

pacific

ENSO

update

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A Quarterly Bulletin of the Pacific El Niño/Southern Oscillation Applications Center (PEAC)
Providing Information on Climate Variability for the U.S.-Affiliated Pacific Islands

www.soest.hawaii.edu/MET/Enso

CURRENT CONDITIONS

El Niño conditions have developed in the Pacific. During years that follow a strong El Niño (e.g., 1983 and 1998), almost all of Micronesia, much of Hawaii, and American Samoa experience a period of prolonged dryness. Most islands of Micronesia typically enter their dry season at the start of the calendar year; on some islands (especially those north of 10° N), the normal dry season persists until June or July. In Micronesia, dry conditions associated with El Niño may commence in November of the El Niño year and extend until June or July of the following year. El Niño-related dry conditions manifest as less than normal rainfall during the typical dry season months and as an extension of the length of the dry season in both directions (e.g., earlier than normal dry season onset, and a later than normal end to the dry season.) In Hawaii, dry conditions related to El Niño occur in the same months as they do in Micronesia, but while this is the normal dry season in Micronesia, it is the normal winter rainy season for much of Hawaii. If the El Niño event is weak or moderate, the years that follow it may be very dry, but most often it is not quite as dry for these events as in the strong ones. The effects of ENSO on the rainfall in American Samoa are somewhat less defined than in Micronesia with a tendency for dry conditions to be experienced only after a strong El Niño and wet conditions experienced during weak La Niña.

During the 3rd quarter (July, August and September) of 2006, rainfall totals of less than 80% of normal were reported at some locations within Yap State, the northern RMI, and Guam and the CNMI. Rainfall totals in excess of 120% of normal occurred in only a few locations including American Samoa, some of the outer Islands of Pohnpei State (Nukuoro and Kapingamarangi), and in the southern RMI (Mili). The highest rainfall total recorded in Micronesia for the first half of 2006 was 106.54 inches at the airport on Kosrae; Nukuoro and Palikir followed next with 100.25 inches and 95.64 inches, respectively. The highest rainfall amount on Kosrae was only slightly less than normal (98%). The lowest recorded rainfall total in Micronesia during the first half of 2006 was 14.91 inches at Tinian in the CNMI. Only some rainfall totals in the CNMI, Guam and in the northern RMI were less than 20 inches during the first half of 2006.

Below normal rainfall is anticipated throughout much of Micronesia and Hawaii for the next six months. Island residents are urged to begin voluntary water conservation measures, and to undertake low-cost repairs and maintenance of

the means of obtaining drinking water. If extremely dry conditions develop in the next 3 to 6 months, then a more serious effort may be required to ensure adequate water supplies for all islanders.

El Niño conditions may cause two or three tropical cyclones to form in the region east of Pohnpei and into the Marshall Islands from now through January 2007, increasing the odds that some of the islands of Micronesia will experience a tropical storm or typhoon. Particularly at risk are Guam and the CNMI where the odds of a damaging typhoon rise to 1 in 3 for the months of November through January (Comparatively, the risk in non-El Niño years during these months is approximately 1 in 10.) Though the risk of a typhoon is normally very low in the Marshall Islands, El Niño increases their chances as well. Notable El Niño-related tropical cyclones in the Marshall Islands include Typhoon Zelda (1991) and Typhoon Paka (1997). In American Samoa the risk of a damaging hurricane is also increased during moderate El Niño events. As the current event is expected to remain weak to moderate, the risk of a hurricane in American Samoa is expected to be greater than normal.

The following comments from the EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION were posted on the U.S. Climate Prediction Center web site on October 29, 2006:

Synopsis: El Niño conditions are likely to continue into early 2007.

“... [current] oceanic and atmospheric anomalies are consistent with the early stages of El Niño in the tropical Pacific. Over the past several months most of the statistical and coupled model forecasts have trended towards warmer conditions in the tropical Pacific through the Northern Hemisphere winter. The latest NCEP coupled forecast system (CFS) predictions indicate El Niño conditions for the remainder of 2006 and into the NH spring (SH fall) 2007. More than two-thirds of the other statistical and coupled model predictions also indicate El Niño conditions during the same period.”

“Global effects that can be expected during November-March include drier-than-average conditions over most of Malaysia, Indonesia, [and] some of the U.S.-affiliated islands in the tropical North Pacific, ...”

CURRENT CONDITIONS

SST (Sea Surface Temperatures)

From mid-July through mid-August, SSTs were greater than 0.5°C between 165°E and 150°W and also between 80°W and 105°W. From mid-September to mid-October, equatorial ocean surface temperatures remained greater than 0.5°C above average across the equatorial Pacific between 155°E and the South American coast, with departures exceeding +1°C between 165°E and 145°E and also between 85°W and 125°W. During this time, SST anomalies decreased in the western tropical Pacific and increased slightly in the eastern tropical Pacific. SST anomalies in mid-October remained positive (between +0.8°C and +1.2°C) in all of the Niño regions. In the subsurface waters there has been a gradual warming since February. During Aug-Sep 2006, positive subsurface anomalies were observed across

most of the equatorial Pacific between 200 m depth and the surface.

Low-level easterlies have been weaker than normal over the western equatorial Pacific between 130E and 170E, and anomalous westerly winds have also dominated the east-central equatorial Pacific since July. Most statistical and coupled models predict slightly to moderately positive SST anomalies (weak to moderate El Niño) in the Niño 3.4 region through the next 3-6 months, consistent with the recent increase in SST and build-up in upper-ocean heat content along the equator. With all these aforementioned factors in place, **it seems likely that weak to moderate El Niño conditions will continue for at least the next 3 months.**

SOI (Southern Oscillation Index)

In September, the SOI was negative for the fifth consecutive month. During the past 6 months, the value of the SOI was + 0.9, -0.8, -0.7, -0.8, -1.6, and - 0.7 for the months April through September, respectively. The persistently negative values of the SOI that occurred since May 2006 are consistent with weak El Niño in the Pacific basin. **With the climate expected to be in a state of weak to moderate El Niño for the next few months, the SOI should average near -1.0 for the next three to six months, with month-to-month fluctuations within the range of -0.5 to - 1.5.** Normally, positive values of the SOI in excess of +1.0 are associated with La Niña, and negative values of the SOI below -1.0 are associated with El Niño. The SOI is an index representing the normalized sea level pressure difference between Darwin, Australia and Tahiti (or other sites representative of the western and eastern tropical Pacific, respectively).

