COUNTRY HYDROMET DIAGNOSTICS

Informing policy and investment decisions for high-quality weather forecasts, early warning systems, and climate information in developing countries.

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Palau NMHS Peer Review Report

Reviewing Agency: Met Office

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SOFF Systematic Observations Financing Facility — Weather and climate data for resilience | Alliance for Hydromet Development

The findings, interpretations and conclusions expressed are those of the named authors alone and do not necessarily reflect those of the agencies involved.

Authorisation for release of this report has been received from the Peer Reviewing Agency (Met Office) and the Country NMHS (Palau WSO).

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Glossary

AFIS	Aerodrome Flight Information Service
AWS	Automatic Weather Stations
BOM	Bureau of Meteorology
CIS-PAC5	Climate Information & knowledge Services for resilience in 5 island countries of the Pacific
CliDE	Climate Data for Environment
COFA	Compact of Free Association
COSPPAC	Climate & Oceans Support Programme in the Pacific
CREWS	Climate Risk and Early Warning Systems
CRRF	Coral Reef Resilience Foundation
DRR	Disaster risk reduction
EARWatch	Early Action Rainfall Watch
ECMWF	European Centre for Medium-range Weather Forecasting
EEZ	Exclusive Economic Zone
EQPB	Environmental Quality Protection Board
FSM	Federated States of Micronesia
GBON	Global Basic Observing Network
GCF	Green Climate Fund
GEF	Global Environment Fcaility
GFS	Global Forecasting System model
GHG	Greenhouse Gas
GOS	Global Observing System
GTS	Global Telecommunication System
ITIC	International Tsunami Warning Centre
JMA	Japan Meteorological Agency
KMA	Korea Meteorological Administration
LIDAR	LIght Detection And Ranging
MAPSO	Micro Art Paperless Surface Observations
METAR	METeorological Aerodrome Report
MHEWS	Multi-Hazard Early Warning System
NCEI	US National Centre for Environmental Information
NCAR	National Center for Atmospheric Research
NDRMF	National Disaster Risk Management Framework
NEC	National Emergency Committee
NEMO	National Emergency Management Office
NIWA	National Institute of Water and Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration
NWP	Numerical Weather Prediction
NWS PRH	National Weather Service Pacific Region Headquarters
Oscar/Surface	Observing Systems Capability Analysis & Review tool
PACIOOS	Pacific Islands Ocean Observing System
PACRISA	Pacific Research on Island Solutions for Adaption
PICOF	Pacific Islands Climate Outlook Forum
PICRC	Palau Iternational Coral Reef Centre
PMC	Pacific Meteorological Council

PMU	Project Management Unit
PPUC	Palau Public Utility Corporation
QC	Quality Control
QMS	Quality Management System
QPE	Quantitative Precipitation Estimate
QPF	Quantitative Precipitation Forecast
RBON	Regional Basic Observing System
RIC	Regional Instrument Centre
RMI	Republic of the Marshall Islands
ROP	Republic of Palau
RSMC	Regional Specialised Meteorological Centre
SDP	Station Duty Manual
SIDS	Small Island Developing State
SMS	Short Message Service
SOFF	Systematic Observations Financing Facility
SOP	Standard Operating Procedure
SPREP	Secretariat of the Pacific Regional Environment Programme
UA	Upper Air
UCAR	University Corporation for Atmospheric Research
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USNWS	United States National Weather Service
WDQMS	WMO Data Quality Management System
WFO	Weather Forecast Office
WIGOS	WMO Integrated Global Observing System
WIS	WMO Information System
WMO	World Meteorological Organisation
WRF	Weather Research & Forecasting model
WRP	Weather Ready Pacific
WSO	Weather Service Office

Executive Summary

Ten critical hydrometeorological elements have been assessed by the peer advisor and beneficiary against maturity of service within the Palau national context. The Republic of Palau (ROP) currently has maturity scores ranging closely between 2 and 3 across the ten value chain elements – key gaps are identified and remedial recommendations offered. The Weather Service Office (WSO) Palau is unusual in comparison to some other Small Island Developing States (SIDS) NMHSs in relation to its support from the US National Weather Service (USNWS) via the Compact of Free Association (COFA), providing a stable basis for foundation weather services. However, main services are limited in scope so WSO Palau continues to strive to achieve results, especially in relation to outreach and communication of the meteorological message to users, and the WSO continues to require support to further develop further service capability of benefit to the Republic of Palau.

Key focus should include, in particular, consideration of:

- Climate & hydrological services
- The governance context, data sharing and understanding the national value of products and services provided beyond COFA-funded WSO services
- Observing and service infrastructure across the Republic of Palau

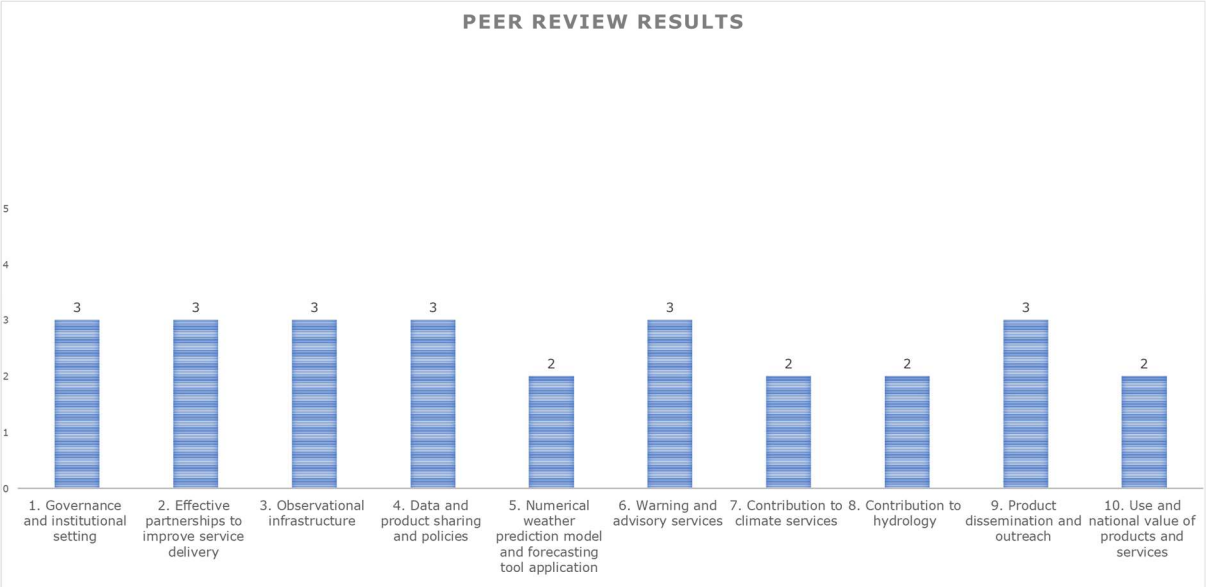


Fig 1: Summary of Maturity Level Assessment for the National Meteorological Service of Palau

Element	Maturity level score
1. Governance and institutional setting	3
2. Effective partnerships to improve service delivery	3
3. Observational infrastructure	3
4. Data and product sharing and policies	3
5. Numerical weather prediction model and forecasting tool application	2
6. Warning and advisory services	3
7. Contribution to climate services	2
8. Contribution to hydrology	2
9. Product dissemination and outreach	3
10. Use and national value of products and services	2

Table 1: Summary of Maturity Level Assessment of National Meteorological Service of Palau as in Fig 1 above.

CHD methodology

This report has been prepared using CHD operational guidance in support of the WMO GBON SOFF initiative. An initial desktop review was performed based on information provided by WSO. An in-country visit and subsequent follow-up visit to WFO Guam were undertaken alongside work to support SOFF delivery, with interviews held primarily with the three WSOs and NWS (associated with COFA provisions to Palau). This report presents the ten most critical hydrometeorological elements assessed against maturity of service with recommendations to remediate specific issues.

Gaps, Urgent Needs and Key Recommendations

Governance & Institutional Settings:

- WSO Palau should continue to work with ROP government and partners to sustainably strengthen resourcing core delivery and sustainable implementation of projects and thus meet national needs with respect to protection of life and property.
- The WSO should achieve formal endorsement of the CREWS-funded strategy with ROP government and further progress the legal status of the WSO within the national context.
- Noting the impending mandatory retirement of a number of WSO staff, WSO Palau should investigate options for succession planning with USNWS and ROP government, noting the challenges of incoming SOFF implementation and associated opportunities for role modernisation and staff training and development.

Effective Partnerships to Improve Service Delivery:

- WSO Palau should promote the benefits of their work to national government and further strengthen and exploit national and regional partnerships.
- The WSO should continue to collaborate with international partners such as SPREP/PMC on Weather Ready Pacific in terms of new regional facilities and opportunities to introduce enhanced products and services.

Observational Infrastructure:

- WSO Palau should fully engage with the SOFF programme to access funding to ensure sustainability of observing networks to meet national GBON targets.
- The WSO should strengthen links with partner organisations where there are opportunities to access third party observations network data, clarifying data policy with eg UCSD to provide free and unrestricted sharing of GBON-nominated data.
- The WSO should review its arrangements for National Focal Points and engagement with respect to WIGOS, Oscar and WDQMS, noting that Palau is not currently a formal WMO member.

Data & Product Sharing & Policies:

- WSO Palau should consider formalisation of a GBON-compliant data policy within national legislation in anticipation of SOFF investment.

Numerical Model & Forecasting Applications:

- WSO Palau should review skills and training in relation to interpretation of satellite and model outputs from global centres, enabling greater confidence in

refining and adding local value to NWS forecasts where appropriate, notably for probabilistic ensemble outputs.

- The WSO should enhance feedback and communication with WFO Guam and wider USNWS to improve quality of local forecasts.

