29 August 2024

GBON National Gap Analysis

Systematic Observations Financing Facility

Weather and climate data for resilience

WEATHER CLIMATE WATER

Screening of the National Gap Analysis (NGA) of Suriname

WMO Technical Authority screens the GBON National Gap Analysis to ensure consistency with the GBON regulations and provides feedback for revisions as needed. *The screening of the NGA is conducted according to the SOFF Operational Guidance Handbook, version: 04.07.2023 and the provisions in Decision 5.7 of the SOFF Steering Committee.*

Following iterations with peer advisor and beneficiary country, WMO Technical Authority confirms that the National Gap Analysis is consistent with GBON regulations. While the WMO GBON Global Gap Analysis identified the need for 2 surface stations 1 upper air stations over land to meet the GBON horizontal requirement, the **WMO Technical Authority confirms the NGA results which indicate the need for 5 surface land stations and 1 upper station based on specific national circumstances.**

Date: 28 October 2024

Signature:

Albert Fischer

Director, WIGOS Branch, Infrastructure Department, WMO

GBON National Gap Analysis Report
Suriname

Beneficiary Country Focal Point and Institute	Dewdath Bhaggoe MBA BTech Deputy Director of Research and Innovation Ministry of Public Works Permanent Representative of Suriname at WMO
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1. Country information from the GBON Global Gap Analysis

It is within this framework that Suriname has carried out an in-depth diagnosis of the current situation of the observation network, highlighting the state of the stations in terms of territorial coverage, equipment, infrastructure, needs and staff skills.

Suriname, though geographically distinct as a mainland country in South America and not an island, is considered a Small Island Developing State (SIDS) due to its shared challenges with other SIDS. These include vulnerability to climate change, such as sea-level rise and extreme weather, and reliance on a small, undiversified economy. Suriname's geographic isolation, low population density, and limited infrastructure further align it with the developmental challenges faced by island nations. Recognized as part of the SIDS group by the United Nations since the 1992 U.N. Conference on Environment and Development in Rio de Janeiro, Suriname's inclusion underscores its susceptibility to similar environmental and economic challenges. As a SIDS, Suriname gains access to international support for sustainable development, climate adaptation, and economic resilience. Promoting gender equity and supporting Indigenous communities are crucial to achieving sustainable and inclusive growth, strengthening Suriname's ability to address these challenges.

The GBON Global Gap Analysis conducted by WMO in June 2023 (Table I), considering Suriname as SIDS. Suriname is a continental country with a significantly larger size compared to many other SIDS members, the real GBON requirement of internationally shared stations sums up to 16 (high density network). Currently, none of Suriname's surface stations is GBON compliant, but MDS (Meteorologische Dienst Suriname) does operate an upper air station in Paramaribo, although this is not fully GBON compliant at the moment.

As part of the GCCA+ Phase 1 and 2, an UNDP/EU project, a series of Automatic Weather Stations (AWSs) were procured and subsequently installed within the country's borders over a period of five years. The installation works were successfully concluded within the previous

year. A lot of experience and learning process has been established with the technical and logistical capacity, together with the needed know-how, required to operate and maintain a network of such stations. Nevertheless, the financial capacity of the MDS is not sufficient to have for example spare parts for these AWSs.

Considering the current situation, Suriname is able to meet the surface GBON low-resolution targets in a relatively short time and with a relatively minor investment. However, it requires a well-coordinated approach where different projects are leveraged, with SOFF being a critical element of the approach. Moreover, even a full high-resolution compliance could be achieved within reasonable resources and time horizon. The main support from different international projects should include the acquisition of AWSs, proven to function in Suriname, as well as the development of a calibration lab. It should also be noted here that the choice of the location of the current and proposed stations had to take into account that most of the hinterland offers limited access to no access at all as well as potential security issues, especially in the deep south of the country. Hence, currently, it is impossible to have a very homogeneous coverage of the country. Such an activity would not only benefit and serve the neighbouring countries but would also establish a regional perspective leading to overall regional gains.

