# Systematic Observations Financing Facility

## Report for Second Potential Funders' Forum

28 June 2021

SOFF
Systematic Observations Financing Facility

Weather and climate information for the global public good

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# Acronyms

AMCOMET ..... Ministerial Conference on Meteorology
AMMA ..... African Monsoon Multidisciplinary Analysis
AWS ..... Automated Weather Stations
CHD ..... Country Hydromet Diagnostics
COP26 ..... Twentieth Six meeting of the Conference of the Parties
CREWS ..... Climate Risk and Early Warning Systems Initiative
CSI ..... Country Support Initiative
ECMWF ..... European Centre for Medium-Range Weather Forecasts
EEZ ..... Exclusive Economic Zones
EUMETNET ..... European National Meteorological Services
FCS ..... Fragile and Conflict-affected States
GBON ..... Global Basic Observing Network
GCF ..... Green Climate Fund
GEF ..... Global Environment Facility
HMEI ..... Association of Hydro-Meteorological Equipment Industry
IMF ..... International Monetary Fund
LAM ..... Limited Area Model
LDCs ..... Least Developed Countries
MDBs ..... Multilateral Development Banks
NMHSs ..... National Hydrological and Meteorological Services
NWP ..... Numerical Weather Prediction
OECD ..... Organization for Economic Co-operation and Development
OECD DAC ..... OECD Development Assistance Committee
OECD ODA ..... OECD Official Development Assistance
RBF ..... Results-Based Financing
REAP ..... Risk-Informed Early Action Partnership
SBSTA ..... UNFCCC Subsidiary Body for Scientific and Technological Advice
SIDS ..... Small Island Developing States
SOFF ..... Systematic Observations Financing Facility
SPREP ..... Secretariat of the Pacific Regional Environment Programme
UN MPTF ..... UN Multi-Partner Trust Fund
UNDP ..... United Nations Development Programme
UNEP ..... United Nations Environment Programme
UNFCCC ..... United Nations Framework on Climate Change
UNHLPF ..... UN High-level Political Forum
WDQMS ..... WIGOS Data Quality Monitoring System
WIGOS ..... WMO Integrated Global Observing System
WMO ..... World Meteorological Organization

# Executive Summary

**This document provides the basis for discussions at the second forum for potential funders of the Systematic Observations Financing Facility (SOFF), virtually taking place on 28 June 2021.** Based on the feedback and discussions that took place at the SOFF first potential funders' forum in March 2021, the objective of the second funders' forum is to advance discussions on the value proposition of the SOFF, on the proposed institutional and operational design and arrangements of the Facility and on the timeline and status of preparations; and to jointly define the expectations for the subsequent meetings.

**All monitoring and prediction of weather and climate start from observations – these data provide the only source of knowledge about the atmosphere and the climate system.** Weather and climate are inherently global, and to understand and predict them anywhere, observations even from the farthest reaches of the globe need to be made available to the global monitoring and prediction model systems.

**The first three links of the meteorological value chain - observations, data exchange, and global numerical prediction - are of global significance.** Failure in delivering these links severely affects the quality of global weather and climate prediction and limits the ability of all countries to adapt to climate change and promote resilient development. Data from the World Meteorological Organization (WMO) observational data exchange monitoring system reveal that the current coverage of surface-based observations falls far short of what is needed for robust forecasts and predictions, especially in the Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

**The international development community has been concerned about the lack of surface-based observations for decades, and many attempts have been made to address the problem.** However, the experience so far has not been encouraging: Investments made in observing systems over the last three decades have generally not resulted in a significant and sustained increase in observational data exchange and the situation is getting worse. For Africa, the number of radiosonde observations provided to the global models decreased by roughly 50% between 2015 and early 2020 and has dropped further since. The most frequently encountered issues are (i) lack of a global approach to address the global nature of the problem; (ii) lack of an appropriate measure of success, i.e., international data exchange; (iii) lack of predictable and long-term support; (iv) lack of a coordinated and integrated implementation approach; and (v) lack of a realistic financing model that undermines sustainability.

**WMO Members (193 states and territories) have committed to establishing the Global Basic Observing Network (GBON) to address the problem of missing observations.** It will define in clear and quantitative terms the commitments of the WMO Members to acquire and internationally exchange basic surface-based observations. The potential benefits directly enabled by the full implementation of GBON, via its implementation in countries with the largest current data gaps, are estimated to exceed USD 5 billion per year. According to the World Bank, every dollar invested in GBON would help unleash additional economic benefits at a benefit-cost ratio of over 25:1.

**WMO and the members of the Alliance for Hydromet Development[1] are committed to establishing the Systematic Observations Financing Facility (SOFF)** to respond to the problems in a transformational manner and to ensure that LDCs and SIDS have the capacity, financing and incentives to deliver on their GBON commitments. The goal of SOFF is to contribute to strengthening climate adaptation and resilient development through improved weather forecasts, early warning systems, and climate information services. SOFF would contribute to this goal through the sustained collection and international exchange of high-quality surface-based weather and climate observations in compliance with GBON.

**SOFF will address the persistent problem of missing foundational observations in a systematic manner** by (i) deploying a global approach with sustained international data exchange as a measure of success; (ii) providing innovative finance; and (iii) enhancing technical competence and effective coordination. Through the combination of these features, and by leveraging its resources through close cooperation with other partners, SOFF will channel international support to strengthen countries' basic observation capacity in new, more effective and sustainable ways.

**SOFF will support and leverage the investments of the members of the Alliance for Hydromet Development and other partners in the other parts of the meteorological value chain, including "last mile" investments, and more broadly climate and resilient development** (i) through creating the foundation for improved outcomes in the upstream portion of the hydromet value chain – the effectiveness of investments in the latter part of the chain depends on the first parts of the chain that today are weak in many developing countries; (ii) through standardized peer-to-peer country hydromet assessments covering the whole value chain; (iii) through the partnership with Implementing Entities that would embed SOFF into their larger projects and blend their resources with SOFF resources; and (iv) through its multi-stakeholder governance structure.

**Achieving sustained GBON compliance requires the effective collaboration of many stakeholders in new ways**. This requires a SOFF institutional structure and governance that is both, inclusive and focused. It needs to take advantage of the competencies and unique value proposition of the institutions that form the SOFF institutional structure. The SOFF institutional options proposed in the report for the first potential funders' forum[2] have been further analyzed.

**Based on an in-depth analysis, it is proposed to establish SOFF as a UN Multi-Partner Trust Fund (UN MPTF)**. UN MPTF is the UN mechanism for the administration of pooled financing instruments totaling more than USD 15 billion. The UN MPTF Office as trustee has a track record in 139 countries. Of relevance for SOFF is its experience with the direct transfer of resources to countries through results-based financing. The fund would be guided by a

[1] The Alliance was launched at UNFCCC COP 25 and is comprised of the following 13 members: Adaptation Fund; African Development Bank; Asian Development Bank; Climate Investment Funds; European Bank for Reconstruction and Development; Global Environment Facility; Green Climate Fund; Islamic Development Bank; United Nations Development Programme; United Nations Environment Programme; World Bank; World Food Programme; World Meteorological Organization.

[2] Find SOFF first funders' forum report at: https://public.wmo.int/en/our-mandate/how-we-do-it/development-partnerships/Innovating-finance/SOFF-funders-forum

Steering Committee as a decision-making body, a multi-partner advisory board that would advise the Steering Committee, a SOFF Secretariat that would manage SOFF operations, and Implementing Entities consisting of the Multilateral Development Banks (MDBs) and UN organizations that are members of the Alliance for Hydromet Development.

It is envisioned to establish SOFF as a "UN coalition fund". WMO would co-create the fund jointly with the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP); both organizations have expressed interest to join WMO as co-creators. This would position SOFF as a joint UN initiative and would increase SOFF reach and visibility.

The UN co-creators of the fund would play well-defined complementary roles in the governance structure. It is proposed that WMO become the SOFF technical authority and Steering Committee co-chair and co-decision maker, jointly with the funding partners. UNDP would be the (co)chair of the multi-stakeholder advisory board, and UNEP would host the SOFF Secretariat with a potential contributing role of WMO that would be further fleshed out.

This proposed framework offers the required flexibility, simplicity and speed for SOFF creation. It would benefit from existing, pre-cleared Standard Legal Agreements already in place, including with potential funders. The SOFF MPTF would be legally established by late October 2021 to accommodate contributions already this year.

In its initial five-year implementation period, SOFF would prioritize support to SIDS and LDCs for its three phases of support – Readiness, Investment, and Compliance. All other OECD ODA eligible countries would be eligible to apply for SOFF support for only the Readiness phase. In the Readiness phase the country's hydromet status would be diagnosed, its GBON gap defined, and a GBON National Contribution plan developed. The Investment phase would support countries through infrastructure and capacity development investments to achieve a fully operational GBON system that collects and internationally exchanges data. The Compliance phase would support countries through long-term results-based finance to operate and maintain GBON and ensure sustained international data exchange. The impact of increased observations in forecast performance in SOFF supported countries and globally would be regularly monitored.

SOFF requires USD 400 million of financing over an initial 5-year implementation period to progressively achieve and sustain GBON compliance in all 67 SIDS and LDCs and offer Readiness phase support to other OECD ODA eligible countries. After the initial five-year implementation period, sustaining GBON in SIDS and LDCs and its international data exchange over time is expected to require USD 50 million per year. Long-term compliance funding will cease as countries graduate over time from LDC and ODA-eligible SIDS status. At that point the benefits and development impact of observations would have been demonstrated, the capacity would have been developed and systemic changes implemented. As a result, countries should be in a position to continue operating and maintaining their contribution to GBON.

**SOFF concept and design have been developed through multiple consultations, bringing together many stakeholders, including over 30 international organizations.** SOFF consultations and design process have included (i) the establishment of five multi-stakeholder working groups; (ii) formal intergovernmental consultations and decisions taken through the WMO constituent bodies; (iii) in-depth assessments with selected countries, (iv) engagements with the African Group of Negotiators, the Group of Least Developed Countries, the Alliance of Small Island States, the African Ministers in charge of meteorology (AMCOMET); (v) consultations with the insurance sector and the Hydro-Meteorological Equipment Industry (HMEI). SOFF creation has been receiving strong support from beneficiary countries and major international partners.[3]

**Two additional potential Funders' Forums are planned for late September and late October 2021 with the aim to announce the creation of SOFF at COP26.** SOFF is expected to be "open for business" by mid-2022.

[3] https://public.wmo.int/en/our-mandate/how-we-do-it/development-partnerships/Innovating-finance/SOFF-support-statements

# 1. The meteorological value chain and the role of observational data

All monitoring and prediction of weather and climate start from observations – these data provide the only source of knowledge about the atmosphere and the climate system. Weather and climate are inherently global, and in order to understand and predict them anywhere, observations even from the farthest reaches of the globe are needed. However, merely making the observations is not enough – in order to make effective use of them for monitoring and prediction, the data need to be made available where the global model systems used for monitoring and prediction are operated.

In this section, the main elements of the meteorological value chain are presented, with the emphasis on its initial, global links, namely observations, data exchange, and global numerical prediction models. The role of observations is described, with a focus on the consequences, both locally and globally, of having an insufficient quantity. WMO ongoing monitoring of the observational data exchange reveals that the current data coverage falls far short of what is needed, especially in LDCs and SIDS. WMO Members have committed to implement the GBON to help mitigate this problem. Recognizing the need for financial and technical assistance to support the implementation of GBON in the poorest and most poorly observed areas of the globe, WMO and the members of the Alliance for Hydromet Development[4] are establishing the SOFF.

## 1.1 Predicting the weather, an inherently global problem

Weather and climate services are generated by the meteorological value chain shown in figure 1. Good outcomes - users taking action in response to weather and climate prediction, resulting in lives saved, protection of property, and increased economic activity - happen when all links work and are working effectively together. This value chain can be schematically described as follows:

- Weather and climate observations are routinely made over all areas of the globe.
- Observations are exchanged internationally, in particular with global Numerical Weather Prediction (NWP) systems (box 1).
- NWP output monitoring and prediction data for weather and climate are generated and shared with all WMO Members (193 countries and territories).
- Global NWP output is used by National Hydrological and Meteorological Services (NMHSs) and other entities, including in the private sector, to generate weather and climate information: i.e., local forecast products, watches and warnings, seasonal outlooks, climate monitoring and prediction products, etc.
- Weather and climate information services are delivered to users, including national and local authorities, businesses, media, academia and the general public.
- Effective decisions in response to weather and climate information are made by authorities, agents in all economic sectors, and individuals.

[4] More information on the Alliance for Hydromet Development at: https://public.wmo.int/en/our-mandate/how-we-do-it/partnerships/wmo-office-of-development-partnerships

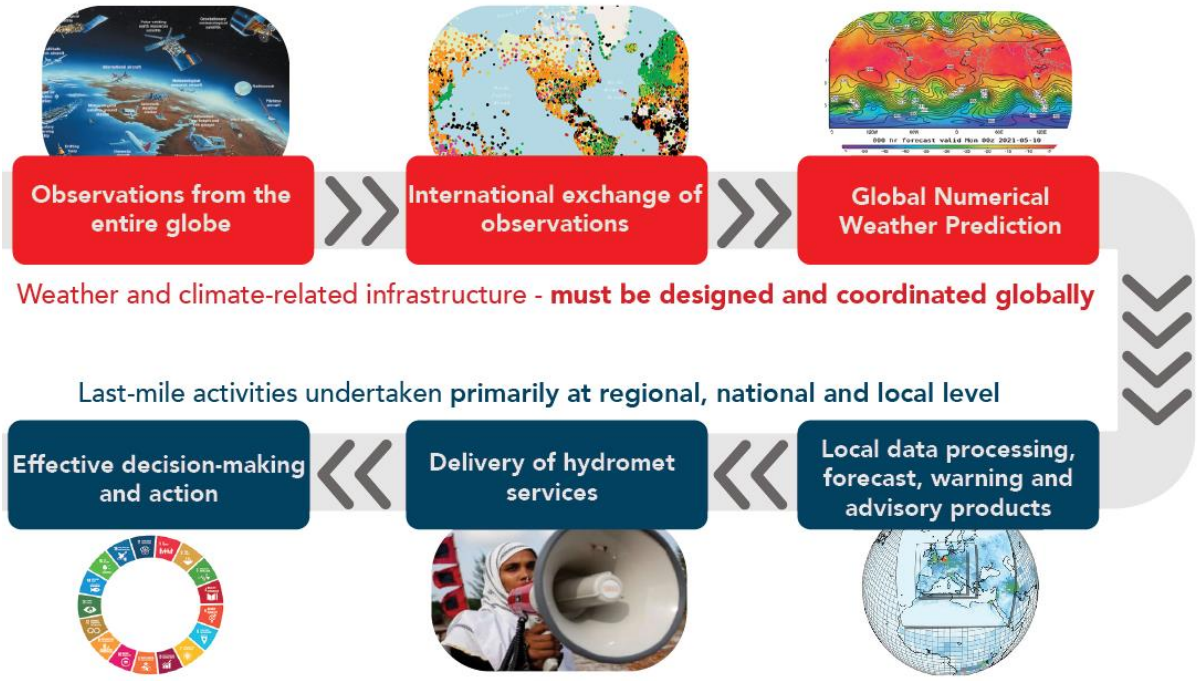



Figure 1. The weather and climate services value chain. All links in the chain must operate effectively to yield success.

**The first three links in the value chain (shown in red) constitute the global meteorological infrastructure and rely on a global implementation approach (box 1).** In contrast, the last three links (in blue) are typically implemented nationally. The implications of the global nature of the first three links cannot be overstated. Beyond a prediction horizon of 24 to 36 hours, the use of global observational data and global models to underpin the predictions in any location is needed, even if the target area for a given prediction is very small and local (box 2). Conversely, without local efforts everywhere to make and exchange observations, the models cannot effectively generate the data needed for forecasting at the national and local levels. All countries, therefore, share an interest in the first three links in the chain, while they handle the last three individually.

