pacific ENSO update

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Pacific ENSO Update

*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, with additional special reports on important changes in ENSO conditions as may be required from time to time.*

*For more information about this issue, **please contact:***

Nicole Colasacco
Editor, *Pacific ENSO Update*
Pacific ENSO Applications Center
University of Hawaii, Dept. of Meteorology
2525 Correa Road, HIG #350
Honolulu, HI 96822
Tel: 808-956-2324 Fax: 808-956-2877
WWW: http://lumahai.soest.hawaii.edu/Enso/index.html
E-mail:
nicole.colasacco@noaa.gov

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CURRENT CONDITIONS

On February 2nd, NOAA's Climate Prediction Center announced the official return of **La Niña**. According to the press release, "Oceanic sea surface temperatures have met the operational definition of La Niña for the November through January period. La Niña is the periodic cooling of ocean waters in the east-central equatorial Pacific, which can impact the typical alignment of weather patterns around the globe. NOAA predicts this La Niña event will likely remain into late spring and possibly into summer."

Typically, the islands of Micronesia are **slightly wetter than normal during a La Niña year**, unless it is the year directly following El Niño. The month-to-month variability of rainfall is less during La Niña than during El Niño; this is primarily a result of the westward shift of tropical cyclone development during La Niña. The typhoon threat is reduced at most islands during this La Niña, as it was during the latter half of 2005 when climatic conditions trended toward La Niña.

During 2005, most of the USAPI had near normal annual rainfall with annual totals falling between 80% and 120 % of the long-term average (**Fig. 1a, 1b**). Annual rainfall totals for 2005 exceeded 120% of normal only at a few locations including American Samoa, Polowat and Kapingamarangi. Annual rainfall totals for 2005 were less than 80% of normal only at some locations in the northern RMI, including Kwajalein, Wotje and Utirik. The highest official annual rainfall total recorded in Micronesia during 2005 was the 217.87 inches at Palikir, Pohnpei Island followed next by the 200.21 inches recorded at the airport on Kosrae. Rainfall on the summit of Nahna Laud (the highest mountain in the interior of Pohnpei Island) was once again over 300 inches (according to a rain gage placed there as part of the University of Guam/ Conservation Society of Pohnpei experimental rain gage network). The lowest recorded annual rainfall total during 2005 was the approximately 41 inches of rain at Wotje in the northern RMI. Abundant rainfall is anticipated throughout much of Micronesia and American Samoa for the next three

cont'd on page 2

CURRENT CONDITIONS

to six months. Tropical cyclone activity, which was very quiet in Micronesia during 2005, should be slightly reduced for most of 2006, returning to near normal during September through December of 2006 (see each island summary for the meaning of a "normal" tropical cyclone threat).

Collectively, the present oceanic and atmospheric anomalies are consistent with the development of weak La Niña conditions in the tropical Pacific. The most recent EL NIÑO/ SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION (see p. 12) stated that "current conditions (stronger-than-average easterly winds over the central equatorial Pacific) and recent cooling trends in observed oceanic conditions support the continuation of La Nina conditions in the tropical Pacific during the next 3-6 months."

CURRENT CONDITIONS

SEA SURFACE TEMPERATURE (SST)

Sea surface temperature anomalies have trended cooler throughout the central and eastern equatorial Pacific during the past few months. By early January 2006, equatorial SSTs were up to 1°C cooler than average in most areas between the 180º meridian eastward to 110°W, while positive anomalies of +1°C were found only in equatorial waters between Papua New Guinea and Pohnpei (150°E and 160°E). Subsurface temperatures were up to 2°C colder than normal to depths of 200 meters across the entire equatorial strip of the eastern tropical Pacific. Warmer-than-normal subsurface water was found only west of the 180° meridian. This **pattern of SST and subsurface temperature is consistent with La Niña.**

SOUTHERN OSCILLATION INDEX (SOI)

Throughout 2005, the SOI has trended upward with some large month-to-month variations. From January 2005 through December 2005, the monthly values of the SOI were: + 0.3, -4.1, -0.2, -1.0, -1.2, + 0.1, 0.0, -0.8, + 0.4, + 1.1, -0.3, -0.2. The 5-month running mean centered on October was approximately zero. With the weak La Niña forecast, the SOI should average slightly positive for the next three to six months, with month-to-month fluctuations within the range of -0.5 to +1.5. During La Niña the value of the SOI tends to be positive and during El Niño it tends to be negative (see SOI special discussion on p. 11).

TROPICAL CYCLONE SUMMARY

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 North Pacific tropical cyclone names are obtained from warnings issued by the Japanese Meteorology Agency (JMA). 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

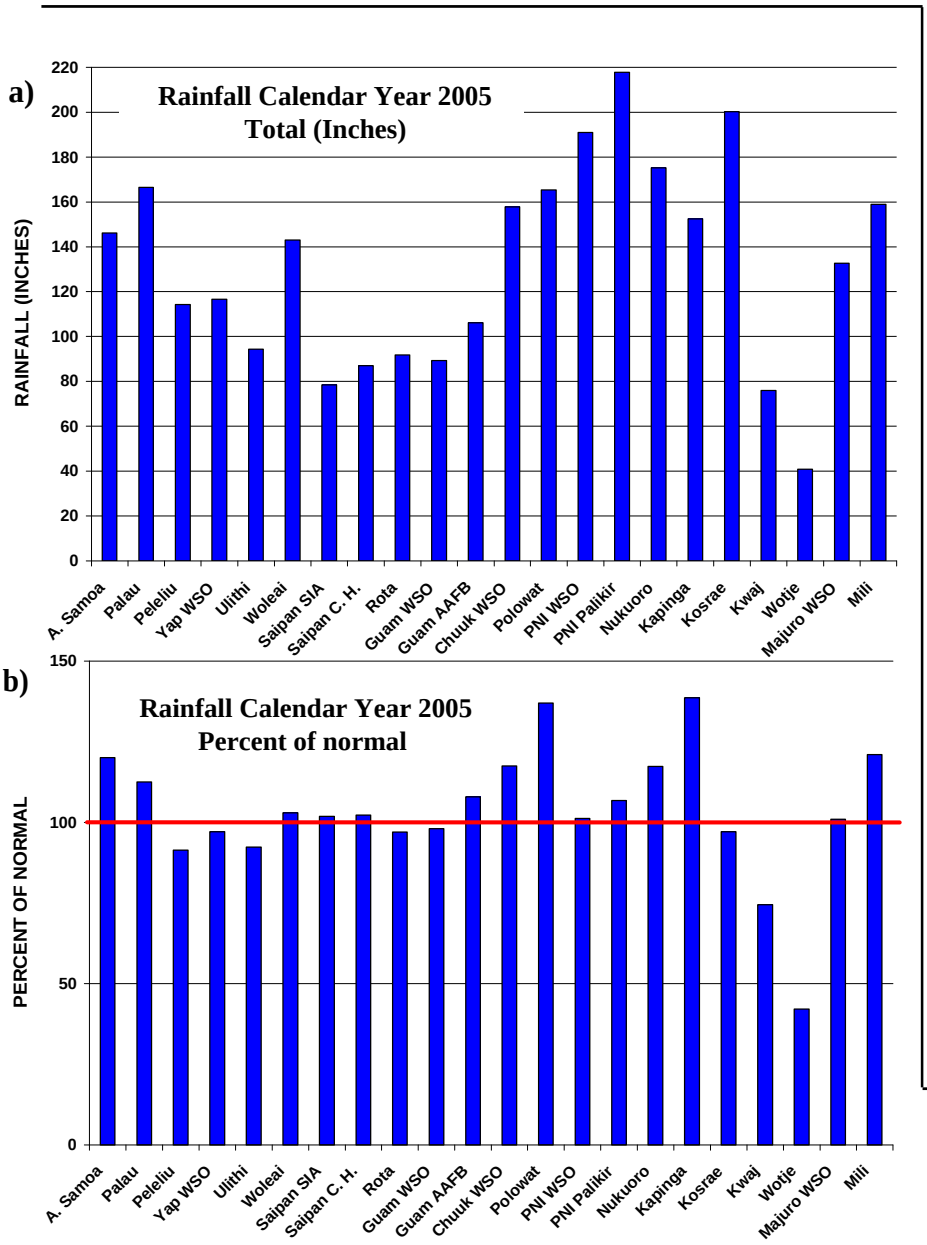


Figure 1. (a) Rainfall totals in inches and **(b)** anomaly (expressed as percent of normal) at the indicated islands for calendar year 2005.

