20.05.2024

GBON National Gap Analysis

Systematic Observations
Financing Facility

GBON Gap Analysis Report

Chad

Weather
and climate
data for
resilience

Screening of the National Gap Analysis (NGA) of Chad

WMO Technical Authority screens the GBON National Gap Analysis to ensure consistency with the GBON regulations and provides feedback for revisions as needed. *The screening of the NGA is conducted according to the SOFF Operational Guidance Handbook, version: 04.07.2023 and the provisions in Decision 5.7 of the SOFF Steering Committee.*

Following iterations with the peer advisor and beneficiary country, WMO Technical Authority confirms that the National Gap Analysis is consistent with GBON regulations.

Date: 21 May 2024

Signature:

Albert Fischer

Director, WIGOS Branch, Infrastructure Department, WMO

Beneficiary Country Focal Point	Mr. Sakine Youssouf Batchomi, Agence Nationale de la Météorologie (ANAM)
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WMO Technical Authority	

1. Country information from the GBON Global Gap Analysis

In June 2023, the WMO GBON Global Gap Analysis conducted (Table 1) revealed that Chad was suffering from major limitations in its observational network, with only 1 out of 33 surface stations (low-resolution) and no upper air capacity. However, during the last two years, through an UNDP project, 54 new automatic weather stations (AWS) were installed. More 16 stations should be added until September 2023, bringing the total number of new AWSs to 70. While the number of stations deployed in this project may be an asset, there are some concerns regarding them as will be detailed in Sections 2 and 3 below.

Considering the present country state, it appears that, through a well-structured and gradual process, Chad could fulfil the surface GBON (low-resolution) compliance in the central and southern parts of the country. The northern parts of the Chad are more complex to address due to limited access and potential security issues. Thus, six locations were identified as having the potential to host stations, but these should be well evaluated and checked during the investment phase. With rehabilitating the existing stations as well as adding new ones, Chad would be able to reach a full low-resolution GBON compliance.

The two existing upper-air stations, in N'Djamena and Sarh, which use hydrogen as the lifting gas, are not currently operational due to technical reasons (lack of consumables, awaiting for restocking, and issues with hydrogen generator, all being addressed). They belong to ASECNA (Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar), a private company providing meteorological services to the aviation industry.

ASECNA is planning to add additional 3 upper-air stations in other airports in the future. In such a case, through the SOFF initiative, it will be required only to add a a single new upper-air station, in order to reach a full GBON-Compliance. This should go together with a contribution to the operation of the ASECNA stations.

However, since ASECNA's plan is still in discussions (currently, it seems that only one new upper-air station has the better chances to be realised), the peer advisor, together with ANAM,

has identified two possible locations for fully funded SOFF stations to serve as a substitute for the non-realised ASECNA stations.

Currently, Chad is quite close to achieve a low-resolution GBON-compliance. Investments in the already existing network, together with a potential addition of stations in the north of the country, could lead to a substantial increase in the availability and reliability of the observational data. This will result in improvement of the quality of global NWP models outputs including products and forecasts at national and regional level.

Table 1.WMO GBON Global Gap Analysis (provided by WMO, June 2023)

GBON horizontal resolution requirements	GBON target	Reporting	Gap improve	Gap new	Gap total
Surface stations Horizontal resolution: 200km	33	1	32	0	32
Upper-air stations Horizontal resolution: 500km	6	0	2	4	6

2. Analysis of existing GBON stations and their status against GBON requirements

Surface

Until 2021 Table 1 would have properly reflected the situation in Chad. However, since 2021, through a major project, the National Adaptation Program, led by UNDP, additional 54 automatic weather stations (AWS) were installed but only below 14^0 Latitude, in the southern regions of the country. By the end of the project, in September 2023, 12 additional AWS will be installed also only in the southern and central parts. Therefore, the manual stations are replaced by new AWS that are able to become GBON compliant.

However, due to technical reasons (related to IT and being now looked after by an expert from the GISC Casablanca (Morocco)), data from these stations are not shared internationally through WIS. Another issue, a more lasting one, is the fact that the choice of the local positioning of these stations in the field was not done with the help of a meteorologist. Based

on experience, this leads to reasonable doubts as to whether the selected locations meet rules and regulations of WMO as to positioning of observing stations. During a mission conducted by the Peer Advisor focal point and a consultant in June 2023, the members of the mission visited a few new AWS physically. Whereas some of the AWS were well positioned, others could not be considered meeting WMO standards, particularly with respect to their exposure and representativeness. Only those stations meeting the standards should be considered for further activities and the generation of the National Contribution Plan.

