

# COUNTRY HYDROMET DIAGNOSTICS

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



April 2024

## SENEGAL Peer Review Report

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Royal Netherlands  
Meteorological Institute  
Ministry of Infrastructure and the  
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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.

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## Executive Summary

The Agence National de l'Aviation et de la Météorologie (ANACIM) is the responsible agency for delivering reliable weather and early warning services in Sénégal. The Royal Netherlands Meteorological Institute (KNMI) reviewed the meteorological branch of ANACIM using the standardized Country Hydromet Diagnostics tool to benchmark and assess the hydromet capacity to deliver these services.

Key findings of this review are:

**1. Funding and Legal Framework:**

The legislative context and support for ANACIM is strong and clearly delineates ANACIM's competencies and responsibilities at the national level. Core functions are primarily funded by sources outside ANACIM and are not secure, therefore serious funding challenges exist. There is significant experience in international hydromet projects, but a leading position in research and development projects is lacking. A plan for training of staff exists but it is not put into action due to lack of funds.

**2. Effective partnerships:**

A clear and effective operational structure for collaboration exists, with equal status for all partners. New services and products are developed in these partnerships, but in many cases the delivery cannot be sustained after the end of the projects. A more prominent role for ANACIM would be desirable.

**3. Observational infrastructure:**

There are significant issues with the surface and upper air observation networks. A WIGOS Implementation Plan exists, but its execution is difficult. Basic elements of the Standard Operating Practices are present, but severe challenges exist related to calibration, QC, and maintenance and staffing to perform these tasks. Urgent development needs include the modernization of surface observation techniques and obsolete data loggers.

**4. Data and product sharing and policies**

A small amount of GBON-compliant observational data is shared internationally. Out of 13 stations, only 5 transmit in the GTS. Existing data-sharing policies or practices or existing but outdated infrastructure severely impede two-way data sharing. Most of the stations are not fully compliant, and there are significant availability issues. The data that is accessible and can be shared for free is limited.

**5. Numerical model and forecasting tool application**

ANACIM makes use of model results from limited external and internal sources (without data assimilation) and remote sensing products in the form of maps, figures and numerical data for nowcasting, short- and medium-term forecasting time ranges. The entire value chain of weather forecast deployment, verification and assimilation needs to be further developed to make the most of the available information.

**6. Warning and advisory services**

The basic alert service is in place and operational 24 hours a day. Forecasting and warning services are used in the event of floods, heat waves, dangerous swells, gusty winds, lightning and density dust. There is a weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies. Many types of alerts are missing, especially for different types of hazards, such as flash flooding, although MHEWS is in place in the country, it is not yet very developed. The alerts are

often too general, covering a large region, which may not be useful to users. Alerts are in CAP format but procedures are not written and there are no specific procedures between ANACIM and disaster management agencies.

## 7. Contribution to Climate Services:

Climate services have been developed for a range of applications following a National Action Plan. However, the step to sustainable, operational provision of these services requires an additional effort and a strengthened collaboration between ANACIM and professionals from different sectors.

## 8. Contribution to hydrology:

Hydrological services are in place, but their basic input (models and observation network) could be improved considerably. There is a well-functioning relationship between ANACIM and DGPPE (the Directorate of Water Resources Management and Planning), but there is room for further improvements of the meteorological services supporting hydrological applications. Working and formal agreements in Senegal for the exchange of hydrological data appear to be effective. There are also formal agreements for the exchange of hydrological data with the Hydrological Service of Senegal and neighbouring countries.

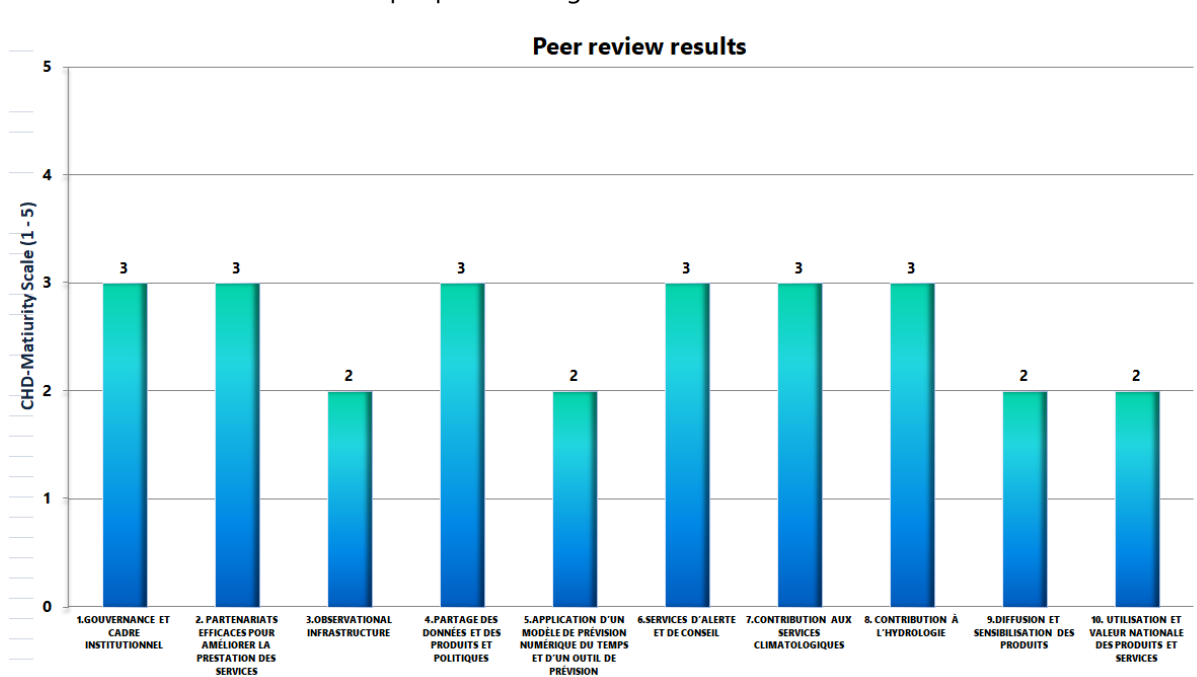
## 9. Product dissemination and outreach:

Traditional and modern communication channels are used by ANACIM for the dissemination of information. ANACIM does not have its own TV, Video or Audio facilities. Education and awareness initiatives exist, but there is room to expand these activities and provide more educational material on different languages, levels, topics and media. Some efforts are made to reach marginalised communities and indigenous people, but much more is possible.

## 10. Use and national value of products and services

There is no systematic feedback process in place to independently monitor user satisfaction on a regular basis, although some ad hoc actions are taking place.

The Royal Netherlands Meteorological Institute (KNMI) stands ready to assist ANACIM in addressing its challenges, fostering strategic and operational advancements, and modernizing its meteorological services for the benefit of the people of Sénégal.



Element	Maturity level score
1. Governance and institutional setting	3
2. Effective partnerships to improve service delivery	3
3. Observational infrastructure	2
4. Data and product sharing and policies	3
5. Numerical weather prediction model and forecasting tool application	2
6. Warning and advisory services	3
7. Contribution to climate services	3
8. Contribution to hydrology	3
9. Product dissemination and outreach	2
10. Use and national value of products and services	2

ANACIM needs development support along the entire value chain from weather data collection to data transmission and the provision of meteorological services. The following critical deficiencies have been identified:

- By Presidential Decree No. 2015-981 of 10 July 2015, the State of Senegal authorises the recovery of weather data for the benefit of ANACIM. In reality, this recovery does not fully meet the needs of ANACIM in terms of national, regional and global responsibilities. ANACIM's annual budget is \$14,480.73, the main sources of funding of which come from a government subsidy (aeronautical and meteorological fees as well as project funding from partners). It is strongly recommended to diversify and strengthen the partnership to enable the sustainability of operations and increase the motivation to develop value-added services based on the needs of end users.
- The ANACIM observation system has critical shortcomings in the development of the means of acquiring, concentrating and processing the information coming from the various stations and the use of modern means of dissemination is an imperative to improve the quality of the services provided. For efficient processing of meteorological information, some equipment is lacking, such as: no weather radar, the surface weather observation system is semi-automatic (data transfer is done manually, and therefore does not allow the exchange of data in near real time 24/7), no integrated data management system to store and process all observation data in a single system, and enable automated data processing, quality assurance and control, and dissemination of data for further use.
- Senegal to comply with the directive, the meteorological service provides data to students, universities, and researchers involved in non-commercial activities at a flat rate. Most of this data is provided free of charge under certain conditions. If data relating to a specific place or special phenomenon is required, a request is submitted to ANACIM, which will then decide whether or not to provide the requested data. In most cases where the data is requested for non-commercial purposes, the data is communicated, provided that the user agrees not to share it with third parties and cites the source of the data or agrees to be a co-author with ANACIM. The requested data may be provided for remuneration if the requesting authority or

person carries out paid consultancy work or if the data is requested by a private sector institution. Revenues from the weather data are insignificant compared to the ANACIM budget, which is a major difficulty to move to fully open and free data.

- There is an SMS alert system and a mobile application to effectively disseminate forecasts and warnings to sectors of activity impacted by the weather and to citizens. Weather forecasts are drawn up every day for different validity periods and disseminated through the press (TV, Radio, Print Press, Online Press, SMS) and sent to authorities, technical services, professional organisations and local communities. They are of a general nature and applied to marine and agricultural activities during the rainy season period or to other areas at the request and order of users or within the framework of specific projects. Almost constant monitoring is carried out for high-impact and extreme events. Warnings in the form of alerts are issued in the event of significant or dangerous weather events and significant weather changes on the territory of the Republic of Senegal within 24 to 72 hours and along the coast. Weather monitoring, including rain warnings, is conducted day and night, 7 days a week during the rainy season. Weather alerts are provided directly to the public by the media and social media. In addition, at the request of customers, special severe weather warnings are issued such as intensified wind for fishermen or boaters. These warnings are provided directly to customers. Impact based forecast is also developed on the health field. Heatwaves and health impact early warning system is implemented operationally with the collaboration of General public health, red cross, civil protection, environment and communities. Weekly heatwaves forecast with potential health impact are provided over the Senegalese territory during the heat-health campaign from March to June.
- Cooperation with other government authorities should be further strengthened, especially in the area of civil protection, and new partnerships should be established with public media and rural radio organizations such as the Union of Community Radios of Senegal (URACS), which should be trained to enable effective use of the information provided by ANACIM for basic users.

