September 30, 2024

Systematic Observations Financing Facility

GBON National Contribution Plan

Democratic Republic of Congo

Systematic Observations
Financing Facility

Weather and climate data for resilience

GBON National Contribution Plan

Democratic Republic of Congo

ISO 3166-1 Alpha-3: COD

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Résumé executif en français

Ce document a été élaboré par l'Office fédéral de météorologie et de climatologie (MétéoSuisse) et l'Agence Nationale de Météorologie et Télédétection par Satellite (METTELSAT) dans le cadre du programme SOFF (Systematic Observations Financing Facility; `https://un-soff.org/`) de l'Organisation Météorologique Mondiale (OMM). Ce "Plan National de Contribution" suggère une série d'actions et d'investissements à effectuer afin que la République Démocratique du Congo (RDC) parvienne à être compatible avec les critères GBON (Global Basic Observing Network) de l'OMM. Ces critères, que la RDC s'est engagée à respecter lors du 18ème Congrès Météorologique Mondial en 2019, définissent des objectifs clairs concernant l'acquisition et le partage à l'international de données météorologiques essentielles (pression, température, humidité, vent, précipitation).

Ce plan propose en premier lieu une approche séquentielle pour les investissements SOFF en RDC. Il s'agît de procéder par étapes d'investissement de 24 mois au plus, chacune suivie de 12 mois de vérification, afin de permettre aux stations de mesure qui deviennent compatibles avec les critères GBON de rapidement transitioner vers la phase 3 du projet SOFF ("Compliance Phase"), lors de laquelle des fonds seront disponibles pour en garantir l'entretien sur le long terme. Au vu du nombre de stations à mettre en place pour atteindre une compatibilité GBON au niveau national (68 stations de surface, 12 stations aérologiques), il est ainsi proposé que la phase 2 et 3 du projet SOFF avancent en parallèle dans le cas de la RDC.

Le plan est constitué de 6 modules (objectifs GBON généraux - modèle d'affaires et dévelopement institutionel - dévelopment d'infrastructures GBON - dévelopement des capacités humaines - gestion des risques - transition vers la phase d'investissement) et cent trente recommendations distinctes, toutes listées dans le Tableau 3. Ce document est complété par une analyse des besoins GBON en RDC ("National Gap Analysis"), ainsi qu'un diagnostic complet de METTELSAT en tant que service hydro-météorologique national ("Country Hydromet Diagnostics"), tous deux disponibles en ligne sur le site du projet SOFF[1].

Ce plan est destiné à servir de base aux demandes d'investissement SOFF, qui seront rédigées par l'entité d'implémentation ("SOFF Implementing Entity") et METTELSAT, avec le soutien de MétéoSuisse (en tant que SOFF "Peer Advisor"). Les recommendations de ce document constituent une série d'objectifs explicites, qui servira de feuille de route pour renforcer le réseau de mesures météorologiques de METTELSAT, tant pour les mesures de surface que les mesures en altitude par radiosondage.

Les objectifs de ce plan national de contribution SOFF sont extrêmement ambitieux, mais néanmois atteignables en principe. Sachant que tant la technologie que les situations géo-politiques sont prônes à des dévelopements disruptifs rapides, il est primordial que tous les partenaires du projet - le pays bénéficiaire, l'entité d'implémentation, le conseiller pair, ainsi que le secrétariat et comité de direction SOFF - approchent ce document avec pragmatisme, flexibilité, et agilité. Une appropriation forte de ce plan et du projet SOFF par la METTELSAT, et le Gouvernement de la RDC de manière générale, est une condition impérative à son succès.

[1] `https://un-soff.org/document-library/`

Executive summary

This document has been assembled by the Federal Office of Meteorology and Climatology (MeteoSwiss) and the Democratic Republic of Congo (DRC)'s National Meteorological and Hydrological Services (NMHS), in french *Agence Nationale de Météorologie et Télédétection par Satellite* (METTELSAT) within the scope of the Systematic Observations Financing Facility (SOFF) project. This "National Contribution Plan" contains a series of recommendations for investments to be made in order for the DRC to become Global Basic Observing Network (GBON)-compliant at the national level. The DRC committed to abide by the GBON requirements at the 18^{th} World Meteorological Congress in 2019, with clear goals regarding the acquisition and international sharing of basic meteorological observations (i.e. pressure, temperature, humidity, wind, precipitation).

First and foremost, this plan advocates for a sequential approach to SOFF investments in the DRC. A series of Investment Rounds, each comprised of a 24-month period of "active" investments followed by a 12-month "commissioning" period, ought to enable newly established GBON observing sites to rapidly transition to the SOFF Compliance Phase (at which point funds will be available to maintain these sites in the long term). In view of the number of stations to be deployed (68 surface and 12 upper-air stations) to reach GBON compliance at the national level in the DRC, the SOFF Phase 2 and 3 would thus be proceeding in parallel in the DRC.

This plan is comprised of 6 modules (National Target toward GBON Compliance - GBON Business Model and Institutional Development - GBON Infrastructure Development - GBON Human Capacity Development - Risk Management Framework - Transition to SOFF Investment Phase) and 130 specific recommendations, all listed in Table 3. This document is completed by the evaluation of the GBON targets for the DRC (known as the "National Gap Analysis") and an in-depth review of the state of DRC's NMHS as of July 2024 (known as the " Country Hydromet Diagnostics"), both available from the SOFF website[2].

This plan is meant to serve as a basis for all SOFF Investment Round funding requests, that will be assembled by the SOFF Implementing Entity (IE) and METTELSAT, with the support of MeteoSwiss (as SOFF Peer Advisor). The specific recommendations of this National Contribution Plan constitute a series of explicit goals, that altogether ought to serve as a guide towards the strengthening of the meteorological (surface and upper-air) observing network of METTELSAT in the DRC.

The ideas and objectives laid out in this National Contribution Plan are extremely ambitious, but nonetheless achievable in principle. Bearing in mind that both technology and geo-political situations are both prone to rapid & disruptive evolution, it is crucial that all project partners (namely, the Beneficiary Country, the Implementing Entity, the Peer Advisor, the SOFF Secretariat and Steering Committee (StC)) be pragmatic, flexible and agile when working towards implementing the vision outlined in this plan. A strong ownership of this plan (and of the SOFF project in itself) by METTELSAT, and the DRC Government in general, is absolutely imperative to see it succeed.

[2] `https://un-soff.org/document-library/`

Table of contents

Disclaimer

All Uniform Resource Locators (URLs) mentioned in this document are valid as of September 30, 2024, unless specified otherwise. This file was compiled using the 2024/10/22 - v1.0 soffreport LaTeX class.

Relevant concepts and terminology

The following core concepts will be used throughout this document.

A **national GBON network** is comprised of a series of individual **GBON observing sites**, that must each be compliant against the official **GBON requirements**.

A GBON observing site can host **manual stations** (surface and/or upper-air) and/or **Automatic Weather Stations (AWSs)**. The use of radiosonde auto-launchers is not foreseen for the SOFF project in the DRC.

Manual and AWS **surface stations** are deployed/installed on a measurement field.

Manual **upper-air stations** are comprised of a sounding preparation hall, a launch pad, and, if warranted, H_2 production and storage facilities.

GBON observing sites hosting manual stations (surface or upper-air) are also comprised of an office to host the local **observers**.

A CI/CC approach for SOFF investments in the DRC

The challenges currently faced by the DRC and METTELSAT, are highlighted in the DRC Country Hydromet Diagnostics (CHD) document assembled as part of the SOFF Readiness Phase for this country. These challenges strongly suggest that the GBON National Contribution Target specified in Module 1 of this document cannot/should not be realized within a single SOFF Investment Round. The National Contribution Target (see Module 1) must be understood as a long-term vision: one that will require multiple, successive rounds of investments, each building upon the outcomes of the preceding ones.

This National Contribution Plan (NCP) document describes a comprehensive concept that would allow the DRC to eventually become fully GBON compliant. Given that technologies and geo-political situations are prone to rapid, sometimes disruptive evolution, it remains crucial that all SOFF partners - namely the Beneficiary Country, the Implementing Entity, the Peer Advisor, the SOFF Secretariat, and the SOFF Steering Committee - approach this NCP with a decisively agile mindset. This document presents a global concept and guiding principles. The individual Investment Requests will be responsible for detailing specific objectives for each round. In particular, each Investment Request will include specific targets that will have to be met in order to proceed with a follow-up SOFF investment round in the DRC.

The stabilization of early investments is paramount to the success of this multi-round NCP. **It is thus crucial that surface and upper-air stations that become GBON compliant as part of a specific Investment Round be allowed to enter the SOFF Compliance phase immediately.** Doing so will ensure that initial SOFF investments in the DRC form a solid and coherent foundation on which the latter rounds can be built. The DRC CHD unambiguously revealed that it is a lack of investments in long-term stabilization measures that have prevented METTELSAT to realize the expected benefits of (at least 3) previous capacity development projects intended to strengthen its observing network and capabilities. Provided that the novel concept of a "Compliance Phase" is implemented appropriately, SOFF will be uniquely suited to avoid succumbing to the same pitfall.

We shall refer to the proposed concept of successive, sequential SOFF Investment Rounds with the continuous entry of suitable stations into SOFF Compliance (on a station-by-station basis) as **"Continuous Implementation / Continuous Compliance (CI/CC)"**. It implies that the SOFF Implementation and Compliance Phases proceed in parallel to one another, as illustrated in Fig. 1. Successive, sequential Investment Rounds (each to be submitted to the SOFF Steering Committee for approval and funding) feed a number of newly-GBON-compliant stations into the SOFF Compliance Phase. The process continues until such time as the NCP described in this document is realized, or the success criteria of a given Investment Round fail to be met.

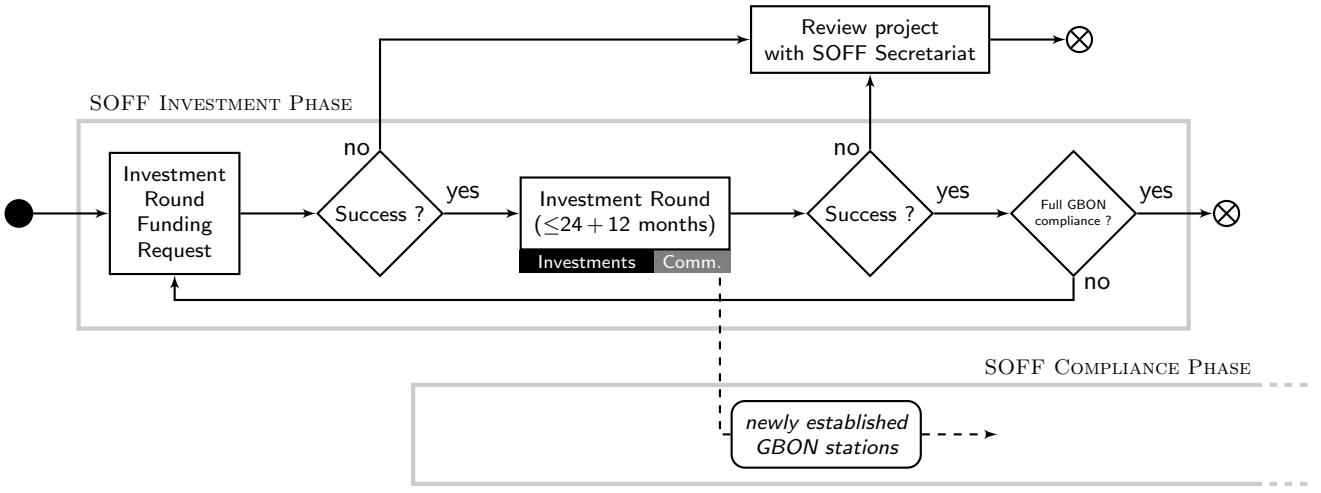

Figure 1: Illustration of the Continuous Implementation / Continuous Compliance (CI/CC) concept put forward in this NCP. A series of sequential Investment Rounds, each one with short term objectives, are used to eventually attain full GBON compliance at the national level. Each Investment round includes a 12-month Commissioning period to demonstrate the stability of newly-established GBON observing sites. Stations enter the SOFF Compliance Phase immediately after the end of the Commissioning period, to ensure their continued stability. A new Investment Round proceeds only if the success criteria set by the preceding one have been met. With this scheme, the SOFF Investment and Compliance Phase will proceed in parallel.

Module 1. National Target toward GBON Compliance

The outcomes of the GBON Global and National Gap analyses for the DRC are summarized in Table 1. The GBON vision for the DRC is that of 68 surface and 12 upper-air stations located throughout the country, as illustrated in Figs. 2 and 3. Realizing this vision in full is a highly challenging but nonetheless attainable objective in principle. With a radius of influence $R^*_{\text{inf}} = 141\,\text{km}$ for surface stations ($R^*_{\text{inf}} = 354\,\text{km}$ for upper-air stations) [3], 98.1% of the DRC would be located within the resulting surface network area of influence A^*_{inf} (95.7% for the upper-air network).

Table 1: GBON National Contribution Target for the DRC.

Type of station	WMO GBON Global Gap Analysis, June 2023				GBON National Contribution Target	
	Target	Reporting	Gap		To improve	New
			To improve	New	[# of stations]	
	[# of stations]					
Surface	59	0	35	24	28	40
Upper-Air	10	0	0	10	0	12

Achieving GBON compliance in the DRC is a significant undertaking that will strongly benefit from being broken up in a series of sequential Investment Rounds.

Recommended activity 1.1. *Each Investment Round ought to last at most 36 months (including a 12-month commissioning period), and have objectives designed accordingly.*

Maintaining small investment timelines implies that risks can be assessed more exhaustively and reliably. Doing so also ensures that the project team can remain agile, with the ability to respond to technological and/or geo-political changes.

Recommended activity 1.2. *METTELSAT ought to assemble a "SOFF Task Team" for each Investment Round.*

Members of the SOFF Task Team should all have clearly defined roles and responsibilities. In particular, each team member should be contributing actively to the SOFF project: for example by planning/following-up on investments and logistics, by coordinating training and formations, by ensuring prompt and smooth communications with the Implementing Entity, the Peer Advisor and the GBON observing sites, by tracking progress and assembling progress reports, by studying the environmental impacts of specific investments, or by liaising with stakeholders and relevant Civil Society Organizations (CSOs).

A strong involvement from the personnel at the GBON observing sites in the provinces will be key to the success of SOFF in the DRC. In addition to liaising with its observing sites when assembling the Investment Request (in collaboration with the Implementing Entity):

Recommended activity 1.3. *METTELSAT ought to consider having one representative of each observing site (to benefit from a given Investment Round) present in the SOFF Task Team.*

Recommended activity 1.4. *Members of the SOFF Task Team ought to meet on a bi-weekly basis. The detailed attendance and succinct meeting notes ought to be shared with the Implementing Entity and the Peer Advisor.*

Recommended activity 1.5. *METTELSAT ought to organize a kick-off workshop at the start of each Investment Round.*

Using the Investment Request documents as input, the workshop should be used to validate an explicit and exhaustive project plan, specifying (at least) deliverables, deadlines, and responsibilities for the entire duration of the Investment Round. METTELSAT ought to consider having at least one representative of each observing site (to benefit from the Investment Round) be present in the workshop.

To have its network become GBON compliant, METTELSAT faces a series of complex challenges. SOFF was designed to tackle some of these directly: for example, the lack of operational funding and the lack of infrastructure. However, METTELSAT will also need to tackle a series of obstacles that cannot be (directly) overcome with an isolated financial investment. These obstacles include, in particular, a strong distrust of AWSs throughout the institution, and a declining ecosystem with ongoing, nation-wide losses of infrastructures, real estate, and personnel.

[3] in accordance with GBON regulations; see Appendix A of the DRC's National Gap Analysis (NGA) document for details.

Given this state-of-affairs, the proposed sequential approach to GBON compliance in the DRC is as follows:

1. Stabilization of manual surface stations at key, currently-operational observing sites.
2. Identification of a suitable AWS technology for the transition to automatic observing systems.
3. Strengthening/assembly of regional centers for network maintenance and operation.
4. Deployment of a first upper-air system, and assembly of the necessary division within METTELSAT.
5. Gradual surface network expansion to increasingly-remote sites, with a controlled phase-in of AWSs.
6. Gradual upper-air network expansion.

