20.05.2024

SOFF
Systematic Observations Financing Facility

GBON National Contribution Plan CHAD

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CHAD

Weather
and climate
data for
resilience

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Module 1. National Target toward GBON compliance

The national target toward GBON compliance is provided in the Table 1 below. The table is based on the WMO Global assessment (June 2023) which calls for 33 surface stations and 6 upper air sites to achieve the low-resolution GBON requirements. To capitalize on existing initiatives and focusing on sustainability while preventing duplication, the implementation of GBON as suggested in this NCP will be based on the GEF (Global Environment Facility)/UNDP Project "Chad National Adaptation Plan (NAP)". The NAP project aimed at installing a total of 69 Automatic Weather Stations (AWS), mostly in the southern part of the country, below 14^0 Latitude North. Whilst the number of stations is larger, their uneven distribution leads to the need for additional surface weather observing stations in the northern areas. At the time of writing the National Contribution Plan (NCP), out of the 69 NAP stations, 47 were already operational, 7 were installed but are still not operational due to telecom issues and 15 others are still awaiting their installations. The installed AWS are of ADCON Type whose specifications can be seen in Annex 1. These stations being of automatic type, calibration requirement is rather would be too onerous. It would be cheaper to simply replace defective parts.

A number of projects exist in Chad with strong potential to help advance GBON implementation:
CREWS-Chad – Training and data management and international data sharing
CREWS-Central Africa: Data sharing and training
PILIER: Implementation of full operational centre with data management and ICT systems
FSRP: Training of Forecasters, Technicians and Agrometeorlogists
WMO SWFDP: Training

Taking advantage of this synergy and capitalizing on existing efforts in the country (see grey box above), this NCP considers the exploitation of 19 of the UNDP stations (Table 2), which are already in operations and ownership of the Chad Meteorological Service (Agence Nationale de la Météorologie (ANAM)), to be part of the GBON low-density network and build additional capacity to the target of 33 surface stations through the SOFF resources and activities. In addition, there are regional programs and projects that can be leveraged to advance GBON, particularly in the area of data management and training. Among those, CREWS-Central Africa; CREWS Chad; WMO SWFP (Severe Weather Forecasting Program), Food Safety Resilience Program (FSRP) and PILIER ("Projet Intégré de Lutte contre les Inondations et pour la Résilience Urbaine de la ville de N'Djamena"). Moreover, the services of the Regional Training Centre in Niamey (Agrhymet) can be used to advance the implementation of GBON and sustain its operation in Central Africa.

Type of station	Baseline (Results of the GBON National Gap Analysis)				GBON National Contribution Target	
	Target (# of stations)	GBON-compliant stations (#)	Gap		To improve	New
			New	To improve		
Surface standard density	33	1	0	32	27	6
Upper-air	6	0	4	2	0	3

Table 1. National target towards GBON compliance.

1.1 Selection of GBON Surface Stations

Table 2 and Figure 1 (circle radius of 200 km) below show the list of UNDP Stations retained for GBON and the additional ones to be funded by SOFF. The selection of surface observation stations for GBON was essentially based on the available newly installed AWS and the AWSs to be installed by the UNDP Project and aiming at having as possible a country wide coverage:

- 19 of the operational NAP AWS are well positioned and operational; therefore, they are readily selected for GBON although they are not transmitting their data internationally yet;
- 6 AWS were installed but are not functional; therefore, due to their adequate positions, it is recommended that they are rehabilitated through SOFF;
- 2 other AWS, amongst those planned for installation, are retained for GBON;
- Due to the lack of data North of the 14° Lat North, it is recommended that SOFF funds the installation and operation of additional 6 AWSs in Bardai, Faya Largeau, Koro-Toro, Fada, Zouar and Biltine. It is also recommended for these stations to consider using the EUMETSAT Data Collection Platform (DCP) to ensure sustained telecommunication of data to the WIS.

Note1: Contrary to the North of Chad (Sahelian and Saharian zones) which consisted of prairie and desert and arid areas, the South of the country (the sudanian zone) is the most populated with significant agricultural activities. Figure 1 shows a denser stations' coverage in the south, which is capable of representing a higher-resolution GBON. It is recommended to keep this higher resolution to assist with nowcasting, better services to support agricultural activities and to provide accurate early warning services to the population. Since most of these stations are already installed, SOFF would focus only on the maintenance of the stations and the acquisition of spare parts.

Standard density surface network – GBON target					
Station number	**Station location**	**Lat**	**Lon**	**Status**	**Deploying entity**
1	Mangalmé	12°21'31'' N	19°36'10'' E	**Installed, operational and handed over to ANAM. Not transmitting internationally yet.**	**UNDP**
2	Melfi	11°03'51'' N	17°56'03'' E		
3	Ati	13°14'24'' N	18°19'06'' E		
4	Bokoro	12°22'37'' N	17°03'37'' E		
5	Pala	9°21'56'' N	14°55'08'' E		
6	Kélo	9°19'47'' N	15°50'12'' E		
7	Moundou	8°29'38'' N	16°10'18'' E		
8	Larmanaye	8°02'05'' N	15°42'28'' E		
9	Doba	8°41'22'' N	16°49'51'' E		
10	Goré	7°54'38'' N	16°38'212'' E		
11	Ngouri	13°38'55'' N	15°22'20'' E		
12	Kyabé	9°27'55'' N	18°57'05'' E		

13	Moissala	8°18'33" N	18°00'23" E		
14	Iriba	15°07'56" N	22°13'48" E		
15	Goz-Beida	12°13'18" N	21°24'57" E		
16	Aboudeia	11°26'41" N	19°16'47" E		
17	N'djamena	12°20'24" N	14°55'07" E		
18	Am-Timan	11°02'22" N	20°16'07" E		
19	Sarh	9°06'46" N	18°20'49" E		
20	Bongor Aéroport	10°17'35" N	15°22'11" E	**Installed but non operational**	
21	Goundi	9°21'43" N	17°22'09" E		
22	Haraze Mangueigne	9°56'47" N	20°54'15" E		
23	Abéché	13°50'39" N	20°50'06" E		
24	Oum Hadjer	13°17'39" N	19°41'52" E		
25	Mongo	12°11'00" N	18°41'00" E		
26	Nokou	14°33'25" N	14°48'34" E	To be installed	
27	Daguela	10°38'43" N	18°26'47" E		
28	Faya-Largeau	17°55'14''N	19°8'17''E	**To be installed**	**SOFF**
29	Bardaï	21°21'0'' N	16°58'58''E		
30	Zouar	20°2650'59''N	16°30'59''E		
31	Biltine	14°30'52''N	20°56'17''E		
32	Fada	17°10'34''N	21°35'30''E		
33	Koro Toro	16°08'48''N	18°29'24'' E		

