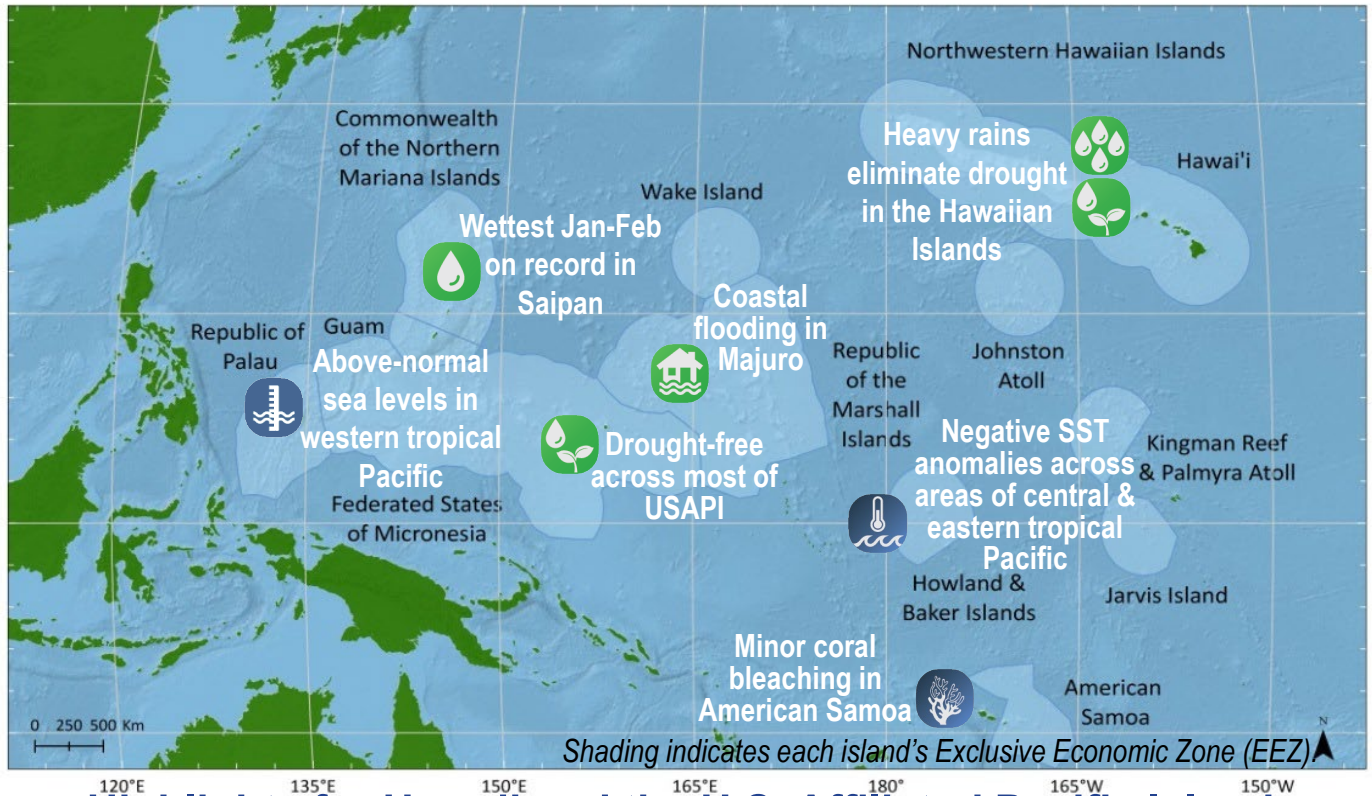




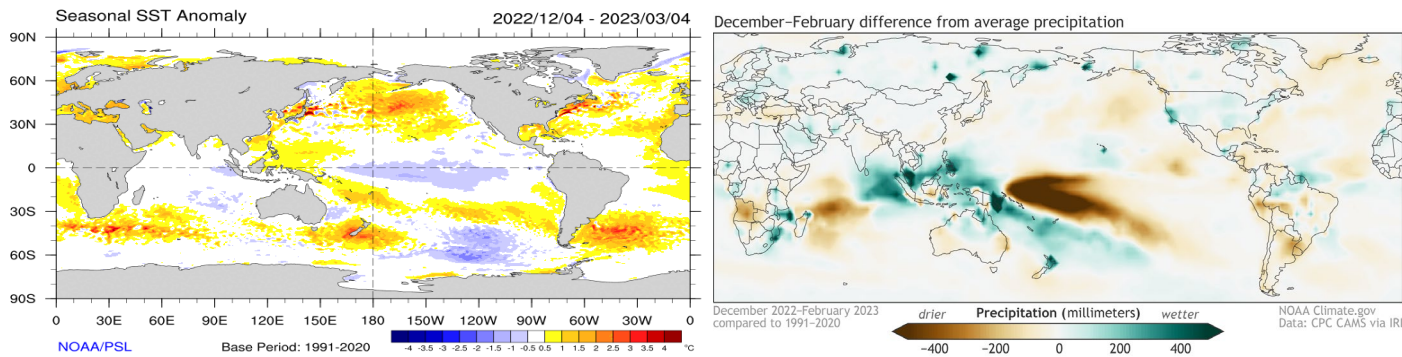
Significant Events – For December 2022–February 2023



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

- NOAA Climate Prediction Center (CPC) issued its final La Niña Advisory (Mar 9) with La Niña ending and ENSO-neutral conditions present in the central tropical Pacific in Niño 3.4 by early March. In the tropical eastern Pacific, sea surface temperatures (SSTs) were above-normal in both Niño 3 and Niño 1+2 regions (Mar 9). According to the latest ENSO prediction model simulations, there is agreement that ENSO-neutral conditions are expected during Mar-May 2023 with a low likelihood (3%) of El Niño development. For summer 2023, the current IRI plume favors El Niño conditions developing, while the NOAA CPC forecaster consensus favors ENSO-neutral conditions persisting through summer 2023.
- For the Dec 2022-Feb 2023 (DJF) period, precipitation was near-normal to above-normal across most of the U.S. Affiliated Pacific Islands (USAPI) and the Hawaiian Islands.
- For the DJF period, most of the USAPI region was drought-free, with exception of Severe (D2) drought in Kapingamarangi (Dec-Jan) and drought development in the Republic of the Marshall Islands (RMI) in Kwajalein and Wotje (late Feb). In the Hawaiian Islands, wet conditions during DJF led to the elimination of drought, according to the U.S. Drought Monitor (USDM).
