



SOFF OPERATIONAL GUIDANCE HANDBOOK



**FOR SOFF COUNTRIES,
PEER ADVISORS AND
IMPLEMENTING ENTITIES**

SYSTEMATIC OBSERVATIONS FINANCING FACILITY, MAY 2025

Document review comments

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This document is dynamic, it will be iteratively improved to reflect decisions of the SOFF Steering Committee as well as the feedback on good practices and lessons learned from peer advisors, countries, Implementing Entities, and the WMO Technical Authority as SOFF implementation proceeds. The responsibility for maintaining the handbook lies in the SOFF Secretariat with the support of the WMO Technical Authority.

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1.GBON National Gap Analysis

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1. Purpose

This document provides guidance to the SOFF peer advisors, countries, and Implementing Entities for the development of the **GBON National Gap Analysis** (National Gap Analysis in short). It is developed referring to the WMO GBON Global Gap Analysis (Global Gap Analysis in short).

The objective of the National Gap Analysis is to define the gap between the mandatory requirements of the GBON regulations and the existing country surface and upper-air networks. In other words, it serves as the basis for identifying the number of observing stations that need to be installed or rehabilitated to become compliant with the mandatory requirements of the GBON regulations.

The National Gap Analysis is one of the outputs of the SOFF Readiness Phase. The peer advisors should complete the Analysis including using the template (Annex I A) on behalf of and in collaboration with the country. The guidance in this document is based on the GBON Chapter of the Guide to WMO Integrated Global Observing System (WIGOS), WMO-No. 1165¹ developed by the World Meteorological Organization (WMO) Commission for Observation, Infrastructure, and Information Systems (INFCOM) for implementing GBON by all WMO Members. The peer advisors should follow this guidance along with WMO standard practices, provisions, and technical guidance material for the implementation of observing systems, data management and exchange (information) systems, and GBON.²

The WMO Secretariat and SOFF Secretariat stand available to respond to questions, provide support, and share good practices in every phase of GBON implementation.

2. Scope

The guidance provided in this document focuses on the scope of SOFF support. The following aspects define the scope of SOFF support and Table 1 summarizes the standard practices of the GBON regulations included in the scope of SOFF.

- **GBON regulations:** The GBON regulations consist of two types of requirements: standard practices, mandatory and identified in WMO regulations by using the verb "shall" and recommended practices, identified by using the verb "should". Since SOFF support initially covers the GBON standard practices, this document focuses on the guidance needed for those requirements. It is up to countries to explore and assess ways and resources to meet the recommended GBON practices.
- SOFF supports establishing and operating the GBON standard density. However, in countries where through relatively small interventions, stations

¹ <https://library.wmo.int/records/item/55696-guide-to-the-wmo-integrated-global-observing-system?offset=4>

² <https://community.wmo.int/en/activity-areas/wigos/gbon/implementation-global-basic-observing-network-gbon/defining-initial-composition-gbon/references-gbon-material>

and related infrastructure could be fixed to start quickly delivering data (“easy fixes”), even above GBON standard density, peer advisors are encouraged to assess whether SOFF interventions are reasonable.

- **Station types:** GBON standard practices establish a required minimum number of stations for each country (depending on the surface area of the respective Member) of primarily two specific types: surface and upper-air and, where appropriate, marine meteorological observing stations or platforms. SOFF focuses initially on surface and upper air stations.
- **GBON marine stations:** Marine meteorological stations may be considered by SOFF at a later stage, including potentially through sub-regional/regional cooperation modalities. Therefore, SOFF peer advisors are encouraged to include in their GBON National Gap Analysis the assessment of country marine stations and related GBON requirements when considered relevant.

Table 1. Summary of the standard practices of the GBON regulations.

GBON requirements per station type	GBON Variables						
	SLP	T	H	W	P	SD	SST
<ul style="list-style-type: none"> • Surface land stations Standard density³: 200km • Observing cycle: 1h • Real-time data exchange to WIS 	X	X	X	X	X	X	
<ul style="list-style-type: none"> • Upper-air stations operated from land Standard density³: 500km • Vertical resolution: 100m, up to 30 hPa • Observing cycle: twice a day • Real-time data exchange to WIS 		X	X	X			
<ul style="list-style-type: none"> • Surface marine stations in Exclusive Economic Zones:⁴ 500 km 	X						X
<ul style="list-style-type: none"> • Upper-air stations operated in Exclusive Economic Zones:⁴ 1000 km • Vertical resolution: 100m, up to 30 hPa 		X	X	X			

SLP: Atmospheric pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; SD: Snow depth, SST: Sea surface temperature.

³ For Members whose surface area of the Exclusive Economic Zone is significantly larger than the land surface area, for the WMO GBON Global Gap Analysis in June 2023, the EEZ area has been added to the total surface area which is the basis for the target number of stations. The standard density requirements for Small Islands have been calculated with 500 km for surface stations and 1000 km for upper-air stations. See Manual on WIGOS, 3.2.2.7, Note 7.

⁴ Although GBON marine stations are not part of SOFF initial scope, peer advisors are encouraged to analyse in this step when considered relevant e.g., SIDS, the status of current marine stations for future GBON marine observations investments.

3. Roles and responsibilities

Country National Meteorological and Hydrological Service

- Is responsible for implementing the activities of the Readiness phase with the support from the peer advisor and the prospective Implementing Entity.
- Prepares the Assignment Terms of Reference following the standard Terms of Reference provided by the SOFF Secretariat, in collaboration with the peer advisor and in coordination with the prospective Implementing Entity.
- Submits the funding request for the SOFF Readiness phase support using the standardized template provided by the SOFF Secretariat.
- Is responsible for collaborating with the peer advisor to provide all the necessary information and participate in and facilitate the national activities the peer advisor needs to conduct in order to develop the Readiness phase outputs.
- Confirms receipt of the peer advisors' report with the Readiness phase outputs and provides comments on the outputs as needed.

Peer advisor

- Is accountable to the country.
- In dialogue with the country, provides independent technical advice, analysis and recommendations to support the country in implementing the activities of the Readiness phase.
- Develops the Readiness phase outputs and is responsible for their quality and timely delivery. Communicates regularly with the country and the Implementing Entity.
- Engages with the civil society, including on the identification of stakeholders of relevance for GBON implementation.
- Submits the final report with the Readiness phase outputs to the country for comments and to the prospective Implementing Entity for feedback.
- Submits the final report including the country's comments and the prospective Implementing Entity's feedback to the SOFF Secretariat.
- Notifies the SOFF Secretariat and the prospective Implementing Entity of any delays that may impede the timely delivery of the outputs, and for assignments for which the delivery takes more than six months submits a semi-annual progress report.

Implementing Entity

- Participates in the Readiness phase activities and collaborates with the country and the peer advisor to ensure a common understanding of the Readiness phase outputs and that they address the technical needs for the design and implementation of the Investment phase.
- Contributes to the definition of the Terms of Reference and provides feedback on the outputs delivered by the peer advisor

- Based on its experience in the country, supports the work of the peer advisor, e.g. by sharing its knowledge and facilitating access to the network of relevant stakeholders.