TROPICAL CYCLONE

maximum intensity) for a given tropical cyclone among the agencies that are noted in this summary when appropriate.

During the calendar year 2005, the JTWC numbered only 25 tropical cyclones in the western North Pacific. The JMA named only 23 of these. Normally there are approximately 31 numbered tropical cyclones in the western North Pacific basin during a calendar year, with a breakdown of 18 typhoons (TY), 10 tropical storms (TS) and 3 tropical depressions (TD). The TY-TS-TD breakdown for 2005 was 16, 8, and 1, respectively. In addition to a reduction in the annual number of tropical cyclones in the western North Pacific basin during 2005, the region of tropical cyclone formation was pushed well to the west of normal. During 2005 no tropical cyclones formed south of 20°N and east of 160°E; a region designated as the "El Niño Box" by Lander (1994) (**Fig. 2**). Tropical cyclone formation is observed in the "El Niño Box" primarily during El Niño years; Almost no tropical cyclones form in this region during non-El Niño years. Only one tropical cyclone, Tropical Storm Nalgae, formed north of 20°N and east of 160°E during 2005. The typhoon season of 2005 ended with a whimper on December 18 when the JTWC issued the final warning on unnamed Tropical Cyclone 25W as it dissipated over water to the southeast of Ho Chi Minh City.

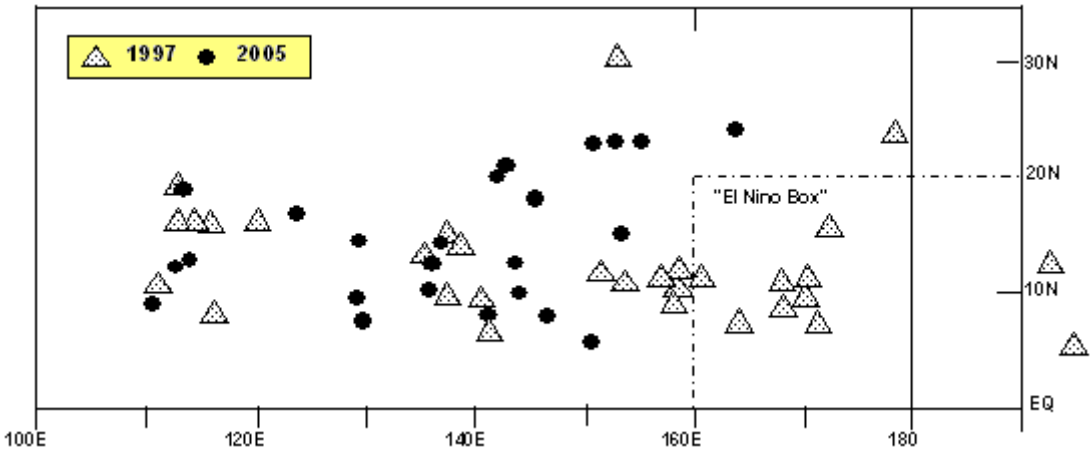


Figure 2. The formation locations of the tropical cyclones of 1997 (triangles) and 2005 (black dots). The formation location of each tropical cyclone is defined as that point on the JTWC best track where the cyclone first acquired 25 kt wind speeds. Note the several tropical cyclones in the "El Niño Box" during the El Niño year of 1997, and the lack of tropical cyclone formation in this region during 2005 (a year described as ENSO Neutral trending towards weak La Niña at year's end). *Figure from Lander, 1994: An exploratory analysis...Mon. Weather Rev., 122, 636-651.*

PEAC TROPICAL CYCLONE OUTLOOK

The May 2005 PEAC tropical cyclone outlook for the western North Pacific basin made during early 2005 called for no above-normal activity in any category (e.g., number of typhoons and number of intense typhoons). Through all of 2005, this held true, with numbers of tropical cyclones below normal, and locations of tropical cyclones shifted to the west and north of normal. No typhoons made a direct strike in Micronesia during 2005. The preliminary PEAC tropical cyclone outlook for 2006 is for activity to be reduced through August, then increase to near normal levels in the final four months of the year.

LOCAL SUMMARY AND FORECAST

American Samoa: Overall, rainfall in American Samoa was above average for 2005. Pago Pago WSO recorded 146.23 inches (120%) for the year, and Aafasou recorded 256.53 inches (133%). Only a few locations in the USAPI had rainfall that was more than 120% of the annual normal. Abundant rainfall in June, August, and September (normally the dry season) accounted for much of the surplus. The year ended with a wet December where 21.03 inches (145%) at Pago Pago and 29.20 inches (150%) at Aafasou.

America Samoa Rainfall Summary 4th Quarter 2005 and 2005 Total

Station		Oct	Nov	Dec	Total	2005
Pago Pago WSO	Rainfall (inches)	6.75	9.69	21.03	**37.47**	**146.23**
	% of Normal	63%	89%	145%	**104%**	**120%**
Aafasou	Rainfall (inches)	13.22	23.89	29.2	**66.31**	**256.53**
	% of Normal	70%	132%	150%	**118%**	**133%**

Climate Outlook:

Computer forecasts and a consensus of outlooks from several regional meteorological centers indicate that rainfall in American Samoa is likely to be slightly above normal through the current rainy season. Long-range computer rainfall forecasts, however, have only limited skill in the tropical Pacific islands.

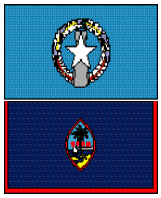
The threat of a tropical cyclone in the islands of American Samoa is expected to be near normal. According to NIWA's Climate Update normal distribution of tropical cyclones in the South Pacific region near American Samoa indicates that one to two tropical cyclones should pass within 300 nm of American Samoa <http://www.niwascience.co.nz/ncc/icu/2005-10/article>. These cyclones would produce episodes of heavy rainfall and gale force northwesterly winds. A direct strike by an intense hurricane such as occurred during

LOCAL SUMMARY AND OUTLOOK

February 2005 is not expected.