Suriname operates an upper-air station in Paramaribo. Soundings are conducted twice a week, with an additional session for Ozone measurements once a week. The costs for conducting soundings twice daily to meet the GBON requirements will be significantly higher. This is due to increased consumables, potential staff capacity issues, and the need to conduct soundings during nighttime.

Addition necessary laboratory for calibration could lead to substantial increase in the availability and reliability of the observational data in a sustainable way. 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.

The land area of Suriname is 163,800 square kilometres and the EEZ (Exclusive Economic Zone) is 127,800 square kilometres. 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.

Table I. WMO GBON Global Gap Analysis (June 2023).

A. GBON horizontal resolution requirements	B. Target	C. Reporting (GBON compliant)[1]	D. Gap to improve	E. Gap new	F. Gap total
	[# of stations]				

[1] The rationale for classifying surface and upper-air stations as reporting is based on the WIGOS Data Quality Monitoring System (WDQMS) for the chosen time period (WMO GBON Global Gap analysis, June 2023). Stations with data availability more than 80% on at least 80% of days, are considered as reporting. Other listed stations are counted as having the possibility to be improved.

Surface stations Standard density[2] 200 km	2	0	2	0	2
Upper-air stations over land Standard density[2] 500km	1 (Daily)	0	0	1	1

Meteo Service Suriname (MDS) has registered 9 surface stations in WIGOS OSCAR/Surface (https://oscar.wmo.int/surface/#/search/station#stationSearchResults) of which one station has a GBON affiliation, what is visible in the WIGOS Data Quality Monitoring System (https://wdqms.wmo.int/gbon/land_upper-air/monthly/availability/all/2024-04) Although 9 stations are WIGOS registered, these are not all in use. 5 out of these 9 stations have been in sleeping mode since the internal war in Suriname, and later due to financial constraints.

2. Analysis of existing GBON stations and their status against GBON requirements

Table II. Assessment of existent stations per their operational status and network ownership

GBON Requirements	Existing observation stations (# of stations)			
	NMHS network		Third-party network	
	Reporting (GBON compliant) [3]	To improve	Reporting (GBON compliant) [3]	To improve
Surface land stations Standard density [4] 200km Variables: SLP, T, H, W, P, SD	**0**	**5**	**0**	**0**
Upper-air stations operated from land Horizontal resolution[4]: 500km	**0**	**1 (daily observation)**	**0**	**0**

[2] For SIDS, for the WMO GBON Global Gap Analysis in June 2023, the EEZ area has been added to the total surface area which is the basis for the target number of stations. The standard density requirements for SIDS have been calculated with 500 km for surface stations and 1000 km for upper-air stations.

[3] The rationale for classifying surface and upper-air stations as reporting is based on the WIGOS Data Quality Monitoring System (WDQMS) for the chosen time period during the development of National Gap Analysis Stations with data availability more than 80% on at least 80% of days, are considered as reporting. Other listed stations are counted as having the possibility to be improved.

[4] For SIDS, for the WMO GBON Global Gap Analysis in June 2023, the EEZ area has been added to the total surface area which is the basis for the target number of stations. The standard density requirements for SIDS have been calculated with 500 km for surface stations and 1000 km for upper-air stations.

Vertical resolution: 100m, up to 30 hPa Variables: T, H, W				
Surface marine stations in Exclusive Economic Zones:[7] 500 km Variables: SLP, SST	**0**	**0**	**0**	**0**
Upper-air stations operated in Exclusive Economic Zones:[5] 1000 km Vertical resolution: 100m, up to 30 hPa Variables: T, H, W	**0**	**0**	**0**	**0**

GBON Surface Land Observation Stations

MDS observation network is made up of eight (8) types of stations:

1. Main synoptic weather stations
2. Secondary synoptic weather stations
3. Climatological weather stations
4. Automatic Weather stations
5. Rain gauge stations.
6. Automatic rain gauges.
7. Radar
8. Third party weather stations

[5]Although GBON marine stations and stations in EEZ are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g. SIDS, the status of current marine stations for future GBON marine observations investments.