Early Warning and Advisory Services:

- WSO Palau should aim to implement impact-based warning evaluation in partnership with ROP government stakeholders, building on training currently being undertaken.
- The WSO should work with ROP government to consider availability of NEMO staff outside normal working hours to remedy gaps in warning processes, notably for immediate tsunami notification.

Contribution to Climate Services:

- WSO Palau should undertake consultation/outreach with ROP government and key industry representatives to identify climate requirements and potential funding sources to support the development of climate services tailored to sector needs.

Contribution to Hydrology:

- WSO Palau should formalise the data sharing agreement between the WSO, the PPUC and the wider Palau Water Task Force under the NDRMF, recognising a potential leading role in hydrological matters for the WSO within ROP government.

Product Dissemination & Outreach:

- WSO Palau should consider how they might develop communication materials/outreach to overcome language barriers and reach remote or marginalised communities.
- The WSO should work with Palau government to implement sensitisation training for new ROP government staff to ensure effective use of WSO Palau products and services.

Use of National Products and Values:

- WSO Palau should consider implementing routine formal user feedback questionnaires to improve the products and services.
- The WSO should look to implement a more robust local QMS and associated capacity building/ training via projects such as SOFF (observations)

Chapter 1: General information

Introduction

Overview

The Republic of Palau (ROP) is an island country in the Micronesia subregion of the Western Pacific. The Palau archipelago lies to the west of the Federated States of Micronesia (FSM), with Guam 830 miles (1,330 km) to the northeast and the Philippines 550 miles (890 km) to the west. All but 6 of Palau's approximately 340 coral and volcanic islands lie within an expansive lagoon, enclosed by a barrier reef that stretches northeast to southwest for almost 70 miles (115 km). Babelthuap is the main island, covering 153 square miles (396 km2, comprised of rolling upland rising to 242 m at Ngerchelchuus.

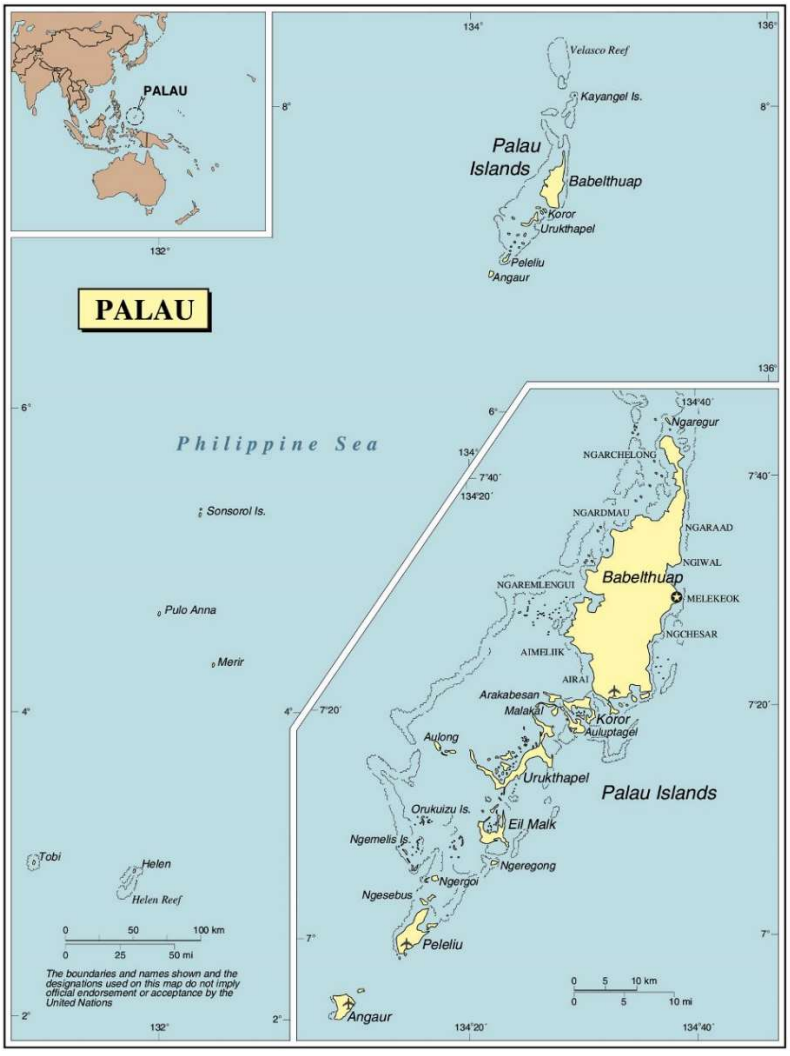


Figure 1: Map of Palau courtesy © 2024 Mapsland

While Palau's total land area is only 180 square miles (466 km2), the country's maritime Exclusive Economic Zone (EEZ) occupies c.230,000 square miles (c.600,000 km2) of the Pacific Ocean.

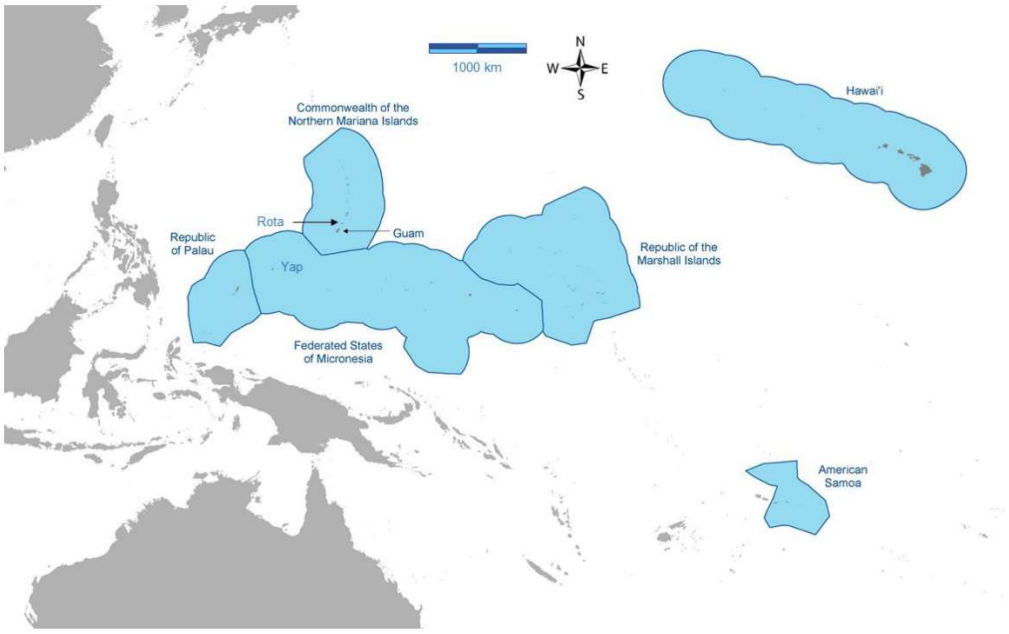


Figure 2. Map of the Exclusive Economic Zones of American-affiliated Pacific Islands. Reproduced by permission from Pacific RISA, US National Oceanic and Atmospheric Administration, **pacificrisa.org**.

Climate & Natural Hazards

Palau has a tropical rainforest climate with an annual mean temperature of 28°C (82°F)[1]. Rainfall is heavy throughout the year, ranging from c.3000-4000 mm/year, and it is wettest between May-September. The average humidity is c.80%, with March typically being the driest month when northeast trade winds prevail (from December through to March). Prevailing oceanic currents offshore are the North Equatorial Current and the Pacific Equatorial Countercurrent.

Palau lies on the edge of the typhoon belt. Tropical storms frequently develop near Palau every year, though it is rare for typhoons to affect the islands directly. Typhoons Mike, Bopha and Haiyan are the only confirmed recorded tropical systems that have directly struck Palau as typhoons; Typhoon Surigae (2021) also produced typhoon-strength winds over northern Babeldaob/Kayangel.

The National Meteorological Service of Palau

Operational meteorological services are provided in Palau via the Weather Services Office (WSO) in close collaboration with the US National Oceanographic and Atmospheric Administration's (NOAA) National Weather Service (USNWS) under the Compact of Free Association (COFA) [2]. WSO collaborates closely with NWS across all their operations and in particular respect to provision of funding, technical and logistical support for forecast products and observations. Administration, financial, operational, management, and oversight assistance is provided under contract to WSO via the National Weather Service Pacific Region Headquarters (NWSPRH) as part of COFA.

[1] Republic of Palau - Brittanica & discussion with WSO Palau
[2] The Compacts of Free Association

Chapter 2: Country Hydromet Diagnostics

Element 1: Governance and institutional setting

1.1 Existence of Act or Policy describing the NMHS legal mandate and its scope

The Republic of Palau (ROP) and the United States of America (USA) signed the Compact of Free Association (COFA) in 1994. This treaty requires the USA to provide three services for Palau, a postal service, an air traffic service and a meteorological service. The National Oceanic and Atmospheric Administration (NOAA) National Weather Service (USNWS) deliver weather services and associated programs throughout the Republic in line with COFA's Article VII (Weather Services and Associated Programs). According to Sections 5 to 13 of Article VII of COFA, USNWS provides weather services through a WSO created in Koror, Palau, later moved to Airai and known as WSO Palau since 2018. Subsequently, at the operational level, the National Weather Service Pacific Region Headquarters (NWSPRH) based in Honolulu, Hawaii Islands provides administration, financial, operational, management, and oversight assistance to WSO Palau via a contract between the USNWS and the Government of Palau.

