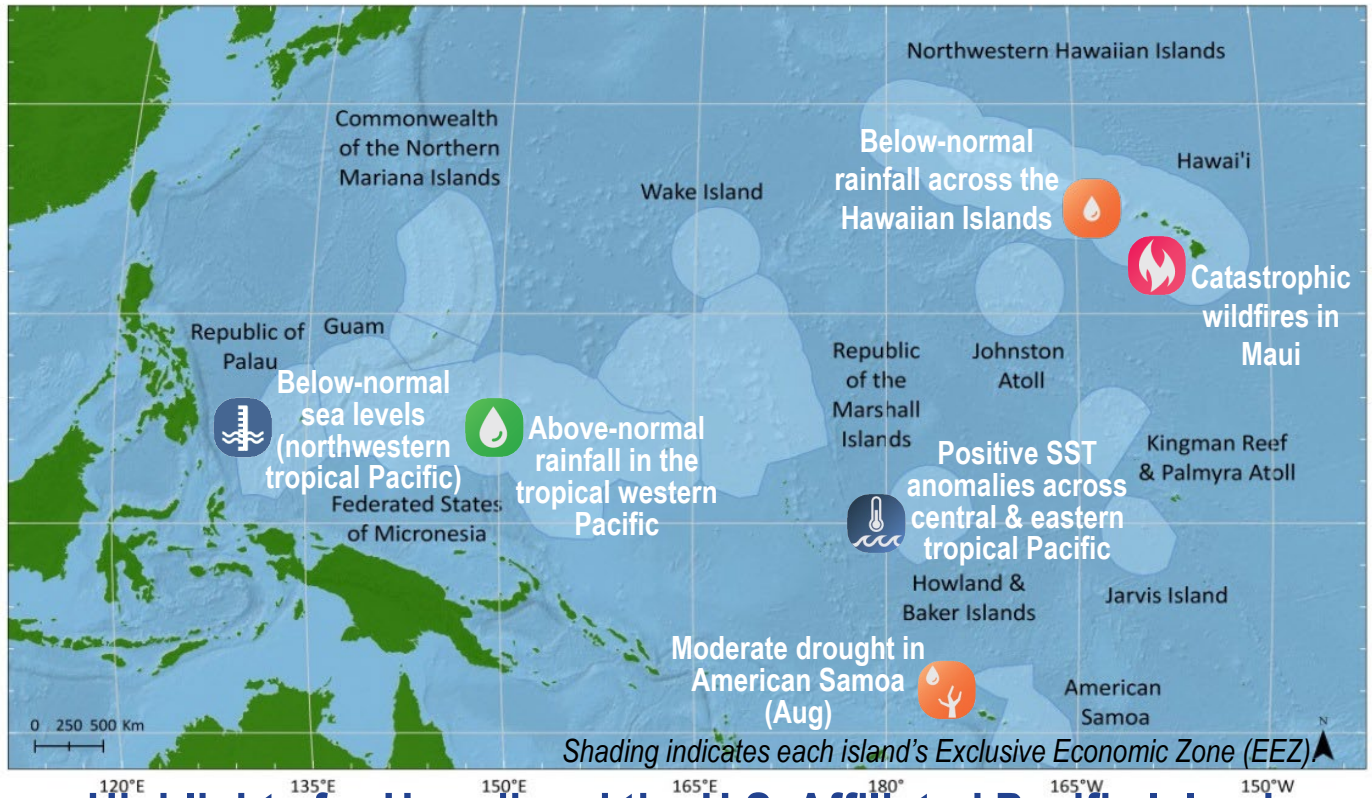




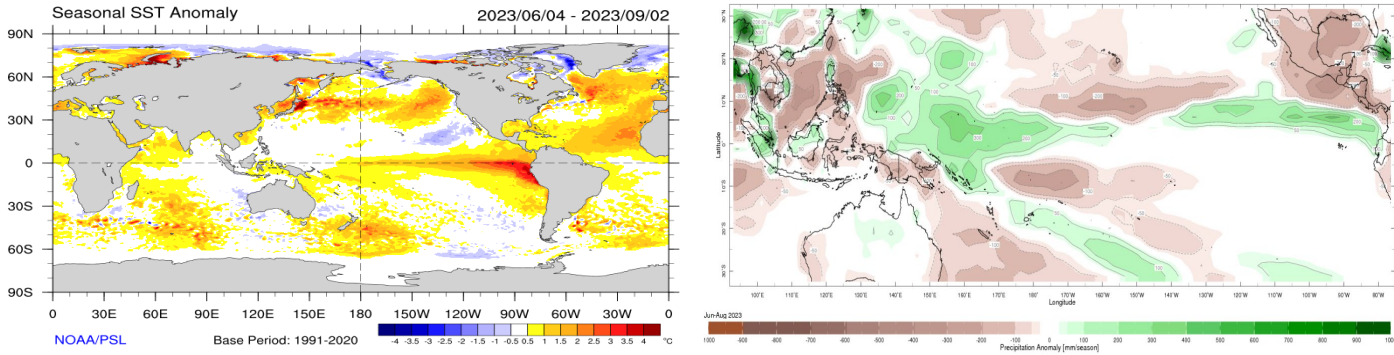
Significant Events – For June 2023–August 2023



Highlights for Hawaii and the U.S. Affiliated Pacific Islands

- El Niño Advisory was in effect (Sept 14) with above-normal sea surface temperatures (SSTs) observed across the equatorial Pacific Ocean and strengthening in the central and east-central Pacific Ocean. El Niño is expected to continue through the Northern Hemisphere winter with greater than a 95% chance to persist through the January-March 2024 period, according to the NOAA Climate Prediction Center (CPC).
- For the June-August (JJA) period, precipitation was above normal across much of the U.S. Affiliated Pacific Islands (USAPI) including Palau, Guam, Commonwealth of the Northern Mariana Islands (CNMI), and in the Federated States of Micronesia (FSM). Conversely, drier-than-normal conditions were observed across areas of the Republic of the Marshall Islands (RMI), American Samoa, and the Hawaiian Islands.
- For the JJA period, most of the USAPI region was drought-free, except for moderate drought observed in American Samoa during August 2023. In the Hawaiian Islands, drought intensified during JJA with moderate-to-severe drought observed in Molokai, Maui, and the Big Island in August 2023.
