

**MEMBER REPORT**  
*United States of America*  
*Pacific Region*

ESCAP/WMO Typhoon Committee  
17th Integrated Workshop  
(Video Conferencing)  
29-30 November 2022

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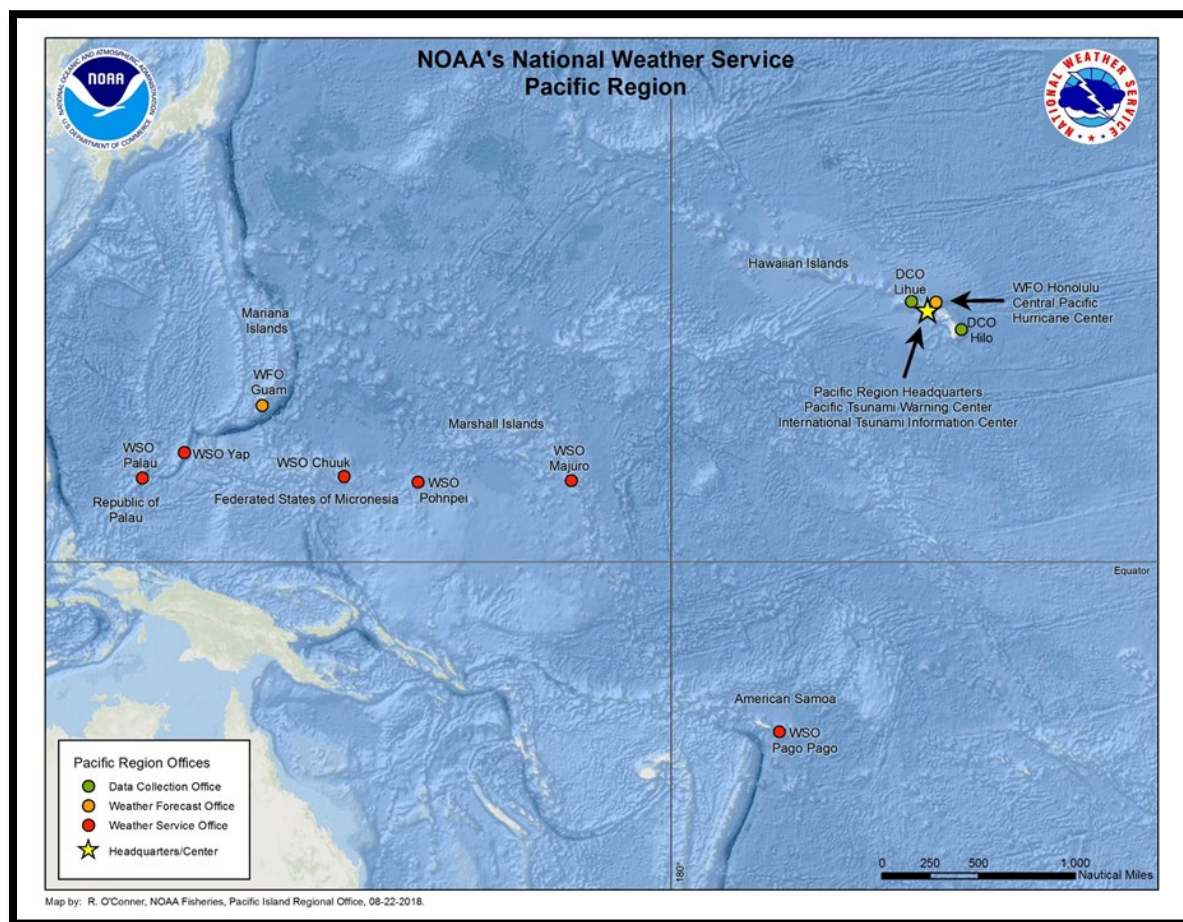
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## I. Overview of tropical cyclones which have affected/impacted Member's area since the last Committee Session

The Pacific Region of the United States of America (USA) National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) encompasses both the western North Pacific Islands in Micronesia (except Kiribati) and the Central Pacific areas. In Micronesia, the USA tropical cyclone activities involve the NWS Pacific Region and the Department of Defense Joint Typhoon Warning Center (JTWC) located at Pearl Harbor, Hawaii. The NWS Weather Forecast Office (WFO) on Guam provides weather forecasts, advisories, watches, and warnings within its Area of Responsibility (AOR). The WFO Guam AOR roughly extends from 130 Degrees East Longitude eastward to the International Date Line, covers an ocean area of more than 4 million square miles (about 10.4 million square kilometers) and includes more than 2000 Micronesian islands. This AOR includes the Commonwealth of the Northern Mariana Islands (CNMI), Republic of Palau, Federated States of Micronesia (FSM), Republic of the Marshall Islands, and the U.S. Territory of Guam. The FSM is composed of the States of Yap, Chuuk, Pohnpei, and Kosrae.



*Figure 1: U.S. National Weather Service, Pacific Region*

When tropical cyclones occur within the Guam AOR, WFO Guam issues watches and warnings for the U.S. Affiliated Islands of Micronesia. WFO Guam uses the track, intensity and wind distribution information provided by JTWC to produce plain-language and graphical forecast and warning products informing the general public and governmental agencies of impending severe weather.

