

21 October 2024

# **GBON National Gap Analysis**

## SENEGAL

Systematic Observations Financing Facility

Weather and climate data for resilience







### Screening of the National Gap Analysis (NGA) of Senegal

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 5 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 7 surface land stations and 1 upper station based on specific national circumstances.** 

Date: 28 October 2024

Signature:

Infial

Albert Fischer Director, WIGOS Branch, Infrastructure Department, WMO



### Document review process notes:

Version 18.10.2023 for SOFF peer advisors and Implementing Entities feedback by 10 January 2023 Version 4 submitted to SOFF secretariat on 23 May 2024



### GBON National Gap Analysis Report SENEGAL

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Version 1	18.10.2023	Sent for beneficiary. Feedback received 15.11.2023
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### Introduction

As of 1 January 2023, the extraordinary session of the World Meteorological Congress (Cg-Ext 2021) approved Resolution 2 Modifying the Technical Regulations relating to the establishment of the Global Basic Observing Network (GBON). The regulation puts an obligation on all Members to acquire and exchange the most essential surface observation data at a minimum level of spatial resolution and time interval internationally. Once implemented, GBON improves the availability of the most essential surface data, which has a direct positive impact on the quality of weather forecasts.

The GBON regulations were published in the WIGOS Manual (WMO-No. 1160), Annex VIII of the WMO Technical Regulations, 2019 edition, section 3.2.2, and describes in clear terms the spatial and temporal resolution of surface weather stations. They also include standard practices and procedures that members are required to follow and recommended practices and procedures that members are urged to comply with.

To implement GBON at the national level, members are encouraged to complete the GBON National Gap Analysis to identify and understand existing gaps in the required observational network and create a national plan to close these gaps.

It is in this context that Senegal has carried out an in-depth diagnosis of the current situation of the meteorological observation network, highlighting the state of the stations in terms of territorial coverage, equipment, infrastructure, needs and skills of personnel.





### **1. Country information from the GBON Global Gap Analysis**

ANACIM has registered 13 surface stations in the WDQMS database (Fig. 1). However, they do not provide data in the schedule that complies with GBON requirements. Further information on the number and status of surface measuring stations as well as other capacity gaps is described in figures 1 and 2. Two upper air observations are recorded in the WDQMS database (Fig. 2). Table I summarizes compliance with WMO global GBON requirements.

Senegal has two upper-air observation sites located at AIBD (Blaise Diagne International Airport) and Tambacounda (Fig. 2). One of the two upper-air stations (Tambacounda) is co-administered by the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) and ANACIM. both upper-air stations operate (balloon launch) twice a day: 00 and 12 UTC. The AIBD upper-air station is fully administered by the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA).



*Figure 1 :* The status of surface weather stations in Senegal and availability based on WDQMS information. Time period (WMO GBON Global Gap analysis, June 2023).







*Figure 2* : The status of upper air stations in Senegal and availability based on WDQMS information. Time period (WMO GBON Global Gap analysis, June 2023).

**Table I. WMO GBON Global Gap Analysis (June 2023).**Illustration of the information thatthe WMO Secretariat provides to each country.

B. Target	C. Reporting (GBON compliant ) <sup>1</sup>	D. Gap to improve	E. Gap new	F. Gap total			
[# of stations]							
5*	2	3	0	3**			
1*	0	1	0	1			
	B. Target 5* 1*	B. TargetC. Reporting (GBON compliant) 15*21*0	B. TargetC. Reporting (GBON compliant) 1D. Gap to improve5*231*01	B. TargetC. Reporting (GBON compliant) 1D. Gap to improveE. Gap new[# of stations]5*2301*010			

\*GBON global target is based on the following calculations for surface and upper air stations, respectively, target number of stations = surface area of the country km<sup>2</sup>/200 km x 200 km (or 500 km x 500 km) (Fig. 4 and Fig. 5). \*\*Based on the geographical dimensions of Senegal (197 000 Km<sup>2</sup>).

<sup>&</sup>lt;sup>2</sup> 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.



<sup>&</sup>lt;sup>1</sup> 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.



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

#### Surface stations :

Tables 3 and 4 and Figure 7 summarize the existing SNH and third-party observation networks (AIBD) relevant to GBON. Annex 1 provides more detailed information.

Five (5) surface observation stations (Dakar, Saint Louis, Tambacounda, AIBD and Ziguinchor) are fully GBON compliant among the 13 stations reporting internationally. The data are transferred using the GTS system into the global observation network.

Stations use the RSTFA/SMT to transmit their data directly via GTS through the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) transmission system.

The intention of the Senegalese meteorological service is to improve the observation sites by installing a transmission system to transmit directly through the RSTFA/MTS system without going through the ASECNA system.

Eight (8) surface observation stations (Linguère, Kolda, Kaolack, Podor, Matam, Kédougou, Diourbel, Cap-Skirring) are not compliant with the GBON because they do not operate 24 hours a day due to a lack of staff. Although the infrastructure exists, some equipment such as 10-meter wind devices is absent or out of service. So it takes a medium investment to fix the appalling deficiencies of surfaces observation stations to bring them into compliance with the GBON.

### Upper air stations:

Senegal has two Upper-air stations over land sites located at the AIBD (Blaise Diagne International Airport) and in Tambacounda.

The map of Upper-air stations over land in Senegal with 500 km diameter buffer is shown in figure 6. The station in Tambacounda is currently out of order. Areas which are not covered represent regions where surface stations are more than 500 km apart. It shows that without station Tambacounda, the GBON horizontal resolution requirement is not met.

