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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Solomon Islands Peer Review Report

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WORLD METEOROLOGICAL ORGANIZATION

Alliance for Hydromet Development

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Portions of this report draw on the National Strategy for Meteorological Services and Framework for Weather, Climate, and Ocean Services, 2023-2028, and on the Weather Ready Pacific proposal of the Pacific Meteorological Council (2021), and we wish to acknowledge the authors of those documents for the considerable work done.

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List of acronyms

ACCESS	Australian Community Climate and Earth-System Simulator (model)
AWS	Automatic Weather Station
ASOS	Automated Surface Observing System
AWOS	Automated Weather Observing System
CAP	Common Alerting Protocol
COSPPac	Climate and Oceans Support Programme in the Pacific
CREWS	Climate Risk and Early Warning Systems
ECMWF	European Centre for Medium-Range Weather Forecasts (model)
ENSO	El Niño–Southern Oscillation
EW4A	Early Warnings For All initiative
GBON	Global Basic Observing Network
GFS	Global Forecast System (model)
ISO	International Organization for Standardization
LDC	Least Developed Country
NMHS	National Meteorological & Hydrological Service
SIMS	Solomon Islands Meteorological Service
SOFF	Systematic Observations Financing Facility
SOP	Standard Operating Procedure
UNDP	United Nations Development Programme
WRF	Weather Research and Forecasting (model)
WIPPS	WMO Integrated Processing and Prediction System
WIGOS	WMO Integrated Observing System

Executive Summary

Solomon Islands is an archipelagic state located in what are generally the warmest waters in the world, in the equatorial western Pacific. The country is subject to a range of hydrometeorological and geohazards including heavy rain, riverine flooding and flash flooding, strong winds, tropical cyclones, storm surge, drought, tsunami, earthquakes and volcanic eruptions. Solomon Islands is also highly vulnerable to the impacts of climate change.

The Solomon Islands Meteorological Service (SIMS) operates in a difficult budgetary environment, with low and unstable core government funding due to competing priorities, and a large reliance on assistance from development agencies for any major projects. Within this context, it is challenging to maintain observations and service provision in a way that meets the basic needs of the Solomon Islands community and also those of the wider region for observations and service provision. For example, upper air observations have been discontinued for some time due to the high cost of consumables, and maintenance of instrumentation is an ongoing issue. As well as directly impacting the information available to forecasters for their warnings and information to the community, this means that there are very few calibrated and reliable observations able to be used in global and regional numerical weather, ocean and climate models, which are therefore less accurate for their predictions for the country and the region. Virtually no marine observations are available despite small craft marine transport being the dominant transport mode for the country.

SIMS collaborates with other Government agencies, with humanitarian and development agencies, and with the broader Pacific and World Meteorological Organization community to maintain and improve services where possible. The long-term collaborations of SIMS with other SW Pacific nations have been particularly useful in maintaining climate and weather services.

Engagement with the broader population is achieved through social media and traditional media, although inhibited by generally low levels of literacy and communications challenges across the physically and socially complex archipelago. Quality control processes are used to track aviation services deficiencies and prioritise areas for improvement. Work continues to refine the SIMS mandate through improved foundational legislation, and a national strategy has been published to define four major goals around institutional capacity, infrastructure capacity, stakeholder partnerships, and operational effectiveness.

Long term international partnerships will be particularly useful in helping SIMS support the economic growth and physical safety of the Solomon Islands community. Specific areas of assistance should include observational support to meet global standards for upper air and surface observations, including marine observations to the degree possible, improving SIMS staff capacity, addressing SIMS facility needs, expansion of quality management approaches, partnership and stakeholder engagement, integrated forecasting systems and supporting information technologies, targeted efforts to build flood warning capabilities, and continued work to implement a country-wide, impact-based, multi-hazard forecasting and warning system in support of Solomon Islands' Sendai Framework commitments.

Summary of assessed ratings for Country Hydromet Diagnostics elements

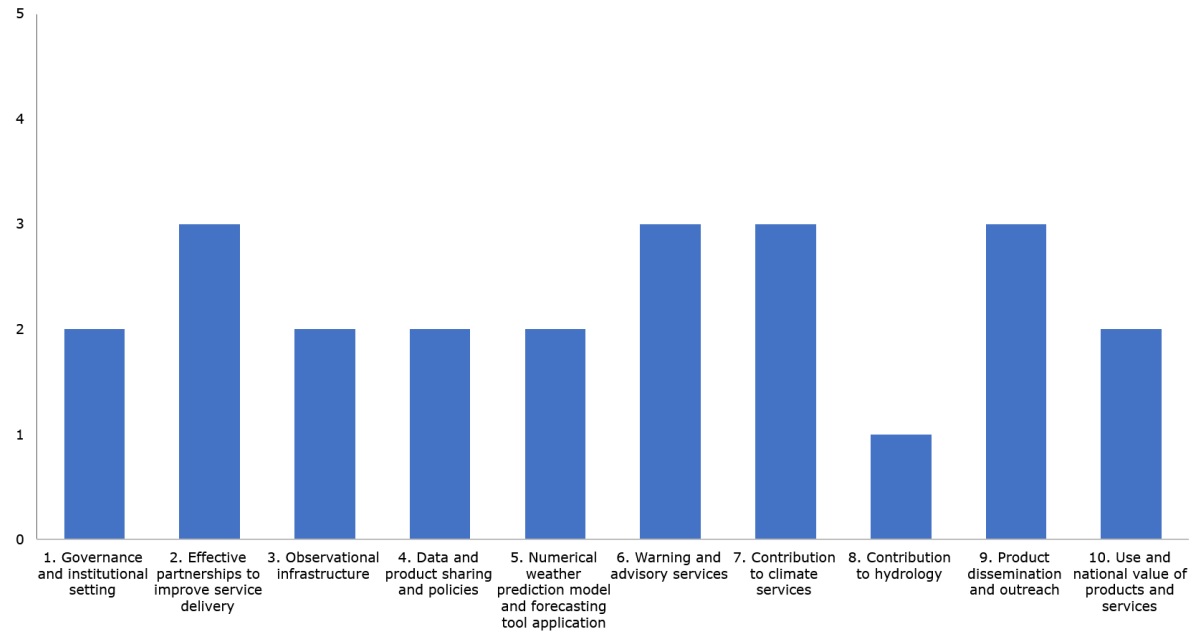

Figure 1 - Summary of assessed ratings for the ten Country Hydromet Diagnostics elements. Each rating is out of five, with five reflecting a relatively high degree of maturity.

Element	Maturity level score
1. Governance and institutional setting	2
2. Effective partnerships to improve service delivery	3
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	3
8. Contribution to hydrology	1
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

Solomon Islands is situated in the south-west Pacific Ocean, immediately east of Papua New Guinea and just south of the Equator. Its land mass of 28,400 km² extends over nearly 1000 islands and a northeast-southwest distance of approximately 1700 km with an exclusive economic zone of 1,589,477 km^2 (22nd largest in the world). The population of around 700,000 lives mostly in small rural communities dispersed over the larger islands. Per capita Gross Domestic Product is relatively very low at around USD $2300 (nominal, 145th in the world) or USD $2400 (PPP, 175th in the world). The country faces substantial development challenges.

The country is located in the Indo-Pacific Warm Pool, the mass of warm ocean water located in the western Pacific and eastern Indian Ocean. This area is important for the world's climate, acting as the heat engine for the global climate system by supporting atmospheric deep convection throughout the year, with a peak during the Southern Hemisphere summer. The climate is humid throughout the year, with high average rainfalls and high rainfall variability between locations (due to topographic factors) and between years (due to large scale climate drivers and smaller scale influences such as tropical cyclones).

Weather and climate hazards include flash floods and riverine floods, tropical cyclones, and droughts. Geohazards include earthquakes, landslides, tsunamis, and volcanic eruptions. The population is highly exposed to these hazards, with low-income subsistence lifestyles and most living near the coast, and many in low-quality housing.

Tropical cyclones in the area tend to be in their early stages of formation, due to the near-equatorial latitude, before moving southwards and intensifying as they move over other countries (Figure 2). However, the heavy rain, swells, and wind associated with the storms still pose significant risks. In April 2014, for example, rains associated with the formation of Tropical Cyclone Ita killed 22 people and affected over 50,000. In April 2020, 27 passengers went missing from an inter-island ferry during Tropical Cyclone Harold during COVID-related evacuations.