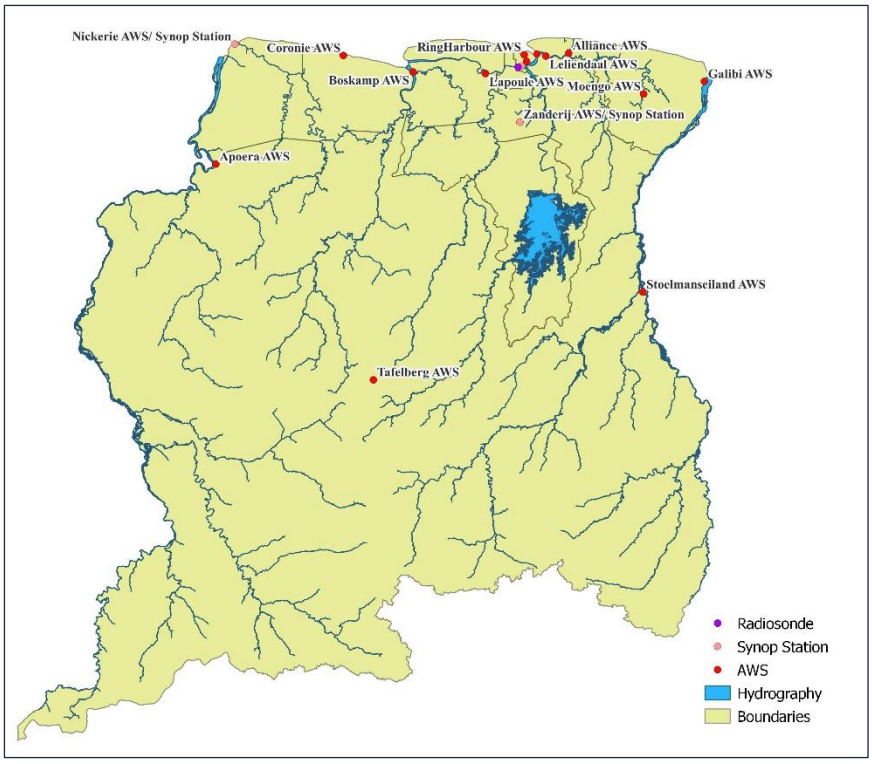


Figure 1. Map with Radiosonde, Synop and AWS network

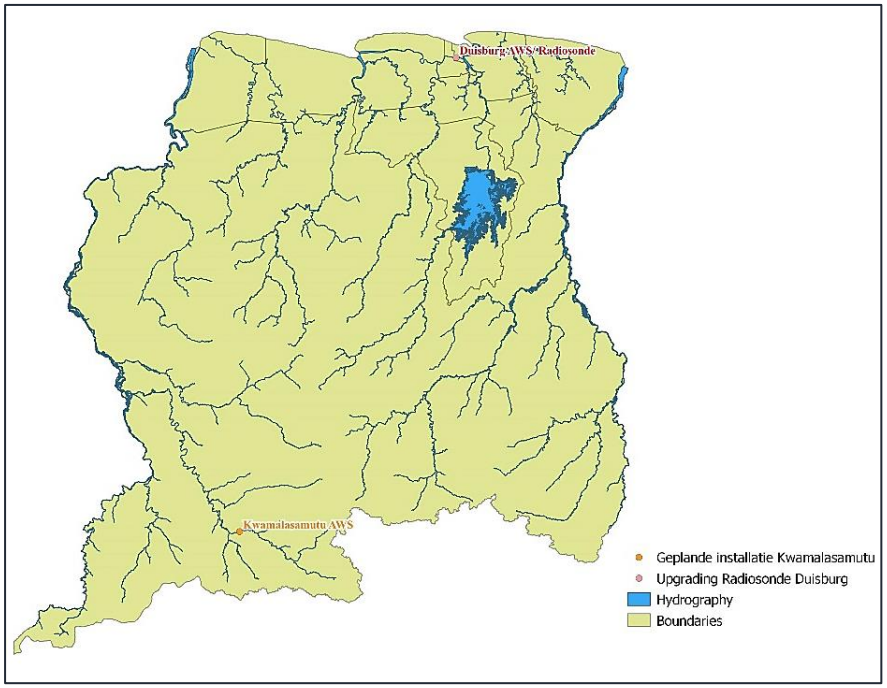


Figure 2. Map with the planned AWS Installation and the location of the upper air observation that needs to be upgraded

1. Main synoptic weather stations

There is one (1) main synoptic weather station at the Johan Adolf Pengel Airport commonly known as Zanderij Airport.

This station operates night and day without interruption (24/24 operation) and observations are made every hour. SYNOP messages are written and transmitted every hour from 00:00UTC to 23:00UTC to the Brasilia Databank, using the Aeronautical Message Handling System (AMHS). Brasília databank is a significant hub for meteorological and aviation data in South America. This databank collects, stores, and disseminates meteorological data from various weather stations across the continent.

2. Secondary synoptic weather stations

There are two (2) secondary synoptic stations: Nickerie and Zorg en Hoop. These stations do not operate continuously and have specific operating hours (16/24 operation), The operating hours are from 08:30UTC – 00:30UTC. However, SYNOP messages are written and transmitted every hour (from 00 to 23), when the station is open via the Aeronautical Message Handling System (AMHS) to the Brasília databank

3. Climatological weather stations

There are three (4) climatological stations: Zanderij, Zorg en Hoop, Cultuurtuin, and Nickerie.

Only station Zanderij operates 24 hours a day (24/24 operation). The other 2 stations operate from 08:30UTC – 00:30UTC (16/24 operation), and the measurements are intended for climatological monitoring of Suriname. The measurements are done at 11:30UTC, 17:30UTC and 18:30UTC

4. Automatic Weather stations