There is no formal legislation or definition of the WSO within Palau government underpinning the COFA-sponsored delivery of weather services. However, the WSO is recognised as the national alerting authority for hydrometeorological hazards and is part of the NDRMF (National Disaster Risk Management Framework) in Palau for warnings and advisories. The WSO maintains strong relationships with the National Emergency Committee (NEC), National Emergency Management Office (NEMO) and other government agencies - all roles & responsibilities of organizations are indicated in the ROP NDRMF. WSO Palau is not formally involved with any aviation services, the Palau International Airport or any other aviation institutions, besides certifying ROP Aerodrome Flight Information Service (AFIS) employees who undertake reporting of weather observations. Palau is not yet a member of WMO, but operations are all delivered under the WMO framework and Palau enjoys 'proxy membership' through NOAA.

1.2 Existence of Strategic, Operational and Risk Management plans and their reporting as part of oversight and management.

A 10 year strategic plan for WSO Palau was developed and published under the Climate Risk and Early Warning Systems (CREWS) project in 2022 and an implementation plan is in use; the WSO Strategic Plan and risk management plans are annexed to the ROP NDRMF. Main priority areas of the strategic plan are to:

(1) Reduce the impacts of weather, water, and climate events by modifying and simplifying the way people receive, understand, and act on information; and

(2) Utilize science and technology to provide the best observations, forecasts, and warnings.

1.3 Government budget allocation consistently covers the needs of the NMHS in terms of its national, regional, and global responsibilities and based, among others, on cost-benefit analysis of the service. Evidence of sufficient staffing to cover core functions

The WSO's annual operational budget is entirely provided by USNWS – it is not possible to disclose this budget due to commercial contract confidentiality – see 1352.209-72 Restrictions against disclosure provided by USNWS. This annual budget is, however,

confirmed to be sufficient for salaries and day to day operations. WSO Palau collaborate closely USNWS across all forecast and observing operations. The existing upper air station in Palau is funded through NOAA including the costs associated with maintenance, spares and repairs. USNWS also provide technical and logistical support in relation to troubleshooting and securing supplies for the upper air network in Palau. Local technical staff in Palau maintain services and systems and are supported by USNWS staff based in Guam and Hawaii. There is limited scope for ongoing capacity development under the current COFA-funded budget, but opportunities to benefit from internationally-funded capacity building project periodically arise and WSO Palau have proven adept at engaging with them (see section 1.5 below).

1.4 Proportion of staff (availability of in-house, seconded, contracted- out) with adequate training in relevant disciplines, including scientific, technical, and information and communication technologies (ICT). Institutional and policy arrangements in-country to support training needs of NMHS.

WSO Palau employs 2 meteorologists (including the Meteorologist-in-Charge), 1 supervisory weather service specialist, 6 weather service specialist, 3 meteorological technicians/electronics programme specialists and 1 maintenance coordinator. There are 13 permanent staff, including 4 females and 9 males. In addition, there are 3 female and 2 male local contract observers. Of the 13 permanent staff, 2 retire by 2026 and another 3 by 2027 – there is a mandatory national retirement age of 60 in Palau. There needs to be consideration of staff succession, though noting that COFA-budgeted headcount doesn't accommodate a doubled-up shadowing approach for additional new staff.

The WSO maintains adequate skills for operational tasks outlined under COFA, including meteorological, technical and ICT-based skills, with training required as new services or equipment comes into use. As a prerequisite to taking on a role, WSO specialist staff complete selected online training on meteorology and hydrology through the University Corporation for Atmospheric Research (UCAR) Comet Met Ed program. The two primary training courses currently provided to WSO Palau staff in-role by NOAA are via the Pacific Leadership Academy, which provides leadership and management training to senior staff at the WSOs, and the Pacific International Training Desk in Honolulu which provide training courses focused on meteorology and forecasting. WSO Palau staff have undertaken a range of tropical meteorology training courses through the Pacific International Training Desk, including: Thermodynamics; Satellite Interpretation; Surface and Upper-Air Analysis; General Circulation; Local Circulations; Tropical Weather Features; Numerical Weather Prediction; Forecast Philosophy; Forecast Verification; Marine Forecasts; Tsunamis; Severe Weather and Tropical Cyclones; Tropical Climate Variability; and Messaging and Weather Communications. Continuous professional development beyond this is often provided through project funding.

1.5 Experience and track record in implementing internationally funded hydromet projects as well as research and development projects in general.

Palau WSO is experienced in seeking out hydromet investment opportunities and has been engaged in projects with numerous partners including:

- The Climate Risk and Early Warning Systems (CREWS) initiative has provided a platform for a number of initiatives in Palau, including:

- A Strategic Plan for WSO Palau, developed in 2022 (awaiting official FSM government sign off) via the Strengthening Hydro-Meteorological and Early Warning Services in the Pacific (CREWS Pacific SIDS 2.0) project.
- The CREWS Traditional Knowledge project, funded by the Secretariat of the Pacific Regional Environment Programme (SPREP), aiming to establish community-based early warning and response mechanisms for extreme weather, climate and disaster risk reduction. This included a process for integrating traditional knowledge indicators to collected information underpinning the national early warning system. This was undertaken in partnership with WSO Palau, NEMO, Palau Red Cross Society and the Palau Historical Preservation Office.

- The Enhancing Disaster and Climate Resilience in the Republic of Palau project was initiated by the United Nations Development Programme (UNDP) in March 2019. The project aimed to improve capacity for preparedness and mitigation of Palau's resilience to man-made, geophysical, climate and different types of related hazards; and enhance resilience to climate change impact through improved disaster preparedness and infrastructure. WSO Palau benefitted from the implementation of 4 new Automatic Weather Stations (AWS) and a wave-rider buoy to underpin and help improve early warning services.
- Enhancing Climate Information and Knowledge Services for resilience in 5 island countries of the Pacific Ocean (CIS-Pac5) is an ongoing project which is being delivered by the United Nations Environment Programme (UNEP) in Palau. CIS-Pac5 aims to deliver on the Pacific SIDS need for accurate, timely and actionable information and early warnings on local weather, water, climate and ocean conditions and related risks to human and environmental health. WSO Palau will receive 4 AWS, 1 airport Automated Weather Observing System (AWOS), 1 C-band radar and a Rainbird mobile software app provided by Korean Met Agency (KMA). UNEP will also integrate the existing operation 4 AWS implemented by UNDP within the duration of the project timeframe.
- The Taiwanese Government has funded a project within Palau to implement better flood observing and warning infrastructure via the 5-year employment of a local consultant with NEMO as the focal point. The project has ensured the inclusion of WSO Palau as a core partner to host 23 tipping bucket rain gauges and CCTV sites. These data support more effective and timely flood warnings from the WSO in relation to road erosion and landslides.
- The People's Empowerment Project was funded by the UN Women's Empowerment Project, in partnership between NWS WSO Palau and others including: NEMO, Palau Red Cross Society, Historical Preservation Office, Division of Gender, Environmental Quality Protection Board, Emergency Health Program, Behavioural Health Program and the Bureau of Agriculture. This project has employed outreach consultations on Emergency Preparedness, Crisis Response and Recovery to ensure user focus; and has targeted the empowerment of the female and children population of Palau by giving them the necessary tools to respond to emergency and humanitarian crises to help their communities.

Summary score and recommendations for Element 1

Palau is assessed as **Maturity Level 3** on the CHD scale – ***Moderately well mandated, managed and resourced and clear plans for, and sufficient capacity to address operational gaps.***

RECOMMENDATIONS:

- WSO Palau should continue to work with ROP government and partners to sustainably strengthen resourcing core delivery and sustainable implementation of projects and thus meet national needs with respect to protection of life and property.
- The WSO should achieve formal endorsement of the CREWS-funded strategy with ROP government and further progress the legal status of the WSO within the national context.
- Noting the impending mandatory retirement of a number of WSO staff, WSO Palau should investigate options for succession planning with USNWS and ROP government, noting the challenges of incoming SOFF implementation and associated opportunities for role modernisation and staff training and development.

Element 2: Effective partnerships to improve service delivery

2.1. Effective partnerships for service delivery in place with other government institutions.

As outlined above, USNWS is the primary partner for service delivery internationally under the COFA agreement. WSO Palau also maintains strong national partnerships in relation to service delivery and the WSO is one of 28 NDRMF partners who hold routine quarterly and ad-hoc meetings, chaired by the Palau Vice President with the Ministry of Public Infrastructure Industry as vice chair. The NDRMF has been in place since 2010 and covers environmental risks associated with tropical cyclones, drought, fire, seas, tsunami, wildfires – the framework is subject to national review every c.5 years. Key stakeholders who the WSO engage with in this context include:

- ROP Office of the Vice President – guides the integration of the WSO in government, owning the COFA agreement with USNWS and ensuring participation within the NEC. The WSO Meteorologist in Charge has worked closely with the Vice President's Office to ensure a strong working relationship – this is the office that can best influence national legislation and provide funding opportunities.
- NEMO – Another key government ministry relationship, NEMO is responsible for public safety and works closely with the WSO on Weather, extreme event emergencies and disaster risk reduction. The WSO provides data and products to NEMO for effective decision making central to the NEC.
- Office of Environmental Response and Coordination within the President's Office – coordinates environmental matters and requires data & products from the WSO on climate change.
- Ministry of Education – collaborators within the NEC, using weather products and warnings; also provide support for services and educate about weather, climate, water and ocean.
- Ministry of Health & Human Services – the Bureau of Public Health receives weather warnings and climate data from the WSO and is a potential source of funding for research grants involving weather and climate.
- Bureau of Public Works and the Palau Energy Office – receive weather warnings and climate data from the WSO; potential sources of support and funding.
- The Palau Public Utility Corporation (PPUC) – the WSO provides warnings and climate data to support maintenance of power and water operations and minimise service disruption in the event of severe weather.
- Transportation stakeholders - the WSO also cooperates with a range of stakeholders for dissemination of weather and warning data, notably working with the US Federal Aviation Authority regarding the training of meteorological observers and operation of observation stations at airports around the nation. A goal would be to expand weather services provided, eg provision of radar data when established under work outlined above. Airport sites are also favourable locations for selection as GBON observing stations where possible, as they tend to be well exposed sites with high security and good communication availability.
- WSO Palau also provides informal advice, warnings and climate data where required within Palau to NGOs including the Palau Red Cross and the Palau Conservations Society.