WMO Technical Authority

- Provides basic technical support to the country, peer advisor, and prospective Implementing Entity on GBON regulations.
- Is responsible for the technical screening of the draft GBON National Gap Analysis and the draft GBON National Contribution Plan against the GBON regulations.
- Is responsible for establishing and administering the pass-through mechanism for contracting and funding of the technical assistance provided by the peer advisors.

SOFF Secretariat

- Facilitates communication, coordination and collaboration between the country, the peer advisor, the prospective Implementing Entity and WMO Technical Authority.
- Reviews the Readiness funding request, including the Terms of Reference, for compliance and consistency with the information requirements in the template and provides feedback as needed. Transmits the funding request to the SOFF Steering Committee for its decision.
- Confirms receipt of the peer advisors' report with the Readiness phase outputs.
- Organizes exchange of knowledge and experiences and captures lessons learned.

4. GBON National Gap Analysis steps

The following four steps guide the development of the GBON National Gap Analysis:

4.1. Step 1 – Country information from the GBON Global Gap Analysis

In this step, the peer advisor reviews the National Gap Analysis based on a Global Gap Analysis developed and provided by WMO to the country.

The country information in the Global Gap Analysis provides a "default" assessment of the status of the observational data exchange measured against GBON requirements and the total number of stations that need to be improved or newly installed.

Table 2 illustrates the information provided by the WMO Secretariat that the peer advisor and the country will use as the starting point for the National Gap Analysis.

- **GBON horizontal resolution requirements:** The GBON regulations as published in the [Manual on WIGOS \(WMO-No. 1160\)](#) and [Guide to WIGOS \(WMO-No.1165\)](#);

- A. **GBON target:** Number of surface and upper-air stations required based on the Global Gap Analysis calculated by the WMO Secretariat.
- B. **Reporting (GBON compliant):** The rationale for classifying surface and upper-air stations as reporting is based on the WIGOS Data Quality Monitoring System (WDQMS) for the chosen time period (for WMO GBON Global Gap analysis, June 2023). Stations that were either green (GBON compliant), or orange ("potentially GBON compliant") on at least 80% of days, are considered as reporting. Other listed stations are counted as having the possibility to be improved.
- C. **Gap to improve:** Number of surface and upper-air stations that could a priori be improved to meet GBON requirements, for example, by increasing the number of shared observations (as default per the Global Gap Analysis).
- D. **Gap new:** Number of new surface and upper-air stations that need to be established and installed (as default per the Global Gap Analysis).
- E. **Gap total:** The total of how many stations need to, either be improved, or newly installed (as default per the Global Gap Analysis), to meet the GBON target. SOFF will only provide support for the number of stations that does not exceed this target. Deviations from the Global Gap Analysis should be explained (i.e., the end of previous development projects) with links to supporting information.

Table 2. WMO GBON Global Gap Analysis (June 2023). Illustration of the information that the WMO Secretariat provides to each country.

A. GBON horizontal resolution requirements	B. Target	C. Reporting (GBON compliant) ⁵	D. Gap to improve	E. Gap new	F. Gap total
	[# of stations]				
Surface stations Standard density ³ 200 km					
Upper-air stations over land Standard density ³ 500km					

The Global Gap Analysis only provides an initial top-down estimation based on the WDQMS web tool. In the next step, the peer advisor and the country take a deeper look into the country's actual situation. This includes looking at stations that could contribute to GBON but are not captured in the Global Gap Analysis.

⁵ The rationale for classifying surface and upper-air stations as reporting is based on the WIGOS Data Quality Monitoring System (WDQMS) for the chosen time period (WMO GBON Global Gap analysis, June 2023). Stations that were green (GBON compliant) on at least 80% of days, are considered as reporting. Other listed stations are counted as having the possibility to be improved.

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

In this step, the peer advisor assesses existing stations in the country that could contribute to GBON. This includes stations operated by the National Meteorological and Hydrological Service (NMHS), other governmental agencies, and the private sector, which could contribute to GBON. The peer assesses the operational status of the stations, including the variables they measure and report, and provides a geographical visualization of the distribution of the stations. The networks are evaluated based on the mandatory GBON requirements.

The elements to be analyzed in step 2 are:

- **NMHS network:** Number of stations managed by the NMHS and their reporting status against GBON requirements, i.e., reporting or to be improved. During this step as part of the evaluation, all GCOS Surface Network (GSN) and GCOS Upper Air Network (GUAN) in the country should be included. While it is recognized that the reporting requirements for these networks do not fully align with GBON standards, these stations represent an ongoing commitment by the NMHS to climate monitoring. Therefore, priority should be given to stations that already meet, or can be enhanced to meet, the minimum GBON requirements. For detailed guidance on GCOS stations, please refer to document GCOS-144, available from WMO library: [Guide to the GCOS Surface Network \(GSN\) and GCOS Upper-Air Network \(GUAN\)](#)
- **Third-party networks:** Number of surface and upper-air stations operated by the third party which could contribute to or become GBON stations and their reporting status against GBON requirements, i.e., reporting or to be improved.
- **Station information:** Name, owner, and funding source of a station, and which variables a station is reporting and how regularly (see Table 4).

The status of existing stations is defined as follows:

- **Reporting (GBON compliant):** The rationale for classifying surface and upper-air stations as reporting is based on the WIGOS Data Quality Monitoring System (WDQMS) for the chosen time period (WMO GBON Global Gap analysis, June 2023). Stations that were green (GBON compliant) on at least 80% of days, are considered as reporting. Other listed stations are counted as having the possibility to be improved.
- **Improve:** Whether the station exists but is not fully operational and can be improved to report internationally as per the GBON requirements (e.g., the station is out of service, is manual and does not operate 24/7, has broken instruments, reports on only some variables, or not as often as required, the observations are not exchanged internationally via WIS or other issues with

the data transmission system). The actions for improvements should be assessed and outlined in the GBON National Contribution Plan.

Table 3. Assessment of existing stations per their operational status and network ownership.

GBON Requirements	Existing observation stations (# of stations)			
	NMHS network		Third-party network	
	Reporting (GBON compliant) ⁵ above	To improve	Reporting (GBON compliant) ⁵ above	To improve
Surface land stations Standard density ³ 200km Variables: SLP, T, H, W, P, SD				
Upper-air stations operated from land Standard density ³ : 500km Vertical resolution: 100m, up to 30 hPa Variables: T, H, W				
Surface marine stations in Exclusive Economic Zones: 500 km Variables: SLP, SST				
Upper-air stations operated in Exclusive Economic Zones: ⁴ above 1000 km. Vertical resolution: 100m, up to 30 hPa Variables: T, H, W				

Secondly, the status of the existing stations is analysed in terms of the GBON variables and international reporting cycle requirements. The reporting cycle is assessed per station with respect to one-hour reporting frequency for surface stations and twice a day for upper-air stations.

Table 4. Assessment of existing GBON stations per station characteristics.

Station name	Station type (S/UA/M ⁶)	Owner (NMHS/3rd party)	Funding source	GBON variable measured							Reporting cycle (obs/day)	GBON Compliant (Y/N)
				SLP	T	H	W	P	SD	SST		

⁶ Please see guidance on marine stations in Section 2 on Scope.