**Box 1. A primer on monitoring and predicting the Earth's atmosphere**

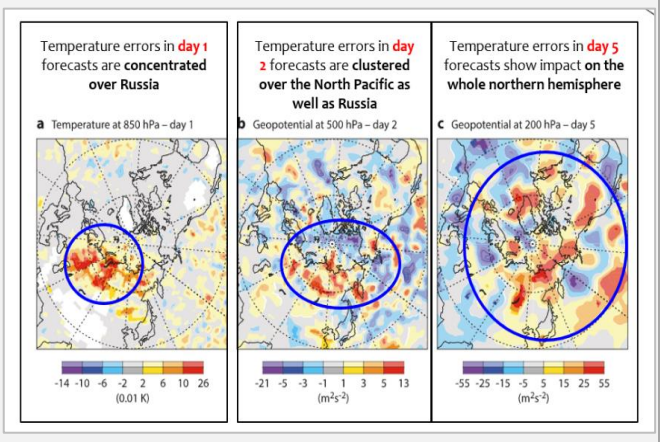
**Weather or climate prediction is therefore global by necessity, not by choice.** Weather systems develop and move across the planet regardless of political boundaries. The atmosphere has no horizontal boundaries and only in its entirety can it be simulated mathematically.

**The foundation of all weather and climate monitoring and prediction is global NWP done by the Global Producing Centres operated by WMO Member states and territories.** An NWP prediction starts by assimilating vast amounts of meteorological observations from the entire globe into an Earth system model to build a worldwide model estimate of the instantaneous weather. The model then uses the laws of physics to evolve this "initial weather" forward in time. The quality of NWP output can be objectively quantified, and progress in NWP relies on extensive use of broadly agreed measures of lead time, or *range* - the extent forward in time that can be predicted -, and *skill* - the quality of the prediction at a given time.

**The ability to accurately predict the weather is limited by what is known as the "butterfly effect".** The impact of the butterfly effect is profound: Any small, local gaps or errors in our knowledge of weather anywhere will propagate and amplify in the models, eventually degrading forecast skill everywhere. The only practical way to limit the errors – in other words, to improve the skill and range of the prediction – is to ensure that the "initial weather" of the model is as accurate as possible everywhere, and this can only be achieved with frequent observations made everywhere. **The international exchange of observations is therefore just as important as the observations themselves – observations that are not made cannot be exchanged, and observations that are not exchanged have no value for prediction.**

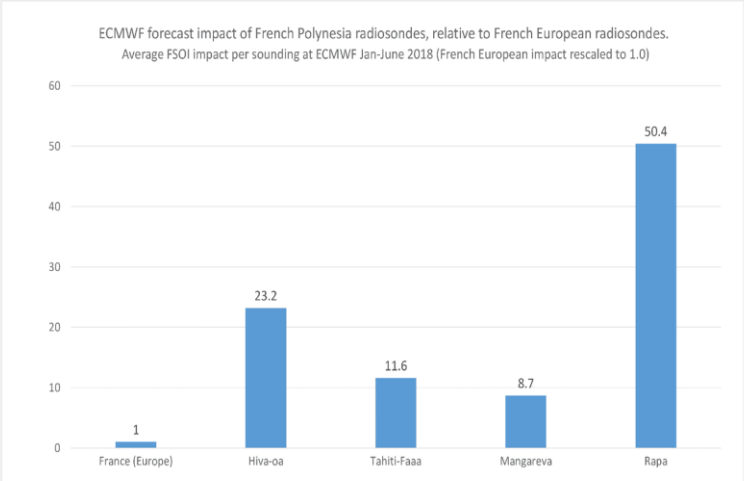
**Box 2. The value of observations beyond national boundaries**

**Russian radiosondes in 2015.** Balloon-borne radiosondes remain the single most important source of observations for numerical weather prediction and climate analysis. This was demonstrated clearly in 2015 when Russia had to cut its radiosonde programme from two ascents per day to one. The European Centre for Medium-Range Weather Forecasts (ECMWF) analysis pictured on the right shows the significant negative impact of the reductions in radiosondes on forecast skill over the entire Northern Hemisphere (darker colors indicate a greater impact on performance).




**United States regional observing activities.** Even a large country like the US relies on surface-based observations obtained from far beyond national borders for specific prediction needs. This is evidenced by the long-standing US funding for radiosonde observations in the Marshall Islands, in the Federated State of Micronesia and in the Caribbean as well as by the Winter Storms Reconnaissance program providing drop-sonde (radiosondes deployed from aircraft) coverage over the North Pacific.

**Global impacts: radiosondes in the Pacific.** NWP systems can provide very detailed analyses of the statistical impact on forecast skill of observations by type, and by location. The impact on NWP skill especially of isolated radiosonde observations in remote locations can be very large indeed. The graph shows that the impact on forecast skill, measured globally, of radiosondes launched over French Polynesia is up to 50 times larger than the impact of similar observations made over Europe.



**Even though all weather prediction starts with global models, the information needed for weather and climate services is often highly local**. Questions like *what is the likelihood of rain over my fields tomorrow? will the approaching hurricane hit my city, or will it make landfall 50 km up the coast? how high will our new sea wall need to be? will my village be able to base its economy on its current crops 10 years from now?* are examples that all require highly localized information for their answers.

**Detailed local information about weather and climate is provided by *downscaling* of global model output,** typically obtained by using a fine-scale Limited Area Model (LAM) as a "magnifying glass" within the global model (figure 2). The LAM has a finer grid-mesh than the global model and is thus able to better represent the local geography – topography, coastline, land use, etc. – and as a result also the interaction between the surface and the atmosphere.

**Even in LAM-based approaches, however, the outer, global model remains the primary source of observational information for the local domain.** This central role played by the global model means that the effect of missing local observations will propagate down to the smallest scales, and the supply of local observations to the global model is thus critical to the success of the method. Downscaling simply will not work unless the global model already has an accurate representation of the weather patterns over the LAM area – a magnifying glass cannot by itself add new information, nor can it correct the wrong information.

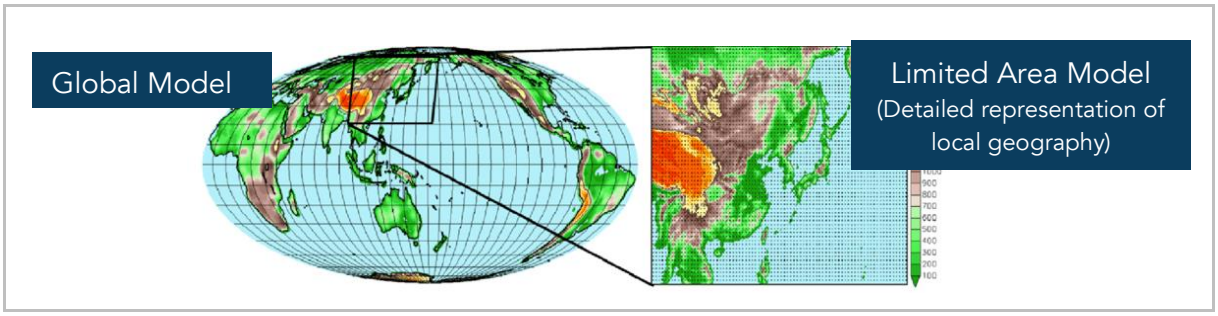



Figure 2. Downscaling of weather and climate information via nesting of limited area model within global model. Source: WMO Secretariat

## 1.2 Reanalysis – Numerical Weather Prediction used for climate monitoring and prediction

**Not only weather prediction, but nearly all climate monitoring and climate prediction, is based on NWP.** Climate monitoring and prediction, through the use of reanalysis, shares many of the same weather observational requirements. As described in box 1, each NWP run starts by updating the model estimate of the "initial weather" based on the most recent observations. The process of blending observations into the model at regular intervals is called data assimilation and the resulting model estimates of the initial weather are called "analyses".

**Over time, a global NWP system will thus generate a long sequence of such analysis datasets that contain a complete history of the global weather.** Such analysis datasets are immensely valuable for a range of applications that cannot use "raw" observations directly. However,

periodic system upgrades (model changes, processing methods, etc.) introduce artificial jumps and other inconsistencies that limit the use of these datasets for climate monitoring purposes in particular. To create consistent data records, it is necessary to conduct reprocessing, or *reanalysis*, of archived observations using a fixed configuration of the NWP system.

**Today, reanalysis products provided by the global NWP centres are, by far, the most-used datasets for climate studies.** They provide the backbone for all climate monitoring. They are used to calibrate and verify climate prediction and to help develop, test and validate models used for long-range climate projections.

**The quality of reanalysis data is measured using the same measures (skill and range) used for weather prediction, and the observational data required for weather prediction and many climate applications are largely the same.** In addition to generating poor quality weather forecasts, our knowledge about past and current climate and our ability to predict and project future climate scenarios will also be poor in areas where observations are missing. This will severely limit the ability of countries to plan and to adapt to climate change, and the ability of development partners to design and implement meaningful and effective adaptation projects.

### 1.3 Which observations are needed, and what are the data sources?

**Weather and climate prediction requires observations of the state of the atmosphere, ocean, and land, that are obtained from a wide range of instrumentation deployed on land, in and above the ocean, in the air and space.** The most important observations are those of the basic model state variables, namely wind, temperature, humidity, and surface atmospheric pressure. Table 1 below lists the primary sources, divided into two categories: Space-based, and surface-based.

**Table 1. Observations of (five) primary predicted model variables needed everywhere on the globe, ideally at a horizontal density comparable to that of the model.**

| Variable | Source(s) | Details |
|---|---|---|
| Wind (two components) | Surface- and space-based | Space-based: Horizontal coverage<br>Surface-based: Vertical structure |
| Temperature | Surface- and space-based | Space-based: Horizontal/vertical coverage<br>Surface-based: Detailed vertical structure |
| Humidity (water vapor concentration) | Surface- and space-based | Space-based: Horizontal/vertical coverage<br>Surface-based: Detailed vertical structure |
| Surface atmospheric pressure | Surface-based | Surface-based only<br>(not measured from space) |

**While satellites provide excellent and near-continuous data coverage, Table 1 reflects the fact that some measurements cannot be made or will not in the foreseeable future be made from space, namely surface pressure and detailed measurements of the vertical structure of the atmosphere.** Furthermore, many satellite data are difficult to use over land, snow and ice surfaces and the use of satellite data relies on a good distribution of surface-based measurements for anchoring, calibration and validation.

## 1.4 Lack of surface-based observations - a persistent global problem

**Despite several decades of significant investments made in strengthening the meteorological sector in developing countries, many areas of the globe remain far from achieving the goal of continuous, robust, real-time international exchange of surface-based observations**. Figure 3 shows the international exchange of in-situ observations of surface pressure - a key input variable for all modeling - as of 18 May 2021. Observing stations shown in black (no observations exchanged) or red (sporadic exchange of observations) represent lost opportunities to serve the entire global population with better weather and climate data products. The local situation in countries with predominantly black or red stations – or with too few stations altogether, as shown by the predominantly white areas – is even more dire. In these areas, not only will it be nearly impossible to provide high-quality forecast products – in most cases, it will be impossible to even assess how good or how bad those forecast products are, since there are no observations against which they can be verified. Satellite observations can help ensure a realistic model representation of large-scale atmospheric dynamics in the upper layers of the atmosphere but cannot be used to verify forecasts of surface weather. Without the exchange of surface-based observations, the rest of the value chain has an inadequate base on which to build.

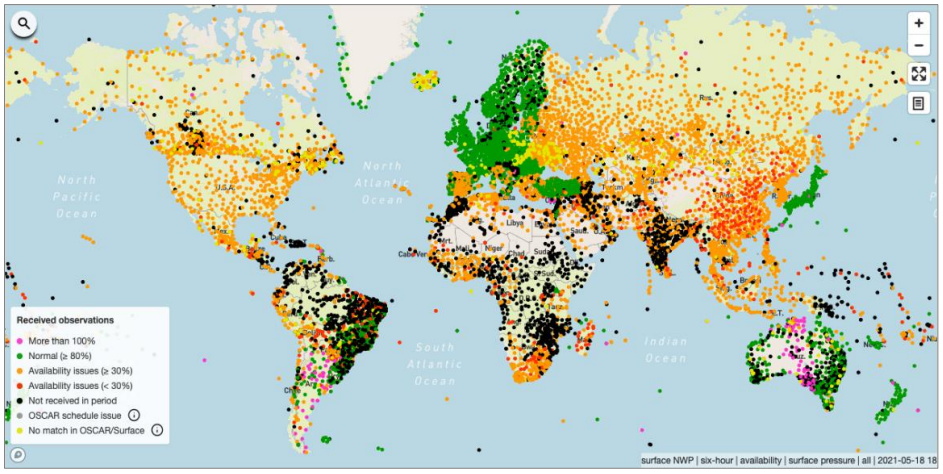



Figure 3. Surface pressure observations received by global NWP Centres on 18 May 2021
Source: WIGOS Data Quality Monitoring System

## 1.5 The Global Basic Observing Network (GBON) – addressing the problem of missing data

**In order to address the observational coverage gaps shown in figure 3 and help ensure a reliable supply of observational data of the most important variables (see table 1) to the NWP systems, 193 WMO Members (states and territories) decided in 2019 to implement the GBON**[5] and to initiate the development of regulatory material for this network, with the aim of having the regulations take effect in January 2022.

**The GBON design is based on up-to-date observational requirements for Global NWP assembled by technical experts working under the WMO Commission for Observation,**

[5] https://community.wmo.int/gbon

Infrastructure and Information Systems.[6] Drawing on 20 years of NWP observational data impact studies coordinated by WMO, the GBON regulations specify in clear, quantitative terms the commitments of the WMO Members to acquire and 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.

The implementation of GBON would represent a major strengthening of the global observing capabilities, and the immediate result would be the availability of better model guidance for weather and climate monitoring and prediction at all spatial scales. This would enable the provision of vastly improved and enhanced weather and climate services at global, regional, national and local levels to all WMO Members. The improvement in service delivery capabilities would be especially large in the areas where the current coverage of observations is poor.

## 1.6 Economic benefits of the global meteorological infrastructure

Since NWP is the basic engine behind all weather and climate services, its quality measures, skill and especially range, can be translated into economic terms. For instance, the safety of life in extreme weather situations typically depends on forecasting skill in the short-range, as do the safety and efficiency of air and land transportation as well as the efficiency of sectors like renewable energy generation. Protection of assets and property and safety, and efficiency of marine transportation depend on longer range, and sectors such as agriculture and water management even longer range. Climate analysis and prediction uses yet longer time horizons.

A recent working paper[7] published jointly by the World Bank, WMO and the Met Office of the United Kingdom provides an estimate of the economic impact of the international exchange of observations via an assessment of the contribution of surface-based observations to NWP skill. It must be emphasized that any economic benefits from weather and climate services result from the operation of the entire value chain shown in figure 1 and that the impact of observations or observational data exchange, therefore, cannot be estimated in isolation. However, as shown in the paper there is overwhelming scientific evidence that the continued lack of surface-based observations in many parts of the world is currently the primary bottleneck limiting further improvements in NWP skill, and that addressing this problem would result in immediate benefits. The paper further estimates the improvement in NWP skill that would result from achieving worldwide full compliance with GBON regulations, and proceeds to translate this improvement into economic benefits via a forward projection of the current economic benefits mentioned above.

The potential benefits directly enabled by the full implementation of GBON, primarily via its implementation in countries with the largest current data gaps, are estimated to exceed USD

[6] Until the WMO Reform, approved by the World Meteorological Congress in 2019, Commission for Basic Systems and the Global Climate Observing System

[7] Kull, Daniel Werner; Riishojgaard, Lars Peter; Eyre, John M.; Varley, Robert Andrew.2021. The Value of Surface-based Meteorological Observation Data (English). Washington, D.C.: World Bank Group. Available at: http://documents.worldbank.org/curated/en/192461614151036836/The-Value-of-Surface-based-Meteorological-Observation-Data.