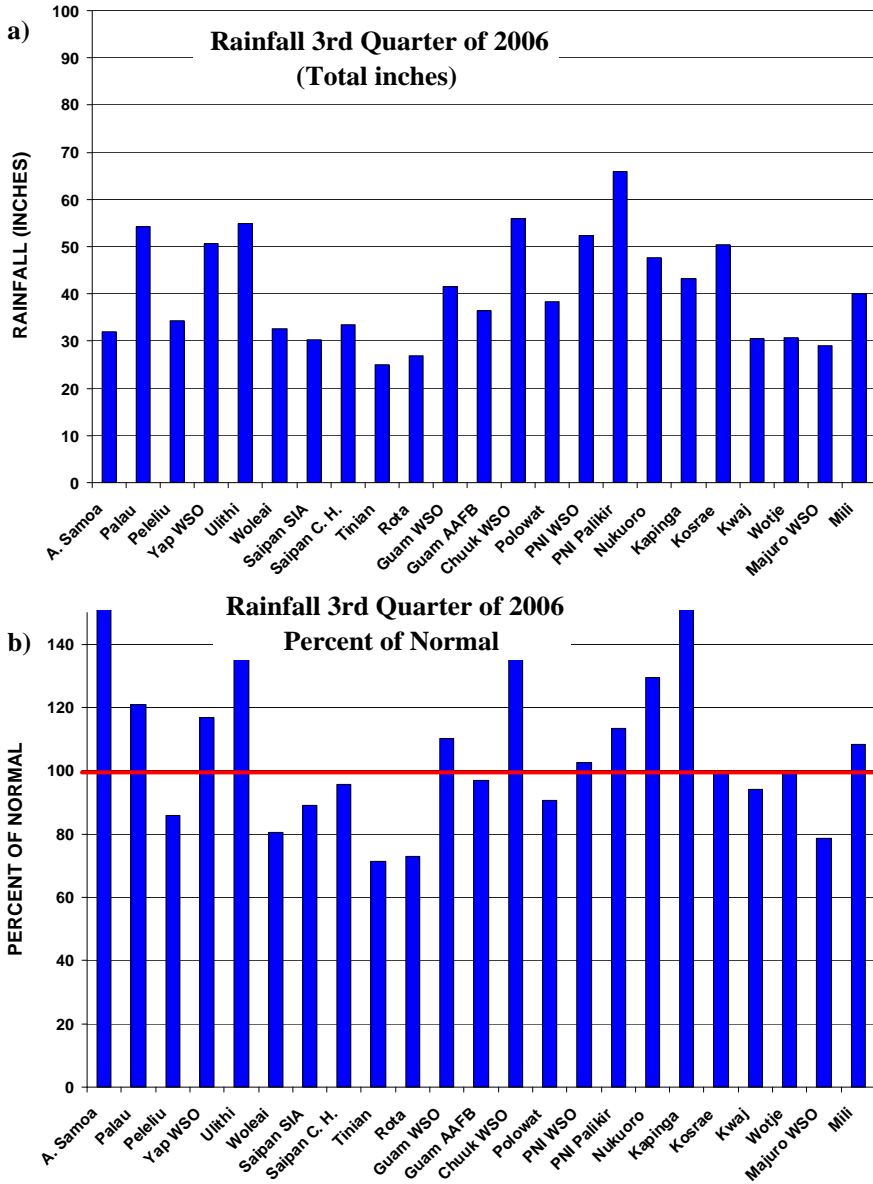


Figure 1. (a) Rainfall totals in inches and (b) anomaly (expressed as percent of normal) at the indicated islands for the 3rd quarter of 2006.

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 Japanese Meteorology 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 pressure, 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

Discussion

For purposes of seasonal statistics, the JTWC archives Southern Hemisphere tropical cyclone activity for the upcoming 2007 cyclone season within the period July 2006 through June 2007. During mid October, the first TC of the 2007 cyclone season formed in the south Pacific. Hurricane Xavier moved southward between Fiji and the Solomon Islands. Xavier was a small hurricane that briefly reached a very high intensity of 115 kts. It remained over water and did not inflict any damage to any islands.

In the western North Pacific, the season's tropical cyclones have become typhoons well to the north of Micronesia. One of the most notable cyclones in the north Pacific basin was Hurricane/Typhoon Ioke. This very large, very intense, and long-lasting typhoon formed to the south of Hawaii and moved on a long track toward Japan. On the way it passed directly over Wake Island, forcing a complete evacuation of the island. Damage from the storm was extensive. Several of the areas of disturbed weather in the central Pacific traveled westward and affected the RMI. In early October, the tropical disturbance that became Typhoon Soulik (TC 21W) tracked close to Majuro and to Kwajalein. Gusty southerly winds associated with this tropical system produced high seas that topped the seawall on the southern boundary of the Majuro Airport. Saltwater entered a retention facility for fresh water that is used to collect rainwater from the runway, and 8 million gallons of fresh water was contaminated and had to be disposed of. Normally this fresh water would have been transferred to the reservoir facility (also at the airport). Most recently, the very powerful Super Typhoon Cimaron (TC22W) developed close to Guam, then moved westward. It became a super typhoon east of Luzon where it made landfall.

TROPICAL CYCLONE

PEAC Tropical Cyclone Outlook

The PEAC tropical cyclone outlook for the period November 2006 through January 2007 is for tropical cyclone development and movement patterns within Micronesia to be displaced toward the east with the development of 2 or three TCs in the region Marshall Islands westward to the north of Kosrae. These TCs may be accompanied by Southern Hemisphere twins. Such cyclones pose an increased threat to Guam and the CNMI.

Beginning in November and continuing through next April or May, the threat of a hurricane passing near American Samoa is increased. At least 2 or 3 tropical cyclones should pass close enough to A.S. during this period to bring northwesterly gales to American Samoa and its territorial waters. A direct strike is not anticipated, but the risk is higher than normal.

The PEAC forecast considered input from two seasonal outlooks for tropical cyclone activity in the western North Pacific basin: (1) The City University of Hong Kong Laboratory for Atmospheric Research, under the direction of J. C-L. Chan, and (2) The Benfield Hazard Research Centre, UCL (University College London), Tropical Storm Risk (TSR) research group, UK, led by Dr Adam Lea and Professor Mark Saunders.

The Hong Kong group posted the following on its website <http://weather.cityu.edu.hk/tc_forecast/2006_forecast_JUN.htm> in June:

The predicted number of all TCs (Tropical depressions, tropical storms and typhoons, (TD+TS+TY)) is 30.

The predicted number for tropical storms and typhoons (TS+TY) is 28.

The predicted number of typhoons (TY) is 18.

