PACIFIC ENSO UPDATE

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

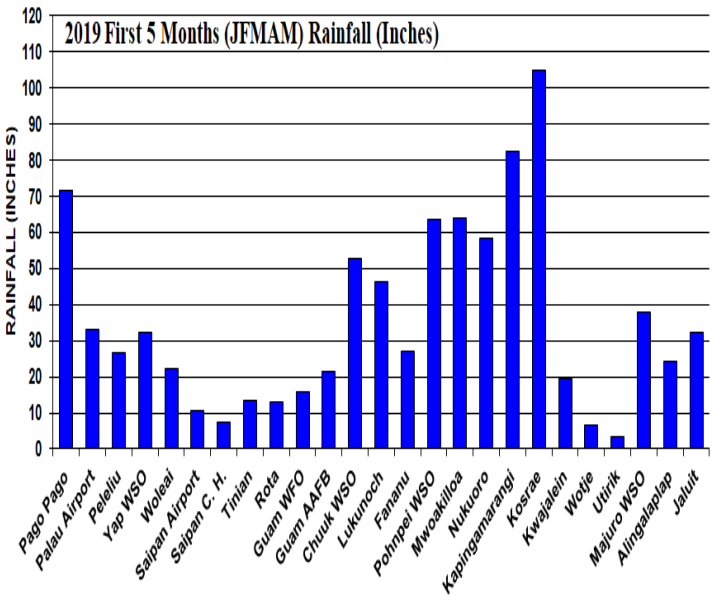
http://www.weather.gov/peac

CURRENT CONDITIONS

Rainfall

The first half of 2019 was very dry at many locations across Micronesia (see Figures R-1 and R-2). Drought was particularly severe in the CNMI and in the northern RMI. A very dry first-half of a calendar year is typical of the year following El Niño; also known as the post-Peak phase of El Niño, or the El Niño Year (+1). Whereas 2018 was noted for a very busy typhoon season for Micronesia (especially for Guam and the CNMI) and a very busy Hurricane season for Hawaii; so far during 2019, TC activity has been relatively subdued in Micronesia and Hawaii. After widespread dryness at many locations through July of 2019, southwesterly monsoonal winds made their first surge into Micronesia during the first week of August (see the time series of Saipan sea-level pressure in Figure R-3 that nicely highlights the timing of the monsoon surge of early August, and another one in mid-September). Heavy rainfall occurred throughout the Mariana Islands during both of these monsoon episodes. In addition, gusty southwest winds with very high surf affected locations in Palau, Yap, Guam and the CNMI.

1)



2)

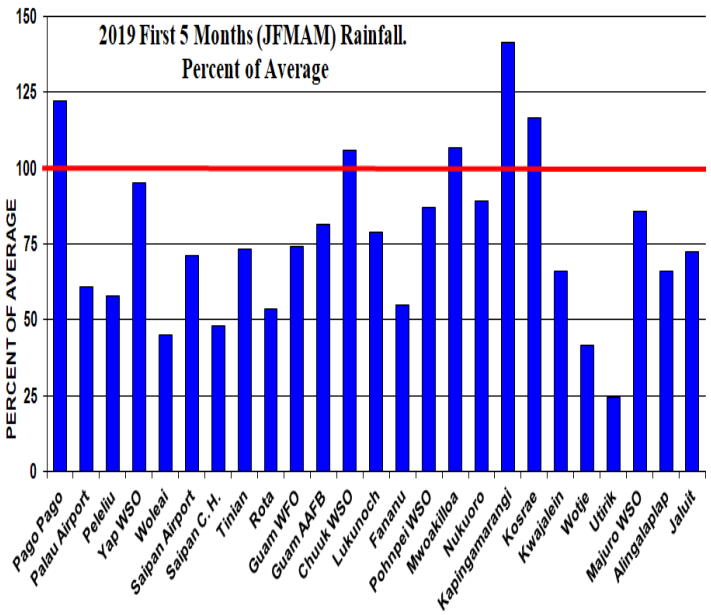


Figure 1 *2019 First 5 Months rainfall amounts in inches at the indicated locations.*
Figure 2 *2019 First 5 Months rainfall as a percent-of-average at the indicated locations.*

3)