At this point in time, it is expected that the first SOFF Investment Round in the DRC will tackle the first two items of this sequence, with the following specific goals:

A. Demonstrate that, with proper financial and technical support, METTELSAT is able to operate and maintain GBON-compliant observing sites in a sustainable manner.

B. Identify (by means of exhaustive tests in-situ) a suitable AWS technology for a controlled transition from manual to automatic observing systems, and build within METTELSAT the necessary capacity to operate and maintain them.

It is important to acknowledge the fact that French is the official working language within METTELSAT. Although most METTELSAT employees typically master more than one language, English is usually not one of them. At the same time, English remains the dominant language used by SOFF, the World Meteorological Organization (WMO), and manufacturers alike for most communications. Although modern translation tools can certainly help overcome this language barrier, they can still prove inadequate to fully process complex and/or technical documents and drawings.

Recommended activity 1.6. *METTELSAT ought to ensure that at least one member of the SOFF Task Team is fluent in English.*

This person should be assigned the task to bridge the language gap in support of all SOFF activities, from French to English and vice-versa. All project stakeholders should however also keep this language barrier in mind, and contribute to erase/smooth it to the best of their abilities.

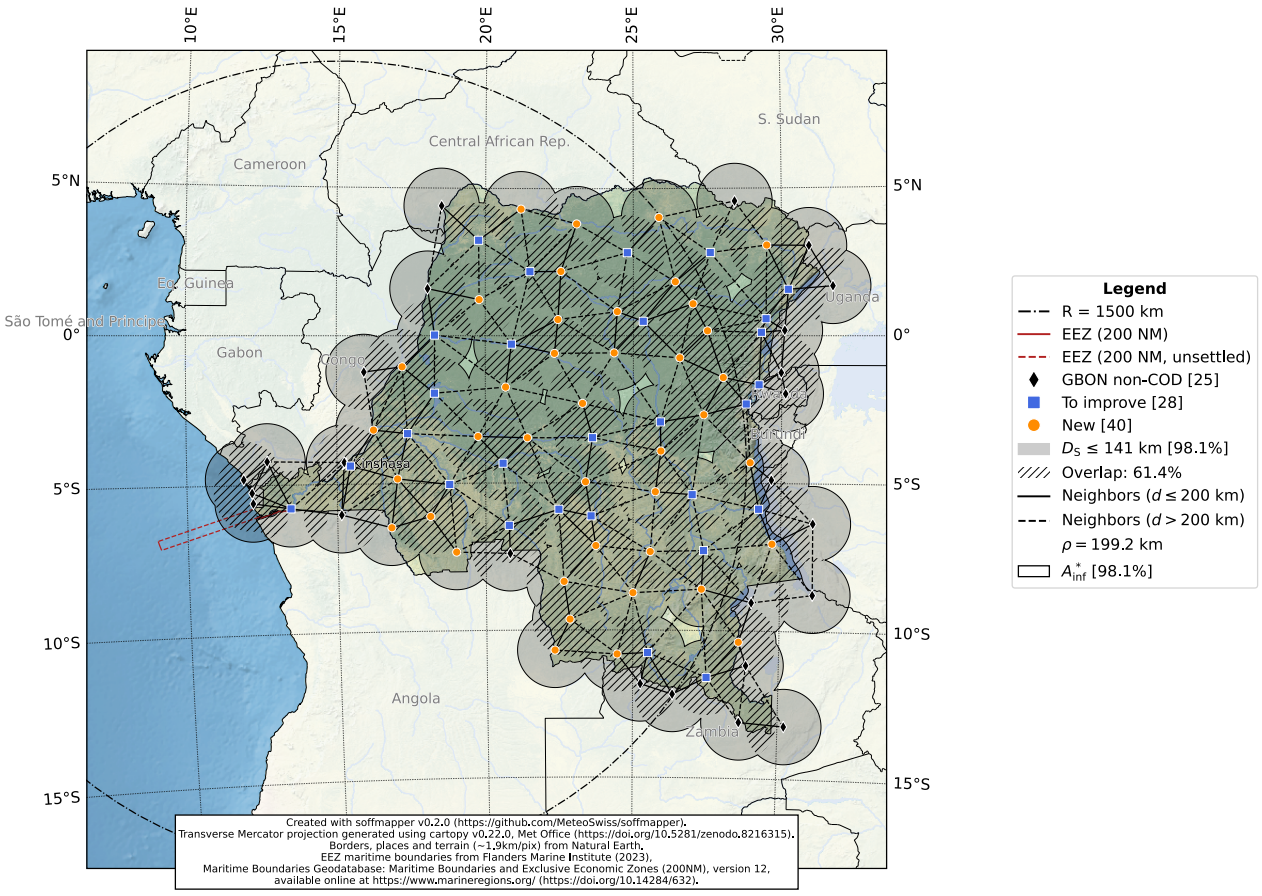

Figure 2: Map of METTELSAT surface stations to improve (blue) and to be setup anew (orange) in order to achieve GBON compliance at the national level in the DRC. Black diamonds indicate GBON observing sites in neighboring countries, either existing or planned as part of SOFF. Neighboring stations are linked by black lines (dashed if they are separated by more than 200 km). All positions located up to $D_S = 141$ km from a station are shaded in black, with hashed areas indicating zones where two or more stations are closer than D_S. The mean horizontal separation (in the GBON sense) of this network, accounting for stations in the neighboring countries, is $\rho = 199.2$ km. A total surface area $A^*_{inf} = 98.1\%$ of the DRC is located within a distance $D_S = 141$ km from a planned GBON observing site (see Appendix A of the National Gap Analysis - NGA for details). A reference circle of 1'500 km in radius centered on the capital Kinshasa is drawn for reference.

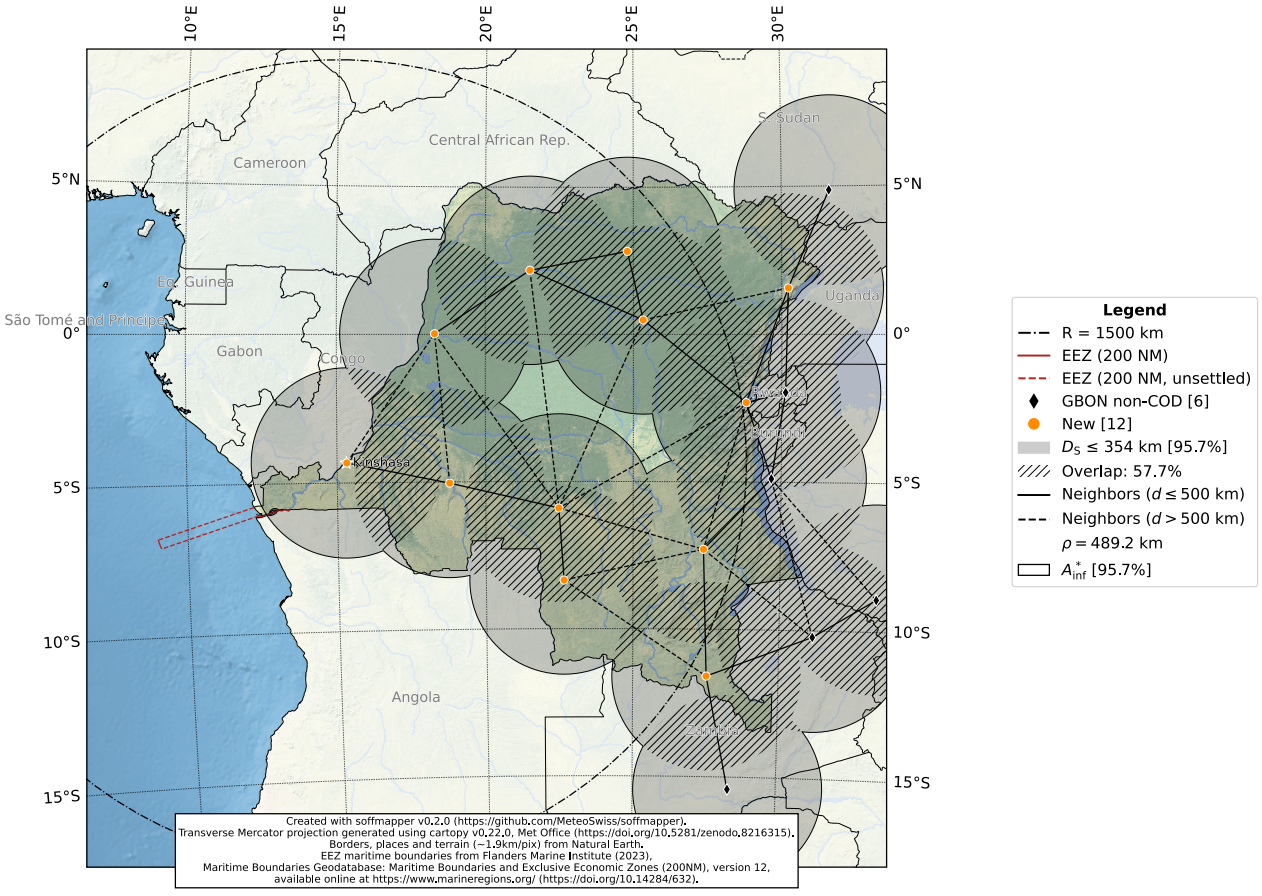

Figure 3: Same as Fig. 2, but for the upper-air network. The lines connecting neighboring stations are dashed if the separation is larger than 500 km and the distance $D_S = 354$ km, in accordance with GBON regulations.

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

The CHD identified at least three key governmental stakeholders of METTELSAT that could be relevant for GBON compliance: the Airways Authority, in french *Régie de Voies Aériennes* (RVA), the National Agronomical Study and Research Institute, in french *Institut National pour l'Étude et la Recherche Agronomiques* (INERA), and the Waterways Authority, in french *Régie des Voies Fluviales* (RVF). The latter two entities operate their own observation network throughout the DRC, whereas the first relies directly on METTELSAT observational infrastructures at several airports throughout the country. In addition, the DRC's air force, that operates its own set of airports, also has a vested interest in meteorological observations from (and an existing working relationship with) METTELSAT for the purpose of aeronautical meteorology.

All these stakeholders stand to benefit directly from seeing the DRC becoming GBON compliant, in that it would provide them with a steady, reliable stream of quality meteorological observations nation-wide. However, according to the CHD, none appear to have the financial means to actively contribute to the deployment of a GBON network in the DRC, which in itself is not part of their responsibilities either. From that perspective, METTELSAT is the sole governmental actor in the DRC with a suitable mandate to operate and maintain GBON-compliant stations.

Achieving GBON compliance at the national level in the DRC will require to setup 40 new stations. Although some of the historical METTELSAT observing sites may still prove accessible and suitable (be it from a site safety or meteorological perspective), this may not be the case at all locations. The availability of trained/trainable skilled personnel in the station's immediate vicinity is also a challenge in remote locations of the DRC. From these perspectives, there is a significant potential for operational synergies between the METTELSAT network and those of its stakeholders.

Recommended activity 2.1. *When planning for a new GBON site, METTELSAT should evaluate the possibility to deploy instruments either on one of its own (historical) location, or, if feasible and more suitable in terms of site safety and/or availability of personnel, on one of the existing site of its key stakeholders.*

Deploying a METTELSAT station on a stakeholder site evidently requires an excellent working relationship between the partners, together with a written set of rules and guidelines specifying the rights and duties of each partners. From that perspective, the "*long-standing dispute*" (World Bank, 2023; Gomez and Nikiema, 2023) between METTELSAT and the RVA poses a very high risk to the long-term stability of SOFF investments on airport grounds (see Sec. 5.1 for possible mitigation measures). In any case, irrespective of its location:

Recommended activity 2.2. *The establishment of any new GBON observing site by METTELSAT (even on historical observing locations) should begin by a very careful and exhaustive site assessment in terms of safety, utilities, long-term access, personnel availability, and meteorological suitability.*

The CHD also identified that METTELSAT suffers from a trust and image deficit vis-à-vis the majority of its stakeholders and the Government. This was influenced by several METTELSAT projects that were not met with the expected level of success in recent years, coupled with METTELSAT being challenged to meet most of its stakeholders needs.

Recommended activity 2.3. *METTELSAT should first aim at establishing a series of GBON observing sites at locations over which it has direct control, before considering synergies with stakeholder networks.*

In doing so, METTELSAT would effectively demonstrate its ability to sustainably operate and maintain a network of GBON observing sites to its stakeholders and plausible station-hosting partners. These initial GBON observing sites would serve as a complete system demonstration, in terms of practical requirements and data returns. They would make for an ideal basis to subsequently explore and negotiate specific network synergy opportunities.

2.2 Assessment of potential GBON sub-regional collaboration

A series of DRC's neighboring countries are also SOFF Beneficiary Countries, namely: Rwanda, South Sudan, Tanzania, Uganda, and Zambia. Many of the challenges faced by these different countries in terms of GBON compliance are similar to those of the DRC, albeit with different scales and intensities.

Recommended activity 2.4. *METTELSAT should monitor the progress towards GBON compliance of neighboring countries, together with the associated solutions implemented as part of SOFF.*

Special consideration should be given to specific solutions and/or systems found to fulfill their objectives in the region. In turn, METTELSAT and its Peer Advisor should also strive at informing SOFF partners in the region (and beyond) of the SOFF developments and solutions in the DRC.

Recommended activity 2.5. *METTELSAT should consider attending every WMO Technical Conference (TECO).*

TECOs are held every two years, with the next one planned for 2026. These venues would provide the ideal means for METTELSAT to report on the progress of the SOFF project in the DRC. In turn, these venues would also allow METTELSAT to interact with manufacturers & WMO, and keep track of recent technological developments and best-practices in the field of meteorological measurements.

Recommended activity 2.6. *Participation to TECOs should be contigent upon the submission by METTELSAT of at least one poster describing the SOFF project status in the DRC.*

This poster should cover the following elements: project status, recent successes & challenges, new lessons learned, and the next steps. There is likely to be much interest by the international community to also hear in more details about specific aspects of GBON observations in the DRC. METTELSAT should therefore systematically consider the possibility, in addition to the general project status update, to submit additional posters on key aspects implemented recently as part of SOFF (for example: 24/7 shifts, maintenance, calibration, formations, etc . . .).

The Global Information System Centre (GISC) in Casablanca stands out as a plausibly key partner of METTELSAT to reach GBON compliance in the DRC. Close ties already exist between these two institutions, in the sense that manual observations from METTELSAT are being submitted (manually) to the Global Telecommunication System (GTS) via a dedicated WMO Information System (WIS) 2.0-based web interface assembled and operated by GISC Casablanca.

Recommended activity 2.7. *METTELSAT should maintain and further enhance its working relationship with GISC Casablanca, and by extension with the Regional WIGOS Center (RWC) and the Regional Instrument Center (RIC) at the same location, that ought to become METTELSAT's prime GISC/RWC/RIC partners.*

These co-located entities stand to provide METTELSAT with a crucial, high-level support towards achieving GBON compliance.

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

The DRC CHD revealed that METTELSAT faces a long-stream of insufficient budget allocations from the government (see also World Bank, 2023; Gomez and Nikiema, 2023). Together with the current lack of sustainable revenue generation from aeronautical services, it implies that METTELSAT is not able to actively maintain its observing systems. The fact that 59.6% of METTELSAT employees are currently unpaid in the provinces also hinders its ability to reliably operate its observing network, let alone incorporate additional observing sites.

The solution to these financial problems is in principle political, and thus complex. It is paramount that METTELSAT continues to advocate for a suitable operational budget. From that perspective, the SOFF project ought to provide METTELSAT with an excellent opportunity to demonstrate its ability to operate a GBON network (with all the resulting benefits for the DRC), if given the proper financial means to do so. However, until such time as the baseline financial situation of METTELSAT improves, its ability to operate a large GBON network will remain largely compromised (see Sec. 5.1).