With these changes, the average predictions from all the potential predictors therefore call for a ***near-normal year for all TC categories for the entire WNP.***

[The mean numbers for these statistics from the JTWC are 30, 28, and 18 for (TD+TS+TY), (TS+TY) and (TY), respectively.]

The UK group posted the following on its website in August: <<http://tsr.mssl.ucl.ac.uk/docs/TSRNWPForecastAug2006.pdf>>

August Forecast Update for Northwest Pacific Typhoon Activity in 2006, issued: 4th August 2006.

The TSR (Tropical Storm Risk) August forecast update for Northwest Pacific typhoon activity in 2006 anticipates activity ***5-10% above the long-term norm.*** The forecast spans the full Northwest Pacific season from 1st January to 31st December 2006 (95% of typhoons historically occur after 1st May) and is based on data available through the end of July 2006. ... TSR's main predictor for overall activity is the forecast anomaly in August-September 2006 Niño 3.75 sea surface temperature (SST). We anticipate this will be $0.24 \pm 0.30^\circ\text{C}$ warmer than normal and thus slightly enhancing for activity. This is the final TSR monthly forecast update for the 2006 Northwest Pacific typhoon season. A verification of all forecasts will be issued in early January 2007.

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LOCAL SUMMARY AND FORECAST



American Samoa: After a dry 2nd quarter of 2006, the 3rd quarter of the year (normally the heart of American Samoa's dry season) saw abnormally wet conditions. During September, 15.78 inches of rainfall (236% of normal) was reported at the Pago Pago Weather Service Office (WSO). Pago Pago received 164% of normal rainfall in the 3rd quarter.

American Samoa Rainfall Summary 3rd Qtr 2006

Station		Jul.	Aug.	Sep.	3rd Qtr
Pago Pago WSO	Rain (Inches)	8.27	7.99	15.78	32.04
	% of Normal	132%	119 %	236%	163%
Aafasou	Rain (Inches)	8.37	13.01	9.16	30.54
	% of Normal	46%	85%	81%	81%

Climate Outlook: American Samoa is now entering the onset of its next rainy season. Earlier computer forecasts (and the official PEAC forecasts as well) had indicated that rainfall in American Samoa was likely to remain above normal as the island group entered its dry season. This was not the case, however, and conditions have been dry. Long-range computer rainfall forecasts have only limited skill in the tropical Pacific islands, and American Samoa is in a region where the effects of ENSO are more varied than at other locations. Thus, for this outlook, a forecast based on climatology and persistence would indicate continued drier than normal conditions with a normal onset to the next rainy season.

The threat of a damaging tropical cyclone in any of the islands of American Samoa is essentially over until the next rainy season (2006-07). After consultation with American Samoa WSO personnel (Akapo), we agree that the threat of a damaging tropical cyclone is greatest during weak El Niño conditions. During strong El Niño's, the cyclone paths shift eastward into French Polynesia, and during La Niña, the cyclones tracks are shifted westward into the Coral Sea. With some climate models indicating a trend toward weak El Niño conditions in the latter half of 2006, it would be prudent for American Samoa to begin contingencies for a busy cyclone season. Normal cyclone activity for an entire rainy season indicates that two or three named tropical cyclones would pass to the south of American Samoa, producing episodes of heavy rainfall and gale force northwesterly winds.

Predicted rainfall for American Samoa from November 2006 through September 2007 is:

Inclusive Period	% of long-term average
Nov - Dec 2006 (Onset of next Rainy Season)	120%
Jan - Apr 2007 (Heart of Next Dry Season)	120%
May - Jun 2007 (Onset of next Dry Season)	100%
Jul - Sep 2007 (Heart of next Dry Season)	100%

LOCAL SUMMARY AND FORECAST



Guam/CNMI: While rainfall on Guam during the 3rd quarter of 2006 was greater than normal at most reporting locations, extreme month-to-month variation in Guam's rainfall was observed. Very wet conditions persisted for all of July through the first half of August, followed by very dry conditions from mid-August to the last week of September (less than 4 inches of rain at the WSO). Wet conditions returned again in late September and lasted through late October. During the mid-August to late-September dry spell, it became so dry that wildfires were observed in the southern grasslands. This rainfall pattern is possibly the result of the Madden Julian Oscillation (MJO). The MJO (also referred to as the 30-60 day or 40-50 day oscillation) appears to be the main intra-annual fluctuation that can be used to explain weather variations in the tropics. While the MJO affects the entire tropical troposphere, it's effects are most evident in the Indian and western Pacific Oceans. The MJO involves variations in wind, sea surface temperature (SST), cloudiness, and rainfall. The manifestation of the MJO signal in Micronesia is to produce several weeks of wet weather broken by a week or two of hot dry weather.

Guam and CNMI Rainfall Summary 3rd Qtr 2006

Station		Jul.	Aug.	Sep.	3rd Qtr
Guam					
GIA	Rain (Inches)	20.56	12.07	8.96	41.59
	% of Normal	195%	88%	66%	110%
AAFB	Rain (Inches)	16.38	11.33	8.75	36.46
	% of Normal	150%	84%	66%	97%
Dededo (Ypapa)	Rain (Inches)	20.78	12.45	10.00	43.23
	% of Normal	176%*	85%*	66%*	104%*
CNMI					
Saipan Intl. Airport	Rain (Inches)	12.78	9.57	8.02	30.37
	% of Normal	158%	77%	59%	89%
Capitol Hill	Rain (Inches)	15.09	10.45	8.00	33.54
	% of Normal	168%	84%	59%	96%
Tinian Airport	Rain (Inches)	11.09	7.46	6.40	24.95
	% of Normal	123%	60%	47%	71%
Rota Airport	Rain (Inches)	10.75	9.82	6.44	27.01
	% of Normal	103%	74%	48%	73%

* % of normal for Dededo is with respect to WSO Finigayan

LOCAL SUMMARY AND FORECAST

Rainfall totals at stations in the CNMI during the 3rd quarter of 2006 were generally dry, especially during August and September. On Tinian and Rota the September totals were less than half of normal for what is typically the wettest month of the year. As on Guam, July was a wet month in the CNMI, and the only month during which any of the recording locations received more than 100% of normal rainfall.

