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Systematic Observations Financing Facility

GBON National Contribution Plan of Suriname

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Weather and climate data for resilience

GBON National Contribution Plan
Suriname

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Module 1. National Target toward GBON Compliance

The land area of Suriname is 163,800 square kilometers and the EEZ (Exclusive Economic Zone) is 127,800 square kilometers. With a resolution of 200 km this will mean 4 land stations and 3 marine stations although these marine stations are not part of the GBON requirements.

In the National GBON Gap Analysis, the MDS has only one surface station that is partially GBON compliant. However, the hourly SYNOP messages from this station are not being delivered to GTS. This station is situated at the Johan Adolf Pengel International Airport, also known as Zanderij Airport, with the WIGOS ID: 0-20000-0-81225.

This station operates 24 hours without interruption and observations are made every hour. SYNOP messages are written and are transmitted to the Brasilia Databank, using the Aeronautical Message Handling System (AMHS). The other 2 surface/Synop stations, Nickerie WIGOS ID: 0-20000-0-81202 and Zorg en Hoop (WIGOS ID: 0-20000-0-81200) do not operate continuously and have specific operating hours (16/24 operation). The operating hours are from 08:30UTC – 00:30UTC. These three stations are Synop stations with both manual and automatic weather stations, and observers are in place. More specific information on the current status of the WIGOS registered SYNOP stations can be found in Annex 1.

The other 3 stations are Tafelberg (WIGOS ID: 0-20000-0-81250), Stoelmanseiland (WIGOS ID: 0-20000-0-81209) and Kwamalasamutu (without a WIGOS number yet). All these 3 stations are strategically located in the inland part of Suriname. This area is more difficult to access, but very important to receive meteorological data. Tafelberg and Stoelmanseiland are sleeping stations; there are AWSs installed, but face challenges in transmitting data. In Kwamalasamutu the Meteorological Service of Suriname (MDS) is currently strategizing to set up a new Automatic Weather Station (AWS), a remote area crucial for weather monitoring in the far southwest region of the country. The establishment of this AWS is pivotal for collecting real-time weather data, facilitating informed decision-making and precise forecasting, particularly for the southern region of Suriname. However, financial support is imperative to ensure optimal operation of this vital weather infrastructure. Although MDS is backed by projects like the UNDP/EU -GCCA+ Phase 1 and 2 and the India-UN initiative, additional funding is needed to guarantee the seamless functioning of the AWS and to maintain reliable and up-to-date weather information not only for Suriname but also for neighboring nations.

Although there is significant support available to help MDS improve its AWS network and provide more accurate local weather information, none of the stations are GBON compliant. Additionally, the SYNOP messages are not being delivered to the GTS network, failing to meet the GBON requirements for hourly distribution.

Suriname does operate an upper-air station in Paramaribo. Soundings are twice a week with once a week including Ozone measurements. To improve this to a twice daily upper sounding as GBON requires this is assessed as a present GBON gap.

Table 1. GBON National Contribution Target

Type of station	WMO GBON Global Gap Analysis, June 2023				GBON National Contribution Target	
	Target	Reporting	Gap		To improve	New
			To improve	New		
	[# of stations]				[# of stations]	
Surface	2	0	2		4	1
Upper-air	1	0		1	1	
Marine	***when applicable**					

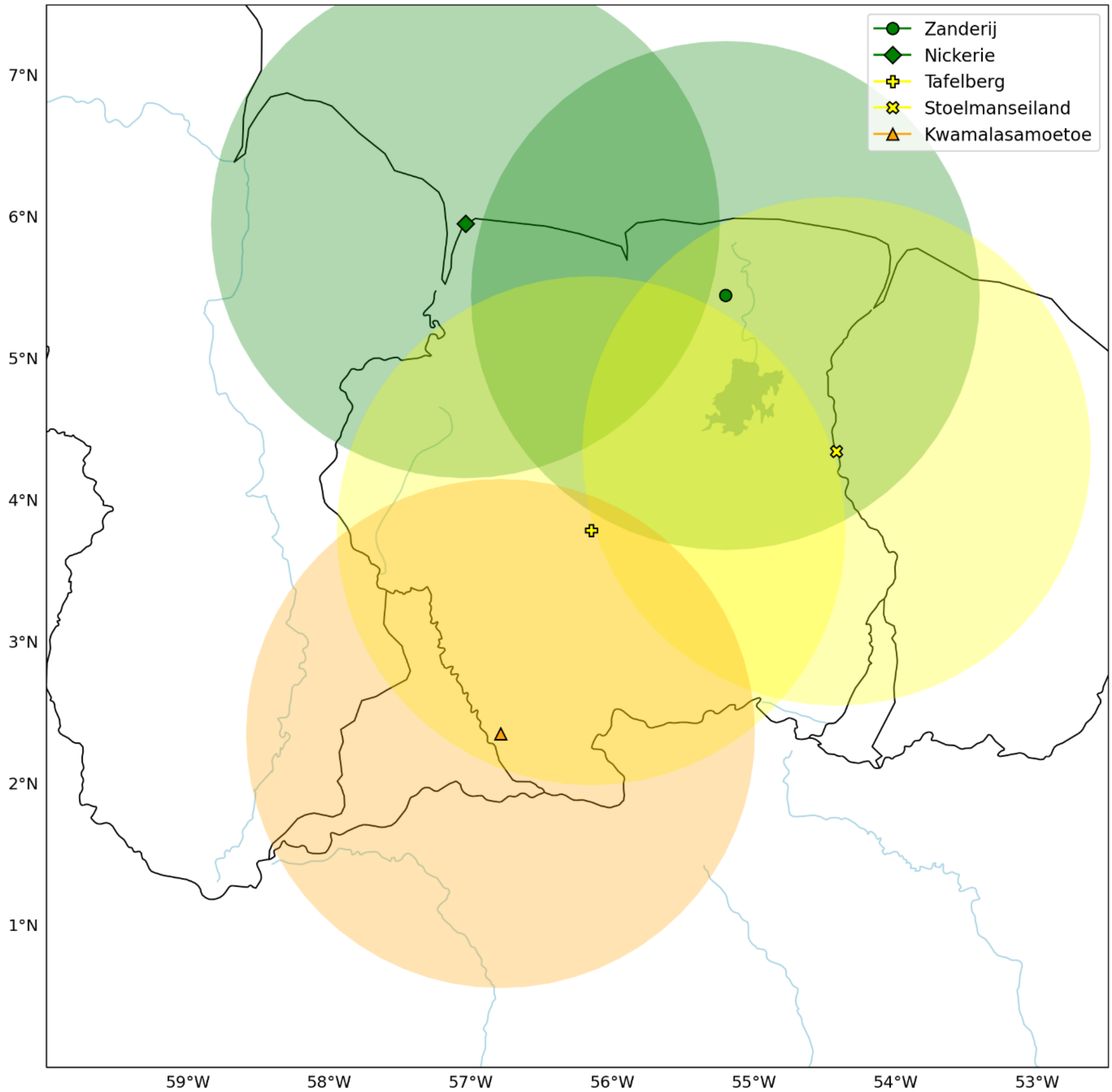

Figure 1. Total of surface stations to be improved and a new station as a result from the Gap Analysis (without Synop station Zorg en Hoop). The stations are with circles of 200 km. With in green the Synop stations, in yellow two sleeping stations. All four (4) stations are ready for improvement. Station five (5) (in orange) is a new station and is needed to cover the South West part of Suriname.

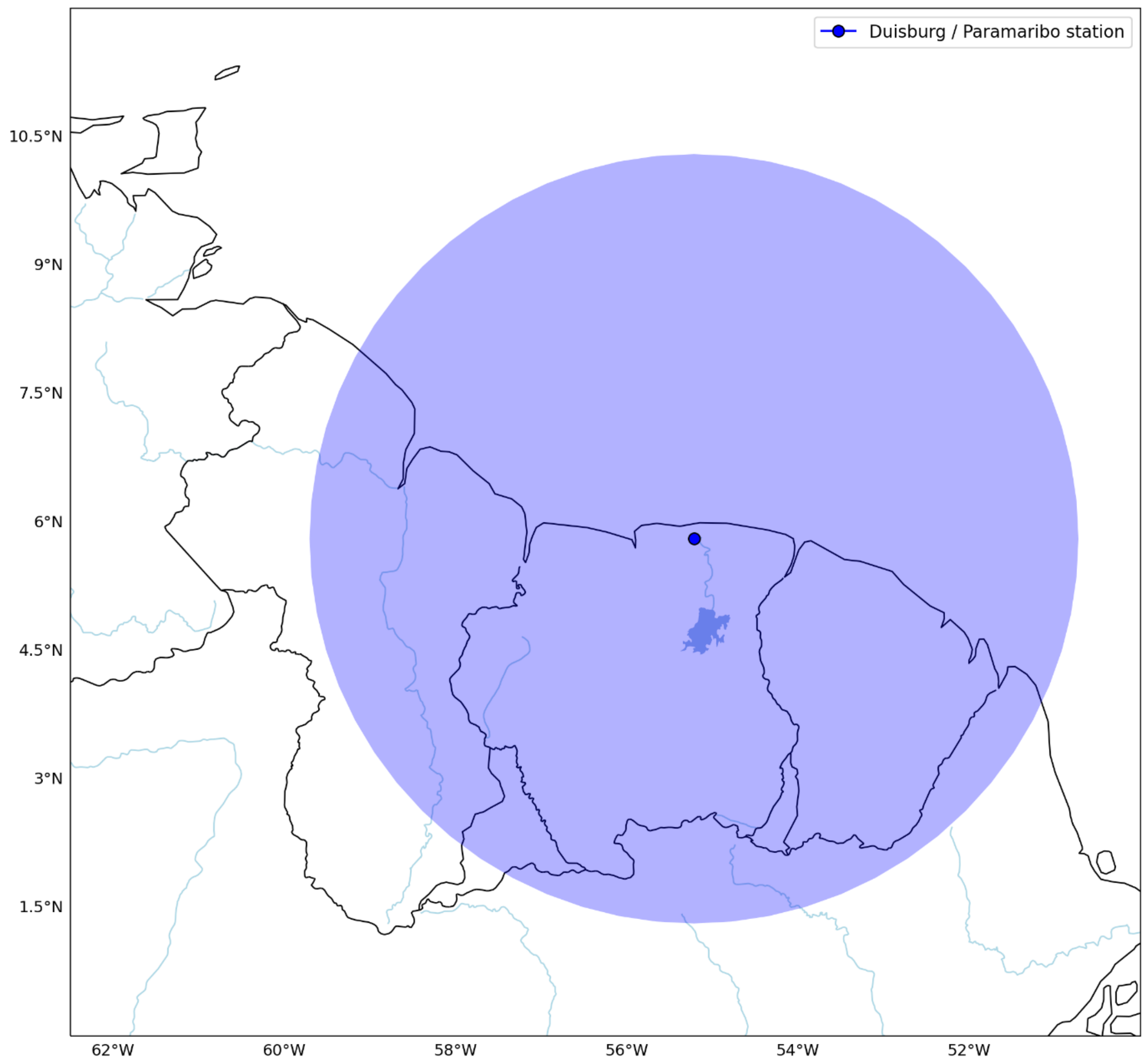

Figure 2. Upper Air Station (Paramaribo/Duisburg) with a circle of 500 km.

1.2 Establishment of the National target toward GBON compliance

After thorough discussions and feedback, it has been suggested to evaluate five (5) existing surface stations equipped with Automatic Weather Stations (AWS) to ensure compliance with the Global Basic Observing Network (GBON) standards. Additionally, one automatic surface observation station, where the AWS is yet to be installed, will be included in this assessment. The need for upgrade of the Upper Air Station of Paramaribo is also included in this assessment. The upgraded stations will significantly improve the GBON network while also enhancing the functionality of the sounding station. Moreover, with the proposed technical approach, data from manual stations can also be incorporated, even if they do not meet the temporal resolution criteria of GBON. However, the MDS has expressed concern about sharing observations from existing stations due to their operation and maintenance. Therefore, it is proposed that financial support be provided for station maintenance, setting up data flow, and sets of spare parts to address this concern.

