COUNTRY HYDROMET DIAGNOSTICS

Informing policy and investment decisions for high-quality weather forecasts, early warning systems, and climate information in developing countries.

July 2024

Guinea-Bissau Peer Review Report

Instituto Português do Mar e da Atmosfera

Weather and climate data for resilience

Systematic Observations Financing Facility

WORLD METEOROLOGICAL ORGANIZATION

Alliance for Hydromet Development

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List of Abbreviations

AHD	Alliance for Hydromel Development
ASECNA	Agency for the Safety of Air Navigation in Africa and Madagascar
AWS	Automatic Weather Station
CAP	Common Alerting Protocol
CHD	Country Hydromet Diagnostics
CSO	Civil Society Organization
ECMWF	European Centre for Medium-Range Weather Forecasts
EW4All	Weather Warnings for All
Franc CFA	Franc Communauté financière d'Afrique
GFS	Global Forecast System
INAM	Mozambique National Meteorological Institute
INAMet	Angola National Meteorological Institute
INM-GB	Guinea Bissau National Meteorological Institute
INMG-CV	Cape Verde National Meteorological and Geophysics Institute
INMG-ST	São Tomé e Principe National Meteorological and Geophysics Institute
IPMA, IP	Portuguese Institute for Sea and Atmosphere
IT	Information Technology
NCP	National Contribution Plan
NGA	National Gap Analysis
NMHS	National Meteorological and Hydrological Service
NOAA	National Oceanic and Atmospheric Administration
PC	Personal Computer
PR	Permanent Representatives
SNPC	National Civil Protection System
SOFF	Systematic Observations Financing Facilities
UN	United Nations
UNEP	United Nations Environment Programme
WMO	World Meteorological Organization
WMC	World Meteorological Centres
NWP	Numerical Weather Prediction
WIGOS	WMO Global Observing System

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The findings, interpretations and conclusions expressed are those of the named authors alone and do not necessarily reflect those of the agencies involved.

Authorisation for release of this report has been received from the Peer Reviewing Agency and the Country National Meteorological and Hydrological Service (NMHS) as of January 2024.

Disclaimer

This report has been prepared based on information and analysis provided by INM-GB and IPMA. While reasonable care and skill has been taken in preparing this report, no representation or warranty, expressed or implied, is made as to the accuracy, completeness, or suitability of the information and assumptions relied upon, and we do not accept any liability whatsoever for any direct or consequential loss arising from any use of this report or its contents.

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Executive Summary

Weather and Climate information in Guinea-Bissau is provided by the Guinea-Bissau National Meteorological Institute (INM-GB). INM-GB is the Governmental Institution responsible for providing meteorological and climatological services in the Country. Its main service consists in providing daily weather forecasts, aviation information, marine forecasts, weather warnings and climate monitoring information.

Guinea-Bissau joined the World Meteorological Organization (WMO) on the 13th of January 1978.

Currently, the INM-GB remains as a semi-autonomous body under the Ministry of Transports, Communication and Digital Economy of Guinea-Bissau. The INM-GB works closely with National Civil Protection System (SNPC)and supports the strengthening of emergency communications and early warning systems at the national level. INM-GB also provides information for airport and flight operations, working closely with several stakeholders, including the aviation sector. There are no private sector operators providing meteorological observations or data services in Guinea-Bissau.

At present, INM-GB is experiencing some difficult times, which are severely constraining its core activities, particularly in terms of securing the technological component of meteorological observation and forecasting. In addition, there is the problem that results from the few human resources with specialized knowledge in the area of meteorology with employment contracts with INM-GB.

In addition to all these structural constraints, INM-GB lacks adequate working facilities, thus it is difficult to guarantee that its personnel have the best conditions to perform their duties, which is also a worrying obstacle to its performance. While INM-GB have been supported in the past through a few international projects, not much progress has been achieved due to the financial constraints and to political instability the country faced ever since its independence in 1973.

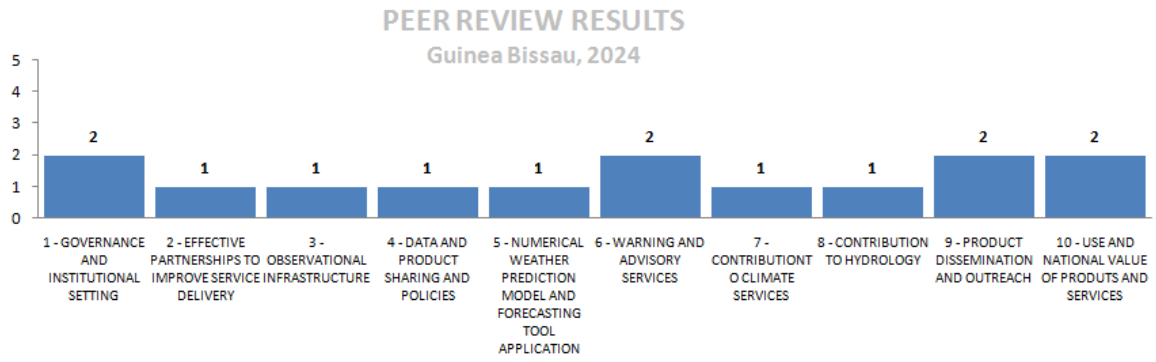

Figure 1 - Overview of the CHD process for Guinea-Bissau

The Country Hydromet Diagnostics (CHD) process concluded that the overall capacity of the INM-GB is at level 1, though the exceptions in element 1, 6,9 and 10which received a rating of level 2.