- February satellite analysis showed above-normal sea levels across the western tropical Pacific, while near-normal to below-normal sea levels were observed across the central and eastern tropical Pacific.

# Climate Overview – For December 2022–February 2023



Seasonal sea surface temperature anomaly map for 12/4/22 to 3/4/23 (left) and seasonal precipitation patterns during Dec 2022–Feb 2023 depicted as departures from the long-term (1991–2020) average (right) where brown colors represent below-normal precipitation and green represents above-normal precipitation. Sources: NOAA PSL, NOAA ENSO Blog, NOAA CPC CAMS via IRI.

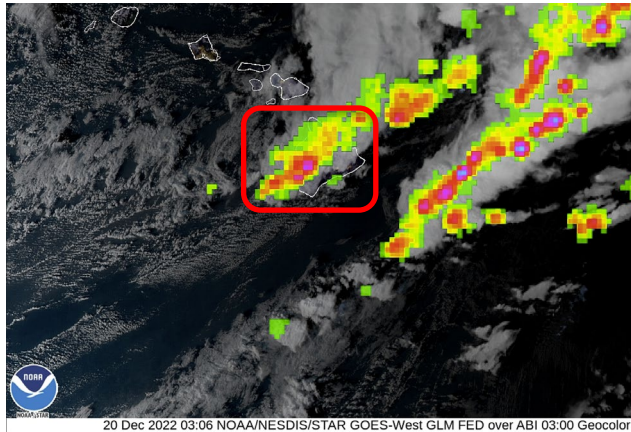
Across much of the equatorial Pacific Ocean (east of 160°E), sea surface temperatures (SSTs) ranged from slightly below-normal to above-normal with ENSO-neutral conditions present in early March. Two of four Niño regions registered negative SST anomalies on the NOAA CPC update (3/6/23) at the end of the DJF period: Niño 3.4 region at -0.2°C; Niño 3 at 0.1°C; Niño 1+2 at 1.1°C; and Niño 4 at -0.2°C.

During the DJF period, above-normal sea levels were observed across most of the western tropical Pacific, while near-normal to slightly below-normal levels were observed during Dec 2022–Jan 2023 in the central and eastern tropical Pacific before transitioning to near-normal to slightly above-normal levels during late February. By early March, the basin-wide sea level pattern was consistent with the end of the La Niña event, according to the UH Sea Level Center.