2.2. Effective partnerships in place at the national and international level with the private sector, research centres and academia, including joint research and innovation projects.

Palau WSO maintains numerous national and international partnerships for collaboration. The relationship with NOAA/USNWS is key and the US is a significant partner in the region, acting as a coordinating entity between the WSOs in the ROP, Republic of the Marshall Islands (RMI) and the Federated State of Micronesia (FSM) under the COFA agreement. There are regular Micronesia Managers Meetings chaired by USNWS which provide coordination of activities and priorities in the region and represent strong ongoing collaboration between the WSOs. NOAA provide training opportunities in meteorology, forecasting and management through in-person training courses run out of either Hawaii or Guam offices.

The Secretariat of the Pacific Regional Environment Programme (SPREP) is the regional organisation established by the Governments and Administrations of the Pacific charged with protecting and managing the environment and natural resources of the Pacific. The Headquarters is based in Apia, Samoa with other SPREP offices in Fiji, RMI and Vanuatu. SPREP's mandate is to promote cooperation in the Pacific region and provide assistance in order to protect and improve its environment and to ensure sustainable development for present and future generations. The Pacific Meteorological Council (PMC) is a specialized subsidiary body of SPREP, established in August 2011 to facilitate and coordinate the scientific and technical programme and activities of the regional meteorological services. The PMC provides policy relevant advice to the SPREP on the needs and priorities of its member countries and territories in relation to meteorology. SPREP / PMC could serve as an important partner in the SOFF implementation phase, providing the opportunity to coordinate training programmes at a regional level, enabling efficiencies in the design and commissioning of the training programmes and enabling access to ongoing refresher training for SOFF countries in the region.

WSO Palau also maintains relationships with a variety of other stakeholders including: the Climate and Oceans Support Programme in the Pacific (COSPPac) with the Australian Bureau of Meteorology (BoM): the Pacific Islands Ocean Observing System (PacIOOS); the Japanese Meteorological Agency (JMA); the Taiwan Meteorological Service; the University of Hawaii Sea Level Centre; Pacific Research on Island Solutions for Adaptation (PACRISA); Palau International Coral Reef Centre (PICRC); Pacific Islands Climate Outlook Forum (PICOF); and the Coral Reef Research Foundation (CRRF). The WSO also has access to a UNESCO (United Nations Educational, Scientific and Cultural Organization) partnership in collaboration with NEMO relating to the International Tsunami Information Centre (ITIC), enabling provision of tsunami warnings to the Palau public based on outputs received.

2.3. Effective partnerships in place with international climate and development finance partners.

As noted in Section 1.5, Palau WSO has had significant success with partner projects as articulated above. Of particular currency is the ongoing Green Climate Fund (GCF) funded UNEP Enhancing Climate Information and knowledge Services for resilience in 5 island countries of the Pacific Ocean (CIS-Pac5) project, which is under way for Palau and neighbouring Pacific countries (Cook Islands, Niue, Tuvalu and RMI). The project includes the deployment of various observing infrastructures, also absorbing previous UNDP-implemented AWS investments. The project has been developed with GBON compliance as a core part of the design of the instrumentation in partnership with the National Institute of Water and Atmospheric Research (NIWA). BoM are also operating as a partner in this

project, providing the Climate Data for the Environment (CliDE) database as well as communications systems and data processing.

This programme will seek GBON sustainability funding in Palau through SOFF going forwards, along with the proposals for other SOFF beneficiary countries in the region (notably RMI). This includes consideration for alignment with respect to instrumentation, training and the full data processing chain. As part of SOFF investment, international data sharing via WIS2.0 will be implemented where this has not been delivered by CIS-Pac5. There is also scope for the establishment of a regional calibration and supply centre in Fiji funded via the Weather Ready Pacific (WRP) initiative which could provide calibration services to all SOFF nations in the Pacific region. This would enable access to high quality calibration equipment and centralized expertise to all NMHSs in the region, where a distributed approach across the islands would be challenging to implement. This could be coordinated through regional organisations such as SPREP in recognition of the increasing need for calibration across the region.

2.4. New or enhanced products, services or dissemination techniques or new uses or applications of existing products and services that culminated from these relationships.

New product and service development is limited within the COFA framework, but WSO Palau has been involved in developing a number of outputs via previously outlined projects and partnerships including: monthly rainfall updates; weekly agromet updates; and weekly ocean and climate updates. WSO has also become the secondary operator for the Palau tsunami alert system (siren) when NEMO is not open (at night), testing operation monthly. SOFF implementation is expected to include the establishment of connectivity to WIS 2.0 from AWS stations implemented by successive UNEP and UNDP projects and underpinning training/capacity development of WSO staff to achieve this outcome.

Summary score, recommendations, and comments for Element 2

Palau is assessed as **Maturity Level 3** on the CHD scale – ***Moderately effective partnerships but generally regarded as the weaker partner in such relationships, having little say in relevant financing initiatives***

RECOMMENDATIONS:

- WSO Palau should promote the benefits of their work to national government and further strengthen and exploit national and regional partnerships
- The WSO should continue to collaborate with international partners such as SPREP/PMC on Weather Ready Pacific in terms of new regional facilities and opportunities to introduce enhanced prods and services.

Element 3: Observational infrastructure

3.1. Average horizontal resolution in km of both synoptic surface and upper-air observations, including compliance with the Global Basic Observing Network (GBON) regulations.

Only 6 hourly manual observations are received from the single WSO Palau Koror/Airai location presently against a national GBON target of 3 stations. WSO Palau currently directly operates a main network of 4 hourly Automatic Weather Stations (AWSs) supplied by UNDP and Palau Disaster Preparedness and Improved Infrastructure project supplied between 2018-2022, though GBON compliance has not achieved where these are not connected to WIS 2.0. This is expected to be supplemented by the CIS-Pac5 investment in a further 4 stations. The existing Upper Air (UA) observation in Palau (national target = one station) is supported by the USNWS and currently undertakes 2 radiosonde launches daily, largely meeting the GBON temporal requirement. With a land area of about c.466 km2 spread over the islands, resolution for the single current surface and UA stations sharing data internationally is therefore 466km2 per station; Palau's large exclusive economic zone (EEZ), however, lends itself to an average horizontal resolution over sea of c.600,000 km2 for these stations.

3.2. Additional observations used for nowcasting and specialized purposes.

There are a range of third-party surface observations available across Palau. The Coral Reef Research Foundation (CRRF) established an autonomous weather station on Ngeanges Island in the Central Rock Islands in 2007. The station is on a 40ft (12m) tower on top of a 100ft (30m) rock island where there is no ideal site in the Rock Islands due to the topography. The University of California San Diego's (UCSD) Scripps Institution of Oceanography (SIO) has also provided 5 XMet autonomous weather stations. The Xmet data is not currently shared via the GTS/WIS 2.0 and is only available via an online webpage. Two of these stations are located in the remote South West Islands at Sensorol (which has an existing GOS General nomination on OSCAR) and Hatohobei (Tobi; currently RBON nominated). Sensorol is recommended to be used for a GBON site if arrangements with UCSD can be made within the duration of the proposed SOFF project, noting a desire to reuse existing infrastructure where possible.

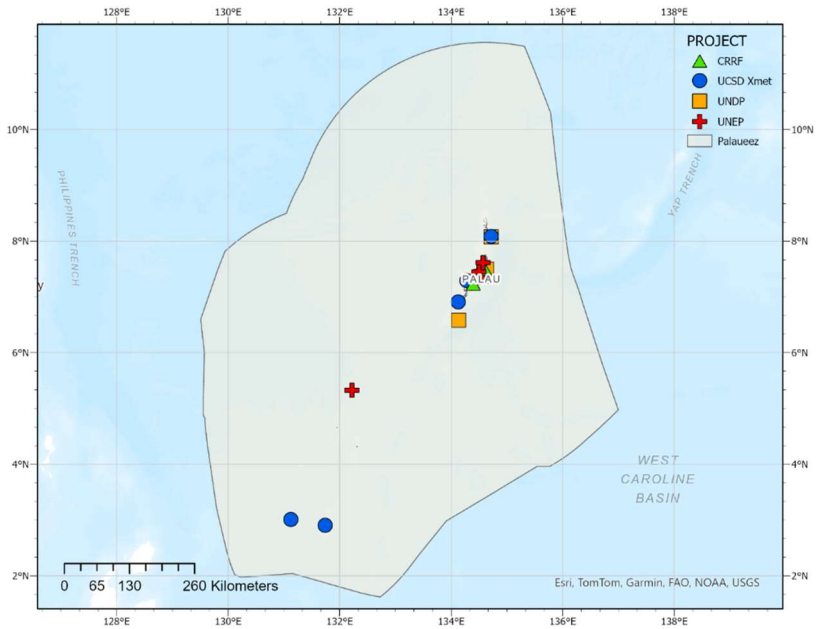


Figure 3 – Map of all operational and planned surface observations in Palau (EEZ shown in yellow)

Palau relies upon a number of other additional third party observations including: Palau International Airport METAR observations in Airai; cooperative observers; WSO hourly rain gauges; and Taiwan-funded rain gauges and CCTV. New weather radar data is expected to be available in the future via the CIS-Pac5 project. Palau also has an existing network of marine observations, from a variety of partners, including: surf observers; waverider buoys; and an University of Hawaii sea level centre tide gauge at Malakal. However, there is a continuing need for improved coverage to better represent the marine EEZ.