5 billion per year. Based on the overall GBON cost estimates used in the paper, every dollar invested in GBON would help unleash additional economic benefits at a benefit-cost ratio of over 25:1, i.e., for every dollar invested, at least twenty-five US dollars in socio-economic return could be realized. The net present value realized from achieving GBON compliance is USD 46 billion.

## 2. The persistent problems causing missing observations in SIDS and LDCs

Observational data are missing in many parts of the world (figure 3), but the data gaps have been particularly severe and persistent particularly in SIDS and LDCs. The lack of observations acts as a bottleneck at the start of the value chain (figure 1) and limits the quality of forecasts and climate data products globally, but especially in areas from which observations are missing. This in turn limits the benefits from any investments in the downstream areas of the value chain.

The international community has been concerned about the lack of observations for decades, and many attempts have been made to address the problem. Estimates indicate that members of the Alliance for Hydromet Development are currently managing an active hydromet[8] project portfolio of at least USD 2.5 billion, not counting national or international co-financing, of which about USD 500 M[9] are aimed at improving observing systems in developing countries. Assuming an average project life cycle of five years, this would amount to an expenditure of USD 100M per year. However, the past experience has not been encouraging: Investments made in observing systems in developing countries over the last three decades have generally not resulted in a significant and sustained increase in observational data exchange. On the contrary, the data gap has been growing. For Africa, the number of radiosonde observations provided to the global models decreased by roughly 50% between 2015 and early 2020, and has dropped further since. This is a serious problem due to the fact that among all observations, radiosonde data routinely have the highest individual impact on NWP skill and that, especially in the tropics, the type of information they provide is difficult to obtain from other sources.

Why have substantial investments in observing systems not translated into increased observational data sharing? Starting in 2013, WMO has held a number of regional workshops[10] aimed at increasing the understanding of persistent problems limiting the effective implementation of the WMO Integrated Global Observing System (WIGOS).[11] The most frequently encountered issues, as stated by many of the countries participating in these

[8] For the purposed of this report, the term "hydromet" refers to all investments related to strengthening weather observations and forecasting, early warning systems and climate information services.
[9] SOFF Working Group on financing mechanism and opportunities: Analysis of Alliance Members Hydromet funding. Document available upon request.
[10] See WIGOS workshops reports, including recommendations to the international development community in Oceania (Fiji 2017), Africa (Kampala and Windhoek 2018), Caribbean and Central America (Belize 2019) at: https://community.wmo.int/wigos-events-and-reports
[11] https://public.wmo.int/en/about-us/vision-and-mission/wmo-integrated-global-observing-system

workshops and echoed by major development and climate finance partners, can be grouped into five main problem areas, that are outlined in the remainder of this section.

## 2.1 Lack of a global approach to address the global nature of the problem

**Development projects are typically single-country focused, and their natural response to observing system issues will therefore be to attempt to establish national observational infrastructure.** However, the action that is needed to establish a functioning data exchange is generally not purely national. It will involve collaboration with – and in many cases investment in – system components and entities outside the country such as Regional Telecommunication Hubs, Global Information System Centres, Regional WIGOS Centres, all the way to the intended recipients of the observations, the Global Producing Centres running the NWP models. Therefore, single-country projects – even when successful in installing national networks – generally do not result in improved observational data exchange. Since observations that are not exchanged do not help substantially improve the prediction of the NMHSs, they will have no real incentive to maintain or even operate the delivered national networks once the projects are completed and the support ceases.

**Last-mile projects rely heavily on the use of global model data, and while the importance of these data is well understood by those designing the projects, the role of local observations is less so.** The critical link between the exchange of local observations and the local quality of model data – including through their contribution to the quality of high-resolution down-scaled products – is generally not fully recognized, nor is the critical role played by observations as the only objective means of forecast verification. Furthermore, in small or medium-sized countries it is often the case that the observations that would be most important for their weather forecasts would need to come from outside their borders. Traditional single-country, last-mile focused projects with no control over, or even coordination with, projects in neighboring countries, therefore, often do not see a reasonable value proposition in investing in local observing systems. Ongoing failure to address this problem has been detrimental to the availability of radiosonde observations, especially over Africa.

## 2.2 Lack of appropriate measure of success

**While the lack of observations from developing countries is well recognized and frequently cited in climate project rationales and design documents, the lack of awareness of the critical role of data exchange has led to conflating the problem of missing data with the problem of missing observing stations (box 3).** Ultimately what matters is that observational data are shared, not merely that observational hardware is installed. Therefore, the success of interventions needs to be defined as sustained delivery of observational data to the NWP centres, not the completion of hardware installation projects. The time-bound, single-country nature of projects leads to a focus on observing hardware investments. Issues around the delivery of observations, in particular international data exchange, are rarely addressed, since they are difficult, open-ended and need to involve technical and financial support beyond the project cycle and collaboration with entities outside the project recipient country.

**Box 3. Examples - lessons learned from past projects[12]**

- **Multi-country hydromet project:** A climate readiness project completed in 2019 covering 11 countries in sub-Saharan Africa made significant investments in upgrading observing system elements. The project final evaluation assessed the upgraded observing systems elements as successful overall, with a good likelihood of sustainability. However, the WIGOS Data Quality Monitoring System (WDQMS)[13] for May 2021 shows no data delivery from seven countries, very few data from two countries and reasonable data delivery only from the remaining two.
- **Single country hydromet development project in Africa:** A comprehensive network of 50 Automated Weather Stations (AWS) was installed in the country. The project was completed in 2019 and the final evaluation rated the project as successful. However, as of today, no observations are available at the NMHS, no observations are being internationally exchanged, no standard data formats are in place, and the telecommunication capabilities are inadequate.
- **Multiple single-country projects within the same LDC**: Multiple donors and implementing entities are active within the same LDC, resulting in a very comprehensive "network of networks" of AWSs. Of 100 stations in total, only 50 were operating in June 2020. And for the operating stations different vendors, different data formats and no common point of delivery have limited their effectiveness. Finally, the country's NMHS only has access to data from five stations, and of these, the WDQMS shows that only data from two stations are routinely exchanged.

## 2.3 Lack of predictable and long-term support

**Short-term projects with tight milestones and delivery schedules are ill-suited to address systemic issues and cannot provide the necessary long-term support to ensure long-term operation and maintenance of the country's observing system.** For example, AWSs are seen by donors and implementing entities as a modern, high-efficiency, low-cost means of providing meteorological data, but in many developing countries the perception is rather different. Even after AWS networks have been installed, many NMHSs in developing countries continue to rely on manual observations made by human observers and transmitted by outdated communication methods for meeting their WMO obligations. There are strong structural reasons behind this and institutional barriers that are not easily removable via short-term project approaches. AWS networks are often perceived as threats to job security among NMHS staff and there is no clear link between the data they provide, and the daily operations or quality of service provided by the NHMS.

**While AWS networks may be officially being welcomed by the recipient countries, the reality is that these networks have in many cases been orphaned from the outset and failed to gain traction in the beneficiary countries.** Building and publicizing the links between the data they provide and the quality of local forecast products, managing the impact on employment prospects and expected qualifications of NMHS staff, and advocating for acceptance and support of the associated hardware in local communities all require long-term commitment and technical and financial support beyond what can be provided by time-bound projects.

[12] Cases and lessons learned as documented and presented by countries at WIGOS workshops and reflected in projects evaluations.

[13] The WDQMS webtool is a resource developed and operated by WMO together with ECMWF to monitor the routine delivery of data into WMO's international data exchange system.

## 2.4 Lack of coordinated and integrated implementation approach

In many cases, several development and climate finance initiatives have – more or less independently of each other – attempted to address the issue of missing observations via separate projects within the same country. Many beneficiary countries thus find themselves in situations with many disparate observing networks relying on vendor support from different donor countries, providing data in different proprietary formats, requiring separate stocks of spare parts, etc. (box 3). This is not sustainable, and it would not be sustainable even for a NMHS in a developed country.

Operating and maintaining observing networks also require a coordinated approach for the provision of technical assistance. Many development partners providing support and investing in basic observations do not have sufficient in-house capacity to design and support the implementation of these projects. As a result, they draw on international consultants that very often apply different approaches for different projects.

Engagement between the national government of a recipient country and an external development partner regarding hydromet development projects often starts with the Ministry of Finance or the Ministry of Foreign Affairs and may not involve the NMHS until fairly late stages, if at all. Both, per WMO regulations and in practice, the NMHS acts as the national node in the international exchange of observations. However, in several countries, implementing entities have failed to recognize the critical role of the NMHS until after all project resources have been expended, and hardware has been purchased and installed, but no data are flowing from it. No institutional, technical, or financial support and thus no incentives to the NMHS had been foreseen, and as a result, no observational data were exchanged.

## 2.5 Lack of realistic financing model undermines sustainability

In developing countries, SIDS and LDCs in particular, the lack of observations can be directly tied to the lack of local resources to pay for them. Figure 4 shows the horizontal density of observations (left panel) of observations currently exchanged internationally for NWP, and available financial resources, measured by GDP per $km^2$ surface area (right panel); a larger surface area implies a larger observing remit. Since SIDS are characterized by their Exclusive Economic Zones (EEZ) being many times larger than their land areas, calculations for SIDS were made including both EEZ and land areas. The differences in "ability to pay" between rich and poor countries are striking. Even discarding cases like Monaco or Singapore (very high concentrations of wealth in small surface areas), the range of this measure spans six orders of magnitude (the richest countries' GDP corresponds to one million times more dollars per $km^2$ than that of the poorest countries). Scarce local resources lead to scarcity of observations, as evidenced by the similarity between the left and right panels in figure 4 if one compares the dark red areas in the left graph with the dark blue and purple areas in the right panel (mostly Africa and Pacific Islands). The combination of very low income with large geographic responsibilities in SIDS and LDCs makes it particularly challenging to achieve a reasonable density of sustained observations in many parts of the world.

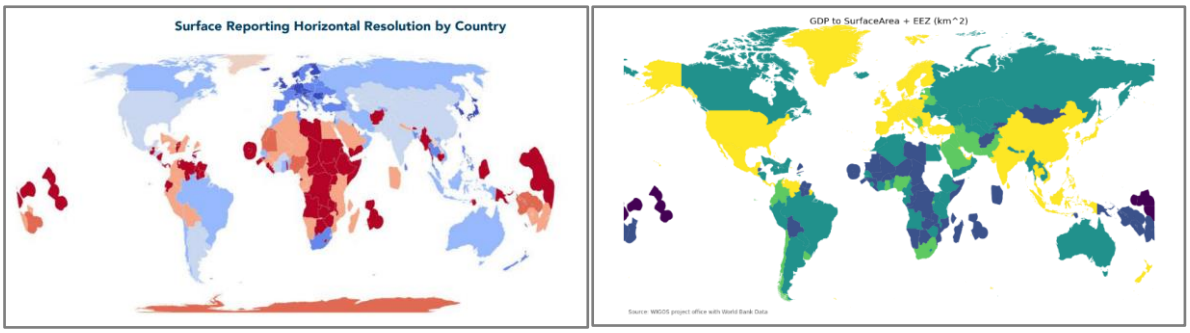



Figure 4. Ability to pay versus the ability to observe: Left panel: density of observations by nation (red do not meet requirements). Right panel: National GDP/km2 of surface area; darker colors (blue and purple) show fewer resources per unit area. Source: WMO secretariat, 2021

**The unequal geographic distribution of wealth makes it unrealistic to believe that a reasonable minimum density of observations can be sustained in many parts of the world.** The assumption enshrined in the WMO Convention is that each WMO Member bears the sole responsibility for providing the required data over its national territory. The Paris Agreement implicitly bases its language on Systematic Observation on the same assumption.

**Assumptions of responsibility by international agreements, when combined with short-term, project-based approaches, leave the fundamental challenges of data sharing unresolved.** Externally funded hydromet development projects typically include the sustainability of the project's investment as a de-facto pre-condition. Project documents aim to demonstrate that after the project ends the country can and will cover the long-term operations and maintenance costs of the infrastructure financed by the project. However, having a strategy does not in itself guarantee that any systems implemented by the project will be sustainable, and the approach leads to a series of ad hoc projects, most of which eventually will not reach fruition in terms of sustainable data sharing. The main reasons for this are (i) the operation and maintenance costs of AWS, which are often either underestimated or overlooked, and (ii) the high operating costs of radiosonde stations which often lead to radiosondes not being addressed at all in project approaches. Missing resources for maintenance and repair have all contributed to the lack of past successes. This was identified as a key factor in the World Bank's evaluation of its hydromet projects: "Maintenance continues to be a problem. Only four of the 12 closed African projects reported attention to maintenance."[14] The Board of the Green Climate Fund (GCF) acknowledged that the GCF alone cannot ensure the sustainability of recently approved investments in basic observations.[15]

**Finally, commercial approaches, e.g., via full or partial privatization of the initial part of the value chain, or via seeking revenue to cover the cost of certain government services, cannot be reconciled with the need for free and unrestricted international exchange of observations.** Due to their role at the beginning of the value chain and prevailing international agreements,

[14] Independent Evaluation Group. World Bank Group, 2012. "Adapting to Climate Change: Assessing World Bank Group Experience--Phase III of the World Bank Group and Climate Change." Available at: https://openknowledge.worldbank.org/handle/10986/21106

[15] Green Climate Fund, 2018. "Enhancing Climate Information and Knowledge Services for resilience in 5 island countries of the Pacific OceanCook" Available at: https://www.greenclimate.fund/document/enhancing-climate-information-and-knowledge-services-resilience-5-island-countries-pacific

observations are difficult for national governments to monetize, and a wealth of economic analyses have shown that attempting to do so would severely limit the use and impact of the data.[16] However, in their quest for revenue, some national governments may attempt to limit the freedom of their NMHS to exchange data, including observations. Blocking the exchange of observations will have the unintended side effect of severely limiting the scope and quality of weather and climate services that the NMHS can provide for its national territory, thus preventing it from being able to deliver any services at all that can be monetized. WMO is currently updating its data policy (WMO Unified Policy on International Exchange of Earth System Data).[17] A major element of the new policy will be to help improve access to and use of model output data for all Members. This will allow them to significantly improve and expand their service delivery capabilities.

## 3. SOFF value proposition

**The SOFF is designed to respond to the problems identified in section 2 in a transformational manner and to ensure that SIDS and LDCs have the capacity, financing and incentives to implement their GBON commitments and thus deliver the benefits identified in section 1.** The design of SOFF is based on an 18-month preparation process involving key stakeholders and partners and led by WMO (see section 6). A key element of SOFF is that it will also engage these stakeholders and leverage these partners in its implementation. The defining features of SOFF are summarized in box 4.

**Box 4. What is SOFF?**

- **A global initiative to address a persistent problem in a global and systematic manner** – i.e., missing surface-based weather and climate observations from developing countries.
- **An initiative with an exclusive focus on the initial part of the meteorological value chain** that creates the foundation for effective policy and investment decisions.
- **A dedicated financing mechanism** that provides grants and technical assistance, with a focus on SIDS and LDCs, to enable sustained compliance with the GBON requirements.
- **A mechanism that is built on peer-to-peer collaboration and support** among national meteorological services, harnessing their operational experience as providers of peer technical advice and assessments.
- **A commitment of the Alliance for Hydromet Development**, supported by beneficiary countries and multiple stakeholders.

