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GBON National Contribution Plan Of

SENEGAL

Systematic Observations
Financing Facility

Weather
and climate
data for
resilience

GBON National Contribution Plan

SENEGAL

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Introduction

The Global Basic Observing Network (GBON) National Contribution Plan identifies the infrastructure and human and institutional capacities needed to achieve a progressive target toward GBON compliance. This includes activities required to ensure the sustained operation and maintenance of the national observing network contributing to GBON. The Plan should be designed to respond to the country's circumstances and geographical constraints and based on progressive but realistic ambition toward full GBON compliance. The objective of the GBON National Contribution Plan is to ensure that through the implementation of its proposed activities, the Systematic Observations Facility (SOFF) beneficiary country has the capacity to generate and internationally exchange GBON observations sustainably. Ultimately, the Plan should focus on optimizing the investments and activities that can achieve the largest impact on the Numerical Weather Prediction (NWP) models.

Each module references WMO Technical Regulations and other guidance material of relevance.

Senegal is located in the far west of West Africa, between 12° and 16° 30 North latitude and 11° 30 and 17° 30 West longitude, and covers an area of 192,712 km^2, with a population of 18,032,473 inhabitants from the 2023 census. Its climate is Sudano-Sahelian with the alternation of a rainy season (3 to 5 months depending on the area) dominated by the monsoon flow from the Saint Helena High and a dry season (7 to 9 months) marked by the predominance of maritime (northwest) and continental (interior) trade winds. Rainfall varies between 200 mm in the north and more than 1500 mm in the south and is marked by high inter-annual and intra-seasonal variability. After a period of declining rainfall between 1969 and 1990, since the mid-1990s there has been a beginning of a return of wet years, but with a high interannual variability in rainfall. Projections based on the RCP4.5 scenario predict a greater decrease in precipitation between 2022 and 2025 in the southern and eastern regions of the country, compared to the north and centre.

Average temperatures shows a west-east gradient, from 24°C in Dakar to more than 35°C in the interior of the country. Based on the RCP4.5 scenario, climate models predict a temperature increase of 0.95°C in Dakar and 1.28°C in the eastern and southern regions of the country, over the period 2022-2050 (Tambacounda, Kédougou, Kolda, Matam, Kaffrine). The number of hot days (Tmax > 40°) shows an increase everywhere in the country and presents a maximum over Sengal in the Sahelian band from 27 models for RCP8.5 scenario over 2021-2040 period.

Economy and Demography

Ranked among the least developed countries with a current gross domestic product (GDP) of US$23.578 billion with a population growth that has quintupled from 2.8 million in 1960 to 18,032,473 in 2023. Its population had a life expectancy of 67 years in 2017 (World Bank Indicators, 2019). The country is characterized by rapid urbanization with an annual urban population growth of 3.7%. However, the rural population, mainly agricultural, remains the largest part of the population, i.e. 54.8% according to (National Agency for Statistics and Demography, 2014).

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-based stations	5	2*	3	0	5*	2**
upper-air stations	1	0	1	0	1*	0

* Minimum to fulfil GBON requirement. Note that all five surface stations need small investments to ensure continued GBON compliance.
** Minimum to meet the GBON requirement; the location has already been determined; the choice is made on the region of Kaffrine and Kidira.

Table 2: New proposed surface-stations and stations to improve.

Station Type	improve	New
New and improved surface-based stations	Kolda*, Kedougou*, Linguère*, Matam*, Podor*	Kaffrine + Kidira
New and improved upper-air stations	Tambacounda**	None

* These stations-based stations (non-operational 24/7) are not GBON compliant (gaps for time) and require minor investments to improve their operational status. The investment for the improvement of these stations is to increase the staff and renew certain equipment (wind device and real-time transmission system).. (see Figure 4 of this document).

** These Tambacounda Upper-air stations (to improve) Upper Air Station co-administered by Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) and ANACIM which is recommended to be improved in the SOFF.

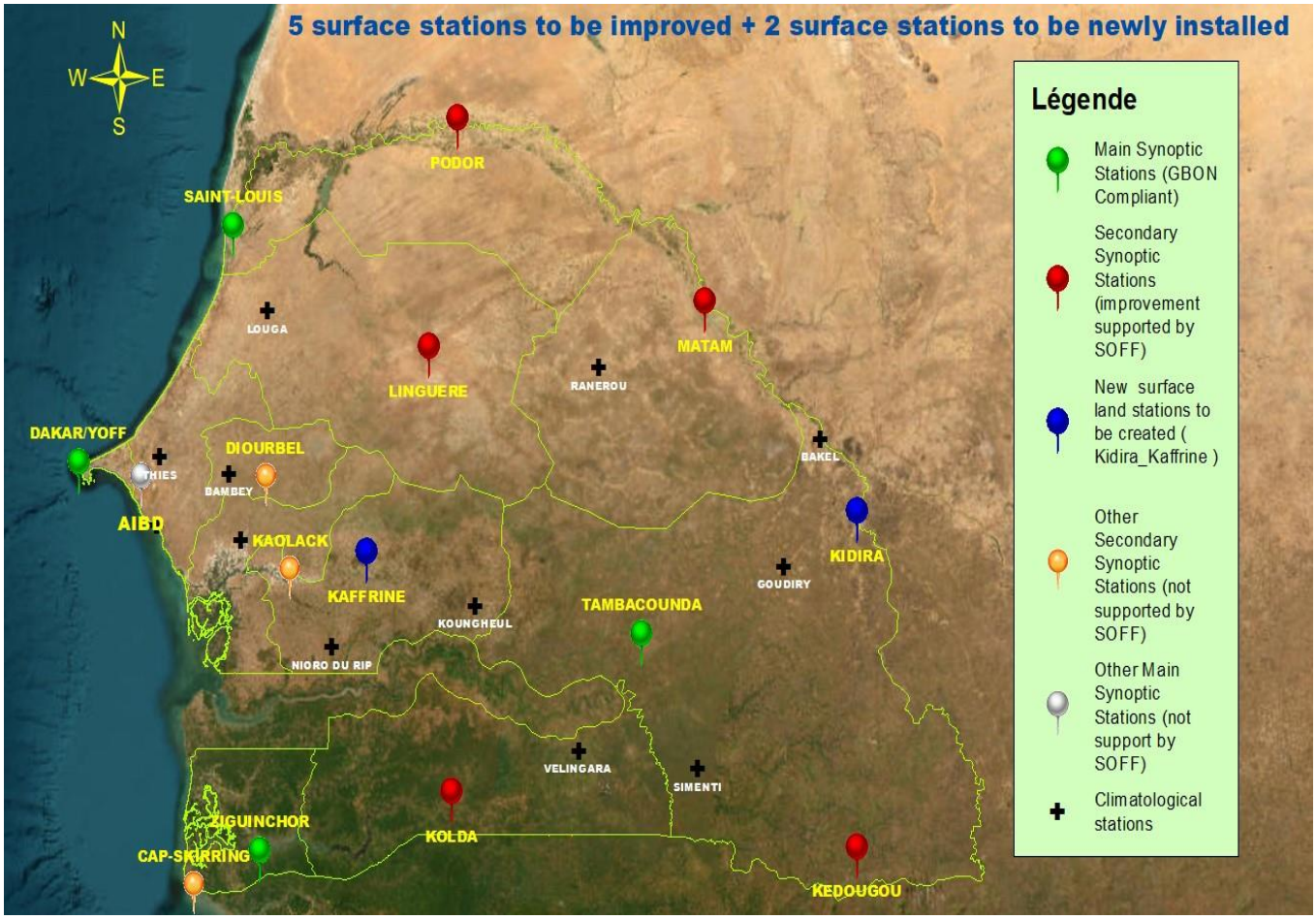

Figure 1: Map of existing and proposed surface and upper-air stations with 200km/500 (diameter) km circles (500km/1000 km for SIDS) (**Fig. 4 and 5**). Map of primary (Green marker, 24/24h) and secondary (red marker orange marker, 19/24h) weather stations in Senegal, as well as climatological stations (black cross, 12/24h) and the blue markings, represent the proposed new stations.

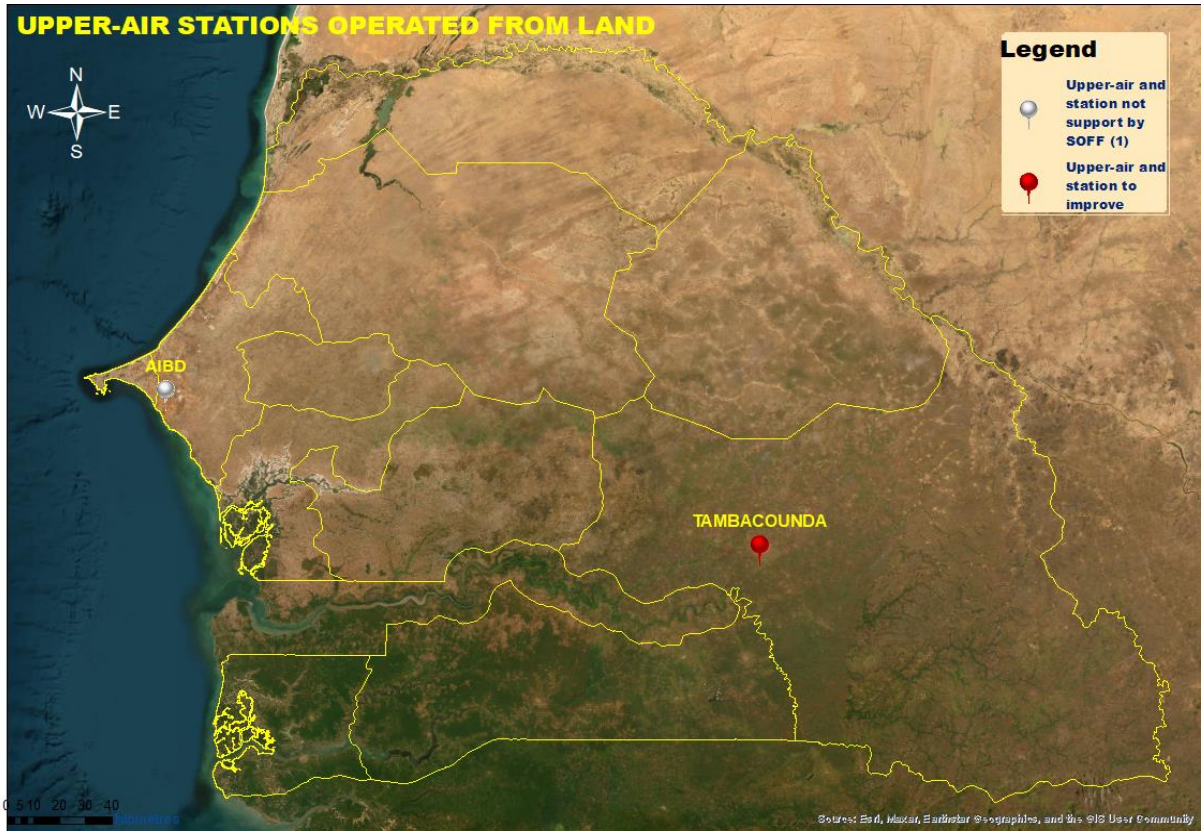

Figure 02: Map of existing Upper-Air stations (Red markers existing, and green markers Proposed stations).

