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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St. Vincent and the Grenadines

Peer Review Report

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National Meteorological Services of St. Vincent and the Grenadines (NMSSVaG), Argyle International Airport, St. Vincent and the Grenadines

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

Authorisation for release of this report has been received from the Peer Reviewing Agency and the Country National Meteorological Service as of 01.12.2024.

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Table of Contents

Executive Summary

The Saint Vincent and the Grenadines Meteorological Service (SVGMS) is the national meteorological service agency, a department unit presently established under the Aviation Services Department, which is under the auspices of the Ministry of National Security, Air and Sea Port Development of St. Vincent and the Grenadines (SVG). Since its foundation back in 1960, it was mainly providing services for the civil aviation sector. Over the past few years, however, its activity has expanded. In addition to the aviation sector, the SVGMS currently provides services and products to the national Emergency Services, Water, Agriculture, and other sectors.

The SVGMS faces a number of challenges that can be summarized as follows:

a. Legal framework – currently, the SVGMS still acts without any proper legislative framework. A dedicated legal act is already under processing since three years, and there is no reference to SVGMS in any other governmental act.

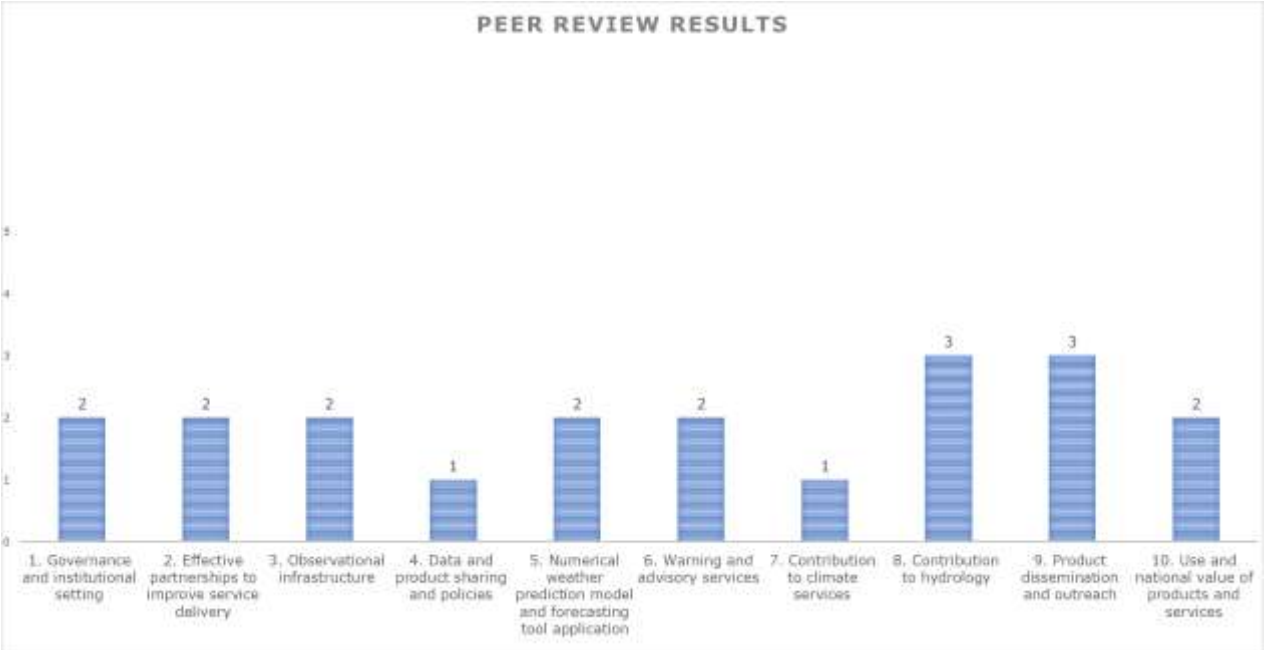
b. WMO Membership – currently, SVG is not a Member of WMO. The SVGMS should push the government of SVG to apply for a full Membership with WMO.

c. Observational network – there is a need to find a sustainable solution for the maintenance and real-time transmission of the data from the AWSs, including the procurement of relevant spare parts and finding an adequate replacement for the soon to be retired single technician of the SVGMS.

d. Operational Centre –adaptations and changes are required to allow for 24/7 operations.

e. Hydrological Service – the government should aspire towards establishing a hydrological service, either as part of the SVGMS or the National Water Company. Such a service could issue flood forecasts and warnings, deliver different hydrological products and take the responsibility for the national hydrological data archive.

The Peer reviewed results are presented in Fig 1 below.



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

Fig 1. The maturity level scores for the SVGMS, according to the CHD Methodology

1. General information

Introduction

St. Vincent and the Grenadines

St. Vincent and the Grenadines is an independent island state located in the Eastern Caribbean. It lies between latitudes 13.0° and 13.3°N, and longitudes 61.1° and 61.3°W. Its territory consists of the main island of Saint Vincent and, south of that, two-thirds of the northern part of the Grenadines, a chain of 32 smaller islands, most of which are unpopulated.

The capital and largest city is Kingstown. The country has an area of approximately 369 km^2 plus an Exclusive Economic Zone in the Caribbean Area with an additional extent of approximately 70,000 km^2, and a population of approximately 110,000 inhabitants[1][2]. Thus, the overall population density is quite high, but unevenly dispersed.

The country gained its independence from the United Kingdom in 1979, becoming and remaining a member of the British Commonwealth, as well as joining different regional and continental organizations and communities.

Inform Risk Index

The country has an Inform risk index of 2.6 (scale 0-10, 0 is optimum) and is thus positioned in the risk[3] class "Low". This means that the country is at a low risk of a humanitarian crisis in case of natural or man-made disaster. The coping capacity of the country is relatively high as well.

Hazard and exposure: 1.8 [0-10]

Vulnerability: 3 [0-10]

Lack of coping capacity: 3.4 [0-10]

Topography

The island of Saint Vincent has densely forested volcanic mountains running north to south, with many of its mountain ranges located in its centre. There are many short, fast-flowing rivers. However, though they are numerous, all streams are small except after heavy rains. There are no navigable rivers. The windward side of the island is very rocky and steep, while the leeward side has more sandy beaches and bays. The island highest peaks are on the volcano Soufrière (1,234 m).

Climate

The country is classified as having a typical Marine Tropical Climate with a wet /hurricane season occurring between June and November, and a dry season between December and May. There is very little seasonal variation of temperature as the islands experience warm and humid conditions year round[3]. The mean temperature is 26.8°C while the average yearly maximum temperature is 31.2°C, and the average yearly minimum temperature is 22.3°C. The coolest months are between November and February with a diurnal range of approximately 3°C to 7°C (Fig 2.).

[1] http://www.meteo.gov.vc/meteo/index.php/products-services/climate-data

[2] https://en.wikipedia.org/wiki/Saint_Vincent_and_the_Grenadines

[3] CIMH (2018). Country Profile: St. Vincent and the Grenadines. Barbados: Bridgetown. Accessed January 18, 2018. http://rcc.cimh.edu.bb/files/2018/06/Country-Profile-St.-Vincent-and-the-Grenadines.pdf