The Central Pacific Hurricane Center (CPHC) is co-located with the NWS Honolulu Forecast Office (HFO). The NWS Honolulu Forecast Office activates the CPHC when tropical cyclones form in, or move into, the Central Pacific region from 140 Degrees West Longitude westward to the International Date Line. CPHC is also the World Meteorological Organization (WMO) Regional Specialized Meteorological Center (RSMC) for tropical cyclones in this region and in this capacity is known as RSMC Honolulu. The NWS Forecast Office in Honolulu's AOR covers around 5 million square miles (about 13 million square kilometers) from the Equator to 30N between 140W and 160E.

## 1. Meteorological Assessment (highlighting forecasting issues/impacts)

### *Central North Pacific (140W to 180, North of the Equator) Overview*

The 2022 tropical cyclone season featured below normal activity across the RSMC Honolulu AOR. There was one tropical cyclone which entered the central North Pacific during the period from 1 January through 15 November 2022.

Hurricane Darby moved into the RSMC Honolulu AOR from RSMC Miami AOR on 14 July as a Category 2 hurricane with 90 knot maximum winds. Darby encountered wind shear and dry mid-level air which helped weaken the cyclone to a tropical storm strength on July 15. Continued hostile atmospheric conditions continued to weaken Darby, which then dissipated south of Hawaii on 17 July.

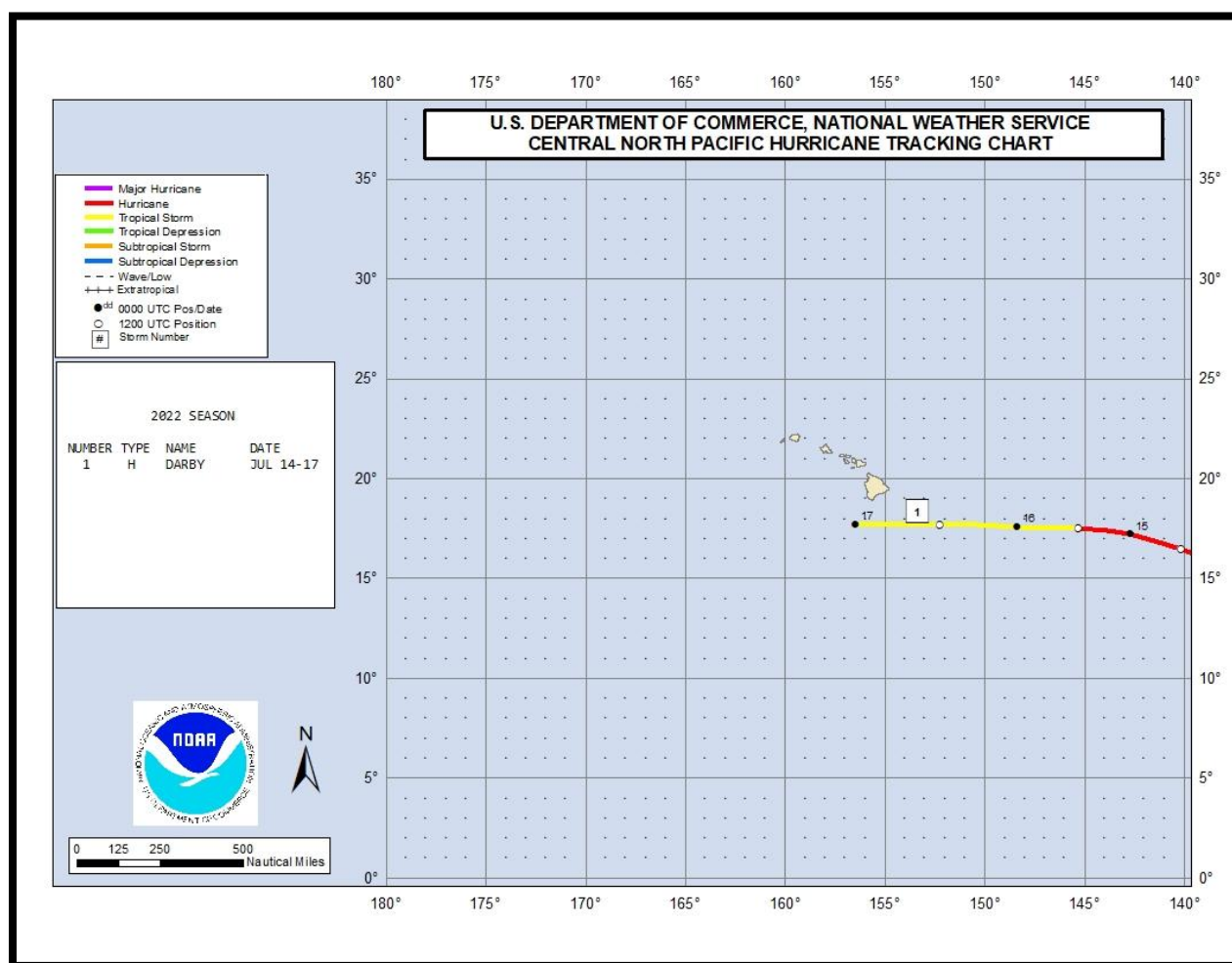


Figure 2: Preliminary central North Pacific tropical cyclone and invest tracks: 1 January 2022 to 15 November 2022

