Amendement note: GBON National Contribution Plan of Guinea Bissau for SOFF investment in Guinea Bissau

Prepared by IPMA Peer Advisor for SOFF Guinea Bissau

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August 2026

1. Rational of this amendment

The GBON National Contribution Plan (NCP) for Guinea Bissau was approved by the SOFF Steering Committee. However, due to a recent change in the conditions on use the Upper-Air data in Guinea Bissau, we have conducted a targeted review of the NCP. The strategy for the upper-air observational programme will no longer be rely only on a third party service, align with this new approach and we are providing this amendment of the NCP request as per agreement with the SOFF secretariat.

2. GBON Guinea Bissau Station's network

Regarding the GBON National Gap Analysis (NGA) for Guinea Bissau it was proposed in the National Contribution Plan (NCP) to improve the meteorological observations coverage in Guinea Bissau with the installation of three automatic surface weather stations, and also it was identified the need of one upper-air station to fulfil the GBON standard density requirements.

During the preparation of the NCP for Guinea Bissau, besides the identification of the 3 locations for the installation of the automatic surface weather stations, it was identified a third party that was able to ensure the upper-air observational program in the region.

During the period of time where documents here prepared we find some difficulties in stabilized an agreement that could lead us to a Memorandum of Understanding with the third party (ASECNA).

Regarding the constrain generated by difficulty mentioned and the identified need in relation upper-air data coverage in the region the proposal is now to install a new upper-air station to fulfil the GBON standard density requirement and to contribute to the international data exchange with two daily observations concerning the upper-air soundings.

Due to the new approach it will be possible to insure the installation and the operation of the new upper-air site in INM GB facilities , Observatory of Bissau. Bissau Observatory, Latitude 11.856464 and Longuitude ,-15.5900025, high 21meters

Changes need in the NCP.

Figure 1 - Bissau Observatory and 500Km circle line

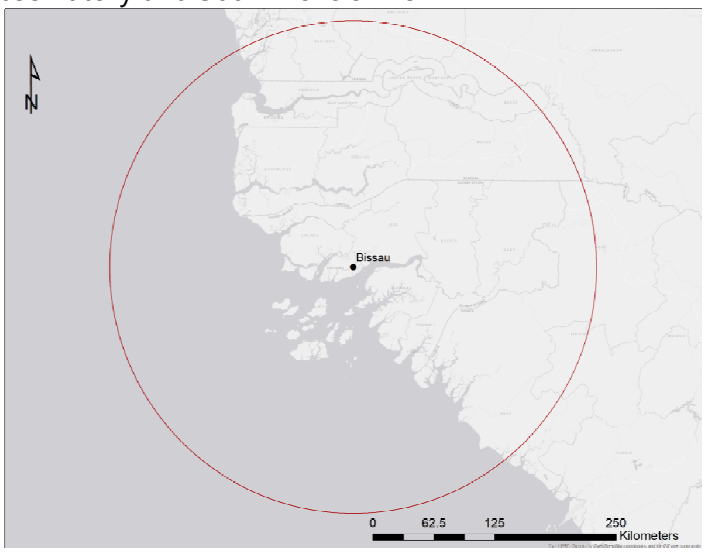

Table1 - GBON National Contribution Target

Type of station	WMO GBON Global Gap Analysis, June 2026				GBON National Contribution Target	
	Target	Reporting	Gap		To improve	New
			To improve	New		
	[# of stations]				[# of stations]	
Surface	1	0	1	0	3	0
Upper-air	1	0	0	1	0	1*
Marine	*when applicable					

3. Roles and responsibilities

Beneficiary country National Meteorological and Hydrological Service

The installation of a GBON-compliant upper-air observing station in Guinea-Bissau represents a strategic investment that directly supports the implementation of the Global Basic Observing Network (GBON) and aligns with the mandate of the Systematic Observations Financing Facility (SOFF). The GBON National Gap Analysis identifies the establishment of an upper-air station at Bissau Airport as a priority action to address one of the country's most significant observational gaps. Currently, ASECNA conducts only pilot balloon (PIBAL) observations. These observations do not provide the vertical atmospheric profiles required under GBON standards, and vertical wind profile measurements are not performed at the mandatory synoptic observation times of 00 UTC and 12 UTC. Furthermore, ASECNA has been unable to confirm whether upper-air observations would eventually be

available in near real time, a prerequisite for GBON compliance. More importantly, ASECNA has provided no firm commitment, implementation plan, timeline, or secured resources for upgrading its upper-air observing capabilities to meet GBON requirements. In the absence of such assurances, there is no basis to conclude that ASECNA will undertake or sustain the necessary re-equipment and operational enhancements. Consequently, Guinea-Bissau is currently unable to meet GBON upper-air requirements or contribute the required upper-air observations to the Global Telecommunication System.

SOFF financing would enable the transition from the existing limited upper-air capability to a fully operational radiosonde station capable of conducting twice-daily launches at 00 UTC and 12 UTC, in accordance with GBON requirements. Radiosonde observations provide essential measurements of air temperature and humidity, atmospheric pressure, and wind direction and speed throughout the atmosphere, significantly improving numerical weather prediction, severe weather forecasting, aviation meteorology, and climate monitoring. Given Guinea-Bissau's high vulnerability to flooding, coastal hazards, and climate variability, the availability of high-quality upper-air observations would substantially strengthen national forecasting and early warning services while enhancing regional and global weather prediction through the exchange of quality-assured observations.

A key strength of this investment is that the upper-air station will be operated by meteorological technicians from the Guinea-Bissau National Meteorological Service (NMS). This arrangement will reinforce national ownership of the observing system, build long-term technical capacity within the NMS, and ensure that expertise in radiosonde operations, quality management, and data transmission is developed and retained within the country. The collaboration with ASECNA, which already hosts meteorological infrastructure at Bissau Airport, provides an efficient operational environment while enabling the NMS to assume responsibility for the GBON-compliant upper-air observations. This institutional partnership enhances the sustainability of the investment and contributes to strengthening the national meteorological service.

The proposed investment is fully consistent with SOFF's objective of supporting Least Developed Countries in achieving and sustaining GBON compliance through targeted investments in observing infrastructure and operational capacity. By replacing the current pilot balloon observations with twice-daily radiosonde launches operated by trained national meteorological personnel, SOFF would address a critical GBON compliance gap while creating lasting institutional capacity in Guinea-Bissau. This investment directly implements the recommendations of the GBON National Gap Analysis, strengthens the regional observing network in West Africa, and supports the Early Warnings for All initiative through the sustained provision of high-quality upper-air observations exchanged internationally for improved weather and climate prediction.

Signatures

Peer advisor focal point	Ricardo Deus Dr. 11-08-2026 Assinado por: **RICARDO JOÃO RATOLA CAPELA DEUS** Num. de Identificação: 09803117 Data: 2026.08.25 16:03:03+01'00'
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WMO Technical Authority signature	

october 2024

GBON National Contribution Plan of Guinea Bissau

Systematic Observations Financing Facility

Weather and climate data for resilience

GBON National Contribution Plan
[Guinea Bissau]

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Module 1. National Target toward GBON Compliance

TheGlobal Basic Observation Network (GBON) promotes a fundamental review of the international exchange of observation data, which support all meteorological, climatic and water services and products, taking into account not only infrastructure but also human and institutional capacity needs.

This Plan was developed taking into account Guinea-Bissau's socio-demographic situation, in order to ensure the definition of realistic objectives for achieving the GBON.

The Republic of Guinea-Bissau, is a small coastal country in West Africa with high vulnerability to climate change, particularly in the form of seawater intrusion that results from sea level rise, tidal surges, and other adverse weather conditions. Seawater intrusion poses a severe threat on the country's mangroves which is a major source of livelihood (mangrove rice) in addition to providing coastal protection and a biodiversity habitat.

The climate is intertropical and characterized by two alternating seasons. A short rainy season (June to October), although there is irregular rainfall in May and November, which are the transition months, and a 5-month dry season (December to May). In recent years, there has been a gradual decrease in rainfall, a fact often justified as the progressive approach of the Sahel phenomenon and uncontrolled clearing of forests for agricultural purposes. The hot and humid south-westerly winds, commonly known as the "maritime monsoon", coming from warm currents in the Gulf of Guinea predominate during the rainy season, while the northerly wind, the "Haramatan", predominates during the dry season.

In agricultural terms, the country has potential fertile land with favourable conditions for agriculture and is made up of 8 regions (Cacheu, Oio, Biombo, Bafata, Gabu, Bolama/Bijagós, Quinara and the Autonomous Sector of Bissau).

Three rainfall zones are distinguished: the southern zone (Tombali, Quinara and Bolama-Bijagós) characterized by an annual average of over 2000 mm; the north-western zone (Bissau, Biombo, Cacheu and Oio) characterized by an annual average of between 1400 and 1800 mm and the eastern zone (Bafatá and Gabú) where the average annual rainfall is between 1300 mm and 1500 mm.

The maximum rainfall is reached in August, with a monthly average of over 300 mm. The minimum, close to 0, occurs between December and April (dry season). Three rainfall zones are distinguished: the southern zone (Tombali, Quinara and Bolama-Bijagós) characterized by an annual average of over 2000 mm; the north-western zone (Bissau, Biombo, Cacheu and Oio) characterized by an annual average of between 1400 and 1800 mm and the eastern zone (Bafatá and Gabú) where the average annual rainfall is between 1300 mm and 1500 mm.

The GBON National Gap Analysis proposed to improve the meteorological observations in Guinea Bissau with the installation of three automatic surface weather stations. Regarding the upper-air station the proposal is to integrate one new station (that will be installed by third party) to fulfill the GBON standard density requirement and to contribute to the international data exchange of hourly marine and land surface observations and two daily observations concerning the upper-air soundings.

(Summarize the national target toward GBON compliance in the table below and provide the technical details as needed)

Table1 - 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	1	0	1	0	3	0
Upper-air	1	0	0	1	0	0*
Marine	*when applicable					

** The Upper-air station to be installed and operated by Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA)*

(Add here a map of existing and proposed surface and upper-air stations with 200km/500 (**diameter**) km circles (500km/1000 km for SIDS) to indicate the coverage of the stations and provide the explanation as needed [1])Figure 1. Map of existing and proposed surface and upper-air stations. Please use horizontal resolution as diameter = radius is half the horizontal resolution.

Figure 1 represents the proposed spatial distribution of the AWS to be installed, under SOFF initiative to integrate the GBON network in Guinea Bissau.

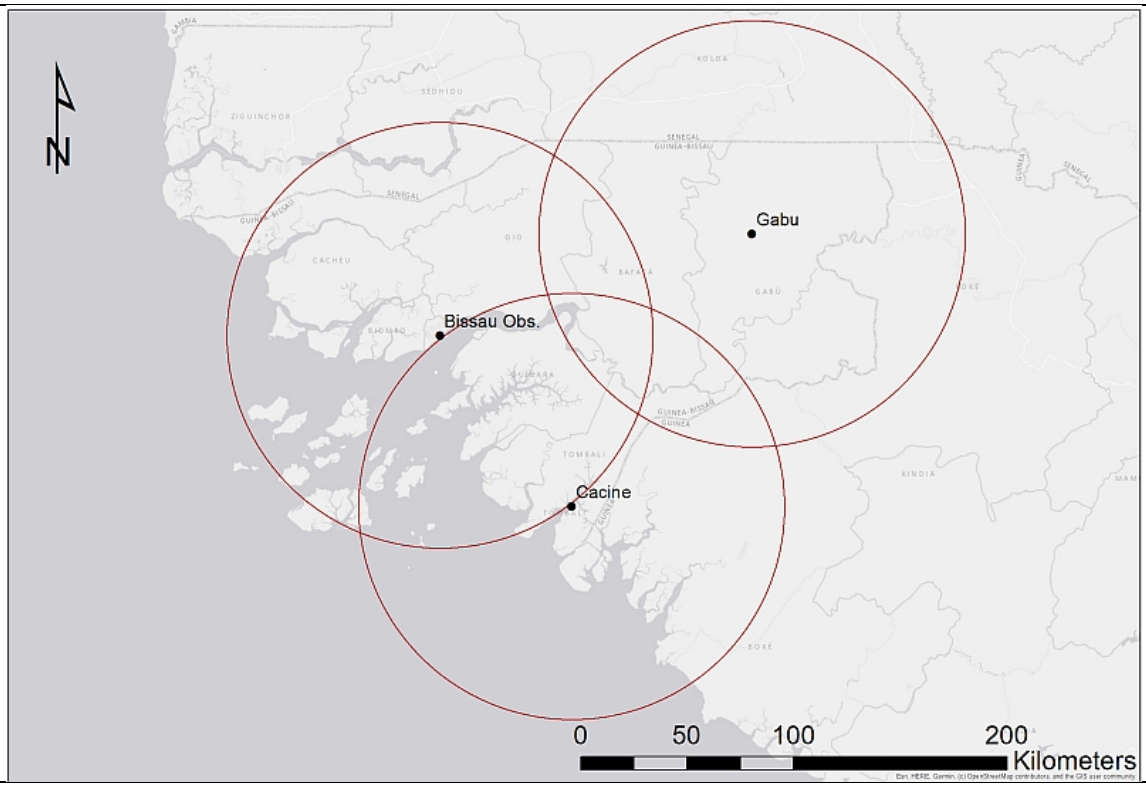

Figure1.Map of the proposed surface meteorological stations to be declared as GBON stations in Guinea Bissau