Table 2: UNDP and other AWS surface stations proposed for retention for GBON

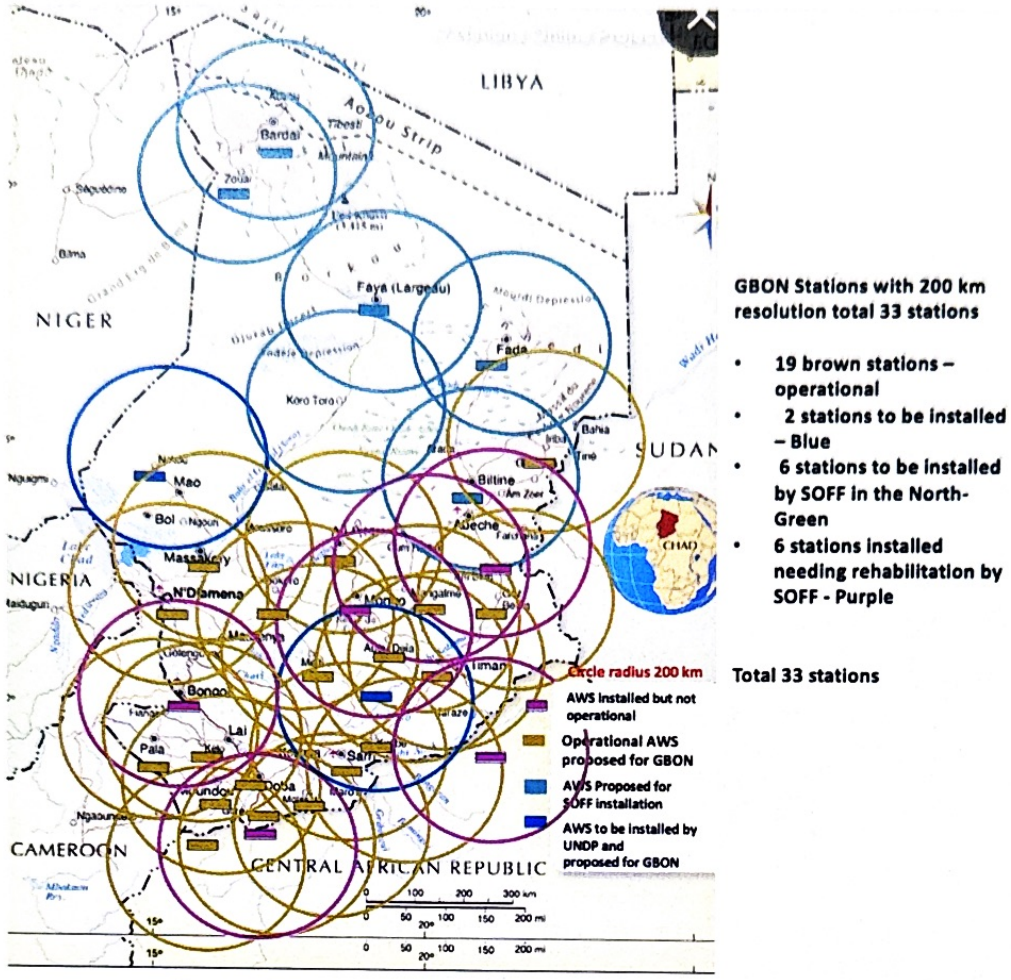


Fig 1: Proposed GBON Surface Stations- Stations with brown circles to operationalize (transmission of their data internationally); Stations with purple circles need to be rehabilitated to transmit data. Stations with light green circles are additional stations to be purchased and installed by SOFF. Finally, the Blue circled stations are those remaining to be installed and are retained for GBON operation.

Note 2: The capitalization of UNDP AWSs can be further enhanced through the purchasing of additional similar AWS (ADCON Type) by SOFF thus facilitating maintenance, spare parts use and training.

Note 3: Due to long time storage (3 years) of AWS batteries in an incontrollable environment before their effective installation, these batteries were already failing. As of 22 Mar 2024, out of the 19 stations selected as operational, only 5 are working now due to battery failure. This means all batteries need to be replace during the first investment phase. These batteries were guaranteed to work for 5 years and they are now beyond their life span.

1.2 Identification of upper air observation sites

The identification of GBON upper air sites in Chad was performed in close alignment with the planning of ASECNA (Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar). ASECNA is in charge of operating the major airports in Chad, such as the international airports of N'Djaména and Sarh. Other airport operations management is delegated to the ASECNA Delegation, which falls under the Civil Aviation Authority (l'Autorité de l'Aviation Civile (ADAC)).

ASECNA already operates 2 upper air observation sites in N'Djaména and Sarh and its delegated authority plans to install, starting in January 2024, one upper air observation site at the Amdjarass airport followed by another upper air station in Moundou (no target date is currently available). Considering the GBON requirement of 6 Upper air sites for Chad, it is therefore recommended that SOFF helps with the installation and operation of 2 new upper air stations in Faya Largeau and Ngolo Fitri bringing the total number of upper air site to 6. The proposed GBON upper air setup is presented in Figure 2 below. Considering that the southeastern area is not covered otherwise, it is strongly recommended that SOFF implements an supplementary upper air site in Goz-Beida, bringing the total number of upper air sites installed by SOFF to 3 and the final network to 7 sites. Such a site in Goz-Beïda would cover the southwestern area of Sudan and northeastern part of Central African Republic. which would also serve Sudan, South Sudan and Central African Republic. Fig 3 shows the location of the proposed sites. The purple circle covers very well the southern regions of Chad.

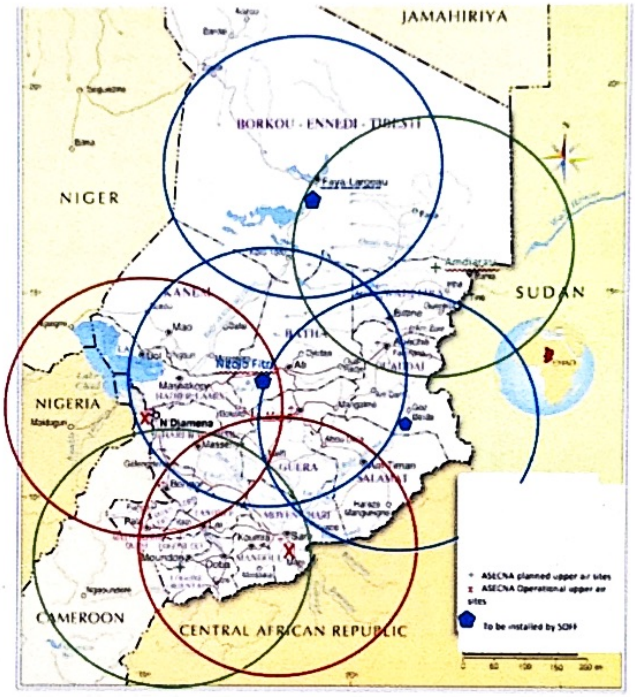


Fig 2: Proposed GBON Upper Air Observation Sites. Red circles are the current ASECNA upper air sites (N'Djamena, Sarh); Green Circles are ASECNA additional upper air sites planned (Moundou and Amdjaras) in the near future; Blue circles are the upper air sites recommended for SOFF installation

ASECNA (Agence pour la sécurité de la navigation aérienne en Afrique et à Madagascar) is an important local partner of ANAM. ANAM currently runs it operational meteorology desk at the ASECNA operation centre. Initial discussion with the ASECNA Representative indicated strong willingness to build close collaboration with ANAM, particularly in data sharing and by participating in training workshops. SOFF will, therefore, help strengthen this relationship through development of a MoU between ANAM and ASECNA.

It is to be noted that ASECNA is present in 17 countries in Africa, some of which are targeted within SOFF. ASECNA purchases, in bulk, consumables and spare parts for its member countries. The peer advisor recommends that high-level discussions, likely guided by WMO, to be initiated to look for leveraging actions considering all the deployments of upper air stations within SOFF on those countries where ASECNA has a role to play. This could offer a possibility for effective handling of resources and potentially an improved cost-benefit approach.

Module 2. GBON Business Model and Institutional Development

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

In Chad, hydrometeorological services are provided by two separate entities: All Meteorological and climatological services are provided by the agency "Agence Nationale de la Météorologie (ANAM)", andthe hydrological services by the "Direction des Resources en Eau (DRE)". These institutions areunder the "Ministère de l'Aviation Civile et de la Météorologie Nationale (MACN)" and the "Ministère de l'Hydraulique urbaine et rurale", respectively. Since the focus of SOFF is on Surface and upper air observation stations, the main player in GBON is ANAM.

ANAM was created through a Presidential Decree N0 521/PR/PM/MDAMN/2017 (12 May 2017), which sets the rules of its organization and operation. It has a Board of Directors composed of representatives of various Ministries (11 Members) with the Chair being the Secretary General of the MACN. ANAM is responsible for weather observations and forecasting and climate services.

ANAM works in partnership with other government agencies to produce ten-day bulletins and produce Early Warnings, especially in the food security sector. In that context, ANAM works in partnership with the following projects: Information System for Food Safety and Early Warning (" Système d'information sur La Sécurité Alimentaire et l'Alerte Précoce (SISAAP)"), The National Office for Food Safety (" L'Office Nationale pour la Sécurité Alimentaire (ONASA) "), the National Agency for Support to Rural Development (" l' Agence Nationale d'Appui au Développement Rural (ANADER) ", the Ministry of Livestock ("Ministère de l'élévage"), Water Resources Directorate ("La Direction de ressources en eau (DRE)"), and with the Direction of Civil Protection ("la Direction de la Protection Civile (DPC) "). It also collaborates with the "Commission of the Basin of Lake Tchad (CBLT)" in data exchange and use of CBLT Automatic Weather System (AWS) information. ANADER, through its regional entities, provides data on precipitation.