Climate Outlook: With the onset of El Niño in the 2nd half of 2006, the rainfall on Guam and in the CNMI is likely to be below normal through the first half of 2007. El Niño conditions provide an opportunity for tropical cyclones to form further east than normal (e.g., in the Marshall Islands) and thereby increase the threat of a damaging typhoon on Guam and in the CNMI. During non-El Nino years, the odds of typhoon force winds on Guam or on any individual island in the CNMI is about 1 in 10; however, during El Nino years that chance rises to about 1 in 3. Dangerous surf from a typhoon does not require that the typhoon pass close to any location, so it is almost certain that at least one episode of dangerous typhoon-generated waves will affect the islands. Every year several lives are lost due to hazardous surf and the rip currents produced by them.

Rainfall is anticipated to be below normal for Guam and the CNMI during the upcoming dry season. The dry season months are expected to be drier than normal, and the dry season may be lengthened on both ends (meaning an early start beginning in November 2006 and an extension into June or July 2007). Island residents are urged to begin voluntary water conservation measures now, and to undertake low-cost repairs and maintenance to water infrastructure. If extreme dry conditions develop in the next 3 to 6 months, a more serious effort may be required to ensure adequate water supplies for all islanders. The risk of wildfires will be high beginning in late January and continuing through June. Residents are urged to clear away brush and loose combustible materials located near their homes. During the record drought of the dry season of 1998, nearly 12% of Guam's land area was scorched by wildfires.

Predicted rainfall for the Mariana Islands from November 2006 through October 2007 is as follows:

Inclusive Period	% of long-term average	
	Guam/Rota	Saipan/Tinian
Nov – Dec 2006 (End of Rainy Season)	85%*	80%*
Jan 2007 – Mar 2007 (1 st half of Next Dry Season)	75%	70%
Apr – Jun 2007 (2 nd half of Next Dry Season)	70%	60%
Jul – Oct 2007 (Next Rainy Season)	95%	90%

*A typhoon passage in these months could result in an extreme 24-hour rain event

**For more information on
Guam's weather and climate go to
www.weather.gov/guam**

LOCAL SUMMARY AND FORECAST



Federated States of Micronesia

Yap State: Rainfall throughout Yap State during the 3rd quarter of 2006 was abundant. Nearly all locations on Yap Island and on Ulithi reported above normal precipitation, with most reporting sites on Yap Island and on Ulithi receiving between 45 and 55 inches of rain during the three months of the 3rd quarter. The only rain-recording site in Yap State that was somewhat drier than normal was Woleai, where the 3-month total of 32.57 inches was 81% of the normal for the period, and was the lowest value recorded in Yap State.

Climate Outlook: Nearly all of the western North Pacific tropical cyclones for the first half of 2006 affected Yap while in their early stages of development. While no direct strike by a typhoon is anticipated for any island in Yap State for the remainder of 2006 through the first half of 2007, it is possible that one or two more tropical cyclones will pass close enough to one or more islands of Yap State to bring heavy showers, some gusty winds and high seas.

During a typical El Niño, rainfall in Yap tends to drop below normal by November, and remain below normal through June of the year following El Niño. Residents of Yap State should begin water conservation measures by the end of November, and make

Yap State Rainfall Summary 3rd Qtr 2006

Station		Apr.	Aug.	Sep..	3rd Qtr
Yap Proper					
Yap WSO	Rain (Inches)	13.91	18.15	18.53	50.59
	% of Normal	96%	119%	137%	117%
Dugor*	Rain (Inches)	16.46	15.73	15.91	42.54
Gilman*	Rain (Inches)	15.80	15.34	11.40	48.10
Luweech*	Rain (Inches)	13.65	16.61	16.23	46.49
Maap*	Rain (Inches)	19.67	18.38	10.97	49.02
North Fanif*	Rain (Inches)	15.80	17.03	16.77	49.60
Rumung*	Rain (Inches)	21.05	23.40	10.86	55.31
Tamil*	Rain (Inches)	17.86	14.92	14.40	47.18
Outer Islands					
Ulithi	Rain (Inches)	18.01	26.86	9.91	54.78
	% of Normal	146%	208%	86%	149%
Woleai	Rain (Inches)	13.76	12.73	6.08	32.57
	% of Normal	98%	87%	52%	81%

* Long term normal is not established for these sites

LOCAL SUMMARY AND FORECAST

all reasonable repairs and routine maintenance to rain catchments and other drinking water infrastructure. As on Guam, Yap Island is prone to wildfires during very dry conditions. Residents may wish to clear away brush and combustible materials from areas they wish to protect from fire. At this time, the dry conditions are not expected to be as bad as those experienced during 1998.

Predicted rainfall for Yap State from November 2006 through October 2007 is as follows:

Inclusive Period	% of long-term average	
	Yap and Ulithi	Woleai
Nov 2006 – Jan 2007 (Onset of the Dry Season)	90%*	85%*
Feb – May 2007 (Heart of Next Dry Season)	80%	75%*
Jun – Jul 2007 (Onset of next Rainy Season)	90%	85%
Aug – Oct 2007 (Heart of next Rainy Season)	100%	110%

*A typhoon passage in these months could result in an extreme 24-hour rain event.

Chuuk State: The Chuuk WSO recorded 55.90 inches of rainfall during the 3rd quarter of 2006. This was 146% of normal, and was the highest 3-month rainfall total among all the recording locations in Chuuk State. Though the 3rd quarter totals everywhere were lower than at the Chuuk WSO, the readings at most sites in Chuuk State were still moderate, with values generally ranging between 45 to 55 inches. Only at Polowat and Ettal were the 3-month totals less than 40 inches. Substantial month-to-month rainfall variations associated with the MJO (that were very pronounced on Guam) were also observed on some of the islands of Chuuk State. Following August totals that were close to 20 inches, the September totals were less than 10 inches on some islands. Polowat, which tends to be among the drier locations in Chuuk State had 38.35 inches during the 3rd quarter of 2006, which was roughly 91% of normal for that location.

Climate Outlook: In the final 2 months of 2006 through January 2007, approximately 2 or 3 numbered tropical cyclones are expected to pass north of Chuuk State. The near passage of a tropical cyclone may produce gale-force winds and an extreme daily rainfall total of 5 inches or more at some locations. While no direct strikes by a typhoon of any island or atoll of Chuuk State is expected during 2006, residents should always be prepared for the possibility.

During a typical El Niño, rainfall in Chuuk State tends to drop below normal by November, and remain below normal through March or April of the year following El Niño. Residents of Chuuk State should begin water conservation measures by the end of November, and make all reasonable repairs and routine maintenance to rain catchments and other drinking water infrastructure. At this time, the dry conditions are not expected to be as bad as those experienced during 1998. Rainfall amounts should recover to near normal by May or June of 2007.