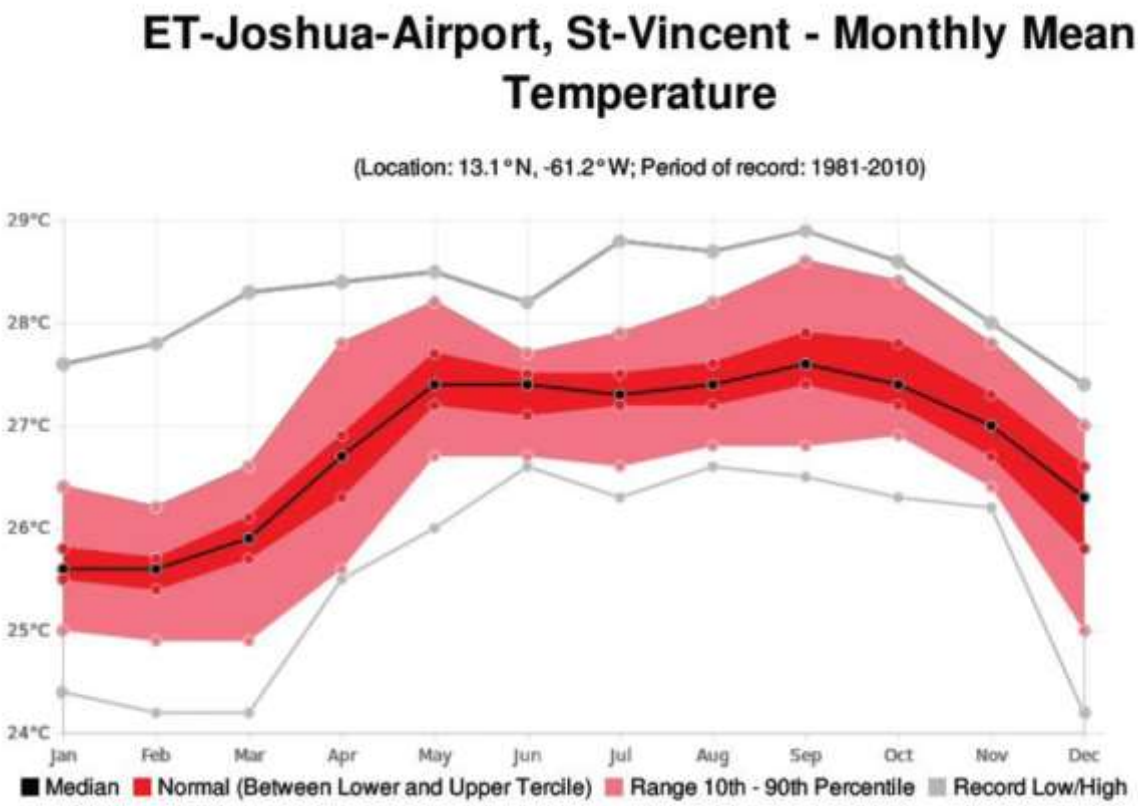


Fig.2: Mean Near-Surface Air Temperature at ET Joshua (Arnos Vale, 1981 – 2000)

As a rugged island located between the Atlantic Ocean and the Caribbean Sea, annual precipitation totals are high in most places and significant in most months. On average, St. Vincent receives 2,160 mm of rainfall per year and goes up to over 4000 mm at the highest elevations. Most of the rainfall occurs on the windward side of the island and/or along the central mountain range due to orographic lifting. Rainfall is significantly lower in the Grenadines, which are semi-humid to semi-arid[3].

During the wet season, which runs from June to November, Saint Vincent receives over 200 mm in rainfall per month[3] (Fig.3). There is also considerable inter-annual variability in the rainfall record. There is evidence that some of the variability is driven by global climatic fluctuations such as the El Niño-Southern Oscillation (ENSO) pattern.

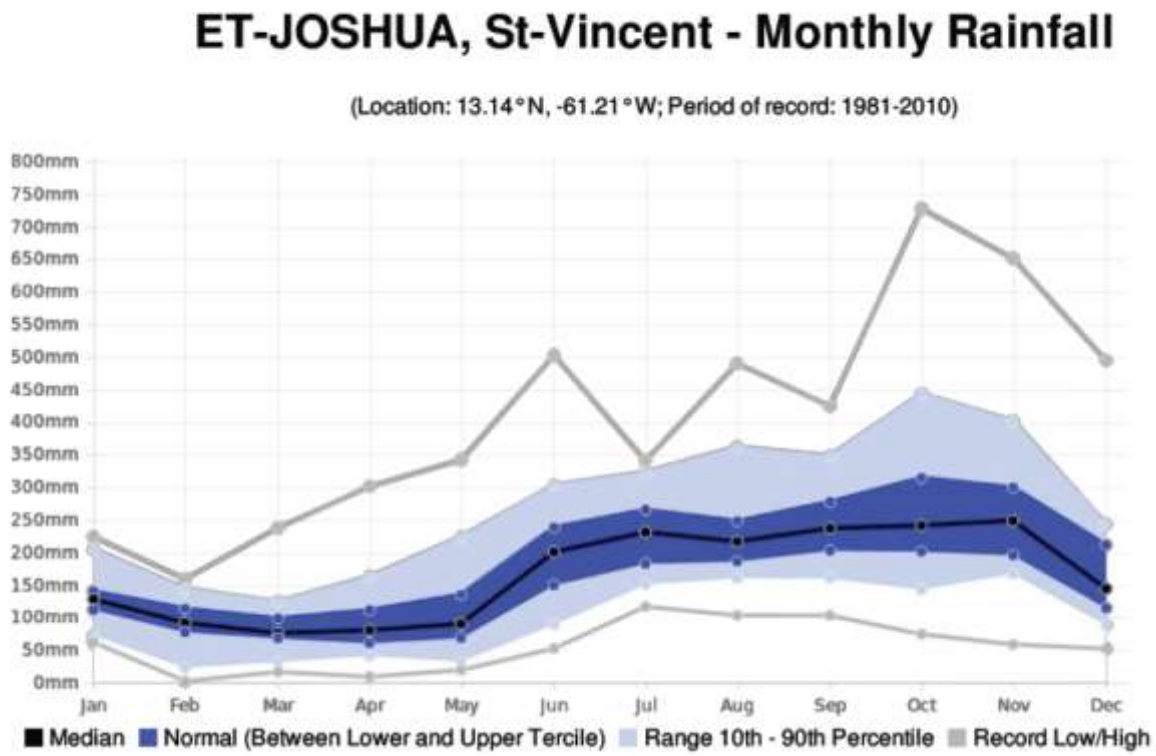


Fig. 3: Monthly Rainfall Totals at ET Joshua (Arnos Vale, 1981 – 2000)

Climate projections for SVG indicate an increase in sea surface temperatures, reduced average annual rainfall, prolonged and frequently occurring droughts, and the potential for an increase in the number and intensity of tropical storms. Due to the geographical location and topography of the islands, the exposure of its infrastructure, natural resources and population's livelihoods to natural hazards is significant. Increasing climate extremes are making the country even more vulnerable.

The National Meteorological Services of St. Vincent and the Grenadines (SVGMS)

SVGMS is the national meteorological service agency, a unit under the Aviation Services Department, which is under the auspices of the Ministry of National Security, Air and Sea Port Development of St. Vincent and the Grenadines. It is the official provider of weather and climate information and related products and services for the country.

Established in 1960, the SVGMS initially had the main task to operate a single weather station, staffed by air traffic services personnel, providing basic meteorological and aeronautical information and air traffic control services at the Arnos Vale airport between sunrise and sunset. The airport was later renamed to E. T. Joshua airport and its facilities were subsequently upgraded, which required the SVGMS to extend its operations beyond the previous operational hours. On 14 February 2017, the SVGMS commenced operations at the Argyle International Airport, the offices moved there and the service finally became 24/7.

CHD methodology

This report has been prepared using the methodology described in the 2022 update of the Country Hydromet Diagnostics. A joined workshop was organised in Barbados, with representatives of the Meteorological Services of SVG, St. Lucia and Dominica, as well as representatives from regional and international organisations. This workshop was followed by a country visit, followed by report revision and approval. The in-country visit included meetings in the capital Kingston, the Argyle International Airport as well as visits to Arnos Valley (St. Vincent) and Bequia (one of the Grenadines islands) observation sites.

This document is intended to provide crucial information for the SOFF initiative implementation phase, which in St. Vincent and the Grenadines is coordinated by GeoSphere Austria together with the World Food Programme (WFP), as well as informing the ambitious EW4All initiative of the U.N. The assessment by GeoSphere Austria has been facilitated by an on-site visit as well as various remote consultations. Following the CHD structure, this report is presented along the ten most critical elements of the hydromet value cycles with an indication of their respective maturity level and some high-level recommendations to help lift up that maturity level, and as mentioned above, with special emphasis on monitoring, forecasting, climate projection and warning systems for climate-related hazards, across timescales.

The Country Hydromet Diagnostics (CHD) provides a high-level strategic assessment of National Meteorological and Hydrological Services (NMHS), their operating environment, and their contribution to high-quality weather, climate, hydrological and environmental services and warnings. It integrates existing approaches, standards and data provided by WMO and partners, using a peer review approach. The CHD methodology (2022 update of the Country Hydromet Diagnostics) has been developed under WMO leadership and with guidance of a multi-party Working Group. The CHD aims at informing policy and investment decision-making, in particular guiding investments of the members of the Alliance for Hydromet Development. The Alliance brings together major development and climate finance partners behind a joint commitment to strengthen developing country hydromet capacity. Through the Diagnostics, developing countries are expected to benefit from better targeted and aligned financial and technical support.