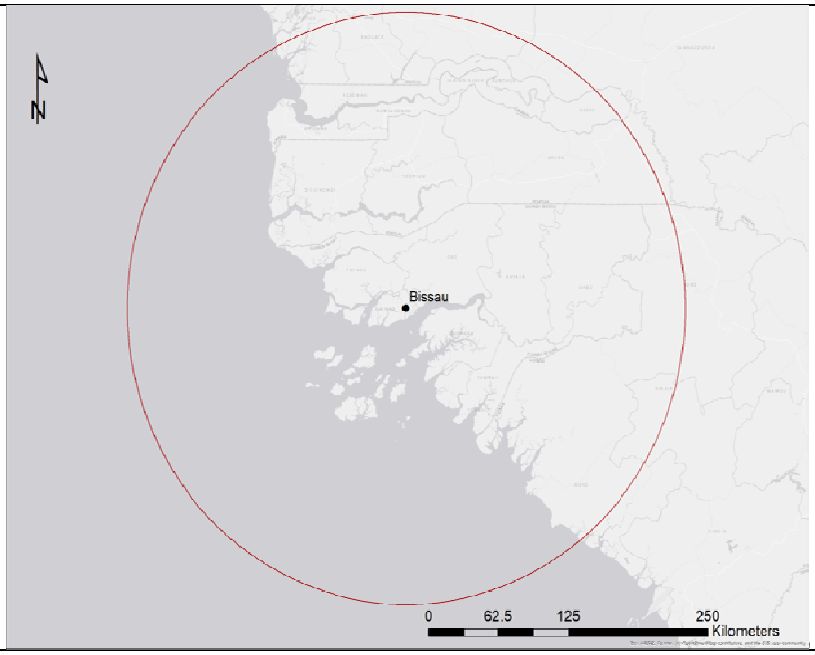

Figure2 Map with the location of upper air station to be included as GBON stations in Guinea Bissau. The Upper-air station to be installed by Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA)

Module 2. GBON Business Model and Institutional Development

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

Identify:

- *Governmental stakeholders operating and acquiring meteorological observations or with the potential to support GBON;*

Weather observations and forecast and also climate information in Guinea Bissau are provided by the National Institute of Meteorology of Guinea-Bissau (INM-GB). INM-GB is the National Authority in Meteorology and Climatology and its mission is to pursue national policies in the fields of meteorology and climatology. Currently, INM-GB is a public institute, part of the state's indirect administration, endowed with legal personality, administrative and financial autonomy, its own assets, under the superintendence and tutelage of the Minister of Transports, Telecommunications and Digital Economy.

The INM-GB, through its president, is the Authority that ensures the permanent representation of its country at the WMO, as well as being the designated Meteorological Administrator at the International Civil Assessment Organization (ICAO).

In relation to the private sector, we could not find operators, with online information, providing meteorological observations data in Guinea-Bissau. However, there are institutions that have

manual precipitation recording systems and stations, namely the Ministry of Agriculture, universities and specific projects.

It was possible to find some stakeholder for the INM-GB at the National level, Ministry of Internal Affairs, which is the main coordinator body of disaster management activities. It is responsible for coordinating disaster risk reduction at the National level and supporting the strengthening of emergency communication and early warning systems in the country.

INM-GB works with several National institutions and has some ministerial departments as stakeholders, namely linked to the environment, civil protection, agriculture, aeronautics, water management and maritime navigation, among others.

INM-GB has close working relations with the Civil Aviation Agency of Guinea-Bissau (AACGB) and the representation of the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) in Guinea-Bissau as part of the implementation of aeronautical meteorology activities, in accordance with the recommendations of Annex III of the Chicago Convention.

There is an action plan defined between INM-GB and ASECNA in which it is agreed that ASECNA will acquire a upper-air station, which will be installed in the airport infrastructures of Bissau airport, as well is the entity responsible for acquiring all the necessary equipment (balloons, radiosondes and gas) for the operationalization of the observation program. INM-GB will be responsible for providing its technical human resources for the execution of the observational program.

At sub-regional, regional and international level, INM-GB actively participates in the activities of institutions such as the Regional Centre for Agro-Hydro-Meteorology (AGRHYMET), the African Centre of Meteorological Applications and Development (ACMAD), the World Meteorological Organization (WMO), the International Civil Aviation Organization (ICAO) and the Intergovernmental Panel on Climate Change (IPCC), through its special programs.

The work provided by INM-GB for the benefit of its partners is limited given its level of development, compared to what exists at international level.

INM-GB, given the lack of updated meteorological and communications equipment and qualified human resources cannot meet at National and International level, the partners' and stakeholder needs in terms of meteorological and climatological information. INM-GB scientific partnership with National university and research institutions, as proposed by WMO, needs greater investment to reach the modern society requirements.

At international level, INM-GB's scientific contributions are much reduced. It was possible to find cooperation and knowledge sharing initiatives, through international cooperation, aligned with training actions promoted by WMO at regional level.

- *Private sector operators providing meteorological observations and data services in the country (for ship-based observations, identify fleet of ships government-owned or private and research owned) to install instrument packages)*

Guinea Bissau is one of the Countries in Africa that has more problems in relation to the meteorological stations network. On the basis of the current situation it can be identified the financial problem as a result of a lack of investment in management activities and in modernization of the observation network.

Taking in account the last two years information, according with information provided by the INM-GB PR, only 20.000000 CFA Franco (2.121,62 Euros in 10/01/2024), are made available from Government to face all the operational costs for all INM-GB activities

It is very difficult to find international projects that directly fund the meteorological and climate activities from INM-GB. The funds available are mainly related to adaptation of agricultural production systems.

The investments made, mainly in adaptation projects, on meteorological observational equipment did not result in the increase of the level of meteorological data shared among the National and International level.

Several institutions have potential to become aINM-GB partner:

- The airport handling and logistics company NAS – National Aviation Services, that is operating in International Airport Osvaldo Vieira invested in the development of infrastructure, equipment and technology, could be a potential INM-GB support partner taking in account that they can be helpful not only for improving the meteorological observation system but the poorly modernized INM-GB ICT infrastructure.
- Companies associated with sport fishing have some potential for partnership with INM-GB, taking into account that their activity need meteorological and oceanic data, and INM-GB could provide this information through a specific data service. This partnership could be bidirectional, taking into account that sport fishing boats can be seen as potential floating platforms that allow the collection of meteorological but also maritime data.
- Modern agriculture, dominated by large agricultural companies, requires agrometeorological data recorded in the places where activity is carried out, inorder to better monitor the conditions and evolution of meteorological parameters necessary for the activity. INM-GB has a fundamental role in supporting this economic sector, however the spatial scale at which it carries out its activity is not compatible with the very specific requirements that this type of agriculture requires. In this sense and in a complementary way to the objectives that the INM-GB meteorological observation network must guarantee, it will be very relevant to promote the sharing of meteorological data, obtained by private companies, with INM-GB in order to improve the coverage of the country in terms of meteorological observation. This process must be preceded by close work between INM-GB and agricultural companies so that the equipment is installed in accordance with international rules and meets technical requirements.
- The land transport sector in Guinea Bissau is a potential partner for INM-GB, taking into account that the transport of people and goods, in the country, is currently guaranteed by the use of vehicles (trucks, buses). The vulnerability of this transport is quite high considering the severe weather situations (very heavy rain) that characterize the climate of Guinea Bissau. In this sense, INM-GB should look at companies in this sector as potential partners that could help support the maintenance of the observation network.

Provide recommendation on how they could contribute to the implementation of the Plan and required activities to materialize the proposed partnerships:

a. *Existing partners and relationships;*

The INM-GB should draw up or revise memoranda of understanding with existing partners to include a clause allowing the use of their stations to contribute to GBON when necessary, as well as the sharing of data in accordance with the WMO's universal data policy.

b. Potential new partners and their roles.

The INM-GB should meet with all those interested in meteorological and climatological data in order to create the synergies needed to obtain reliable data. The SOFF contribution will reinforce the position of INM-GB. The National Institution, Transport and Communications (airport handling and logistics company), Agriculture (private companies) and Forestry, Fisheries (private operators) and National Education Ministers are the most relevant Government Institutions stakeholders that need meteorological / hydrological and climate information for support of their daily activities but also allow long term planning.

2.2. Assessment of potential GBON sub-regional collaboration

- *Identify neighboring countries and regional organizations of relevance for potential sub-regional collaboration.*

The Republic of Guinea-Bissau is a West African country bordered by Senegal to the north, Guinea-Conakry to the south and east, and the Atlantic Ocean to the west.

Regarding the difficulties related with systematic meteorological observations on the region not so many neighboring countries are identified for potential regional collaboration, but it is possible to create more synergies with Senegal, Nigér, Cabo Verde and São Tomé e Principe taking in account that Netherlands are Peer Advisors in the SOFF initiative.

- *Provide recommendations for potential optimization of the observing network through sub-regional network design and other sub-regional partnerships for the implementation of the Plan.*

Strengthening collaboration and communication with potential donors and training centres in the region is a strategic approach for Guinea-Bissau in order to acquire additional resources for capacity building.

It is suggested that the INM-GB establish direct and continuous communication channels with donor organizations, such as the Civil Aviation Authority of Guinea-Bissau (CAAGB) and the Directorate-General for the Environment, to keep up to date on their funding opportunities, priorities and application procedures. Close collaboration and partnership with the training centers of the WMO, IPCC, ICAO, ACMAD and AGRHYMET.

It should strengthen the participation of which it is a member, namely the African Center for the Application of Meteorology to Development (ACMAD), the AGRHYMET Center and the Inter-State Committee to Combat Drought in SAHEL (CILSS).

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

- *Assess the current funding sources, budget allocations and financial status related to operations of the NMHS-owned observing network.*

The INM-GB totally depends on the Government General State Budget (GSB).From the analysis made in January 2024, the proposed State Budget for the INM-GB for 2023 was 217 279 551 CFA francs, corresponds to €23 279,70, submitted to the government via the Ministry of Transport and Communications. However, this budget is not allocated by the government, only the one corresponding to staff salaries. As in previous years, the INM-GB received 20 000 000 CFA francs (€2.142,61) from the State Budget for 2023 to cover the cost related with observational maintenance, weather forecasts service and information disseminating.

The annual cost with human resources (staff) is 75 079747 CFA francs (8 040,66 €).

There is a project submitted to the GEF through UNDP/Bissau for funding, called UNDP-GEF LDCF PROJECT "Strengthening climate information and early warning systems for resilient and adaptive development to climate change in Guinea-Bissau". In relation to this project INM-GB did not, until now, have any formal interaction with the project managers related to agrometeorological data or equipment.

- *Provide recommendation of a business model for public-private collaboration for the implementation of the Plan, based on the SOFF private sector business models,*[1] *including:*

a. *Recommendation of a business model to operate and maintain the GBON infrastructure, considering arrangements for SOFF financial support during the Compliance phase*

In terms of management and regarding the extremely difficult economic and human resources conditions that INM-GB operates the meteorological service, we recommend that a full-public (according with the 4 options business models that SOFF identify) approach should be the most adapted to the reality of the Country.

However, it is recommended that, in a short time, a Public-Private solution should be analyzed taking in regard that for example, for information technologies, it is quite difficult to recruit human resources with a profile suited to the necessary requirements. In this sense, this could be one of the points to be analyzed in the future with INM-GB, taking into account the enormous impact that information technologies currently have on organizations.

