

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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Federated States of Micronesia NMHS

Peer Review Report

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Authorisation for release of this report has been received from the Peer Reviewing Agency and the Country NMHS.

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Glossary

APCC	Asia-Pacific Climate Centre
ATC	Air Traffic Control
AWS	Automatic Weather Stations
BOM	Bureau of Meteorology
BUFR	Binary Universal Form for the Representation of meteorological data
CLiDE	Climate Data for Environment
COFA	Compact of Free Association
COP	Conference Of the Parties
COSPPAC	Climate & Oceans Support Programme in the Pacific
CCS	Chuuk Conservation Society
CMC	Chuuk Women's Council
CPUC	Chuuk Public Utility Corporation
CREWS	Climate Risk and Early Warning Systems
CRS	Catholic Relief Service
CSO	Civil Society Organisation
DCO	Disaster Coordination Office
DECEM	Department of Environment, Climate change & Emergency Management
ECMWF	European Centre for Medium range Weather Forecasts
EEZ	Exclusive Economic Zone
ENSO	El Nino Southern Oscillation
FAA	Federal Aviation Authority
FINPAC	Finnish-Pacific project
FMI	Finnish Meteorological Institute
FSM	Federated States of Micronesia
GBON	Global Basic Observing Network
GCF	Green Climate Fund
GFS	Global Forecast System
ICT	Information and Communications Technology
IOM	International Organisation for Migration
JMA	Japan Meteorological Agency
KMA	Korea Meteorological Administration
METAR	METeorological Aerodrome Report
MHEWS	Multi-Hazard Early Warning System
MoU	Memorandum of Understanding
NCEI	National Centres for Environmental Information
NFP	National Focal Point
NIWA	National Institute of Water and Atmospheric Research
NMHS	National Meteorological & Hydrological Service
NOAA	National Oceanic and Atmospheric Administration
NWSPRH	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
PIMS	Pacific Island Meteorological Strategy
PMC	Pacific Meteorological Council
PTWC	Pacific Tsunami Warning Centre
PUC	Pohnpei Utility Corporation
QMS	Quality Management System
QPE	Quantitative Precipitation Estimate
QPF	Quantitative Precipitation Forecast
RMI	Republic of the Marshall Islands
SDM	Station Duty Manual
SEB	Socio-Economic Benefit
SOFF	Systematic Observations Financing Facility
SOP	Standard Operating Procedure
SPREP	Secretariat of the Pacific Regional Environment Programme
TAF	Terminal Aerodrome Forecast
UA	Upper Air
UNFCCC	United Nations Framework Convention on Climate Change
USNWS	United States National Weather Service
WDQMS	WMO Data Quality Management System
WFO	Weather Forecast Office
WIGOS	WMO Integrated Global Observing System
WMO	World Meteorological Organisation
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 Federated States of Micronesia (FSM) national context. FSM currently has maturity scores ranging closely between 1 and 2 across the ten value chain elements – key gaps are identified and remedial recommendations offered. The Weather Service Offices (WSOs) in FSM are unusual in comparison to some other Small Island Developing States (SIDS) NMHSs in relation to their support from the US National Weather Service (USNWS) via the Compact of Free Association (COFA), providing a stable basis for foundation weather services. However, the main services are limited in scope, especially in relation to the understanding and communication of the value of WSO products and services to users, and thus the WSOs continue to require support to further develop service capability of benefit to FSM.

Key focus should include, in particular, consideration of:

- 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 FSM
- Climate & hydrological services

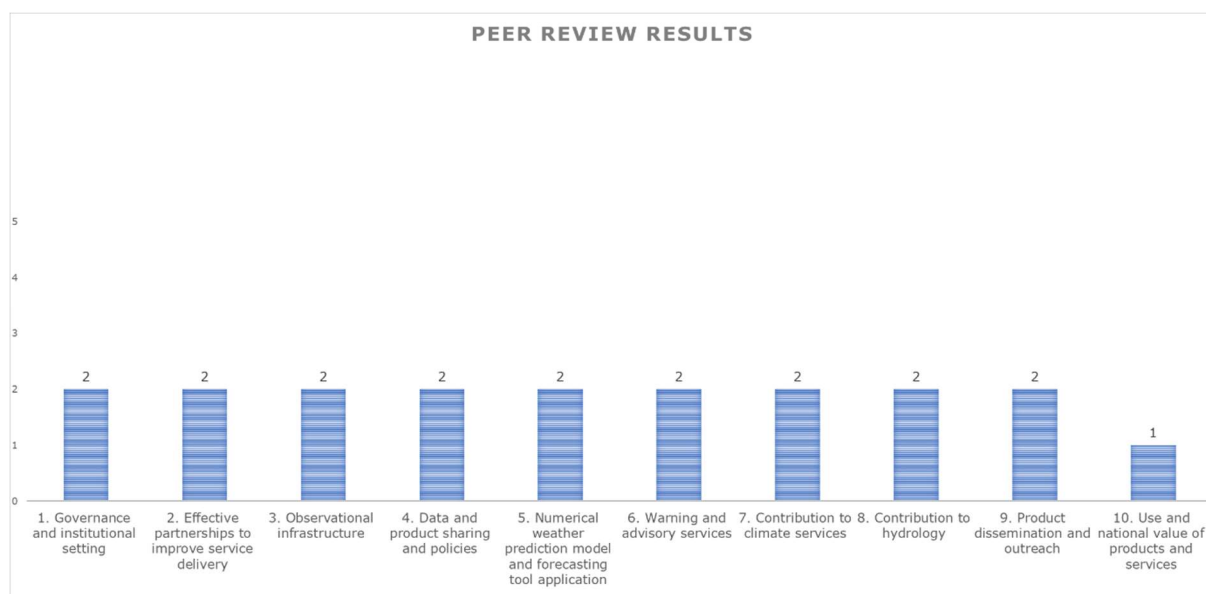


Fig 1: Summary of Maturity Level Assessment for the National Meteorological Service of the Federated States of Micronesia

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

Table 1: Summary of Maturity Level Assessment of National Meteorological Service of the Federated States of Micronesia 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. 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:

- FSM WSOs should continue to work with FSM and State governments and partners to sustainably strengthen resourcing and thus meet national needs with respect to protection of life and property.
- WSOs should achieve formal endorsement of the CREWS-funded strategy with FSM government and further progress the legal status of the WSOs within the national context.