The low level classification is mainly related with the fact the INM-GB has a very small number of technical staff with appropriate skills, low budget to support core activities, a very

small number of meteorological, climatological and agrometeorological stations in fully operational mode. Furthermore, INM-GB does not operate automatic weather stations, has a low number of technicians in its core mandate areas, including climate, and its technological infrastructure is not adapted to the challenges posed by digitalization.

With these constrains, its contribution to modern hydrology services is very poor.

Recommendations related with INM-GB performance context are the following:

Human resources training – INM-GB has a small group of employees that can be considered to have adequate qualifications to fulfil its mission. Nevertheless, it is imperative to implement a training strategy in order to improve the capabilities of its technicians in different areas of meteorological and climate observations, and not less important in the information technology (IT) area, which is very relevant to the success of most initiatives. Furthermore, it is crucial to train administrative technicians for project management, a fundamental area of knowledge to support the execution of project activities financed by international entities. It is recommended that INM-GB continues to use the training initiatives promoted by the WMO, taking advantage of synergies established with other national meteorological services in order to bring, together, the necessary conditions to be able to respond to the challenge launched to NMHSs with regard to the EW4All initiative.

Education and Training – in order to develop qualified personnel in the medium and long-term, the strategy has to start at the education levels. Therefore, it is recommended to strengthen the Meteorology and Climate courses in secondary and higher education institutions, while at the same time formalizing their relations with INM-GB. In parallel and included in the processes of acquiring meteorological and technological equipment, dedicate a set of training and training sessions (spread over 3 years) on the subject of observation and manipulation of meteorological instruments and calibration procedures, as well as strengthening skills in infrastructure technology management.

Observation capacity – the country and the institution has very limited weather observation capacity. It is recommended to gradually expand, through different international initiatives (e.g. SOFF). The meteorological observational network is very limited, in terms of number of stations and equipment. The recommendation will be to capitalize the investment to be made through the Systematic Observations Financing Facility (SOFF) initiative, to modernize the INM-GB observation network (Install automatic meteorological observation systems, namely automatic meteorological stations, communication and data acquisition systems) based on the investment plan defined in the National context for an optimal observation network.

IT infrastructure –the current technological infrastructure is practically non-existent and is based on a group of regular PCs and 2 modems that ensure the internet connection. It is highly recommended that a simple technological solution be installed, based on the most recent equipment and good practices, to constitute the INM-GB computers network. In this solution, virtual servers can be made available and applications can be installed increasing the IT support level to support the provision of quality services. Installing information technology solutions will allow the collection and sharing of observational data is of paramount importance to enhance the performance of INM-GB.

Data–without adequate systems for collecting, validating, archiving, disseminating and sharing data, INM-GB cannot bring additional value to society as a whole. In this sense, it is

extremely important that the meteorological data collected are made available to economic sectors and societyin general. In this particular case, historical data is very relevant as it allows trend analysis, which is fundamental for understanding climate variability, but also for understanding future climate scenarios and their impacts.

Therefore, given the limited availability of meteorological and climatological data from Guinea-Bissau, it is highly recommended that INM-GB uses specific applications made available within the scope of WMO, and on which SOFF will contribute, to transposes its records into a digital version and makes its historical series available. Such course of action will enable the preservation of meteorological and climatological data series and its accessibility to the international community.

Facilities –Nowadays, any entity needs to carry out its activity in facilities suitable for the mission it proposes. Currently, INM-GB headquarters are poorly suited to organizational and functional requirements, and that is why it is strongly recommended that INM-GB undertakes the modernization and adaptation of its infrastructure. Such an achievement is meant to provide adequate working spaces, with appropriate technical infrastructure, systems and all the logistical components that will enable the institution to run daily operations in a more robust and effective manner. Taking into account the existing infrastructures at the INM-GB headquarters and the conditions in which they are found, it is essential that they be recovered, namely the technical building, which will be decisive for the verification and calibration activities of meteorological equipment.

Cooperation– INM-GB external and international visibility is rather low due to economic constrains. Participation in regular meetings with representatives from national and international organizations should be encouraged and led by INM-GB. A specific internacional agenda should be drafted with the support of international partners (e.g.Instituto Português do Mar e da Atmosfera (IPMA); Instituto Nacional de Meteorologia e Geofisica de Cabo Verde, (INMG-CV); Instituto Nacional de Meteorologia e Geofisica de São Tomé e Principe (INMG-ST)); Instituto Nacional de Meteorologia de Angola (INAMet); Instituto Nacional de Meteorologia de Mozambique (INAM) to enhance INM-GB visibility to a wider community, while at the same time open new opportunities for funding.

Cooperation at a national level will also be very relevant; INM-GB should promote sessions with governmental and non-governmental organizations, highlighting in this case the CSOs with highly relevant activities within local communities.

The Peer reviewed results are presented in the figure 1.

1. General information

Introduction

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 intrusions resulting from sea level rise, tidal surges, and other adverse weather conditions. Seawater intrusions pose a severe threat on the country's mangroves, a biodiversity-rich system which is a major source of livelihood (mangrove rice) and provides coastal protection, among other essential ecosystem services.

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

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.

CHD methodology

This report has been prepared using the methodology described in the 2022 update of the Country Hydromet Diagnostics (CHD). An initial review was performed, using information supplied from the WMO and INM-GB, among other partners.

The CHD aims to address the need for a standardized, integrated, and operational tool and approach for the evaluation of National Meteorological Services. Its core mission is to assess the operational context of these services and the delivery of high-quality weather, climate, hydrological services and warnings. This comprehensive diagnostics tool consolidates existing WMO assessment materials, synthesizes various methods and data into an easily comprehensible format, verifies information through peer review, and fills gaps in missing data.

