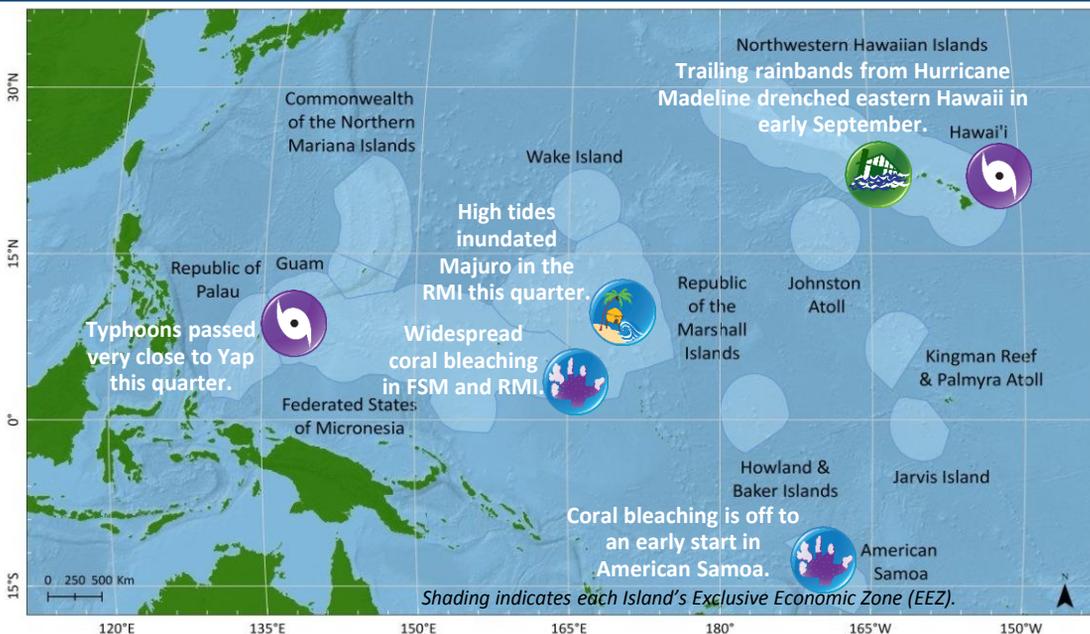


Climate Impacts and Outlook

Hawaii and U.S. Pacific Islands Region

4th Quarter 2016

Significant Events and Impacts for 3rd Quarter 2016



La Niña Advisory

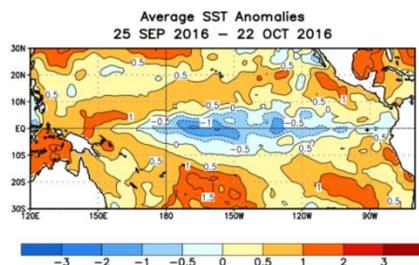
Above-normal rainfall was recorded in Guam and the Commonwealth of the Northern Mariana Islands.

Near-normal rainfall was also reported in Hawaii, the Federated States of Micronesia, the Republic of Palau, and the Marshall Islands. Below normal rains were reported in American Samoa.

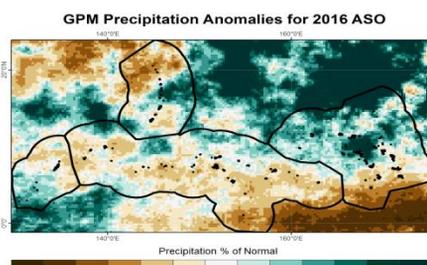
Sea levels have markedly increased across the western Pacific since March 2016.

As of November 1st, there has been a total of 27 tropical cyclones in the western North Pacific.

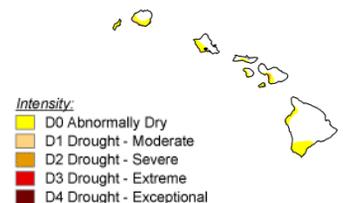
Regional Climate Overview for 3rd Quarter 2016



Sea-Surface Temperature Anomalies, valid Oct 25, 2016. Source: <http://www.cpc.ncep.noaa.gov/>



Aug-Oct 2016 precipitation anomaly. Source data [NASA GPM](http://www.nasa.gov/). Brown areas are dry; wet areas green.