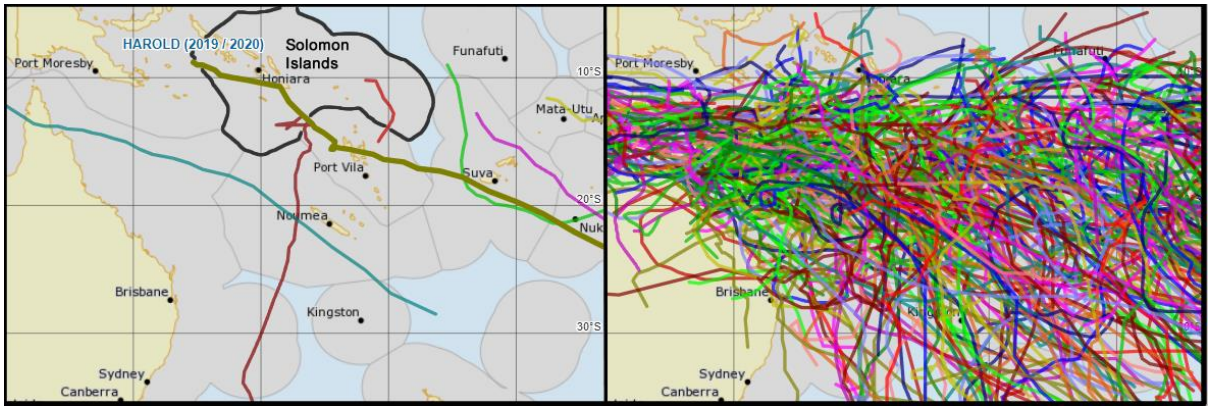

Figure 2 - Tropical cyclones occurring during the 2019/2020 season (left), and for all years (right). Solomon Islands and its capital Honiara is shown within its Exclusive Economic Zone (black outline). The track of TC Harold is indicated as a bold olive line. Source: Southern Hemisphere Tropical Cyclone Data Portal, Bureau of Meteorology

There is very high confidence that Solomon Islands will be impacted by climate change, with increases in surface air temperature and sea-surface temperature, annual and seasonal mean rainfall, intensity and frequency of days of extreme heat, intensity and

frequency of days of extreme rainfall, ocean acidification, and sea-level rise. Drought incidences are expected to decrease, and the overall number of tropical cyclones is expected to generally decline.

Solomon Islands is therefore highly exposed to current weather and climate factors, and highly exposed to climate change. The characterization of current weather and climate in the country is also very important for regional and global forecasting, due to the formation of tropical cyclones in the region, the passage of tropical atmospheric waves (for example, the Madden-Julian Oscillation and equatorial Rossby waves), and the heat input from the ocean into the world's energy cycle. There are strong justifications for improving hydrometeorological observations and forecasts for the benefit of the country and for the broader global community.

Country Hydromet Diagnostics methodology

This report has been prepared using the methodology described in the 2022 update of the Country Hydromet Diagnostics. An initial desktop review was performed, using information supplied from the Solomon Islands Meteorological Service, World Meteorological Organization, and other partners. An in-country visit was then undertaken, followed by report revision and approval. The in-country visit included meetings in the capital Honiara, as well as with the provincial government in Gizo (Western Province, the largest province and a key tourism development area), and observation site visits at Gizo, Munda (site of Solomon Islands' second international airport), Honiara, and Honiara International Airport on Guadalcanal Island.

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 Solomon Islands Meteorological Service (SIMS) operates under the 1985 Meteorology Act, which is a brief Act that gives a broad scope for operations. The Act defines the general purposes and functions of organisation as to:

(a) advise the Government on all matters relating to meteorology;

(b) promote the most effective use of meteorological services;

(c) further the science of meteorology, with special reference to Solomon Islands;

(d) establish and maintain a national network of meteorology stations and observing stations ensuring a high standard of quality;

(e) provide information and advise the Government of severe weather conditions likely to affect the safety of human life or property in Solomon Islands;

(f) provide meteorology services in order to ensure the safety and efficiency of aviation and marine services;

(g) provide meteorological data and advice in support of selected national development projects and other important weather sensitive economic activities;

(h) collect, collate, archive and make available meteorological data as requested for the purposes of assisting persons and authorities engaged in primary production, industry, trade and commerce;

(i) co-operate with any authority administering meteorological services and other relevant scientific institutions of any other country;

(j) participate in the work of the appropriate international organisations particularly in the World Meteorological Organization and the International Civil Aviation Organization;

(k) make arrangements and enter into any contract or agreement with any ministry, authority or person in Solomon Islands or outside Solomon Islands to compile and record meteorological reports and information;

(l) arrange means of communication for the transmission and reception of meteorological reports and information in Solomon Islands or outside Solomon Islands; and

(m) conduct or make arrangements for the training of persons in meteorology.

An updated Act is under preparation, following the preparation of drafting instructions in recent years. Legislation progresses relatively slowly in Solomon Islands due to a wide deliberative process, but there is high confidence that the updated Act will be formalized in the coming years.

Other relevant Acts include the National Disaster Council Act 1989, Environment Act 1998, Shipping Act 1998, and Essential Services Act. and the 2008 Civil Aviation Act, Part 174 which covers Met Service functions for aviation weather services. SIMS currently sits within the Ministry of Environment, Climate Change, Disaster Management

and Meteorology, which is a common and appropriate set of alignments for meteorological agencies.[1]

The Meteorological Service is not explicitly mandated to produce tsunami or flood warnings. Tsunami warnings are produced by the Pacific Tsunami Early Warning Centre and Japan Meteorological Agency. When tsunami warnings are received the Met Service works with the National Disaster Management Office to ensure they are effectively delivered to government and communities.

Water resources and hydrology are managed by the Water Resources Management Division of the Ministry of Mines, under the River Waters Act (1996) and the Water Authority Act (1992). These acts do not deal with flood warnings as such. The Water Resources Division can carry out water supply investigation and assessments, spot checks and advice on catchment hydrology, installation of hydrological loggers for water level, rainfall data collection, flow measurements and archiving of data. It can also provide information on river assessment for hydropower.

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

At time of writing, a comprehensive National Strategy for Meteorological Services and Framework for Weather, Climate, and Ocean Services 2023-2028 has been prepared, in association with the Climate Risk and Early Warning Systems (CREWS) project. Brief annual reports are produced, operational plans, risk assessments, and audit reports. In some cases the planning is highly budget dependent (see below) and somewhat aspirational in terms of the ability to plan against resources available to produce the desired outcomes.

SIMS has an active quality management programme for aviation with regular reports produced regarding the quality of aviation services. A comprehensive evaluation of the meteorology and impacts of Tropical Cyclone Harold (April 2020) demonstrates a commitment to accountability for major events. However, aviation site visits and the further expansion of formal quality management are constrained by budget factors.

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

According to the National Strategy, the annual budget (reported as USD 500K as of 2023) "is not adequate for enhancing the services" This was confirmed in country. Part of the reason for budget uncertainty has been Government decisions around recent overarching priorities such as the COVID-19 emergency response or preparing for the 2023 Pacific Games, which have resulted in reallocation of funds. SIMS is not the only Government agency to be subject to these uncertainties (nor is Solomon Islands the only country to experience these challenges).

Staffing numbers are relatively low, with 62 staff in total. Professional salaries for staff are not thought to reflect the training and expertise required for meteorological services.

[1] A 2011 survey of 72 National Meteorological and Hydrological Services reported that meteorological service providers were predominantly located in ministries of the environment (38%) and transport (29%). Source: *Guidelines on the Role, Operation and Management of National Meteorological and Hydrological Services. 2017 edition. WMO-No. 1195.*

Staff retention is an ongoing problem in some categories. As of 2018, approximately 8% of staff were women.

In terms of non-Government budget sources, an important long-standing desire for Solomon Islands, as for many other Pacific countries, is the implementation of cost-recovery from the aviation sector for the cost of providing services. Costs can in theory be recovered from overflight or landing fees. Since aviation is one of the more demanding clients in terms of defined requirements for accurate, quality-managed meteorological services, it is appropriate and useful for the costs of those services to be recovered from the sector. However, implementation of this principles has been a major challenge across the region. In the case of Solomon Islands, the aviation industry as a whole is not self-funded. An Asian Development Bank analysis in 2018 noted that:

"Challenges facing the Solomon Islands air transport subsector include (i) limited funds to cover rehabilitation, maintenance, and development of aviation infrastructure; (ii) limited capacity to develop and manage regulatory frameworks; and (iii) difficult geography and small economies of scale, which do not support cost recovery for air services. Because a concession would not be commercially viable without government financial support, it is importance to maximize the revenue streams against the expenditure programme."[2]

Cost recovery for aviation meteorology is therefore part of the long-term (rather than immediate) effort to make the sector overall self-sustaining. Discussions with aviation representatives suggest that they are aware of this as an issue to be resolved in the future. The forthcoming revision of the Meteorology Act may also assist in clarifying arrangements.

No cost-benefit analysis for the value of SIMS services to the country is available.

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.

