COUNTRY HYDROMET DIAGNOSTICS

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

December 2025

Tuvalu Peer Review Report

Reviewing Agency: Meteorological Service of New Zealand

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List of acronyms

ADB	Asian Development Bank
AWOS	Automated Weather Observing System
AWS	Automated Weather Station
BIP-M	Basic Instruction for Meteorologists
BIP-MT	Basic Instruction for Meteorological Technicians
BOM	Bureau of Meteorology, Australia
CHD	Country Hydromet Diagnostics
CIEWS	Climate Information Early Warning System
CIS-Pac5	Enhancing Climate Information and Knowledge Services for resilience in the 5 island countries of the Pacific Ocean
COSPPac	Climate and Oceans Support Programme in the Pacific
CREWS	Climate Risk and Early Warning Systems
DFAT	Department of Foreign Affairs and Trade (Australia)
ECMWF	European Centre for Medium-Range Weather Forecasts (model)
EEZ	Exclusive Economic Zone
FMS	Fiji Meteorological Service
GBON	Global Basic Observing Network
GCF	Green Climate Fund
GDP	Gross Domestic Product
ICT	Information and Communications Technology
LDC	Least Developed Country/ies
JICA	Japan International Cooperation Agency
MetService	Meteorological Service of New Zealand Limited
METAR	Meteorological Aerodrome Report
MFAT	New Zealand Ministry of Foreign Affairs and Trade
MHEWS	Multi Hazard Early Warning System
MPWIELMD	Ministry of Public Works, Infrastructure, Environment, Labour, Meteorology and Disaster
NCOF	National Climate Outlook Forum
NDC	National Disaster Committee
NDMO	National Disaster Management Office
NFWCOS	National Framework for Weather, Climate and Ocean Services for Tuvalu 2023-2032
NMHS	National Meteorological and Hydrological Service
NIWA	National Institute of Water and Atmospheric Research (NZ)
PIMS	Pacific Islands Meteorological Strategy
PMC	Pacific Meteorological Council
RESPAC	UNDP Disaster Resilience for Pacific Small Island Developing States project
RSMC	Regional Specialised Meteorological Centre
SIDS	Small Island Developing States
SPC	Secretariat for the Pacific Community
SOFF	Systematic Observations Financing Facility
SOP	Standard Operating Procedure
SPREP	Secretariat of the Pacific Regional Environment Programme
TAF	Terminal Aerodrome Weather Forecast
TMS	Tuvalu Meteorological Services
UKMO	United Kingdom Meteorological Office
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USP	University of the South Pacific
WIGOS	WMO Integrated Global Observing System
WMO	World Meteorological Organization
WRP	Weather Ready Pacific Decadal Programme

Executive Summary

Tuvalu is a small independent nation consisting of a chain of nine reefs and atolls for a total land area of only about 26 square km scattered over 500,000 square km of the South Pacific. This is the second smallest land area of any nation globally.

The highest point in Tuvalu is 4.5 meters above sea level, and few of its atolls have land areas more than 800m wide. Due to the low elevation and small surface area, Tuvalu is often referred to as the first country that will be totally submerged as a result of climate change.

Tuvalu is very vulnerable to high impact weather and ocean events with large swells from these events and king tides regularly inundating parts of the country. These inundation events are exacerbated by sea-level rise.

The Tuvalu Meteorological Service (TMS) is effective in providing meteorological, ocean and climate services to the people of Tuvalu, and providing warnings of hazards in times of danger. It does so with limited resources and with challenges around hiring and retaining appropriately trained staff.

Whilst there are significant issues and gaps in terms of basic infrastructure and systems, TMS is well-connected nationally in terms of disaster management, and has robust communication channels to its users across the many islands that make up the country.

With targeted support from development partners, TMS can make the jump to being a world-class service, delivering critical information to the people of Tuvalu as climate change continues to exacerbate the impacts of weather and ocean events.

Priorities for investment could include:

- Basic observations infrastructure to bring Tuvalu into compliance with the Global Basic Observing System (GBON)
- Improved internet connectivity and a backup power supply
- Training for technical staff in equipment maintenance, calibration and ICT support
- Training for meteorological staff to BIP-MT standards
- Improved systems for visualising and interacting with basic data products

Summary of assessment ratings for CHD elements

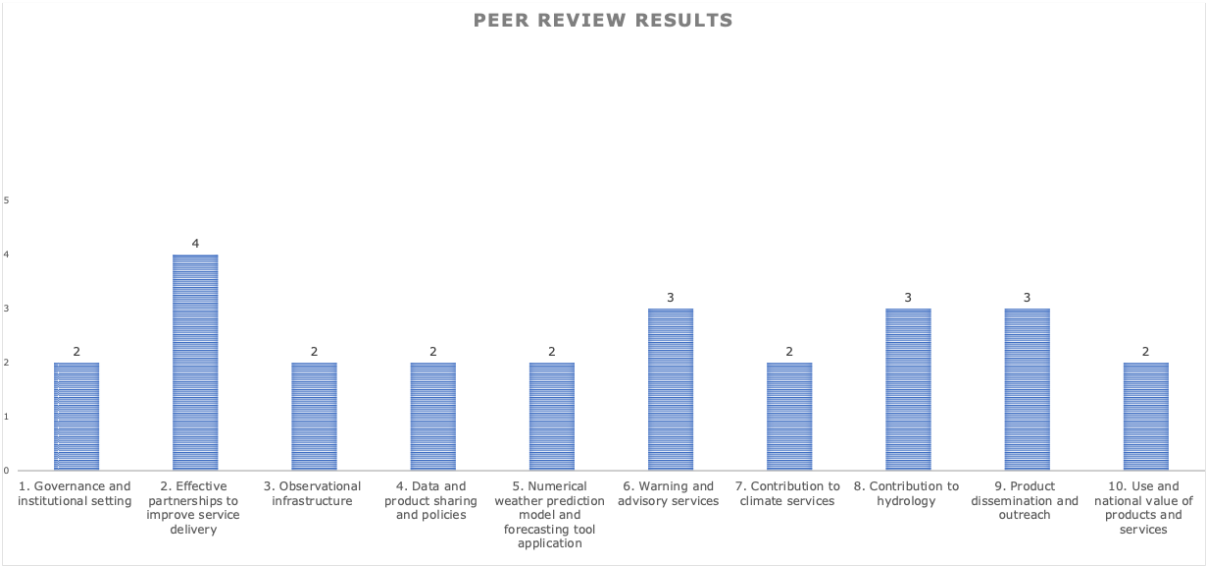


Figure 1: Summary of assessed ratings for the ten Country Hydromet Diagnostics elements. Each rating is out of five, with five reflecting a relatively high degree of maturity.