[16] See examples and references on the benefits of open data policies: (i) WMO Permanent Representative of Hungary presenting at the Data Conference how and why the country switched to an open data policy: https://meetings.wmo.int/WMO-Data-Conference/Documents/06_Konelia%20Radics_RK_WMODataConference.pdf; (ii) WMO Data Conference preparation workshop lists the benefits of the Copernicus open data policy and includes a reference to the underlying economic analysis: https://meetings.wmo.int/WMO-Data-Conference/PublishingImages/SitePages/Preparatory%20Workshops/Copernicus%20Data%20Policy%20Benefits%20for%20Environmental%20Services.pdf; (iii) Open data access approaches in the Group on Earth Observations and the research community: https://meetings.wmo.int/WMO-Data-Conference/PublishingImages/SitePages/Preparatory%20Workshops/Robert%20Chen_Open%20Data%20Access%20Approaches%20in%20GEO%20and%20the%20Research%20Community.pdf

[14] WMO Unified Data Policy Resolution, available at: https://public.wmo.int/en/unified-wmo-data-policy-resolution-cg-ext-21

## 3.1 What is the goal and the theory of change of SOFF?

The goal of SOFF is to strengthen climate adaptation and resilient development through improved weather forecasts, early warning systems and climate information services. SOFF will contribute to this goal through sustained collection and sharing of high-quality surface-based weather and climate observations in compliance with the GBON, leading to improved weather and climate prediction products. SOFF will achieve this outcome through eight outputs delivered across Readiness, Investment and Compliance phases (see section 5). The improved weather and climate prediction products will underpin last-mile adaptation and resilient development projects and programmes and therefore contribute to increase their effectiveness and maximize benefits. Annex 1 presents a graphical overview of the basic elements of the SOFF Theory of Change.

## 3.2 How will SOFF address the persistent problems of missing observations?

SOFF will address the persistent problems in a systematic manner by (i) deploying a global approach with sustained international data exchange as a measure of success; (ii) providing innovative finance; and (iii) enhancing technical competence and effective coordination. Through the combination of these features, and by leveraging its resources through close cooperation with other partners, SOFF will channel international support to strengthen countries' basic observation capacity in new, more effective and sustainable ways.

### 3.2.1 Deploying a global approach with sustained data exchange as a measure of success

SOFF actions will be guided by an optimal and internationally agreed global design and corresponding metrics – the GBON requirements. GBON clearly defines the countries' international data exchange obligations for the most essential surface-based weather and climate data.

GBON metrics will guide SOFF investments. SOFF will provide the resources for beneficiary countries to close the GBON gap. In other words, GBON metrics will ensure the "right" level of investments, and SOFF will deliver these investments through an integrated and coherent intervention (see below).

GBON compliance will constitute the measure of success. The GBON metrics and WDQMS allow for an objective assessment of countries' compliance with its obligation for the international exchange of basic surface-based observations. In other words, success - of countries and SOFF –will be measured by the amount and quality of internationally exchanged data.

### 3.2.2 Providing innovative finance

SOFF finance will (i) be grants-only; (ii) be predictable and long-term; (iii) contribute to operations and maintenance costs; and (iv) use a results-based approach for payments.

Grant finance. SOFF will provide both, additional and grant-only resources. In view of scarce resources, governments need to make trade-off decisions between investments in observations and investments in other parts of the value chain and other sectors of the economy. This inevitably disadvantages investments in observations where the benefits reach beyond individual countries and countries benefit from observations made by other countries. Therefore, SOFF provides additional international resources beyond existing country envelopes set by development and climate finance partners. Grant-only support for SIDS and LDCs is justified by (i) the global public goods dimension of recipient countries' contribution to GBON; (ii) the limited institutional and fiscal capacity, in particular as measured by GDP per square kilometer reflecting the surface area to be observed (figure 4); (iii) the debt sustainability challenges and rapidly unfolding post-COVID debt crisis; (iv) the high vulnerability of SIDS and LDCs to extreme weather events and the impacts of climate change; and (v) the global call on all developed countries and climate finance providers to increase the level of grant finance to support the most vulnerable, in particular for adaptation (call led by the COP26 UK – Presidency).

Predictable long-term finance. SOFF will provide long-term financial and technical support, beyond time-bound projects. The long-term nature of support and the predictability of resources will allow countries to make corresponding policy and investment decisions. For example, countries could consider establishing public-private partnerships in support of the generation and exchange of observations that to be successful require long-term engagements.

Finance for operations and maintenance. Achieving sustained GBON compliance in SIDS and LDCs requires not only capital expenditures and short-term efforts to improve institutional capacity, e.g., resources to purchase or improve fixed assets like observations equipment and staff training, it also requires the provision of finance for operations and maintenance. SOFF will substantially contribute to cover operations and maintenance costs – in the long term (see above) and through results-based finance (see below).

Results-based finance. In the compliance phase, SOFF will ensure that countries have the means and incentive for the sustained generation and international exchange of observational data through the provision of results-based finance (section 5).

### 3.2.3 Enhancing technical competency and coordination

Operating and maintaining observing networks and internationally exchanging the data is a complex undertaking, in particular for countries with limited human and institutional capacity and challenging country circumstances. SOFF will enhance beneficiary countries' capacity by harnessing the operational experience of advanced NMHSs. These NMHSs will provide hands-on peer-to-peer technical and institutional assistance and assessments, including South-South peer support (section 5). The SOFF Secretariat will systematically capture lessons learned by countries, peer advisers, Implementing Entities and other partners, feed them back into operations, and share them with all SOFF stakeholders.

**SOFF will ensure coordinated action to strengthen countries' basic observations capacity at the global and country level.** SOFF will provide the mechanism for effective collaboration and coordination among the several scientific, financial, and operational partners involved in strengthening the weather and climate observing system in developing countries. SOFF will effectively bring together all major partners with a clear focus on the primary links of the hydromet value chain that can only be implemented under a globally coordinated approach and coherent action at the country level to succeed. In order to address the problem of multiple development and climate finance partners supporting different parts of a countries' basic observing network in a fragmented manner, relying on different vendors with interoperability challenges and requiring different spare parts, SOFF will close the GBON investment gap through standardized single interventions with one competitive procurement of equipment for each beneficiary country or sub-region.

## 3.3 How will SOFF coordinate and leverage other sources of finance?

**The Alliance for Hydromet Development recognized the urgency of addressing the issue of missing observational data in a coordinated manner (box 5).** Through the Alliance founding declaration, all members committed to seeking innovative ways to finance developing country surface-based observations through the creation of a Systematic Observations Financing Facility.[18]

**Box 5. The Alliance for Hydromet Development – the international community's quest for a new way to support hydromet development**

**The Alliance unites efforts of major development and climate finance partners to close the capacity gap on high-quality weather forecasts, early warning systems and climate information**. Recognizing the importance of investments in basic observations and the substantial sustainability and delivery challenges of the current assistance model, the creation of SOFF is a commitment and priority of the Alliance. Along with many other international partners, the members of the Alliance have substantially contributed to the development of SOFF (see Section 6).

**The Alliance was launched at UNFCCC COP 25 and is comprised of the following 13 members:** Adaptation Fund; African Development Bank; Asian Development Bank; Climate Investment Funds; European Bank for Reconstruction and Development; Global Environment Facility; Green Climate Fund; Islamic Development Bank; United Nations Development Programme; United Nations Environment Programme; World Bank; World Food Programme; World Meteorological Organization.

**SOFF will support and leverage Alliance members' and partners' investments in the other parts of the meteorological value chain and more broadly climate and resilient development** (i) through improved outcomes in the upstream portion of the hydromet value chain; (ii) through country hydromet assessments; (iii) through the partnership with Implementing Entities and coordination with other stakeholders in recipient countries; and (iv) through its governance structure.

[18] See Alliance declaration at: https://ane4bf-datap1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/ckeditor/files/Alliance_for_Hydromet_Development_Declaration.pdf?MK76pyj0R4sEbJb3c90y.W6S7km7PAEN

**SOFF creates leverage through its outcomes.** Sustained GBON compliance is a foundational element of the value chain (figure 5). The effectiveness of investments in the latter part of the chain – where the substantial part of today's international hydromet development investment is placed – fully depends on the first parts of the chain that are weak in many developing countries. GBON compliance enables investment decisions based on improved weather and climate prediction products and projects designed on a better "climate rationale" basis (section 1).

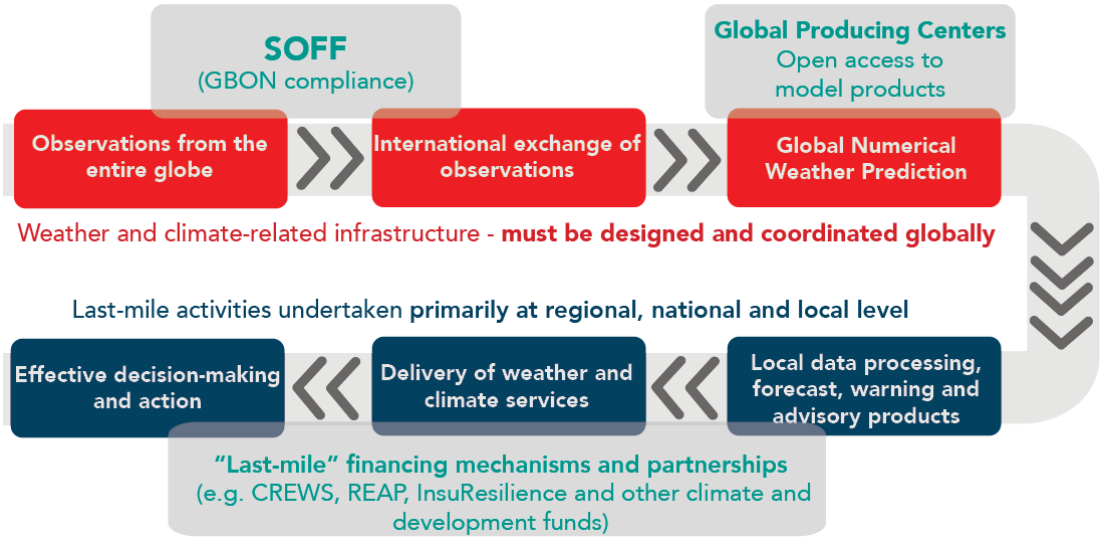



Figure 5. SOFF contribution to the latter links of the meteorological value chain.

**SOFF creates leverage through its authoritative country hydromet gap assessments.** The Country Hydromet Diagnostics (CHD) (box 6) are not only an important element of SOFF support, but they also inform investments of all other development and climate finance partners. By authoritatively assessing the whole value chain and identifying gaps with a peer-to-peer approach, they provide the analytical foundation for prioritizing and sequencing hydromet investments. For each SOFF investment decision, the SOFF Steering Committee will be informed by the CHD, including an overview of international partners' country hydromet investments. SOFF funding partners, Alliance members, CREWS and other initiatives will be able to use this information for their investments in the respective country.

**Box 6. What is the Country Hydromet Diagnostics?**

**The CHD are a standardized, integrated and operational tool and approach for assessing National Meteorological Services**, their operating environment, and their contribution to high-quality weather, climate, hydrological and environmental services and warnings. The CHD have been developed by the Alliance for Hydromet Development, spearheaded and technically guided by WMO.

**The CHD aim at informing policy and investment decision-making,** in particular guiding investments of the members of the Alliance for Hydromet Development. Through the CHD, developing countries will benefit from better targeted and aligned support as the assessment of maturity levels indicates where additional focus and support is needed.

**The CHD are an umbrella tool** that synthesizes existing approaches and data provided by WMO Members and partners. It completes and validates this information through a structured peer review process. The WMO Community Platform provides the primary source of data, and the results of the Diagnostics are going to be integrated in the platform, adding substantial value to it.

**The CHD use peer review as their overarching approach**, following examples of other organizations, including the Organization for Economic Co-operation and Development (OCED) process for the peer review of members' development assistance. As peers, advanced NMHSs from developed and developing countries undertake the Diagnostics, strictly following the tool. This enables coherent and standardized assessments across countries.

**The CHD are being developed and implemented through a phased and learning approach**. In the first phase, the prototype was developed by a multi-stakeholder working group. Following the development of the CHD, Alliance members partnered with 16 countries to road-test the tool. These were Afghanistan, Austria, Chad, China, Cote d'Ivoire, India, Kyrgyz Republic, Liberia, Maldives, Morocco, Myanmar, Nigeria, North Macedonia, Sierra Leone, Switzerland, Turkey.

**The countries – both, those NMHSs assessing and those being assessed – and Alliance members participating in the road-testing, welcomed the CHD as an effective tool and process**. They were valued as "authoritative" assessments through peers that established the big picture and corresponding gaps and provided the common basis for more detailed project preparations. The results of the road-testing evidenced the severe challenges that many countries face, including with many of them showing the lowest maturity ratings for the most basic capacity requirements in terms of equipment, skills, or user engagement to deliver services of value despite growing risks to vulnerable communities. The CHD and the road-testing results will be showcased in the first Hydromet Gap Report issued by the Alliance for Hydromet Development to be launched at the UN High-level Political Forum (UNHLPF) in July 2021.

**The tool is now being refined based on the lessons learned from the road-testing**, through the multi-stakeholder working group. During the interim phase, until SOFF is operational, it will be offered on-demand to Alliance members at the initial stage of project development in a country. Undertaking a CHD will be a mandatory first step of the SOFF Readiness phase (section 5).

**SOFF creates leverage through its Implementing Entities.** Whenever possible, SOFF resources – funding and technical advice – will be embedded into larger country hydromet investment operations supported by the Implementing Entities, either within a country or at sub-regional level to create economies of scale and blend SOFF resources with resources provided by the Implementing Entities. Implementing Entities can draw on the advisory services provided by advanced NMHSs for the SOFF part of the projects and programmes and for the best integration of SOFF into larger operations.

**SOFF creates leverage through its governance structure.** The SOFF funding partners not only invest in SOFF but channel substantial resources through their bilateral and/or multilateral channels in resilient development and climate adaptation. As SOFF decision-makers, the funding partners can ensure that SOFF creates the foundation for these other investments and that this foundation is properly used in the investments made by these partners. Investments funded by the Climate Risk and Early Warning Systems Initiative (CREWS) are critical to be able to realize the benefits from SOFF investments. Therefore, it is proposed that CREWS be represented in the SOFF governance structure (box 7). In addition, it is

proposed that the SOFF Advisory Board include representatives from initiatives like the Risk-Informed Early Action Partnership (REAP) and InsuResilience; this would help ensure SOFF "last mile" links and leverage (section 4). REAP is of particular importance as an overarching framework for ensuring last-mile delivery, and SOFF will make a significant contribution to achieving its goals (box 8).

**Box 7. The SOFF/CREWS symbiotic partnership**

**SOFF and CREWS are playing complementary roles and are mutually dependent for their success.** Both mechanisms prioritize SIDS and LDCs. The effectiveness of CREWS is dependent on SOFF outputs and outcomes, i.e., better global climate and weather products based on substantially increased observations from SIDS and LDCs. At the same time, achieving the SOFF goal of strengthened resilient development and climate adaptation requires initiatives like CREWS. In the absence of SOFF, CREWS has also been investing in basic observations, but given its institutional set-up is not equipped to fully address the challenges stated in section 2 in a sustained manner.

**With the creation of SOFF, CREWS can deploy its resources exclusively to the latter part of the value chain and "last mile" national actions.** In order to create a formal collaboration mechanism, it is proposed that CREWS be represented in the SOFF governance structure (section 4). CREWS would inform, contribute to, and benefit from SOFF policy and strategy decisions as well as all SOFF country investment decisions.

**Box 8. Risk-Informed Early Action Partnership (REAP) aims to make 1 billion people safer from disasters by 2025**

**REAP brings together an unprecedented range of stakeholders** across the climate, humanitarian and development communities committed to driving a systemic shift towards acting earlier – in advance of a hazard striking - to reduce the impacts of disasters.[19]

**To underpin this shift towards earlier action, the basic observational data exchange, supported by SOFF**, will lead to improved, earlier, more reliable weather forecast data, everywhere, the basis on which anticipatory action plans and triggers are built. Improved data will minimize forecast inaccuracies and support the uptake of risk-informed early action approaches.