Recommended activity 2.8. *METTELSAT staff members (Observers and/or Station Keepers, maintenance technicians) working on GBON observing sites or at Regional Maintenance Centers (RMCs) to be established as part of the SOFF project in the DRC should be paid fairly, regularly, and reliably.*

Ideally, SOFF should not substitute itself to the DRC Government to pay staff base salaries. SOFF should however anticipate to cover supplemental staff-costs necessary to attain GBON compliance, such as compensation for night shifts.

Recommended activity 2.9. *The SOFF Implementing Entity (IE) for the DRC should identify a suitable means to cover supplemental staff-costs by direct interaction with the beneficiaries (e.g. the individual observers).*

The DRC CHD did not identify possible private partners suitable to establish a public-private collaboration towards GBON compliance as of July 2024. The recommended model, for now, is thus that of a fully-public setup, in which METTELSAT is accountable for the delivery of data, as well as network operation and maintenance. This proposition remains valid, should some GBON observing sites be hosted by a METTELSAT's stakeholder (see Sec. 2.1). Given the significant GBON National Contribution Target (see Table 1) and size of the DRC, the use of any other business model

would risk seeing a rapid multiplication of partners, thereby significantly hindering the ability of METTELSAT to operate a GBON network reliably and uniformly on a nation-wide basis. This approach, however, should not become dogma.

Recommended activity 2.10. *For each Investment Round funding request, METTELSAT should evaluate whether the emergence of new private partners (e.g. in the field of Information and Communications Technology (ICT)) could warrant a change towards another business model (e.g. public-private) to maintain and operate the GBON network in the DRC.*

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

The DRC CHD identified that METTELSAT has drafted a national WMO Integrated Global Observing System (WIGOS) plan (see p.79 of METTELSAT, 2024, that was submitted to the WMO as supplementary material to the DRC's CHD).

Recommended activity 2.11. *METTELSAT should strive at implementing its draft WIGOS plan, in direct support of the SOFF project.*

The SOFF project in the DRC builds upon significant investments by the World Bank and the World Meteorological Organization (WMO) (via the Climate Risk and Early Warning Systems (CREWS) initiative). These projects, that we shall colloquially refer to as the "Hydromet project", formally ended in 2023. A CREWS Accelerated Support Window (CREWS-ASW) funding request was submitted by METTELSAT in July 2024, in an attempt to stabilize some of the investments made as part of the Hydromet project. In particular, the CREWS-ASW funding request includes the setup of a data transfer mechanism between recently-installed AWSs and the GTS (which was not achieved in the original Hydromet project). The DRC is also a beneficiary country in the scope of CREWS Central-Africa project, currently in the initial planning phase.

Recommended activity 2.12. *METTELSAT should allocate sufficient personnel to its different capacity development projects, to ensure that their respective implementation timelines can be met.*

Recommended activity 2.13. *METTELSAT should ensure that a regular exchange of information takes place between the teams assigned to its different capacity development projects.*

2.5 Review of the national legislation of relevance for GBON

A draft law on meteorology, clarifying the functional assignments of sector institutions in the DRC, was assembled and submitted to the government as part of the Hydromet project. However, this law has not yet been approved and its current status is unknown to the authors of the present document. Given the importance of this law in strengthening its capacity (including financially) and ensuring its legal status for the long term, METTELSAT should continue to actively advocate for the draft law on meteorology to be formally examined by the government.

The outcome of the debate by the government around this law proposal evidently lies outside of METTELSAT's control. Nonetheless, the World Bank having identified "*a lack of political will [from the government] to support METTELSAT in fulfilling its mission*" (World Bank, 2023), it is clear that seeing this law promulgated would send a strong message in support of METTELSAT and all the capacity development activities it is undertaking (including SOFF).

The DRC CHD also noted the creation in 2019 of a national framework to aid in the decision-making process for questions related to meteorological and climatological issues (in french, "*Cadre National des Services Climatologiques*"). This framework was formally established by decree 22/19, but was never set up in practice. Doing so would evidently be beneficial to the DRC. However, unlike the draft law on meteorology, it is the framework that stands to benefit from the assembly of a GBON network, and not the other way around.

The review of the legislation related to procurement, importation and customs processes in the DRC has not revealed any specific element liable to significantly affect the fluent implementation of this NCP.

Recommended activity 2.14. *METTELSAT ought to ensure that its import-export permit is up-to-date and remains valid throughout the SOFF project.*

The law 10/010 from 2010-04-27 regulates public tenders. However, for projects financed by international partners, it is the public tender rules and regulations from these partners that will take precedence. METTELSAT does not, in principle, benefit from any specific import tax exemption. However, there is still the possibility to ask for some level of exoneration for specific projects.

Recommended activity 2.15. *METTELSAT ought to submit to the responsible ministry a formal request for tax exoneration applicable to SOFF-related imports, both during the Investment and Compliance phases of the project.*

The decree 22/40 from 2012-10-12 that defines the legal status of METTELSAT specifies that it is responsible for all the DRC's international meteorological obligations, in particular those stemming from WMO conventions. The free sharing of GBON data internationally is therefore not expected to be a problem. Nonetheless:

Recommended activity 2.16. *METTELSAT ought to clearly mention its commitment to the free and open international sharing of GBON data in relevant documents, such as business & operational plans, 5/10-year strategy, etc . . .*

Module 3. GBON Infrastructure Development

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

The maps of the 68 surface and 12 upper-air stations found via the NGA to be sufficient for the DRC to reach GBON compliance are shown in Figs. 2 and 3. All 12 upper-air stations and 40 surface stations must be established anew. A total of 28 surface stations were in activity as of July 2024, in the sense that the sites are visited on a regular basis by METTELSAT personnel as part of their duties. At least 3 different models of AWSs can be found on some of these sites. We refer the interested reader to the DRC's NGA for an exhaustive list and description of all these sites.

The long term vision of the METTELSAT surface network in the DRC is that of an AWS network, managed at the METTELSAT National Headquarters (NHQ) with a series of RMCs distributed throughout the country (See Fig. 4). However, the DRC CHD have revealed that there is currently little ownership for the different AWSs that METTELSAT has seen being deployed on some of its sites over the past 15+ years. These AWSs models, including those set up as part of the Hydromet project from the World Bank, were also found to be unfit to be deployed at additional GBON observing sites. No maintenance or calibration processes exist for these systems, and the local staff was never trained to care for them, let alone operate them. Their data are not reaching the GTS, and are not integrated within the METTELSAT operational chain either. Several AWS have also experienced partial/total hardware failures, while others have been vandalized.

On the other hand, every active METTELSAT observing site today hosts a manual station comprised in part of (mercury) thermometers (incl. dry and wet, minimum and maximum) inside a Stevenson screen, a barograph and/or a barometer, a pluviometer and/or a pluviograph, an anemometer (at 2-m) and a weather vane. These devices are uniform throughout the METTELSAT network, although several of these instruments will typically be broken or inoperable at each location. METTELSAT has operating procedures in place for all these instruments, the data of which are used for issuing local Meteorological Aerodrome Reports (METARs) and surface synoptic observations (SYNOPs), and for climate monitoring. Today, the only data from the DRC to reach the GTS is acquired using manual instruments: individual observations are transferred manually to Kinshasa (via radio, SMS, instant messaging, ...), from where they are manually uploaded to GISC Casablanca via a dedicated web interface. The data reach the GTS in insufficient quantity, but they are typically of sufficient quality according to the WIGOS Data Quality Management System (WDQMS) criteria.

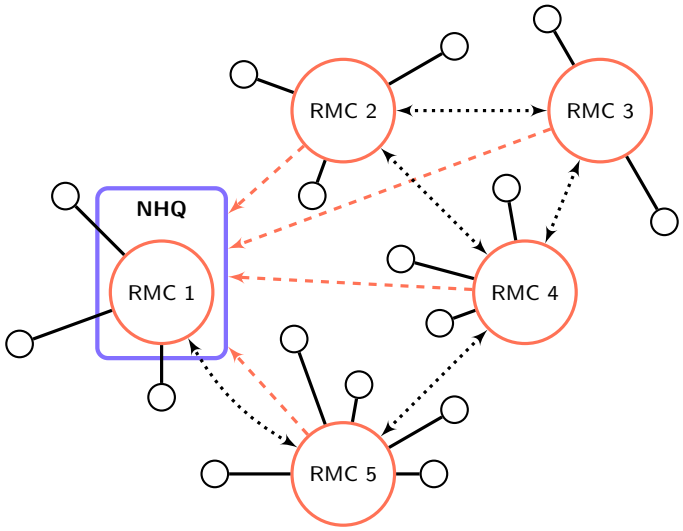

Figure 4: Schematic illustration of the proposed organizational structure of the METTELSAT GBON observing sites (small circles). A series of METTELSAT Regional Maintenance Centers (RMCs) (big circles), each reporting to the National Headquarters (NHQ) in Kinshasa (red dashed lines), are distributed throughout the country. These sites host skilled, trained personnel and equipment (including spare parts) necessary to maintain GBON observing sites under their responsibility. GBON observing sites are assigned to a specific RMC so as to maximize their accessibility by trained personnel (full lines). RMCs report to the NHQ but ought to have the operational and administrative freedom to organize and handle by themselves the regular maintenance operations of the GBON observing sites under their responsibility. The METTELSAT instrument calibration team is located at the NHQ: it has the ownership of all instruments on all sites, and remains responsible for any calibration procedures. RMCs ought to maintain close ties with neighboring ones (by means of regular exchanges) to maximize redundancy, strengthen local connections and solutions, and ease the spread of relevant operational and technical know-how (dotted lines).

Recommended activity 3.1. *METTELSAT should begin by stabilizing its manual surface stations at key observing sites, to see them become GBON-compliant.*

Doing so would allow METTELSAT to build upon existing skills and expertise to rapidly stabilize and subsequently maintain (by means of the SOFF Compliance phase) GBON observing sites that will act as the backbone of the network. These key sites are those that are bound to evolve into RMCs and, for some, eventually also host upper-air stations. They include international airports and regional capitals. We cannot and shall not provide here an exhaustive list of all these sites, the selection of which is prone to be affected by the changing situation on the ground. We do nonetheless provide in Table 2 a list of sites showing most potential to be targeted in the first SOFF Investment Round in the DRC.

Table 2: List of several METTELSAT observing sites, that (as of November 7, 2024) appear reasonably well suited to eventually serve as the backbone of the GBON network and evolve into RMCs. The first SOFF Investment Round ought to aim at stabilizing a subset of these sites. Station coordinates are approximate, with an accuracy better than ∼10 km.

Province	Station name	Latitude [°]	Longitude [°]	Number of Observers†	Gender balance† F/M [%]	Unpaid observers† [%]
Kinshasa	Kinshasa/N'Dolo*	-4.3255	+15.3262	8‡	12/88‡	0(?)‡
Sud Ubangi	Gemena	+3.2373	+19.7697	7	0/100	100
Tshopo	Kisangani	+0.4904	+25.3327	3	0/100	33
Haut Katanga	Lubumbashi	-11.5894	+27.5298	3	0/100	33
Nord-Kivu	Goma	-1.6604	+29.2395	6	0/100	66
Kasai Central	Kananga	-5.8990	+22.4778	4	75/25	25
Equateur	Mbandaka	+0.0214	+18.2911	5	0/100	0
Haut-Uele	Isiro	+2.8226	+27.5982	4	75/25	100
Maniema	Kindu	-2.9271	+25.9140	2	50/50	100
Tanganika	Kalemie	-5.8721	+29.2481	3	0/100	100
Kasai Oriental	Mbuji-Mayi	-6.1245	+23.5711	6	17/83	33
Kasai	Tshikapa	-6.4394	+20.7930	1	0/100	100
Lualaba	Kolwezi	-10.7653	+25.5092	5	0/100	80

† As communicated by METTELSAT on 2024-09-18.
* The NGA lists the station of Kinshasa/N'Djili as possible GBON site for the capital. However, the site of N'Dolo may prove more suitable in terms of access for METTELSAT personnel, and its ability to host an upper-air station down the line. This station is located within the grounds of a military airport.
‡ Observers at the site of N'Dolo are trained by METTELSAT, but employed by the Air Force (3) and the RVA (5).

Rapidly stabilizing manual stations at a few key sites would create motivation among the staff, and build trust with the stakeholders. Having METTELSAT take full ownership of the equipment responsible for GBON observations is paramount to ensure that necessary resources and attention are summoned for operation and maintenance purposes.

Recommended activity 3.2. *Each manual surface station should be equipped with analogue wet and dry thermometers located within a Stevenson screen, an anemometer and vane, a rain gauge, and one digital barometer.*

The addition of a hygrometer would be beneficial in principle, but it is not strictly necessary if a suitable analog version cannot be procured. To stabilize a manual surface station and ensure its durability, METTELSAT should favor analog instruments that do not require electricity to operate, do not have moving parts, do not require consumables, and require minimal calibration. In practice, this implies that METTELSAT ought to prefer rain gauges over pluviographs. The digital barometer is the only exception to this recommendation, for the following reasons:

- reading a digital barometer is significantly faster than an analog one,
- unlike all other instruments located on the measurement field, the barometer will be located indoor where electricity is/could be made available (more easily), and
- analog barometers contain mercury, the use of which is nowadays heavily regulated through the Minamata Convention[4].

[4] `https://minamataconvention.org/en`

Each manual surface station to be stabilized should see all its existing manual equipment listed in Rec. 3.2 renewed. This is warranted, for thermometers and barometers, on the basis of the Minamata convention, and for the anemometer and rain gauges, on the basis of network uniformity. On-site visits and current photos indicate that Stevenson screens on most sites will need important repairs, or to be replaced entirely. For the wind measurements, the analog anemometers should be placed at 2 m above-ground for ease of use by the observers.

Recommended activity 3.3. *METTELSAT ought to use the renewal of existing instruments at manual stations as an opportunity to develop and implement formal practices and data validation mechanisms to ensure the continuity and stability of its measurement time series.*

The assembly and careful documentation of this manual-to-manual transition will directly serve as a basis to planning the transition to AWSs down the line.

Digital barometers will require calibrations at regular intervals (on the order of 2 years or so, depending on the specific make and model). As highlighted in the DRC's CHD, METTELSAT used to host a Regional Calibration center in Kinshasa.

Recommended activity 3.4. *METTELSAT should seek to re-establish a national calibration center at its NHQ, with an initial focus on atmospheric pressure.*

On the one hand, doing so would provide METTELSAT with the means to maintain the digital barometers to be deployed throughout its network. On the other, it would allow METTELSAT to start re-growing its Calibration Team (in terms of expertise, personnel, technical infrastructure), thereby preparing itself to perform advanced maintenance and calibration activities for AWSs. In any case:

Recommended activity 3.5. *METTELSAT should ensure that the instruments used for acquiring GBON observations are regularly calibrated with a level of accuracy sufficient to meet the GBON quality requirements.*

Instrument calibrations should occur at least with a frequency specified by the manufacturer, and more often in case of data quality issues. Broadly, METTELSAT could calibrate its instrument either by having them shipped from the GBON observing sites to the NHQ (possibly via its RMCs), or by sending experts on the ground with field calibration kits.

Recommended activity 3.6. *METTELSAT should carefully assess the logistics associated with the calibration of its observing equipment, and adopt the most favorable option.*

Travel throughout the DRC remains extremely difficult and time consuming, such that sending experts on the ground may prove inefficient, in particular as the GBON network of METTELSAT grows. The shipping of instruments for calibrations at the NHQ may prove more practical, provided that station staff is able to reliably uninstall, ship, receive and re-install observing equipment. Irrespective of the chosen calibration approach:

Recommended activity 3.7. *METTELSAT should implement a formal & reliable procedure to safely and regularly transfer instruments and material between its NHQ and its GBON observing sites (via its RMCs).*

As the network grows and RMCs are established, METTELSAT might consider implementing hybrid calibration approaches. For example, experts from the NHQ could travel with field calibration kits to RMCs (only), where RMC personnel could gather multiple observing instruments to be calibrated from the GBON sites under their responsibility.