Having seventeen (17) automatic weather stations scattered across the entire country which provides valuable coverage for monitoring meteorological conditions nationwide. The automatic weather stations utilize satellite communication to transmit their data to a centralized system (Hydrometclouds). From there, the Meteorological Service Suriname, receives the real-time data.

5. Rain gauge stations.

Suriname has a total of 42 manual rain gauges that monitor precipitation patterns across the country. Out of these, 18 belong to the Meteorological Service Suriname and 24 to the Civil Aviation of the Ministry of Transport, Communication, and Tourism. This shows a collaborative effort towards comprehensive monitoring of precipitation patterns.

6. Automatic rain gauges.

There are eighteen (18) automated rain gauges, which are strategically placed across various geographical locations. These gauges, known as automatic rain gauges (ARS), are capable of collecting precipitation data and relaying it to the Hydrometclouds through satellite communication systems. The Meteorological office receives this data, but has to pay for the data download.

7. Doppler radar station

MDS operates a Doppler C-band radar at Zanderij airport. The radar is a C-band from Vaisala. At the moment the radar is under service and no images are available.

8. Third-party weather stations

There are other observation networks belonging to third parties that operate in the following areas:

- Anton de Kom University
- Staatsolie - Suriname's National Energy, Oil & Gas Company
- Staatsolie Power Company Suriname N.V. (SPCS)- Hydroelectric Power at Afobaka Lake
- Aeronautics - Gumair
- ILACO N.V. - Consultancy and engineering firms
- Civil Aviation Department- Ministry of Transport, Communication and Tourism

The MDS is currently engaged in a collaborative effort with various parties; however, no official letter of agreement has been executed to date, except for the Civil Aviation Department and Maritime Authorithy Suriname.

