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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Seychelles Meteorological Authority (SMA) Peer Review Report

Reviewing Agency: SOUTH AFRICAN WEATHER SERVICE

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

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List of Abbreviations

AFD – African Development Bank

AWS – Automatic Weather Station

BUFR - Binary Universal Form for the Representation of meteorological data

CHD – Country Hydromet Diagnostic

CREWS – Climate Risk and Early Warning Systems

DRR – Disaster Risk Reduction

ECMWF – European Centre for Medium-Range Weather Forecast

EWS – Early Warning Services

FTP – File Transfer Protocol

GBON – Global Basic Observation Network

GCF – Global Climate Fund

GTS – Global Telecommunication System

ICT - Information and Communication Technologies

SMA- Seychelles Meteorological Authority

MQTT – Message Queuing Telemetry Transport

NGO – Non-Governmental Organization

NMHS – National Meteorological and Hydrological Service

NWP – Numerical Weather Prediction

QA/QC – Quality Assurance/Quality Control

RADAR- Radio Detection and Ranging

RSMC – Regional Specialised Meteorological Centre

SAWS - South African Weather Service

SOFF – Systemic Observation Financing Facility

SWFP – Severe Weather Forecasting Programme

SWIO – South West Indian Ocean

UNDP – United Nations Development Programme

WFP – World Food Programme

WIGOS - WMO Integrated Global Observing System

WIS – WMO Information System

WMO – World Meteorological Organization

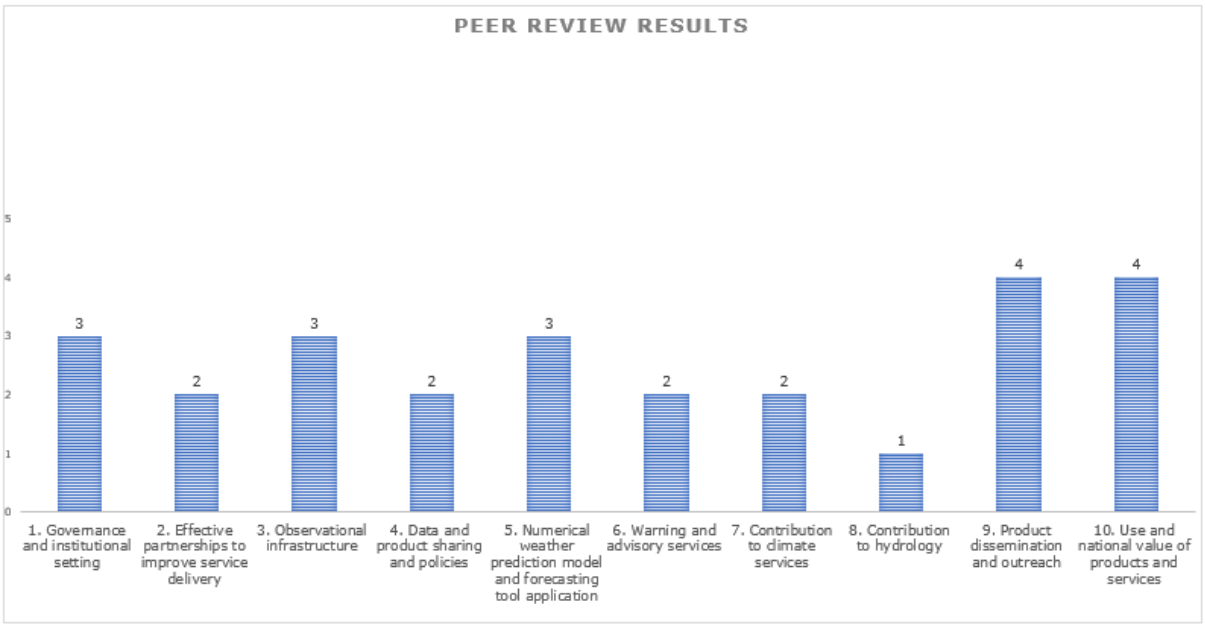
Executive Summary

The Republic of Seychelles is an archipelago made up of 115 islands scattered over a massive Exclusive Economic Zone (EEZ) of about 1.37 million square kilometres, with a total landmass area of 455 square kilometres. The archipelago lies in the heart of the Indian Ocean between 4°S and 10°S; and 46°E and 54°E; northeast of Madagascar; and off the Eastern coast of Africa, the inner granitic islands include the main island of Mahé, followed by Praslin and La Digue, while the outer islands are both granitic and coralline. Despite the highest peak of the granitic islands Morne Seychellois being 905m, the coralline islands are low-lying islands with limited and no elevations that are especially threatened by climate change. The unique geography of the EEZ includes coral reefs, seagrass beds, mangroves, and a variety of coastal and aquatic ecosystems.

Meteorological activities in the Seychelles are closely monitored and studied by the Seychelles Meteorological Authority (SMA), responsible for providing weather forecasts, issuing warnings, and conducting a range of meteorological services. Given its geographical location, the archipelago is prone to monsoons, which are characterized by strong winds and substantial rainfall. These monsoons, influenced by the Indian Ocean Dipole and the El Niño-Southern Oscillation, are vital for Seychelle's agricultural sector as they provide the necessary water supply for crops. Furthermore, the position of the Inter-Tropical Convergence Zone (ITCZ) governs the Seychelles weather and climate conditions. The rainfall varies according to the height above sea level, and ranges from 76.2 mm in July to 404.8 mm in January. The mean annual rainfall for Mahé is 2369.4 mm over the coast. Rainfall also tends to be higher on the west facing slopes and ridges of La Misere, since most rainfall occurs during the northwest monsoon. The heavy downpour normally occurs from late December to the beginning of January. Excessive rainfall can lead to flooding and landslides, posing risks to inhabitants and infrastructure.