Recommended activity 3.8. *METTELSAT should review and (if warranted) grow/evolve its calibration setup with each SOFF Investment Round, to ensure that it is continuously able to meet the necessary GBON quality requirements for the stations to be rehabilitated/re-established.*

For the first Investment Round, METTELSAT ought to consider acquiring reference digital barometers to be setup at its NHQ as national etalons. Irrespective of the variable considered:

Recommended activity 3.9. *METTELSAT should plan for any national etalons located at its NHQ to be regularly checked and calibrated against international etalons at a WMO RIC.*

The WMO RIC in Casablanca would appear as a highly suitable partner in that matter.

The transition to AWSs should occur gradually, and be strictly managed to ensure that these systems can in fact be sustainably integrated within the METTELSAT operational chain.

Recommended activity 3.10. *Prior to deploying a new AWS technology dedicated to GBON observations, METTELSAT should first seek to perform in-depth tests at its headquarters.*

These tests would help ensure that the selected technology is truly fit-for-purpose. They are also paramount to build trust and ownership throughout the institution. They will enable the assembly of relevant teams, training material, and operational guidelines, all to ensure that METTELSAT can be ready to operate the relevant AWSs technology from the first day it is deployed in the field.

Recommended activity 3.11. *METTELSAT should ensure that all key departments are taking an active part in pre-deployment tests of new AWSs, and contribute to establishing dedicated rules and guidelines for operations, maintenance, and calibration.*

As mentioned previously, AWSs have already been deployed on METTELSAT sites as part of (at least) 3 distinct capacity development projects in the past. To date, however, none of these systems could be be stabilized and operated on a long-term basis. Following on-site visits performed by MeteoSwiss as part of the CHD process, none of these AWS models appear suitable for being deployed at additional sites: either because of a lack of spare parts, inefficient and/or unsuitable designs, or because they are simply no longer available on the market. Given this state-of-affairs:

Recommended activity 3.12. *METTELSAT should only implement palliative care activities (i.e. the regular cleaning of the system) for the AWS models currently deployed on its GBON observing sites.*

In particular, SOFF funds ought not to be used to actively maintain the existing AWS systems currently deployed on METTELSAT observing sites (for example, to buy spare parts or repair broken elements).

Nonetheless, even though an active, long-term (SOFF-financed) maintenance of existing AWSs is not recommended, these systems would provide METTELSAT with an ideal means to start the (gradual) transition process from manual to automatic stations. This would be particularly true if the CREWS-ASW funding request recently submitted by METTELSAT was to be approved, and the proposed assembly of a dedicated WIS2.0-box successful.

Recommended activity 3.13. *METTELSAT should establish and implement clear operational guidelines to stabilize and secure its GBON observing sites.*

At the very least, doing so will require to:

- establish a formal procedure for weekly inspections and (basic) maintenance of the observing equipment, including the creation of inspection reports,
- ensure that the local staff is able to perform maintenance activities once per week at least,
- implement regular ground maintenance activities (incl. grass mowing and ground cleanup),
- secure the sites by delineating them with fences,
- add a dedicated information panel to each site, aimed at passers-by, to explain in layperson's terms the content and importance of the measurement site for the region, the DRC, and the World,
- establish a "GBON Compliance Team" responsible for monitoring the overall performance of the network & follow-up on issues, and
- organize regular open-days at the site, to raise awareness among local authorities and create ownership within the local community.

As the GBON network of METTELSAT grows, AWS technology may have to be deployed on GBON observing sites to be established anew.

Recommended activity 3.14. *When transitioning to AWS technology, METTELSAT should first seek to deploy new AWSs on a few GBON observing sites hosting manual surface stations.*

Recommended activity 3.15. *METTELSAT should ensure that Rec. 3.13 is also followed for GBON observing sites hosting an AWS but no observers, by means of a Station Keeper that ought to visit the site at least once per week.*

Recommended activity 3.16. *METTELSAT should strive at deploying hardware solutions across its GBON network that, short of being uniform, are highly compatible with one another.*

This recommendation is applicable to both manual and automatic systems. Given the physical size of the network, doing so is paramount to facilitate maintenance and calibration activities, and maximize resilience in general. From that perspective:

Recommended activity 3.17. *METTELSAT and the SOFF IE in the DRC should ensure that selected technological solutions are compatible with any recommendation or guidelines issued by the Task Team (TT)-FirstMile assembled under WMO's Standing Committee on Information Management and Technology (SC-IMT).*

The new observing equipment to be selected by METTELSAT should evidently be able to measure all baseline GBON variables with the necessary quality and frequency.

Recommended activity 3.18. *METTELSAT and the SOFF IE in the DRC should abide by the official GBON Tender Specifications for AWSs and radiosonde-related procurements, namely Task Team GBON (TT-GBON) documents 6.1*[5] *and 6.2*[6]*.*

Recommended activity 3.19. *The SOFF IE in the DRC ought to consult and interact closely with METTELSAT when preparing call-for-tenders, to ensure that all appropriate needs and requirements can be specified in sufficient details.*

The SOFF Peer Advisor can evidently also be consulted to aid in the drafting of call-for-tenders and other specification documents.

The transport of human personnel between stations is extremely challenging in the DRC. This implies that METTELSAT ought to favor robustness and maintainability over data quality when selecting equipment, provided the minimal GBON requirements are met. Regular maintenance operations ought to be performed by local staff to the largest extent possible. At the very least, this implies that it should be possible for local staff to replace faulty equipment, without expert knowledge or highly sophisticated tools. Local staff should also have the means to self-run basic station diagnostics –for example via dedicated status Light-Emitting Diodes (LEDs) in case of AWSs– and more advanced ones with remote support from experts. The ability to diagnose empty batteries in paramount.

Recommended activity 3.20. *METTELSAT should have several of its key observing sites evolve into Regional Maintenance Centers (RMCs) and upper-air stations.*

The existence of RMCs is paramount to ensure that all GBON observing sites within the network can be rapidly and easily accessed by trained, skilled personnel for regular and emergency maintenance purposes. To that end, RMCs ought to stock sufficient spare parts. However:

Recommended activity 3.21. *The ownership of all observing instruments should lie with the Instruments & Calibration Team at the National Headquarters (NHQ).*

This ought to ensure that operating and maintenance practices are uniform throughout the network. It also implies that any instrument purchase is made by the the Instrument & Calibration Team, and the any network growth/evolution is coherent and consistent nation-wide.

Recommended activity 3.22. *METTELSAT should ensure that robust, reliable communication channels exist between the NHQ, the RMCs, and the GBON observing sites hosting manual stations, including the means to communicate in real time with video.*

Recommended activity 3.23. *METTELSAT should implement a formal procedure to document all station maintenance activities.*

All maintenance reports should be made available to METTELSAT headquarters upon completion of the activity. Ideally, they ought to describe in details the nature of the intervention, and enable/encourage the inclusion of pictures.

At several sites located on airports, local observers are responsible for the assembly of METARs. In view of the communication challenges in the DRC, and to maximize reliability and resilience:

Recommended activity 3.24. *When operating an AWS on a manned site, METTELSAT should ensure that local observers have a direct access to the live meteorological measurements acquired by the automatic system, independent of the station's connectivity to the outside World.*

We present in Fig. 5 a schematic view of the relationships between specific teams that ought to be assembled by METTELSAT to operate its GBON network.

Recommended activity 3.25. *To support the operation of its GBON network, METTELSAT ought to consider assembling an Instruments & Calibration Team, an ICT Team, a GBON Compliance Team, and a Human Richness Office.*

[5] https://wmoomm.sharepoint.com/:b:/s/wmocpdb/Ecvr45QvsGZAsQA5FZFcnawBiVkAsBFp36U-t_Z52Isq3A?e=NEfgs8
[6] https://wmoomm.sharepoint.com/:b:/s/wmocpdb/EZeqACbXbOlEs-bieNiO4wYBBOBmeYjb3gE9Ddvpa3nVhQ?e=xN2lYo

The envisaged, non-exhaustive responsibilities of each team are listed in Fig. 6. Attaining GBON compliance with manual stations will require to establish shifts. In Fig. 7, we illustrate one possible shift structure for a team of 6 observers. In this scheme, observers are on shift for 7 consecutive days, with every third shift being a night-shift. On their off-weeks, observers work on alternative duties, as specified in Fig. 6. SOFF ought to be well suited to cover staff-costs related to weekend and night work (see Recommendation 2.9).

The DRC straddles the Coordinated Universal Time (UTC)+1 and UTC+2 time zones, such that operational radiosounding will need to occur around midday and midnight to be GBON compliant. From that perspective, the assembly of 24/7 shifts of observers at key METTELSAT observing sites hosting manual surface stations, foreseen to eventually also host upper-air stations, will greatly facilitate the deployment of manual upper-air systems at those locations in future SOFF Investment Rounds.

Recommended activity 3.26. *When deploying upper-air stations, METTELSAT should favor manual systems (and thus avoid auto-launchers) to maximize the reliance of its GBON upper-air network.*

This is particularly warranted given the significant technical complexity of auto-launchers (particularly in terms of maintenance) that, at the same time, do not provide significant benefit in terms of data quality.

Recommended activity 3.27. *In view of the growing scarcity of He worldwide, METTELSAT ought to favor the use of H_2 as lift gas for its upper-air stations.*

Although it would be the preferred solution from a reliance and logistics perspective, the ability for METTELSAT to procure H_2 regularly and reliably by means of an external contractor is likely to prove impossible for most/all GBON observing sites to host manual upper-air stations. Nonetheless:

Recommended activity 3.28. *When establishing a new upper-air station, METTELSAT should carefully assess the possibility to procure a sufficient amount of H_2 with the necessary regularity by means of a local manufacturer, and only commit to setting up a local H_2 production at the GBON observing site if no suitable alternative is identified.*

Site access for staff can be particularly challenging in provinces, with airports located several kilometers away from city centers, coupled with a general lack of public transport options.

Recommended activity 3.29. *METTELSAT should ensure that its staff members have the means to access the applicable GBON observing site(s) and/or RMC.*

Previous Capacity Development projects in the DRC, including the World Bank's Hydromet project, have opted for the purchase of vehicles. This option, however, involves recurring maintenance and operational costs, together with a significant logistical overhead for METTELSAT. In view of the large availability of private transport options at most locations, METTELSAT ought to instead consider compensating its staff financially for their use of these private transport services, rather than growing its fleet of vehicles.

The purchase of additional duty vehicles may be warranted when RMCs are formally established in future SOFF Investment Rounds, to facilitate the visit and access of near-by GBON observing sites. But in any case:

Recommended activity 3.30. *Before investing in any new fleet vehicle, METTELSAT should carefully consider and balance the associated operational, maintenance, and logistical costs against the possibility to hire private transport services whenever necessary.*

Recommended activity 3.31. *METTELSAT should ensure that its personnel can work in a safe and comfortable environment, including at night in the case of GBON observing sites hosting manual (surface and/or upper-air) stations.*

In particular, this implies that each manual GBON observing site hosting a manual surface station should have access to a reliable supply of electricity, sufficient to allow for the simultaneous use of at least a few lights, a computer, and a digital barometer, and (if warranted) an upper-air data acquisition system.

Recommended activity 3.32. *In view of its strained relationship with the RVA, and until such time as this situation can be improved significantly, METTELSAT should aim at having its GBON observing sites set up as independently from the RVA as possible.*

Each observing site is associated to a distinct set of specific circumstances, that will need to be carefully assessed as part of the relevant Investment Requests. Nonetheless, the following needs/objectives can already be formulated for GBON observing sites hosting manual (surface and/or upper-air) stations:

- **Power:** independent and reliable energy source 24/7. When a direct connection to the grid is not realistic or not reliable enough, a dedicated, stand-alone setup should be considered.
- **Network**: a stable internet connection must be available 24/7 to enable (at the very least) the transfer of SYNOP messages to WIS 2.0, and the use of video calls to communicate with the NHQ.
- **Sanitation:** personnel at GBON observing sites should have access to basic sanitation services, including toilets or latrines and running water.
- **Furniture**: GBON observing sites should be equipped with (at least) one work station to assemble SYNOP/METAR messages, one communication work station, and one generic work station, all fully-furnished with a desk, a chair, and a lamp. Observing staff at GBON sites also ought to have access to a rest area comprised of at least one table and one chair (distinct from the work stations) where they can eat and rest.

Recommended activity 3.33. *METTELSAT ought to ensure that its staff maintains its GBON observing sites, and provide them with the necessary equipment's and consumables to do so.*

Basic, regular maintenance activities of work stations and sanitation facilities require (at least) brooms, buckets, hand soap and detergent, sponges and paper rolls. Other consumables for GBON observing sites hosting manual stations include blank A4-paper sheets, pens & pencils, light bulbs, ample supply of specialized forms to be used for operations, as well as any material necessary to ship forms/material/instruments to the NHQ, as warranted by the METTELSAT operational and calibrations procedures. At some sites, specific equipment (such as protective suits to dislodge bee nests) may also be warranted.

3.2 Design of the ICT infrastructure and services

The manual data currently acquired by METTELSAT are first transferred manually to the institution's headquarters in Kinshasa, from where they are manually uploaded onto the GTS by means of a dedicated web-interface developed and maintained by GISC Casablanca.

Recommended activity 3.34. *To attain GBON compliance, observers at manual surface stations should be able to upload their data in real time directly to the GTS/WIS, by means of a dedicated web-interface.*

Ideally, this web interface would be part of a dedicated WIS 2.0 box, that could subsequently also be used for ingesting AWS data. In case of connectivity or hardware issues at the sites:

Recommended activity 3.35. *METTELSAT ought to consider being able to summon on short notice the capacity to have manual observations transferred by the observers to its NHQ (via Short Message Service (SMS), two-way radio, or any other suitable means) for upload to the GTS/WIS.*

Doing so would provide an important backup to the default data flow. In any case:

Recommended activity 3.36. *METTELSAT observers should be able to identify themselves when uploading data onto the GTS/WIS.*

The transmission of data acquired by the AWSs deployed by the World Bank as part of the Hydromet project in the DRC relies on a series of METEOSat channels allocated to METTELSAT to send messages once per hour directly from the station to EUMETSAT in Germany. From there, the messages were intended to be transferred to the METTELSAT headquarters in Kinshasa for ingestion and transcoding by the MESSIR-NEO software, for subsequent transmission towards the Regional Telecommunication Hub (RTH) Brazzaville and eventual ingestion into the GTS. As of July 2024 however, this vision remains to be realized. A CREWS-ASW submitted by METTELSAT in July 2024 seeks to deploy a dedicated WIS 2.0 Box in collaboration with (and on the servers from) GISC Casablanca. The solution is expected to ingest messages issued by the AWSs deployed as part of the Hydromet project directly from EUMETSAT in Germany.

The AWSs deployed within the scope of the "China Aid" project, on the other hand, rely on General Packet Radio Service (GPRS) technology to send messages to China, from where they are redirected to a dedicated terminal in Kinshasa (but never subsequently forwarded to the GTS).