SIMS has 62 staff, including 34 observers at manual observation sites (Table 2). Staff have a mixture of qualifications, with (as of 2020) one PhD candidate, 4 MSc qualifications (including two in Water Resources), 6 with BSc, and 7 with World Meteorological Organization Class 2-4 qualifications.

Table 2 - Staff profile as of July 2023 (courtesy SIMS)

2023 trainees	Observers	Climate & Ocean	Forecasters	Management	Research	QMS	Total
7	34	4	12	2	1	2	62

The Weather Ready Pacific proposal gives the following summary in terms of forecasting staff, valid as of 2020:

"Staff turnover is an issue, not so much with staff specifically trained as forecasters, but more so others with general science/environment degrees who move into other jobs.

[2] Asian Development Bank, 2018, Transport Sector Project Development Facility: Report and Recommendation of the President, https://www.adb.org/projects/documents/sol-51214-001-rrp

Retention of staff is also related to remuneration with postgraduate qualifications in forecasting not reflected in pay scales compared with other professionals in government.

The Met Service has indicated there is an overall need for more staff to be trained at centres such as the Bureau of Meteorology Regional Training Centre in Melbourne, which is the main location for training of Solomon Islands Met Service staff. Similarly, to produce better flood warnings there is a need for specialist training in hydrology. There is support for the development of a Regional Training Centre. However, is unclear how long it will take to establish the training centre with the appropriate expertise and existing providers will play an important role in the immediate future."

Audit reports suggest that the capacity and training of engineering, observations and administrative staff face similar challenges. Human capacity is also frequently mentioned as a priority in the Draft National Strategy.

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

Annual reports, media reports and other publicly available documents, together with in-country discussions, confirm that SIMS actively collaborates with the development sector to help achieve community outcomes. Examples include impact-based forecast and warning services training (2020), assistance from the Australian Government & UNDP in building a new forecast centre (2022-23), and observational infrastructure projects. Opportunities for more general research and development projects seem more limited.

Summary score and recommendations for Element 1

Element 1 is assessed as **Maturity Level 2** (out of 5), expressed as 'Effort ongoing to formalize mandate, introduce improved governance, management processes and address resource challenges' in the Country Hydromet Diagnostic template. This rating reflects the ongoing resource challenges for core funding, reflected in the low budget, which provide a severe limitation on overall capacity, as well as the relative age and brevity of the 1985 Meteorology Act.

Strategies for improving SIMS' maturity level in this area are largely already in place, including revisions of the Meteorology Act, pursuing aviation cost recovery, and building services in partnership with other government agencies. For some of these strategies, SIMS will be hindered by a 'chicken and egg' problem where funding is difficult to obtain in situations where Government sees little current priority in services and is not used to experiencing high quality services (for example the availability of calibrated, frequent observations and detailed predictions). Where development projects exist, it may be necessary to continue to highlight the difference that high quality services that such projects can help create and obtain commitments for continuing funding following project cessation.

Element 2: Effective partnerships to improve service delivery

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

SIMS partner with the Water Resources Department for hydrology-related matters, with the Ministry of Communication and Aviation for aviation issues, with the National Disaster Management Office for warnings, and the Solomon Islands Maritime Administration for marine matters. SIMS' placement within the Ministry of Environment, Climate Change, Disaster Management and Meteorology makes the cross-agency links for climate, environment and disaster matters relatively straightforward. Evidence from in-country consultations showed that SIMS is valued and trusted by partners, although there is some mutual frustration at the agency capacities available to meet need.,

Volcanoes of Solomon Islands are monitored by the Geological Survey Division of the Ministry of Mines, Energy and Rural Electrification. There is cordial cooperation between the Geological Survey Division and SIMS, but the Geological Survey Division is also challenged by relatively low resourcing and a lack of instrumentation. Cooperation is likely to be high during a volcanic crisis due to the need to collaborate on aviation and marine hazards from the volcanoes. In early 2023, representatives from both agencies attended international workshops in New Zealand regarding cooperation in this area[3].

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.

Private sector and academic cooperation appears relatively limited outside the aviation industry, with the exception of that facilitated by international humanitarian organisations (see below). Aviation is by far the most important private sector client, with SIMS providing quality-managed aviation forecasting services.

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

SIMS works closely with international climate and development finance partners, with numerous historical and current projects. This creates its own workload, particularly as such projects tend to be short-term, but services to Solomon Islands have benefited from this work. Numerous observations-related projects have occurred, and also projects aimed at improving community use of forecast and warnings information and extending world's best practices. For example, SIMS has worked with the Solomon Islands Red Cross and Australia on traditional weather and climate knowledge relationships, and has a strong ongoing programme with Australia through the Climate and Oceans Support Programme in the Pacific (COSPPac) on improving climate services to the population. UNDP has strongly supported SIMS, particularly through a project with Australia to construct a new forecasting centre building in Honiara.

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.

The well-developed climate services area on the SIMS website shows a maturity of services produced through long-term partnership arrangements for COSPPac, including traditional seasonal calendars, seasonal outlooks, and other advanced climate products. Evidence suggests that these projects are most successful when they are done within

[3] See Tupper & Leonard, 2023, 'Workshop Report: Developing the future vision for seamless multi-hazard warnings for volcanic eruptions https://eartharxiv.org/repository/view/5408/

longer term partnerships rather than short term projects. The relative lack of core government funding for new products heightens the importance of these partnerships for service delivery.

Ongoing development work includes the implementation of impact-based forecasting and warning services, which is a major challenge for all NMHSs in the world.

Summary score, recommendations, and comments for Element 2:

The assessment of this element for Solomon Islands is challenging, as the indicators mostly relate to power relationships but need to be considered within the country context. SIMS is a well-respected and connected agency operating in an environment where relatively little core government support is available and the agency is reliant on overseas development assistance for innovation, which naturally tends to put this agency at a disadvantage, particularly when many of those projects are short term. Within this framework, the level of partnership effectiveness is assessed as a mid-range **Level 3,** interpreted as *'Moderately effective partnerships but generally regarded as the weaker partner in such relationships, having little say in relevant financing initiatives.'* This is not a reflection on SIMS so much as the difficult environment in which many Solomon Islands agencies operate.

Improving this element in the future is a long-term challenge and rests on the success of the strategies mentioned in the previous discussion, including more sustainable funding and user-reliance on services. It is essential that SIMS is supported through this process in providing authoritative and high-quality services under SIMS branding, so that partners and users do not turn to other sources of sometimes dubious provenance (for example, products from international 3rd parties that may not be appropriate for the Solomon Islands context).

Element 3: Observational infrastructure

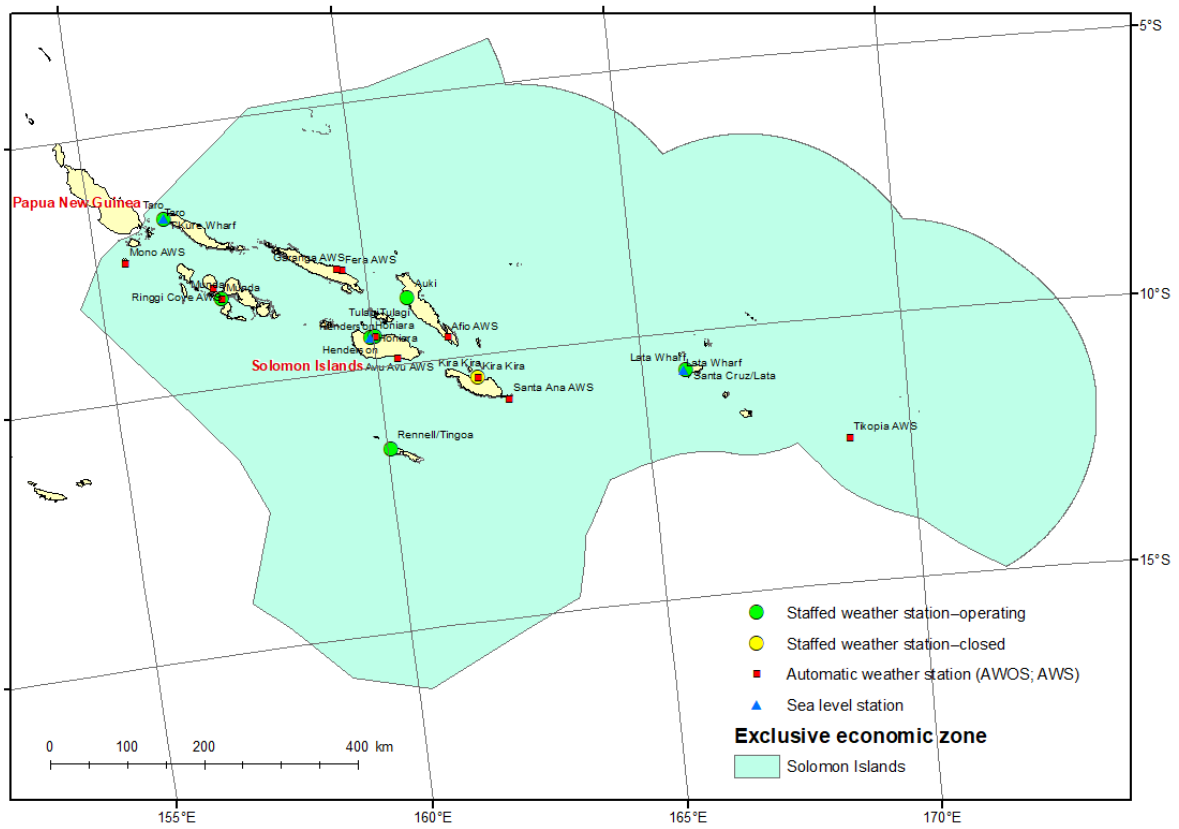

Figure 3 – Map of existing surface stations.