Module 2. GBON Business Model and Institutional Development

2.1. Assessment of national governmental and private organizations of relevance for the operation and maintenance of GBON

The MDS operates within the jurisdiction of the Ministry of Public Works, and has the responsibility of gathering data related to weather, climate, ozone, radiosonde, regional seismology, and atmospheric distribution of radioactive material. The MDS plays a crucial role in providing advice and warnings to diverse sectors including society, shipping, and aviation. These services are designed to mitigate risks associated with climate change and ensure safety. However, there are challenges in delivering these products and services optimally and in a timely manner.

Outside of the MDS no hydrometeorological observation networks are relevant to GBON. However, certain weather stations are operated by consultancy bureaus, universities, or research institutes for research purposes. These stations are stand-alone systems, typically intended for temporary installation to serve specific scientific objectives, and do not transmit real-time data. The location or equipment of such stations may not conform to the established standards or requirements of GBON. Nevertheless, MDS extends its support to the installation and operation of these stations, and relevant data is shared with MDS from these stations.

MDS collaborates and coordinates with various government agencies and organizations that are dependent on weather conditions. This collaboration occurs on a daily basis as well as on separate projects. For instance, MDS collaborates with the National Coordination Center of Disaster Relief (NCCR) and UNDP projects on Climate Change. Additionally, MDS also collaborates with both state-owned and private media broadcasting to disseminate weather forecasts. The feedback from the different stakeholders at the SOFF stakeholder meeting at the Ministry of Public Works of OW in Suriname in January 2024 confirmed this collaboration and coordination. The stakeholders meeting in January 2024 was the first stakeholders meeting on meteorology and climatology and was very welcomed. The stakeholders also requested to have more and closer contact between individual stakeholders and also to have more regular stakeholder meetings as was organized in January to discuss the different issues the Meteorological Service of Suriname deals with.

Two private sector partners have shown a willingness to contribute to the implementation of the plan. The State Oil Company, which operates in the oil, gas, and renewable energy sectors with a coverage area extending from the coastal region to central Suriname, is one key partner. Additionally, a partner from the aviation sector, which provides both domestic and regional air transportation, as well as transportation services to offshore drilling platforms, has expressed interest in supporting the initiative. A Memorandum of Understanding (MOU) will be signed to formalize their contributions.

MDS has signed a Letter of Intent with the University of Suriname, as well as a Letter of Agreement with the Civil Aviation, the Maritime Authority of Suriname, and the Department of Water Resources. Additionally, MDS has a long-term partnership, since 1999, with the Royal Netherlands Meteorological Institute (KNMI), specifically in the areas of long-term climate monitoring and research, upper sounding measurements, and dissemination and monitoring of atmospheric upper air and ozone data.

Before each radiosonde launch for atmospheric measurements, calibration is performed in the office laboratory to ensure accuracy. However, this is not the case for traditional manual instruments. Although there is a government department responsible for metrology in Suriname, the precision measurement and calibration services required for manual instruments are currently unavailable due to a lack of expertise within the department.

For now, the calibration of automatic weather stations is being supported by the Caribbean Institute for Meteorology and Hydrology (CIMH), which temporary provides the necessary technical expertise to ensure the accuracy and reliability of these systems.

Recommendation

It is recommended that the Meteorological Service Suriname (MDS) take a more active role in forming collaborative partnerships with both the public and private sectors to address resource gaps in key areas such as maintenance, IT infrastructure, and technical and scientific capacity for calibration activities. This approach was confirmed and endorsed by stakeholders during the meeting in January 2024. Such partnerships would allow MDS to more effectively and efficiently leverage resources, particularly in situations where limited capacity affects the delivery of high-quality services. By pooling resources and expertise, MDS can better resolve calibration challenges.

2.2. Assessment of potential GBON sub-regional collaboration

The MDS in collaborating and cooperating with CIMH (Caribbean Institute for Meteorology & Hydrology), the Caribbean Meteorological Organization (CMO), and the Caribbean Disaster Emergency Management Agency (CDEMA) which is a regional inter-governmental agency for disaster management that falls directly under the Caribbean Community (CARICOM)

The Caribbean-CREWS (Climate Risk and Early Warning Systems) and CARICOF (Caribbean Climate Outlook Forum) also benefit from climatological data.

The MDS is open to collaborating with countries in the region to optimize the installation, operation, and maintenance of the observation network. Regionally, MDS is available to be part of the initiative implementing Multi-Hazard Early Warning System (MHEWS), sharing the observational data in near real-time. Also, with INMET, Instituto Nacional de Meteorologia, Brazil, there is a collaboration on forecasting and extreme weather. After the upgrade and installation of additional communication facilities as part of the SOFF/GBON initiative, this would enhance data exchange capacity in the future.

Increased number of good quality observations supports both regional and global scale weather modelling. Also sharing of data amongst the regional partners supports in providing early warning services. This would result in the improvement of the quality of global NWP models' outputs including products and forecasts at the national and regional levels. A further investment in Suriname could lead to improvements in global model quality, especially over the tropical Atlantic Ocean and the Caribbean Sea, an area prone to hurricane development.

Data sharing

It has been observed that the northern part of Suriname has a dense surface network of automatic weather stations than in remote areas, providing valuable information for operational services and research. However, all data is not delivered, so they are no GBON compliant stations. The spatial coverage of meteorological networks has been optimized since 2018, but maintenance support in the form of spare parts and sensors is still needed. While few are WIGOS stations, their data availability does not meet GBON requirements.

Meteorological station networks

In general, the spatial coverage of meteorological Network has been optimized after 2018. The GBON compliant networks in Suriname has been considered in National Gap Analysis. There are WIGOS stations, however, their data availability does not meet GBON requirements and will not be considered further here.

Even if the density of network exceeds GBON requirement for horizontal resolution, maintenance support in the form of spare parts/sensors is still needed and also quality of the stations/data.

Technical and capacity support

Equipment purchases from the same supplier should be implemented nationally to create synergies in network operation, training, and maintenance. Implementing equipment purchases from the same supplier nationwide would result in several advantages. Firstly, it would create synergies in network operation, meaning that all equipment across the country would be compatible and work seamlessly together. Secondly, it would simplify training processes, as personnel would only need to learn how to operate one type of equipment, rather than multiple different systems. Lastly, it would streamline maintenance procedures, as technicians would be familiar with the equipment and spare parts would be standardized, making repairs more efficient. The challenges encountered in transportation of equipment and customs procedures make this an unsustainable and cost-inefficient solution, especially considering the number of automatic stations in Suriname.

Recommendation

Exchanges within WMO Regional Instrument Centre (RIC) could be established. This could facilitate and promote the exchange of technical expertise and best practices. This network will be very useful in various areas, as regional training and capability building, data sharing using a network data hub, calibration actions across the network. To continue evaluating and seeking synergies between organizations in the region. The MDS will need to strengthen its cooperative relationships with the neighboring countries Guyana, Brazil and French-Guyana particularly in areas such as calibration, technical expertise, and resource sharing. Special attention should also be given to collaboration on joint issues related to GBON regulations, ensuring compliance and enhancing regional capabilities.

2.3. Assessment of a business model to operate and maintain the network

Four basic business models, from full public ownership to full private ownership, can be deployed with variations, depending on the specific country context:

1. Fully public: Fully State/NMHS owned and operated GBON infrastructure
2. Public-Private: State/NMHS owned and Private Partner operated
3. Public-Private: State/NMHS and Private Partner owned
4. Fully Private: owned and operated by a private partner with a direct contract with the State/NMHS SOFF

At present, the only feasible operational model is the fully public one. In addition to governmental budget funding, the MDS has received cost-recovery mechanisms and commercial operations. However, it has been found that cost-recovery and commercial operations alone are not enough. Therefore, the impact of allowing cost-recovery mechanisms on the budget for operating and maintaining observation infrastructure needs to be evaluated. The civil aviation sector is the most potential end-user sector, comprising private aviation companies.

The MDS relies on various sources of funding to carry out GBON-compliant operations, including Governmental budget funding, international development collaboration projects, and financial support from the UNDP(IE) for station maintenance and missions. KNMI provides financial supports for the operation, and maintenance of the radio-sounding station. To ensure adequate financing for timely maintenance and sensor replacement at stations, MDS needs to develop a lifecycle plan for AWS and ICT infrastructure. This plan will provide a systematic justification for budget and project funding allocations.

The maintenance of most stations outside of GBON is sustained through an annual budget provided by the government. However, the budget is inadequate in terms of providing complete coverage of the entire network as well as investing in spare sensors. Other factors, including lack of capacity, a vast network, communication challenges, and inaccessibility of stations, pose additional difficulties. To address some of these challenges regarding GBON compliant stations, the SOFF investment phase funding request aims to provide a solution. To achieve this, the MDS seeks to establish beneficial partnerships with aviation operators and other entities that can provide financial support for the operation and maintenance of GBON observation infrastructure. Additionally, exploring the possibilities of cost-recovery mechanisms will be part of the partnership's priorities.

The primary aim of the SOFF proposal is to establish a sustainable funding model for the network, given the limited government resources available to maintain and sustain it. The network will contribute to global data and maintain continuous operation. To achieve this objective, it is recommended to evaluate public and private partnerships regularly throughout the observation value chain, from station to end-user interface, for infrastructure maintenance and operations. Additionally, it's important to explore viable cost-recovery mechanisms.

Recommendation

Therefore, to ensure a reliable and effective network, a sustainable funding model is essential. The evaluation of public and private partnerships could identify the best partnerships for infrastructure maintenance and operations, which would help to ensure the network's continuity and effectiveness. It is also crucial to explore the possibilities of cost-recovery mechanisms to guarantee the network's long-term sustainability.

It is not advised to develop immediately the private sector or commercial services, at this stage of development within MDS. MDS requires assistance to first increase the quality, reliability and effectiveness of its public responsibilities before trying to extent its services to private customers.

Incorporating SOFF support by the investment plan being developed between United Nations Development Programme (UNDP) and MDS, assisted by KNMI. MDS can hopefully absorb financial support for procurement, instalment of station hardware and find the human resources required for the SOFF operations and related training and education. MDS annual governmental budget is approximately 150,000 USD per year.

2.4. Assessment of existing national strategies and projects related to observing networks

The Ministry of Public Works defines the policy of the MDS and provide the following mandates:

1. **Recognition of MDS:** The policy designates the MDS as the primary agency responsible for various aspects of meteorology, aviation meteorology, climatology as well as their practical applications.
2. **Infrastructure Establishment and Modernization:** MDS is mandated to establish, maintain, operate, and modernize meteorological infrastructure and associated Information and Communication Technology (ICT) facilities to ensure efficient service delivery.
3. **Meteorological Stations and Early Warning Systems:** The policy emphasizes the establishment, operation, and maintenance of meteorological stations, as well as the modernization of observation systems and early warning mechanisms. Innovative financing methods, including cost recovery mechanisms, are to be adopted to ensure the sustainability of the network.
4. **Quality Information Provision:** MDS is tasked with providing reliable, accurate, and high-quality weather and climate and services such as radioactive material in the atmosphere.
5. **Accessibility of Data and Services:** The policy mandates ensuring universal access to reliable and quality meteorological data and services at all times.
6. **Data Exchange and Dissemination Mechanisms:** MDS is required to adopt meteorological data exchange and dissemination mechanisms to regulate data sharing effectively.
7. **Adherence to Standards:** The policy underscores the adoption of international and national standards for observation, instruments, data collection, and forecasting to maintain the quality of services provided.

8. **Research and Development Promotion:** MDS is encouraged to promote research and development activities aimed at enhancing knowledge and understanding in the fields of meteorology as well as their practical applications.
9. **Human Resource Management:** Ensuring an adequate and competent workforce equipped with the latest scientific knowledge and technological advancements for MDS.

Strategies follow national 5-year plans of the government

The AWS network was established between 2018 and 2023. However, some of the sensors and data loggers of the network now require replacement and maintenance, which is one of the primary focus areas. To ensure that all observation stations are systematically operated and maintained, a lifecycle plan needs to be developed. This plan should be closely connected to annual and long-term budgeting, with the SOFF programme serving as the appropriate platform. The lifecycle plan will also support better coordination between budget funding allocation, projects, and the achievement of long-term strategic goals.