The upper-air station AIBD (New Senegal Airport) is administered by the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) and operates (balloon launches) twice a day: 00 and 12 UTC and standard surface observations are made every hour. This station is GBON compliant.

The Tambacounda upper-air station (Surface station belonging to ANACIM) is coadministered by the ASECNA and ANACIM. In principle it prepares two balloon launches per day : 00 and 12 UTC. All the equipment for the radiosonde and the transmission system via VSAT are provided by ASECNA but the operation of the station is done with ANACIM staff.

Two issues with the operation of the Tambacounda upper-air station need to be solved to become fully operational and GBON compliant. First, arrangements should be in place to ensure the provision of consumables to operate the station reliably. A second hydrogen





preparer is needed at the site. Second, additional and well-trained operators are needed to operate the balloon launches twice a day. SOFF funding is sought to solve both issues.

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

	Existing observation stations (# of stations)						
GBON Requirements	NMHS n	etwork	Third-party network				
	Reporting to req.	To improve	Reporting to req. <sup>3</sup>	To improve			
<b>Surface land stations</b> Standard density <sup>4</sup> 200km Variables: SLP, T, H, W, P, SD	2	5	1*	0			
Upper-air stations operated from land Horizontal resolution: 500km							
Vertical resolution: 100m, up to 30 hPa	0	0	0	0			
Variables: T, H, W							

\*One station (AIBD) (Compliant) is administered by the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) and operates (balloon launches) twice a day: 00 and 12 UTC and standard surface observations every hour.

Of the surface weather stations, only five (5) operate 24 hours a day. The remaining eight (8) weather stations operate 18 hours per day, with a six (6) hour interruption.

Messages from the stations are transmitted hourly to the ASECNA Transmission Centre and then transmitted internationally by the WMO Global Telecommunication System (GTS). Technical incidents may prevent international data reporting to the WDQMS data monitoring system.



<sup>&</sup>lt;sup>3</sup> 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.

<sup>&</sup>lt;sup>4</sup> 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.



The climatological stations (12 surface observation stations) operate 12 hours a day with a 12-hour interruption, their information is only used locally for climatological study purposes.

### Table III. Assessment of existing, manned GBON stations per station characteristics and network ownership

Station name	Statio n type	Owner tatio (NMHS/ F type 3rd	Funding source	GBON variable measured				Reporting cycle	Reporting cycle	GBON Compliant	
	(3/0A)	party)		SLP	т	н	w	Р	(obs/day)	(rep/day)	(1/N)
Dakar Yoff	S♦	MMHS	GOV.	Y	Y	Y	N	Y	24	24	Y
Diass AIBD	S♦	ASECNA	ASECNA	Y	Y	Y	Y	Y	2	2	Y
Diass AIBD	UA♦	ASECNA	ASECNA	0	Y	Y	Y	0	24	24	Y
Saint Louis	S♦	MMHS	GOV.	Y	Y	Y	Ν	Y	24	24	Y
Podor	S♦	MMHS	GOV.	Y	Y	Y	N	Y	19	19	N
Linguère	S♦	MMHS	GOV.	Y	Y	Y	N	Y	19	19	N
Matam	S♦	MMHS	GOV.	Y	Y	Y	Ν	Y	19	19	N
Diourbel	S♦	MMHS	GOV.	Y	Y	Y	N	Y	19	19	N
Kaolack	S♦	MMHS	GOV.	Y	Y	Y	N	Y	19	19	N
Tambacounda	S♦	MMHS	GOV.	Y	Y	Y	N	Y	19	19	Y
Tambacounda	UA♦	MMHS	GOV.	0	Y	Y	Y	0	0	0	N
Ziguinchor	S♦	MMHS	GOV.	Y	Y	Y	Y	Y	24	24	Y
Cap Skirring	S♦	MMHS	GOV.	Y	Y	Y	N	Y	19	19	N
Kolda	S♦	MMHS	GOV.	Y	Y	Y	N	Y	19	19	N
Kédougou	S♦	MMHS	GOV.	Y	Y	Y	N	Y	19	19	N
Mbour	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Bambey	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Thies	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Fatick	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Nioro	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Vélingara	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Louga	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Koungheul	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Goudiry	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Bakel	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Simenti	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N
Ranérou	S	MMHS	GOV.	N	Y	Y	N	Y	12	0	N

Notes: Assessment of existing GBON stations per station characteristics. Station type: S♦: Surface Synoptic Stations, UA♦: Upper-Air; S : surface climatological stations , Owner of the station : NMHS or name of third-party; GBON variables: SLP: Sea-level pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; Reporting cycle: Number of observation reports exchanged internationally per day (0-24); GBON compliance: weather the station is GBON compliant or not (see GBON guide on compliance criteria).

The implementation of some projects has undoubtedly produced significant gains in the area of strengthening meteorological equipment in Senegal.





The projects are part of the win/win framework, such as agricultural research institutes and insurance companies that support ANACIM for the acquisition of meteorological equipment in exchange for the benefit of free meteorological data.

In particular, Automatic Weather Stations (AWS) have been installed over the past seven years as part of various projects. Data is recorded every 10 minutes and sent to a central database at the Meteorological Operations Service (DEM). Currently, data from automatic stations are not automatically transmitted to the WMO Global Telecommunication System (GTS), but allow meteorological observers to use them in addition to manual observations. This means that for GBON compliance (hourly and 24/7 operation) data from AWS stations need to be disseminated through WIS2.0.