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.

Seven synoptic stations are operational in Solomon Islands, reporting 3-hourly (but with some missing data and instrument issues) (figure 3). According to the 2022 Annual Report, three stations' (Auki, Lata and Tinggoa) performance did not reach the expected level of observations receipt (above 80%), with this being attributed to staff issues. GBON international receipt of these stations of these observations has been patchy. As of the June 2023 Global GBON Gap Analysis undertaken by the World Metorological Organization, the Solomon Islands had no GBON-compliant surface stations.

The average horizontal resolution over the total surface area of Solomon Islands (approximately 1.6 million km$^{2)}$ is dependent on the metric used.

- In terms of GBON compliance, the resolution is undefined (zero fully compliant stations)
- For stations that report internationally, the 7 synoptic stations give a resolution of approximately 500 km (250,000 km^2)
- For all operational stations, including non-SIMS aviation stations, the resolution is approximately 350 km (122,500 km^2)
- For all stations including unserviceable stations, the resolution is approximately 280 km (78,400 km^2)

No upper air observations are performed. An upper air station was operational in Honiara, but ceased operation due mainly to the cost of consumables (as is the case for many stations in the SW Pacific).

In GBON terms, it could be argued that approximately three upper stations are appropriate for the country, given the 1700 km NW – SE orientation of the archipelago. Suitable sites exist at Taro or Munda in the west and Lata in the east for the addition of upper air stations to the one located near Honiara. The original site at Honiara is now no longer suitable, and SIMS is planning for a nearby location on Tulagi island immediately to the north.

3.2. Additional observations used for nowcasting and specialized purposes.

As in many other countries, the development and availability of automatic weather stations has resulted in many deployments by other well-intentioned agencies in an effort to meet community needs, without necessarily considering the funding of long-term maintenance and connecting these observations to local NMHS networks and the global meteorological network.

For Solomon Islands, additional observations are available from automatic weather stations, rain gauges and river gauges installed from various providers. These stations do not report internationally and are subject to maintenance challenges, particularly where they have been installed as part of short-term projects. SIMS and other users have some access to these observations, where the sites are still operational and the data is being received.

As seen in Figures 2 & 3, a significant part of the Solomon Islands marine Exclusive Economic Zone extends southwards in the Coral Sea, in an area where tropical cyclones frequently form and intensify. Any improvement in synoptic, marine and surface observations over this area will be of substantial benefit to Solomon Islands and other countries for forecasting and tracking tropical cyclones as they develop.

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

SOP implementation appears to be patchy and affected by resourcing issues. Audit reports strongly suggest that there are ongoing issues maintaining the observational network, including for the synoptic stations as well as the automatic stations. For example, a 2022 Audit report for Munda noted that *"Unserviceable and lack of basic instruments from the MET Stations was raised in the previous years and nothing has been done so far. Auditors have noted and raised a major nonconformity of basic instruments in Munda Met Station as stated; no evaporation pan, no sunshine recorder, no wind vane, no cup counter anemometer, no Maximum Thermometer and no AWS. It was also sighted that the thermometer screen was too high and the roof was rotten."*

Similar observations have been made for other stations, including at Henderson airfield (Honiara), which as the main international airport would be expected to have the highest quality of station.

On-site visits were made to the main SIMS office at Honiara, Henderson airfield, Gizo (UNDP installed AWS), and Munda (synoptic station) as part of this assessment. At each station, there was evidence of ongoing efforts to improve the situation when compared to the audit reports, but also of ongoing and new problems. For example, at Munda Met Station, an evaporation pan was present, but not correctly levelled and unused. At Henderson, an evaporation plan was present, but unused due to a lack of fresh water. At Gizo, the AWS was working, but the site was considerably overgrown

due to a lack of site maintenance (SIMS advised that no maintenance budget is available for the AWSs).

At Munda airport, where many millions of dollars (USD) have been invested in airport upgrades to an international standard, an aid project had installed a high-quality Automated Surface Observing System (ASOS) station to provide observations directly to the airport control tower. However, insufficient consultation occurred with SIMS, and no provision was made for integrating these automated observations with the official synoptic observations. At time of writing, the ASOS station was not providing useful data due to technical problems, and aviation authorities were awaiting repairs to be undertaken.

The situation at Gizo and Munda reflects that, when additional or parallel weather observations sites are installed, insufficient integration with the existing network and insufficient maintenance funding can significantly affect or negate the usefulness of the end result. A whole-of-country approach to a sustainable meteorological network, focused through the NMHS, is the appropriate solution.

3.4 Implementation of sustainable newer approaches to observations.

Budgetary challenges mean that the current approach to observations is unsustainable. Central government appropriations are insufficient to maintain the existing or any expanded network, and no aviation funding appears to be received to maintain the synoptic stations. As discussed above, automatic stations installed under project funding do not generally come with ongoing maintenance budgets, meaning that it is assumed that the host meteorological service will service these stations using their insufficient budget. Typically, this means that automatic weather stations are a short-term solution.

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

In terms of sustainable synoptic stations, no stations depend on automatic techniques due to the presence of manual observations. In terms of the total number of surface observations, of the order of 75% use automatic techniques (but, as noted above, this is unsustainable).

One possible future option, should budget become available, would be for each synoptic station to be designated as a 'Tier One' station with an automatic weather station installed, and observer presence to add manual elements to observations for as much of the day as possible. This would allow 24/7, hourly observations but with the added value of observer manual observations and enhanced site security, and the potential for observers to undertake basic instrument and site maintenance and back-up manual observations if the AWS fails. Unstaffed AWSs installed under development programmes could be maintained as 'Tier Two' sites, with regular maintenance but no emergency return to service provisions (which are very expensive) or manual back-up. Again, this is dependent on budget being made available to SIMS (see discussion on the Systematic Observations Financing Facility below).

Summary score, recommendations, and comments for Element 3

The overall intent of this criterion is to determine the level of compliance of the observational infrastructure and its data quality with prescribed World Meteorological Organization regulations and guidance. Solomon Islands is assessed as **Maturity Level Two** for this criterion, reflecting a 'Basic network, large gaps, mostly manual observations with severe challenges and data quality issues.' This assessment is heavily influenced by the lack of upper air observations, which are critical from the global and

regional perspective, the lack of international availability of the automatic weather observations, and the data quality challenges from the synoptic stations. However, with the addition of upper air observations and some improvements in maintenance of sites, an assessment of Maturity Level Three ('Moderate network with some gaps with respect to World Meteorological Organization regulations and guidance and with some data quality issues') would be achievable.

The quality of SIMS audit reports for aviation purposes should be noted in this respect. These reports provide accountability and traceability for the actual status of critical observations sites, and reflect a strong positive intent for continuous improvement. In the long term, linking aviation quality requirements with cost recovery from the aviation sector, including funds sourced from overflights of Solomon Islands and including landing fees, would substantially improve the sustainability of meteorological observations.

Another important issue to consider for the future network is that Solomon Islands is a maritime nation, with on-water safety and economic prosperity critically important. The frequency of strong wind warnings for the southern Solomon Islands was commented on during consultations, with one interview noting that mariners will check the weather, but proceed to sea regardless. Better maritime observations will support greater detail in maritime forecasts, to allow more tactical decision-making and help raise the safety culture.

The Systematic Observations Financing Facility is likely to be the best prospect for Solomon Islands being able to move towards a sustainable approach to observations. The provision of a larger percentage of reliable observations through this project has potential to kick-start a process of co-contribution and increased core government support once the improvements associated with reliable weather observations are demonstrated. This process must, however, be intentionally managed to ensure commitment and visibility of the process with the Solomon Islands government. It will also be critical to ensure that observations are available to the general public as well as key users, so that the value, usefulness, and visibility of these observations is maximised.