This report is the one of the results of a much wider-scope project, coordinated by the Systematic Observations Financing Facility (SOFF) Secretariat under the World Meteorological Organization (WMO). SOFF aims at creating a sustainable process to enhance and strengthen the National Surface and Upper-Air observational networks and to bring them closer to the Global Basic Observations Network (GBON) criteria. In addition, the SOFF initiative is now a part of a much larger initiative, namely Early Warnings for all (EW4All), targeted at providing early warning information of weather and climate induced disasters to everybody on Earth by 2027. Following the defined methodology, the CHD is based on the ten most critical elements of the hydro-met value cycle, grouped under four categories – (i) enablers, (ii) observation and data processing system, (iii) service and product production and dissemination, and (iv) user and stakeholder interaction.

The 10 elements of the Diagnostic are defined as follows:

Enablers

(1). Governance and institutional setting - The formalization of the NMHS mandate and its implementation, oversight, and resourcing.

(2). Effective partnership to improve service delivery - Effectiveness of the NMHS in bringing together national and international partners therefore improving the service

offering. This includes the academic, research, private sector and climate and development finance institutions.

Observation and data processing system

(3). Observational infrastructure - The level of compliance of the observational infrastructure and its data quality with prescribed standards.

(4). Data and product management, sharing, and policies - The nature of data and product sharing on a national, regional, and global level.

(5). Numerical model and forecasting tool application - The role of numerical model output and forecasting aids such as remotely sensed products in product generation; whether models are run internally and if the value-added compared to global models is determined.

Service and product production and dissemination

(6). Warning and advisory services - NMS role as the authoritative voice for weather related warnings and its operational relationship with disaster and water management structures.

(7). Contribution to climate services - NMS role in and /or contribution to a national climate framework according to the established climate services provision capacity. The assessment on this point will be based on, and complement the recently completed work on, the capacity assessment of climate information services in North Macedonia.

(8). Contribution to hydrology - NMS role in and contribution hydrological services according to mandate and country requirements.

(9). Product dissemination and outreach - Effectiveness of the NMS in reaching all public and private sector users and stakeholders.

User and stakeholder interaction

(10). Use and national value of products and services - Accommodation of public and private sector users and stakeholders in the service offering and its continuous improvement.

For each value cycle element, a limited number of standardized indicators is used, and each indicator uses explicitly defined data sources. The assessment of these critical elements of the National Meteorological Service should lead to their maturity level. Note that Level 5 is the highest attainable maturity level in the CHD assessment.

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

Since its foundation back in 1960, the SVGMS is operating without an accompanying legal act defining its goals, roles and responsibilities.

A draft for a legislative framework for the Member States of CARICOM (Caribbean Community), including SVG, was prepared based on funding of the Caribbean Meteorological Organization (CMO) in 2021. After some adaptations to the legal structure of SVG, the legislation process has commenced in SVG, but is still not finalized.

In other related laws, such as the National Emergency and Disaster Management Act (2006), the Central Water and Sewage Act (1991) and the Waste Management Act (2000), there is no reference to SVMGS.

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

Currently, there is a strategic plan in action (for the years 2021 until 2026). The plan was created through a collaboration with the Caribbean Meteorological Organization (CMO). Its main priorities include an enabling policy, improving the institutional and system environment of SVGMS, strengthening of infrastructure capacity for delivery of effective weather, water and climate services, and establishment of partnerships to ensure a successful risk communication and to build up human capacity to strengthen operational services. It also includes a risk management plan. The implementation of the strategic plan is monitored annually by means of reports and meetings.

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 current budget of the SVGMS amounts to 1.2 million East Caribbean Dollars (for 2024), out of which around 60% is spent for staffing and the rest goes, mostly, to facility maintenance. Investments (e.g. for new AWSs), procurement of spare parts or IT services lack proper budgetary funding. The sole budget provider is the government. Although the SVGMS is a provider of meteorological services for aviation in the country, there is no direct cost recovery mechanism through this sector or through other business engagement.

The current budget is insufficient to solve the challenges facing the observational network (upgrading it to AWSs, data broadcasting and transmissions costs, storage of spare parts, etc.) and it would be even more limited if the future needs for marine stations is to be taken into account.

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

The SVGMS currently has a well-trained and highly motivated staff of 12 employees. However, due to the small number of forecasters (3), there is almost no redundancy, and the manager is the only possible backup. The situation is even worse with the technical

staff, which currently includes one single technician, who is about to retire in less than three years.

There are currently no researchers, no trained hydrologists (all hydrological specialists currently work for the water company), and no marine experts available in the small team of employees (despite the country being an Islands country).

The only major institute providing education and training for such experts needed by SVGMS is located outside of SVG: The Caribbean Institute for Meteorology and Hydrology (CIMH) in Barbados, of which the SVGMS is a member. The CIMH is the only major provider of education and training in the fields of meteorology, hydrology and climatology in the whole Caribbean Region. No further educational or training possibilities in these technical areas exist in the country itself.

With regard to gender balance, the organization currently has 4 male and 8 female employees.

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

The SVGMS is currently involved in several internationally funded projects, including a component of the CREWS initiative, SDRC (Strengthening Disaster and Climate Resilience in the Eastern and Southern Caribbean), implemented by the CIMH and funded by USAID.

Overall, these projects, some of which are already close to finishing, do already have a positive impact on the work of the SVGMS. However, additional projects are required in or to bridge the different existing gaps, for which government funding is not available or where SVGMS does not have any previous experience. Proper coordination is required to ensure the sustainability of the improvements triggered by external funding.

Summary score and recommendations for Element 1

The CHD Element 1 score for the "Governance and Institutional Setting" assessed as Maturity Level 2 on the CHD scale, reflecting "Effort ongoing to formalize mandate, introduce improved governance, management processes and address resource challenges".

While the SVGMS has proven to be, especially in the last few years, a steadily progressing institution, a set of recommendations that should be both realistic and aligned with the current situation of the country could be followed:

a. To finalize the legislation process of the act formally establishing SVGMS. To review and update, to the extent appropriate, all other governmental acts which are related to the activities of a National Weather Service according to the WMO specifications.

b. The SVGMS should invest effort in searching for additional potential sources of income that add to its current budget, especially for investments in observational, IT and other infrastructure. These sources could include an agreed cost recovery mechanism for aviation, but also revenues from other sectors may be of relevance, in particular tailored products and services for the marine sector, for the quickly developing touristic industry and for agriculture and forestry.

c. The SVGMS should take measures addressing the lack of redundancy of forecasting. Most importantly, it should get prepared for the planned retirement of its sole technician through a specific procurement action.

d. To expand its current capacities, a careful planning is required for the establishment of future hydrological, climatological and marine services of the SVMGS. Nowadays there is nobody at the SVMGS who can provide any support in these fields. One

possible strategy is to create hybrid positions (a technician, who could also work as a forecaster, a hydrologist, who could also have some knowledge about marine meteorology, etc.). Such a strategy will require identifying promising young locals; send them to the CIMH, but with a proper consideration of their educational needs and their future possible assignments.

e. It is recommended that the government of SVG applies for WMO membership. Such a membership would bring the SVGMS many benefits, including better awareness of different potential international projects and funding sources. It could also improve the legal status of SVGMS in the absence of a dedicated establishment law.

Element 2: Effective partnerships to improve service delivery

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

The SVGMS has functioning and quickly developing partnerships with different governmental and semi-governmental institutions, like the National Emergency Management Organization (NEMO), the Water Company and the Ministry of Agriculture. However, these partnerships are very often based on informal and personal contacts, rather than being formalized (through legislation and/or MoUs). Moreover, there is a complete array of additional relevant partners inside the governmental structure of SVG, with whom no partnership exists yet, like the Ministry of Tourism, Marine and Port Authority and the Ministry of Environment.

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

Currently, there are no partnerships in place with the private sector. As for research centers and academia, due to the limited capacities of SVG in itself, the only strong partnership SVGMS is enjoying is with CIMH. This partnership is focused on training, maintenance support, spare parts purchase and calibration (even this is only on a partial base). There is certainly potential to expand this collaboratio

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

Through different development projects, there is an existing project-based partnership with the CREWS secretariat, CIMH and CMO, USAID as well as SOFF.

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 most important outcome so far is the development of a capacity of delivering observations through WIS2.

Summary score, recommendations, and comments for Element 2

The CHD Element 2 score for the "Effective partnerships to improve service delivery" assessed as Maturity Level 2 on the CHD scale, reflecting, "Limited partnerships and mostly excluded from relevant finance opportunities".