### *Western North Pacific (130E to 180, north of the equator) Overview*

In 2022, near normal tropical cyclone activity was observed across the broader western North Pacific basin; however, tropical activity was largely displaced west and north of the Guam AOR that spans from the Equator to 25N between 130E and the International Date Line. Such westward

and northward displacement, indicative of the overall La Nina pattern of 2022, continues the overall pattern that has dominated the region since 2020 resulting in continued below-normal tropical cyclone activity within the Guam AOR. Similar to 2020 and 2021, environmental conditions remained unfavorable for strong tropical cyclone development due to the general lack of low-level equatorial westerlies and an increase in upper-level shear, especially north of 10N. Monsoon-related heavy rain events in Micronesia were limited in frequency and generally confined to the far western extent of Micronesia, including Yap and Palau. In September, a burst of tropical cyclone activity along 20N, north of the Marianas, focused southwesterly monsoon flow over the Marianas bringing a few days of heavy rain. Additionally, in mid-October, a disturbance just west of the Marianas brought 6 to 8 inches (152 to 203 mm) of rain to Guam as it drifted away to the west.

In the past 12 months (1 Nov 2021 – 14 Nov 2022), the JTWC warned on 31 tropical cyclones with 14 having developed in the Guam AOR and only 2 directly affecting any of the Micronesia islands requiring the issuance of tropical cyclone watches or warnings: Rai (28W, December 2021) and Malakas (02W, April 2022). A third system, Tropical Depression 27W, developed near the main islands of the Republic of Palau in late October 2022 and intensified into Tropical Storm Banyan as it drifted west, away from the Republic of Palau. Of the 14 tropical cyclones in the Guam AOR, only 4 reached typhoon intensity before moving north or west, out of the AOR.

Rai (28W) passed through Yap State, FSM and near Kayangel, Palau, as an intensifying tropical storm. Observations from the Palau International Airport, about 50 miles (80 km) south of Kayangel, indicated peak wind gusts of 43 kt. Rai continued west, quickly achieving typhoon intensity as it exited the Republic of Palau and continued toward the Philippines. Malakas (02W) developed into a tropical depression southwest of Chuuk, FSM and trekked northwest across Yap State. Intensification was slow, largely hindered by a well-formed low-level circulation. Gradual consolidation and improved organization of the low-level circulation center fostered gradual intensification as Malakas aimed for the islands of Fais and Ulithi in Yap State, FSM. While ground observations were not recorded at these islands, satellite scatterometer data indicated 40 kt winds in the vicinity. For Yap Island, farther to the west, stronger winds (gusts up to 21 kt) and widespread rains followed 1 to 2 days after Malakas' passage as a strong and wet monsoonal flow set up over the area. Banyan (27W) developed into a tropical depression just northeast of the main islands of the Republic of Palau. It was slow to develop due to significant wind shear, so it was assessed as a 30 kt depression as it passed over the Republic of Palau. A significant burst of convection overcame the synoptic wind shear and fostered some quick intensification of 27W into a tropical storm as it pulled away to the west of the islands. Wind observations at the Weather Service Office, Palau, showed maximum sustained winds of 26 kt with gusts to 48 kt. These strong wind gusts resulted in considerable damage to poorly constructed structures and the slow-moving 27W led to prolonged heavy rains across the islands.