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.

For upper-air stations, no observations have been performed since October 2011 due to lack of consumables. When they were performed, observations were shared internationally. The seven staffed surface stations have observations shared internationally, with some data quality issues as noted previously. These issues have been ongoing, perhaps with some slight improvement for surface stations – for example, a joint GCOS-WIGOS workshop in 2017 noted that 4 stations were sharing observations 3 hourly, and 3 stations were sharing only 4-5 observations during the day.

Regional WIGOS Centres are in the process of being established in RA V.

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

Solomon Islands actively share observational data in accordance with World Meteorological Organization principles. At the moment, there is no formal national WIGOS partnership agreement in support of this, but there is continued positive intent towards sharing observations. There are no substantive policy barriers against sharing GBON data.

As already noted, SIMS also receives data from AWSs installed by third parties (particularly NIWA New Zealand and UNDP) under project arrangements. These observations are not shared internationally or assimilated into local, regional or global models – not as a result of explicit policy decisions, but because this was not included in project scopes – a common oversight in such projects globally. It would be helpful if a national policy decision was made and implemented to ensure that all future observations projects approved by the Solomon Island Government included the operationalisation of appropriate data sharing arrangements to ensure that both SIMS and the global community (through World Meteorological Organization) were able to receive and assimilate high quality observations from stations installed.

SIMS's website includes provision to show AWS observations to the public directly (eg https://met.gov.sb/8-am-aws-reports/), but this is not functioning correctly.

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

At the national level, SIMS partners with the Water Resources Department for flood-related matters, including river and rainfall observations exchange. However, the amount of river and rainfall data available in real-time is extremely limited.

Regionally, SIMS is part of the Severe Weather Forecasting Programme in the SW Pacific in which participant countries share a common approach to dealing with severe weather events and using annotated model guidance to provide consistent cross-border responses to developing systems. Through this mechanism, the entire region stands to benefit from improved surface and upper air observations as part of improved compliance with GBON requirements. As noted above, many AWSs have been installed in the region through project arrangements, without data sharing being included. In some cases, the observations are not easily usable in integrated forecasting systems by

the responsible NMHSs, or accessible to the public. Addressing this issue systematically would increase observational utility and forecast skill across the region.

SIMS also cooperates with many regional and global partners in service provision. This includes in climate services (as discussed elsewhere), receipt and use of satellite data and intense rainfall observations, and numerical modelling data.

Summary score, recommendations, and comments for Element 4

Solomon Islands is assessed at **Maturity Level 2** for data and product sharing and policies, described as *'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'* in CHD guidelines. In this case, the rating is mainly attributable by the technical and resource frustrations of SIMS capabilities (such as the lack of upper air capacity and the non-transmittal of AWS observations), rather than any policy issue. SIMS clearly has an open policy intent to share observations and products with the public and with the global community.

As noted above, it would be likely be helpful in the development of national WIGOS-related policies, to specify that the default deliverable for any 3rd-party led hydrometeorological observations-related project accepted by the Solomon Islands Government is that observations should be shared and received globally under World Meteorological Organization provisions.

Consideration could also be given to extending this principle to relevant seismic, tsunami and volcanic monitoring data, in partnership with the Geological Survey Division of the Ministry of Mines, Energy and Rural Electrification. This is because issues of data availability can also significantly inhibit geohazard monitoring networks, including in the SW Pacific, and the global impetus for improved multi-hazard warnings, including under the *Early Warnings For All (EW4A)* initiative will require seamless coordination with geohazard management agencies.

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.

SIMS has access (in an ungridded format) to global and regional models provided by Australia (ACCESS model), European Centre for Medium-Range Weather Forecasts (ECMWF), the US (Global Forecast System, GFS), UK, and others. The skill, resolution and usefulness of these models is steadily increasing. In the deep tropics, intraseasonal scale products are also very important for hazards management due to the influence of tropical atmospheric waves such as the Madden-Julian oscillation, equatorial Rossby waves, and Kelvin waves. SIMS has access to commentary from the Australian Bureau of Meteorology and others on these features, as well as longer term seasonal forecasts.

Figure 4 shows an example of the numerical model guidance available during Tropical Cyclone Harold. Graphical guidance such as this is used directly in formulating forecasts and warnings within SIMS.

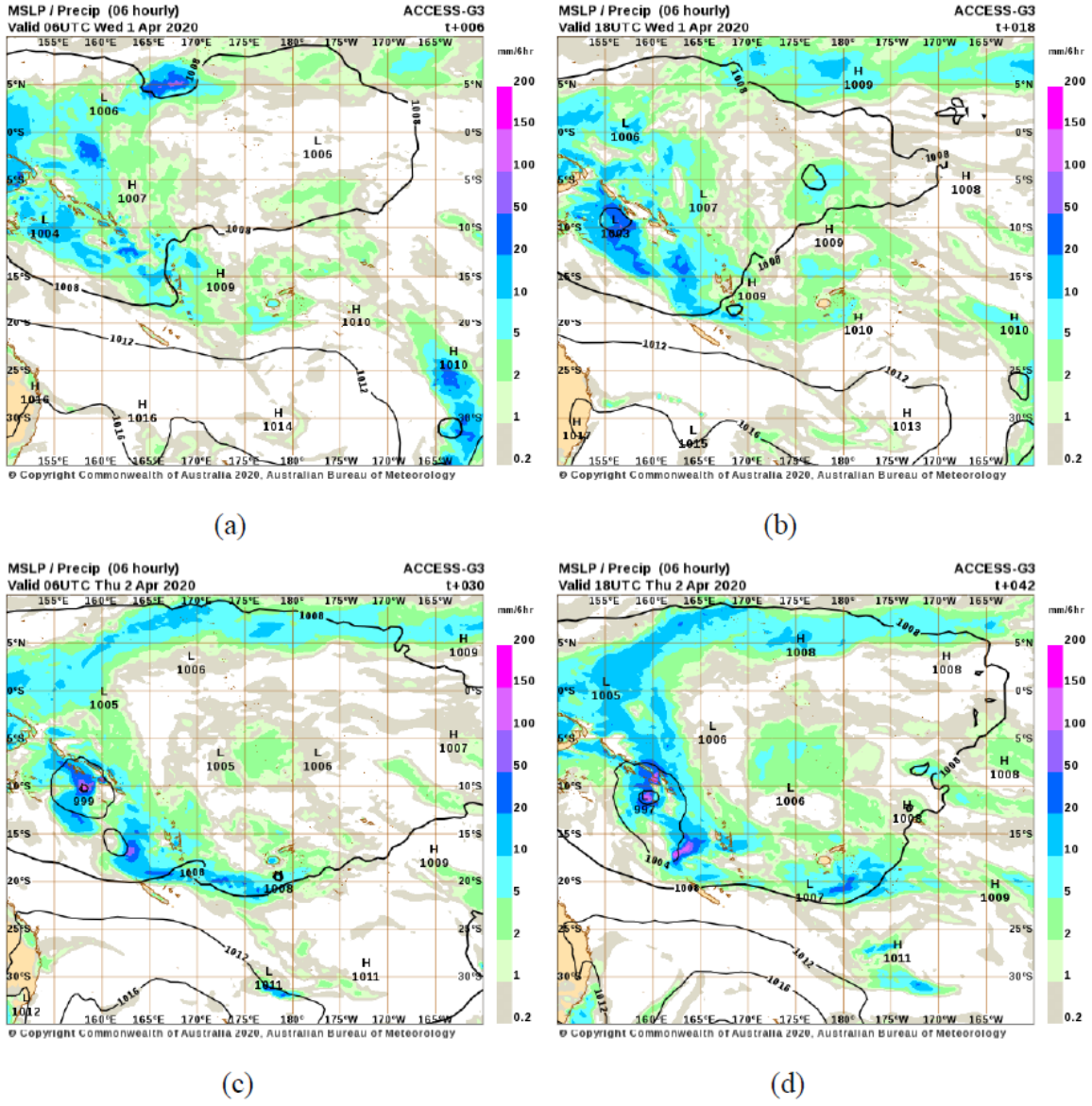

Figure 4 - Numerical model guidance for four different time steps during the formation stages of Tropical Cyclone Harold. Source: Australian Bureau of Meteorology, through SIMS TC Harold evaluation report. This shows a broad regional model view, as no Solomon Islands-specific view is available from the Bureau for these models.

However, due to forecasting system limitations and the lack of gridded data, numerical model data cannot be directly manipulated within the forecasting office as part of the forecast process. This does limit the ability of SIMS to explore different forecast outcomes and produce tailored or graphical forecasts for specific locations, or to post-process NWP predictions to produce improved local guidance.

In addition, the guidance from global and regional models is not available in graphic form to SIMS at full resolution, limiting the ability of SIMS to give detailed advice to stakeholders.