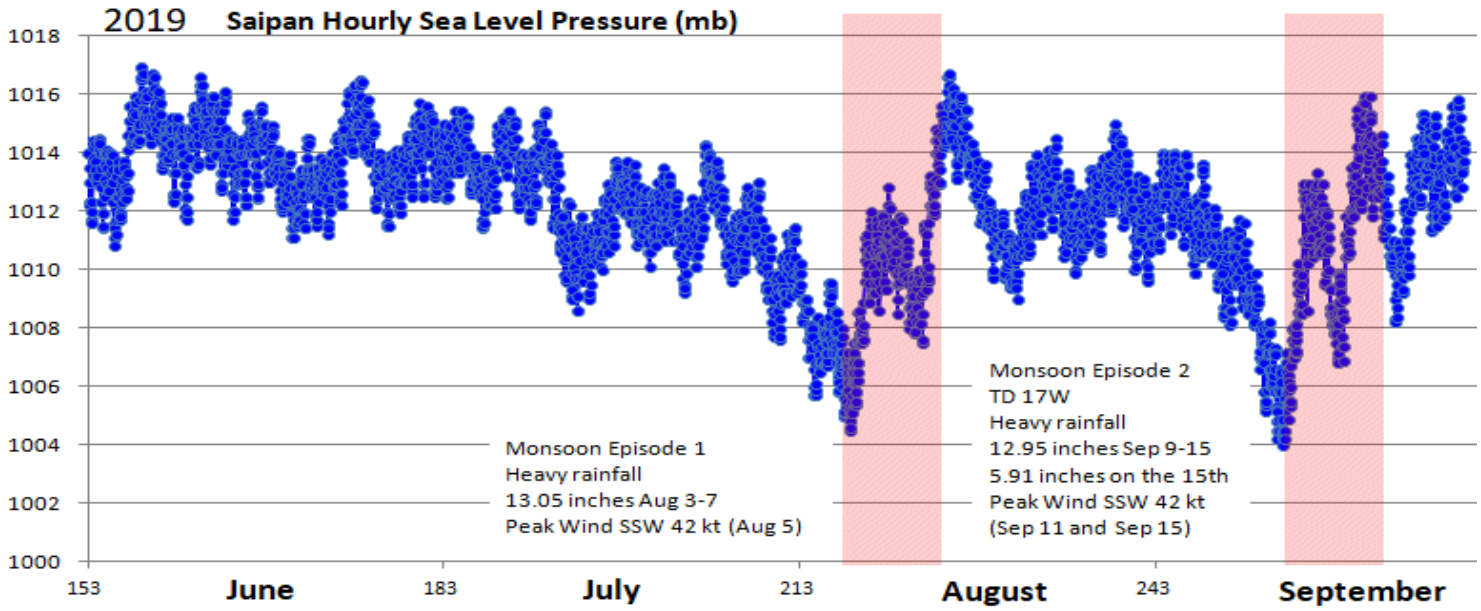


Figure 3
A time series of the hourly sea-level pressure readings at the Saipan International Airport during June through September 2019. Relatively steady higher pressure readings are seen in June through mid-July. In the latter half of July, the SLP dropped steadily reaching a low-point of near 1004 mb on the 3rd of August as the axis of the monsoon trough reached the station. Roughly a month later (in mid-September), the monsoon trough re-formed across Micronesia and once-again lifted northward, with the axis of the trough crossing Saipan on September 9. In general, heavy rainfall associated with the monsoon trough occurs primarily to the south of the axis of minimum pressure; hence the two recent periods of very heavy monsoonal rainfall on Saipan (red-shaded) bands occurred when the wind had shifted to the southwest on the south side of the trough axis. Ironically, the highest winds and seas and heavy rainfall occur while the SLP is rising!

In summary, the main weather story of the first half of 2019 was the persistent dryness at many of the islands of Micronesia, particularly at islands in the western half of the region (e.g., Palau, Yap, Guam and the CNMI), and at islands located in the northern portions of the region (e.g., Yap, Guam and the CNMI, the northern atolls of Chuuk State, and the northern atolls of the RMI). Drought was particularly severe in the CNMI and in the northern RMI. At some islands, however, rainfall was abundant — this includes: some of the atolls of central and southern Chuuk State; Pohnpei Island and most of the atolls of Pohnpei State; Kosrae; and some of the central and southern atolls of the RMI. Conditions at American Samoa were also wet through the first half of 2019, even though it was a quiet period for tropical cyclones there.

Recent Conditions for June, July, August (JJA)

Rainfall totals for the three-month period June, July and August was mostly near-average across Micronesia (Figures R-4 and R-5). Much wetter than average 3-month totals were observed at Kapingamarangi and at American Samoa. Some lingering dryness was observed at some of the atolls of the RMI. Dryness at some locations in western Micronesia (e.g., Palau, Yap and Guam) was the result of early dryness followed by a sharp increase of rainfall in August (see August summary next).

