-islands-forebodes-the-future-of-extreme-events/) on 26 June: *"On Tuesday, waves inundated the southern part of Majuro, the capital of the Republic of the Marshall Islands (RMI), flooding homes and causing extensive damage to property. The waves reached two and a half meters high, according to Majuro Weather Service meteorologist Reggie White, who serves on Pacific RISA's Advisory Committee. The flooding caused the Majuro airport to close for the day, after the runway seawall crumbled under the weight of the waves, and a United Airlines flight bound for Majuro was redirected. High swells could persist for several days, so residents are doing what they can to prepare for further inundation possible through Thursday. ..."*

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Nearly all the islands of eastern Micronesia (and Hawaii) have long-term downward trending time series of annual rainfall (See Fig. 2, pg. 12).

RMI Rainfall Summary 2nd Quarter and 1st Half of 2013						
Station		**Apr.**	**May**	**June**	**2nd Qtr**	**1st Half**
RMI Central and Southern Atolls						
Majuro WSO	**Inches**	6.46	6.60	10.55	**23.61**	**41.60**
	% Norm	63%	59%	91%	**71%**	**74%**
Laura	**Inches**	8.03	6.99	13.19	**28.21**	**53.08**
	% Norm	79%	63%	114%	**85%**	**95%**
Arno	**Inches**	7.17	5.28	9.65	**22.10**	**35.50**
	% Norm	70%	47%	83%	**67%**	**63%**
Aling-laplap	**Inches**	6.12	7.90	7.69	**21.71**	**37.61**
	% Norm	69%	75%	72%	**72%**	**79%**
Jaluit	**Inches**	9.66	6.63	14.86	**31.15**	**51.35**
	% Norm	94%	59%	128%	**94%**	**92%**
Mili	**Inches**	11.03	14.01	15.03	**40.07**	**75.81**
	% Norm	107%	125%	130%	**121%**	**136%**
RMI Northern Atolls						
Kwajalein	**Inches**	9.34	1.97	4.66	**15.97**	**19.38**
	% Norm	124%	20%	48%	**59%**	**50%**
Wotje	**Inches**	1.27	1.17	6.85	**9.29**	**9.95**
	% Norm	18%	12%	75%	**36%**	**27%**
Utirik	**Inches**	0.19	1.45	8.58	**10.22**	**13.44**
	% Norm	3%	17%	105%	**44%**	**40%**

Climate Outlook: Near normal rainfall returned to the northern RMI during June and continued into July. The central and northern atolls of the RMI are now entering their rainy seasons, and near average rainfall is anticipated for the next several months at all RMI locations. In the current ENSO-neutral climate state, there are no strong signals for either very wet or very dry conditions, but the long-term trend might suggest that it would be prudent to anticipate dry conditions to recur again in the northern RMI during the first few months of 2014, although a repeat of the extreme drought conditions of 2013 are not expected.

Predicted rainfall for the RMI from July 2013 through June 2014 is as follows:

Inclusive Period	**% of long-term average / Forecast rainfall (inches) [1]**		
	South of 6ºN	**6ºN to 8ºN**	**North of 8ºN**
July - Sept 2013	**100% (36.94 inches)**	**100% (36.94 in)**	**90% (32.65 in)**
Oct - Dec 2013	**100%**	**100%**	**95%**
Jan - Mar 2014	**100%**	**90%**	**85%**
Apr - June 2014	**100%**	**90%**	**90%**

Continued on Page 12….

Seasonal Sea-Level Outlook for the US-Affiliated Pacific Islands

The following sections describe: (i) the Canonical Correlation Analysis (CCA) forecasts for seasonal (mean and maxima) sea-level anomalies (seasonal cycle removed) for the forthcoming seasons July-August-September (JAS), August-September-October (ASO), and September-October-November (SON) of 2013, (ii) the observed monthly mean and maximum sea-level anomalies for the season April-May-June (AMJ) 2013, and (iii) Seasonal Sea Level Variability. ***Note that the anomalies 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 the CCA-forecasting technique adapted here does not account for sea-level deviations created by other atmospheric or geological factors such as tropical cyclones, storm surges or tsunamis.*

(i) Seasonal Sea-Level Forecast (deviations with respect to climatology) for JAS, ASO, and SON 2013 (Table 1).
Forecasts of the sea-level deviations in the USAPI (see http://www.prh.noaa.gov/peac/map.php for location of stations) are presented using CCA statistical model. Based on the independent SST values in AMJ 2013, 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) show skillful forecasts for these three consecutive seasons.