The Severe Weather Forecasting Programme in the SW Pacific also provides interpretive guidance (Figure 5) that reflects model data and professional discussion between SW Pacific colleagues. Post event reports, such as the TC Harold Report quoted here, inform this guidance and spur further model developments for improved forecasts. In this way, SIMS is part of a global effort for the improvement of model-based interpretive guidance.

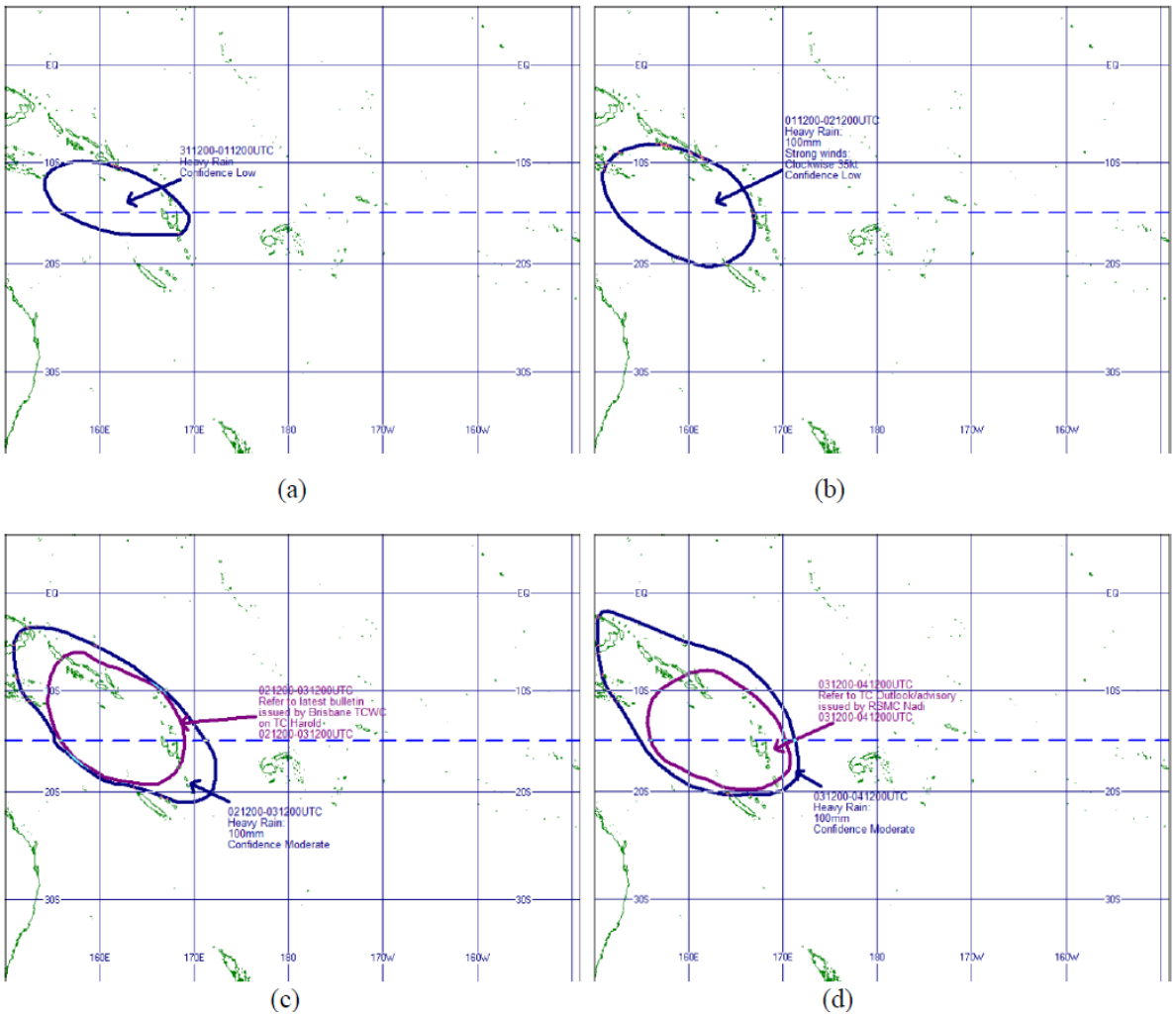

Figure 5 - Interpretive forecast guidance, based on model data and professional collaboration, used by Solomon Islands and other countries during TC Harold as part of the Severe Weather Forecasting Program. Source: MetService NZ, through SIMS TC Harold evaluation report.

The relative lack of surface and upper air observations in the SW Pacific is a significant barrier to improving global and regional model skill. Were observations to be significantly increased in the region to fulfil GBON standards, the quality and confidence

(and therefore usability) of numerical predictions and related guidance would also improve.

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

Locally-run modelling can be problematic for small NMHSs due to the heavy burden associated with computing resources, quality control mechanisms, observations ingestion, training and retention of staff.

In this context a pilot project was undertaken as part of BMKG Indonesia collaboration in the region in 2018. The research-quality Weather Research & Forecasting model (WRF) was installed and tested for Solomon Islands, demonstrating that higher resolution output could be produced to better account for topography. It is not clear whether any local observational assimilation was occurring in the pilot project, which strongly limits the potential usefulness of this approach. Discussions onsite in relation to the WRF project also confirmed that such an approach is currently beyond the technical capacity of SIMS to maintain.

In this context, the World Meteorological Organization has recently issued Guidelines on High-resolution Numerical Weather Prediction (World Meteorological Organization-No. 1311, June 2023)[4], defining six levels of appropriateness of NWP use according to country capacity. These guidelines highlight the complexity of running models in country with full data assimilation.

It may be most sustainable in the long term to reach agreements within the region of what high resolution modelling or downscaling could be performed on behalf of individual countries, but using the resources available to regional and global centres as part of the World Meteorological Organization Integrated Processing and Prediction System (WIPPS) (newly renamed from the World Meteorological Organization Global Data-processing and Forecasting System, GDPFS), which defines global cooperative arrangements designed to reduced the burden on individual countries. The contribution of Solomon Islands of improved GBON compliant observations and verification data could substantially enhance the case for regional centres producing high resolution dynamical modelling specifically for Solomon Islands, or prioritizing Pacific Island Countries as part of regional and global initiatives. Such modelling could be realistically co-branded and made available through SIMS to users, including the general public if possible, and key users at minimum, to reinforce SIMS' role as the meteorological authority in the country.

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

SIMS uses probabilistic forecasts produced for climate purposes through regional and global centres, and also for tropical cyclone forecasting purposes through the Brisbane and Nadi tropical cyclone warning centres. Ensemble predictions are also available through the SW Pacific Forecast Demonstration Project.

Summary score, recommendations, and comments for Element 5

Despite the strong cooperative arrangements in the SW Pacific, including for severe weather forecasting and climate products, Solomon Islands is assessed as **Maturity Level 2** for this criterion, expressed as *'Basic use of external model output and remote sensed products in the form of maps and figures, covering only a limited forecast time range'.* This is largely due to the challenges of manipulating data internally to produce Solomon Islands-specific products.

[4] Available at https://library.wmo.int/doc_num.php?explnum_id=11654

It is not necessarily appropriate for the country to pursue a strong local modelling capability due to the large overhead associated with numerical modelling, but the skill and use of model data could be significantly improved through enhanced forecast production systems being available to forecasting staff, combined with improved local observations being contributed to GBON, and agreements within the World Meteorological Organization Integrated Processing and Prediction System to ensure that the highest possible resolution NWP is made available to the country, both in graphical form and through database availability.

Further discussions are recommended, particularly within the context of the Severe Weather Forecasting Programme and the Weather Ready Pacific initiative, to explore whether one of the Regional Specialised Meteorological Centres in the region could assist SIMS in a partnership arrangement to help provide the maximum achievable and sustainable NWP implementation.

Element 6: Warning and advisory services

6.1. Warning and alert service cover 24/7.

SIMS operations, warnings, and alert services cover 24/7. In practice, it can be quite difficult to reach individual communities, particularly out of hours when communication systems are very limited. This means that short-response warning situations such as tsunamis or flash flooding can be quite problematic. This is a national issue that extends beyond SIMS operations but is a challenge when implementing an impact-based, multi-hazard early warning system. In the long term, mobile phone coverage is expected to increase in the Solomon Islands, and with it, the ability to access warnings.

24/7 warnings services are also vulnerable to staff shortages within SIMS and partner organisations. Normally, meteorological services give the utmost priority to real-time warnings, but partner organisations are not always able to do this. For this reason, SIMS has procedures in place that enable it to issue short-fuse warnings such as tsunami warnings immediately, before consulting with the National Disaster Management Office.