Station type: S: Surface, UA: Upper-Air; M: Marine; Owner of the station: NMHS or name of third-party; GBON variables: SLP: Atmospheric pressure; T: Temperature; H: Humidity; W: Wind; P: Precipitation; SD: Snow depth; SST: Sea surface temperature; Reporting cycle: Number of observation reports exchanged internationally per day (0-24); GBON compliance: weather the station is GBON compliant or not (GBON Chapter of the Guide to WIGOS (WMO-No. 1165)⁷ on compliance criteria).

4.3. Step 3 - National Gap Analysis results

In step 3, the peer advisor compares the information provided by WMO in the Global Gap Analysis with the results of the in-country assessment performed in step 2.

As a result, step 3 defines the GBON national stations gap against the target number of GBON stations as provided by the WMO in the Global Gap Analysis.

Table 5. Results of the GBON national gap analysis.

GBON requirements	GBON target	Approved national target	GBON Compliant	Stations gap	
				To improve	New
	[# of stations]				
Surface land stations Standard density ³ 200km Variables: SLP, T, H, W, SD Observing cycle: 1h					
Upper-air stations operated from land Standard density ³ 500km. Vertical resolution: 100m, up to 30 hpa Variables: T, H, W Observing cycle: twice a day					
Surface marine stations in Exclusive Economic Zones: ⁴ Density: 500 km Variables: SLP, SST Observing cycle: 1h					

⁷ <https://library.wmo.int/records/item/55696-guide-to-the-wmo-integrated-global-observing-system>

Upper-air stations operated in Exclusive Economic Zones: ⁴ Density: 1000 km Vertical resolution: 100 m, up to 30 hPa Variables: T, H, W Observing cycle: twice a day					
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SLP: Atmospheric pressure; T: Temperature; H: Humidity; W: wind; P: Precipitation; SD: Snow depth; SST: Sea surface temperature.

A list of surface, upper-air and marine stations compliant with the GBON regulations and recommended to assign to GBON should be summarized in Table 6.

Table 6. Recommended existing surface, upper-air and marine stations to be assigned to GBON.

Station name	Station type (S/UA/M ⁸)

4.4. Step 4 – Country endorsement and integration into National Contribution Plan

In step 4, WMO Technical Authority screens the draft National Gap Analysis Report (Annex I A.) to ensure consistency with the GBON regulations, provides feedback as needed, and submits a final satisfactory note once the revisions are addressed.

The gap analysis results provide the basis and starting point for the development of the GBON National Contribution Plan. As part of the Contribution Plan, the peer advisor and the country further assess and, as needed, adjust the GBON target to consider national circumstances and geography, sub-regional optimization of network design, feasibility, and a phased approach.

⁸ Please see guidance on marine stations in Section 2 on Scope.

2.GBON National Contribution Plan

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Glossary

SOFF Countries: In its initial three-year implementation period, SOFF will prioritize support to SIDS and LDCs for all phases of support. All other OECD ODA- eligible developing countries will be eligible for SOFF support under the Readiness phase only.

Climate Data Management System (CDMS): An integrated computer-based system that facilitates the effective archival, management, analysis, delivery, and utilization of a wide range of integrated climate data.

GBON Gap Analysis: Defines the gap between the mandatory requirements of the GBON regulations and the existing country surface - and upper-air station networks. In other words, it serves as the basis for identifying the number of observing stations that need to be installed or rehabilitated to become compliant with the mandatory requirements of the GBON regulations.

Global Basic Observing Network (GBON): Internationally agreed standard specifying obligations of WMO Members to acquire and internationally exchange certain observations: which parameters to measure, how often, at what horizontal and vertical resolution, when and how to exchange them, and which measurement techniques are appropriate to use.

Implementing Entities: Entities that serve as SOFF Implementing Entities for the investment phase – these include the major multilateral development partners that play a role in hydromet project implementation. All Implementing Entities must be members of the Alliance for Hydromet Development.

National Meteorological and Hydrological Services (NMHS): NMHS own and operate most of the infrastructure that is needed for providing the weather, climate, hydrological and related environmental services for the protection of life and property, economic planning and development, and for the sustainable exploitation and management of natural resources. The NMHSs from the SOFF countries are the focal points for SOFF support.

Numerical Weather Prediction (NWP): A series of processes to predict future atmospheric conditions by solving dynamics and physics equations that explain the movements and changes of the atmosphere.

Peer advisors: NMHSs that are members of WMO are eligible to serve as peer advisors for SOFF. NMHSs interested in becoming SOFF peer advisors must demonstrate (i) substantial expertise in the areas of advisory services required for SOFF, (ii) a track record in partnering with and supporting other NMHSs, and (iii) a commitment to make available adequate human resources.

SOFF Secretariat: The Secretariat is responsible for the administration, reporting, monitoring and evaluation, communications, and resource mobilization of the SOFF

UNMPTF. The SOFF Secretariat is accountable to the Steering Committee and supports its functioning as well as the functioning of the Advisory Board. It is administratively hosted by WMO in Geneva, Switzerland, and follows WMO administrative policies and procedures.

The Commission for Observation, Infrastructure and Information Systems (Infrastructure Commission) (INFCOM): Contributes to the development and implementation of globally coordinated systems for acquiring, processing, transmitting, and disseminating Earth system observations, and related standards; coordination of the production and use of standardized analysis and model forecast fields; and development and implementation of sound data and information management practices for all WMO programmes and their associated application and services areas.

Global Telecommunication System (GTS): A key component of the World Weather Watch (WWW), collects and distributes observation data and forecast products. It has been implemented and operated by National Meteorological and Hydrological Services of members and by international organizations. Due to its technical limitations and high operational cost, the GTS will be phased out and replaced by WIS 2.0 in the next few years.

WMO Information System (WIS): The WMO data-sharing framework for the 21st century. Its new architecture, the WIS 2.0, with its technical specifications and implementation plan, has been approved by WMO Members. WIS 2.0 will be a collaborative system of systems using Web-architecture and open standards to provide simple, timely and seamless sharing of trusted weather, water and climate data and information through services. WIS 2.0, enabling the WMO Unified Data policy and supporting the Global Basic Observing Network (GBON), makes international, regional, and national data sharing simple, effective, and inexpensive. WIS 2.0 is composed of a handful of Global Services operated by a few global centres, and National Nodes implemented by each Member of WMO, all connected by Internet.

WIS 2.0 in a box (wis2box) is a Free and Open Source (FOSS) Reference Implementation of a WIS 2.0 National Node. The project provides a plug and play toolset to ingest, process, and publish weather/climate/water data using standards-based approaches in alignment with the WIS2.0 principles. wis2box also provides access to all data in the [WIS2.0 network](#). wis2box is designed to have a low barrier to entry for data providers, providing enabling infrastructure and services for data discovery, access, and publishing.

WMO Observing Systems Capability Analysis and Review Tool (OSCAR): Contains quantitative user-defined requirements for observation of physical variables in application areas of WMO (i.e. related to weather, water, and climate). OSCAR also provides detailed information on all earth observation satellites and instruments, and expert analyses of space-based capabilities.

WMO Technical Authority: WMO serves as SOFF Technical Authority and provides basic technical support to the peer advisors, IEs and countries on GBON regulations. WMO is also responsible for the technical screening of the GBON Gap Analysis and the National Contribution Plan against the GBON regulations and the independent verification of the status of countries' stations against the GBON regulations.