Table 1: **Forecasts of sea-level anomaly (in inches) for JAS, ASO, and SON 2013.**

	Seasonal Mean Deviations [1]				Seasonal Max Deviations [2]					
Tide Gauge Station	**JAS**	**ASO**	**SON**	**Forecast Quality [3]**	**JAS**	**ASO**	**SON**	**Forecast Quality [3]**	***Return Period [4] for JAS Season***	
Lead Time [5]	0	1M	2M		0	1M	2M		*20 Year*	*100 Year*
Marianas, Guam	+4	+4	+4	Good	+19	+19	+19	Good	*6.3*	*10.9*
Malakal, Palau	+4	+2	+2	V. Good	+38	+38	+38	Good	*8.1*	*10.2*
Yap, FSM	+4	+3	+2	V. Good	+29	+30	+30	Good	*8.4*	*11.3*
Chuuk, FSM**	+4	+3	+3	N/A	+29	+30	+30	N/A	*N/A*	*N/A*
Pohnpei, FSM	+4	+3	+3	V. Good	+31	+31	+32	V. Good	*5.8*	*7.0*
Majuro, RMI	+2	+2	+2	Good	+42	+42	+42	Fair	*3.5*	*4.2*
Kwajalein, RMI	+3	+3	+3	Fair	+40	+41	+41	Good	*5.2*	*6.8*
Pago Pago, AS	+3	+3	+3	Good	+28	+28	+27	Good	*4.1*	*5.2*
Honolulu, Hawai'i	+1	+1	+2	Fair	+20	+20	+20	Fair	*4.1*	*5.4*
Hilo, Hawai'i	+1	+1	+2	Fair	+23	+22	+22	Fair	*3.4*	*5.7*

Note: (-) indicates negative anomalies (fall of sea level from the mean), and (+) indicates positive anomalies (rise of sea level from the mean); N/A: data not available. Deviations from -1 to +1 inch are considered negligible, and deviations 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. See http://www.prh.noaa.gov/peac/peu/2012_3rd/sea_level.php#footnote for explanations of footnotes 1 through 5.

Remarks: The forecast values of sea level for JAS, ASO, and SON seasons (Table 1, above) indicate that most of the stations in the north Pacific region are likely to be higher than normal in the forthcoming seasons (e.g., 2-4 inches). In Hawaii, both Honolulu and Hilo are likely to be closer to normal during the same time period.

While the overall conditions indicate the continuation of ENSO-neutral, below average SSTs prevailed in the eastern Pacific while near-average SSTs persisted across the rest of the equatorial Pacific. Low-level winds were near average, and upper-level winds are anomalously westerly across the equatorial Pacific. As a result, currently the sea level in the north Pacific Islands are 4-8 inches higher than normal. However, as the season progresses the sea level is likely to fall but still be slightly elevated (i.e., 2-4 inches) during the forthcoming seasons.

(ii) Observed Monthly Sea Level Deviation in the April-May-June (AMJ) 2013 Season.
The monthly time series for sea level deviations 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.deviations. Locations of these stations can be found at: http://www.prh.noaa.gov/peac/map.php.

Seasonal Sea-Level Outlook for the US-Affiliated Pacific Islands

Table 2: Monthly observed max/mean sea-level deviations in inches, with year-to-year standard anomalies.

Tide Gauge Station	Monthly Mean Deviations[1]				Monthly Max Deviations[2]			
	Apr	May	June	Standard Deviations	Apr	May	June	Standard Deviations
Marianas, Guam	+6.0	+7.0	+7.2	3.7	+22	+22	+23	4.0
Malakal, Palau	*	*	*	4.2	*	*	*	4.0
Yap, FSM	+7.8	+7.0	+7.2	3.5	+35	+35	+35	4.0
Chuuk, FSM*	*	*	*	*	*	*	*	*
Pohnpei, FSM	+2.8	+4.9	*	2.2	+36	+35	*	3.0
Majuro, RMI	+2.0	+3.0	*	2.2	+43	+43	*	3.0
Kwajalein, RMI	+6.5	+6.0	+6.7	2.7	+43	+43	+43	3.0
Pago Pago, American Samoa	+6.1	+6.4	+9.1	4.2	+29	+32	+35	4.5
Honolulu, Hawai'i	-2.0	+1.0	+2.0	1.7	+16	+22	+23	2.0
Hilo, Hawai'i	-1.0	+1.5	+1.0	2.1	*	+25	+22	2.4

* Data currently unavailable; [1] Difference between the mean sea level for the given month and the 1983 through 2001 mean sea level value at each station; [2] Same as [1] except for maxima.