Fig 3: Automatic stations installed at ANACIM weather stations but are not registered for the WIGOS Data Quality Monitoring System (WDQMS)

### 3. Results of the GBON National Gap Analysis

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





<u>Based on the analysis presented, two (2) surface stations and one (1) upper-air sounding</u> <u>station in need of improvement would fulfil the minimum requirements of GBON for spatial</u> <u>coverage in Senegal.</u> In the middle and south of the country, the horizontal resolution complies well with the regulations, but towards the north, from Saint Louis to Tambacounda, the horizontal resolution is poor (figure 2). It is therefore proposed that two (2) additional stations are added to the GBON network in this area to bring the resolution into GBON compliance.

<u>Small improvements are also needed for each of the four (4) GBON complient stations</u>. The main problems are the unreliable ultrasonic anemometers that are installed at these stations. Frequent failures of wind measurements lead to bad and or missing data. It is therefore proposed to replace the sonic anemometers with the more robust classical windobservation equipment.

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 of stations using the VPN system, which will enable the stations to transmit directly to the global SMT network via the ASECNA transmission centre, which operates 24 hours a day.

The installation of a RSTFA/SMT network is necessary to meet Senegal's data transmission limitations on the global network. With the RSTFA/SMT network, data will be transmitted directly, thus avoiding any delays and risks of degradation of information for users and its transmission on the global network. For the moment, deployment is taking place on platforms where ASECNA has a station at AIBD. Further thought needs to be given to setting up the RSTFA/SMT network on all ANACIM platforms.

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







*Figure 4* : Area not covered by surface observation stations (the centre and south-east of the country). Overview of surface stations in Senegal requiring investment to become or remain GBON compliant.











a third-party network will not be supported by SOFF.

**Figure 6**: the map of upper-air stations in Senegal, with a buffer zone of 500 km in diameter. The Tambacounda East station does not operate regularly, the areas that are not covered by the buffer zone are more than 500 km apart and therefore do not respect the horizontal resolution of the GBON.





	Global GBON	Approved national	GBON	Stations gap		
GBON requirements	target (# of stations)	target (# of stations)	Compliant stations (#)	To improve	New	
Surface land stations	5	7	2	5*	2**	
Upper-air stations operated from land	1	1	1***	1	0	

**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.

\* Minimum to meet GBON requirements. Non-compliant surface stations that require small investments to ensure ongoing GBON compliance. there are three things to do: reinforce the staff to allow the stations to operate 24 hours a day, buy wind equipment at 10 meters and set up a VPN transmission system for a better availability of surface land observations (GBON). The 5 stations to improve are: Kolda, Kedougou, Linguere, Matam, Podor.

**.**\*\* Minimum to meet the GBON requirement; the location has already been determined; the choice is made on the region of Kaffrine and Kidira.

\*\*\*The upper-air station AIBD (New Senegal Airport) is administered by the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) and operates (balloon launches) twice a day: 00 and 12 UTC and standard surface observations are made every hour. This station is currently GBON compliant (note that it was diagnosed 'non-compliant' in the WMO GBON Global Gap Analysis from June 2023, represented in table 1 of this document).

## **3.1 Recommended existing surface, upper-air and marine<sup>5</sup> stations to be designated to GBON**

Table 5. Recommended existing surface, upper-air and marine stations to be designated to GBON.

Station name	Station type (S/UA/M <sup>6</sup> )
PODOR	S
МАТАМ	S
KEDOUGOU	S
KOLDA	S
LINGUERE	S

<sup>&</sup>lt;sup>6</sup> Please see guidance on marine stations in Section 2 on Scope.



<sup>&</sup>lt;sup>5</sup> Although GBON marine stations are not part of initial SOFF scope, peer advisors are encouraged to analyse in this step when considered relevant e.g., SIDS, the need for future GBON marine observations investments according to the GBON requirements.





Fig 7 : Distribution of manual surface weather stations in Senegal in accordance with GBON requirements





### 4. Report completion signatures

#### Peer Advisor signature

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Senior scientist / Coordinator International Affairs Royal Netherlands Meteorological Institute (KNMI)



WMO Technical Authority screening signature

Alluffich

#### **Beneficiary Country signature**

Dr. Ousmane Ndiaye,

Director of Meteorological Operations of the Senegal National Agency for Civil Aviation and Meteorology (ANACIM)









**Annex 1.:** GBON National Contribution Target Surface-based stations

*Fig 8 :* GBON-compliant ground stations (green), non-GBON-compliant ground stations (purple), and stations to be created to correct horizontal resolution (blue).



Fig 9: GBON-compliant upper-air station (Green) and Non-GBON-Compliant upper-air station (Red)





### Annex 2.

Information about the existing observation stations in Senegal.

The observational data from third parties are shared with ANACIM.

Type of station	Number of stations	Owner of station	Measured variables
Fully automatic surface weather stations	25	NHMS	T, H, W, P, SLP
Synoptic stations	13/13 <sup>*</sup> functional	NHMS	T, H, W, P, SLP
Upper-air stations	2/1 <sup>*</sup> functional	ASECNA	T, H, W, P
Agro-climate stations	12/12 <sup>*</sup> functional	NHMS	T, H, W, P
Automatic synoptic, climatological and rainfall stations	255	NHMS	P, T, H, W
Manual rain station	360	NHMS	Р

Of the 25 fully manual surface stations, only 13 are registered in the WIGOS database and the remaining 12 are surface climate stations. The automatic stations regularly provide data to ANACIM's data server. Automatic rainfall stations regularly provide data to ANACIM's data server and manual rain gauges are more numerous and are operated locally. The poor performance of automatic stations and automatic rain stations is due to aging sensors and a lack of tracking.