Element	Maturity level score
1. Governance and institutional setting	2
2. Effective partnerships to improve service delivery	4
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	3
7. Contribution to climate services	2
8. Contribution to hydrology	3
9. Product dissemination and outreach	3
10. Use and national value of products and services	2

Table 1: As for Figure 1, in tabular form

Chapter 1: General information

Introduction

Tuvalu is a small independent nation consisting of a chain of nine reefs and atolls with a total land area of 26 square kilometres, scattered over 500,000 square kilometres of the South Pacific Ocean. Tuvalu has the second smallest land area of any nation globally.

With a total population of around 12,000, Tuvalu has the third smallest population of any independent country. Half of the population live in the nation's capital, on the largest and most developed island, Funafuti.

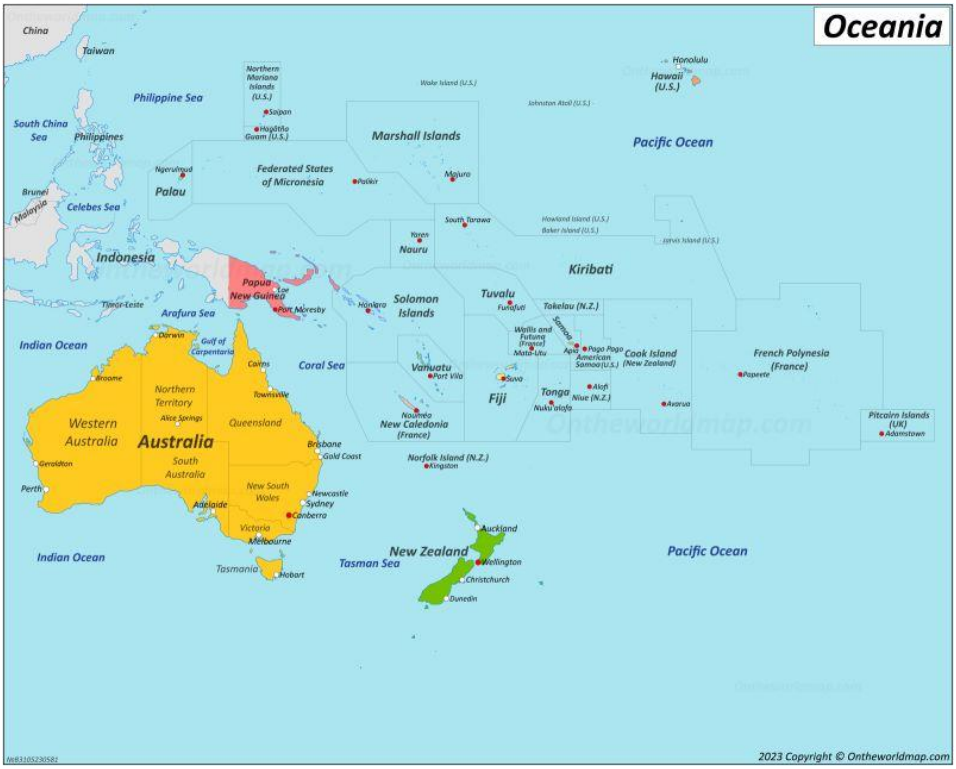


Figure 2: Map of Oceania (source: https://ontheworldmap.com/oceania/)

With a Gross Domestic Product of USD $5,465 USD per capita[1] (2023), Tuvalu is classified as a Small Island Developing State[2]. The economy is heavily reliant on fishing and remittances from Tuvaluans working abroad. There is some subsistence agriculture.

The highest point in Tuvalu is 4.5 metres above sea level and few of its atolls have land areas more than 800 metres wide. As such, Tuvalu is very vulnerable to high impact weather and ocean events with large swells from these events and king tides regularly inundating parts of the country. These inundation events are exacerbated by sea-level rise associated with global warming.

Tuvalu has a hot, humid, tropical maritime climate, between the inter-tropical and South Pacific convergence zones. In Funafuti, there is little variation in temperature throughout the year. The maximum temperature is between 31–32°C and the minimum temperature between 25–26°C all year round. The country has two distinct seasons—a wet season

[1] *https://datatopics.worldbank.org/world-development-indicators/*
[2] *https://www.un.org/ohrlls/content/list-sids*

from November to April and a dry season from May to October. Despite this, Funafuti receives on average more than 200 mm of precipitation each month. Tuvalu relies on rainwater as there are no sources of fresh water on the reefs and atolls.

Figure 3: Map of Tuvalu (source: https://ontheworldmap.com/Tuvalu)

Tuvalu is around 900 km south of the Equator and, whilst tropical cyclones are rare, Tuvalu has been impacted in the past (*1972 tropical cyclone Bebe, 1997 tropical cyclones Gavin, Hina and Keli*[3]*, tropical cyclone Pam*, 2015). Other significant natural hazards include severe thunderstorms, coastal inundation and droughts.

The services of the Tuvalu Meteorological Services (TMS), alongside partner agencies, are vital to the safety and economic activity of its citizens, however resourcing is insufficient to meet basic service needs, and staff retention and turnover is a significant challenge.

[3] *https://terranova.org.au/repository/paccsap-collection/current-and-future-tropical-cyclone-risk-in-the-south-pacific-country-risk-profile-tuvalu/current-and-future-tropical-cyclone-risk-in-the.pdf*

In 2025, the Australian Government opened a climate visa programme for Tuvaluans, allowing 280 Tuvalu citizens to emigrate to Australia per year under a random ballot. In the first year, over 3000 citizens applied for the ballot, out of a total population of around 12,000. With the potential for 10% of the population to emigrate within 4 years, this will without doubt increase the difficulties in attracting and retaining qualified staff.

CHD methodology

This report has drawn on the National Framework for Weather, Climate and Ocean Services for Tuvalu 2023-2032 (NFWCOS).

The NFWCOS was supported by "Enhancing Climate Information and Knowledge Services for resilience in 5 island countries of the Pacific Ocean". This programme is led by the United Nations Environment Programme (UNEP) and funded by the Green Climate Fund (GCF). This programme is also referred to as UNEP CIS-Pac5.

This was followed by in-country interviews with Mr Tauala Katea, Director of the Tuvalu Meteorological Service (TMS).

A follow up meeting was held in July 2025 with TMS Director and staff, and with the project manager for CIS-Pac5.

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 Tuvalu Meteorological Service (TMS) is a Department within the Ministry of Public Works, Infrastructure Development & Water (MPWIDW). Its mission is "to provide quality, reliable, timely and cost-effective weather, climate, water and ocean services and other related environmental services to the public and other stakeholders"[4].

In 2020, the Meteorological Services Act[5] confirmed the role of TMS as the sole national authority to provide official meteorological and ocean forecast, prediction, information, warnings and related services including dissemination of long-term and seasonal forecasts.