4th Quarter, 2006

LOCAL SUMMARY AND FORECAST

Chuuk State Rainfall Summary 3rd Qtr 2006

Station		Jul.	Aug.	Sep.	3rd Qtr
Chuuk Lagoon					
Chuuk WSO	Rain (Inches)	13.43	20.42	22.05	55.90
	% of Normal	102%	140%	191%	146%
Piis Panew*	Rain (Inches)	15.17	7.56	15.06	37.79
Xavier H. School*	Rain (Inches)	13.50**	20.59	16.22	50.31
Southern Mortlocks					
Lukunoch*	Rain (Inches)	14.26	22.45	9.54	46.25
Ettal*	Rain (Inches)	16.47	12.74	7.17	36.38
Ta*	Rain (Inches)	13.68	14.38	12.03	40.09
Northern Atolls					
Fananu*	Rain (Inches)	18.00	17.41	9.74	45.15
Onoun*	Rain (Inches)	17.89	24.67	7.27	49.83
Northern Mortlocks					
Losap*	Rain (Inches)	18.09	22.24	12.90	53.23
Nama*	Rain (Inches)	15.78	21.97	16.33	54.08
Western Atolls					
Polowat	Rain (Inches)	21.96	8.96	7.43	38.35
	% of Normal	157%	60%	56%	91%

* Long-term normal is not established for these sites

** Estimated

Predictions for Chuuk State from November 2006 through October 2007 are as follows:

Inclusive Period	% of long-term average			
	Chuuk Lagoon Losap and Nama	Polowat	Northern Islands	Mortlocks
Nov-Dec 2006	95%	90%	90%	95%
Jan-Mar 2007	75%	70%	70%	80%*
Apr – Jun 2007	90%	85%	85%	90%
Jul–Oct 2007	100%	100%	90%	100%*

*A typhoon passage in these months could result in an extreme 24-hour rain event.

LOCAL SUMMARY AND FORECAST

Pohnpei State: During the 3rd quarter of 2006, the rainfall on Pohnpei Island was slightly above normal. Pingelap and Mwoakilloa were drier than at most locations on Pohnpei Island, but Nukuoro and Kapingamarangi were wetter than normal. It has been wetter than normal on Kapingamarangi for a very long time (perhaps because of the effects of continually warmer than normal SST on the cloud systems in the area). The 3-month total of 43.30 inches at Kapingamarangi was 193% of the normal for this period, and marks the highest departure from normal rainfall at any recording location in Micronesia for the 3rd Quarter of 2006.

The 3rd quarter rainfall total of 65.88 inches at Palikir was the highest reading in Pohnpei State. It was also the highest value of rainfall recorded during this time period throughout Micronesia and American Samoa. Only the experimental rain gage on top of Nahna Laud (the highest mountain in the interior rainforest highlands of Pohnpei Island) recorded more rainfall – an estimated 76.99 inches from August to October 2006. The rain gages on top of Nahna Laud and at other sites in locations in the remote interior of Pohnpei Island have now been in operation for over 3 years as a joint project between The UOG and the Conservation Society of Pohnpei (CSP).

Climate Outlook: The risk of a damaging tropical storm or

Pohnpei State Rainfall Summary 3rd Qtr 2006

Station		Jul.	Aug.	Sep.	3rd Qtr
Pohnpei Island					
Pohnpei WSO	Rain (Inches)	17.32	20.45	14.52	52.29
	% of Normal	94%	124%	90%	103%
Palikir	Rain (Inches)	24.70	22.73	18.45	65.88
	% of Normal	118%	121%	101%	113%
Nahna Laud*	Rain (Inches)	26.96	30.03	20.00**	76.99**
Atolls of Pohnpei State					
Nukuoro	Rain (Inches)	20.55	15.20	11.83	47.58
	% of Normal	143%	134%	108%	129%
Pingelap	Rain (Inches)	18.76	13.68	9.32	41.76
	% of Normal	118%	92%	62%	91%
Mwoakilloa*	Rain (Inches)	19.99	17.39	11.89	49.27
Kapingamarangi	Rain (Inches)	14.79	18.72	9.79	43.30
	% of Normal	142%	304%	166%	193%

* Long term normal is not established for these sites

** Estimated

LOCAL SUMMARY AND FORECAST

typhoon is unlikely at any island in Pohnpei State for the remainder of 2006, and for the first half of 2007. The early stages of developing tropical cyclones may bring some episodes of heavy rain to Pohnpei for the remainder of the year and through January of 2007. Because of El Niño, it is possible that a tropical cyclone could form in the Marshall Islands in the three months of November 2006 through January 2007; any such tropical cyclone should pass to the north of all islands in Pohnpei State bringing gusty westerly winds and a chance for a day or two of heavy rainfall.

Dry conditions related to the El Niño that began in the 2nd half of 2006, should not affect Pohnpei too harshly. Most islands from Pohnpei Island eastward into the Marshall Islands could, however, experience a month or two of abnormally dry weather at any time during the period November 2006 through April 2007, after which rainfall amounts should return to near normal. As a precaution, residents of Pohnpei State should make all reasonable repairs and routine maintenance to rain catchments and other drinking water infrastructure. At this time, the dry conditions are not expected to be as bad as those experienced during 1998.

Predicted rainfall for Pohnpei State from November 2006 through October 2007 is as follows:

Inclusive Period	% of long-term average	
	Pohnpei Island and atolls	Kapingamarangi
Nov 2006 – Jan 2007	90%	100%
Feb – Apr 2007	80%	100%
May – Jun 2007	95%	100%
Jul – Oct 2007	100%	95%

Kosrae State: Rainfall averaged close to normal on Kosrae during the 3rd quarter of 2006 due primarily to a very wet July. As on Guam and other islands of Micronesia, sharp month-to-month differences (possibly related to MJO) were experienced. Kosrae's approximately 50-inch rainfall totals for the 3 months of the 3rd quarter of 2006 were similar to totals experienced at many other locations throughout Micronesia. Quite often (especially when other islands are experiencing their dry sea-

Kosrae State Rainfall Summary 3rd Qtr 2006

Station		Jul.	Aug.	Sep.	3rd Qtr
Airport (SAWRS)	Rain (Inches)	27.91	10.23	12.25	50.39
	% of Normal	164%	62%	71%	99%
Utwa*	Rain (Inches)	21.99	16.32	11.84	50.15
Tofol*	Rain (Inches)				
Nautilus*	Rain (Inches)				

* Long term normal is not established for these sites

LOCAL SUMMARY AND FORECAST

sons), Kosrae rainfall totals are the highest in all of Micronesia. For example, during the first-half of 2006, rainfall at Tofol (a village on the east side of the island) was 106.55 inches and this was the highest rainfall total recorded in Micronesia for that time period.