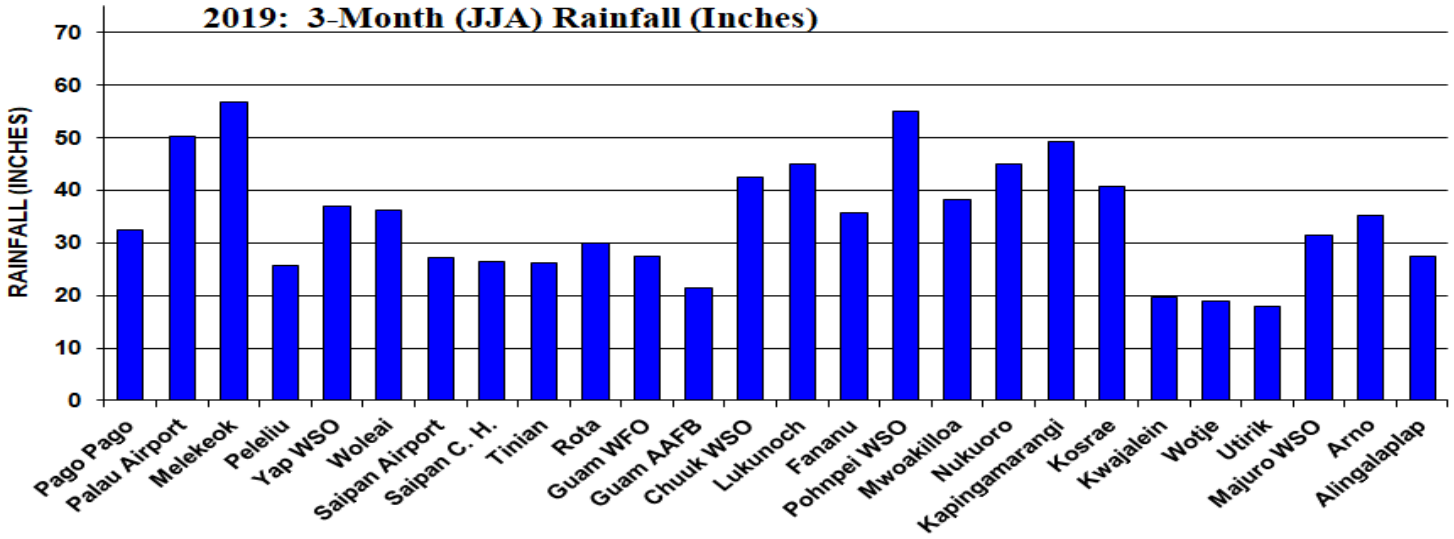
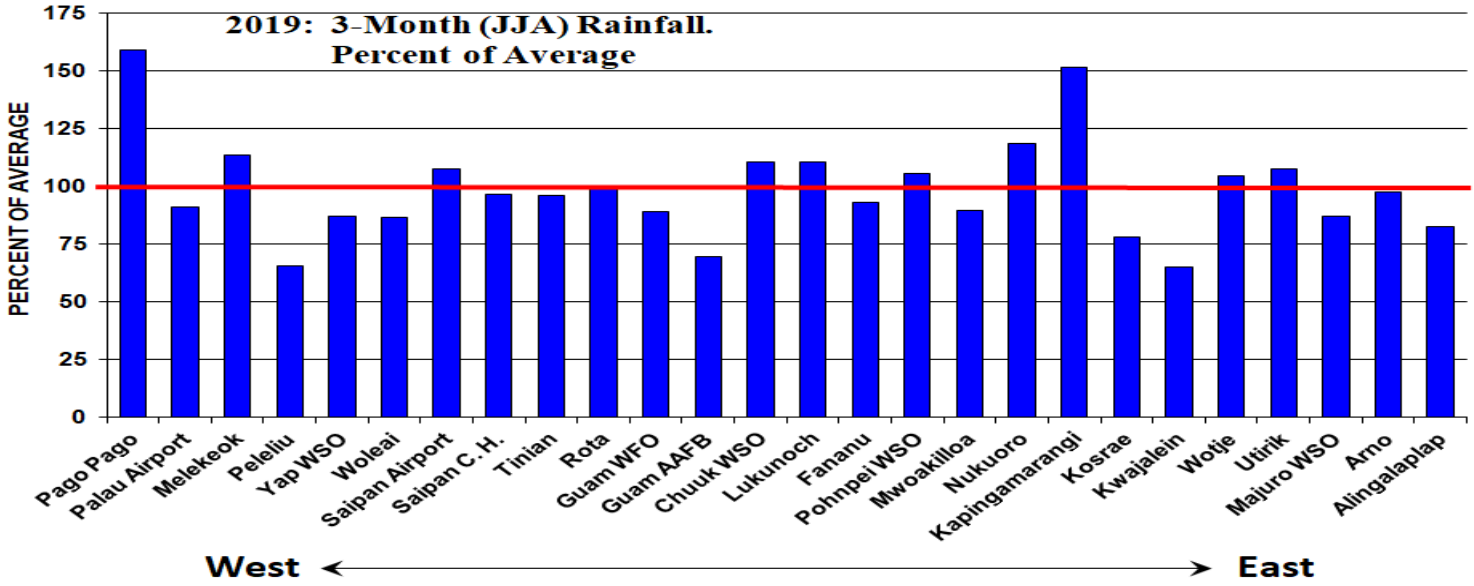


Figure (Above). 2019: 3-month (JJA) rainfall amounts in inches at the indicated locations.

Figure (Below) 2019: 3-month (JJA) rainfall as a percent-of-average at the indicated locations



Recent Conditions for August and September

Rainfall during August 2019 was mostly at-or-above average across all of Micronesia (see Figure R-6). Only a few August readings were below average (the red-highlighted amounts on Figure R-6), but even these were not especially dry. As of late September, nearly all locations across the region were drought free (Figure R-7).

4)