**For this reason, SOFF is recognized as a foundational commitment to support the achievement of REAP Target 3**: $500 million invested in early warning system infrastructure and institutions to target early action in 'last/first-mile' communities, building on existing initiatives.[20]

## 4. Proposed SOFF institutional arrangements

**Achieving sustained GBON compliance requires the effective collaboration of many stakeholders in new ways**. This requires a SOFF institutional structure and governance that is both, inclusive and focused. It needs to take advantage of the competencies and unique value proposition of the institutions that form the SOFF institutional structure. The SOFF

[19] More information on REAP available at: https://www.early-action-reap.org/who-we-are
[20] REAP Framework for Action available at: https://www.early-action-reap.org/sites/default/files/2021-01/20210125_REAP_Summary_NEW.pdf

institutional options proposed in the report for the first potential funders' forum[21] have been further analyzed. Based on this analysis, it is proposed to establish SOFF as a UN Multi-Partner Trust Fund (UN MPTF). The fund would be guided by a Steering Committee as a decision-making body, a multi-partner advisory board that would advise the Steering Committee, a SOFF Secretariat that would manage SOFF operations, and Implementing Entities consisting of the Multilateral Development Banks (MDB) and UN organizations that are members of the Alliance for Hydromet Development. These different roles are discussed further below.

## 4.1 UN Multi-Partner Trust Fund

It is proposed that SOFF be established as a UN MPTF that pools contributions from SOFF funding partners, with the UN Multi-Partner Trust Fund Office serving as SOFF trustee. The UN MPTF Office was established in 2003 and is administratively housed within UNDP. It is the UN mechanism for the administration of pooled financing instruments totaling more than USD 15 billion. The UN MPTF Office has a track record in 139 countries. It has experience in receiving and pooling financial resources from many public bilateral and multilateral as well as private sources.[22] Of particular relevance for SOFF is the UN MPTF Office experience with the direct transfer of resources to countries through results-based financing.

It is envisioned to establish SOFF as a "UN coalition fund". WMO would co-create the fund jointly with the United Nations Environment Programme (UNEP) and the United Nations Development Programme (UNDP); both organizations have expressed interest to join WMO as co-creators. This would position SOFF as a joint UN initiative and would increase SOFF reach and visibility.

The UN MPTF Office as the trustee for the Facility would provide fiduciary oversight and other support services in accordance with legal frameworks established between the United Nations, the co-founders (WMO, UNEP, UNDP) and the SOFF funding partners. The UN MPTF Office uses a pass-through modality where each SOFF Implementing Entity (selected UN organizations and MDBs, see section 4.6) applies its own procedures, provided they meet the UN MPTF requirements with regards to safeguards and fiduciary principles. The costs for the UN MPTF Office trustee function correspond to an administrative fee of one percent of the contribution by funding partners.

This proposed framework offers the required flexibility, simplicity and speed for SOFF creation. It would benefit from existing, pre-cleared Standard Legal Agreements already in place between the Trustee (UN MPTF Office), all UN agencies and programmes (including UNEP, UNDP), the World Bank, OECD Development Assistance Committee (OECD DAC) donors, non-DAC middle income and developing country donors, and private philanthropies. The SOFF MPTF would be legally established by late October 2021 to accommodate contributions already this year (section 6).

[21] Find SOFF first funders' forum report at: https://public.wmo.int/en/our-mandate/how-we-do-it/development-partnerships/Innovating-finance/SOFF-funders-forum

[22] Examples of funds under UN MPTF Office trusteeship include the Partnership for Action on Green Economy, the UN Programme on Reducing Emissions from Deforestation and Forest Degradation, the Central Africa Forest Initiative, and the newly established Global Fund for Coral Reefs.

## 4.2 WMO role

**WMO, joined by UNEP and UNDP, would be the founder of the SOFF and a co-decision maker**. According to UN MPTF policies, the founding UN organization co-chairs the Steering Committee in a decision-making role; if a fund is established as a "UN coalition fund" any of the UN coalition partners can play this role on behalf of the others. In coordination with UNEP and UNDP, it is proposed that WMO become the Steering Committee co-chair. A senior-level coordination mechanism among the three coalition members would be established to provide an aligned position for Steering Committee decisions.

**WMO would be the SOFF technical authority and independent verifier of GBON compliance.** The WMO Secretariat, guided by the WMO Commission for Observation, Infrastructure and Information Systems, would be responsible for verifying both, the GBON national contribution (i.e., what it takes to close the GBON gap) and the achievement of GBON compliance. Verification of the GBON national contribution and the corresponding plan on how to close the GBON gap would trigger SOFF investment support. Annual verification of GBON compliance would trigger results-based finance for the contribution to operations and maintenance costs. WMO would also substantially contribute to the annual GBON compliance and SOFF impact report in two ways: First, it would report on global GBON compliance. Second, in collaboration with Global Producing Centres, WMO would assess the impact of SOFF investments on forecast accuracy.

## 4.3 SOFF Steering Committee

**The Steering Committee would** oversee the overall activities of the Facility, decide on its strategic direction, approve and amend SOFF governance documents and operational guidelines, ensure that the operations of the Facility are consistent with its mandate and objective, and ensure complementarity between SOFF and "last mile" initiatives. It would approve overall funding allocations and individual funding requests. The Steering Committee would meet as often as needed at least two times a year virtually or physically. The Decisions by the Steering Committee would be made by consensus among decision-making members and taking into consideration the views of the non-decision-making members and recommendations of the Advisory Board. SOFF would follow an adaptive learning process. Based on inputs from the SOFF Secretariat and the SOFF Advisory Board (see below) the Steering Committee would continuously monitor, assess and, as needed, make adjustments in SOFF operational modalities.

**The Steering Committee would be composed of decision-making and non-decision-making members.** Decision-making members would be all funding partners and WMO. Non-decision-making members would include the (co)chair(s) of the Advisory Board (UNDP and potential co-chair), a representative from the Trustee providing financial information and advice (UN MPTF Office), a representative from the SOFF Secretariat host institution (UNEP), and the head of the SOFF Secretariat. In order to closely link the CREWS and SOFF initiatives, a representative from the CREWS could potentially be part of the SOFF Steering Committee in a non-decision-making role (box 7).

## 4.4 SOFF Advisory Board

A multi-stakeholder SOFF Advisory Board would be established. Its objectives would be to ensure that SOFF responds to beneficiary countries' needs; that it creates synergies with major adaptation and resilience initiatives, linking SOFF with the "last mile" policy and investment decisions; and that the SOFF strategic direction evolves as GBON evolves. The Advisory Board would virtually meet ahead of each Steering Committee meeting to prepare recommendations for the Steering Committee. As a prospective SOFF co-founding partner, UNDP expressed interest in (co)chairing the Advisory Board. The chair(s) would be expected to leverage the knowledge, advocacy and political influence of their institution(s).

The Advisory Board would bring together the most important SOFF stakeholders. It would be composed of the chair(s) (UNDP and a potential co-chair), beneficiary country representatives (potentially LDC Group and AOSIS Group representatives), two representatives from the Alliance for Hydromet Development (on a rotating basis, one representative from the Implementing Entities and one representative from the environment and climate funds), a representative from UN organizations that are not part of the Alliance for Hydromet Development, representatives from the major SOFF-related initiatives (e.g. Global Commission on Adaptation, REAP, InsuResilience, GFDRR, ClimDev, Center for Disaster Protection), a representative from civil society organizations, a representative from the Global Producing Centres (on a rotating basis) and a private sector representative (potentially the Association of Hydro-Meteorological Equipment Industry – HMEI).

## 4.5 SOFF Secretariat

SOFF requires a highly specialized secretariat to manage SOFF operations and to coordinate and ensure coherence of action by the many SOFF partners. The SOFF Secretariat would be administratively hosted by one of the three UN coalition partners. UNEP has expressed interest in hosting the Secretariat, with a potential contributing role of WMO that would be further fleshed out. The Secretariat would be accountable to the Steering Committee. The SOFF Secretariat requires substantial management, technical, and operational expertise yet will be kept as lean as possible. Employment of SOFF Secretariat staff would follow the human resource policies and procedures of the SOFF host institution. The budget of the SOFF Secretariat would be approved by the Steering Committee on an annual basis as a direct cost to the Fund.

The SOFF Secretariat would deliver on a variety of tasks. It would support the work and decision-making of the Steering Committee and provide secretariat support for the Advisory Board. It would develop the Fund's investment plan, receive and review support requests and manage submission of funding proposals for Steering Committee decision, report to the Steering Committee and the trustee on SOFF progress based on information provided by the SOFF partners, and coordinate the production of the annual GBON compliance and the SOFF impact report.

The SOFF Secretariat would administer the provision of peer review and advisory services to beneficiary countries and their implementing entities through the Country Support Initiative (CSI). CSI was established by a World Meteorological Congress decision in 2019 as a peer-

to-peer advisory service with its own governance structure.[23] However, since the CSI has not yet been institutionalized and to avoid institutional fragmentation and reduce costs, the intended CSI work program would be fully integrated into the SOFF and administered by the SOFF Secretariat. The scope of CSI advisory services provided by WMO members on a peer-to-peer basis would be tailored to SOFF needs. It would include the CHD assessments (box 7) and the provision of technical advice to eligible countries and SOFF implementing entities (section 5).

### 4.6 SOFF Implementing Entities

Major multilateral development partners playing an important role in hydromet project implementation are expected to become SOFF Implementing Entities for the investment phase - MDBs (World Bank and regional development banks) and UN organizations (UNDP, UNEP, World Food Programme). All Implementing Entities would need to be or become members of the Alliance for Hydromet Development. Implementing Entities could partner with other national or international organizations, including bilateral cooperation agencies, for SOFF implementation. Implementing Entities would receive a maximum implementation fee of 7% to cover their institutional costs.

## 5. SOFF operational framework

This section describes the proposed basic operational design and arrangements for SOFF. The following elements of the SOFF operational framework will be developed and further advanced as a basis for the startup arrangements for SOFF to become operational.

- Updated GBON gap assessment presenting an overview of countries' data delivery status, measured against the draft GBON requirements. The initial gap assessment was undertaken in January 2020 and formed the basis for calculating the SOFF funding needs.
- SOFF compliance definition and results-based payments - calculation methodology and administrative arrangements for disbursement of resources directly to the NMHSs.
- Fine-tuned CHD, jointly refined with all members of the Alliance for Hydromet Development and reflecting the country road-testing experience.
- Technical guidance of SOFF phased support implementation – from Readiness to Compliance – based on selected country experiences.

The final detailed arrangements would be defined by the SOFF Secretariat in an operational manual to be approved by the SOFF Steering Committee early after the formal establishment of SOFF.

### 5.1 Eligible countries

In its initial five-year implementation period, SOFF would prioritize support to SIDS and LDCs for all three phases. All other OECD ODA eligible countries would be eligible to apply for SOFF support for only the Readiness phase. In many of these countries, targeted technical assistance alone has the potential for rapid gains in GBON compliance, supported where

[23] Resolution 74 (Cg-18) (2019). Closing the capacity gap: scaling up effective partnerships for investments in sustainable and cost-efficient infrastructure and service delivery. Available at: https://library.wmo.int/doc_num.php?explnum_id=9827

necessary by investment funding from multilateral or bilateral partners. The lessons learned from engaging with these countries would help SIDS and LDCs find innovative solutions to achieve GBON compliance. The complete list of proposed SOFF eligible countries is provided in annex 2. The countries presented in the list include: ODA recipient countries from the DAC List of ODA Recipients effective for reporting on 2021 flows;[24] LDCs countries as per OECD DAC list; SIDS, as per United Nations classification,[25] that are also ODA recipients.

## 5.2 SOFF prioritization criteria

**Country prioritization criteria for SOFF support would be approved by the Steering Committee**. Criteria could include the following:

- **Close the most significant data gaps:** Emphasis on those geographic areas that currently have the poorest observational coverage, hence where strengthening the basic weather and climate observing network would most speedily improve the overall quality of the NWP outputs.
- **Create leverage:** Opportunities for blended finance and integration of SOFF funding into larger operations; countries or regions with hydromet/climate projects programs with satisfactory performance currently funded by Implementing Entities or under preparation.
- **Target "easy fixes":** Countries where through relatively small interventions, stations and related infrastructure could be fixed to quickly start delivering the data into the global system.
- **Maximize delivery capacity:** Countries where Implementing Entities and peer advisors' have the ability to effectively operate and deliver SOFF support.

**Targeted support for Fragile and Conflict-affected States (FCS) may be needed**. The criteria listed above could mean that FCSs end up at the bottom of the priority list. To ensure that opportunities for action are not neglected in those countries, and to develop best practices for SOFF delivery in FCS, a specific portion of resources, approved by the Steering Committee, could be devoted to mobilizing efforts to implement SOFF in FCS in collaboration with Implementing Entities specifically focused on these countries.

## 5.3 Readiness phase – Assess the hydromet gap and plan to close the GBON gap

In the Readiness phase a country's hydromet status would be assessed, its GBON gap defined, and a plan to close the gap developed. The following table describes the outputs and responsible partners in this phase.

| Outputs | Partner |
|---|---|
| Country Hydromet Diagnostic, including GBON gap | Country NHMS, peer reviewer/adviser (advanced NMHS) |
| GBON gap verification | WMO Technical Authority |

[24] https://www.fisu.net/medias/fichiers/dac_list_oda_recipients_for_reporting_2021_flows.pdf
[25] List of SIDS | Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States

| | |
|---|---|
| GBON National Contribution plan | Country NHMS, peer reviewer/adviser (advanced NMHS), Implementing Entity |
| GBON National Contribution plan verification | WMO Technical Authority |

The Readiness phase involves four steps:

Step 1. Readiness support proposal. Countries would submit a request for SOFF Readiness support through their NMHS and, if applicable, through the respective Implementing Entity in charge of the project or program in which SOFF funding would be embedded.[26] The SOFF Secretariat would inform the Steering Committee regularly on the Readiness pipeline and the status of Readiness requests approved by the Steering Committee. Advanced NMHSs would be selected and contracted, in coordination with the beneficiary country and in collaboration with the WMO Secretariat, by the SOFF Secretariat to provide peer review and advisory services on a cost-recovery basis. The SOFF Secretariat would administer these services through the CSI (section 4.5). The resource allocation for these services during the Readiness phase would be capped at USD 100 K per country.[27]

Step 2. CHD and GBON gap assessment. The peer reviewer/advisor would apply the CHD methodology. As discussed in box 6, the CHD[28] is a tool developed by the Alliance for Hydromet Development for assessing National Meteorological Services and their contribution to high-quality weather, climate, hydrological, environmental information services, and warnings. One of the elements assessed in the CHD is the country's GBON gap. The GBON gap would be verified by the WMO Technical Authority (see step 4 below) and would serve as the analytical basis to develop the GBON National Contribution plan.

Step 3. GBON National Contribution plan development. Based on the verified GBON gap report, the country NMHS supported by the peer reviewer/adviser (advanced NMHS), in collaboration with the Implementing Entity, would prepare the GBON National Contribution plan ("GBON plan"). This plan would specify the required investments to close the GBON gap, including infrastructure (stations), telecommunications specifications, installation and operation standards, institutional and human capacity, and training. The GBON plan would constitute the technical basis for the SOFF funding proposal in the SOFF Investment phase (SIDS/LDCs) or for other sources of funding (other OECD/ODA eligible countries). It would be technically reviewed by the WMO Technical Authority.

Step 4. WMO Technical Authority verification of the GBON gap and the GBON National Contribution plan. The WDQMS webtool is a resource developed and operated by WMO

[26] In the case of OECD ODA eligible countries that do not have SIDS/LDC status, the SOFF Readiness support would be provided without involving Implementing Entities but in collaboration with international development and climate finance partners active in the country or planning to invest.