3.3. Standard Operating Practices in place for the deployment, maintenance, calibrations and quality assurance of the observational network.

Station Duty Manuals (SDMs) and checklists for WSO services and equipment are provided through USNWS at the operational level and these are in the process of being collaboratively updated. There is no national WIGOS governance mechanism in place and National Focal Points for WIGOS, Oscar/Surface and WDQMS are via the USNWS. Local technical staff in Palau are supported by USNWS staff based in Guam and Hawaii in terms of basic maintenance, but the WSO is unable to perform regular calibration locally – calibrated equipment is provided by USNWS from mainland facilities eg the US Pressure Standards Laboratory. For proposed SOFF investment, there is potential for a future calibration arrangement to be put in place with a Regional Instrument Centre (RIC) and discussions have been undertaken for a Fiji-based SPREP facility to potentially serve Pacific nations.

A NIWA manual is in place for expected CIS-Pac5 AWSs, but SOPs for the ongoing operation of the planned GBON AWS network (including UNDP, UNEP and UCSD stations) are to be further developed under SOFF (to include connection to WIS 2.0) and owned by the proposed observation network officer position. A consultant has also been hired under the Taiwanese-funded project for the further development of other SOPs for service provision between the WSO, NEMO and other stakeholders.

3.4 Implementation of sustainable newer approaches to observations.

The majority of observations in Palau use automatic techniques – AWSs can be viewed directly by the WSO, including the 4 UNDP AWSs and UCSD stations. However, none of the current AWSs are connected to WIS 2.0 (and thus are not GBON compliant) and the only internationally exchanged observations are the manual 6 hourly observations disseminated from the main WSO Airai location via the USNWS EDIS (Email Data Input System). The growing observation network of AWSs requires connection to WIS 2.0 and sustainable ongoing maintenance for GBON compliance and SOFF is seen as a long-term funding partner for this; Palau would also benefit from additional maintenance support for marine observations within its EEZ should this become available via SOFF. The implementation of a C-band radar will bring significant benefits for the WSO and partners in terms of hydrometeorological forecasting and early warnings.

3.5. Percentage of the surface observations that depend on automatic techniques.

From a total of 13 surface observations (WSO-operated and third party), only one station is manual at the main WSO Airai site, giving a 92% automation level across the nation. However, as above, the only surface observations routinely shared internationally in real

time are manual 6 hourly SYNOPs (via EDIS) and METARS (via AFIS) from the WSO/airport location in Airai. AFIS observers are trained and certified by the WSO.

Summary score, recommendations, and comments for Element 3

Palau is assessed as **Maturity Level 3** on the CHD scale - ***Moderate network with some gaps with respect to WMO regulations and guidance and with some data quality issues***.

RECOMMENDATIONS:

- WSO Palau should fully engage with the SOFF programme to access funding to ensure sustainability of observing networks to meet national GBON targets
- The WSO should strengthen links with partner organisations where there are opportunities to access third party observations network data, clarifying data policy with eg UCSD to provide free and unrestricted sharing of GBON-nominated data.
- The WSO should review its arrangements for National Focal Points and engagement with respect to WIGOS, Oscar and WDQMS, noting that Palau is not currently a formal WMO member.

Element 4: Data and product sharing and policies

4.1. Percentage of GBON compliance – for how many prescribed surface and upper-air stations are observations exchanged internationally. Usage of regional WIGOS centres.

Land Surface SYNOP (6 hourly manual data only from main WSO GBON site) and USNWS-funded UA radiosonde data are shared globally. WDQMS shows Airai (c.4 SYNOP observations per day), and Palau as a whole, is currently not compliant for surface observations both in terms of daily output and coverage of the EEZ area of responsibility (0%). The current OSCAR-nominated stations at Tobi and Sonsorol are not presently sharing to the GTS/WIS2.0. The Koror UA station, funded by USNWS, is however currently compliant (95%+). Palau is currently not migrated to WIS 2.0 and is not transferring data using WIS 2.0 protocols; as above, the WSO continues to use the USNWS EDIS. Palau has no GHG monitoring stations currently.

4.2. A formal policy and practice for the free and open sharing of observational data.

Palau does not have a stated formal data sharing policy for free and unrestricted sharing of synoptic/BUFR observational data internationally, but WSO Palau aligns with NOAA data sharing policies (Section 6 Integrity of Scientific Activities), ensuring free flow of all forms of scientific information in accordance with WMO Unified Data Policy. As such, all observational data produced by WSO Palau (surface and upper air) is reported to the GTS via the USNWS and is openly discoverable/usable. There are no national or international agreements or interagency protocols for data exchange (noting Palau is not currently a WMO member), monitoring systems and baseline data providing for the production of all priority hazard data products, but available AWS data is shared with Weather Forecast Office (WFO) Guam. The WSO has limited capability in place for quality controlling, archiving and sharing observational data locally. Quality control is undertaken by a meteorologist at WSO level via a NWS system called MAPSO (Micro Art Paperless Surface Observations) and has a monthly output. QC of data from NOAA-supported sites is also undertaken at Pacific Region Headquarters (NWS PRHQ) regional level and at NOAA's National Centre for Environmental Information (NCEI). This QC does not apply to the AWS network, only data from WSO Palau and the 5 cooperative observing sites.

4.3. Main data and products received from external sources in a national, regional and global context, such as model and satellite data.

WSO Palau has the Japanese HIMAWARICAST satellite data system, which pulls in data directly via a satellite receiving station on the office grounds. Forecasts are received via internet/email from Guam WFO; other NOAA and WMO websites with satellite images, wave images and NWP output (eg - GFS, ECMWF; see Section 5.1) are also used by the WSO. Not all WSO staff have been trained on remote sensed data and interpretation for priority hazards. Internet bandwidth is stable at WSO Palau with a download speed of 10-50 Mbps.

Summary score, recommendations, and comments for Element 4

Palau is assessed as **Maturity Level 3** on the CHD scale - ***GBON data sharing compliance with regards to either surface or upper-air data and a data policy and practices and infrastructure in place that promote the free and open use of data for research and academic purposes as well as the in-house use of external data.***

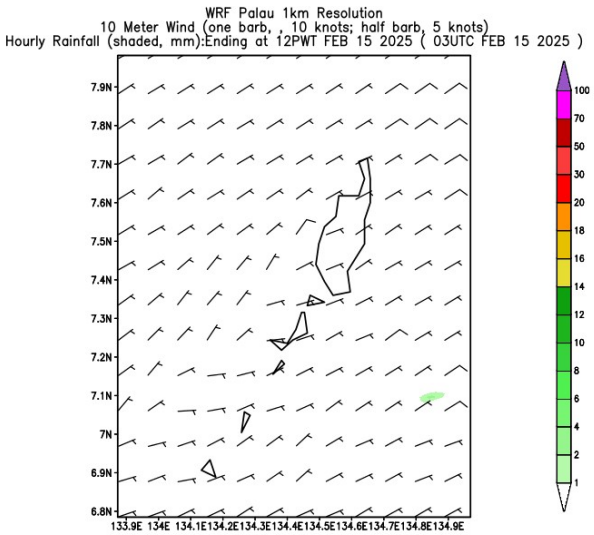
RECOMMENDATIONS:

- WSO Palau should consider formalisation of a GBON-compliant data policy within national legislation in anticipation of SOFF investment.

Element 5: Numerical model and forecasting tool application

5.1. Model and remote sensed products form the primary source for products across the different forecasting timescales.

Forecast model products are provided by WFO Guam and other NOAA websites. WSOs primarily focus on tailoring and translating direct products and guidance from WFO Guam to local circumstances – the WFO and wider USNWS base their forecasts and guidance on a suite of global models. WSOs directly receive Global Forecast System (GFS; 22km resolution every 6 hours), Weather Research & Forecasting (WRF; 3 hourly at 1, 3 and 9km resolution over the islands) and ECMWF (9km resolution every 12 hours) model data and JMA satellite imaging (eg - scatterometer, HIMAWARI datasets). WSO Palau staff also refer to the CLIME app and Windy.com for general forecast/flow interpretation. As such, modelling and other products received by the WSO are deemed sufficient for general forecasting purposes. WSO specialist staff are trained in basic interpretation and use of model and observational products and have improving access to World Meteorological Centre/Regional Centre hazard products and guidance but further capacity building in this area would be beneficial to boost meteorologist confidence. A key task is tailoring of WFO Guam guidance and products for the specific needs of local people to increase reach and accessibility.