Current projects are:

- GCCA+ phase 2/UNDP-EU: Resilience building through integrated water resource management, sustainable use and coastal ecosystems management
- India-UN project: 'Enhance early warning service delivery to communities of Suriname in order to build their resilience to flooding due to excess rainfall'
- Makandra project: Capacity Building, Internship and developing Climate Scenario analysis: MDS and KNMI

The aforementioned projects not only enhance the observing network of the Meteorological Service Suriname (MDS) but also contribute to the development of national strategies. These initiatives play a crucial role in capacity building and in strengthening the overall capabilities of the service, ensuring its ability to meet both national and international meteorological standards.

Recommendation

To ensure consistency and complementarity of GBON-related investments and development projects for the Meteorological Service of Suriname (MDS), the following recommendations are proposed:

1. **Align Projects with Strategies**
   - Ensure GBON investments align with national meteorological priorities and regional frameworks, such as those from WMO and CMO.
   - Coordinate with national climate and environmental strategies to prevent duplication and maximize impact.
2. **Enhance Stakeholder Coordination**
   - Establish a task force within MDS to oversee GBON projects and maintain communication with stakeholders, including government agencies, private sector partners, regional institutions, and international donors.
   - Conduct regular stakeholder meetings to review progress, address gaps, and ensure consistency across projects.

3. **Harmonize Data Management Systems**
   - Ensure the integration of planned investments in data systems, such as CLIMSOFT upgrades and real-time capabilities, with existing systems to maintain data quality and GBON compliance. Additionally, establish connections with other national data platforms related to Weather, Climate, and Water.
   - Allocate resources for staff training aimed at proficiently managing and integrating new technologies.
4. **Focus on Capacity Building**
   - Prioritize training for meteorologists, technicians, and IT staff to operate and maintain GBON infrastructure.
   - Utilize regional partnerships, such as with CIMH, for ongoing technical training in calibration, remote sensing, and data analysis.
5. **Leverage Public-Private Partnerships**
   - Collaborate with private sector partners in energy, aviation, and technology to support infrastructure development and maintenance.
   - Secure MOUs with key partners for sustained GBON support.
6. **Monitor and Evaluate Projects**
   - Develop a comprehensive monitoring and evaluation framework for all GBON-related projects to track progress, ensure consistency, and make necessary adjustments to avoid overlap or redundancy in investments.
   - Use evaluation data to guide future investments and improve project coordination.

By implementing these recommendations, MDS can ensure that its GBON-related investments and projects are aligned, effective, and supportive of national and regional objectives, enhancing the overall meteorological service in Suriname.

2.5. Review of the national legislation of relevance for GBON

The formal basis of the Meteorological Department Suriname (MDS) is signed by national decree number 12795 dated October 27, 1962, at the unification of the Meteorological Department Suriname. Its national decree came into effect on January 1, 1963. It is the authority for weather and climate information and forecast.

There are no known constraints regarding GBON implementation nor subsequent international data distribution in Suriname.

Acknowledging the importance of exchange of meteorological data and information for sustainable development, protection of lives and properties, research and decision support one need the permission from the Ministry of Public Works.

There are no known constraints by national legislation regarding GBON implementation.

Although the MDS can give full mandate in the field of hydrometeorological observations and data distribution, the permission from the Permanent Secretary of the directorate is needed.

Recommendation

The development of guidelines aimed at promoting data exchange and interoperability among line agencies, the public, and individuals is of utmost importance. Such guidelines facilitate efficient information sharing and collaboration, thereby benefiting a wide range of stakeholders both nationally and internationally. Evidence-based decision-making and innovation are supported as a result

Legislation related to procurement, importation, and customs processes

Legislation related to procurement, importation, and customs processes in Suriname governs the acquisition of goods and services, as well as the importation of items into the country. Here's a summary of how this legislation applies to the installation of Automatic Weather Stations (AWS) and Automatic Rain stations (ARS) in Suriname:

Procurement Rules and Regulations: The government of Suriname has established procurement rules and regulations that must be followed when acquiring goods and services. These rules ensure transparency, fairness, and efficiency in the procurement process.

International Bidding Process: Larger purchases, such as the acquisition of Automatic Weather Stations and Automatic Rain stations, typically require an international bidding process. This process allows for competition among suppliers on a global scale, ensuring that the best value for money is obtained.

Local Suppliers: In some cases, local suppliers may be required or preferred for certain purchases. This could be mandated by government policies aimed at promoting local businesses and industries.

Import Tax: When importing goods into Suriname, a percentage of import tax may be applicable depending on the nature of the items being imported. It's important to consider these taxes when budgeting for procurement projects.

Tax Exemptions: Some purchases may be exempt from import tax, depending on the nature of the goods and any relevant agreements or exemptions granted by the government.

In the case of the installation of AWS and ARS under the GCCA+ project, procurement is conducted according to the Procurement Rules and Regulations of the government of Suriname. The UNDP, as the implementation partner, procures the necessary instruments through this project, adhering to both Surinamese procurement laws and the rules of the GCCA+ project. Depending on the size and nature of the purchases, international bidding processes may be required, and import taxes must be factored into the procurement process.

Module 3. GBON Infrastructure Development

3.1. Design the surface and upper-air observing network and observational practices

Exchanging data directly with the World Meteorological Organization (WMO) network services is indeed a possibility, primarily for institutions, countries, and researchers involved in meteorological, climatological, hydrological, and related sciences. The WMO plays a pivotal role in facilitating the free and unrestricted exchange of meteorological and related data and information across its member states and territories. This exchange is crucial for weather forecasting, climate change research, and disaster risk reduction. However, to engage in direct data exchange with WMO network services, data sharing from existing stations to GTS/WIS2 has to be in place, which is not yet the case for the MDS.

The challenges to navigate the following paths:

1. Membership and Affiliation: Being part of a national meteorological or hydrological service (NMHS) that is officially recognized by a WMO member country can provide the necessary platform for data exchange. These entities usually have established protocols for data sharing with the WMO.
2. WMO Program Participation: The WMO operates various programs and projects, such as the World Weather Watch (WWW) and the Global Climate Observing System (GCOS), which are designed to facilitate the collection, sharing, and utilization of meteorological and related data. Participation in these programs often requires contributing data to and using data from the WMO's global network.
3. Data Policies and Standards: The WMO has established policies and standards to govern the exchange of data and information. These policies promote the free and unrestricted exchange of data while respecting national and international laws and regulations. Familiarizing yourself with these policies is essential for any entity wishing to exchange data with the WMO network.
4. Technical Infrastructure: Exchanging data with the WMO network services often requires specific technical infrastructure, including data formats (e.g., BUFR, GRIB) and protocols (e.g., WIS - WMO Information System). Ensuring compatibility with these technical requirements is crucial for successful data exchange.
5. Collaboration and Agreements: In some cases, direct exchange of data with the WMO may require formal agreements or memoranda of understanding (MoUs), especially when sensitive or proprietary data are involved. These agreements outline the terms and conditions of the data exchange, including data usage, sharing, and publication rights.
6. Contribution to WMO Databases and Services: One of the most direct ways to engage in data exchange is by contributing to WMO-managed databases and services, as WIS2.0. This contribution not only facilitates the global exchange of information but also enhances the data's reach and impact.

In exchanging data with the WMO should start by contacting the national meteorological or hydrological service or the WMO directly to understand the specific requirements and opportunities for collaboration. The WMO's commitment to data sharing is central to its mission to support countries in providing weather and climate services to protect life and property and to promote sustainable development.

The aim of SOFF investment phase project is to maximize the impact of observations on global numerical weather prediction (NWP) skill through:

1. Rehabilitating Upper-air sounding station with 2 times of sounding daily.
2. Installing 1 surface automatic weather station. And upgrade of 4 surface automatic weather station where 2 are in significantly remote areas
3. A regional optimization of the network design.

As highlighted in the Gap Analysis for MDS and further detailed in the Suriname Country Hydromet Diagnostics report (CHD), the current observational network suffers from limited maintenance capabilities

Suriname has a quite dense surface manual and automatic weather networks over the northern part of the country, and widely scattered over the remote areas.

Table 2: List of five (5) potential SOFF stations, of which four (4) are already WMO – WIGOS/OSCAR registered AWS stations in Suriname. One station (Kwamalasamutu) is not yet registered. All five stations are proposed to be rehabilitated under SOFF to GBON compliancy.

	Station Name	WIGOS_ID	Owner	Type	Lat	Lon	Required
1	Zanderij Airport	81225	MDS	AWS and Manual	5.27N	55.20W	Upgrade
2	Nickerie	81202	MDS	AWS and Manual	5.57N	57.02W	Upgrade
3	Stoelmanseiland	81209	MDS	AWS	4.35N	54.42W	Upgrade
4	Tafelberg	81250	MDS	AWS	3.78N	56.15W	Upgrade
5	Kwamalasamutu	No number	MDS	AWS	2.20N (around)	56.47W(around)	New

Rehabilitation of each of the five (5) proposed AWS to GBON compliance will involve the procurement, shipping, transportation, and installation of the following components:

- Temperature sensor
- Humidity sensor
- Atmospheric pressure sensor
- Rainfall sensor
- Wind sensor, including both speed and direction.
- Datalogger, complete with a solar panel and battery pack.
- Procurement of 5 spare sensor sets for temperature, humidity, atmospheric pressure, and wind speed and direction.

A critical aspect will be the IT hardware necessary for data transfer via WIS2.0. This will necessitate corresponding open-access software and capacity building for MDS staff in data sharing, for which support will be requested from WMO.

Additionally:

- Organization of periodic AWS maintenance SOPs (based on the manufacturer's instructions), including capacity, transportation, tools, etc., or alternatively, outsourcing maintenance to an external party.
- Furthermore, MDS's requirements for updated hardware and software for data and database management, and the minimum system specifications for WIS2.0, must be met.
- Only Zanderij, an International Airport station is 24/7-manned station. Station rehabilitation and upgrading GBON compliancy, including data transmission to WIS2.0 will require new staff, training and special SOP protocols.
- Station security (risks of theft) is minimized

Specific technical specifications will be utilized via MDS when supporting UNDP in preparing tender documents during investment phase.

Upper air station

MDS does operate an upper-air station in Paramaribo (WIGOS number: 0-20008-0-PMO). Soundings are twice a week with once a week including Ozone measurements. MDS recognises that information of the atmospheric state (temperature, humidity, pressure, and horizontal wind) in the vertical profile is critically important when initializing weather forecast models and for aeronautical navigation. The GBON requirement of spatial resolution for upper-air sounding is 500 km or better with sufficient temporal resolution for observation per location being 2 soundings in 24 h.

Table 3: UAS in Paramaribo/Duisburg Suriname.

Station Name	WIGOS_ID	Lat	Lon	Upper-air	Required
Paramaribo	PMO	5.81N	55.21W	UAS	Upgrade

Upgrading or rehabilitation of manual upper-air radio sounding station means:

1. Consumable parts (balloons, sondes etc.) for operation
2. Required maintenance and renovation to infrastructure
3. Include annual maintenance
4. Sufficient human recourses and skills training will have to be included

Observational practices defined per network

The AWS stations in Suriname provide data to the Synoptic Unit every 15 minutes, meeting the GBON's hourly observation requirement. However, the absence of interfaces to WIS 2.0 or GTS hinders the sharing of this data. Furthermore, this AWS data has to be paid for through HydrometCloud.

MDS is eager to expand data sharing. However, ensuring the reliability and quality of the data requires support for station maintenance and operation.

As part of these efforts, upper air sounding stations will be upgraded to align with the GBON recommendation of two daily observations.

Preliminary maintenance plan for existing and improved/new stations, including calibration practices

To develop a preliminary maintenance plan for both existing and new/improved stations, including calibration practices, a collaborative effort between the AWS-network maintenance program, the MDS, and the equipment manufacturer must be established. Sensor calibration is critically important in Suriname, not just for GBON compliance. Currently, MDS staff does not perform field calibration of instruments when anomalies or malfunctions are detected. The maintenance plan shall be based on the conditions and recommendations set by the manufacturer. Initially, maintenance visits to the station shall be conducted one to four times annually, depending on the station's accessibility and budget. Owing to the unavailability of a handheld calibration device, the temperature, humidity, pressure, and precipitation sensors are not calibrated annually. At present, MDS staff is unable to conduct equipment maintenance and (re)calibration programs due to a lack of resources, materials, replacements, and calibration facilities in Suriname. It is also not possible to send instruments for inspection and (re-)calibration to a WMO Regional Instrument Centre (RIC) for example in Barbados because of financial constraints and the absence of temporary replacement sensors limit this option.