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

Warnings are issued to the public for heavy rain, strong winds, tropical cyclones including storm surges, thunderstorms, tsunami, malaria risk, climate outlooks (drought, wet spells), and specific sectors such as aviation and marine communities.

Verification of warning performance mostly focuses on high profile events, such as Tropical Cyclone Harold, with discussions on process improvement fed back into annual planning.

The development of specific flood warnings (rather than warnings of rain leading to flash flooding) is an ongoing challenge, as discussed later.

Onsite discussions with the leadership of the National Disaster Management Office verified the strong relationship with SIMS, but also provided specific suggestions for service improvement. These included quantitative rainfall forecasts and much less generalised forecasts and warnings, so that impacts can be evaluated. The National Disaster Management Office would like warnings in Geographic Information System format for combining with population exposure and vulnerability information, and would also like the case meteorological information at higher resolution. An example was given of the national disaster management staff accessing 3rd party model interfaces (eg 'Windy') directly because they were unable to get the same information from SIMS. One of the issues with this is that it deprives SIMS of the opportunity to contextualise the modelling, explaining where it may or may not be accurate, what alternative scenarios should be considered, and how the data presented might relate to impacts.

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.

The development of impact-based multi-hazard early warning services is still in its relatively early stages, following an initial training workshop held in 2020, and then a follow-up in January 2023. The January 2023 workshop included participants from SIMS, the National Disaster Management Office, and stakeholders. As noted above, the technical capacity of SIMS to support detailed emergency response operations needs improvement. The Common Alerting Protocol (CAP) warning format is not yet implemented.

Government commentary has noted that about 80% of the people live in rural areas where there are poor communications and low literacy rates. This poses additional challenges for implementation of impact-based warning systems, but also reinforces the potential benefits.

The improvement of end-to-end, impact-based warning systems is one of the top priorities of the new National Strategy for Meteorological Services and Framework for Weather, Climate, and Ocean Services.

Summary score, recommendations, and comments for Element 6

Solomon Islands is assessed as being at **Maturity Level 3** for Warning and Advisory Services, which is described in the CHD as being *'Weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies.'*

Building better warning and advisory services is an important challenge and can be achieved using long-term partnership approaches – it is a difficult area to rapidly improve due to the complexity of warning frameworks and meeting technological challenges. It is, however, a global priority to address under the Sendai Framework and related initiatives such as the UN Early Warnings for All effort, and sustained effort will make an important difference.

In addition to riverine issues, it is important to consider geohazard issues, particularly (as noted earlier) in relation to working with the Geological Survey to prepare for any potential significant volcanic unrest. The 2022 eruption of Hunga Tonga-Hunga Ha'apai in Tonga was a reminder of the rapid development and extreme effects of eruptions at normally manageable volcanoes. Evidence given during onsite discussions indicates that the relationship between SIMS and the Solomon Islands Geological Survey is sound, as their relationship with client agencies, but both institutions need substantial further capacity development to provide a seamless multi-hazard warning service together.

Finally, a strong unified approach is also highly desirable for dealing with very low probability, high impact events such as meteorite impacts or severe solar storms. Having an established, impact-based multi-hazard warning system across the country, with strong local engagement and high levels of government integration, will put Solomon Islands in the best position to deal with all types of natural hazards.

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.

SIMS is well positioned institutionally to support Climate Services in Solomon Islands, being located in the Ministry of Environment, Climate Change, Disaster Management and Meteorology. The role of SIMS is supported in legislation, and the agency is appropriately engaged.

Since 2003, Solomon Islands has been a partner in the Australian-led COSPPac and its predecessor programme, the Pacific Islands Climate Prediction Project[5]. This programme supports an ocean portal, an Online Climate Outlook Forum, a Water Storage Outlook Model, tidal information, sea level data, a Malaria early warning system, a drought monitoring and response system, and climate bulletins. Solomon Islands also has strong bilateral relationships with other Pacific Island nations who share a very strong interest in climate and concern regarding climate change issues.

In addition, as previously mentioned, forecasting in the deep tropics is strongly influenced by short term and longer-term climate drivers, including intraseasonal elements such as the Madden-Julian Oscillation and seasonal factors such as ENSO. This means that forecasts for the weekly to seasonal timescales have a real potential to drive user decisions, even in a situation where the day-to-day short-term forecast does not change.

However, basic climate services are compromised by the current status of the observational network, which means that climate data is much lower quality than should be the case. Communications, technological and literacy challenges interfere with the ability of the population to access data directly or use it most effectively. Agency resourcing, including having very few staff in the climate area, interferes with the capacity of SIMS to advocate for the most effective use of climate data for planning and adaptation activities. Considering the importance of climate change and climate adaptation to the country and the high priority placed on climate actions by development partners as well as by the Solomon Islands government, this is an unfortunate situation.

Despite the limitations of observations, climate service provision in the country is relatively well developed considering the relatively meagre resources available. The SIMS website gives access to 3-month rainfall outlooks, climate summaries, traditional knowledge summaries, climate data from individual sites, ocean forecasts, and some sector-specific information. Climate observations are held in the CliDE (Climate Data for the Environment application) application, used by 14 member countries of the South Pacific Regional Environment Programme (SPREP).

Summary score, recommendations, and comments for Element 7

In terms of formal climate services evaluation, Solomon Islands rates well in terms of national governance and decision-support products, but less strongly in terms of basic climate systems, monitoring of social-economic benefits, observational aspects and ability to support capacity development. Overall, Solomon Islands is assessed as being at **Maturity Level Three** for contribution to climate services, or 'Essential Capacity for Climate Services Provision', noting the support provided by COSPPac for services and the dedication of local staff.

Improvements can be gained through strengthening the observations network and the ability for the public and agencies to use the data directly, staffing support, and funding

[5] See http://cosppac.bom.gov.au/

ongoing work to promote the understanding and use of the data, including in critical planning decisions in the context of disaster resilience and climate change. Continued regional partnerships are essential for maintaining climate services.

Similarly to the above discussion regarding observations and numerical modelling partnerships, it will also be useful if any new climate-related development initiatives in-country are encouraged or mandated to work in sustainable long-term partnerships with SIMS. COSPPac is a good model in that regard.

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.

Qualitative warnings for heavy rain are produced by SIMS, with the Water Resources Management Division of the Ministry of Mines, Energy, and Rural Electrification undertaking some Community Based Disaster Risk Management (CBDR) focusing mainly on flood monitoring and early warning systems. Very limited quantitative information is available. This is further complicated by the convective nature of tropical rainfall, and high spatial and temporal variability implied. A very small amount of work has been done to develop modelling for flood management in the country.

The current situation was summarised in the Weather Ready Pacific initiative proposal in May 2021, which noted that *"for river monitoring, there is only one water level recording station and one only hydrometric water level station recording real time nation-wide. Further, because much of the recent equipment (e.g. AWS) is funded by climate change projects, which may have another priority focus e.g. food security, the equipment is located in coastal areas and is not that useful for heavy rain and flood warnings. There is a high priority need to fund and locate weather stations and hydrological equipment in river catchments where flooding leads to a significant loss of life. This is clearly reflected in the following response from the Solomon Islands, "More water level stations and rainfall stations need to be installed country wide for the purpose of accuracy and coverage in data and monitoring. Without rainfall data, hydrologic forecasting is impossible."*

The Honiara Flood Risk Management Study and Plan (also May 2021) recommended measures to:

- Improve national-level heavy rainfall alert and warning system.
- Install and operate real-time rainfall and river gauges in Greater Honiara, including design features to mitigate the risk of vandalism.
- Develop flash flood guidance system or similar for Greater Honiara.
- Develop flood forecasting system for Mataniko and Lungga rivers.
- Strengthen flood warning dissemination and risk communication.
- Provide capacity building to support hydrological monitoring.
- Facilitate development of community-based flood warning systems using robust processes to maintain systems.

Indicative costings were given for developing improved emergency response, as shown (in part) in Figure 6 below.

OPTION	ESTIMATED COST (US$)	PRIORITY	RESPONSIBILITY
OPTIONS TO IMPROVE EMERGENCY RESPONSE			
Improve national-level heavy rainfall alert and warning system	-	High	SIMS
Develop flash flood guidance system or similar for study area	$150,000	High	SIMS
Develop flood forecasting system for Mataniko and Lungga Rivers	$175,000	High	SIMS
Strengthen flood warning dissemination and risk communication	-	High	SIMS, NDMO
Install and operate real-time river and rainfall gauges in study area	Included in cost below	High	WRD
Provide capacity building to support hydrological monitoring	$330,000 plus $70,000 a year	High	WRD
Facilitate development of community-based flood warning system	$250,000	High	NDMO, HCC, GPG, SIMS

Figure 6 - Options given in 2021 Honiara Flood Risk Management Study and Plan to improve emergency response systems

The above recommendations strongly suggest that the quantitative requirements of the hydrological community in Solomon Islands are still developing, and that this will be an ongoing challenge over some years.