In addition to monsoons, the Seychelles also experiences tropical cyclones, which typically form during the wet monsoonal season from November to April. The occurrence of cyclones can have severe impacts on the country's economy, particularly its tourism sector. Therefore, accurate forecasting and timely warnings are essential for preparedness and minimizing potential risks associated with these extreme weather events. Furthermore, climate change poses a significant challenge for the Seychelles, as its low-lying islands are vulnerable to rising sea levels. As a response, the Seychelles government has implemented various measures to combat climate change and adapt to its effects. These include the creation of marine protected areas, promoting sustainable tourism practices, and investing in renewable energy sources. As climate change continues to pose challenges, it is essential for local authorities, scientists, and international partners to collaborate and develop sustainable strategies to effectively mitigate and adapt to the impacts of climate.

Strengthening hydromet services in Seychelles requires substantial investment and concerted efforts from government, development partners, the private sector, and regional cooperation between the various role players in the hydromet value chain. The National Contribution plan highlighted some of the cost implications to address weather and climate observational infrastructure gaps which undermine the efforts of the Early Warning Systems (EWS) internationally. Technical assistance, expert guidance and training, as well as upgrades to the equipment and tools for monitoring and forecasting, are proposed, as detailed in the GBON National Contribution Plan. It is for this reason that SOFF secretariat is called upon to note these gaps and support Seychelles in addressing them.



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

Chapter 1: General information

Introduction

The Seychelles Meteorological Authority (SMA) owns, operates, and maintains a network of 24 surface land stations and one upper-air land station across the main island Mahe, and the outer island groups, Southern Coral Group, Amirante Islands, Alphonse Group, Aldabra Group and Farquhar Group.

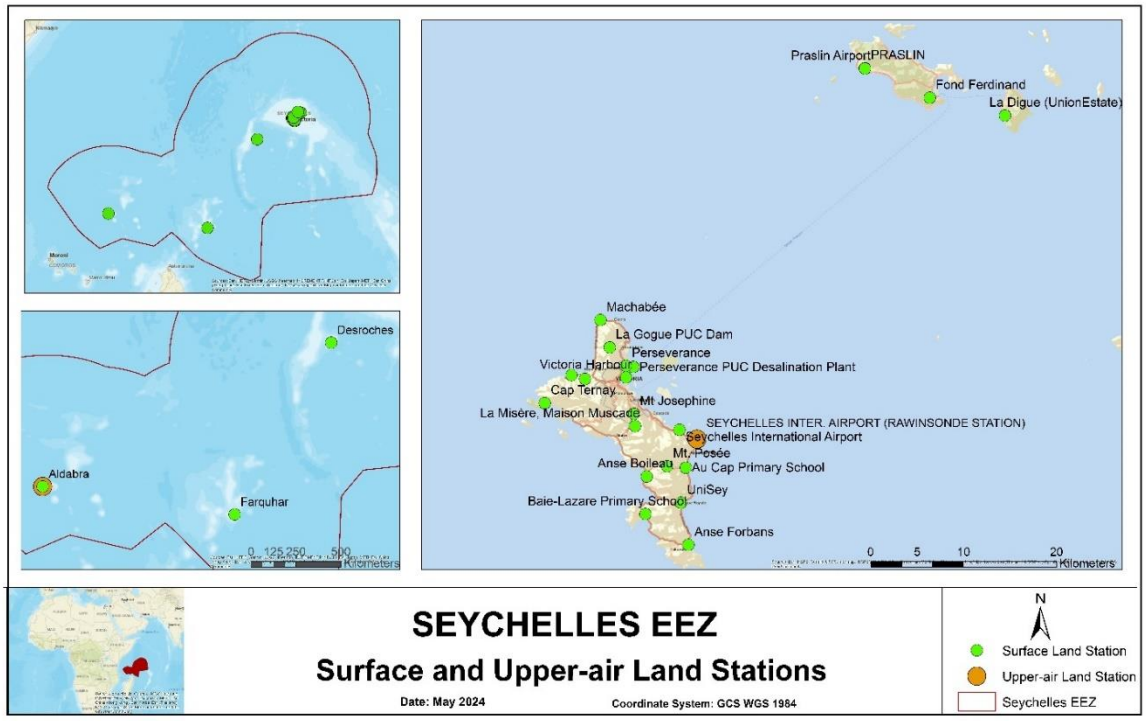
The SMA surface land stations perform 3-hour observations for national requirements, except for the Seychelles International Airport AWS, which exchanges data internationally every 3 hours. The upper-air (radiosonde) land station at the Seychelles International Airport, performs one ascent per day at 12h00 UTC

The technical and local assessment of the GBON stations indicated the need to rehabilitate the surface land station located at the Seychelles International Airport and for the re-opening and replacement of five silent/non-reporting stations with new Automatic Weather Stations that meet the GBON technical requirements. Moreover, an additional surface land station will be installed on Coetivy Island located approximately 290km from the south of Mahe to cover the southern part of the Seychelles Exclusive Economic Zone (EEZ). The existing upper-air (radiosonde) land station at Seychelles International Airport should be rehabilitated to meet the GBON technical requirements and a new station is proposed to be established and installed on the outer island of Aldabra Island to address the data gap to the South of Mahe.