## Chapter 1: General information

### Short Country Profile

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

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

### **Economy and Demography**

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

### CHD methodology

The Country Hydromet Diagnostics responds to the need for a standardized, integrated and operational tool and approach for diagnosing National Meteorological Services, their operating environment, and their contribution to high-quality weather, climate, hydrological and environmental information services and warnings. The CHD is an umbrella tool that draws on and adds value to existing WMO assessment material by synthesizing existing approaches and data into an easily interpretable form, validating the information provided by WMO Members through a peer review process, and obtaining missing information.

The Diagnostics aims at informing policy and investment decision-making, in particular guiding investments of the members of the Alliance for Hydromet Development. The Alliance brings together major development and climate finance partners behind a joint commitment to strengthen developing country Hydromet capacity. Through the Diagnostics, developing countries are expected to benefit from better targeted and aligned financial and technical support. The Country Hydromet Diagnostics is based on the ten most critical elements of the Hydromet value cycle, grouped under four categories – enablers, observation and data processing system, service and product production and dissemination, and user and stakeholder interaction.



Country information available in WMO database and answers provided by NMHS focal points to a questionnaire developed based on the indicators of the CHD have been used as first source information to prepare this report. Various reports related to Senegal meteorological and hydromet capacities have also been used for information of interest in this peer review process. However, it may be mentioned that the main focus of this report is on the NMS. This report presents a review of each of the ten most critical elements of the Hydromet value cycle based on the information mentioned above, and rates each of them with a Maturity level score (based on the assessment of the indicators). At the end, recommendations of the reviewers to help lift up the rating of the maturity level in respect of these critical elements have been listed.



*Figure 1 : Meeting between KMNI and the Director of Meteorological Operations of ANACIM*



*Figure 2 : Working session between KMNI, partners and ANACIM meteorological operations technicians*

## Chapter 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**

ANACIM was established on 28 July 2011 through presidential decree, building on former meteorological service departments, which have existed since 1966. Since its inception the meteorological service has become a member of the WMO. Its missions include, among other things, the management of meteorological observation networks on the national territory, the provision of information for the protection of people and property and for added value to climate-dependent economic activities.

The powers of the National Agency for Civil Aviation and Meteorology (ANACIM) are provided for by Law No. 2015-10 of 4 May 2015<sup>1</sup> on the Civil Aviation Code and Decree No. 2011-1055 of 28 July 2011 establishing and setting its organizational and operating rules, amended by Decree presidential No. 2015-981 of 10 July 2015.

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

Annual Work Plan (AWP) and a Strategic Plan 2021-2025<sup>2</sup> available. The risk mapping currently being developed will be followed by a risk management plan.

#### **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**

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

ANACIM has a total budget in 2023 of about 13 million \$US. About 93% of this is direct public funding. A large fraction of its budget, is related to aviation, reflecting ANACIM's central position in Senegal's strategic civil aviation pole. About 7% comes from revenues from the provision of weather information to other sectors, mainly in the field of agricultural insurance, as well as from climate projects like ClimDev.

Of the total budget approximately 92% is allocated to payroll, 8% is mainly used for operations and maintenance. In the last three years, ANACIM's budget has remained stable with no significant increase or decrease.

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<sup>1</sup> [Presidential Decree](#)

<sup>2</sup> [Strategic Plan 2021-2025](#)

#### 1.4 Proportion of staff (availability of in-house, seconded, contracted-out) with adequate training in relevant disciplines, including scientific, technical, and information and communication technologies (ICT). Institutional and policy arrangements in-country to support training needs of NMHS.

The National Agency for Civil Aviation and Meteorology (ANACIM) is the civil aviation authority in Senegal, among others, it is responsible for the supervision and coordination of all meteorological, climatological and scientific activities related to climate change; the management of the meteorological observation network, including installations, equipment maintenance and data exchange on a global scale.

The Directorate of Meteorological Exploitation (DEM) of ANACIM currently employs 128 people. Women make up only 12% of the total workforce as shown in the table below.

Staff information	Total number	
Managers (All administration support staff)	9	
Met (Forecaster, Met Application, Data quality)	34	
Met Tech (Observation officers and supervisors, Instrument maintenance)	75	
Research	2	
Technology and information (IT)	6	
Others (Administration, Data collectors)	2	
Total current employees	128	
Staff by gender	Number	Percentage
Male	112	88%
Female	16	12%

It is recommended that ICT staff members improve their capabilities (e.g. programming skills and technical understanding) to enable the establishment of a real-time observation network information system to improve the quality of observations and real-time data reporting through WIS2.0.

Meteorology is not currently included in the curriculum of Senegalese universities. ANACIM has not put in place an effective internal training system to provide internal training to its staff. Internationally funded projects must address critical training needs in Senegal and more specifically at ANACIM in order to ensure the sustainability of project results. Twinning partnerships and peer advisor cooperation are strongly recommended to strengthen ANACIM's operational capacity during the modernization of its systems. In the longer term, the capacity of Senegalese universities should be strengthened so that they are able to provide basic training in meteorology.

Table for training is included in the application for SOFF funding

Training Module/Activities to Support the Acquisition of WMO Competencies
Barometer calibration training and data quality control
Project Management/Budgeting Training
Development and training of staff on the quality management system
Training in the operation and maintenance of automatic stations and installed manual equipment
Weather Observer Training

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

ANACIM has extensive and solid experience in the implementation of hydrometeorological projects funded by the international community. In addition, the organization has strong partnerships with national and international organizations to ensure sustainable and impactful project results. Recently completed and ongoing projects can be found at: <https://www.anacim.sn/spip.php?article63>.

#### **Summary score and recommendations for Element 1**

Maturity Score 3: ANACIM has a clear legal mandate. There is a Strategic Plan in place, and a risk management plan is in development. Core functions are primarily funded by sources outside ANACIM and are not secure, therefore serious funding challenges exist. There is significant experience in international hydromet projects, but a leading position in research and development projects is lacking. A plan for training of staff exists but it is not put into action due to lack of funds.

The legislative context and support for ANACIM is strong and clearly delineates ANACIM's competencies and responsibilities at the national level. The implementation of projects funded by international partners and funds is also a strong point of ANACIM.

#### **It is recommended:**

- to work towards a more balanced and sustained funding of ANACIM, especially for its core tasks and for training of staff;
- to work towards a stronger position in research and development of weather and climate services and warnings;
- Enhance the capacity and capability of ICT staff, e.g. programming skills and technical understanding;

## **Element 2: Effective partnerships to improve service delivery**

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

ANACIM is well integrated institutionally with other governmental institutions, especially aviation. During the rainy season the Multidisciplinary Working Group (GTP)<sup>3</sup> meets every 10 days. This group

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<sup>3</sup> Link to the GTP portal on monitoring the agricultural campaign in Senegal: <https://gtp.cnsa.anacim.sn>

is made of different government institutes, such as agriculture, hydrology, vegetation and food security, which come together to discuss potential issues and how the rainy season is developing. In the remainder of the year meetings are less frequent and involve fewer members. ANACIM also has a closer relationship with hydrology to develop flood warnings.

ANACIM is solely responsible for climate services under its mandate. When a public entity wishes to establish a weather station, an authorization from ANACIM is required. This strengthens collaboration between different government institutions and allow the organization to know what exists and verifies the norms.

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

A collaboration partnership exists with meteo-France for forecasting products. Additional products come from ECMWF, UK-MetOffice, NOAA (WRF), NCEP (GFS) and Dust Barcelona Center. Other partnerships include the Netherlands (KNMI) and Morocco, as well as international institutions like AGHRYMET, ACMAD, EAMAC (training center), ENM (French Meteorology University) and the Columbia University (USA).

There are common projects with national universities, e.g. the University of Dakar (UCAD). Students are sent to ANACIM in internship from universities (UCAD, UGB and UASZ, etc.), and ANACIM provides support with teaching masterclasses, student supervision and data sharing as part of these collaborations.

ANACIM collaborates through a public private partnership with [Jokkalente](#), which provides services through voice messaging to users.

There is also a collaboration with [MLouma](#), a company specializing in the digitalization of agriculture, e.g. providing rainfall data to farmers communities. With the support of its partners such as ANACIM, MLouma has developed in recent years a range of tools that address the real problems of producers based on specifications developed by international organizations with an inclusive approach.

Collaboration with the private sector also includes the national insurance sector with ANACIM collecting and providing data to calculate the index.

Since its creation in 1984, ANACIM has been in charge of the coordination of the Multidisciplinary Working Group (GTP, see also element 2.1) and the Early Warning System (EWS), whose mission is to continuously monitor hydrometeorological and agricultural situations and contribute to the early warning system to alert communities in time so as to avoid or curb food disasters.

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

ANACIM is participating in the SOFF initiative representing Senegal as beneficiary country with the Islamic Development Bank as implementing agency and the Royal Netherlands Meteorological Institute (KNMI) as peer advisor.

The Agence Française de Développement (AFD), through the Green Climate Fund, has provided ANACIM with a C-band radar that will make it possible to monitor the city of Dakar and its surroundings on the intensities and rains that may fall in the city of Dakar and the surrounding area. The project, which amounts to approximately 2.1 billion CFA, supports ANACIM and the DGPRES for the monitoring of groundwater, the environment and rainfall.

The Science-Policy Dialogue Platform on the Adaptation of Agriculture and Food Security to Climate Change (CCASA) is established with the aim to promote sustainable agricultural productivity by for

adopting practices that integrate climatic phenomena and hazards, leading to better food security. It also aims for a better consideration of the climate change dimension in development policies and strategies both at the national and local levels. This platform is one of the entities of National Committee on Climate Change (COMNAC).

The Agricultural Risk Management Platform (PARM, <https://p4arm.org>) was set up by the initiative of the G8 and G20 and funded by the European Union, the French Development Agency, the Italian Cooperation and IFAD. It provides technical support to governments for the management of agricultural risks and their integration into national investment plans and strategies. This platform is under the supervision of the Ministry of Agriculture and Rural Equipment.

The PARM and CCASA platforms described above help ANACIM to better serve the agriculture and food security sectors.

#### **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.**

Many collaborations and projects exist and have come to fruition. For instance, ANACIM provides historical data for solar energy services and climate data on a cost-recovery basis. However, the sustainability of the results coming from many projects is difficult once the money for the development of new products or services has dried up.

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

Maturity Score 3 : A clear and effective operational structure for collaboration exists, with equal status for all partners. New services and products are developed in these partnerships, but in many cases the delivery cannot be sustained after the end of the projects. A more prominent role for ANACIM would be desirable.

ANACIM has several partnerships with national and international organizations. Each may have a different scope of their mission and role: providers of hydrometeorological information and data, technical sectoral partners, communicators and community relays and finally, end-users at both national and community level.

#### **It is recommended:**

- that ANACIM works towards a more prominent role in international climate and development finance partnerships as well as in international research projects.
- that development projects include a feasible plan for sustained operation after end of the development phase.
- to build institutional capacity and to strengthen and diversify partnerships for climate finance and development.