Summary of status of the existing stations

Firstly, among the seventeen (17) surface weather stations one (1) operates 24/24 and two (2) meteorological stations operate 16/24. Additionally, the hourly data from these stations is transmitted to the Regional OPMET Data Bank of Brazil in Brasilia. From there, the meteorological data is likely shared internationally through other data banks.

The data reporting internationally on the WDQMS Data Monitoring System is limited and currently not compliant with the GBON (Global Basic Observing Network) standards. This is due to various factors, including technical limitations or resource constraints. The direct transmission of data to the GTS (Global Telecommunication System) is costly.

Finding cost-effective solutions to enhance data reporting compliance and WIS 2.0 supportive could be beneficial in improving the efficiency and reliability of global meteorological data exchange.

The Upper Air station in Paramaribo is in use twice a week instead of twice a day to be GBON compliant. The facilities are available, but the personnel and consumables are not for twice a day.

Variables and frequency of transmission of meteorological parameters:

Secondly, the status of existing stations is analysed in terms of GBON variables and international reporting cycle requirements (Table III). The reporting cycle is assessed per station according to the reporting frequency of once per hour for surface and marine stations and twice per day for upper-air stations. More specific information on the current status of the WIGOS registered SYNOP stations can be found in Annex 1.

Table III. Assessment of existing GBON stations per station characteristics. Station type: S: Surface, UA: Upper-Air; M: Marine; Owner of the station: NMHS or name of third-party; GBON variables: SLP: Atmospheric pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; SD: Snow depth; SST: Sea surface temperature; Reporting cycle: Number of observation reports exchanged internationally per day (0-24); GBON compliance: whether the station is GBON compliant or not (see GBON guide on compliance criteria).

Station name	Station type (S/UA/ M[6])	Owner (NMHS /3rd party)	Funding source	GBON variable measured							Reporting cycle (obs/day)	GBON Compliant (Y/N)
				SLP	T	H	W	P	SD	SST		
SMJP	S	NMHS	Gov	X	X	X	X	X	-	-	24	N
SMZO	S	NMHS	Gov	X	X	X	X	X	-	-	16	N
SMNI	S	NMHS	Gov	X	X	X	X	X	-	-	16	N
SMPA	UA	NMHS	Gov/ KNMI		X	X	X				2/week	N

3. Results of the GBON National Gap Analysis

Table IV. Results of the GBON national gap analysis. SLP: Atmospheric pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; SD: Snow depth; SST: Sea surface temperature**.**

GBON requirements	Global GBON target	Approved national target	Reporting	Gap	
				To improve	New
	[# of stations]				
Surface land stations	2	5	0	4	1
Upper-air stations operated from land	1	1	0	1	0
Surface marine stations in Exclusive Economic Zones:[7] Density 500 km Variables: SLP, SST Observing cycle: 1h	3	0	0	0	0

[6] Please see guidance on marine stations in Section 2 on Scope.
[7] Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g. SIDS, the need for future GBON marine observations investments according to the GBON requirements.

Upper-air stations operated in Exclusive Economic Zones: [8] Density 1000 km Vertical resolution: 100 m, up to 30 hPa Variables: T, H, W Observing cycle: twice a day	1	0	0	0	1

3.1 Recommended existing surface, upper-air and marine[10] stations to be designated to GBON

Table V. Recommended existing surface, upper-air and marine stations to be designated to GBON.

Station name	Station type (S/UA/M[11])
Zanderij Airport	S
Nickerie	S
Paramaribo	UA
Kwamalasamutu	S
Tafelberg	S
Stoelmanseiland	S

[8] Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g. SIDS, the need for future GBON marine observations investments according to the GBON requirements.
[9] Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g., SIDS, the need for future GBON marine observations investments according to the GBON requirements.
[10] Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyze in this step when considered relevant e.g., SIDS, the need for future GBON marine observations investments according to the GBON requirements.
[11] Please see guidance on marine stations in Section 2 on Scope.