The only private sector providing operational observations and data services in Chad is ASECNA and its Delegated Authorities (the Delegation) described in section 1.2 above. They operate in Chad 17 conventional surface observation stations (with observers) of which 13 are co-located with the new AWSs of ANAM (UNDP stations), but ASECNA does not have access to the AWS data. It has a great interest in accessing the ANAM AWS data instead of their conventional system data. ASECNA is also open to contributing to the operation and maintenance of ANAM station data. This could be achieved by establishing a MOU between ANAM and ASECNA. ASECNA also has an optical fibre connection with ANAM, which could facilitate data exchange between them. In addition, using the ASECNA WIS (WMO Information System) connection could help disseminate ANAM data internationally, thus meeting the GBON requirements.

Recommendations

1. ANAM and ASECNA to sign a formal agreement for the exchange of data between them and with the international community as well as regarding the maintenance of the stations and the data transfer infrastructure. Noting the capability of ASECNA to acquire equipment in bulk and to appropriately store them, it is strongly recommended to include this aspect in any agreement.

2. Acquisition of consumables for upper air stations is an expensive endeavor. And noting that ASECNA does order them in bulk for all their locations in Africa, it is recommended, in light of the optimal operation of GBON stations in Africa (at least for the 17 ASECNA Member States), that WMO negotiates with ASECNA to include SOFF funded consumables and spare parts in its purchasing process.
3. Explore further, through a MOU or a PPE, the potential access to the ASECNA training sessions by the ANAM forecasters and technicians and vice versa.
4. The World Bank Project on Food Safety and Resilience Program (FSRP), which has just started, plans, under its Component 1 (digital advisory services for the prevention and management of agricultural and food crises), to strengthen digital hydrometry and agro-advice services for farmers (Sub-component 1.2)) to train meteorological engineers and technicians. It is therefore recommended to explore potential synergies in assuring the availability of maintenance technicians and equipment for the GBON stations.
5. For the government to allocate additional resources (Human and financial) to ensure adequate operation of ANAM, and to establish a proper legislative framework for national and international data sharing in line with the WMO data Policy. Currently, the observational data is sold noting that the client base is very small. ANAM should focus, instead, in developing and selling products and services for efficient decision-making, which would result in mobilizing resources for its efficient and effective operations. This could enhance ANAM business options and expand its portfolio through cost-recovery mechanisms.

2.2. Assessment of potential GBON sub-regional collaboration

The Republic of Chad has the following neighboring countries: Sudan (Political Stability global rank 182), Libya (186), Niger (174), Cameroun (171), Nigeria (178), and Central African Republic (185). Thus, it is surrounded by countries which are considered politically unstable. In addition to these boundary conditions, Chad (global rank 185) is going through a governmental transition resulting in more emphasis on the government's future internal structure than any other external relationship within its region.

None of the neighboring countries has been selected in the first batch of countries considered for SOFF. However, stations identified near borders can also serve the neighboring countries once their data are transmitted internationally. Efforts should be made to have these countries share their own data as well, and to enhance the cooperation of NMCs within the region regarding monitoring and downstream meteorological applications.

One aspect to be considered in terms of resource optimization is the purchasing of the same type of AWS equipment (ADCON) and the establishment of a cooperative agreement with ASECNA, which also operates in three of the neighboring countries (Cameroun, Niger and Central African Republic). This would facilitate regional maintenance and more effective spare parts management and training. As the other neighboring countries get involved in SOFF, regional discussions could be organized on these items, as Chad is a pilot project.

It is particularly important to highlight that Chad and one of its neighboring countries, Sudan, belong to the countries targeted within the Early Warnings for All initiative (EW4All). As it is well known, SOFF is contributing to the pillar "Detection, observations, monitoring, analysis and forecasting of hazards" with specific actions toward closing the significant Global Basic Observing Network (GBON) gap. The downscaled action plan for the Early Warnings for All initiative, considers an action to provide SOFF long-term, open-ended grant financial and technical support to close Africa's GBON gap and to internationally exchange the mandatory GBON data in a sustained manner. It is foreseen to have a

specific workshop within the EW4All initiative to capitalize on the activities foreseen therein and to use it as a platform to further engage with those intergovernmental agencies, regional commissions, and regional centers, financing institutions and UN agencies and programs that may facilitate the sustainability of the deployed network. This, in turn, is a prerequisite for a future national early warning system that is urgently needed.

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

As described in section 2.1 above, ANAM is responsible for the provision of meteorological services, including weather forecasts and warnings, in Chad. It is an Agency, which should be self-funded, but currently, its budget covers mainly the salary costs. No budget is allocated for the operations and maintenance of its infrastructure other than some royalty from the Aviation Industry (ASECNA Delegation). In its creation act, it was endowed with a legal personality and financial autonomy. Unfortunately, it is not yet entrusted which such kind of financial independence from the government that would be needed to sustain all its NMS functions. The lack of qualified personnel, operational infrastructure and capacities currently constitute still major obstacles for ANAM in this regard. In consideration of the limited availability of a relevant private sector in the field of meteorology, it is advisable to adopt a fully public business model, ie, for the government to assume full control of the observational capacities/operation and services. This model should be set up in a way that it does not prevent ASECNA from providing support to reinforce ANAM capabilities. With government intervention, ANAM shall be responsible for the operations, maintenance and replacement of the equipment, considering its life cycle and subsequent replacement. ANAM should be supported by ASECNA through an agreement as discussed above.

This business model has the following risks:

Risk	Impact	Likelihood
Financial risk – changing funding based on political governance changes, leading to limited or discontinued budget and resources	High	Medium to high considering the government is in transition to a new set up
Sustainability challenges – low flexibility on adapting to changing circumstances or if political forces drive into other directions	High	Medium – due to Govt in transition
Market competition – potential competition with the private sector and leading to distorted markets	No impact due to non-existence of competing private sector	Low – since there is no private sector operating weather information in the region.
Quality of the services – due to limited resources	High	Medium to high due to lack of Human resources and infrastructure
Management competence – due to lack of personnel or corresponding training to manage a larger and more complex service	High	Medium...currently significant lack of qualified personnel

Limited legal frameworks and data policies in place that limit the exploitation of the new capacities	Medium – there is already a government decree in place which needs updating	Low
Data gaps usually due to "operate to fail" approach triggered by constrained resources	Medium	Medium – no assurance of sustained funding from the government to ensure continuous maintenance of the stations
Ineffective monitoring and tracking of the network and its related purchases etc	Medium	Medium to high – All stations are new but personnel for maintenance is lacking

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

In February 2022, Chad submitted its first National Adaptation Plan to the UNFCCC based on the NAP project. ANAM benefits from the 69 AWSs[1] installed and to be installed under the project (implemented by UNDP). It is recommended to leverage the NAP project and other ongoing projects and activities in Chad as mentioned above to facilitate the buildup and operations of the GBON stations and to avoid duplication of efforts in data acquisition and exploitation. A strategic plan is under development through CREWS-Chad project and includes human resources capacity building and modernization of materials and infrastructure including additional weather observation stations. The Plan also calls for an effective data management system, which will be facilitated by the implementation of the PILIER project through the establishment of a fully equipped Hydro-meteorological operational Centre. The Centre will be equipped with adequate servers and data management software to facilitate the provision of accurate weather and climate services and warnings. Therefore, SOFF implementation will lean on the data management system that will be provided by PILIER (project implementation began on 8 Aug 2023). The World Bank Project FSRP will support the training of meteorological engineers and technicians, therefore offering the opportunity for qualified maintenance services. The CREWS project (WMO/WB), terminating in 2024, will facilitate the international transmission of ANAM data and the implementation of WIS 2.0 when it becomes available for the pre-operational phase of its implementation in 2024 (WIS 2.0 is currently in its implementation pilot phase).

2.5. Review of the national legislation of relevance for GBON

The Decree for the creation of ANAM makes it responsible for the provision of meteorological data and related services in Chad. Its responsibilities include:
reviewing and implementing the government's meteorological policy;
- monitoring climate change;
- implementing the Conventions and Protocols on climate change;
- making weather and climate data, forecasts and information available to public and private users;
- implementing and collaborating with the Ministry of the Environment, cloud seeding activities

ANAM is normally not exempted from tariffs. However, when it receives a donation of equipment, as it will be the case for SOFF, it is customary for the Minister of Civil Aviation to write to the Minister of

[1] UNDP installed a total of 69 stations: 64 from NAP and 5 other provided by the PGCRCT (Project de gestation Communautaire de risques climatiques au Tchad) to the NAP project to take advantage of their installation program. Both NAP and PGCRCT were managed by UNDP.