Module 2: GBON business model and institutional development

The business model of ANACIM relies on public-private partnership. This is the model that the organization is recommended to continue with and further strengthen. But this model is subject to regulation defined by the state of Senegal and need funding for improvment.

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

ANACIM is an ex-officio member of the Commissions, Committees, Assemblies and Councils whose purpose relates to its missions, and ensures the application at the national level of the International Standards and Recommended Practices (SARPs) established by the International Civil Aviation Organization (ICAO) and the World Meteorological Organization (WMO).

Private organizations cannot make meteorological observations for their own needs without the guidance of ANACIM. Before starting to collect meteorological observations, ANACIM should be consulted to ensure that the sensors and equipment installation conditions will produce observations of sufficient quality. Technical support can be offered in win/win mode on condition that the data is shared free of charge with ANACIM. For example, ASECNA conducts observations at the Blaise Diagne International Airport (AIBD) to meet aviation safety needs, but all the meteorological data collected is archived in the ANACIM national database.

As a legal entity under public law, placed under the technical supervision of the Ministry of Civil Aviation and Meteorology (ANACIM) and the financial supervision of the Ministry of Finance, the Civil Aviation and Meteorology Authority of Senegal has financial and management autonomy. It is in charge of the management, control and regulation of civil aviation and meteorological activities in

Senegal.

The powers of the National Agency for Civil Aviation and Meteorology (ANACIM) are provided for by Law No. 2015-10 of 4 May 2015 on the Civil Aviation Code and Decree No. 2011-1055 of 28 July 2011 establishing and setting its organizational and operating rules, amended by Decree No. 2015-981 of 10 July 2015.

Its tasks include, among other things, the management of meteorological observation networks on the national territory, the provision of information for the protection of people and property and for added value to climate-dependent economic activities.

To do this, the meteorological service continuously monitors the atmosphere through in situ observations at the level of its observation network but also remotely sensed observations (satellite, radar), analyzes the weather in an operational manner to develop messages, forecast bulletins and also analyzes climate models and historical data to provide climate forecasts.

The weather also receives information from supranational entities such as the climatological bulletins of ACMAD and AGRHYMET, the seasonal forecasts of IRI, NOAA, the outputs of weather forecast models of the major WMO world centers such as ECMWF, Météo-France and the UK Met Office. Given the specificity of this information, reception takes place on an intra-day, daily or monthly basis.

This information is analysed and contributes to the production of information at the national level. It should be noted that the free access to this strategic information provided by the Météo is obtained thanks to collaboration agreements that it has developed with certain donors (USAID, BAD, etc.) and its status as permanent representative to the World Meteorological Organization (WMO).

Apart from ANACIM's network of observations, there is no other private sector that provides meteorological services in Senegal. However, some companies have ground stations that collect data to use for their own purposes. As part of the national implementation of WIGOS, this framework allows for the conclusion of service agreements with ANACIM to provide the data collected and to ensure the level and quality of observations at these stations. The list of private companies with climate weather stations is as follows (abbreviations and acronyms are explained in ANNEX 1):

- SENELEC ;
- ONAS ;
- LPAOSF ;
- DGPRE;
- DA;
- DEEC/CGQA;
- PLANET GUARANTEE;
- DPV ;
- ONAS ;
- ANCAR ;
- ANER ;
- ASECNA.

For a better organization of the approval of the measures, these companies are not allowed to share data directly with the general public. The data must be sent to ANACIM for quality control and archiving. Subsequently, ANACIM may share this data free of charge with any interested party.

ANACIM is recommended to seek further partnerships among this kind of private sector actors to support widening and carrying out GBON compliant observations.

ANACIM has several partnerships with national and international organizations. We distinguish four types of actors in the national chain for meteorological services, linking early warning to rapid action, which are categorized according to the scope of their mission and their role:

a) providers of hydrometeorological information and data (ANACIM and DGPRE), ACMAD, AGHRYMET, ABN and OMVS at the Regional level;

b) Technical sector partners, whose role is to overlay hydrometeorological data on top of their sector data in order to produce a contextualised service or advice adapted to the decision-making needs of planners and communities in their sector. For example, the Directorate of Agriculture, in partnership with ANACIM, will be responsible for contextualizing the sowing date forecasts to produce agro-meteorological advice adapted to each identified and selected sub-zone. The same is true for the planner of the Ministry of Health, who, on the basis of ANACIM's rainfall forecasts, plans their malaria control campaign; It is important to note that the interaction between providers and sectoral partners will take place within the National Framework for Climate Services (CNSC), which will also serve as a platform for dialogue with users within the CNSC.

c) Then there are the communicators and community relays who are in charge of popularizing on a large scale the climate services and various products resulting from the co-production work between ANACIM and the sectoral technical partners. Here, the role of the Early warning system (SAP) and the GTP should be noted as a major vehicle for the large-scale dissemination of early warnings at national and community level. Public media are also involved, as well as rural radio organizations such as the Union of Community Radios of Senegal (URACS) which will have to be trained to communicate climate information for sectoral users through dedicated radio programs. Finally, public community relays, such as rural extension agents, and private community relays, such as Non-Governmental Organizations (NGOs) and parastatal organizations with representations at the community level (Red Cross, World Vision, etc.), will play a fundamental role in ensuring maximum dissemination of the early warnings developed;

d) Finally, end-users at both the national level (sectoral planners and national decision-makers) and the community level (peasants, pastoralists and fishers and other communities vulnerable to climate risks) come as the last links in the national product chain. However, it is recommended that the needs of the latter serve as a guiding principle for the initiative of the National Framework for Climate Services (CNSC), and lead the development of adapted services for effective decision-making. Finally, rigorous monitoring and evaluation of the satisfaction of these end-users with the products provided, one of the feedback channels between users and providers of climate services, will be crucial to the success of the CNSC.

Thus, all these actors are represented in the following summary diagram according to their role in the national chain for climate services in Senegal.

New Potential Partners and Collaborators and Their Role

The mission of the Multidisciplinary Working Group (WPG) is to continuously monitor hydrometeorological and agrosilvopastoral situations in order to contribute to the early warning system in order to alert the community in time in order to avoid or curb food disasters. Since its inception in 1984, it has expanded with the involvement of other services to a more comprehensive newsletter with information on all aspects of the crop year. As a reminder, the GTP initially consisted of only 03 members who are: the National Meteorological Directorate, in charge of coordination, the Agriculture Directorate and the Hydraulic Studies Directorate. With a larger group, technical meetings are held at the end of each decade during the wintering period and field missions are organized to collect data and assess the reality in the terroirs. To this end, bulletins and reports on the agricultural season are published. The GTP is the tool for informing and guiding the Early Warning System for Food Security. At this level, we should be pleased with the encouraging results obtained at the local

level (Kaffrine, Fatick, Koungheul, etc.) and which deserve to be scaled up. While the GTP and SAP are important tools for decision-making, it is important to remember that funding for these is often problematic and justifies a certain lethargy during periods of lack of funding.

In the CNSC, there is a need to strengthen their position for greater production and dissemination of information for better decision-making.

PARM : The Agricultural Risk Management Platform (PARM); set up at the initiative of the G8 and G20 and funded by the European Union, the French Development Agency, the Italian Cooperation and IFAD and provides technical support to governments for the management of agricultural risks and their integration into national investment plans and strategies. In April 2015, Senegal began the PARM process to better integrate agricultural risk management into agricultural policies, strategies and investment plans. This platform is under the supervision of the Ministry of Agriculture and Rural Equipment and brings together the sectors involved in agricultural risk management such as ANACIM, DPV, DA, CSE, DIREL etc.

The ORSEC Plan: The Emergency Organization Plan (Orsec) has a national vocation, it is the preferred relief tool that articulates the various responses of the State to quickly come to the aid of victim populations in times of disaster. The national ORSEC plan is drawn up by the Minister of the Interior, decided and triggered by the Prime Minister. National Flood Management Committee.

The National Flood Management Committee, which is under the supervision of the Ministry of Urban Renewal and the Living Environment, is made up of all the technical services of the administration in charge of flood management. It manages flood situations, the status of the 55 pre-winter operations and the status of implementation of flood management activities. Among other things, it is in charge of "continuing the clipping and mowing of basins, lakes and ponds to increase their storage capacity, finalizing the pre-positioning of the pumping device in flood-prone areas, continuing to raise awareness on hygiene measures and phytosanitary treatment of water bodies, referring the matter to the ministry in charge of infrastructure, especially the AGEROUTE, in order to reduce the inconvenience caused on the main roads and to increase the monitoring of structures, the ANACIM has been asked to provide seasonal forecasts and meteorological information throughout the wintering period.

The Executive Secretariat/National Council for Food Security (SE/CNSA): Under the supervision of the Prime Minister's Office, this structure coordinates a multidisciplinary reflection group for the revision of the national food security strategy with the support of the FAO. Its mission is to:

a) Collect information on food security;

b) Analyze this information and bring it to the authorities for decision;

c) Coordinate the actions of the various structures that contribute to food security;

d) Prepare an annual report on food security;

e) Monitoring and evaluating projects and programmes that contribute to food security.

The National Committee on Climate Change (COMNACC): The COMNACC established by decree is a very dynamic structure that plays a role of information, awareness-raising, training and facilitation in the design, financing, implementation, validation and monitoring of national, sub-regional and regional programmes and projects relating to the priority areas of climate change. In this capacity, it regularly produces national reports on the issues at stake in the negotiations and takes part in the sessions of the Conference of the Parties to the United Nations Framework Convention on Climate Change. It can be used to better integrate climate science into the direction of the negotiations. Similarly, COMNACC is a multidisciplinary framework, in which various institutional actors are represented, which positions it as a communication channel that can reach several institutional actors that are targets of the national framework for climate services.

Non-Governmental Organizations (NGOs): Among the NGOs, the following may be noted:

a) ENDA Energy ;

b) Wetlands International Sénégal ;

c) World Union for Conservation of Nature (UICN) ;

d) Red Cross (Croix Rouge);

e) Federations of Non-Governmental Organizations (FONGS) ;

f) Council of Non-Governmental Organizations (CONGAD) As a result of experiences in the field and approaches that make it possible to better assess the needs of populations and actors, these actors are located at different levels of the system.

ASECNA has an operational calibration laboratory to serve Senegal and the sub-region. At the same time, ANACIM plans to invest in calibration equipment and initiate operational calibration activities for its observation network. Collaboration to build human capacity in the field of calibration is considered to be of critical importance for national meteorological services in the West African region.

ASECNA is developing a lot of ways to assist member countries, it has set up a system for distributing data through a VPN network. A protocol has been signed between ANACIM and ASECNA to allow the technicians of the two entities to pool their efforts for the installation and calibration of barometers not used due to lack of calibration.