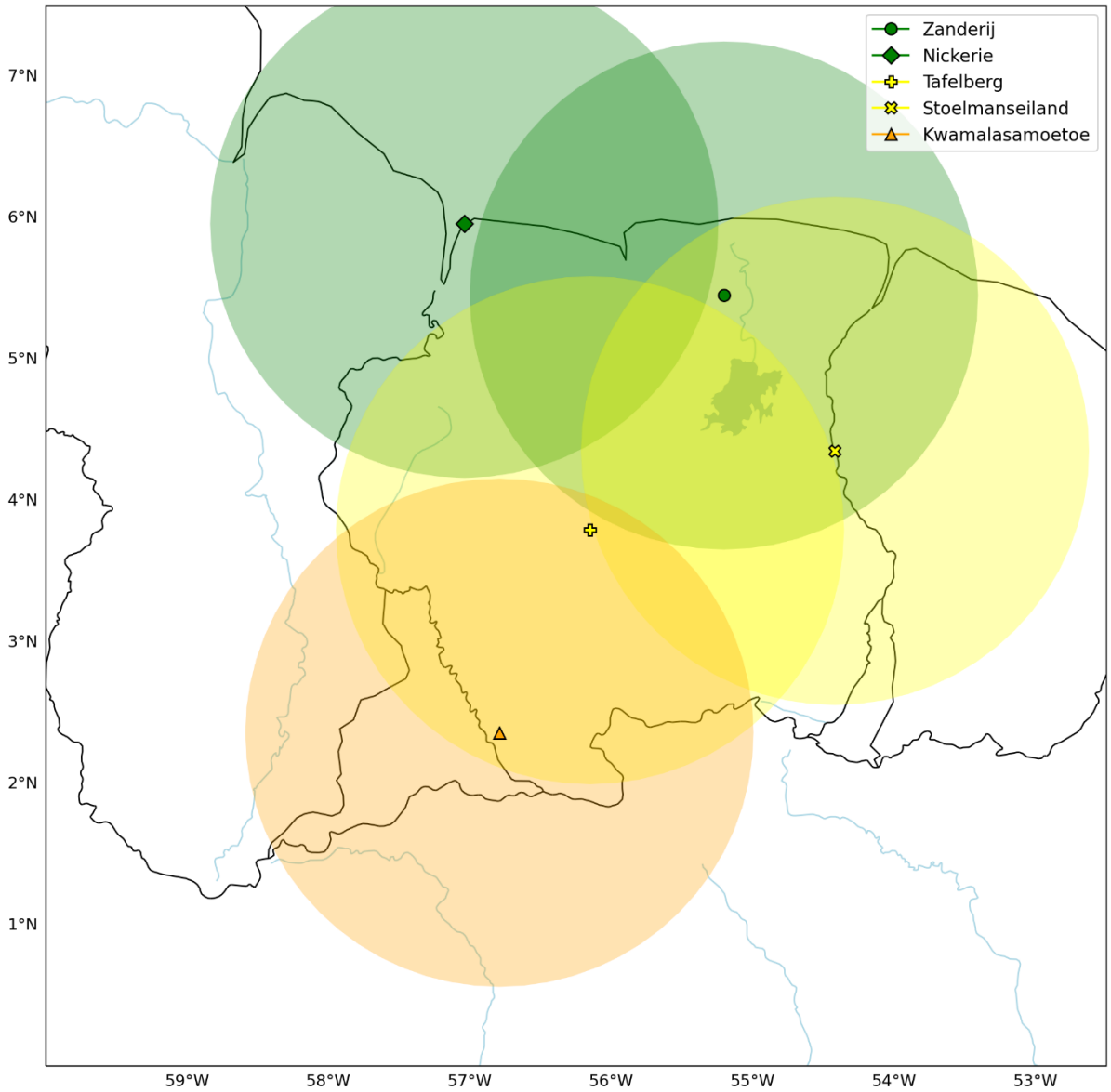


Figure 3. Total of surface stations to be improved and a new station as a result from the Gap Analysis (without Synop station Zorg en Hoop). The stations are with circles of 200 km. With in green the Synop stations, in yellow two sleeping stations. All four (4) stations are ready for improvement. Station five (5) (in orange) is a new station and is needed to cover the South West part of Suriname.