Nevertheless INM-GB should promote MoU with the private sector, mainly with operator from the economic sectors that really depend on meteorology and climate information for their activities and investments. To overcome the finance constraints the proposed business plan will be based on the establishment of MoU with different economical actors, regarding the new automatic weather stations network that will be classified for GBON network.

INM-GB should engage a National communication operator where, in an exchange of meteorological data in near-real-time, INM-GB could have access to an annual credit (data communication cards) from mobile network to support the National and International communication of meteorological information but also to an amount of budget that will allow to execute the sensors calibration program.

The same approach should be implemented with the energy sector, namely the oil and gas company, allowing INM-GB to have access to fuel credit to support the maintenance plan. With

[1] See chapter 4 of the Operational Guidance Handbook on SOFF private sector archetypal business models

airport handling and Logistics Company for supporting the annual costs of the training and capacity building plan, safeguarding the reinforcement of the skills of human resources assigned to aeronautical activities, both with regard to meteorological observation but also in the maintenance and management of meteorological measuring equipment.

Also INM-GB, in order to training its technicians in the new automatic observation systems that SOFF will allow, should use the training and technical workshops made available within the scope of WMO.

To support the business plan it is really relevant, at this stage, to identity the minimum yearly budget for operating the new network of stations that will be included in GBON network, taking in account the several cost centers, example: communications, stations maintenance plan (transports and human resources), IT operation task, dissemination, capacity workshop, spears acquisition).

SOFF Operational Manual defines 4 possible basic business models.

1. Fully public: Fully State owned and operated GBON infrastructure
2. Public-Private: State owned and Private Partner operated
3. Public-Private: State and Private Partner owned
4. Fully Private: Owned and operated by a private partner contracted by the State

b. Identify potential private sector operators depending on the proposed business model

Given that we could not find any reference to private partners operating meteorological observation in Guinea Bissau the proposal is to continue the actual funding model, entirely public. However, it is recommended to plan, in a short time, a mixed solution study.

The development of a legal framework for collaboration between the public and private sectors could also be explored as part of the new approach.

The following sector should be approached with the aim to establish MoU between INM-GB and:

- Communications sector, regarding the support of the communications costs from the meteorological observational network, Orange, MTN and Guinetel companies develop their activities in Guinea Bissau;
- Transports sector, in the scope of aviation meteorological service marine data service and land transport service. NAS, ASECNA, in aviation sector, STGB in land transportation and marine transport companies that operate in Guinea Bissau, Consulmar, Sotramar and BELETRANS;
- Energy sector, in terms of support of the costs from the fuel consumption to ensure the stations maintenance plan;
- Agriculture sector, establish programs with Ministry and service contract with private companies;
- Fishery sector, establish programs with the Ministry and service contracts with private companies.

c. Develop a financial plan for operating the modernized infrastructure, including considerations on the total cost of ownership

Currently, INM-GB does not have a cost recovery mechanism for the service that has been provided, including aviation services and commercial activities that contribute to the core

budget. It is highly recommended that cost recovery mechanisms are included in the INM-GB strategy. However, this is beyond the scope of GBON and SOFF initiative.

There is a strong potential to engage with National existing partners and end-users, as well as to explore new partnership opportunities already identified earlier in section.

It is important to incorporate in the strategy plan a data sharing policy, with defined data/service pricing procedures, i.e. the conditions that will allow generating revenue when costs are recovered.

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

- *Review the national strategies for establishing and improving observing network*

Guinea-Bissau is a small country taking into account the climate change experienced all over the world, nevertheless there is a strong need to modernize the meteorological observational network by installing automatic weather stations in different locations in order to obtain a more dense network that produces accurate data and generates reliable meteorological information.

The distribution of the stations is related to the spatial and temporal distribution of rainfall in the three zones identified above and the type of agriculture practiced in each of these agricultural zones (Plateau, Bas-funds and Mangrove).

Bearing in mind that mangrove (saltwater) agriculture, which is more practiced in the south, requires a lot of water, it is extremely important for farmers to have meteorological information and seasonal forecasts in order to better guide their agricultural activities and to be able to manage the water in their pocosins properly. This information is only possible with the installation of stations throughout the country.

The country is increasingly threatened by climate change, especially in the east and northwest, due to the gradual decrease in rainfall and the rise in temperatures.

The INM-GB strategy plan includes an observational network with 4 types of stations, synoptic, marine, agrometeorological and hydrological.

The “so-called” optimal network incorporates:

- 07 synoptic stations;
- 04 marine stations;
- 07 Agrometeorological stations;
- 60 pluviometric rainfall stations;

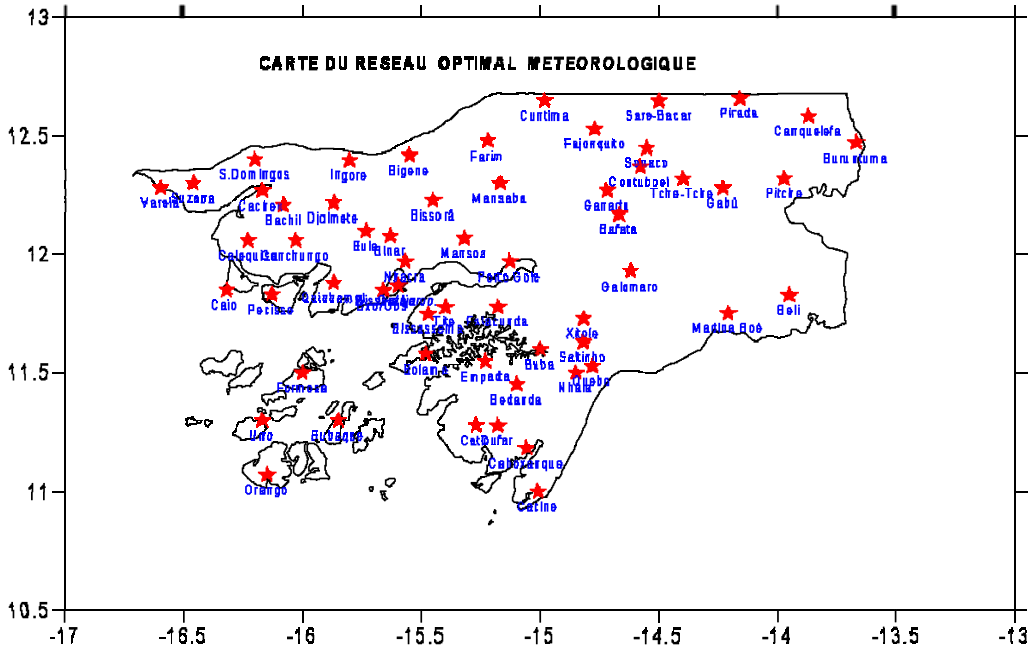

Figure3. Map of the optimal network from INM Guinea Bissau

The INM-GB plan identifies the rehabilitation of 3 synoptic stations, 3 climatological stations and 5 hydrological, with the aim to have, at least, one operational meteorological station in each administrative regions, Bafatá, Biombo, Bissau, Bolama, Cacheu, Gabu, Oio, Quinara and Tombali.

Table 2. Synoptic Stations and their Operational Status

Local	Type	Date created	Latitude (N)	Longitude (W)	Alt. (m)	Current status
Bolama	**Synoptic**	**1905**	**11º60'**	**15º48'**	**20**	**To be rehabilitated**
Bissau/Aerop	Synoptic	1941	11º53'	15º39'	29	Operational
Bafatá	**Synoptic**	**1950**	**12º17'**	**14º67'**	**43**	**Rehabilitate**
Bissorã	**Synoptic**	**1950**	**12º23'**	**15º45'**	**10**	**To be installed**
Farim	**Synoptic**	**1950**	**12º48'**	**15º22'**	**03**	**To be installed**
Cufar	**Synoptic**	**1950**	**11º17'**	**15º11'**	**19**	**To be installed**
Gabu	**Synoptic**	**1941**	**12º28'**	**14º23'**	**83**	**To be rehabilitated**

Table 3. Agrometeorological Stations and their Operational Status

Local	Type	Date created	Latitude (N)	Longitude (W)	Alt. (m)	Current status
M.Boé/Beli	**Agrometeorology**	**1950**	**11º45'**	**14º13'**	**75**	**To be installed**
Quinhamel	**Agrometeorology**	**1985**	**11º88'**	**15º86'**		**To be installed**
Caboxanque	**Agrometeorology**	**1992**	**11º17'**	**15º07'**		**To be installed**

Contuboel	**Agrometeorology**	**1989**	**12º36'**	**14º58'**	**08**	**To be installed**
Bissau/Granja	**Agrometeorology**	**1992**	**11º51'**	**15º36'**		**To be installed**
Bula	**Agrometeorology**	**1950**	**12º10'**	**15º73'**	**30**	**To be installed**
Bubaque	**Agrometeorology**	**1940**	**11º04'**	**16º02'**	**30**	**To be installed**

Table 4. Main and auxiliary weather stations

Local	Type	Date created	Latitude (N)	Longitude (W)	Alt. (m)	Current status
Bissau/Obs	Climatology	1916	11º80'	15º59'	20	To be rehabilitated
Buba	**Climatology**	**1940**	**11º40'**	**15º85'**	**10**	**To be rehabilitated**
Gabu	**Climatology**	**1941**	**12º17'**	**14º14'**	**83**	**To be rehabilitated**
Catio	**Climatology**	**1946**	**11º28'**	**15º27'**	**18**	**To be installed**
Caió	**Climatology**	**1950**	**11º83'**	**16º32'**	**39,5**	**To be installed**
Varela	**Climatology**	**1950**	**12º28'**	**16º60'**	**13**	**To be installed**
Cacine	**Climatology**	**1950**	**11º13'**	**15º01'**	**06**	**To be installed**
Pirada	**Climatology**	**1950**	**12º66'**	**14º16'**	**55**	**To be installed**
Sonaco	**Climatology**	**1950**	**12º48'**	**14º48'**	**25**	**To be installed**
Orango	**Climatology**	**1995**	**11º04'**	**16º09'**		**To be installed**
Formosa	**Climatology**	**1995**	**11º33'**	**15º50'**		**To be installed**
Quêbo Coli	**Climatology**	**1996**	**11º32'**	**14º47**		**To be installed**

Table 5. List of classic Rain Gauge Stations and Their Operational Status

Local	Type	Date created	Latitude (N)	Longitude (W)	Alt. (m)	Current status
Tche-Tche	**Raingauge stations**	**190055**	**12º17'**	**14º12'**		**To be installed**
Mansaba	Raingauge stations	190010	12º17'	15º17'	43	Operational
Canchungo	**Raingauge stations**	**190006**	**12º04'**	**14º02'**	**15**	**To be installed**
Cacheu	**Raingauge stations**	**190005**	**12º26'**	**16º16'**	**14**	**To be installed**
Fulacunda	**Raingauge stations**	**190023**	**11º47'**	**15º18'**	**34**	**To be rehabilitated**
Potugole	**Raingauge stations**	**190019**	**11º97'**	**15º13'**	**10**	**To be rehabilitated**
Buruntuma	**Raingauge stations**	**190016**	**12º46'**	**13º66'**	**100**	**To be installed**
Xitole	Raingauge stations	190031	11º73'	14º82'	30	Operational