Recommended activity 3.37. *METTELSAT should aim at having its AWSs transmit their data directly to a WIS 2.0 box.*

Recommended activity 3.38. *METTELSAT should favor solutions where the AWSs actively push data out (i.e. no external polling is necessary).*

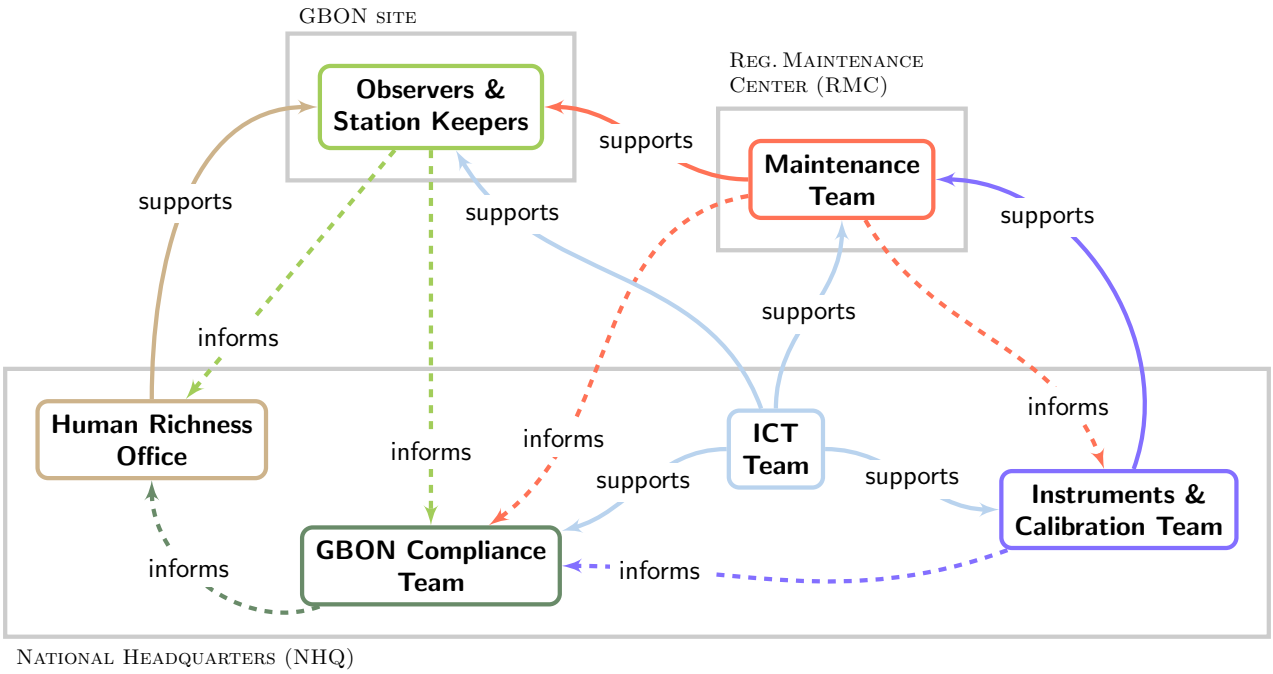

Figure 5: Summary of the teams (and their inter-connectivity) proposed to be assembled within the METTELSAT ecosystem in order to sustainably operate a GBON network. Interactions involving active support are traced using full lines; dashed lines indicated interactions dominated by (regular) transfer of information. In general, support flows upward towards the field, while information flows downward towards the NHQ. See Fig. 6 for list of each team's responsibilities.

Observers

- work in shifts
- issue local METARs
- assemble hourly SYNOPs 24/7 and submit them to the GTS/WIS
- assemble monthly station activity and performance reports

Human Richness Office

- oversees the shifts of the Observers
- validates the payment of relevant compensations
- supports shift re-organization in case of emergency (e.g. via staff swaps)
- organizes formations and team building exercises
- actively contributes to creating safe, inclusive and dignified work environments
- receives and acts upon reports of incident and/or misconduct
- handles conflict resolution
- monitors the need for additional human resources

Station Keepers

- perform basic (weekly) station and site maintenance
- perform basic troubleshooting with support from their RMC

GBON Compliance Team

- monitors the GBON compliance of all sites using WMO and custom tools
- maintains the relevant OSCAR/Surface entries up-to-date
- compiles monthly compliance reports
- follows-up compliance issues with the Instruments & Calibration Team, the RMCs, and the Observers

ICT Team

- supports all other teams with (technical) communication issues
- troubleshoots data flow issues
- develops custom data monitoring tools

Maintenance Team

- supports Observers & Station Keepers with basic troubleshooting
- performs advanced and emergency station maintenance
- stores spare instruments and parts
- deploys new/re-calibrated instruments, and ships problematic ones to the Instruments & Calibration Team

Instruments & Calibration Team

- is responsible for the purchase of new instruments
- keeps exhaustive activity records for each individual instrument and monitors their life-cycle
- operates and maintain the necessary calibration facilities
- monitors the activities of the RMCs
- organizes the planned and un-planned calibration of instruments for all GBON sites, in collaborations with the RMCs
- advises the GBON Compliance Team on data quality issues

Figure 6: Responsibilities of the teams proposed to be assembled within the METTELSAT ecosystem, to enable the sustainable operation of its GBON network.

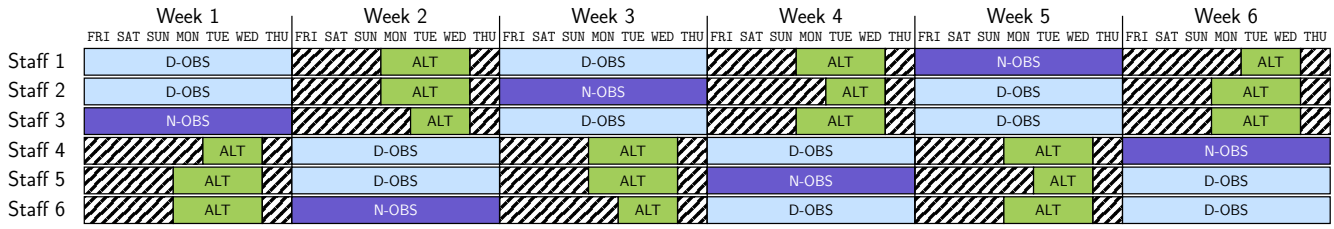

Figure 7: Possible shift structure for a 6-observer METTELSAT GBON observing site hosting a manual surface station to be stabilized as part of the first SOFF Investment Round. METTELSAT and local site personnel ought to have the freedom to adjust this scheme based on their specific national/regional/local circumstances. Two teams of three observers working in 7-day shifts of 8 hrs per day could enable round-the-clock manual GBON observations to reach the GTS. In this proposition, staff members are being granted an additional recovery day (hashed zones) after a night shift (labeled N-OBS in the diagram). On their off-shift (labeled ALT), the observers can work as Station Keepers, on station monitoring and maintenance activities (see Fig. 6).

Doing so would significantly simplify the current data transmission chain, thereby increasing its reliability. One should note that this does not imply stopping the use of the MESSIR-NEO software by METTELSAT, that remains highly meaningful for its operations (beyond the transcoding of raw AWS observations).

Although METTELSAT could certainly be responsible for the management of a cloud-based WIS 2.0 box, a collaboration to that effect with GISC Casablanca would appear highly desirable, at least as long as SOFF financial support remains warranted to maintain the box operational. A cloud-based instance appears favorable, in that it would not require METTELSAT to operate and maintain sensitive ICT equipment on-premises. It terms of reliability, it would also be advantageous if the station data, after reaching the World Wide Web, did not have to be ingested in Kinshasa (without added value) before reaching the WIS 2.0 Box.

Recommended activity 3.39. *If not already done as part of the CREWS-ASW project, METTELSAT should seek to deploy a WIS 2.0 box in collaboration with GISC Casablanca.*

3.3 Design the data management system

We present in Fig. 8 a schematic overview of the data management system foreseen in this NCP. In view of the current state of its data management infrastructure, METTELSAT should initially focus its efforts on ensuring that its GBON observing sites see their data available in near-real time on the GTS/WIS. In doing so, newly-established surface/upper-air stations would stand to immediately contribute to the current METTELSAT forecasting activities that rely on global Numerical Weather Predictions (NWPs) and data extracted from the GTS (but not on data extracted directly from the METTELSAT observing network). Real-time data from manual surface & upper-air stations should also be available at the observing site itself to ensure that METTELSAT can continue its operations in provinces without disruption in case of connectivity loss (see Recommendation 3.24).

Recommended activity 3.40. *METTELSAT should ensure that data from its GBON observing sites are easily accessible by its stakeholders.*

This could be achieved, for example, by means of a web-interface granting public access to the latest measurements of a given station, as illustrated in Fig. 9. Such an interface could be deployed in the cloud alongside a medium-term archive of stations measurements to also enable direct queries by users (see Fig. 8).

Recommended activity 3.41. *When designing new ICT solutions for data management purposes, METTELSAT should always consider and give preference to cloud-based solutions.*

Cloud-based solutions not only allow to minimize the need to operate and maintain physical ICT equipment, they also provide for a straightforward means to scale-up infrastructure: a clear advantage given the CI/CC approach of this NCP, and the significant growth that METTELSAT will need to experience in order to reach GBON compliance at the national level.

Recommended activity 3.42. *METTELSAT should implement a formal Quality Management System (QMS) to assess and monitor the performance of its GBON network.*

This QMS should incorporate official WMO tools (in addition to in-house tools and indicators), including the WIGOS

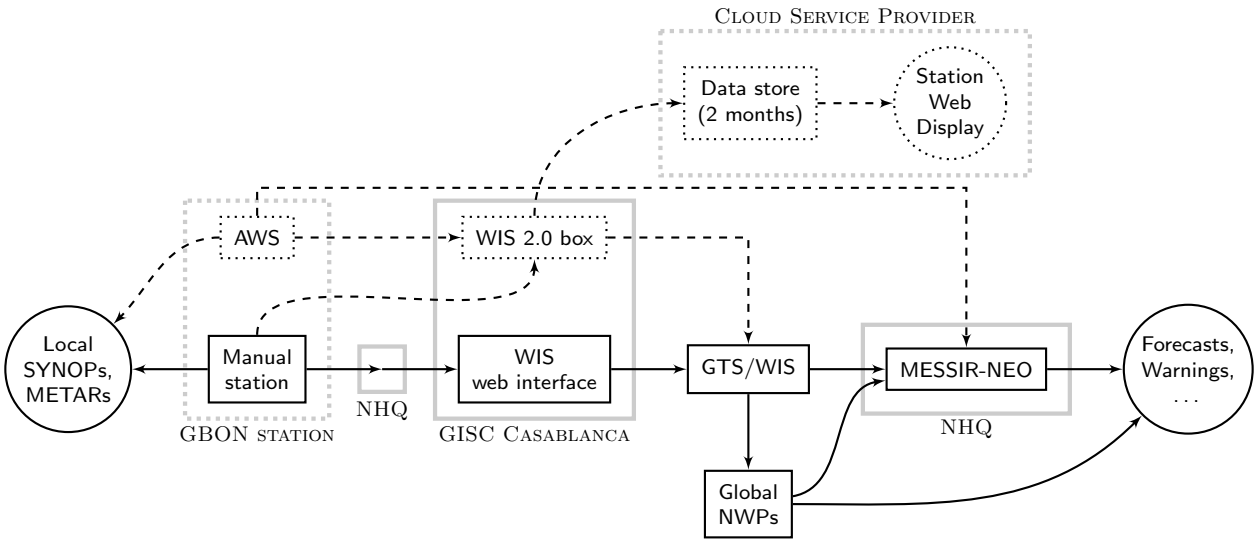

Figure 8: Schematic data management system proposed in this NCP. The redundancy of manual and automatic measurements, foreseen to be initially setup for a handful of key GBON observing sites, is paramount to enable a controlled transition towards AWSs. New data flows to be setup as part of SOFF are traced with dashed lines. Dotted lines identify new infrastructures. The current channel through which manual METTELSAT observations reach the GTS is shown using full arrows. This pathway ought to be reinforced, so that it can serve as a backup for manual observations to be submitted directly to a dedicated WIS 2.0 Box by station observers.

Data Quality Management System (WDQMS)[7] and the GBON compliance app[8].

Recommended activity 3.43. *METTELSAT should assemble a GBON Compliance Team, that ought to be formally responsible for assessing the performance of its GBON observing sites on a weekly basis (at least).*

Recommended activity 3.44. *METTELSAT should ensure that the metadata of its GBON observing sites is kept up-to-date on Observing Systems Capability Analysis and Review Tool (OSCAR)/Surface*[9]*.*

This, in turn, implies that:

Recommended activity 3.45. *METTELSAT ought to actively maintain detailed records of each of its GBON observing sites, that would include (at least) an exhaustive list of relevant stakeholders; site details (including pictures), floor plans, and access information; local personnel details (including responsibilities and expertise); deployed instruments (including serial numbers) and hardware.*

Recommended activity 3.46. *METTELSAT, by means of the Instruments & Calibration Team, ought to keep exhaustive activity records (e.g. dates, location and outcome of any installation, calibration, or service event) for each individual observing equipment.*

Recommended activity 3.47. *METTELSAT management should be kept informed of the GBON compliance level of its network, which also ought to be included in the institution's yearly objectives.*

3.4 Environmental and sustainability considerations

The DRC faces important challenges in terms of environmental sustainability, and so does METTELSAT. Implementing environmentally-sustainable solutions requires tackling significant obstacles, for example the generalized lack of waste management and/or recycling infrastructures.

Recommended activity 3.48. *METTELSAT should systematically consider and assess the environmental impact and sustainability of any financial investment made to achieve GBON compliance in the DRC.*

[7] https://wdqms.wmo.int/
[8] https://gbon-compliance.wmo.int/
[9] https://oscar.wmo.int/surface/#/

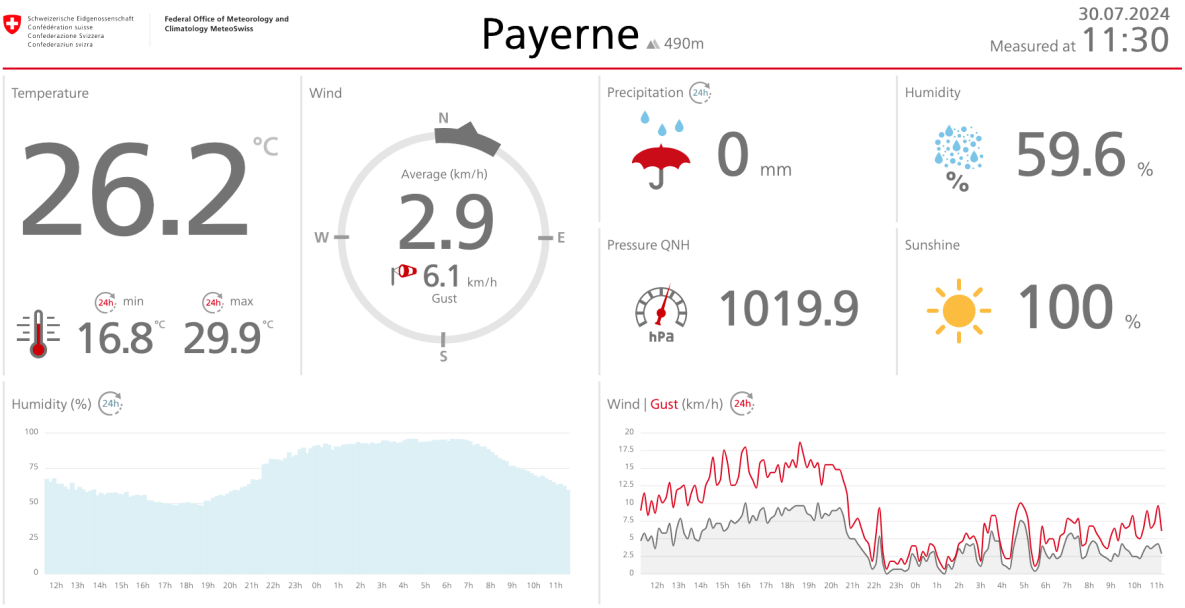

Figure 9: Screenshot of the so-called SMN-Display webpage, providing public access to the real-time measurements from the GBON station of the Federal Office of Meteorology and Climatology (MeteoSwiss) in Payerne. The page is accessible under: `https://swissmetnet-display.ch/pay/en`

Doing so constitutes an important first step towards being able to minimize one's environmental impact. It is also important to consider the full life-cycle of equipment to be installed, and plan for adequate funds to allow for the appropriate dismantlement of equipment at its end-of-life. For the case of radiosondes, for example, METTELSAT should pay close attention to the biodegradability of the different models.

Recommended activity 3.49. *METTELSAT should plan for the removal and appropriate disposal of antiquated, broken, and/or non-functional equipment from the measurement field(s) of its GBON observing sites.*

This is particularly true for analog equipment containing mercury.

It would also be beneficial, from a sustainability and social perspective, to favor short supply chain within the scope of the SOFF project in the DRC.

Recommended activity 3.50. *Whenever possible, METTELSAT should favor the use of local/regional/national contractors.*

The repair of Stevenson screens, for example, is one activity that could possibly be organized using local entities.