Finance to release the goods without paying the taxes. Information on the equipment, types, costs and weights needs to be provided to the DG ANAM, who will seek his minister's confirmation to write to the Minister of Finance in a request to lift the requirement for paying taxes and excises.

The main overall recommendation is to keep the DG ANAM always in the loop during the purchasing of the equipment to avoid delays, to seek support from the Ministry of Aviation and Meteorology, to effectively capitalize on the role and legal mandate of ANAM, and to obtain derogation for paying taxes and excises for Meteorological equipment and spare parts. Purchasing of initial equipment will need to be made by an external body like the World Food Program (WFP), the implementing entity in the case of Chad. At the time of procurement or purchasing of the stations (spare parts and all related infrastructures), either directly or through ASECNA or by WFP, taxes and potential customs fees should be properly accounted for even if it will, eventually, be cancelled by the Minister of Finance. The strengthening of the institutional mandate will become critical for a sustainable approach to network maintenance and operation as well as the general well-being of ANAM itself. If possible, this legal framework should not only describe the mandate but also the underlying aspects that would support and maintain the mandate. Proper communication and infrastructure facilities, observation networks, databases and data exchange policies need to be put in place. While steering the political agenda as a whole is beyond the capacities or intentions of the activities within SOFF, advocacy towards the establishment of this legal framework will be performed and supported in all the instances possible.

Module 3. GBON Infrastructure Development

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

As highlighted in the National Gap Analysis (NGA), Chad has benefitted from the acquisition of 69 AWS, through a UNDP project for the National Adaptation Program (NAP), offering, therefore, the opportunity to move forward towards a full low-resolution GBON compliance. As mentioned above, these stations were installed south of the 14° Lat North, leaving the northern part of Chad with basically no observing stations. Upper air sites are also missing in northern Chad as described in paragraph 1.2 above. Additional effort is therefore required to install AWS and upper air observation sites in that region to ensure full GBON compliance. This effort needs to be multi-faceted and consider the current political situation and technical aspects to ensure or at least facilitate future long-term sustainability. As an initial step, network design and planning require overcoming the following:

- **Security and safety** – due to the political and social state of the country, it is highly difficult to guarantee the safety and integrity of stations (The Government is in transition with a referendum and general election expected by Dec 2024). To no lesser degree, guaranteeing the safety of the relevant staff (observers and technicians) assigned to the stations is also a challenge, particularly in the North, where armed groups may interfere.
- **Maintenance of stations** – difficult physical access to stations (poor road conditions particularly in rainy season and in the North, lack of vehicles), lack of human resources, as well as lack of technical capacity are all limiting factors that need to be considered early on
- **Data communication and transmission** – the northern part of the country lacks stable internet and cellular network connections. In particular, network coverages is an issue. This may hinder station deployment and data transmission in the north (consideration should be given to the EUMETSAT Satellite-based data transmission service - the Data Collection Service (DCS)). In terms of international data transmission, the link to ASECNA through the fibre optic and the use of its telecommunication system could address this issue. The implementation of WIS 2.0, as soon as available, would greatly assist with the international transmission of data.

These three items alone limit the potential station deployment to populated areas with proper infrastructure that can enable the sustained operation of a station.

In addition, planning of the network should consider all the costs related to equipment purchase, operations, maintenance and replacement as well as all the related indirect costs to its operability (vehicles to support maintenance, ICT, licensing, spare parts and common equipment, staff training, management and administrative workload among others) for the whole extent of the life cycle of the network.

To facilitate maintenance of the proposed GBON stations and considering that the existing GEF/UNDP/NAP project Stations will be used, it will be essential that the new equipment to be purchased by SOFF is from the same manufacturer (ADCON). This will facilitate the acquisition and maintenance of all GBON stations in Chad. Annex 1 provides the specifications of the ADCON stations and a picture of a fully operational ADCON AWS.

With all these many aspects that have to be accounted for, and taking into account the current state and capabilities of ANAM, a phased approach (Figure 3) with a long-term perspective is considered as the best option to enhance the capacity of the country while maintaining an expansion rhythm that adapts to the needs and resources throughout the whole investment phase. The phases are considered

to take an overall time of 5 years and should advance the country towards GBON compliance for surface and upper air stations.

Phase 1 – First year: Implementing the first batch of Surface GBON stations

- Purchase replacement batteries for all existing stations selected for GBON (see Note 3 above)
- Facilitate the establishment of an MoU for collaboration between ASECNA and ANAM for:
    - The exchange of data nationally and internationally using the ASECNA link to WIS (WMO Information System).
    - The contribution to the maintenance of the stations including an acquisition of spare parts for stations.
    - The exploration with WMO of the opportunity for a formalized agreement with ASECNA for a purchase of Upper air consumables for Chad and other ASECNA Member Countries, ensuring that the equipment of upper air stations to be purchased by SOFF are similar to the ASECNA ones.
- Get the first 19 NAP stations (see Fig 1 above - brown circled stations) selected for GBON to transmit internationally, ensuring that their batteries were all replaced (See note 3 above) - a low hanging fruit.
- Identify the telecommunication issues affecting the 6 NAP stations (purple circled stations in Fig 1) and develop a plan for their rehabilitation; Work with GISC Casablanca to establish a mechanism for sharing the data internationally as a back-up to ASECNA approach through the RTH Niamey (less reliable, currently) or to its WIS system.
- Develop plans for purchasing spare parts for the whole network of the existing stations and additional proposed stations for the North. Make arrangements for the purchase of spare parts for AWSs.
- Identify, hire and train station caretakers (not to be mixed up with local observers), taking into account existing staff from ASECNA.
- Adapt the activities as much as possible to ensure it is in-line with the FSRP and the Strategic Plan

Phase 2 – Year two and three: Completing the Surface Observation Network

- Rehabilitate the 6 NAP Stations (See purple circle in Fig 1) and ensure transmission of their data internationally bringing the number of operational GBON stations to 25.
- Initiate the planning for the installation of additional upper air stations with similar equipment as ASECNA and conduct potential site visits (see Fig 2 – Stations with blue circles)
- Initiate the purchase of spare parts for surface observation stations and of additional 6 AWSs (light green circles in Fig 1). These stations need to be of the same manufacturer as the NAP stations (ADCON System) to facilitate effective maintenance.
- Get the two stations to be installed by UNDP (Blue circles) operationally transmitting internationally.
- Install WIS 2.0 in the box when ready for an international data transmission.
- In line with the strategic plan implementation, fine-tune human resources planning.
- Identify and train maintenance technicians including site caretakers.
- acquire two 4 x 4 vehicles suitable to support stations maintenance activities.

Phase 3 – Years 4 and 5: Completing the upper air network

- Proceed with the purchasing and installation of equipment and the procurement of consumables for the 2 proposed upper air sites in Faya Largeau and Ngolo Fitri (blue circles in Fig. 2) - including adequate facilities for housing the Hydrogen generator and launch pad.
- Ensure with the vendors that related ICT and data management process and quality control and assurance mechanisms are in place.
- Incorporate the two planned ASECNA upper air stations (Fig 2 - Green Stations) into GBON once installed.
- Purchase consumables.
- Hire and Train relevant personnel

The proposed phases of investment above, represented in Fig 3, should be accompanied with a full plan detailing the type of stations, the parameters observed, their maintenance strategy and costs for implementation for various components; a proper maintenance strategy should be developed in collaboration with the manufacturer. The Implementing Entity, supported by the Peer Advisor, will be in charge of the tendering processes based on the WMO guidance.