2.2 Assessment of potential GBON sub-regional collaboration

Sub-regional collaboration for GBON is currently limited to the exchange of experience through workshops.

ASECNA has a calibration laboratory, which is operational to serve all member countries [1](Benin, Burkina Faso, Cameroon, Central African Republic, Comoros, Congo, Côte d'Ivoire, Gabon, Guinea Bissau, Equatorial Guinea, Madagascar, Mali, Mauritania, Niger, Senegal, Chad and Togo) of the said organization including Senegal. At the same time, ANACIM is working on a project to acquire calibration equipment and to launch operational calibration activities for its own equipment.

The advantage of hosting ASECNA's headquarters and its technical directorate has allowed Senegal to benefit from the assistance and support of ASECNA's expertise in the technical field. It is in this perspective that ASECNA is strongly involved in the implementation of WIS2.0 for which it will have the technical management of the installations and hosting of the dedicated servers.

The Tambacounda station is fully equipped by ASECNA. This station operates 24 hours a day and provides surface and aloft observations. It is a station administered and managed by ANACIM.

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

ANACIM has a total budget in 2023 of eight billion seven hundred and four fourteen two hundred and ninety-three (8,794,293,837 CFA francs or $US 14,762,958), of which 93.18% of direct public credits are taken into account. The remaining 6.82% comes from revenue from the provision of weather information and partners mainly in the field of agricultural insurance. In recent years, ANACIM's budget has remained stable with no significant increase or decrease. Currently, roughly half of this budget is needed for operating and maintaining the observations and processing of the data. This includes only a small budget (~100 kUS$) for replacement of sensors.

Due to the Covid-19 pandemic, the budget has been reduced, with no direct impact on the overall functioning of the service (payroll, staff). The maintenance, rehabilitation and construction of infrastructure and observation stations and automatic station installations were possible with the support of ANACIM's financial partners.

[1] MEMBER STATES OF ASECNA

ANACIM must guarantee the development of products identified by the beneficiaries and not yet realized. Strengthen the capacity of the meteorological service both in terms of skills/human resources and equipment required to ensure the development of climate services. Finally, strengthen the storage and analysis capacity of weather and climate databases.

The Compagnie Nationale d'Assurance Agricole du Sénégal (CNAAS) has been collaborating with ANACIM since 2011 in terms of technical and scientific support for the development of index-based agricultural insurance in Senegal. Indeed, as part of this activity, ANACIM had to install more than a hundred automatic rainfall stations. In addition, ANACIM is responsible for the management of these stations (maintenance) and also for the collection of data that is transmitted at the end of each year for the calculation of the index. ANACIM will look into the possibility of developing this collaboration into a business model for additional GBON stations in Senegal.

It is estimated that an additional investment by SOFF of between 8 and 9 M US$ is required in the coming years for the improvement of existing stations, addition of two new surface stations, training of personnel, setting up the calibration facilities and operation and maintainence of the stations in order to fully comply to GBON. This budget will be detailed in the SOFF investment phase funding request.

Operation and maintainance of the observation network after this implementation period is planned to be covered by the regular budget of ANACIM with an additional contribution from SOFF to be specified later.

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

The implementation of the projects has undoubtedly produced significant gains in the area of human capacity building and weather equipment. But being limited in time, these projects are doomed to failure if there are no means to sustain the gains.

The most relevant projects are those that are part of the win/win framework, such as the agricultural research institutes and insurance companies that support ANACIM for the acquisition of weather equipment in exchange for benefiting from free weather data.

With regard to the financing of operational activities and the acquisition of equipment, the Government of Senegal plays a very important role. Some weather stations located at or near aerodromes make a significant contribution to air traffic safety. This is why there is a great deal of technical and financial collaboration between ANACIM and the authority managing Senegal's airport activities.

In particular, Automatic Weather Stations (AWS) have been installed over the past seven years on various projects (listed below) and acquired through various tendering processes. As a result, the network is not homogeneous, but the types of sensors appear to be comparable. The data is recorded every 10 minutes and sent to a central database at the Directorate of Meteorological Operations (DEM). Manual stations are managed by observers, who collect data every hour.

On-going projects to support ANACIM in its efforts towards GBON compliance (abbreviations and acronyms are explained in ANNEX 1):

1) ACASIS : Alert to Heatwaves in the Sahel and their Health Impacts;
2) AICCRA : Accelerating Impacts of CGIAR Climate Research For Africa;
3) AMMA 2050;
4) AVENIR 2022;
5) OMM CREWS;
6) PRGTE;
7) CLIMDEV;

8) ADM;

9) REVARD;

10) PROVAL CV;

11) OSIRIS;

12) PCE;

13) PAM;

14) Projet « 4R » PAM;

15) SWIFT (Science for Weather Information and Forecasting Techniques);

16) The Support Project to the National Agricultural Insurance Company of Senegal (CNAAS) for the Strengthening of Resilience in WAEMU Countries (CNAAS-BOAD);

17) Project to promote innovative finance and community adaptation in municipalities around community nature reserves (PFNAC).

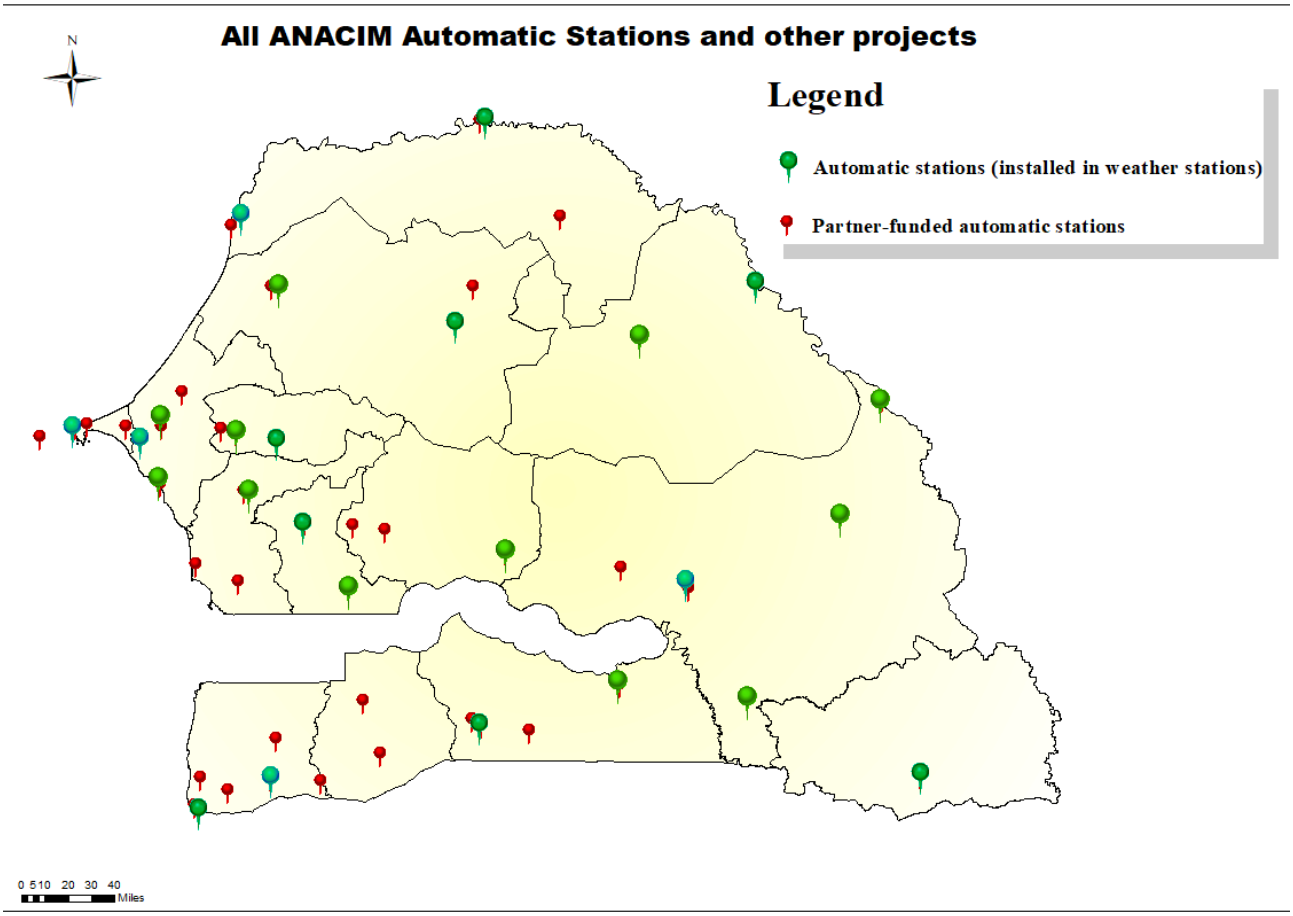

Figure 03: *Automatic stations installed at ANACIM weather stations but are not registered for the WIGOS Data Quality Monitoring System (WDQMS)*

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 (AMS) 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 Branch (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.

These projects are executed by ANACIM technical staff and most of them work on multiple projects of similar nature. It is important that ANACIM ensures consistency and continuity of the technologies applied (incl. IT) by applying strict selection criteria for new infrastructure and by adhering to the long-term strategic plan for the future observation network.

2.5 Review of the national legislation of relevance for GBON

The institutional development of ANACIM from 1827 to the present day:

- from 1827-1863: The meteorological observations started in Saint-Louis, Goree, Bakel and Dagana; from 1863: creation of the first weather station in St. Louis;
- from 1959 : The weather service was integrated with ASECNA, a regional body (14 Francophone countries), which had been created in St. Louis December 12, 1959 for the Safety of Air Navigation;
- from 1960 : Section Weather: It was responsible for liaising between the Senegalese Government, the World Meteorological Organization and the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA);
- From 1966 : Office Meteorology;
- from 1970 : Division of Meteorology; from 1975 : National Meteorological Service (SMN) ;
- from 1979 : National Directorate of Meteorology (DMN). It is this structure which has prevailed until May 2008 and which led, with the restructuring process began in 2004, the creation of the National Agency of Meteorology Senegal (ANAMS);
- from 2011: National Agency for Civil Aviation and Meteorology (ANACIM) established on 28 july 2011 by Presidential Decree No. 2011-1055 of 28 July 2011[2].

Since its inception the meteorological service represents Senegal as a member of the World Meteorological Organization and works under the authority of the ANACIM Civil Aviation and Meteorology Authority (ANACIM).

Its missions include, among other things, the management of meteorological observation networks on the national territory, the provision of information for the protection of people and property and for added value to climate-dependent economic activities.

In Senegal, the government has agreed to pay customs duty on all weather equipment acquired by ANACIM through purchase or donation. Only AWS weather equipment and sensors are exempt from VAT by the government.

It is recommended that ANACIM apply for the exemption from VAT for computer equipment.

To ensure the proper functioning and delivery of climate services, it is imperative to organize and regulate the various activities of meteorology: from the establishment and management of stations to the provision of services. To this end, a code on the exploitation of meteorological activities is currently being drafted (draft of the code already available).