1. Introduction

The GBON National Contribution Plan ("the Plan") and the GBON National Gap Analysis constitute the analytical basis for implementing GBON. These two products underpin the support provided by the Systematic Observations Financing Facility (SOFF) and are the main outputs of the SOFF Readiness phase. On a demand basis, they are complemented by the Country Hydromet Diagnostics (CHD).

The GBON National Contribution Plan identifies the infrastructure, human and institutional capacity needed to achieve a progressive target toward GBON compliance. This includes activities required to ensure the sustained operation and maintenance of the national observing network contributing to GBON. The Plan should be designed to respond to the country's circumstances and geographical constraints and based on progressive but realistic ambition toward full GBON compliance. The objective of the GBON National Contribution Plan is to ensure that through the implementation of its proposed activities, the SOFF country has the capacity to generate and internationally exchange GBON observations sustainably. Ultimately, the Plan should focus on optimizing the investments and activities that can achieve the largest impact on the Numerical Weather Prediction (NWP) models. The guidance provided in this document focuses on the scope of SOFF support. The GBON regulations, station types, GBON marine stations, and phased approach aspects define the scope of SOFF support.

The guidance contained in this document is structured in six modules that constitute the building blocks of a GBON National Contribution Plan. The modules are: (i) GBON National Contribution Target; (ii) GBON business model and institutional development: partnerships and business model needed to operate and maintain the observing network; (iii) Infrastructure development: investments needed to increase or improve the observing network and its related infrastructure; (iv) Human capacity: technical and managerial capacities required to operate and maintain the observing network; (v) risk management: mitigation measures to address risks to the sustainability of the observing network; and (vi) Transition to SOFF investment phase: support the country and the Implementing Entity (IE) in preparing for the SOFF investment phase.

2. Purpose

This document provides operational guidance to SOFF peer advisors, countries, and IEs to develop a GBON National Contribution Plan. The Plan constitutes the technical basis

of the funding request for the SOFF Investment phase or other funding sources, as applicable.⁹

To ensure consistency and standardization of SOFF implementation, SOFF requires peer advisors, countries, and IE to follow the guidance provided in this note to develop the GBON National Contribution Plan, including using the template (Annex II A), to deliver the final report.¹⁰

This document is based on the GBON Chapter of the Guide to WIGOS (WMO-No. 1165)¹¹ developed by the World Meteorological Organization (WMO) Commission for Observation, Infrastructure and Information Systems (INFCOM) to implement GBON by all WMO Members.

The peers should follow this guidance along with WMO standard practices, provisions, and technical guidance material for the implementation of observing networks and GBON.¹² The WMO Secretariat and SOFF Secretariat are available to respond to questions, provide support, and share good practices in every phase of GBON implementation.

3. Development of the Plan

3.1. Collaboration

Development of the Plan requires good collaboration among the country, its peer advisor, and the IE that will support the implementation of the Plan (when applicable). To ensure a common understanding of the Plan's final recommended activities and their use for the SOFF Investment phase, the collaboration between peer advisors, countries, the IEs, and WMO Technical Authority starts early. The section below outlines the roles and responsibilities of each partner related to the development of the Plan.

3.2. Roles and responsibilities

Country National Meteorological and Hydrological Service

- Is responsible for implementing the activities of the Readiness phase with the support from the peer advisor and the prospective Implementing Entity.
- Prepares the Assignment Terms of Reference following the standard Terms of Reference provided by the SOFF Secretariat, in collaboration with the peer advisor and in coordination with the prospective Implementing Entity.

⁹ Other ODA-DAC eligible countries are not eligible for SOFF Investment Phase funding. These group of countries are supported only with the Readiness Phase.

¹⁰ See more details on the requirements for the delivery of Readiness phase outputs in the SOFF Operational Manual. <https://alliancehydromet.org/wp-content/uploads/2022/11/Decision-item-2.2-Adoption-of-the-SOFF-Operational-Manual.pdf>

¹¹ <https://library.wmo.int/records/item/55696-guide-to-the-wmo-integrated-global-observing-system>

¹² <https://community.wmo.int/en/activity-areas/wigos/gbon/implementation-global-basic-observing-network-gbon/defining-initial-composition-gbon/references-gbon-material>

- Submits the funding request for the SOFF Readiness phase support using the standardized template provided by the SOFF Secretariat.
- Is responsible for collaborating with the peer advisor to provide all the necessary information and participate in and facilitate the national activities the peer advisor needs to conduct in order to develop the Readiness phase outputs.
- Confirms receipt of the peer advisors' report with the Readiness phase outputs and provides comments on the outputs as needed.

Peer advisor

- Is accountable to the country.
- In dialogue with the country, provides independent technical advice, analysis and recommendations to support the country in implementing the activities of the Readiness phase.
- Develops the Readiness phase outputs and is responsible for their quality and timely delivery. Communicates regularly with the country and the Implementing Entity.
- Engages with the civil society, including on the identification of stakeholders of relevance for GBON implementation.
- Submits the final report with the Readiness phase outputs to the country for comments and to the prospective Implementing Entity for feedback.
- Submits the final report including the country's comments and the prospective Implementing Entity's feedback to the SOFF Secretariat.
- Notifies the SOFF Secretariat and the prospective Implementing Entity of any delays that may impede the timely delivery of the outputs, and for assignments for which the delivery takes more than six months submits a semi-annual progress report.

Implementing Entity

- Participates in the Readiness phase activities and collaborates with the country and the peer advisor to ensure a common understanding of the Readiness phase outputs and that they address the technical needs for the design and implementation of the Investment phase.
- Contributes to the definition of the Terms of Reference and provides feedback on the outputs delivered by the peer advisor.
- Based on its experience in the country, supports the work of the peer advisor, e.g. by sharing its knowledge and facilitating access to the network of relevant stakeholders.

WMO Technical Authority

- Provides basic technical support to the country, peer advisor, and prospective Implementing Entity on GBON regulations.
- Is responsible for the technical screening of the draft GBON National Gap Analysis and the draft GBON National Contribution Plan against GBON regulations.
- Is responsible for establishing and administering the pass-through mechanism for contracting and funding of the technical assistance provided by the peer advisors.

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- Facilitates communication, coordination and collaboration between the country, the peer advisor, the prospective Implementing Entity and WMO Technical Authority.
- Reviews the Readiness funding request, including the Terms of Reference, for compliance and consistency with the information requirements in the template and provides feedback as needed. Transmits the funding request to the SOFF Steering Committee for its decision.
- Confirms receipt of the peer advisors' report with the Readiness phase outputs.
- Organizes exchange of knowledge and experiences and captures lessons learned.

3.3. Modules

The guidance in this document describes, for each module, a set of assessments/activities that the peer advisor needs to perform and the expected outputs. The outputs represent the activities and corresponding technical details the peer advisor recommends for the country to undertake during the Investment Phase. The peer-recommended activities should ensure harmonized and sustained operation and maintenance of the network after the closure of the Investment phase.

The assessments/activities indicated in this document are all considered essential and describe the minimum requirements for implementing GBON based on the technical guidance from WMO. However, it is up to the peer advisor and the country in collaboration with the Implementing Entity to decide what other activities and assessments are required to complete the Plan.