**Annex 3 :** Information on the dates of creation of all surface stations in the Senegal observation network.

Name of station	Qualifier	Lat	Long	Altm	Installation of manual station	Installation of AWS
Dakar -Yoff	Synoptic	14°44'	17°30'	27	1947	2016
Cap Skiring	Synoptic	12°24'	16°45'	11	1977	2017
Diourbel	Synoptic	14°39'	16°14'	7	1912	2016
Kaolack	Synoptic	14°08'	16°04'	6	1918	2017
Kédougou	Synoptic	12°34'	12°13'	178	1918	2023
AIBD (ASECNA)	Synoptic	14°54'	16°91'	20.59	2017	2017
Kolda	Synoptic	12°53'	14°58'	35	1922	2022
Linguère	Synoptic	15°23'	15°07'	20	1933	2023
Matam	Synoptic	15°39'	13°15'	15	1918	2023
Podor	Synoptic	16°39'	14°58'	6	1904	2022
Saint Louis	Synoptic	16°03'	16°27'	4	1957	2023
Tambacounda	Synoptic	13°46'	13°41'	49	1919	2017
Ziguinchor	Synoptic	12°23'	16°16'	26	1918	2017
Bambey	Climate	14°42'	16°28'	20	1921	2017
Fatick	Climate	14°20'	16°24'	6	1918	2022
Goudiry	Climate	14°11'	12°43'	59	1940	2017
Louga	Climate	15°37'	16°13'	38	1887	2023
Nioro du Rip	Climate	13°33'	15°47'	25	1931	2022
Vélingara	Climate	13°09'	14°06'	4	1932	2022
Bakel	Climate	14°54'	12°28'	6	1918	2023
Koungheul	Climate	13°58'	14°50'	11	1931	2022
Mbour	Climate	14°25'	16°58'	10	1931	2023
Thies	Climate	14°11'	12°42'	20	1887	2022
Ranérou	Climate	15°18'	13°57'	6	1931	2019





### Annex 4.

Current state of meteorological stations





TAMABACOUNDA WEATHER STATION						
TITLE/EQUIPMENT	PROBLEMES RENCONTRES	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS			
Surface Measurement Equipment	<ul> <li>✓ Dilapidated thermometer screen.</li> <li>✓ Obsolete equipments; some defective.</li> <li>✓ Lack of maintenance of equipment.</li> <li>✓ No wind recorder.</li> </ul>	✓ Some observations that are not made or are erroneous lead to a problem with the reliability of the forecasts	<ul> <li>Repaint or replace the shelter and defective instruments.</li> <li>Acquire the missing instruments.</li> <li>Repaint or replace the Shelter and defective implements.</li> <li>Acquire missing implements.</li> <li>Perform regular calibration of devices according to WMO standards.</li> <li>Acquire a recording anemometer.</li> <li>Plan for the replacement of mercury-containing devices with digital devices.</li> </ul>			
Equipment measuring wind at altitude (low-lying wind)	<ul> <li>✓ Functional radiosonde.</li> <li>✓ Functional theodolite.</li> <li>✓ But there is a problem of orientation.</li> </ul>	<ul> <li>✓ Allows wind measurements to be made in the lower layers.</li> <li>✓ No information on low-level winds</li> </ul>	<ul> <li>✓ Reinstall or replace the theodolite.</li> <li>✓ Renew GIP bottles.</li> <li>✓ Acquire a sufficient stock of consumables</li> </ul>			
Transmission	<ul> <li>✓ Is done by phone.</li> <li>✓ R.S.F.T.A. (Aeronautical Fixed Telecommunications Service Network) or GSM-GFU(Closed User Group),</li> </ul>	<ul> <li>✓ Transmission delay.</li> <li>✓ Source of error and control problem.</li> </ul>	✓ Use VSAT			
Building	✓ Old	✓ Harsh working conditions	✓ Renovating and repainting the premises			
Station Environment	<ul> <li>✓ Problem of electrification of the Park (difficulty in carrying out night measurements).</li> <li>✓ Problem with the disposal of waste from the borehole.</li> <li>✓ Poorly maintained park.</li> </ul>	<ul> <li>✓ Problem of insecurity for operators.</li> <li>✓ Data availability issue.</li> </ul>	<ul> <li>✓ Proceed with the electrification of the fleet.</li> <li>✓ Construct a proper septic tank.</li> <li>✓ Regular cleaning and weeding.</li> </ul>			
Work Environment	<ul> <li>✓ Lack of backup power in the event of a power outage</li> </ul>	<ul> <li>Degradation of the service provided</li> </ul>	<ul> <li>✓ Replace aging IT equipment.</li> <li>✓ Improve coordination with ADS for the use of the generator set.</li> <li>✓ Repair the generator set automation</li> </ul>			
Human Resources (Staff)	✓ Lack of manpower	<ul> <li>✓ Difficulties in performing understudies.</li> </ul>	✓ Reinforcement of staff to five (5) officers			