Effective Partnerships to Improve Service Delivery:

- FSM WSOs should promote the benefits of their work to national and state governments and ensure a consistent mandate for sustainable services provision across all states.
- WSOs should aim to increase reach and accessibility (language, culture) activities in relation to warning and weather messages, eg enhanced Facebook communication and engagement with traditional community structures

Observational Infrastructure:

- FSM WSOs should fully engage with the SOFF programme to access funding for new automated surface observations and additional radiosonde observations to meet national GBON targets
- WSOs should strengthen links with partner organisations where there are opportunities to access third party observations network data
- WSOs should review its arrangements for National Focal Points and engagement with respect to WIGOS, Oscar and WDQMS.

Data & Product Sharing & Policies:

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

Numerical Model & Forecasting Applications:

- FSM WSOs should review skills and training in relation to interpretation of sat and model outputs from global centres, enabling greater confidence in refining and adding local value to NWS forecasts where appropriate.
- WSOs should enhance feedback and communication with WFO Guam and wider USNWS to improve quality of local forecasts.

Early Warning and Advisory Services:

- FSM WSOs should aim to initiate regular reviews of warning performance, both internally and based on third party feedback where possible.
- WSOs should work with FSM/State governments or private organisations/individuals to encourage funding for greater local observing infrastructure eg more representative and automatic rain gauges to enhance local warning tailoring

Contribution to Climate Services:

- FSM WSOs should undertake consultation/outreach to key stakeholders and engage with FSM government to identify climate requirements and potential funding sources to support the development of tailored climate services.
- WSOs should consider implementing dedicated specialist climate staff, potentially funded via SOFF or other initiatives; capacity building of skills and experience should also include the DECEM national climate focal point to enhance understanding of climate risks in government.

Contribution to Hydrology:

- FSM WSOs should formalise the relationship and SOPS between the WSOs and Utility companies and FSM/State governments, recognising potential leading role in hydrological matters for the WSOs within FSM government.

Product Dissemination & Outreach:

- FSM WSOs should consider how they might implement further outreach and communication activities to reach remote or marginalised communities.
- WSOs should work with FSM/State governments to influence local TV stations or other forms of telecoms/technology to host WSO forecast/warning messaging.

Use of National Products and Values:

- ABMS should consider as part of their strategy refresh how QMS, user satisfaction and the needs of users can be reasonably consulted and accommodated within the context of the national scenario.

Chapter 1: General information

Introduction

Overview

The Federated States of Micronesia (FSM) is a grouping of 607 small islands in the Western Pacific, south of the US territory of Guam and c.2,500 miles southwest of Hawaii, lying just above the Equator. While the FSM's total land area is relatively small at almost 271 square miles (702 km²), the country's waters occupy nearly 1.2 million square miles (c.3 million km²) of the Pacific Ocean, giving the country the 14th-largest Exclusive Economic Zone (EEZ) in the world.

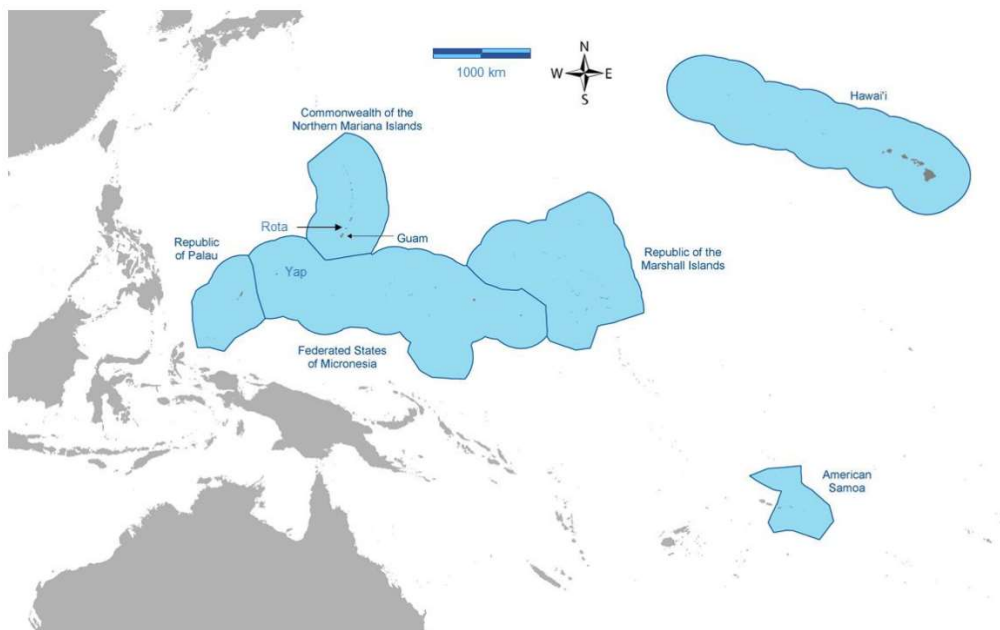


Figure 2: Map of the Exclusive Economic Zones of US-affiliated Pacific Islands. Reproduced by permission from Pacific RISA, US National Oceanic and Atmospheric Administration, pacificrisa.org.

FSM has four States: Yap, Chuuk, Pohnpei and Kosrae, each centred around one or more "high islands". All but Kosrae include numerous atolls. The nation's capital is Palikir, located on Pohnpei Island, while the largest city is Weno, located in the Chuuk Lagoon. Yap State is made up of 4 large islands, 7 small islands and 134 atolls, with a total land area of 45.6 square miles. Chuuk State has a total land area of 49.2 square miles and includes seven major island groups. Pohnpei State has 133.4 square miles of land area, of which c.130 is accounted for by Pohnpei island, the largest in FSM. Kosrae is essentially one high island of 42.3 square miles.