Empada	**Raingauge stations**	**190025**	**11º55'**	**15º23'**		**To be rehabilitated**
Tite	Raingauge stations	190022	11º78'	15º40'		Operational
Galomaro	**Raingauge stations**	**190029**	**11º56'**	**14º37'**		**To be installed**
Bambadinca	**Raingauge stations**	**190015**	**12º02'**	**14º52'**		**To be installed**
Pitche	**Raingauge stations**	**190017**	**12º32'**	**13º97'**		**To be installed**
S. Domingos	Raingauge stations	190032	12º24'	16º12'	22	Operational
Calequisse	Raingauge stations	190033	12º06'	16º23'	50	Operational
Bigene	Raingauge stations	190034	12º41'	15º55'	50	Operational
Ingoré	**Raingauge stations**	**190035**	**12º40'**	**15º80'**	**30**	**To be installed**
Djolmete	**Raingauge stations**	**190036**	**12º13'**	**15º52'**	**30**	**To be installed**
Mansoa	**Raingauge stations**	**190010**	**12º01'**	**15º32'**	**08**	**To be rehabilitated**
Cuntima	**Raingauge stations**	**190038**	**12º39'**	**15º02'**		**To be installed**
SareBacar	**Raingauge stations**	**190039**	**12º51'**	**14º27'**		**To be installed**
Fajonquito	**Raingauge stations**	**190040**	**12º52'**	**15º76'**		**To be rehabilitated**
Ganadu	**Raingauge stations**	**190042**	**12º16'**	**14º43'**		**To be installed**
Canquelifa	**Raingauge stations**	**190043**	**12º58'**	**13º86'**		**To be installed**
Cade	**Raingauge stations**	**190044**	**12º14'**	**13º54'**	**50**	**To be installed**
Pecixe	**Raingauge stations**	**190045**	**11º83'**	**16º13'**		**To be installed**
Caravela	**Raingauge stations**	**190046**	**11º33'**	**16º20'**	**15**	**To be installed**
Uno	**Raingauge stations**	**190047**	**11º13'**	**16º10'**		**Installing**
Bissassema	**Raingauge stations**	**190049**	**11º45'**	**15º28'**		**Installing**
Bedanda	**Raingauge stations**	**190051**	**11º27'**	**15º06'**	**14**	**Installing**
Nhacra	**Raingauge stations**	**190062**	**11º97'**	**16º57'**		**Installing**
Binar	**Raingauge stations**	**190060**	**12º07'**	**16º24'**		**Installing**
Bachil	**Raingauge stations**	**190063**	**12º13'**	**16º64'**		**Installing**
Nhala	**Raingauge stations**	**-**	**11º53'**	**15º28'**		**Installing**
Foia	**Raingauge stations**	**-**	**11º48'**	**16º36'**		**Installing**
Guiledje	**Raingauge stations**	**-**	**11º20'**	**15º07'**		**Installing**
I. Galinha	**Raingauge stations**	**-**	**11º28'**	**16º18'**		**Installing**
Fa	**Raingauge stations**	**190014**	**12º06'**	**14º49'**		**Installing**
Quebo	Raingauge stations	190057	11º53'	14º78'		Operational
Saltinho	**Raingauge stations**	**-**	**11º63'**	**14º82'**		**To be installed**

- *Review of existing or planned hydromet development projects related to GBON*

The proposed plan for the hydrometric network is based on the classic rain gauge stations. The solution, meteorological equipment, proposed in the plan does not fit in the GBON requirements. Therefore INM-GB should be processed with his plan of reinforcing the network of hydromet stations, taking in account that the data will not contribute directly to GBON network.

However, the meteorological stations to be installed within the scope of SOFF will also have the profile of a hydrological station, which will allow these stations to be compatible with GBON requirements.

- *Provide recommendation on activities to ensure consistency and complementarities of current and planned investments and development projects of relevance for GBON*

Taking in account that INM-GB does not have AWS and does not have access to the data from the potential meteorological equipment installed in the Country, it is strongly recommended that the AWS that will be defined for GBON network will result from the INM-GB plan for establishing and improving observing networks.

Also INM-GB should include an important point in the MoU with the Ministry of Agriculture and Transport sectors to ensure that INM-GB have, previously access, to information regarding the meteorological equipment that will be installed under International or National projects.

This will allow INM-GB to ensure that the stations acquired by this Institution are installed, configured with meteorological sensors in compliance with GBON requirements.

2.5. Review of the national legislation of relevance for GBON

- *Review the national legislation related to responsibility for measuring and providing weather observations related to GBON.*

The INM-GB is the National Authority in Meteorology and Climatology and its mission is to pursue national policies in the fields of meteorology and climatology. Its President, ensures the permanent representation of the country at the WMO. All the responsibility to insert and update metadata information from meteorological observation (all king of stations) in OSCAR platform is an attribution of INM-GB.

- *Review the legislation related to procurement, importation and customs processes of relevance for the proposed Plan's activities and investments.*

It could be found information related with procurement, within the scope of its attributions, in the Ministry of Economy and Finance, which is the governmental institution in charge of the general orientation of the Economic and Financial Policy of the Government and the management of the State's assets, namely to define the develop and enforce the public procurement regulations.

Regarding the ongoing project, Public Administration Management Support Project (PAGAP) that started in March 2023 and will end in 2026, namely the specific objective i, "b) establishing a more efficient public procurement system", some changes may be introduced in the system related to the procurement in the coming years.

However, following the usual procedure, it is recommended that INM-GB continues to include taxes and custom costs in their budget and future project proposals, to avoid any issues related to procurement.

No legal constrains found for the support of the implementation of GBON activities in the Guinea Bissau. The implementing entity from SOFF project will ensure that the procedures will take place accordance with the terms of the current funding request and UN principles: 1. Best Value for Money; 2. Fairness, integrity, and transparency; 3. Effective international competition; 4. The interest of the UN.

Usually foreign companies join National companies to reply to tenders. In terms of importation and customs it could not be found any remarkable information, just the usual taxes that are normal in African Countries. Regarding the procurement it must be written in the requirements that all importation costs must be included.

- *Provide recommendation on how to address any constraints related to the national legislation required to implement GBON.*

Currently, in Guinea-Bissau, the legislative power is considered to be very unstable, and the legislative texts concerning the officials are not uniform. Consequently, there are no legislative texts and regulations adapted to meteorology.

According to the government structure of Guinea-Bissau, INM-GB is supervised by the Ministry of Transport, Communications and Digital Economy, so one of the recommendations will be that the President of INM-GB establishes regular working meetings with its supervisory authority, promoting the monitoring of all phases of the implementation of SOFF. This monitoring will allow a rapid response, by the supervisory Ministry, to any constraints that are identified.

Another recommendation would be to establish a committee to monitor the implementation of SOFF, which should be composed of representatives from the various state entities directly involved, namely: Ministry of Transport, Communications and Digital Economy, Ministry of the Environment, Ministry of Agriculture, Ministry of Easter and Ministry of Finance. This committee will meet periodically to monitor the progress of the SOFF implementation phase, share information on the progress of the work and resolve any problems that may arise during implementation.

Module 3. GBON Infrastructure Development

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

Provide recommendation on a harmonized observing network design, including siting and instrumentation of new and improved stations, including:

a. A map of observing network distribution and a list of the required new or rehabilitated GBON stations;

The INM-GB operates and maintains 19 rain collectors deployed nationally, 3 synoptic, 3 climatological and 12 hydrological stations.

From this 5 meteorological observational station only 3 are classified as operational and none is an automatic weather station. INM-GB does not operate upper air or marine meteorological observational station.

The table below provides information of the surface observing networks, along with the current station metadata in WMO/OSCAR surface, and an analysis at the time of reports being received at the WMO monitoring centers.

Table 6. Surface observing networks, status metadata in WMO/OSCAR

Network	Current stations	Oscar/surface		WDQMS
		Declared status	Assessed status	
Surface	6 stations	5 stations	5 stations	3 stations
	● **3operational**	● **3 operational** ● **2 unknown**	● **3 operational** ● **2 unknown**	● **1 reporting** ● **2 unknown**

The global gap analysis provided by WMO estimated the need for 1 GBON surface land stations for standard density to meet the horizontal resolution requirement.

The GBON national gap analysis conducted by INM-GB and IPMA, in December 2023, indicates the need for 3 surface land stations and 1 upper air station to potentially be integrated in the national GBON network.

From the information shared by INM-GB Director a upper air station will be installed by the airport handling and logistics company, and will be operated by INM-GB technicians.

The proposal includes 3 new surface stations, taking in account that:

- Region with lack of surface and upper air meteorological observations;
- Actual meteorological equipment and observational programs cannot meet the GBON requirements;
- Technical facilities, namely for sensors management, without conditions to be used for equipment maintenance purposes;
- Transmission systems do not meet reporting cycle required by GBON and the implementation of WIS 2.0;
- INM-GB does not have AWS stations;
- Area that can be defined in climate transition region, regarding the Köppen-Geiger Climate Classification;

- The increase in average sea levels has deteriorated the living conditions of coastal populations whose livelihoods depend entirely on traditional fishing activities;
- Region very sensible to climate change, regarding the potential impacts in Guinea Bissau economical tissue and activities;
- Regarding the spatio-temporal distribution of precipitation we can find three distinct zones and type of agriculture practiced in each of these zones (Planalto, Bas-fonds and Mangrove)

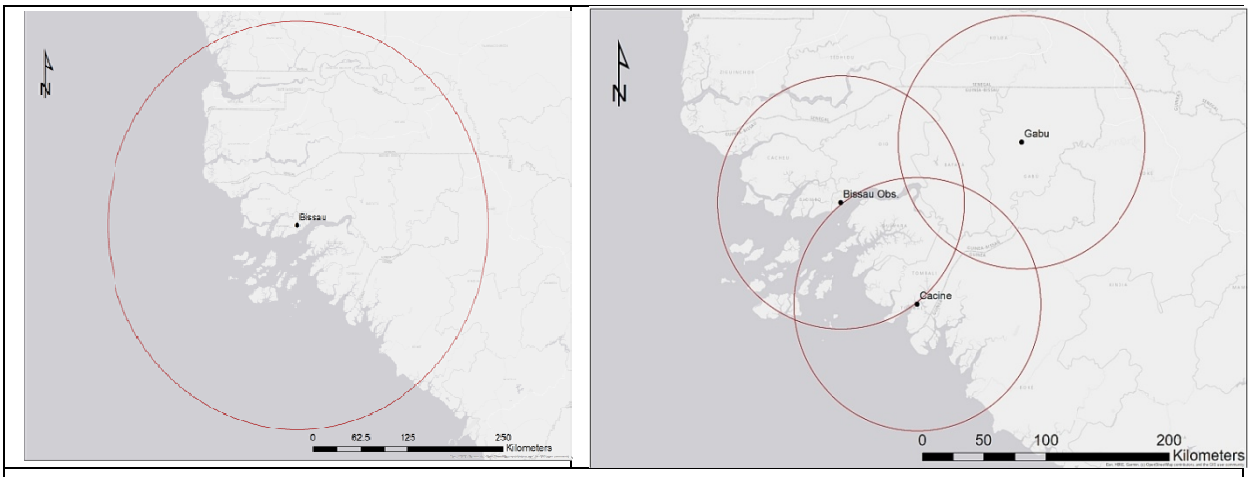

Figure4. a) Map of the future upper air station; b) Map of the proposed surface stations;

Table 7. List of stations and actual status, proposed to GBON network

Station name	*WIGOS ID*	*Station Type*	*Owner*	*Status*	*Type*	*Installation date*	*Required*
Bissau Observatory	0-624-0-61782	S	INM-GB	Operational	Manual	1916	New
Cacine	-	S	INM-GB	Non Operational	Manual	1950	New
Gabu	-	S	INM-GB	Non Operational	Manual	-	New
Bissau Airport	-	UA	ASECNA	Planned	Manual	-	New

b. A list of observation instruments and systems per site; and

From the assessment analysis it can be identified that INM-GB operates manual surface stations (classic stations). Only 3 surface land stations are identified for GBON (Bafatá, Bissau Observatory and Bolama).

INM-GB currently does not operate upper-air stations. A new upper-air station will be installed by ASECNA. And the proposal is that this station could meet the GBON requirements

All investment related to the installation, whether in the support infrastructure, meteorological support equipment, consumables (gas, balloons and probes) as well as the training of INM-GB technicians who will operate the launch will be provided by the ASECNA entity.

The most relevant meteorological instruments that are in use in the GBON declared stations are described in following table:

Table 8. Instruments actually installed at the stations

Station name	*Parameters*						
	Atmospheric pressure	**Air temperature**	**Air humidity**	**Horizontal wind speed**	**Horizontal wind direction**	**Precipitation**	**Sun hours**
	Barometer	*mercury thermometer*	*Thermo-hygrographs*	*Anemometer*	*wind vane*	*Udometer*	*Heliographs*
BAFATÁ	□	□	□	X	X	□	X
BISSAU OBSERVATORY	X	□	□	X	□	□	X
BOLAMA	X	□	□	□	X	□	X

From the list of stations identified under the INM-GB National plan, the proposal, under the SOFF initiative, will be to install automatic weather stations composed of sensor compliance with the WMO requirements.

The parameters that will be included in the obervational program from land surface stations are: atmospheric pressure (station level and reduce to mean sea level; air temperature and relative humidity (2meters height); horizontal wind speed and direction (10meters height); and precipitation (1meter height) and global solar radiation (2meters height).

Table9. Instruments proposed to the new stations

Instuments / stations	**Bissau Obs.**	**Gabu**	**Cacine**
barometer	yes	yes	yes
thermohygrometer	yes	yes	yes
Sonic wind sensor	yes	yes	yes
rain gauge	yes	yes	yes
pyranometer	yes	yes	yes

From the mission that IPMA technicians made to Guinea Bissau, one of the actions was related with the AWS installations site assessment. Consult document in the annexes.