The Act clearly defines the mandate and responsibilities of TMS, establishing it as the authoritative voice on weather, ocean and climate services in Tuvalu. In addition, there are penalties under the Act for persons or organizations, other than TMS, who issue meteorological services or warnings.

For aviation services, TMS provide METAR/SPECI reports and landing conditions for Funafuti International Airport. Fiji Meteorological Service (FMS) provides the aviation forecast service (TAFs) for Tuvalu as part of its regional responsibilities. There are complimentary activities supported by both the New Zealand and Australian Governments and Civil Aviation Authority to improve aviation services.

Hydrological services fall under the Public Works Department and are mostly limited to ground water and saltwater intrusion. Tuvalu has no significant surface hydrology.

Multi-Hazard Early Warning Systems (MHEWS) are coordinated under the National Disaster Risk Management Plan. This details the responsibilities and requirements for each government department.

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

A Strategic Plan (2020-2024) was developed through CREWS funding. The key outcomes identified in the plan include:

- Building capability and ensuring that staff members are fully trained and competent to perform their duties
- Improving communication of information and services
- More resilient connectivity and ICT infrastructure
- Improved meteorological services for the public, aviation and mariners
- Improved climate information and prediction services
- Implementation of Multi-Hazard Early Warning Systems (MHEWS)
- Meeting its obligations nationally, regionally and in the international arena

[4] *National Framework for Weather, Climate and Ocean Services 2023*

[5] *Tuvalu Legislation, including the Meteorological Services Act (Revised, 2022), can be found at https://tuvalu-legislation.tv/cms/*

The plan is currently under review and an update, funded by GCF, is in preparation and planned to be released in 2026.

In 2023, a National Framework for Weather, Climate and Ocean Services (NFWCOS) was developed under the 'Enhancing Climate Information and Knowledge Services for resilience in the 5 island countries of the Pacific Ocean' project, referred to as UNEP CIS-Pac5 (Five Atolls Project). This provides a strategic direction and appropriate actions for TMS to achieve its vision and mission to provide quality and reliable weather, water, climate and ocean services in next 5 years. Strengthening observational capacity is one of the key components of the programme.

Care has been taken to ensure that these frameworks closely aligned with the Pacific Islands Meteorological Strategy (PIMS) 2017-2026 and Weather Ready Pacific (WRP) Decadal Programme of Investment.

There is no formal risk management framework or plan in place; however, TMS have internal processes in place to manage risks such as staff shortages and absences for key observation and forecasting roles, with all staff receiving cross-training in observation and forecasting activities.

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.

TMS receives an annual operating budget of around AUD570,200 with some fluctuation between AUD 500,000 and 600,000 from year to year. With a total staff of 25, around 57% percent of the budget goes to personnel costs. As a percentage, this is lower than some other services in the region but, given the relatively small total budget, there are significant budget constraints.

The budget constraints force TMS to prioritise weather services and there is limited capacity to enhance its service offerings beyond this. TMS relies to some extent on donor funding to support its staffing and the development of its services to meet user needs for climate and ocean information. Even considering this, staff numbers are insufficient to cover current functions and are inadequate in terms of meeting the goals of the Strategic Plan and the NFWCOS.

The relatively low salaries for government employees, and opportunities overseas, also drive high staff turnover and emigration. This has been a major challenge for TMS and has led to disruptions to the continuity of the organization's operational services. The migration of people out of the country will be accelerated by the introduction of a climate visa arrangement with Australia.

TMS is very dependent on Donor programmes. The major contributors and implementers include the Asian Development Bank (ADB), Australian Government (DFAT), New Zealand Government (MFAT), UNEP, UNDP and World Bank. Support for the upper air programme (consumables and technical assistance) is received from the UKMO and NZ MetService under the WMO Voluntary Cooperation Programme.

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.

TMS has a 25 full-time staff. In classifying their staff, TMS use the terms Forecaster, Observer, and Technician for their technical staff. In this report, Forecasters equate to *Meteorologist*, and the observers to *Meteorological Technicians*.

	Staff	Staff with degree
Director	1	1
Administration and management	1	-
General Forecasting	5	1
Observations	10	-
Climate Services	4	1
Technical staff	4	1

There are 18 male and seven female staff. One staff has a Master degree and four have Bachelor Degrees.

There are a further seven staff attached to TMS through the CIS-Pac5 project and Climate Risk Early Warning System (CREWS). These are all fixed term for the duration of project. Most of these additional staff are females with only 2 male staffs.

The technical staff consist of a Principal Technical Officer (PTO), an IT Officer, a Senior Technician and Handyman.

In addition to observer training, all observers also receive basic forecasting training and other relevant training such as that conducted by JICA, the Region Training Centre in Fiji, and Pacific Desk in Hawaii. In 2023 and 2024, four staff received short-term training at the Pacific Desk.

As of late 2023, two staff were overseas on long-term training at University of South Pacific. There is no facility for back-filling positions whilst staff are receiving training.

The UNEP CIS-Pac5 project includes two-week training on AWS maintenance hosted in New Zealand in years 1, 3, and 5 of the project, as well as local training during the equipment installation.

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

Tuvalu has a good track record in implementing internationally-funded hydromet projects. As with many countries in the region, it can be a challenge to sustain infrastructure and capability beyond the project completion, due to the limited available operational funding.

To some extent, this shortfall in operational funding is being addressed by initiatives and programmes such as SOFF, Weather Ready Pacific and the Climate and Oceans Support Programme in the Pacific (COSPPac).

Some major projects underway or recently completed include the Water Infrastructure Project, CIS-Pac5, COSPPac, Tuvalu Coastal Adaptation Project and UNDP RESPAC.

Summary score and recommendations for Element 1

TMS are assessed as **Level 2** for Element 1 of the CHD. This is defined as 'Effort ongoing to formalize mandate, introduce improved governance, management processes and address resource challenges.'

Element 1: Governance and Institutional Setting			Description: The level of formalization of the NMHS mandate and its implementation, oversight, and resourcing.	
Level one: Weakly defined mandate; serious funding challenges; essential skills lacking; little formalized governance and future planning.	Level two: Effort ongoing to formalize mandate, introduce improved governance, management processes and address resource challenges.	Level three: Moderately well mandated, managed and resourced and clear plans for, and sufficient capacity to address operational gaps.	Level four: An effective service but with a few shortcomings related to its mandate, governance, and resourcing and in the process to address the gaps.	Level five: Strong and comprehensive mandate, highly effective governance, secure funding, and readily available skills base.

TMS provide an effective service that has a clear mandate and is well-managed. There are clear plans for the future development of TMS outlined in the Strategic Plan and the NFWCOS. The key limiting factor is insufficient financial and human resources, coupled with the difficulties in maintaining capability due to staff turnover.

Recommendations

To improve its rating in this area, it is recommended that TMS:

- Finalise the updated Strategic Plan and introduce a simple risk-management framework to manage staffing and operational continuity; and
- Advocate for increased core government funding and establish structured workforce development pathways to reduce turnover and reliance on donors.