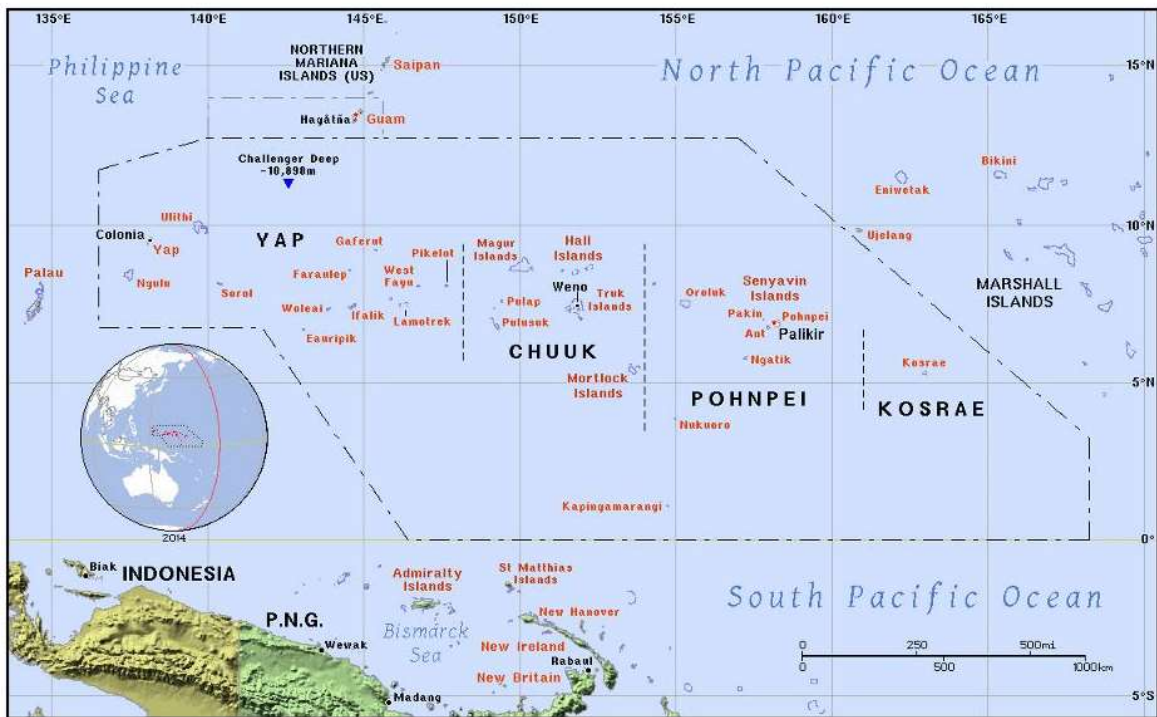


Figure 3: Map of FSM courtesy © Copyright 2024 Mapsland

Climate & Natural Hazards

As per Wikipedia: "FSM has a tropical rainforest climate: the weather is warm, humid and rainy all year round. The islands are located north of the equator and are affected by constant trade winds, which temper the climate – this can be affected by year-to-year ENSO variation. Minimum temperatures range all year round between 22 and 25°C, with maximum temperatures between 30 and 32°C. Precipitation oscillates between 2,500 and 5,000mm per year, although they can surpass 6,000mm. Mount Nahnalaud, 750m high on the island of Pohnpei, receives an average of 10,160mm, being one of the rainiest places on earth, almost always with overcast skies. In general, rains are produced by short, but very intense showers and storms. The driest places are the flat atolls, where rainfall can drop below 3,000mm. The driest months are January and February, with a minimum of 250mm and 20 days of rain."¹

The National Meteorological Service of FSM

Operational meteorological services are provided in FSM via the WSOs in Pohnpei, Chuuk and Yap, 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. FSM WSOs work in step with USNWS across all their operations, and in particular with respect to provision of funding, technical and logistical support for 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 [Federated States of Micronesia - Wikipedia](#)

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

There is no national legislation outlining responsibility for measuring and providing weather observations or forecast services in FSM. However, the mandate and primary areas of responsibility are defined by the Compact of Free Association (COFA), signed by FSM and the United States of America (USA) in 1986. This treaty requires the USA to provide three main services for FSM, one of which is the meteorological service. USNWS deliver weather services and associated programs (including observations) throughout the nation in line with COFA's Article VII (Weather Services and Associated Programs). According to Sections 5 to 13 of Article VII of COFA, the USNWS provides weather services through a WSO created in Yap, Chuuk and Pohnpei. 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 FSM via a contract between the USNWS and the Government of the Federated States of Micronesia.

Beyond COFA, the WSOs in each state report to the FSM Vice President and there is a Memorandum of Understanding (MoU) between the separate WSO offices and the state governments. WSO Pohnpei acts as the main national office, differing slightly in constitution to other WSOs, and has been part of the UNFCCC Conference of the Parties (COP) negotiation team. There is an ambition within the FSM WSO Strategic Plan (not yet endorsed by the President) to have the weather service more formally recognised within the structure of FSM government, possibly within the Department of Environment, Climate Change & Emergency Management (DECHEM). There is no overarching Multi-Hazard Early Warning Services (MHEWS) Act in FSM but the WSOs are recognized as the national alerting authority for hydrometeorological hazards and have warning responsibilities for 5+ main hazards. In terms of aviation services, the WSOs only provide METAR observations for ATC and train airport observers – there are no forecast services provided, with TAFs provided by Guam Weather Forecast Office (WFO). FSM WSOs routinely provide air samples via WMO programmes.

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

A strategic plan for WSO FSM was developed under a Climate Risk and Early Warning Systems (CREWS) project in 2022. The draft strategic plan is currently under review by FSM central government and has not yet been approved or implemented – there is no current timeline for approval, but this is expected to be revisited as part of SOFF investment.

Main priorities within the strategic plan include: improvement of communications for MHEWS; differentiation between climate change and severe weather that FSM are already experiencing and how this can be attributed/harnessed for MHEWS; and improvement on hydrological forecasting alongside meteorology. Given the significant change in the operational capabilities, responsibilities and need for future planning represented by the SOFF initiative in order to achieve GBON compliance in FSM, WSO FSM have indicated that the strategic plan may require update and revision to reflect the changing nature of WSO

operations. No formal national operational or risk management plans are in place, but Station Duty Manuals (SDMs) are provided through USNWS.

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 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. The existing upper air stations in Yap, Chuuk and Pohnpei are funded through USNWS including the costs associated with maintenance, spares and repairs. Local technical staff in FSM are supported by USNWS staff based in Guam and Hawaii. There is limited scope for ongoing capacity development under the current budget - periodically there are capacity building project opportunities that arise, generally via DECEM, but these do not come via the COFA route.

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.