The plan included several activities but, one of the most important was to evaluate the conditions of the existing meteorological stations and as well as the framing of the surroundings in terms of the conditions for the installation of an meteorological station in accordance with the WMO rules.

The identified locations resulted from joint work with technicians from INM GB, IPMA and the local administrations that were involved.

- Bissau Observatory, Lat. 11.856464and Long. ,-15.5900025, high 21meters
- Cacine, Regional Fish Center, Lat. 11.12943 and Long. -15.02316, high 5meters
- Gabu, Airport Nova Lamelo Facilities, Lat. 12.301389 and Long. -14.242975, high 70meters

c. *Investments and activities needed for the installation of new stations and the improvement of existing stations*

Regarding the fact that INM-GB does not have AWS in the National observation network, and the technical and local assessment of the GBON stations identified the need of 3 surface land, the investment activities under SOFF support will be based in the installation of new automatic equipment, automatic weather stations (AWS), in locals where meteorological stations exists or already existed, but with classic profile.

Along with the investment in the meteorological, acquisition of field verification/calibration equipment is very relevant taking in account that INM-GB does not have any calibration equipment.

Also very important is the investment in capacity and training of the INM-GB technical team in handling the different types of equipment and technology.

Table 10. Reference budget for the new 3 stations proposed for SOFF support and field calibration equipment and 3-year calibration in laboratory and capacitation and training sessions

		Unit Price EUR	Quantity	Total EUR
1-Installation of new AWS				
	1.1 - Equipment meteo AWS	13,000.00	3	39,000.00
	1.2 - Transport CIP Bissau	4,500.00	1	4,500.00
	1.3 - Meteorological Park (Civil work + Fences)	4,000.00	3	12,000.00
	1.4 - Installation (3 stations)	5,000.00	3	15,000.00
	1.5 - Local travel expenses	1,250.00	3	3,750.00
	1.6 - Data communications (volume estimated, 1.5Gb/month/station and 10Gb for dataware housel system communication)	540.00	5	2,700.00
	1.7 - AWS Maintenance (6 days for each action. 4 visits regular basis and 1 reactive per year for 5 years)	4,600.00	5	23,000.00
2-Data warehouse				
	2. - Software + Hardware (Data collection system, data management system, data quality control application, wis2.0)	14,000.00	1	14,000.00
3-Spares and tools				

	3.1 - data acquisition system (2 spares)	2,500.00	2	5,000.00
	3.2 - sensor spares for the meteo AWS (3 spares for temperature and humidity, pressure, wind, radiation and precipitation)	6,000.00	3	18,000.00
	3.3 - spares for AWS (solar panels, batteries, lightning protection, communication, cables etc) (3 spares each)	2,400.00	3	7,200.00
	3.4 - Tools	1,500.00	1	1,500.00
	3.5 - Calibrations (transport and calibration process for 4 years, air temperature and humidity, pressure sensors)	800.00	18	14,400.00
4-Field Calibration Equipment				
	4.1 - Calibration station (Pressure, T/HR and Precipitation)	11,500.00	1	11,500.00
	4.2 - Field calibration (3 persons, 6 days by semester)	1,840.00	4	7,360.00
5 - Capacitation				
	5.1 - AWS capacitation			
	5.1.1 - Training sessions on installing AWS and sensors management	4,000.00	3	12,000.00
	5.1.2 - Training meteorological technicians maintenance	5,200.00	5	26,000.00
	5.2 - Data collection system training	5,500.00	3	16,500.00
	5.3 - Data management system training	4,000.00	3	12,000.00
	5.4 - Capacity and training sessions on calibration equipment	4,000.00	3	12,000.00
	5.5 - Local capacitation on WIS2.0 platform *	3,500.00	3	10,500.00
	5.6 - Training on information technology stack	3,500.00	2	7,000.00

	5.7 - Training of trainers, meteorology, hidrology (2 INM-GB technicians)	7,380.00	3	22,140.00
Total investment / 5 years				**297,050.00**

d. Observational practices defined per network

The performances of a surface observational network have a big dependence on the:

- Skills, training and competencies from the technical staff team. This team must have responsibilities in instruments, communication system equipments and IT systems, not only in the installation processes but also in maintenance and repair of instruments, support equipment and system performance and diagnostics;
- Understanding the functionality of the meteorological instruments and methods applied to the meteorological observations procedure;
- Preventive and corrective maintenance on instruments and systems in accordance with Standard Operating Procedures (SOPs) to ensure quality and availability of the meteorological observations. In this case it is really important to define and execute, in a higher level, maintenance plan;
- Calibration of instruments is crucial to ensure the quality of the recorded meteorological data. Along with the maintenance plan, a calibration plan must be defined with regard to the recommendations from WMO in terms of calibrations standard procedures;
- Metadata management information is a very relevant activity that must be implemented and incorporated in the networks management activities from INM-GB.

Therefore it is highly recommended that the INM-GB technical staff team responsible for the GBON stations (surface, marine and upper air) receive regular training on the installation and management of AWS, diagnostics procedures and repair actions on instruments and systems.

e. Preliminary maintenance plan for existing and improved/new stations, including calibration practices / - equipment / -facilities

Currently INM-GB manages a meteorological observational network composed only by classic weather stations used to execute meteorological observations programs.

For maintaining the quality of meteorological observations at the level of standards established by the WMO a maintenance plan for meteorological stations was developed for the GBON surface land stations managed by INM-GB.

The efficiency in the maintenance of the meteorological stations will depend on the existence of qualified technicians, equipment and maintenance tools, allocated to the maintenance team.

INM-GB defined a maintenance plan for the current meteorological observational network to ensure data availability for National and International exchange with very limited resources. The country has been negatively impacted by the political instability which contributes to the lack of investment in the meteorological observational system.

The GBON requirements of data availability and quality cannot be achieved with INM-GB current resources (human and equipment).

The interventions defined in the maintenance plan will have different frequencies for each observing system, sensors and components, aligned with WMO guides and SOP and also taking in account the recommendations proposed by manufacturers or suppliers.

The INM-GB maintenance plan to be implemented will be based on a preventative maintenance schedule of 90 days for GBON stations. Corrective maintenance actions will be performed to fit in the 5 days window to ensure that the station meets the WMO and National monthly data availability performance target.

INM-GB technical team, that has its headquarters in Bissau, is responsible for all meteorological stations maintenance activities and the plan, preventive and corrective maintenance will be conducted by this INM-GB maintenance technical team.

Two approaches for calibration of measuring instruments for GBON stations can be proposed, the laboratory calibration and field calibration.

The laboratory calibration must be performed in a laboratory operated in accordance with IEC/ISO 17025, ensuring that the measurement and traceability standards are used to perform the required calibrations.

Field verification and calibration are conducted for certain sensors by using the field calibration equipment. Field verification/calibration equipment must be calibrated in a laboratory at defined intervals, in order to ensure credible measurements and traceability.

At this stage, INM-GB:

- does not have any calibration equipment, portable system or laboratory equipped with environmental chamber for the calibration of air temperature and humidity sensors as well for atmospheric pressure sensor;
- The actual maintenance plan defines two visits per year to each meteorological station, and calibrations are made abroad, namely in Niamey in Níger.

Regarding the inexistence of calibration laboratory conditions, the best approach is to plan that all laboratory calibration for GBON air temperature, humidity and pressure sensors will be performed by a credential laboratory company or a meteorological service partner.

Portuguese Sea and Atmosphere Institute (IPMA) can assist INM-GB in the calibrations procedures and also calibration processes can be made in IPMA own calibration laboratory (not credentialed). Also calibration service can be contracted to TAP Maintenance & Engineering credentialed laboratory, entity that IPMA uses for meteorological instruments calibration.

To be able to execute the sensor calibrations from the maintenance plan, it is imperative that INM-GB has a group of spare sensors for the essential parameters, namely air temperature and humidity, atmospheric pressure and precipitation, allowing the execution of the calibration program without stopping or downtime of the observational programs.

Along with the calibration in the laboratory, the field verification/calibration equipment is very relevant. It will be necessary to acquire that type of equipment, in order to allow regular field verifications in complement to the laboratory calibrations.

Plan includes 3 maintenance procedures.

PM	**Preventive Maintenance**	**Regular verification of the meteorological park condition, cleaning of park and the sensors (namely temperature and humidity shield, precipitation sensor, solar panel) verification of the precipitation sensor.**
CM	**Calibration Maintenance**	**Laboratory calibration procedure for sensors (stations and verification/calibration equipment)**
FV	**Field Verification/calibration**	**Field verification/calibration with portable equipment**

Proposed plan for air temperature and relative humidity and pressure sensors involve the use of the spares (3) in a rotative solution, a procedure that ensures the yearly calibration.

Precipitation sensors should be checked in each PM and verify each FV.

Table 11. Example scheme for the maintenance procedures for air temperature, relative humidity and pressure sensors (PM- Preventive Maintenance, CM - Calibration Maintenance, FV - Field Verification)

Station name	***Year1***				***Year2***				***Year3***			
	1T	*2T*	*3T*	*4T*	*1T*	*2T*	*3T*	*4T*	*1T*	*2T*	*3T*	*4T*
Bissau observatory	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*
			FV		*CM*		*FV*		*CM*		*FV*	
Gabu	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*
			FV		*CM*		*FV*		*CM*		*FV*	
Cacine	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*	*PM*
			FV		*CM*		*FV*		*CM*		*FV*	

- The calibration procedure for air **temperature and relative humidity sensors**

Calibration Maintenance

1. starts by sending the 3 spares to calibration, one or two month before the end of the certificate date;
2. the 3 sensors that return from calibration will replace the sensors that are in stations, and the removed 3 will go to calibration;

The procedure will include 6 calibrations in 2 batches for each year for this type of sensor.

Field Verification

The regular procedures will include a field verification or calibration, if needed, using the portable station. The process will be done in one-year interval or whenever the sensor reveals an expected behavior, regarding the recorded data.

Preventive Maintenance

The regular visit, monthly, to the meteorological park involves the verification of the condition of all structures, cleaning of park and the sensors (namely temperature and humidity shield, precipitation sensor, solar panel) verification of the precipitation sensor.

Taking in account the stability of atmospheric pressure sensors, manufacturer proposal for calibration and the WMO recommendation the calibration, in laboratory, plan for this type of sensors can fit in a two years circle, using the spares (3) for the calibration circle.

- The calibration procedure for **atmospheric pressure sensors**

Calibration Maintenance

1. start with sending of the 3 spares to calibration, month previous to the end certificate date;
2. when return from calibration, the 3 sensors will replace the sensors that are in stations, and the removed 3 will go to calibration;

The procedure will include 6 calibrations in 2 batches in the third year for this type of sensors.

Field Verification

The regular procedures will include a field verification or calibration, if needed, using the portable station. The process will be done in one year interval or whenever the sensor reveals an unexpected behavior, regarding the recorded data.

Preventive Maintenance

The regular visit, monthly, to the meteorological park involves the verification of the condition of all structures.

- The calibration procedure for **precipitation sensors**

Calibration Maintenance

For precipitation sensors it is recommended that the procedure is based on the field verification /calibration and preventive maintenance with special attention to the verification of the rain collector.

Field Verification

The regular procedures will include a field verification or calibration, if needed, using the portable station. The process will be done in one year interval or whenever the sensor reveals a not expected behavior, regarding the recorded data.

Preventive Maintenance

The regular visit, monthly, to the meteorological park involves the verification of the condition of all structures, cleaning of park and verification of the precipitation sensor.

The investment required for maintenance activities correspond to the cost of two human resources, stay and fuel for the transport vehicle.

The proposed maintenance plan includes a preventive maintenance with calibration procedure if planned, each 90 days for GBON stations from INM-GB and 1 reactive maintenance with 2 persons team.

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

The type of sensors must be adapted to the environmental conditions from the Country and taking in account the purpose of the data that will be recorded at the station. In this case the WMO recommendation must be the reference for the establishment of the GBON network in Guinea Bissau.

Information from upper-air observation system will be not considered, taking in account that ASECNA supports the acquisition of the equipment and the operational cost.