The six modules should be undertaken in parallel so that the final Plan is consistent across all the modules. Each module references WMO Technical Regulations and other guidance material of relevance.

3.4. Final report

Annex II A provides the template for the final report to be delivered by the peer advisors. The final report contains the Plan in the form of peers' recommended activities and corresponding technical details for each module.

4. GBON National Contribution Plan

The modules of the Plan are:

- **Module 1. GBON National Contribution Target:** Establishment of a progressive national target toward GBON compliance
- **Module 2. GBON business model and institutional development:** public-private business model, partnerships, and institutional and financial arrangements needed to operate and maintain the observing network, with a view to the SOFF compliance phase.
- **Module 3. GBON infrastructure development:** infrastructure investments required to increase or improve the observing network and its Information and Communications Technology (ICT)
- **Module 4. GBON human capacity development:** Human technical and managerial capabilities required to operate and maintain the observing network and quality data flow
- **Module 5. Risk Management:** Operational risks of the observing network and required mitigation measures
- **Module 6. Transition to SOFF investment phase:** Support the country and the IE in preparing the Investment phase funding request.

Module 1: National target toward GBON compliance

The national target towards GBON compliance should take account of the gap analysis, but also recognize the reality of the situation within the country as well as regional efforts to strengthen observing capacity. The GBON target number of stations in the WMO Global GBON Gap Analysis was calculated on a simplified approach where the country's surface area was divided by the horizontal resolution squared. However, this method is imprecise for small countries or countries having complex geometric shapes. Also, the method does not consider observing stations that may exist across the border of the Country. Factors such as **climatic zones, availability of funding, availability and location of resources, security, communication, availability of personal and accessibility of sites**, all play an important role in determining what is a sustainable national target. Efforts to strengthen observing capacity in other countries also may mean that it is not necessary for a particular country to invest in a certain capability. Efforts should be made to be as pragmatic as possible to ensure that the target takes into account what is possible, and sustainable, within a particular country and not just the GBON gap. Based on all these criteria, the SOFF peer advisor, in collaboration with the country and in coordination with

the IE, recommends a GBON National Contribution Target. When designing the observing network of the respective countries, peer advisors and countries should consider the stations which are in neighboring countries, and how they affect a global horizontal resolution and whether cooperating is possible.

The “shall” provisions for the GBON requirements for different types of observing stations are summarised in Table 15 in the [WIGOS guide document](#). The “shall” provisions refer to the minimum/ standard horizontal resolutions, 200 km for surface stations and 500 km for upper-air stations (500 km/ 1000 km for Small Island States respectively). It shall be noted that SOFF is just supporting the establishment of GBON standard density requirements. However, if, for example, there are regional considerations—such as adjacent fragile, conflict-affected states with no outlook for GBON coverage, or arrangements with other funds where only compliance-phase funding will be necessary for the country—SOFF can consider a deviation from the GBON standard target. Furthermore, for countries that are in the group of Small Island Developing States (SIDS), but whose EEZ is **not** significantly larger than the land surface area, the horizontal resolution for mainland countries can be considered for determining the GBON target number of stations (for the land surface area). Activities and outputs for module 1 are summarized in Table 1.

Table 1. Peer advisor activities and outputs for Module 1.

Activity item	Activity	Outputs	Relevant guidance material
1.1	National GBON Gap Analysis	<ul style="list-style-type: none"> Results of the GBON national gap analysis as the country baseline 	GBON National Gap Analysis guidance note tailored for SOFF
1.2	Establishment of the GBON National Contribution Target	<ul style="list-style-type: none"> Recommendation on the GBON National Contribution Target following Table 2 in the National Contribution Plan 	GBON Chapter of the Guide to WIGOS (WMO-No. 1165) ¹³

Module 2: GBON business model and institutional development

In module 2, the peer advisor assesses the institutional capabilities of the National Meteorological and Hydrological Service (NMHS), other relevant governmental institutions and local and sub-regional GBON stakeholders, and potential private partners. Based on this assessment, the peer advisor, in dialogue with the country and in coordination with the IE, recommends one of the four possible public-private business models and other institutional strengthening activities and partnerships required for the sustainable operation and maintenance of the observing network.

¹³ [Guide to the WMO Integrated Global Observing System](#)

This module also includes assessing existing national strategies, national legislation, and ongoing development cooperation programmes related to GBON. In collaboration with the IE, the peer advisor should assess existing development cooperation projects related to GBON and propose activities to ensure consistency/complementarity of these activities. Activities and outputs for module 2 are summarized in Table 2.

Table 2. Peer advisor activities and outputs for Module 2.

Activity item	Activity	Outputs	Relevant guidance material
2.1	Assessment of national governmental and private organizations of relevance for the operation and maintenance of GBON	<ul style="list-style-type: none"> Identified governmental stakeholders operating and acquiring meteorological observations or with the potential to support GBON Identified private sector operators providing meteorological observations and data services in the country (for ship-based observations, identify fleet of ships government-owned or private and research owned) to install instrument packages) Recommendation on how they could contribute to the implementation of the Plan (such as on operation, maintenance, calibration, etc.) and required activities to materialize the proposed partnerships: <ol style="list-style-type: none"> Existing partners and relationships. Potential new partners and their roles 	<i>Guide to the WMO Integrated Global Observing System</i> (WMO-No. 1165), Chapter 6 ¹⁴
2.2	Assessment of potential GBON sub-regional collaboration	<ul style="list-style-type: none"> Identified neighboring countries and regional organizations of relevance for potential sub-regional collaboration. Relevant WMO Regional Centres such as Regional Instrument Centre (RIC), Regional WIGOS Centre (RWC) and Regional Training Centre (RTC) should be considered. Recommendations for potential optimization of the observing network through sub-regional network design and other sub-regional partnerships for the implementation of the Plan 	

¹⁴ https://library.wmo.int/index.php?lvl=notice_display&id=20026#.Y-ou0HbMJjE

Activity item	Activity	Outputs	Relevant guidance material
2.3	Assessment of a business model to operate and maintain the network	<ul style="list-style-type: none"> Assessment of the current funding sources, budget allocations and financial status related to operations of the NMHS-owned or managed observing network implementing a Total Cost of Ownership (TCO) approach Recommendation of a business model for public-private collaboration (Annex II B) for the implementation of the Plan, based on the SOFF private sector business models,¹⁵ including: <ul style="list-style-type: none"> Recommendation of a business model to operate and maintain the GBON infrastructure, considering arrangements for SOFF financial support during the Compliance phase Identify potential private sector operators depending on the proposed business model Develop a financial plan for operating the modernized infrastructure, including considerations on the total cost of ownership 	<p>SOFF private sector business models¹⁶</p> <p>World Bank. Recommendations for the Design of Sustainable Meteorological Observation Networks and Systems in Developing Countries¹⁷</p> <p>Guidelines for Public-Private Engagement (WMO-No. 1258)</p> <p>Annex II B. Archetypal SOFF business models</p>
2.4	Assessment of existing national strategies and projects related to observing networks	<ul style="list-style-type: none"> Review of the national strategies for establishing and improving observing networks Review of existing or planned hydromet development projects related to GBON Recommendation on activities to ensure consistency and complementarity of current and planned investments and development projects of relevance for GBON 	

¹⁵ See Annex II B on SOFF private sector archetypal business models

¹⁶ See Annex II B on SOFF private sector archetypal business models

¹⁷ <https://www.worldbank.org/en/news/feature/2022/10/11/charting-a-course-for-sustainable-hydrological-and-meteorological-networksannex>

Activity item	Activity	Outputs	Relevant guidance material
2.5	Review of the national legislation of relevance for GBON	<ul style="list-style-type: none"> Review of national legislation related to responsibility for measuring and providing weather observations related to GBON Review of the legislation related to procurement, importation and customs processes of relevance for the proposed Plan's activities and investments Recommendation on how to address any constraints related to the national legislation required to implement GBON 	

Module 3: Infrastructure development

In module 3, based on the gaps identified in the GBON National Gap Analysis, the peer advisor assesses and recommends the investments in infrastructure required to meet the national target toward GBON compliance.