Element 2: Effective partnerships to improve service delivery

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

As previously noted, TMS is part of a broader government ministry that also covers infrastructure, water, public works and disasters. It has proactive and functional relationships with the other departments in government including the National Disaster Management Office (NDMO), Public Works Department (PWD), Climate Change Department (CC), Fisheries Department and the Tuvalu Broadcasting Corporation (TVBC).

TMS is an active member of the National Disaster Committee (NDC).

Overall, connections between the different functions of government work well, reflecting the small size of the country and the value of close personal relationships.

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.

The Meteorological Services Act designates TMS as the sole provider of information and services relating to weather, climate and oceans. As such, there is no private meteorological sector to speak of.

TMS has well-established partnerships at the national level with media, commercial fisheries and the Red Cross. The Red Cross is a key partner is engagement with the Island Councils and at a community level through the National Climate Outlook Forum (NCOF), working to increase hazard awareness and improve the understanding of services.

Research initiatives are set by TMS as well as by donors and regional agencies such as SPC and SPREP in discussion with TMS. TMS have loose partnerships in place with offshore academia and research organizations especially in Australia, Fiji (USP), New Zealand, and the United States (Pacific Desk).

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

TMS has well established partnerships with key regional partners such as the Australian Bureau of Meteorology (BOM), Meteorological Service of New Zealand Ltd (MetService), the former National Institute of Water and Atmospheric Research Ltd (NIWA) of New Zealand (now Earth Science New Zealand), other National Weather Services in the region, the Secretariat for the Pacific Community (SPC), Secretariat of the Pacific Regional Environment Programme (SPREP), and WMO.

The Director of TMS is a member of the Pacific Meteorological Council (PMC).

Tuvalu also has well-established partnerships with finance partners such as DFAT, the Green Climate Fund (GCF), MFAT, UNDP, UNEP, World Bank and WMO.

At the present time, the most significant projects are the GCF/UNEP CIS-Pac5 and COSPPac, each spanning multiple years. COSSPac, now on its third iteration, has been running since 2012 and has provided long term support for climate services and observing infrastructure for sea level.

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.

A number of new services have been delivered through development projects. An example is the SPC supported installation and training on a set of Wave and Inundation Forecasting Tools, designed to monitor inundation events.

Summary score, recommendations, and comments for Element 2

The Tuvalu Meteorological Service is assessed as **Level 4** for this element of the CHD. This is defined as 'Effective partnerships with equal status in most relationships and approaching relevant funding opportunities in a coordinated manner.

Element-2: Effective partnerships to improve service delivery			Description: The level of effectiveness of the NMHSs in bringing together national and international partners to improve the service offering.	
Level one: Works in isolation and does not value or promote partnerships. .	Level two: Limited partnerships and mostly excluded from relevant finance opportunities	Level three: Moderately effective partnerships but generally regarded as the weaker partner in such relationships, having little say in relevant financing initiatives.	Level four: Effective partnerships with equal status in most relationships and approaching relevant funding opportunities in a coordinated manner.	Level five: NMHS is regarded as a major national and regional role player. It has extensive and productive partnerships and is viewed as an honest broker in bringing parties together and provide national leadership on relevant finance decisions.

TMS has effective partnerships nationally and internationally, and plays an active role in the region.

Recommendations

Given the small size of the country, and its ongoing challenges, it is not likely to increase the rating in this area. To maintain its rating in this area, it is recommended that TMS:

- Formalise cooperation with key national partners through SOPs or MOUs; and
- Strengthen coordination with regional/donor agencies to sequence projects and capture lessons learned for future proposals.

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.

With a land area of only 26 square kilometres, Tuvalu has very little space to place weather stations. There are currently four synoptic surface stations and one upper-air observation station, with an approximate average distance between synoptic stations of 145 km.

At present, none of the stations are fully GBON compliant.

Station name	Observations Taken	Frequency
Funafuti	Upper air Synoptic observations (temperature, humidity, pressure, rainfall and wind at 10 metres)	1 flight per day 3-hourly
Nui	Synoptic observations	12-hourly
Niulakita	Synoptic observations	12-hourly
Nanumea	Synoptic observations	12-hourly

The upper air station at Funafuti undertakes one flight per day at 00UTC. Data are shared internationally in obsolete formats (TEMP code) by emailing the files to the New Zealand MetService, where they are then distributed via the GTS. The station's upper air sounding system potentially has the capability to generate compliant high-resolution (BUFR files) but this would require a number of downstream software changes to display and processing systems.

The limitation to one flight per day is driven by staff availability and by the level of funding received from the UKMO for the consumables.

Manual surface observations are taken every three hours at Funafuti and 6-hourly at the outlying stations; however, staffing issues frequently result in a reduced frequency of reporting. The remote stations communicate their observations to the Funafuti Office by radio, and they are emailed in obsolete formats (SYNOP) to the New Zealand MetService which shares the observations internationally on the GTS.

TMS operates five Tipping Bucket (TB3) automatic rain gauge sites distributed across the islands (Nanumea, Vaitupu, Nukufetau, Funafuti, Nukulaelae). At the time of writing, only three of these sites are operational. The observations are collected by data logger.

The CIS-Pac5 project is providing eight AWSs which are planned to be fully GBON compliant. Four of the AWS have already been installed and remaining five AWS are scheduled for 2026 and 2027 (Table 2). All of the AWS measure atmospheric pressure, temperature, humidity, wind speed and direction, precipitation, solar radiation, ground temperature and soil moisture.

The Partnerships for Aviation project, funded by DFAT and supported by the Australian Bureau of Meteorology, installed an Aviation Weather Observing System (AWOS) at Funafuti in 2024 which shares instrumentation with the AWS.

Station name	Lat	Long	Elevation	Installed / planned
Nanumea AWS	-5.682874°	176.124957°	2 m	September 2023
Vaitupu AWS	-7.469340°	178.676258°	2 m	September 2023
Funafuti AWOS	-8.525376°	179.196714°	3 m	May 2024
Nukulaelae AWS	-9.371324°	179.810820°	2 m	November 2024
Niulakita AWS	-10.790332°	177.145713°	4 m	Feb 2026
Nanumanga AWS	-6.286794°	176.315021°		Apr 2026
Nui AWS	-7.246361°	177.145713°		Apr 2026
Nukufetau AWS	-8.026967°	178.314137°	14 m	Apr 2026
Niutao AWS	-6.108412°	177.334973°		Awaiting construction of new airstrip

Table 2 - AWS Installed/Planned under CIS-Pac5

3.2. Additional observations used for nowcasting and specialized purposes.

Tuvalu has two operational wave buoys, one at Funafuti and the other at Vaitupu. The buoys are co-located on Department of Fisheries moorings and are supported by SPC. The buoys assist in monitoring sea conditions and in providing channel outlooks for dredging (Coastal Protection) and construction of harbour facilities. The data are used for nowcasting but are not archived.