Recommendations:

a. Formalizing the existing partnerships with different governmental and semi-governmental entities through updating the related acts or/and via MoUs.

b. To explore possible partnerships with the private sector in the fields of tourism, transportation and agriculture.

c. Due to the large impact of climate change on SVG, to explore potential collaboration with foreign universities regarding possible research projects related to the ecological environment of the country.

d. As mentioned earlier, if SVG would become a full Member of WMO, this could trigger additional partnerships and cooperation with international players.

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.

According to the GBON Criteria, SVG should operate at least one surface and one upper-air station, transmitting data 24/7 and on a real-time base. The SVGMS is currently operating 4 AWSs, performing observations on a 10 minutes interval base, and one single manual station. However, due to different technical issues (related to transmission, data management and storage, etc.), none is providing the data on a real-time basis to headquarters, and hence data is currently not internationally exchanged.

As for upper-air observations, the SVGMS not operating any. However, due to the proximity of Barbados to SVG, the upper-air observations performed in Barbados can provide the required coverage.

3.2 Additional observations used for nowcasting and specialized purposes.

The SVGMS currently does not operate any additional observations system. However, the staff is using the freely available imagery of the Radar operating in Barbados.

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

Partially yes, as the deployment of the existing stations was successfully accomplished with the support of CIMH. Station maintenance is performed following a SOP. However, the single technician working at SVGMS will retire in less than three years and this will affect the transfer of knowledge unless recruitment is accomplished on time. In addition, due to the lack of spare parts (or the funds to obtain such), the maintenance of the existing SOP is time-limited and not sustainable. The calibration can only be performed at CIMH, but their calibration services are limited to few sensors (temperature, humidity and precipitation sensors and only from a single vendor).

Basic data quality checks are being performed regularly and through an established SOP, but since the data flow is delayed, no near-real-time initial QC is possible.

3.4 Implementation of sustainable newer approaches to observations.

None.

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

80%, but again, due to the abovementioned technical issues, none of the existing AWSs is transmitting its data in real time.

Summary score, recommendations, and comments for Element 3

The CHD Element 3 score for the "Observational Infrastructure" assessed as Maturity Level 2 on the CHD scale, reflecting "Basic network, large gaps, mostly manual observations with severe challenges and data quality issues.".

Recommendations:

a. Through different projects and initiatives such as SOFF, the issue with the real-time base data transmission will most likely be solved, at least for a single station. However, if a coordinated approach is taken, procedures developed for one station can also support the whole network, also regarding the management of spare parts.

b. Due to the proximity of SVG to Barbados, it is not recommended to invest in procuring an upper-air station for SVG.

c. A purchase, installation and training with a data management system is highly recommended.

d. A more burning challenge is the upcoming retirement of the single technician. Funds should be allocated in good time to send a person to CIMH for a proper training. To minimize resources a cooperation for weather stations should be considered with the Water Company. Spare parts and maintenance can be shared to save costs.

e. Furthermore, it is recommended to explore possibilities for the engagement of local observers, coming from the local communities in the vicinity of the station. Such observers could be trained to perform basic maintenance duties, where it would be inefficient to send staff from the headquarters.

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 centers.

Currently, none of the 5 stations operated by the SVGMS are GBON-compliant. Though the 4 AWSs do perform measurements on a 10 min base, due to transmission issues, none is shared internationally in real-time. Data is also not available for SVGMS purposes in real-time.

SVGMS does not operate any upper-air stations, but as mentioned in the previous chapter, the upper-air station in Barbados fulfils also the necessary GBON requirements for SVG as well (the requirement holds that an upper-air station should be located in a distance of up to 1000 km, whereas the distance in between the countries is less than 250 km).

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

None. However, through an informal partnership with the water company, data is shared with them, as well as with any other governmental entity requesting it. However, this is done only for past observations, as no data is available on a real-time base.

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

SVGMS makes use of global models, such as GFS and ECMWF, but only through their respective websites. Through the Severe Weather Forecasting Programme (SFWP) Eastern Caribbean, SVG has free access to the operational high-resolution AROME Model (2.5km grid) from Meteo-France and global models from Europe and North America. Additional support for NWP is provided to SVGMS by the CIMH, which uses the Weather Research and Forecast Model (WRF). Flood forecasting involves the use of real-time precipitation or precipitation forecasts and stream flow routing models to forecast flow rates and water levels for periods ranging from a few hours to days ahead, depending on the size of the watershed or river basin. The concept applied utilizes 48-hour precipitation forecasts and rainfall-runoff modeling to predict flow at points of interest.

Summary score, recommendations, and comments for Element 4

The CHD Element 4 score for the "Data and Product Sharing and Policies" assessed as Maturity Level 1 on the CHD scale, reflecting, "No observational data is shared internationally, either because not available to be shared or due to the lack of data sharing policies or practices, or the existing infrastructure does not allow data sharing.".

Recommendations:

a. As mentioned in Element 3, through different projects (such as SOFF), SVGMS should continue working on fixing the real-time data transmission issues regarding its observational network.

b. A basic data management software should be procured, with which the observational data could be received, archived, quality checked (at least basically), transmitted nationally and internationally and, most importantly, be easily internally accessed and visualized (Near real-time as well as historical data).

c. Through a formal process like the currently processed legal act on meteorology or MoUs, a technical framework should be established to allow other governmental entities to receive all monitoring data (NRT as well as archived).

d. The SVGMS should undertake, with high priority, to improve its general internet infrastructure, so the usage of the different websites of the global models, satellite imagery, etc. will become faster and easier. At a later stage, we recommend that SVGMS procure basic forecaster stations, adapted to the needs and constraints of the SVGMS facilities. Subsequently, SVGMS should consider the installation and operations of a satellite receiver station, through an adequate interface to the forecaster stations.

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.

The forecasters of the SVGMS have access to the visual results of: a. the runs of different global models (GFS, ECMWF). b. results of a seasonal model (provided by CIMH). c. the weather radar of Barbados (covering also the entire territory of SVG). However, the entire access is established through the respective websites of the different operating organizations. No raw data is reaching the SVGMS, and there are no resources available to post-process and archive these data in order to enhance the services provided.

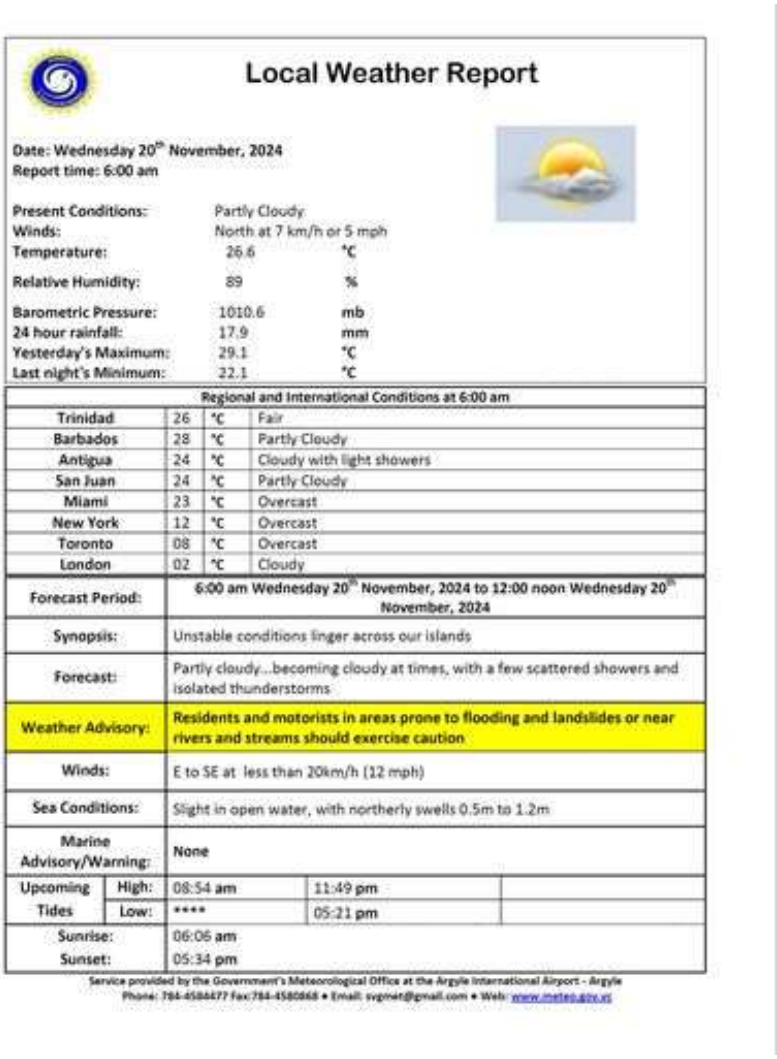
5.2 a) Models run internally (and sustainably), b) Data assimilation and verification performed, c) appropriateness of horizontal and vertical resolution.