Current Hawaii Drought Status as of October 27, 2016. Source: <http://www.drought.gov>

The region is under a La Niña Advisory. Current weather patterns are showing signs of a climate state of La Niña (e.g., above normal sea-surface temperatures and sea levels). The August-October Oceanic Niño Index (ONI) is -0.7 with the October monthly value at -0.8° C.

Sea-surface temperatures are above normal across the western Pacific, with a localized region of cold anomalies along the equatorial eastern Pacific. The warmest anomalies exceeding 0.5° C continue to be found across the RMI, FSM, and CNMI. In Pohnpei, water temperatures are as warm as 30.1° C at a depth of 40m! Meanwhile, cold anomalies near -1.0° C are evident near the Howland and Baker Islands. Sub-surface water temperature anomalies remain cool and are $2-4^{\circ}$ C below normal to a depth of 150m between 160° W and 130° W. This represents a slight expansion of the colder deeper waters in the eastern Equatorial Pacific compared to last quarter.

The monthly mean sea level in most of the stations recorded rises in the past quarter and all are above normal currently. Majuro reported an abrupt rise in September and is currently 10 inches above normal! Consistent with the climate state of La Niña, sea-levels at Palau, Yap, Kapingamarangi, and Kwajalein are all 6 inches above normal and Guam is 2 inches above normal.

In Hawaii, rainfall was above normal for the quarter at Honolulu (149%), Kahului (118%), and Hilo (184%), resulting in a slight reduction of drought conditions across the state. A strong thunderstorm dropped over 5 inches of rainfall in a 2-hour period on top of Puu Kukui on Maui. From Aug-Oct, Saipan and Guam were above normal with 144% and 114% of average rainfall respectively. In Kwajalein and Majuro in the RMI, rainfall was near to above normal with 100% and 120% of average rainfall. In the FSM, quarterly rainfall was quite variable: Chuuk (59%), Kosrae (90%), and Pohnpei (120%) of normal. Further west, drought conditions eased as rains returned to the islands of Yap (164%) and Palau (153%). In American Samoa, rainfall was below normal for the quarter (55%).

Tropical Cyclone (TC) activity in the western North Pacific basin was near normal. From Aug-Oct, there was no tropical cyclone activity in the SW Pacific, which is also normal. Meanwhile in the eastern Pacific, Hurricane Madeline brought heavy rains to Hawaii at the end of August, with over 5" of rain in parts of Kauai.

Sectoral Impacts for 3rd Quarter 2016

Facilities and Infrastructure – Heavy rains on Maui in mid-September led to rapid rises on area rivers, including the Wailuku River. The river flooding caused extensive damage to Iao Valley State Park and homes in the Iao Valley. The heavy rains also resulted in numerous landslides along the Honoapiilani and Hana Highways, temporarily snarling traffic.

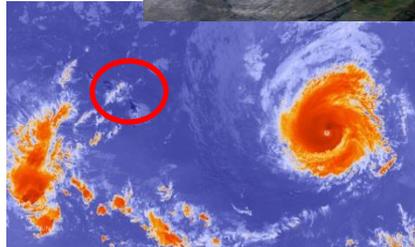
The northeastern atolls of Yap State (Ulithi and Fais) were affected by Typhoon Haima on the night of 15 October. Haima was a tropical storm as it passed over Fais and became a CAT 1 typhoon as it moved toward Ulithi Atoll.

Water Resources – The water storage reservoir on Majuro, RMI was near capacity as of 1 November. In Koror (and other local Palau communities), 24-hour municipal water service is now fully restored, however the recovery from the ecological damage may yet take several more months of abundant rainfall. In Chuuk, rain was reported on 26 of the 30 days in September!

Natural Resources – Reports that coral bleaching has returned to the FSM, RMI as sea-surface temperatures in the region climb above 31° C.

Unusually calm weather has been reported in American Samoa for the last several weeks, resulting in a Bleaching Watch across the territory. In the Nu'uuli backreef along Coconut Point in American Samoa, crown of thorns starfish continue to do damage and general poor fishing has also been reported.