### **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.**

Measurements are done manually, there are some practices to assure data quality. However, many staff are not adequately trained, maintenance of grounds and equipment is difficult. Automatic weather stations exist but are currently not incorporated into the GBON observation network. Only 5 stations are conforming to GBON requirements, out of 13 synoptic stations and 1 out of 2 upper air stations. Observations are done manually and there are some problems with wind instruments. There

are also some horizontal resolution gaps, synoptic stations are mainly located near population centres. West of the country has resolution which exceeds GBON requirements but the east of the country has gaps.

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

There is a network of automatic stations owned by CNAS, with are used in internal weather reports but do not send data to the GBON database. There are no marine or oceanographic stations. Climatological stations are added to OSCAR database.

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

There is a national WIGOS governance mechanism and national process for data quality defined but currently it is not possible to calibrate equipment and maintenance of instruments is challenging due to lack of funds and trained staff.

The WIGOS National Focal Point has already been designated. However, the existing WIGOS governance mechanism is not operational. Two staff members were trained in the use of OSCAR/surface. They need additional training on (1) how to update information in the OSCAR surface, and (2) general training on WIGOS and the OSCAR surface.

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

### **3.4 Implementation of sustainable newer approaches to observations.**

A National WIGOS Implementation Plan was adopted/approved, but the execution of this plan is hampered by lack of funding and trained staff.

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

Automatic weather stations are used internally for weather forecasts but the data is not sent to WIGOS. All measurements sent internationally are taken manually.

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

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

In particular, Automatic Weather Stations (AMS) have been installed over the past seven years as part of various projects. Data are recorded every 10 minutes and sent to a central database at the Meteorological Operations Branch (DEM). Currently, data from automatic stations are not automatically transmitted to the WMO Global Telecommunication System (GTS/WIS), but allow meteorological observers to use them in addition to manual observations.



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

*Table 1 Station Information. Of the 25 fully manual surface stations, only 13 are registered in the WIGOS database and the remaining 12 are surface climate stations. The automatic stations regularly provide data to ANACIM's data server. Automatic rainfall stations regularly provide data to ANACIM's data server and manual rain gauges are more numerous and are operated locally. The poor performance of automatic stations and automatic rain stations is due to aging sensors and a lack of replacements.*

Based on gap analysis, ANACIM operates both automatic and manual surface weather stations: information about the existing observation stations in ANACIM can be found from the table above. The observational data from third parties are shared with the ANACIM.

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

Maturity Score 2: indicating that "part of the territory is not covered by surface stations. Of the two upper-air stations, only one is operational." There are significant issues with the surface and upper air observation networks. There is experience with the operation of AWSs, but due to technical issues observations from this network are not yet shared. There are some additional observations available (mainly rain gauges) but these are not shared outside Senegal. A WIGOS Implementation Plan exists, but its execution is a big challenge. Basic elements of the Standard Operating Practices are present, but severe challenges exist related to calibration, QC, and maintenance and staffing to perform these tasks.

Urgent development needs include the modernization of surface observation techniques and obsolete data loggers. It is essential to set up an information system for the weather observation network to improve the quality of observations and the reporting of data in real time. For this, it is necessary to set up a network of stations through the VPN system that will allow the stations to transmit directly into the global SMT network via the ASECNA transmission center that operates 24 hours a day.

The installation of WIS2.0 in Senegal is the responsibility of ASECNA in collaboration with ANACIM technicians.

#### **It is recommended to:**

- Improve the observation network to comply with the GBON requirements, according to the National GBON Contribution Plan prepared for the SOFF initiative;
- Put in place calibration and maintenance practices by sufficiently trained staff ;
- Implement the national WIGOS implementation plan;
- Transform the observation network from mainly manual stations to reliable AWS observations that are shared through WIS2;
- Enable the establishment of a real-time observation network information system to improve the quality of observations and real-time data reporting.



## 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.**

5 Stations are fully GBON compliant, and 13 stations report internationally. Data is transferred using the GTS system, migration to WIS2.0 is not completed yet. Although measurements are taken and sent regularly, there are some data sharing issues, with the data often being unavailable in real-time on WIGOS. The national plan for the implementation of WIGOS has already been developed and adopted but is not yet operational due to financial difficulties.

Upper air stations:

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

The map of Upper-air stations over land in Senegal (see Figure A6.1 in Annex 6). with 500 km diameter buffer is shown in figure A6.1 in Annex 6. The station in Tambacounda is currently out of order. Areas which are not covered represent regions where surface stations are more than 500 km apart. It shows that without station Tambacounda, the GBON horizontal resolution requirement is not met.

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

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

Two issues with the operation of the Tambacounda upper-air station need to be solved to become fully operational and GBON compliant. First, arrangements should be in place to ensure the provision of consumables to operate the station reliably. A second hydrogen preparer is needed at the site. Second, additional and well-trained operators are needed to operate the balloon launches twice a day. SOFF funding is sought to solve both issues.

International exchange of observational data:

The documents from two upper-air observation stations are sent to the ANACIM archiving office and the observed data are accessible via the ASECNA RSTFA network.

It is necessary to set up a network of stations through the VPN system that will allow the stations to transmit directly into the global SMT network via the ASECNA transmission center that operates 24 hours a day.

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

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

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

ANACIM data is regulated by presidential decree as a paid service. However, the data shared internationally as part of the world weather watch is free of charge and is basic data. The daily forecasts are regularly produced and disseminated free of charge, so that there is a certain amount of free data.

ANACIM follows a national open data policy and shares observation data with national (agricultural insurance, research institutes) and international organizations. The data can be viewed online on the ANACIM website<sup>4</sup>.

To comply with the directive, the meteorological service of Senegal provides data to students, universities, and researchers for non-commercial use at a flat rate. Most of this data is provided free of charge under certain conditions (free for students and paid for private companies). If data relating to a specific location (research or field study) or a particular phenomenon (bad weather or weather-related accident) are required, a request is submitted to ANACIM, which will then decide whether or not to provide the requested data. In most cases where the data is requested for non-commercial purposes, the data is communicated, provided that the user agrees not to share it with third parties and cites the source of the data or agrees to be a co-author with ANACIM. The requested data may be provided for a fee if the requesting authority or person carries out paid consultancy work or if the data is requested by a private sector institution.

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

In Senegal, forecasting is based mainly on model advice from limited external and internal sources (a regional model without data assimilation) and remote sensing products in the form of maps, figures and numerical data and covering nowcast, short- and medium-term forecast time ranges.

Forecasters access EUMETSAT's satellite products via a ground-based satellite receiver (images). It also has access to different results from global and regional models, such as:

- ECMWF IFS (rainfall accumulation, wind, cloud cover, temperature) through PUMA system;
- NCEP-GFS (rainfall accumulation, wind, cloud cover, temperature) through Web portal;
- ICON model
- ECMWF IFS-EPS
- Météo France (Arpège)
- UK Met Office model data.

The model output access is available through SYNERGIE as charts, maps and not raw data for forecast and warning. It is however possible to extract the raw data from websites as usually done by the ANACIM's researchers.

The Data taken from Global Models are mostly used by weather and climate staff and shared with students for their Master and PhDs. However the general public and communities receive climate products and services for their own activities.

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

Maturity Score 3, reflecting "A small amount of GBON-compliant observational data is shared internationally. Out of 13 stations, only 5 transmit in the GTS. Existing data-sharing policies or practices or existing but outdated infrastructure severely impede two-way data sharing." Most of the stations are

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<sup>4</sup> [ANACIM](#)

not fully compliant, and there are significant availability issues. The data that is accessible and can be shared for free is very limited. Most is available as a paid service.

**It is recommended to:**

- modernize the transmission of real-time data from surface stations. Automation and development of quality control as well as improvement of human capabilities are expected as key success factors of this element.
- to make all main stations fully GBON compliant and make the data connection between the stations and the regional WIGOS Centres more reliable.
- to give the execution of the WIGOS implementation plan a high priority.
- Define a framework for discussion to identify needs and establish mechanisms for sharing data with partners and users of weather information.

## 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.

Most NWP data used by the Senegalese Meteorological Service are from simulations performed by external parties. The EUMETCast Africa service, through the Preparation for the Use of Meteosat Second Generation in Africa (PUMA) stations, offers access to the European Centre for Medium-Range Weather Forecasts (ECMWF), United Kingdom Met Office (UKMO) and Météo-France models, which provide data on a synoptic scale. For Senegal, as a non-member of ECMWF, access to model forecasts is currently limited. However, ANACIM welcomes the move of ECMWF towards more open data.

Generally, most externally generated NWP data are from global models that have relatively coarse horizontal grids, making them less well suited to regions where convective rainfall is dominant such as Senegal. Satellite data is thus key to filling the gap associated with sparse data observing networks.

Global analysis data are used by ANACIM as lateral boundary conditions to drive the regional WRF model and for weather forecasts such as nowcasting. The Early warning is provided by observation data and real time satellite images.

#### **Forecast products:**

Very short-term forecast (<24 hours) describe the weather expected over the whole country for the next 24 hours, accompanied by a detailed forecast such as temperature, winds, clouds expected for the 14 regions of Senegal. These very short-term forecasts are based on a high-resolution atmospheric model (WRF, 3x3km resolution) and observational data, including satellite products and radar images during rainy period over Senegal.

The short-term forecast (between 24 and 72 hours ahead) gives the evolution of the weather and the future state of the sky over the entire territory for the next 3 days. These short-term forecasts are also based on the WRF model as well as on deterministic and ensemble forecasts from global models. During the monsoon season, observational data from the ANACIM's network are used to assess the daily accumulation rain of the model (WRF).

The medium-term forecast (between 4 to 10 days ahead) gives the evolution of the weather over the entire territory 4 to 10 days in the future. It is based on observation data, satellite image and outputs from global and limited area models. Sub-seasonal forecasts such as weekly products are highly used for this forecast range with ENS forecast.

A seasonal forecast of rainfall and its characteristics (April to October) and temperature (November to March) is produced every month. Data and model outputs from the major climate forecasting centers (ECMWF, NOAA, KMA, IRI, UK Met Office, Météo France etc.) are used to produce these forecasts.

The climate service of the ANACIM geoportal aims to distribute climate projections for Africa in an intelligible way, using a post-processing algorithm that produces maps and temporal diagrams. It includes several parameters such as surface temperatures, precipitation, and agriculture yields, on a monthly scale. The current version on the ANACIM website is debiased for Africa using CDF-t algorithm, and then rescaled by month.

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

The WRF regional model is run on an appropriate 3 km resolution by ANACIM on its own HPC using boundary and initial conditions from global models such as Global Forecast System (GFS). There is no data assimilation, and the daily verification is only made for rain during the monsoon season. After the rainy season, verification is done by the modelling team to assess the model output with the aim to improve the model skills.