None.

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

Since the initial, and still major purpose and goal of the SVGMS is to support the national aviation services, probabilistic forecasts are used to issue TAFs (Terminal Area Forecast). In addition SVGMS utilizes ensemble forecasts (GFS, ECMWF, WRF, AROME) to issue following forecast products:

- 6-hour weather reports at 6:00 AM and 12:00 Noon (Fig. 4)-
- 12-hour weather report at 6:00 PM with an update provided the following day at 6:00 AM (Fig. 5).
- 72 Weather Outlooks revised and completed on a daily basis (Fig. 6).
- Monthly Climate Bulletin with data from the Regional Climate Center, which includes long-range forecasts and sector-specific guidance. The bulletin provides key advisories for sectors such as health, agriculture, water, and tourism services, helping stakeholders in these areas make informed decisions (Fig. 7).



Local Weather Report

Date: Wednesday 20th November, 2024
Report time: 6:00 am

Present Conditions:	Partly Cloudy	
Winds:	North at 7 km/h or 5 mph	
Temperature:	26.6	°C
Relative Humidity:	89	%
Barometric Pressure:	1010.6	mb
24 hour rainfall:	17.9	mm
Yesterday's Maximum:	29.1	°C
Last night's Minimum:	22.1	°C

Regional and International Conditions at 6:00 am

Trinidad	26	°C	Fair
Barbados	28	°C	Partly Cloudy
Antigua	24	°C	Cloudy with light showers
San Juan	24	°C	Partly Cloudy
Miami	23	°C	Overcast
New York	12	°C	Overcast
Toronto	08	°C	Overcast
London	02	°C	Cloudy

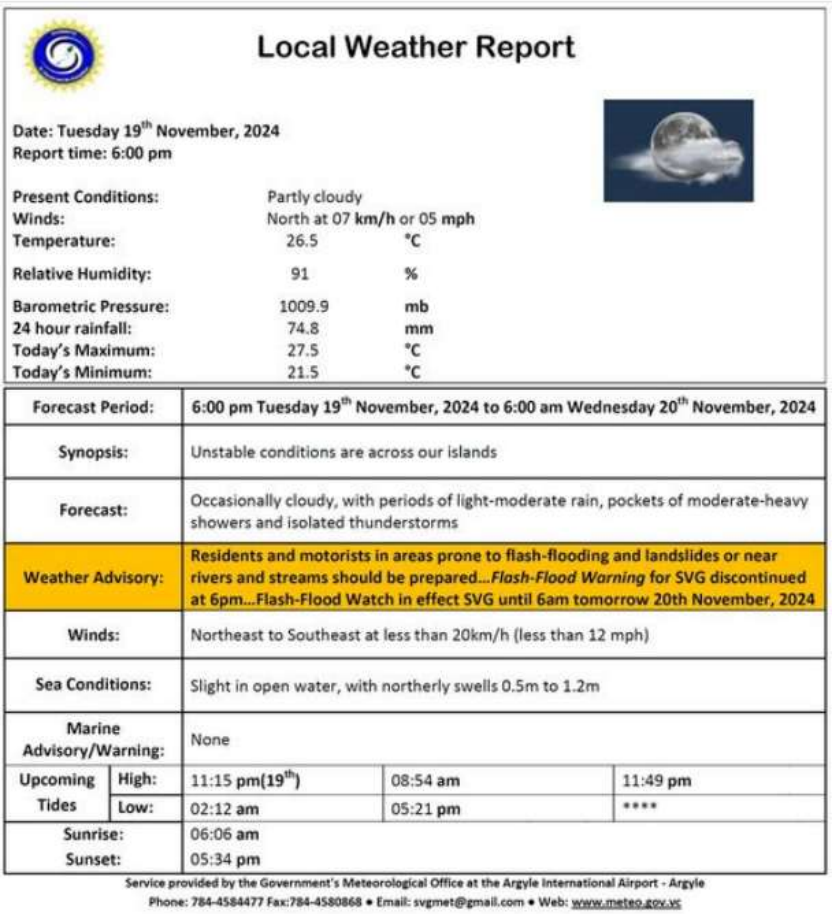
Forecast Period:	**6:00 am Wednesday 20th November, 2024 to 12:00 noon Wednesday 20th November, 2024**		
Synopsis:	Unstable conditions linger across our islands		
Forecast:	Partly cloudy...becoming cloudy at times, with a few scattered showers and isolated thunderstorms		
Weather Advisory:	**Residents and motorists in areas prone to flooding and landslides or near rivers and streams should exercise caution**		
Winds:	E to SE at less than 20km/h (12 mph)		
Sea Conditions:	Slight in open water, with northerly swells 0.5m to 1.2m		
Marine Advisory/Warning:	**None**		
Upcoming Tides **High:**	08:54 am	11:49 pm	
Low:	****	05:21 pm	
Sunrise:	06:06 am		
Sunset:	05:34 pm		

Service provided by the Government's Meteorological Office at the Argyle International Airport - Argyle
Phone: 784-4584477 Fax:784-4580868 • Email: svgmet@gmail.com • Web: www.meteo.gov.vc

Fig. 4: Exemplary short term weather report issued at 6:00 AM and 12:00 Noon.

Svg Met
19. November um 14:03 ·

Local Weather Report issued by the St. Vincent and the Grenadines Meteorological Service at 6:00 pm on Tuesday 19th November, 2024.



Local Weather Report

Date: Tuesday 19th November, 2024
Report time: 6:00 pm

Present Conditions:	Partly cloudy	
Winds:	North at 07 **km/h** or 05 **mph**	
Temperature:	26.5	**°C**
Relative Humidity:	91	**%**
Barometric Pressure:	1009.9	**mb**
24 hour rainfall:	74.8	**mm**
Today's Maximum:	27.5	**°C**
Today's Minimum:	21.5	**°C**

Forecast Period:		**6:00 pm Tuesday 19th November, 2024 to 6:00 am Wednesday 20th November, 2024**		
Synopsis:		Unstable conditions are across our islands		
Forecast:		Occasionally cloudy, with periods of light-moderate rain, pockets of moderate-heavy showers and isolated thunderstorms		
Weather Advisory:		**Residents and motorists in areas prone to flash-flooding and landslides or near rivers and streams should be prepared…*Flash-Flood Warning* for SVG discontinued at 6pm…Flash-Flood Watch in effect SVG until 6am tomorrow 20th November, 2024**		
Winds:		Northeast to Southeast at less than 20km/h (less than 12 mph)		
Sea Conditions:		Slight in open water, with northerly swells 0.5m to 1.2m		
Marine Advisory/Warning:		None		
Upcoming Tides	**High:**	11:15 **pm(19th)**	08:54 **am**	11:49 **pm**
	Low:	02:12 **am**	05:21 **pm**	****
Sunrise:		06:06 **am**		
Sunset:		05:34 **pm**		

Service provided by the Government's Meteorological Office at the Argyle International Airport - Argyle
Phone: 784-4584477 Fax:784-4580868 • Email: svgmet@gmail.com • Web: www.meteo.gov.vc