[27] This amount was estimated based on the experience and lessons learned obtained from the road-testing of the Country Hydromet Diagnostics. The Steering Committee could approve higher amounts., under exceptional circumstances for countries with especially difficult circumstances.

[28] More information on the Country Hydromet Diagnostics prototype available at: https://ane4bf-datap1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/ckeditor/files/Country_Hydromet_Diagnostics_final_draft_for_prototyping_6_August_2020_amd_0.pdf?UwqgJr2W5Pi51QahqvXzNvT1s8ezwU6b

and ECMWF to monitor the routine delivery of data into WMO's international data exchange system. WMO would use the system's information to verify the country's GBON gap and GBON plan and issue a technical review note to the SOFF Secretariat to confirm the technical veracity. In case of objections to the GBON gap and/or the plan, WMO would describe the issues and recommend changes. With the support of the peer advisor, the country would revise the gap and/or plan accordingly. The SOFF Secretariat would facilitate the dialogue between WMO, the country and the other partners.

### 5.4 Investment phase – Close the GBON gap

The Investment phase would support eligible countries (SIDS and LDCs) through SOFF-funded infrastructure and capacity development investments to achieve GBON compliance in line with the verified GBON plan. The following table describes the outputs and responsible partners in this phase.

| Output | Partner |
|---|---|
| GBON infrastructure installed and operating in compliance with GBON requirements | - Country NMHS<br>- Implementing Entities<br>- As requested, technical support to be provided by peer adviser (advanced NMHS) |
| GBON human and institutional capacity developed | |

**The SOFF investment would generally be incorporated as a component of an existing or planned hydromet or climate resilience and adaptation project.** This would ensure in-country coordination, ensure effective action across the entire hydromet value chain, gain economies of scale in implementation and reporting, ensure high-quality support from the Implementing Entities to the NMHS for GBON gap closure, and raise the profile of the NMHS with central authorities (e.g., Ministry of Finance or Planning). In some cases, an Implementing Entity may combine the GBON plans of several countries under a regional project.

**The investment phase would consist of two steps: preparation and approval, and implementation.** The Implementing Entity would be the principal actor in managing these steps in close cooperation with the recipient government and the SOFF Secretariat.

**Step 1. Funding proposal preparation and approval.** The investment phase begins with the approval of the funding proposal by the SOFF Steering Committee upon recommendation of the SOFF Secretariat. This approved proposal would have sufficient technical information to allow the Implementing Entity to prepare its internal project documentation in coordination with the country's counterpart agencies (the NMHS and the main counterpart ministry of the Implementing Entity, in many cases the Ministry of Finance).

The level of funding would be particular to each country's GBON gap needs. In the most common cases, the Implementing Entity would either:

- use the GBON National Contribution plan to amend an existing approved hydromet or resilience project under implementation to add the GBON component; or

- incorporate the GBON component in a hydromet or resilience project under preparation.

In the spirit of simplification and efficiency of SOFF, the Implementing Entity would follow its procedures and no specific SOFF requirements and documentation would be imposed onto Implementing Entities. Once the SOFF Steering Committee has approved the funding proposal, the Implementing Entity would complete the preparation, appraisal, and negotiation of the project with the country's government authorities and in consultation with the SOFF Secretariat. If the requirements of the GBON plan are fully incorporated in the approved project without significant change, the SOFF Secretariat would be informed of the conclusion of negotiations. If there are substantial differences, the Steering Committee would need to approve the revised GBON National Contribution plan in the project. To ensure coordination at the country level, the NMHS and Implementing Entity would inform the embassies of SOFF funding partners. As the projects would be processed following the Implementing Entity guidelines and procedures, all fiduciary controls, flow of funds, environmental and social risks mitigation, institutional arrangements, and other requirements would be completed with due care by the Implementing Entity. The existing Implementing Entity grievance and control mechanisms would apply to the project.

Step 2. Project implementation. Upon completion of step 1, the NHMS (in collaboration with other country agencies, as appropriate) would implement the project's activities. These activities would include issuing bidding documents to purchase and install equipment for surface observations and human and institutional capacity-building activities. In order to guarantee that the SOFF funded systems meet the GBON requirements, WMO would prepare guidance documents describing expected measurement, communications and other capabilities of hardware or systems to be purchased and installed. This material can be used in the preparation of tender specifications. Also, ahead of SOFF operationalization, in consultation with HMEI, the hydromet industries' association, (see section 6) guidance would be developed for possible public-private business models under which GBON compliance might be achieved. This may include service contracts operations and/or maintenance, or integrated design, installation, operations, and maintenance contracts.

To ensure that its investments and technical assistance are based on the best available science and cutting-edge technology, and tailored to the circumstances of the beneficiaries, SOFF would leverage the ongoing activities of WMO constituent bodies such as the WMO Commission for Observation, Infrastructure and Information Systems. This includes identifying measures to ensure that installation of new weather observation stations will be climate-resilient (measures to mitigate potential risks of flooding, erosion, extreme heat and other issues that could damage and make the weather stations non-operational), monitoring and mitigating the environmental impact of observing technologies, and monitoring and assessing evolving observing technologies and weather and climate prediction modeling capabilities.

The SOFF Secretariat, in collaboration with WMO, would continue to engage with hydromet equipment suppliers to inform them about the global program, equipment procurement opportunities and the standard technical specifications. It is also proposed that HMEI be part of the SOFF Advisory Board (section 4). This effort aims to foster technological and

environmental sustainability advancements, promote competition and ensure the most cost-effective solutions for the country and the SOFF.

**During project implementation, the Implementing Entity and the NHMS could draw on technical assistance from the peer advisors**. The costs of this support would be included in the country's funding proposal and would be approved by the Steering Committee. Some of the support areas envisioned include (i) technical advice for bid assessment or evaluation; (ii) advice to ensure the correct commissioning and initial operation of equipment; and (iii) advice to support dispute resolution with suppliers on technical matters; (iv) staff training, capacity building and institutional strengthening.

**At the end of the Investment phase, the surface observation equipment should be fully operational and collect and internationally exchange data following GBON requirements**. The Country NMHS and the Implementing Entity would inform the SOFF Secretariat of the completion of all activities in the Investment phase. A GBON Investment phase completion report would be prepared by the NMHS with the Implementing Entity's support and technical quality assurance. The completion report would describe results achieved and lessons learned. The completion report would also explain the institutional arrangements to secure stained GBON compliance and SOFF compliance phase support.

### 5.5 Compliance phase – Ensure sustainability with GBON requirements

The Compliance phase would support countries to operate and maintain the basic surface-based observation network and the international sharing of data in full compliance with GBON requirements. While the Investment phase would provide resources to close the GBON gap, compliance phase support would be provided for all operating stations exchanging data per GBON requirements, including those that were installed before SOFF intervention. If the NMHS has been operating some surface observation stations according to GBON requirements, the country could apply for results-based financing (RBF) after the issuance of the first annual GBON compliance report. Given the complexities and significant gaps that several countries face, SOFF would support progressive GBON national compliance, i.e., provision of results-based finance for each compliant GBON station, rather than waiting for the entire national GBON compliance, acknowledging that the ultimate goal is to ensure full national GBON compliance.

The following table describes the outputs and responsible partners in this phase.

| Output | Partner |
|---|---|
| Annual GBON compliance report published, including the assessment of the impact of improved observations in forecast performance. | - WMO Technical Authority<br>- Global Producing Centres<br>- SOFF Secretariat<br>- As requested, support to be provided by peer adviser (advanced NMHS)<br>- Trustee |
| GBON data shared internationally and results-based finance provided | |
| On-demand GBON operational and maintenance advisory provided | |

The compliance phase involves five steps and would continue as long as a country is eligible for compliance grants:

Step 1. Legal Agreement with the country NMHS. The SOFF trustee would sign a Legal Agreement with the NMHS of the recipient country specifying the requirements and expectations for receiving annual RBF based on GBON data collected and shared.

Step 2. Verification of results. At the end of each calendar year, WMO would prepare an Annual GBON compliance and SOFF impact report, published by the SOFF Secretariat. Compliance would be assessed based on publicly available WDQMS data and a transparent methodology that includes the definition of the annual average percentage of reporting required to qualify as compliant. The proposed requirements would be developed by WMO ahead of the operationalization of the SOFF for Steering Committee approval. In rare situations where there is a difference of opinion between the NHMS and the WMO on stations' compliance, the SOFF Secretariat would facilitate discussions between WMO and the NMHS to resolve the discrepancies.

Step 3. Annual RBF disbursed. Upon WMO verification of compliance, the SOFF Secretariat would inform the Steering Committee and, on a non-objection basis, give green light to the Trustee to disburse the RBF to the NMHS. The amount of results-based payments for each compliant station would correspond to a "flat rate" global average of 75% of operating and maintenance costs that include institutional and human capacity required for the operation of the station and international exchange of observations. Results-based payments would occur annually and represent a contribution to cover operating and maintenance costs for a given year for which compliance has been certified. Given the retroactive nature of the payments, SOFF would provide RBF with the only condition that the resources go to the NMHS. There would be no additional fiduciary requirements. Payments would be made to the NMHS through a jointly held account between the NMHS and the Ministry of Finance. This follows the approach already practiced in other UN MPTF programs, e.g., the *Fonds National de Stabilisation Economique et Sociale du Mali*, which delivers RBF directly to the country.[29]

Step 4. Continuous GBON compliance monitoring and technical assistance. To avoid end-year surprises, the SOFF Secretariat, in collaboration with the NMHS and WMO, would facilitate periodic monitoring of GBON compliance of a country's stations. The NMHS would also have access to the WQDMS throughout the year to check the status of their observations. These early checks would allow the NHMS to take early corrective action on the stations' performance and data collection and request SOFF technical support as needed. At any time of the year, the NHMS would be able to request the SOFF Secretariat for technical assistance (through the peer advisors) to provide support in addressing possible problems or identified issues with the stations and data sharing. The responsibility for fixing the issues with the station(s) would remain with the NHMS. The reimbursable cost of peer technical assistance would be capped at USD 100,000 for each country for the SOFF initial 5-year implementation phase.

[29] Trust Fund Factsheet - Mali Stabilization Fund-FNSSE (undp.org)

Step 5. Annual GBON compliance and SOFF impact report. This report would provide the status of GBON compliance per country and globally and assess the improvement of weather forecast performance linked to SOFF-supported increased observations sharing. The report would also provide feedback on the quality of observations. It would be developed by WMO in collaboration with the Global Producing Centres. The report would be issued by the SOFF Secretariat, and production costs would be covered by SOFF resources.

## 5.6 SOFF sustainability

If SOFF is to address the sustainability challenge of hydromet investments in LDCs and SIDS effectively, its own sustainability would have to be assured. It is estimated that assuring GBON compliance of these countries would require USD 50 million on an annual basis. The literature on global public goods is clear that in the long term sustained provision of global public goods requires a global financing mechanism that involves some form of global financial resource mobilization, similar to the funding of national public goods by national taxation.[30] However, for now, this option appears to be a distant possibility. In the meantime, for SOFF to function as a long-term financing mechanism for sustained compliance with GBON commitments, another approach for its funding has to be found.

Countries have in some cases either individually or jointly funded observations outside their own borders in order to serve their own interests. Examples include the joint US/European funding of observations during the African Monsoon Multidisciplinary Analysis campaign in West Africa, and the US funding for observations in the Caribbean and the North Pacific. Similarly, the 28 Member States of the European National Meteorological Services (EUMETNET) jointly fund the operation of a small number of radiosonde stations.

While recognizing the need for long-term finance, potential funders may not be able to commit to providing funding indefinitely from their national budgets. They are therefore looking for development and climate financing mechanisms to be time-bound and offer "exit" options. For SOFF, the exit option is that long-term compliance payments will cease as countries graduate over time from LDC and ODA-eligible SIDS status. At that point the benefits and development impact of observations would have been demonstrated, the capacity would have been developed and systemic changes implemented. As a result, countries should be in a position to continue operating and maintaining their contribution to GBON and sharing their observations. For example, between 2018 and 2024 ten or more countries are expected to graduate from LDC status.[31]

[30] See, for example, Inge Kaul, "Global Public Goods: A concept for framing the Post-2015 Agenda?" DIE Discussion Paper 2/2013.https://www.ingekaul.net/wp-content/uploads/2014/01/Internetfassung_DiscPaper_2_2013_Kaul1.pdf The author notes "the possibility of generating new, additional financial resources by introducing a 'globalization user fee' in the form of a modest levy on currency transactions." (p. 27)."

[31] 2023, and São Tomé and Príncipe and Solomon Islands will leave the category in 2024. Nepal was selected to be graduated to developing countries on 2018. However, the authorities of Nepal requested to postpone it till 2021. Angola was expected to graduate in 2021, but the preparatory period was extended by three years because of the economic difficulties of the country and its dependence on commodities. Bangladesh met the criteria for the first time in 2018 and is likely to graduate in 2024 according to the UN Department of Economic and Social Affairs." (https://en.wikipedia.org/wiki/Least_developed_countries)

The possibility to have the operations and maintenance expenditures of hydromet agencies funded from fees charged to private business users of the weather information has been explored. However, the benefit of basic observations is maximized when they are freely available to all nationally and globally. This is the reason for the general move among WMO Members toward an open data policy for Earth system data. Under such circumstances, there would be no incentive for the private sector to pay for basic observations, especially in SIDS and LDCs. (See Section 2.5 above).[32]

This leaves the regular "replenishment" option for sustainable SOFF resource mobilization in the foreseeable future. Replenishments of development and climate funds at regular multi-year intervals are a common method for raising the concessional resources required on an ongoing basis, commonly continuing for decades.[33] SOFF could organize its own replenishment cycle (e.g., on a five-year basis), based on the experience with the current initial resource mobilization effort. Alternatively, SOFF replenishments could be organized alongside one of the regular replenishments of a major development or climate fund. This might broaden the funder base and make for a more efficient replenishment process. It would also reinforce the notion that SOFF funding is a foundational investment that underpins the effectiveness and sustainability of the investments of other development and climate funds.

## 5.7 SOFF Program risks and mitigation measures

Like every new initiative, SOFF will face certain risks that have to be assessed and managed. Annex 3 summarizes the main risks. The risks fall into three broad categories: (i) contextual risks; (ii) programmatic risks; and (iii) institutional risks. For each risk item, annex 3 identifies mitigation responses.

## 5.8 Continuous learning and reporting

SOFF is built on a long history of lessons learned about the implementation of observing systems in developing countries and will be structured as a learning initiative. Guided by the Steering Committee, the SOFF Secretariat would work closely with WMO, Implementing Entities, NMHS peer reviewers/advisors, recipient countries and Advisory Board members to track any implementation difficulties, test alternative implementation options where appropriate, and build on the emerging experience with its innovative delivery model. The SOFF Secretariat would facilitate the exchange of information and knowledge among all SOFF stakeholders. The Secretariat would capture and exchange information in particular in the following areas:

- Lessons of implementation: good practices and errors to avoid during the three phases of support, including related to operations and maintenance of surface observation systems and supporting infrastructure;
- Innovations in particular related to delivery models and the creation of links and leverage to "last mile" investments; and

[32] WMO Unified Data Policy Resolution, available at: https://public.wmo.int/en/unified-wmo-data-policy-resolution
[33] For example IDA completed its 19th triannual replenishment in 2019, and IFAD its 12th in 2020.

- **GBON compliance and the impact of increased observations** in forecast performance in SOFF supported countries and globally, including through the issuance of the annual GBON compliance and SOFF impact report (section 5.4).

**In the fourth year of implementation, an independent external evaluation would be commissioned**, supported by the Advisory Board, and submitted to the Steering Committee. The evaluation would cover the effectiveness of systems, spot checks of various implementation and compliance reports submitted by Implementing Entities and NHMSs, verification reports, and the M&E system.