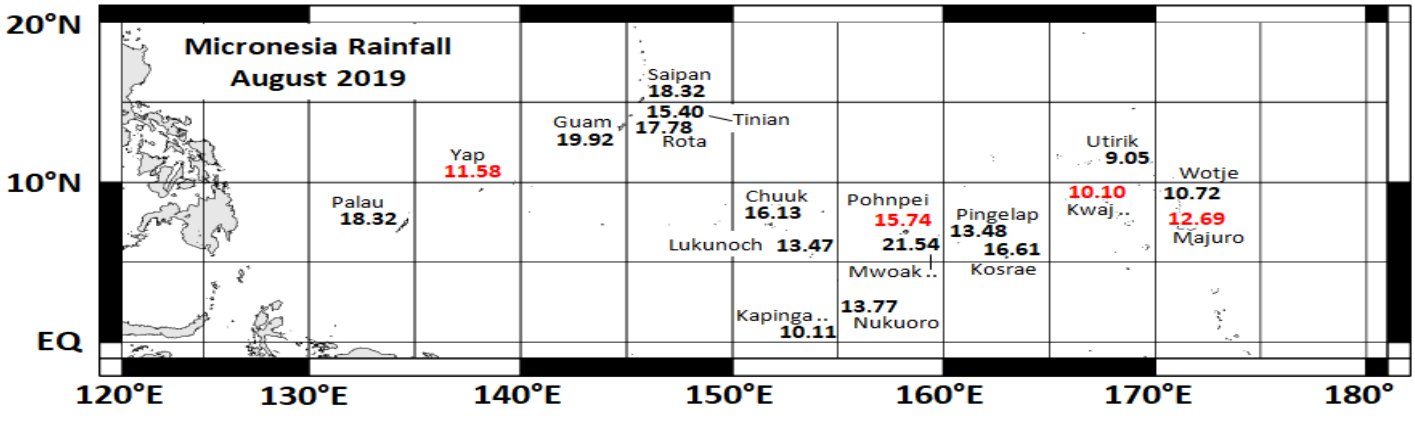
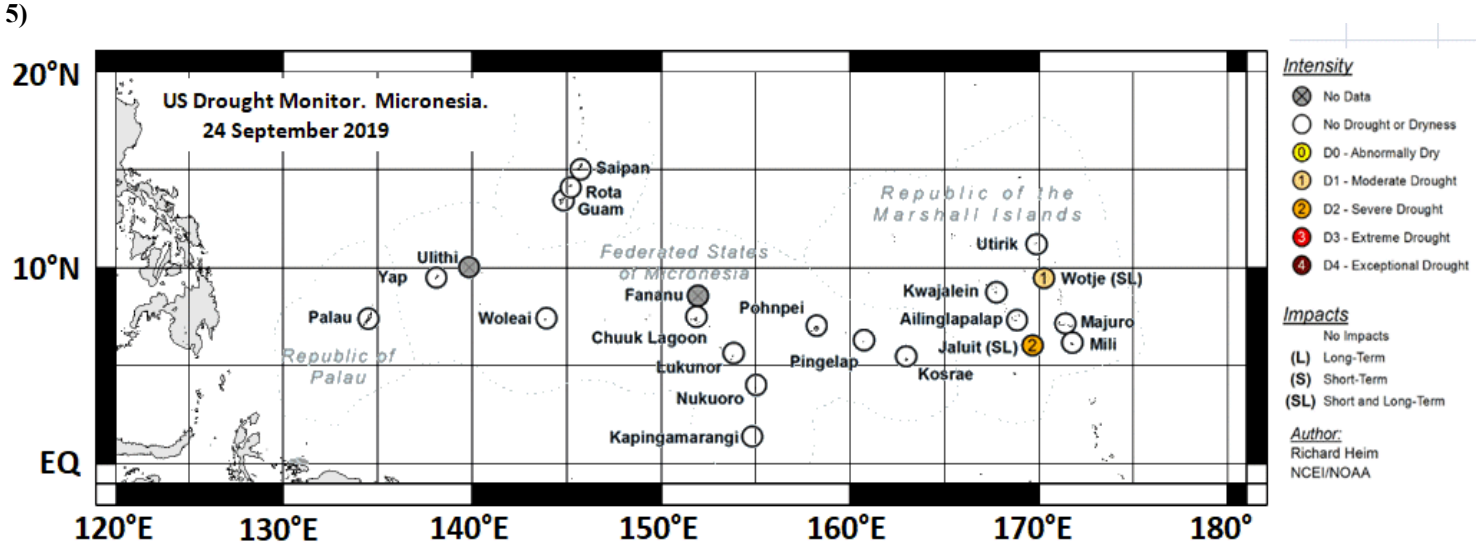


Figure 4. 2019: August rainfall amounts in inches at the indicated locations. Red highlighted values indicate dryness of < 80% of average rainfall

Figure 5. Latest US drought monitor figure for Micronesia (adapted from the chart provided by USDM author, Mr. Richard Heim. No drought or dryness was indicated for most locations. Some locations in the RMI have been recently dry and also over the long-term, hence the SL designation.

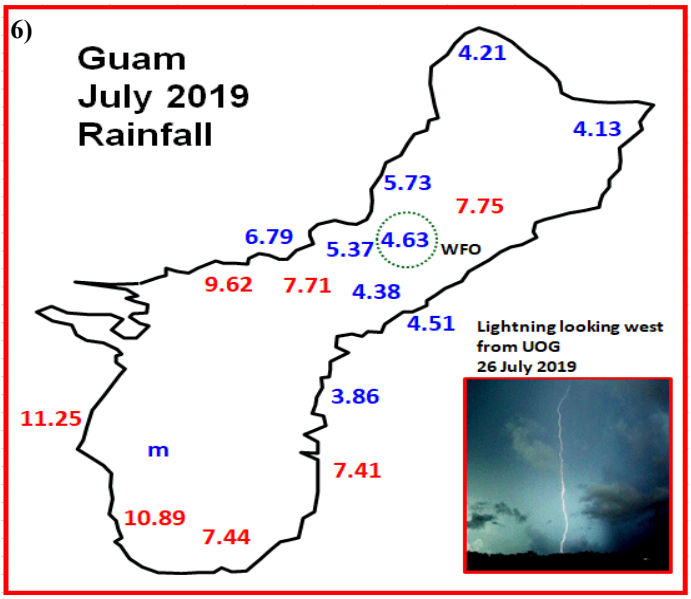
5)