With the outcome from CHD, donors can understand the constraints of potentially beneficiary countries and institutions in order to anticipate their needs, in a more informed way, and coordinate technical and financial assistance. Such an approach contributes to

improve the resilience of people and institutions in the face of challenges posed by a changing climate.

CHD reviews10 vital elements of the hydromet value cycle, spanning enablers, observation and data processing systems, service and products and dissemination and user / stakeholder interaction. The evaluation of these elements appeal to a set of standardized indicators and explicitly defined data sources to determine the maturity level of the INM-GB, with Level 5 representing the highest attainable maturity level in the CHD assessment.

An in-country visit was undertaken, followed by a report revision and approval. The visit included meetings in the INM-GB headquarters, located in the capital Bissau, as well as a visit to each of the 5 potential locations previously selected for the installation of meteorological automatic stations. The international airport infrastructure was also visited.

Figure 2 - Map of the proposed surface meteorological stations to be declared as GBON stations in Guinea-Bissau

2. Country Hydromet Diagnostics

Element 1: Governance and institutional setting

- *1.1 Existence of Act or Policy describing the NMHS legal mandate and its scope*

The National Institute of Meteorology of Guinea-Bissau, referred to as INM-GB for short, is an organization created by Decree-Law No. 11/2011, of August 9, under the supervision of the Ministry of Transport, Communications and Digital Economy. INM-GB is a public institute, integrated into the indirect administration of the State, endowed with legal personality and administrative and financial autonomy and its own assets. The definition and monitoring of strategic guidelines and objectives set for INM-GB is coordinated with the aforementioned Ministry.

- *1.2 Existence of Strategic, Operational and Risk Management plans and their reporting as part of oversight and management*

The Strategic Plan for the period2018-2022from INM-GB was developed and approved in 2016, but due to the subsequent political instability its implementation has never been possible.

- *1.3 Government budget allocation consistently covers the needs of the NMHS in terms of its national, regional, and global responsibilities and based, among others, on cost-benefit analysis of the service. Evidence of sufficient staffing to cover core functions.*

In budgetary terms, for the year 2023, the value of 217,279,551 CFA Francs was defined and submitted to the Government through the Ministry of Transport, Communications and Digital Economy.

In terms of budget implementation, the amount of 75,079,747 CFA Francs was made available indirectly for payment of salaries and the amount of 20,000,000 CFA Francs was directly allocated to the operating fund for activities related to weather forecasting as well as dissemination of data.

Not generalizing to previous years, INM-GB in 2023 had access to a value, directly from the state's central administration, approximately 35% of the budget required for that same year.

- *1.4 Proportion of staff (availability of in-house, seconded, contracted- out) with adequate training in relevant disciplines, including scientific, technical, and institutional and policy arrangements in country to support training needs of NMHS.*

INM-GB has thirty-five workers, 12 with open-ended contracts, 13 hired, with renewable contracts, 2 interns, and 8 retired (but still working with contract) based on its headquarters and stations, around the country.

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

INMGB staff is relatively old (8 already retired). In terms of age distribution 83% are older than 40 years and only 17% are less than40 years old. The average age of INM-GB is 49 years and 46% of the staff have more than 50 years old.

Female staff represents 37% of the workforce, where 15% have university education, 38% secondary school level, 31% are meteorological observer and 15% have administrative qualifications.

In general, INM-GB staff are have the following qualifications: 26% with university education, 26% with secondary school level, 28% meteorological observer and 20% administrative.

- *1.5 Experience and track record in implementing internationally funded hydromet projects as well as research and development projects in general*

We could identify a very limited portion of staff members, from INM-GB, with experience in track record of implementing international funded projects.

Over the years, INM-GB has been benefiting from some support from development and cooperation projects. However, frequent political instability discouraged international partners from financing interventions in the country, and in some cases even caused the discontinuation of ongoing projects. For these reasons, several internationally funded projects have included capacity-building activities of INM-GB staff conducted outside the country.

- *Summary score and recommendations for Element*

Element 1 "Governance and Institutional Setting" score -**Maturity Level 2** on the CHD scale. This score reflects the serious funding challenges; weakly defined mandate; unadjusted essential skills; lack of human resources with strong skills in IT; little formalized governance and future planning.

Recommendations for improving governance and institutional settings:

a. *Return to good practices of establishing strategic plans for at least 5 years,*

b. *Ensure a greater percentage of the budget made available by the central government for investments in the modernization of meteorological observation networks,*

c. *Define cost recovery activities to ensure sustainable funding for crucial services (operational services, meteorological forecast, climate monitoring),*

d. *Establish a standing committee, headed by INM-GB and with representatives of all the relevant governmental agencies, to coordinate development and cooperation projects with investment in meteorological, climatological and hydrological fields.*

Element 2: Effective partnerships to improve service delivery

- *2.1. Effective partnerships for service delivery in place with other government institutions*

INM-GB has established some partnerships with other government institutions for service delivery, namely with the Civil Aviation Authority and the Agency for the Safety of Air Navigation in Africa and Madagascar(ASECNA) in Guinea-Bissau, the Civil Protection Service, the General Direction for Environment, the General Direction for Water Resource, the General Direction for Agriculture and the Port Maritime Institute. However, these

partnerships require renewal actions with the aim of further strengthening and enhance collaboration in delivering essential services.

Existing and future partnerships mapping and evaluation is needed in order to reach optimized services in terms of efficiency and effectiveness, which is particularly important to address the country's meteorological and hydrometeorological needs.

- *2.2. Effective partnerships in place at the national and international level with the private sector, research centers and academia, including joint research and innovation projects.*

At the moment, INM-GB has no formal relationships with any actors from the private sector. There is only a minimal informal partnership with some sectors, namely academic, agriculture, aeronautical and marine. Nevertheless, there is much potential for the enhancement of the collaboration between national entities from several sectors as recommended above, which could certainly create win-win situations.