FSM currently has 29 staff spread across the 3 WSOs according to the following structure (including gender ratio):

FSM WSO Office	Pohnpei	Chuuk	Yap	TOTAL
Official in Charge	1	1	1	3
Administrative Specialist	1			1
Staff Meteorologist		1		1
Supervisory Weather Service Specialist	1	1	1	3
Weather Service Specialist	5	5	3	15
Electronic Programme Specialist	2	1	2	4
Facility Technician	1	1	1	3
TOTAL	11	10	8	29
Gender ratio (M/F)	10/1	9/1	7/1	26/3

Figure 4: Table of WSO staff positions and gender balance across FSM WSOs

The full complement should be 37 staff across all the WSOs, thus 8 positions are currently unfilled. 6 staff (3 in Chuuk, 2 in Yap and 1 in Pohnpei) are within 2-3 years of the expected retirement age of 60, indicating a potential need to undertake succession planning to compensate for loss of skills and experience (*note that retirement at 60 is not mandatory in FSM).

WSO staff are well trained via staff competency frameworks determined by COFA/USNWS; certification of staff is via NOAA and the University of Hawaii. NOAA provide training opportunities in meteorology, forecasting and management through in-person training courses run out of either Hawaii or Guam offices. The two primary training courses currently being offered by NOAA are 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 focussed on meteorology and forecasting.

Ongoing training and development for ICT applications is also required in relation to the need to support direct GBON data dissemination to WIS 2.0, with an ambition to establish dedicated ICT staff positions. FSM surface observations are not currently GBON-compliant (not automated and submitting hourly to the GTS or WIS 2.0) and this is expected to be addressed within a funding proposal for SOFF support. It is intended in the longer term that the regional Weather Ready Pacific programme and the Pacific Meteorological Council (PMC) may also be able to contribute to support ICT training of FSM staff, alongside more general training available for meteorology, hydrology and electronics. This would be expected to be achieved via accredited courses facilitated through a regional training facility in Fiji supplemented by on-line and twinning initiatives.

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

WSO FSM are aiming to secure SOFF funding and have participated in other regional international projects in recent years including:

- Climate Risk and Early Warning Systems (CREWS): A Strategic Plan for the WSOs has been developed (awaiting official FSM government sign off) via the [Strengthening Hydro-Meteorological and Early Warning Services in the Pacific \(CREWS Pacific SIDS 2.0\)](#). A CREWS [Green Climate Fund \(GCF\) scale up project](#) involving FSM for early warning was also initiated in June 2024 - no funding or capacity development has been received as yet.
- [Tsunami Ready Programme](#): FSM WSOs have been engaged in tsunami readiness capacity development activities and are now responsible for Tsunami warnings, supporting disaster managers in FSM government at individual State level. The WSOs have received training and coordination from the US National Weather Service Pacific Region Headquarters (NWSPRH) in order to respond to warnings issued by the Pacific Tsunami Warning Centre (PTWC) – Chuuk and Pohnpei WSOs are fully capable, Yap is in progress (Kosrae has no WSO currently so is supported by WSO Pohnpei).
- [Climate and Ocean Support Program for the Pacific \(COSPPac\)](#): Established a Pacific Island Climate Outlook Forum in FSM including development of an Early Action Rainfall Watch (EARWatch). WSO staff take part in these project activities and have incorporated training and development within WSO capability.

Summary score and recommendations for Element 1

FSM is assessed as **Maturity Level 2** on the CHD scale – **effort ongoing to formalize mandate, introduce improved governance, management processes and address resource challenges.**

RECOMMENDATIONS:

- FSM WSOs should continue to work with FSM and State governments and partners to sustainably strengthen resourcing and thus meet national needs with respect to protection of life and property.

- WSOs should achieve formal endorsement of the CREWS-funded strategy with FSM government and further progress the legal status of the WSOs within the national context.

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. USNWS are a significant partner in the wider Pacific region and act as a coordinating entity between the WSOs of FSM, RMI and Palau. There are regular Micronesia Managers Meetings chaired by NWS which provide coordination of activities and priorities in the region, offering ongoing collaboration between the WSOs.

The WSOs are also strongly engaged with a number of key partners nationally in relation to service delivery, including:

FSM Government:

- FSM President's Office: The COFA agreement ensuring US funding of the WSOs is managed at this level, requiring support and engagement from the lead WSO in Pohnpei.
- Department of Environment, Climate Change and Emergency Management (DECEM): The WSOs are mandated to provide national services by the President's Office via DECEM. DECEM undertakes national disaster and mitigation planning and the WSOs are members of the National Disaster Task Force coordinated by DECEM.

State Governments:

- Disaster Coordinating Offices (DCOs): DCOs come under the mandate of the state governor, following DECEM guidance but maintaining disaster plans at the state level. The WSOs' roles and responsibilities regarding provision of warnings and advice are documented in these plans; DCOs recognise the important contribution of the WSOs and WSOs form part of the state task forces in emergency situations.
- Public Utility Corporations: Utilities provide utilities to each state and implement FSM government policy. Utilities receive rainfall data to map against reservoir levels and provides this information to the WSOs. The WSOs provide warnings and daily forecast services to aid management of rainfall data and reservoir levels. The WSOs also provide tide and marine tables for safe transportation of equipment between the islands. There is no formal agreement that covers this activity but services are well established.

The WSOs also provide informal advice where required within FSM to the International Organisation for Migration (IOM) Mission and NGOs including: the Red Cross, Chuuk Women's Council (CWC), Catholic Relief Service (CRS), Chuuk Conservation Society (CCS) and the Youth Council in FSM.

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.

FSM's WSOs maintain a range of partnerships for science and research, notably internationally. These have included: the Secretariat of the Pacific Regional Environment Programme (SPREP) and the Pacific Meteorological Council (PMC); the South Pacific Community (SPC); Asia Pacific Climate Centre (APCC); the Pacific Islands Ocean Observing System (PacIOOS) for water quality and wave buoy cooperation; the Finnish

Meteorological Institute (FMI) in relation to the Finnish-Pacific (FINPAC) project; Korean Meteorological Agency (KMA); Japanese Meteorological Agency (JMA) for HIMAWARICAST; and the University of Hawaii Sea Level Centre for tide gauge collaboration.

SPREP is the regional organisation established by governments charged with protecting and managing the environment and natural resources of the Pacific. The Headquarters is based in Samoa, with other SPREP offices in Fiji, RMI and Vanuatu. SPREP's mandate is to promote cooperation in the Pacific region and provide assistance to protect and improve its environment and to ensure sustainable development for present and future generations. PMC is a specialised 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. The PMC adopted the Pacific Island Meteorological Strategy (PIMS) 2017-2026, developed and published by SPREP. PIMS sets out the strategic context and direction for strengthening the National Meteorological and Hydrological Services (NMHSs) in the region to be able to deliver effectively their core functions on weather and climate, and to ensure they have capacity to fulfill their responsibilities over the next decade. The strategy identifies four priority areas for action: 1. Improved weather services, in particular aviation, marine and public weather services; 2. Improved end-to-end Multi Hazard Early Warning Systems (MHEWS); 3. Enhanced infrastructure (data and information services) for weather, climate and water; 4. Improved climate services.