Table 12. Meteorological sensors information requirements

Parameter	Unit	Range	Resolution	Precision	Stability	uncertainty	Characteristics	output	Additional information
Air pressure	hPa	600 to 1100	0.1	0.3hPa (15º to 25ºC) 0.6 hPa (0º to 40ºC)	< 0.1 per year	0.15	3 sensors equipment	Digital	Static Header pressure
Wind field	m/s degree (º)	0 to 60; 0 to 359	0.1; 1º	3% < 35m/s 5% > 35m/s	NA	NA	ultrasonic	Digital	Most have 10m cable
Air Temperature and humidity	˚C; %	-40 to 55; 0 to 100	0.1˚; 0.1%	0.2˚ 1.2%	NA	0.2˚; 3%	Combined sensor	output 0-1V	Most have 3.5m cable
Precipitation	mm	0 to 300 mm/h	0.2mm	2% < 60mm/h 5% < 250mm/h	NA	5% or 0.1mm	Collecting Gauge Orifice Area 200cm2	Analogical	Solid and stable mast
Global radiation	W/m2	300 to 2800			<0.5% /year	<2% daily	Sensibility 5 at 20 µV/W/m2		Spectral sensor

Table 13. Communication, logger and computing information - CENTRAL

DESCRIPTION	TYPE	TECHNOLOGY	NUMBER EQUIPMENTS	CHARACTERISTICS	OUTPUT	ADDITIONAL INFORMATION

CENTRAL COMMUNICATIONS	hardware	Modem, GPRS/3G or router	1	Connected to processor unit	Digital	Compatible with data mobile communications cards
LOGGER - CENTRAL	software	Open technology	1	Install at server	Digital	Based in open technology with possibility of programming
COMPUTER	hardware	Server, Computer system	1	Mount in a rack cabinet	-	Non license solution
ENERGY	hardware	Battery holder	1	Mount in a rack cabinet	-	Dimension for 72 hours without net energy
PROCESSOR UNIT	software	Based in standard programming language	1	Data processing software	Digital	Non license solution. Based in open technology with possibility of programming
WIS 2.0	software	Software developed by WMO	1	Dissemination software	-	Install the server system.

Table 14. Logger, communications and energy - AWS

description	type	technology	Number equipments	Characteristics	output	Additional information
Remote communications - AWS	hardware	Router	3 + (3 spear)	Install at the stations	Digital	Compatible with data communication cards
Logger AWS	hardware	-	3 + (2 spear)	Install at the stations	Digital	Non license solution. Based in open technology with possibility of programming
Computer	hardware	Portable PC	2		-	Non license solution

Energy	hardware	System, solar energy and Battery	3 + (3 spear)	Install at the stations	-	Dimension for 120 hours without net energy

Table 15. Portable verification and calibration system

PARAMETER	UNIT	RANGE	RESOLUTION	PRECISION	STABILITY	UNCERTAINTY	CHARACTERISTICS	OUTPUT	ADDITIONAL INFORMATION
PRESSURE	hPa	600 to 1100	0.1	0.3hPa (15º to 25ºC) 0.6 hPa (0º to 40ºC)	< 0.1 per year	0.15	3 sensors equipment	Digital	Static Header needed
AIR TEMPERATURE AND HUMIDITY	°C; %	-40 to 55; 0 to 100	0.1°; 0.1%	0.2° 1.2%	NA	0.2°; 3%	Combined sensor	output 0-1V	Most have 3.5m cable
PRECIPITATION	mm	0 to 300 mm/h	0.2mm	2% < 60mm/h 5% < 250mm/h	NA	5% or 0.1mm	Collecting Gauge Orifice Area 200cm2	Analogical	Solid and stable mast

g. Considerations for stations' security, constant power supply, communication and related contingencies (risks can be incorporated in section 5).

According to the proposal regarding the equipment that will be installed within the scope of the SOFF initiative, and taking into account the constraints of the country and INM-GB, it will be essential that measures related to guaranteeing the safety and operability of the equipment are taken into consideration.

In line with usual recommendations for the installation of this equipment, the first approach for the locations for the installation of the meteorological equipment, have considered the following requirements:

- places where meteorological stations already exist in operational regime, which belong to INM-GB and which currently have meteorological technicians in place, in order to continue the data series;
- places that belong to a state entity, that have regular human activity and presence. allowing easy accessibility to the meteorological instrument park, by INM-GB maintenance technicians;
- areas in which the coverage of the mobile data network, provided by National operators, has sufficient signal for data transmission as well as allowing the establishment of connections for maintenance purposes (whenever necessary);

- in relation to electrical energy, the AWS solution will involve the use of energy obtained using photovoltaic panels and a battery (which can withstand at least 5 days without charging from solar energy);
- implement a solution that identifies and communicates in near-real time the location, using the GPS signal, of the communications support equipment (modem/router);

In terms of the location in which the communication, relating to data collection, filing system and data processing as well as the technological infrastructure that will support IT applications for the dissemination of meteorological data within the scope of GBON, the proposal identifies the installation of all this equipment at the headquarters of INM-GB with the AWS communication and data transmission system being dedicated.

3.2. Design of the ICT infrastructure and services

Provide recommendation on ICT infrastructure and services design and solutions on data transmission from an observing station to the national real-time data management system and GTS and WIS 2.0, including:

a. Detailed description of the ICT infrastructure and services design

Taking in account that INM-GB does not have any AWS the financing proposal for the installation of stations will incorporate the acquisition of infrastructure, hardware infrastructure and software solution, to support the meteorological observational data from automatic procedures, when it's possible, in an open source and non licensing technologies.

INM-GB operates in its headquarters a very simple IT infrastructure network composed by cables, switches and network points connected to work PC. All this equipment (sponsored by AGRHYMET Regional center) is installed in a normal room without the standard characteristic for an informatics system.

Figure5. Photo of the room where the PC are installed, with the climate data base and climsoft with an internet modem.

The internet connection is provided by operator MTN that provides up to 4Mbps. For GSM/GPRS/4G/5G data transmission INM-GB, for the future Automatic Weather Stations network data transmission, must select a company that provides cell phone coverage over the whole country, including remote areas.

Figure6. Room where de internet modem is installed

The IT infrastructure proposed, that will support AWS network, must be composed by a small rack solution where the physical servers, dedicated scalable storage and the UPS will be installed.

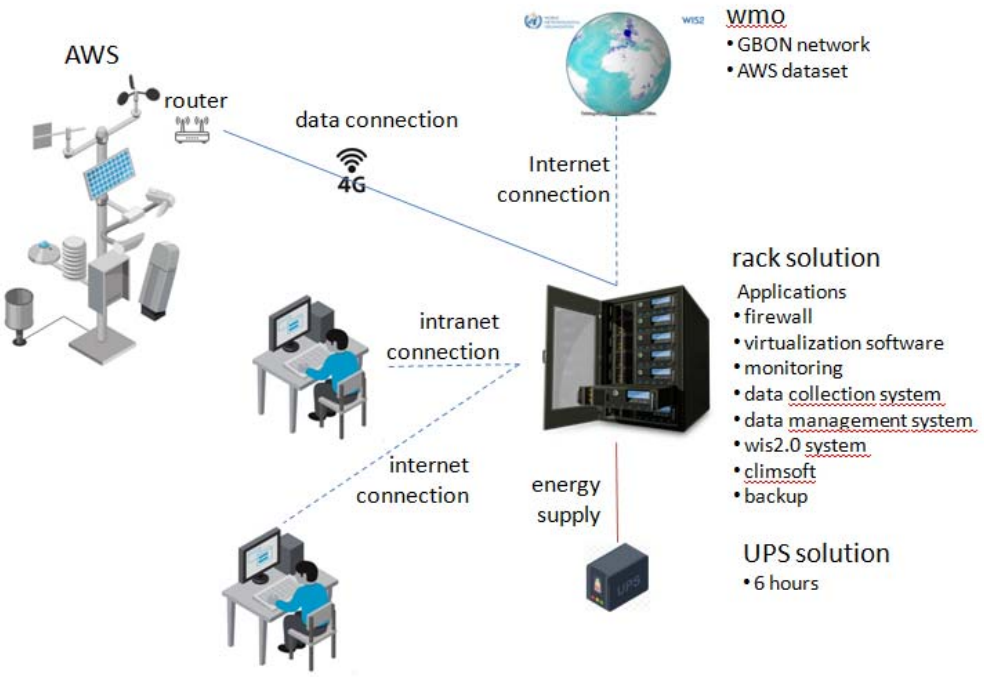

Figure7. Scheme from the IT infrastructure proposal

The virtual servers that will be installed in the virtualization solution will host all the application/software, and this application will be reachable by different protocol (http, https, ftp and ssh) or remote desktop connection

The proposed IT solution must incorporate the two internet connections, allowing not only the redundancy in the internet connection but also increased security in terms of internet threats by using firewall application and providing the IT team with management tools, not only for IT equipment, but also for various network assets.

It will be through this solution that connections to AWS must be configured, the secure connection to the various National, Regional and Worldwide data centers, of which WMO stands out.

Figure 7 represents the schematic IT infrastructure that must be installed under SOFF initiative.

Together with IT technicians, a solution must be found for the physical accommodation of this computer system, a location that must safeguard the minimum conditions that guarantee the normal functioning of this equipment. The energy issue stands out. The energy power of the electrical network must be available in accordance with the requirements as well as the thermal conditioning of the location, and it would be desirable for a solution to be found in which a watertight compartment would be built in one of the available rooms in the INM-GB headquarters building. This is a determining point for the normal functioning of the proposed technological solution.

Figure8. Example from a rack mount solution with cooling system

b. Technical specifications for the data collection system from the observing station to the collection point

Actually INM-GB only operates with manual meteorological stations, observations are compiled and transmitted by cell phone directly to the Meteorological Center from Bissau Airport and then transmitted to Dakar Regional Data Center.

The connection between the station and the data collection system (informatics application) must be based in an Information Communication Technology (ICT) that will allow the support of data communication from the remote AWS to the Global Telecommunications System (GTS) in a near real time, or with a defined frequency. The designed system must also have the capability to be transmitted in Binary Universal Form for the Representation (BUFR) format from the source (AWS) to the GTS.

Along with the data collection system an informatic application, data management system DMS, must be installed allowing the automatic and/or manual on-site weather observations and transfer data. This DMS is a key element in the observation value chain, from the measuring station to the end-user interface. It is recommended that the data management system must be based in open source technologies and open protocols to ensure sustainable and redundant operation, maintenance and development throughout its lifecycle. The proposed DMS must be able to be deployed in a local server or in a cloud environment, depending on national laws and regulations, staff capacity, as well as an organizational decision.

The system must allow not only the data collection but also the remote logger programming and management.

c. *Technical specifications of the data services (compatible with the requirements of WIS 2.0)*

The WIS 2.0 requirements identified that AWS should have a data logger solution that handle the data transfer protocols, MQTT and SFTP. Data collected from the AWS must be converted automatically to generate BUFR reports for WMO international data exchange through GTS and WIS 2.0. The functionality of converting data to BUFR must automatically without any need to be loaded on a database.

Actually INM-GB SYNOPTIC reports are provided in TAC format sent to the NHS where BUFR messages are compiled (coder / decoder) and submitted to Dakar Regional Data Center that share the data in GTS. The SYNOPS on the GTS are compiled manually by weather observers, and it is only for some main and intermediate synoptic hours.

The recommendation on the ICT infrastructure will meet the compliance with WMO standards. The minimum data dissemination program will be hourly data available and shared internationally by using the WIS2.0 BOX from the WIS2 framework. The data will flow directly from the observational station to the national data collection system, in real-time, and to GTS and WIS 2.0 according to data and metadata WMO standards described in the reference guide.

Requirements for local solution:

Hardware

1. Technological solution that will allow the manage and hosting of virtual servers;
2. Expandable storage solution that will allow the manager of disk space from the virtual server;
3. Rack mount dimensioned for hosting the hardware;
4. Router for data collection;
5. Modem for redundant data collection;
6. 2 portable PC with internet connection for maintenance of AWS in the field (preferably rugged laptops);
7. 2 desktops for monitoring purposes;
8. Training of INM-GB IT team on management of the Technological infrastructure;
9. Backup solution

Information Communication Technology

1. Application for managing the virtual server's environment;
2. One virtual server for the data collection system (manage data collection from the remote stations)
3. One virtual server for data management system (manage collected data; monitoring systems from the network, server, dataflow and data availability; quality control procedures applied to the processed data generation of BUFR message and dissemination; availability of data for meteorological and climate purposes - CLIMSOFT)

4. One virtual server for hosting the INM-GB WIS 2.0 platform (publishing data under WMO international data exchange through GTS and WIS 2.0.)
5. Recover and restore solution using the backup system
6. Training in virtualization solution
7. WMO workshop / training on WIS 2.0 in a box

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

More and better qualified human resources are required, and professional training is imperative. The latter will be included in the capacity workshops, practical training session, with the aim to improve the skills from INM-GB technical team, in evaluating meteorological and computer data.