At the international level, INM-GB has been able to participate in international meetings and capacity building with regional centres, with support from the WMO. Examples of such participation have occurred under the Severe Weather Forecasting Programme (SWFP)-West Africa and AGRHYMET in Niger.

- *2.3. Effective partnerships in place with international climate and development finance partners.*

Some initiatives related to meteorology have been co-sponsored by the Food and Agriculture Organization (FAO) and the United Nations Development Programme (UNDP), but their effectiveness is very limited due to INM-GB's low capacity to assimilate knowledge and benefit from the support and assistance provided.

INM-GB submitted a project proposal to the Global Environment Facility (GEF) through UNDP/Bissau, called UNDP-GEF Least Developed Countries Fund (LDCF) PROJECT "Strengthening climate information and early warning systems for resilient development and adaptable to climate change in Guinea-Bissau". However, INMGB is not totally involved due to the abovementioned difficulties, i.e. INM-GB is currently not in a position to participate very actively in the process given the low capacity levels of the staff.

- *2.4. New or enhanced products, services or dissemination techniques or new uses or applications of existing products and services that culminated from these relationships.*

INMGB is issuing weather forecast information based on the products obtained by weather information systems available for the Region regarding the information provided by Global Telecommunication System (GTS)and European Centre for Medium-Range Weather Forecasts (ECMWF). Regardless of the above, INMGB does not have computational facilities to run a regional numeric model.

- *Summary score, recommendations, and comments for Element 2*

Element 2 "Effective partnerships to improve service delivery" score - Maturity Level 1 on the CHD scale. This scorer eflects the very limited partnerships, at National and International levels, but also related with no evidence of participation in relevant financing opportunities.

Recommendations for more effective partnerships to improve service delivery:

a. *Identify the potential from several economic sectors, to engage the establishment of long-term partnerships. This approach can be extended to governmental entities, for instance from the Ministry of Agriculture, the Ministry of Energy, and the Ministry of Internal Administration.*

b. *Identify the private partners with whom to establish sustainable relationships. Good examples might be the electricity company, telecommunication operators, oil industry, etc. It is recommended that the focus of the selection is to find new users for potential services and products, but also to support the maintenance of INMGB's future observation systems.*

c. *Continue to increase the level of collaboration with international partners, particularly with the WMO and other UN Agencies, and the Community of Portuguese Speaking Countries (CPLP).*

d. *Strengthen the collaboration with technical schools and Universities in order to increase education and capacity-building opportunities available for the INMGB staff, particularly focusing in meteorology, climate and hydrology. Implementing this recommendation will enable an increase in the number of experts in Guinea-Bissau in the long term.*

Element 3: Observational infrastructure

- *3.1. Average horizontal resolution in km of both synoptic surface and upper-air observations, including compliance with the Global Basic Observing Network (GBON) regulations*

The INMGB operates and maintains 19 classic weather stations (CWS) deployed nationally, 4 synoptic, 3 climatological and 12 hydrological stations (rain collectors).

From the 19 meteorological observational stations, only 8 are classified as operational and none is an automatic weather station. INMGB does not operate upper air or marine meteorological observational station.

Surface meteorological observation programs are carried out using classical meteorological stations.

The stations from Bissau Airport, Bolama and Bafatá perform and issue observations in the Meteorological Aerodrome Report METAR bulletins every 3 hours during the period 09UTC to 18UTC.

Data from the three synoptic stations declared to the WMO as part of the OSCAR/SURFACE platform are transmitted to the Meteorological Centre at Bissau Airport via a cell phone provided by the Agency for the Safety of Air Navigation in Africa and Madagascar (ASECNA) to observers of these stations in the interior of the country. ASECNA guarantees data transmission to the DAKAR Regional Centre.

In terms of upper air observations, 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.

- *3.2. Additional observations used for nowcasting and specialized purposes*

None existing.

- *3.3. Standard Operating Practices in place for the deployment, maintenance, calibrations and quality assurance of the observational network.*

INM-GB, under bilateral cooperation, carries out calibration of its classical meteorological equipment in the Regional Instrument Centre (RIC) from Niger. The calibration plan for this equipment does not have the ideal frequency but it guarantees some traceability of the equipment.

Regarding the national governance mechanism within the World Meteorological Organization Information System (WIGOS) framework, Guinea-Bissau currently does not have such a mechanism established. The absence of this governance structure may impact the coordinated management and use of observational data and resources.

Training INM-GB staff in the WMO Information System for the WMO Global Observing System (OSCAR/Surface), is needed. Additionally, INM-GB has not established a national process to guarantee the quality of information received from the WMO Information System (WIS) Data Quality Monitoring System (WDQMS). The absence of a structured procedure for addressing data quality issues may require attention to ensure the reliability and accuracy of observations.

- *3.4 Implementation of sustainable newer approaches to observations*

No information available.

- *3.5. Percentage of the surface observations that depend on automatic techniques.*

Currently INMGB does not operate Automatic Weather Stations (AWS) in the country. Hence, INM-GB meteorological observation program does not comply with GBON requirements.

- *Summary score, recommendations, and comments for Element 3*

Element 3 “Observational Infrastructure” score: **Maturity Level 1** on the CHD scale. This score is directly related to the non-existence, or limited to basic observations, of a surface observation network, according to the standards recommended by WMO and the non-existence of upper air observations.