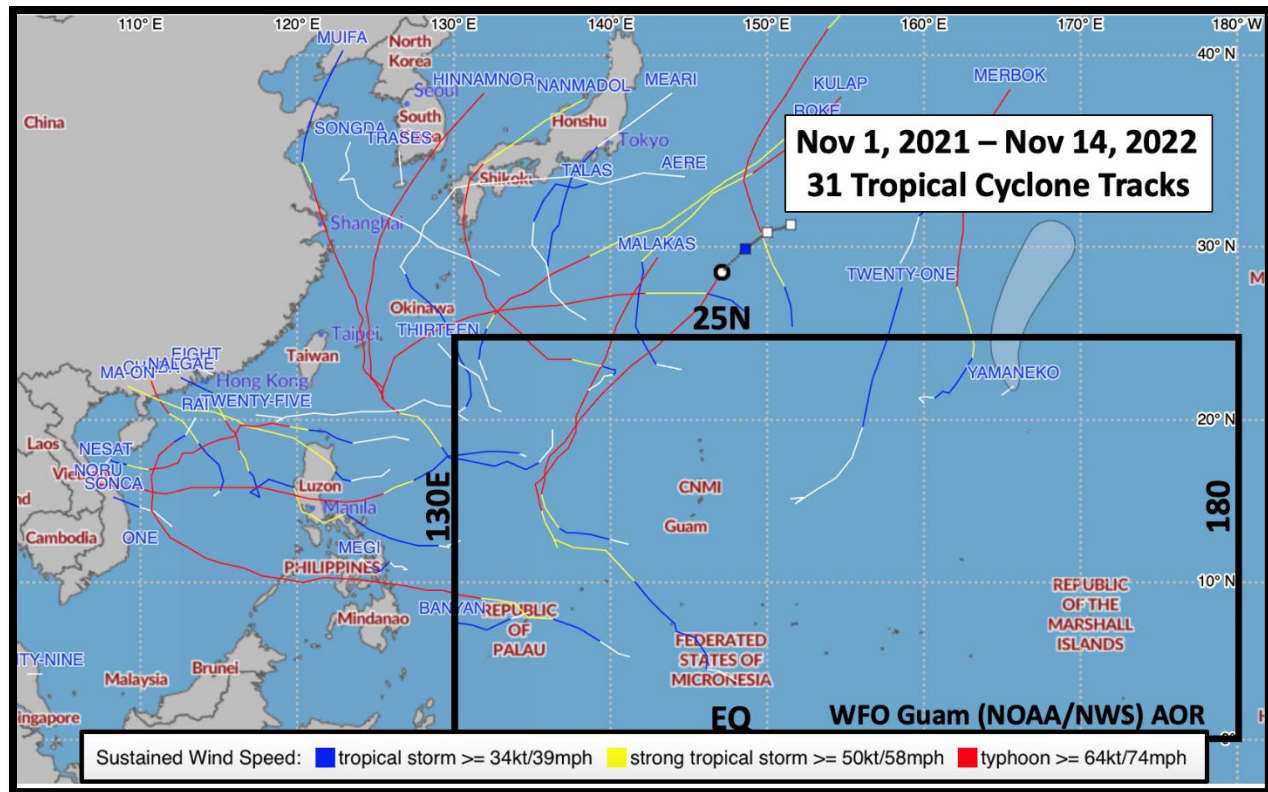


Figure 3: Western North Pacific tropical cyclones 1 November 2021 to 14 November 2022

## 2. Hydrological Assessment (highlighting water-related issues/impact)

### *Central North Pacific (140W to 180, North of the Equator) Overview*

The region experienced what is characterized as typical for La Nina ENSO, with persistent near to below normal rainfall. These drier than normal conditions have largely remained in place since 2020, although some relief occurred during the spring of 2021, and again in the spring of 2022, many areas recorded worsening impacts including dry rangelands, wildfires and water shortages through late summer of 2022. Severe to extreme drought remained in place across some portions of the state of Hawaii and other remote islands in the central north Pacific region into late summer 2022.

There was little or no relief provided by the summer tropical season of 2022. Moisture from tropical cyclones was not persistent, only fleeting and isolated rainfall was observed in windward areas as Darby moved by to the south of Hawaii.

### *Western North Pacific (130E to 180, north of the equator) Overview*

The end of 2021 throughout 2022 saw below normal to slightly below normal rainfall across the Marianas. Micronesia, with the exception of Yap State, saw well above to above normal rainfall, with Yap State slightly below normal. Although rainfall improved to current above normal totals, the end of 2021 and beginning of 2022 were very dry for some locations. The end of 2021 and beginning of 2022 saw drought conditions across portions of Pohnpei and Chuuk States, FSM and

the Republic of the Marshall Islands. Most of the systems developing into tropical cyclones in late 2021 and 2022 formed north and west of the islands, resulting in these drier conditions.

A La Nina pattern continued through 2022 resulting in a northward and westward displacement of tropical cyclone formations. A number of developing tropical systems moved through the region as only disturbances or invest areas. Only three cyclones affected the region through 2022: Typhoon Rai (28W, December 2021), Typhoon Malakas (02W, April 2022) and tropical depression (27W, October 2022) that transited Palau and developed into Banyan as it pulled away.

The hydrological impacts from these three tropical cyclones were as follows:

- Typhoon Rai moved through portions of Yap State and the Republic of Palau as a Tropical Storm, affecting several islands as it moved through. Although typhoon watches and warnings were issued, Rai did not reach typhoon strength until well northwest of Micronesia. Rai did bring beneficial rains to Yap State and Palau.
- Typhoon Malakas moved through eastern Yap State, affecting several islands. Malakas remained a tropical storm until well north of Yap State and west of the Marianas. Eastern Yap State received beneficial rains from Tropical Storm Malakas and the ensuing wet southwesterly monsoon flow.
- Tropical Depression Banyan developed over the Republic of Palau and brought torrential rain and gusty winds with it. In fact, the monthly rainfall totals for the Republic of Palau ranged from 13 to 28 inches (352 to 698 mm) and exceeded several rainfall records across the country.

Dry conditions developed over the northern Marshall Islands beginning in January 2022. Dry conditions eased over southern Pohnpei State in late January 2022, to again return in June 2022. Drought continued over Kapingamarangi, FSM into late October. Drought Information Statements (DGT) were provided by WFO Guam on a bi-weekly basis or as needed throughout the year. Dry conditions developed over northern Chuuk State beginning in February 2022. In all, 26 DGT products were issued. Beneficial rains eased the water shortage in Chuuk State in March 2022 and around late May to early June 2022 in the Marshall Islands. Although drought conditions existed, they were less severe than in 2017.

Other hydrologic events in the Mariana Islands during the past year have resulted in the issuance of several hydrologic products over the past year, mostly during the past six months. These products ranged from Hydrologic Outlooks to Urban and Small Stream Flood Advisories to Flash Flood Watches and Warnings.

### **3. Socio-Economic Assessment (highlighting socio-economic and DRR issues/impacts)**

#### ***Central North Pacific (140W to 180, North of the Equator) Overview***

RSMC Honolulu conducted dozens of tropical cyclone related outreach events, over 100 broadcast and print media interviews, and many formal emergency manager briefings. Many of the events,



interviews and briefings were a mix of in person and virtual according to the latest state of the COVID pandemic locally.