The security of the stations has been assessed, and in the 2 northern stations no foreseeable issues have been identified, the southern 2 stations and the third new station in the south have to be improved for security reasons. However, automatic data distribution and maintenance may present a challenge, which must be addressed through careful planning and capacity building during the investment phase.

The primary challenge with automatic data distribution is communication challenges from the stations. Technical solutions such as mobile internet and satellite can mitigate these challenges, but given the accessibility of remote areas, they will remain challenges in the future. The coverage of mobile networks will increase over time, which will improve the situation.

Preventive and corrective maintenance will be addressed in the investment phase. This includes planning the storage of spare parts at convenient locations for maintenance, improving SOPs and maintenance practices, and ensuring the availability of off-road vehicles or other transportation means.

Calibration of sensors shall be conducted in collaboration with neighboring countries. The installation of calibrated sensors to the station during maintenance visits and the retrieval of old sensors for calibration require an adequate pool of spare parts to be truly effective and support the environmental sustainability goals of the SOFF program.

Given that the Meteorological Service of Suriname (MDS) does not currently have an internal calibration unit, a structured approach is essential to ensure the proper maintenance and calibration of both manual and automatic instruments at existing and new GBON stations.

The following plan outlines detailed maintenance and calibration practices for each type of instrument.

1. Manual Instruments
Some weather stations still use manual meteorological instruments such as thermometers, barometers, and rain gauges. However, the Department of Metrology in Suriname lacks expertise in precision measurements, so alternative arrangements are needed to maintain the accuracy of these instruments.

Calibration Practices:
- Calibration Frequency: At least once a year.
- External Calibration Support: Seek support from the Caribbean Institute for Meteorology and Hydrology (CIMH) or an internationally accredited calibration laboratory for periodic calibration.
- Logistics: Arrange for instruments to be shipped to calibration facilities or set up temporary mobile calibration units with the support of regional institutions like CIMH.

Maintenance Plan:
- Routine Checks: Monthly visual inspections for wear, tear, and mechanical issues.
- Preventive Maintenance: Lubrication, cleaning, and recalibration every 6 months.
- Replacement Strategy: Replace any equipment that cannot be calibrated after consulting with experts.

2. Automatic Weather Stations (AWS) are equipped with various sensors that require precise calibration for accurate data. Critical sensors should be calibrated every 6 months, while less critical sensors should be calibrated annually. It's recommended to formalize the collaboration with the Caribbean Institute for Meteorology and Hydrology (CIMH) for calibration support. Routine sensor checks, preventive maintenance, and battery checks are essential. Additionally, maintaining an inventory of critical spare parts and promptly replacing sensors showing a loss of accuracy during calibration is crucial.

3. Capacity Building
MDS needs to develop calibration expertise. Steps for Capacity Building include staff training, for using the filed calibration kit, and setting up a collaboration with the CIMH and/or neighboring countries.

4. Calibration Documentation and Record Keeping
Accurate record-keeping of maintenance and calibration activities is crucial. Practices include obtaining and storing calibration certificates, maintaining detailed maintenance logs, and using a centralized digital system to track calibration due dates.

The MDS must prioritize the establishment of clear partnerships to enhance regional coordination. Collaborating with the National Meteorological and Hydrological Services (NMHSs) of neighboring countries, along with strategic considerations from the SOFF initiative and involvement from the WMO Regional Information Centre (RIC) in Barbados, may provide viable alternatives for instrument calibration. It is essential to address the specific conditions of sensors in Suriname to ensure accurate measurements. In the short term, regular calibration is preferred. Therefore, the consideration of a field calibration kit is necessary, enabling efficient recalibration at the regional center in Barbados.

Technical specification for new instruments and observing systems for the procurement process

The MDS has been harmonizing their station network and has acquired most stations, data collection and data management system from the supplier named OTT HydroMet. To fully utilize and support existing network, including spare part pool, for the coming 3 years, it is highly recommended that the new station is integrated into the existing system. Specifications for the AWS spare parts are detailed including model numbers from certain supplier based on existing station network.

Table 4. AWS sites and activities improvement investment proposal

#	Item/activity	Quantity	Unit price	Cost estimate (USD)
1	SatLink3 Logger/Transmitter	10		
2	Battery, 12VDC, 75AH	10		
3	Solar Panel Charger Ctrl,8 amp [Voltage-Regulators]	10		
4	WS 200 Wind Speed and direction Sensor	10		
5	Humidity and Temp Sensor, includes 3.5 meter cable	10		
6	Rain Gauge (metric), Stainless Steel (outer housing only), 0.2mm/Tip (inc.50ft/15m cable)	5		
7	Accubar Barometric Pressure Sensor, SDI-12, 0.2mB @ 20C	10		
8	Fencing of AWS			
9	Training in WIS, ICT, Collection and data Management system			
10	Charge for Internet per year			
	Total			See IFR

Table 5: Activities and investments required for installing new AWS in Kwamalasamutu

#	Activity		Cost estimate (USD)
Site selection, preparation and station installation			
1	Site prospection (staff/inter island travel)		
2	Station Installation (staff costs; 2-wks; 2p; interisland)		
3	Site ground preparation works (labour, equipment hires, ….)		
4	Protective fencing and construction materials		
Instruments and Equipment's			
5	AWS instrumentation		
6	Int'l Equipment transport		
7	Local equipment transportation cost (By boat/plane)		
8	Import duties, customs clearance;		
Human Capacity Development element (observer)			
9	Meteorological observer trainings WMO BIP-MT updates		
10	Local technical assistance service contract		
11	Local expenditures, communication costs		
	Total		See IFR

To prepare the tender specifications for TT-GBON approved procurements, TT-GBON approved material | World Meteorological Organization (wmo.int) document will serve as input, referencing Sections 6.1 (surface) and 6.2 (UAS) from the World Meteorological Organization (WMO) guidelines. These sections outline essential technical requirements for AWSs (table 4 and 5) and radiosonde-related procurements (table 9).

The MDS staff executes field calibration of instruments when anomalies a/o mal-functioning is detected. When required, instruments can be sent for inspection and (re-)calibration to the being the WMO RIC or Regional Instrument Centre for region RA IV in Barbados.

The equipment manufacturers will also be involved in designing an equipment maintenance and (re) calibration programs. It is also recommended to cooperate closely with KNMI on maintenance and calibration aspects where needed.

KNMI strongly recommends accompanying any AWS rehabilitation effort under SOFF (or complementary programs) with a robust field program for continuous maintenance and calibration of AWS equipment and sensors.

KNMI and MDS recommend to invest in the following field calibration equipment, required for improving operations and maintenance of weather field instruments (Table 6).

Table 6. Field calibration equipment requirement

#	Field Calibration Test equipment	Sensors	Quantity
1	Temp/humidity sensor with rad. shield	Temp/humidity	2
2	Barometric Pres. Transfer standard	Atmospheric pressure	2
3	Rain gauge calibration device	Precipitation calib.	2
4	Prop.torque etc.	Wind verification	2

This leads to the following investment requirement for Field calibration and test equipment.

Table 7. Investment requirement for field calibration equipment

Item	Quantity	Unit price	Cost estimate (USD)
Field calibration and test equipment	2		
Toolset (travel standard), multimeter, oscilloscope.	2		
Recertification cost of calibrators	2		
		Total	See IFR [11]

Upgrading and rehabilitation of the upper air sounding station is recommended.

One manual upper-air radio sounding station including

1. Consumable parts (balloons, sondes etc.) for the first year of operation
2. Required maintenance/renovation to infrastructure
3. Include annual maintenance during warranty period

Table 8. Investment requirement and an indicative cost estimate of the UAS upgrade

#	Item/activity	Quantity	Unit price	Cost estimate (USD)
1	Rehabilitation works UAS building	1 at PMO		
2	H_2 hydrogen generator & storage	1		
3	H_2 hydrogen storage tank, piping, valves,	1		
4	Ground monitoring system hard-/software	1		

	• Upper-air Ground System • UPS and Desktop PC			
5	Ground System lease contract for 5-years	1 (5-yr)		
6	Consumables: Balloons	400 p.a. for 5-yrs		
7	Consumables (radiosondes)	400 p.a. for 5-yrs		
7	Helium gas cylinder (backup)	1 per yr		
8	Shipping and transportation	Per shipment		
9	Import duties, customs clearance	Per import		
			Total	See IFR

Table 9. Investment Requirement for Upper-air Sounding technical assistance

Technical assistance Investment cost for UAS operations (5-yr)				
Item #	Qualification	# staff	Annual cost (USD)	5-yr cost (USD)
1.	technical assistance UAS: Qualified in meteorology & UAS	1		
2.	Meteorological Technician (UAS qualified)	2		
			Total	See IFR

3.2. Design of the ICT infrastructure and services

Detailed description of the ICT infrastructure and services design

The development of an ICT infrastructure for a value chain of automatic observation networks should begin by hiring and training staff with the necessary skills and knowledge relevant to IT in meteorological observation. MDS should gain knowledge and skills in meteorological data, data processing principles and tools, data formats, system architecting, software development, database, Application Programming Interface (API), network management, as well as web development to ensure resilience.

The Ministry of Public Works has a decent ICT environment, but the MDS unit needs to be strengthened while planning the SOFF/GBON related improvements.

For Zanderij Airport the SYNOP messages are written and are transmitted to the Brasilia Databank, using the Aeronautical Message Handling System (AMHS).

Currently, HydrometCloud is storing the incoming station data for MDS; MDS gets the data through NOAA and this is stored on the local computers with no back-up solution.

The Climatological and Instrumental units have been harmonizing their station network and have acquired data collection via NOAA (National Oceanic and Atmospheric Administration). The data collection system allows real-time data flow from AWS to the database. Although the data management system is still in the deployment phase and will take time to be fully operational, it can be considered as an operational system from the GBON surface observation point of view. ClimSoft is a Climate Database Management System what would be very functional for the climatological unit.

Technical specifications

The following is a brief description of the data management system that can serve a real-time database. It is highly recommended to use it as a data source for the WIS2.0 interface. With this approach, there is no need for separate short-term storage, although the data collection system could serve in that role to some extent.

Using the database for data flow allows centralized real-time monitoring of the system, real-time quality control, and a centralized source for metadata. However, manual quality control will be performed with a delay.

Regarding data management in general at the MDS, using data flow via database simplifies overall data management remarkably. Station or data collection providers only need to plan how to get data to the data management system, without needing to know about who and how the data will be used or accessed. As for metadata management, MDS will use Climsoft, which is a software suite for storing meteorological data securely and flexibly, and for extracting useful information from the data.

Automatic real-time quality control (QC) can be performed in the data management system, preventing the delivery of erroneous values.

Centralized data collection and storage provide benefits such as real-time quality control, a centralized source for metadata, and a centralized real-time monitoring system. It also simplifies data flow at the MDS.

A modern, functional Data Management System is a vital component in the value chain of observation from the measurement station to the end-user interface. The following outlines some general key elements to consider in technical and budgetary perspectives for the database, which the existing Data Management System fills at least to some extent.

The database system should be able to ingest and store multiple types of weather observation data formats, including surface weather observations, upper-air radio-sounding observations, and aviation weather observations. Climatological observations should also be included. However, data from weather radars, which have a large volume and require more storage capacity than single point/profile data, are beyond the scope of this document.

Data ingestion to the database should be made with a modular approach so that new data feeds can be added with minimal effort and modification to the existing components and database structures. A data quality control (QC) module should be an independent and/or modular part of the system. The quality control module should perform real-time quality control and enable non-real-time manual quality control.

The database system should support queries of time series with adequate performance and should be able to serve as real-time and long-term (climatological) data storage. Modules to calculate added value parameters and use of data from the archive should be made possible. These may include aggregate parameters like daily means, minimums, and maximums.

The system should be able to store relevant metadata regarding stations, station networks, and observations. Automatic updates to the WMO/OSCAR system are preferred. All metadata should be stored and maintained in a specific location. The extent of the available metadata and updates to and from WMO/OSCAR needs to be clarified during the implementation phase of the WIS 2.0 interface.