Related to data policies: ANACIM will make observational data from stations that have been established or have been upgraded through SOFF open and freely available, cf WMO Unified Data Policy.

RECOMMENDED ACTIVITIES MODULE 2:

It is recommended that ANACIM revitalize its technical sectoral partners (Air Transport, Agricultural Insurance, Directorate of Agriculture , etc.) whose role is to superimpose meteorological data on their

[2] ANACIM | Agence Nationale de l'Aviation Civile et de la Météorologie

sectoral data in order to produce a contextualized service or advice adapted to the decision-making needs of planners and communities in their sector.

ANACIM has already concluded memoranda of understanding with the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) in the technical and training field. A barometer calibration program should be developed to enable ANACIM technicians to perform the appropriate calibration and adjustment to eliminate systematic errors in measuring instruments. These MOUs may be revised to include clauses that allow for the extension of the ASECNA VPN to the ANACIM centre in order to make data available to WIS 2.0 and to address the low rate of transmission from stations to the Global Telecommunication System (**GTS**).

It is recommended that ANACIM develops an effective communication and outreach strategy to execute the WIGOS National implementation plan following the establishment of the WIGOS Senegal National Component. If WIGOS is operational, ANACIM will be able to take advantage of possible private sector funding for the maintenance of the weather stations for which it is responsible. This funding can then be used to upgrade existing stations. Partnering with the private sector provides an opportunity to leverage the private sector's ability to procure needed infrastructure faster than the public sector.

Module 3: Infrastructure development

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

The objective of the SOFF investment phase project is to maximize the impact of the observations on the overall figures. Proficiency in Weather Forecasting (NWP) through:

- Installation or rehabilitation of upper air sounding stations;
- The installation of surface weather stations in areas that are clearly under-observed;
- Sub-regional optimization of network design.

Senegal and the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) signed an agreement in 1960 for the establishment of meteorological stations. From this date, aeronautical meteorological services are provided by the Civil Aviation and Meteorological Administrations of ASECNA.

This agreement has enabled Senegal to benefit from the infrastructure (Surface-Station and Upper-air) in Senegal's airports and aerodromes. ASECNA's objective was not only to build infrastructure but also to contribute to the development of meteorology in Senegal and to the training of meteorological personnel.

In 1974, by mutual agreement with ASECNA, the State of Senegal took over all the stations except for the one at Dakar Yoff International Airport, which remains administered by ASECNA. The collaboration with ASECNA has enabled surface observation stations and upper air stations to be potential GBON weather stations and transmit weather data to the Global Telecommunication System (GTS) and WIS centres.

Two new surface-based stations and eight surface-based stations to be improved(Table I).
A study of the current spatial and temporal resolution of ANACIM's network of weather stations revealed the following shortcomings:

In the central and southern parts of the country, the horizontal resolution complies well with the regulations, but towards the north and east, the horizontal resolution is low (Figure 01). We propose the creation of two (2) additional stations that will be added to the GBON network in this area to correct the horizontal resolution at 200 km in GBON compliance.

Of the thirteen (13) stations, only five (5) operate continuously 24/24 and another eight (8) operate 19/24 discontinuous. This is a gap that needs to be corrected.

Only five (5) stations are equipped with operational wind devices. For the other eight (8) stations, the wind is estimated.

The hardware investment required under the SOFF program will include new wind sensors and data loggers.

Small improvements are needed for each of the five (5) GBON compliant stations. 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 planned to replace the sonic anemometers with the more robust classical windobservation equipment.

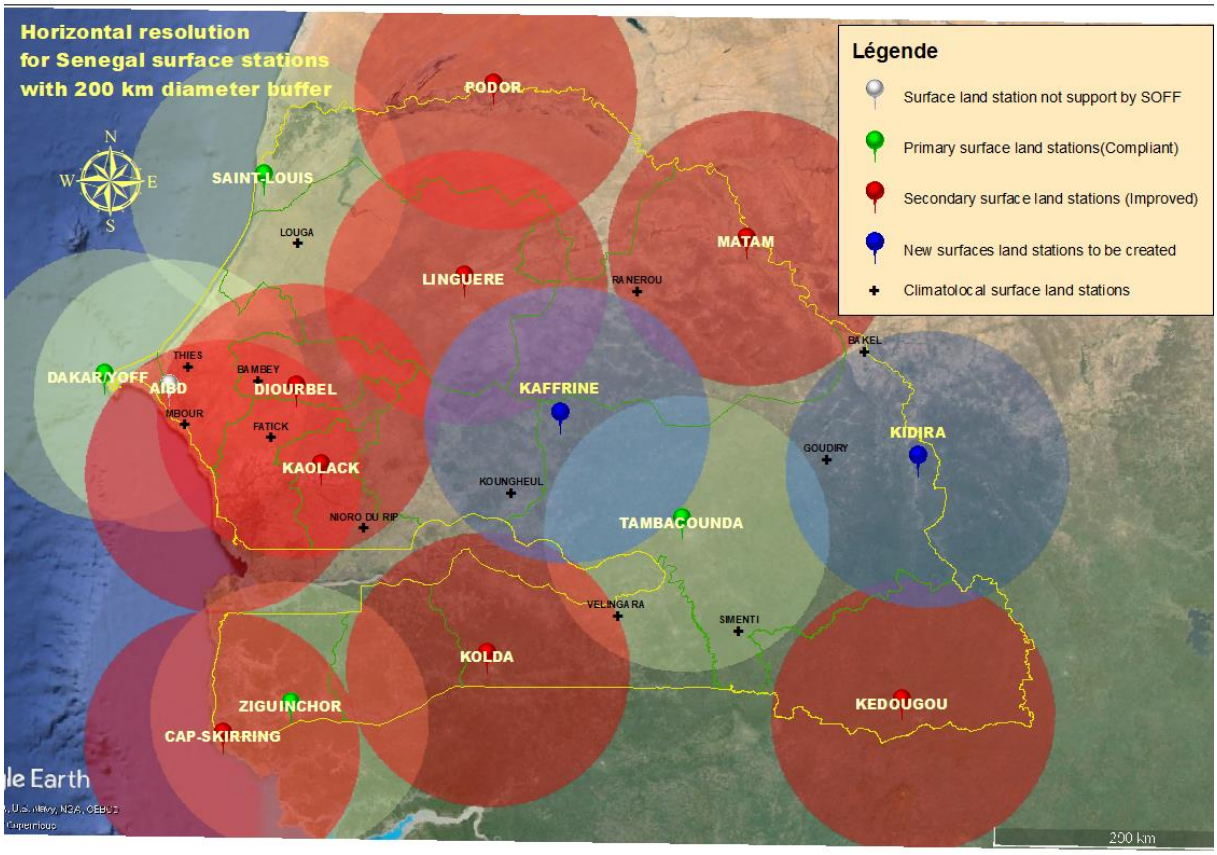

Figure 04 *: primary and secondary surface stations in Senegal, with 200 km diameter buffer. Areas which are not covered by the buffer represent regions where surface stations are more than 200 km apart, and therefore do not meet the GBON horizontal resolution.*

In particular, Automatic Weather Stations (AWS) have been installed over the past seven years under various projects (e.g. agricultural insurance, various projects) and acquired through different tendering processes. As a result, the network is not homogeneous, but the types of sensors appear to be comparable. The data is recorded every 10 minutes and sent to a central database at the Directorate of Meteorological Operations (DEM). Manual stations are managed by observers, who collect data every hour.

The failure rate of meteorological instruments in the observation network is very high due to the lack of maintenance and renewal of the meteorological park. We can even say that the instruments of all the stations need to be renewed. ANACIM has begun a policy of banning mercury by replacing mercury-based equipment with electronic equipment, but much remains to be done. Before entering the SOFF investment phase, the project execution team must evaluate the capital and operating budget (as indicated in the gap analysis).

The new or improved surface stations will be equipped with instruments according WMO technical specifications and recommendations for Tender of equipment (*link*).

Two improved Upper-air sounding stations

Senegal has two upper-air observation sites located at AIBD and Tambacounda (**Fig 02 and Fig 05**). One of the two stations is administered by the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) and operates (balloon launch) twice a day: 00 and 12 UTC.
The Upper Air station in Tambacounda that will be improved will be equipped with instruments according WMO technical specifications and recommendations for Tender of equipment (*link*).

Tree improved Upper-air stations (pilot probe)

Previously, all major ground-based synoptic observing stations conducted the pilot's manual sounding twice daily at 17 and 06 UTC, but for several years these observations have not been made due to the absence or failure of equipment.

ANACIM would like to see the resumption and rehabilitation of upper-air stations (pilot's manual sounding) for these different reasons:

- ✓ Assimilation of wind data into forecast models;
- ✓ Operators who request data for study purposes in the wind energy sector;
- ✓ Satisfying the demand in the aviation sector.

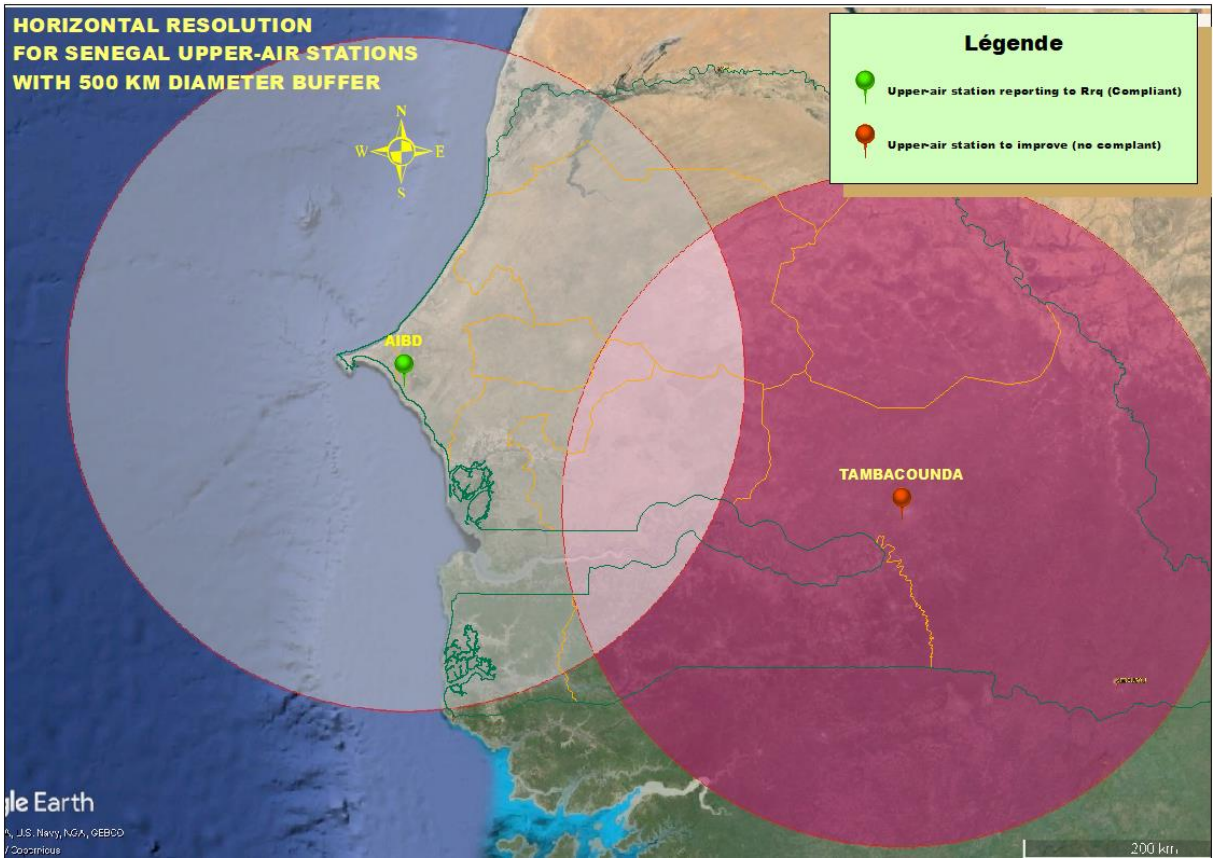

Figure 05 *Map of functioning upper air in Senegal, with 500 km diameter buffer. Areas which are not covered by the buffer represent regions where surface stations are more than 500 km apart, and therefore do not meet the GBON horizontal resolution.*

As these manual pilot probes are not strictly part of the GBON requirements they will not be eligible for funding through SOFF, and other funding to restore these stations will be sought for.