- On August 8th, a series of fast-spreading wildfires (fueled by dry vegetation, drought conditions, and powerful downslope winds) broke out in Maui devastating the West Maui town of Lahaina as well as other areas including the town of Kula in Upcountry Maui. The wildfires were one of the deadliest in U.S. history and the worst natural disaster in Hawaii's history.

Climate Overview – For June 2023–August 2023



Seasonal sea surface temperature anomaly map for 6/4/23 to 9/2/23 (left) and 3-month seasonal precipitation anomalies for the June–August 2023 period (right). Areas with above-normal precipitation are depicted in green while areas with below-normal amounts are depicted in brown. Source: NOAA PSL, IRI, NOAA CPC CAMS-OPI.

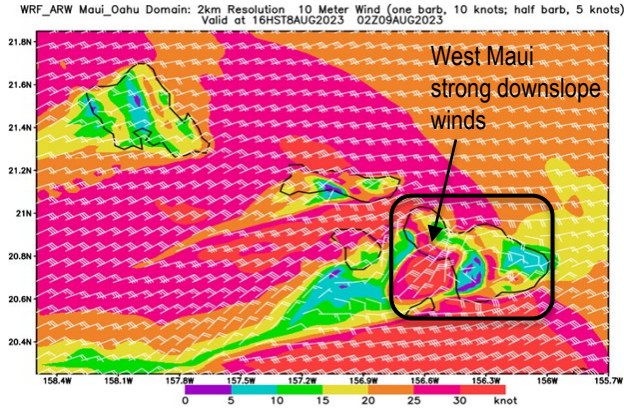
By the end of the JJA period, SSTs were above-normal across the central and eastern tropical Pacific Ocean with an El Niño Advisory in effect (9/14/23). According to the latest NOAA CPC update (9/14/23), Niño region SST departures were above normal across the equatorial Pacific Ocean with Niño 3.4 at 1.6°C, Niño 3 at 2.2°C, Niño 1+2 at 2.9°C, and Niño 4 at 1.1°C.