Two of the stations, located in the two main airports (N'Djamena and Sarh) are run by ASECNA. However, these two stations are run in parallel to the new AWS of ANAM (located very closely to each other) and eventually should merge to single stations.

Upper-Air

The abovementioned ASECNA is running two upper-air stations in the two main airports (N'Djamena and Sarh), but currently the stations are experiencing technical issues (to be solved, hopefully, soon), but also their data is not yet shared internationally. ANAM, on the contrary, does not run any upper-air stations.

In summary, Table 2 shows the current situations of the stations (surface and upper air) and Table 3 presents the list of existing AWS with recommended stations for GBON, according to their geographical location, accessibility and maintenance feasibility. Unfortunately, the mission was not able, due time constraints, to visit all of the stations already installed (due to the vast distances between the stations and the underdeveloped road infrastructure). However, even with the relatively limited physical survey of seven of the stations, had shown that eventually, all of the stations should be checked physically during the investment phase (as part of the National Contribution Plan for Chad). Hence, it should be emphasised, that this choice is only a preliminary one. T. If any of these stations will not fulfil these standards, another station in their vicinity should be chosen instead.

Table 2. Assessment of existent stations per their operational status and network ownership

GBON Requirements	Existing observation stations (# of stations)			
	NMHS network		Third-party network	
	Reporting	Improve	Reporting	Improve
Surface stations Horizontal resolution: 200km Variables: SLP, T, H, W, P, SD	**54/0 (working, but the data does not reach the GTS)**	27	2	0

Upper-air stations Horizontal resolution: 500km Vertical resolution: 100m, up to 30 hPa Variables: T, H, W	0	0	2/0 (existing, but due to technical reasons, are temporary non-functional)	2

Table 3. Assessment of existing GBON stations per station characteristic. Proposed SOFF supported GBON stations have marked by blue.

Station name	Station type (S/UA)	Owner (NMHS/third-party)	Funding source	GBON variable measured						Reporting cycle	GBON Compliance (Y/N)
				SLP	T	H	W	P	SD		
Abdi	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Abéché	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Aboudeia	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Adre	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N

Amdam	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Am-Timan	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Ati	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Ba-Illi	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Bao	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Baro	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Bébédjia	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Bébédjia ITRAD	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N

Békamba	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Bessao	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Binder	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Bitkine	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Bokoro	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Bol	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Bongor	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Boumou	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N

Daguela	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Deli	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Djeddah	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Doba Aéroport	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Dona-Manga	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Dourbali	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Farchana	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Fianga	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N

Gagal	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Gama	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Goré	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Goundi	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Goun-Gaya	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Goz-Beida	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Guelend eng	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Haraze-Manguei gne	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N

Iriiba	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Kélo	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Kyabé CT	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Lagon	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Laï	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Larmana ye	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Léré	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Mailao	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N

Mangalmè	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X		hourly	N
Mani	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X		hourly	N
Massaguet	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X		hourly	N
Massakory	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X		hourly	N
Massenya	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X		hourly	N
Melfi	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X		hourly	N
Moissala	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X		hourly	N
Mongo	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X		hourly	N

Moundou Aéroport	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Moussaf oyo-ITRAD	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
N'Djamé na Aéroport	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
N'Djamé na Aéroport	U	ASEC NA	ASECNA		X	X	X			Currently non-operational, in the future, once a day	N
Ngouri	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Oum Hadjer	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Pala	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N

Sarh Aéroport	S	NMHS	UNDP (till Sep 2023)	X	X	X	X	X	X	hourly	N
Sarh Aéroport	U	ASEC NA	ASECNA		X	X	X			Currently non-operational, in the future, once a day	N

Notes: Assessment of existing GBON stations per station characteristics. Station type: S: Surface, US: Upper-Air; Owner of the station: NMHS or name of third-party; GBON variables: SLP: Sea-level pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; SD: Snow depth; Reporting cycle: Number of observation reports exchanged internationally per day (0-24); GBON compliance: weather the station is GBON compliant or not (see GBON guide on compliance criteria).

- **Remark**: during the visit of the mission, only seven surface stations and two upper-air stations were visited and, the rest should be checked, either by a visit or by constant monitoring of their measurements. The utilization of the latter stations depends on the actual functionality and level of representability, which cannot be evaluated at this stage. Thus, the choice of the stations for GBON is just a preliminary one that may be modified should additional leverage with other activities be achieved or based on practical and logistical criteria appearing in the discussions with the implementing entity at the time of preparing the Investment Phase.