Table 1: List of stations identified to cover the data gap over the Seychelles

#	Station name	WIGOS-ID	Latitude	Longitude	Date Established	Program/Network affiliation
1	ALDABRA	0-20000-0-63995	-9.4017	46.2061	1968-01-01	GOS General: Non-reporting, RBCN - deprecated: Closed, RBON: Operational; GBON: Planned
2	DESROCHES	0-20000-0-63994	-5.6951	53.6502	2001-01-01	GBON: Planned; GOS General: Non-reporting
3	FARQUHAR	0-20000-0-63996	-10.1225	51.1611	2001-01-01	GOS General: Non-reporting
4	LA DIGUE	0-690-0-UNIO	-4.3663	55.8288	2021-12-01	GBON: Planned
5	PRASLIN	0-20000-0-63981	-4.3205	55.6931	2001-01-01	GBON: Planned, RBCN - deprecated: Closed, RBON: Non-reporting, RBSN(S) - deprecated: Closed
6	SEYCHELLES INTERNATIONAL AIRPORT	0-20000-0-63980	-4.6701	55.5138	1894-01-01	CLIMAT(C) - deprecated: Closed, GBON: Operational, GOS General: Operational, GSN: Operational, RBCN - deprecated: Closed, RBON: Operational, RBSN(S) - deprecated: Closed
7	Coevity	To be registered in OSCAR/Surface	-7.1322	56.2736	n/a	GBON: Planned

Furthermore, this report provides an overview of the existence of weather observations infrastructure owned, operated and maintained by third parties within the Seychelles, which can be considered if they meet GBON requirements for the development of the National WMO Integrated Global Observing System (WIGOS) implementation plan.



CHD methodology

This report has been prepared using the methodology described in the 28 February 2023 update of the Country Hydromet Diagnostics (CHD) Operational Guidance for SOFF. An initial desktop review was performed, using information supplied by the Seychelles Meteorological Authority (SMA), the World Meteorological Organization (WMO), "Country Hydromet Diagnostic Report 2022" and the "Hydromet Alliance Gap Report". An in-country visit was then undertaken by the peer advisor delegation for the assessment of the observation infrastructure for data collection required for development of the GBON National Gap Analysis and well as the GBON National Contribution plan. This data was also relevant for development of this report.

This document will provide crucial information for the SOFF initiative implementation phase in Seychelles, which is coordinated by South African Weather Service (SAWS) together with World Bank, as well as informing the ambitious EW4All initiative. This assessment by SAWS has been facilitated by an on-site visit as well as various remote consultations. Following the CHD structure, this report is presented using the ten most critical elements of the hydromet value cycles, with an indication of their respective maturity levels and some high-level recommendations to help increase that maturity level, with a special emphasis on monitoring, forecasting, climate projection and warning systems for climate-related hazards, across all timescales.

Chapter 2: Country Hydromet Diagnostics

Element 1: Governance and institutional setting

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

The legal mandate of the Seychelles Meteorological Authority and its scope is regulated and described by the Meteorological Act 16 of 2015. This mandate positions the Seychelles Meteorological Authority, abbreviated to SMA, as the as a sole recognized national provider on meteorological and climate services in Seychelles. Furthermore, this Act also gives the sole responsibility of advice on installation of meteorological and climatological stations in Seychelles to SMA. This public institution, of a scientific technical nature, is endowed with legal personality, autonomy and administrative responsibility to: -

(a) maintain, extend and improve the quality of meteorological services
(b) provide public good services and commercial services
(c) ensure ongoing collection and updating of meteorological data
(d) be the custodian of a reliable national climatological record
(e) take measures to fulfil the country's international obligations under the Convention of the World Meteorological Organization
(f) provide meteorological services to international air and sea navigation, and
(g) fulfill any other weather-related obligations as may be prescribed.

Even though SMA has a commercial section where data is seen as a commodity for income generation, it should be noted that a fair and equitable exchange of data and products is essential for the success of the entire weather enterprise, as data availability is crucial for life-saving missions, such as disaster risk reduction, food security and for meeting the breadth of societal demands that cannot be met by a single sector, especially in the least developed countries.

Having considered the requirements for a GBON assigned network, it is critical that the budget to operate and maintain this network must consider the entire life cycle of the entire network, which requirements include but are not limited to:

a. Upgrading of the current network to be assigned to the GBON observation network
b. Consumables to be used during the operational period
c. Communication costs
d. Transportation costs for maintenance
e. Tools required to maintain the network

f. Replacement of the full network at the end of this operational period.

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

The current SMA strategic plan covers the period 2025-2029. This strategic plan provides a roadmap for SMA to fulfil its mandate of provision of timely weather and climate information and services for the safety of life, protection of property and conservation of natural environment. The plan provides a new strategic direction and will be useful for guiding SMA in the making of the day–to–day decisions and for evaluating the progress and changes in approaches needed moving forward.

The plan considers the Meteorology Act of 2015 – covering the transition of Seychelles National Meteorological Services (SNMS) to the Seychelles Meteorological Authority (SMA), the National government plan, the sector plan, the WMO strategic plan, the Sendai Framework of Action (2015-2030) and UN Sustainable Development Goals (SDGs), among others. This plan recognizes global emerging issues such as implementation of the Global Framework for Climate Services (GFCS), implementation of WMO Integrated Global Observation System (WIGOS) (which is an integrated, coordinated and comprehensive observing system to satisfy, in a cost-effective and sustained manner, the evolving observing requirements of Member states in delivering their weather, climate, water and related environmental services), together with implementation of the WMO Information System (WIS), which is critical for international exchange of data and information.

