18.08.2023

GBON National Gap Analysis

Systematic Observations
Financing Facility

GBON Gap Analysis Report

South Sudan

Weather
and climate
data for
resilience

WEATHER CLIMATE WATER

Screening of the National Gap Analysis (NGA) of South Sudan

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.

While the WMO GBON Global Gap Analysis identified the need for 16 surface land and 3 upper air stations, the **WMO Technical Authority confirms the NGA results which indicate the need for 16 surface land and 1 upper air stations at this stage based on specific national circumstances.**

Date: 27th Oct 2023

Signature:

Albert Fischer
Director, WIGOS Branch, Infrastructure Department, WMO

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Peer Advisor Focal Point and Institute	Mr. Giora G.H. Gershtein, GeoSphere Austria – Federal Institute for Geology, Geophysics, Climatology and Meteorology
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1. Country information from the GBON Global Gap Analysis

In January 2022, the South Sudan government's meteorological observational network was assessed by WMO evaluating its adherence to the standard practices of the GBON regulations. The outcome of this evaluation (summarised in Table 1) highlighted significant deficiencies. The network comprised a remarkable smaller amount of surface stations than the recommended quantity. In addition, it was affected by various limitations in meeting the necessary requirements. Moreover, the country lacked any upper air stations.

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

GBON horizontal resolution requirements	GBON target	Reporting	Gap improve	Gap new	Gap total
Surface stations **Horizontal resolution**: 200km	16	0	2	14	16
Upper-air stations **Horizontal resolution**: 500km	3	0	0	3	3

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

Based on the aforementioned gap analysis performed by WMO back in 2022, South Sudan's Meteorological Service (SSMS) operated three (3) surface weather stations. However, the more recent gap analysis carried out in 2023 by Geosphere Austria within the SOFF Readiness Phase activity, has revealed contrasting findings. Namely, one of the stations had been severely damage due to outbursts of civil unrest (the country has been affected by unrests since the independence in 2011 until 2018, however while it benefits of a rather

peaceful period since a few years civil turmoil occurs periodically). Consequently, there are only two (2) stations in South Sudan, both operated by the SSMS:

1. **Juba** surface weather station, located at the Juba International Airport: this station is a non-WMO standard AWS operating every day only during daytime and providing observations of all relevant meteorological parameters at hourly frequency. It is to be noted, that the previous manual station and WMO-standard-compliant AWS station are no longer operating;
2. **Wau** surface weather station: manual station operating every day only during daytime, providing observations of all relevant meteorological parameters on a 3-hourly basis.

In addition to the two (2) stations mentioned above, there are three sites which used to host manual surface stations also operated by SSMS (Figure 1). These stations are nevertheless affected by various limitations as follows.

- **Malakal** surface weather station: currently measuring only 2m-temperature and rainfall precipitation during daytime;
- **Renk** surface weather station: one observer is assigned to the station, but with no equipment after it being destroyed in connection with recent civil unrest;
- **Raja** (or Raga) surface weather station: currently with no observers and with the weather station partially damaged, again in connection with recent civil unrests.

No other national entity, public or private, is operating weather observations stations in South Sudan. It is to worth mentioning, that some United Nations (UN) organisations, e.g. WFP and FAO, are operating weather observation networks in the country. While these station networks will be considered in the implementation phase, it is important to highlight that they are not state-owned and that they can only be factored in if they are following WMO standards, and therefore are GBON-compliant. In addition, the future functionality of the network is also of concern. As already mentioned, no upper air stations are operated in the country neither there is capacity nor infrastructure for such systems.

Based on the information above, Table 2 presents the outcomes of the conducted observational network gap analysis and Table 3 illustrates the results of the assessment of the existing GBON stations per station characteristic. According to analysis, the current GBON surface stations are not fulfilling neither GBON horizontal spatial nor temporal low-resolution requirements. This analysis demonstrates that, de facto, the country does not fulfil the GBON requirements in any of the stations and requires significant investment with a detailed and well-designed national contribution plan to be brought up to GBON compliance.