3. Results of the GBON National Gap Analysis

Surface stations:

The existing network, as previously mentioned, includes fifty-four (54) stations, which plans to expand it to 70 by end of September 2023. The authors of this report have devised a recommended list of stations, which according to their location, accessibility and maintenance feasibility, might serve as GBON stations. However, it is not yet fully clear, which of these truly fulfils the WMO standard requirements, with exception of N'Djamena, Bongor, Kelo, Moundou, Doba and Sarh, which have been deemed suitable for GBON according to the mission's evaluation. For the rest of the stations, a specific check needs to be performed to ensure their suitability. This check could be performed only during and as part of the investment phase.

A major concern involves the fact that the UNDP project, responsible for installing all these AWS and thus providing the budget for their installation and maintenance is due to end in September 2023, whereas ANAM currently has no capacity to take this responsibility, and

continuating the operability and maintenance of those many stations. Nevertheless, ASECNA is ready to support the maintenance of the stations located at the airports (in return for a full real-time data sharing of all of the stations of ANAM). In addition, the ministry of Agriculture, through yet another project (Food Safety and Resilience Program), is willing to support the maintenance of AWS serving their areas of interest and establish synergies if possible.

In addition to all of the abovementioned challenges, additional challenges exist:

a. Security - especially of the stations located not in airports or governmental compounds.
b. Safety – of observers and technicians.
c. Limitations in consumables and spare parts - the UNDP project does not include consumables and, more importantly, spare parts. In addition, there is no adequate storage place for them.
d. Data communication and transmission - the data is transmitted through the cellular network, but ANAM might have no funds to continue and pay for these costs.
e. Men power – currently there is a lack of IT specialists and a very small team of technicians, which are poorly qualified.

Another major challenge, looking at Figure 1, is immediately identified – all the newly installed stations were installed south of latitude 14, thus leaving almost 35% of the territory of Chad virtually without any stations. The authors of this report suggest adding additional 6 stations in the north, to be located in airports, due to their relatively easy accessibility and safety. However, the detailed location and positioning of these stations should be performed as part of the National Contribution Plan and the funding request for the Investment Phase.

Upper-air station:

ASECNA does run two upper-air stations (At the N'djamena and Sarh airports), but it is currently facing some technical issues with running them that are being investigated. Nevertheless, ASECNA is planning to add yet another 3 upper-air stations at other airports, which might be used for GBON as well. In such a case, an instalment of an additional single upper-air station in Faya Largeau, together with a contribution to the operation of the stations of ASECNA, might bring Chad to become upper-air GBON compliant. Thus, 2 existing ASECNA stations, 3 new ASECNA ones and an additional ANAM new station.

Currently, it seems that there is quite a high chance for an ASECNA station in Amdjarass (in the north-east of Chad). However, it is still highly unclear, whether the plan for the other two stations will materialise eventually. In order to cope with this possible challenge, the peer advisor, together with ANAM, had identified two additional locations as possible substitues for these stations. In such a case, Pala might serve as the substitute for the location in Moundou and Ngolo (Fitri) for Abeche. The SOFF National Contribution Plan will be adapted accordingly. In any case, the plan is to bring Chad to have 6 fully-functional upper-air stations, covering, as much as possible, most of the territory of the country, as can be seen in Figure 2.

Table 4. Results of the GBON national gap analysis
SLP: Sea-level pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; SD: Snow depth

GBON requirements	Target (# of stations)	GBON Compliant stations (#)	Stations gap	
			New	Improved
Surface stations · Horizontal resolution: 200km · Variables: SLP, T, H, W, SD · Observation cycle: 1h	33	0	6	27
Upper-air stations · Horizontal resolution: 500km · Vertical resolution: 100m, up to 30 hpa Variables: T, H, W · Reporting cycle: twice a day	6	0	3	0

Table 5a. Recommended existing/new surface stations to be designated to GBON

Standard density surface network – GBON target			
Station number	Station location	Status	Deploying entity
1	Mangalmé	Installed, operational and	UNDP
2	Melfi		

3	Ati	handed over to ANAM. Not transmitting internationally yet.
4	Bokoro	
5	Pala	
6	Kélo	
7	Moundou	
8	Larmanaye	
9	Doba	
10	Goré	
11	Ngouri	
12	Kyabé	
13	Moissala	
14	Iriba	
15	Goz-Beida	
16	Aboudeia	
17	N'djamena	
18	Am-Timan	
19	Sarh	
20	Bongor Aéroport	Installed but non operational
21	Haraze Mangueigne	
22	Abéché	
23	Oum Hadjer	
24	Mongo	
25	Goundi	
26	Nokou	To be installed
27	Daguela	