During the DJF period, most of the USAPI were drought-free, with exception of Severe drought (D2) in southern FSM in Kapingamarangi (Dec–Jan) and drought development (D1) in Kwajalein and Wotje (RMI) during February in response to precipitation shortfalls (last 30-day period). Median precipitation for the DJF period was above normal across much of the USAPI. For DJF, Airai (Palau) recorded 39.54 in. (116% of normal). In FSM, Yap observed 25.25 in. (116% of normal), Kapingamarangi 24.92 in. (75% of normal, 7<sup>th</sup> driest), Pohnpei 43.79 in. (109% of normal), Lukunor 22.59 in. (70% of normal, 7<sup>th</sup> driest), Kosrae 62.07 in. (116% of normal), and Chuuk 37.94 in. (127% of normal, 3<sup>rd</sup> wettest Feb). In the Mariana Islands, Saipan observed 19.22 in. (190% of normal, wettest Jan–Feb on record) and Guam 29.03 in. (194% of normal, 2<sup>nd</sup> wettest). In the RMI, Majuro observed 31.95 in. (113% of normal) for DJF, while Kwajalein logged 14.28 in. (92% of normal). In American Samoa, precipitation was slightly below normal (37.48 in., 93% of normal) at Pago Pago. Across much of the Hawaiian Islands, above-normal rainfall was observed for the DJF period, with drought-free conditions across the island chain by February, according to the USDM. For the DJF period, Lihue observed 18.65 in. (169% of normal), Honolulu 5.83 in. (98% of normal), Molokai 15.69 in. (179% of normal), Kahului 9.72 in. (135% of normal), Kailua Kona 5.0 in. (140% of normal), and Hilo 36.36 in. (121% of normal).

In the South Pacific region (east of 135°E), tropical cyclone (TC) activity has been below normal for the 2022–23 season, with 5 named storms with an Accumulated Cyclone Energy (ACE) Index of 16.8 (normal 45.9) by 3/1/23, including Tropical Cyclone Gabrielle (2/8–2/12) which impacted New Zealand as a powerful tropical storm leading to a national emergency declaration in response to widespread flooding, landslides, and damage to infrastructure and roads. In the Southern Hemisphere (South Pacific & South Indian basins), above-normal tropical cyclone activity has been observed with 13 named storms and an ACE Index of 159.4 (normal is 130.3). Notably, Tropical Cyclone Freddy (2/6/23–3/12/23), which formed near Indonesia, tracked over 5,000 miles across the Indian Ocean making landfall twice in both Madagascar and Mozambique during its 35-day path. TC Freddy appears to have broken the record for the longest-lasting TC as well as the record for the highest ACE Index of any storm in history in the Southern Hemisphere, according to preliminary reports from the World Meteorological Organization and NASA.

# Sectoral Impacts – For December 2022–February 2023



GOES-West Geostationary Lightning Mapper satellite image portraying flash density during a Kona Low storm event impacting the Big Island (red box) on 12/20/22. Warm colors represent a higher-density of lightning flashes. Image credit: NOAA-NASA.

**Facilities and Infrastructure** – A strong Kona Low (12/18-20) impacted the Hawaiian Islands bringing severe thunderstorms, heavy rainfall, hail, high-elevation snowfall, flash flooding, and damaging winds. The hardest hit areas included portions of Maui and Hawaii Island where strong winds downed trees and power lines leading to outages affecting 12,000 residents on Maui and more than 40,000 people on Hawaii Island. Moreover, strong winds damaged homes and businesses, and impacted transportation due to debris and downed power lines on roadways. On Maui, storm debris blocked intakes at multiple water treatment facilities, according to Maui Department of Water Supply. On Mauna Kea, blizzard-like conditions were observed including a reported wind gust of 160 mph (based on preliminary data) at the Mauna Kea Observatory. In RMI, several inundation events impacted low-lying areas in Majuro (12/9-11; 1/23; 2/20-22) flooding roads and buildings, and covering roadways with debris. Strong winds on Majuro damaged homes, downed power lines, and caused power outages (1/17). In American Samoa, heavy rains led to a landslide in the village of Asili (12/17).