Predicted rainfall for American Samoa from January 2005 through December 2006 is:

Inclusive Period	% of long-term average
Jan - May 2006 (Heart of 2006 Rainy Season)	110%
Jun -Sep 2006 (Next Dry Season)	95%
Oct - Dec 2006 (Onset of next Dry Season)	110%



Guam/CNMI: Rainfall on Guam during 2005 was near normal at most locations. The 2005 annual total of 89.22 inches at the Guam International Airport (GIA) was near normal at 98%. In stark contrast to torrential island-wide rainfall on several days in 2004, there were few island-wide heavy rain events in 2005. At the GIA, there were eight days during 2005 with 24-hour rainfall in excess of 2 inches and one day with rainfall in excess of 4 inches. By contrast during 2004 there were thirteen days with 24-hour rainfall totals in excess of 2 inches and four days with 24-hour rainfall in excess of 4 inches. The biggest rain event of 2005 spanned the last day of August and the first day of September when a total of 6.82 inches was recorded at the GIA. The greatest 24-hour total during this event was 4.53 inches. This rainfall was in association with the passage of Typhoon Nabi to the north of Guam on 30 August. The peak wind gust at the GIA during Nabi's passage was 45 mph, and this was the GIA's highest wind gust for the year. Nabi was the only typhoon during 2005 to produce typhoon-force winds on an island in Micronesia (for more indepth information see the 4th quarter, 2005 Pacific ENSO Update).

Guam Rainfall Summary 4th Quarter 2005 and 2005 Total

Station		Oct	Nov	Dec	Total	2005
Guam Intl Airport	Rain (Inches)	12.13	6.06	3.36	**21.55**	**89.22**
	% of Normal	101%	74%	62%	**84%**	**98%**
Anderson AF Base	Rain (Inches)	8.45	9.13	4.37	**21.95**	**106.16**
	% of Normal	66%	100%	73%	**79%**	**108%**
University Of Guam*	Rain (Inches)	12.11	5.38	2.96	**20.45**	**20.43**
Saipan Intl Airport	Rain (Inches)	15.84	5.56	7.33	**28.73**	**83.97**
	% of Normal	147%	96%	190%	**140%**	**109%**
Capitol Hill	Rain (Inches)	14.20	6.23	8.84	**29.25**	**86.89**
	% of Normal	118%	85%	184%	**121%**	**102%**
Tinian Airport	Rain (Inches)	12.52	5.25	5.12	**22.89**	**76.61**
	% of Normal	104%	72%	107%	**95%**	**92%**
Rota Airport	Rain (Inches)	16.86	7.81	5.35	**30.02**	**91.90**
	% of Normal	133%	90%	94%	**111%**	**97%**

* Long term normal not established for this site

LOCAL SUMMARY AND FORECAST

During 2005, most of the CNMI rainfall stations reported slightly less total rainfall in inches than on Guam, but similar amounts in terms of percent of normal. The Saipan International Airport (SIA) and Capitol Hill experienced 110% and 102% of the annual normal, respectively. The heavy rains (6-9 inches) from Typhoon Nabi as it passed north of Saipan on the last day of August represented the most extreme 24-hour rainfall for the year. Rota's annual rainfall of 91.90 inches was similar to that on Guam. The 2005 annual total of 76.61 inches recorded at Tinian was the lowest value recorded at the CNMI, but it was still 92% of the mean annual rainfall.

Climate Outlook:

During La Niña years the tropical cyclone season in the western North Pacific basin is often delayed, and the number of tropical cyclones through mid-July is typically below normal. Also during La Niña years, the site of formation of the basin's tropical cyclones is shifted to the west, reducing the threat of typhoons on Guam and the CNMI. Thus, during all of 2006 (especially during the months of September through December) two or three tropical storms and one or two typhoons should pass within 200 miles of a Guam and CNMI location. The odds of typhoon force winds (or greater) at any location on Guam or in the CNMI during any year (status of ENSO not considered) are approximately 1 in 7. During El Nino years, the odds of typhoon force winds on Guam or on any individual island in the CNMI rise to about 1 in 3. During non-El Nino years the odds fall back to around 1 in 10. Dangerous surf from typhoons do not require that the typhoons pass close to any location, so it is certain that at least one episode of dangerous typhoon-generated waves will occur. Every year several lives are lost due to hazardous surf and the rip currents produced by them.

Rainfall is anticipated to be near normal to above normal for Guam and the CNMI for 2006. Predicted rainfall for the Mariana Islands from January through December 2006 is as follows:

Inclusive Period	% of long-term average	
	Guam/Rota	Saipan/Tinian
Jan - May 2006 (Heart of Dry Season)	110%	100%
Jun - Jul 2006 (Onset of next Rainy Season)	100%	95%
Aug - Oct 2006 (Heart of Next Rainy Season)	110%	100%
Nov - Dec 2006 (Onset of next Dry Season)	100%	100%

Federated States of Micronesia

Yap State: The total 2005 annual rainfall at the WSO on Yap Island was near normal at 116.62

LOCAL SUMMARY AND FORECAST

inches (97%). Annual rainfall totals for 2005 at other recording locations on Yap Island were near to slightly greater than the WSO, and ranged from a low of 113.37 at Maap to a high of 135.18 at Gilman. At Ulithi, the 2005 annual total of 94.26 inches was 92% of normal. The highest annual rainfall recorded in Yap State during 2005 was the 143.13 inches (103%) measured at Woleai, which (at its more southern location) is normally wetter than Ulithi and Yap Island.

Yap Rainfall Summary 4th Quarter 2005 and 2005 Total

Station		Oct	Nov	Dec	Total	2005
Yap WSO	Rain (Inches)	3.33	11.64	9.87	**24.84**	**116.62**
	% of Normal	28%	128%	110%	**83%**	**97%**
Dugor*	Rain (Inches)	6.86	11.99	14.00	**32.85**	**123.69**
Gilman*	Rain (Inches)	4.60	13.15	10.31	**28.06**	**135.18**
Luweech*	Rain (Inches)	2.96	11.66	9.79	**24.41**	**128.68**
Maap*	Rain (Inches)	7.90	9.40	11.43	**28.73**	**113.37**
North Fanif*	Rain (Inches)	8.62	8.76	12.83	**30.21**	**115.62**
Rumung*	Rain (Inches)	10.69	9.98	13.97	**34.64**	**132.73**
Tamil*	Rain (Inches)	5.13	9.74	13.42	**28.29**	**120.78**
Ulithi	Rain (Inches)	6.50	6.74	6.20	**19.44**	**94.26**
	% of Normal	64%	87%	81%	**77%**	**92%**
Woleai	Rain (Inches)	7.17	9.20	20.02	**36.93**	**143.13**
	% of Normal	53%	85%	175%	**103%**	**103%**

* Long term normal not established for this site

Climate Outlook:

The tropical cyclone threat for 2006 is near normal, with the greatest threat occurring in the months of September through December. One or two tropical storms may form near Yap in the first half of 2006 bringing heavy rainfall. In the latter half of 2006, approximately 2 or 3 tropical cyclones should pass close enough to Yap (and/or its outer islands) to cause gales. The threat of a direct strike by a typhoon at Yap Island and at Ulithi is roughly one-half to two-thirds that of Guam and the CNMI. The threat is even less further south at Woleai. While we expect no direct strikes by a typhoon of any island or atoll of Yap State during 2006, residents should always be prepared for the possibility.