The WRF model is run twice per day (00Z and 12Z). The products of post-processing are distributed to forecasters.

### **5.3. Probabilistic forecasts produced and, if so, based on ensemble predictions.**

Probabilistic forecasts based on ensembles are only produced for the seasonal timescale, but ANACIM also has access to ensemble projections from global models for the medium and long-term.

Continuous monitoring and regular updates on the evolution of climate indicators and models are carried out by ANACIM at the end of each month.

ENS forecast produced by global model are used for early warnings by the probability of exceedance (thresholds) to meteorological parameters. Severe weather vigilance maps are provided by using mainly the ENS forecasts.

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

Maturity score 2: *This reflects "the basic use of model results from limited external and internal sources (without data assimilation) and remote sensing products in the form of maps, figures and numerical data and covering nowcasting, short- and medium-term forecasting time ranges."*

The entire value chain of weather forecast deployment, verification and assimilation needs to be developed to make the most of the available information. There are good elements and good practices, but new tools and automation would fill a missing link and bring efficiency to the weather forecasting process. For modelling and remote sensing products, ANACIM has access to NETCDF, GRIB, SHP numerical files but limited access to numerical prediction models.

#### **It is recommended to:**

- Improve the implementation of the regional forecasting model WRF (resolution?);
- Systematically monitor and report on the performance (reliability) of the regional model;
- Add and/or improve forecast products at medium-range time scales (1 to 10 days), seasonal (1 to 6 months) and decadal / climate timescales (10 to 50 years);
- Add and /or improve forecasting tools;
- Increase the available expertise in Senegal in the field of climate modelling, and forecasting of extreme phenomena (heat waves, floods, droughts, high swell, gales, etc.);

- For ANACIM to develop towards a weather forecasting centre of excellence for Africa.

## Element 6: Warning and advisory services

### 6.1. Warning and alert service cover 24/7.

Weather forecasts are produced every day for different periods of validity and disseminated through the press (TV, radio, print media, online press, SMS) and social media (Twitter<sup>5</sup>; Facebook<sup>6</sup>; YouTube<sup>7</sup>), see figure 4. They are also sent to technical services, professional organisations and local communities, both in French and Wolof, and are of a general nature.

An early warning system is set up to warn people about abnormally high temperatures that have become a major problem in Senegal for human and animal health. This ongoing monitoring and early warning program is part of the collaboration between NOAA, ANACIM and the Directorate General of Public Health (DGSP) on the provision of heat wave forecasts during the heat season from March to June and the dissemination of early warning to minimize the impact of heat on health, but also throughout the year, for example for fishing activities.



Figure 3 : International Workshop on heat waves

In recent years, early warning systems have been improved by strengthening risk awareness and communication to make proactive decisions. Aware of the growing demand for meteorological information, ANACIM has put the concerns of users at the heart of its policy. In 2022, more than five hundred thousand (500,000) short messages (SMS) were sent to users to inform and/or alert them of

<sup>5</sup> [Anacim \(@meteosenegal\) / X \(twitter.com\)](#)

<sup>6</sup> [Facebook](#)

<sup>7</sup> [ANACIM Prévisions - YouTube](#)

an occurrence of rain or extreme weather phenomena of dangerous swell, strong winds, rain exceeding established thresholds.

Specific forecasts focussing on marine and agricultural activities are produced during the rainy season, as well as forecasts for other areas at the request and order of users or as part of specific projects.

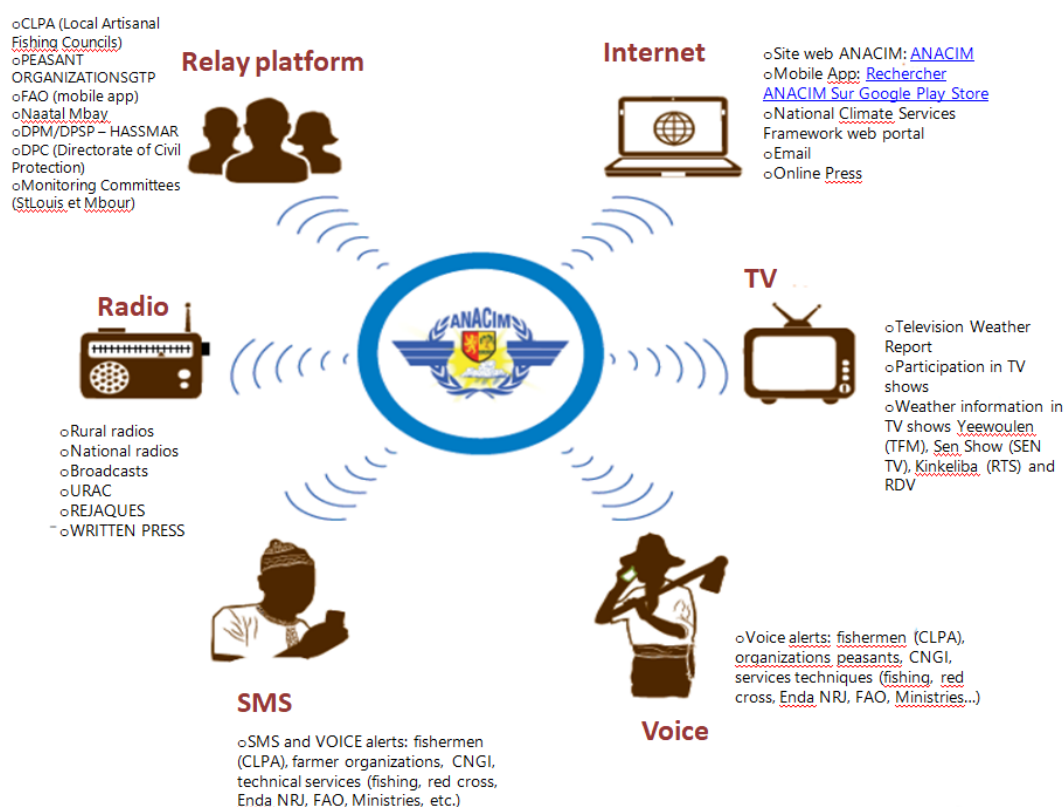


Figure 4 : Dissemination of alerts by ANACIM

Warnings in the form of alerts are issued in the event of major or dangerous meteorological events based on forecast and major meteorological changes in the territory of the Republic of Senegal within hours up to 72 hours before the expected event. Weather monitoring, including rainfall warnings, is carried out day and night, 7 days a week during the rainy season mainly for authorities and floods management actors.

Weather warnings are provided directly to the public via the media. In addition, at the request of customers, special severe weather warnings are issued such as increased wind for fishermen or sailors and farmers. These warnings are provided directly to specific customers.

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

The main atmospheric weather forecast bulletins are:

- Daily bulletins for the general public, valid for 24 hours twice a day and 72 hours once a day, posted daily on the website and sent to the press;
- A weekly and decadal bulletin, giving an overview of the weather for respectively the coming week and the next 10 days, sent to the Presidency, the Prime Minister's Office, the ministry

responsible and the technical structures of certain ministerial departments for advice on agricultural activities and flood management at the weekly meetings of the ministry responsible for floods;

- A weather bulletin broadcast by national television RTS;
- A 24-hour bulletin for tourism sent daily to the ministry responsible;
- Notices and alerts in the event of exceptional phenomena and/or social and cultural days.

These bulletins focus on extreme temperatures, precipitation (incl. wet and drought periods) and wind, as well as hazards like floods, heat waves, dangerous swells, gusty winds, lightning and density dust.

The following products are available for maritime activities:

- Coastal navigation bulletins;
- Daily bulletin as part of the Global Maritime Distress and Surveillance System (GMDSS);
- Daily marine forecast bulletins for small-scale fishing;
- Special bulletins for the Port of Dakar, the French Navy and certain departments of the Ministry of Fisheries;
- A daily weather forecast transmitted to DP World for the planning of its port activities;
- Daily special report over Senegalese offshore for fuel exploitation.



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.



Figure 5 : Example of a warning for fishermen



Figure 6 : Example of a National Television Alert





# Bulletin d'alerte précoce de vagues de chaleur pour la santé

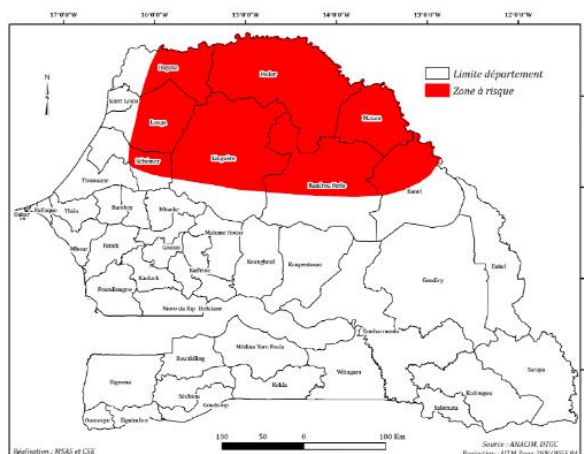


**BULLETIN N°: 11**

DATE DE DIFFUSION : 21 JUIN 2023

PERIODE DE VALIDITE : DU 21 AU 27 JUIN 2023

## IMPACTS SANITAIRES DE LA VAGUE DE CHALEUR



Légende

NIVEAU DE VIGILANCE	ALERTE	IMPACTS SANITAIRES
<span style="background-color: #800000; color: white; padding: 2px;"> </span>	<b>Très dangereux</b> Coup de forte chaleur possible	Aggravation possible des maladies cardio-vasculaires et pulmonaires
<span style="background-color: #FF0000; color: white; padding: 2px;"> </span>	<b>Dangereux</b> Coup de chaleur possible	Epuisement, syncope, déshydratation sévère, crampes
<span style="background-color: #FFA500; color: white; padding: 2px;"> </span>	<b>Très inconfortable</b> Attention aux personnes vulnérables	Déshydratation, étourdissements, maux de tête, vertiges
<span style="background-color: #FFD700; color: white; padding: 2px;"> </span>	<b>Surveillance</b>	Négligeable

Figure 7: Example of Heatwaves and health impacts early warning report

The heat health early warning system are implemented by ANACIM in collaboration with the General Public Health, the Red Cross, and the Environment and Civil protection for the health vulnerability and NOAA's support for the forecasting tools. The Heat-health report is weekly produced for professional health and communities to reduce the health impacts related to heatwaves.