Hosting of the infrastructure

The MDS needs to have their own computer rooms which hosts their infrastructure. MDS needs a cloud-based data storage with a back-up solution. There are plans to contract a local hosting service. These plans should be followed carefully, and utilization of server hosting facilities of ICT-center be considered. Server hosting by ICT-center, can provide main or backup computer rooms. It is assumed that services will include also cloud services.

Furthermore, the climate department of MDS is in need for a Climate Database Management System for example ClimSoft and training on this as well.

Detailed description of the measures to ensure resilience and continuity of the full data processing chain

Data delivery and gaps

The delivery of GBON hourly weather observations should follow the guidelines set by the World Meteorological Organization (WMO) in their guidance document (no. 3061) and GBON practices, where applicable. However, although GBON defines certain protocols that should be used in the collection of data from weather stations, they should be considered as recommendations and not mandatory requirements, given the existing infrastructure and software.

Currently, the proposed system lacks a WIS 2.0 capable interface, which requires significant support in the ICT field. Therefore, the first step is to ensure that data flows efficiently from the proposed GBON station to international dissemination via WIS 2.0. Once this is achieved, existing stations can be added to international delivery using these solutions.

Observations obtained from abroad via GTS or WIS 2.0 will be utilized in the forecasting process. In the next step, a data policy needs to be developed to store international observations in the same database.

Recommendation

It is highly recommended that all the six proposed stations and data flow to WIS2.0 should be integrated into the existing system via the data management system. Efforts should also be made to improve the efficiency of the current system, ensuring the resilience and continuity of the full data processing chain. This requires reliable equipment, adequate human resources, and full-time monitoring. On the technical side, it also means having backup and recovery plans for doubled environments, starting from AWS to data communications and servers.

Budget considerations; Resilience and the continuity of the full data processing chain:

The budget should encompass the necessary infrastructure for operating a robust data management system and storing data securely. Moreover, investing in a solution for backing up essential data is essential. It is prudent to establish a valid support contract with a hardware vendor throughout the hardware's lifespan, which typically ranges between 5-8 years before system renewal becomes necessary.

To ensure resilience, skilled staff and IT hardware are imperative, along with a comprehensive lifecycle plan and budget. Both the MDS and the Ministry bear sole responsibility for managing the entire data pipeline and developing an ICT infrastructure for the automatic observation network's value chain. Initiating with building the requisite human capacity and resources is advisable. Adequate staffing should be prioritized, with training provided in relevant IT skills and meteorological observation knowledge to bolster resilience.

The organization is encouraged to cultivate expertise in various areas, including meteorological data, data processing principles and tools, data formats, software development, database management, API integration, network management, WIS2.0, and web development.

3.3. Design the data management system

The system should provide:

a. Short-term data storage and access through the services and protocols required by applications for national and international operational activities
b. Acquisition of data to and from WIS 2.0 and other national or international sources required for operational activities
c. Data delivery to the national CDMS
d. Discovery and descriptive metadata management
e. Monitoring of data, processing and services

Short-term data storage and access through the services and protocols required by applications for national and international operational activities

The MDS aims to provide access to data used by operational applications on a real-time basis and the capability to deliver data to a Climate Data Management System for long-term archiving purposes. Setting up a short-term data storage and access for meteorological applications at a national and international level involves integrating a complex ecosystem of technologies and protocols. The goal is to ensure that the data is not only stored securely and efficiently but is also easily accessible and distributable to support operational activities related to weather forecasting, research, and emergency response planning.

The MDS will concentrate on collecting, storing, accessing, and distributing meteorological data:

1. Data Collection and Ingestion

Meteorological data is collected from various sources such as satellites, radar systems, and weather stations. Data ingestion protocols need to be versatile and capable of handling various data formats (e.g., BUFR, GRIB) and communication protocols (e.g., FTP, SFTP, HTTP/HTTPS), while many applications require real-time or near-real-time data processing.

2. Data Storage

Due to the vast amount of data generated, a combination of in-memory data stores for immediate access and SSD-based databases for more persistent yet fast-access storage solutions are often used for short-term storage. For national and international operations, data lakes in the cloud, such as Google Cloud Storage, can offer scalable, secure, and cost-effective storage solutions that support various data formats used in meteorology.

3. Data Access and Distribution

APIs are widely used to provide access to meteorological data, and these APIs can serve data in formats like XML, which are easily consumed by applications. For broader distribution, protocols, and services like FTP, HTTP/HTTPS, or specialized meteorological data distribution systems like the Global Telecommunication System (GTS) used by the World Meteorological Organization (WMO) are critical. Services like Datasur (national) provide a web server that allows for direct access to scientific data sets, including meteorological data.

4. Scalability and Reliability

Leveraging cloud platforms can provide the necessary scalability and reliability for Meteorological applications. Cloud platforms offer auto-scaling, load balancing, and disaster recovery services.

5. Security and Compliance

Ensuring the confidentiality, integrity, and availability of meteorological data is paramount, including encryption in transit and at rest, along with robust access controls. Adhering to national and international regulations and standards, especially when dealing with data that might have implications for national security or sensitive operations, is critical.

Acquisition of data to and from WIS/GTS, WIS 2.0 and other national or international sources required for operational activities

Acquiring data from the WMO Information System WIS 2.0, and other national or international sources is critical for operational activities in meteorology, climate monitoring, and other environmental sciences.

For the MDS the following steps for acquiring data for operational activities have to be develop:

1. Identify Specific Data Requirements:
    - Determine the types of data needed (e.g., real-time weather observations, forecasts, climate datasets) and the required resolution and frequency.
    - Understand the format in which data is provided and any preprocessing that may be necessary.
2. Access Protocols and Permissions:
    - Gain an understanding of the protocols for accessing data from WIS 2.0, and other sources. This may include FTP, HTTP, APIs, or specialized software.
    - Ensure that you have the necessary permissions or subscriptions to access the data, as some datasets may have restrictions based on usage or geographical location.
3. Utilize Appropriate Technology:
    - Use software and tools compatible with the data formats provided by these sources. This might include GIS software, programming languages like Python or R for data analysis, and specific libraries or APIs for data retrieval and manipulation.
    - Consider the infrastructure needed to store and process large volumes of data, which may include cloud storage solutions or local data servers.
4. Collaboration and Training:
    - Engage with the meteorological and scientific community to stay informed about best practices and new developments in data acquisition and analysis.
    - Participate in training sessions, workshops, or forums organized by international bodies like the World Meteorological Organization (WMO) or by national meteorological agencies.
5. Compliance with Standards and Policies:
    - Adhere to international standards for meteorological data, such as those set by the WMO, to ensure compatibility and interoperability with global systems.
    - Be mindful of data usage policies, copyright laws, and ethical considerations, especially when sharing or publishing data.
6. Monitor and Evaluate Data Quality:
    - Implement procedures for the continuous monitoring and evaluation of data quality and integrity, including the verification of data sources and the assessment of data accuracy and completeness.

By systematically addressing these aspects, organizations can effectively acquire and utilize data from WIS 2.0, and other national or international sources for their operational activities, thereby enhancing their capacity to provide accurate and timely information for decision-making, research, and service delivery.

Data delivery to the national Data Management System

Delivering data to a national Data Management System typically involves several steps to ensure the accuracy, security, and efficiency of the process. Here's a general outline of the steps involved:

1. Data Collection: Data is collected from various sources, which could include government agencies, research institutions, private organizations, etc. This data can be in various formats such as structured (databases), semi-structured (CSV files, XML), or unstructured (text documents, images).
2. Data Standardization: Before sending data to the national Data Management System, it's important to standardize it to ensure consistency and interoperability. This involves cleaning the data, resolving any inconsistencies or errors, and mapping it to a common data model or schema.
3. Data Transformation: Depending on the format of the collected data and the requirements of the Data Management System, data may need to be transformed or converted into a specific format. This could involve data manipulation, aggregation, or normalization.
4. Data Encryption and Security: Data security is paramount when transmitting data to a national Data Management System, especially if it contains sensitive information. Encryption techniques such as SSL/TLS should be used to secure data in transit, and access controls should be implemented to restrict unauthorized access.
5. Data Transmission: Once the data is prepared and secured, it can be transmitted to the national Data Management System. This could be done via secure file transfer protocols (e.g., SFTP), web services (e.g., RESTful APIs), or other communication channels.
6. Data Validation: Upon receiving the data, the national Data Management System should perform validation checks to ensure the integrity and accuracy of the data. This could involve checking for completeness, consistency, and adherence to data standards.
7. Data Integration: After validation, the incoming data may need to be integrated with existing datasets within the Data Management System. This could involve merging data from different sources, resolving conflicts, and updating existing records.
8. Metadata Management: Metadata, which provides information about the data (e.g., its source, format, semantics), should be managed effectively within the Data Management System. This helps users understand and interpret the data accurately.
9. Data Quality Assurance: Regular monitoring and quality assurance processes should be in place to ensure the ongoing quality and reliability of the data within the national Data Management System. This could involve data profiling, anomaly detection, and data cleansing activities.
10. Access and Sharing: Once the data is successfully ingested into the Data Management System, appropriate access controls should be enforced to regulate who can access the data and under what conditions. Additionally, mechanisms for sharing data with authorized users or external stakeholders should be established.

By following these steps, organizations can effectively deliver data to a national Data Management System, ensuring that it's accurate, secure, and compliant with relevant standards and regulations.

Discovery and descriptive metadata management

Discovery and descriptive metadata management are crucial aspects of effective data management within any system, including a national Data Management System. Here's an overview of what this entail:

Effective management of discovery and descriptive metadata involves:

1. Establishing standards and guidelines for metadata creation, ensuring consistency and interoperability.
2. Providing tools and interfaces for metadata entry, editing, and validation.
3. Integrating metadata management functionalities into the Data Management System's user interface and search capabilities.
4. Implementing metadata repositories or catalogs to store and organize metadata records efficiently.
5. Regularly updating and maintaining metadata to reflect changes in datasets and ensure accuracy and relevance.
6. Training users on the importance of metadata and how to create and use it effectively.

By managing discovery and descriptive metadata effectively, organizations can enhance data discoverability, understandability, and usability within the national Data Management System, ultimately maximizing its value for users and stakeholders.

Monitoring of data, processing and services

Monitoring of data, processing, and services is a critical aspect of maintaining the efficiency, reliability, and security of any system, particularly in the realm of information technology (IT) and data management.

Key considerations and approaches to effective monitoring:

1. Real-time Monitoring:
   Implement systems that continuously monitor data flows, processing activities, and service availability in real-time. Real-time monitoring helps detect anomalies, identify bottlenecks, and respond promptly to any issues that may arise.

2. Performance Monitoring:
   Keep track of the performance metrics of data processing pipelines, database queries, and service response times. Monitoring performance metrics helps in optimizing resource utilization, improving efficiency, and ensuring timely delivery of services.

3. Alerting Mechanisms:
   Set up alerting mechanisms to notify relevant stakeholders when predefined thresholds or conditions are met. Alerts can be configured for various scenarios such as system failures, abnormal data patterns, or security breaches, enabling quick intervention and resolution.

4. Logging and Auditing:
   Implement comprehensive logging mechanisms to capture detailed records of data transactions, processing steps, and service interactions. Logging facilitates troubleshooting, forensic analysis, and compliance with regulatory requirements.

5. Security Monitoring:
   Employ security monitoring tools and techniques to detect and respond to potential security threats, unauthorized access attempts, or data breaches. Security monitoring involves monitoring network traffic, access logs, and system activity for suspicious patterns or anomalies.

6. Capacity Planning: Monitor resource utilization and capacity trends to anticipate future requirements and plan for scalability. Capacity planning involves analyzing historical data, forecasting growth patterns, and provisioning resources accordingly to ensure optimal performance and scalability of systems and services.

7. Compliance Monitoring: Implement monitoring controls to ensure compliance with regulatory standards, industry best practices, and organizational policies. Compliance monitoring involves regular audits, assessments, and documentation of adherence to applicable requirements.

8. Service Level Agreement (SLA) Monitoring: Monitor service levels against predefined SLAs to ensure that service commitments are met. SLA monitoring involves tracking key performance indicators (KPIs) such as uptime, response time, and availability, and taking corrective actions if SLAs are not being met.

9. Data Quality Monitoring: Monitor data quality metrics such as accuracy, completeness, and consistency to ensure that data remains reliable and fit for use. Data quality monitoring involves profiling data, identifying discrepancies, and implementing data cleansing or validation processes as needed.