Establishment of the National target toward GBON compliance

- In order to correct the shortcoming of the horizontal resolution, it is necessary to create new and improved surface-based stations in the Kaffrine region and the Kidira department for addition to the GBON (**Figure 04**).
- Small improvements are needed for each of the five (5) GBON compliant stations. 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 planned to replace the sonic anemometers with the more robust classical windobservation equipment.
- Small improvements are needed for the Tambacounda station. The equipment already exists, but there is a lack of fungal products and technical staff for the hydrogen room.
- Senegal does not have any marine stations, given the extent of the sea coast and the importance of maritime and fishing activities; we propose the creation of three (3) marine weather stations in Dakar, Saint Louis and Carabane. As well as the reactivation of the sounding pilots that were carried out by the coastal stations of Saint Louis, Ziguinchor and Dakar. It is realized that currently, marine stations are not eligible for SOFF funding.

Observational practice:

Measurements are done manually; there is a quality control system to ensure the quality of the data. However, many staff members are not sufficiently trained to maintain the equipment. Automatic weather stations are not currently integrated into the GBON observing network.

A Maintenance Plan for existing and improved/new stations is currently lacking. ANACIM does not have a calibration laboratory but collaborates with ASECNA for the installation of certain equipment (e.g. barometers). ANACIM will prepare and implement a network maintenance plan that includes regular sensor calibrations."

All stations have a power supply, but currently only stations located in airports are equipped with generators for the event of a power failure. To mitigate the effect of power outage, all stations will be equipped with a power backup system.

Communications are made by telephone or internet. Installation of an RSTFA/SMT network, necessary to avoid the difficulties of transmitting Senegal's data on the global network. With the RSTFA/SMT network, the transmission of data will be done in a direct way, thus avoiding any delay and risk of degradation of the information to users and its transmission over the global network.

3.2. Design of the ICT infrastructure and services

ANACIM has a Datacenter supported by two 165 KVA power generators and 30 KVA inverters to ensure the high availability of electrical energy.

The data center consists of servers configured under a virtual environment. These include a server that provides the domain controller, the mail server, the server for collecting automatic stations, the server containing the CLIDATA weather database and other applications servers in the field of meteorology and aeronautics.

The IT and telecom architecture is secured by the following security equipment:

- An ASA firewall to provide network filtering;
- Two features for web filtering and bandwidth management;
- A C195 ironport for spam filtering;
- Antivirus server and Kaspersky Endpoint clients to enhance desktop security;

A demilitarized zone (DMZ) is configured to house externally visible servers to further protect production servers from cyberattacks.

To ensure the collection, processing and dissemination of meteorological products, ANACIM has two fiber optic lines with a symmetrical rate of 20 MB.

More than 16 weather stations are interconnected via VPN at ANACIM headquarters to facilitate the reporting of weather data.

Technical specifications of the data collection system from the observation station to the collection point

The stations that are interconnected to the ANACIM headquarters report the data collected via a Monthly climatological table (TCM) form with all the parameters (temperature, pressure, humidity; sunshine, wind speed and direction, precipitation, etc.).

As part of the implementation of WIGOS, ANACIM has undertaken the deployment of the WMO information system (WIS2.0) in all weather stations in Senegal. The system is installed in a virtual environment with redundancy from another server. Training and deployment will take place at the station level. This system, which will be deployed in a web version, will strengthen the collection of weather data.

Once the data has been collected, it is transmitted by telephone to the headquarters for archiving and to the Regional Transmission Centre (CRT) in Blaise Diagne International Airport (AIBD) for further transmission to the Global Telecommunication System [and the WIS Global Information System Centers (GISC) via the ASECNA transmission centre.

Meteorological documents for archiving prepared at stations are generally mailed to the Meteorological Operations Branch for archiving. Errors may occur as a result of the loss of mail due to difficulties in getting it to headquarters. Bad weather or technical problems may result in documents and information not being transmitted on time.

There is also the digitization of the Monthly Climatological Table (TCM) and its deployment which is effective at the level of nine (09) stations, allowing the daily reporting of data measured at the stations. This is made even easier with the interconnection of several weather stations to ANACIM's VPN. This automation of data reporting reduces the margins of error with automated control rules, developed by the department in charge of the Meteorological Information System. Interconnection should continue and the electronic Monthly Climate Table (MCT) should be deployed at all stations for near-real-time availability of information.

Technical specifications of the data collection system from the observation station to the collection point Our approach, which is compatible with the requirements of WIS 2.0, is structured as follows:

1) Use of web applications for the dissemination of weather and climate information, products and services, taking into account the needs of users and technological developments. In addition, users have different web solutions to access data, products and services;
2) ANACIM also has different web pages, a mobile application and an API for feeding external applications (external partners: startups, projects, etc.).
3) ANACIM has high-speed internet connections In addition, the ANACIM and dedicated links for the transfer and/or reception of large amounts of data;
3) Data, products and services accessible to users from our web platforms can also be downloaded. With adequate storage space, this information can be stored for a sufficient period of time to allow the user to access and download content;
4) The metadata of our stations is also filled in and stored on Oscar surface.

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

- ✓ Installation of a state-of-the-art data center with 2 HPCs:
- ✓ IT Brigade System for Monitoring and Alerting;
- ✓ Redundancy of electrical infrastructure (inverters, generators);
- ✓ Periodic and external database backups;
- ✓ Outsourcing of certain servers and services to Senegal Numérique (formerly Agence de l'Informatique de l'Etat) and to external suppliers.

3.3. Design the data management system

The central database used by ANACIM for climate data is Clidata. The data is entered daily by operators through the Clidata server. Climatological tables are extracted from the database automatically.
Currently, an SMS (short message service) from ASECNA is used to send observational station data to GTS. Implementation of WIS2.0 is in progress managed by ASECNA. ANACIM developed an API to send data to the World Weather Information Service (WWIS), and developed and implemented an extranet that could be used to send data to WIS. External users of the data can get access through ftp, extranet, API's, and email.

More details are given below.

a. Short-term storage and access of data through the services and protocols required by applications for domestic and international business activities:

Some of the data and observations are several years old and are different in nature. It exists in the form of handwritten papers or diagrams. Eventually these archives should be digitized before the paper degrades and become unreadable.

Also, there are often gaps in the data due to the absence of measurements for certain periods (sometimes there are several days of missing data for a year).

However, ANACIM has a meteorological database management system (Clidata) as well as other platforms to ensure:

- Backup: storage arrays are installed at the data center and allow large amounts of data to be backed up;
- API: Developed to automatically make weather information available to other external client applications;
- Web platforms: different platforms have been developed for better user access to meteorological information. Among these platforms: the climate geoportal, the ENACTS portal, SAEMA, the extranet, etc.

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

- Data from the Manual Network: ANACIM has twenty-five (25) ground-based observation stations, including thirteen (13) synoptic and twelve (twelve) climatological;
- Automatic Network data: we have automatic stations spread throughout the national territory. These are mainly stations manufactured by ADCON and Pulsonic;
- Satellite and global data;

The data collected through the WIS system is stored in the storage array installed at ASECNA. However, ANACIM can create a communication channel with ASECNA to transfer them and ensure a second storage at ANACIM.

c. Transmission of data to the national data management system :

Data from the observation network are collected from ANACIM headquarters by telephone. A collection office has been set up and is in charge of this task. At the end of each month, documents (Monthly climatological table (TCMs) and observation books) from the entire observation network are sent to headquarters.
The information contained in these documents is entered into Clidata by the data entry operators at the service level in charge of the meteorological database through the clidata software package which operates in client/server mode. Controls are in place to ensure the quality of the data.
For the automatic network, a system of automatic data centralization has been set up by the department in charge of the meteorological database. Subsequently, this data is processed and exported to the automatic station database. Finally, the data is also transmitted to the CDMS through the processing of electronic Monthly climatological table (TCMs) and the extraction and export of the data to the meteorological database.

d. Descriptive Metadata Discovery & Management, Data Monitoring, Processing, and Services:

The data resulting from the collection is stored in the database servers of the CLIDATA system. The Technical Department ensures the regular backup of these database servers.

e. Descriptive and discovery metadata management

The Clidata software package used for the management of meteorological data includes a metadata management module. But there is also the WMO Oscar Surface web solution that also allows metadata management.

f. Monitoring of data, processing and services

Mechanisms are in place to monitor the data. Indeed, a stationary station constitutes a risk of data loss, it is imperative to check and set up alert systems. The data that ANACIM receives from its sources is processed before being stored.

3.4. Environmental and sustainability considerations

Local generation of hydrogen will limit transportation needs to be considered. Limiting energy consumption will also be a factor to consider chosing computer equipment and the designing the offices for the emplyees operating the station. Regular maintenance of sensors and other equipment as well as proper security measures will avoid unnecessary replacements of hardware.
In general, sustainability and limiting of the usage of material and energy will be important factors in procurement decisions and maintenance and calibration practice of the stations.

RECOMMENDED ACTIVITIES MODULE 3:

Install near real-time connection to the global WMO Information System (WIS2.0) at all 15 surface stations and 2 upper air stations. Based on the WMO GBON requirements, 5 of the 13 stations assigned as GBON stations meet all WMO specifications for parameter measurement and transmissions to the GTS, but the remaining remaining stations do not meet the hourly data transmission requirements. The automatic stations (AWS) installed in the stations do not transmit in real time to the GTS but provide additional information for manual observations. These AWS observations should also be linked to WIS2.0

Installation of an RSTFA/SMT network, necessary to meet the dificulties of transmitting Senegal's data on the global network. With the RSTFA/SMT network, the transmission of data will be done in a direct way, thus avoiding any delay and risk of degradation of the information to users and its transmission over the global network.