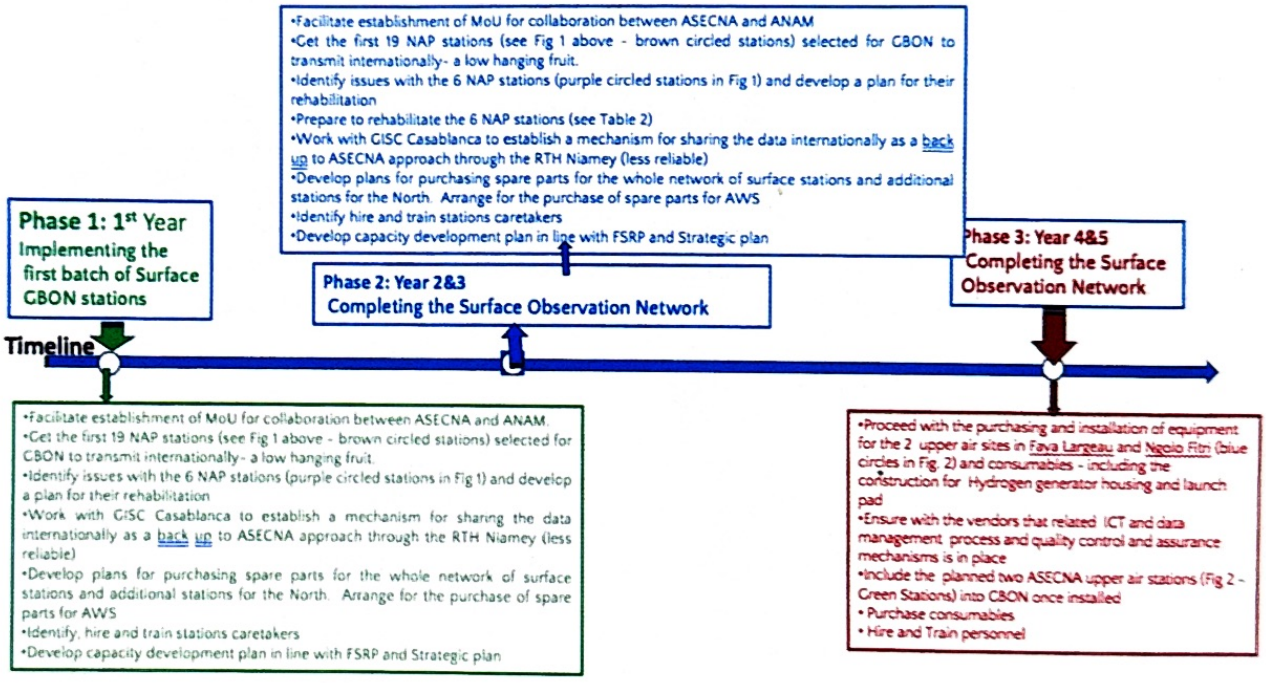


Fig 3: Roadmap to GBON compliance - Investment phases

3.2. Design of the ICT infrastructure and services

ICT infrastructure and services will be based on the system planned for deployment by the PILIER project in the establishment of the hydrometeorological operational forecast centre (2024-2025 time frame). The IT architecture includes servers to equip a data centre with associated software for data management. The proposed ICT infrastructure can be seen in Fig 4 below:

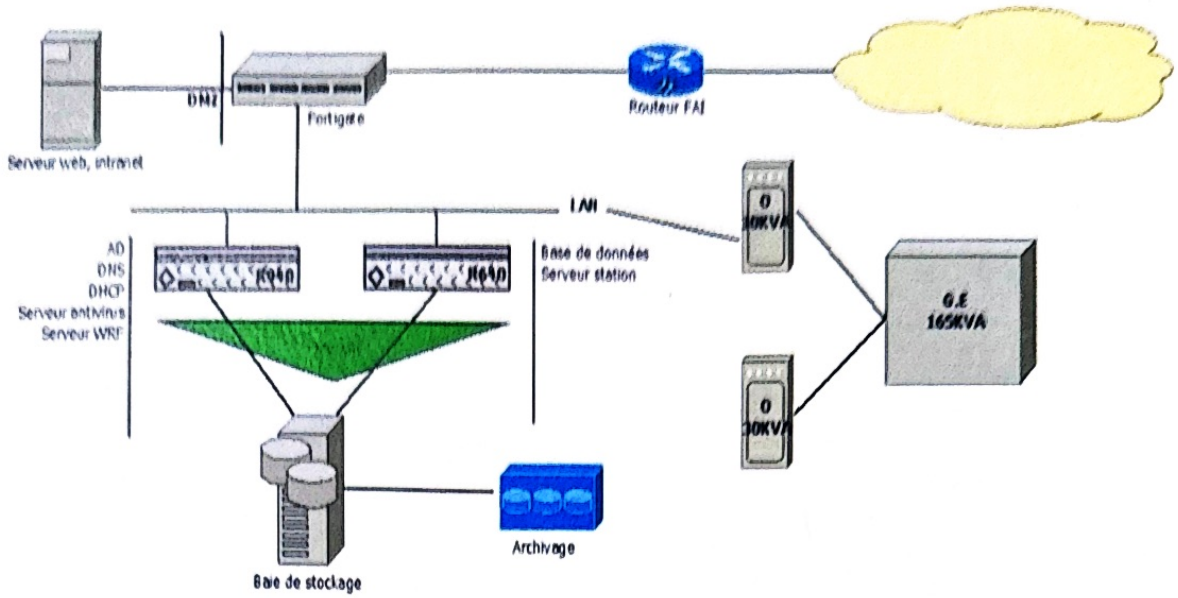


Fig 4: Planned IT architecture under PILIER Project for the Hydromet operational centre,

ADCON AWSs installed in Chad operate currently with SIM cards from two cell phone providers (Airtel and MovAfrica). Data are currently provided through this channel from the stations to ANAM servers but are not transmitted internationally. This will be addressed by the CREWS project and this capacity will be further expanded by the PILIER Project. Additional stations provided by SOFF in the north should consider the use of EUMETSAT Data Collection Services (DCS) for the data collection and transmission to international network through WIS. The use of DCS is preferred in the north because of the limited cell phone network. The IT infrastructure planned for PILIER includes comms center, Databases and archive system, servers and necessary software for data management.

3.3. Design the data management system

As mentioned in paragraph 3.2 above, the PILIER-funded hydromet operational centre will be equipped with servers for hosting and running the data management systems, the database as well as data visualization system (forecaster workstations). The proposed infrastructure will allow ANAM to access international data as well as to share its own. Details of the equipment and technical specification can be seen in Annex 2, an extract of the full proposal of the ICT system under PILIER and which can be found here. Basically the database will reside on a highly redundant and secure storage service easily accessible by WIS 2.0 when it becomes available in 2024 to transmit data internationally, noting fiber optic for internet is already in place at the ANAM.

3.4. Environmental and sustainability considerations

Current stations are all fenced and installed in locations where they are secured from vandalisms and not interfering negatively with the environment. Additional stations shall have similar characteristics, in particular being easily accessible to ensure their maintenance. However, consideration should be given to secure at least a couple of 4 x 4 vehicles to be used to visit the observation sites for maintenance activities. Spare parts and qualified technicians should be secured to ensure quick reaction\intervention to fix problems with the stations without delays. A governmental commitment in ensuring that ANM has the means to look after the stations is crucial for continuing the contribution of Chad to GBON. Finally, aspects of flooding and severe weather shall be taken into account during

the planning phase, trying to avoid that newly constructed stations are frequently affected by adverse weather conditions.

Module 4. GBON Human Capacity Development Module

4.1. Assessment of human capacity gaps

ANAM has a total staff of 21 people, who are located in the Capital and they are divided as follows:

- Management: 5 Engineers including the Director General, his Deputy and 3 Directors.
- Forecasting: 5 Meteorologists
- Technical support staff: 5 technicians of which 4 support Agrometeorological/climate and forecasting activities, leaving only one for the maintenance of stations. One of the technical staff is a female.
- General support staff: 8 including secretariat staff, HR and Finance officers and a guardian.

As it can be seen, there is no dedicated IT expert available. The staff number is rather on the high side regarding management functions, but too small to sustain forecasting and maintenance functions. An effort is required to hire and train new forecasters and maintenance technicians. The draft 2023-2028 strategic plan calls for a total staff of 70 including at least 7 operational meteorologists and 6 maintenance technicians.

4.2. Design capacity development activities for technical staff

Capacity development is one of the Pillars of the draft strategic plan 2023-2028 of ANAM. Human Resources plans and staff retention programs should be developed and acted on as soon as possible. In doing so, ANAM should capitalize on the opportunities offered by the CREWS, PILIER and FSRP projects to hire and train the required personnel. Workshops should be facilitated and participation in various training workshops of the Severe Weather Forecasting Program (SWFP) of Central Africa should be encouraged. The deficit in the number of technicians should be addressed as a priority, considering the number of operational AWS requiring continuous maintenance. It is also recommended to hire two IT specialists in the mid-term.