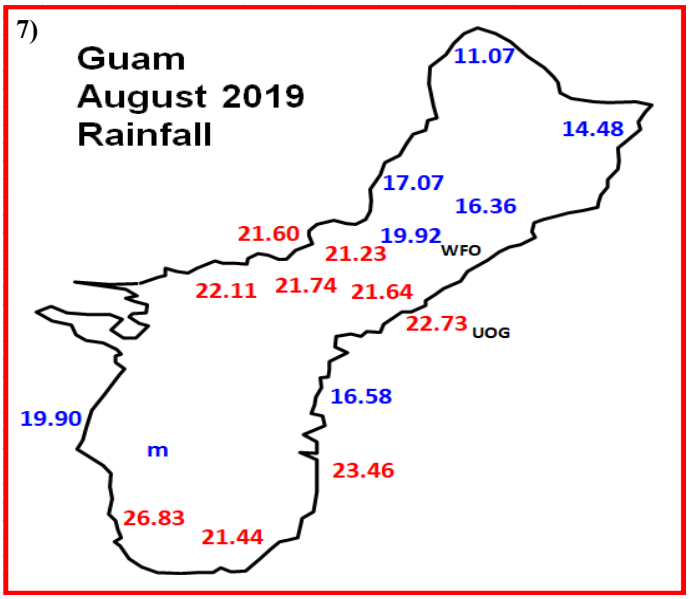
Recent Conditions
Heavy rainfall on Guam and in the CNMI during August and September 2019

Relatively dry weather was experienced on Guam and in the CNMI during the first half of 2019, with dry conditions extending into July (e.g., Figure R-8 left). With the season's first arrival of the monsoon in early August, very heavy rainfall occurred on Guam (Figure R-8 right) and on Saipan and other islands of the CNMI. August rainfall totals at WFO Guam and at the Saipan International Airport were near 20 inches. Rainfall at some locations on Guam exceeded 20 inches during August. The WFO Guam has experienced 20 inches or more rainfall in August 14 times over its 70-year climate record — for a one-in-five, or 20% rate of occurrence. By contrast, the SIA has had 20 inches or more of rainfall during August only 3 times in 31 years, for a one-in-10, or 10% rate of occurrence. As of the time of this writing (25 September), the September total rainfall at WFO Guam was 16.01 inches, and 20.39 inches at SIA —wet indeed! Rainfall totals in excess of 20 inches have occurred 8 times at the WFO in its climatic record. The SIA has no occurrences of rainfall in excess of 20 inches (at least in the SIA record from 1989-2018), so the 2019 September rainfall to-date of 20.39 inches is already a record high.

6)