The choice of initial investments should focus on strengthening the network, so it provides the largest impact on NWP skill, i.e., (i) through the installation or rehabilitation of upper air (radiosonde) stations, (ii) installation of surface stations in significantly under-observed regions (far from currently reporting stations), (iii) sub-regional optimization of the network design.

The recommendations provided in this module should be in line with the GBON regulations requirements for network design and data exchange and other requirements critical for sustainable and high-quality operations of the observing network (e.g., timeliness of data in international use, correct data format standards in data exchange, and quality of data values). The Manual on the WMO Integrated Global Observing System (WMO-No. 1160),¹⁸ the Manual on Codes (WMO-No. 306), Volumes I.1,¹⁹ I.2²⁰ and I.3²¹ the Manual on the WMO Information System (WMO-No. 1060),²² and Manual on the Global Telecommunication System (WMO-No. 386)²³ are the key WMO Technical Regulations to be followed for the establishment of a new network, and for reporting and making observations and metadata internationally available through the WMO Information System (WIS) and WMO OSCAR/Surface metadata management system.

¹⁸ https://library.wmo.int/index.php?lvl=notice_display&id=19223#.Y-oxynbMjjE

¹⁹ https://library.wmo.int/index.php?lvl=notice_display&id=13617#.Y-oyHXbMjjE

²⁰ https://library.wmo.int/index.php?lvl=notice_display&id=10684#.Y-oyQXbMjjE

²¹ https://library.wmo.int/index.php?lvl=notice_display&id=19508#.Y-oyS3bMjjE

²² https://library.wmo.int/index.php?lvl=notice_display&id=9254

²³ https://library.wmo.int/index.php?lvl=notice_display&id=21811

The recommendations for the design of the observing network and the required infrastructure should follow the national strategy for the development and management of observing networks so that the components of the modernized infrastructure and operation practices are harmonized with the existing network. The focus must be on GBON regulations while maximizing additional benefits for other observing networks and applications, e.g., for climatological applications, as feasible. As much as possible, the peer advisor and country are encouraged to leapfrog to the latest technological developments in the framework of the WMO Technical Regulations, including through the implementation of WIS 2.0 (Annex II C).

The network should respond to the country's circumstances, e.g., the situation in fragile and conflict-affected countries, need for resilient infrastructure in places facing severe weather hazards. Lessons learned from previous hydromet development projects, and the current state of the infrastructure are good indicators of the potential challenges that need to be considered. Activities and outputs for module 3 are summarized in Table 3.

Table 3. Peer advisor activities and outputs for Module 3.

Activity item	Activity	Outputs	Relevant guidance material
3.1	Design the surface and upper-air observing network and observational practices	<ul style="list-style-type: none"> • Recommendation on a harmonized observing network design, including siting and instrumentation of new and improved stations, including: <ol style="list-style-type: none"> a. A map of observing network distribution and a list of the required new or rehabilitated GBON stations with their WIGOS IDs and coordinates. b. A list of observation instruments and systems per site; and c. Investments and activities needed for the installation of new stations and the improvement of existing stations d. Observational practices defined per network 	<p>SOFF-tailored guidance on the GBON Tender Specifications</p> <p>Manual on the WMO Integrated Global Observing System (WMO No. 1160 Chapter 3.2.2 and Appendix 3.1.)²⁴</p> <p>Guide to the WMO Integrated Global Observing System (WMO No. 1165, Chapter 10)</p> <p>Guide to Instruments and Methods of Observation (WMO No. 8)²⁵</p> <p>-Volume I (Chapters 2-6 and 12)</p> <p>-Volume II (Chapter 2)</p>

²⁴ https://library.wmo.int/index.php?lvl=notice_display&id=19223#.Y-oxynbMjIE

²⁵ https://library.wmo.int/index.php?id=12407&lvl=notice_display#.Y-o04XbML-o

Activity item	Activity	Outputs	Relevant guidance material
		<ul style="list-style-type: none"> e. Transition operation plan, for the case of manual stations being upgraded to automatic f. Preliminary maintenance plan for existing and improved/new stations, including calibration practices g. Current and future engagement plans with Regional WIGOS Centers (Annex II D) in terms of metadata management and data quality monitoring system performance h. Current and future engagement plans with Regional Instrument Centers in terms of calibration and maintenance (Annex II E). i. Technical specification for new instruments and observing systems for the procurement process j. Considerations for stations' security, power and communication and related contingencies (risks can be incorporated in section 5). 	<p>-Volume III (Chapters 1,4 and 8)</p> <p>-Volume V (Chapters 1-5)</p> <p>Annex II D. Recommended practice for coordination and collaboration between SOFF peer advisors and RWC</p> <p>Annex II E. Short guidance on approaches for traceability assurance in GBON stations</p> <p>WMO IOM Report No. 136: Generic Automatic Weather Station (AWS) Tender Specifications²⁶</p>
3.2	Design of the ICT infrastructure and services	<ul style="list-style-type: none"> • Recommendation on ICT infrastructure and services design and solutions on data transmission from an observing station to the national real-time data management system and WIS 2.0, including: <ul style="list-style-type: none"> a. Detailed description of the ICT infrastructure and services design b. Technical specifications for the data collection system from the observing 	<p>Manual on the WMO Information System, Volume II - Manual on WIS.</p> <p>Guide to WMO Information System, Volume II - Guide to WIS</p> <p>Provisions for the Transition from the WMO Information System (WIS) 1.0 and Global Telecommunication</p>