Predicted rainfall for Yap State from January 2006 through December 2006 is as follows:

LOCAL SUMMARY AND FORECAST

Inclusive Period	% of long-term average	
	Yap and Ulithi	Woleai
Jan – May 2005 (The Dry Season)	115%	125%
Jun - Oct 2006 (Heart of Next Dry Season)	110%	110%
Nov – Dec 2006 (Onset of next dry Season)	100%	100%

Chuuk State: Rainfall was abundant throughout most of Chuuk State during 2005. The annual totals at over half of the recording stations throughout the state were over 150 inches. The WSO Chuuk rainfall total was 157.79 inches (117% of normal). Polowat topped the list of Chuuk recording sites in amount of annual rainfall with 165.34 inches (137%). In terms of percent of normal annual rainfall among stations in all of Micronesia, only Kapingamarangi, which received 139% of its normal rainfall, exceeded the percentage value of Polowat's 2005 annual rainfall. The magnitude of Polowat's 2005 annual rainfall was exceeded only at Koror and at stations on Pohnpei and in Kosrae.

Chuuk rainfall summary 4thQuarter 2005, and 2005 Total

Station		Oct	Nov	Dec	Total	2005
Chuuk Lagoon						
Chuuk WSO	Rain (Inches)	14.89	5.96	17.97	**38.82**	**157.79**
	% of Normal	111%	58%	166%	**112%**	**117%**
Piis Panew*	Rain (Inches)	7.55	7.55	6.35	**21.45**	**105.65**
Xavier High School*	Rain (Inches)	12.70	6.54	16.56	**35.80**	**152.00 *** **
Mortlocks						
Lukun-och*	Rain (Inches)	7.85	9.76	20.05	**37.66**	**139.05**
Ettal*	Rain (Inches)	15.84	9.00**	15.64	**41.84**	**153.03**
Ta*	Rain (Inches)	8.41	8.09	11.32	**27.82**	**133.64**
Hall Islands						
Fananu*	Rain (Inches)	9.68	6.58	7.09	**23.35**	**117.97**
Onoun*	Rain (Inches)	14.89	10.78	8.51	**34.18**	**142.24**
Eastern Atolls						
Losap*	Rain (Inches)	10.66	9.83	11.95	**32.44**	**151.47**
Nama*	Rain (Inches)	8.71	12.72	14.52	**35.95**	**156.90**
Western Atolls						
Polowat	Rain (Inches)	8.44	9.04	15.39	**32.87**	**165.34**
	% of Normal	70%	98%	167%	**108%**	**137%**

* Long term normal not established for this site.** November missing: estimated from nearby stations *** January and February missing; used values at WSO Chuuk for annual total

LOCAL SUMMARY AND FORECAST

Climate Outlook:

The tropical cyclone threat for 2006 should be near normal, with the greatest threat occurring in the months of September through December. One or two tropical depressions may form within Chuuk State in the first half of 2006 bringing heavy rainfall, but then moving northwestward out of Chuuk State before becoming typhoons. In the latter half of 2006, approximately 2 or 3 tropical cyclones should pass through Chuuk State causing gales to some islands and heavy rainfall throughout most of the region. The threat of a direct strike by a typhoon at any island or atoll in Chuuk State is roughly one-third to one-half that of Guam and the CNMI. While we expect no direct strikes by a typhoon of any island or atoll of Chuuk State during 2006, residents should always be prepared for the possibility.

Based on the development of weak La Niña conditions during the first half of 2006, rainfall at islands and atolls of the Chuuk Lagoon and on the other atolls of Chuuk State should be wetter than normal for most months of the year, and especially in the spring (late March through early June) when the trade-wind trough becomes established in the region. Southern Islands could be very wet during this period.

Predictions for Chuuk State from January 2006 through December 2006 are as follows:

Inclusive Period	% of long-term average			
	Losap/Nama	Polowat	Hall Is.	Mortlocks
Jan - Mar 2006	115%	115%	110%	115%
Apr - Jun 2006	120%	120%	110%	120%
Jul - Sep 2006	110%	110%	100%	110%
Oct - Dec 2006	120%	120%	110%	120%

Pohnpei State: Rainfall was abundant throughout all of Pohnpei State during 2005. On Pohnpei Island, the 2005 annual totals were near or above 200 inches at many locations around the coastal perimeter of the island. The annual total of 217.87 inches at Palikir (on the northwest side of Pohnpei Island) was the highest officially recorded value in all of Micronesia during 2005. (Unofficially, the experimental UOG/CSP rain gage on top of Nahna Laud recorded over 300 inches of rain during 2005.) The enormous amount of rainfall at Palikir was actually near normal at 107%. The annual rainfall total for 2005 at the Pohnpei WSO (on the north side of Pohnpei Island) was 191.05 inches (101%). On the atolls of Pohnpei State, the rainfall during 2005 was abundant, and exceeded 150 inches at all recording locations. Kapingamarangi has been wetter than normal for a long time, and continued to be very wet through its dry season and the final quarter of 2005. The current shift of the climate to weak La Niña may finally force an end to the long period of well-above normal rainfall at Kapingamarangi.

Climate Outlook:

During La Niña years, the tropical cyclones of the western

LOCAL SUMMARY AND FORECAST

Pohnpei Rainfall Summary 4th Quarter 2005, and 2005 total

Station		Oct	Nov	Dec	Total	2005
Pohnpei Island						
Pohnpei WSO	Rain (inches)	12.17	13.85	14.94	**40.96**	**191.05**
	% of Normal	73%	88%	98%	**86%**	**101%**
Palikir	Rain (inches)	16.71	15.74	15.22	**47.67**	**217.87**
	% of normal	N/A	N/A	N/A	**N/A**	**107%****
Nahna Laud*	Rain (inches)	16.77	14.11	N/A	**N/A**	**N/A**
Atolls of Pohnpei State						
Nukuoro	Rain (inches)	9.08	7.90	14.26	**31.24**	**175.29**
	% of Normal	84%	66%	119%	**90%**	**117%**
Pingelap	Rain (inches)	10.97	11.78	11.80	**34.55**	**167.82**
	% of Normal	74%	83%	88%	**81%**	**94%**
Mwok-illoa*	Rain (inches)	7.88	12.08	11.68	**31.64**	**154.64**
Kapinga marangi	Rain (inches)	9.64	7.49	10.91	**28.04**	**152.53**
	% of Normal	200%	91%	125%	**129%**	**139%**

* Long term normal not established for this site ** Annual mean base on PRISM N/A – Not Available

North Pacific form west and north of normal. If weak La Niña conditions persist through much of 2006, then the risk of a damaging tropical storm or typhoon would be very unlikely at any island in Pohnpei State during 2006. The very early stages of developing tropical cyclones may bring some episodes of heavy rain to Pohnpei, but these systems should not become tropical storms or typhoons until they are well away from Pohnpei.

Based on weak La Niña conditions during the first half of 2006, rainfall at Pohnpei Island and the atolls of Pohnpei State should be wetter than normal for most months of the year, particularly in the spring (late March through early June) when the tradewind trough becomes established in the region. The only exception to this is Kapingamarangi where La Niña-related weather patterns may finally shift heavy rainfall away from this island.

Predicted rainfall for Pohnpei State from January 2006 through December 2006 is as follows:

Inclusive Period	% of long-term average	
	Pohnpei Islands/ Atolls	Kapingamarangi
Jan - Mar 2006	125%	100%
Apr - Jun 2006	130%	100%
Jul - Sep 2006	110%	95%
Oct - Dec 2006	110%	90%

LOCAL SUMMARY AND FORECAST

Kosrae State: Although the 2005 annual rainfall values recorded on Kosrae were among the highest in Micronesia, they were near normal. The 2005 annual totals were approximately 200 inches at locations around the coastal perimeter of the island. The 2005 annual total of 200.21 inches at Kosrae Supplemental Aviation Weather Reporting Station (SAWRS) (located at the airport on the north side of the island) was 97% of normal. At the Nautilus hotel on the east side of the island the 2005 annual rainfall was 195.65 inches.