TMS forecasters have access to the JMA Himawari geostationary satellite imagery, via the NZ MetService MetConnect Pacific platform and the SATAID system provided by JMA. During internet outages, HimawariCast may be the only source of up to date information.

The UNEP CIS-Pac5 project plans to install two additional wave buoys, including one for the Northern Group. Also, under the CIS-Pac5 project, a C-Band weather radar is planned to be installed at the Funafuti Office in 2026 or 2027.

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

Maintenance and calibration of the surface observing network is very limited, although TMS make their best efforts. This is due to several factors.

Transport to the outer islands is by ship, which is irregular and also expensive, which limits opportunities for site visits.

There is also very limited workshop space for the local technicians to utilise. This is being addressed through the new building and refurbishment of the wood working and mechanical workshops.

In the past, field calibration kits have not been available to allow traceability of observations. More recently, the CIS-Pac5 project has delivered instruments, spares,

field inspection instruments and training in maintenance and inspections. However, the scope of this activity is limited and there are still no formal calibration procedures in place.

Regional calibration facilities are available through the Regional Instrument Centres (RIC) in Australia and the Philippines, and the RIC currently under construction in Fiji. Technical support is also provided from New Zealand. The cost of freight within the region is, however, prohibitive and limits the extent to which instruments can be sent overseas for calibration.

In terms of quality control, all synoptic messages, including those received from the three island stations, are reviewed and checked by the Senior Observer.

TMS has one staff member who has received WMO OSCAR/Surface training and is registered as a station contact. This staff member has also been on extended (3 year) training at USP in Fiji. During the absence, TMS have no other means of editing metadata, or adding new stations in OSCAR Surface.

The Government of Tuvalu is in the process of re-establishing airstrips on the outer islands. Runways have been reestablished at Nanumea, Vaitupu and Niulakita with operations planned to start in 2026. This may improve the ability of TMS to maintain its remote stations.

3.4 Implementation of sustainable newer approaches to observations.

TMS has no WIGOS implementation plan in place but, given the lack of observations taken by other parties, this is not a high priority. Otherwise, observations practices follow standard WMO guidelines.

Updated and modernised offices have been built at Funafuti and are planned for the three outer stations within the next two years. Five new stations with new offices for the remaining islands are planned in the medium term.

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

There are very few automated observing systems in Tuvalu. Currently, all synoptic, upper air and rainfall observations are manually performed.

As noted, the UNEP CIS-Pac5 project has installed three AWS and plans to install an additional five AWS in 2026 and 2027. Given the difficulty in accessing the remote islands, it may be prudent to continue some level of staffing and conduct manual and automated observations in parallel.

Taking into account the cost of labour, maintenance costs, the existing infrastructure and the complexity of automated systems, upper air observations should remain manual for the foreseeable future.

Summary score, recommendations, and comments for Element 3

The Tuvalu Meteorological Service is assessed as **Level 2** for this CHD element. This describes a basic network, large gaps, mostly manual observations with severe challenges and data quality issues.

Element-3: Observational Infrastructure			Description: The level of compliance of the observational infrastructure and its data quality with prescribed WMO regulations and guidance.	
Level one: No or limited, basic surface observations and no upper-air observations.	Level two: Basic network, large gaps, mostly manual observations with severe challenges and data quality issues.	Level three: Moderate network with some gaps with respect to WMO regulations and guidance and with some data quality issues.	Level four: Comprehensive mostly automated network providing good traceable quality data fully compliant with WMO regulations and guidance.	Level five: Comprehensive and highly automated advanced network including additional measurements and remote sensing platforms providing excellent data fully compliant with WMO regulations and Guidance.

The current network is basic with some large gaps. The observations are mostly manual observations with severe challenges in providing suitable maintenance and calibration.

Current projects will partially address the issues with the observations network, potentially bringing Tuvalu up to Level 3 for this element.

Recommendations

To improve its rating in this area, it is recommended that TMS:

- Activate BUFR capability for the upper air program and increase to two flights per day with external support;
- Develop basic calibration/inspection SOPs to improve data quality;
- Ensure the data from the CIS-Pac5 AWS is shared internationally; and
- use CIS-Pac5 installations to build in-house technical capability to support the network.

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.

Observations from the upper air and synoptic stations operated by TMS are shared internationally. The observations, however, do not meet the GBON requirements for temporal frequency and, as such, are not GBON compliant. All observations are shared in obsolete alphanumeric formats, which limits the benefits of the observations to numerical weather prediction and therefore the benefits back to Tuvalu.

TMS has no direct connection to the GTS, and has no WIS2.0 capability. Observations are shared with Australia and New Zealand via email for sharing on the GTS.

A potential challenge for TMS, and other NMHS in the region is the ability to encode and decode BUFR messages. An important requirement for TMS is to still be able to receive bulletins in traditional synoptic code. This could be addressed through installing a WIS2.0 node.

The information available from the Regional WIGOS Centre is also not used.

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

There is no formal policy for the free and open sharing of observational data, however, the Meteorological Act is specific on the functions of the Meteorological Service, which include:

- *Ensure compliance with the conventions and any other relevant standards and recommended practices of WMO and ICAO, as appropriate;*
- *Exchange of meteorological, ocean and hydrological data when requested by Meteorological Services of other jurisdictions, in accordance with the Convention of the World Meteorological Organization (WMO) 1950;*

The Act also specific that, *subject to any intellectual or copyright laws in Tuvalu, the Department shall have the copyright over all meteorological, ocean and hydrological related data collected, generated and archived, including all published works by the Department or any person authorized by the Department to use meteorological, ocean and hydrological data.*

As such, the free and open exchange of data appears to be covered by the current Act.

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

Meteorological staff at TMS access a range of data and products from external sources. With no dedicated GTS/WIS connectivity, the primary source of forecast and guidance material is the 'MetConnect Pacific' platform hosted by NZ MetService. The main products available through this platform are observations, deterministic and ensemble NWP products, forecast and analysis charts and satellite imagery.

Data and products are received in the form of images, charts and open text, with no capability to ingest or use gridded data fields.

Other websites used include SatAID (JMA), charts from UKMO and ECMWF, seismic information from the California Integrated Seismic Network, meteograms and high seas forecasts from NOAA and the commercial 'Windy' website which is used for streamline analysis.

The internet connectivity is also a constraining factor for TMS. An undersea cable has just been installed which has the potential to significantly increase bandwidth and reliability. Satellite imagery received via the HimawariCast service are used for real-time monitoring of large-scale weather events and situational awareness. Staff were last trained on the use of satellite imagery in 2018.