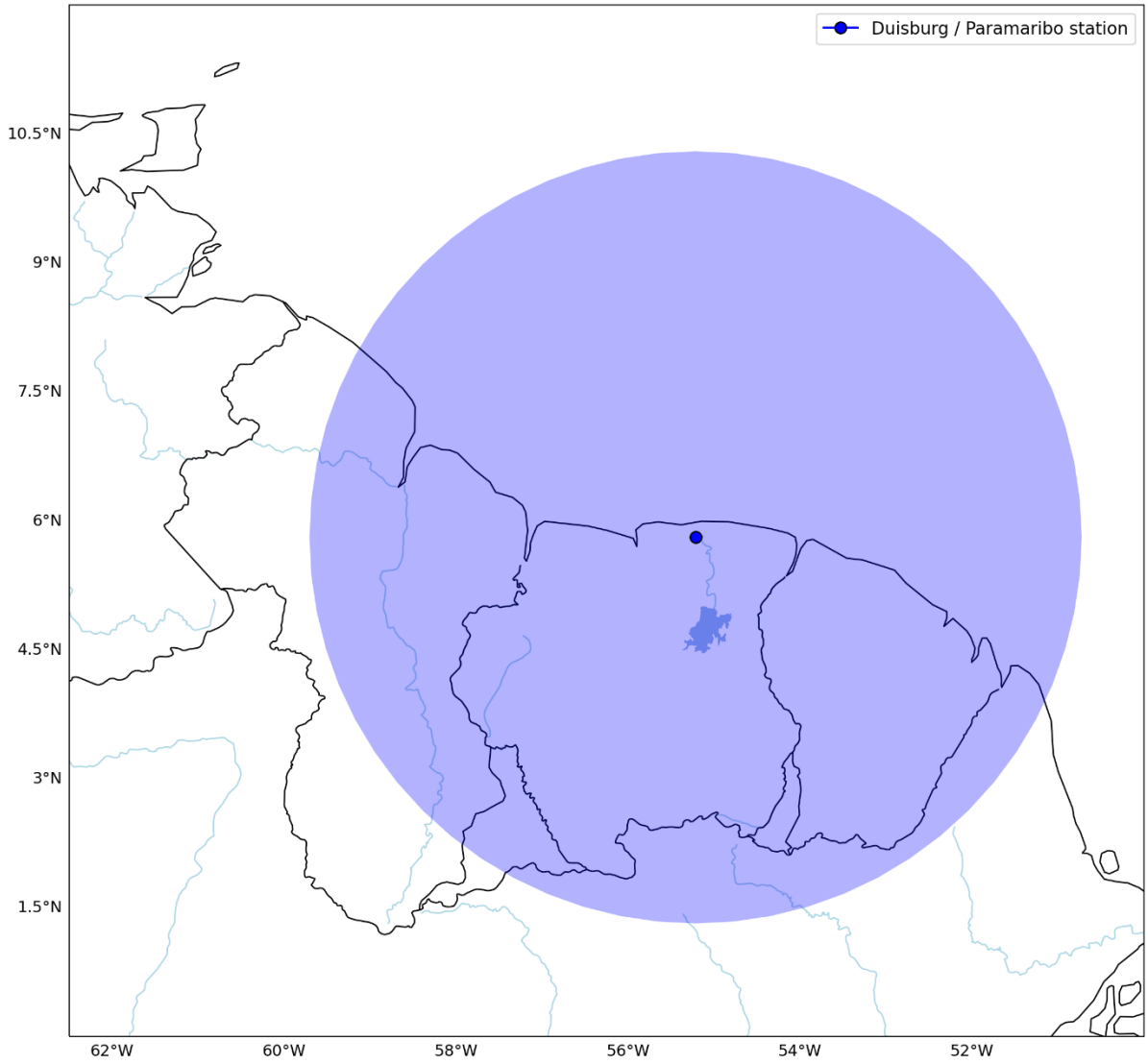


Figure 4. Upper Air Station (Paramaribo/Duisburg) with a circle of 500 km.