²⁶ https://library.wmo.int/index.php?lvl=notice_display&id=22031#.Y-o1I3bML-o

Activity item	Activity	Outputs	Relevant guidance material
		<p>station to the collection point</p> <p>c. Technical specifications of the data services (compatible with the requirements of WIS 2.0)</p> <p>d. Detailed description of the measures to ensure resilience and continuity of the full data processing chain</p>	<p>System to WIS 2.0 -WIS 2.0 Transition Guide.</p> <p>Annex II C: WMO Information System 2.0</p>
3.3	Design the data management system	<ul style="list-style-type: none"> • Recommendation on requirements for a data management system aimed to provide access to data used by operational applications on a real-time basis and the capability to deliver data to a Climate Data Management System (CDMS) for long-term archiving purposes. The system should provide the following: <ul style="list-style-type: none"> a. Short-term data storage and access through the services and protocols required by applications for national and international operational activities b. Acquisition of data to and from WIS 2.0, as well as other national or international sources required for operational activities c. Data delivery to the national CDMS (current status and plan) d. Discovery and descriptive metadata management e. Monitoring of data, processing and services 	<p>Manual on the WMO Information System, Volume II – Manual on WIS.</p> <p>Guide to WMO Information System, Volume II – Guide to WIS</p> <p>Provisions for the Transition from the WMO Information System (WIS) 1.0 and Global Telecommunication System to WIS 2.0 -WIS 2.0 Transition Guide.</p> <p>Annex II C: WMO Information System 2.0</p>

Activity item	Activity	Outputs	Relevant guidance material
'3.4	Environmental and sustainability considerations	<ul style="list-style-type: none"> • Recommend pragmatic approaches and measures for environmentally responsible design and evolution of the national networks to achieve GBON requirements, including: <ol style="list-style-type: none"> a. Development and use of specifications that consider environmental sustainability for procurement of measurement instrument equipment to meet the GBON requirements b. Integration of sustainability considerations for the management of operations of GBON stations, including installation, calibration, and maintenance c. Careful material selection for the development, shipping and day-to-day operations of GBON stations, with a focus on developing and using reusable instruments and sustainable methods of observation (e.g., elimination of single-use plastics). 	Recommendations related to environmental sustainability will be considered for future amendments to WIGOS regulatory material and GBON guidance, with the long-term goal of advancing more environmentally-friendly weather and climate observing systems, technologies and practices. These recommendations will evolve and become more detailed over time as new information is gathered, analysed and translated into requirements.

Module 4: Human capacity development

In module 4, the peer advisor assesses the human capacity development gaps and related activities needed to close the gap. The capacity development activities should target both technical staff to operate and maintain the observing network and staff to manage the implementation of the Plan.

The type of human expertise and training needs depend on the infrastructure chosen and the country's circumstances. In the case of opting for a public-private partnership, it is essential to ensure that the country has the expertise and capacity to engage in, monitor, and manage the contractual relationships and control the quality of the services delivered. Capacity development activities identified in the Plan should systematically

promote women's empowerment and Civil Society Organizations (CSOs) involvement. Activities and outputs for module 4 are summarized in Table 4.

Table 4. Peer advisor activities and outputs for Module 4.

Activity item	Activity	Outputs	Relevant guidance material
4.1	Assessment of human capacity gaps	<ul style="list-style-type: none"> A summary of staff skills, education levels, and capacity gaps for technicians, experts, and management, including Port Meteorological Officers (PMO) when applicable, gender balance and gender opportunities 	Guidelines for Trainers in Meteorological, Hydrological and Climate Services (WMO- No. 1114) ²⁷
4.2	Design capacity development activities for technical staff	<ul style="list-style-type: none"> Recommendation on training activities and recruitment for technical staff, including: <ol style="list-style-type: none"> Surface and upper air operations Instrument and station maintenance at site Calibration and maintenance at the workshop WIGOS metadata and WDQMS Network monitoring ICT system operations 	Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology, (WMO- No. 1083) ²⁸
4.3	Design capacity development activities for senior management	<ul style="list-style-type: none"> Recommendation on training activities and recruitment for management in <ol style="list-style-type: none"> Strategic and financial planning Project management 	A Compendium of Topics to Support Management Development in NMHSs (ETR-24) ²⁹
4.4	Gender and CSOs considerations	<ul style="list-style-type: none"> Recommendations on activities, consultations, and areas of collaboration for the implementation of 	Gender Equality and Women's Empowerment in Disaster Recovery. Disaster Recovery Guidance Series,

²⁷ https://library.wmo.int/index.php?lvl=notice_display&id=15292

²⁸ https://library.wmo.int/index.php?lvl=notice_display&id=10770

²⁹ https://library.wmo.int/index.php?lvl=notice_display&id=20744

Activity item	Activity	Outputs	Relevant guidance material
		the Plan to ensure active CSOs participation and promotion of gender balance and gender opportunities	Global Facility for Disaster Reduction and Recovery (GFDRR), 2018 ³⁰ Gender, adaptation and disaster risk reduction. Policy Brief, UNDP and GGCA, 2017 ³¹ Annex to draft Decision 9/1 (INFCOM-2). Priorities for the INFCOM Gender Team ³²

Module 5. Risk Management Framework

In module 5, the peer advisor, in collaboration with the country and in coordination with the IE anticipates operational risks for the implementation of the Plan and the sustained operation and maintenance of the observing network and recommends mitigation actions. Activities and outputs for module 5 are summarized in Table 5.

Table 5. Peer advisor activities and outputs for Module 5.

Activity item	Activity	Outputs	Relevant guidance material
5.1	Assess the risks of the observing network and propose mitigation measures	Based on the SOFF Risk Management Framework, identify risks and recommend a risks management framework , including: <ul style="list-style-type: none"> a. Identification and analysis of risks b. Mitigating measures and responsible c. Monitor and evaluation 	Guide to the Implementation of Quality Management Systems for National Meteorological and Hydrological Services and Other Relevant Service Providers (WMO-No. 1100)

³⁰ <https://www.gfdrr.org/sites/default/files/publication/gender-equality-disaster-recovery.PDF>

³¹ <https://www.undp.org/publications/gender-adaptation-and-disaster-risk-reduction>

³² Annex to draft Decision 9/1 (INFCOM-2) [https://meetings.wmo.int/INFCOM-2/_layouts/15/WopiFrame.aspx?sourcedoc=/INFCOM-2/English/2.%20PROVISIONAL%20REPORT%20\(Appeared%20documents\)/INFCOM-2-d09-GENDER-ISSUES-approved_en.docx&action=default](https://meetings.wmo.int/INFCOM-2/_layouts/15/WopiFrame.aspx?sourcedoc=/INFCOM-2/English/2.%20PROVISIONAL%20REPORT%20(Appeared%20documents)/INFCOM-2-d09-GENDER-ISSUES-approved_en.docx&action=default)

Module 6. Transition to SOFF investment phase

This module involves supporting the country and the IE in preparing the Investment phase funding request based on the recommendations provided in the Plan. Close communication with the IE is necessary as the NCP is finalized, to ensure smooth preparation of the Investment Funding Request and a link between the details of the NCP and the funding request.

3. Country Hydromet Diagnostics

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1. Introduction

The CHD³³ aims to inform investments and capacity development in the whole meteorological value chain by developing a high-level assessment of National Meteorological and Hydrological Services (NMHS), their operating environment, and their contribution to high-quality weather, climate, hydrological and environmental services, and warnings. It integrates existing approaches, standards, and data provided by WMO and partners using a peer review approach. The CHD has been developed by the Alliance for Hydromet Development³⁴ under WMO leadership and with the guidance of a multi-party Working Group. The consolidated results of CHDs contribute to assessing regional and global gaps and progress.

Through the CHD, countries and their partners get an initial understanding of the support and capacity building needed to make effective use of the outputs and outcomes of SOFF for activities in the downstream part of the value chain, i.e., local data processing, forecast, early warning, advisory products, and delivery of services and effective decision making for adaptation, disaster risk management, and resilient development.