10. Continuous Improvement: Continuously review and refine monitoring processes and tools based on feedback, lessons learned, and changing requirements. Continuous improvement ensures that monitoring capabilities remain effective and aligned with evolving business needs and technological advancements.

3.4. Environmental and sustainability considerations

Integrating environmental and sustainability principles into the design and advancement of national networks in Suriname is crucial to meeting Global Basic Observing Network (GBON) requirements. To achieve GBON compliance while upholding environmental sustainability in the procurement of measurement instruments and equipment, it is essential to adopt pragmatic approaches that balance technical performance, cost-effectiveness, and environmental responsibility.

The MDS will include the following recommendations:

a. Development and use of specifications that consider environmental sustainability for procurement of measurement instrument equipment to meet the GBON requirements

- Prioritize equipment with low energy use, minimal hazardous materials, and eco-friendly packaging.
- Select equipment with energy-saving features and low energy consumption.
- Opt for durable, long-lasting equipment and responsible materials.

- Require recyclable or biodegradable packaging and recycling programs for equipment disposal.
- Source locally to reduce transportation emissions and support the local economy.
- Include environmental criteria in supplier selection and conduct audits for compliance.
- Train procurement teams on sustainable practices and encourage suppliers to adopt eco-friendly practices.
- Track environmental impact metrics in procurement reports and require environmental impact documentation from suppliers.
- Regularly update procurement specifications to incorporate new sustainability practices and gather feedback on environmental performance for refinement.

b. Integration of sustainability considerations for the management of operations of GBON stations, including installation, calibration, and maintenance. To ensure environmentally responsible management of GBON stations in Suriname, sustainability should be integrated throughout their lifecycle. Here are the key approaches:

- Sustainable Installation:
  - Site Selection: Minimize environmental disruption and use locally sourced materials.
  - Renewable Energy: Install solar panels or wind turbines and include energy storage systems.
- Eco-Friendly Calibration and Maintenance:
  - Use remote technologies and data-driven maintenance.
  - Use drones for inspections and environmentally safe cleaning agents.
- Training and Capacity Building:
  - Educate technicians on sustainability practices and engage local communities.
- Monitoring and Continuous Improvement:
  - Regularly assess environmental impact and conduct sustainability audits.
- Community and Stakeholder Engagement:
  - Involve communities in planning and operations and ensure transparency in reporting.

c. Careful material selection for the development, shipping and day-to-day operations of GBON stations, with a focus on developing and using reusable instruments and sustainable methods of observation (e.g., elimination of single-use plastics). To align GBON stations in Suriname with environmental and sustainability goals, MDS can:

- Use eco-friendly, non-toxic, and recyclable materials.
- Utilize sustainable packaging and optimize logistics.
- Reduce single-use plastics and use renewable-powered equipment.
- Invest in durable, maintainable, and upgradable instruments made from eco-friendly materials.
- Segregate and recycle waste.
- Train staff on sustainable practices and involve local communities (involve local communities in sustainability initiatives at GBON stations, such as recycling programs on the importance of environmental stewardship)
- Track and report on material usage and environmental impact for improvement.

These actions will ensure that GBON stations are operationally effective and aligned with environmental sustainability objectives.

Module 4. GBON Human Capacity Development

4.1. Assessment of human capacity gaps

The Meteorological Service (MDS) in Suriname faces a major challenge in retaining highly educated staff. Many Surinamese leave the country for study or work, resulting in a lack of personnel and difficulties in operating and developing processes. To ensure the MDS can continue to function sustainably, staff retention must be addressed. Staff issues also have to deal with good payment to keep the educated staff in place.

As a result of staff changes, basic training needs to be repeated more often, so it is essential to provide effective knowledge transfer to new staff members and to offer advanced-level training to those who have mastered the basics, including IT, programming, server administration, and forecasting.

The MDS must build its capacity through training and cooperation with other World Meteorological Organization (WMO) members. At the moment only one person is qualified with the WMO BIP-MT, although WMO has updated Basic Instruction Package (BIP-MT 2022) not any of the personnel is not yet qualified.

Regular training activities should be conducted to create a professional and technical workforce that has access to new skills and is capable of taking advantage of advances in meteorology, particularly in information technology, modeling, and forecasting. This is a significant challenge, but it is essential to ensure that the MDS stays modern and effective.

The MDS has developed a Competency-Based Framework (CBF) for Meteorology Officers, but it does not meet all the WMO Guidelines for Education and Training of Personnel in Meteorology and Operational Hydrology (WMO-No.258) requirements for Public Weather Services (PWS) personnel. The University of Applied Sciences has implemented the WMO guidelines in Meteorology and Hydrology modules.

Table 10. Assessment Human capacity MDS

SI	Position	Education level	Current capacity	Number Employees/Gender balance (F/M)	Gap and challenges
1	Management	Diploma/ Certification High Professional Education	Training in the field of competency assessment of the Technicians and Observers, involve in impact-based forecast and modelling through national and international workshops and seminars. Training in basic Management skills	6 (2/4)	**Skill Gap:** A lack of university-trained executives can lead to a skill gap, especially in areas requiring specialized knowledge like meteorology. This can impact the agency's ability to make accurate forecasts, conduct research, and implement advanced technologies. **Leadership Gap:** Effective leadership is crucial in scientific organizations. The manager with a strong educational and research background is necessary.
2	Supervisor/ Technical Staff	Diploma/Certification in Secondary Vocational Education and High Professional Education	The Jr and Sr Meteorological Technicians are mostly involved in observations and basic forecasting, data Collection and dissemination, data sharing and key entry and operation of stations in the field. There are employees in some units that are professionally trained and some are not certified.	29 (18/11)	There is limited staff, placing a heavy workload on technicians. This can lead to burnout and affect the overall efficiency and accuracy of the office's output. This required for Training professionals on ICT, in forecasting and modelling. By investing in training, new technology, and

					collaboration, the field can continue to advance and meet the growing demands placed on it by a changing world.
3	Admin staff	Diploma/ Certification Secondary Vocational Education and Primary school	plays a critical role in helping organizations achieve efficiently and effectively. Maintains office services by organizing office operations and procedures, preparing payroll, controlling correspondence, designing filing systems, reviewing and approving supply requisitions, and assigning and monitoring clerical functions.	10 (6/4)	Lack of comprehensive understanding of their organization's workings and no optimal interacting with various departments and levels of management. They must be adept at prioritizing tasks from different departments or executives, which can sometimes lead to conflicts or overwhelming workloads. The need to stay updated with the latest office technologies and software can be daunting and requires continuous learning and adaptation.

Successful and sustainable development of human capacity within an organization is dependent upon three main components: the individual, the organization, and the availability of training opportunities. To ensure that an organization's workforce is equipped with the necessary skills and knowledge to effectively carry out its objectives, each of these components must be given due consideration.

Firstly, the individual's capabilities, competencies, and potential for growth must be assessed and developed. This can include identifying areas for improvement, developing a personalized plan for professional development, and providing opportunities for skill-building and training.

Secondly, the organization must foster a culture of learning and development to support the

growth and success of its employees. This can include providing a supportive work environment, promoting a culture of collaboration and knowledge-sharing, and offering incentives for continued education and training.
Finally, the availability of training opportunities is crucial for ensuring that individuals have access to the resources they need to develop their skills and knowledge. This can include classroom training, online courses, mentorship programs, and on-the-job training.

Table 11. Human capacity on different organization levels

	Institutional capacity	**Capacity building**	**Impact**
The Ministry of Public Works	Increasing or enhancing the capacity of institutions to perform their functions. The ministry must pay special attention to developing systems and structures in both departments that are necessary to function effectively, work on sustainability and achieve the goals.	The connections and coordination between individuals and organizations harmonizes and provides opportunities for exchange and advancement of a high-quality system that supports.	Identifying a communications strategy, improving staff recruitment, ensuring thoughtful leadership succession, updating technology or improving the way results are measured
Organisation (MDS)	Make effective and responsible use of those capabilities in pursuit of common objectives between heads, supervisors and staff. Sufficiently staff, support and maintain these capabilities throughout their work cycle.	Program wise strengthening the institutional and financial domain. Works sustainably by following institutionalized processes and creating a new generation of competent personnel through training and interactive workshops (national and international).	Efficient and effective planning and management. Improves or develops systems and structures necessary to function effectively and work towards sustainability and to achieve the goals.
Individual	Ultimately, improved knowledge, skills, resources and working conditions at both the individual and institutional levels lead to better performance of key initiatives across a wide range of sectors and issues.	Strengthening the capacity of individuals within the organization through a blended training strategy. Implements and provides leadership at all stages of the strategic design process.	Individual skills and confidence

Communication: *There is not enough communication both horizontally and vertically. Poor communication often leads to less job satisfaction and demotivation*
Quality: *quality can be recognized when everyone feels responsible for achieving an outcome that corresponds to the intended result. The efficiency and productivity are not yet to the satisfaction of the directorate/ministry. Also a shortage of qualified staff.*
Process: *a well-managed process is important for the organization. Not everyone masters the processes on the work floor. The division of labor is not understood by everyone.*
Regulations, rules and procedures: *people often do not adhere to them, which causes friction among themselves. Units are closed during a shift, which does not promote the continuity of the departments.*
Commitment, responsibility and involvement*: the values and objectives are not taken seriously.*
Improvement: the working environment, employment conditions, team building, recognition, appreciation, varied and challenging work, the social aspect of work, responsibility, learning and career opportunities

Learning is a self-driven process. Each staff member is responsible for their learning results. Motivation, attitude, preparedness, and undistracted participation in training events are key factors in achieving sustainable learning results.

The organizational culture and management support ensure the competence of staff members and facilitate the development of the organization. The organization must determine necessary competence and have an internal development process to support the quality management system.

The management must ensure staff members can participate in training events. Training opportunities depend on the internal development process, annual planning, and access to external training. Equal access to training events must be ensured, regardless of gender, age or position.

Operational and Financial Plan for Staff Capacity Contribution

The operational and financial strategy designed to enhance MDS's staff capacity for supporting the ongoing operations of newly established or rehabilitated GBON stations encompasses the following key components:

1. Recruitment and Training:
   - Recruitment: MDS will initiate a targeted recruitment campaign aimed at hiring additional meteorologists, technicians, and IT specialists to oversee the extended GBON network.
   - Training: MDS will invest in capacity-building initiatives through collaborative efforts with regional partners, such as KNMI, CIMH, and WMO. These endeavors will focus on areas including calibration, remote sensing, and data management. The training programs will be bolstered by financial support from international donors (SOFF, UNDP, KNMI) and public-private partnerships.

2. Collaboration with External Experts:
   - MDS will foster technical partnerships with CIMH, KNMI, and other regional institutions to address critical skill gaps, particularly in the realms of calibration and maintenance, until internal capacity is established.

3. Financial Planning:
   - Budget Allocation: A portion of the funds from GBON-related investments will be earmarked for staff training and capacity building.
   - Sustainability Planning: The financial framework will encompass provisions for ensuring the long-term sustainability of human resources through mechanisms such as salary increments, retention schemes, and continuous training.

4. Partnerships:
   - Public-Private Partnerships: MDS will engage private sector entities, including the State Oil Company and aviation partners, to secure additional resources for staff capacity building, encompassing technical support and operational funding.

This integrated operational and financial approach will ensure that MDS can develop the necessary human capacity to maintain and operate GBON stations efficiently.

4.2. Design capacity development activities for technical staff

The training needs have already been described in the previous paragraph.