The CAP is generally used to publish severe weather over the Senegalese coast and the territory (see figure 8)

Afficher/Masquer XML
Validation externe
Terminer cette session

identifiant urn:oid:2.49.0.1.686.0.2024.4.2.10.44.20

sender previsionсенegal@anacim
sent 2024-04-02T10:44:20-00:00

status Test
msgType Alert
scope Public

language fr
category Met
responseType Prepare

event Vagues de Chaleur

urgency Immediate
severity Severe
certainty Likely

onset 2023-04-26T12:00:00-00:00
expires 2023-05-02T12:00:00-00:00

senderName ANACIM

Modèles de texte pour 'headline', 'description', 'instruction' IFRC messaging

**headline**  
Alerte de Vagues de Chaleur et Impacts Sanitaires

**description**  
Des températures élevées de 43 à 45°C sont attendues dans les localités Sud-est (Kédougou, Tambacounda) et Nord-est (Matam et Podor) durant la période du 26 avril au 02 Mai 2023. Ces pics de températures journalières entraîneront un risque modéré de vagues de chaleur.

**instruction**  
Des coups de chaleur et un sentiment d'inconfort seront ressentis dans les localités de Tambacounda, Kédougou, Matam et Podor. Un suivi régulier des personnes vulnérables est recommandé. Rester à l'abri et écouter les médias locaux pour plus d'informations des autorités locales.

web http://www.anacim.sn

image uri

image mimeType

contact previsionсенegal@anacim.sn

**areaDesc**  
Localités Sud-est et Nord-est

**a** liste de paires de coordonnées 'lat,lng' délimitées par des espaces  
Localités Sud-est et Nord-est

**circle**  
format: lat,long<space>radius

**geocode**  
format: 'type' = 'value'

**polygon**  
16.5803,-14.3481 16.1936,-14.6558 16.0036,-14.8096 15.8345,-14.8755 15.517  
format: SW SE NE NW SW (lat,lon points)

Figure 8: Alert in CAP format sent by ANACIM.

## Summary score, recommendations, and comments for Element 6

Maturity level 3: The basic alert service is in place and operational 24 hours a day. Forecasting and warning services are used in the event of floods, heat waves, dangerous swells, gusty winds, lightning and density dust. There is a weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies. Many types of alerts

are missing, especially for different types of hazards, such as flash flooding, although MHEWS is in place in the country, it is not yet very developed. The alerts are often too general, covering a large region, which may not be useful to users. Alerts are in CAP format but procedures are not written and there are no specific procedures between ANACIM and disaster management agencies. When disseminating warnings through different channels, the information may not reach everyone because there may be difficulties in understanding the message. Here, it is recommended that all stakeholders make efforts to ensure that the weather does not surprise anyone. Another challenge is the lack of a comprehensive warning map, presenting weather warning information in a user-friendly format so that the warning is easily accessible to the public to immediately see the overall weather situation.

**It is recommended to:**

- Develop additional and more specific alerts: e.g. flash floods;
- Increase the spatial resolution of the alerts;
- Raise awareness among the population and users of weather information for a better understanding of weather reports and forecasts;
- Add and improve warning tools for a better provided services adapted to community needs;
- Increase the available expertise in Senegal in the field of early warning system;
- Develop Impact based forecast for floods management.

## Element 7: Contribution to Climate Services

### **7.1. Where relevant, contribution to climate services according to the established capacity for the provision of climate services.**

There is a national action platform since 2017, based on the global plan for the improvement of climatological services. By a ministerial decree a national framework for climate services was established, as well as an observation network, a data management system and a monitoring and forecasting system that allow the production and provision of climate information and services. So a national climate services framework exists but there is a lack of funds for a full implementation of the plan. The national framework also needs to be updated.

There are partnerships between public and private sectors to provide services. Some of these services are freely available and others, providing more precise and tailored information, need to be paid for. Eighteen (18) climate information products are currently available, though eight (8) are not yet fully operational. These include insolation, local forecasts (in progress), lightning zones and zones at risk, fodder availability, water resource availability, rainfall intensity forecasts, favourable conditions for the quantity and quality of pasture and favourable conditions for diseases and their location. The 'Cadre national des services climatologiques' is coordinated by ANACIM. The work on the website is ongoing, but much more effort is needed to make significant progress and further develop it for different sectors.

A platform called ENACTS<sup>8</sup> ("Enhancing National Climate Services") has been set up to enable the institution to further strengthen its production system. Thirty (30) ANACIM staff have been trained to use the platform. The production of reliable climate information depends on the availability of credible, high-resolution climate data. In order to make localised climate data available at the Senegalese level, the USAID/CINSERE project financed the implementation of the ENACTS tool, piloted by IRI. The aim of the ENACTS tool in Senegal is to improve ANACIM's meteorological database and build the capacity of ANACIM's Meteorological Operations Department to produce very high-resolution climate information. The ENACTS tool generates climate data series in a complete

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<sup>8</sup> <https://iri.columbia.edu/resources/enacts/>

spatio-temporal grid over more than 30 years by combining observations from ANACIM stations with satellite rainfall estimates (for precipitation) and climate model re-analysis products (for temperature). The Maproom is a collection of maps and other figures describing the climate and its impact on different sectors. The maps and figures can be manipulated and are linked to the original data. Even if you are mainly interested in the raw data rather than the figures, the Maproom is a good place to go.

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

Maturity Score 3: Climate services have been developed for a range of applications following a National Action Plan. However, the step to sustainable, operational provision of these services requires an additional effort and a strengthened collaboration between ANACIM and professionals from different sectors.

#### **It is recommended to:**

Update the existing National Plan for Climate Services, and find sufficient resources for its execution;  
Provide climatological products that have been developed with external stakeholders as operational services and secure the resources for this;  
Improve and evaluate the existing user interface;  
Provide climatological products that have been developed with external stakeholders as operational services and secure the resources for this.

## **Element 8: Contribution to hydrology**

### **8.1. 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 DGPRE<sup>9</sup> (Water Resources Management and Planning) manages a hydrometric observation network covering all the catchment areas and operates a good hydrological database. However, despite the ongoing modernisation of its measurement network, its spatial coverage needs to be increased. Of the more than 100 stations that were operational in the early 1980, only 53% are currently operational. However, if we consider only the optimised network, which has a total of 75 stations, 66% are now operational.

Hydrological products disseminated through DGPRE are:

- Daily Bulletin<sup>10</sup> shared every day
- Output from the GTP<sup>11</sup> (Multi-disciplinary working group, see also element 2.1 ) is every 10 days
- Monthly Bulletin<sup>12</sup> that includes all stations
- Annual report
- Alerts when the situation is abnormal
  - If flow is above a certain level then an alert is given regardless of the weather situation
  - The weather situation is considered, but is not a required criterion
  - Based on observation, not models
  - Regional weather forecasts are sometimes used but not on a routine basis

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<sup>9</sup> [www.dgpre.gouv.sn](http://www.dgpre.gouv.sn)

<sup>10</sup> [WEATHER FORECAST](#)

<sup>11</sup> [Products of GTP](#)

<sup>12</sup> [SEASONAL FORECAST](#)

Warnings are provided to the ministry and the press, none are given directly to the population. When the risk is a little below the risk level an automatic sms-alert is sent to government officials and the Civil Protection Directorate. Alerts for flash floods follow a separate route through ANACIM. The actions following such an alert is the responsibility of the civil protection agency, which is also responsible for several specific follow-up actions after certain warnings are issued.

There is a dedicated platform for the prevention of flooding-impacts. Currently there is no national model used for this service; model output provided through AGRYMET is used instead.

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

The Directorate of Water Resources Management and Planning (DGPRE) is a state structure, one of its sovereign missions is hydrological monitoring through an observation network on the various watercourses. It produces information on water resources on a regular basis.

DGPRE is under the administrative supervision of the Ministry of Water and Sanitation. It regularly produces information on knowledge of water resources. These include, but are not limited to:

- Mapping of watersheds and flood zones;
- Hydrological bulletins (daily, weekly, decadal during flood periods, monthly throughout the year for reference hydrological stations);
- Technical Notes;
- Flood Warning Bulletins;
- Hydrological Yearbooks

To better fulfil its mission the directorate relies on meteorological products provided by ANACIM. Thus, each year a report<sup>13</sup> is made in the form of a synthesis of the various agro-hydro-meteorological situations which have reported regular monitoring from May 1st to October 31st by the G.T.P. of Senegal. Highlights of the rainy events are presented in the first section. The second section summarizes the results of hydrological analyses on the main rivers during the wintering season. The impact of hydrometeorological factors on the agro-pastoral season (phytosanitary pressure, livestock and vegetation cover situation) is analysed in the other sections, as well as the situation on the markets.

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

ANACIM manages a complete database through CLIDATA, which includes a metadata management module. But there is also the WMO Oscar surface web solution which also allows metadata management. The data from the collection is stored in the CLIDATA database servers.

Created within the framework of the AGRHYMET Programme, the GTP aims to contribute to early warning for food security by providing comprehensive information on the agricultural season. Its technical coordination is ensured by the National Agency for Civil Aviation and Meteorology (ANACIM). The group composed of the services involved in the field of agricultural production (Directorate of Agriculture, Directorate of Water Resources Planning Management, Directorate of Plant Protection, Directorate of Livestock, Ecological Monitoring Center, Food Security Commission, Executive Secretariat of the National Council for Food Security, National Committee of CILSS, Directorate of Analysis, Forecasting and Statistics...) publishes at the end of each decade a Ten Agrometeorological Bulletin intended for national authorities, donors and technicians, the press, etc.

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<sup>13</sup> [annual report gtp 2022 \(anacim.sn\)](https://anacim.sn/annual-report-gtp-2022)

As part of the implementation of the Global Framework for Climate Services, this group has been expanded to include agricultural insurance, INP, CNCR, CONGAD, ANCAR, URAC, Environment, Directorate-General for Health and the press.

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

There is a good working and formalized relationship between the DGPRES and ANACIM. The legal context for the division of responsibilities in hydrological services is strong and clear.

To better succeed in its mission, the Directorate of Water Resources Management and Planning (DGPRES) also relies on meteorological products. This state of affairs demonstrates the natural and complementary relationship between the DGPRES and ANACIM. As such, a working framework has been established between the two structures through a partnership agreement.

An assessment of the DGPRES's needs in terms of climatological services produced the following results:

- Rainfall trends (long-term observations and climate projections) ;
- Climate change scenarios and potential impacts on water resources;
- Rainfall forecasts for the winter period.
- Climatic analyses of the following parameters: rainfall, relative humidity, temperature, evapotranspiration, sunshine, wind, etc.);
- Simulations of extreme hydrometeorological events (droughts and intense rainfall);
- Rainfall statistics, IDF (Intensity Duration Frequency) rainfall curves.