Summary score, recommendations, and comments for Element 4

The Tuvalu Meteorological Service is assessed as **Level 2** for this CHD element. A limited amount of GBON-compliant data is shared internationally. The existing data sharing practices and the existing infrastructure severely hamper two-way data sharing.

Element-4: Data and Product Sharing and Policies			Description: The level of data and product sharing on a national, regional and global level.	
Level one: No observational data is shared internationally, either because not available to be shared or due to the lack of data sharing policies or practices, or the existing infrastructure does not allow data sharing.	Level two: 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.	Level three: Moderately well mandated, managed and resourced and clear plans for, and sufficient capacity to address operational gaps.	Level four: Fully meeting GBON data sharing compliance with a data policy and practices and infrastructure in place. These support free and open sharing of data nationally and, for some products, regionally or internationally as well as the in-house use of external data.	Level five: Exceeding GBON data sharing compliance and additional data (marine, radar, etc.) contributing to regional and international initiatives with policies that promote free and open two-way sharing of data and products

It is expected that in future, the provision of data will be from a mix of manual and automated observations. The installation of a WIS2.0 node, either nationally or regionally, would address many of the issues around two-way data exchange.

Recommendations

To improve its rating in this area, it is recommended that TMS:

- Install a WIS2.0 node and provide staff training in its use to modernise two-way data exchange;
- Develop a simple data-sharing policy and begin regular use of Regional WIGOS Centre tools for metadata and monitoring; and
- Increase internet bandwidth and investigate backup communications options.

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.

In terms of service delivery, TMS provides:

- daily weather forecasts, severe weather warnings
- strong wind warnings, swell warnings
- tsunami warnings
- monthly climate summaries, climate outlooks and ocean outlooks
- monthly Early Action Rainfall (EAR) watches

Underpinning these services, TMS access a range of products. These are primarily charts, imagery and text, all from external sources. No gridded products are used. MetConnect Pacific is a major source of data and products. Chart products and text guidance are updated twice daily.

Remote sensing data, and some model guidance, is accessed via the HimawariCast reception system, which has its own dedicated data display system.

Local forecasts are generated from these external sources and translated into the local Tuvaluan language for dissemination. There is minimal local processing or interpretation of forecast information.

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

TMS has no capability to internally run models and there is no access to gridded fields or additional processing of externally-sourced NWP data.

Forecast verification is performed routinely but primarily in a qualitative manner and with limited scope to affect changes to systems or procedures.

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

There is some use of probabilistic forecast information, in terms of seasonal and sub-seasonal predictions, through the MetConnect Pacific Platform, but no post processing of ensemble predictions.

Summary score, recommendations, and comments for Element 5

The Tuvalu Meteorological Service is assessed as **Level 2** for this CHD element. Basic use of external model output and remote sensed products in the form of maps and figures, covering only a limited forecast time range.

Element-5: Numerical Weather Prediction Model and Forecasting Tool Application			Description: The role of numerical weather prediction model output and other forecasting tools in product generation. Whether local modelling is sustainably used to add value to model output from WMO Global Data-processing and Forecasting System (GDPFS) centres.	
Level one: Forecasts are based on classical forecasting techniques without model guidance and only cover a limited forecast time range.	Level two: Basic use of external model output and remote sensed products in the form of maps and figures, covering only a limited forecast time range.	Level three: 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.	Level four: Digitized model output from internal (with data assimilation) and/or external (regional) sources and remote sensed products and data used and value-added through post-processing techniques extended into longer ranges.	Level five: Optimal combination of global, regional and local models, remote sensed data, post-processing techniques and automated probabilistic product generation over weather and climate time scales with minimal human intervention supported by up-to-date verification statistics.y sharing of data and products

There are some elements that approach Level 3 for this element, including the issuing of medium range forecasts and outlooks, but there is a lack of any internal processing or value adding.

Recommendations

To improve its rating in this area, it is recommended that TMS:

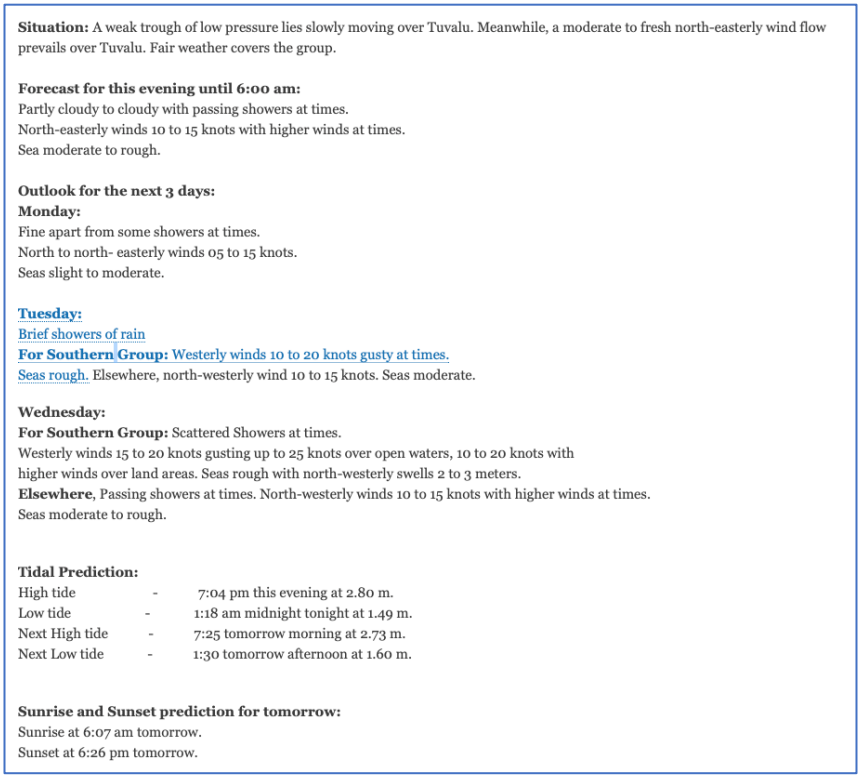
- implement a basic forecast visualisation system to allow some access to and use of gridded NWP data; and
- Introduce simple quantitative forecast verification to benchmark service delivery standards.

Element 6: Warning and advisory services

6.1. Warning and alert service cover 24/7.

The TMS Office is staffed on a 24-hour basis by observers, with forecasters working between 05:00 and 08:00, and from 12:00 to 18:00. For events or hazards occurring outside of these hours, the observers can contact the forecasters to come to the office.

Forecast bulletins are issued each morning and evening, with the evening bulletin providing more detailed information and the morning bulletin providing an update. These are issued in English and local Tuvalu language. Forecasts are issued for three days only.



Situation: A weak trough of low pressure lies slowly moving over Tuvalu. Meanwhile, a moderate to fresh north-easterly wind flow prevails over Tuvalu. Fair weather covers the group.