Kosrae Rainfall Summary 4th Quarter 2005 and 2005 Total

Station		Oct	Nov	Dec	Total	2005
Kosrae Airport SAWRS	Rainfall (inches)	10.98	14.34	28.07	**53.39**	**200.21**
	% of Normal	68%	90%	194%	**115%**	**97%**
Nautilus *	Rainfall (inches)	10.91	15.14	26.92	**52.97**	**195.65**

* Long term normal is not established for these sites.

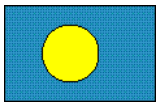
Climate Outlook:

During La Niña years, the tropical cyclones of the western North Pacific form to the west and north of normal. If weak La Niña conditions persist through much of 2006, then a damaging tropical storm or typhoon would be very unlikely at Kosrae during 2006. The very early stages of developing tropical cyclones may bring episodes of heavy rain to Kosrae, but these systems should not become tropical storms or typhoons until they are well away from Kosrae.

Based on the development of weak La Niña conditions during the first half of 2006, rainfall at Kosrae should be slightly wetter than normal for most of the year, and particularly in the spring (late March through early June) when the trade-wind trough becomes established in the region.

Predicted rainfall for Kosrae State from January 2005 through December 2006 is as follows:

Inclusive Period	% of long-term average
Jan - Mar 2006	**100%**
Apr - Jun 2006	**120%**
Jul - Dec 2006	**100%**



Republic of Palau: Palau was drier than normal during the first half of 2005, and wetter than normal for the second half of 2005, yielding an annual total for 2005 that was wetter than normal. The WSO Koror had a 2005 annual rainfall total of 166.50 inches (113% of normal). Annual Rainfall amounts were less at Nekken (138.13 inches), and Peleliu (114.23 inches).

Because of the westward shift in tropical cyclone formation during 2005, Palau was in the path of many of the basins tropical disturbances, some of which became tropical cyclones when near the Philippines or in the South China Sea. This tendency should continue, with Palau experiencing abundant rain from tropical disturbances.

Palau Rainfall Summary 4th Quarter 2005 and 2005 Total

Station		Oct	Nov	Dec	Total	2005
Koror WSO	Rainfall (inches)	11.87	17.58	17.30	**46.75**	**166.50**
	% of Normal	86%	155%	144%	**126%**	**113%**
Nekken*	Rainfall (inches)	13.48	15.42	9.98	**38.88**	**138.13**
Palau Intl. Airport*	Rainfall (inches)	8.08	19.77	N/A	**N/A**	**N/A**
Peleliu*	Rainfall (inches)	8.64	13.89	13.83	**36.36**	**114.23**

* Long term normal not established for this site

Climate Outlook:

Dry conditions in Palau during the first half of 2005 were consistent with the end of El Niño. Then, in the latter half of the year, wet conditions prevailed as the climate trended towards weak La Niña. If weak La Niña conditions persist through much of 2006, then the formation region of tropical cyclones should be pushed westward, and Palau will be affected by many tropical disturbances that will contribute to abundant rainfall. In general, most tropical storms and typhoons that move past Palau stay well to the north, but westerly gales, heavy rain showers, and rough seas are often experienced as they move by. During 2006, there should be several episodes of heavy rainfall and 2 or 3 occurrences of gusty westerly winds and rough seas from tropical cyclones passing to the north, as the focus of the basin's tropical cyclone activity is shifted to the west of normal.

Based on the development of weak La Niña conditions during the first half of 2006, rainfall should be wetter than normal for most months of the year.

Predicted rainfall for Palau from January 2006 through December 2006 is as follows:

Inclusive Period	% of long-term average
Jan - Mar 2006	**120%**
Apr - May 2006	**110%**
Jun - Sep 2006	**100%**
Oct - Dec 2006	**110%**

Republic of the Marshall Islands (RMI): There was a large north-south gradient of rainfall in the RMI during 2005, with the northern RMI experiencing very dry conditions, while some islands further to the south had very abundant rainfall. The northern atolls of the RMI (Kwajalein, Utirik and Wotje) were among the driest of locations in Micronesia during 2005; some of the central and southern atolls (ex. Mili) were very wet. Rainfall was above normal during the final quarter of 2005 at most locations, particularly Mili where the three month total rainfall was 62.08

LOCAL SUMMARY AND FORECAST

LOCAL SUMMARY AND FORECAST

inches. Even Kwajalein had above average rainfall for final quarter of 2005, with a three month total of 33.89 inches (110%) that was nearly as much rainfall as the other nine months of the year. The most rainfall recorded in the RMI during 2005 was at Mili with 158.93 inches (121% of the WSO normal), followed by the 132.66 inches (101%) at the WSO.

RMI Rainfall Summary 4th Quarter 2005, and 2005 Total

Station		Oct	Nov	Dec	Total	2005
RMI Central and Southern Atolls						
Majuro WSO	Rainfall (inches)	16.51	18.52	11.84	**46.87**	**132.66**
	% of Normal	119%	145%	100%	**122%**	**101%**
Laura*	Rainfall (inches)	16.51	10.88	7.17	**34.56**	**117.64***
Arno*	Rainfall (inches)	N/A	16.03	N/A	**N/A**	**N/A**
Ailing-Laplap*	Rainfall (inches)	12.86	15.78	8.18	**36.82**	**97.72**
Mili*	Rainfall (inches)	13.84	22.30	25.94	**62.08**	**158.93**
RMI Northern Atolls						
Kwaj-alein	Rainfall (inches)	16.86	12.33	4.70	**33.89**	**76.01**
	% of Normal	142%	116%	58%	**110%**	**74%**
Utirik	Rainfall (inches)	8.18	5.37	2.70**	**16.25**	**46.60**
	% of Normal	81%	59%	39%	**62%**	**54%**
Wotje	Rainfall (inches)	4.42	3.35	3.00	**10.77**	**15.76**
	% of Normal	39%	33%	39%	**37%**	**42%**

* Long term normal not established for this site

Climate Outlook:

With anticipation of weak La Niña conditions to persist for at least the first half of 2006, tropical cyclones in the western North Pacific basin should form to the west of normal. Thus, the RMI has a very low risk of a typhoon during 2006.

Based on the development of weak La Niña conditions during the first half of 2006, rainfall at most RMI locations should be adequate. The northern island of Kwajalein, Utirik and Wotje should not be quite as dry during the first half of 2006 as they were during the first half of 2005. In fact, computer forecasts and a consensus of outlooks from several regional meteorological centers indicate that rainfall in the RMI is likely to be above normal (even in the north), at least through the next three months.

Predicted rainfall for the RMI from January 2006 through December 2006 is as follows:

Inclusive Period	% of long-term average		
	S. of 6°N	6°N to 8°N	N. of 8°N
Jan - Apr 2006	100%	120%	110%
May - July 2006	100%	110%	95%
Aug - Dec 2006	95%	110%	105%

Rainfall normals and predicted rainfall outlooks are provided by University of Guam WERI.