Recommendations for improving the observational infrastructure:

a. *Using time-phased implementation procedures based on partnerships with international institutions, INM-GB will be able to modernize its surface and upper air observation network, and thus become a GBON network compliant organization.*
b. *Include specific milestones to ensure that the following phase is not started without completion of the previous one. In particular, it is important to end the phases related with the sustainability of activities and the installation of meteorological automatic stations, which are critical to enhance the capacity of the country. The recommendation extends to all components of the observational network, including Information Technology (IT) and training.*

c. *In order to fully meet the demands of modern society, it is extremely important that INM-GB equips its infrastructure, in which its employees perform their duties, with working conditions that are most appropriate to their mission. It is very important that INM-GB technical buildings can be restored in such a way that the minimum conditions for the good performance of its employees are guaranteed.*
d. *Implement capacity-building and training initiatives for INM-GB staff aligning with the required upgrade of the professional competencies on weather observation and forecast.*

Element 4: Data and product sharing and policies

- *4.1. Percentage of GBON compliance – for how many prescribed surface and upper-air stations are observations exchanged internationally. Usage of regional WIGOS centres*

INMGB operates 3 classic weather stations that are declared in the Global Basic Observing Network (GBON). However, there are challenges with the stations' functionality, specifically with one station that is actually reporting hourly and the other two, reporting every 3 hours (between 9 to 18UTC). This status highlights the need to modernize and potentially expand the network to meet GBON reporting station requirements more comprehensively.

The observational data from the operational observation stations is sent to the Regional Telecommunication Hub(RTH) Dakar by email, and then routed to the GTS.

- *4.2. A formal policy and practice for the free and open sharing of observational data.*

No information available.

- *4.3. Main data and products received from external sources in a national, regional and global context, such as model and satellite data.*

The forecast team has access to the basic products and data from stations in the country, as well as data available on the various WIS websites in the region only through GTS, ECMWF and EUMETSAT respective websites. Additionally, the meteorological operational team has a very unstable and low bandwidth internet connection.

- *Summary score, recommendations, and comments for Element 4*

Element 4 "Data and Product Sharing and Policies" score: **Maturity Level 1**on the CHD scale. This score is based on a very low percentage of observational data shared internationally, either because data is not available to be shared or due to the lack of data sharing practices or the existing infrastructure does not allow data sharing.

Recommendations for improving data and product sharing and policies:

a. *A new legal framework approach for a formal open data policy regarding observational data is needed, as derived from WMO technical standards and guidance[1,2].*

b. *Build capacity on observational data and communication protocols to meet the basic international dissemination standard.*

c. *The installation of a network of automatic surface meteorological stations is imperative for INM-GB, taking into account that to comply with WMO requirements, particularly with the GBON network, the provision of hourly data is mandatory.*

d. *The implementation of the WMO Information System (WIS) 2.0 platform in Guinea-Bissau will give INMGB the ability to validate process, and use observational data from its observation network in a centralized and expert manner, in accordance with GBON requirements, and share such data internationally. The migration to the WMO Information System (WIS) 2.0 could also offer benefits in terms of data efficiency and accessibility, and it must be an area for future development within the INM-GB.*

e. *In order to maintain the management and dissemination capacity of observation data from Guinea-Bissau stations, it is important to install the WIS2.0 application solution, which will require training existing human resources in IT and in new meteorological observation system.*

f. *Given the enormous constraints in terms of INM-GB IT resources, it will be very important to establish a plan to modernize and reinforce the technological infrastructure accompanied by the training of human resources in the IT sector.*

g. *The modernization of the IMN-GB technological infrastructure will allow the weather monitoring and forecasting service to use the full potential of meteorological information available via the internet to improve the forecasting service based on the various numerical weather forecasting products made available by various entities and international partners.*

Element 5: Numerical model and forecasting tool application

- *5.1. Model and remote sensed products form the primary source for products across the different forecasting timescales*

INM-GB uses satellite images accessible from websites of other countries and international consortiums (EUMETSAT, NOAA), the information is basically used for support of short-term forecasting applied to aeronautical and meteorological surveillance activities..

In terms of numerical model products INM-GB forecast team uses information from global numerical models namely GFS (22km spatial and 6 days for time resolution) and ECMWF

[1] Technical Regulations, Volume I – General Meteorological Standards and Recommended Practices

[2] Manual on the WMO Integrated Global Observing System

(9km spatial and 6 days for time resolution). In terms of procedure, the technicians access these models through different private companies' websites (e.g.Windy, Freemeteo, Wunderground). The information related with weather forecast is accessible through charts and graphics. In terms of the levels of data, the surface level is the most used, also 850hPa and 500hPa.

- *5.2. a) Models run internally (and sustainably), b) Data assimilation and verification performed, c) Appropriateness of horizontal and vertical resolution*

Actually, INM-GB has no datacentre or internal network; without technological infrastructure and with a weak internet network, INM-GB is not be able to operationalize numerical weather forecast models. In addition, there is a need to allocate human resources with specific training and exclusive dedication to tasks related to this activity.

- *Summary score, recommendations, and comments for Element 5*

Element 5 score for the "Numerical Weather Prediction Model and Forecasting Tool Application" assessed as **Maturity Level 1** - on the CHD scale. This score reflects a situation where "Forecasts are based on classical forecasting techniques without model guidance and only cover a limited forecast time range".

a. *Systematize procedures at INM-GB within the scope of the numerical weather forecast service, using for this purpose the services and products developed and made available by international consortiums for the region, in accordance with WMO Guidelines on High-resolution NWP*[3]

b. Establishment and consolidation internal procedures to promote the use of data and information generated by international entities, ECMWF, NOAA, that develop work for weather forecast systems and severe phenomena, with the aim of improving the knowledge and capabilities of the meteorological surveillance and forecast team in Guinea-Bissau.