The strategy further recognizes the importance of data rescue endeavors as well as climate action plans due to climate change being a serious concern for Small Islands Developing States (SIDS). The strategy is driven by the increased responsibilities imposed by the Meteorology Act 2015, especially the new responsibility for marine services, and an increased emphasis on services related to climate change and climate risk. Implementation of the Regional Integrated Multi-Hazard Early Warning System (RIMES) is also a driving factor as there is the potential for a sub-regional hub of RIMES being based in Seychelles. The HYDROMET project, managed by the Indian Ocean Commission (IOC) with funding from GCF/AFD/EU is one of the projects nationally that can be considered in support of GBON implementation.

The outcome of the "Diagnostic of Multi-Hazard Early Warning Capacities in Seychelles" Country Report by Alice Soares, Rose Osinde-Alabaster and Yvette Ramos proposed a plan for governance and institutional strengthening which was aimed at governance, strategy, and organizational structure as well as human resources and capacity development.

There is an operational plan in place, and SMA is reporting on a quarterly basis on this plan as part of oversight and management of its activities. However, no risk management plan in place yet.

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

The total annual budget for SMA for 2024 was 17'000'000 Seychelles Rupees (60%) provided by the Government plus 11'000'000 Seychelles Rupees (40%) for cost recovery from aviation services.

Approximately 8 000000 Seychelles Rupees goes to personnel cost, 9 000000 Seychelles Rupees goes to operational cost and 11 000000 Seychelles Rupees is for investments.

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.

The staff base of SMA comprises approximately twenty-nine (29) employees, of which twenty (20) are trained in relevant disciplines, including scientific, technical, information

and communication technologies (ICT) as well as data management. Fourteen (14) of the twenty-nine (29) employees are male and fifteen (15) are female, which indicates gender balance within SMA.

Table 2: Staff Representation at SMA

Number of Staff (Management)	7
Meteorologist	11
Meteorological Technician	0
Hydrologist	0
Hydrological Technician	0
Climate Services	1
Researcher	1
Other	9
Total Staff number M:F	14:15

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

SMA has been involved in the implementation of the Multi-Hazard Early Warning System, HYDROMET project, managed by the Indian Ocean Commission (IOC) with funding from GCF/AFD/EU and EWS for Floods, managed by WMO with funding from USAID. The funding received was 15'455'614 USD for the HYDROMEt project and 180'000 USD from CREWS SWIO.

Summary score and recommendations for Element 1

The CHD Element 1 score for the "Governance and Institutional Setting" was assessed as being at Maturity Level 3 on the CHD scale, reflecting "moderately well mandated, managed and resourced with clear plans for, and sufficient capacity to address operational gaps."

Recommendations:

a) Risk Management plans with reporting timelines to be developed for SMA.

Element 2: Effective partnerships to improve service delivery.

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

There is limited effective partnerships for service delivery in place with other government institutions. For example, hydrology in Seychelles is carried out by other agencies, and there are no standard operating procedures in place nor formal mechanisms within the country to coordinate, on a regular basis, activities between the meteorological agency and hydrological services. There are no existing MoUs with governmental departments for maintenance and operation of weather observation networks or data sharing.

The SMA is the designated national meteorological authority responsible for ensuring compliance with international standards in respect of aviation, maritime, and public forecasting. SMA is also a standing member of the National Disaster Management Service's advisory forum, which serves as a multi sector platform for consultation and discussion around the delivery of services linked to extreme weather and other high impact events. This forum supports national efforts toward disaster risk mitigation and reduction through informed, coordinated planning.

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.

There are no partnerships identified at the national level for provision of weather and climate services, however, there is a formal agreement between SMA and international partners for observation data, including an agreement with Indian National Centre for Ocean Information (INCOIS) for the weather buoy deployment and with UKMO for the provision of upper-air consumables. Furthermore, the SMA multi-sectoral consultative platform, in the form of the National Climate Outlook Forum, exists to foster regular cooperative dialogue with national stakeholders and sits twice annually. Research activities emanating from these engagements are funded through government and international donor funds. There are two (2) research project undertaken by SMA and international partners, namely *Building resilience in the Indian Ocean* (BRIO) aimed at helping the countries develop capacity in doing climate projection and *Sub-seasonal impact-based forecasts for cyclonic activity in the South-West Indian Ocean* (PISSARO) which is a project focussed on atmospheric and oceanic forecasting at the sub-seasonal scale for applications over the South-West Indian Ocean basin.

No formal agreements between public and private sector for service delivery as well as operation and maintenance of networks is in place. SMA and private sector actors also meet on an ad-hoc basis for deliberation on matters pertaining to licencing. SMA as the "authoritative voice" for warning services and the overall meteorological services, meets with private sector service providers such as the media on any weather-related activity in the Seychelles to ensure alignment in the publication or broadcasting of weather-related articles.

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

There are no formal partnerships established with international climate and development finance partners. However, relevant projects are ongoing in the country.

The CREWS SWIO project is one of the initiatives approved by the CREWS Steering Committee on 17 November 2020, with the SMA identified as one of the beneficiaries. Through this project, SMA is benefiting from the development of its institutional strategy. The project also provides advisory services to the Indian Ocean Commission (IOC) and beneficiary countries to ensure optimal utilization of investment funds made available through the AFD GCF HYDROMET and World Bank DRM Programmes. The CREWS SWIO initiative is implemented in close coordination with other regional projects such as ClimSA, Global Climate Change Alliance (GCCA)+, Building Resilience in Indian Ocean (BRIO), the Intra-Seasonal to Seasonal Forecasts with AROme (PISSARO), and Indian Ocean Solar Radiometry Network (IOSNet) projects.