Climate Outlook: The risk of a damaging tropical storm or typhoon is unlikely at Kosrae through the first half of 2007. Because of El Niño, it is possible that a tropical cyclone could form in the Marshall Islands sometime between November 2006 and January 2007, but any such storm should pass to the north of Kosrae State, perhaps bringing gusty westerly winds and a chance for a day or two of heavy rainfall.

Dry conditions related to the El Niño that began in the 2nd half of 2006 should not affect Kosrae too harshly. Most islands from Pohnpei Island eastward into the Marshall Islands could, however, experience a month or two of abnormally dry weather between November 2006 and April 2007, after which rainfall amounts should return to near normal. As a precaution, residents of Kosrae State should make all reasonable repairs and routine maintenance to rain catchments and other drinking water infrastructure. At this time, the dry conditions are not expected to be as bad as those experienced during 1998.

Predicted rainfall for Kosrae State from November 2006 through October 2007 is as follows:

Inclusive Period	% of long-term average
Nov – Dec 2006	90%
Jan – Mar 2007	80%
Apr – Jun 2007	95%
Jul – Oct 2007	100%



Republic of Palau: During the 3rd quarter of 2006, the rainfall throughout most of Palau was above normal. July was particularly wet with monthly rainfall near or above 20 inches at some locations (23.81 inches at the Airport, and 24.21 inches at Nekken Forestry). The driest 3rd quarter total was reported from Peleliu with 34.40 inches (63% of the value at the WSO). Palau has a complex pattern of monthly rainfall with the highest average rainfall in the months of June and July; the lowest average

Republic of Palau Rainfall Summary 3rd Qtr 2006

Station		Jul.	Aug.	Sep.	3rd Qtr
Koror WSO	Rain (Inches)	19.61	17.14	17.46	54.21
	% of Normal	109%	115%	147%	121%
Nekken*	Rain (Inches)	24.21	12.19	13.51	49.91
Intl. Airport*	Rain (Inches)	23.81	17.51	18.43	59.75
Peleliu*	Rain (Inches)	11.47	12.04	10.89	34.40

* Long term normal is not established for these sites

LOCAL SUMMARY AND FORECAST

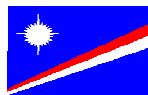
rainfall in the months of February, March and April; and a secondary minimum in September. The annual migration of the monsoon trough across Palau — and the paths taken by tropical cyclones in response to the position of the monsoon trough — govern the behavior of the mean monthly rainfall on Palau.

Climate Outlook: In general, most tropical storms and typhoons that move past Palau stay well to the north, causing westerly gales, heavy rain showers, and rough seas as they move by. During the remainder of 2006 and through January 2007, there should be 2 or 3 more brief episodes of heavy rainfall, gusty westerly winds and rough seas from tropical cyclones passing to the north.

Because of the El Niño event that began in the 2nd half of 2006, rainfall throughout Palau is anticipated to fall below normal during November and December of 2006, and possibly fall substantially below normal from February 2007 through April of 2007. Thereafter, the rainfall should return to near normal. Residents of the Republic of Palau should begin water conservation measures by the end of November, and make all reasonable repairs and routine maintenance to rain catchments and other drinking water infrastructure. At this time, the dry conditions are not expected to be as bad as those experienced during 1998.

Predicted rainfall for Palau from November 2006 through October 2007 is as follows:

Inclusive Period	% of long-term average
Nov 2006 – Jan 2007	85%
Feb – Apr 2007	70%
May – Jun 2007	90%
Jul – Oct 2007	100%



Republic of the Marshall Islands (RMI): During the 3rd quarter of 2006, rainfall throughout the RMI was slightly drier than normal. Most locations recorded approximately 30 inches of rain during these 3 months with the most (39.99) reported at Mili and the least (20.09) reported at Jaluit. During the summer and fall of 2006, the central North Pacific had its first named tropical cyclone (Ioke) since 2004 (see *Tropical Cyclone section, pages 2-3*). There was a large north-south gradient of rainfall in the RMI, with the northern RMI experiencing very dry conditions, while some islands further to the south had abundant rainfall.

Climate Outlook: While the RMI normally has a very low risk of a tropical storm or typhoon during any month of the year. However, due to El Niño, there is a 50% risk that a numbered tropical depression or a named tropical storm will pass through the RMI between November 2006 and January 2007. Notable tropical cyclones occurring in the RMI during EL Niño include Typhoon Zelda (NOV 1991) and Typhoon Paka (DEC 1997).

During El Niño, the rainfall pattern in the RMI is very complex. Usually the northern islands of the RMI enter a prolonged dry spell for the first several months in the year that follows the El Niño year. The central RMI (including Majuro) are often quite dry while the southern RMI and Kiribati are wetter. Ma-

LOCAL SUMMARY AND FORECAST

RMI Rainfall Summary 3rd Qtr 2006

Station		Jul.	Aug.	Sep.	3rd Qtr
RMI Central and Southern Atolls					
Majuro WSO	Rain (Inches)	7.31	6.29	11.55	25.15
	% of Normal	71%	56%	100%	76%
Laura	Rain (Inches)	8.39	3.79	N/A	N/A
	% of Normal	N/A	N/A	N/A	N/A
Aling-laplap	Rain (Inches)	9.92	10.86	10.23	31.01
	% of Normal	111%	103%	96%	103%
Mili	Rain (Inches)	12.17	11.60	12.46	36.23
	% of Normal	118%	104%	108%	110%
RMI Northern Atolls					
Kwajalein	Rain (Inches)	5.81	11.54	7.06	24.41
	% of Normal	77%	116%	73%	90%
Utirik	Rain (Inches)	1.50	3.11	2.75	7.36
	% of Normal	23%	37%	34%	32%
Wotje	Rain (Inches)	2.65	5.34	6.11	14.05
	% of Normal	37%	56%	67%	54%

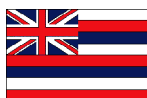
Majoro had a severe dry spell lasting 4 or 5 months in early 1983, 1992 and 1998. During other notable El Niño events, Majoro did not suffer such a prolonged dry spell (for example: early 1973 and early 1977).

Residents of the central and northern RMI should begin water conservation measures by the end of November, and make all reasonable repairs and routine maintenance to rain catchments and other drinking water infrastructure. At this time, the dry conditions are not expected to be as bad as those experienced during 1998.