ZIGUINCHOR WEATHER STATION						
TITLE/EQUIPMENT	PROBLEMES RENCONTRES	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS			
Surface Measurement Equipment	<ul> <li>✓ Dilapidated thermometer screen.</li> <li>✓ Obsolete equipment.</li> <li>✓ Some defective.</li> <li>✓ Failure to calibrate devices. No wind recorder.</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Average wind not provided</li> </ul>	<ul> <li>Repaint or replace the shelter and defective implements.</li> <li>Acquire missing instruments. Repaint or replace the Shelter and defective implements.</li> <li>Acquire missing implements.</li> <li>Perform regular calibration of devices according to WMO standards.</li> <li>Acquire a recording anemometer. Plan for the replacement of mercury-containing devices with digital devices.</li> </ul>			
Equipment measuring wind at altitude (low-lying wind)	<ul> <li>✓ Theodolite out of order.</li> <li>✓ No hydrogen preparation equipment.</li> <li>✓ Absence of a hydrogen room.</li> </ul>	<ul> <li>✓ Wind measurements in the lower layers are not possible.</li> <li>✓ No information on low-level winds.</li> </ul>	<ul> <li>✓ Replace theodolite.</li> <li>✓ Renew GIP bottles.</li> <li>✓ Acquire a sufficient stock of consumables.</li> </ul>			
Transmission	<ul> <li>✓ Is done by phone.</li> <li>✓ R.S.F.T.A. (Aeronautical Fixed Telecommunications Service Network) or GSM-GFU(Closed User Group).</li> </ul>	<ul> <li>✓ Delay in transmission.</li> <li>✓ Source of Error and Control Problem</li> </ul>	<ul> <li>Install a standalone internet connection at the station</li> </ul>			
Building	<ul> <li>✓ Dilapidated.</li> <li>✓ Unusable hydrogen preparation room</li> </ul>	<ul> <li>Degradation of the service provided</li> </ul>	<ul> <li>✓ Refurbish the premises.</li> <li>✓ Set up a break room.</li> <li>✓ Install air conditioning</li> </ul>			
Station Environment	✓ The park confined to the airport's houses, trees and parking lot in a flood zone.	<ul> <li>✓ Source of errors for measurements.</li> </ul>	<ul> <li>Relocate the park to a location that meets the site standards (already identified)</li> </ul>			
Work Environment	<ul> <li>✓ Non-functional computer equipment.</li> <li>✓ Insufficient office equipment.</li> <li>✓ Lack of emergency power outage.</li> </ul>	<ul> <li>Degradation of the service provided</li> </ul>	✓ Replace IT equipment			
Human Resources (Staff)	✓ Lack of manpower	<ul> <li>Difficulties in performing understudies</li> </ul>	✓ Reinforcement of staff to five (5) officers			



SAINT LOUIS WEATHER STATION						
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS			
Surface Measurement Equipment	<ul> <li>✓ Dilapidated thermometer screen.</li> <li>✓ Obsolete equipment, some defective.</li> <li>✓ Failure to calibrate devices</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Average wind not provided</li> </ul>	<ul> <li>Repaint or replace the Shelter and defective implements.</li> <li>Acquire missing instruments. Perform regular calibration of devices according to standards.</li> <li>Acquire a recording anemometer.</li> <li>Regularly calibrate the devices to the standards set by the WMO and relocate the meteorological park.</li> </ul>			
Equipment measuring wind at altitude (low-lying wind)	<ul> <li>✓ Theodolite out of order.</li> <li>✓ No hydrogen preparation equipment.</li> <li>✓ Absence of a hydrogen room.</li> </ul>	<ul> <li>✓ Wind measurements in the lower layers are not possible.</li> <li>✓ No information on low-level winds.</li> </ul>	<ul> <li>✓ Replace theodolite.</li> <li>✓ Renew GIP bottles.</li> <li>✓ Acquire a sufficient stock of consumables</li> </ul>			
Transmission	<ul> <li>✓ Is done by phone, RSFTA or by phone.</li> <li>✓ The Internet is unstable because it is shared.</li> </ul>	<ul> <li>Delay in transmission.</li> <li>Source of Error and Control Problem.</li> </ul>	<ul> <li>Install a standalone internet connection at the station</li> </ul>			
Building	<ul> <li>✓ Dilapidated.</li> <li>✓ Unusable hydrogen preparation room</li> </ul>	<ul> <li>Degradation of the service provided</li> </ul>	<ul> <li>✓ Renovate the premises.</li> <li>✓ Set up a break room.</li> <li>✓ Install air conditioning</li> </ul>			
Station Environment	<ul> <li>✓ The park was confined to the vicinity of the houses and the airfield fence wall.</li> <li>✓ The observation room has been set up in a temporary conterner.</li> </ul>	<ul> <li>✓ Source of errors for measurements</li> </ul>	<ul> <li>Relocate the park to a location that meets the site standards (already identified)</li> </ul>			
Work Environment	<ul> <li>✓ Non-functional computer equipment.</li> <li>✓ Insufficient office equipment.</li> <li>✓ Lack of emergency power outage.</li> </ul>	<ul> <li>Deterioration of the services provided</li> </ul>	✓ Replace IT equipment			
Human Resources (Staff)	✓ Lack of manpower	<ul> <li>Difficulties in performing understudies</li> </ul>	✓ Reinforcement of staff to five (5) officers			