There was also a collaboration between the hydrological service, ANACIM and universities to prepare climate projections and climate scenarios. A geoportal provides climate information, with different scenarios etc. This is used by the users regularly. However, communication could improve the awareness of the existence of the portal and the data that is available.

With the country's northern neighbours in Nouakchott<sup>14</sup>, in 1972 and in 1978 in Bamako<sup>15</sup>, Senegal, Mauritania and Mali signed a convention giving the Senegal River (OMVS<sup>16</sup>) an international status.

The result of the agreement was the construction of the Diama and Manantali dams.

And in the south of the country, Senegal participates in the Organization for the Development of the Gambia River (OMVG<sup>17</sup>) is a sub-regional institution that brings together four member countries, Gambia, Guinea, Guinea Bissau and Senegal. The OMVG High Commission is the implementing body for integrated development projects and programmes implemented by the four member countries for the rational and harmonious exploitation of the common hydroelectric resources of the Gambia, Kayanga Géba and Koliba-Corubal river basins.

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

Maturity Score 3: Hydrological services are in place, but their basic input (models and observation network) could be improved considerably. There is a well-functioning relationship between ANACIM and DGPRES (the Directorate of Water Resources Management and Planning), but there is room for further improvements of the meteorological services supporting hydrological applications. Working and formal agreements in Senegal for the exchange of hydrological data appear to be effective. There

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<sup>14</sup> [Conventions : relative au statut du fleuve Sénégal du 11 Mars 1972 \(cda-omvs.org\).](#)

<sup>15</sup> [Les conventions de base – OMVS](#)

<sup>16</sup> [Organisation pour la Mise en Valeur du fleuve Sénégal \(OMVS\) – OMVS](#)

<sup>17</sup> [Accueil | Site Web du Projet Energie OMVG \(pe-omvg.org\)](#)



are also formal agreements for the exchange of hydrological data with the Hydrological Service of Senegal and neighbouring countries. Outreach related to the use of the geoportal containing climate scenarios for Senegal could be improved.

**It is recommended to:**

- Evaluate the coordination mechanism of the flood warning system installed in Senegal to determine the means to be mobilized and the capacities to be implemented;
- To improve the awareness within Senegal of the existence of the climate information portal;

## 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?).**

Basic information, alerts and forecasts for Senegal are available on the ANACIM website. There is also an application for smart devices with Android systems, which also provides basic information. ANACIM is also present on social media platforms and mobile platforms with SMS. Once they receive the bulletin they use a mailing list with all users and call selected users who are at risk. The forecasts cover a large area and may not always be relevant for all users.

### **9.2. Education and awareness initiatives in place.**

ANACIM has organised an open day to educate local population on meteorological services. The ANACIM website also contains some educational material in French that can be used by the public. ANACIM periodically organises travelling training courses for farmers and fishermen on the use of weather information and forecasts. Finally, classes and teachers often visit the headquarters and meteorological stations in the interior of the country.

### **9.3. Special measures in place to reach marginalized communities and indigenous people.**

Local community radio stations are used to disseminate warnings in local language. Whatsapp audio messaging is used to alert users who are illiterate. However, this is still in development and is limited to warnings. There are difficulties in reaching everyone, especially in rural settings. Although messages are translated, ANACIM needs to pay for the service for a certain number of messages. As there is a lack of funding for the service and for the translations, the reach of the information is limited to users who subscribe.

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

Maturity Score 2: Traditional and modern communication channels are used by ANACIM for the dissemination of information. ANACIM does not have its own TV, Video or Audio facilities. Education and awareness initiatives exist, but there is room to expand these activities and provide more educational material on different languages, levels, topics and media. Some efforts are made to reach marginalised communities and indigenous people, but much more is possible.

**It is recommended to:**

- Collaborate with other sectors to disseminate meteo/climate information on other relevant channels.
- Further develop local radio stations and WhatsApp audio messages to reach marginalised communities and indigenous and illiterate people.

## Element 10: Use and national value of products and services

### 10.1. Formalized platform to engage with users in order to co-design improved services.

ANACIM is well integrated institutionally with other governmental institutions, especially aviation. For instance, during the rainy season the Multidisciplinary Working Group (GTP) meets every 10 days. This group (see also element 2) is made of different government institutes, such as agriculture, hydrology, vegetation and food security, which come together to discuss potential issues and how the rainy season is developing. In the remainder of the year meetings are less frequent and involve fewer members. There is also a well-functioning relationship in the field of hydrology between ANACIM and DGPRE (the Directorate of Water Resources Management and Planning). The relationships mentioned above are formalised in most cases, but they focus on the provision of operational services to other governmental institutions and the general public. A formalised platform for co-design and development of new services by ANACIM and its public and private stakeholders does not exist. These activities are generally done on ad-hoc and project basis.

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

A workshop was held once to gain feedback from stakeholders and users, which led to a recommendation that this should be done more regularly. Feedback is sometimes done at the end of the projects. Also at the end of season, an evaluation of the forecasts is done and feedback is also monitored through social media. However, this feedback remain ad-hoc and there is no systematic feedback process in place to independently monitor user satisfaction on a regular basis.

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

ANACIM must guarantee the development of products identified by the beneficiaries and not yet realized. There is a need to strengthen the capacity of the meteorological service both in terms of skills/human resources and equipment to ensure the development of climate services. Technical capacity, e.g. the storage and analysis capacity of meteorological and climate databases should also be strengthened.

### Summary score, recommendations, and comments for Element 10

Maturity score 2: some ad hoc actions are taking place, but a systematic approach to user feedback and improving or developing new services is currently not in place. This is mainly due to lack of human and technical resources.



## Annex 1 Consultations (including experts and stakeholder consultations)

### Anacim agents met

NOM	UNIT	ROLE
Sidy Gueye	ANACIM	Managing director
D' Ousmane Ndiaye	ANACIM	Director of Meteorological Operations
Oumar Konté	ANACIM	Head of Agrometeorology Department
Sadibou Ba	ANACIM	Head of Meteorological Operations Department
Papa Ngor Ndiaye	ANACIM	Head of Forecasting
Koutaille Ba	ANACIM	Technical Director
Mme Adama Niang	ANACIM	Head of Coordination and International Affairs Office
Ibrahima Diallo	ANACIM	Head of Weather Observation Department
Mamythioro Diouf	ANACIM	Project Coordinator
Mme Adjé Awa	ANACIM	Head of Meteorological Information System Dep
Mme Ndeye Amy Sall	ANACIM	Agrometeorologist
Mathilde Sarr	ANACIM	Head of Meteorological Information System Office
Abdoulaye I.I. Mbengue	ANACIM	Head of Maintenance
Lansana Sambou	ANACIM	Maintenance Engineer
Diadji Cissé	ANACIM	Maintenance technician
Moustapha gueye	ANACIM	Chief Surface Meteorological Station of Mbour
Habib Senghor	ANACIM	Forecaster (Numerical Prediction Specialist)
Saliou ndir	ANACIM	Archivist

### Partners

NOM	UNIT	ROLE
Bakary FATY	DGPPE	GTP focal ponctuel
Khady CISS	DPV	GTP focal ponctuel
Iba DIOP	CSA	GTP focal ponctuel
Khalisse DIOUF	CSE	GTP focal ponctuel
Saliou FALL	DA	GTP focal ponctuel
Aissatou SENE	SECNSA	GTP focal ponctuel
Ndèye Maty MBENGUE	DIREL	GTP focal ponctuel

SECNSA: Executive Secretariat of the National Food Security Council

DPV: Plant Health Directorate

CSA: Commissariat for Food Safety

CSE : Ecological Monitoring Center

DA : Directorate of Agriculture

DIREL : Directorate of breeding

## Annex 2 Urgent needs reported

ANACIM needs development support along the value chain of meteorological service provision and early warning. The most urgent needs can be summarized as follows:

Following critical gaps have been identified:

Although the current legal framework allows meteorological data collection services, but the resources collected only cover a small part of the overall operation of the service (payroll, staff). For its operation, ANACIM benefits from an annual subsidy from the Government in the form of fees (Aeronautics and Meteorology) and also project financing. In addition to fees, it is strongly recommended to allocate additional resources for the acquisition of weather equipment and staff training.

ANACIM's observing system has critical deficiencies that currently do not allow for effective delivery of nowcasting and early warning services.

A study of the current spatial and temporal resolution of ANACIM's network of weather stations revealed the following shortcomings:

In the centre and south of the country, the horizontal resolution complies well with the regulations, but towards the north, the horizontal resolution is low (see annex 6 Figure A6.3). We propose the creation of two (2) additional stations that will be added to the GBON network in this area to correct the horizontal resolution at 200 km and 100 km in GBON compliance.

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

Only four (4) stations are equipped with operational wind devices. For the other ten (10) stations, the wind measurement is estimated by default or failure of wind devices.

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

Cooperation between other government authorities should be further strengthened, particularly in the area of disaster risk reduction, and new partnerships should be established with the NGO sector to enable effective use of the information provided by ANACIM by basic users.

Observational data are essential for the hydrometeorological value chain, so priority should be given to the establishment of a functional and sustainable observing infrastructure, including station maintenance and calibration, data quality control and data management practices, including holistic ICT infrastructure and services suitable for acquisition and archiving, real-time data processing and automated transmission via WIS 2.0.

## Annex 3 Information supplied through WMO

- 📄 A Compendium of Topics to Support Management Development in National Meteorological and Hydrological Services;
- 📄 A5. gender-equality-disaster-recovery;
- 📄 CIMO-16 Commission des instruments et des méthodes d'observations N° 1138) ;
- 📄 Climate Data Management System Specifications (WMO-No. 1131) ;
- 📄 Commission des observations, des infrastructures et des systèmes d'information (OMM-N° 1306) [Abridged final report] ;
- 📄 Directives à l'intention des formateurs dans le domaine des services météorologiques, hydrologiques et climatologiques ;
- 📄 Directives concernant les demandes de bourse\_wmo\_1104\_fr ;
- 📄 ÉGALITÉ DE GENRE \_Genre\_SEN\_vF ;
- 📄 Gender-equality-disaster-recovery ;
- 📄 Guide des instruments et des méthodes d'observation (OMM-N° 8) [2021 - Volume I – Mesure de variables météorologiques] ;
- 📄 Guide des instruments et des méthodes d'observation (OMM-N° 8) ;
- 📄 Guide du système mondial d'observation (OMM-N° 488) ;
- 📄 Guide du Système mondial intégré des systèmes observations intégrés ;
- 📄 Guide du Système mondial intégré des ;
- 📄 Guide sur l'application de normes d'enseignement et de formation ;
- 📄 Guide sur la mise en oeuvre de systèmes de gestion de la qualité pour les Services météorologiques ;
- 📄 Guide sur les compétences (OMM-N° 1205) ;
- 📄 Guidelines on the Role, Operation and Management of National Meteorological and Hydrological Services (WMO-No. 1195) ;
- 📄 Manuel des codes, Volume I.1 – Codes internationaux (OMM-N° 306) ;
- 📄 Manuel du Système d'Information de l'OMM (OMM-N° 1060) ;
- 📄 Manuel du Système mondial de télécommunications (OMM-N° 386) ;
- 📄 Manuel du Système mondial intégré des systèmes d'observation de l'OMM (OMM-N° 1160) ;
- 📄 Manuel sur le Cadre mondial pour la gestion de données climatologiques de qualité (OMM-N° 1238) ;
- 📄 Instruments and Observing Methods (IOM) Report;
- 📄 Publication OSCAR – Version 1.8.3 Manuel d'utilisation OSCAR\_Surface ;
- 📄 SOFF private sector business models ;
- 📄 UNDP Gender, Adaptation and DRR Policy Brief 2-WEB;
- 📄 UNDP Linkages Gender and CC Policy Brief 1-WEB

## Annex 4 List of materials used

(this may include WMO Guidance Materials, Data and Information, Review Reports, Database etc.)