# 6. Roadmap to COP 26 and beyond

## 6.1 The journey so far

**The creation of SOFF has been a multi-partner endeavor since the beginning**. Initial thinking started immediately after the approval of the GBON concept by the World Meteorological Congress in July 2019. In December 2019, the fifty-first session of the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) recognized the importance of sustained systematic observation and the development of the GBON and re-emphasized the need for sustained funding to meet the essential needs for global climate observation under the Convention.

**The SOFF concept and design have been developed through multiple workshops and working groups**, bringing together many stakeholders, including over 30 international organizations. The outcome of this process was presented at the first forum of potential funders that took place on the 24th March 2021.

**The first SOFF potential funders' forum, co-hosted by the WMO President and Secretary-General, was attended by more than 100 participants**, including delegations from 31 potential funders, 28 country delegations and one delegation each from the European Commission, the Nordic Development Fund and the Bill and Melinda Gates Foundation. Twenty multilateral and partner organizations participated as observers, including all members of the Alliance for Hydromet Development. Twenty-three statements of support[34] were delivered by representatives from beneficiary countries[35] and international development and climate finance institutions. Strong SOFF support was voiced by international partners, including the Managing Director of the International Monetary Fund (IMF),[36] heads of members of the Alliance for Hydromet Development[37] including GCF and Global Environment Facility (GEF), the Director-General of ECMWF,[38] and a joint statement of ECMWF, European Organisation for the Exploitation of Meteorological Satellites

[34] Find the statements at: https://public.wmo.int/en/our-mandate/how-we-do-it/development-partnerships/Innovating-finance/SOFF-support-statements
[35] See the statements of support of selected beneficiary countries at: https://vimeo.com/528211540
[36] See Dr. Kristalina Georgieva's statement at: https://vimeo.com/527815590
[37] See the statements of support of the members of the Alliance for Hydromet Development at: https://vimeo.com/527813891
[38] See Dr. Florence Rabier's statement at https://vimeo.com/527815135

(EUMETSAT) and EUMETNET.[39] The outcomes of the first potential funders' forum were captured in the summary of the chairperson.[40]

Following the first forum, the SOFF team has continued to engage with potential funders, responding to questions raised during and after the meeting, while utilizing the feedback received to refine the design of the Facility. This report for the second potential funders' forum reflects the contributions and views obtained through this process and various other tracks of an extensive SOFF consultation process with beneficiary countries, scientific and technical partners, climate and development finance institutions, and the private sector.

Beneficiary countries have been consulted throughout the process, including through the WMO Regional Associations and their Presidents, and have shaped the design of the Facility.

- The African Group of Negotiators emphasized the importance of observations for Africa. The African Heads of State launched the Africa Adaptation Initiative[41] with the aim of closing the adaptation-financing gap. This requires strengthening the basic weather and climate observations infrastructure and capacity to better inform decision-making.
- The Group of Least Developed Countries highlighted in multiple UNFCCC submissions that the persisting weather and climate data gaps are hindering their members' efforts to act effectively and proactively on adaptation. Closing the gap for essential weather and climate observations in these countries is a priority and requires dedicated, predictable and long-term financial and technical support. The Group appreciated the outcome of the first potential funders' forum and reiterated their strong support to establish SOFF at COP26.[42]
- The Alliance of Small Island States stated that the existing data gaps are undermining the global understanding of climate-related risks, the foundation on which early action decisions are made. They firmly advocated for the establishment of SOFF to increase observations in the SIDS and improve the quality of forecast, to reduce the losses and damages that cost these islands so much. The Prime Minister of Fiji[43] called on development partners to back the SOFF as it supports the global campaign to build a more resilient world.

SOFF was also discussed at the Ministerial Conference on Meteorology (AMCOMET), in March 2021. The African Ministers in charge of meteorology adopted the Integrated African Strategy on Meteorology. In their statement,[44] the ministers noted with concern that the

[39] Find the Joint statement of the European meteorological institutions and the World Meteorological Organization in support of the creation of the Systematic Observations Financing Facility at: https://public.wmo.int/en/our-mandate/how-we-do-it/development-partnerships/Innovating-finance/joint-statement-european-meteo-institutions-wmo-soff

[40] Find the summary of the outcomes of the first potential funders forum at: https://library.wmo.int/doc_num.php?explnum_id=10617

[41] More information on the Africa Adaptation Initiative at: https://africaadaptationinitiative.org/

[42] See the LDC Group Chair statement at: https://public.wmo.int/en/our-mandate/how-we-do-it/development-partnerships/Innovating-finance/SOFF-support-statements/sonam-p-wangdi

[43] See the Fiji Prime Minister statement at: https://vimeo.com/527815912

[44] See an extract of the African Ministerial Conference on Meteorology (AMCOMET) at: https://public.wmo.int/en/our-mandate/how-we-do-it/development-partnerships/Innovating-finance/SOFF-support-statements/AMCOMET-5

existing gaps in observation and corresponding infrastructure in Africa limit the capacity to provide meteorological services and hamper adaptation efforts. They urged bilateral and multilateral development partners to consider funding SOFF.

**The private sector has been engaged** through a working group on SOFF benefits for the insurance sector[45] and consultations with the association of HMEI. Initial Discussions with HMEI are focusing on private sector experience in establishing, operating and maintaining basic observing systems in SIDS and LDCs and the many failures private sector operators have seen. In addition, options are explored for public-private business models for the operation and maintenance of basic observing systems supported by SOFF.

**The Crisis Lookout Initiative has supported the creation of the SOFF with a request to the G7.[46]** This initiative, spearheaded by the UK-based Centre for Disaster Protection and aiming to drastically change the way we prepare and respond to disasters, presented a solutions paper to the G7, recommending to G7 countries that they support SOFF.

## 6.2 Next steps

**Political momentum has been building up on the road to UNFCCC COP 26.** UN Secretary-General António Guterres has called for a 'breakthrough' on adaptation efforts to protect the world and the most vulnerable from climate impacts, especially SIDS and LDCs. COP26 represents a critical milestone to scale up the world's action on adaptation and resilience. The Leaders' Dialogue on the Africa Covid-Climate Emergency in April 2021 stressed the once-in-a-generation opportunity to 'build forward better' from the Covid crisis, focusing on climate adaptation. At the Summit, the African Development Bank and the Global Center on Adaptation launched the Africa Adaptation Acceleration Program[47] to implement the African Union's Africa Adaptation Initiative vision. Within this context, through a joint effort of multiple SOFF stakeholders, SOFF is increasingly recognized as being foundational for effective adaptation and resilient development by providing the critical observational platform on which the hydromet value chain must be built.

**At the UN High-Level Political Forum in July 2021, the Alliance for Hydromet Development will launch its first Hydromet Gap Report**. The Report will present the CHD as the common assessment tool of the Alliance, showcase the results of its initial application ("road-testing") with several countries, highlight the importance of urgently closing the basic observations gap, and present the SOFF as the common commitment and priority of the Alliance.
**In parallel, stakeholder consultations will continue.** Public-private consultations will be organized with the support of the Varysian hydromet network. These include a general consultation to seek feedback from the Varysian network members; and a consultation linked to the Secretariat of the Pacific Regional Environment Programme (SPREP) event with a focus on Pacific NMHSs and the associated issues, including the lack of observational data.

[45] More information on SOFF benefits to the insurance sector at: https://library.wmo.int/index.php?lvl=notice_display&id=21773#.YL4RFJMzare
[46] See the Crisis Lookout Solutions Paper at: https://static1.squarespace.com/static/5c9d3c35ab1a62515124d7e9/t/607856e19abc3368d276132e/1618499302881/Crisis_lookout_14Aprilv4.pdf
[47] More information on the Africa Adaptation Acceleration Program at: https://gca.org/programs/africa-adaptation-acceleration-program/

Additionally, public virtual consultations will be organized, and a call for feedback will allow stakeholders to provide comments and suggestions for the final SOFF design.

**Two more potential funders' forums are planned beyond the second Forum on 28 June 2021.** The third SOFF potential funders' forum is planned for late September 2021. At that event, the further advanced SOFF proposal will be presented, and final feedback sought. In October, the World Meteorological Congress will discuss the new data policy, GBON and SOFF. The fourth potential funders' forum is scheduled to take place in late October.

### 6.3 Making SOFF operational

**SOFF would be legally established by end-October, following the fourth potential funders' forum**. Once legally established, SOFF would be able to accommodate contributions from funders. As UN MPTF has in place contribution agreements with all major donors, SOFF initial capitalization could take place by the end-December 2021.

**The aim is to announce SOFF creation at a high-level event at the COP26**, joined by the initial funding partners.

**Once a threshold for minimum initial contributions is reached, SOFF would be made operational**. The financial threshold required to operationalize SOFF would be jointly agreed upon with the initial funders. The first step of operationalization would be the establishment and staffing of the SOFF Secretariat. The SOFF Secretariat would then prepare all basic documents for the functioning of the SOFF for decision at the first Steering Committee meeting, including for example the SOFF operational policies. Under this scenario, SOFF is expected to be "open for business" by mid-2022.

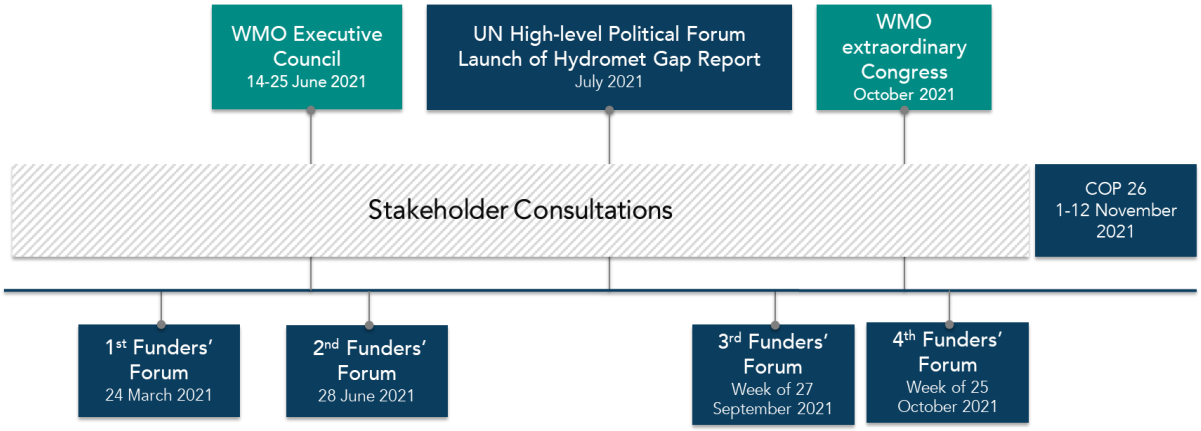
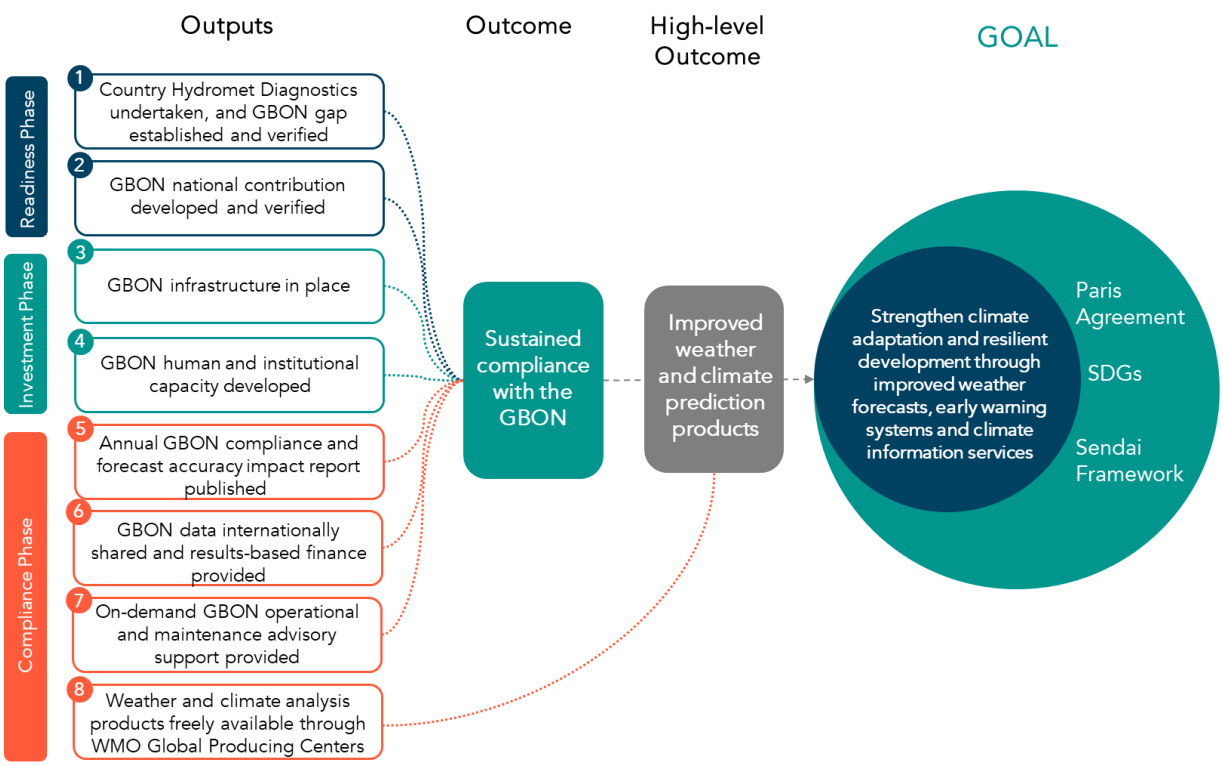



Figure 6. SOFF preparation timeline to COP 26

# Annex 1. SOFF Theory of Change



## Annex 2. SOFF eligible countries

| | Region[48] | Country | Country Group[49] |
|---|---|---|---|
| 1 | Sub-Saharan Africa | Benin | LDC |
| 2 | Sub-Saharan Africa | Burkina Faso | LDC |
| 3 | Sub-Saharan Africa | Burundi | LDC |
| 4 | Sub-Saharan Africa | Central African Republic | LDC |
| 5 | Sub-Saharan Africa | Chad | LDC |
| 6 | Sub-Saharan Africa | Democratic Republic of the Congo | LDC |
| 7 | Sub-Saharan Africa | Eritrea | LDC |
| 8 | Sub-Saharan Africa | Ethiopia | LDC |
| 9 | Sub-Saharan Africa | Gambia | LDC |
| 10 | Sub-Saharan Africa | Guinea | LDC |
| 11 | Sub-Saharan Africa | Lesotho | LDC |
| 12 | Sub-Saharan Africa | Liberia | LDC |
| 13 | Sub-Saharan Africa | Madagascar | LDC |
| 14 | Sub-Saharan Africa | Malawi | LDC |
| 15 | Sub-Saharan Africa | Mali | LDC |
| 16 | Sub-Saharan Africa | Mauritania | LDC |
| 17 | Sub-Saharan Africa | Mozambique | LDC |
| 18 | Sub-Saharan Africa | Niger | LDC |
| 19 | Sub-Saharan Africa | Rwanda | LDC |
| 20 | Sub-Saharan Africa | Senegal | LDC |
| 21 | Sub-Saharan Africa | Sierra Leone | LDC |
| 22 | Sub-Saharan Africa | Somalia | LDC |
| 23 | Sub-Saharan Africa | South Sudan | LDC |
| 24 | Sub-Saharan Africa | Sudan | LDC |
| 25 | Sub-Saharan Africa | Tanzania | LDC |
| 26 | Sub-Saharan Africa | Togo | LDC |
| 27 | Sub-Saharan Africa | Uganda | LDC |
| 28 | Sub-Saharan Africa | Zambia | LDC |
| 29 | South Asia | Afghanistan | LDC |
| 30 | South Asia | Bangladesh | LDC |
| 31 | South Asia | Bhutan[50] | LDC |
| 32 | South Asia | Nepal | LDC |

[48] The regional classification is based on World Bank country classification accessed on February 22, 2021.