There are several regional organizations / bodies of relevance for implementation of GBON within the sub-region from which Seychelles Meteorological Authority can leverage upon for collaborations such as the Southern African Development Community (SADC) Secretariat through its Sub-sectoral Committee on Meteorology (SCOM) and Climate Services Centre (CSC). The SADC ClimSA Programme aims to contribute to the efforts of SADC Member State countries to adapt to climate change and climate variability by providing science-based climate prediction and information services into national and regional planning processes. It aims to strengthen the climate services value-chain through building the capacities of decision-makers at all levels to make effective use of climate information and services. Through this programme, a few weather observation stations were established within the Seychelles.

The ClimSA Station is a platform for retrieving, processing and visualizing climate and earth observations (EO) datasets for the implementation of climate services. The platform is a full version of the climate station and is being integrated in the Climate Service Information Systems (CSIS) at the regional level and has already been deployed to the National Meteorological and Hydrological Services (NMHSs) of the SADC Member States.

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.

No evidence of enhanced products and services could be found during the assessment, however SMA issues 10-day forecasts for the country, based on the existing web-based numerical weather prediction models and publish these forecasts on the SMA website. Furthermore, SMA issue aviation related weather forecasts.

Summary score, recommendations, and comments for Element 2

There are no existing MoUs with governmental departments for maintenance and operation of weather observation networks or data sharing. Furthermore, there are a few agreements with international organisations for provision of upper air consumables and supply and deployment of Weather buoys over the Indian ocean. No mention of ongoing research activities was evident during this assessment.

It is hereby recommended that SMA establish MoU/agreements with the Islands management cooperation for data and technological exchange, to enhance data and systems availability from adjacent islands.

The Effectiveness of partnerships to improve service delivery for the SMA was assessed at level 2 "Limited partnerships and mostly excluded from relevant finance opportunities" based on limited agreements being in place.

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.

The Seychelles Meteorological Authority (SMA) operates and maintains a network of 24 surface land stations, of which 6 (six) could potentially be included in the national GBON network. The 6 (six) stations considered will be affiliated to GBON.

Table 3: Surface land observing stations identified for GBON

#	Station name	WIGOS-ID	Latitude	Longitude	Date Established	Program/Network affiliation
1	ALDABRA	0-20000-0-63995	-9.4017	46.2061	1968-01-01	GOS General: Non-reporting, RBCN - deprecated: Closed, RBON: Operational; GBON: Planned
2	DESROCHES	0-20000-0-63994	-5.6951	53.6502	2001-01-01	GBON: Planned; GOS General: Non-reporting
3	FARQUHAR	0-20000-0-63996	-10.1225	51.1611	2001-01-01	GOS General: Non-reporting
4	Mt Josephine	0-690-0-63006MJ	-4.6546	51.1611	2023-06-01	GBON: Operational
5	PRASLIN	0-20000-0-63981	-4.3205	55.4699	2001-01-01	GBON: Planned, RBCN - deprecated: Closed, RBON: Non-reporting, RBSN(S) - deprecated: Closed
6	SEYCHELLES INTERNATIONAL AIRPORT	0-20000-0-63980	-4.6701	55.6911	1894-01-01	CLIMAT(C) - deprecated: Closed, GBON: Operational, GOS General: Operational, GSN: Operational, RBCN - deprecated: Closed, RBON: Operational, RBSN(S) - deprecated: Closed

Additionally, SMA has 1 upper-air (radiosonde) land station located at the Seychelles International Airport. The station currently performs 1 ascent per day at 12h00 UTC. A new upper-air station is recommended to be installed at Aldabra.

Table 4: Upper air observing stations identified for GBON

#	Station name	WIGOS-ID	Latitude	Longitude	Date Established	Program/Network affiliation
1	SEYCHELLES INTER. AIRPORT (RAWINSONDE STATION)	0-20000-0-63985	4.6790°S	55.5308°E	1976-01-01	GBON, Global Upper Air Network (GUAN)
2	ALDABRA	0-20000-0-63995	-9.4017	46.2061	1968-01-01	GBON: Planned

3.2. Additional observations used for nowcasting and specialized purposes.

No additional observation data from other data sources. Only SMA observation and model data is in use for provision of services, including the 42 manual rainfall stations and 15 Davis stations. Access to satellite data assists in provision of nowcasting services.

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

There is limited capacity to perform regular calibration, quality control and maintenance of the observing systems that are operational. SMA have only 3 staff members trained on OSCAR/Surface. It is critical to enhance the capacity and capability of SMA to ensure sustainability of the observation infrastructure.

3.4 Implementation of sustainable newer approaches to observations.

There is no evidence of implementation of sustainable newer approaches to observations.

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

Only 26% of the SMA infrastructure has been automated. This does not meet the minimum GBON requirements. Fifteen Davis Automatic Weather Stations have been deployed within the last 5 years, however, an assessment of these stations suggests that GBON requirements are not yet met. Implementation of Seychelles Meteorological Authority Observation Network Evolution (SMA-ONE) as well as WIS2.0 enhanced the data delivery in real time to the SMA. There is currently no radar capability for monitoring of priority hazards within the Seychelles.

Summary score, recommendations, and comments for Element 3

Observational infrastructure for the SMA is assessed at **level three (3)** "Moderate network, with some gaps with respect to WMO regulations and guidance and with some data quality issues".

It is hereby recommended that: -

1. All identified surface weather observation stations for GBON be upgraded to meet the hourly data transmission as per GBON requirements.
2. All sensors and data loggers be upgraded to meet the GBON minimum requirements.
3. Standard Operating Practices (SOP) for the deployment, maintenance, calibrations, and quality assurance of the observational network be developed.
4. Human capacity and capabilities to perform regular calibration, quality control and maintenance of the observing systems in operation be built.