Forecast for this evening until 6:00 am:
Partly cloudy to cloudy with passing showers at times.
North-easterly winds 10 to 15 knots with higher winds at times.
Sea moderate to rough.

Outlook for the next 3 days:
Monday:
Fine apart from some showers at times.
North to north- easterly winds 05 to 15 knots.
Seas slight to moderate.

Tuesday:
Brief showers of rain
For Southern Group: Westerly winds 10 to 20 knots gusty at times.
Seas rough. Elsewhere, north-westerly wind 10 to 15 knots. Seas moderate.

Wednesday:
For Southern Group: Scattered Showers at times.
Westerly winds 15 to 20 knots gusting up to 25 knots over open waters, 10 to 20 knots with higher winds over land areas. Seas rough with north-westerly swells 2 to 3 meters.
Elsewhere, Passing showers at times. North-westerly winds 10 to 15 knots with higher winds at times.
Seas moderate to rough.

Tidal Prediction:

High tide	-	7:04 pm this evening at 2.80 m.
Low tide	-	1:18 am midnight tonight at 1.49 m.
Next High tide	-	7:25 tomorrow morning at 2.73 m.
Next Low tide	-	1:30 tomorrow afternoon at 1.60 m.

Sunrise and Sunset prediction for tomorrow:
Sunrise at 6:07 am tomorrow.
Sunset at 6:26 pm tomorrow.

Figure 4 - example of evening forecast bulletin (16 February 2025)

Warnings are issued based on information provided by Fiji Meteorological Service and broad scale warnings from MetConnect Pacific. Warnings are produced locally based on available information and are included in the daily bulletins.

The weather forecasts and storm warnings are made available on the TMS Website (https://tuvmet.tv/), the TMS Facebook page and are broadcast by the Tuvalu Broadcasting Corporation (TVBC) which operates Radio Tuvalu. Warnings are also propagated in the remote islands using a system of church bells.

In terms of backup communications, all remote stations are equipped with redundant communication systems consisting of HF radio and Chatty Beetle systems connected to with sirens and internet.

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

TMS disseminates warnings and alerts for wind, swell, storm surge, tsunami and heavy thunderstorms. Tropical cyclone warnings are issued as well, although in the past these have mainly related to heavy swell.

In terms of feedback and lessons learnt, there are formal meetings of Department Heads after hazardous events where the preparation and response is discussed and analysed. The outcomes of these meetings can drive revisions to policies and procedures.

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.

There are no common alerting procedures in place. Two staff attended a training session in 2023 but there are no plans for implementation at this point.

Summary score, recommendations, and comments for Element 6

The Tuvalu Meteorological Service is assessed as **Level 3** for this CHD element. TMS operates a weather-related warning service with strong public reach and standard operational procedures driving close partnership with relevant institutions, including disaster management agencies.

Element-6: Warning and Advisory Services				Description: NMHS' role as the authoritative voice for weather-related warnings and its operational relationship with disaster and water management structures.
Level one: Warning service not operational for public preparedness and response.	Level two: Basic warning service is in place and operational but with limited public reach and lacking integration with other relevant institutions and services.	Level three: Weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies.	Level four: Weather-related warning service with strong public reach and standard operational procedures driving close partnership with relevant institutions, including disaster management agencies.	Level five: Comprehensive, impact-based warning service taking hazard, exposure and vulnerability information into account, with strong public reach. It operates in close partnership with relevant national institutions, including disaster management agencies and registered Common Alerting Protocol alerting authorities.

Although a small service, TMS has strong connections with local agencies that are strengthened by being in the same Ministry. The effectiveness of the warning service is aided by the relatively small size of the population.

Recommendations

To improve its rating in this area, it is recommended that TMS:

- Update its SOPs for working with the NDMO and further develop its real-time warning capability;
- Introduce impact-based warning components and document lessons learned after major events; and
- Work towards implementation of CAP-based warnings to improve dissemination across multiple channels.

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.

For ranking climate services, the Country Hydromet Diagnostics uses a six-point rating scale, ranging from 'Not Applicable', through 'Less than Basic', 'Basic', 'Essential', 'Full' and 'Advanced'. The scale is applied across six core data points, in alignment with the WMO Checklist for Climate Services Implementation[6]

Climate Services Governance

The Meteorological Act clearly defines the role of the TMS in monitoring the climate and also includes climate within the broader definition of meteorology.

The climate section of TMS comprises four staff: Climate Scientific Officer, Climate Prediction Officer, Database Officer and Communication Officer

Overall, climate activities are well coordinated within Tuvalu and the TMS plays a role within the framework. As a result, Tuvalu's capacity is ranked as 'Essential' in this area.

Basic systems

As discussed in the previous sections, the overall climate observing network, data management, monitoring and forecasting systems for Tuvalu's climate services are assessed as 'Basic'.

Some data rescue is performed but on a best-efforts basis.

User Interface

TMS has no mechanism for users to interact with climate data but does undertake user engagement. Basic climate services such as outlooks are disseminated to relevant agencies. As such, Tuvalu is assessed as 'Basic'.

Provision and application of Climate Services

As mentioned, TMS can provide some climate services including monthly climate summaries, climate outlooks, ocean outlooks and monthly Early Action Rainfall (EAR) watches.

For this reason, Tuvalu is ranked as 'Essential' in this area.

Monitoring and evaluation of the socio-economic benefits

TMS has no capacity to measure the socio-economic benefits of its climate services. Tuvalu is assessed as 'Basic' in this area. Development projects do measure their benefits.

Capacity Development
TMS does not conduct any formal capacity development of other agencies or departments. Some workshops and training are provided through development projects. TMS is rated as 'Basic' for this criterion.

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[6] *https://extranet.wmo.int/edistrib_exped/grp_has/_en/Archives%202011_2022/Archives%202020/18582-2020-S-CS-Checklist_en.pdf*

Summary score, recommendations, and comments for Element 7

The Tuvalu Meteorological Service is assessed as **Level 2** for this CHD element. It has a basic level of capacity for climate services provision.

Element-7: Contribution to Climate Services				Description: NMHS role in and contribution to a national climate framework according to the established climate services provision capacity.
Level one: Less than basic Capacity to provide Climate Services	Level two: Basic Capacity for Climate Services Provision	Level three: Essential Capacity for Climate Services Provision	Level four: Full Capacity for Climate Services Provision	Level five: Advanced Capacity for Climate Services Provision

Recommendations

To improve its rating in this area, it is recommended that TMS:

- Introduce efforts to undertake data rescue;
- Work towards making climate data accessible through national or regional platforms; and
- Co-develop tailored climate products with key sectors and introduce basic user-feedback mechanisms.

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.

Tuvalu has no significant surface hydrology. There are no rivers or streams and very little groundwater. The country is reliant on rainfall harvesting and desalination for its water supply which falls under the responsibility of the Public Works Department.