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Coastal Waters Forecast for WESTERN MICRONESIA
National Weather Service Tiyan GU
405 PM ChST Mon Feb 3 2025

Western Micronesia Waters out to 40 nautical miles

PMZ161-032000-
Palau Coastal Waters-
405 PM ChST Mon Feb 3 2025

.TONIGHT...Northeast wind 5 to 15 kt. Wind waves 1 to 3 ft.
Northeast swell 4 to 6 ft and north 3 to 4 ft. Scattered showers and
isolated thunderstorms.
.TUESDAY...Northeast wind 10 to 15 kt. Wind waves 2 to 3 ft.
Northeast swell 4 to 5 ft and north 3 to 4 ft. Numerous showers and
isolated thunderstorms.
.TUESDAY NIGHT...Northeast wind 10 to 15 kt. Wind waves 2 to 3 ft.
Northeast swell 4 ft and north 3 to 4 ft. Scattered showers and
isolated thunderstorms.
.WEDNESDAY...East wind 10 to 15 kt. Wind waves 2 to 3 ft. Northeast
swell 4 ft and north 3 to 4 ft. Scattered showers and isolated
thunderstorms.
.WEDNESDAY NIGHT...East wind 10 to 15 kt. Wind waves 2 to 3 ft.
Northeast swell 4 ft and north 3 to 4 ft. Numerous showers and
isolated thunderstorms.
.THURSDAY...East wind 10 to 20 kt. Wind waves 2 to 4 ft. Northeast
swell 4 to 6 ft and north 4 to 6 ft. Chance of showers and slight
chance of thunderstorms.
.FRIDAY...East wind 15 to 20 kt. Wind waves 3 to 4 ft. Northeast
swell 5 to 7 ft and north 3 to 5 ft.
.SATURDAY...East wind 15 kt. Wind waves 3 ft. Northeast swell 5 to
6 ft and north 3 to 4 ft. Chance of showers and slight chance of
thunderstorms.
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Figure 4 – Examples of 1km WRF model and Coastal Waters Forecast products provided to WSO Palau by WFO Guam

These inputs contribute to the following primary WSO Palau products:

ROUTINE PRODUCTS ISSUED BY NWS WSO PALAU					
PRODUCT	**SOURCE**	**FREQUENCY**	**DURATION**	**UPDATES**	**PRODUCT DISTRIBUTION**
Coastal Marine Products	WFO Guam, PacIOOS, Others	As soon as possible	As Needed		NEMO for distribution, WSO Palau FB Page
Monthly/Daily Climate Report	WSO	Monthly	1 Month		NEMO for distribution if needed; public request if needed
Daily Forecast	WFO Guam	Daily	1 day	As needed	NEMO, NWS WSO Palau FB Page, as requested
NON-ROUTINE PRODUCTS ISSUED BY NWS WSO PALAU					
PRODUCT	**SOURCE**	**FREQUENCY**	**DURATION**	**UPDATES**	**PRODUCT DISTRIBUTION**
Tsunami Product	PTWC, WFO Guam, CISN	As soon as provided	As Needed	As Needed	NEMO for distribution; NWS WSO Palau FB Page
TC Product	JTWC, WFO Guam	As soon as provided	As Needed	As Needed	NEMO for distribution; NWS WSO Palau FB Page
Flood	WFO Guam, State Reps	As soon as provided	As Needed	As Needed	NEMO for distribution; NWS WSO Palau FB Page
Drought	PEAC, ACCESS-S, EAR Watch	Monthly, Seasonal	Monthly, Seasonal	As requested	NEMO for distribution; NWS WSO Palau FB Page

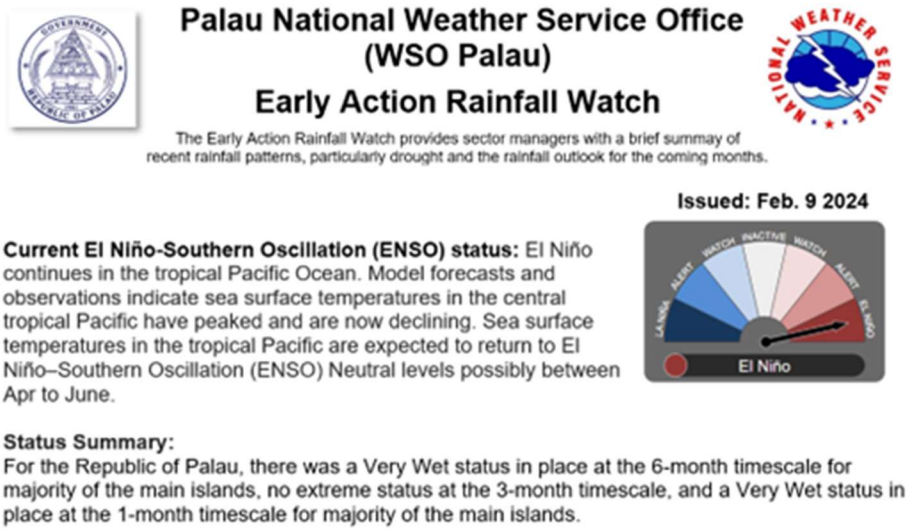
Figure 5 – Products issued by WSO Palau

5.2. a) Models run internally (and sustainably), b) Data assimilation and verification performed, c) appropriateness of horizontal and vertical resolution.

WSO Palau does not have any internal modelling capability and relies on USNWS and other partnerships to deliver model-based products, forecasts and warnings. The WSO does not have an integrated system for analysis, weather forecasting and visualisation.

5.3. Probabilistic forecasts produced and, if so, based on ensemble predictions.

No probabilistic forecasts are produced locally. Some probabilistic products are received by the WSOs from WFO Guam but forecasts produced locally are generally based on deterministic output. Use of ensemble forecast output is primarily focused on local production of probabilistic elements in multi-day rainfall forecasts and are based on USNWS NWP and products received from WFO Guam. EARwatch (Early Action Rainfall watch) products provided via BOM/OCOF are used for rainfall outlooks on longer 1-3 month/climate timescales. WSO Palau would benefit from general NWP and probabilistic forecasting sensitisation training.



Palau National Weather Service Office (WSO Palau)

Early Action Rainfall Watch

The Early Action Rainfall Watch provides sector managers with a brief summay of recent rainfall patterns, particularly drought and the rainfall outlook for the coming months.

Issued: Feb. 9 2024

Current El Niño-Southern Oscillation (ENSO) status: El Niño continues in the tropical Pacific Ocean. Model forecasts and observations indicate sea surface temperatures in the central tropical Pacific have peaked and are now declining. Sea surface temperatures in the tropical Pacific are expected to return to El Niño–Southern Oscillation (ENSO) Neutral levels possibly between Apr to June.

Status Summary:
For the Republic of Palau, there was a Very Wet status in place at the 6-month timescale for majority of the main islands, no extreme status at the 3-month timescale, and a Very Wet status in place at the 1-month timescale for majority of the main islands.

Figure 6: Example of Early Action Rainfall Watch (EARWatch) summary produced by WSO Palau

Summary score, recommendations, and comments for Element 5

Palau is assessed as **Maturity Level 2** on the CHD scale - ***Prediction based mostly on model guidance from external and limited internal sources (without data assimilation) and remoted sensed products in the form of maps, figures and digital data and cover nowcasting, short and medium forecast time ranges.***

RECOMMENDATIONS:

- WSO Palau should review skills and training in relation to interpretation of satellite and model outputs from global centres, enabling greater confidence in refining and adding local value to NWS forecasts where appropriate, notably for probabilistic ensemble outputs.
- The WSO should enhance feedback and communication with WFO Guam and wider USNWS to improve quality of local forecasts.

Element 6: Warning and advisory services

6.1. Warning and alert service cover 24/7.

WSO Palau produces public warnings and alerts 24/7 as part of the NDRMF Multi Hazard Early Warning System (MHEWS) in association with active participation in the NEC during emergencies relating to natural hazards. Tropical cyclone, drought and storm surge warnings are created by WFO Guam based on specific forecast points (against criteria defined in the WSO SDM) – the WSO highlights warnings and special weather statements to NEMO and advises on their local reformulation and dissemination. This is underpinned, in particular, by a local tropical cyclone SOP and Tsunami support plan produced with NEMO and annexed to NDRMW. The WSO adheres to agreed lead times, thresholds, communication channels and a review process for warnings issued under NDRMF, though some gaps in the full warning value chain remain (eg availability of NEMO outside of normal working hours).

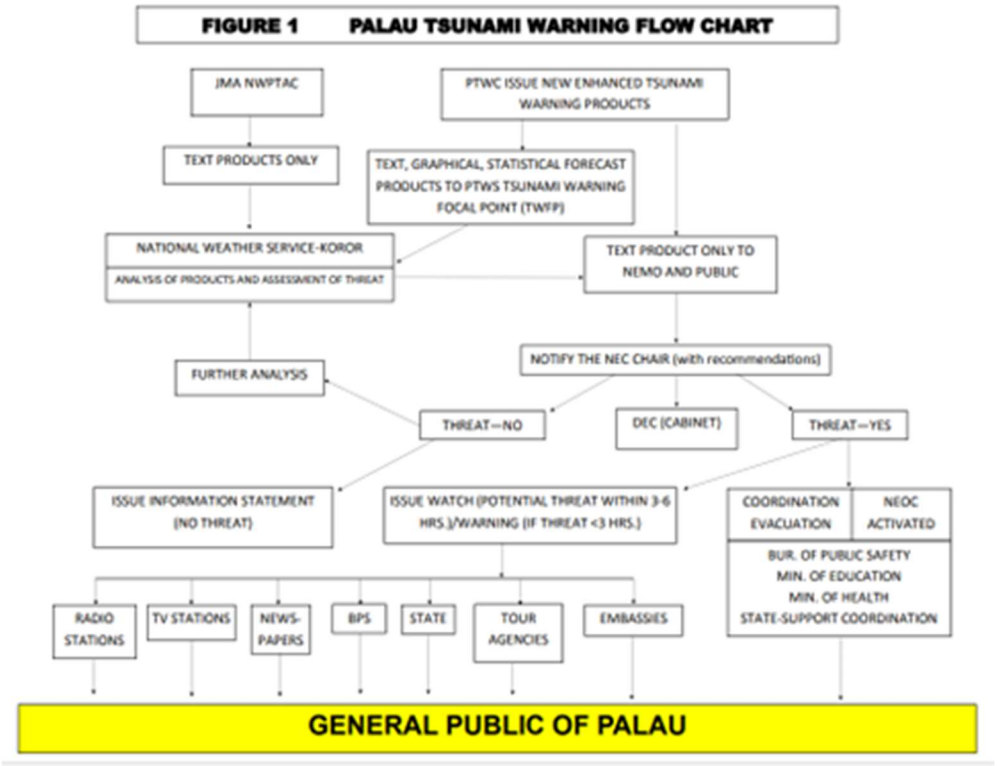


Figure 7: SDM process example of the Palau Tsunami Warning Flow Chart

6.2. Hydrometeorological hazards for which forecasting and warning capacity is available and whether feedback and lessons learned are included to improve warnings.