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.

The Global Basic Observing Network (GBON) gap analysis for Seychelles suggested six (6) surface stations and 1 upper air station to meet the GBON compliance requirement for the country. They had only one AWS and one upper air observing station that were aligned with the GBON compliance requirements. The country needed five additional GBON compliant station surface observation station to meet the spatial requirement for GBON.

Further assessment suggested consideration of an additional upper air station at ALDABRA to address the data gap in the south. The installation of an upper air station at ALDABRA could be considered later. It is therefore recommended that that Seychelles install 6 new surface land stations and 1 new upper-air station.

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

No formal data policy is in place addressing free and unrestricted data sharing from SMA, however, the Seychelles Meteorological Authority Act of 2015, Part II, section 5 states: "The functions of the Authority shall be to- (a) record, update and maintain, meteorological observations required for meteorological and related purposes in accordance with international standards".

Through this Act, data is being provided for public good and commercial activities which includes data exchange of monitoring systems and baseline data necessary to produce data products for all priority hazards. The climate section at SMA is responsible for monitoring and quality control of collected meteorological data.

WMO calls for the development of the National WMO Integrated Global Observing system for the country, where all stakeholders operating and managing observation networks can work together towards developing the national observation infrastructure to minimise duplication of national efforts in the deployment of infrastructure. This is one of the activities to be conducted with Seychelles to address the global requirement for WIGOS implementation.

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

There is very limited hydrological monitoring in Seychelles. The mandate of hydrological observation and monitoring is with other institutions, hence the SMA's ability to deliver impact-based or localized/targeted warnings for events such as heavy rainfall is inadequate. Given the nature of flood risk in Seychelles, resulting mainly from rainfall and/or coastal surge events, enhanced capacities for risk assessment and monitoring are urgent.

The forecasting section at SMA have access to various numerical weather prediction models (NWP) such as ECMWF as well as satellite products (EUMETSAT) through the internet. Furthermore, SMA has rolled out WIS2.0BOX (see https://wis2.meteo.sc/) which

is being utilised to access WMO data and products. SMA have a stable internet connection, at 100 Mbps data line with the download bandwidth speed of between 10 and 50 Mbps.

Summary score, recommendations, and comments for Element 4

This element is hereby assessed at level two (2) "Moderately well mandated, managed and resourced and clear plans for, and sufficient capacity, to address operational gaps.". There are no MoU's with government departments which include agreements for data sharing. Furthermore, only one station meets the GBON requirement resulting in a limited amount of GBON-compliant data being shared internationally.

It is hereby recommended that:

1. SMA develop a data policy for the country aligned with the WMO Unified Data Policy, but taking the SMA mandate into consideration.
2. Seychelles install 6 (six) new automatic surface land stations and 1 new upper-air station and rehabilitate the existing upper-air station at the airport.
3. Develop a national WIGOS plan for the Seychelles.

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.

SMA perform both aviation and public weather forecasting. They utilize Numerical Weather Prediction products for wind direction and speed at various pressure levels, maximum and minimum temperature, sea level pressure, geopotential height, vorticity, relative humidity at various levels, instability indices, cloud cover and waves. The WRF model from World Meteorological Centres (WMCs) which also cover similar products such as ECMWF, Regional Specialized Meteorological Centres (RSMCs) including Regional Climate Centres (RCCs) assist with forecasting and related services. The type of products used are mainly charts and text received from Meteo-France; ECMWF; NCEP; UKMO; SAWS as a regional specialized centre. There is limited capacity within SMA to post-process NWP, including Ensemble Prediction System (EPS) products.

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

Deterministic NWPs are extensively in use at SMA for issuance of forecast and warning. This is made possible by an integrated system for analysis, weather forecasting and visualization that has been installed.

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

SMA produces seasonal outlooks designed to inform the public and other users such as disaster risk management, water resource management and agricultural sector of the expected weather conditions that are potentially ahead, to assist in risk mitigation and planning, and is based on probabilistic NWP. There is however limited capacity to post-process NWP, including Ensemble Prediction System (EPS) products within SMA.

Summary score, recommendations, and comments for Element 5

The CHD Element 5 'Numerical Model and forecasting tool application' of SMA is hereby assessed at level three (3) "Prediction based mostly on model guidance from external and limited internal sources (without data assimilation) and remote-sensed products in the form of maps, figures and digital data and cover nowcasting, short and medium forecast time ran.". The NMHS does not have capabilities such as supercomputing to assimilate data from the national observations infrastructure or to run its own model(s).

It is therefore recommended that: -

1. Enhancement of the current computing capabilities for SMA be considered to allow for delivery on forecasting of extreme events at a local level, where the global models are not able to fully address local requirements.
2. Personnel capacity development to build inhouse capabilities to access and use WMCs/RCs products and guidance for forecasting of hazards.

Element 6: Warning and advisory services

6.1. Warning and alert service cover 24/7.

The Seychelles Meteorological Authority provides 24/7 forecasting services, all year-long which include weather warning and alert services. The office utilizes the RSMC Pretoria-issued guidance maps for the provision of warning services for the country. There is no coordination of Multi-Hazard Early Warning Services through the Disaster Management centre.

Standard operating procedures (SOPs) for the issuing of warnings are not in place. They should be developed to facilitate the smooth assessment and issuing of warnings and alerts.

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

Seychelles is prone to hydrometeorological hazards for which forecasting and warning capacity is available, although limited, due to capabilities such as supercomputing to assimilate data from the national observations infrastructure or to run its own model(s).