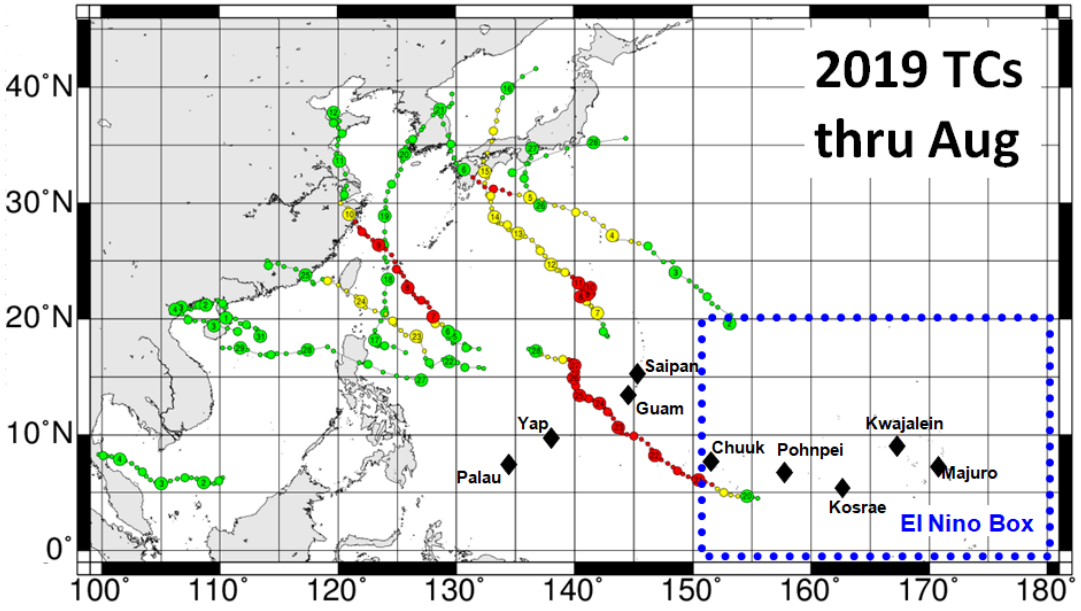


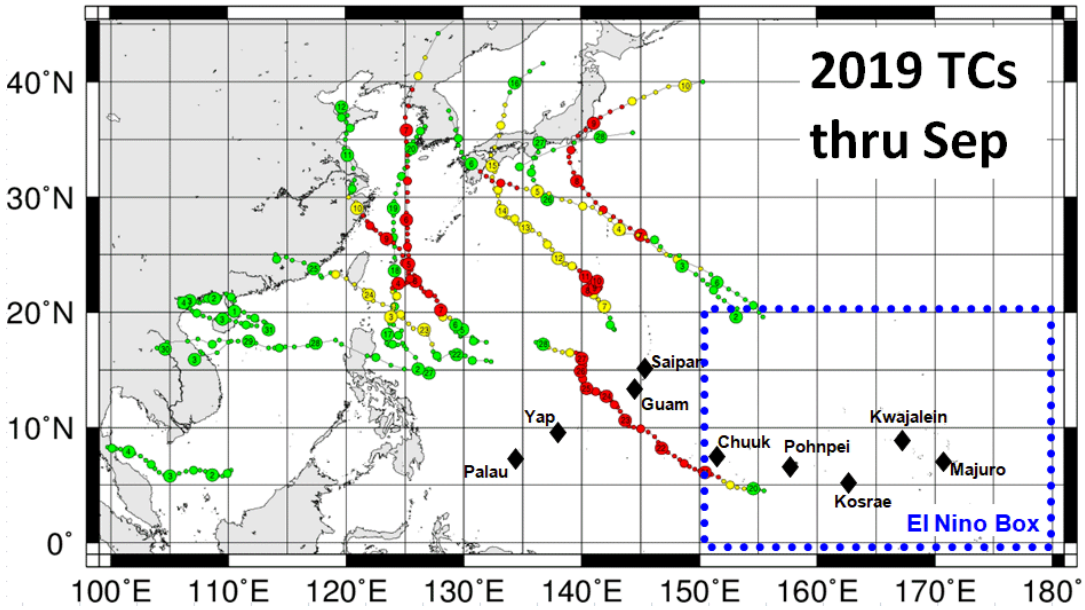
7)



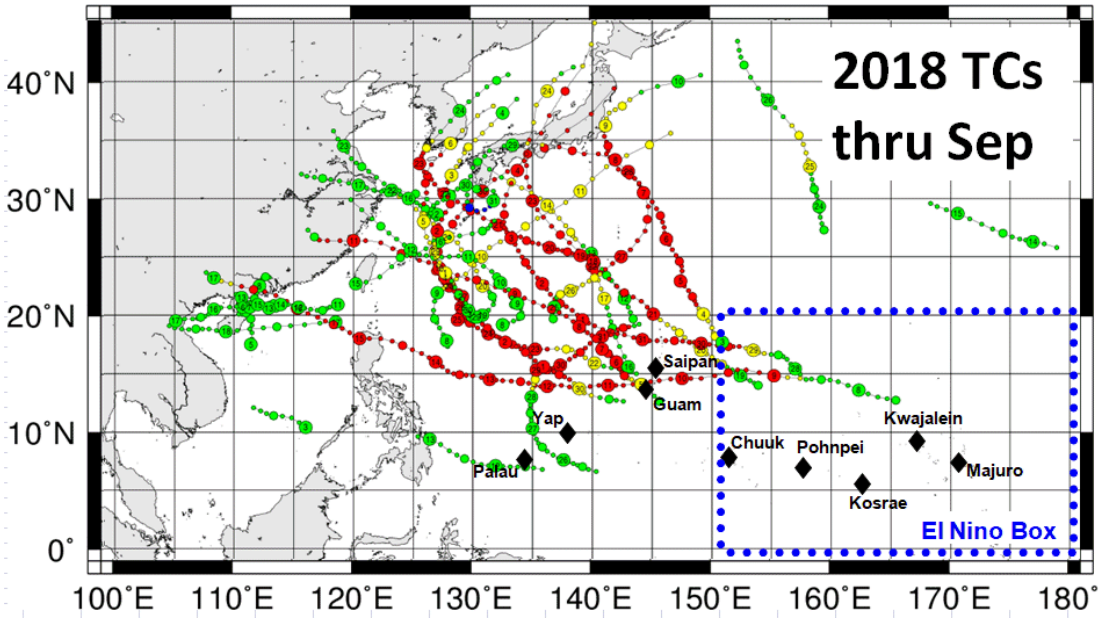
Figures (6)) July monthly rainfall across the island of Guam. Rainfall totals over 7 inches are highlighted red. The little inset is a picture of lightning taken by M. Lander on the 26th of July while hunkered down in a field just west of the University of Guam campus. **(Figure 7)** August monthly rainfall across the island of Guam. Rainfall totals in excess of 20 inches are highlighted red.

TROPICAL CYCLONES





Tropical Cyclones Cont.



SEA LEVEL

The behavior of the sea level across most of Micronesia during 2018 and through the first half of 2019 (see Figure 1) was typical for that seen during a canonical El Niño event (Figure 2) if one considers the onset, maturation and peak of the event to be within 2018, and the post-peak phase of the event set to 2019. As seen in Figure 2, the sea level was above average during the 1st Quarter of 2018, but underwent a substantial lowering during the course of 2018, with Guam and Palau (not shown) exhibiting the most pronounced fall, and islands father to the east (e.g., Kwajalein) not falling as much. In early 2019, the sea level began to rise throughout Micronesia, and by the summer months (JJA), the sea level was substantially above average.