WSO Palau is responsible for highlighting and reformulating a range of warnings under NDRMF and maintains a 24/7 watch for incoming WFO Guam and wider US government guidance, initiating local dissemination of warning messages where required. WFO Guam issues special weather statements, advisories and warnings for Palau including:

- Typhoon warnings and guidance – warnings and products are received by WSO Palau from WFO Guam and the US Navy Joint Typhoon Warning Centre. The WSO also receives products from the Regional Specialised Meteorological Centre (RSMC)

Tokyo at the Japan Meteorological Agency (JMA), but WSO protocol is to follow US NOAA advice as primary.

- Tsunami Information Statement and Tsunami Threat Messages – received directly by fax by both WSO Palau and WFO Guam from the Pacific Tsunami Warning Centre (PTWC). Given the short response time for tsunami warning, WFO Guam calls WSO Palau directly to ensure receipt of official tsunami warnings products and prompt WSO dissemination within Palau. WSO Palau primarily inform NEMO to initiate national response; this can be more challenging outside of normal office hours though contingency contact plans are in place. It is recommended that further consideration is given by ROP government to availability of NEMO staff outside normal working hours to remedy gaps in this process in an emergency scenario. The WSO participates in Pacific Tsunami Wave Exercises to ensure readiness.
- Coastal Flood Statements and Special Weather Statements – these are for general meteorological/wave events, excluding tsunamis. There is no specific statement issued for pluvial flood events - WFO Guam will generate freeform Special Weather Statements that may discuss potential for heavy rains and landslides, etc, but there is no NOAA federal entity that specifically issues pluvial flood statements at this time for ROP. Flood prone areas are identified by the WSO with NEMO based on an inundation model that has been developed for coastal and non-coastal areas, along with use of LIDAR.

Prior to 2012 WSO also provided aviation warnings/products directly, but now only weather observation information is provided by WSO for airport observer AFIS issue.

The WSO evaluates MHEWS performance and feedback (eg on Initial Damage Assessment Report) and lessons learnt are translated into improvements in the national process. Warning QMS is only undertaken against observations, not impact; QMS training is in progress via UNEP and is planned to be implemented for weather statements. An archive system for forecasts/hazard warnings and monitoring data/metadata is partially available for verification.

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WWPQ82 PGUM 100621
SPSPQ2

SPECIAL WEATHER STATEMENT
NATIONAL WEATHER SERVICE TIYAN GU
421 PM ChST Sat Apr 10 2021

PMZ161-171-110800-
KOROR PALAU-YAP-
421 PM ChST Sat Apr 10 2021

...DISTURBANCE TO BRING INCREASING SHOWERS, WINDS AND SEAS TO PALAU
AND YAP...

A broad, weak disturbance, Invest Area 94W, is centered southeast of
Yap near 4N145E. Based on available information, confidence remains
fairly low that this circulation will become a significant tropical
cyclone over the next several days. However, what is likely is that
Yap and Koror will see increasing showers, thunderstorms and gusty
winds as early as Sunday night as the system approaches these
locations. Heavy rain is possible. WFO Guam will continue to monitor
this situation for any changes and issue updated information as
needed.

Residents need to stay alert with their surroundings and up to date
with the latest information, and listen to instructions from your
local weather service office and emergency officials. The latest
local forecast can be found under WMO Header FZPQ52 PGUM and also on
the WFO Guam website: www.weather.gov/gum/MarineForecasts.
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Figure 8: Example of a Tropical Cyclone Special Weather Statement issued for Palau

6.3. Common alerting procedures in place based on impact-based services and scenarios taking hazard, exposure and vulnerability information into account and with registered alerting authorities.

Common Alerting Procedures (CAP) are in place only for ocean services (ie – tsunamis) – others have been discussed but not yet implemented. WSO has access to NEMO impact, hazard, exposure and vulnerability information in relation to its warnings in the form of hazard/risk maps. Information held in WSO registry of alerting authorities is updated.

Summary score, recommendations, and comments for Element 6

Palau is assessed as **Maturity Level 3** on the CHD scale - ***Weather-related warnings service with modest public reach and informal engagement with relevant institutions, including disaster management structures.***

RECOMMENDATIONS:

- WSO Palau should aim to implement impact-based warning evaluation in partnership with ROP government stakeholders, building on training currently being undertaken.
- The WSO should work with ROP government to consider availability of NEMO staff outside normal working hours to remedy gaps in warning processes, notably for immediate tsunami notification.

Element 7: Contribution to Climate Services

7.1. Where relevant, contribution to climate services according to the established capacity for the provision of climate services.

COFA only sponsors a defined scope of funded services. Some limited climate services (including data rescue) are undertaken by the WSO to identify long time series hazard patterns. The US National Centre for Environmental Information (NCEI) and BoM's CLIDE system archive all data, and daily observations are retained by NWS dating back to c.1950s, with daily records retained locally. The WSO has a relatively basic level of foundation systems (eg data management, monitoring, production & delivery of climate information or services), user interfaces and decision support products and services in relation to climate services. Weekly, monthly, and seasonal climate hindcast and forecast for the week ahead are produced as part of a Palau Ocean and Climate Outlook Forum across national stakeholders (see below). As above, EARwatch provides data for longer range/climatic rainfall outlooks, provided to government partners via local exchange.

Pacific Islands - Ocean and Climate Outlook Forum (OCOF) No. 208

Country: Palau

Part 1: Recent climate

TABLE 1: Monthly Rainfall

Station (include data period)	Oct-2024	Nov-2024	Dec-2024				
			Total (mm)	33%tile	67%tile	Median	Rank
	Total (mm)	Total (mm)	Rainfall (mm)				
Koror (1951-2024)	205.0	209.3	531.6	262.4	348.2	310.6	72/74

Figure 9: Example of Ocean and Climate Forum output

There is a National Climate Change Office, but it is mainly administratively focused on grants for policies, procedures and resource mobilisation as opposed to action. Palau's National Strategy outlines plans for weather, water and climate and the WSO perceive there to be demand for improved climate services from the public and aqua/agriculture departments, notably around better use of observational data to cater for various industry sectors. Under CIS-Pac5 project, there has been sector-based outreach to understand user needs for climate services, but further consultation would benefit the development of effective climate services tailored to Palau's needs.

Summary score, recommendations, and comments for Element 7

Palau is assessed as **Maturity Level 2** on the CHD scale - ***Basic Capacity for Climate Services Provision.***

RECOMMENDATIONS:

- WSO Palau should undertake consultation/outreach with ROP government and key industry representatives to identify climate requirements and potential funding sources to support the development of climate services tailored to sector needs.

Element 8: Contribution to hydrology

8.1. Where relevant, standard products such as quantitative precipitation estimation and forecasts are produced on a routine basis according to the requirements of the hydrological community.

WSO Palau delivers some operational hydrology outputs and, building on observational data from AWS and other rain gauges, produces Quantitative Precipitation Estimates (QPE) to underpin monthly total rainfall products and forecasts. Experimental Quantitative Precipitation Forecast (QPF) output for the Palau area is provided by WFO Guam, but is not currently operationally supported. Hydrological data and guidance on flooding, drought and landslides are provided to all members of the Palau Water Task Force (the WSO is included alongside NEMO, PPUC, Bureau of Public Works and Division of Fire & Rescue).

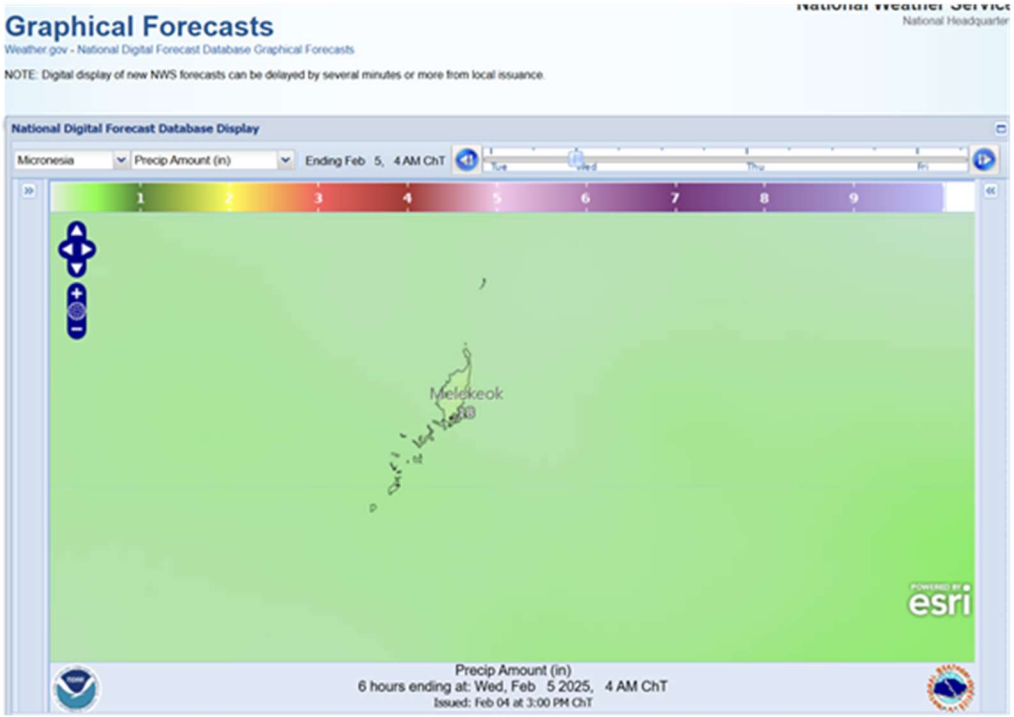


Figure 9: Example of precipitation amount graphical output received by WSO Palau from WFO Guam

8.2. SOPs in place to formalize the relation between Met Service and Hydrology Agency, showing evidence that the whole value chain is addressed.