The training plan should, at a minimum include:

- **Weather observations and weather parameters:** this training should offer the fundamentals to move towards station operations. It should provide a basic understanding of the siting criteria for observing stations, including WMO CIMO standards, and give a basic understanding of the parameters that are critical, their interrelations and basic meteorological background information with a focus on observations and guidelines, functionality and fundamental principles, maintenance of mechanic and electronic components (rules and procedures), data collection, storage (data logger) and general concepts of data transfer.
- **Station components and maintenance:** conducting weather observations, maintenance and operations of stations both manual and automatic. These trainings should also be offered to those individuals located at or near the station location for easier maintenance and operations. Additional technicians should be recruited based on this training, with a minimum of 2 to cover the 16 stations targeted in GBON. The operations and maintenance should also include the

managerial aspects on generation of SOPs and checklists. Very important to highlight and focus on in-situ maintenance, maintenance of mechanic and electronic components

- **Calibration:** Although calibration is not required for automatic stations, it is important to train the technicians in this technical field as well, considering some conventional weather stations still are in use. This training should be performed in cooperation with the WMO Regional Instrument Centre of Casablanca (Morocco) and should include a visit to this center. The calibration plan and training should exploit the capacities deployed in SOFF through the small set of manual stations and the AWSs. It is particularly relevant that the role of calibration is explained and embedded into procedures downstream and all maintenance aspects that will require this knowledge.
- **IT, ICT and potentially HPC or cloud services**: the lack of IT personnel will need to be addressed with at least two IT experts to handle all aspects relates to communication, server operations (Hydromet operation centre) and similar services. They may also facilitate the in-house programming of simplified but effective data quality and data management procedures. This training should include Ubuntu, Linux, docker and Python at a minimum. The training should work on configuration and administration of hardware (server, networks, clients) and software (operative systems, databases, communication)
- **Data transfer and WIS2** specific training: this will be coordinated with CREWS which will address the deployment of WIS2 in a box system for the international transmission as well as for the additional capacities the tools has to offer that can assist in other activities of ANAM.
- **Best practices in data quality and quality management:** this should support the IT training to enable that there is a quality management system in-house that can evolve according to ANAM needs. This training should offer knowledge of the value chain and its components where QM is needed, as well as usability of benchmarking.

4.3. Design capacity development activities for senior management

Senior management development is a very important endeavor to ensure the complex processes of the weather service are managed efficiently and effectively in order to deliver on its mandate. It is therefore recommended that ANAM Managers participate in various management trainings, such as the Executive Training Programme on Leadership and Management, offered by WMO to Managers of NMHSs. Managers should also consider getting, on their own, proper training on Project management and human and financial resources management available online and at some Universities. Therefore, the capacity development of weather service managers should focus on:

- Developing leadership skills, including strategic thinking, decision-making and communication.
- Change management, especially in the evolving nature of SOFF; it is important to gather the skills to lead and manage change within the organization and its staff members.
- Financial training and financial management and budgeting. Managers need to familiarize themselves with financial statements, resource allocation and the financial implications of the decisions taken.
- Project management training and Measurement and evaluation through the definition of key performance indicators to assess the effectiveness of the activities.
- Strategic planning and regional networking, especially within the UN arena to develop action plans that have cross-sectorial approaches and optimize networks to achieve strategic national objectives.

- Enhancement of the communication skills of the future spokesperson of the organization and to establish the high-level dialogues required and drive decisions towards the organization's strategies.
- Dedicated Media training
- Technology and digital literacy, to leverage technologies as required.

More specifically the training should include the following components

- An exchange to benchmark with another well-established weather service: taking advantage of the collaboration with the Peer Advisor institution visits to WMO and GeoSphere Austria facilities to exchange best practices.
- Exchange with WMO ETR to identify training activities on management. Potentially participate in Senior Management Capacity Building courses.
- Training on project management: identify a course (remote) to establish a basic knowledge of administrative skills for project management and KPIs.
- Financial training: to gather the expertise and tools to handle the costing of projects, budgets, and basic day-to-day operations of a weather service.

4.4. Gender and CSOs Considerations

Civil Societies Organizations (CSOs) which could include community-based Organizations and Non-Governmental Organizations (NGOs) are, in most cases, the recipient of weather services to support their activities. They need, therefore, to be considered in weather-related outreach programs. SOFF's key objective is the improvement of warnings of high-impact meteorological events whose impacts are exacerbated on most vulnerable people (gender, elderly, sick ones). CSOs constitute the best conduits in reaching out to these most vulnerable people. Within the investment phase, it is recommended to make use of the stakeholder engagement workshops to include a specific dialogue platform for the CSOs addressing gender opportunities while at the same time advocating for the rights of marginalized groups and more vulnerable individuals. For examples women organizations, Priests and Imams would be invited to these workshops to increase sensibility and understanding of the local communities on the importance of the data collected from the system for their safety, decision-making and food security and potential role they could play in securing the availability of data (e.g., caretaker role to reduce vandalism). The outcomes of the workshops are to be included as formal recommendations for the SOFF activities and be used as guidelines to promote equity and equality. To this aim, an initial dialogue, with the International Federation of the Red Cross and Red Crescent and its Anticipatory Action as well as with UN Women, will be established to act as a community liaison for these activities. It is also recommended to establish outreach activities with secondary schools and Universities to encourage women to embrace a profession in meteorology and climatology. ANAM will also seek opportunities to develop internship program to increase women and youth interest in meteorology.

Module 5. Risk Management Framework

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

Chad does not have a risk management framework in place but a proper management of risks is required during and after the SOFF investment phase to prevent potential setbacks and to adapt as much as possible to an emerging risk. In addition, understanding the role of the Implementing Entity, the risk management should follow the internal approaches existing at IE and that will facilitate the execution of the investment phase. Chad has a government in transition with a referendum on the type of estate occurring in December 2023 and a General election expected by December 2024. It is anticipated that things will go smoothly, otherwise it may be difficult to impossible (armed opposition is on standby) to implement the project.

The table below describes the most critical risks that may be encountered to be added to those presented in the business model selection.

Risk	***Risk level***	***Likelihood***	***Impact***	***Risk Mitigation Measures***
Non-compliance with fiduciary and procurement standards in some SOFF activities	*Medium*	*Possible*	*Major*	*Support by IE.*
SOFF-funded investments cause environmental or social impacts	*Low*	*Unlikely*	*Minor*	*No major impact expected here.*
NMHS staff depart after being trained	*High*	*Likely*	*Major*	*Adequate payment, equipment and working space needed.*
Slow implementation and delays in procurement, installation and capacity building activities	*High*	*Likely*	*Major*	*Strong support by IE, realistic planning needed.*
After the conclusion of the Investment phase, GBON data are not collected or shared or are shared of insufficient quality	*Medium*	*Possible*	*Major*	*Before the start of the investment phase, a legal framework and national strategy for ANAM are needed. Ensure telecom subscriptions are valid*

Destruction or theft of SOFF-financed equipment and infrastructure	*High*	*Likely*	*Major*	*Station deployment close to populated areas and existing infrastructure. Ensure availability of caretakers who are paid regularly; reach out to local communities*
Countries cannot make optimal use of data, including accessing or using improved forecasts products from the Global Producing Centers throughout the hydromet value chain	*High*	*Possible*	*Moderate*	*Management training and training plan.*
Meteorological conditions that affect the deployment activities by limiting accessibility to sites and constructions as needed.	*Medium*	*High*	*Major*	*Adaptation of the timings and flexibility in the phased approach fulfilling the milestones consecutively. Take into account meteorological conditions in the planning phase*
Limited availability of potential staff members to be trained to ensure full operations of the network.	*High*	*Moderate*	*Major*	*Ensure a sufficient number of staff is secured and the training plan is followed; outreach to secondary schools and higher education facilities*

Module 6. Transition to SOFF investment phase

The transition to the SOFF investment phase is to be based on the Readiness Phase deliverables and, in particular, this NCP that has been drafted in coordination with the beneficiary country and the implementing entity.

Summary of GBON National Contribution Plan

Provide summary of GBON National Contribution Plan by filling this table

Components	Recommended activities
Module 2. GBON business model and institutional development	1. ANAM and ASECNA to sign an agreement for the exchange of data between them and with international communities as well as for the maintenance of the stations.
	2.WMO to negotiate with ASECNA to include in their purchase process SOFF-funded consumables and spare parts
	3. Agreement with ASECNA for ANAM staff to participate in ASECNA Training sessions
	4. Work with the WB FSRP to train meteorological Engineers and technicians
	5. Govt to clarify ANAM Legislation on data policy and to allocate additional resources (Financial and HR) to ensure adequate operations of ANAM
Module 3. GBON infrastructure development	1. Initiate the phased approach for implementation: Phase 1:1: Implementing the first batch of Surface GBON station; Phase 2: Completing the Surface Observation Network and planning the installation of upper air sites; Phase 3: Completing the upper air network
	2. Use the ICT infrastructure and services of PILIER in support of data management
	3. Initiate stakeholder engagement activities to promote engagement, seek for business opportunities and generate an advocacy platform for ANAM activities and role as a national critical infrastructure.
	4. implement WIS 2.0 as soon as available
	5. purchase a vehicle for the maintenance of stations
Module 4. GBON human capacity development	1. Establish a tailored technical training plan for the current and expected staff
	2. Initiate training on higher management aspects including an exchange visit at the Peer Advisor facilities and WMO in Geneva.
Module 5. Risk Management	1. Through the Implementing Entity and supported by the Peer Advisory and Beneficiary Country, monitor the evolution of the investment phase through the identified risks and initiate mitigation actions as required.