TMS has no capability to provide quantitative precipitation estimation or forecasts. They do provide the Public Works Department with rainfall data and outlooks, to assist with managing the water supply and operation of desalination plants.

This situation may change for Funafuti with the installation of a weather radar under the CIS-Pac5 project, currently planned for 2026/27.

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 are working arrangements between the TMS and the Water Department (which is in the same Ministry). The drought monitoring plan has standard operating procedures, developed with the Disaster and Public Works Departments, with key indicators for operation of desalination plants.

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

Rainfall observations data are shared with the Water Department which is in the same Ministry.

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

There are no joint projects designed to build hydrometeorological cooperation and possibly little need for these.

Summary score, recommendations, and comments for Element 8

The Tuvalu Meteorological Service is assessed as **Level 3** for this CHD element. Although hydrology is not a focus for TMS, there are moderately well-functioning working relationships between TMS and the relevant departments within the Ministry.

Element-8: Contribution to Hydrology			Description: NMHS role in and contribution to hydrological services according to mandate and country requirements.	
Level one: No or very little meteorological input in hydrology and water resource management.	Level two: Meteorological input in hydrology and water resource management happens on an ad hoc basis and or during times of disaster	Level three: There is a moderately well-functioning relationship between the meteorological, hydrological and water resources communities but considerable room for formalizing the relationship and SOPs.	Level four: The meteorological, hydrological and water resources sectors have a high-level formal agreement in place and an established working relationship and data sharing take place, but institutions still tend to develop products and services in isolation.	Level five: The meteorological, hydrological and water resources sectors have robust SOPs and agreements in place to work closely in developing new and improved products and providing seamless and advanced services.

There is some room for improvement, and this may be driven by the installation of new observations infrastructure under the CIS-Pac5 project.

Recommendations

To improve its rating in this area, it is recommended that TMS:

- Formalise rainfall and drought-information sharing with the Public Works Department through SOPs; and
- Prepare for radar-enabled rainfall estimation and undertake joint training with Public Works Department staff.

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?).

TMS uses a range of communications channels to disseminate its forecasts, outlooks and warnings. It operates a basic website through which it delivers the national forecast, updated twice daily. Facebook is one of the most widely used methods of communication, with high levels of uptake across the country and TMS reach about 10% of the population through this channel, with more people reached if the sharing of warnings on other government and private pages is considered.

Information is also disseminated through a relationship with Radio Tuvalu (operated by the Tuvalu Government). Island Councils have their own standard operating procedures and methods. For example, in the case of church bells, different rings can mean different alerts. Megaphones are also used.

9.2. Education and awareness initiatives in place.

The Island Councils and the International Federation of the Red Cross (IFRC) have been active in running education programs in the remote islands in relation to hazards and response. This has involved, in some cases, acting out scenarios relating to specific hazard responses.

Household surveys are also being undertaken as part of the CISPac-5 Project and these are around halfway complete.

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

As described above in 9.1 and 9.2.

Summary score, recommendations, and comments for Element 9

The Tuvalu Meteorological Service is assessed as **Level 3** for this CHD element. Moderately effective communication and dissemination strategies and practices are in place, based largely on in-house capabilities.

Element-9: Produce Dissemination and Outreach				Description: The level of effectiveness of the NMHS in reaching all public and private sector users and stakeholders.
Level one: Dissemination using only limited traditional channels such as daily newspapers and the national broadcaster and with little control over messaging and/or format.	Level two: Traditional communication channels and a basic dedicated website is used to disseminate forecasts and basic information.	Level three: A moderately effective communication and dissemination strategy and practices are in place, based only on in-house capabilities and supported by user-friendly website.	Level four: A large fraction of the population is reached using various communication techniques and platforms, in collaboration with partners, and a user-friendly and informative website and apps. Outreach and education activities occur regularly.	*Level five: Advanced education, awareness and communication strategy, practices and platforms in place using various technologies tailored to reach even marginalized communities and in close cooperation with several partners.*

The website is basic but the reach of Facebook as a communication tool is more important. Most of the population can be reached in the event of a hazard warning through existing channels.

Recommendations

To improve its rating in this area, it is recommended that TMS:

- Modernise its website and create simple infographics and templates to complement Facebook communication; and
- Expand community hazard-awareness programmes with the Red Cross and Island Councils using survey insights from CIS-Pac5.

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 formalised platform to engage with users, apart from the Facebook page.

There are several national committees which TMS is a part of including the National Disaster Committee. However, there is no established mechanism for the co-design and/or co-production of tailored products and services.

No studies have been undertaken on the social and economic benefits (SEB) of weather, climate and water hydrological services in the last 10 years.

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

No formal user satisfaction surveys are conducted.

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

There are currently no formal quality management processes in place.

Summary score, recommendations, and comments for Element 10

The Tuvalu Meteorological Service is assessed as **Level 2** for this CHD element. Service development draws on informal stakeholder input and feedback.

Element-10: Use and National Value of Products and Services			Description: Accommodation of public and private sector users and stakeholders in the service offering and its continuous improvement.	
Level one: Service development lacks any routine stakeholder feedback practice.	Level two: Service development draws on informal stakeholder input and feedback.	Level three: Services development draws on regular dialogue with major stakeholders.	Level four: Service development draws on survey data and regular dialogue based on formal relationships with major stakeholders to ensure continuous improvement.	*Level five: Strong partnerships, formal and objective survey and review processes exist with all major stakeholders enabling service co-design and continuous improvement.*

Recommendations

To improve its rating in this area, it is recommended that TMS:

- Establish a lightweight user forum and post-event feedback process;
- Introduce basic quality-management foundations; and
- Explore opportunities through development projects for socio-economic benefit assessments.

Annex 1 Consultations (including experts and stakeholder consultations)

- Director of NMHS
- NMHS Staff
- Project staff (CIS-Pac5 Project)
- Bureau of Meteorology (re Partnerships for Aviation)

Annex 2 Urgent needs reported

Looking across the value chain, may of TMS's observational needs are being met through project investments, in particular CIS-Pac5. The greatest needs are in downstream systems and in human capability. Specific and urgent needs are as follows:

- Development of capability and capacity to maintain the AWS network and the planned weather radar;
- Development of capability and capacity to value add to forecast and warning products including from the planned radar; and
- Implementation of visualisation and processing systems for the generation of forecasts, warnings and downstream products.

Annex 3 Information supplied through WMO

- Data from WMO metadata systems (OSCAR-Surface)
- Data from WMO monitoring systems (WDQMS)
- Data from WMO Country Profile database

Annex 4 List of materials used

- National Framework for Weather, Climate and Ocean Services 2023-2032
- Tuvalu National Adaptation Plan: Climate Impact, Vulnerability & Risk Assessment Hazard Assessment: Final Report, 2024