From onsite discussions with Water Resources officials in June 2023, it appears that their situation has further deteriorated due to recent retirements. New appointments are yet to be made.

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

SIMS has an amicable working relationship with the Water Resources Management Division. Procedures are relatively simple given the early stages of development of the warning system. However, legislated responsibilities are unclear, with some ambiguity around flood warning responsibilities. Water Resources staff are generally more involved with post-event analysis after flooding than in any flood warning system, leaving a gap in warning arrangements.

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

Data is shared between agencies, although technical systems are somewhat limited. Data sharing arrangements are expected to develop further in the future.

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

The agencies work together to address issues, but flood warning systems are still in early development. The above discussed study and recommendations demonstrates a strong commitment to improving cooperation between agencies.

Summary score, recommendations, and comments for Element 8

Solomon Islands is assessed as having **Maturity Level 1** in this area: *No or very little meteorological input in hydrology and water resource management*. This reflects that there are good relationships, but there is little in the way of a functional flood warning system other than qualitative heavy rain warnings.

This is a challenging situation for Solomon Islands, and there are no easy systematic fixes. However, the Honiara flood management plan outlines a path forwards, with the focus on Honiara as the urbanised capital city being a sensible route towards better services for the country. Building institutional capacity in both SIMS and Water Resources Management will be necessary for implementation of this plan.

A specific difficulty will be the forecasting and monitoring of quantitative heavy rainfall, given the topographic influences inland from the coast, the lack of real-time observations, and the nature of tropical convection meaning that wide spatial variation of heavy rainfall amounts will be expected between catchments. Improving weather observations and numerical weather prediction for the country is necessary to enhance the potential skill of quantitative rainfall predictions (and hence early warnings for the potential for riverine or flash flooding), and these will then need to be supplemented by real time reporting gauges for key rivers, coupled with 24/7 emergency evacuation alerts for key risk areas.

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?).

SIMS makes full use of the available technologies for dissemination in Solomon Islands, including social media (through its Facebook page), radio, website, and newspaper. SIMS does not operate its own television production facilities, but uses graphical media when possible to illustrate its messaging on Facebook. As noted previously, communications reach in the country is often challenging due to its very rural and low-tech nature, and this is the major limitation on product dissemination.

The SIMS website is relatively user friendly and informative, given the size and resource challenges of the country.

9.2. Education and awareness initiatives in place.

SIMS frequently partners with agencies, including local and development agencies to provide education and awareness outreach to communities, such as schools. As always, these are limited by budget availability, but the evidence is that the agency is very outwardly focused in this area.

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

SIMS strongly recognises traditional knowledge and also the marginalisation of many communities in the country. SIMS works in partnership with other agencies (for example, with disaster management and with humanitarian agencies) to outreach to remote and marginalised communities to the degree possible.

A critical facet of NMHS operations in a country with strong traditional knowledge is to enable the community to see both their own knowledge and modern weather forecasting services as empowering and complementary, rather than competing. Educative programmes can strongly help in this respect.

A presentation from SIMS in the context of a COSPPac project in 2022 affirmed this, and noted that *'while SIMS produce weather, climate and ocean forecasts, there is little uptake and use of these information by the community…. Community members usually ignore advices from SIMS due to lack of understanding technical terms used in the information provide thru radio, and they tend to rely on readily available traditional knowledge on weather and climate and its interaction with the environment around them which they are familiar with.'*

The project was a partnership between SIMS, the Australian Bureau of Meteorology, and World Vision, and demonstrated both that community response to SIMS advice can be strengthened while affirming traditional knowledge, and that there is much more to do in this area.

This general view was also reinforced by informal input from a marine services official, who noted that marine operators were obtaining SIMS wind warnings, but proceeding on their trips regardless.

Summary score, recommendations, and comments for Element 9

Solomon Islands is assessed as being marginally at **Maturity 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*.

This may be misleadingly low due to SIMS's partnership commitments and obvious collaboration and greater than in-house resources. However, the proportion of user outreach is nowhere sufficient for full population coverage, meaning that it is difficult to argue for a higher maturity level due to the criteria attached to that. Improvements in impact-based warning systems and services delivery systems will considerably assist in this area.

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.

Engagements are less formal at this stage, but SIMS has often conducted user workshops in various forms. The draft National Strategy has an objective to 'Enhance coordination between national and interagency', through establishing a national platform and conducting workshops.

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

Independent user satisfaction surveys are not conducted, although some use feedback is received. A 2018 external aviation audit noted that 'SIMS are receiving very sparse feedback via email from pilots. No evidence of engagement with users to seek feedback or to improve services was provided during audit.' The need for customer satisfaction surveys was reiterated in a 2022 aviation audit.

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

A mature QMS (ISO 9001:2015) is in place for services to aviation, supported by regular audits at key facilities and overall, and led by SIMS staff. Based on the audit reports, it is a challenge to get consistent service improvement through this process, due the multiplicity of issues being addressed. However, the process itself is very valuable at driving the improvements that can be made, and showing accountability and transparency to users.

Quality management processes are less mature across other areas of SIMS operations, but a general commitment to continuous improvement is evident across the agency. Additional resourcing is required to implement and certify quality management across other critical areas, such as marine, climate and warning services.

Summary score, recommendations, and comments for Element 10

Based on the evidence available, a **Maturity Level Two** rating is given for Solomon Islands, reflecting that *Service development draws on informal stakeholder input and feedback.*

Development of formal stakeholder liaison mechanisms, expanding the implementation of quality management systems to non-aviation sectors, and implementing regular, externally assessed customer satisfaction surveys would substantially improve the maturity assessment in this area, and help drive other sectors of SIMSs operations forwards. These actions are consistent with the recently published National Strategy.

Annex 1 Consultations (including experts and stakeholder consultations)

Ministry of Environment, Climate Change, Disaster Management and Meteorology

- Solomon Islands Meteorological Service
- National Disaster Management Office

Ministry of Mines, Minerals and Rural Electrification

- Water Resources Management Division

Solomon Islands Maritime Administration

Ministry of Communication and Aviation

- Air Traffic Management Division
- Airport Management Division

Western Province Provincial Government

Site visits performed at Honiara, Henderson Airport, Gizo, and Munda during 19-23 June 2023.

United Nations Development Programme

Australian High Commission

Annex 2 Urgent needs reported

The Solomon Islands Meteorological Service have recently developed a National Strategy that lays out key priorities, including four Strategic Goals:

• Strategic goal 1: Ensure that SIMS has an enabling and conducive institutional environment with sufficient institutional capacity through designing enabling policy and legislative framework which is served by sufficient funding and revenue to deliver effective weather, climate, and ocean services, and other related environmental services

• Strategic goal 2: Strengthen SIMS infrastructure capacity to deliver effective weather, climate, and ocean services

• Strategic goal 3: Strengthen partnerships with stakeholders to improve service delivery, increase the use of meteorology, climate, and ocean products, and ensure successful risk communication

• Strategic goal 4: Strengthen human capacity, performance management, and operational efficiency within SIMS

These goals are best met through long term, partnership approaches rather than short-term projects. However, SIMS clearly has an urgent need to stabilise and upgrade the observational network, and is a participant in the Systematic Observations Financing Facility process as part of that goal. The other obvious pressing need is for support for the forecasting team once they have moved into the new building (currently under construction), as there is no provision for upgraded forecasting systems within the building project.

Annex 3 Information supplied through World Meteorological Organization

- World Meteorological Organization Monitoring System Data
- World Meteorological Organization EW4All Rapid Assessment for Pillar-2
- World Meteorological Organization Hydrology Survey
- Data from Checklist for Climate Services Implementation

Annex 4 List of materials used

Asian Development Bank, 2018, Transport Sector Project Development Facility: Report and Recommendation of the President, https://www.adb.org/projects/documents/sol-51214-001-rrp

Australian Government Pacific Climate Change Science country report: Solomon Islands. Available at https://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/13_PACCSAP-Solomon-Islands-11pp_WEB.pdf

Bureau of Meteorology, Australia, internal visit reports

BMKG Indonesia, presentation to Regional Workshop on Strengthening Multi-hazard early warning system capacity in Pacific Island Countries: Solomon Islands, 2018

Honiara Flood Risk Management Study and Plan, May 2021

National Strategy for Meteorological Services and Framework for Weather, Climate, and Ocean Services, 2023-2028 (September 2023)

Solomon Islands Meteorological Service audit reports and internal documents:

- Part 174 External Audit Report (Bureau of Meteorology) 2018
- Part 174 External Audit Report (PASA) 2023
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- Honiara internal audit report 2022
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