Inundation on Majuro from recent high tides. Photo courtesy of Lee Jacklick, WSO Majuro.

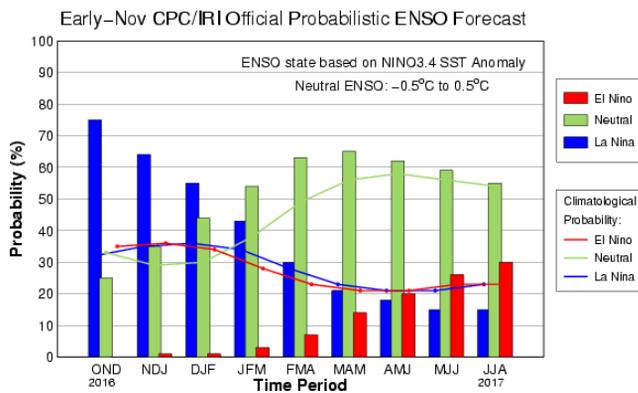


Hurricane Madeline approaching Hawaii. Photo courtesy of NOAA.

Bleached corals in Kwajalein, RMI. Photo courtesy of Scott Johnson, NOAA Coral Reef Watch collaborator.



Regional Outlook for 4th Quarter 2016 (Nov-Jan)



ENSO Probabilities, Valid October 2016. Source: <http://iri.columbia.edu/our-expertise/climate/forecasts/ens0/current/>

Following the latest ENSO prediction models, there is a 65% chance of La Niña conditions lasting through the northern hemisphere winter season.

The SST anomaly outlook for the 4th quarter indicates 1-2° C above-normal values in Hawaii, RMI, FSM, Guam, and CNMI. Near-normal SST anomalies are projected to continue around American Samoa. NOAA's Coral Reef Watch most recent four-month Bleaching Outlook projects thermal stress relief across much of the western Pacific. Current bleaching episodes in the USAPI are expected to diminish by the end of the year, if not sooner, except for American Samoa which will gradually worsen.

The forecast values for sea level in the 4th quarter indicate that all western Pacific stations are likely to be above normal (3-5 inches above) across all of Micronesia. American Samoa is expected to be slightly above normal, and in Hawaii, both Honolulu and Hilo are also likely to be slightly elevated.

Near-normal rainfall is projected for FSM and RMI and average to above normal rainfall is projected for American Samoa. In the FSM, Kapingamarangi will likely become very dry as La Niña progresses. In Guam and CNMI, near to slightly below normal rainfall is anticipated for the quarter, with near to slightly above normal rains across the Hawaiian Islands.

Tropical cyclone (TC) activity in the western north Pacific is expected to be below-average in the 4th quarter, as activity shifts west and north of Micronesia, though Palau and Yap will be near-normal. In the southwest Pacific, for the period Nov-Jan, TC activity for American Samoa is expected to be near normal, with a 30-year average of 1 storm for the early season.

Regional Partners

Pacific ENSO Applications Climate Center:
<http://www.prh.noaa.gov/peac/>

NOAA NWS Weather Forecast Office Honolulu:
<http://www.prh.noaa.gov/pr/hnl/>

NOAA NWS Weather Forecast Office Guam:
<http://www.prh.noaa.gov/pr/guam/>

NOAA National Centers for Environmental Information:
<http://www.ncei.noaa.gov/>

NOAA NMFS Pacific Island Fisheries Science Center:
<http://www.pifsc.noaa.gov/>

NOAA OceanWatch - Central Pacific:
<http://oceanwatch.pifsc.noaa.gov/>

NOAA Coral Reef Watch:
<http://coralreefwatch.noaa.gov/>

USGS Pacific Islands Water Science Center:
<http://hi.water.usgs.gov/>

USGS Science Center – Pacific Coastal and Marine Science Center:
<http://walrus.wr.usgs.gov/>

University of Hawaii - Joint Institute of Marine and Atmospheric Research:
<http://www.soest.hawaii.edu/jimar/>

University of Guam - Water and Environmental Research Institute:
<http://www.weriguam.org/>