The hydrometeorological hazards which affect Seychelles and for which the SMA is responsible for issuing warnings include Tsunami; Storm surge/Coastal flood; Landslide/Mudslide & Debris flow; Heat wave; Wind; Tropical cyclone; Thunderstorms/Squall lines; High Seas/Rogue waves, Rain/Wet Spell; Flash floods; Dust storm/Sandstorm. There are no defined platforms for collection of information to perform hazard impact assessment. Additionally, no evaluation of the SMA performance and role (e.g. service delivery and coordination) within the national MHEWS/Disaster Risk Reduction platform is done.

SMA is housed at the Seychelles international airport and is equipped with fail-safe systems such as power back-up, equipment redundancy and on-call personnel systems, including business continuity and contingency plans. SMA benefit from these systems.

The Multi-Hazard Early Warning assessment report for Seychelles suggests a strong integrated system for quantifying direct and indirect disaster damages and losses. This is achieved through the Damages and Loss Accounting System (DALA) in use since the 2004 Tsunami disaster. Additionally, regular Post Disaster Needs Assessment (PDNA) are undertaken in line with the national protocols, to enhance understanding of disaster induced damages and losses. It is noted that the approach for the estimation of damages and losses has not fully taken account of other cascading impacts of the disasters, i.e. no particular reference to risk and vulnerability analysis being linked to the secondary and tertiary impacts of the hydro-meteorological hazards such as coastal erosion, embankment collapse, rock falls and mudlines.

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.

Seychelles Meteorological Authority has implemented the Common Alerting Protocol (CAP) for issuing of severe weather warnings that the SMA is responsible for. Standard operating procedures are not in place.

Summary score, recommendations, and comments for Element 6

The CHD Element 6, (Warning and advisory services) is assessed at level 2 "Basic warning service is in place and operational, but with limited public reach and lacking integration with other relevant institutions and services."

It is hereby recommended that:

1. Standard Operating Procedures (SOP) for a Multi-Hazard Early Warning System (MHEWS) be developed for the country.
2. Capacity development be conducted for assessment of the early warnings issued, as well as incorporation of these outcomes into the improvement of the early warning services.
3. A multi-stakeholders forum on disaster management be established to deliberate and plan the utilization of MHEWS outputs nationally.

Element 7: Contribution to Climate Services

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

The Seychelles Meteorological Authority provide a basic contribution to the climate services of the country which is hosted by the Ministry of Agriculture, Climate Change and Environment through operation and maintenance of the national weather observation network as well as climate science research. The Ministry has a Climate Science and Data Management (CSDM) Section that caters for all of the Ministry's GIS, remote sensing and data management needs.

Summary score, recommendations, and comments for Element 7

The CHD Element 7, Contribution to Climate services, is assessed at level 2 "Basic Capacity for Climate Services Provision".

Future development of the Seychelles Climate Science and Data Management (CSDM) Section envisages expansion to have capacity to support climate research currently undertaken by the Meteorological Agency.

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.

Hydrology in Seychelles is not the responsibility of the Meteorological Agency. It is carried out by other agencies which have comprehensive policies and strategies (such as The Seychelles National Wetland Conservation and Management Policy (2005; the Seychelles Coastal Management Plan 2019-2024)) for management of hydrological services nationally. Some of these policies and strategies are not linked to the law for enforcement.

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

There are no standard operating procedures in place nor formal mechanisms within the country to coordinate, on a regular basis, activities between the meteorological agency and hydrological services. Furthermore, there is no evidence that hydrological predictions are undertaken in Seychelles. There is however a national committee within the country for coordinating disaster risk reduction activities where all national agencies are represented, established through the Disaster Risk Management Act 2014.

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

There are no agreements in place for data sharing (between local and national agencies, and across international borders as required) on hydrological data in place or under development.

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

There is no evidence of joint projects/initiatives with hydrological community designed to build hydrometeorological cooperation which could be identified during this assessment.

Summary score, recommendations, and comments for Element 8

CHD element 8 is assessed at level 1 - "No or very little meteorological input in hydrology and water resource management". Hydrology is hosted by other agencies and SMA role is mainly supportive to hydrology.

It is hereby recommended that:

1. There is a need for enhancement of hydrological services within the Seychelles through installation of a hydrological observation and monitoring network.
2. An agency responsible for hydrology be established to ensure coordination of the services.

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?).

The Seychelles Meteorological Authority SMA have a well-equipped studio for recording and broadcasting of weather forecasts nationally. Furthermore, it disseminates information through various media platforms such as Television; Radio; Printed media; Website; E-mail; social media and Third-party messaging mobile phone application (ex. WhatsApp).

9.2. Education and awareness initiatives in place.

School visits to the office as well as outreach by meteorologists to schools are one of the ongoing activities of the Meteorological Agency.

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

No specialised measures in place to reach marginalized communities.

Summary score, recommendations, and comments for Element 9

CHD element 9 is assessed at level 4 where "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." Furthermore, existing local disaster risk community forums are used to ensure communication reaches all levels of the society.

It is hereby recommended that:

1. It is recommended that SMA consider a developing a plan to reach communities with special needs to ensure they also benefit from the agency services.

Element 10: Use and national value of products and services

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

SMA participate during multi-sector consultative platforms such as the National Climate Outlook Forum to foster regular cooperative dialogue. Furthermore, they participate at the National Disaster Risk Management Committee which is composed of ministries, agencies and other stakeholders and coordinates Disaster Risk Reduction activities at the national to sub-national levels.