Recommended activity 3.51. *METTELSAT should carefully assess and plan for the necessary consumables to be delivered to each of its GBON observing sites and/or Regional Maintenance Centers (RMCs), and for the resulting waste to be appropriately disposed of.*

Module 4. GBON Human Capacity Development

4.1 Assessment of human capacity gaps

The DRC CHD identified that the majority of METTELSAT staff have received basic training in accordance with their duties. However, only few have received recent training on modern scientific, technical and ICT technologies. The majority of training and formations occur on a site-by-site basis, with no coordination at the national level, for example in term of scope, curriculum, training material, requirements, and certification process. A majority of METTELSAT personnel is also yet to be trained on the operation, maintenance, and exploitation of modern meteorological infrastructures and tools and the role (and importance) of GBON. Overall, women represent less than 15% of METTELSAT employees, with several sites employing only men. As of June 2024, METTELSAT reported a total of 623 staff members nation-wide: of the 309 located at the NHQ, 24% are unpaid. In the provinces, the ratio of unpaid staff reaches ∼60% overall (see Table 2 for site-specific data).

Achieving GBON compliance will most likely require METTELSAT to hire new staff members or/and explore the possibility to relocate existing staff members. Several new tasks, for example within the GBON Compliance Team and the Human Richness Office (see Fig. 5), can most certainly be integrated in existing, relevant units. At several GBON observing sites however, acquiring round-the-clock GBON manual measurements will require additional observers, irrespective of the chosen shift model (see Fig. 7). The 40 GBON sites to be established anew (see Module 1) would (at the very least) need to be paired with a local Station Keeper. At the METTELSAT NHQ, the Instruments & Calibration Team will eventually most likely need to be expanded with additional members to handle the network growth. It is also very plausible that new staff members will be required to maintain the upper-air network. One should note, however, that new hires (that would occur over several years) do not necessarily need to translate 1-to-1 into a net growth of the current METTELSAT personnel count. In addition to natural personnel fluctuations, METTELSAT also appears to have a significant potential for internal re-organization.

Recommended activity 4.1. *When selecting sites to benefit from a given Investment Request, METTELSAT and the SOFF Implementing Entity should carefully assess the capacity of METTELSAT to allocate, train, and employ the necessary personnel.*

Doing so will remain critical until a significant improvement in the financial support from the Government, in particular in terms of staff salaries and pensions, materializes itself (see the DRC CHD for details).

The Compendium of WMO Compentency Frameworks (WMO no. 1209)[10] ought to provide METTELSAT with an ideal reference list of competencies, performance criteria, knowledge and skills required for staff members of NMHSs.

Recommended activity 4.2. *METTELSAT should use WMO no. 1209 to regularly evaluate and address the detailed training needs of its personnel.*

Recommended activity 4.3. *METTELSAT should ensure that each SOFF Investment Request includes the necessary training components (following WMO no. 1209) warranted by the technical elements planned for deployment in the Request.*

4.2 Design capacity development activities for technical staff

Recommended activity 4.4. *All existing (and future) METTELSAT personnel at GBON observing sites (that are to become GBON compliant) should be provided dedicated training on: GBON and SOFF principles and requirements; SYNOP assembly; data upload to the GTS/WIS; GBON compliance monitoring (via WDQMS).*

All expertise regarding upper-air observations has been lost within METTELSAT, such that the deployment of upper-air stations will also require exhaustive, extensive, dedicated training.

Physical movement in the DRC is very challenging. It is therefore paramount for GBON sites to require as little on-site visits from outside personnel as possible. To that end:

Recommended activity 4.5. *METTELSAT should ensure that the local staff (namely, Observers and/or Station Keepers) is trained to perform the basic regular maintenance of the observing equipment, together with simple troubleshooting tasks.*

For both manual and automatic surface stations, regular maintenance should include, for example, the thorough dusting of instruments and covers (incl. Stevenson screens), and the cleaning of pluviometer buckets.

[10] `https://library.wmo.int/idurl/4/56877`

Recommended activity 4.6. *METTELSAT should ensure that the local station staff is able to perform more advanced troubleshooting with remote support from experts.*

This would require METTELSAT to establish clear operational guidelines and station maintenance procedures, with an exhaustive supporting manual. Coherent training courses and material should be assembled and dispensed accordingly.

Recommended activity 4.7. *METTELSAT should train and certify its personnel to follow all applicable procedures.*

Refresher courses must be made available upon request from the staff, or when compliance/quality issues are identified.

The transition from manual to automatic systems also implies a gradual change from manual to digital operations for METTELSAT personnel.

Recommended activity 4.8. *METTELSAT should raise the digital awareness and aptitude of its staff, both at its NHQ and in the provinces, by means of dedicated, specialized training as warranted by new/evolving tasks and responsibilities.*

Recommended activity 4.9. *When hiring new staff, METTELSAT should keep in mind the future needs of its RMCs and upper-air stations in terms of technical expertise.*

In particular, RMCs and upper-air sites will benefit from the availability of technical expertise in electronics and ICT among the staff, in addition to physics and meteorology.

Recommended activity 4.10. *Existing and new members of the Instruments & Calibration Team at the METTELSAT NHQ should be trained in modern calibration practices.*

This training could take the form (at least in part) of an in-depth visit to RIC Casblanca. Such a visit would also be the perfect means to establish a working relationship between experts, and clarify the logistics of interactions between METTELSAT and RIC Casablanca. METTELSAT ought also to consider sending some of its calibration experts to visit neighboring, SOFF-benefiting countries to discuss best calibration practices, in anticipation of the transition to AWSs.

Recommended activity 4.11. *Existing and new members of the Instruments & Calibration Team should receive dedicated, in-depth training on the use, maintenance and calibration of any AWS to be deployed within the METTELSAT network.*

These training may require specific, complementary capacity developments, for example in electronics and core ICT concepts.

Recommended activity 4.12. *Existing and new members of the GBON Compliance Team should be trained in the use of WDQMS and the GBON compliance app, OSCAR/Surface, as well as in QMS principles.*

Recommended activity 4.13. *Existing and new members of the Human Richness Office should be trained, ideally with formal certification, in the principles of (at least) conflict resolution, gender balance, and health & safety at the workplace.*

Recommended activity 4.14. *Existing and new members of the ICT Team supporting GBON observations should receive dedicated training on the assembly, deployment, use, maintenance, and upgrade of a WIS 2.0 Box, and any ICT technology warranted by new observational systems.*

4.3 Design capacity development activities for senior management

The CI/CC approach outlined in this NCP implies that a series of SOFF Investment Round funding requests will need to be assembled by METTELSAT and the SOFF Implementing Entity over the course of the project. To that end:

Recommended activity 4.15. *METTELSAT should have its senior management undertake in-depth training, ideally coupled with formal certification, in both strategic and financial project planning.*

It appears particularly important for METTELSAT senior management to use the time of the Investment Phase to anticipate and carefully plan for the transition to the Compliance Phase.

Recommended activity 4.16. *METTELSAT, with the help of the SOFF IE in the DRC, should carefully review all its financial mechanisms (incl. reporting & planning) and associated procedures.*

It would be paramount for this recommendation to be implemented well before METTELSAT enters the SOFF Compliance Phase, to ensure that sound, safe, clear financial mechanisms for the Compliance Phase can be put in place and validated in time.

Recommended activity 4.17. *METTELSAT should have its senior management, together with all the members of the SOFF Task Team, undertake formal training in project management techniques and principles.*

Achieving GBON compliance in the DRC is a challenging objective, that could strongly benefit from an agile mindset.

Recommended activity 4.18. *METTELSAT should have members of the SOFF Task Team, alongside its senior management, trained in the Agile methodology.*

METTELSAT project leaders ought to subsequently promote this methodology within the institution, and in particular within the scope of SOFF. The use of comprehensive QMSs is also key to the stabilization of a GBON network.

Recommended activity 4.19. *METTELSAT should have the members of the SOFF Task Team trained to design, assemble, and champion the use of QMSs within the institution.*

Human resources form a key component to the success of the SOFF project. To that end:

Recommended activity 4.20. *The METTELSAT senior management should perform regular evaluations of the current need for human resources to support the GBON network.*

Recommended activity 4.21. *METTELSAT should implement formal, coherent, transparent recruitment mechanisms (incl. exhaustive job descriptions, candidate screening, interviews, and selection).*

Recommended activity 4.22. *METTELSAT should seek to establish clear salary grids for all positions throughout the institution.*

Recommended activity 4.23. *METTELSAT should keep track of the presence and absence rate of all its staff members.*

4.4 Gender and CSOs considerations

Recommended activity 4.24. *METTELSAT should strive at providing a safe, inclusive, and dignified work environment.*

Recommended activity 4.25. *METTELSAT should assemble a detailed professional code-of-conduct, to be formally signed by all its employees.*

Recommended activity 4.26. *All METTELSAT employees should receive a dedicated, mandatory formation on the institution's code-of-conduct, including the prevention of corruption.*

Recommended activity 4.27. *METTELSAT ought to establish solid, transparent processes to receive and act upon reports of incidents and/or misconduct within the institution.*

According to the SOFF Gender Action Plan adopted by the SOFF StC on 2022-11-02 (Decision 3.3), SOFF Beneficiary Countries are expected to demonstrate 50% of women participating in the capacity building activities, and 50% of women participating in consultations with civil society organizations. The first step towards eventually meeting these objectives is to closely assess and monitor the gender balance throughout the institution and its activities.

Recommended activity 4.28. *METTELSAT ought to maintain clear personnel statistics, including age and gender distributions, for all its sites, for all SOFF-related teams, and for all SOFF-related activities (e.g. workshops, trainings).*

This information should be used by the upper management to assess the gender and age balance within the institution at regular intervals. They should also be provided to the SOFF Implementing Entity and Peer Advisor as part of a regular project progress reports.

It is also paramount to raise awareness regarding the importance and numerous benefits of achieving gender balance within a given institution like METTELSAT.

Recommended activity 4.29. *METTELSAT ought to organize for all its employee mandatory formations on gender sensitive topics (including gender balance), diversity and inclusion, sexual harassment, and intercultural communication.*

Recommended activity 4.30. *METTELSAT, by means of its senior management, ought to clearly position itself and the whole institution in favor of gender balance and diversity.*

This could be achieved by means of a charter and/or the assembly of a working group, for example.

Recommended activity 4.31. *METTELSAT and the Implementing Entity should ensure that all applicable SOFF investments are designed and implemented in such a way so as to promote gender balance and diversity.*

This recommendation implies that, in accordance with the SOFF Gender Action Plan, METTELSAT should strive at having woman represent at least:

- 50% of all participants in SOFF-related and supported trainings,
- 50% of all participants in SOFF consultations, planning workshops, etc ...
- 50% of staff for operating and maintaining GBON observing sites, and
- 50% of staff in decision-making and project management positions.

It is clear that these are ambitious objective that will require time and efforts to be met given the current gender balance within METTELSAT (we refer the interested reader to the CHD for details). Nonetheless, no matter how long the journey, it is paramount that METTELSAT as an institution keeps gender and inclusivity issues close at heart, with constant, sustained, genuine efforts deployed towards improving the existing state-of-affairs.

Finally, Civil Society Organizations (CSOs) ought to provide METTELSAT with an efficient means to reach and interact with additional/new stakeholders and the general public (for example via local CSOs focused on woman's empowerment, but not only).

Recommended activity 4.32. *METTELSAT ought to identify, keep track, and setup an active liaison program with key CSOs at all its GBON observing sites, with a focus on local CSOs that stand to benefit most from meteorological and climate information.*

GBON observing sites, through their staff, ought to provide METTELSAT with the ideal means to build meaningful, sustained, local connections, for example by means of dedicated visits and workshops. Doing so, in turn, ought to also contribute to boost the visibility, safety and local ownership of upper-air and surface stations.

Module 5. Risk Management Framework

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

SOFF in the DRC faces several of the contextual and programmatic risks outlined in the SOFF Risk Management Framework, as well as risks specific to the implementation plan outlined in this NCP. They are all reviewed here (including the respective risk levels) in view of the situation on the ground as revealed by the CHD.

5.1.1 Insufficient institutional capacity and/or political commitment to ensure successful implementation of SOFF

Risk level	Likelihood	Impact	Significance of residual risk
Very High	Very Likely	Major	Very High

Description In the Hydromet project completion report, the World Bank (2023) noted that "*the absence of Government counterpart funding reflected a lack of political will to support METTELSAT in fulfilling its mission*". Until this state-of-affair changes, METTELSAT is unlikely to see an improvement in its long-standing stream of insufficient budget allocations, or in the (so far) nonexistent revenue generation from aeronautical services resulting from the "*long-standing dispute*" between METTELSAT and the RVA (World Bank, 2023; Gomez and Nikiema, 2023).

Risk Mitigation Measures The CI/CC approach outlined in Fig. 1 is (also) designed to gradually strengthen the position of METTELSAT vis-à-vis its stakeholders.

Recommended activity 5.1. *Until the financial situation of METTELSAT improves, SOFF should stand ready to support all the operational costs of newly established GBON observing sites, and proceed with Investment Requests accordingly.*

Recommended activity 5.2. *Until the dispute between METTELSAT and the RVA can be resolved in such a way that a solid, collaborative relationship can be re-established between the two entities, SOFF investments should be made on RVA grounds only if it can be demonstrated explicitly that METTELSAT will be granted stable, regular, long-term access to the station.*

Residual risk after mitigation measures As identified by the CHD, the existence of explicit, written agreements and Memorandum of Understanding does not guarantee that they will be followed in practice.

5.1.2 Programmatic targets cannot be reached because of conflict and/or political insecurity negatively affecting SOFF implementation

Risk level	Likelihood	Impact	Significance of residual risk
Very High	Very Likely	Major	High

Description Several regions of the DRC, in particular in the East (incl. North-Kivu and Ituri) are subject to severe security threat and active, long-lasting armed conflicts.

Risk Mitigation Measures

Recommended activity 5.3. *In view of the security risks for the staff of METTELSAT, the IE, the Peer Advisor, and contractors, as well as the risk of damage to METTELSAT infrastructures, SOFF investments should not be made in regions where an advice against all travel is in place, as emitted (for example) by the United Kingdom Foreign, Commonwealth and Development Office.*

Residual risk after mitigation measures Implementation of SOFF activities might need to be halted (or not even started) in specific regions if the security situation deteriorates, despite the risk mitigation measures and proactive engagement.

5.1.3 Non-compliance with fiduciary and procurement standards in some SOFF activities

Risk level	Likelihood	Impact	Significance of residual risk
High	Possible	Major	Medium

Risk Mitigation Measures SOFF relies on the Implementing Entity's fiduciary and procurement standards during the Investment phase. In particular, the Implementing Entity will have signed an agreement before receiving funds that includes explicit fiduciary and procurement standards. Both the Peer Advisor and the Implementing Entity will also be provided with extensive WMO guidance on standards and good practices for implementing GBON.

Recommended activity 5.4. *The SOFF IE should issue (at least) annual reports to ensure that the SOFF Secretariat remains informed of the emergency of possible risks of non-compliance situations and the corrective actions that the IE is planning to take.*

Residual risk after mitigation measures Even with strong fiduciary and procurement standards, procedures, and oversight in place, there is a residual risk of non-compliance in the DRC.

5.1.4 METTELSAT staff depart after being trained

Risk level	Likelihood	Impact	Significance of residual risk
High	Possible	Major	Medium

Risk Mitigation Measures The SOFF Compliance phase provides financial support for operations and maintenance, which includes staff-costs. This can be expected to help hire/retain METTELSAT staff, in particular in the provinces.

Recommended activity 5.5. *Each Investment Round funding request should carefully assess the METTELSAT staffing situation associated with the specific sites to be (re-)rehabilitated.*

In particular, it should outline the anticipated need for direct staff-cost support when the station enters the SOFF Compliance phase.

Recommended activity 5.6. *The SOFF Steering Committee should approve a specific Investment Round funding request only if it can reasonably foresee that (re-)habilitated stations will be allowed to enter the SOFF Compliance phase once they have become GBON compliant.*

Recommended activity 5.7. *METTELSAT should strive at becoming an attractive employer that can retain highly-skilled personnel.*

Doing so requires an evolution of the current salary scales by the government, which lies outside of the control of METTELSAT (that should nonetheless continue advocating for it). METTELSAT should also strive at increasing its attractivity as an employer, by offering stimulating positions with clear opportunities for skill growth and career evolution.