FOURTH QUARTER 2005
STATE OF HAWAI'I SUMMARY

October: As the first month of the Hawaiian wet season, October produced several heavy rain events and wetter than normal conditions for many areas of the island chain…The first significant heavy rain event of the month was a continuation of heavy rains that began on September 30 resulting from the low level remnant of Hurricane Kenneth passing beneath a strong upper level low pressure system. Mainly moderate to fresh trade winds dominated … from October 2 through October 18. … On October 22 and 23, a shear line, the first of the 2005-2006 wet season, brought wet trades to many areas of the state. This event was followed on October 24 by a trade wind disturbance…Finally, during the early morning hours of October 31, terrain-induced heavy rains in southeasterly low level winds produced nearly 11 inches of rain in the Punaluu area of windward Oahu and 1 to 6 inches of rain along other areas of the Koolaus.

November: November 2005 produced a relatively stable weather pattern over most of the island chain with only one very localized flash flood event squeezing in on November 30 [on windward Oahu]. The rest of the month can be broken into two parts...trades and no trades. From November 1 through 18, mainly moderate trade winds affected the state…. Starting on November 19 and continuing through the end of the month, a series of strong north Pacific storms pushed the low level high pressure ridge southward over the island chain, producing a light wind pattern dominated by local land and sea breezes… the November 23 front marked the first cold front of the 2005-2006 wet season and its occurrence is about one month later than normal.

December: While the first week of December provided some active weather over the Hawaiian Islands, the airmass became quite stable for the remainder of the month to produce very dry conditions for most areas of the state….The island of Kauai experienced record-setting dryness …with all gages reporting below normal totals and most at less than 10 percent of normal.. All gages on Oahu recorded well below normal totals..and more than half of the sites posted totals at less than 10 percent of

HAWAI`I LOCAL SUMMARY

normal…[Most gauges on Maui and the Big Island were well below normal.] Following a period of moderate trades from December 9 through December 14, the subtropical ridge of high pressure settled over the island chain, pushed southward by a series of strong storms in the northwest Pacific. The presence of the ridge over the state resulted in very stable conditions, little or no rain, and winds dominated by local land and sea breezes. This stable weather pattern persisted for the rest of the month.

Kevin R. Kodama, Senior Service Hydrologist
National Weather Service Forecast Office, Honolulu, Hawaii

Editor's Note: Individual rainfall station information and specific island information for Hawaii can be found in the Monthly Precipitation Summaries at <http://www.prh.noaa.gov/hnl/pages/hydrology.php>.

HAWAI`I LOCAL SUMMARY

Climate Outlook:

According to the Climate Prediction Center and the IRI's 90 day official forecast for Hawaii, dynamical and statistical tools predict a tendency towards warmth [warmer than normal air temperatures] from FMA (February-March-April) 2006 to MMJ (May-June-July) 2006. Dynamical and statistical tools also indicate a tendency towards above median precipitation from FMA to MAM 2006. For the FMA and MAM all four Hawaii stations have a 40% chance of having above normal rainfall.

Based upon this and other statistical and dynamic models PEAC's forecast is as follows:

Inclusive Period	% of long-term average			
	Lihue	Honolulu	Kahului	Hilo
Jan - Mar 2006	120%	130%	110%	130%
Apr - Jun 2006	110%	120%	100%	120%
Jul - Sep 2006	climatology for all stations			
Oct - Dec 2006	climatology for all stations			

Experimental Sea level Forecasts
(deviations with respect to climatology) for the U.S-Affiliated Pacific Islands

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 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.

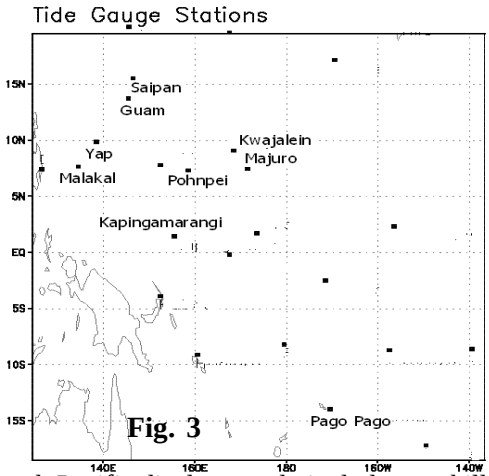


Fig. 3

(i) Seasonal Sea Level Forecast for JFM, FMA, and MAM 2006

Forecasts of the sea level anomalies in the USAPI are presented using CCA statistical model. Locations of all stations are shown in **Fig. 3**. Based on the independent SST values in OND 2005 *(for SST data, see http://iridl.ldeo.columbia.edu/expert/SOURCES/.NOAA/.NCDC/.ERSST/.version2/.SST/)*, the resulting CCA model was used to forecast the sea level of three consecutive months: Jan-Feb-Mar (JFM), Feb-Mar-Apr (FMA), and Mar-Apr-May (MAM) (**Table 1**). CCA cross-validation forecast skills for 0, 1, and 2-month leads are presented (**Fig. 4**).

As in the previous season (OND), this season (JFM) also provided very skillful forecast (**Fig. 4**). Most of the tide gauge stations show strong skill level (**Table 1**). Only Saipan of north Pacific displays a relatively lower skill level; however, it is still above 0.4. The majority of the tide gauge stations in all the three consecutive months (JFM, FMA, MAM) are very well predicted with a mean skill greater than 0.6 (at 0 to 2-month lead time). The effect of the spring predictability barrier is therefore less dominant for the prediction of sea level in this season.

Results of the CCA model forecasts revealed that all the tide gauge stations (except Malakal in MAM) are likely to rise in the forthcoming seasons (**Table 1**). The rising trend has also been observed consistently in all the USAPI islands located in the vicinity of north-west, north-east, and south Pacific Ocean. However, it is also worth noting here that —other than Guam—all the northeastern Pacific islands display very marginal positive deviations; the deviations gradually increased as we move towards north-central, north-eastern, and south Pacific.

The differences of atmospheric circulation in the equatorial western/central Pacific explains this phenomenon very well. Initially the tropical easterly winds were active in OND. As the season advanced, the westerly anomalies developed in the western Pacific became active in AMJ. They gradually strengthened and displaced eastward in JAS. As the year advanced, the westerlies continued to propagate eastward to the equatorial eastern Pacific and finally shifted towards the south Pacific. Due to the switching of the prevailing wind direction, piled-up water in the tropical western Pacific flowed back eastward toward South America. As a result, the northwestern Pacific Islands are experiencing a drop in sea level while the northeastern and south Pacific Islands are experiencing a rise in sea level from OND to JFM.

(ii) Observed monthly sea level deviation in Oct-Nov-Dec (OND), 2005

The monthly time series (October to December) for sea level deviations have been taken from the UH Sea Level Center. The full time

NEW – Experimental Sea level Forecasts (con't)

Table 1: Forecasts of sea level deviation in inches (JFM: Jan-Feb-Mar, FMA: Feb-Mar-Apr, and MAM: Mar-Apr-May)

Tide Gauge Station	JFM	FMA	MAM	Forcst. Quality
Lead time	0	1M	2M	
Guam	+4	+4	+5	Strong
Saipan	**	+1	+2	Moderate
Malakal	**	+1	-1	Good
Yap	**	+1	+1	Strong
Pohnpei	+5	+5	+4	Strong
Kapingamar	+6	+4	+5	Good
Majuro	+4	+4	+3	Good
Kwajalein	+3	+4	+4	Strong
Pago-Pago	+4	+3	+5	Strong