### ***Western North Pacific (130E to 180, north of the equator) Overview***

WFO Guam conducted formal presentations for and held meetings with territorial officials (Governors and Lt. Governors), emergency managers, military leaders and the Federal Emergency Management Agency (FEMA). The WFO completed more than 100 broadcast, radio and print media interviews and has participated in more than a dozen outreach events, both virtual and in person. External engagements are becoming more frequent across the region as the COVID-19 pandemic wanes.

Since 1 November 2021, only two tropical cyclones had significant socio-economic impacts in the WFO Guam AOR: Typhoon Malakas (02W) in April 2022, and Tropical Storm Banyan (27W) in October/November 2022. Typhoon Malakas brought severe tropical storm force conditions to islands in Yap and Chuuk States, FSM. Tropical Storm Banyan approached Yap Proper and the Republic of Palau (ROP) as a tropical disturbance and was upgraded to a tropical depression just prior to passage over the ROP. Banyan was upgraded to a tropical storm by the JTWC 6 hours later, just after passing over the ROP. Much of Palau experienced near-tropical storm force conditions with wide-spread wind damage, flooding and several mudslides. The sudden and brief onslaught of inclement weather conditions caught many in the republic by surprise.

Of note, a non-tropical weather event caused widespread inundation across the Republic of the Marshall Islands (RMI) and the FSM. A combination of higher sea levels due to the ongoing La Nina, ongoing astronomical high tides/King Tides, and several regional and distant storm systems/swell sources, caused inundation across many islands and atolls of the region affecting 30,000 of the FSM's 100,000 population, displacing hundreds, and destroying food crops and agriculture. This event resulted in many high-level intergovernmental discussions regarding global sea level rise and planning for the future.

These events revealed gaps in awareness and preparedness in the region and a need to mitigate risks for the future through early warning communications and education. WFO Guam is the only official local weather source in the region. Unlike cities and states in the continental U.S. where broadcasters communicate weather information to the public, residents in the region rely on WFO Guam and its partners to communicate weather information. In an effort to increase weather communications, WFO Guam has partnered with a local Guam TV station to provide weekly weather outlooks (since July 2020) and also produces bi-weekly weather columns for the local Guam daily newspaper (since September 2021).

Additionally, WFO Guam is working with the U.S. Department of Defense to initiate region wide virtual weather briefings ahead of significant weather threats to provide early hazards and warnings to military, state and national leaders in the AOR to promote preparedness and risk reduction.

#### **4. Regional Cooperation Assessment (highlighting regional cooperation success and challenges.**

RSMC Honolulu provided a Disaster Risk Reduction (DRR) subject matter expert to speak at the tropical cyclone forecaster attachment training in Malaysia in October 2022. A letter of agreement was signed between the Badan Meteorologi Klimatologi dan Geofisika (BMKG) and NOAA operationalizing aviation SIGMET (Significant Meteorological Information) collaboration between Tropical Cyclone Advisory Centers (BMKG MWO Ujung Pandang - NWS MWO HFO) in Sept 2022. This agreement adds to the existing collaboration agreements between Honolulu and the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), and Honolulu and Japan Meteorological Agency (JMA) using the JMA collaboration portal.

Initiative to increase visibility and sharing of Dvorak tropical cyclone analysis issued by various NMS through GTS in support for improved tropical cyclone strength and center position estimates, which feeds into increased numerical model and operational forecasting skill. Will need to continue to emphasize this initiative for more widespread regional adoption.

*Figure 4: Email alert to WRN Ambassadors in Palau and Yap State during TY Surigae, April 2021*

For more on the National Weather Service's Weather-Ready Nation Ambassador Program, visit <https://www.weather.gov/wrn/>

**Identified opportunities/challenges, if any, for further development or collaboration:**

NWS will continue to use the opportunity to engage in multilateral forums and engage with partners in international agreements to help infuse the global weather enterprise with our new weather and climate information, new science, and innovative technology and seek opportunities to learn best practices from other countries to improve our technology and service delivery. We will continue to expand our partnerships to help improve and sustain observation and communications networks essential for early warnings.

**Priority Areas Addressed:**

Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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## 2. Annual Tropical Cyclone Exercises

### **Main text:**

Annual tropical cyclone exercises were conducted by the Government of Guam, Government of the CNMI, the Republic of Palau and the State of Hawaii with participation by NWS Offices at Honolulu and Guam and the U.S. FEMA in order to maintain a level of skill and situational awareness when dealing with tropical cyclones.

WFO Guam participated in several typhoon exercises, both in-house and externally with regional civilian and military partners. WFO Guam provided virtual heavy weather briefs in support of the annual Department of Defense's joint services typhoon exercise. WFO Guam also created an exercise scenario for the Government of Guam's Tabletop Exercise with discussion keying in on advanced warning communications from WFO Guam to trigger actions from each government agency during a storm's approach. In-house typhoon exercises maintain a multifaceted approach to strengthen forecasters' skill sets in not only the procedural of operating the forecasting software and techniques but in also communicating a variety of hazards associated with tropical cyclones through a focus on impact-based decision support services, including the creation of information graphics, templates and plain-language communications.