Set up a network of stations through the VPN system that will allow the stations to transmit directly into the global SMT network via the ASECNA transmission center that operates 24 hours a day. This is essential for verification of observations and the reporting of data in real time.

Plan and Set-up calibration and maintenance facilities, including means of transport, secure storage spaces, supporting software, spare parts and tools, etc.

The number of new surface stations to be constructed as well as the 8 surface stations and 2 upland stations to be upgraded are shown in Annex 1 of the gap analysis for the GBON. The equipment and rehabilitation of ground stations and the staff to be recruited are indicated in Annex 1 of the GBON gap analysis.

Module 4: Assessment of human capacity gaps

4.1 Assessment of human capacity gaps

The Directorate of Meteorological Operations of ANACIM has 128 agents; 112 men and 16 women. The breakdown by department is as follows:

IT staff includes:

- Two (02) telecommunications engineers;
- One (01) Microcomputer Engineer;
- Three (03) Senior Technicians ;

The meteorological department brings together:

- Sixteen (16) Meteorological Engineers;
- twelve (12) Senior Meteorological Technicians (TS);
- Eighty-nine (89) Meteorological Technicians (TMs);

The technical service brings together:

- two (02) Maintenance Engineers;
- three (03) maintenance technicians;

Many of these meteorological technicians are not qualified. This state of affairs is the consequence of the recruitment of volunteers who have served several years in the network and who have acquired know-how, thus benefiting from replacement contracts. When there have been temporary departures on leave or retirement or the creation of new observation sites, the operational volunteer staff has been put to good use and this has created staff who know how to observe from experience, but unfortunately do not have the diploma to retrain them.

A very small number of observers (15%) have received prior training in meteorology. The remaining observers have not received any training or basic information on the spot, either from former observers or from service technicians. Observation is considered secondary work and is of no importance.

Staff information	Total number	
Managers (All administartion support staff)	9	
Met (Focasters, Met Aplication, Data quality)	34	
Met Tech (Observation officers and supervisors, instruments Maintenance)	75	
Research	2	
Technology and information (IT)	6	
Others (Administration, Data collectors)	2	
Total current employee	128	
Staff Disagreted by Gender	**Number**	**Percentage**
Male	112	88%
Femele	16	12%

Table 3 The number of staff members in different tasks in ANACIM

In terms of personnel, the biggest challenge is to recruit qualified specialists in the field of meteorology. There is no school in the country that offers degrees in meteorology. The Directorate of Meteorological exploitation (DEM) has to train meteorological observers because there is a lack of personnel in this sector. In addition, the majority of the staff on duty are unqualified. Another aspect that requires special attention is the upgrading of knowledge and renewal of meteorological

observers, as a large proportion of employees are over 57 years of age (45%), in fact constituting the largest age group. This substantial experience and knowledge will need to be acquired and developed in the medium term. There is a need to expand training and upgrading of knowledge for service technicians. It is particularly difficult to find qualified technicians with sufficient maintenance skills and specialized for weather instruments as well as engineers to properly maintain and renew the observation infrastructure.

As a result, inspection and maintenance missions are not regularly carried out due to the lack of maintenance and inspection schedules, which is essential for the proper functioning of equipment and the monitoring of personnel.

The engineers and senior technicians are all graduates of African School of Meteorology and Civil Aviation (EAMAC) or the Hydrometeorological Institute for Training and Research (LH. F.R.) from Algeria and hold a university degree or equivalent.

ANACIM does not have a gender policy. The gender balance rate is very unfavourable to women by 16 (12 percent) and 112 (88 percent) respectively. On the basis of competence, women occupy high positions of responsibility like men.

4.2 Design capacity development activities for technical staff

It is now that ANACIM is in the process of executing the quality management system implementation program. It is strongly recommended that ANACIM develop the Quality Management System Capacity Building Process to improve the Capacity Building process by following the WMO Recommendations (No. 1205).[3]

As a result, ANACIM is in the process of implementing a training plan for its staff in preparation for the implementation of the QMS. There is a need to expand training and upgrading of knowledge for service technicians. It is particularly difficult to find qualified technicians with sufficient specialized maintenance skills for weather instruments and engineers to properly maintain and renew the observation infrastructure. As a result, inspection and maintenance missions are not regularly carried out due to the lack of a maintenance and inspection schedule, which is essential for the proper functioning of equipment and the monitoring of personnel.

The agreements signed with ASECNA in the framework of staff capacity building will enable ANACIM to acquire minimum competencies in relation to WMO guidelines.

a) Quality management system (QMS):

It is imperative that ANACIM has a process-based and clearly demonstrable quality management system. The adoption of a quality approach to the products and services provided by NMHSs has been driven by a number of imperatives, including the requirements of WMO and the International Civil Aviation Organization (ICAO) for the provision of aviation meteorological services. If the prolonged absence of the QMS exposes ANACIM to non-compliance. Once the QMS is in place, it is recommended that ANACIM attach greater importance to the quality management system processes and related documentation. The model process matrix in Appendix 3 (WMO-No. 1100) is very useful in identifying and meeting the requirements of this article. This matrix contains useful elements for demonstrating the processes on which the quality management system is based. It is also a good planning tool in that it helps to define the requirements for other items, such as risk, planning, resources, and monitoring and measuring the results achieved by the system. The process matrix can also be useful in an audit.

b) Data archiving:

[3] Guidelines for Public-Private Engagement (wmo.int)

The Clidata software package used for the management of meteorological data includes a metadata management module. But there is also the WMO Oscar Surface web solution that also allows metadata management. The data resulting from the collection is stored in the database servers of the CLIDATA system. The Technical Department ensures the regular backup of these database servers.

c) Data transfer:

Data from the observation network are collected from ANACIM headquarters by telephone. A collection office has been set up and is in charge of this task. At the end of each month, documents (TCMs and notebooks) from the entire observation network are sent to headquarters. The information contained in these documents is entered into Clidata by the data entry operators at the service level in charge of the meteorological database through the clidata software package which operates in client/server mode. Controls are in place to ensure the quality of the data. For the network of automatic stations, a system of GPRS transfer and automatic centralization of data has been set up by the service in charge of the meteorological database. Subsequently, this data is processed and exported to the database dedicated to automatic stations.

Finally, the data is also transmitted to the CDMS through the processing of electronic Monthly climatological table (TCM) and the extraction and export of the data to the meteorological database.

d) Data quality control and assurance:

Basic programming skills and scientific understanding must be upgraded to a sufficient level to apply quality assurance and quality control methods and algorithms. Relevant staff need capacity building to manage the scientific context that underpins the different quality assurance and quality control methods. Benchmarking the quality assurance and quality control methods of other dedicated organizations would bring substantial benefits to ANACIM. A roadmap for the implementation of relevant automatic quality assurance and quality control methods should be developed.

e) Instrument and station maintenance at site:

In recent years, ANACIM has made changes in the procurement of equipment by inserting performance and performance clauses in the provisions of the specifications for the launch of contracts. Among other clauses, it is requested the installation and on-site training of technicians in charge of monitoring and maintaining the equipment.

At the time of the launch of the contract, the Builder undertakes to provide a performance and performance guarantee. It shall be ten (10) per cent of the original amount of the contract plus or minus, as the case may be, its amendments. It will be a first-demand guarantee issued by a banking institution licensed in the country and acceptable to it.

The absence of a performance and performance guarantee, or if necessary an increase in performance, precludes the payment of the sums due to the Manufacturer, including the lump sum start-up advance.

The amount of the performance bond will be reduced by five percent (5%) after the provisional acceptance of the services, materialized by a provisional acceptance report.

The guarantee of good performance and performance remains assigned to the guarantee of the commitments entered into by the "Supplier" or the "Contractor" until the final acceptance of the Services, materialized by a Final Acceptance Report.

In any event, the performance and performance bond must be released no later than three (3) months after the expiry of the warranty period. ANACIM undertakes to return the original warranty to the "Supplier" or "the Holder" within thirty (30) days of its release.

f) Calibration and maintenance at workshop:

In Senegal, the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) is responsible for the calibration of weather observation sensors. All calibration and verification services are carried out according to their standard operating procedures. These SOPs guarantee the quality

and reproducibility of their interventions in ASECNA member countries, including Senegal. For several years, ASECNA has been committed to a quality approach that has focused on the main business processes such as quality circles and training of laboratory staff with regard to the ISO 17025 [4]standard for Accreditation among others.

Our technicians regularly participate in training workshops organized by ASECNA or the Metrology Laboratory of the National Meteorological Directorate of Morocco (World Meteorological Organization Regional Instrumentation Center for Region I (Africa I)). They received technical information and training in the use of the calibration and testing equipment in the laboratory/field. Sharing expertise and facilities in this regional collaboration is efficient and effective.However, maintenance and calibration also require ongoing local support and capacity building. It is recommended that ANACIM proceed with the project to create a calibration laboratory to enable technicians to work with great efficiency by taking charge of meteorological sensors and equipment.

g) Network monitoring and ICT system operations:

ICT staff members need to improve their capabilities (e.g. programming skills and technical understanding) to enable the establishment of a time observation network information system to improve the quality of observations and real-time data reporting. For this, it is necessary to set up a network of stations through the VPN system that will allow the stations to transmit directly into the global SMT network via the ASECNA transmission center that operates 24 hours a day.

The installation of an RSTFA/SMT network is necessary to meet Senegal's data transmission limits on the global network.

With the RSTFA/SMT network, the transmission of data will be done in a direct way, thus avoiding any delay and risk of degradation of the information to users and its transmission over the global network.

For the time being, the deployment is taking place on the platforms where ASECNA has a station at AIBD. Further thought must be given to the implementation of the RSTFA/SMT network on all ANACIM platforms to allow the transmission of meteorological data 24 hours a day.

4.3. Design capacity development activities for senior management

Based on the discussions, the entire project organization (from management to project contact points/project managers) would benefit from capacity building in portfolio and project management and coordination, as well as alignment of the project portfolio with the organization's strategy. It is recommended that the organization consider training in the following ways:

- International collaboration on development;
- Benchmarking organizations with a mature project and portfolio management and coordination culture;
- Certification of key personnel for portfolio and project management with an internationally recognized certificate.