Recommendation on training activities and recruitment for technical staff:

a. Instrument and station maintenance at the site;

The technical staff have undergone adequate training on the maintenance of various types of sensors. The team benefits from the Standard Operating Procedures (SOPs) for all instruments and competency requirements shared during the training and at the site of the maintenance. In addition, a group of technical staff is trained to operate and maintain the upper-air system throughout its lifecycle when required. As the measurements will be taken twice daily, it is imperative to train additional employees in the measurement technique to ensure accurate results.

b. Calibration and maintenance at the workshop;

The MDS (Meteorological Data System) is responsible for ensuring that meteorological observation sensors are calibrated accurately. This requires the establishment of a calibration laboratory, providing training and support to technical staff, and a thorough understanding of the concept of quality through calibration. It is crucial that calibration information is integrated into the value chain of observation to ensure its proper use. Senior staff must be capable of analyzing calibration results to support lifecycle and maintenance planning.

c. Network monitoring

Ensuring the regular upgrading of personnel responsible for network monitoring is crucial for maintaining the efficiency, security, and reliability of the network infrastructure. The World Meteorological Organization (WMO) often introduce modifications that could include updates to data formats, communication protocols, security standards, and reporting requirements. In order to remain compliant with evolving standards and practices and to keep pace with these changes, organizations must direct their investment to these areas. This investment will guarantee that network monitoring teams are well-equipped to adapt to and comply with evolving standards and practices.

d. ICT system operations

It is essential to enhance the proficiency of ICT operators to ensure uninterrupted and seamless data collection from local stations to global distribution centers. As the data collection and distribution process operate continuously in today's interconnected world, it is crucial for operators to possess technical skills and adaptability to novel technologies and methodologies as they emerge.

4.3. Design capacity development activities for senior management

Designing capacity development activities for senior management involves a strategic approach to enhance their skills, knowledge, and competencies, enabling them to lead effectively in a rapidly changing business environment. Training activities should focus on areas critical for strategic decision-making, leadership, technological adaptation, financial planning and project management.

a. **Strategic and financial planning**

Developing strategic and financial planning for senior management is a crucial aspect of aligning organizational goals with financial resources, ensuring sustainable growth, and mitigating risks. The first step in this process entails establishing clear and measurable strategic objectives that align with the organization's mission and vision. Comprehensive analysis of historical financial statements, including income statements, balance sheets, and cash flow statements, is vital to gain insights into past performance and identify trends.

Senior management must identify and evaluate potential risks that could hinder the attainment of strategic and financial objectives. Additionally, it is critical to establish mechanisms for collecting feedback from stakeholders and incorporating this feedback into strategic decision-making processes. It is essential to understand that strategic and financial planning is an iterative process that necessitates flexibility and agility to respond to changing internal and external conditions.

By developing a comprehensive strategic and financial planning framework, senior management can guide the organization effectively towards its long-term objectives while ensuring financial sustainability and resilience in the face of challenges and opportunities. This approach provides a solid foundation for senior management to make sound financial decisions and effectively manage risks.

b. **Project management**

Project management for senior management involves overseeing and guiding the strategic direction and execution of projects within an organization. Senior managers are responsible for setting project priorities, allocating resources, and ensuring that projects align with the organization's goals. By adopting this approach to project management, senior management can effectively oversee and guide projects to successful outcomes, ensuring alignment with organizational goals and maximizing value delivery.

4.4. Gender and CSOs considerations

In the context of the Systematic Observation Financial Facility (SOFF) of the World Meteorological Organization (WMO), it's crucial to integrate gender considerations and recognize the roles and needs of both men and women. Gender considerations can be incorporated into the SOFF program, particularly concerning CSOs involved in systematic observation initiatives.

Incorporating gender considerations and recognizing the role of CSOs, within the Systematic Observations Financing Facility (SOFF) of the World Meteorological Organization (WMO) is essential for ensuring inclusivity and effectiveness.

The impact of climate change and extreme weather events is not gender-neutral, as it affects women, girls, men, and boys differently due to socioeconomic circumstances, cultural beliefs, or traditions that can contribute to inequality. Women, in particular, are often placed in situations of disadvantage during disasters. Therefore, it is essential to include those who are likely to be the most affected by crises in the preparedness process. This necessitates equal access on political, social, and economic levels and the ability to participate in decision-making.

In addition to being fair, engaging the entire population in climate change adaptation and resilience building has substantial evidence that shows women are often the most resilient members of society and the powerful agents of change in the event of a disaster. Women have historic coping mechanisms that can be useful when designing and tailoring local grassroots level early warning systems or other climate change adaptation services and activities.

Directly involving women in designing hydrometeorological and climate services leads to saving lives and livelihoods, as the needs of different groups have been better identified. Therefore, it is crucial to recognize the gendered aspect of climate change and extreme weather events and take appropriate steps to ensure that women are included in the decision-making process. This approach will not only address the inequality but also harness the potential of women in building resilient communities.

Encouraging the involvement of CSOs is essential. Suriname has a Red Cross Society (SRK) where MDS established collaborations with. A further recommendation is to enhance cooperation with the Ministry of Health, acknowledging the growing concern over weather related health phenomena in Suriname. This collaborative approach will ensure a more inclusive and comprehensive response to the challenges posed by weather and climate variability.

Recommendations in activities, consultations, and areas of collaboration for the implementation of the Plan to ensure active CSOs participation and promotion of gender balance and gender opportunities

1.Activities

Gender-Sensitive Capacity Building:

Provide capacity-building sessions for Civil Society Organizations (CSOs) that focus on gender-sensitive approaches to their work, including data collection, project implementation, and advocacy.

Joint Project Implementation:

Promote projects that require the joint effort of multiple CSOs and encourage gender balance in team composition and leadership roles.

Awareness Campaigns:

Initiate awareness campaigns that emphasize the significance of gender balance and inclusion in environmental and meteorological efforts, highlighting the contributions of women and underrepresented groups.

Innovation Challenges:

Organize innovation challenges or hackathons that encourage CSOs to develop solutions that address gender-specific challenges in the field of systematic observations and climate services.

2.Consultations:

Stakeholder Meetings:
Hold regular stakeholder meetings with CSOs, local communities, and gender experts to discuss progress, challenges, and opportunities for improving gender balance.

Feedback Surveys:
Conduct surveys among CSOs and community members to gather feedback on the effectiveness of gender integration strategies within the Plan and to identify areas for improvement.

Policy Roundtables:
Facilitate roundtable discussions with policymakers, CSOs, and gender advocates to ensure that policies supporting systematic observations and related activities are gender-responsive.

Gender Impact Assessments:
Conduct gender impact assessments for projects under the Plan, involving CSOs in the process to ensure that both men's and women's needs are taken into consideration.

3.Areas of Collaboration:

Partnerships with Gender-focused Organizations:
Establish partnerships with organizations that specialize in gender equality to provide expertise and support for integrating gender considerations into CSO activities.

Collaborative Research:
Engage in collaborative research efforts with academic institutions, CSOs, and gender experts to study the impacts of climate change and environmental policies on different genders.

Data Sharing and Best Practices:
Create platforms for CSOs to share data, best practices, and lessons learned regarding the promotion of gender balance in environmental and meteorological efforts.

Advocacy Networks:
Form advocacy networks that include CSOs, gender equality organizations, and other stakeholders to lobby for policies and programs that support gender balance and opportunities in environmental and climate-related fields.

Implementation Strategy:

Gender Action Plan:
Develop a comprehensive gender action plan within the overall Plan, detailing specific activities, targets, and timelines for achieving gender balance and enhancing gender opportunities.

Resources:
Allocate dedicated resources, including funding and training materials, specifically for gender-related activities and initiatives within CSO projects.

Monitoring and Evaluation:
Establish robust M&E frameworks that include gender-sensitive indicators to track progress toward achieving gender balance and identifying areas for improvement.

Regular Reporting:
Require CSOs to submit regular reports on gender-related outcomes and experiences, using this information to continually adapt and improve the Plan's implementation.

By implementing these recommendations, the Plan can ensure that CSOs are not only active participants in its activities but are also champions of gender balance and opportunities, leading to more inclusive and effective outcomes.

Recommendations for MDS on CSO Engagement and Gender Balance in the SOFF Plan Implementation

To enhance CSO participation and promote gender balance in the SOFF Plan and gender opportunities, MDS should consider the following:

1. Gender Inclusion in SOFF Activities

- Consultations on Gender Balance: Engage gender-focused CSOs to identify the challenges that women encounter in the fields of meteorology and technology. Formulate policies aimed at augmenting female participation in GBON activities.
- Implementation of Gender Quotas: Ensure that women constitute a minimum of 50% of participants in SOFF-funded trainings, workshops, and decision-making roles, under the SOFF Gender Assessment Guidance.

2. CSO Roles Beyond Gender Inclusion

- Community Engagement: Foster collaboration with CSOs to heighten awareness regarding the benefits of GBON, particularly in underserved areas, and garner community input on station placement and operation.
- Station Safeguarding: Galvanize communities through CSOs to protect stations from theft or vandalism.
- Environmental Stewardship: Advocate for sustainability by encouraging CSOs to promote the use of renewable energy and environmentally friendly station installations.
- Training and Capacity Building: Empower CSOs to train communities in basic station maintenance, thereby supporting MDS operations.
- Inclusive Participation: Engage CSOs with expertise in vulnerable groups to ensure that all communities have access to GBON data.

3. Additional Areas of Collaboration

- Public Awareness Campaigns: Collaborate with CSOs to heighten awareness regarding climate change, weather risks, and the role of GBON in providing real-time data.
- Feedback Mechanisms: Establish channels for community feedback through CSOs to

enhance transparency and accountability in GBON projects.
- Gender-Sensitive Data: Gather gender-disaggregated data to comprehend how men and women interact with meteorological services differently.

4. Capacity Building for CSOs
- Provide training on the technical aspects of meteorology and GBON operations to enhance the contributions of CSOs to community education and MDS activities.

By undertaking these measures, MDS can ensure that CSOs not only advocate for gender balance but also actively contribute to the operational success and sustainability of the GBON stations through initiatives focused on community engagement, safeguarding, and capacity building.

Module 5. Risk Management Framework

5.1 Assess the risks of the observing network and propose mitigation measures

The World Meteorological Organization (WMO) has formulated two pivotal programs, namely the Global Basic Observing Network (GBON) and the Systematic Observations Financing Facility (SOFF), aimed at augmenting the accessibility of fundamental weather and climate observations across the globe. These initiatives assume an indispensable role in enhancing the precision of forecasts and fostering the resilience of societies against weather-related calamities. Nevertheless, operational risks could impede such networks' efficacy and sustainability.

To ensure that the needs of customers and end-users are met, the MDS established a Quality Management System (QMS) for Air Navigation (WMO no. 1100). Although the certification had expired in 2018 due to insufficient funding, the personnel still work according to the QMS procedures. To effectively manage and mitigate operational risks within the different units of a meteorological observing network. It is crucial to adopt tailored approaches for each. The MDS is in the process to develop Standard Operating Procedures (SOPs) to effectively manage and mitigate operational risks within the different units of the MDS, —namely the Instrument Maintenance Unit, the Climatological Unit, and the Synoptic Unit—it is crucial to adopt tailored approaches for each.

During the Investment phase of the SOFF implementation, the risk mitigation procedures of the Implementing Entity (IE) will be relied upon, whereas the beneficiary's risk mitigation procedures will support the Operational phase.

The following table summarizes the key risks for investment and operation phase to be carefully considered and handled by IE (UNDP), beneficiary (MDS), and peer adviser (KNMI).