Recommended activity 5.8. *METTELSAT should ensure that there is sufficient redundancy in terms of the distribution of specific, expert knowledge among its staff, to build resilience in case of unforeseen departures.*

Recommended activity 5.9. *METTELSAT should assemble clear, comprehensive training material to facilitate and speed-up the on-boarding of new personnel, and ensure a uniform training quality throughout the institution.*

Residual risk after mitigation measures Even with SOFF support, trained staff might decide to leave for other reasons, leaving a capacity gap. METTELSAT is unlikely to meet the same salary standards as the private sector. It should instead rely on its ability to provide stimulating positions, highlighting its contribution to improving the quality of life of local populations.

5.1.5 SOFF investments cause environmental or social impacts

Risk level	Likelihood	Impact	Significance of residual risk
High	Possible	Major	Low

Risk Mitigation Measures SOFF will rely on the environmental and social standards guidelines, and procedures of the IE in the DRC, including its grievance and control mechanisms. SOFF financial investments are expected to have modest environmental and social impacts. The main risk lies in a further degradation of the image of METTELSAT vis-à-vis its stakeholders, the government and the general population, should the project fail to result in tangible outcomes.

Recommended activity 5.10. *Individual SOFF Investment Rounds should target easy fixes, and do so within a time frame of no more than 24 months.*

Recommended activity 5.11. *METTELSAT should make clear, explicit allocation of sufficient personnel to follow-up and execute the actions outlined in the Investment Round financing requests.*

Recommended activity 5.12. *METTELSAT should maintain close ties with the Implementing Entity and the Peer Advisor throughout the duration of the SOFF project, and keep them apprised of any developments, expected or not.*

Recommended activity 5.13. *METTELSAT, by means of a dedicated formation, ought to raise awareness regarding the environmental impact of meteorological observations (including the specific danger associated with mercury instruments, and the disposal & recycling of electronic waste) among its staff (including managers) in Kinshasa and the provinces.*

Recommended activity 5.14. *METTELSAT should systematically assess the expected environmental and social impact associated with a given SOFF financial investment, to be included in the relevant Investment Request.*

Residual risk after mitigation measures Even with strong environmental and social standards, procedures, and oversight in place, there is some residual risk of non- compliance.

5.1.6 Slow implementation and delays in procurement, installation and capacity building activities

Risk level	Likelihood	Impact	Significance of residual risk
High	Likely	Moderate	Medium

Risk Mitigation Measures MeteoSwiss, as SOFF peer advisor, will stand ready to provide technical advice to the SOFF IE when facing technical difficulties with procurements. Funding requests for each Investment Rounds will be the result of multiple consultations between METTELSAT, MeteoSwiss and the IE where foreseeable issues related to procurement and installation are discussed and potential solutions identified. The SOFF Secretariat will also closely monitors implementation and facilitate troubleshooting among SOFF partners to find solutions or corrective measures. The WMO Technical Authority will also provides additional ad hoc technical guidance on GBON implementation to MeteoSwiss and the IE.

Furthermore, the proposed approach of stabilizing manual surface stations with a gradual, controlled transition to automatic systems builds upon existing skills. This will allow to spread the need for capacity building over a longer time frame, while minimizing the risk associated with a sudden and drastic operational change.

In terms of equipment installation, the METTELSAT network will be assembled gradually, starting with the most easily accessible sites and manual equipment.

Recommended activity 5.15. *METTELSAT should deploy AWSs on new and/or remote GBON observing sites only once a solid network backbone (comprised of RMCs) has been established.*

Residual risk after mitigation measures Even with strong risk mitigation measures, situations where factors outside SOFF control delay the implementation may arise (from economic crises to conflict).

5.1.7 After the conclusion of the Investment Phase, GBON data are not collected or shared or are shared of insufficient quality or do not improve forecast skills/climate services

Risk level	Likelihood	Impact	Significance of residual risk
High	Possible	Major	Medium

Risk Mitigation Measures SOFF will contribute to operations and maintenance expenses through result-based finance provided upon sharing of data by METTELSAT. The SOFF Investment Phase includes upfront operations and main-

tenance funding for the first year after a GBON infrastructure has been installed. This will ensure that METTELSAT demonstrates that it can share the data before the first annual results-based payments kick in.

Recommended activity 5.16. *METTELSAT should implement a performance-validation mechanism to authorize the payment of SOFF-funded supplemental staff-costs to its personnel by the Implementing Entity.*

This could be done by the Human Richness Office, for example (see Fig. 6).

Risk will be mitigated further by proceeding with a series of sequential Investment Rounds in the DRC (see Module 1). The WMO Technical Authority will provide extensive guidance to MeteoSwiss and the IE on standards and good practices for implementing GBON in the DRC. Together with the SOFF Secretariat, they will monitor progress toward GBON compliance, as part of the SOFF Compliance Framework, including data quality and provide quarterly feedback. Recommendation 3.34 would mitigate this risk by simplifying (and thus strengthening) the GBON data flow.

Residual risk after mitigation measures Even with the innovative SOFF payment mechanism, METTELSAT may not be able to summon the required minimum contribution to operations and maintenance activities (to be complemented by SOFF result-based finance). Security and political conditions in the DRC may also interfere with the operation of observation facilities, and/or with the sharing of data.

5.1.8 Destruction or theft of SOFF-financed equipment and infrastructure

Risk level	Likelihood	Impact	Significance of residual risk
High	Likely	Major	High

Description Previous deployment of AWSs by the World Bank as part of the Hydromet project have revealed that technical equipment is prone to theft or vandalism at specific locations, at times triggered by a general misinformation regarding the nature and purpose of the equipment.

Risk Mitigation Measures In addition to site protective measures, engagement with the local community is crucial to enhance the security of the sites.

Recommended activity 5.17. *When selecting new GBON observing sites, METTELSAT should give priority to the safety of its equipment over the quality of the measurements.*

Recommended activity 5.18. *SOFF-funded equipment and material should be deployed on GBON observing sites that have measurement fields that are clearly delineated and identified as such, by means of an explanatory panel written in the languages spoken within the local community.*

Recommended activity 5.19. *METTELSAT should design and implement an outreach program targeting local communities, in order to raise awareness regarding the nature, role and importance (for the local community) of material and equipment on its GBON observing sites.*

This program should rely on local METTELSAT personnel to reach out and liaise with the local community (and local government) at least once per year: for example, by means of an open day or via dedicated radio programs.

Recommended activity 5.20. *METTELSAT should identify all stations were its material was subject to theft or vandalism in recent years. At those sites, METTELSAT should ensure that activities to engage with the local community take place very rapidly after the deployment of SOFF-funded equipment.*

Residual risk after mitigation measures Even with strong security measures and engagement of the local community, this risk may materialize in specific locations.

Module 6. Transition to SOFF Investment Phase

MeteoSwiss will support and accompany METTELSAT and the IE in preparing the first Investment Round funding request, based on recommendations made in this NCP.

Recommended activity 6.1. *The first Investment Round funding request to be prepared by the SOFF IE in the DRC and METTELSAT should target easy fixes achievable within a maximum of 2 years of active investments (followed by 1 year of commissioning), with the goal to see newly-GBON-compliant stations enter the SOFF Compliance Phase immediately upon completion of the Investment Round.*

Recommended activity 6.2. *The first Investment Round should focus on stabilizing a few key sites (see Table 2), and have them become GBON compliant by means of manual surface stations.*

The subset of key sites for this first Investment Round should take into account the availability of METTELSAT personnel on-site, the geo-political stability of the region, its accessibility, as well as the site's potential to eventually evolve into a RMC.

Recommended activity 6.3. *The first Investment Round should also incorporate the possibility for METTELSAT to perform in-depth, in-situ tests of AWSs to identify suitable technology for expanding the GBON network in the DRC.*

Manufacturers of AWS could possibly be contacted directly for discussing such an assessment. The emission of a formal call-for-tender would however likely be more apt at identifying suitable AWS technology and relevant manufacturers.

Recommended activity 6.4. *All Investment Round funding requests should include clear objectives and specific targets that will have to be met before a subsequent Investment Round is submitted to the SOFF Steering Committee.*

Recommended activity 6.5. *All Investment Round funding requests should refer to this NCP, and include a list of all the Recommendations specified in Table 3 (noting whether they are met fully, partially or not at all).*

Summary of the GBON National Contribution Plan

The specific recommendations made throughout this NCP are listed in Table 3. The reader is referred to the specific Modules for further information regarding each recommended activity.

Table 3: Summary of the GBON National Contribution Plan for the DRC.

Module Id.	Page	Recommended activities
Module 1. National Target toward GBON Compliance		
1.1	7	Each Investment Round ought to last at most 36 months (including a 12-month commissioning period), and have objectives designed accordingly.
1.2	7	METTELSAT ought to assemble a "SOFF Task Team" for each Investment Round.
1.3	7	METTELSAT ought to consider having one representative of each observing site (to benefit from a given Investment Round) present in the SOFF Task Team.
1.4	7	Members of the SOFF Task Team ought to meet on a bi-weekly basis. The detailed attendance and succinct meeting notes ought to be shared with the Implementing Entity and the Peer Advisor.
1.5	7	METTELSAT ought to organize a kick-off workshop at the start of each Investment Round.
1.6	8	METTELSAT ought to ensure that at least one member of the SOFF Task Team is fluent in English.
Module 2. GBON business model and institutional development		
2.1	11	When planning for a new GBON site, METTELSAT should evaluate the possibility to deploy instruments either on one of its own (historical) location, or, if feasible and more suitable in terms of site safety and/or availability of personnel, on one of the existing site of its key stakeholders.
2.2	11	The establishment of any new GBON observing site by METTELSAT (even on historical observing locations) should begin by a very careful and exhaustive site assessment in terms of safety, utilities, long-term access, personnel availability, and meteorological suitability.
2.3	11	METTELSAT should first aim at establishing a series of GBON observing sites at locations over which it has direct control, before considering synergies with stakeholder networks.
2.4	11	METTELSAT should monitor the progress towards GBON compliance of neighboring countries, together with the associated solutions implemented as part of SOFF.
2.5	12	METTELSAT should consider attending every WMO TECO.
2.6	12	Participation to TECOs should be contigent upon the submission by METTELSAT of at least one poster describing the SOFF project status in the DRC.
2.7	12	METTELSAT should maintain and further enhance its working relationship with GISC Casablanca, and by extension with the RWC and the RIC at the same location, that ought to become METTELSAT's prime GISC/RWC/RIC partners.
2.8	12	METTELSAT staff members (Observers and/or Station Keepers, maintenance technicians) working on GBON observing sites or at RMCs to be established as part of the SOFF project in the DRC should be paid fairly, regularly, and reliably.
2.9	12	The SOFF Implementing Entity (IE) for the DRC should identify a suitable means to cover supplemental staff-costs by direct interaction with the beneficiaries (e.g. the individual observers).
2.10	13	For each Investment Round funding request, METTELSAT should evaluate whether the emergence of new private partners (e.g. in the field of ICT) could warrant a change towards another business model (e.g. public-private) to maintain and operate the GBON network in the DRC.
2.11	13	METTELSAT should strive at implementing its draft WIGOS plan, in direct support of the SOFF project.
2.12	13	METTELSAT should allocate sufficient personnel to its different capacity development projects, to ensure that their respective implementation timelines can be met.
2.13	13	METTELSAT should ensure that a regular exchange of information takes place between the teams assigned to its different capacity development projects.
2.14	13	METTELSAT ought to ensure that its import-export permit is up-to-date and remains valid throughout the SOFF project.
2.15	13	METTELSAT ought to submit to the responsible ministry a formal request for tax exoneration applicable to SOFF-related imports, both during the Investment and Compliance phases of the project.
2.16	14	METTELSAT ought to clearly mention its commitment to the free and open international sharing of GBON data in relevant documents, such as business & operational plans, 5/10-year strategy, etc ...
Module 3. GBON infrastructure development		

Table 3: continued.

Module Id.	Page	Recommended activities
3.1	16	METTELSAT should begin by stabilizing its manual surface stations at key observing sites, to see them become GBON-compliant.
3.2	16	Each manual surface station should be equipped with analogue wet and dry thermometers located within a Stevenson screen, an anemometer and vane, a rain gauge, and one digital barometer.
3.3	17	METTELSAT ought to use the renewal of existing instruments at manual stations as an opportunity to develop and implement formal practices and data validation mechanisms to ensure the continuity and stability of its measurement time series.
3.4	17	METTELSAT should seek to re-establish a national calibration center at its NHQ, with an initial focus on atmospheric pressure.
3.5	17	METTELSAT should ensure that the instruments used for acquiring GBON observations are regularly calibrated with a level of accuracy sufficient to meet the GBON quality requirements.
3.6	17	METTELSAT should carefully assess the logistics associated with the calibration of its observing equipment, and adopt the most favorable option.
3.7	17	METTELSAT should implement a formal & reliable procedure to safely and regularly transfer instruments and material between its NHQ and its GBON observing sites (via its RMCs).
3.8	17	METTELSAT should review and (if warranted) grow/evolve its calibration setup with each SOFF Investment Round, to ensure that it is continuously able to meet the necessary GBON quality requirements for the stations to be rehabilitated/re-established.
3.9	17	METTELSAT should plan for any national etalons located at its NHQ to be regularly checked and calibrated against international etalons at a WMO RIC.
3.10	17	Prior to deploying a new AWS technology dedicated to GBON observations, METTELSAT should first seek to perform in-depth tests at its headquarters.
3.11	18	METTELSAT should ensure that all key departments are taking an active part in pre-deployment tests of new AWSs, and contribute to establishing dedicated rules and guidelines for operations, maintenance, and calibration.
3.12	18	METTELSAT should only implement palliative care activities (i.e. the regular cleaning of the system) for the AWS models currently deployed on its GBON observing sites.
3.13	18	METTELSAT should establish and implement clear operational guidelines to stabilize and secure its GBON observing sites.
3.14	18	When transitioning to AWS technology, METTELSAT should first seek to deploy new AWSs on a few GBON observing sites hosting manual surface stations.
3.15	18	METTELSAT should ensure that Rec. 3.13 is also followed for GBON observing sites hosting an AWS but no observers, by means of a Station Keeper that ought to visit the site at least once per week.
3.16	18	METTELSAT should strive at deploying hardware solutions across its GBON network that, short of being uniform, are highly compatible with one another.
3.17	19	METTELSAT and the SOFF IE in the DRC should ensure that selected technological solutions are compatible with any recommendation or guidelines issued by the TT-FirstMile assembled under WMO's SC-IMT.
3.18	19	METTELSAT and the SOFF IE in the DRC should abide by the official GBON Tender Specifications for AWSs and radiosonde-related procurements, namely TT-GBON documents 6.1[11] and 6.2[12].
3.19	19	The SOFF IE in the DRC ought to consult and interact closely with METTELSAT when preparing call-for-tenders, to ensure that all appropriate needs and requirements can be specified in sufficient details.
3.20	19	METTELSAT should have several of its key observing sites evolve into Regional Maintenance Centers (RMCs) and upper-air stations.
3.21	19	The ownership of all observing instruments should lie with the Instruments & Calibration Team at the National Headquarters (NHQ).
3.22	19	METTELSAT should ensure that robust, reliable communication channels exist between the NHQ, the RMCs, and the GBON observing sites hosting manual stations, including the means to communicate in real time with video.
3.23	19	METTELSAT should implement a formal procedure to document all station maintenance activities.

[11] https://wmoomm.sharepoint.com/:b:/s/wmocpdb/Ecvr45QvsGZAsQA5FZFcnawBiVkAsBFp36U-t_Z52Isq3A?e=NEfgs8
[12] https://wmoomm.sharepoint.com/:b:/s/wmocpdb/EZeqACbXbOlEs-bieNiO4wYBBOBmeYjb3gE9Ddvpa3nVhQ?e=xN2lYo

Table 3: continued.