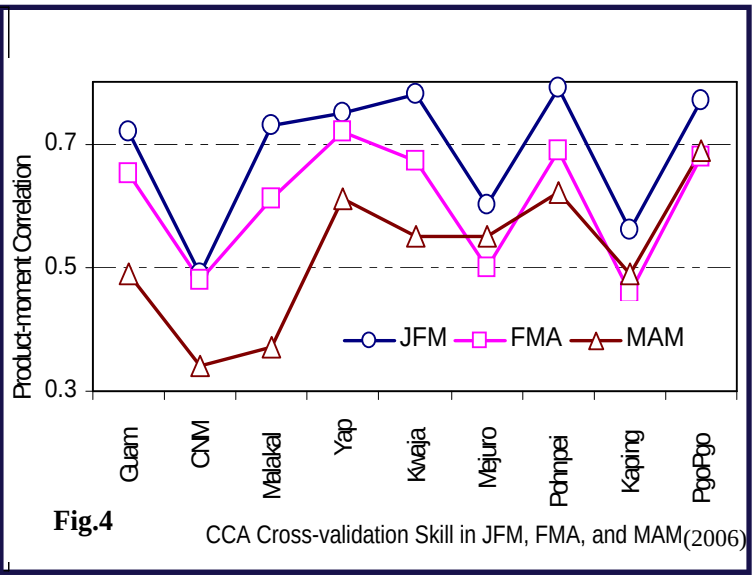


Fig.4 CCA Cross-validation Skill in JFM, FMA, and MAM(2006)

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 negligible and denoted by **. Deviations +/- 2 in. are unlikely to cause any adverse impact.

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 (**Fig. 4**). Higher skills correspond to greater expected accuracy of the forecasts. Skill levels greater than 0.4 and 0.5 are thought to be moderate and good, while skill levels greater than 0.6 and 0.8 are thought to be strong and very strong respectively.

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, 1, and 2 month leads based on SSTs of previous JAS.

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. Locations of all these stations are shown in Fig 1.

Table 2 provides the monthly observed sea level deviations (in inches). All tide gauge stations, with the exception of Guam, recorded positive deviations in this quarter (4th quarter). The sea level at Malakal and Kapingamarangi in the northwest Pacific Ocean, and Kwajalein and Majuro in the northeast Pacific Ocean recorded considerable positive sea level deviations (**Table 2**). Similiarly, Yap and Pohnpei recorded moderate positive deviations. In the south Pacific, Pago Pago recorded considerable positive deviations.

Unlike the previous three quarters (JFM, AMJ, and JAS) when Guam continuously displayed positive deviations, Guam tended to show negative deviations at the beginning of this quarter (-1.5 inches in Oct.). However, due to the unavailability of data for the later part of this quarter at print time, this trend could not be verified independently.

In the last quarter's issue, our forecasts provided positive deviations for all the tide gauge stations –except Guam, Saipan, Yap, and Kwajalein— in OND (**Fig. 5** dotted line). Negligible variations were predicted in Guam, Saipan, Yap, and Kwajalein. Real-time observed sea level data in OND provided consistency with the forecast values (**Fig. 5**). In all cases, the direction of the deviations—either positive or negative— has been found to match with the forecast values. However, quantitatively the forecasts values of Malakal, Kwajalein, and Pago-Pago were considerably lower than the real-time observed values.

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

Tide Gauge	October		November		December	
	Dev.	SD	**Dev.**	SD	**Dev.**	SD
Guam	**-1.5**	(3.6)	**N/A**	(3.7)	**N/A**	(4.1)
Saipan	**N/A**	(2.5)	**N/A**	(3.1)	**N/A**	(2.9)
Malakal	**5.0**	(4.1)	**+2.8**	(4.1)	**0.8**	(4.1)
Yap	**+1.7**	(4.2)	**+1.0**	(3.8)	**-1.4**	(3.8)
Kwajalein	**+4.6**	(3.0)	**+4.4**	(3.1)	**+3.5**	(3.4)
Majuro	**+3.8**	(3.3)	**+3.7**	(3.9)	**+3.4**	(4.2)
Pohnpei	**+2.9**	(4.5)	**+2.4**	(4.7)	**+1.7**	(5.0)
Kapingamar.	**+3.1**	(2.8)	**+5.2**	(3.3)	**+5.8**	(3.2)
Pago Pago	**+4.6**	(2.3)	**+6.3**	(2.0)	**+3.6**	(1.9)

Average observed/forecasted seasonal sea level deviation: Oct-Nov-Dec

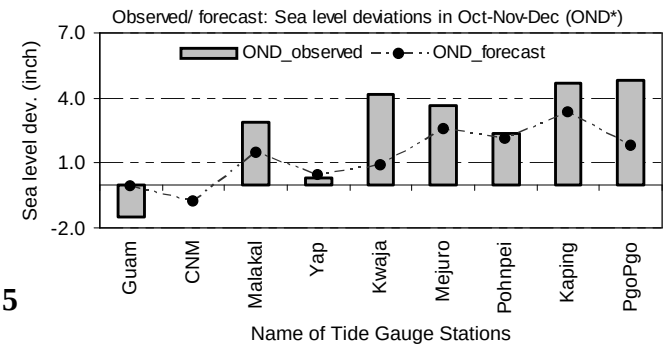


Fig. 5

Note: - indicates negative deviations (fall in sea level from mean), and + indicates positive deviations (rise in sea level from mean), N/A: data not available.

The ENSO Cycle: Southern Oscillation Index (SOI)

The SOI, or Southern Oscillation Index, is the normalized difference in sea surface air pressure between Tahiti, French Polynesia and Darwin, Australia. In the early 20th century, Sir Gilbert Walker documented a pattern of reversing air pressure between stations in the eastern tropical Pacific and the western tropical Pacific/Indian Ocean. He coined this relationship the "Southern Oscillation". Later, this "seesawing" atmospheric pattern was connected to El Nino and La Nina events. In order to quantify these events, an index was created using one station to represent the eastern Pacific region and one station to represent the western Pacific/Indian Ocean region. Tahiti and Darwin were chosen as the stations because of their long data records. In general terms, the equation for the Southern Oscillation Index is the atmospheric pressure at Tahiti minus the atmospheric pressure at Darwin.

During El Niño, higher than average air pressure covers Indonesia and the western tropical Pacific and below-average air pressure covers the eastern tropical Pacific (**Fig. 6)**. Because winds flow from regions of high to low pressure, the trade wind activity is weakened or in a strong El Nino even reversed. **During El Niño** events the SOI has a **large negative value** (generally below -1) due to lower-than-average air pressure at Tahiti and higher-than-average pressure at Darwin.

During La Niña, the situation is reversed. Below-average air pressure covers Indonesia and the western tropical Pacific and above-average air pressure covers the eastern tropical Pacific (**Fig. 6**). The trade winds become stronger than normal. **During La Niña events** the SOI has a **large positive value** (generally above +1) due to higher-than-average air pressure at Tahiti and lower-than-average pressure at Darwin.