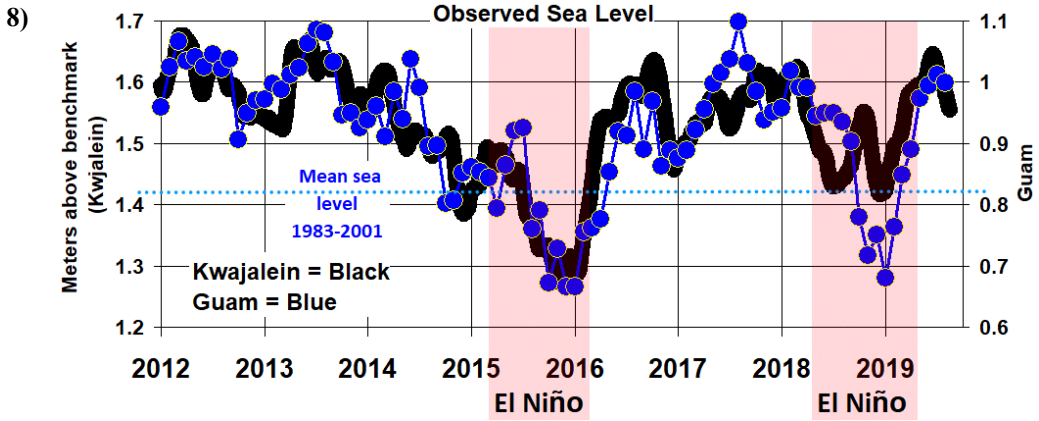


Figure 8. A time series of the sea level at Guam (blue dots) and at Kwajalein (black line). A substantial lowering of sea level typically accompanies El Niño, with a rapid rise of sea level occurring in the year following El Niño. Notice the similarity of the behavior of the sea level during 2018/19 with respect to the behavior of the sea level during the El Niño event of 2015/16 (red-shaded bars).

9)

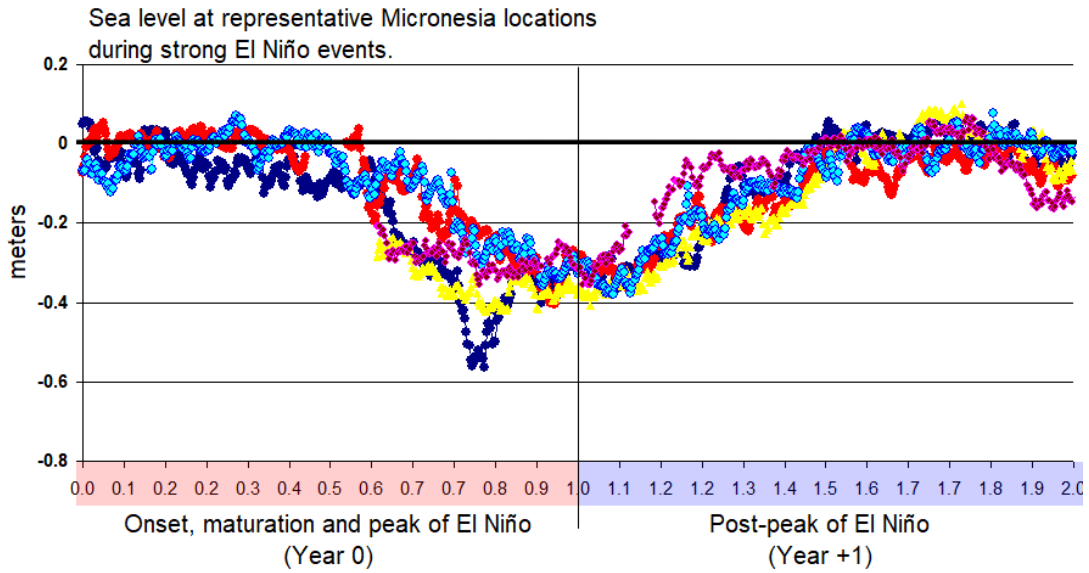


Figure 9. Daily sea level at selected Micronesian Locations (Guam, Yap or Palau) during the course of strong El Niño events, with respect to the sea level at the end of the event. Events included are 1972/73, 1982/83. 1997/98, 2009/10 and 2015/16. Note the typical timing of the minimum sea level at the end of Year (0). The outlying low values in the dark blue time series occurred on Guam during the 1972/73 event.

The highest rates of regional sea level rise over the past two decades have occurred in the western tropical Pacific (WTP) (Figure 3), with values that are nearly three times the global average [Nerem et al., 2010]. Merrifield [2011] used tide gauge data to show that the regional sea-level rise rate increased abruptly in the early 1990s, and that the trend shift matched an enhancement in trade wind speeds averaged across the tropical Pacific. Numerical model simulations [Merrifield and Maltrud, 2011; McGregor et al., 2012] confirm that the steady intensification of the trade winds largely accounts for the amplitude and spatial pattern of WTP sea-level rise since the early 1990s (depicted in Figures 3 and 4). Linear trends applied to WTP sea level time series such as in Figure 3 can give the impression that sea level rise is a particular concern for this region relative to other ocean regions. On the contrary, unique sea level changes in this region rise and fall with low frequency trade wind fluctuations.