DAKAR YOFF WEATHER STATION				
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS	
Surface Measurement Equipment	<ul> <li>✓ Weather park to be rehabilitated.</li> <li>✓ Obsolete equipments,some defective.</li> <li>✓ Failure to calibrate devices</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Average wind not provided.</li> </ul>	<ul> <li>Acquire the missing instruments (Wind apparatus and class A tank).</li> <li>Regularly calibrate the devices to the standards set by the WMO and relocate the meteorological park.</li> <li>Acquire a Recording Anemometer</li> </ul>	
Equipment measuring wind at altitude (low-lying wind)	<ul> <li>✓ Theodolite out of order.</li> <li>✓ No hydrogen preparation equipment.</li> </ul>	<ul> <li>✓ Wind measurements in the lower layers are not possible.</li> <li>✓ No information on low-level winds.</li> </ul>	<ul> <li>✓ Replace theodolite. Renew GIP bottles.</li> <li>✓ Acquire a sufficient stock of consumables.</li> </ul>	
Transmission	<ul> <li>✓ Is done by phone, RSFTA or by phone.</li> <li>✓ The Internet is unstable because it is shared.</li> </ul>	<ul> <li>✓ Delay in transmission.</li> <li>✓ Source of Error and Control Problem.</li> </ul>	$\checkmark$ Install a standalone internet connection at the station	
Building	<ul> <li>✓ Dilapidated.</li> <li>✓ Unusable hydrogen preparation room</li> </ul>	<ul> <li>Degradation of the service provided</li> </ul>	<ul> <li>✓ Renovate the premises.</li> <li>✓ Set up a break room.</li> <li>✓ Install air conditioning</li> </ul>	
Station Environment	✓ Old parc .	Source of errors for measurements	✓ Rebuild the park and fence	
Work Environment	<ul> <li>✓ Non-functional computer equipment.</li> <li>✓ Insufficient office equipment.</li> </ul>	<ul> <li>Degradation of the service provided</li> </ul>	✓ Replace IT equipment	
Human Resources (Staff)	✓ Lack of staff	<ul> <li>Difficulties in performing understudies</li> </ul>	$\checkmark$ Reinforcement of staff to five (5) officers	



CAP SKIRRING WEATHER STATION				
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS	
Surface Measurement Equipments	<ul> <li>✓ Dilapidated thermometer screen.</li> <li>✓ Equipment is often obsolete, some defective.</li> <li>✓ Failure to calibrate devices.</li> <li>✓ Meteorological park to be rehabilitated</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ No wind logger.</li> </ul>	<ul> <li>✓ Replace the shelter and defective instruments, acquire the missing instruments.</li> <li>✓ Perform regular calibration of devices according to WMO standards.</li> <li>✓ Acquire a recording anemometer.</li> <li>✓ Plan for the replacement of mercury-containing devices with digital devices.</li> </ul>	
Transmission	<ul> <li>✓ Is done by phone, RSFTA or by phone.</li> <li>✓ The Internet is unstable because it is shared.</li> </ul>	<ul> <li>✓ Delay in transmission.</li> <li>✓ Source of Error and Control Problem.</li> </ul>	$\checkmark$ Install a standalone internet connection at the station	
Building	<ul> <li>✓ Dilapidated.</li> <li>✓ Unusable hydrogen preparation room.</li> </ul>	<ul> <li>Degradation of the service provided.</li> </ul>	<ul> <li>✓ Renovate the premises.</li> <li>✓ Set up a break room.</li> <li>✓ Install air conditioning.</li> </ul>	
Station Environment	<ul> <li>✓ Proximity to buildings, roads and tall trees.</li> </ul>	✓ Source of errors for measurements	<ul> <li>Délocaliser le parc dans un endroit déjà identifié conforme aux normes.</li> </ul>	
Work Environment	<ul> <li>✓ Equipements informatiques non fonctionnels</li> <li>✓ Equipements de bureaux insuffisants.</li> </ul>	✓ Dégradation du service fourni.	✓ Replace IT equipment.	
Human Resources (Staff)	✓ Lack of Staff.	<ul> <li>The station operates in termittance (closed at certain times).</li> </ul>	<ul> <li>Reinforcement of staff to four (4) officers.</li> </ul>	



PODOR WEATHER STATION				
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS	
Surface Measurement Equipment	<ul> <li>✓ Dilapidated thermometer screen. Equipment is often obsolete, some defective.</li> <li>✓ Failure to calibrate devices. Missing Wind Measurements (Estimated Wind).</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Inaccurate data</li> </ul>	<ul> <li>Replace the shelter and defective instruments, acquire the missing instruments.</li> <li>Perform regular calibration of devices according to WMO standards. Acquire a recording anemometer.</li> <li>Plan for the replacement of mercury-containing devices with digital devices.</li> </ul>	
Transmission	<ul> <li>✓ Can be done by landline phone or telephone.</li> <li>✓ No RSTFA. Internet non-existent.</li> </ul>	<ul> <li>✓ Transmission delay.</li> <li>✓ Source of Error and Control Problem</li> </ul>	✓ Provision of PCs and Internet connection.	
Building	✓ Old	<ul> <li>✓ Difficult working conditions don't encourage people to stay there</li> </ul>	✓ Refurbish and repaint Premises.	
Station Environment	✓ The station is located in the city centre, away from the airfield.	<ul> <li>✓ Source of errors for measurements.</li> <li>✓ Lack of precision for aeronautics.</li> <li>✓</li> </ul>	✓ Relocate the station to the aerodrome.	
Work Environment	<ul> <li>Non-functional computer equipment.</li> </ul>	<ul> <li>✓ Difficulty communicating with tutorship and exchanging documents.</li> <li>✓</li> </ul>	✓ Replace computer equipment.	
Human Resources (Staff)	✓ Lack of Staff.	<ul> <li>✓ The station operates in termittance (closed at certain times).</li> </ul>	<ul> <li>Reinforcement of staff to four (4) officers.</li> </ul>	