4.4. Gender and CSOs considerations

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

Legal and political context In Senegal, the GII Gender Inequality Index remains high with a value of 0.523, ranking it 125 out of 162 countries in 2018. The Constitution (promulgated in January 2001) is based on the principle of gender equality. In addition, Senegal has ratified the main international and regional conventions on women's rights, including the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and the Maputo Protocol 2. However, there is a lack of

[4] ASECNA online - Calibration

harmonization between national legislation and international commitments. The axes of the Priority Action Plan (2019-2023) of the Emerging Senegal Plan (PSE) integrate gender for an inclusive, equitable or egalitarian anticipation of actors in the development process. Senegal has a National Strategy for Equity and Gender Equality II (SNEEG) [5]until 2026 to achieve equality between women and men in fields and sectors. It aligns with the Sustainable Development Goals (SDGs) (2030). This strategy is budgeted at nearly EUR 16.8 million, but the mobilisation of funds remains a major challenge for its implementation. The law on parity passed in 2010 provides for "absolute parity between men and women in all elective institutions" and "lists of candidates alternately composed of persons of both sexes", under penalty of inadmissibility. Thus, during the 2017 legislative elections, 41.82% of the deputies in the hemicycle were women, which is well above the world average (24.1%) and the sub-Saharan average (23.8%). However, this parity is not respected at all levels, with the 2014 local elections recording a total of only five women elected for 557 municipalities. In addition, access to education remains highly unequal: 11.1 per cent of adult women have completed at least secondary education compared to 21.4 per cent of men. The Family Code, adopted in 1972, forms the basis of laws and regulations that discriminate against women.

The inclusion of women in the design of hydrometeorological and climate services directly saves lives and livelihoods, as the needs of different groups have been better identified.

In terms of why organizations pursue gender equality in governance, strategy, programmes and decision-making, the recently updated WMO Gender Action Plan is highlighted. It emphasizes that organizations that respect and value gender equality and diversity attract and retain talented staff and improve overall organizational performance, have happier employees, are more innovative, and have better governance. Teams that are gender-diverse have better decision-making processes and attract more external partnerships, as well as better access to local communities. Encouraging women in leadership positions has also been shown to lead to significant achievements in climate change adaptation and disaster preparedness.

The National Observatory for Parity supports the Head of State on issues of equity and gender equality, and monitors the progress of the results of actions undertaken to promote parity, as well as the level of compliance with national and international commitments to women and the correction of inequalities/discrimination between men and women. The institutionalization of gender in public administrations has made significant progress with the creation of gender units in ministries. Thus, the number of cells is 25, bringing the proportion of ministries with gender mainstreaming mechanisms to 71.4% in 2018 compared to 62.86% in 2017, an increase of 8.5%. At the local level, gender-responsive budgeting is reflected in local government development plans. But few Senegalese local governments allocate budgetary resources to address gender inequalities.

At ANACIM, the balance between women and men is 12/88. ANACIM does not have a gender equality policy or gender non-discrimination measures. According to discussions with the hiring human resources department heads, new staff members are hired based on their skills and not on their gender. Recommendations on activities, consultations, and areas of collaboration for the implementation of the National Contribution Plan to ensure the active participation of CSOs, as well as the promotion of gender balance and opportunities at work are discussed below.

Gender balance, women's empowerment and non-discrimination

- Assess human capacity gaps by summarizing staff skills, education levels, and capability gaps for technicians, experts, and managers, taking into account gender balance and gender opportunities, including but not limited to the following, but not limited to:
    - ✓ Are women meaningfully involved in the design, implementation, monitoring and evaluation of all projects and programmes?

[5] Genre_SEN

- ✓ Are women promoted to equal access to financial services, to senior positions of responsibility, including the position of Chief Executive Officer?
- ✓ Are women promoted to equal access and control over financial resources within the Agency?
- ✓ Is there any consideration for public-private partnerships on gender ;
- ✓ Is gender issues part of a cross-cutting dynamic to focus interventions on the satisfaction of women's and girls' strategic interests and the transformation of social gender relations?
- ✓ Is there support for strengthening women's access to and bargaining power in the labour market?
- ✓ Is there a strengthening of the intervention capacity of gender cells and focal points?
- ✓ Is there a strengthening of the intervention capacity of gender cells and focal points?
- ✓ Compile gender-disaggregated statistics, in particular with regard to governance, human resources and service delivery (2.3.1 (c) of the WMO Plan of Action for Gender Equality).

- Along with an internal analysis of the organization's gaps, the WMO Plan of Action for Gender Equality provides the following guidance for consideration:
  - ✓ Increase women's participation by:
    - **a)** identifying and appointing experts from NMHSs or other national institutions to participate in the work of WMO governance bodies and their working structures, and;
    - **b)** seeking equality in the composition of delegations to sessions of the WMO Plan of Action for Gender Equality;
  - ✓ Harmonization of national legislation with international law and the persistence of discriminatory provisions and loopholes in national legislation.
  - ✓ Rigorous implementation of gender-responsive and gender-responsive legislation.
  - ✓ Strive to achieve gender balance, including in management and work structures of the WMO Plan of Action for Gender Equality).
  - ✓ Encourage and support female networks of experts (1.1.3(c) in WMO Gender Action Plan).
  - ✓ Designate NMHS focal points for gender equality (1.3.4(c) of the WMO Plan of Action for Gender Equality).
  - ✓ Strengthen the capacity of NMHS staff in unconscious bias, inclusive leadership, gender mainstreaming and the delivery of gender-sensitive services through training and workshops of the WMO Plan of Action for Gender Equality).
  - ✓ Offer internships for young professionals, especially women, and secondments of meteorological staff on a rotational basis in the WMO Plan of Action for Gender Equality).
  - ✓ Conduct research and provide the Secretariat with case studies, stories and examples of gender mainstreaming, including in service delivery, for the development of a compendium of good practices from the WMO Plan of Action for Gender Equality.
  - ✓ Adapt weather and climate services to the specific needs and roles of women and men, and;

- ✓ Provide education and training for women users to access and use weather and climate information and products from the WMO Plan of Action for Gender Equality.

During the investment phase of SOFF, it is strongly recommended to promote the participation of 50% of women in capacity-building activities and 50% of women in consultations with civil society organizations. It should be noted that 50% female participation is not possible in all-male training events for maintenance technicians. But in the IT department, women make up more than 50% of the staff.

Active participation of CSOs

It is expected that, during and after the implementation phase of the SOFF, the following engagement activities, in collaboration with CSOs (Civil Society Organizations), will provide mutual benefits and foundations for sustainable operation and financial context in the short, medium and long term.

- Organize stakeholder engagement workshops on the implementation of the SOFF (Exchange of Observational Data in Support of Weather/Climate and Water Services/Products) project deliverables. Promoting equal participation of women and men.
- It is recommended that special attention be paid to seeking partnerships with CSOs to support the operation and maintenance of the GBON station(s) in the short, medium and long term. Such support could be found in communities that are already taking climate measurements.
- Organize high-level dialogues, including CSO representation on the benefits, co-production, and ownership of the new GBON national infrastructure.

Operational and Financial Plan:
ANACIM has adopted a Strategic Development Plan based on the Air and Tourism Hub Strategy 2021-2025 to fully execute its missions that includes the provision of quality weather forecasts and climate services. In line with this Plan, ANACIM recently updated its Manual of Administrative, Financial and Accounting Procedures with a view to improving its organizational efficiency and it is currently being validated by the Top Management of ANACIM. This includes staff capacity for the sustained operation of the observation network, including the improved and added GBON stations.

RECOMMENDED ACTIVITIES MODULE 4:

Capacity building of ANACIM staff

Prepare capacity building activities for ANACIM staff in specific areas related to work on the job (calibration of some devices in the observation network, installation of automatic stations, and data quality control. Make a plan and put in place arrangements for the transfer of skills from experienced staff to newly recruited staff. Improving the upskilling process is recommended as a task for department heads who supervise the staff under their responsibility.

Organise a refresher training on project management, as well as budgeting for staff from the Observation and Maintenance department. This department is the focal point of WIGOS and OSCAR-SURFACE, responsible for the observation network, the collection and the quality control of observation data and compliance with GBON requirements and WMO Unified Data Policy requirements.

Organise training for ANACIM staff on the quality management system to ensure that the quality management system is fully implemented in the Agency (currently only in aviation services).

Recruit new observers to operate the eight (8) surface stations that operate in discontinuity. For GBON compliance, these surface stations must operate 24 hours a day and transmit data via WIS2.0. Support will be needed during both the investment and compliance phase.

Initiate on-site training in the operation and maintenance of automatic stations and manual equipment installed in weather stations for observers and maintenance technicians.

Module 5. Risk Management

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

WMO recommends that its members have a quality management system (QMS) in place to ensure that customer and end-user requirements are met (WMO-No. 1100)[6]. By applying the WMO guidelines, and taking into account the challenges of its field, ANACIM must finalize the implementation of the Quality Management System that it has already started.

Recommendations for risk management during the implementation and operation period of the SOFF investment

As outlined in the SOFF 21 Operations Manual, ANACIM risk mitigation procedures will be used for the implementation of SOFF during the investment phase. The operational phase is supported by the recipient's risk mitigation procedures.

The table below summarizes the key risks related to the investment and operation phase that need to be carefully considered and addressed by the EI, the recipient and the advisor.

Potential key risks for investment and operation during SOFF implementation	Probability	Mitigation measures and responsibilities	Monitoring and evaluation
Technical risks: Equipment compatibility, obsolescence of technologies, communication and data transmission, power supply, environmental conditions; security.	Medium	Careful planning; Installation of backup systems, physical protection and cyber security measures; Training;	Regular monitoring, evaluation and reporting by The Directorate of Meteorological Operations of ANACIM
Human Capacity risks: Lack of qualified technicians for the installation and maintenance of weather equipment (baromter, thermograph, hygrograph, etc....), IT, communication and power systems	Low	Participation of maintenance technicians in training and development seminars. Responsibility of the Human Resources Branch of ANACIM.	Monitoring, evaluation and planning should be part of the annual maintenance plan in collaboration with the HR Branch.
Organisational risks: Maintenance plan (preventive and periodic) is lacking or not executed	High	Make/update an annual maintenance plan for all equipment and automatic stations existing in the ANACIM	Monitoring, evaluation and planning (incl. resourcing) should be done annually by the Directorate of

[6] Guide to the Implementation of Quality Management

due to lack of resources.		observation network and make available the necessary resources for its execution. Responsibility of the Directorate of Meteorological Operations.	Meteorological Operations.
Organisational risks: Non-involvement of maintenance technicians in the choice of equipment and their non-participation in the preparation of tender books for the technical specifications of weather equipment and automatic stations	Low	Transparent collaboration between the procurement unit and the maintenance department for the participation of maintenance technicians in the implementation of automatic equipment and stations	It is imperative that due attention be given to identifying and mitigating risks, and that appropriate resources be allocated to them. A Quality Management Manager controls the analysis and reduction of the risk of inconsistency

RECOMMENDED ACTIVITIES MODULE 5:

It is strongly recommended that ANACIM complete as soon as possible the implementation of the Quality Management System that it has already started.

Make an annual maintenance plan for all equipment and automatic stations existing in the ANACIM observation network.

Increase the facilities (incl. transport and tools) for and capacity of ANACIM staff in specific areas related to certain tasks, e.g. observations, installations, maintenance and calibration of equipment, and enable them to quickly and adequately respond to malfunctioning stations, also at more remote locations. This will minimize equipment downtime and avoid non-compliance with GBON requirements.

Module 6. Transition to SOFF investment phase

The transition from the SOFF Readiness Phase to the to the Investment phase is facilitated by the Gap Analysis and National Contribution Plan (this document) prepared by the Beneficiary Country NMHS (ANACIM) and the Peer Advisor (KNMI) which are submitted to the SOFF Secretariat. KNMI will remain available in an advisor role in the Investment Phase, collaborating with the Implementing Entity (IsDB) and ANACIM.