RSMC Honolulu participated in multiple federal, state, and local annual tropical cyclone exercises in Hawaii. The United States Coast Guard District 14 held their annual HUREX hurricane exercise 16-20 May 2022. In addition to the scenario graphics that RSMC Honolulu usually creates, this year they also provided simulated weather briefings during the first two days of the week-long exercise. The RSMC also provided exercise graphics and a simulated briefing for the State of Hawaii Makani Pahili Emergency Operations Center activation functional exercise on 9 May and a briefing/scene-setter for the Honolulu Department of Emergency Management Hurricane Mobilization Timeline Rehearsal of Concepts drill on 24 May.

### **Identified opportunities/challenges, if any, for further development or collaboration:**

Staff turnover at partner agencies continued at high levels and many key decision makers are new and lack experience. Combined with limited in-person interactions due to the pandemic, exercise participation was crucial to build those skills and relationships ahead of a real disaster.

### **Priority Areas Addressed:**

Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings, watches, and advisories.

Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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### 3. Tropical Cyclone Workshops

**Main text:**

In the western North Pacific, WFO Guam conducts annual Tropical Cyclone, Disaster Preparedness and Climate Workshops for Guam and Micronesia. These workshops are tailored for each island and designed for decision makers in the local, state and national governments and agencies. These workshops have been suspended and reduced to a 2-hr virtual seminar to Guam and the CNMI due to the global COVID-19 pandemic. An in-person workshop was delivered in Saipan, CNMI in October and will expand to other islands in 2023 as travel resumes.

**Identified opportunities/challenges, if any, for further development or collaboration:**

Primary means of educating decision makers of all agencies and ensuring that the information is continually updated.

**Priority Areas Addressed:**

Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings, watches and advisories.

Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication and information sharing capability.

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#### 4. StormReady® and TsunamiReady®



##### Main Text

StormReady® is a program designed by the National Weather Service to help communities and counties implement procedures and supplemental programs to reduce the potential for disastrous, weather-related consequences. StormReady® helps communities evaluate their current levels of preparedness for and response to extreme weather-related events. These communities demonstrate a strong commitment to saving lives and protecting property when hazardous weather strikes. By participating in StormReady®, local agencies can earn recognition for their jurisdiction by meeting guidelines established by the NWS in partnership with federal, state and local emergency management professionals. TsunamiReady® is a similar program that expands preparedness and response of coastal communities to tsunami threats. After the initial recognition, communities can reapply every four years.

WFO Guam is part of a small team in the NWS tasked with examining external engagements with core partners and decision makers. Revamping and modernizing the StormReady® application and program are a primary focus of the group as it looks at relationships and communications with partners.

RSMC Honolulu assisted the needs of the 18 StormReady and TsunamiReady communities across the State of Hawaii in 2022, including the recognition of one new community this year. This recognition included ensuring the community had disaster action plans in place and held outreach events to convey a preparedness message.

WFO Guam was able to meet in-person with 3 of its 6 StormReady and TsunamiReady communities as travel to neighboring islands resumed in 2022. Visits included reviews of community and EOC disaster plans, standard operating procedures, and multiple outreach seminars and community engagements focused on natural disaster preparedness and education.

##### Identified opportunities/challenges, if any, for further development or collaboration:

As of 9 November 2022, there were 3,241 StormReady® and/or TsunamiReady® communities in the United States. All of the locations in the Pacific Region, including WFO Guam and RSMC Honolulu AOR are both StormReady® and TsunamiReady®.

##### Priority Areas Addressed:

Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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## 5. Outreach and Education Activities

### Main Text

Numerous outreach and education activities conducted in 2022 include:

*Expanded Pacific Hydrology Discussions.* Both WFO Guam and RSMC Honolulu provide input into the Climate Prediction Center's Monthly *ENSO Diagnostics Discussion* and employ the use of more comprehensive and targeted products--the *Hydrologic Outlook* product for extreme rainfall events and the *Drought Information Statement* for drought events.

*RSMC Press Conferences.* RSMC Honolulu hosted three press conferences in 2022. The first with high-ranking government officials to announce the 2022 Central Pacific Hurricane Season Outlook on 18 May. The second press conference was to announce the commencement of Hurricane Preparedness Week. The third press conference was to update the hydrological prediction for the coming wet season.

*RSMC Honolulu media interfaces.* RSMC Honolulu conducted several media interviews in preparation for hurricane season as well as event-specific interviews and briefings as tropical cyclones remnants impacted the Hawaiian Islands.

*RSMC Honolulu hosted virtual training webinars.* RSMC Honolulu hosted virtual webinars covering Central Pacific Hurricane Center products, one developed for emergency managers and one for media. The two webinars had 67 attendees in real time and the recorded videos received an additional 162 views.

*University Course Enhancement.* RSMC Honolulu hosts twice weekly weather discussions involving students and professors at the University of Hawaii (UH) Department of Meteorology, which engages the students in operational weather application focusing on societal impacts. These discussions have been virtual but were recently converted into hybrid with on-site and virtual participation by students and faculty. At least two forecast personnel and management have been invited as guest instructors at university classes at UH and Leeward Community College.

*World Meteorological Day.* WFO Guam celebrated this day, 23 March, to commemorate the creation of the World Meteorological Organization. WFO Guam marked the occasion by participating in a Proclamation Signing with the Governor of Guam and officials from the Guam Homeland Security/Office of Civil Defense (GHS/OCD), and from the Commonwealth of the Northern Mariana Islands Homeland Security and Emergency Management (CNMI HSEM). Virtual and onsite guests included staff from the Weather Service Offices in Palau, the Federated States of Micronesia (FSM) and the Marshall Islands.