Fig. 5: Exemplary short term forecast issued at 6:00 PM

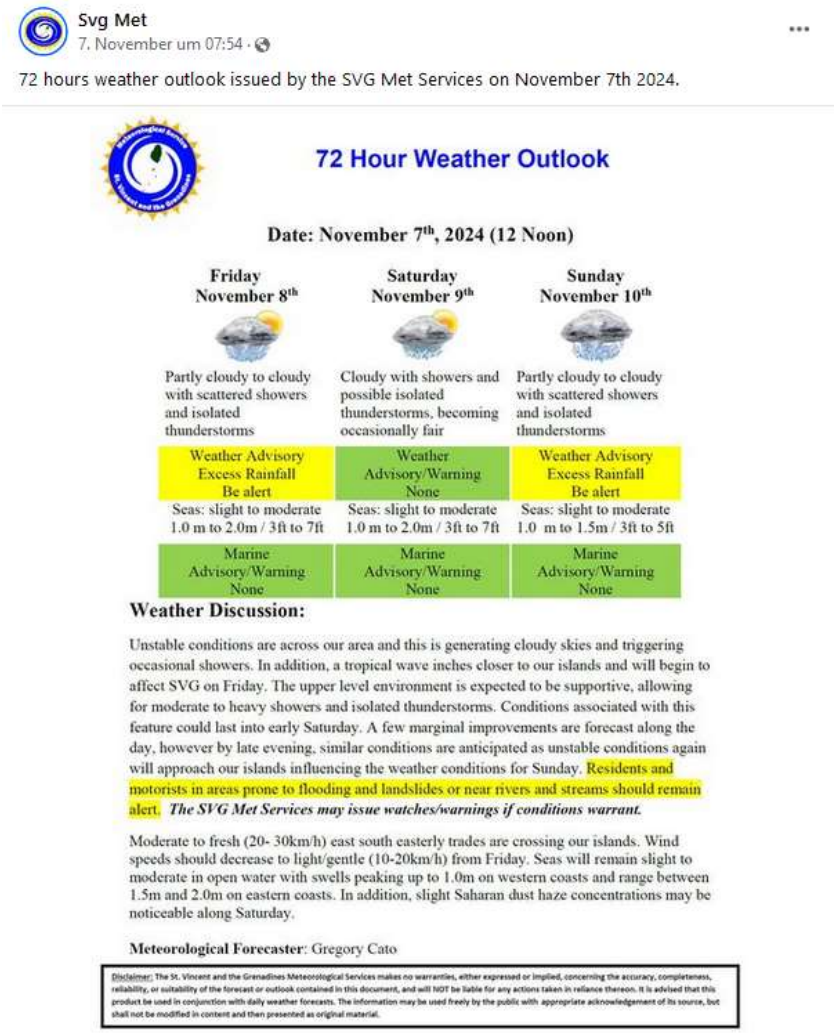


Fig. 6: Exemplary 72 hour weather outlook.

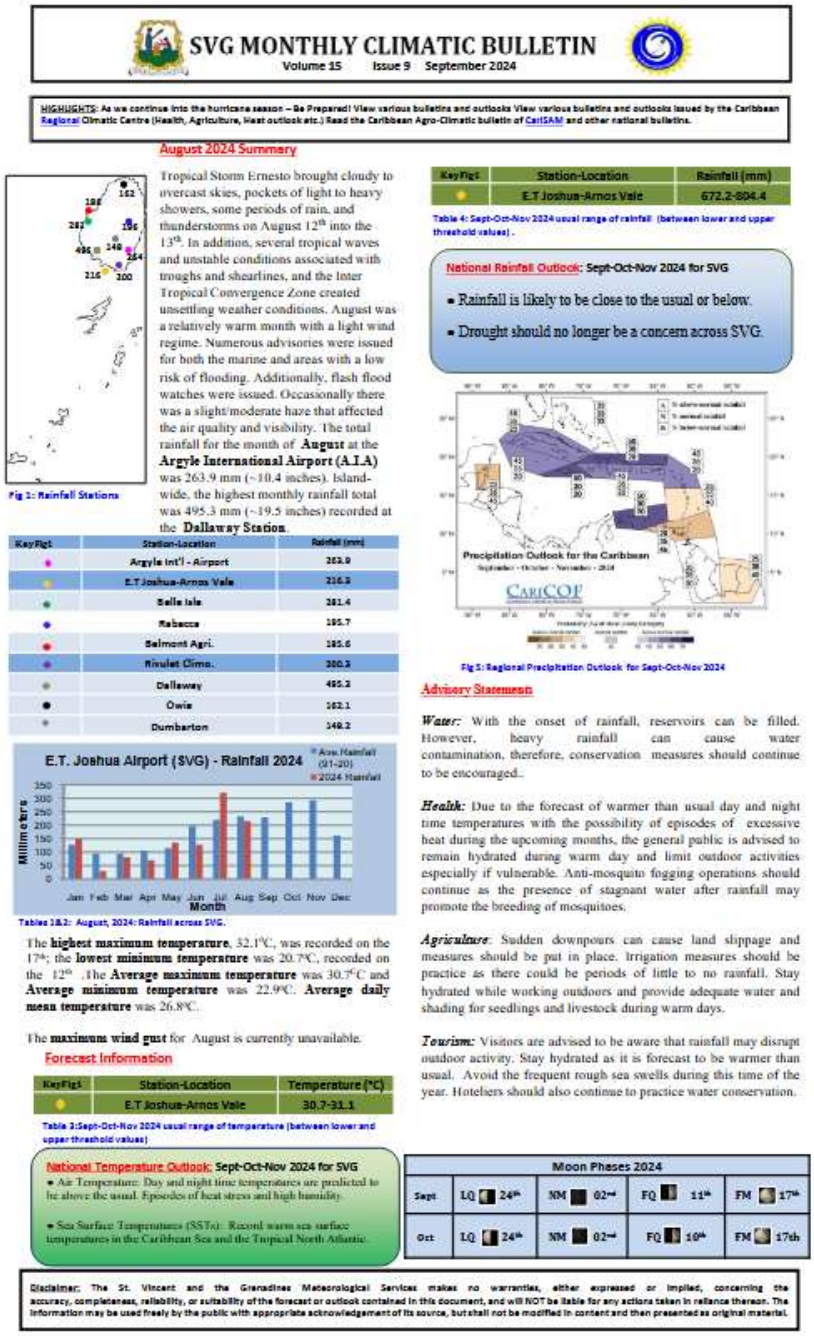


Fig. 7: Exemplary monthly climate bulletin.

Summary score, recommendations, and comments for Element 5

The CHD Element 5 score for the "Numerical Weather Prediction Model and Forecasting Tool Application" assessed as Maturity Level 2 on the CHD scale, reflecting, "Basic use of external model output and remote sensed products in the form of maps and figures, covering only a limited forecast time range.".

Recommendations:

a. Through the procurement of suitable forecasting stations (also available to staff dealing with climatology, marine, and hydrology as well as other tasks), an easier and more effective access to the different global models should be

established. However, the basic requirement for reaching this milestone is the improvement of the basic internet infrastructure of the SVGMS.

b. It is highly not recommended that SVGMS engage in the operation of a regional model. Cooperation within the region in the limited area modelling domain would be a more efficient and effective option.

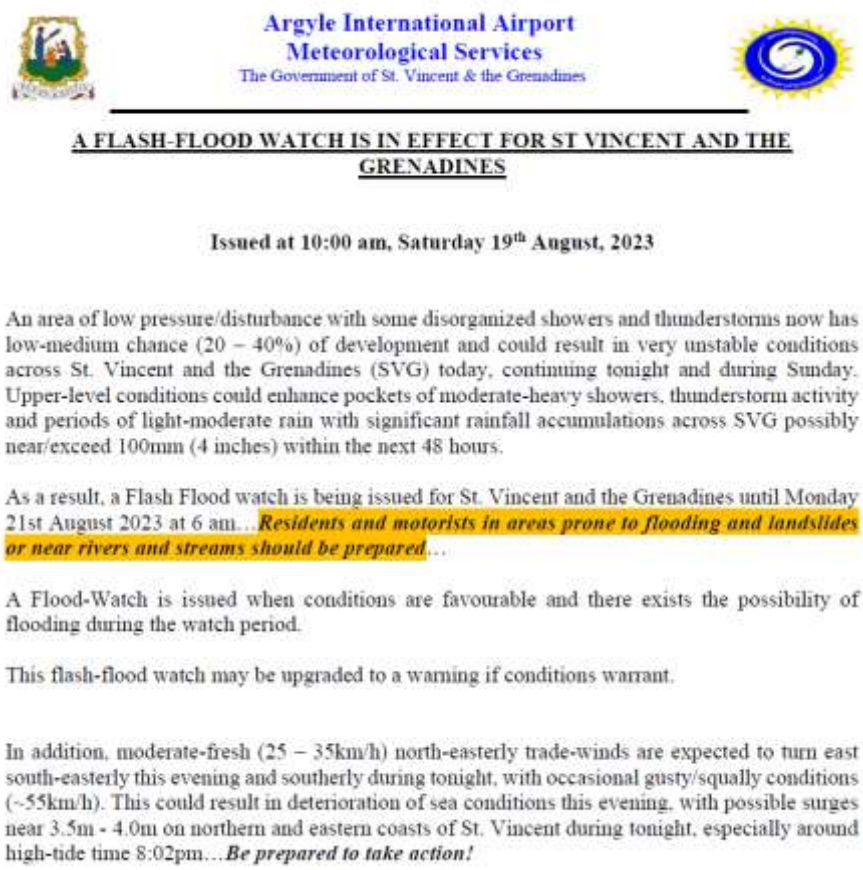
c. However, in case that more human resources become available in the future, including R&D staff, proper post-processing schemes tailored to local needs could be developed, especially in the field of nowcasting and MOS, but also for climatology at a higher resolution.

d. In case more resources become available, we also recommend to perform basic verifications of the results of the global models for the SVG area and for the region.