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	**0**	**2**	**0**	**0**
Upper-air stations Horizontal resolution: 500km Vertical resolution: 100m, up to 30 hPa Variables: T, H, W	**0**	**0**	**0**	**0**

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		
Juba Intl. airport	S	NMHS	gov	x	x	x	x	x	x	Daytime hourly	N
Wau Intl. airport	S	NMHS	gov	x	x	x	x	x	x	Daytime 3-hourly	N
Malakal Airport	S	NMHS	gov		X			X		Daytime 3-hourly	N
Renk Airport	S	NMHS	gov							None	N

Raja Airport	S	NMHS	gov						None	N

** In Renk and Raja airports there used to be weather stations, however damaged and malfunctioning (or partially functioning) equipment is left to date. The observer, who was assigned to the Renk station for daytime observations, is still available. The observer, who was assigned to the Raja station for daytime observations, is no longer available*

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).

3. Results of the GBON National Gap Analysis

Surface stations

The existing network includes, as stated earlier, two (2) GBON non-compliant stations, whereas the basic low-resolution GBON requires a network of at least sixteen (16) stations, providing observational data with hourly frequency throughout the day. In order to reach a low-resolution compliance, it is suggested to first revive the stations in the existing five (5) observations sites and then proceed, with a corresponding sensible timeline and approach, with the installation of another eleven stations (11) as showed in Tables 4 and 5, as well as in figure 1.

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	16	0	**14**	**2**

Upper-air stations · **Horizontal resolution**: 500km · **Vertical** resolution: 100m, up to 30 hpa **Variables**: T, H, W · **Reporting cycle**: twice a day	1* (despite the need for 3 stations, at this stage of SSMS's, it is highly recommended to limit the investment in this direction and ensure first surface capacity)	0	3	0

Table V. Recommended existing/new surface, upper-air and marine stations to be designated to GBON.

Station name	Station type (S/UA/M[1])
Juba Intl. Airport	S
Juba Intl. Airport	UA
Wau Airport	S
Malakal Airport	S
Renk Airport	S
Raja Airport	S
Yambio Airport	S
Aweil Airport	S
Rumbek Airport	S
Kuajok	S
Torit Airport	S
Bor Airport	S
Bentiu Airport	S
Abyei	S
Pibor Airport	S
Pariang	S

The major current and future challenges to be taken into consideration when preparing the national contribution plan with sustainability as one of its principles include:

a. **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. To no lesser degree,

[1] Please see guidance on marine stations in Section 2 on Scope.

guaranteeing the safety of the relevant men power (observers and technicians) assigned to the stations is also a challenge.

b. **Maintenance and calibration** – There are no facilities and no equipment available. Moreover, the stations outside of the capital are difficult to access, due to both security and poor roads, which might in turn worsen during the rain seasons. Maintenance can also be affected by considered the lack of transportation means belonging to the SSMS.
c. **Consumables and spare parts** – there are none, currently at the SSMS. In addition, there is no adequate space to store such material in a secure way.
d. **Data communication and transmission** – the country is lacking a stable and widespread internet and cellular network across the country. This can hinder station deployment and data transmission.
e. **Men power** - currently, the SSMS has not enough observers. A manual station requires at least three (3) observers in order to function, when five (5) is a more sustainable number. Except Juba (having six (6)) and Wau (having three (3)), the rest have one (1) or no observers. The SSMS has no trained technicians to perform maintenance and calibration duties.
f. **SSMS budget** limitations– the operational budget of SSMS is just enough to cover the salaries of the current staff.

Upper-air station

No upper air stations are currently operated in South Sudan. While upper air stations are very relevant, the present very limited capacity of the organisation leads to the strong recommendation to firstly focus on the surface network. In the National Contribution Plan it will be explored how one upper air station could be deployed, likely at Juba airport. However, this significant investment, which requires substantial sustained resources (budget and personnel) is only advised once the surface network has reached an improved state. It is to be noted that upper air stations require much larger resources, robust infrastructure and skilled staff, which are currently largely beyond the current capacity of the SSMS.

Nevertheless, a first solution to this major gap might be addressed by establishing a procedure to get information already available on GTS from the neighboring countries, e.g., Ethiopia, Kenya, and Uganda weather services as well as initiating a dialogue with Ethiopia, Kenya and Uganda weather services and bordering SOFF countries for SOFF upper-air station deployment in bordering areas to optimize network deployment.

In the last phase of the proposed National Contribution Plan (NCP), a feasibility study for the implementation of upper-air stations, would be performed. The study will be initiated by a single upper air station at the Juba Airport.