RECOMMENDED ACTIVITIES MODULE 6:

It is recommended that the transition to the SOFF investment phase be made following the Gap Analysis and National Contribution Plan submitted to the SOFF Secretariat (this document).

The Peer Advisor, The Royal Netherlands Meteorological Institute (KNMI) remains available for advisory services during the preparation of the Investment Phase Funding Request as well as during the SOFF Investment Phase. This longer term commitment ensures consistency of the activities as planned.

Summary of GBON National Contribution Plan

Components	Recommended activities
Module 2. GBON business model and institutional development	It is recommended that ANACIM revitalize its technical sectoral partners (Air Transport, Agricultural Insurance, Directorate of Agriculture, JOKALANTE, etc.) whose role is to superimpose meteorological data on their sectoral data in order to produce a contextualized service or advice adapted to the decision-making needs of plnners and communities in their sector.
	Equip the maintenance department with a liaison car that allows maintenance technicians to intervene immediately if necessary. Facilitate the implementation of the maintenance plans drawn up annually by the maintenance manager.
	ANACIM has already concluded memoranda of understanding with the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) in the technical and training field. A barometer calibration program should be developed to enable ANACIM technicians to perform the appropriate calibration and adjustment to eliminate systematic errors in measuring instruments. These MOUs may be revised to include clauses that allow for the extension of the ASECNA VPN to the ANACIM centre to address the low rate of transmission from stations to the Global Telecommunication System (**GTS**).
	It is recommended that ANACIM develop an effective communication and outreach strategy to execute the WIGOS National implementation plan following the establishment of the WIGOS Senegal National Component. If WIGOS is operational, ANACIM will be able to take advantage of possible private sector funding for the maintenance of the weather stations for which it is responsible. This funding can then be used to upgrade existing stations. Partnering with the private sector provides an opportunity to leverage the private sector's ability to procure needed infrastructure faster than the public sector.
Module 3. GBON infrastructure development	Install near real-time connection to the global WMO Information System (WIS2.0) at all 15 surface stations and 2 upper air stations. Based on the WMO GBON requirements, 5 of the 13 stations assigned as GBON stations meet all WMO specifications for parameter measurement and transmissions to the GTS, but the remaining stations do not meet the hourly data transmission requirements. The automatic stations installed in the stations do not transmit in real time to the GTS but provide additional information for manual observations.
	Installation of an RSTFA/SMT network, necessary to meet the dificulties of transmitting Senegal's data on the global network. With the RSTFA/SMT network, the transmission of data will be done in a direct way, thus avoiding any delay and risk of degradation of the information to users and its transmission over the global network.

	It is essential to set up an information system for the weather observation network to improve the quality of observations and the reporting of data in real time. For this, it is necessary to set up a network of stations through the VPN system that will allow the stations to transmit directly into the global SMT network via the ASECNA transmission center that operates 24 hours a day.
	Rehabilitate pilot sounding stations (Saint Louis, Ziguinchor et Dakar) that have been out of service for several years. There are three stations for which the necessary equipment needs to be acquired and the technical rooms rebuilt. Set-up calibration and maintenance facilities, including means of transport, secure storage spaces, supporting software, spare parts and tools, etc.
Module 4. GBON human capacity development	Capacity building of ANACIM staff The lack of capacity of ANACIM staff is in specific areas related to work on the job (calibration of some devices in the observation network and installation of automatic stations). In the same way, there is a lack of capacity in data quality control. Logistical resources (transport vehicle, spare parts and calibration laboratory) are also a problem for ANACIM.
	Put in place srrangements for the transfer of skills from experienced staff to newly recruited staff. Improving the upskilling process is recommended as a task for department heads who supervise the staff under their responsibility.
	The Head of Observation and Maintenance is the focal point of WIGOS and OSCAR-SURFACE, he is also responsible for the observation network, the collection and the quality control of observation data. He participates in the budgeting of the resources necessary to maintain and operate the observing network and to comply with the WMO-related observation recommendations. It is recommended, given the task of compliance with GBON requirements and WMO Unified Data Policy requirements, to consider refresher training on project management, as well as budgeting.
	Train staff on the quality management system to ensure that the quality management system is fully implemented in the Agency (currently only in aviation services).
	Recruit new observers to operate the eight (8) surface stations that operate in discontinuity, for GBON compliance, these surface stations must operate 24 hours a day and transmit data via WIS2.0. Support will be needed during both the investment and compliance phase.
	Initiate on-site training in the operation and maintenance of automatic stations and manual equipment installed in weather stations for observers and maintenance technicians.

Module 5. Risk Management	It is strongly recommended that ANACIM complete as soon as possible the implementation of the Quality Management System that it has already started.
	The decentralization of maintenance nationwide to be responsive and for more efficiency, in order to equip maintenance technicians with means (vehicle and work tools) to minimize equipment downtime in order to avoid non-compliance with GBON requirements in accordance with them.
	The lack of capacity of ANACIM staff is in specific areas related to certain tasks: observation, installation, maintenance and calibration of observation equipment. In the same way, there is a lack of immediate grasp of the problems of the resorts that are in the interior of the country.
Module 6. Transition to SOFF investment phase	It is recommended that the transition to the SOFF investment phase be made following the Gap Analysis and National Contribution Plan submitted to the SOFF Secretariat (this document). The Peer Advisor, The Royal Netherlands Meteorological Institute (KNMI) and the recipient jointly completed the application for funding for the implementation phase of SOFF. This allows for better coordination in the transition phase.

Report completion signatures

Peer Advisor signature

Dr. Gé Verver,
Senior scientist / Coordinator International Affairs Royal Netherlands Meteorological Institute (KNMI)

Beneficiary Country remarks and signature

Dr. Ousmane Ndiaye
Director of Meteorology of the Senegal National Agency for Civil Aviation and Meteorology (**ANACIM)**

WMO Technical Authority screening remarks and signature

ANNEX 1 Abreviations and Acronyms

ABN : Niger Basin Authority.
ACASIS : Alert to Heatwaves in the Sahel and their Health Impacts
ACMAD: African Center of Meteorology Application for Development.
ADM : Municipal Development Agency
AFOM: Strengths, Weaknesses, Opportunities and Threats.
AGEROUTE : Agency for Works and Road Management
AGRHYMET: Centre specialized in Agriculture, Hydrology and Meteorology.
AIBD : Blaise Diagne International Airport
AIC : Agriculture Intelligente face au Climat.
AICCRA : Accelerating Impacts of CGIAR Climate Research For Africa
AMMA 2050 : The African Monsoon Multidisciplinary Analysis for 2050
AMMA: Multidisciplinary Analysis of the African Monsoon
ANACIM : National Agency for Civil Aviation and Meteorology
ANAMS: National Agency of Meteorology Senegal
ANAT : National Agency for Spatial Planning
ANSD: National Agency for Statistics and Demography
AWS : Automatic Weather Stations
BNSP: National Fire Brigade
CC: Climate change
CCASA : Science-Policy Dialogue Platform on Adaptation of Agriculture and Food Security to Climate Change
CCNUCC: United Nations Framework Convention on Climate Change
CDMS : Climate Data Management Systems
CEDAW : Convention on the Elimination of All Forms of Discrimination against Women
CGQA: Air Quality Management Centre
CLIMDEV : The Climate for Development in Africa
CMSC : Global Framework for Climate Services
CNAAS : National Agricultural Insurance Fund of Senegal
CNCR: National Framework for Rural Consultation and Cooperation
CNSC : National Climate Services Framework
COGIC: Interministerial Crisis Management Operations Centre
COMNACC: National Climate Change Committee
COMRECC: Regional Climate Change Committee
CONGAD: Council of NGOs in Support of Development
COP21 : Conference of the Parties
COPIL: Steering Committee
CPDN : Nationally Determined Planned Contribution
CRT: Regional Transmission Centre
CST: Scientific and Technical Committee
DA: Directorate of Agriculture
DEEC: Department of the Environment and Classified Establishments
DEM : Meteorological Operations Branch
DGPRE: Directorate of Water Resources Management and Planning
DGS: Directorate-General for Health
DPC : Directorate of Civil Protection
DPV: Plant Protection Directorate
ECMWF : European Centre for Medium-Term Forecasts
EDEQUE : Doctoral School of Water and Water Quality
ENACTS : Enhancing National Climate Services initiative,

FAO: Food and Agriculture Organization of the United Nations
FONGS: Federations of NGOs of Senegal/ Actions Paysannes
GBON : Global Basic Observing Network
GDP: Gross Domestic Product
GIEC : Intergovernmental Panel on Climate Change
GPRS : General Packet Radio Services
GRC : Disaster Risk Management
GTP: Multidisciplinary Working Group
GTS: Global Telecommunication System
ICAO : International Civil Aviation Organization
IQA: Air Quality Index
IRI : International Research Institute
LERSTAD : Laboratory for Studies and Research in Statistics and Development
LPAOSF: Simeon Fongang Atmospheric and Ocean Physics Laboratory
MISP: Ministry of the Interior and Public Security
NMHS: National Meteorological and Hydrological Services
NOAA : National Oceanic and Atmospheric Administration
NWP: Numerical Weather Prediction
NWP: Proficiency in Weather Forecasting
OCB: Grassroots Community Organization
OMM CREWS : Climate Risk and Early Warning Systems (WMO)
OMS: World Health Organization
OMVS : Organization for the Development of the Senegal River
ONG: Non-Governmental Organization
ORSEC: Organization of Relief
OSIRIS : Observatory on Information Systems, Networks and Infohighways in Senegal
PAM (4R) : World Food Programme
PANA : National Programme of Action for Adaptation to Climate Variability and Change
PARM : Platform for Agricultural Risk Management
PCE : Economic Growth Project
PFNAC : Project to promote innovative finance and community adaptation in communes around community nature reserves in Senegal
PROVAL CV : Water Valorization Project for Value Chain Development
PSE: Emerging Senegal Plan
QMS : Quality Menagment System
REVARD : Reducing Vulnerability and Building Resilience of Vulnerable Communities in the Saloum Islands
RSTFA/SMT : Aeronautical fixed telecommunications service network / The Global Telecommunication System
SAP: Early Warning System
SARP: International Standards and Recommended Practices
SAT (UFR de) : Applied Sciences and Technology
SDDR: Department of Rural Development
SE/CNSA : Executive Secretariat/National Council for Food Security
SIG: Geographic Information System
SOFF : Systematic Observations Financing Facility
SWIFT: Science for Weather Information and Forecasting Techniques
TCM : Monthly climatological table
UASZ : Assane Seck University of Ziguinchor
UCAD: Cheikh Anta Diop University
UGB : Gaston Berger University

UICN: World Union for Conservation of Nature
URACS : Union of Associative and Community Radios of Senegal
VPN : Virtual Private Network
WIS :WMO Information System
WMO : World Meteorologique Organisation
WPG : Multidisciplinary Working Group