Remarks: As compared to May 2013, the monthly mean sea level in June 2013 shows slight rise in most of the USAPI stations, except Pago Pago where a considerable rise has taken place. Honolulu recorded rise while Hilo recorded fall; currently these two stations are slightly above normal. Currently, all north Pacific stations are 6-7 inches higher than normal; the lone south Pacific station is 9 inches higher than normal; and Honolulu and Hilo are 1-2 inches higher than normal.

(iii) Seasonal Sea Level Variability based on SST and SST-Wind (U) based sea level forecasting scheme.

Note: The forecast at 0-season lead means that the 'sea level' of the target season (e.g., JFM) is simulated based on SST-U and SST of the previous season (e.g., OND). Similarly, 1-, 2-, 3-season lead time means sea level forecasts based on SST-U and SST of the previous JAS, AMJ, and JFM seasons. Percent of improvement is shown by the dotted line.

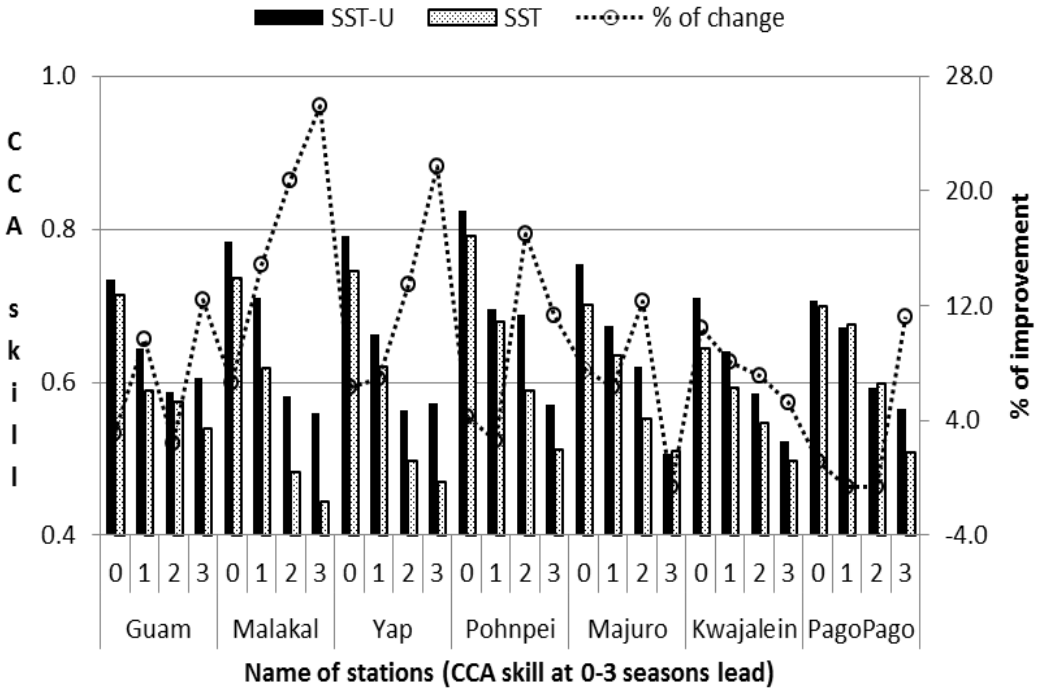


Figure 1: Sea Surface Temperature (SST)-Wind based sea level forecasting scheme: Average of four seasons (i.e., JFM, AMJ, JAS, and OND) forecast skills for each of the USAPI stations at 0-3 seasons-lead.

Remarks: Due to increasing demand for longer lead-time forecasts, PEAC has recently started to re-visit the current SST-based forecasting scheme for improvement. In addition to SSTs, the recent trend of enhanced trade winds west of the dateline has also been hypothesized to be an important factor for improving sea level variability forecasting on longer time-scales. Findings revealed that the combined SST and zonal wind (U)-based forecasts are more skillful than the SST-based forecasts alone (Fig. 1). It is particularly more efficient on longer time scales for most of the stations. The improvement of these forecasts will enable the capability of our clients in the USAPI region to develop a more efficient long-term response plan for hazard management.