c. *Provide the INM-GB with hardware conditions (workstation with memory, processors and disk space suitable for numerical processing procedures) to allow the numerical team to have a development environment*

d. *Promote training to human resources that will incorporate the numerical modelling team, not only in the administration and manipulation of the numerical weather forecast model, but also in the creation and use of the generated products.*

e. *Find a location with suitable conditions for installing the technological infrastructure or find a solution that will ensure the operational functioning of the numerical weather modelling system. In addition to the physical structure, it is very important to ensure a connection to a stable electrical energy source, as well as an internet connection adjusted to the requirements of a modern and robust NMHS*

Element 6: Warning and advisory services

- *6.1. Warning and alert service cover 24/7.*

*INM-GB have assigned a team of meteorological technicians observers and forecasters, integrated in the 24/7 regime for support of aeronautical meteoro*logy service to ensures meteorological surveillance and monitoring at the airport facilities, guaranteeing the operability of meteorological information to support the activities of the Bissau airport infrastructure and the preparation of meteorological bulletins to the civil protection system, when justified.

For regular forecast INM-GB have a team of experts that produce, daily, the national weather forecast information. This team does not fulfil the requirement of a 100% operational service, with all the capabilities to guarantee an effective weather warning system. Nevertheless, the technicians can be called at any moment for emergency situations.

INM-GB is part of the Regional Specialized Meteorological Centre (RSMC) initiative centralized in Dakar and, as such, receives information regarding severe weather warnings issued by this Centre.

[3]https://library.wmo.int/records/item/66217-guidelines-on-high-resolution-numerical-weather-prediction

After receiving this information, the INM-GB team of meteorologists analyses and disseminates the information through the most adequate channels (email, SMS and WhatsApp) to the various government entities related to the emergency system.

In addition to this emergency system, INM-GB notifies media organizations (including radio and television).

In terms of operation, the defined circuit highlights some weaknesses, particularly when severe weather situations occur during periods in which only the aeronautic forecast team of meteorologists is working. This constraint becomes even more relevant when INM-GB is expected to ensure the generation of information related with meteorological surveillance and monitoring24/7so as to provide warning and alert services in line with the UN Early Warnings for All initiative (EW4All).

- *6.2. Hydrometeorological hazards for which forecasting and warning capacity is available and whether feedback and lessons learned are included to improve warnings*

Parameters issued by the RSMC-SWF in Dakar are mainly related with wind and precipitation events. INM-GB does not have a systematized system that enables the communication of users feedback on information generated by the meteorological warning system. Occasionally, INM-GB reports information through its contacts, mainly on WhatsApp. Given these constraints, INM-GB is unable to evaluate the system for issuing warnings, with its users, with the aim of improving information and the way in which it is disseminated.

- *6.3. Common alerting procedures in place based on impact-based services and scenarios taking hazard, exposure and vulnerability information into account and with registered alerting authorities.*

No information available.

- *Summary score, recommendations, and comments for Element 6*

Element 6 score for the “Warning and Advisory Services” assessed as **Maturity Level 2** - on the CHD scale. This score means that the basic warning services are in place and operational, but with limited public reach and lacking integration with other relevant institutions and services.

Recommendations for warning and advisory systems:

a. *It is really important to move forward with the establishment of a 24/7 service that integrates a set of capabilities in terms of meteorological observations and forecasting allowing the real implementation of a national weather warning system.*

b. *With regard to the source of forecast data used in this service, the integration and operationalization of a regional numerical model, with high temporal and spatial resolution, will be extremely important. Such an improvement will allow for more effective meteorological surveillance and the alignment with nowcasting procedures.*

c. *The use of computer tools for manipulating meteorological data is essential for the normal functioning of the meteorological warning service. In this sense, it is imperative that INM-GB has resources, in terms of technological infrastructure, to support an operational team. Installing a high-performance computing systems (adjusted to INM-GB's reality), computer terminals with performance suitable for handling high volume of data and an internet network with speed that adjusts to the needs of accessing data on international circuits is highly recommended.*

d. *It is also very important that INM-GB IT staff is able to implement the dissemination of weather warnings in the Common Alerting Protocol (CAP) format, which demands the organization of specific training sessions for INM-GB technicians to enable them to carry out this activity.*

Element 7: Contribution to climate services

- *Where relevant, contribution to climate services according to the established capacity for the provision of climate services*

INM-GB is the state entity with responsibilities in the area of meteorology and climate, meaning that it must ensure climate services as a whole. Despite the efforts made in recent years, with support from international entities through modernization projects, INM-GB is still far from integrating climate services into its service portfolio, as proposed by the WMO.

Despite investments, through projects, in IT applications dedicated to managing climatological and meteorological data, historical data (long series) from the meteorological and hydrological observation network are not accessible to external users. Internally to INMGB, access and use of data resulting from observation programs also requires the implementation of streamlined consultation and manipulation processes.

Based on the existing historical archive data and its limitations, at various levels, it will be extremely difficult for INM-GB to provide basic climatology services. This assumption was possible to be verified based on the few requests for climate data made by universities, government entities or international aid agencies.

In relation to seasonal forecasts and future climate scenarios for Guinea-Bissau, the INM-GB is not in a position to generate this information itself and therefore to provide a climate data service. The INM-GB, of course, receives forecasts in relation to west-African region from the

Regional Specialized Meteorological Centre (RSMC), based in Dakar, as well as integrated training actions in forecasting severe weather events.

In terms of seasonal forecasting, the capacity to produce this information is quite limited, taking into account the existing scarce human resources, which is the main reason for the non-existence of seasonal forecasting. Thus, INM-GB focuses its activities on validating regional forecasts and disseminating them to its users. When requested, INMGB provides additional information on a regional basis.