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

FSM WSOs are currently engaged in two international programmes beyond USNWS funding of operations including:

- (1) WMO Systematic Observations Funding Facility (SOFF) to receive capacity development support and infrastructure investment to achieve GBON compliance; and
- (2) Green Climate Fund (GCF): FSM Government has yet to secure funding via this route as it was not included in the Enhancing Climate Information and Knowledge Services for resilience in 5 island countries of the Pacific Ocean (UNEP CIS-Pac5) project (which is installing observational and climate data capability in other Pacific nations). Engagement in the CREWS project has provided support and guidance to the FSM WSOs in order to better access future GCF opportunities.

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 FSM WSOs developed the current strategic plan during support from the CREWS project in 2022. New systems and processes are expected to be implemented via SOFF investment. SOFF implementation is expected to include: the installation across FSM of 13 new Automatic Weather Stations (AWSs) and 1 additional radiosonde station to meet the national GBON target; the establishment of connectivity to WIS 2.0 from those stations; and underpinning capacity development of WSO FSM staff to achieve this outcome.

Summary score, recommendations, and comments for Element 2

FSM is assessed as **Maturity Level 2** 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:

- FSM WSOs should promote the benefits of their work to national and state governments and ensure a consistent mandate for sustainable services provision across all states.
- WSOs should aim to increase reach and accessibility (language, culture) activities in relation to warning and weather messages, eg enhanced Facebook communication and engagement with traditional community structures

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.

WSO FSM currently operate a network of 13 manual surface observation sites at the 3 WSO and 10 main synoptic locations at or near airfields on the islands and atolls across FSM. With a total land mass of 702km², density per observation is 54km²; over the c.3 million km² of EEZ, density is c.230,770km². The three existing upper-air observation stations at Yap, Chuuk and Pohnpei give a density of c.1 million km² for each station across the EEZ. Some islands lack 10m wind masts and synoptic surface station reporting is generally only 6 hourly, 3 hourly on request when there's a TC forecast, thus FSM is not currently GBON compliant for surface observations, both in terms of planned and delivered observations. Twice daily observations at FSM upper air stations are generally compliant and should not require further intervention for GBON compliance.

3.2. Additional observations used for nowcasting and specialized purposes.

Some limited additional third party observations are available to the WSOs in FSM. Aviation METARs are produced in Kosrae, Pohnpei, Chuuk and Yap airports (when open) by FAA staff, certified by NWSPRH. The Pacific Islands Ocean Observing System (PACIOOS) have a marine buoy (wave-rider) in Kosrae, Pohnpei, and Yap with data available online. A Spotter wave buoy is located west of Pohnpei and Kosrae and a Korean-funded buoy on east side of Weno provides ocean data.

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 are provided through USNWS at the operational level and these are in the process of being collaboratively updated. The existing upper air stations in Yap, Chuuk and Pohnpei are funded through USNWS 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 across FSM. Local technical staff in FSM 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. 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. Quality control is undertaken at WSO level via a NWS system called MAPSO (Micro Art Paperless Surface Observations) and has a monthly output. There is no national WIGOS governance mechanism in place and National Focal Points for WIGOS, Oscar/Surface and WDQMS are via the USNWS. SOPs are to be further developed under SOFF where new AWS infrastructure is to be implemented in that project and this will be owned by a proposed observation network officer role.

3.4 Implementation of sustainable newer approaches to observations.

SOFF implementation of new stations and data management/comms techniques is expected to enhance sustainability of the observing networks. FSM is not currently GBON compliant as its 13 current manual surface stations only report 6 hourly observations via typed entry to the USNWS EDIS (Email Data Input System) and there are insufficient radiosonde data against national GBON requirements. Some station siting at airports may also be sub-optimal in terms of data quality. No current technical or human skills capability exists within FSM to enable AWS data transmission to WIS 2.0 and the US-provided MAPSO quality control capability is unsupported – note that Pohnpei WSO is unable to use MAPSO and now undertakes local manual QC. These gaps are intended to be addressed via SOFF automation of manual sites and addition of a fourth (Kosrae) station under SOFF.

3.5. Percentage of the surface observations that use automatic techniques.

The 13 surface observation sites are all manual observations (100%). Manual radiosonde launches are undertaken at the 3 upper air stations (100%). Data is manually entered to EDIS and reaches the GTS via USNWS.

Summary score, recommendations, and comments for Element 3

FSM is assessed as **Maturity Level 2** on the CHD scale - ***Moderate network with some gaps with respect to WMO regulations and guidance and with some data quality issues.***

RECOMMENDATIONS:

- FSM WSOs should fully engage with the SOFF programme to access funding for new automated surface observations and additional radiosonde observations to meet national GBON targets
- WSOs should strengthen links with partner organisations where there are opportunities to access third party observations network data
- WSOs should review its arrangements for National Focal Points and engagement with respect to WIGOS, Oscar and WDQMS.

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.

All (100%) of FSM's 3 UA stations are currently compliant, but there is no fourth radiosonde station as would meet the national compliance target. None of the 13 Surface stations are currently compliant (0%). As above, both Surface and Upper Air observations are transmitted via EDIS, involving manual entry every 6 hours of surface synoptic observations. By convention under COFA, compliance is monitored by USNWS rather than the Fiji Regional WIGOS Centre.

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

FSM does not have a formal policy for free and unrestricted sharing of synoptic/BUFR observational data internationally, but WSO FSM 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 FSM (surface and upper air) is reported to the GTS via the USNWS and is openly discoverable/usable.

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

FSM are in receipt of products from the USNWS Weather Forecast Office (WFO) Guam and have access to National Centres for Environmental Information (NCEI) climate data. Chuuk WSO has a HIMAWARICAST system that pulls satellite data directly from the JMA/HIMAWARI satellite downlink.