In addition to WMO guides, the following material was utilised:

- Online material included as references to this document
- The web pages of ANACIM
- ANACIM also shared some material about their organization (e.g., user statistics of web pages etc.) with peer adviser

## ANNEX 5 Abbreviations and Acronyms

ABN: Niger Basin Authority.
ACASIS : Alert to Heatwaves in the Sahel and their Health Impacts
ACMAD: African Center of Meteorology Application for Development.
ADM : Municipal Development Agency
AFOM: Strengths, Weaknesses, Opportunities and Threats.
AGEROUTE : Agency for Works and Road Management
AGRHYMET: Centre specialized in Agriculture, Hydrology and Meteorology.
AIBD : Blaise Diagne International Airport
AIC : Agriculture Intelligente face au Climat.
AICCRA : Accelerating Impacts of CGIAR Climate Research For Africa
AMMA 2050 : The African Monsoon Multidisciplinary Analysis for 2050
AMMA: Multidisciplinary Analysis of the African Monsoon
ANACIM : National Agency for Civil Aviation and Meteorology
ANAMS: National Agency of Meteorology Senegal
ANAT : National Agency for Spatial Planning
ANSD: National Agency for Statistics and Demography
ANCAR : National Agency for Agricultural and Rural Advisory
AWS : Automatic Weather Stations
BNSP: National Fire Brigade
CC: Climate change
CCASA : Science-Policy Dialogue Platform on Adaptation of Agriculture and Food Security to Climate Change
CCNUCC: United Nations Framework Convention on Climate Change
CDMS : Climate Data Management Systems
CEDAW : Convention on the Elimination of All Forms of Discrimination against Women
CGQA: Air Quality Management Centre
CLIMDEV : The Climate for Development in Africa
CMSC : Global Framework for Climate Services
CILSS ; Permanent Inter-State Committee for Drought Control in the Sahel
CNAAS : National Agricultural Insurance Fund of Senegal
CNCR: National Framework for Rural Consultation and Cooperation
CNSC : National Climate Services Framework
COGIC: Interministerial Crisis Management Operations Centre
COMNACC: National Climate Change Committee
COMRECC: Regional Climate Change Committee
CONGAD: Council of NGOs in Support of Development
COP21 : Conference of the Parties
COFIL: Steering Committee
CPDN : Nationally Determined Planned Contribution
CRT: Regional Transmission Centre

CST: Scientific and Technical Committee
DA: Directorate of Agriculture
DEEC: Department of the Environment and Classified Establishments
DEM : Meteorological Operations Branch
DGPRES: Directorate of Water Resources Management and Planning
DGS: Directorate-General for Health
DPC : Directorate of Civil Protection
DPV: Plant Protection Directorate
ECMWF : European Centre for Medium-Term Forecasts
EDEQUE : Doctoral School of Water and Water Quality
ENACTS : Enhancing National Climate Services initiative,
FAO: Food and Agriculture Organization of the United Nations
FONGS: Federations of NGOs of Senegal/ Actions Paysannes
GBON : Global Basic Observing Network
GDP: Gross Domestic Product
GIEC : Intergovernmental Panel on Climate Change
GPRS : General Packet Radio Services
GRC : Disaster Risk Management
GTP: Multidisciplinary Working Group
GTS: Global Telecommunication System
ICAO : International Civil Aviation Organization
IQA: Air Quality Index
IRI : International Research Institute
LERSTAD : Laboratory for Studies and Research in Statistics and Development
LPAOSF: Simeon Fongang Atmospheric and Ocean Physics Laboratory
MISP: Ministry of the Interior and Public Security
NMHS: National Meteorological and Hydrological Services
NOAA : National Oceanic and Atmospheric Administration
NWP: Numerical Weather Prediction
NWP: Proficiency in Weather Forecasting
OCB: Grassroots Community Organization
OMM CREWS : Climate Risk and Early Warning Systems (WMO)
OMS: World Health Organization
OMVG : Organization for the Development of the Gambia River
OMVS : Organization for the Development of the Senegal River
ONG: Non-Governmental Organization
ORSEC: Organization of Relief
OSIRIS : Observatory on Information Systems, Networks and Infohighways in Senegal
PAM (4R) : World Food Programme
PANA : National Programme of Action for Adaptation to Climate Variability and Change
PARM : Platform for Agricultural Risk Management
PCE : Economic Growth Project
PFNAC : Project to promote innovative finance and community adaptation in communes around community nature reserves in Senegal

PROVAL CV : Water Valorization Project for Value Chain Development
PSE: Emerging Senegal Plan
QMS : Quality Menagment System
REVARD : Reducing Vulnerability and Building Resilience of Vulnerable Communities in the Saloum Islands
RSTFA/SMT : Aeronautical fixed telecommunications service network / The Global Telecommunication System
SAP: Early Warning System
SARP: International Standards and Recommended Practices
SAT (UFR de) : Applied Sciences and Technology
SDDR: Department of Rural Development
SE/CNSA : Executive Secretariat/National Council for Food Security
SIG: Geographic Information System
SOFF : Systematic Observations Financing Facility
SWIFT: Science for Weather Information and Forecasting Techniques
TCM : Monthly climatological table
UASZ : Assane Seck University of Ziguinchor
UCAD: Cheikh Anta Diop University
UGB : Gaston Berger University
UICN: World Union for Conservation of Nature
URACS : Union of Associative and Community Radios of Senegal
VPN : Virtual Private Network
WIS : WMO Information System
WMO : World Meteorologique Organisation
WPG : Multidisciplinary Working Group

## ANNEX 6 Map of functioning upper air in Senegal

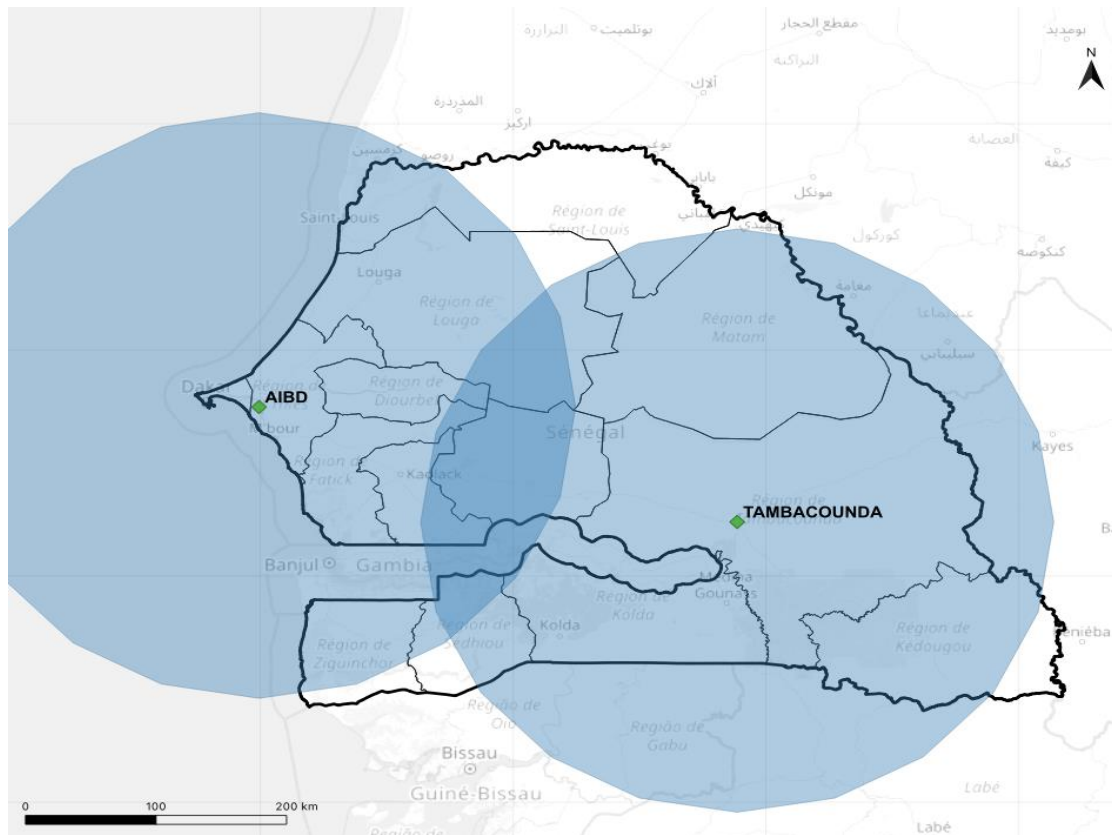


Figure A6.1: Map of functioning upper air in Senegal, with 500 km diameter buffer. Areas which are not covered by the buffer represent regions where surface stations are more than 500 km apart, and therefore do not meet the GBON horizontal resolution.