*Regional Climate Conference.* In 2021, WFO Guam sought to establish a virtual forum to bring weather officials, emergency managers and decision makers together from across the region into one setting to discuss weather, climate and research focused on the western North Pacific. This virtual forum was established due to the COVID-19 pandemic and the inability to travel to islands within the Guam area of responsibility. This second annual Regional Climate Conference held in May 2022 had over 100 attendees from 11 countries and featured speakers from Guam and across

the United States. The coordinated NOAA tropical cyclone outlook for the U.S. Affiliated Pacific Islands was also publicly released in the conference.

*NWS Skywarn Spotter Training.* WFO Guam delivered its first Skywarn Spotter training to an overflow crowd in Saipan, CNMI with over 140 people in attendance to learn more about regional weather, hazards, preparedness and NWS operations and forecasts. The training also established a framework for interested community members to join the NWS as volunteers in citizen science to provide weather and climate impacts information to the WFO Guam. Additional training deliveries are planned for Guam in the coming months.



*Figure 5: WFO Guam Science and Operations Officer speaking at the Skywarn Training in Saipan, CNMI*

*National Preparedness Month.* September was declared National Preparedness Month in the USA. On Guam, staff from the WFO Guam participated in several school visits as well as hosting schools to the WFO. Additional outreach engagements and presentations included the U.S. Coast Guard, Joint Region Marianas, Guam Homeland Security/Office of Civil Defense and numerous media interviews focused on weather threats and preparedness.

*Media Workshops.* WFO Guam developed a communications-based workshop focused on regional media outlets who serve as core community partners in the regional weather enterprise. As force-multipliers in the amplification of weather information to the public, a general knowledge and understanding of WFO Guam operations and procedures for forecast products is needed. The workshop focused on regional weather hazards, the tropical cyclone warning process, NWS text bulletins and the NWS web page. The workshop concluded with 2 exercises for participants, focused on deciphering NWS information and producing concise, plain language messages for the public.



*Figure 6: WFO Guam Science and Operations Officer speaking to Guam Media during station tour. WFO Guam Warning Coordination Meteorologist demonstrating the Rain Gage.*

**Identified opportunities/challenges, if any, for further development or collaboration:**

Outreach events are fundamental in training the general population in disaster preparedness that eventually leads to a more resilient population.

**Priority Areas Addressed:**

Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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## 6. Pacific International Training Desk

### **Main text:**

The Pacific International Training Desk (PITD) was established on the campus of the University of Hawaii at Manoa in 2001 by the US NOAA/NWS at the Weather Forecast Office (WFO) Honolulu. The Pacific Desk is one of NOAA's contributions to the World Meteorological Organization (WMO) Voluntary Cooperation Program (VCP). The Pacific Desk began by offering two-month training internships to visiting students from the Regional Association V (RA V) of the WMO in March 2001 and later expanded the training opportunity briefly to developing countries from WMO RA II nations in east and Southeast Asia, who were also members of the ESCAP/WMO Typhoon Committee. Up until 2016, all the PITD training were conducted at the RSMC Honolulu. In 2016, the PITD training reached out to include the Weather Service Offices in Micronesia. In 2022 the training continued in a virtual capacity due to the ongoing global pandemic.

There are two levels of training offered: Basic (I) and Intermediate (II)

The introductory training itself consists of four components: 1) basic forecaster training, to be implemented through use of e-learning modules that will be readily available to anyone; 2) a month long, instructor led onsite training program carried out at RSMC Honolulu and/or WFO Guam; 3) training on use of communications equipment, also to be funded by the VCP; and 4) in-Island workshops on severe weather event topics.

An intermediate course was started in 2018 and is offered as a supplemental, more in-depth course for returning students.

### **Identified opportunities/challenges, if any, for further development or collaboration:**

The open webinars allow students from the Micronesia Weather Service Offices and from other Pacific Island Nations Meteorological Services to continue their development in the field of Meteorology, Hydrology and Disaster Preparedness. It also offers an insight into other Pacific Island nations' Meteorological services and their operations. Desire and intent to resume in person PITD training in Guam beginning in Feb 2023. Training in Honolulu is already set.

### **Priority Areas Addressed:**

Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings.

Enhance Typhoon Committee's Regional and International collaboration mechanism.

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## 7. Resource Mobilization during Extreme Events

### Main text:

RSMC Honolulu conducted several Emergency Management Briefings during 2022 hurricane season through video teleconferencing. These briefings included personnel at Emergency Operations Centers from the State level to the local level with the State Governor and County Mayors participating at times.

WFO Guam provides virtual and onsite decision support services by way of Heavy Weather Briefs to the Guam Homeland Security/Office of Civil Defense, CNMI Homeland Security Emergency Management and to the governors of both Guam and the CNMI prior to and during the passage of tropical cyclones. Normally provided onsite, these briefs have been delivered virtually due to the COVID-19 pandemic. WFO Guam's Warning Coordination Meteorologist consults with both agency's Joint Information Centers to provide explanation and clarity in government press releases. These particular heavy weather briefings are primarily catered for the island leadership and military decision makers on potential tropical cyclone threats. WFO Guam also provides similar support to the U.S. Embassies in the U.S. Affiliated Islands in the Pacific.