2. Purpose

This document provides tailored guidance to the SOFF peer advisors, countries, and Implementing Entities (IE) for the undertaking of the Country Hydromet Diagnostics (CHD).³⁵

The CHD is a recommended output of the SOFF Readiness Phase. It should be completed in parallel with the GBON Gap Analysis and the GBON National Contribution Plan. Peer advisors should conduct the CHD in collaboration with the country and in coordination with the respective SOFF IE or other funding agency as applicable.

3. Scope

The CHD provides a maturity assessment of the NMHS, its operating environment, and its contribution to high-quality hydromet services, with ten elements assessed (Figure 1). The elements are grouped into four categories, helping to identify where additional focus and support may be needed. Behind each element sit various indicators, which are informed by data sources and by direct interviews and observation for validation purposes.

The CHD does not provide detailed solutions but indicates the focus areas for deeper consideration for all potential projects in-country. National and international partners

³³ <https://alliancehydromet.org/country-hydromet-diagnostics/>

³⁴ <https://alliancehydromet.org/>

³⁵ The generic guidance for the implementation of the CHD can be found at <https://alliancehydromet.org/country-hydromet-diagnostics/>

supporting hydromet activities in the country are encouraged to collaborate in their thinking and sharing of insights while conducting and using the CHD.



Figure 1. The 10 elements assessed in the CHD

4. Roles and responsibilities

Peer advisors. The peer advisor is responsible for performing the CHD on behalf of and in collaboration with the country and, where applicable, in coordination with the Implementing Entity. The peers should deliver the results of the CHD as a report following the template provided in Annex III A.

SOFF country. The country is responsible for collaborating with the peer advisor to provide all the necessary information and facilitate and participate in the national activities the peer needs to conduct to complete the CHD.

WMO Secretariat. The WMO Secretariat provides guidance on the application of the CHD, provides country information from the WMO Community Platform, and screens the CHD

Report to ensure consistency with the CHD approach and provides feedback as needed. WMO uses the results of the CHD to contribute to the national information in the WMO Community Platform and facilitate global knowledge sharing.

SOFF Secretariat. The SOFF Secretariat facilitates the coordination, dialogue and exchanges between the peer advisors, countries and WMO Secretariat and with the IE.

Implementing Entity. The IE collaborates with the peer advisor and the country by providing information on ongoing or planned partnerships to strengthen the country's hydromet capacity.

5. CHD delivery principles

- **CHD delivery period:** The CHD is expected to be completed within six months, as feasible
- **In-country work:** While the CHD is expected to be conducted in the country, there may be circumstances when in-country assessments are not feasible. On some occasions, an in-country visit may not be required because of the extent of knowledge of the peer advisor about the respective country. The process outlined in section 6 assumes that the early steps of the CHD can be performed remotely to minimize the cost and time of in-country attendance.
- **Degree of specificity of recommendations in the CHD:** The CHD includes the assessment of the maturity levels of the 10 Elements and general recommendations on how to advance maturity. More detailed recommendations and proposed activities to improve maturity levels need to occur through specific project preparation follow-up work.
- **Continuous improvement:** Based on the feedback of the peer advisors and countries, WMO regularly reviews the CHD tool and its implementation to capture lessons learned and improve the CHD approach.

6. Country Hydromet Diagnostics

Based on the Table provided in Annex III A, the peer advisor should follow the following stages and steps to assess the level of maturity of each one of the elements and indicators.

Table 1. Stages and steps to access maturity level of CHD elements and indicators.

Stage 1 Information Gathering		Stage 2 Validation & Analysis			Stage 3 Closure	
Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Data review	Synthesis & Investigation	Draft CHD	Refine draft CHD	Finalize CHD	Share CHD results	Lessons learned & improvement

Stage 1 – Information gathering (performed remotely)

Step 1 – Data review. Using the CHD matrix in Annex III B, the peer advisor undertakes an initial desk review using the following sources and any other considered of relevance:

- WMO Monitoring System information.
- Agency reports (e.g., Annual Reports to Government)
- Information on current projects aiming at building NMHS capacity, as required through briefings from project partners (including Alliance for Hydromet Development members)
- Internal and external reviews and evaluations – copies of reports to be requested as needed, including expert reports from current and previous capacity-building projects involving Alliance members.
- Information on key partnerships in-country relevant to NMHS functions.
- Distribution of NMHS functions across agencies (e.g., hydrology, aviation, climate services, observations).

This step ensures that a) available information is used efficiently without duplication of effort, b) the burden on NMHSs is reduced by avoiding redundant information requests, and c) conflicting information is resolved into a definitive report that can be trusted by all parties. The step is not intended to be exhaustive but rather to ensure due diligence.

Step 2 – Synthesis and investigation. During this step, the peer synthesizes existing material (non-interactive desktop approach), evaluates gaps and conflicts in the information available, and as needed and as feasible, closes existing data and information gaps and resolves ambiguities in existing information (interactive). For cost-effectiveness, begin this process remotely if possible, understanding that in-country follow-up may be required. Activities should include:

- Work with NMHS to evaluate Service Delivery Progress Model based on WMO-No. 1129 (use the most appropriate WMO language version as a base for discussion). This is a recommended input tool for Elements 9 and 10 and can either be done offline as a self-assessment or interactively online with the NMHS
- Work through any missing/ambiguous WMO Monitoring System and related information.

Step 3 – Draft Country Hydromet Diagnostics report. The CHD report (see Annex III A) consists of an overview table with the maturity level for each of the ten *elements* of the meteorological value cycle and a narrative of each component describing critical capacity gaps.

- With the information from the previous steps, the peer advisor prepares a draft CHD report to be discussed with the country
- The WMO Secretariat screens the draft report and provides feedback and as needed, technical support to the peer advisor to ensure that their reviews are consistent with the CHD guidance.

Stage 2 – Validation and analysis (performed in-country if feasible)

Step 4 – Refine the draft CHD report

- Interview selected stakeholders (include a range of strong and weak relationships, including key users and sponsors)
- Interview NMHS's operational and technical staff
- Discuss the draft CHD with the head of the NMHS, including possible areas for clarification and any sensitive matters
- Submit draft report to WMO Secretariat for screening against CHD requirements

Step 5 – Finalize the CHD report

- Present revised CHD report to the country and the respective IE when applicable, focusing on key issues from the validation process and any sensitive matters
- Agree on the finalization process
- Complete the CHD report, including feedback received
- Once finalized and cleared by the Secretariat, proceed to have the finalized CHD report signed by the country NMHS's Permanent Representative to WMO (PR) and the peer adviser NMHS's PR.
- Share the signed CHD report (following the template in Annex III A) with the country and the IE for follow-up advisory services and integration in consequent project preparation support, and with WMO and SOFF Secretariat for completion of the Assignment.

Stage 3 – Closure

Step 6 – Share CHD results. The WMO Secretariat updates the WMO Monitoring System with the CHD results. The CHD reports are made public, notably on the Alliance for Hydromet Development website.

Step 7 – Capture lessons learned and continuous improvement. The WMO Secretariat seeks feedback on the process from the country, the peer advisor and the Implementing Entity.