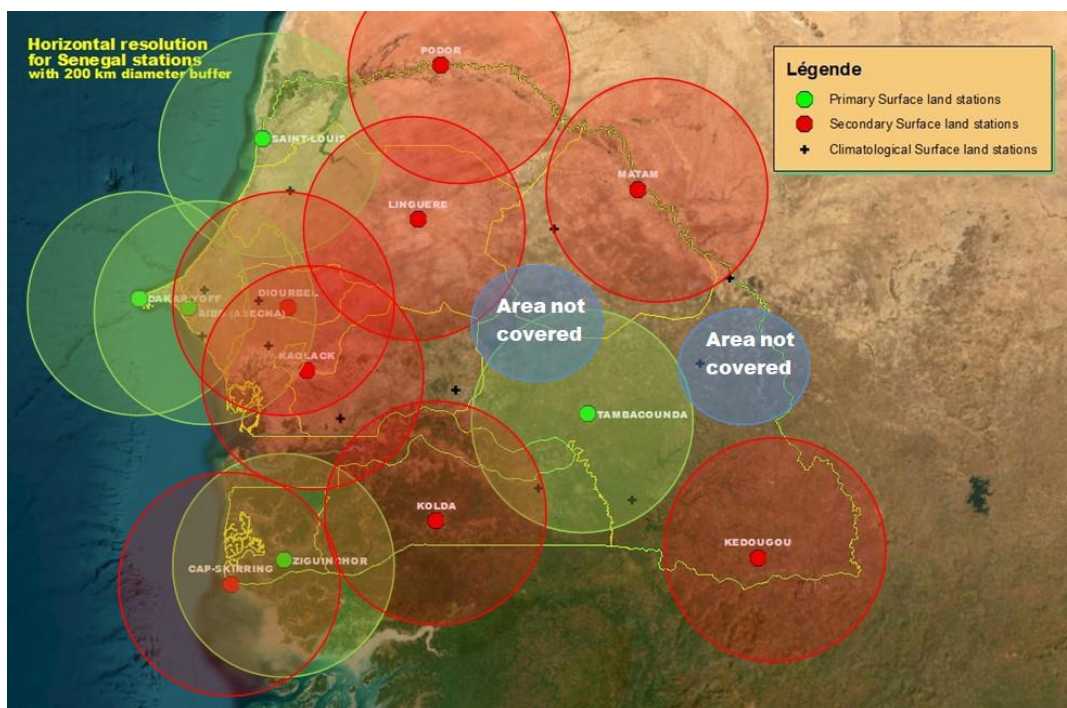


Figure A6.2 : Overview of surface stations in Senegal

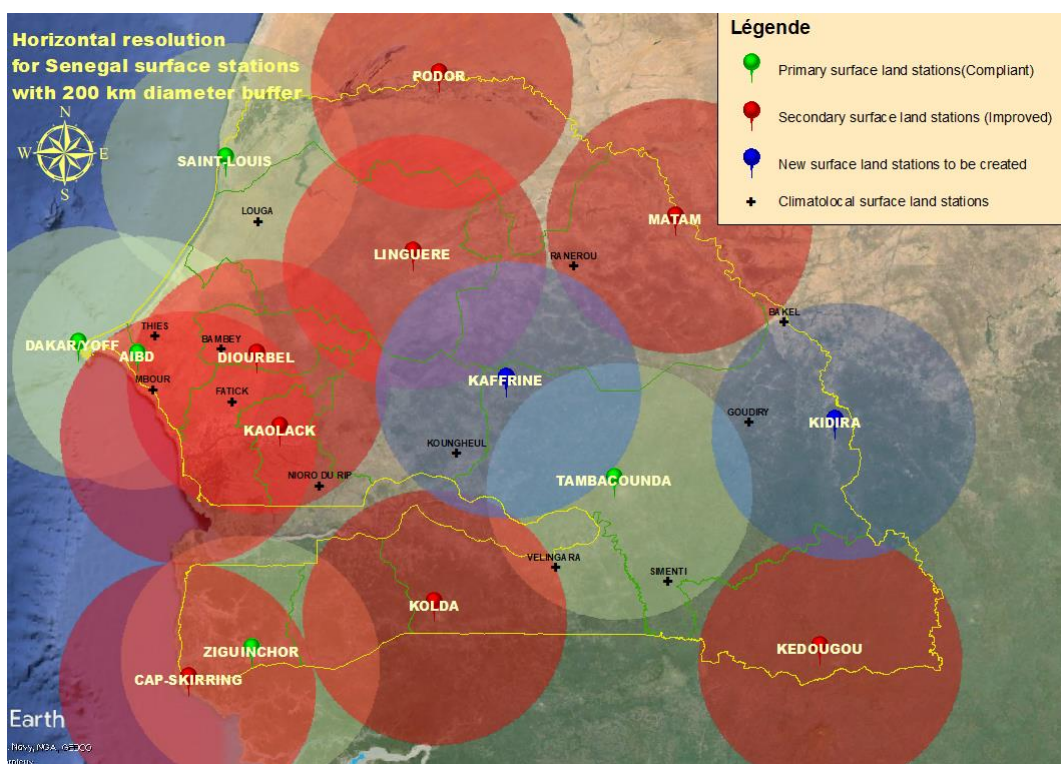
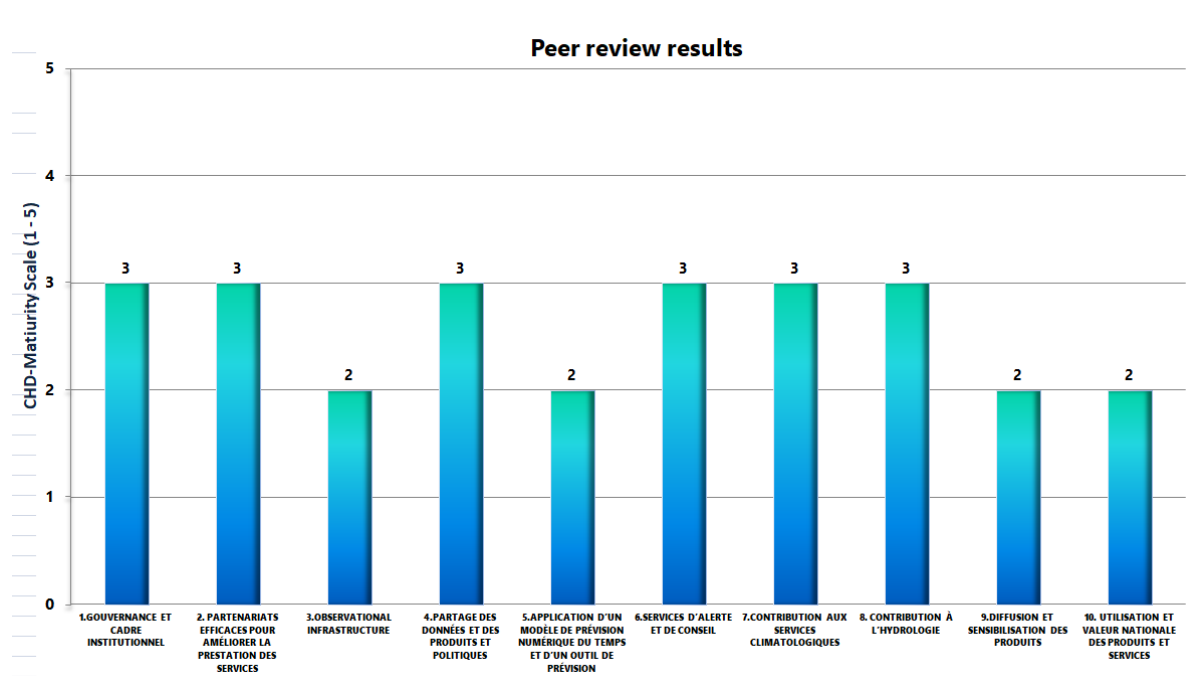


Figure A6.3: Overview of surface stations in Senegal, with two new stations (Kadira and Kafrine) financed by SOFF.

## ANNEX 7 Maturity of the 10 elements of the CHD

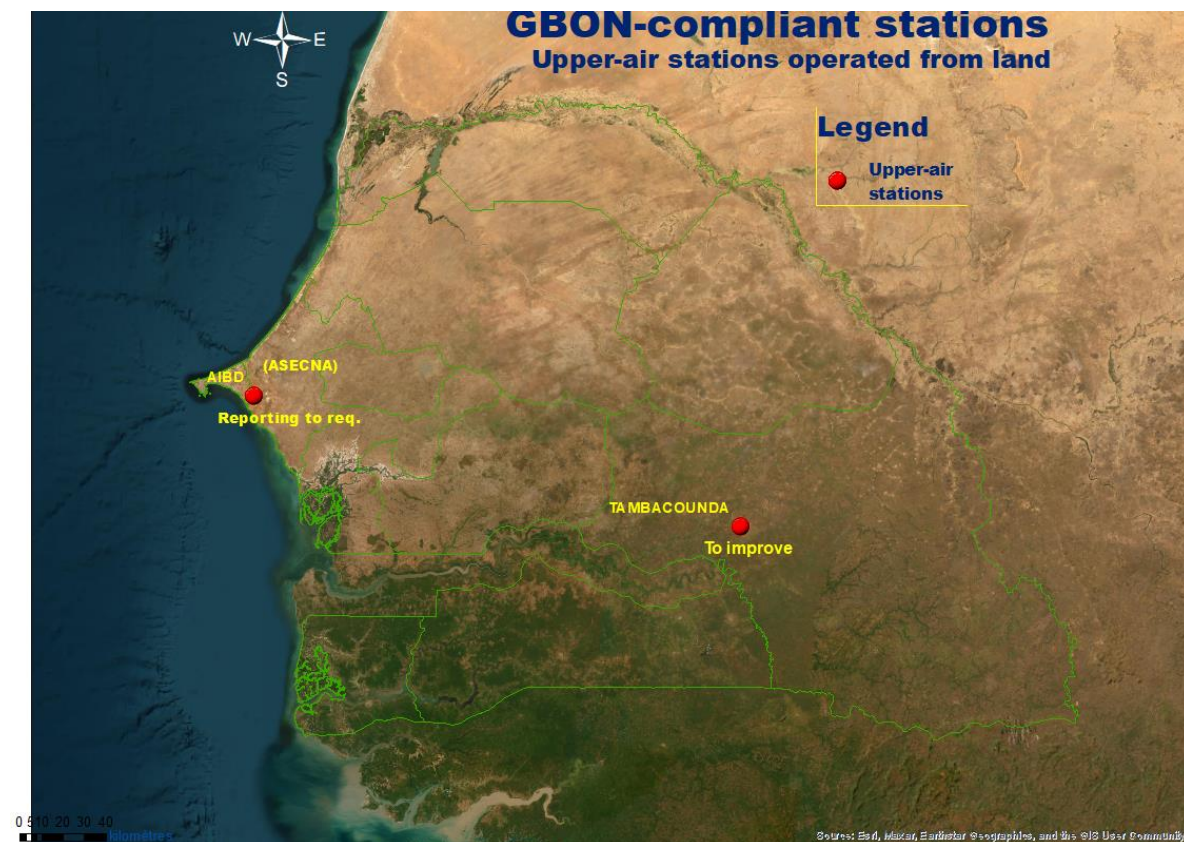


## ANNEX 8 National Target toward GBON compliance (Surfaces-based stations)





## ANNEX 9 GBON compliant Upper air stations operate from land



## ANNEX 8 National Target toward GBON compliance (New proposed Surfaces-based stations)