### Identified opportunities/challenges, if any, for further development or collaboration:

Impact-based decision support services are made available to local decision makers especially in locations that lack meteorological support and knowledge. Social media platforms have made these interagency interactions possible and allowed the sharing of information. NWS continues to look for ways to optimize our use of these tools.

### Priority Areas Addressed:

Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings.

Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

Enhance Typhoon Committee's Regional and International collaboration mechanism.

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## 8. Improved Typhoon-related Disaster Risk Management in Various Sectors

### Main text:

*Tropical Weather Outlook graphic.* During the tropical cyclone season, RSMC Honolulu prepares and transmits both a text and a graphical *Tropical Weather Outlook* that illustrates the probability of tropical cyclone development in the next 48 hours and 5 days respectively.

*Time of Arrival/Departure graphics.* When there is an active tropical cyclone in the AOR, RSMC Honolulu issues graphical products for both “Most Likely Time of Arrival” and “Earliest Reasonable Time of Arrival” to assist government officials and public in their critical decision-making process as they prepare for potential weather impacts. A time of departure graphic is also being developed for experimental use in future seasons. These graphics are also being experimentally produced for tropical cyclones in the Guam AOR.

*Hawaii Emergency Preparedness Executive Consortium (HEPEC).* RSMC Honolulu is a member of the Hawaii Emergency Preparedness Executive Consortium (HEPEC). HEPEC is comprised of emergency managers and disaster mitigation personnel from local, state, and federal agencies. HEPEC meets quarterly to provide updates on current and outstanding threats, both natural and manmade, to the State of Hawaii. RSMC Honolulu Personnel provided several hurricane presentations to this group during the February 2022 and October 2022 meetings.

*Software improvements for Emergency Managers.* Hurrevac (an online application for emergency managers to gather critical hurricane forecast information) improvements were implemented in 2022, including additional information from storm surge modeling in Hawaii.

*IDSS Impact Measurements Initiative Team.* WFO Guam’s Warning Coordination Meteorologist served as the Pacific Region representative on this team in the NWS. The team developed and tested a set of internal and external performance measures to assess NWS IDSS. Team goals were to determine the agency’s readiness and capability of delivering IDSS and how our agency was doing at delivering IDSS. The team utilized two surveys to meet these goals: an event-based survey to be distributed to core partners/agencies immediately following an event requiring decision support services, and an annual review survey, to consider decision support services offered by the WFO throughout the year.

### Priority Areas Addressed:

Enhance capacity to generate and provide accurate, timely and understandable information using multi-hazard impact-based forecasts and risk-based warnings.

Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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## 9. Technological Improvements

### Main text:

Next generation geostationary satellites - GOES and Himawari

- RSMC Honolulu and WFO Guam have been utilizing high resolution imagery available from JMA's Himawari-8 and are now undergoing preparations for the transition to Himawari-9. Both offices also have satellite receive systems to obtain HimawariCast.
- GOES-18 was successfully launched in December 2021 and has been undergoing post launch testing to ensure data integrity. To supplement the GOES-17 Loop Heat Pipe issues, GOES-18 was interleaved and made available to operational forecasters during max heating time periods.

In addition, data continues to be received, analyzed, and evaluated from the multiple sensors and displays coming from many polar orbiting satellite instruments. One of those sensors is onboard the Suomi NPP and JPSS 1 satellite and it continues to play a critical role in locating positions of tropical cyclones. The Visible Infrared Imaging Radiometer Suite (VIIRS) is able to produce a day-night band allowing forecasters to receive visible images at night. VIIRS will also be available on the Joint Polar Satellite Systems 2 (JPSS2) which was launched successfully on November 10.

Continued evaluation and application of ocean surface wind vector scatterometer instruments (ASCAT, RSCAT and Windsat) and ocean wave height altimetry (JASON2, JASON3). While these instruments are subject to the attenuation effects of heavy rainfall and are somewhat limited under very light and very strong wind conditions, they continue to greatly improve our capability to monitor tropical cyclone development and to observe the structure and intensity of tropical cyclones in the AOR.

After a request from the NWS Pacific Region, Synthetic Aperture Radar (SAR) data are available over/around Guam. These data are available at this [NOAA/NESDIS](https://www.star.nesdis.noaa.gov/socd/mecb/sar/AKDEMO_products/APL_winds/wind_images_nic/sarwinds_calendar_now.html) website ([https://www.star.nesdis.noaa.gov/socd/mecb/sar/AKDEMO\\_products/APL\\_winds/wind\\_images\\_nic/sarwinds\\_calendar\\_now.html](https://www.star.nesdis.noaa.gov/socd/mecb/sar/AKDEMO_products/APL_winds/wind_images_nic/sarwinds_calendar_now.html)). There were 10 overpasses between 1 and 24 November.

The Advanced Weather Interactive Processing System (AWIPS) is a technologically advanced information processing, display, and telecommunications system that is the cornerstone of the NWS. AWIPS is an interactive computer system that integrates all meteorological and hydrological data with satellite and radar imagery. In August 2022, a multi-year effort was completed to convert all AWIPS processing servers in each office into a virtualized environment called Hyper Converged Infrastructure (HCI). AWIPS HCI has much improved processing power and redundant capabilities to minimize downtime for maximum high availability.

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