10)

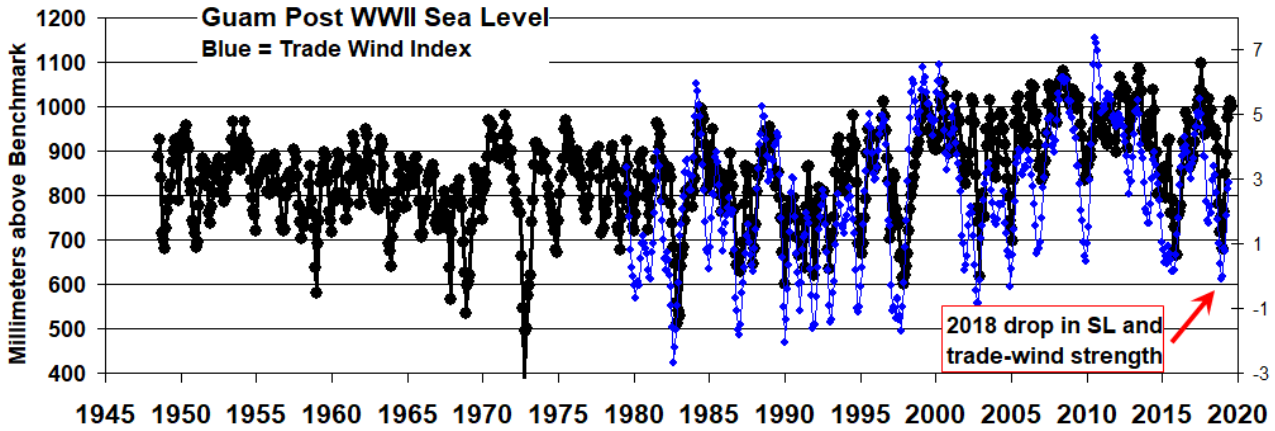


Figure 10. The sea level at Guam plotted with NOAA's Trade Wind Index (5N-5S ; 135E-180) (blue).

Sea Level Cont.

11)

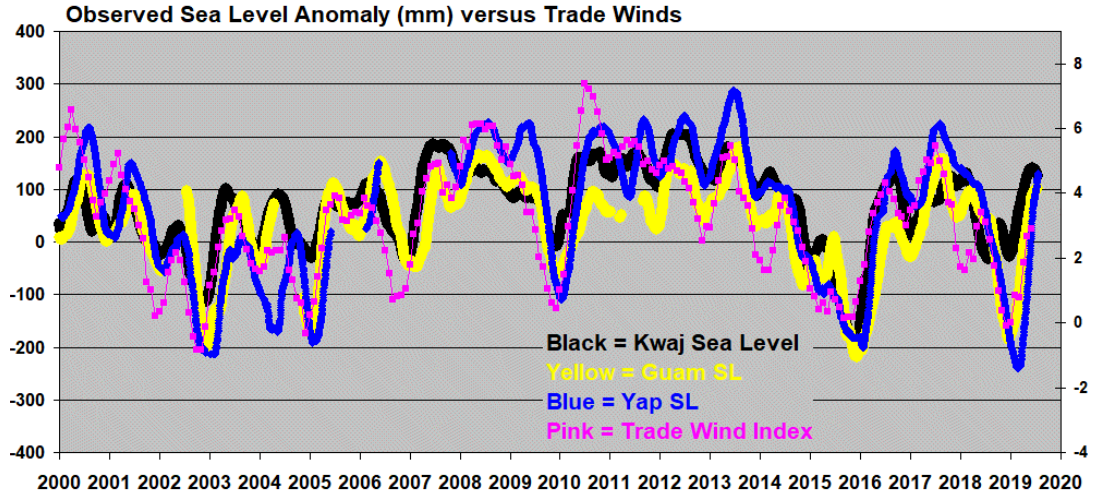


Figure 11. The simple index of the trade winds is clearly related to the sea level, and is likely a dominant cause of the variations, with about a 2-month lead of trade wind changes to sea level response. .

References

Nerem, R. S., D. P. Chambers, C. Choe, and G. T. Mitchum (2010), Estimating mean sea level change from the TOPEX and Jason altimeter missions, Mar. Geod., 33, 435– 446, doi:10.1080/01490419.2010.491031.

Merrifield, M. A. (2011), A shift in western tropical Pacific sea level trends during the 1990s, J. Clim., 24, 4126– 4138, doi:10.1175/2011JCLI3932.1.

Merrifield, M. A., and M. E. Maltrud (2011), Regional sea level trends due to a Pacific trade wind intensification, Geophys. Res. Lett., 38, L21605, doi:10.1029/2011GL049576.

McGregor, S., A. Sen Gupta, and M. H. England (2012), Constraining wind stress products with sea surface height observations and implications for Pacific Ocean sea-level trend, J. Clim., in press.

ACKNOWLEDGEMENTS AND FURTHER INFORMATION

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

Dr. Rashed Chowdhury,
Principal Research Scientist, at 808-956-2324 (rashed@hawaii.edu): for information on ENSO and sea level variability in the USAPI.

University of Hawai'i - Joint Institute of Marine and Atmospheric Research (JIMAR), School of Ocean and Earth Science and Technology (SOEST),
MSB #317, 1000 Pope Road , Honolulu, Hawai'i 96822
Dr. Jim Potemra, PEAC Principal Investigator at jimp@hawaii.edu for more information on climate in Hawai'i.

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

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

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

Pacific ENSO Update Editors:
Sony Vang and Rashed Chowdhury

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

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

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