Element 6: Warning and advisory services

6.1 Warning and alert service cover 24/7.

The SVGMS operates a basic warning and alert system, but not on a 24/7 basis. The forecasters are working only during the operating hours of the international airport, which is essentially from the morning hours to the landing of the last evening flight. However, in some instances they continue to issue warnings beyond their official operational time, mostly from home, and limited to certain predefined meteorological hazards. The warnings are issued in a standard CAP format and are distributed by email, phone, WhatsApp, and with the help of the media. Examples could be seen in Figures 8 and 9.



Argyle International Airport
Meteorological Services
The Government of St. Vincent & the Grenadines

A FLASH-FLOOD WATCH IS IN EFFECT FOR ST VINCENT AND THE GRENADINES

Issued at 10:00 am, Saturday 19th August, 2023

An area of low pressure/disturbance with some disorganized showers and thunderstorms now has low-medium chance (20 – 40%) of development and could result in very unstable conditions across St. Vincent and the Grenadines (SVG) today, continuing tonight and during Sunday. Upper-level conditions could enhance pockets of moderate-heavy showers, thunderstorm activity and periods of light-moderate rain with significant rainfall accumulations across SVG possibly near/exceed 100mm (4 inches) within the next 48 hours.

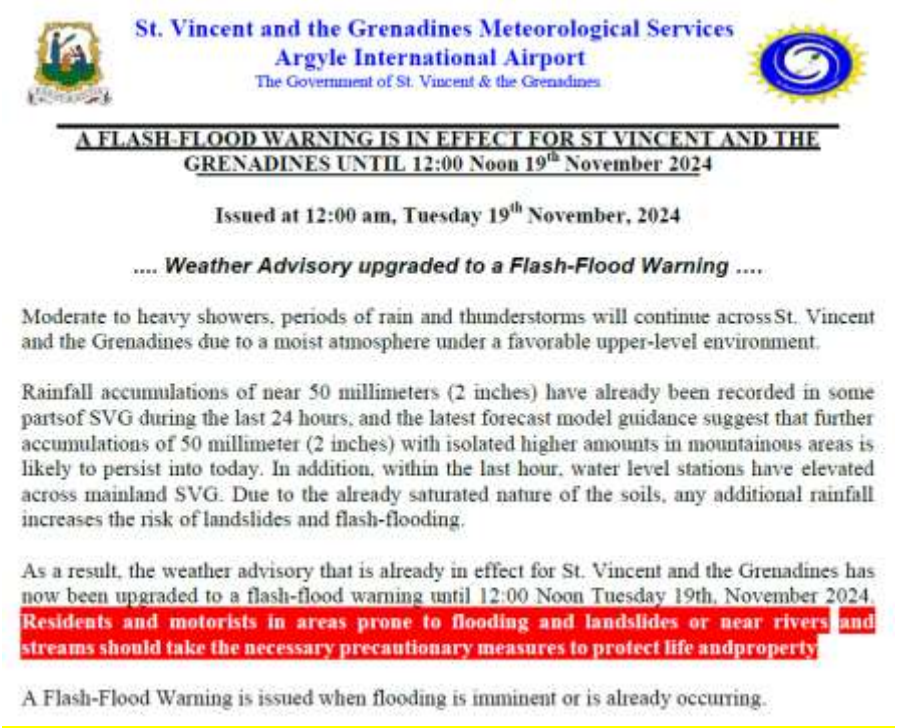
As a result, a Flash Flood watch is being issued for St. Vincent and the Grenadines until Monday 21st August 2023 at 6 am…***Residents and motorists in areas prone to flooding and landslides or near rivers and streams should be prepared***…

A Flood-Watch is issued when conditions are favourable and there exists the possibility of flooding during the watch period.

This flash-flood watch may be upgraded to a warning if conditions warrant.

In addition, moderate-fresh (25 – 35km/h) north-easterly trade-winds are expected to turn east south-easterly this evening and southerly during tonight, with occasional gusty/squally conditions (~55km/h). This could result in deterioration of sea conditions this evening, with possible surges near 3.5m - 4.0m on northern and eastern coasts of St. Vincent during tonight, especially around high-tide time 8:02pm…***Be prepared to take action!***

Fig. 8: Example of an issued watch.



St. Vincent and the Grenadines Meteorological Services
Argyle International Airport
The Government of St. Vincent & the Grenadines

A FLASH-FLOOD WARNING IS IN EFFECT FOR ST VINCENT AND THE GRENADINES UNTIL 12:00 Noon 19th November 2024

Issued at 12:00 am, Tuesday 19th November, 2024

.... Weather Advisory upgraded to a Flash-Flood Warning ....

Moderate to heavy showers, periods of rain and thunderstorms will continue across St. Vincent and the Grenadines due to a moist atmosphere under a favorable upper-level environment.

Rainfall accumulations of near 50 millimeters (2 inches) have already been recorded in some partsof SVG during the last 24 hours, and the latest forecast model guidance suggest that further accumulations of 50 millimeter (2 inches) with isolated higher amounts in mountainous areas is likely to persist into today. In addition, within the last hour, water level stations have elevated across mainland SVG. Due to the already saturated nature of the soils, any additional rainfall increases the risk of landslides and flash-flooding.

As a result, the weather advisory that is already in effect for St. Vincent and the Grenadines has now been upgraded to a flash-flood warning until 12:00 Noon Tuesday 19th. November 2024. **Residents and motorists in areas prone to flooding and landslides or near rivers and streams should take the necessary precautionary measures to protect life andproperty**

A Flash-Flood Warning is issued when flooding is imminent or is already occurring.

Fig. 9: Examples of an issued warning (below).

In addition to the temporal limitation, the warning service is also negatively impacted by the lack of a dense observational network, and especially by the lack of real-time data being transferred to headquarters. Such data are a crucial asset to issue accurate as well as timely warnings.

In the northern part of St. Vincent, there is a community with very limited access to mobile phone networks, the internet or television/radio. It is a particular challenge to warn these people in time.

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

The weather parameters addressed by the abovementioned early warnings are rain, droughts, thunderstorms, volcanic ash, tropical cyclones and heat waves. Through an established communication channel and procedure, warnings regarding floods and landslides are issued in cooperation with the Water Company.

Unfortunately, due to lack of staff, these warnings are currently not passing any systematic verification or validation. The only exception are the products provided for aviation, which are issued based on ICAO criteria and standards and where proper certification is acquired. Moreover, no systematic information is gathered from the end users regarding their level of satisfaction with and general use of the warnings. Such feedback is only collected on an ad-hoc and case-by-case basis. Nevertheless, there are good personal and informal interactions with the national Emergency Authority and the Water Company – the staff of the SVGMS is in constant direct contact with both organizations.

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.

Currently, no impact-based services are provided, though some of the forecasters were trained in this field. The SVGMS is planning to commence providing these in the near future. Nevertheless, SVGMS issues CAP warnings on a constant basis, and delivers those to the emergency authorities of SVG.

Summary score, recommendations, and comments for Element 6

The CHD Element 6 score for the "Warning and Advisory Services" assessed as Maturity Level 2 on the CHD scale, reflecting "Basic warning service is in place and operational but with limited public reach and lacking integration with other relevant institutions and services.".

Recommendations:

a. Currently, the operational unit of SVGMS is not operating 24/7. There is an urgent need to increase the number of forecasters and make it legally and financially possible to bring them into a regular shift work schedule.

b. As previously mentioned, the relations with the warnings receivers should be formalized, including the establishment of a formalized and systematic feedback mechanism.

c. At a later stage, with potential R&D staff, and perhaps through a cooperation with foreign universities and institutions, develop products describing the exposure and vulnerability of the population and the different economic sectors of SVG regarding weather related and other 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.

The current capabilities of the SVGMS regarding climate services, based upon past observations, is quite limited, for the following reasons: a. very limited historical data, mostly limited to one single station (at Arnos Vale). B. No dedicated staff with the required training for or knowledge of climatology**.**

Seasonal forecasts are issued with the support of CIMH. Due to the lack of adequate staff at SVGMS, no research was performed as for downscaling climate models predictions.

Summary score, recommendations, and comments for Element 7

The CHD Element 7 score for the "Contribution to Climate Services" assessed as Maturity Level 1 on the CHD scale, reflecting "Less than basic Capacity to provide Climate Services".