During the JJA period, below-normal sea levels were observed across areas of the northwestern tropical Pacific Ocean with the highest sea level anomalies in USAPI occurring around Palau and western FSM (5-10 cm below normal) as well as in areas of the northeastern Pacific Ocean away from the coast. Elsewhere in the Pacific, above-normal sea levels were observed across the central and eastern equatorial Pacific (5-15 cm above normal) by August. Overall, the basin-wide sea level pattern was consistent with El Niño conditions and the exceptionally negative Pacific Meridional Mode, according to the University of Hawaii Sea Level Center.

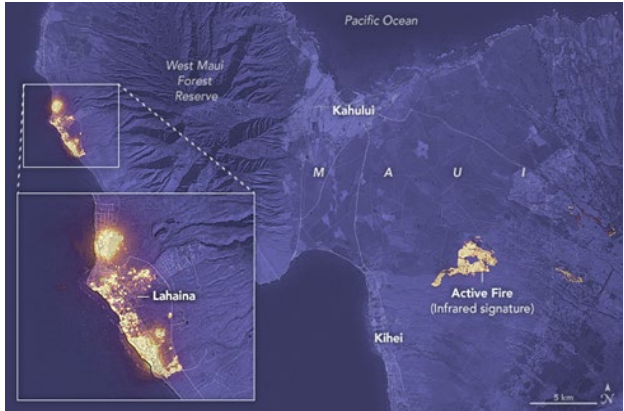
During the JJA period, most of the USAPI was drought-free, with exception of short-term drought development observed in American Samoa in August. Median precipitation for the JJA period was above normal across much of the USAPI with exception of areas of RMI and American Samoa. For JJA, Airai (Palau) recorded 57.11 in. (109% of normal). In FSM, Yap observed 61.37 in. (139% of normal, 3rd wettest), Kapingamarangi 52.77 in. (138% of normal, wettest on record), Pohnpei 71.91 in. (155% of normal, wettest on record), Lukunor 35.77 in. (87% of normal), Kosrae 58.69 in. (128% of normal), and Chuuk 44.52 in. (115% of normal). In the Mariana Islands, Saipan observed 26.09 in. (106% of normal) and Guam 37.16 in. (109% of normal). In the RMI, Majuro observed 30.5 in. (89% of normal) for JJA, while Kwajalein logged 22.24 in. (82% of normal). In American Samoa, precipitation was below normal (13.71 in., 78% of normal, 6th driest August on record) at Pago Pago. Across much of the Hawaiian Islands, below-normal rainfall conditions prevailed during the JJA period, with moderate to severe drought conditions observed across areas of the island chain, according to the U.S. Drought Monitor. For the JJA period, Lihue observed 3.22 in. (55% of normal), Honolulu 0.7 in. (38% of normal), Molokai 0.8 in. (39% of normal), Kahului 0.67 in. (54% of normal), Kailua Kona 0.84 in. (47% of normal), and Hilo 14.7 in. (53% of normal).

In the Northwest Pacific region (west of 135°E), tropical cyclone (TC) activity has been above normal for the 2023 season, with 12 named storms with an Accumulated Cyclone Energy (ACE) Index of 211 (normal 143) by 9/5/23. In the Northeast Pacific region (east of 180°W), the ACE Index has been above normal (105.6 by 9/5/23—normal for the date 86.9) with 10 named storms since late June including the powerful, long-lasting Hurricane Dora (~8/1-8/12 as a hurricane/typhoon) which developed in the Eastern Pacific during early August of the coast of El Salvador. Dora tracked westward across the Pacific Ocean intensifying to a Category 4 hurricane with sustained winds of 145 mph on 8/5/23. The hurricane eventually crossed the International Date Line (8/11) and was reclassified as Typhoon Dora.