There is however no platform or mechanism established for the co-design and/or co-production of tailored products and services. The agency has a dual mandate and it serves as the Meteorological Watch Office (MWO) responsible for issuing of SIGMET information and, where required, AIRMET information. As the Aerodrome Meteorological Office (AMO) it is responsible for issuing Terminal Aerodrome Forecasts (TAF), trend forecasts or landing forecasts, forecasts for take-off, area forecasts for low-level flights, aerodrome warnings, wind shear and aviation-related warnings and alerts. As the Aeronautical meteorological station (AMS) issues Meteorological Aviation Reports (METAR) and Special Meteorological Aviation Reports (SPECI).

SMA have a well-designed website where any useful information about the agency can be accessed as well as a Facebook page for dissemination of weather-related information. This page can also be used to reach SMA for social related activities. The agency as a service provider works closely with media, academia and civil society. The agency has performed social and economic benefits (SEB) of weather, climate and water hydrological services studies and drafted a report titled "SOCIO-ECONOMIC BENEFITS OF IMPROVED HYDROMETEOROLOGICAL SERVICES AND EARLY WARNING SYSTEMS IN SEYCHELLES in 2024." This document has not yet been published.

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

SMA is subjected to independent user satisfaction surveys from time to time. The survey outcomes become an input for service improvement, however there is no plan drafted based on these outputs, as no regular reviews or reports on the accuracy and timelines of services is available.

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

SMA provides aviation-related products and services such as Terminal Aeronautical Forecasts (TAF), Meteorological Aviation Report (METAR), Special Meteorological Aviation Report (SPECI), and aerodrome warnings and has implemented QMS (QMS certification ISO 9001/2015) for international air navigation in full. The agency has not commenced any implementation of quality management for marine services. The QMS also covers climate services which entails climate data management, climate monitoring, climate prediction and service delivery. QMS for early warning services will be implemented within two years.

Summary score, recommendations, and comments for Element 10

CHD element 10 is assessed at level 4 where "Service development draws on survey data and regular dialogue, based on formal relationships with major stakeholders to ensure continuous improvement."

Annex 1 Consultations (including experts and stakeholder consultations)

(1. Mr Vincent Amelie, CEO SMA & Permanent Representative of Seychelles to the World Meteorological Organization

(2. Ms Marie-Eve Denis- SMA

(3. Mr Verunakumar Rajendran

Annex 2 Urgent needs reported

The following need to be addressed to realise significant improvement: -

1. Risk Management plans with reporting timelines to be developed for SMA.
2. SMA to establish MoU/agreements with the Islands management cooperation for data and technological exchange to enhance data and systems availability from adjacent islands.
3. To increase the budget of SMA in order to enhance its capacity to employ additional professional staff, and to procure suitable equipment and ensure its basic maintenance.
4. All identified surface weather observation stations for GBON must be upgraded to meet the hourly data transmission as per GBON requirements.
5. Upgrade all sensors and data loggers to meet the GBON minimum requirements.
6. Standard Operating Practices (SOP) for the deployment, maintenance, calibrations, and quality assurance of the observational network to be developed.
7. Build human capacity and capabilities to perform regular calibration, quality control and maintenance of the observing systems in operation.
8. Develop a national WIGOS plan for the Seychelles.
9. SMA must develop a data policy for the country aligned with the WMO Unified Data Policy, but taking the SMA mandate into consideration.
10. Seychelles must install 6 (six) new automatic surface land stations and 1 new upper-air station and rehabilitate the existing upper-air station at the airport.
11. Enhancement of the current computing capabilities for SMA must be considered to allow for delivery on forecasting of extreme events at a local level, where the global models are not able to fully address local requirements.
12. Personnel capacity development to build in-house capabilities to access and use WMCs/RCs' products and guidance for forecasting of hazards.
13. Standard Operating Procedures (SOP) for a Multi-Hazard Early Warning System (MHEWS) must be developed for the country.
14. Capacity development must be conducted for assessment of the early warnings issued as well as incorporation of these outcomes into the improvement of the early warning services.
15. The multi-stakeholder's forum for disaster management must be established to deliberate and plan for the utilisation of MHWES outputs nationally.
16. There is a need for enhancement of hydrological services within the Seychelles through installation of a hydrological observation and monitoring network.
17. An agency responsible for hydrology must be established to ensure coordination of the services.
18. It is recommended that SMA consider developing a plan to reach communities with special needs to ensure that they also benefit from the agency services.

Annex 3 Information supplied through WMO

1. WMO Monitoring System Data
2. WMO EW4All Rapid Assessment for Pillar-2
3. WMO Hydrology Survey

Annex 4 List of materials used

1. Country Hydromet Diagnostics, published by WMO, 2023
2. CHD Operational Guidance for SOFF, 2023
3. Seychelles Meteorology Act of
4. 2015 SMA Strategic Plan 2025-2029
5. Seychelles Disaster Risk Management Act of 2014
6. DRR Peer Review Report 2018:19
7. DRR Peer Review Report, 2018: TOWARDS EFFECTIVE IMPLEMENTATION OF NATIONAL DISASTER RISK REDUCTION POLICIES, STRATEGIES AND ACTIONS, pg.6
8. CREWS SWIO Seychelles Strategic Planning, Mahe, Seychelles, 28 June to 6 July 2023, Mission Report-20 July 2023.
9. Diagnostic of Multi-Hazard Early Warning Capacities in Seychelles country report, prepared by Alice Soares, Rose Osinde-Alabaster, and Yvette Ramos, n.d. Project Title: Supporting regional cooperation to strengthen seamless operational forecasting and multi hazard early warning systems at national level in the South-West Indian Ocean.