Table 12: Overview of identified risk related to GBON implementation in Suriname

Identification and analysis of operational risks	**Mitigating measures and responsible**	**Monitor and evaluation**	**Risk analysis High, Moderate, Low**
Investment phase The investment phase of the SOFF project carries significant risks that can affect its success and sustainability. However, by identifying and proactively addressing these risks through comprehensive planning, robust financial management, and effective stakeholder engagement, the project can significantly improve the availability and quality of meteorological and climate observations nationwide. This, in turn, will enhance resilience to climate variability and change and provide better protection against their adverse effects.			
Financial Risk The primary risk during the investment phase is financial instability or insufficiency. This risk could stem from fluctuating currency values,	To ensure financial stability, diversify funding sources. Obtain funding from governments, private sector, and international organizations. Develop a	To identify financial risks, create a list including budget overruns, funding cuts, currency fluctuations, and unexpected expenses.	Moderate

changes in donor funding levels, or unforeseen costs.	flexible financial plan and conduct regular audits to ensure efficient fund utilization and budget adjustment.	Use financial management software to track expenditures and revenues, and develop real-time financial dashboards to monitor key metrics and potential risks.	
Technological Risk Implementing new technologies across diverse and sometimes remote areas can lead to issues with interoperability, suitability, and maintenance.	Conduct pilot tests before implementing new technologies. Ensure comprehensive support agreements and warranties from suppliers. Invest in local training programs to ensure staff can operate and maintain new technologies effectively.	Identify technological risks, such as hardware failure, software bugs, data corruption, and poor system performance. Evaluate their likelihood and impact. Monitor performance metrics using dashboards in real-time. Schedule regular reviews to assess efficiency and effectiveness. Collect feedback on performance and usability.	Moderate
Political and Regulatory Risks **Risk Description:** Changes in local or national policies, regulatory environments, or political instability can affect project implementation.	It is imperative to engage with stakeholders, including local government officials, regularly to ensure that project goals are aligned and supported. Furthermore, it is necessary to continuously analyze the regulatory environment in participating countries and be prepared to adapt to changes. Contingency plans should be developed to address potential political disruptions.	To manage risks effectively, identify potential factors, such as regulation changes, government priorities, political instability, and compliance requirements. Monitor relevant laws and policies and establish real-time alert systems for potential impacts. Professional and ethical lobbying and advocacy efforts can ensure project compliance and support.	High
Partnership and Collaboration Risks Reliance on multiple partners can introduce risks related to	It is imperative to establish clear contracts and memorandums of understanding (MOUs) with	To ensure a successful partnership, set clear goals and responsibilities for each partner.	Low

coordination and alignment of goals and processes.	all partners to define roles, responsibilities, and expectations. Regular meetings with all stakeholders should be conducted to ensure ongoing alignment and to address any issues promptly. It is also advisable to constitute a dedicated team to manage partnerships and resolve conflicts efficiently.	Maintain regular communication and gather feedback to stay aligned. Review performance to identify issues and areas for improvement. Keep stakeholders informed of updates and risks.	
Operational Efficiency Risk There is a risk that project implementation may not achieve the intended efficiency due to poor management or inadequate planning.	To deliver projects effectively, use established project management methodologies. Develop and monitor KPIs to assess progress and implement feedback mechanisms for continual improvement. Adhering to these practices optimizes project delivery, improves risk management, and enhances operational efficiency. Commit resources and expertise for successful implementation.	Identify inefficiencies in management, e.g., unclear responsibilities, poor communication, weak leadership, and slow decision-making. Develop KPIs to measure efficiency, such as decision turnaround times, meeting productivity, and leadership effectiveness. Collect data on performance, such as project milestones, decisions made, and outcomes. Audit management practices periodically to assess efficiency and identify improvement areas. Ensure clear role definitions within the team to avoid overlapping duties.	Moderate
Operation Phase It involves the actual implementation and day-to-day functioning. In this phase is critical to ensure smooth operations, effective resource management, and the achievement of project objectives.			
Operational and Maintenance Risks Delays in the routine maintenance of GBON stations, technical	Develop a structured maintenance schedule for all stations.	Monthly maintenance logs, quarterly evaluations of station performance, and	Moderate

malfunctions, and lack of technical personnel could disrupt daily operations.	Train MDS staff on basic maintenance and troubleshooting. Establish support agreements with regional institutions like CIMH for more complex repairs.	reporting on repair incidents.	
Financial Sustainability Risks Insufficient funding to maintain operations after initial external funding decreases**.**	Diversify funding sources through private sector partnerships and government budget allocations. Secure long-term commitments through public-private partnerships and grant applications. Implement cost-efficiency strategies to minimize operational expenses.	Annual financial audits, bi-annual funding reviews, and mid-term financial performance assessments.	High
Technological Adaptation Risks Difficulty integrating new technology with existing systems, leading to inefficiencies or data incompatibility**.**	Plan for phased technology upgrades to ensure compatibility. Provide continuous training for staff on the latest technologies and systems integration. Establish a dedicated IT team to oversee tech implementation and maintenance.	Regular system audits and user feedback sessions to identify technology gaps and needs.	Moderate
Data Quality and Management Risks Inconsistent data quality or delayed transmission of meteorological information.	Adopt standardized data collection, transmission, and quality control procedures. Regularly upgrade data management systems (e.g., CLIMSOFT) to ensure compliance with GBON standards.	Monthly data quality reports, annual system performance audits, and GBON compliance checks.	Moderate
Human Capacity Risks Lack of sufficient technical and operational personnel to manage stations and operations effectively.	Prioritize recruitment and retention of skilled meteorologists and technicians.	Quarterly human resource evaluations, training progress reviews, and capacity-building assessments.	Moderate

	Develop a long-term capacity-building plan with training in calibration, maintenance, and data analysis.		
Environmental and Climate Risks Extreme weather events could damage stations or disrupt operations.	Implement preventive measures during installation, such as elevating stations in flood-prone areas. Develop emergency repair protocols and rapid response teams.	Seasonal weather impact assessments, annual climate risk evaluations.	Moderate
Community Engagement and Security Risks Lack of community ownership may lead to station theft or vandalism.	Engage with local CSOs to raise awareness and build community involvement. Establish local community safeguarding initiatives to protect GBON stations.	Quarterly community feedback surveys, security incident logs, and station condition reports.	Low

Module 6. Transition to SOFF investment phase

The transition to SOFF investment phase is recommended to carry out by following the Suriname Gap Analysis, the Suriname Country Hydromet Diagnostics Report and National Contribution plan. **KNMI, UNDP and MDS have not yet been able to complete the funding request for the SOFF implementation phase.**

Summary of GBON National Contribution Plan

Components	Recommended activities
Module 2: GBON Business development and private sector engagement	- The financial status of MDS to carry out GBON compliant operations consists currently of limited governmental budget funding and foreseen financial support from UNDP (IE) for station maintenance. - Most of the funding of MDS is related to international funding projects. - MDSs operations for the aviation weather is not or very limited paid. - MDS is willing in partnering with Government entities, academia as well as with international weather and climate research institutions. - There is room for further enhancing and widen partnerships nationally and internationally.
Module 3: GBON Infrastructure development	- Following WMO and SOFF guidance, MDS will set-up one (1) new AWS station and improve four (4) of its current AWS and one (1) UAS. - Set-up new GBON compliant observation infrastructure, with subsequent WIS2.0 data communication. - Set-up a monitoring and evaluation chain, starting from station operations, communication, calibration, maintenance and data QA/QC (Quality Assessment and Control). This can be through engagement with SOFF, KNMI, other possibly other country NMHS.
Module 4: GBON Capacity Development	- The Meteorological Service (MDS) in Suriname faces a major challenge in retaining highly educated staff. Many Surinamese leave the country for study or work, resulting in a lack of personnel and difficulties in operating and developing processes. To ensure the MDS can continue to function sustainably, staff retention must be addressed. Staff issues also have to deal with good payment to keep the educated staff in place. - The gap in capacity in INMG is in specific job or task related fields, ranging from instrument maintenance, calibration and automated data transfer and handling using the newer WIS2.0 open free and source-based software ICT and data technology. - Also, climate data including quality control requires more human capacity and solutions.

Module 5: Risk Management	- MDS was certified for Quality Management System (QMS) for Air Navigation (WMO no. 1100), but unfortunately expired in 2018 due to insufficient funding. - Certifying again for this quality insurance to its other monitoring operations and staff development in QMS is recommended. - Furthermore: overworked staff because of a shortage of personnel, incompetence of all staff, instrument failures.
Module 6: Transition to GBON Investment phase	- The transition to the Investment phase is recommended to carry out the NGA and NCP (this document). - **NOT YET!! The peer-advisor, IE and beneficiary have together prepared the funding request for the investment phase.**

Annexes

Annex I: Current state of synoptic meteorological stations

Two Synop stations include both manual and AWS stations.

Zanderij INTERNATIONAL AIRPORT – WIGOS ID: 81225			
Lat: 5.27	**Lon:** 55.12	**Elev: 18m**	**Date opening:** 1942
TITLE/EQUIPMENT	**PROBLEMS ENCOUNTERED**	**IMPACTS ON OPERATIONS**	**PROPOSED SOLUTIONS**
Surface Measurement Equipment	- Datalogger/Transmitter: functional - Temperature and humidity sensor: need replacement - Pressure sensor: need replacement - Precipitation sensor: optimal - Wind sensor: optimal - Solar sensor: optimal - Battery: need replacement - Encloser: need replacement	Data not transmitted internationally	No spare parts are on hand to replace malfunctioning sensors, but since this station is also a manned station, conventional instruments are used to measure missing data
Transmission	Data logger does not connect to GTS. Weather data not in table driven format codes.	Weather data not transmitted to GTS weather data not accepted on GTS	Create interface between AWS to an undefined hub. Equip Server with conversion software.
Building	Office accommodation can be better, with proper internet and suitable working place.	Slow internet will slow down the process of forecasting.	Adequately furnish it with basic necessities a good computer and proper internet.
Station Environment	insecure office environment		Provide for office safety measures/facilities.
Work Environment	Office accommodation can be better, with proper internet and suitable working place.	Slow internet will slow down the process of forecasting.	Adequately furnish it with basic necessities a good computer and proper internet.
Human Resources (Staff)	Capacity low on IT based work	Adoption of new work methods low	Periodic Capacity building trainings
Other remarks			
Picture site			

Nickerie AIRPORT – WIGOS ID: 81202			
Lat : 5.57	**Lon : 57.02**	**Elev : 3m**	**Date opening:** 1921
TITLE/EQUIPMENT	**PROBLEMS ENCOUNTERED**	**IMPACTS ON OPERATIONS**	**PROPOSED SOLUTIONS**
Surface Measurement Equipment	- Datalogger/Transmitter: functional - Temperature and humidity sensor: need replacement - Pressure sensor: optimal - Precipitation sensor: optimal - Wind sensor: optimal - Solar sensor: optimal - Battery: need replacement - Encloser: need replacement	Data not transmitted internationally	No spare parts are on hand to replace malfunctioning sensors, but since this station is also a manned station, conventional instruments are used to measure missing data
Transmission	Data logger does not connect to GTS. Weather data not in table driven format codes.	Weather data not transmitted to GTS weather data not accepted on GTS	Create interface between AWS to an undefined hub. Equip Server with conversion software.
Building	Office accommodation can be better, with proper internet and suitable working place.	No internet available	Adequately furnish it with basic necessities a good computer and proper internet.
Station Environment	insecure office environment		Provide for office safety measures/facilities.
Work Environment	Office accommodation can be better, with proper internet connection and suitable working place.	No internet available	Adequately furnish it with basic necessities a good computer and proper internet.
Human Resources (Staff)	Capacity low on IT based work	Adoption of new work methods low	Periodic Capacity building trainings
Other remarks			

Picture site

Annex II: Abbreviation list

AMHS	Automatic Message Handling System
ARS	Automated Rain Station
AWS	Automated Weather Station
CARICOF	Caribbean Climate Outlook Forum
CARICOM	Caribbean Community
CDEMA	Caribbean Disaster Emergency Management Agency
CDMS	Climate Data Management System
CIMH	Caribbean Institute for Meteorology and Hydrology
CMO	Caribbean Meteorological Organization
CREWS	Climate Risk and Early Warning Systems
ECMWF	European Centre for Midterm Weather Forecasting
EU	European Union
GBON	Global Basic Observation Network – WMO
GCCA+	Global Climate Change Alliance
GTS	Global Telecommunication System
ICAO	International Civil Aviation Organization
IE	Implementing Entity
IFR	Investment Phase Funding Request
INMET	Instituto Nacional de Meteorologia Brasil
KNMI	Royal Netherlands Meteorological Institute
MDS	Meteorological Service Suriname
METAR	Meteorological Airport Reports (used for aviation)
MHEWS	Multi Hazard Early Warning Systems
NCCR	National Coordination Centre for Disaster Relief
NMHS	National Meteorological and Hydrological Service
NOAA	National Oceanic and Atmospheric Administration (USA)
NWP	Numerical Weather Prediction
OSCAR	Observing Systems Capability Analysis Reviewing Tool - WMO
OW	Ministry of Public Works Suriname
SIDS	Small Island Development States
SOFF	Systematic Observations Financing Facility

SYNOP	Synoptic coded weather station messages
UN	United Nations
UNDP	United Nations Development Program
WIGOS	WMO Integrated Global Observing System
WIS2	WMO Information System 2.0
WMO	World Meteorological Organization
WMO RIC	World Meteorological Organization Regional Instrument Centre
WLA	Hydraulic Research Division Suriname

Report completion signatures

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Beneficiary Country signature 27-9-24 Dewdath Bhaggoe MBA BTech Deputy Director of Research and Innovation Ministry of Public Works Permanent Representative of Suriname at WMO
WMO Technical Authority signature