Predicted rainfall for the RMI from November 2006 through October 2007 is as follows:

Inclusive Period	% of long-term average		
	South of 6°N	6°N to 8°N	North of 8°N
July - Sep 2006	100%	105%	100%
Oct - Dec 2006	110%	110%	100%
Jan - Mar 2007	100%	100%	100%
Apr - Jun 2007	100%	100%	90%

LOCAL SUMMARY AND FORECAST



Hawaii: On August 7 and 8, heavy showers fueled by the remnant of Tropical Storm Fabio dropped 15.08 inches in 24 hours on Kauai's Mount Waialeale, resulting in flash flooding on Hanalei River and a brief closure of Kuhio Highway at the Hanalei River Bridge. The only significant heavy rain event took place late September 25 through the early morning hours of September 26 when thunderstorms and showers triggered by an upper level low northwest of Kauai dropped 1- to 3-inch totals over portions of the Big Island and 6- to 10-inch totals over the central Koolau Range on Oahu. A USGS gage on Kaluanui Stream in Oahu's Sacred Falls State Park registered a 4 ft rise in water levels over a 3-hour period. While heavy rains prompted flash flood warnings, no significant damages or injuries were reported.

Additional individual rainfall station information and specific island information for Hawaii can be found in the Monthly Precipitation Summaries which are located online at <http://www.prh.noaa.gov/hnl/pages/hydrology.php>.

State of Hawaii Rainfall Summary (for select stations)
3rd Qtr 2006

Station		Jul.	Aug.	Sep.	3rd Qtr
Lihue Airport	Rain (Inches)	3.75	4.24	1.18	9.17
	% of Normal	177%	222%	44%	136%
Honolulu Airport	Rain (Inches)	0.08	0.11	0.66	0.85
	% of Normal	16%	24%	89%	50%
Kahului Airport	Rain (Inches)	0.14	0.05	0.23	0.42
	% of Normal	29%	9%	59%	30%
Hilo Airport	Rain (Inches)	7.83	5.69	9.52	23.04
	% of Normal	73%	58%	104%	78%

Climate Outlook: According to the Climate Prediction Center's forecast, dynamic and statistical models indicate a tendency toward below normal temperature for Hawaii in November 2006 and below normal temperature from NDJ 2006 to JFM 2007. The models show equal probabilities of above or below normal precipitation for November 2006, but do indicate a tendency toward below normal precipitation from DJF 2007 to FMA 2007. The ENSO phenomenon is found to play an important role in the climate variability in Hawaii. During the late winter and spring of ENSO events, drier-than-average conditions can be expected in Hawaii.

For more information on
Hawaii's weather and climate go to
www.weather.gov/hawaii

EXPERIMENTAL SEA LEVEL FORECASTS

The following sections describe: (i) the CCA-based forecasts for sea level deviations for the forthcoming season, and (ii) the observed monthly sea level deviations. All units are in inches. Note that deviations are defined here as the difference between the mean sea level for the given month and the 1975 through 1995 mean sea level value computed at each station. Also, note that the forecasting technique adapted here does not account for sea level deviations created by other atmospheric or geological conditions such as tropical cyclones, storm surges or tsunamis.

(i) Seasonal Sea Level Forecast for OND, NDJ, and DJF 2006/2007

Forecasts of the sea level anomalies in the USAPI are presented using CCA statistical model. Locations of all stations are shown in Fig 2. Based on the independent SST values in JAS 2006, the resulting CCA model was used to forecast the sea level of three consecutive month periods: Oct-Nov-Dec (OND), Nov-Dec-Jan (NDJ), and Dec-Jan-Feb (DJF) (Table 1). CCA cross-validation forecast skills for 0, 1, and 2-month leads are available online (see Table 1).

Table 1: Forecasts of sea level deviation (in inches) for OND:Oct-Nov-Dec; NDJ:Nov-Dec-Jan; and DJF:Dec-Jan-Feb

Tide Gauge	OND	NDJ	DJF	Forecast Quality ¹
Lead time ²	0	1M	2M	
Guam	-3	-3	-3	Strong
Malakal	-2	-4	-5	V.Strong
Yap	-3	-4	-4	V.Strong
Pohnpei	**	-2	**	V.Strong
Kapingama-rangi	+2	**	**	Strong
Majuro	**	**	**	Strong
Kwajalein	**	-2	**	Strong
Pago Pago	+2	+2	**	Good

1. Forecast quality is a measure of the expected CCA cross-validation correlation skill. In general terms, these forecasts are thought to be of useful skill (or at least fair skill) if the CCA cross-validation value is greater than 0.3. Higher skills correspond to a greater expected accuracy of the forecasts. Skill levels greater than 0.4 and 0.5 are thought to be moderate and good, respectively, while skill levels greater than 0.6 and 0.8 are thought to be strong and very strong, respectively. For more information on the forecast skill, go to the PEAC website at www.soest.hawaii.edu/MET/Enso/peu/2006_3rd/Sea_Level.htm

2. The lead time is the time interval between the end of the initial period and the beginning of the forecast period. For example, lead-0, lead-1M, and lead-2M means ‘sea-level’ of target season 0 (OND), 1 (NDJ), and 2 (DJF) month leads based on SSTs of Jul-Aug-Sep.

Note: (-) indicates negative deviations (fall of sea level from the mean), and (+) indicates positive deviations (rise of sea level from the mean), N/A: data not available. Deviations of +/-1 in. are considered negligible and denoted by **. Deviations +/- 2 in. are unlikely to cause any adverse climatic impact.

Although all the previous forecasts were skillful, this season (OND) has provided the most skillful forecasts (Figure 3). All of the tide gauge stations show strong or good skill level (Table 1). With a mean skill greater than 0.73 (at 0 to 2-months lead time) in all the three consecutive seasons (OND, NDJ, and DJF), the tide gauge stations are very well predicted.

Consistent with the onset of El Niño in August-September 2006, the sea-level in all the north-west and north-east Pacific islands has shown some sign of receding trends; however, a full-fledged sea-level drop (as recorded in previous El Niño years) is yet to be observed. Results of the CCA model forecasts reveal that most of the tide gauge stations in the north Pacific (Guam, Malakal, Yap, and Pohnpei) are likely to experience fall (negative deviations) during the forthcoming OND, NDJ, and DJF seasons (Table 1). Conversely, the central part of the western Pacific (Majuro and Kwajalein, RMI) is likely to display a very marginal rise (positive deviation) in the forthcoming seasons, while Pago Pago in the south Pacific is expected to show a moderate rise during the same timeframe. Note that, according to CPC, the present oceanic and atmospheric anomalies are consistent with the early stages of El Niño in the tropical Pacific, and that existing El Niño conditions are likely to continue into early 2007.