Summary score, recommendations, and comments for Element 4

FSM is assessed as **Maturity Level 2** on the CHD scale - ***A limited amount of GBON compliant data is shared internationally. The existing data sharing policies or practices or the existing infrastructure severely hamper two-way data sharing.***

RECOMMENDATIONS:

- FSM WSOs 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 NWS 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 9km general resolution over FSM, 3km over main islands of Yap, Chuuk, Pohnpei and Kosrae) and [ECMWF](#) (9km resolution every 12 hours) model data and JMA satellite imaging (eg - scatterometer, HIMAWARI datasets). With respect to rainfall, WSOs add value via additional direct consideration of modelling outputs at the seasonal level via EarWatch (BoM modelling provision) and Monthly Climate Outlook Forum (COSSPAC and ABOM products). As such, modelling and other products received by the WSO are deemed sufficient for general forecasting purposes. WSO staff are trained and skilled in the basic interpretation and use of model and observational products, but further capacity building in this area would be beneficial to boost meteorologist confidence and add greater local value to WFO Guam-provided guidance.

```
Zone Forecast for Eastern Micronesia
National Weather Service Tiyan GU
209 AM ChST Tue Feb 4 2025

FMZ013-040845-
Pohnpei-
209 AM ChST Tue Feb 4 2025

.TODAY...Breezy. Partly cloudy with isolated showers. Northeast
winds 20 to 25 mph. Highs near 86. Chance of showers 20 percent.
.TONIGHT...Partly cloudy with isolated showers. Northeast winds
15 to 20 mph. Lows around 78. Chance of showers 20 percent.
.WEDNESDAY...Breezy. Partly cloudy with isolated showers. Northeast
winds 20 to 25 mph. Highs near 86. Chance of showers 20 percent.
.WEDNESDAY NIGHT...Mostly cloudy with scattered showers. Northeast
winds 15 to 20 mph. Lows around 78. Chance of showers 30 percent.
.THURSDAY...Breezy. Partly sunny with scattered showers and isolated
thunderstorms. East winds 20 to 25 mph. Highs near 87. Chance of
showers 40 percent.
.THURSDAY NIGHT THROUGH SATURDAY...Mostly cloudy with a 50 percent
chance of showers. Lows in the upper 70s. Highs in the mid 80s.
.SATURDAY NIGHT THROUGH MONDAY...Mostly cloudy with a chance of
showers and a slight chance of thunderstorms. Lows in the upper 70s.
Highs in the mid 80s. Chance of showers 50 percent.

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Figure 5: Example of WFO Guam Zone Forecast Guidance for Eastern Micronesia

These inputs contribute to:

- Twice daily forecasts – 3-5 day state forecasts updated every 12 hours – uses NWS 7 day forecast updates
- 1-3 month seasonal forecasts
- Warnings and Special Weather Statements– based on guidance updates/alerts
- Flood statements – landslides, daily 24 hour periods, can be updated
- Weekly & monthly rainfall outlooks
- Tide data

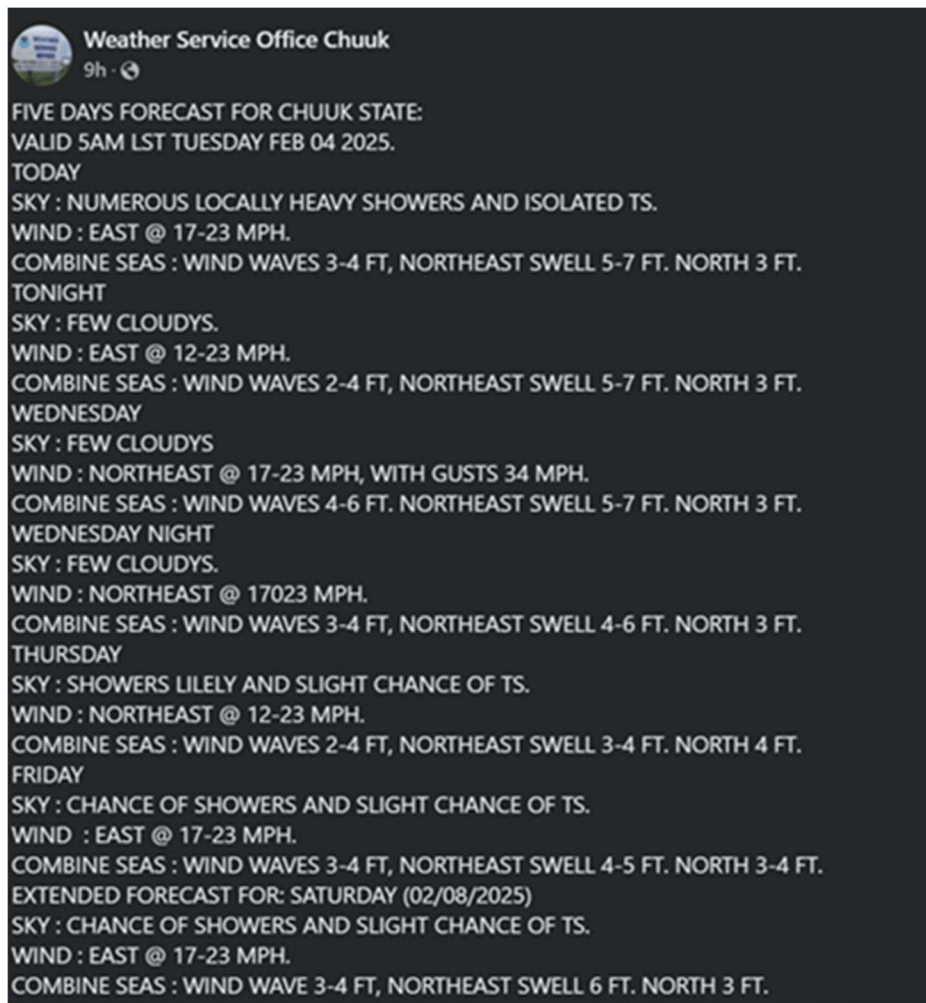


Figure 6: Example of a WSO Chuuk 5 day forecast

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

FSM WSO 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.

Some probabilistic products are received by the WSOs but forecasts produced locally are primarily 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 products provided via BOM/OCOF are used for rainfall outlooks on longer 1-3 month/climate timescales.

Summary score, recommendations, and comments for Element 5

FSM 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:

- FSM WSOs should review skills and training in relation to interpretation of sat and model outputs from global centres, enabling greater confidence in refining and adding local value to NWS forecasts where appropriate.
- WSOs 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.

There is no formal MHEWS framework in place in FSM but a warning and alert service is operated 24/7 based on a Standard Operating Procedure (SOP) with the FSM and state Disaster Coordination Offices (DCOs). The WSO is a partner in special committees during high impact weather events and also translates output for local voice recorded forecasts and social media. Warnings are issued from Guam (against criteria defined in the WSO SDM) and delivered to DECEM who disseminate to the DCOs. Tropical cyclone, drought and storm surge warnings are created by WFO Guam based on specific forecast points – the WSO highlights warnings and special weather statements to DECEM/DCOs and advises on their local reformulation and dissemination. Tsunami warnings are generally issued by a State based on Tsunami Information Statements sent by PTWC, unless there is less than a 2 hour expected time of arrival, in which case the WSO is allowed to send the warning out directly. No monitoring or forecasting capability exists in-country for simultaneous/cumulative hazards.

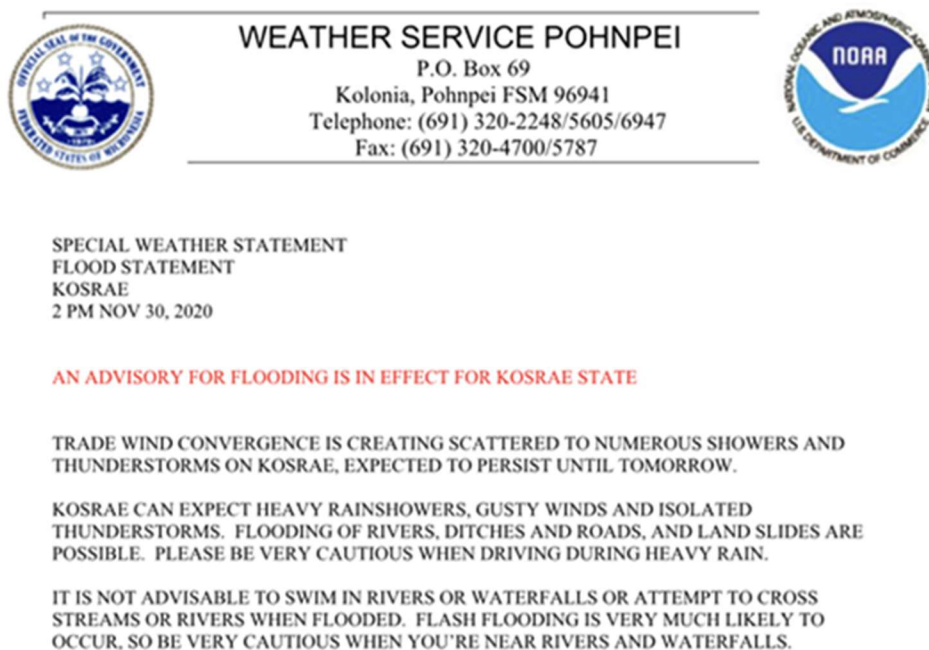


Figure 7: Example of a Pohnpei Special Weather Statement

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

The WSOs maintain a watch for incoming WFO guidance with FSM government disaster response benefiting from 3 layers of resilience, ie – US national level warning/statement guidance, WFO Guam warnings and highlighting via the WSOs. WFO Guam generates the majority of warnings and WSOs translate tropical cyclone, drought and storm surge warnings directly. The PTWC faxes Tsunami Information Statements or Tsunami Threat Messages directly to the WSOs and, in accordance with a USNWS SOP, WFO Guam call FSM WSOs to ensure receipt of official tsunami warnings products. FSM and State DCOs are required to locally re-issue tsunami warnings (unless directly issued by the WSO within