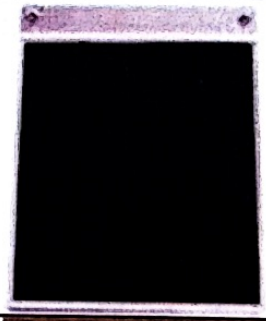
	2. Inclusion of reputable institutions through coordination of the Implementing Entity to assist in the execution of the investment phase.
Module 6. Transition to SOFF investment phase	Transition performed in a coordinated manner with the beneficiary country, the implementing entity and the peer advisor following the agreed National Contribution Plan. The funding request will be also based on the activities agreed in this National Contribution Plan.

Annex 1

ADCON AWS SPECIFICATIONS

Item	PARTS	unit	PICTURES
	A764 3G/4G Series 6 "Configuration RTU Mounting Kit A75x"		UNDP STATION in SAHR
	carte SIM- Standard 40mm Pole. Radio antenna option Adcon antenna GSM Quad TNC con A514 Modbus Model No A514 - Without SIM card-	1	
	Solar Kit 9VDC, 540mA, 5W	1	
	Set of telescopic poles 10m, Alu, thickness 2mm + Pliers Jeu de perches télescopiques 10m, Alu, épaisseur 2mm +	1	
	nippers		
Complete system of Synoptic meteorological station - various components	Set of guy wires for the 10m telescopic pole set	1	
	Lightning protection kit for a set of 10m poles	1	
	Foldable mast base for 10 m telescopic mast, steel	1	
	galvanized.		
	Câble de rallonge 8m, 7 à 7 broches. f. capteur w.Binder	1	
	Base de mât pour le mât télescopique	1	
	Windsenset ADCON Pro10/2 with crossbar	1	
	Adcon TR1 Combined sensor 0-2.5V with cable + shield	1	

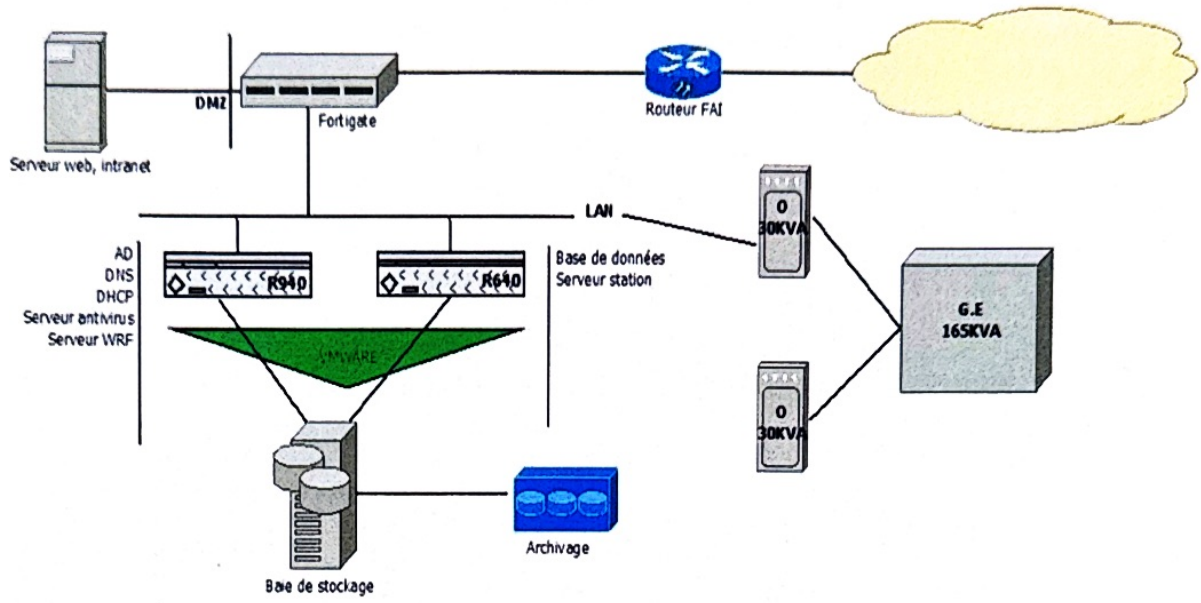
	SR11 Pyranometer with Amplifier Mounting Arm First Class, with 4.5m cable	1	
	Soil temperature profile probe at 100 cm, SDI-11 with 6 sensors	1	
	Adapter cable Soil temperature profile sensor 4 to 7	1	
	pins		
	ADCON Raingauge RG Pro 02 5m cable Housing and trough tilting (alum.) Collection surface: 200 cm^2. Resolution : 0.2mm. Intensity: 0...16 mm/min.	1	
	Câble d'extension 8m, 7 à 7 broches. Capteur F. avec liant	1	
	1m post for RG Pro galvanized steel		
	RG Pro Pole Mast Base	1	
	ADCON BP1 barometric pressure sensor. 500 - 1500mbar, 0.1-2.5V, 2m cable	1	
		1	
	7 pin Y cable 1xm/2xf	1	
	30cm heat and weather resistant cable ties		
	Protective plastic sheath	m	
	Worm gear pliers 70-90mm W	1	

RemoteTelemetry Unit (RTU)	Modèle : A64 GPRSDimens ion : 160 x 60 x 80mm Weight : Approx. 1200 g Item type : Data logger and modem cellular Sensor interfaces : 12 analogs 4 pulses 40 SDI sensors Data memory: 16 MBs Data transmission: GSM/GPRS SIM card size: Regular "mini" Cable connector: 7-pin Binder jack Power source: Solar and battery	Kit	
Solar Panel	Uoc : ~ 11,2V Umpp : ~9,4V Isc : 578mA Lmpp : 540mA Crete: 5,11W (±3%) Connector : male 5-pin Binder Dimensions : 210 x 164mm	1	
Battery Pack	Model: ADCON Type: nickel metalhydride Nominal Voltage: 1.2V Total Voltage: 6.0V Rechargeable: Yes Capacity: 3300 m/Ah	1	

Annex 2

Extract from the full ICT system proposal under PILIER

III.4 Spécifications techniques du Datacenter



Le Datacenter devra être composé de trois parties :

- Une première partie qui va regrouper les onduleurs et le système, de climatisation ;
- Une seconde partie qui va abriter les armoires rack ;
- Et une salle énergie qui va abriter le groupe électrogène et le réservoir de carburant.

a) Architecture physique du Datacenter

Le Datacenter doit abriter également les systèmes ci-dessous :

- Système de sécurité incendie ;
- Système de surveillance environnementale ;
- Système de vidéosurveillance sur IP ;
- Système de contrôle d'accès biométrique

III.5. Architecture réseau du Système d'information

Pour assurer la connexion sur internet du personnel et des serveurs abritant les systèmes et modèles météo, une ligne spécialisée ou fibre optique de 30Mo sera installée au sein du Datacenter avec une bonne gestion de la bande passante.

La bonne politique de sécurité sera configurée au sein du pare-feu pour favoriser les connexions sur internet des sites et systèmes météo internationaux. Les sites d'informations seront aussi autorisés mais les vidéos notamment sur YouTube ou film et téléchargement seront bloqués aux heures de travail.