A study of the current situation at weather stations revealed the following:

In the northern part of Suriname, the spatial resolution is sufficient, but in the southern part, it is very poor. This is partly due to the long travel distances to the sites, which must be accessed by boat or air. There are also limitations on maintenance time and financial resources. Additionally, traveling to inland locations is not always safe. Adding new stations in the south of Suriname will improve the horizontal spatial resolution to meet GBON standards. In Figure 3. in total five (5) stations are shown of which four (4) are to be improved and one (1) is a set-up of a new station. In green circles the synoptical stations are given, the yellow circles are two sleeping stations. All these 4 stations are ready for improvement. In Figure 3. the orange coloured station is a new station what is needed to cover the South West part of Suriname. The MDS has only one surface station what is partly GBON compliance, however the hourly SYNOP messages are not delivered to GTS or WIS. This station is located at the Johan Adolf Pengel International Airport commonly known as

Zanderij Airport. 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 and Zorg en Hoop do not operate continuously and have specific operating hours (16/24 operation). These 3 stations are synoptical stations with manual and automatic weather stations and observers in place. All these three (3) synoptical stations are of great importance for Suriname as these are in the most dense population area and is of high importance for the city of Paramaribo. Furthermore Zorg en Hoop have also a long historical data set. This station is because of these reasons necessary to keep in good condition. Although it is chosen to be GBON compliant to upgrade only the two Synop stations Zanderij Airport and Nickerie and not to upgrade Zorg en Hoop.
The other 3 stations are Tafelberg, Stoelmanseiland and Kwamalasamutu (the last station is without a WIGOS number yet). All these 3 stations are strategically set in the inland part of Suriname. This area is more difficult to access, but very important to receive meteorological data from. Tafelberg and Stoelmanseiland are sleeping stations, there is an AWS station but MDS is not receiving the 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.

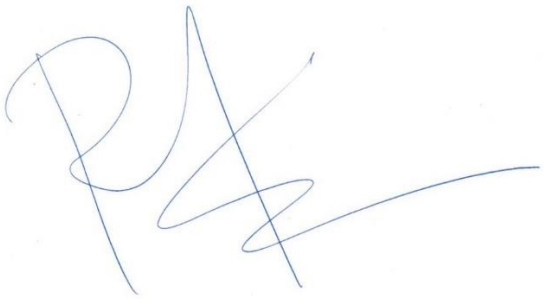
Validation of the data, including comparison of the observations of the manual stations compared to the Automatic Weather Stations would be very useful. Also procedures (SOP) and training would be very helpful to have useful validated data available.

The facilities at the Upper Air Station in Paramaribo are in poor condition because the main MDS building has been newly constructed in a different location. Additionally, there is a lack of a reliable internet connection at Zanderij airport, which is essential for producing accurate weather forecasts.

It is essential to set up an information system for the weather observation network in order to improve the quality of observations and real-time data feedback. To achieve this, it is necessary to set up a network to make data transmission easily accessible. Further thoughts how to achieve this have to be made.

Proposed solutions for the issues mentioned above will be addressed in the Suriname SOFF National Contribution plan to GBON.

4. Report completion signatures

Peer Advisor signature 
Beneficiary Country signature 
WMO Technical Authority screening signature 

ANNEX I Current state of synoptic (WIGOS registered) meteorological stations

Two Synop stations include both manual and AWS stations. However, Tafelberg and Stoelmanseiland are currently sleeping stations and require updating and upgrading, and therefore are not considered in their current state.

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 internat 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