The technical infrastructure to be implemented should be developed in a modular approach in terms of defining the metadata information from the weather stations and equipment; mechanisms for automatic data collection; data transfer protocol; automatic quality control of data from meteorological observations.

The implementation of a DMS solution is a critical point in the meteorological observation value chain using open source technologies and open protocols to ensure sustainable and redundant operation, maintenance and development. DMS must be based on a scalable solution allowing the ingesting and storing of different types of weather observation data from weather stations, namely surface stations, upper-air stations, marine stations, aviation stations, and lightning sensors. Also it is very important that this solution can handle different data formats, vector and raster.

For this flexible solution the data ingestion process must be carried out using a modular approach, so that new data can be added with minimal effort and modification of existing database components and structures. API solution for data ingestion is recommendable.

Supported protocols for data transfer must be aligned with GBON specifications, at least MSQT and SFTP. Also the decode messages received from third-party data collection systems must be included.

In addition, a web based tool must be provided for manual entry of observations from the stations.

Data quality control (QC) module must be designed in such a way that it can produce a quality check independently of the underlying database system. In addition, the QC module must be able to perform quality control in real time and must allow manual quality control in non-real time manual quality control in non-real time.

The system that will incorporate the procedures related to data quality control should be installed in the data logger solution at the AWS and in a informatic system dedicated to managing the meteorological data (Data Management System)

The proposed is that the first level where the "validation" procedure will be implemented in AWS acquisition system where the procedures will identify the gross error, basic time and internal consistency checks. The implementation of these procedures is relevant because some errors introduced during the measuring process cannot be eliminated later.

Quality control applied to the raw data.

Another level control in real-near time is related with the processed data. The proposal is that these level can be done at AWS but also at the data management system, for example these procedures

will check temporal and internal consistency, evaluation of biases and long-term drifts of sensors and modules.

3.3. Design the data management system

Provide recommendation on requirements for a data management system aimed to provide access to data used by operational applications on a real-time basis and the capability to deliver data to a Climate Data Management System (CDMS) for long-term archiving purposes. The system should provide the following:

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

Based on the assessment, the solution proposed will bring to INM-GB the ability to become compliant to WMO requirements.

In terms of technical infrastructure, the solution will allow:

- a local infrastructure (servers, storage, routers, modems) based in a virtual environment that brings compatible solution to cloud service;
- 6 hours' autonomy without external energy;
- email server solution (no license application) will be included in the requirements;
- update versions of the OS;
- Automatic procedures to ensure near real time data management;
- Redundancy;
- Remote software installation and upgrade;
- Security access based in a profile user definition;
- restricted data access by authorization;
- Logging and monitoring of the system information and notification for any technical challenges
- Sustainable and cost effective

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

The recommendation is to implement an ICT solution, based in the virtual environment that will be compliant with WMO standards. The proposal is to insure the minimum data dissemination program, hourly data, and make that data available and shared internationally using the WIS2.0 BOX from the WIS2 framework.

In the proposed scheme, data will flow directly from the observational station to the national data collection system, in real-time, and to GTS and WIS 2.0.

c. *Data delivery to the national CDMS*

Data management system will allow INM-GB to manage not only the collected data from the AWS but also the historical meteorological data from classic stations in manual procedures.

The data management system will incorporate a digital catalogue application where metadata information from all meteorological stations from Guinea Bissau can be managed.

These two solutions will give support to the capability to deliver data, long term series and short time series, to CLIMSOFT that is the Climate Data Management System (CDMS) that INM-GB operates.

d. Discovery and descriptive metadata management

A database solution will give support to queries of time series with the best performance. Data management system must ensure that users can discover real-time and long-term data storage in a user-friendly interface. A statistical module must be available to allow the generating of added value parameters and include the aggregation of parameters, for example daily means, minimums, and maximums.

This application must ensure the export of BUFR message format and delivery to GTS and WIS 2.07 (GBON compliance)

The system must be able to store relevant metadata regarding stations, station networks and observations and make it available through a digital catalogue application capable of offering data to a standard API that will allow automatic updates in WMO/OSCAR -system.

The delivery of GBON hourly observations should be reported by following WMO guidance (nº 3068) and GBON practices.

e. Monitoring of data, processing and services

The data collection module, that will ensure the collect AWS data, is most likely to be proposed by the AWS manufacturer. The data management system shall cover all the needed systems and services for:

- short-term and long-term data storage and access;
- AWS network monitoring, with a dashboard application with a notification service triggered by a no operation station;
- data availability procedures, with a dashboard application solution with a notification service in line with data quality procedures;
- standard API for automatic and M2M interactions;

3.4. Environmental and sustainability considerations

Recommend pragmatic approaches and measures for environmentally responsible design and evolution of the national networks to achieve GBON requirements, including:

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

The INM-GB will consider technical specifications that take environmental sustainability into account when procuring measurement equipment to meet GBON requirements. The surface observation networks will be designed with the aim of having a sustainable weather and climate observation system.

b. Integration of sustainability considerations for the management of operations of GBON stations, including installation, calibration, and maintenance

Considering the theme, related to sustainability, of vital importance for the success of this initiative, it is highly recommended that:

- the equipment acquired does not have associated licensing and preferably open source solutions;

- the applications acquired are preferably open source solutions, without licensing;
- in terms of software, priority should be given to solutions that have a lot of use and supporting documentation in the meteorological community;
- ensure that the installed solution will allow the incorporation, without additional costs, of more automatic meteorological stations that may be acquired by INM-GB or integrated from equipment from other entities;
- the installation locations of the meteorological stations should be chosen for the safety of the location, ease of access, proximity to people who can quickly check the condition of the meteorological park and the installed equipment, if possible;
- this initiative guarantees the costs: maintenance for up to 3 years; data transmission for up to 3 years; calibrations in accredited entities for up to 3 years; ongoing training and capacity building for up to 3 years;

At the same time, the proposed 3-year training plan should be considered, as this action is essential to provide INM-GB technicians with training adapted to the challenges that new technologies bring.

After the equipment has been installed and is operational, a cost plan must be drawn up together with INM-GB so that it can be included in the INM-GB activity plan and budget, to ensure the operationality of the installed systems, taking into account the costs of data transmission, maintenance and calibration.

c. *Careful material selection for the development, shipping and day-to-day operations of GBON stations, with a focus on developing and using reusable instruments and sustainable methods of observation (e.g., elimination of single-use plastics).*

The consumables will comply with current environmental regulations, particularly with regard to packaging (biodegradable whenever possible) and batteries. The materials will be made for the development, transportation and daily operations of GBON stations, with a focus on the development and use of reusable instruments and sustainable observation methods.

Considering that meteorological balloons can fall into the ocean, depending on the east-west circulation that sometimes occurs, the recommendation to purchase blue meteorological balloons is in line with the results of the most recent studies that indicate a lower probability of marine animals ingesting the balloon.

Module 4. GBON Human Capacity Development Module

4.1. Assessment of human capacity gaps

Provide a summary of staff skills, education levels, and capacity gaps for technicians, experts, and management, including Port Meteorological Officers (PMO) when applicable, gender balance and gender opportunities.

INM-GB has thirty three(33) workers, 10 with fixed-term contract, 13 hired, 2 internal and 8 retired (but still working with contract) divided between headquarter and the stations, in the country.

The staff is mainly made up of technical staff (over 80%). Administrative staff represents around 20% of the workforce.

INM-GB staff are relatively old (8 already retired position) the average age is 49 years. In terms of age distribution 83% are older than 40 years and only 17% have less de 40 years. Important also to mention is that 46% of the staff have more than 50 years old.

Female staff represents 37% of the workforce.

There is an urgent need for a human resources management policy that will allow the creation of a Forecast Employment and Skills Management Plan, considering the planned reforms and the necessary training of staff for the meteorology area.

Strengthen the technical skills of INM-GB staff to provide products identified with a view to the country's socio-economic development.

4.2. Design capacity development activities for technical staff

Provide recommendation on training activities and recruitment for technical staff, including:

a. *Instrument and station maintenance at site*
b. *Calibration and maintenance at the workshop*
c. *Network monitoring*
d. *ICT system operations*

Combined answer.

Within the scope of training, IPMA expressed its availability to support in the identified areas, but referred to the difficulty of carrying out missions in INM-GB by IPMA technicians.

Considering the scarcity of financial resources to move Technicians from Guinea Bissau, IPMA informed that it would develop efforts to provide the necessary support to carry out training activities at IPMA, and would therefore make contacts with relevant international organizations, namely the CPLP and with the Camões Institute.

INM-GB must engage with the opportunity of WMO RTCs to assist in providing meteorological observation training to current Observer Technicians as well as AWS training to Maintenance Engineers and Instrument Technicians.

Also it is highly recommended that INM-GB should increased the number of employees for supporting mainly the operational activities. This new human resources should have a meteorological or climatologically background with some skill in the observational systems and a expertise level in new technologies. Also the IT technician profile will be relevant to operate and maintenance the

technological stack that will be installed under the SOFF initiative. Regarding the number and the age of the INM-GB employers the renewal of the INM-GB human resources will be determinant to achieve the objectives inherent in fulfilling the requirements set by SOFF. Other important employee that INM-GB will need for the near future is a technician with project management skills, taking into account that in the next 5 years it will be crucial for INM-GB to be able to respond promptly to the requirements that will be placed on it with the implementation of SOFF.

The recommendation is for each system described to require that capacity and training sessions must be organized locally, abroad and remotely (reference to include in the tender).

In table below is represented the training and capacity activities proposed for INM-GB under the SOFF initiative.

Table16. ***Recommended training and capacity activities, presented in EURO currency***

		year				
Action ID		**1**	**2**	**3**	**4**	**5**
1.5	Training sessions on installing AWS and sensors management. 3 local actions, during 4 days for 4 persons	4.000	4.000			4.000
1.6	Training meteorological technicians maintenance. 3local action for 4 persons and 2 action for 2 persons abroad during 3 days	4.000	7.000	7.000	4.000	4.000
1.7	Training in data collection system. 1 action abroad, 4 days 2 persons;2 local action for 4 persons and 1 remote action. (administrator and expert user profile)	11.000		4.000		1.500
2.3	Training in data management systems. 3 local actionfor 4 persons. (administrator and expert user profile)	4.000	4.000		4.000	
2.4	WIS2.0 capacitation. 1 remote action for 4 persons3 days. 1 abroad action for 1 person for 3 days and 1 local action for 4 persons 2 days.	4.000		5.000	1.500	
2.5	Training in IT. 2 local action for 4 persons for 3 days. 1 abroad session for 2 persons 3 days and 2	5.000	12.000	1.500		1.500

	remote sessions 2 days					
3.2	Training in portable verification and calibration system. 3 local action for 4 persons, 3 days.	4.000	4.000	4.000		
4.1	Training of trainer. 4 days 3 persons abroad.	7.380		7.380		7.380
5.1	Capacitation on project management. 5 days 3 persons abroad.		10.700		10.700	

4.3. Design capacity development activities for senior management

Provide recommendation on training activities and recruitment for management in

e. Strategic and financial planning
f. Project management

Combined answer.

Another recommendation is to organize training sessions for senior staff related with:

Finance: with the aim to support finance staff, this training will provide knowledge and guidance to incorporate best practice procedures in financial management area from INM-GB;

Communication: it is very relevant, in our days, to have dedicated staff in the communication and media area with the main aim:

In the internal communication, to make employees more aware of the importance of this plan for the INM-GB success, and to have the same level of information, understanding and commitment to the strategic objectives of the plan.

Externally, to convince users and partners that the implementation of the plan is a way of improving the value of their activity and a monitoring tool for the success of their mission.

Project management: skills in project management and new business development are essential to enable the plan, ensuring the monitoring and supervising of tasks from the projects given condition to his successful conclusion. It is also recommended that posts be created to manage this SOFF project.

Technical skills in climate and meteorological field: this training proposal will strengthen the INM-GB staff in order to provide identified products for the country's socio-economic development.

4.4. Gender and CSOs considerations

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

Human capital should be considered the most important asset of any institution, which must guarantee rights and an inclusive environment, and be governed by principles of equality, the right to difference and combating any kind of discrimination.

Solidifying the principles set out above is a current concern that cuts across any society.

The WMO Gender Action Plan reinforces the need for organizations to seek equality between men and women in all areas, including leadership positions.