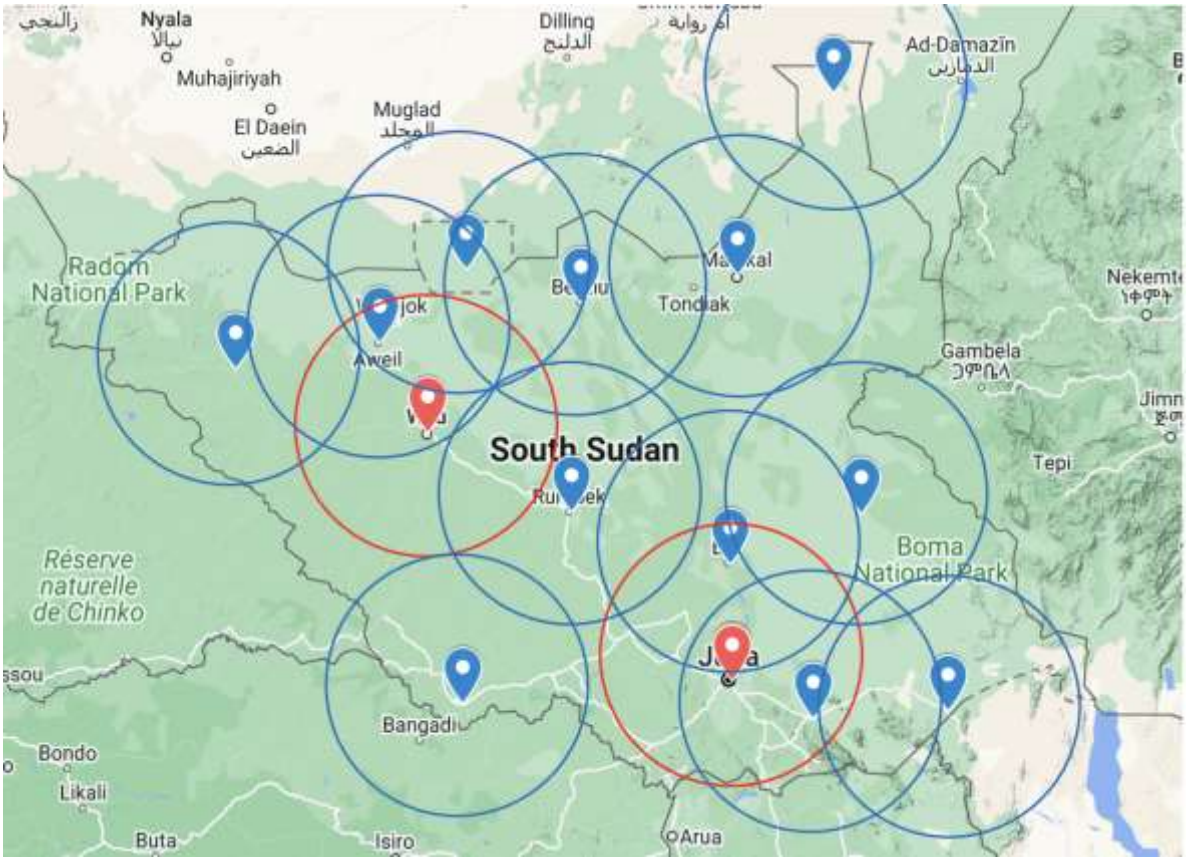

Figure 1. Map of existing surface stations (one at Juba and one at Wau airports marked with a red marker and red 200 km circles) and proposed surface stations (blue markers and circles).

As the SOFF scope is to bring the country to full GBON compliance, the gap analysis suggests that the challenges associated with the conditions of the current observational network, including the capacity to maintain and calibrate the equipment, need to be considered in the roadmap of actions for the investment/implementation phase within the SOFF initiative. This means that to build the foundations for a sustainable GBON-complaint observational network in South Sudan, a multiphase approach, consisting of deployment of manual and AWS stations in subsequent periods, alternated to capacity building intervention and efforts to build in-country training capacity and increase the staff deployed in governmental agencies, is the most realistic way forward to achieve the target.

It is estimated that minor improvements to the observation network would lead to substantially improved availability and reliability of observational data, with consequent improvement of the quality of global NWP models' outputs, thus reflecting on improved numerical weather prediction products, and weather forecasts and early warning at regional and national level.

4. Report completion signatures

Peer Advisor signature

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WMO Technical Authority screening remarks and signature

Beneficiary

Country remarks and signature

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