According to the information available, there is no data relating to the monitoring or evaluation of the socioeconomic benefits of climate services.

- *Summary score, recommendations, and comments for Element 7*

Element 7 score for the "Contribution to climate services" assessed as **Maturity Level 1** - on the CHD scale. This score means that INM-GB has less than the basic capacity to provide climate services.

Recommendations for increased contributions to climate services:

a. *Digitize meteorological observations carried out before and after independence and make them widely accessible.*

b. *Implement an adequate technological storage solution in order to safeguard the data collection.*

c. *Continue to promote the participation of INM-GB technicians in training actions promoted by the WMO through its regional centre in West Africa.*

d. *Provide INM-GB with computer equipment suitable for statistical analysis associated with seasonal forecasts.*

e. *Provide INM-GB with a web services solution in order to make climate data public and accessible, either historical or forecast.*

Element 8: Contribution to Hydrology

- *Where relevant, standard products such as quantitative precipitation estimation and forecasts are produced on a routine basis according to the requirements of the hydrological community.*

The water sector in Guinea-Bissau is public and supervised by the Ministry of Natural Resources (MRN), which administers it through the General Directorate of Water Resources (DGRH).

INMGB, within the scope of its responsibilities and activities, generates information relating to the estimated amount of precipitation that forms part of the weather forecast product.

Regarding meteorological observation of precipitation, though INM-GB has identified a wide network of observation points, currently only 3 stations (non-automatic) report information related to this hydrological parameter in a timely manner.

In Guinea-Bissau we can say that the hydrological service can be classified as "basic" and additional support is needed for the implementation of hydrological services based on operational services

- *SOPs in place to formalize the relation between Met Service and Hydrology Agency, showing evidence that the whole value chain is addressed.*

No remarkable information.

- *Data sharing agreements (between local and national agencies, and across international borders as required) on hydrological data in place or under development.*

INMGB shares data from weather stations with the Dakar Regional Data Centre.

- *Joint projects/initiatives with hydrological community designed to build hydrometeorological cooperation.*

The Agriculture, Hydrology and Meteorology Regional Centre (AGRHYMET) develops training, application and operational hydrology are two good examples of initiatives established by the international hydrological community to support the development of technical skills, reinforce knowledge and exchange experiences between specialized technicians from countries in this region.

In addition to training, an effort has been made to reinforce technology, with the installation of computer equipment and communications' support in order to promote data sharing.

- *Summary score, recommendations, and comments for Element 8*

Element 8 score for the "Contribution to climate services" assessed as **Maturity Level 1** - on the CHD scale. This score is justified by the fact that meteorological input in hydrology and water resource management is very little or none at all.

Recommendations to increase INMGB's contribution to hydrological services:

a. *Establish a formal agreement between the INM-GB National Meteorological Service and the General Directorate of Water Resources that may allow a better understanding of the needs and capacity currently existing in the country.*

b. *Extend the rain gauge network of INM-GB in order to increase the collection of precipitation surface data, which will improve agro-climatic monitoring services and forecasts quality.*

c. *Provide adequate training for meteorologists and climatologists with the aim to increase their knowledge in the use of appropriate tools for precipitation forecasting.*

Element 9: Product Dissemination and Outreach

- *9.1 Channels used for user-centred communication and ability to support those channels (for example, does the NMHS operate its own television, video or audio production facilities? Does it effectively use cutting-edge techniques?).*

INM-GB, through its meteorological forecast service, disseminates information regarding the forecast for the next two days through the media, namely radio and television. Given the greater reach of radio in the country, this is the most appropriate media to bring meteorological information to the most remote areas of Guinea-Bissau.

The INM-GB does not have a website managed by their own technicians where information and data would be available for use.

In addition to the media, INM-GB also uses WhatsApp groups, Facebook and a mailing list to connect with several government agencies, and local and regional offices to provide weather forecast bulletins.

- *9.2 Education and awareness initiatives in place.*

No information available regarding awareness initiatives.

- *9.3 Special measures in place to reach marginalized communities, indigenous people, the youth and the elderly.*

Portuguese is the official language in Guinea-Bissau and French is the most widely spoken foreign language. However, the most widely spoken language in the country is Guinea-Bissau Creole, which in addition to Portuguese and French co-habits with around 20 other African languages.

Within the aim of minimize the problem of the different dialects spoken in the country, INM-GB established links with some regional radios, so as to have the meteorological information spoken some of the dialects.

Nevertheless, it would be important for INM-GB to join initiatives from other national or international entities to improve the communication of meteorological information to the population.

- *Summary score, recommendations, and comments for Element 9*

Element 9 score for the “Product Dissemination and Outreach” assessed as **Maturity Level 2** - on the CHD scale. This score means that traditional communication channels and basic social networks are used to disseminate forecasts and basic information.

Recommendations to increase product dissemination and outreach:

a. *Although the IT fibre network is under development in the country and has not yet reached some regions in good condition, it will be important for INM-GB to establish its position on the internet as the official authority in the areas of meteorology, meteorological warnings and climate.*

b. *To develop a simple internet platform, with a primary focus on publishing information related with meteorological forecasts and severe weather warnings.*

c. *Consolidate dissemination procedures based on the internet platform with social media organizations.*

d. *Use internet resources to disseminate information regarding severe weather warnings in the most widely spoken languages and dialects in the country.*

e. *Establish cooperation relations and agreements with international organizations that are developing activities on the ground, with the involvement of the populations. Such an approach will promote a closer communication with different communities and the identification of "information agents". These agents can be local government officials, community leaders, etc. and they must be trained to understand and translate meteorological information into a language that might reach their communities.*

f. *In order to improve the user/client relation, implement feedback procedures, based in an institutional strategy, and to enhance data services, we recommend that well-trained staff could be recruited to enhance the capabilities related with observation and climate, based on data from a modernized national surface observational network.*

Element 10: Use and National value of product chain

- *10.1Formalizedplatformtoengagewith users in order to co-design improved services.*

INM-GB does not have a dedicated web platform for users to give feedback regarding the information produced by INM-GB. Within the scope of actions developed by UN agencies in Guinea-Bissau, there is a good practice of making these platforms accessible and allowing their use by government entities. However, there is no evidence of the practical use of these platforms, a situation largely related to the lack of human resources available to actively participate in this kind of initiative.