[49] The countries presented in the list include: ODA recipient countries from the DAC List of ODA Recipients effective for reporting on 2021 flows; LDCs countries as per OECD DAC list; SIDS, as per United Nations classification, that are also ODA recipients. While these lists present countries as classified in 2021, it should be noted that **Angola** was an LDCs at the time of writing the SOFF concept and was included in the estimation of the funding needs. Hence, it was considered part of the 68 beneficiary countries. When SOFF is operationalized, the list of countries eligible to SOFF support will be updated in line with their income classification.

[50] The General Assembly resolution A/73/L.40/Rev.1 adopted on 13 December 2018 decided that **Bhutan** will graduate five years after the adoption of the resolution, i.e. on 13 December 2023, and that **São Tomé and Príncipe** and **Solomon Islands** will graduate six years after the adoption of the resolution, i.e. on 13 December 2024.

| | | | |
|---|---|---|---|
| 33 | East Asia and Pacific | Cambodia | LDC |
| 34 | East Asia and Pacific | Lao People's Democratic Republic | LDC |
| 35 | East Asia and Pacific | Myanmar | LDC |
| 36 | East Asia and Pacific | Timor-Leste | LDC |
| 37 | East Asia and Pacific | Tuvalu | LDC |
| 38 | Middle East and North Africa | Djibouti | LDC |
| 39 | Middle East and North Africa | Yemen | LDC |
| 40 | Sub-Saharan Africa | Cabo Verde | SIDS |
| 41 | Sub-Saharan Africa | Mauritius | SIDS |
| 42 | East Asia and Pacific | Fiji | SIDS |
| 43 | East Asia and Pacific | Marshall Islands | SIDS |
| 44 | East Asia and Pacific | Nauru | SIDS |
| 45 | East Asia and Pacific | Palau[2] | SIDS |
| 46 | East Asia and Pacific | Papua New Guinea | SIDS |
| 47 | East Asia and Pacific | Samoa | SIDS |
| 48 | East Asia and Pacific | Tonga | SIDS |
| 49 | East Asia and Pacific | Vanuatu | SIDS |
| 50 | Latin America and the Caribbean | Antigua and Barbuda[51] | SIDS |
| 51 | Latin America and the Caribbean | Belize | SIDS |
| 52 | Latin America and the Caribbean | Cuba | SIDS |
| 53 | Latin America and the Caribbean | Dominica | SIDS |
| 54 | Latin America and the Caribbean | Dominican Republic | SIDS |
| 55 | Latin America and the Caribbean | Grenada | SIDS |
| 56 | Latin America and the Caribbean | Guyana | SIDS |
| 57 | Latin America and the Caribbean | Jamaica | SIDS |
| 58 | Latin America and the Caribbean | St. Lucia | SIDS |
| 59 | Latin America and the Caribbean | St. Vincent and the Grenadines | SIDS |
| 60 | Latin America and the Caribbean | Suriname | SIDS |
| 61 | South Asia | Maldives | SIDS |
| 62 | Sub-Saharan Africa | Comoros | LDC and SIDS |
| 63 | Sub-Saharan Africa | Guinea-Bissau | LDC and SIDS |
| 64 | Sub-Saharan Africa | Sao Tome and Principe[2] | LDC and SIDS |
| 65 | East Asia and Pacific | Kiribati | LDC and SIDS |
| 66 | East Asia and Pacific | Solomon Islands[2] | LDC and SIDS |
| 67 | Latin America and the Caribbean | Haiti | LDC and SIDS |
| 68 | Sub-Saharan Africa | Angola | Other ODA recipient |
| 69 | Sub-Saharan Africa | Botswana | Other ODA recipient |
| 70 | Sub-Saharan Africa | Cameroon | Other ODA recipient |
| 71 | Sub-Saharan Africa | Congo | Other ODA recipient |
| 72 | Sub-Saharan Africa | Côte d'Ivoire | Other ODA recipient |

[51] From 1 January 2022: **Antigua and Barbuda, Palau** (and Panama) will graduate from the DAC List of ODA Recipients.

| | | | |
|---|---|---|---|
| 73 | Sub-Saharan Africa | Equatorial Guinea | Other ODA recipient |
| 74 | Sub-Saharan Africa | Eswatini | Other ODA recipient |
| 75 | Sub-Saharan Africa | Gabon | Other ODA recipient |
| 76 | Sub-Saharan Africa | Ghana | Other ODA recipient |
| 77 | Sub-Saharan Africa | Kenya | Other ODA recipient |
| 78 | Sub-Saharan Africa | Namibia | Other ODA recipient |
| 79 | Sub-Saharan Africa | Nigeria | Other ODA recipient |
| 80 | Sub-Saharan Africa | Saint Helena* | Other ODA recipient |
| 81 | Sub-Saharan Africa | South Africa | Other ODA recipient |
| 82 | Sub-Saharan Africa | Zimbabwe | Other ODA recipient |
| 83 | East Asia and Pacific | China (People's Republic of) | Other ODA recipient |
| 84 | East Asia and Pacific | Democratic People's Republic of Korea | Other ODA recipient |
| 85 | East Asia and Pacific | Indonesia | Other ODA recipient |
| 86 | East Asia and Pacific | Malaysia | Other ODA recipient |
| 87 | East Asia and Pacific | Micronesia | Other ODA recipient |
| 88 | East Asia and Pacific | Mongolia | Other ODA recipient |
| 89 | East Asia and Pacific | Niue* | Other ODA recipient |
| 90 | East Asia and Pacific | Philippines | Other ODA recipient |
| 91 | East Asia and Pacific | Thailand | Other ODA recipient |
| 92 | East Asia and Pacific | Tokelau* | Other ODA recipient |
| 93 | East Asia and Pacific | Viet Nam | Other ODA recipient |
| 94 | East Asia and Pacific | Wallis and Futuna* | Other ODA recipient |
| 95 | Europe and Central Asia | Albania | Other ODA recipient |
| 96 | Europe and Central Asia | Armenia | Other ODA recipient |
| 97 | Europe and Central Asia | Azerbaijan | Other ODA recipient |
| 98 | Europe and Central Asia | Belarus | Other ODA recipient |
| 99 | Europe and Central Asia | Bosnia and Herzegovina | Other ODA recipient |
| 100 | Europe and Central Asia | Georgia | Other ODA recipient |
| 101 | Europe and Central Asia | Kazakhstan | Other ODA recipient |
| 102 | Europe and Central Asia | Kosovo | Other ODA recipient |
| 103 | Europe and Central Asia | Kyrgyzstan | Other ODA recipient |
| 104 | Europe and Central Asia | Moldova | Other ODA recipient |
| 105 | Europe and Central Asia | Montenegro | Other ODA recipient |
| 106 | Europe and Central Asia | North Macedonia | Other ODA recipient |
| 107 | Europe and Central Asia | Serbia | Other ODA recipient |
| 108 | Europe and Central Asia | Tajikistan | Other ODA recipient |
| 109 | Europe and Central Asia | Turkey | Other ODA recipient |
| 110 | Europe and Central Asia | Turkmenistan | Other ODA recipient |
| 111 | Europe and Central Asia | Ukraine | Other ODA recipient |
| 112 | Europe and Central Asia | Uzbekistan | Other ODA recipient |
| 113 | Latin America and the Caribbean | Argentina | Other ODA recipient |
| 114 | Latin America and the Caribbean | Bolivia | Other ODA recipient |

| | | | |
|---|---|---|---|
| 115 | Latin America and the Caribbean | Brazil | Other ODA recipient |
| 116 | Latin America and the Caribbean | Colombia | Other ODA recipient |
| 117 | Latin America and the Caribbean | Costa Rica | Other ODA recipient |
| 118 | Latin America and the Caribbean | Ecuador | Other ODA recipient |
| 119 | Latin America and the Caribbean | El Salvador | Other ODA recipient |
| 120 | Latin America and the Caribbean | Guatemala | Other ODA recipient |
| 121 | Latin America and the Caribbean | Honduras | Other ODA recipient |
| 122 | Latin America and the Caribbean | Mexico | Other ODA recipient |
| 123 | Latin America and the Caribbean | Montserrat* | Other ODA recipient |
| 124 | Latin America and the Caribbean | Nicaragua | Other ODA recipient |
| 125 | Latin America and the Caribbean | Panama | Other ODA recipient |
| 126 | Latin America and the Caribbean | Paraguay | Other ODA recipient |
| 127 | Latin America and the Caribbean | Peru | Other ODA recipient |
| 128 | Latin America and the Caribbean | Venezuela | Other ODA recipient |
| 129 | Middle East and North Africa | Algeria | Other ODA recipient |
| 130 | Middle East and North Africa | Egypt | Other ODA recipient |
| 131 | Middle East and North Africa | Iran | Other ODA recipient |
| 132 | Middle East and North Africa | Iraq | Other ODA recipient |
| 133 | Middle East and North Africa | Jordan | Other ODA recipient |
| 134 | Middle East and North Africa | Lebanon | Other ODA recipient |
| 135 | Middle East and North Africa | Libya | Other ODA recipient |
| 136 | Middle East and North Africa | Morocco | Other ODA recipient |
| 137 | Middle East and North Africa | Syrian Arab Republic | Other ODA recipient |
| 138 | Middle East and North Africa | Tunisia | Other ODA recipient |
| 139 | Middle East and North Africa | West Bank and Gaza Strip | Other ODA recipient |
| 140 | South Asia | India | Other ODA recipient |
| 141 | South Asia | Pakistan | Other ODA recipient |
| 142 | South Asia | Sri Lanka | Other ODA recipient |

## Annex 3. Preliminary risks identification and potential mitigation strategies for SOFF

| RISKS | MITIGATION STRATEGIES |
|---|---|
| Contextual risks | |
| Lack of approval of GBON and the new WMO data policy; SOFF will only make sense if and when WMO Congress approves the GBON regulatory material | The links between the evolving new WMO data policy, GBON and SOFF are inextricable and will need to be carefully and consistently articulated in front of Members on any and all occasions:<br>• In many parts of the world, GBON cannot be implemented without SOFF, and it may not even be approved without SOFF<br>• SOFF will have no justification without GBON<br>• The claimed benefits of SOFF and GBON in developing countries, in particular, are fully contingent on approval of the WMO Unified Policy for Exchange of Earth System Data.<br>• WMO Secretariat is committed to ensuring that GBON and WMO data policy are approved and implemented with SOFF as a key building block. |
| Conflict and safety/political insecurity in countries where funded initiatives are to be implemented, negatively affecting selection of countries and implementation (e.g., delays) | In some countries, the political, economic, or social situation may be such that conflict or general insecurity may arise. Associated risks and volatility could limit the willingness/ability of Implementing Entities to prepare hydromet projects with a SOFF component and/or could negatively affect project implementation and slow or hinder progress and the achievement of outcomes.<br><br>SOFF Secretariat will actively reach out to Implementing Entities to encourage engagement on hydromet projects in fragile and conflict-affected states. For each funded project and initiative, a specific risk management framework will be developed that includes a country/regional assessment and mitigation measures for direct and indirect political risks with a focus on possible conflict or instability, in cooperation with the Implementing Entities. |
| Potential need for multi-country SOFF engagement may not appeal to all Implementing Entities | SOFF metrics of success – data delivery at endpoints thousands of km away from the origin of the observations – may necessitate the implementation of activities along the data delivery chain, in some cases partly outside the country from which the data are missing. This may limit the effectiveness of potentially ear-marked funds and will have to be explained to funders.<br><br>SOFF Secretariat in collaboration with WMO will work proactively with recipient countries and Implementing Entities to ensure a supranational regional focus where needed. |

| | |
|---|---|
| Insufficient institutional capacity and/or political commitment in recipient countries to ensure successful implementation of SOFF investments | Lack of institutional capacity or political support in recipient countries may hamper implementation.<br><br>During the Readiness phase, capacity limitations will be assessed and needed capacity-building measures identified for implementation during the Investment phase. The SOFF Secretariat, jointly with Implementing Entities, will communicate with country counterpart organizations to ensure effective engagement and political support. |
| | Programmatic risks |
| Limited Implementing Entities engagement and/or difficult partner coordination during Readiness and Investment phases | SOFF depends on Implementing Entities' engagement in the hydromet sector in LDCs and SIDS, but not all of them may be requesting assistance, or Implementing Entities may not be able to respond to all requests during the initial five-year SOFF implementation period.<br><br>SOFF Secretariat will engage intensively with all implementing Entities, the Alliance for Hydromet Development and with recipient countries in programming SOFF investments to ensure maximum coverage of LDCs and SIDS during the initial five-year period. |
| Limited or poor-quality peer support for readiness phase and capacity building during investment phase and on-demand support during compliance phase | SOFF will rely on technical support from NMHS peers for its successful implementation. This may not be forthcoming or of poor quality.<br><br>The SOFF Secretariat in collaboration with WMO Secretariat will actively reach out to peers and monitor and report on the implementation of peer support on an ongoing basis. |
| Insufficient investment in downstream components of the hydromet value chain. This will limit the motivation of the NMHS to actively engage in SOFF implementation activities | Reaping the full benefit from improved observations will depend on the effective development of the entire hydromet value chain. Insufficient attention to downstream components will reduce the benefits from improved observations to the recipient country.<br><br>The Country Hydromet Diagnostics gap analysis during the Readiness phase will assess the entire value chain and identify gaps across it. SOFF components will be embedded in broader hydromet projects of Implementing Entities, which are expected to address other key constraints in the hydromet value chain. Other downstream financing partners and initiatives are proposed to be included in the SOFF governance structure, allowing them to both, shape and take advantage of SOFF. |
| Investments have detrimental environmental or social impacts | SOFF funded investments may have detrimental social or environmental impacts, e.g., encroaching on limited natural resources; or observing stations built in protected areas, on fragile or indigenous land; or requirements for land acquisition and involuntary resettlement. |

| | |
|---|---|
| | Implementing Entities will ensure that the social and environmental policies are properly applied to the SOFF components of hydromet projects.<br><br>In addition, SOFF will work with WMO and private sector partners (e.g., HMEI) to pioneer the use of modern technologies to mitigate negative environmental impacts, e.g., of the use of radiosondes.<br><br>National transition to modern technologies (e.g., from manual to automated observing systems) will need to be planned and managed carefully, taking into account both technical capabilities and structural issues around current staff profiles and training needs. |
| Non-compliance with fiduciary and procurement standards (including OFAC and other sanctions-related obligations) | During the Investment phase, SOFF will rely on Implementing Entities to ensure their regular fiduciary and procurement standards are met. |
| Institutional risks | |
| SOFF Secretariat administrative capacity is limited, especially during the start-up phase | During the start-up phase, the SOFF Secretariat is expected to draw on advisory support from UN MPTF; beyond start-up, the host agency and the Steering Committee will proactively work to ensure that the Secretariat is appropriated staffed and resourced. |
| SOFF is mismanaged, compromising its operations and causing reputational damage | UN MPTF has strict trust fund management procedures in place to mitigate such risk. The proposed governance structure has been designed to ensure appropriate policies are developed, implemented, monitored and evaluated, ensuring full oversight of the Facility, as well as full reporting, transparency and accountability functions. |
| SOFF is not able to mobilize sufficient resources or interest from funders and investors to reach optimal operational levels or function at full capacity and/or initial fund-raising targets not compatible with the willingness of funders to commit | The SOFF will launch only if it has sufficient commitment from contributors to establish the first pipeline of country programs. An active resource mobilization effort is underway and will continue during the early phases of implementation. Targets concerning country coverage will be adjusted in line with available resources.<br>Phased strategies will be developed in consultation with funders. |