Module Id.	Page	Recommended activities
3.24	19	When operating an AWS on a manned site, METTELSAT should ensure that local observers have a direct access to the live meteorological measurements acquired by the automatic system, independent of the station's connectivity to the outside World.
3.25	19	To support the operation of its GBON network, METTELSAT ought to consider assembling an Instruments & Calibration Team, an ICT Team, a GBON Compliance Team, and a Human Richness Office.
3.26	20	When deploying upper-air stations, METTELSAT should favor manual systems (and thus avoid auto-launchers) to maximize the reliance of its GBON upper-air network.
3.27	20	In view of the growing scarcity of He worldwide, METTELSAT ought to favor the use of H_2 as lift gas for its upper-air stations.
3.28	20	When establishing a new upper-air station, METTELSAT should carefully assess the possibility to procure a sufficient amount of H_2 with the necessary regularity by means of a local manufacturer, and only commit to setting up a local H_2 production at the GBON observing site if no suitable alternative is identified.
3.29	20	METTELSAT should ensure that its staff members have the means to access the applicable GBON observing site(s) and/or RMC.
3.30	20	Before investing in any new fleet vehicle, METTELSAT should carefully consider and balance the associated operational, maintenance, and logistical costs against the possibility to hire private transport services whenever necessary.
3.31	20	METTELSAT should ensure that its personnel can work in a safe and comfortable environment, including at night in the case of GBON observing sites hosting manual (surface and/or upper-air) stations.
3.32	20	In view of its strained relationship with the RVA, and until such time as this situation can be improved significantly, METTELSAT should aim at having its GBON observing sites set up as independently from the RVA as possible.
3.33	21	METTELSAT ought to ensure that its staff maintains its GBON observing sites, and provide them with the necessary equipment's and consumables to do so.
3.34	21	To attain GBON compliance, observers at manual surface stations should be able to upload their data in real time directly to the GTS/WIS, by means of a dedicated web-interface.
3.35	21	METTELSAT ought to consider being able to summon on short notice the capacity to have manual observations transferred by the observers to its NHQ (via SMS, two-way radio, or any other suitable means) for upload to the GTS/WIS.
3.36	21	METTELSAT observers should be able to identify themselves when uploading data onto the GTS/WIS.
3.37	21	METTELSAT should aim at having its AWSs transmit their data directly to a WIS 2.0 box.
3.38	21	METTELSAT should favor solutions where the AWSs actively push data out (i.e. no external polling is necessary).
3.39	23	If not already done as part of the CREWS-ASW project, METTELSAT should seek to deploy a WIS 2.0 box in collaboration with GISC Casablanca.
3.40	23	METTELSAT should ensure that data from its GBON observing sites are easily accessible by its stakeholders.
3.41	23	When designing new ICT solutions for data management purposes, METTELSAT should always consider and give preference to cloud-based solutions.
3.42	23	METTELSAT should implement a formal QMS to assess and monitor the performance of its GBON network.
3.43	24	METTELSAT should assemble a GBON Compliance Team, that ought to be formally responsible for assessing the performance of its GBON observing sites on a weekly basis (at least).
3.44	24	METTELSAT should ensure that the metadata of its GBON observing sites is kept up-to-date on OSCAR/Surface[13].
3.45	24	METTELSAT ought to actively maintain detailed records of each of its GBON observing sites, that would include (at least) an exhaustive list of relevant stakeholders; site details (including pictures), floor plans, and access information; local personnel details (including responsibilities and expertise); deployed instruments (including serial numbers) and hardware.
3.46	24	METTELSAT, by means of the Instruments & Calibration Team, ought to keep exhaustive activity records (e.g. dates, location and outcome of any installation, calibration, or service event) for each individual observing equipment.

[13] `https://oscar.wmo.int/surface/#/`

Table 3: continued.

Module Id.	Page	Recommended activities
3.47	24	METTELSAT management should be kept informed of the GBON compliance level of its network, which also ought to be included in the institution's yearly objectives.
3.48	24	METTELSAT should systematically consider and assess the environmental impact and sustainability of any financial investment made to achieve GBON compliance in the DRC.
3.49	25	METTELSAT should plan for the removal and appropriate disposal of antiquated, broken, and/or non-functional equipment from the measurement field(s) of its GBON observing sites.
3.50	25	Whenever possible, METTELSAT should favor the use of local/regional/national contractors.
3.51	25	METTELSAT should carefully assess and plan for the necessary consumables to be delivered to each of its GBON observing sites and/or Regional Maintenance Centers (RMCs), and for the resulting waste to be appropriately disposed of.
Module 4. GBON human capacity development		
4.1	26	When selecting sites to benefit from a given Investment Request, METTELSAT and the SOFF Implementing Entity should carefully assess the capacity of METTELSAT to allocate, train, and employ the necessary personnel.
4.2	26	METTELSAT should use WMO no. 1209 to regularly evaluate and address the detailed training needs of its personnel.
4.3	26	METTELSAT should ensure that each SOFF Investment Request includes the necessary training components (following WMO no. 1209) warranted by the technical elements planned for deployment in the Request.
4.4	26	All existing (and future) METTELSAT personnel at GBON observing sites (that are to become GBON compliant) should be provided dedicated training on: GBON and SOFF principles and requirements; SYNOP assembly; data upload to the GTS/WIS; GBON compliance monitoring (via WDQMS).
4.5	26	METTELSAT should ensure that the local staff (namely, Observers and/or Station Keepers) is trained to perform the basic regular maintenance of the observing equipment, together with simple troubleshooting tasks.
4.6	27	METTELSAT should ensure that the local station staff is able to perform more advanced troubleshooting with remote support from experts.
4.7	27	METTELSAT should train and certify its personnel to follow all applicable procedures.
4.8	27	METTELSAT should raise the digital awareness and aptitude of its staff, both at its NHQ and in the provinces, by means of dedicated, specialized training as warranted by new/evolving tasks and responsibilities.
4.9	27	When hiring new staff, METTELSAT should keep in mind the future needs of its RMCs and upper-air stations in terms of technical expertise.
4.10	27	Existing and new members of the Instruments & Calibration Team at the METTELSAT NHQ should be trained in modern calibration practices.
4.11	27	Existing and new members of the Instruments & Calibration Team should receive dedicated, in-depth training on the use, maintenance and calibration of any AWS to be deployed within the METTELSAT network.
4.12	27	Existing and new members of the GBON Compliance Team should be trained in the use of WDQMS and the GBON compliance app, OSCAR/Surface, as well as in QMS principles.
4.13	27	Existing and new members of the Human Richness Office should be trained, ideally with formal certification, in the principles of (at least) conflict resolution, gender balance, and health & safety at the workplace.
4.14	27	Existing and new members of the ICT Team supporting GBON observations should receive dedicated training on the assembly, deployment, use, maintenance, and upgrade of a WIS 2.0 Box, and any ICT technology warranted by new observational systems.
4.15	27	METTELSAT should have its senior management undertake in-depth training, ideally coupled with formal certification, in both strategic and financial project planning.
4.16	27	METTELSAT, with the help of the SOFF IE in the DRC, should carefully review all its financial mechanisms (incl. reporting & planning) and associated procedures.
4.17	28	METTELSAT should have its senior management, together with all the members of the SOFF Task Team, undertake formal training in project management techniques and principles.
4.18	28	METTELSAT should have members of the SOFF Task Team, alongside its senior management, trained in the Agile methodology.

Table 3: continued.

Module Id.	Page	Recommended activities
4.19	28	METTELSAT should have the members of the SOFF Task Team trained to design, assemble, and champion the use of QMSs within the institution.
4.20	28	The METTELSAT senior management should perform regular evaluations of the current need for human resources to support the GBON network.
4.21	28	METTELSAT should implement formal, coherent, transparent recruitment mechanisms (incl. exhaustive job descriptions, candidate screening, interviews, and selection).
4.22	28	METTELSAT should seek to establish clear salary grids for all positions throughout the institution.
4.23	28	METTELSAT should keep track of the presence and absence rate of all its staff members.
4.24	28	METTELSAT should strive at providing a safe, inclusive, and dignified work environment.
4.25	28	METTELSAT should assemble a detailed professional code-of-conduct, to be formally signed by all its employees.
4.26	28	All METTELSAT employees should receive a dedicated, mandatory formation on the institution's code-of-conduct, including the prevention of corruption.
4.27	28	METTELSAT ought to establish solid, transparent processes to receive and act upon reports of incidents and/or misconduct within the institution.
4.28	28	METTELSAT ought to maintain clear personnel statistics, including age and gender distributions, for all its sites, for all SOFF-related teams, and for all SOFF-related activities (e.g. workshops, trainings).
4.29	28	METTELSAT ought to organize for all its employee mandatory formations on gender sensitive topics (including gender balance), diversity and inclusion, sexual harassment, and intercultural communication.
4.30	28	METTELSAT, by means of its senior management, ought to clearly position itself and the whole institution in favor of gender balance and diversity.
4.31	28	METTELSAT and the Implementing Entity should ensure that all applicable SOFF investments are designed and implemented in such a way so as to promote gender balance and diversity.
4.32	29	METTELSAT ought to identify, keep track, and setup an active liaison program with key CSOs at all its GBON observing sites, with a focus on local CSOs that stand to benefit most from meteorological and climate information.
Module 5. Risk management		
5.1	30	Until the financial situation of METTELSAT improves, SOFF should stand ready to support all the operational costs of newly established GBON observing sites, and proceed with Investment Requests accordingly.
5.2	30	Until the dispute between METTELSAT and the RVA can be resolved in such a way that a solid, collaborative relationship can be re-established between the two entities, SOFF investments should be made on RVA grounds only if it can be demonstrated explicitly that METTELSAT will be granted stable, regular, long-term access to the station.
5.3	30	In view of the security risks for the staff of METTELSAT, the IE, the Peer Advisor, and contractors, as well as the risk of damage to METTELSAT infrastructures, SOFF investments should not be made in regions where an advice against all travel is in place, as emitted (for example) by the United Kingdom Foreign, Commonwealth and Development Office.
5.4	31	The SOFF IE should issue (at least) annual reports to ensure that the SOFF Secretariat remains informed of the emergency of possible risks of non-compliance situations and the corrective actions that the IE is planning to take.
5.5	31	Each Investment Round funding request should carefully assess the METTELSAT staffing situation associated with the specific sites to be (re-)rehabilitated.
5.6	31	The SOFF Steering Committee should approve a specific Investment Round funding request only if it can reasonably foresee that (re-)habilitated stations will be allowed to enter the SOFF Compliance phase once they have become GBON compliant.
5.7	31	METTELSAT should strive at becoming an attractive employer that can retain highly-skilled personnel.
5.8	31	METTELSAT should ensure that there is sufficient redundancy in terms of the distribution of specific, expert knowledge among its staff, to build resilience in case of unforeseen departures.
5.9	31	METTELSAT should assemble clear, comprehensive training material to facilitate and speed-up the onboarding of new personnel, and ensure a uniform training quality throughout the institution.
5.10	32	Individual SOFF Investment Rounds should target easy fixes, and do so within a time frame of no more than 24 months.

Table 3: continued.

Module Id.	Page	Recommended activities
5.11	32	METTELSAT should make clear, explicit allocation of sufficient personnel to follow-up and execute the actions outlined in the Investment Round financing requests.
5.12	32	METTELSAT should maintain close ties with the Implementing Entity and the Peer Advisor throughout the duration of the SOFF project, and keep them apprised of any developments, expected or not.
5.13	32	METTELSAT, by means of a dedicated formation, ought to raise awareness regarding the environmental impact of meteorological observations (including the specific danger associated with mercury instruments, and the disposal & recycling of electronic waste) among its staff (including managers) in Kinshasa and the provinces.
5.14	32	METTELSAT should systematically assess the expected environmental and social impact associated with a given SOFF financial investment, to be included in the relevant Investment Request.
5.15	32	METTELSAT should deploy AWSs on new and/or remote GBON observing sites only once a solid network backbone (comprised of RMCs) has been established.
5.16	33	METTELSAT should implement a performance-validation mechanism to authorize the payment of SOFF-funded supplemental staff-costs to its personnel by the Implementing Entity.
5.17	33	When selecting new GBON observing sites, METTELSAT should give priority to the safety of its equipment over the quality of the measurements.
5.18	33	SOFF-funded equipment and material should be deployed on GBON observing sites that have measurement fields that are clearly delineated and identified as such, by means of an explanatory panel written in the languages spoken within the local community.
5.19	33	METTELSAT should design and implement an outreach program targeting local communities, in order to raise awareness regarding the nature, role and importance (for the local community) of material and equipment on its GBON observing sites.
5.20	33	METTELSAT should identify all stations were its material was subject to theft or vandalism in recent years. At those sites, METTELSAT should ensure that activities to engage with the local community take place very rapidly after the deployment of SOFF-funded equipment.
Module 6. Transition to SOFF investment phase		
6.1	34	The first Investment Round funding request to be prepared by the SOFF IE in the DRC and METTELSAT should target easy fixes achievable within a maximum of 2 years of active investments (followed by 1 year of commissioning), with the goal to see newly-GBON-compliant stations enter the SOFF Compliance Phase immediately upon completion of the Investment Round.
6.2	34	The first Investment Round should focus on stabilizing a few key sites (see Table 2), and have them become GBON compliant by means of manual surface stations.
6.3	34	The first Investment Round should also incorporate the possibility for METTELSAT to perform in-depth, in-situ tests of AWSs to identify suitable technology for expanding the GBON network in the DRC.
6.4	34	All Investment Round funding requests should include clear objectives and specific targets that will have to be met before a subsequent Investment Round is submitted to the SOFF Steering Committee.
6.5	34	All Investment Round funding requests should refer to this NCP, and include a list of all the Recommendations specified in Table 3 (noting whether they are met fully, partially or not at all).

Report completion signatures

Peer Advisor signature  Payerne, 30.09.2024
Beneficiary Country signature
WMO Technical Authority signature 

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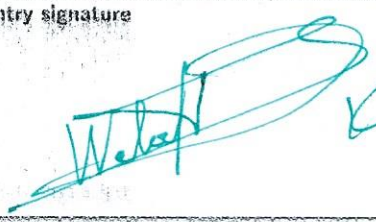
Beneficiary Country signature  Kinshasa, le 30/09/2024.
WMO Technical Authority signature 

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List of acronyms

AWS	Automatic Weather Station
CI/CC	Continuous Implementation / Continuous Compliance
CHD	Country Hydromet Diagnostics
CREWS	Climate Risk and Early Warning Systems
CREWS-ASW	CREWS Accelerated Support Window
CSO	Civil Society Organization
DRC	Democratic Republic of Congo
GBON	Global Basic Observing Network
GISC	Global Information System Centre
GPRS	General Packet Radio Service
GTS	Global Telecommunication System
ICT	Information and Communications Technology
IE	Implementing Entity
INERA	National Agronomical Study and Research Institute, in french *Institut National pour l'Étude et la Recherche Agronomiques*
LED	Light-Emitting Diode
METAR	Meteorological Aerodrome Report
MeteoSwiss	Federal Office of Meteorology and Climatology
METTELSAT	DRC's NMHS, in french *Agence Nationale de Météorologie et Télédétection par Satellite*
NCP	National Contribution Plan
NGA	National Gap Analysis
NHQ	National Headquarters
NMHS	National Meteorological and Hydrological Services
NWP	Numerical Weather Prediction
OSCAR	Observing Systems Capability Analysis and Review Tool
QMS	Quality Management System
RIC	Regional Instrument Center
RMC	Regional Maintenance Center
RTH	Regional Telecommunication Hub
RVA	Airways Authority, in french *Régie de Voies Aériennes*
RVF	Waterways Authority, in french *Régie des Voies Fluviales*
RWC	Regional WIGOS Center
SC-IMT	Standing Committee on Information Management and Technology
SMS	Short Message Service
SOFF	Systematic Observations Financing Facility
StC	Steering Committee
SYNOP	surface synoptic observation
TECO	Technical Conference
TT	Task Team
TT-GBON	Task Team GBON
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
WDQMS	WIGOS Data Quality Management System
WIGOS	WMO Integrated Global Observing System
WIS	WMO Information System
WMO	World Meteorological Organization