Le système d'information abritera aussi une baie de stockage pour le stockage des données météo. Un logiciel de sauvegarde sera déployé avec un serveur de d'archivage qui va compresser toutes les données et systèmes météorologiques.
Ce logiciel de sauvegarde permettra de restaurer tous les serveurs et données de façon instantanée.

a) Spécifications techniques des serveurs

- Un serveur PowerEdge R940

Un Serveur PowerEdge R940 qui sera abritera les serveurs deL'architecture proposée sera composée de deux serveurs qui seront déployés dans une plateforme virtuelle. L'un des serveurs va comporter plusieurs qui vont gérer l'authentification, la protection antivirale et autres services ; Cet hôte va compoter les serveurs ci-dessous :

- Serveur contrôleur de domaine
- Serveur d'antivirus ;
- Serveur DNS et DHCP
- Serveur de collecte des données issues des stations météorologiques ;
- Serveur base de données CLIDATA

L'autre hôte doit disposer les serveurs qui vont héberger les bases de données et système :

- Serveur base de données CLIMSOFT ;
- Serveur web.

Pour gérer la sécurité du système d'information, un boitier Fortigate sera installé comme firewall pour gérer le filtrage web et le filtrage réseau. Cet équipement permettra de créer une zone dématérialisée ou sera installé tous les serveurs web qui seront visible de l'extérieur.

Base de données et systèmes météorologiques avec les caractéristiques techniques ci-dessous :

Spécifications	Description	Quantité
Format	**Rack**	
Processeur	Intel® Xeon® Platinum 8280L 2.7G, 28C/56T, 10.4GT/s, 38.5M Cache, Turbo, HT (205W) DDR4-2933	02

Mémoire	64GB RDIMM, 2933MT/s, Dual Rank	10
Disques	800GB SSD SAS	03
Management	iDRAC9 Enterprise with OpenManage Enterprise Advanced	
NVME	1.6TB, NVMe, Mixed Use Express Flash, HHHL AIC, PM1725b, DIB	04
Carte réseau	- 01 x Intel i350 Quad Port 1GbE BASE-T, Rndc - 02 Emulex LPe31002-M6-D Dual Port 16Gb Fibre Channel HBA	
Garantie matérielle	03 ans	

-Un serveur PowerEdge R640

Un serveur PowerEdge R640 qui abritera le serveur contrôleur de domaine, le serveur d'antivirus, le serveur DNS, DHCP et le Serveur de collecte des données issues des stations météorologiques avec les caractéristiques techniques ci-dessous :

Spécifications	**Description**	**Quantité**
Processeur	Intel® Xeon® Gold 6148 2.4G,20C/40T,10.4GT/s,27M Cache,Turbo,HT (150W) DDR4-2666	02
Mémoire	32GB RDIMM, 2666MT/s, Dual Rank	02
Disques	300 GB SAS	03

Management	iDRAC9 Enterprise with OpenManage Enterprise Advanced
Carte réseau	- 01 x Intel i350 Quad Port 1GbE BASE-T, rNDC - 02 x QLogic 2562, Dual Port 16Gb Optical Fibre Channel HBA, Low Profile
Garantie matérielle	03 ans

- serveur HPE ML350 Gen10

L'ANAM dispose d'un serveur HPE ML350 Gen 10. Ce serveur sera utilisé pour gérer la base de données CLIMSOFT et un serveur web pour la diffusion des informations météorologiques.

b) Baie de stockage Unity 380 XT

L'architecture de stockage hautement redondante qui sera connecté aux serveurs en FC.
La solution proposée devra garantir la haute disponibilité et capable de supporter sans impact sur le fonctionnement des machines virtuelles. La configuration matérielle doit être redondante et permettre le remplacement à chaud des éléments de stockage, des blocs d'alimentation, des contrôleurs de stockage.
L'offre de stockage SAN dans son dimensionnement et sa technologie doit être en adéquation avec les besoins de l'ANAM.

Caractéristiques	Désignations
Type de baie	SAN Hybride
Modèle	Unity 380 XT
Disque Min/Max	6/500
Nombre de contrôleurs	02
CPU	2 x Intel CPUs, 12 cores per Array, 1.7GHz
Mémoire	128 GB
Stockage	04 x 800 FLASH SYSPACK 14 x 1.6TB FLASH 3
Max Lun	150 disques maximum

Taille Max Lun	256 TB
Taille Max File System	256 TB
Max Snapshot	1000
Protocoles supportés	Fibre Channel NFS iSCSI
Connectivité	4 ports FC 16 GB / contrôleur 4 ports ISCSI / contrôleur
Garantie	3 ans

c) Rack et accessoires

L'ensemble des serveurs sera installé dans une armoire avec panneaux latéraux de type NetShelter SX 42U mm de largeur x 1070mm de profondeur.

Caractéristiques minimales :

- Hauteur: 42U
- Profondeur: APC 2X1X16 IP KVM with APC 17" Rack LCD and USB VM Server Module Bundle
- Portes: Perforées à l'avant et à l'arrière
- PDU: 2 modules PDU rackable

d) Licences OS

Les licences pour les systèmes d'exploitation ci-dessous seront nécessaires à la configuration de la plateforme :

Description	**Quantité**
WinSvrSTDCore 2019 FRE OLP 16Lic NL CoreLic	02
VmWare et vSphere derrière version	01
Veeam	01

e) Plateforme de sauvegarde

La plateforme de sauvegarde devra être basée sur une solution intégrée (appliance plus solution de sauvegarde).

Ci-dessous les spécifications techniques attendues :

Spécifications Techniques pour l'Appliance de Sauvegarde intégrée	
Specifications	**Exigences**
Format	• Appliance Physique rackable 2U • Prête en usine pour accélérer le déploiement et simplifier l'utilisation quotidienne.
Interfaces	• Min 8 ports réseau Ethernet 10 Gbps.
Capacité de stockage	• 8TB utile, extensible à 96TB graduellement par palier d'espace disque et ce par simple activation de licence La solution doit permettre le Tiering vers le Cloud jusqu'à 280TB.
Mémoire	• 192 GB Minimum
Performances	• Disques NVMe pour les Meta Data. La solution doit avoir une performance de sauvegarde de 9TB/h avec un ratio de déduplication pouvant être garanti par le constructeur • La solution doit stocker toutes les données dans un seul pool dedéduplication.
Protocoles	• Support de NFS, CIFS simultanément • Offrir un protocole d'accélération de la sauvegarde avec répartition du processus de déduplication entre les nœuds de sauvegarde et la baie desauvegarde.
Déduplication & Compression	• Déduplication à la volée. Déduplication à longueur de segment variable pour optimiser l'espace de stockage. • Compression et déduplication pour l'optimisation de stockage.
Redondance	• Les éléments hardware de la solution tel que disque, Alimentations doivent être remplaçables à chaud. • La solution doit permettre la tolérance à la panne de deux disquessimultanément.

Sécurité	• Cryptage à la volée pour renforcer la sécurité • Verrouillage des fichiers contre l'édition. • Conformités aux standards internationaux de sécurité et rétention à long terme
Chemin vers le Cloud	• La solution doit permettre nativement le Tiering des données vers le cloud publique/privée.
Opérations	• Effectuer les sauvegardes et réplication simultanément. • Sauvegarde des systèmes Unix, Windows et Linux • Sauvegardes des bases de données Oracle, MSSQL, Mysql, MongoDB, Informix, SAP, SAP Hana.. • Sauvegardes des environnements virtuels VMware, Hyperv, et KVM • Fournir des mécanismes pour simplifier les tests « Disaster Recovery». • Fournir des mécanismes pour assurer l'intégrité des données. • La solution doit permettre d'effectuer des sauvegarde et restaurations même pendant les fenêtres de maintenance. • Intégration avancée avec Oracle RMAN, MSSQL Studio, et SAP Studio directement avec ou sans l'outil de sauvegarde. • La solution doit permettre un accès instantané de plusieurs Machines Virtuelles sur la mémoire NVMe de l'Appliance. • Possibilité de sauvegarder les environnements physiques etvirtuels et avoir une seule et unique interface de management HTLM5
Réplication	• Possibilité de Controller la réplication des VM et des sauvegardes. • supporter les topologies de replication: One to One, One to Many, Many to One, Many to Many...
multi-tenancy	• La solution doit fournir la fonctionnalité de « Secure Multi- Tenancy » pour l'isolation des données. • Permettre plusieurs rôles pour l'accès
Administration	• La solution doit fournir une interface de gestion Web avec un accès en SNMP pour le monitoring à distance. • La solution doit inclure un outil de monitoring avancé et reporting de la capacité physique utilisée pour une bonne gestion de Capacity Planning • La solution doit inclure un mécanisme de recherche multicritère dans le catalogue de sauvegarde.

Report completion signatures

Peer Advisor signature Andreas Schaffhauser
Beneficiary Country signature 
WMO Technical Authority signature