28	Faya Largeau	To be installed	SOFF
29	Bardai		
30	Zouar		
31	Biltine		
32	Fada		
33	Koro Toro		

Table 5b. Recommended existing/new upper-air stations to be designated to GBON

Standard density Upper-air network – GBON target			
Stati on num ber	Station location	Status	Deploying entity
1	N'djamena Airport	Existing, currently non-operational	ASECNA
2	Sarh Airport		
3	Abéché Airport	Planned	
4	Amdjarass Airport		
5	Moundou Airport		
6	Faya Largeau Airport	Proposed	SOFF
3*	Ngolo (Fitri) Airport		
5*	Pala Airport		

* To be installed, in case that the station at Abéché will not be installed

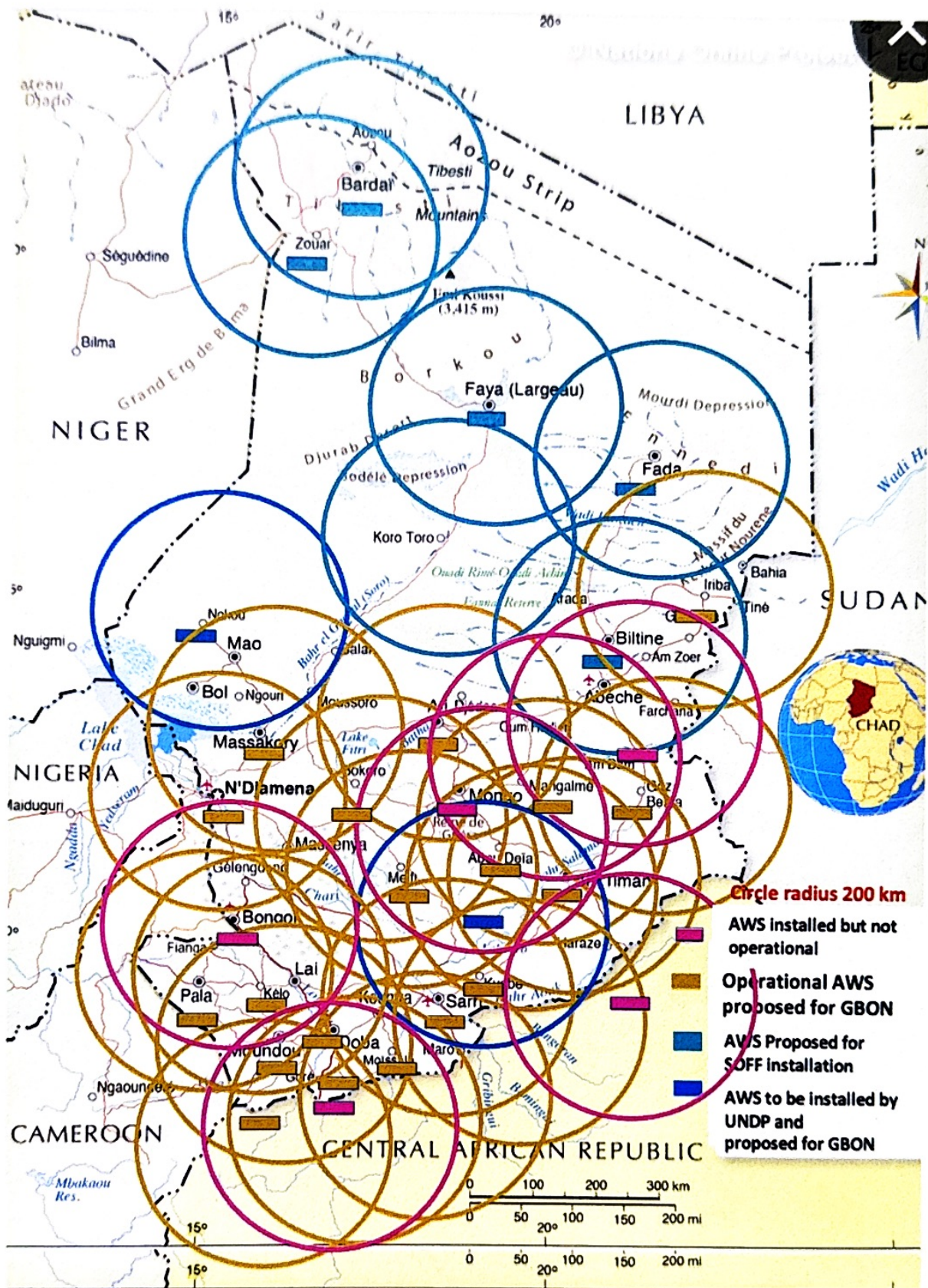** To be installed, in case the station at Moundou will not be installed