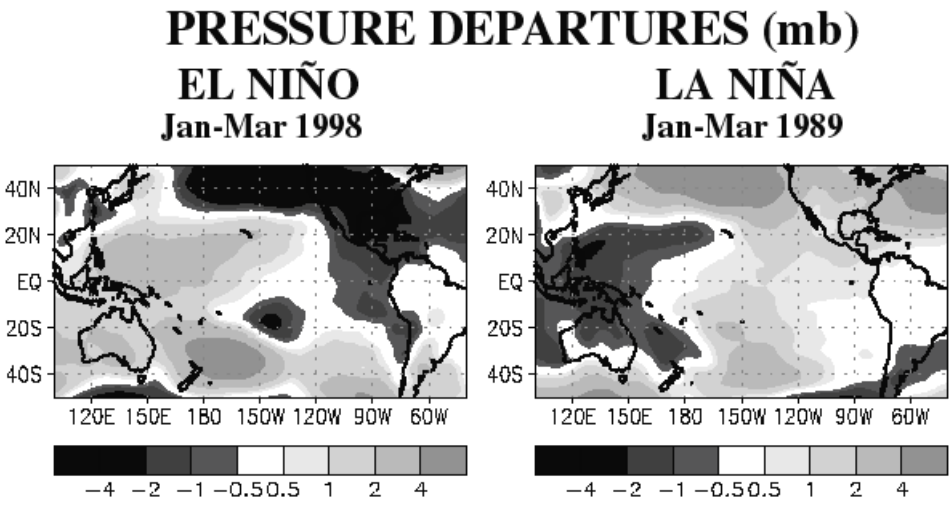


Figure 6. Atmospheric pressure departures from normal in an El Niño and La Niña Year. *Illustration courtesy of NOAA's Climate Prediction Center.*

Figure 7 gives the three month running mean of the SOI for a 25 year period. Note the large negative SOI values (during the 1997-1998 and 1982-1983 El Niños and the large positive deviation during 1988-1989 La Nina.

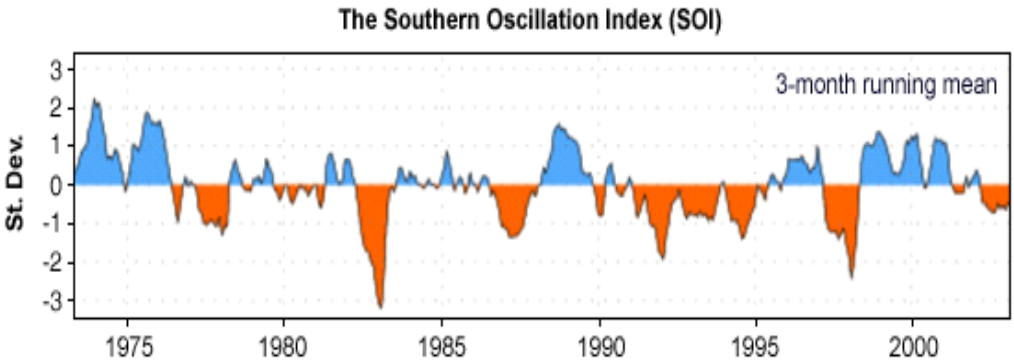


Figure 7. Three month running mean of SOI from 1970-2005. The three month running mean is the average of three months data. For example, the three month running mean for Dec. 2005 would be Nov., Dec., and Jan. averaged. This is done to reduce month to month fluctuations in atmospheric pressure caused by short-term events (such as individual storms). *Illustration courtesy of NOAA's Climate Prediction Center.*

For more information:

Websites with SOI and other ENSO Information

NOAA Climate Prediction Center's Education Materials
<http://www.cpc.ncep.noaa.gov/products/outreach/education.shtml>
Institute for International Research on Climate Prediction's ENSO Basics
<http://iri.columbia.edu/climate/ENSO/index.html>

Website on how SOI is calculated and actual SOI values

NOAA Climate Prediction Center's Atmospheric and SST Index FAQs
<http://www.cpc.ncep.noaa.gov/data/indices/Readme.index.shtml>

Pacific ENSO Update

ENSO FORECAST

Excerpt from PROGNOSTIC DISCUSSION FOR LONG-LEAD OUTLOOKS
NOAA NWS -Climate Prediction Center- Camp Springs, MD- 8:30 am Thursday EST January 19, 2006
http://www.cpc.ncep.noaa.gov/products/predictions/long_range/fxus05.html

Weak La Niña conditions have developed during the past few months... As SSTs in the central equatorial Pacific have become increasingly negative. However since this is a weak late developing episode... It is not clear if typical La Niña impacts will be observed over North America....

The oceanic and atmospheric indicators in the tropical Pacific Ocean have trended toward weak La Niña conditions during the past few months. SSTs along the equator in the eastern and central pacific are more than .5 deg C below normal from the date line to 100W... with much of the region between 175W and 120W more than 1 C below normal. SSTs along the equator west of 170E remain above average. Below normal ocean temperatures in the eastern Pacific extend from the surface to over 150 meters depth. above normal ocean temperatures in the western pacific also extend to depths of 150 meters or more... So the pattern of SSTs should persist through at least the next month. MJO activity is currently weak…

Excerpt from EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION
issued by NOAA NWS Climate Prediction Center-January 12, 2006
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/

***Synopsis**: Developing La Niña conditions are expected during the next 3-6 months.*

Equatorial SST anomalies greater than +0.5ºC were restricted to the region between Indonesia and 165ºE during December, while negative anomalies less than –0.5ºC were observed at most locations between the date line and the South American coast. By the end of the month the SST departures were negative in all of the Niño regions. During the last several months surface and subsurface temperature anomalies have decreased in the region between 180ºW and the South American coast. During the same period persistent stronger-than-average low-level equatorial easterly winds were observed over the central Pacific.Since early November there has been a persistent pattern of enhanced tropical convection near 130ºE (Indonesia) and suppressed convection near the date line (180ºW). Collectively, the present oceanic and atmospheric anomalies are consistent with the development of La Niña conditions in the tropical Pacific.

Over the past several months most of the statistical and coupled model forecasts have trended towards cooler conditions in the tropical Pacific through mid-2006. The spread of the most recent statistical and coupled model forecasts (weak La Niña to ENSO-neutral) indicates some uncertainty in the outlooks. However, current conditions (stronger-than-average easterly winds over the central equatorial Pacific) and recent cooling trends in observed oceanic conditions support the continuation of La Nina conditions in the tropical Pacific during the next 3-6 months.

Based on current conditions in the tropical Pacific, the most recent SST predictions,and on results from historical studies on the effects of cold episodes, we expect wetter-than-normal (drier-than-normal) conditions to prevail over Indonesia (central equatorial Pacific) during the remainder of the NH [Northern Hemisphere] winter...

ACKNOWLEDGEMENTS and FURTHER INFORMATION:

PACIFIC ENSO APPLICATIONS CENTER:
HIG #350, 2525 Correa Road, Honolulu, Hawaii 96822
Contact Nicole Colasacco at 808-956-2324 for more information on the *Pacific ENSO Update* and ENSO-related climate data for the Pacific Islands.
Contact Dr. R. Chowdhury at 808-956-2324 for more information on ENSO and sea level variability in the USAPI.

University of Guam (UOG)
WATER AND ENERGY RESEARCH INSTITUTE (WERI):
UOG Station, Mangilao, Guam 96923
Contact Dr. M. Lander at 671-735-2685 for information on tropical cyclones and climate in the Pacific Islands.

NOAA National Weather Service-Pacific Region
WEATHER SERVICE FORECAST OFFICE (WSFO)
3232 Hueneme Road, Barrigada, Guam, 96913
Contact C. Guard at 671-472-0900 for further information on tropical cyclones and climate in the Pacific Islands.

University of Hawaii (UH) School of Ocean and Earth Science and Technology (SOEST)
DEPARTMENT OF METEOROLOGY:
HIG #350, 2525 Correa Road, Honolulu, Hawaii 96822
Contact Dr. T. Schroeder at 808-956-7476 for more information on hurricanes and climate in Hawaii.