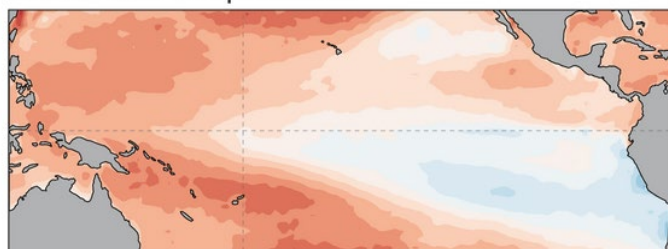


Storm-related infrastructure damage along the North Kohala Coast at Māhukona Beach Park (12/20/22). Photo credit: Hawaii County.

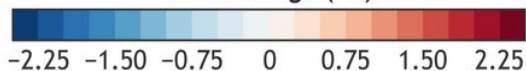


Flooding outside the EPA office in Majuro Atoll (RMI) in association with a king tide event (1/23/23). Photo credit: Neritha Juda; NWS Majuro.

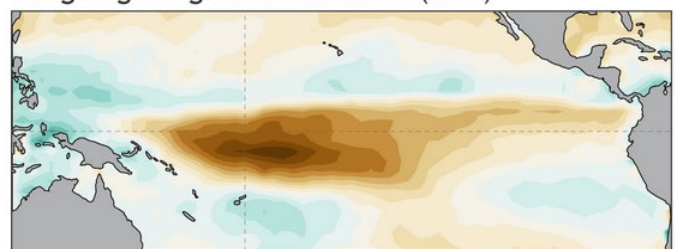
## Sea surface temperatures



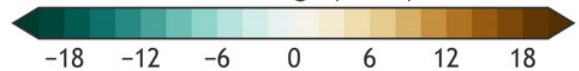
total change (°C)



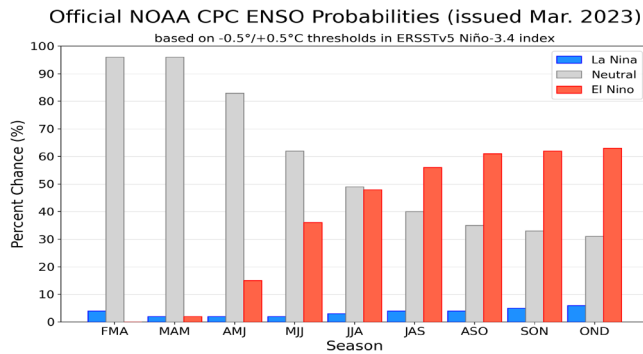
## Outgoing Longwave Radiation (OLR)



total change (W/m<sup>2</sup>)



Long-term trends in climate conditions across tropical Pacific (1982-2022). Linear trends of anomalies in sea surface temperatures (left) where red (blue) shading indicates trends toward more positive (negative) trends and outgoing longwave radiation (right) where brown (green) shading indicates that convection/rainfall is below-average (above-average). Source: ENSO Blog (1/26/23), Climate.gov.



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.  
Source: NOAA CPC.

During February, negative SST anomalies weakened in the central and eastern Pacific Ocean and by early March negative anomalies persisted only in the central Pacific Ocean with the latest (3/9/23) weekly Niño-3.4 index value at  $-0.2^{\circ}\text{C}$ . According to the latest ENSO prediction model simulations, there is agreement ENSO-neutral conditions are expected during Mar-May 2023 with a low likelihood (3%) of El Niño development. For summer 2023, the current IRI ENSO prediction plume favors El Niño conditions developing, while the NOAA CPC forecaster consensus favors ENSO-neutral conditions to persist through summer 2023.

NOAA's Coral Reef Watch four-month coral bleaching heat stress outlook (Mar 2023-June 2023) calls for a high probability (90%) of high heat stress (Alert Level 1-2) developing along a geographic area roughly encompassing the four Niño regions within a few degrees of the Equator extending from  $\sim 160^{\circ}\text{E}$  eastward to the coastal waters of Colombia, Ecuador, and Peru.

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

The ACCESS-S2 model from AUS BOM is forecasting continued above-normal sea levels in the southwestern tropical Pacific. Sea levels there, such as around Fiji and Vanuatu, are likely to gradually return toward normal over the next six months. ACCESS-S2 is also showing evidence of a relatively fast-moving and downwelling oceanic Kelvin wave, which is evidenced by above-normal sea levels near the equator that may reach the Galapagos Islands in the eastern Pacific as soon as April. In the northern tropical Pacific, such as around Hawaii and Guam, the forecast is for continued near-normal sea levels (not including the long-term trend associated with global sea level rise).

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

NOAA National Centers for Environmental Information:  
<http://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/>