- *10.2 Independent user satisfaction surveys are conducted, and the results used to inform service improvement.*

No information found regarding users survey.

- *10.3 Quality management processes that satisfy key user needs and support continuous improvement.*

No quality management information wasfound.

- *Summary score, recommendations, and comments for Element 10*

Element 10 score for the "Use and National value of product chain" assessed as **Maturity Level 2** - on the CHD scale. This score is justified by the fact that, in a non-systematic approach, IN-GB establish informal procedures to obtain information from users.

Recommendations to improve the use and national value of product chain:

a. *Introduce regular procedures to engage with users and asses their satisfaction, and monthly meetings between management area and technicians that allow decision-making processes based in more information.*

a. *Interact with other partners from Governmental Entities, from environmental, water management, agriculture and marine area, to define requirements in relation to participation in international meetings, example: WMO assembly and meetings, Intergovernmental Panel on Climate Change (IPCC) assembly or technical meetings, Conference of the Parties (COP).*

b. *Establish biannual meetings with State representatives, example, Secretariat of State or Ministry of Transport, Communications and Digital Economy, with the aim of developing and monitoring activities of common interest.*

c. *Invite the representatives of the most relevant economic sectors, with regard to the use of meteorological and climate data and services, to periodic meetings with the aim of receive feedback from stakeholders regarding the activities developed by INMGB.*

Annex 1 Consultations (including experts and stakeholder consultations)

National Institute of Meteorology of Guinea-Bissau (INM-GB)		
Name	*Unit*	*Role*
Fernando BaialSambu	PCA	President of INM-GB
Cherno Luis Mendes	Observation Director	1° Vice President INM-GB
Malam da Silva	Meteorologist	2° Vice President INM-GB
Feliciana Mendonça	Forecast Service Director	Service Director
Armandinho Dias	Administrative Service Director	Service Director
Fernando Djú	Administrative Service Director	Finance Director
Orlando Mendes	Climate Service Director	Climatologist
Justino da Costa	Climate Service Director	Meteorologist
Zair Antonio Dju	Climate Service Director	AgroMeteorologist
Luis Ca	Instruments and IT Service	Instruments technician
Eunelia J. Da Silva	AgrometeoService Director	AgroMeteorologist
Samanta João Lona	Climate Service Director	Meteorologist

Guinea Bissau Government institutions			
Name	*Ministry*	*Unit*	*Role*
José Carlos Esteves	Transports, Communication and Digital Economy Minister		Minister of Transports, Communication and Digital Economy
BenvindoNagague	Interior Ministry	Civil Protection Service	
Crisostimo Alvarenga	Ministry of Water Resources	General Direction for Water Resource	Director General
Wilquine Na Betam	APGB	Administrative	Administrative technician
	Ministry of Agriculture	General Direction for Agriculture	Agrometeorologist technician
Rui Antonio da Silva	Ministry of Transports andCommunication	Guinea-Bissau Marine Ports	Direction member
Frankylim Mendes	Ministry of Transports andCommunication	Guinea-Bissau Marine Ports	Port Captain

International organizations			
Name	*Organization*	*Unit*	*Role*
Domingos José Cá	CCIAS-GB		Vice-President Vice
Sanha J. Correia	ONG Tininguena		Operational Coordinator
Toni Injai	ONG ANAG		Finance Director
Jorge Marques	IPMA, Portuguese Institute for Sea and Atmosphere	Climate Division	Meteorologist
Ricardo Deus	IPMA, Portuguese Institute for Sea and Atmosphere	Climate Division	Head of Division
Jorge Neto	IPMA, Portuguese Institute for Sea and Atmosphere	Climate Division	Meteorologist
Eduardo Castanho	IPMA, Portuguese Institute for Sea and Atmosphere	Climate Division	TI Engineer

Annex 2 Urgent needs reported

Modernized the surface meteorological observation network, with installation of an automatic weather station;

Capacitation of human resources to face the new challenges of management of the automatic weather station network;

Improve maintenance, calibration and staff capacities for enhancing the operations and sustainability of the observation network;

Update of the TI infrastructure, namely the data archiving, processing and dissemination.

Implementation and migration to WIS 2.0;

Improvement of the weather warning system in consultation with stakeholders, bringing tailoring messages, supporting decision making and provide support to economic sectors;

Setup a framework of meteorological and hydrological services engagement with stakeholders addressing hydrometeorological challenges, promoting coordination mechanisms with other institutions, ministries and local governments;

Establish, thought cooperation activities, NWP efforts and collaboration with regional NWP centres.

Annex 3 Information supplied through WMO

WMO Global GBON gap Analysis

WMO Monitoring System Data

Annex 4 List of materials used

WMO Guidelines on High-resolution NW

Technical Regulations, Volume I – General Meteorological Standards and Recommended Practices

Manual on the WMO Integrated Global Observing System

INM-GB internal documents relevant to the report

INM-GB strategic plan 2018-2022

IPMA, Mission 2024 report

The following CHD reports were used to prepare this Country Hydromet Diagnostics, namely Mozambique, Cabo Verde, Samoa, South Sudan.