Figure 1. Map of existing surface stations and proposed surface stations (Existing, but not operational currently - Purple markers and circles; existing and operational – brown markers and circles; To be installed by UNDP – blue markers and circles; proposed for installation – teal markers and circles)
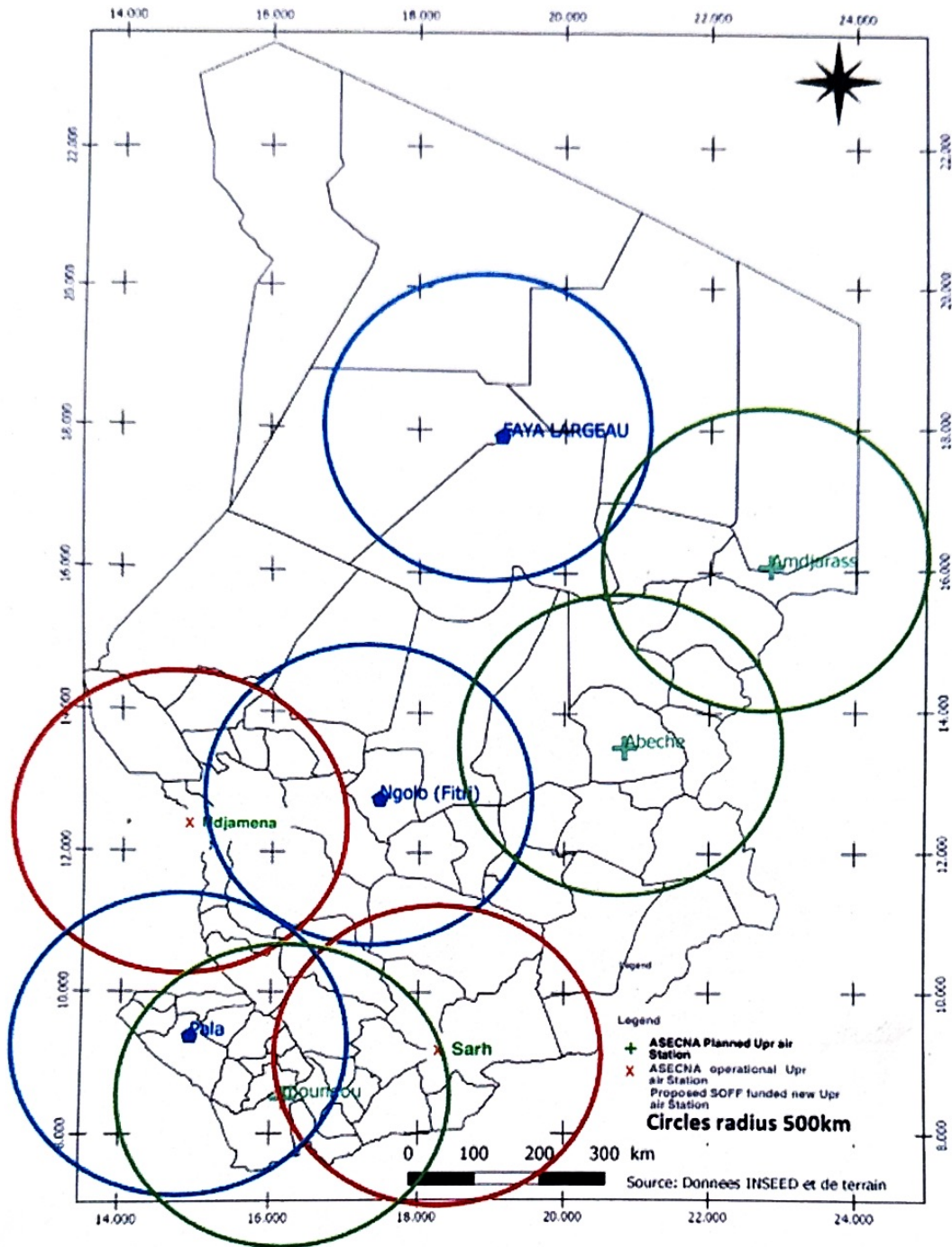
Figure 2. A map of the upper-air stations (existing, run by ASECNA – marked by red markers and circles; planned to be deployed by ASECNA – marked by green markers and circles; planned to be deployed through the SOFF initiative, Faya Largeau in any case, the other two only in case, the parallel ASECNA stations will not be installed – marked by blue markers and circles.)

4. Report completion signatures

Peer Advisor signature

Andreas Schofhauser

WMO Technical Authority screening remarks and signature

Beneficiary Country remarks and signature