Recommendations:

a. Attempts at locating and retrieving historical data are mandatory for any basic climatic products. A promising possibility is to try and find such through the UK Met Office (which was operating the stations in SVG until the independence).

b. One or two of the current or future staff members of the SVGMS should receive training at CIMH and other institutions regarding climate services.

c. Perhaps through a liaison with a foreign research institute, strive towards a statistical downscaling of relevant global or regional climate models (but only after some additional data rescue). Based on that, proper climate scenarios for SVG could be established.

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.

The SVGMS is established as a meteorological service. The national hydrological expertise is currently concentrated within the National Water Company. However, the company focuses on its core business (provision of sufficient-quality water for the different uses of the society in the country) and has no formal mandate as national hydrological service, and hence lacks hydrological forecasters or adequate R&D staff. Nevertheless, the National Water Company does systematically collect hydrological observations. The SVGMS, together with experts from the Water Company, are trying to integrate hydrological elements into meteorological forecasts, advisories and warnings.

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

There are working relations between the SVGMS and the National Water Company, but they were never properly formalized and completely depend upon limited personal contacts, leading to a risk on potential sustainability.

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

The same as in 8.2, there is currently a full bi-directional data sharing between the two entities. Informal Cooperation with the National Water Company.

Summary score, recommendations, and comments for Element 8

The CHD Element 8 score for the "Contribution to Hydrology" assessed as Maturity Level 3 on the CHD scale, reflecting "There is a moderately well-functioning relationship between the meteorological, hydrological and water resources communities but considerable room for formalizing the relationship and SOPs.".

Recommendations:

a. To formalize the working relations between the SVGMS and the National Water Company through a MoU.

b. To update the Water Act, so that it will also include the SVGMS.

c. SVG lacks a formally established national hydrological service based on international criteria (WMO guidelines on the role, operation and management of National Hydrological Services). It is recommended that the SVG government establishes such a service, either as part of the SVGMS or as part of the National Water Company (as a separate department inside of the company), with adequate human resources and technical infrastructure. Both solutions would be adequate as long as cooperation between both entities is formally established and legally defined.

Element 9: Product dissemination and outreach

9.1 Channels used for user-centered 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 SVGMS operates its own website and is active in social media (Facebook, Instagram and WhatsApp groups). WhatsApp is especially effective, thanks to the wide use of this application in SVG and its quite small population. The SVGMS does not operate its own TV, Video or Audio Production facilities, but is regularly present in the national TV and Radio broadcasts.

9.2 Education and awareness initiatives in place.

Throughout the year, but especially during the hurricane season, there are special radio programs addressing different issues related to weather, its impacts and possible adaptation to adverse weather conditions. Education initiatives are occurring only on an ad-hoc basis.

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

The SVGMS makes large efforts in communicating with the entire public of SVG, as well as with the people living in the areas, having larger weaker phone and internet transmission networks. The SVGMS is communicating with these communities through the National Emergency Management Office (NEMO) (having physical and communicational presence throughout the country), but also through a use of the Radio, radio transmission, SMS and meetings with communities. As mentioned before, there are issues reaching communities in the north of SVG in the event of weather alerts.

Summary score, recommendations, and comments for Element 9

The CHD Element 9 score for the "Product Dissemination and Outreach" assessed as Maturity Level 3 on the CHD scale, reflecting, "A moderately effective communication and dissemination strategy and practices are in place, based only on in- house capabilities and supported by user-friendly website".

Recommendations:

a. The SVGMS should not spend its limited resources on establishing its own TV, Radio or Audio production facilities.

b. The SVGMS should undertake to make its different products more accessible for marginalized populations (such as visually and audibly challenged, daltonists, older people, etc.).

c. The SVGMS should be more engaged with the indigenous population, in a cooperation with NEMO, through dedicated workshops and meetings. This would support the creation of public awareness regarding meteorological hazards and support the development of more accessible products.

Element 10: Use and national value of products and services

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

There is currently none. However, due to the good informal working relations with several other governmental entities, the discussions also trigger certain improvements of the services, although not in a structured and systematic way.

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

Surveys are not conducted but are planned to commence next year.

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

Since the SVGMS is the provider of meteorological services for Aviation, it has implemented an ISO process according to ICAO Annex 3 requirements. However, the implementations of the ISO standard was strictly limited to the services provided for aviation.

Summary score, recommendations, and comments for Element 10

The CHD Element 10 score for the "Use and National Value of Products and Services" assessed as Maturity Level 2 on the CHD scale, reflecting, "Service development draws on informal stakeholder input and feedback".

Recommendations:

a. Initiate periodical meetings with the main stakeholders, in which the current services should be discussed and improvements should be identified, together with clear goals and timetables to address those. Each user should appoint a focal point, with whom the SVMGS could work out improvements and draw conclusions with regard to the quality and effectivity of its services and products.

b. In case additional funds to be identified or established, it is highly recommended to work towards a full compliance with ISO QMS for all the services and products of the SVGMS.

Annex 1 Consultations (including experts and stakeholder consultations)

Title	Name	Organization	Role
Mr.	Billy H. Jeffers	SVGMS	Director Manager
Mr.	Peter Providence	SVGMS	Technician
Ms.	Michelle Forbes	NEMO	Director
Mr.	Kenson Stoddard	NEMO	Deputy Director
Mr.	Paul Saunders	NEMO	
Mr.	Danroy Ballantyne	CWSA	Senior Engineer/ Hydrologist
Mr.	Vialey Richards	CWSA	Technician, data management
Ms.	Deborah Daniel	Ministry of Agriculture	Agricultural Planning Officer
Ms.	Andrea R. Best	Civil Aviation	Director
Ms.	Houlda Peters	Caribbean Development Bank (CDB)/NEMO	Training Officer
Mr.	Fedel Mansour	WFP	Head of SVG Satellite Office

Annex 2 Urgent needs reported

The SVGMS faces a number of challenges that can be summarized as follows:

- Legal framework – currently, the SVGMS still acts without any proper legislative framework. A dedicated legal act is already under processing since three years, and there is no reference to SVGMS in any other governmental act.
- WMO Membership – currently, SVG is not a Member of WMO. The SVGMS should push the government of SVG to apply for a full Membership with WMO.
- Observational network – there is a need to find a sustainable solution for the maintenance and real-time transmission of the data from the AWSs, including the procurement of relevant spare parts and finding an adequate replacement for the soon to be retired single technician of the SVGMS.
- Operational Centre – adaptations and changes are required to allow for 24/7 operations.
- Hydrological Service – the government should aspire towards establishing a hydrological service, either as part of the SVGMS or the National Water Company. Such a service could issue flood forecasts and warnings, deliver different hydrological products and take the responsibility for the national hydrological data archive.
-

Annex 3 Information supplied through WMO

1. WMO Monitoring System Data
2. WMO EW4All Rapid Assessment for Pillar-2
3. WMO Hydrology Survey
4. Data from Checklist for Climate Services Implementation

Annex 4 List of materials used

1. Country Hydromet Diagnostics, published by WMO, 2023
2. CHD Operational Guidance for SOFF, 2023
3. CMO Members Legislative Assessment Report, 2022
4. CMO Members Policy Appraisal Report, 2022
5. Final National Strategic Plan, 2021
6. Meteorology Policy, 2022
7. Model Cabinet Memorandum, 2022
8. Model Hydro-Meteorology Bill Explanatory Note, 2022

Annex 5 List of Abbreviations

Abbreviation	**Full Name**
AROME	Application of Research to Operations at MEsoscale
AWS	Automatic Weather Stations
CHD	Country Hydromet Diagnostics
CIMH	Caribbean Institute for Meteorology and Hydrology
CMO	Caribbean Meteorological Organisation
CREWS	Climate Risk and Early Warning Systems
ECMWF	European Centre for Medium-range Weather Forecasts
EW4all	Early Warnings for all
GBON	Global Basic Observing Network
GFS	Global Forecasting Systems Model
ISO	International Standards Organisation
MoU	Memorandum of Understanding
NEMO	National Emergency Management Organisation
NMHS	National Meteorological and Hydrological Service
SOFF	Systematic Observation Funding Facilities
SVG	Saint Vincent and the Grenadines
SVGMS	Saint Vincent and the Grenadines Meteorological Services
SWFP	Severe Weather Forecasting Programme
TAFOR	Terminal Aerodrome Forecasts
USAID	United States Aid Agency
WFP	World Food Programme
WMO	World Meteorological Organization
WRF	Weather & Research Forecasting Model