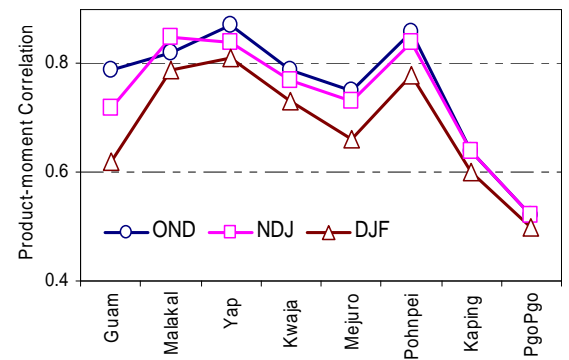


Fig. CCA Cross-validation Skill in OND, NDJ, and DJF

Figure 3: CCA Cross-validation Skill in OND, NDJ and DJF

EXPERIMENTAL SEA LEVEL FORECASTS

(ii) Observed monthly sea level deviation in Jul-Aug-Sep (JAS), 2006

The monthly time series (April to June) for sea level deviations have been taken from the UH Sea Level Center. The full time series (in mm) is available at ftp://ilikai.soest.hawaii.edu/islp/slpp/deviations. Deviations are defined here as the difference between the mean sea level for the given month and the 1975 through 1995 mean sea level value computed at each station.

Table 2 provides the monthly observed sea level deviations (in inches). Unlike the 2nd quarter (AMJ) of 2006 where all the tide gauge stations recorded considerable rise, the 3rd quarter (JAS) displayed a moderate to weak positive deviation among most of the tide gauge stations in the vicinity of USAPI (**Table 2**). Only Majuro at Marshalls and Pohnpei at FSM recorded some marginal negative deviations during July and August, respectively. While the sea level rise in July was very distinct in some of the stations (Malakal, Kwajalein and Kapingamarangi), the rise in August and September was marginal (**Table 2**). The sea-level variation in the northwestern tropical Pacific islands has been identified to be sensitive to ENSO-cycle, with low sea-levels during El Niño and high sea-levels during La Niña events. Consistent with the on-going weak El Niño event, the sea-level has recorded some drop. Because the onset of the current El Niño occurred relatively late in the season (September 2006), considerable sea level drop is yet to be seen, but will most likely be visible in the months to come.

In the last issue, our forecasts provided positive deviations for all the tide gauge stations in JAS (**Figure 4**, dotted line). Real-time observed sea-level data in JAS provided verification for the forecast values (**Figure 4**). Other than very marginal variations in Majuro and Pohnpei, stations in Kwajalein, Kapingamarangi, and Pago-Pago maintained a close match with the forecast levels. Due to unavailability of data, the sea level variations of Guam and Yap could not be verified.

Table 2 : Monthly observed sea level deviations in inches (year to year standard deviation in parentheses)

Tide Gauge Station	Jul	Aug	Sep	Average observed/forecast seasonal sea-level deviations
Marianas, Guam	n/a (3.5)	n/a (3.5)	n/a (3.6)	
Malakal, Palau	+7.3 (4.4)	+4.2 (4.2)	+2.5 (4.3)	
Yap, FSM	n/a (4.5)	n/a (4.0)	n/a (4.6)	
Kwajalein, Marshalls	+5.6 (2.5)	+5.0 (2.1)	+4.0 (2.1)	
Majuro, Marshalls	-0.9 (2.2)	-0.2 (2.2)	+1.1 (3.2)	
Pohnpei, FSM	-0.3 (2.7)	-1.0 (2.6)	+0.1 (3.6)	
Kapingamarangi, FSM	+2.5 (2.3)	+3.0 (2.5)	+2.4 (2.7)	
Pago-Pago, A Samoa	+4.6 (3.1)	+3.9 (2.8)	+3.4 (2.6)	

Figure 4: Average Observed/ forecast seasonal sea level deviations for Jul-Aug-Sep (JAS)

Note: - indicate negative deviations (fall of sea-level from the mean), and + indicate positive deviations (rise of sea-level from the mean), n/a: data not available, Figures in parenthesis are year-to-year SD (standard deviations) for the month.

Pacific ENSO Update

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ENSO FORECAST

Excerpt from PROGNOSTIC DISCUSSION FOR LONG-LEAD OUTLOOKS

NOAA-NWS-Climate Prediction Center-Camp Springs, MD—8:30 EDT Thursday October 19, 2006

http://www.cpc.ncep.noaa.gov/products/predictions/long_range/fxus05.html

SST anomalies across the equatorial Pacific basin between 165E and close to the South American coast are at least +0.5°C above normal, indicating that weak ENSO conditions have commenced. The magnitude of the anomalies has continued to increase, and SSTs are at least 1.0°C above normal in most areas from 170E to 85W. Most prediction tools indicate that SST anomalies in the NINO 3.4 region will remain at least 0.5°C above normal across the Tropical Pacific throughout the fall and winter. The average of the currently available tools is approaching 1.0°C for the peak intensity, which implies that warm episode ENSO (El Niño) conditions could reach moderate levels and may have significant impacts on the United States' Climate during the next three to six months.

EL NINO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION

Issued by NOAA NWS Climate Prediction Center - October 5, 2006

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/

Synopsis: *El Niño conditions are likely to continue into early 2007.*

Equatorial Pacific SST anomalies greater than +0.5°C were observed in most of the equatorial Pacific, with anomalies exceeding +1.0°C between 165°E and 165°W and in several areas east of 150°W. The latest SST departures in the Niño regions are all greater than +0.5. Beginning in February the basin-wide upper ocean heat content increased, and since early April positive anomalies have been observed. Since early July weaker-than-average low-level equatorial easterly winds have been observed across most of the equatorial Pacific. In September the Southern Oscillation Index (SOI) was negative for the fifth consecutive month. Collectively, these oceanic and atmospheric anomalies are consistent with the early stages of El Niño in the tropical Pacific.

Over the past several months most of the statistical and coupled model forecasts have trended towards warmer conditions in the tropical Pacific through the Northern Hemisphere winter. The latest NCEP coupled forecast system (CFS) predictions indicate El Niño conditions for the remainder of 2006 and into the NH spring (SH fall) 2007. More than two-thirds of the other statistical and coupled model predictions also indicate El Niño conditions during the same period.

The Pacific ENSO Update is a bulletin of the Pacific El Niño-Southern Oscillation (ENSO) Applications Center (PEAC). 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 editors, Nicole Colasacco and Sarah Jones, at peac@noaa.gov or at the address listed below.

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