Pacific ENSO Update

LOCAL SUMMARY AND FORECAST

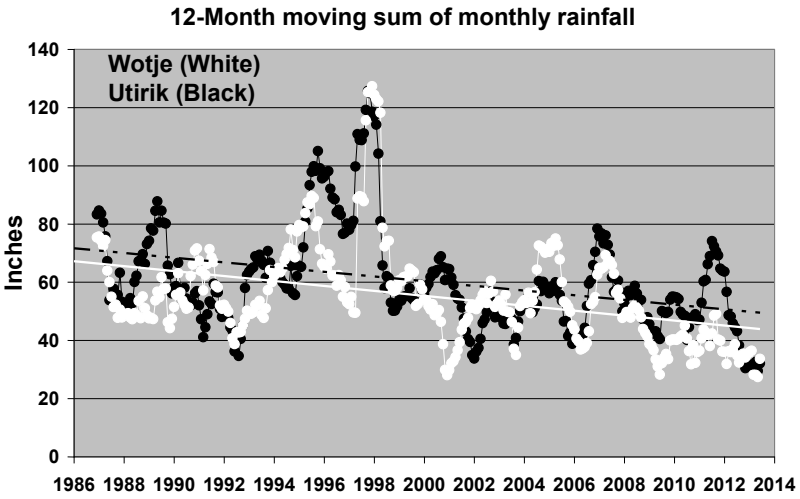
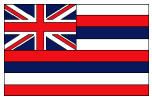


Figure 2. Rainfall time series at Wotje and Utirik from 1986 to present. Values plotted are a 12-month moving sum of the monthly rainfall. Note the long-term decline, and the pronounced fluctuations that are to a large extent related to ENSO. The recent dry conditions are the driest in the 27-year time series.



Hawaii: After a record breaking dry fall 2012 and early winter season, January 2013 saw the beginning of a welcome change in rainfall trends across the state. Good rainfall amounts during the months of January through May provided much awaited relief in drought conditions thought the state but mostly benefiting the western islands. The islands of Kauai and Oahu achieved drought free status by the end of May, and the Big Islands and Maui greatly improving their general drought conditions. In spite of these improvements the persistent drought conditions over Maui and the Big Islands make this the 5th year in a row that drought conditions have persisted through a rainy season in Hawaii.

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During June rainfall trends began to reverse and dwindling rainfall amounts that accompany the onset of the dry season over the islands will make it so that the improvements in drought conditions may be short lived. This has proven to be especially true on the Big Islands where drought conditions have already began to rapidly worsen in the leeward areas. Extreme drought conditions (D3 in the US drought monitor scale) have reappeared in the Pohakuloa region after a brief respite in early June and a new extreme drought area has developed over the Northeastern portion of the North Kohala District. In Maui, extreme drought conditions in the Kihei area have expanded to include the Ulupalakua area and water supplies in the Kualapuu reservoir remain low, maintaining the severe drought designation for agriculture in that area.

State of Hawaii Rainfall Summary 2nd Quarter and 1st Half of 2013

Station		Apr.	May	Jun.	2nd Qtr	1st Half
Lihue Airport	Inches	3.05	0.58	0.70	**4.33**	**15.50**
	%Norm	157%	39%	55%	**92%**	**58%**
Honolulu Airport	Inches	1.75	0.69	0.17	**2.61**	**8.63**
	%Norm	337%	173%	94%	**237%**	**95%**
Kahului Airport	Inches	0.07	0.79	0.27	**1.13**	**7.26**
	%Norm	8%	161%	300%	**77%**	**57%**
Hilo Airport	Inches	2.97	8.43	4.51	**15.91**	**51.55**
	%Norm	45%	115%	71%	**70%**	**48%**

Climate Outlook: The U.S. Climate Prediction Center's Hawaiian Seasonal Outlook Discussion, posted July 18, 2013 and be found on the following website: http://www.cpc.ncep.noaa.gov/products/predictions/90day/fxhw40.html.

ACKNOWLEDGEMENTS AND FURTHER INFORMATION

Pacific ENSO Applications Climate (PEAC) Center:
HIG #340, 2525 Correa Road, Honolulu, Hawai'i 96822
LT Charlene Felkley, PEAC Outreach Officer, at 808-956-2324 for information on PEAC, the Pacific ENSO Update and ENSO-related climate data for the Pacific Islands.
Dr. Rashed Chowdhury, Principal Research Scientist, at 808-956-2324 for information on ENSO and sea-level variability in the USAPI.
Alejandro Ludert, Graduate Research Assistant and Webmaster, at 808-956-2324 for information related to the PEAC website.

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

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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, LT Charlene Felkley, 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.