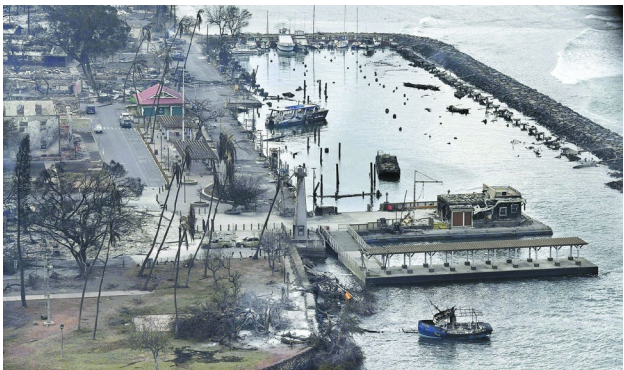
Sectoral Impacts – For June 2023–August 2023



Weather Research & Forecasting Model (WRF) – model simulation (2-km resolution) of 10-meter wind speed (knots) and wind direction across Maui on 8/8/23 4:00 p.m. HST. The simulation shows strong downslope winds (35 knots = 40 mph) out of the northeast impacting West Maui. Source: Department of Atmospheric Sciences, UH, Manoa.



Landsat 8 satellite image of active fires (in yellow) on Maui, including Lahaina, at 10:25 p.m. on 8/8/23. The image is composed of shortwave infrared light observed by the Operational Land Imager on Landsat 8. Source: NASA Earth Observatory.



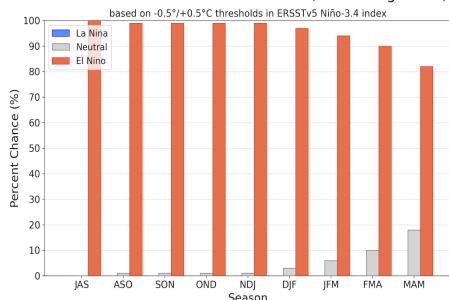
Post-fire aerial photograph of destruction at the Lahaina Harbor. Image credit: The Maui News.

Wildfires – On the evening of 8/8/23, an outbreak of wildfires impacted parts of Maui with catastrophic effects occurring in the historic town of Lahaina, West Maui. The wildfires quickly spread across Lahaina decimating the town with ~97 people perishing and over 2,200 structures either damaged or destroyed. It is estimated that nearly 86% of Lahaina was destroyed in the fires leaving several thousand residents displaced and in need of shelter. In addition, areas of the upper Kula region of Maui were also affected by the wildfires with 19 homes destroyed, according to the County of Maui. In terms of the antecedent climate conditions in Maui during the summer months (prior to the fires), below-normal rainfall was observed in West Maui and in Upcountry Maui causing the U.S. Drought Monitor to introduce areas of moderate to severe drought on the weekly map starting in mid-July with drought conditions intensifying during early August. Looking at observational station data for Lahaina and Kula preceding the wildfire outbreak, the Lahainaluna observing station (NWS COOP #51578) recorded 0.40 in. (25% of normal) of rainfall during Jun-Aug 2023 period, while the Kula Experiment Station site observed 0.37 in. (25% of normal), according to the NOAA Regional Climate Center’s SC-ACIS system and the National Weather Service (NWS) Forecast Office in Honolulu. In terms of the vegetation conditions, Normalized Difference Vegetation Index (NDVI) data (metric used to quantifying vegetation greenness, density, and plant health) from the NASA/USGS Landsat satellite for early August 2023 revealed areas of abnormally dry vegetation (as compared to long-term averages for the period) around West Maui and Upcountry Maui. Lastly, observed maximum wind gusts on the day of the wildfire outbreak (8/8/23) reached 62 mph at Maalaea Bay, according to the NWS. In response to the devastating fires, President Biden officially declared a major disaster on 8/10/23 ordering Federal aid to supplement state and local recovery efforts in the areas affected by the wildfires.

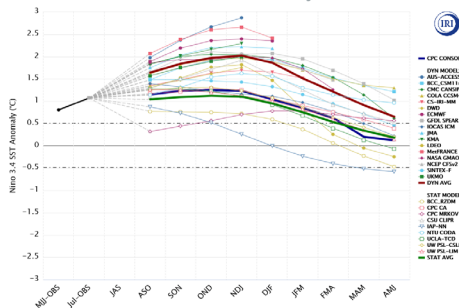
Water Resources – In Majuro (RMI), reservoir storage reached 88% of total capacity (36,000,000 gallons) on 8/31/23. In Maui, Oahu, and Kauai, observed monthly average streamflows (August) on numerous rivers and streams were well-below normal (ranging from the 2nd-20th percentile), according to the U.S. Geological Survey.

Facilities and Infrastructure – In American Samoa, heavy rainfall (7/12-18) caused a landslide in the village of Amanave on the west side of the island of Tutuila on 7/18/23.