DIOURBEL WEATHER STATION				
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS	
Surface Measurement Equipment	<ul> <li>✓ Some obsolete appliances, Obsolete shelter.</li> <li>✓ Failure to calibrate devices.</li> <li>✓ Missing wind measurements.</li> <li>✓ Absence of a barograph.</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Estimated Wind.</li> </ul>	<ul> <li>Replace the shelter and defective instruments, acquire the missing instruments.</li> <li>Perform regular calibration according to the standards established by WMO.</li> <li>Plan for the replacement of mercury-containing devices with digital devices. Acquire a recording anemometer.</li> <li>Mercury barometer to be replaced by a digital barometer.</li> </ul>	
Transmission	<ul> <li>✓ Can be done by landline phone or telephone GSM.</li> <li>✓ No RSTFA.</li> <li>✓ Non-existent internet.</li> </ul>	<ul> <li>✓ Transmission delay.</li> <li>✓ Source of error and control problem.</li> </ul>	✓ Provision of PCs and Internet connection.	
Building	✓ Old/ ✓	<ul> <li>Degradation of the service provided.</li> </ul>	<ul> <li>Renovating and repainting the premises.</li> </ul>	
Station Environment	<ul> <li>✓ Located in the city centre, away from the airfield.</li> </ul>	<ul> <li>✓ Source of errors for measurements.</li> <li>✓ Lack of precision for aeronautics.</li> </ul>	<ul> <li>Relocate the station to the aerodrome.</li> </ul>	
Work Environment	<ul> <li>✓ Non-functional computer equipment.</li> <li>✓ Basic office equipment.</li> </ul>	<ul> <li>Difficulty communicating with tutorship and exchanging documents.</li> </ul>	<ul> <li>✓ Replace computer equipment.</li> <li>✓ Provide office and rest equipment</li> </ul>	
Human Resources (Staff)	✓ Lack of Staff.	<ul> <li>The station operates in termittance (closed at certain times).</li> </ul>	✓ Reinforcement of staff to four (4) officers.	



MATAM WEATHER STATION				
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS	
Surface Measurement Equipment	<ul> <li>✓ Some antiquated appliances, dilapidated shelter.</li> <li>✓ Failure to calibrate devices.</li> <li>✓ Missing Wind measurements (Estimated Wind).</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Inaccurate data.</li> </ul>	<ul> <li>Repaint or replace the shelter and defective instruments, acquire the missing instruments.</li> <li>Perform regular calibration according to the standards established by WMO.</li> <li>Plan for the replacement of mercury-containing devices with digital devices.</li> <li>Acquire Anemometer Recorder.</li> </ul>	
Transmission	<ul> <li>✓ Can be done by landline phone or telephone GSM.</li> <li>✓ No RSTFA.</li> <li>✓ Non-existent internet.</li> <li>✓</li> </ul>	<ul> <li>✓ Transmission delay.</li> <li>✓ Source of error and control problem.</li> </ul>	✓ Provision of PCs and Internet connection.	
Building	✓ Old/	<ul> <li>Degradation of the service provided.</li> </ul>	<ul> <li>Renovating and repainting the premises.</li> </ul>	
Station Environment	<ul> <li>✓ Located in the city centre, away from the airfield.</li> </ul>	<ul> <li>✓ Source of errors for measurements.</li> <li>✓ Lack of precision for aeronautics.</li> </ul>	<ul> <li>Relocate the station to the aerodrome.</li> </ul>	
Work Environment	<ul> <li>✓ Non-functional computer equipment.</li> <li>✓ Basic office equipment.</li> </ul>	✓ Degradation of the service provided.	✓ Replace IT equipment.	
Human Resources (Staff)	✓ Lack of Staff	<ul> <li>The station operates in termittance (closed at certain times)</li> </ul>	<ul> <li>Reinforcement of staff to four (4) officers</li> </ul>	