2 hours ETA) and the WSOs monitor and alert the DCOs accordingly. River/flash flooding warnings are issued by the DCO locally via Flood statements according to WSO local criteria. The WSOs have, however, had to close many rain gauges due to resource and other local issues, so there are few hydrometeorological observations and a pluvial representativity issue across FSM – flood statement issue is based on forecaster experience and local knowledge. Some water level observations are available from the PUCs which assist the WSOs in providing advice and data on rainfall.

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880
WTPQ81 PGUM 280109
HLSPQ1

URGENT - IMMEDIATE BROADCAST REQUESTED
TROPICAL STORM MAYSAK (04W) LOCAL STATEMENT
NATIONAL WEATHER SERVICE TIYAN GU
900 AM CHST SAT MAR 28 2015

...TROPICAL STORM MAYSAK MOVING INTO CHUUK STATE...

.AREAS AFFECTED...
THIS LOCAL STATEMENT PROVIDES INFORMATION AND RECOMMENDED ACTIONS FOR
PEOPLE ON THE ISLANDS OF CHUUK...LOSAP...FANANU AND ULUL IN CHUUK
STATE AND SATAWAL...FARAULEP AND WOLEAI IN YAP STATE.

.WATCHES/WARNINGS...
A TROPICAL STORM WARNING IS NOW IN EFFECT FOR FANANU AND CHUUK IN CHUUK
STATE. TROPICAL STORM CONDITIONS INCLUDING DAMAGING WINDS OF 40 MPH OR MORE
ARE EXPECTED LATE TONIGHT OR SUNDAY MORNING.

A TYPHOON WATCH IS NOW IN EFFECT FOR ULUL IN CHUUK STATE AND FARAULEP IN
YAP STATE. TYPHOON CONDITIONS INCLUDING DESTRUCTIVE WINDS OF 75 MPH OR MORE
ARE POSSIBLE WITHIN 48 HOURS.

A TROPICAL STORM WATCH IS NOW IN EFFECT FOR PULUWAT IN CHUUK STATE...AND
SATAWAL AND WOLEAI IN YAP STATE. TROPICAL STORM CONDITIONS ARE POSSIBLE
WITHIN 48 HOURS.

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Figure 8: Example of a Typhoon Local Statement issued for Chuuk

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.

WSO FSM do not use the Common Alerting Procedure format or hazard/risk maps for warnings.

Summary score, recommendations, and comments for Element 6

FSM is assessed as **Maturity Level 2** on the CHD scale - **Basic warning service is in place and operational but with limited public reach and lacking integration with other relevant institutions and services**

RECOMENDATIONS

- FSM WSOs should aim to initiate regular reviews of warning performance, both internally and based on third party feedback where possible.

- WSOs should work with FSM/State governments or private organisations/individuals to encourage funding for greater local observing infrastructure eg more representative and automatic rain gauges to enhance local warning tailoring

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 and climate elements of the National Strategic Plan have not yet been endorsed by the FSM national government – as such, climate activities within the FSM WSOs are limited. FSM is involved in the Pacific Islands Climate Outlook Forum (PICOF) regarding climate, ocean and ENSO applications. As above, EARwatch provides data for longer range/climatic rainfall outlooks, provided to government partners via local exchange; NCEI and BoM CLIDE archive all data. There is no specific climate data rescue activity, but daily data is retained by NWS dating back to c.1950s and daily records are retained locally

Summary score, recommendations, and comments for Element 7

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

RECOMMENDATIONS:

- FSM WSOs should undertake consultation/outreach to key stakeholders and engage with FSM government to identify climate requirements and potential funding sources to support the development of tailored climate services.
- WSOs should consider implementing dedicated specialist climate staff, potentially funded via SOFF or other initiatives; capacity building of skills and experience should also include the DECEM national climate focal point to enhance understanding of climate risks in government.

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.

Experimental Quantitative Precipitation Forecast (QPF) output for the FSM area is provided by WFO Guam, but is not currently operationally supported. As above, State Utilities companies operate government water resources; WSO forecast outputs assist water management and use. WSOs provide rainfall outlooks (weekly template and monthly) to utilities companies, eg Pohnpei Utility Corporation (PUC) and Chuuk Public Utility Corporation (CPUC), based on this data and warnings/flood guidance statements more generally. There are limited real-time rain gauge measurements and although Utilities share water measurements eg water levels of reservoirs/tanks, there is no Quantitative Precipitation Estimation available.

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

There is no formal hydrology agency in FSM – utilities companies de facto operate FSM government hydrology policy - and thus no arrangements are in place.

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

No formal data sharing agreements have been established with DECEM for hydrological data.

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

Outside of forecast provision to Utilities companies, there is very limited hydrometeorological community activity in FSM.

Summary score, recommendations, and comments for Element 8

FSM 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:

- FSM WSOs should formalise the relationship and SOPs between the WSOs and Utility companies and FSM/State governments, recognising potential leading role in hydrological matters for the WSOs within FSM 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?).

USNWS warnings are sent to DCO (state), DECEM (national), shared by social media (Facebook) and via HF/CB radio/Chattybeetle (Iridium), all via English and local languages as covered in the SDM. Public forecasts and warnings (eg daily forecasts, tide information) are disseminated via Facebook, email distribution lists (via sign-up sheet) and AM/FM radio via the FSM Baptist Church.