Official NOAA CPC ENSO Probabilities (issued Aug. 2023)



Model Predictions of ENSO from Aug 2023

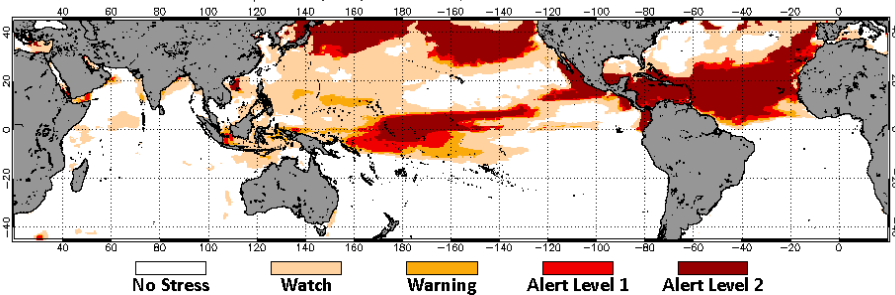


Forecast for each of the three possible ENSO categories for the next 8 overlapping 3-month seasons. Blue bars show the chances of La Niña, gray bars the chances for neutral, and red bars the chances for El Niño (left) and ENSO forecast model predictions (right).
Source: NOAA CPC, Columbia University IRI.

According to the latest ENSO prediction model simulations (above right), there is relatively strong agreement amongst the dynamical models in the IRI ENSO prediction plume of gradual strengthening of positive SST anomalies during the Sept-Nov 2023 period and continuation into the Northern Hemisphere winter (>95% chance through January-March 2024) in association with the on-going El Niño event. Moreover, the probability of a “strong” El Niño to develop (Nov 2023-Jan 2024) has increased to 71%, according to NOAA CPC.

NOAA’s Coral Reef Watch four-month coral bleaching heat stress outlook (Sept 2023-Dec 2023) calls for a high probability (90%) of high heat stress (Alert Level 1-2) developing in areas of the tropical Pacific Ocean extending from ~125° W to ~160° E. Moreover, a heat stress Watch is forecast for areas of RMI, eastern FSM, Guam, CNMI and portions of the Hawaiian Islands.

2023 Sep 12 NOAA Coral Reef Watch 90% Probability Coral Bleaching Heat Stress for Sep–Dec 2023
Experimental, v5.0, CFSv2-based, 28 to 112 Ensemble Members



NOAA Coral Reef Watch four-month coral bleaching heat stress outlook for Sept-Dec 2023. Red and maroon colors represent areas with a high probability of coral bleaching heat stress Alert Levels 1 & 2.
Source: NOAA NESDIS.

During the period of September 2023 through November 2023, above-normal precipitation is forecasted for areas of USAPI, including most of FSM (Chuuk, Kosrae, Pohnpei) and RMI (Kwajalein, Majuro). Average to above-average rainfall is forecasted for the Yap, Guam, CNMI (Saipan) and average rainfall for Palau. Conversely, average-to-below normal precipitation is expected for American Samoa, while below-normal precipitation is expected in the Hawaiian Islands, according to the NOAA Pacific ENSO Applications Climate Center.

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

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

NOAA NMFS Pacific Island Fisheries Science Center:
<https://www.fisheries.noaa.gov/region/pacific-islands#science>

NOAA NWS Weather Forecast Office Honolulu & Guam:
<https://www.weather.gov/hfo/>
<https://www.weather.gov/gum/>

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

NPS Pacific Island Inventory & Monitoring Network:
<https://www.nps.gov/im/pacn/index.htm>

University of Guam - Water and Environmental Research Institute:
<https://weri.uog.edu/>

University of Hawaii - Asia Pacific Data Research Center (APDRC):
<http://apdrc.soest.hawaii.edu/index.php>

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

University of Hawaii - Sea Level Center:
<https://uhslc.soest.hawaii.edu/>

USGS Science Center - Pacific Coastal and Marine Science Center:
<https://www.usgs.gov/centers/pcmssc>

USGS Pacific Islands Water Science Center:
<https://www.usgs.gov/centers/piwsc>

Western Regional Climate Center:
<https://wrcc.dri.edu/>