KEDOUGOU WEATHER STATION			
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS
Surface Measurement Equipment	<ul> <li>✓ Some antiquated appliances, dilapidated weather shelter.</li> <li>✓ Failure to calibrate devices.</li> <li>✓ Missing Wind Measurements (Estimated Wind)</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Inaccurate data</li> </ul>	<ul> <li>Repaint or replace the shelter and defective instruments, acquire the missing instruments.</li> <li>Perform regular calibration according to the standards established by WMO.</li> <li>Plan for the replacement of mercury-containing devices with digital devices.</li> <li>Acquire Anemometer Recorder.</li> </ul>
Transmission	<ul> <li>✓ Can be done by landline phone or telephone GSM.</li> <li>✓ No RSTFA.</li> <li>✓ Non-existent internet.</li> </ul>	<ul> <li>✓ Transmission delay.</li> <li>✓ Source of error and control problem.</li> </ul>	<ul> <li>Provision of PCs and Internet connection.</li> </ul>
Building	<ul> <li>✓ Lack of air conditioning and ventilation.</li> <li>✓ Old.</li> </ul>	<ul> <li>✓ Difficult working conditions don't encourage people to stay there.</li> </ul>	<ul> <li>✓ Install air conditioning.</li> <li>✓ Refurbishing premises</li> </ul>
Station Environment	✓ No electricity.	<ul> <li>✓ Difficulties in working at night.</li> <li>✓ Lack of precision for aeronautics.</li> </ul>	<ul> <li>✓ Ensure that the park is not overrun by dwellings.</li> <li>✓ Payment of electricity arrears from the bills of the National Electricity Company of Senegal (Senelec).</li> </ul>
Work Environment	<ul> <li>✓ Non-functional computer equipment.</li> <li>✓ Basic office equipment.</li> </ul>	<ul> <li>Difficulty communicating with tutorship and exchanging documents.</li> </ul>	<ul> <li>✓ Replace computer equipment.</li> <li>✓ Provide office and rest equipment</li> </ul>
Human Resources (Staff)	✓ Lack of Staff	<ul> <li>The station operates in termittance (closed at certain times).</li> </ul>	<ul> <li>Reinforcement of staff to four (4) officers</li> </ul>



KAOLACK WEATHER STATION			
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS
Surface Measurement Equipment	<ul> <li>✓ Some outdated appliances.</li> <li>✓ Failure to calibrate devices.</li> <li>✓ Missing wind measurements.</li> <li>✓ Absence of a barograph.</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Estimated Wind</li> </ul>	<ul> <li>Replace the shelter and defective instruments, acquire the missing instruments.</li> <li>Perform regular calibration according to the standards established by WMO.</li> <li>Plan for the replacement of mercury-containing devices with digital devices.</li> <li>Acquire a recording anemometer. Mercury barometer to be replaced by a digital barometer</li> </ul>
Transmission	<ul> <li>✓ Can be done by landline phone or telephone GSM.</li> <li>✓ No RSTFA.</li> <li>✓ Non-existent internet.</li> </ul>	<ul> <li>✓ Transmission delay.</li> <li>✓ Source of error and control problem.</li> </ul>	✓ Provision of PCs and Internet connection.
Building	<ul> <li>✓ Lack of air conditioning and ventilation.</li> <li>✓ Rehabilitated.</li> </ul>	✓ Improved working conditions	✓ Install air conditioning.
Station Environment	✓ Rehabilitated.	<ul> <li>Mesures erronées, risque de mesures non effectuées si disparition des instruments</li> </ul>	<ul> <li>✓ Déplacer le parc à l'endroit déjà identifié</li> <li>✓ Achat d'un transformateur abaisseur de tension et le Payement des arriérés d'électricité des factures de la SENELEC.</li> </ul>
Work Environment	<ul> <li>✓ Non-functional computer equipment.</li> <li>✓ Basic office equipment.</li> </ul>	<ul> <li>Difficulty communicating with the tutorship and exchanging documents.</li> </ul>	<ul> <li>✓ Replace computer equipment.</li> <li>✓ Provide office and rest equipment.</li> </ul>
Human Resources (Staff)	✓ Lack of Staff.	<ul> <li>The station operates in termittance (closed at certain times).</li> </ul>	✓ Reinforcement of staff to four (4) officers.



KOLDA WEATHER STATION			
TITLE/EQUIPMENT	PROBLEMS ENCOUNTERED	IMPACTS ON OPERATIONS	PROPOSED SOLUTIONS
Surface Measurement Equipment	<ul> <li>✓ Some obsolete appliances, Obsolete shelter.</li> <li>✓ Failure to calibrate devices.</li> <li>✓ Missing wind measurements.</li> <li>✓ Absence of a barograph.</li> </ul>	<ul> <li>✓ Some observations not made or erroneous.</li> <li>✓ Estimated Wind.</li> </ul>	<ul> <li>Replace the shelter and defective instruments, acquire the missing instruments.</li> <li>Perform regular calibration according to the standards established by WMO.</li> <li>Plan for the replacement of mercury-containing devices with digital devices. Acquire a recording anemometer.</li> <li>Mercury barometer to be replaced by a digital barometer.</li> </ul>
Transmission	<ul> <li>✓ Can be done by landline phone or telephone GSM.</li> <li>✓ No RSTFA.</li> <li>✓ Non-existent internet.</li> </ul>	<ul> <li>✓ Transmission delay.</li> <li>✓ Source of error and control problem.</li> </ul>	✓ Provision of PCs and Internet connection.
Building	<ul> <li>✓ Lack of air conditioning and ventilation.</li> </ul>	<ul> <li>✓ Difficult working conditions don't encourage people to stay there.</li> </ul>	✓ Provision of an air conditioner
Station Environment	<ul> <li>Away from the airfield and is starting to be invaded by houses.</li> </ul>	<ul> <li>Erroneous measurements, risk of missed measurements if instruments disappear.</li> </ul>	✓ Move the station to the aerodrome
Work Environment	<ul> <li>✓ Non-functional computer equipment.</li> <li>✓ Basic office equipment.</li> </ul>	<ul> <li>Difficulty communicating with tutorship and exchanging documents.</li> </ul>	<ul> <li>✓ Replace computer equipment.</li> <li>✓ Provide office and rest equipment</li> </ul>
Human Resources (Staff)	✓ Lack of Staff.	<ul> <li>✓ The station operates in termittance (closed at certain times).</li> </ul>	✓ Reinforcement of staff to four (4) officers.