Figure 9: An example of Pohnpei Facebook forecast output

A key gap is the lack of ability to use national television company to broadcast weather forecasts as they require payment for public forecast broadcasts. Another significant gap is funding for communications to remote islands where disaster coordinators and the public still rely on older technology and residents have limited or unstable internet access for webpages, apps, etc.

9.2. Education and awareness initiatives in place.

Public outreach to schools is undertaken via field trips to the WSOs and networking on CB radio. The WSOs facilitate work shadow/work-study activities and community service via high schools – it is hoped this can identify the next generation of FSM WSO meteorologists.

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

A number of special measures have been put in place by FSM WSOs including establishing manual SYNOP sites in outer islands and undertaking outreach to schools. Challenges remain where there is a need to translate into local languages, notably in remote outer islands – WSO Yap needs to communicate in English and Yapese; WSO

Chuuk must publish in English and Chuukese; and WSO Pohnpei provides forecasts and warnings in English with a translation only into the language of the main island, Pohnpeian. WSO forecasts do not make special considerations for gender, age, disability or culture and thus there is an opportunity to consult stakeholders and the public to undertake outreach activities to better reach remote or marginalised communities.

Summary score, recommendations, and comments for Element 9

FSM is assessed as **Maturity Level 2** on the CHD scale - ***Traditional communication channels and a basic dedicated website is used to disseminate forecasts and basic information.***

RECOMMENDATIONS:

- FSM WSOs should consider how they might implement further outreach and communication activities to reach remote or marginalised communities.
- WSOs should work with FSM/State governments to influence local TV stations or other forms of telecoms/technology to host WSO forecast/warning messaging.

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.

There is no regular formalised process for user engagement or co-design/production of tailored products and services at local and state levels – WSOs respond reactively to feedback received but its main products are defined via COFA outputs. The WSO has participated in occasional engagement activities within FSM including tabletop exercises, workshops and community outreach programmes – these have involved DECEM, DCOs, the local Red Cross and other Civil Society Organisations (CSOs). The FSM WSO Strategic Plan 2021/22 was a result of a government-wide consultation, though the government still need to formally approve this. FSM WSOs also now issue monthly outlooks following engagement in 2024 with stakeholders.

FSM WSOs have been the main organiser for Weather & Climate Outreach programmes, raising awareness of the importance of paying attention to weather updates and warnings of hazards. No Socioeconomic Benefit (SEB) studies have been undertaken on the value of weather, climate and hydrological services by the FSM government.

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

No dedicated user satisfaction surveys have been undertaken by WSO; some feedback has been received after forecasts but no routine active service improvement is currently undertaken due to insufficient resources. WFO Guam regularly 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.

FSM WSOs undertake some basic climate QC via the MAPSO (Micro Art Paperless Surface Observations) application and are aiming to implement a more comprehensive Quality Management System (QMS) for the provision of meteorological warnings issued but there is no expected timeline for this at present. There is no relevant QMS reporting for marine or aviation services; the latter requires US Federal Aviation Authority (FAA) endorsement, no timeline for this is currently available.

Summary score, recommendations, and comments for Element 10

FSM is assessed as **Maturity Level 1** on the CHD scale - ***Service development lacks any routine stakeholder feedback practice.***

RECOMMENDATIONS:

- FSM WSOs should consider consultation and feedback activities that could enhance understanding of meteorological hazards and products available and provide insights for service and product improvements
- WSOs should look to implement a QMS and associated capacity building/training via projects such as SOFF (observations)

Annex 1 Consultations

Meetings were held with the Officers-in-Charge of the FSM WSOs (Johannes Berdon, Joe Lukagawa & Wilfred Nanpei) with the support of Eric Lau and Brandon Bukunt of USNWS.

Annex 2 Urgent needs reported

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

- The governance context, data sharing and understanding the national value of products and services provided by the WSO
- Enhancing WSO FSM's role in the provision and reach of warnings originating from USNWS capability
- Observing and service infrastructure across FSM
- Climate & hydrological services

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 FSM, 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 FSM materials including: Compacts of Free Association (COFA) for FSM; FSM and PIMS Strategic Plans & Annexes.
- Web pages of WSO Palau (<https://www.weather.gov/gum/WSOPohnpei>).
- Online material provided as links in this document.