The ROP NDRMF (and the Palau Water Task Force within that context) is the national platform coordinating disaster risk reduction in relation to hydrological matters. There is no single formal hydrology agency in Palau but the Palau Public Utility Corporation (PPUC) and Environmental Quality Protection Board (EQPB) are responsible for hydrology including data collection, forecasting and water resources assessment activities. In practice, WSO Palau delivers hydrological services to the Palau Water Task Force community and the SOP for this is defined in the NDRMF. There is potential for enhanced understanding of the hydrological value chain, notably with PPUC who maintain water reservoirs.

8.3. Data sharing agreements (between local and national agencies, and across international borders as required) on hydrological data in place or under development.

There are no formal data sharing agreements currently in place in-country, but WSO Palau shares data as required under the NDRMF.

8.4 Joint projects/initiatives with hydrological community designed to build hydrometeorological cooperation.

Palau's Water Task Force has regular meetings during the drought watch period of the year, with water preservation warnings issued by WSO Palau with PPUC. Flood management is being developed via PALARIS (Palau Land and Resource Information System) with new/updated topography & LIDAR data.

Summary score, recommendations, and comments for Element 8

Palau is assessed as **Maturity Level 2** on the CHD scale - ***Meteorological input in hydrology and water resource management happens on an ad hoc basis and or during times of disaster.***

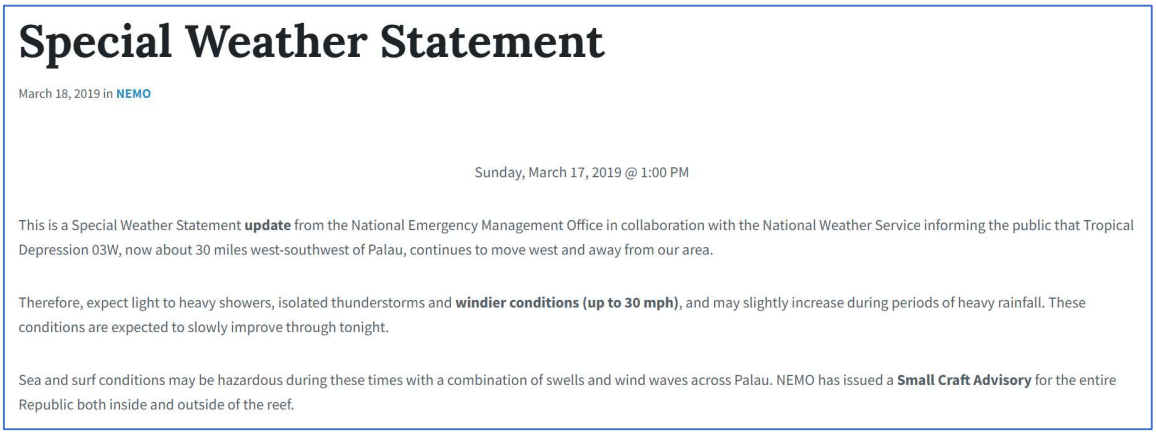
RECOMMENDATIONS:

- WSO Palau should formalise the data sharing agreement between the WSO, the PPUC and the wider Palau Water Task Force under the NDRMF, recognising a potential leading role in hydrological matters for the WSO within ROP government.

Element 9: Product dissemination and outreach

9.1. Channels used for user-centred communication and ability to support those channels (for example, does the NMHS operate its own television, video or audio production facilities? Does it effectively use cutting-edge techniques?).

NDRMF/NEMO warnings (forwarded and augmented by WSO Palau from WFO Guam) are publicised primarily via Facebook, public website, television, radio and SMS. Daily forecasts from the WSO go out to the public on government radio, SMS, and Facebook, with emails sent to relevant agencies; the Chamber of Commerce also forwards on to stakeholders. Tsunami sirens are positioned all over Palau, activated through NEMO, secondarily through WSO. Under the CREWS project, bells were also provided at certain locations in each state for evacuation warnings.



Special Weather Statement

March 18, 2019 in **NEMO**

Sunday, March 17, 2019 @ 1:00 PM

This is a Special Weather Statement **update** from the National Emergency Management Office in collaboration with the National Weather Service informing the public that Tropical Depression 03W, now about 30 miles west-southwest of Palau, continues to move west and away from our area.

Therefore, expect light to heavy showers, isolated thunderstorms and **windier conditions (up to 30 mph)**, and may slightly increase during periods of heavy rainfall. These conditions are expected to slowly improve through tonight.

Sea and surf conditions may be hazardous during these times with a combination of swells and wind waves across Palau. NEMO has issued a **Small Craft Advisory** for the entire Republic both inside and outside of the reef.

Figure 9: An example of NEMO/WSO Palau Special Weather Statement via the PalauGov.pw website

9.2. Education and awareness initiatives in place.

School outreach programmes and emergency plans are in place for schools, with drills held every quarter. The Palau Red Cross, NEMO and WSO Palau meet every quarter with state governors, legislators and the community to review operational matters and outreach. Educational information is disseminated to each state; state disaster plans continue to be a work in progress currently and ongoing training of new staff in understanding WSO outputs would be beneficial.

9.3. Special measures in place to reach marginalized communities and indigenous people.

The NEC communicates warnings to remote island communities and the WSO facilitates translation to local language to increase reach and accessibility. Under state disaster plans, consideration and recognition is given to elderly and disabled persons. Palau Red Cross has identified elderly and at-risk groups in households for emergency preparedness and evacuation since 2010 and this feeds into WSO considerations. WSO Palau should consult stakeholders and the public to understand how to better undertake outreach activities to better reach remote or marginalised communities.

Summary score, recommendations, and comments for Element 9

Palau is assessed as **Maturity Level 3** on the CHD scale - ***A moderately effective communication and dissemination strategy and practices are in place, based only on in house capabilities and supported by user friendly website. It is recommended that further outreach and communication activities are undertaken as outlined in the SOFF National Contribution Plan for Palau.***

RECOMMENDATIONS:

- WSO Palau should consider how they might develop communication materials/outreach to overcome language barriers and reach remote or marginalised communities.
- The WSO should work with Palau government to implement sensitisation training for new ROP government staff to ensure effective use of WSO Palau products and services.

Element 10: Use and national value of products and services

10.1. Formalized platform to engage with users in order to co-design improved services.

WSO Palau is a member of the NEC and coordinates a semi-annual/annual mechanism for the design of products and services tailored to the national need in collaboration with NEC members, state representatives and other stakeholders. The Palau WSO Strategic Plan was a result of a government-wide consultation in 2022, though the government still need to formally approve this. A national Palau Climate Outlook Forum is held in Palau every year - this started via UNEP funding. Feedback from communities and agencies across sectors (agriculture, water) has led to modification of separate Early Action Rainfall Watch (EARwatch) and agromet water products. State visits and an education / awareness program informs new products and services, gathering feedback. The WSO also maintains other engagement channels including Facebook posts, telephone recordings and email. No socioeconomic studies have been undertaken of the value of WSO Palau outputs to this community.

10.2. Independent user satisfaction surveys are conducted, and the results used to inform service improvement.

Facebook polls are used by the WSO to gather ad-hoc comments and feedback from public, leading to the development of new products / services where required. WSO regularly reviews this input and reports on the accuracy and timeliness of its services. WFO Guam also routinely review and report on the accuracy and delivery of their underlying US-sponsored services.

10.3. Quality management processes that satisfy key user needs and support continuous improvement.

An overview of the QC process for observations is described in Section 4.2 – currently this has a limited role in continuous improvement locally. WSO operates QMS for weather observations and service delivery and undertakes climate data management/QC via the MAPSO (Micro Art Paperless Surface Observations) application. Further development of a more robust local QMS system for warnings and observations would be beneficial, potentially via SOFF. There is no relevant QMS reporting for marine or aviation services; the latter as this requires US Federal Aviation Authority (FAA) endorsement.

Summary score, recommendations, and comments for Element 10

Palau is assessed as **Maturity Level 2** on the CHD scale - ***Service development draws on informal stakeholder input and feedback.***

RECOMMENDATIONS:

- WSO Palau should consider implementing routine formal user feedback questionnaires to improve the products and services.
- The WSO should look to implement a more robust local QMS and associated capacity building/ training via projects such as SOFF (observations)

Annex 1 Consultations (including experts and stakeholder consultations)

Meetings were held with the Meteorologist in-Charge WSO Palau (Maria Ngemaes) with the support of Eric Lau and Brandon Bukunt of USNWS

Annex 2 Urgent needs reported

The most urgent needs for WSO Palau, is to develop the following service areas beyond the current scope of COFA USNWS-funded services:

- Climate & hydrological services
- The governance context, data sharing and understanding the national value of products and services provided by the WSO
- Observing and service infrastructure across the Republic of Palau

Annex 3 Information supplied through WMO

The peer adviser acknowledges the guidance provided by SOFF in documents and templates throughout the Readiness phase, notably the CHD EW4All Datasheet for Palau, which established a useful baseline prior to subsequent discussions with stakeholders on mission.

Annex 4 List of materials used

The peer adviser utilised the following materials:

- Interview data, in person contributions and personal communication provided during the drafting of this report.
- Various WSO Palau materials including: Compacts of Free Association (COFA) for Palau; ROP NDRMF Implementation and Strategic Plans & Annexes.
- Web pages of WSO Palau (https://www.weather.gov/gum/WSOPalau).
- Online material provided as links in this document.