It is also suggested that the following gender quota be implemented at the INM-GB:

Women should represent at least 50% of all participants in SOFF-related and SOFF-supported training activities;

Women should represent at least 50% of all participants in SOFF consultations and planning workshops;

Women should represent at least 50% of the staff operating and maintaining GBON stations;

Women should represent at least 50% of decision-making and project management positions, where applicable.

In terms of the gender breakdown of INM-GB staff groups, we can see that women represent only 37% of the workforce. To correct this imbalance, INM-GB needs to develop a gender equity strategy in line with the WMO's recommendations. It is recommended that INM-GB develops a gender equity and equality plan with a view to inclusion and minimizing existing differences.

The INM-GB has strong ties to several NGOs, particularly those related to agriculture, fisheries, environment and culture. Given this connection, which has its origins in the representation of the INM-GB at a national level, it is recommended that the INM-GB continue to actively involve representatives of local communities (CSOs) in the processes of raising awareness of the importance of equipment for better understanding of climate variability, but also in monitoring and surveillance adverse weather situations. The example that the INM-GB adopted in the collaborative process of deciding on the locations for the installation of AWS, which had the active participation of representatives of local communities, involving them and in some way making them jointly responsible for the safety of the equipment to be installed.

In this sense, the organization of small workshops on the theme of meteorology and climate in local communities, CSOs and NGOs is a recommendation that will foster knowledge and interest in these matters among the people of Guinea-Bissau. On the other hand, the organization of this type of activity, close to the population, will help to minimize the problem resulting from the existence of several dialects spoken in the different regions of the country.

Table17. workshop proposed for the local where AWS will be installed

Local /	Activity description	Target
Gabu	Workshop on importance of observational systems, clima change impacts	Local administration, NGO, CSO, community representants
Cacine	Workshop on importance of observational systems	Local administration, NGO, CSO, community representants
Bissau	Workshop on importance of observational systems, clima change impacts	Local administration, NGO, CSO

Module 5. Risk Management Framework

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

Based on the SOFF Risk Management Framework, identify risks and recommend a risks management framework, including:

a. *Identification and analysis of risks*
b. *Mitigating measures and responsible*
c. *Monitor and evaluation*

Table 18. Assess the risks of the observing network and propose mitigation measures

Identification	*Analysis of risks*	*Mitigating measures and responsible*	*Monitor and evaluation*
Contextual risks *Risks related to political instability and safety that jeopardize the completion of the results preparation phase*	Vandalism of the deployed infrastructure.	Install equipment in, or near, to local governmental entities infrastructure	Infrastructure protection and surveillance to mitigate possible vandalism.
	Existence of an electricity network in some regions of the country	Use of photovoltaic energy in the equipment to be installed	Number of equipment operating using solar energy
	Mobile data network coverage	Checking network availability and signal in selected locations	All stations use the mobile data network
	Accessibility of selected sites to the deployed infrastructure and maintenance.	Establish bilateral agreements with National and local governmental institutions	MoU with National and local governmental institutions
Institutional risks *Risks related to the participation of the peer advisor's institutions in the preparation phase activities*	Slow procurement process to acquire the equipment and services	Define collaboration procedure between process partners in order to safeguard compliance with project deadlines	Regular monitoring activities between partners
	Insufficient staff with the necessary skills	Capacity building plan in order to reinforce the number ofspecialized technicians	Monitoring the capacity building
	Restricted access to infrastructure by peer advisor resources	Regular meeting, online and insitu	Pre-planning during visitation of the sites taking into consideration the current road infrastructure.

Conjuntural Risks Related to the current situation in the country	Unavailability staff resources to fully commit to the readiness phase	Improve engagement, communication and planning.	Regular meeting between staff
	Lack of training and capacity building actions.	1. Increase the number of actions for the capacity building plan 2. Organize awareness sessions in the educational institutions like high school and university level	Strengthening of training actions in line with the national strategy. Number of organized seminars within the climate and meteorology areas.
	Lack of support from other government agencies and institutions to the benefits of SOFF to the country	1. Updating legislation to support meteorological services at national level 2. Government commitment to obtaining such support 3. Promote the potential results that the project will bring to the country	Number of state entities using the data generated by the GBON network; Improve the relationship with NGOs and CSOs by promoting thematic workshops

Module 6. Transition to SOFF investment phase

This module involves supporting the beneficiary country and the IE in preparing the Investment phase funding request based on the recommendations provided in the Plan.

Please provide any additional recommendation relevant for the translation of the National Contribution Plan into an Investment Phase Funding Request.

The table presented below include all costs related with the reinforcement and update (GBON requirement) of the meteorological observational network, the modernization of the IT infrastructure from INM-GB and the strengthening of skills of INM-GB employees in the technical areas of meteorology and hydrology and technological support.

Table 19. Total budget proposal, without VAT values

ID			1 year		2 year		3 year		4 year	5 year
			1S	2S	1S	2S	1S	2S		
AWS -1-		Automatic Weather Station								
	1	Surface AWS equipment	39,000.00							
	2	Transport CIP Bissau	4,500.00							
	3	Civil work and infrastructures	12,000.00							
	4	Installation and travel	18.750,00							
	5	Training in AWS installation and sensors management	4,000.00			4,000.00				4,000.00
	6	Training meteorological technicians maintenance	4,000.00		7,000.00		7,000.00		4,000.00	4,000.00
	7	Training in data collection system	4,000.00	7,000.00				4,000.00		1,500.00
	8	Spares	30,200.00							
	9	Tools	1,500.00							
IT -2-		Information Technologies								

	1	Data warehouse application installation (Data collection system, data management system, data quality control application, backup software, firewall software, system monitoring, WIS2.0)	14,000.00	36,000.00					
	2	Hardware, servers, storage, communication, cable network, firewall, system management		60,000.00					
	3	Data management system capacitation	4,000.00			4,000.00		4,000.00	
	4	WIS2.0 capacitation		4,000.00			5,000.00	1,500.00	
	5	Training in IT		5,000.00	7,000.00	5,000.00		1,500.00	
	6	Communications (AWS communications card, data collection and dissemination)	540.00		540.00		540.00	540.00	540.00
Ca -3-		Calibration							

	1	Portable Calibration station (Pressure, T/HR and Precipitation)		11,500.00						
	2	Training in portable calibration system		4,000.00	4,000.00		4,000.00			
	3	Calibrations facilities (intervention to restore the technical calibration building)			90,000.00					
	4	Field verification and calibrations (6 days per semester			1,840.00		1,840.00		1,840.00	1,840.00
	5	Laboratory Calibration (Pressure, T/HR) (6 sensor/year and transport)				3,600.00		3,600.00	3,600.00	3,600.00
Tr -4-		Training of trainers								
	1	Meteorology and hydrology	7,380.00				7,380.00			7,380.00
Pm -5-		Projet management								
	1	Capacitation on project management (3 persons)			10,700.00				10,700.00	
Ma -6-		Maintenance								
	1	4 preventive and 1 reactive (3 persons 6 days actions)	4,600.00		4,600.00		4,600.00		4,600.00	4,600.00
Ta -7-		Taxes								
	1	Import duties for all equipment (AWS and IT systems)	9,800.00							
Co -8-		National consultations								

1	CSOs, and other relevant stakeholders. (2 days event, 30 participants)	25,000.00			30,000.00	
TOTAL/YEAR		**292,020.00**	**142,280.00**	**39,460.00**	**60,780.00**	**28,960.00**

Values from the investment proposed do not include VAT

Summary of GBON National Contribution Plan

Provide summary of GBON National Contribution Plan by filling this table

Components	Recommended activities
Module 2. GBON business model and institutional development	1. INM-GB must adopt and promote MoU with several governmental institutions, which can be used to strengthen relationship with national Governmental Entities such as Ministry of Agriculture, Ministry of Energies and private institutions that operate in the Country.
	2. Establish direct contact with international donors to keep INM-GB updated on their funding opportunities and priorities.
	3. Establishment of MoU with different economical actors, INM-GB should engaged the National communication operator, energy sector, namely the oil and gas company, airport handling and logistics company allowing INM-GB, in a exchange of meteorological data in near-real-time, recover part of the investment made, and establish the minimum conditions for the sustainability of the technological infrastructure as well as the automatic meteorological observation network
	4. Development of the National WIGOS, promoting the implementation plan where stakeholders, owning and operating weather observations infrastructure, can be mobilized to contribute to the rollout of the weather infrastructure that will address data needs for all weather sensitive industries in the country
	5. Evaluate the opportunities for cooperate with NMHS from nearby countries with similar equipment to optimize the maintenance activities in a regional.
	6. Consolidate the business model, fully public, that indicates that INM-GB owned and operated GBON infrastructure. Nevertheless it can be important to define and development a legal framework for the private sector, promoting the collaboration in the observational activities.
	7. INM-GB must be directly involved in coordination from different projects to avoid overlapping and ensure sufficient budget for maintenance costs after the implementation phases from project life cycle
Module 3.	1. The gap analysis developed and provided by WMO to INM-GB estimated the need for 1GBON surface land station and 1

GBON infrastructure development	upper air to meet the horizontal resolution requirement. SOFF Peer Advisor GBON National Gap Analysis conducted in 2023, recommends 3surface automatic weather stations located in Cacine, Farim and Gabu to close the National GBON network gaps for Guinea Bissau, but also additionally this stations will help to close the gap from the south, eastern and north part of the region.
	2. All these 3meteorological stations proposed to be installed within the scope of SOFF will be automatic and will transmit data hourly. These stations will be installed in locations with a history of classic meteorological observations, thus allowing the continuity of the historical data series from these stations.
	3. Establish a spare stock from all type of sensors installed at the AWS.
	4. Define calibration plans and design new calibration procedures and training sessions for the INM-GB technicians.
	5. The entire technological infrastructure that will be installed within the scope of SOFF will be directly and exclusively used within the scope of this project. It will be adjusted to the reality of INM-GB. Technology that is easily accessible on the market must be used, based on standardized hardware and software solutions in open source approach.
	6. The data collection system and data management system must be installed in virtual environment. The technological infrastructure will allow the implementation of quality control procedures in 2 level, at the AWS and at the data management system. That data collected from AWS must beconverted automatically to generate BUFR reports for WMO international data exchange through WIS 2.0 or GTS. The technologicalinfrastructure to support
	7. WIS 2.0 in a box must be installed in a specific virtual infrastructure, and all the data transfer protocol must configure.
Module 4. GBON human capacity development	1. Increase training activities related with meteorological observation systems, namely, calibration sensors, AWS, radar and satellite operation. Identify opportunities to collaborate with neighboring countries institutions related to training on maintenance and calibration of instruments.
	2. Regarding the new IT approachregarding the virtualization solution IT technicians must participate in capacity and training sessions for the different profile (system administration and expert user)
	3. Training in AWS installation, sensors management and in situ calibration
	4. Training Sessions must include training on data collection system, data management system, data quality control and WIS2.0 in a box application
	5.Promote the balance enforced of 50% of women participating in the capacity building activities. It is recommended that INM-GB develop a gender equity plan for the organization to address gender balance.

	6. Recommend awareness campaign amongst local communities; build knowledge, to enhance security of the meteorological infrastructure and systems.
	7. Organize sessions on compliance with GBON and WMO data Policy requirements, refresh training on project management and financial for the finance staff
Module 5. Risk Management	1. Regarding the risk of infrastructure vandalism, installation needs to be on secure locations and awareness campaigns to the local population and authorities on the importance of the weather observations must be conducted.
	2. To avoid non-compliance with the GBON requirements, decentralization capabilities must be addressed to local focal points to minimize on observations networkdowntime
	3. Regarding the slow administrative acquisition procedures, it is recommended to meet private partners to ensure the timelines in restoration of GBON stations
	4. Use the solar energy solution for the AWS installed in the different parts of the country
	5. Important is to maintain a minimum spare equipment.
Module 6. Transition to SOFF investment phase	1. Investment phase is recommended to carry out by following the Gap Analysis and National Contribution plan produced by SOFF Beneficiary country and Peer advisor. All information related with the financial requirements must be used by the implementing entity for prepare the project plan, addressing the GBON compliance requirements and setting objective and reasonable timelines

Annexes (if any)

Report completion signatures

Peer Advisor signature

Telmo Carvalho

Digitally signed by Telmo Carvalho
Date: 2024.10.25 14:28:53 +01'00'

Beneficiary Country signature

Presidente do conselho de Administração do INM-GB e Representante permanente da Guiné-Bissau junto de OMM.

WMO Technical Authority signature