Systematic Observations Financing Facility

Report for First Funders' Forum

24 March 2021

SOFF
Systematic Observations Financing Facility

Weather and climate information for the global public good

This document provides the basis for discussions at the first forum for potential funders of the Systematic Observations Financing Facility (SOFF), virtually taking place on 24 March 2021. The objective of the first forum is to present to potential funders the rationale for the establishment of SOFF; to present the current approach to the institutional design of SOFF; to summarize the process, timeline and status of preparations; to identify participants' questions that have to be addressed; and to present the expectations for the subsequent meetings. Two additional potential Funders' Forums are planned for early July and mid-October 2021.

This document reflects the contributions and views obtained through various tracks of an extensive SOFF consultation process initiated in 2019 with beneficiary countries, scientific and technical partners, climate and development finance institutions, and the private sector. SOFF consultations included the establishment of five multi-stakeholder working groups to advance SOFF concept and design; formal intergovernmental consultations and decisions taken through the World Meteorological Organization (WMO) constituent bodies; in-depth assessments with selected countries and close engagement of all members of the Alliance for Hydromet Development (see Box 5). Details on the SOFF consultation process are presented in Section 6. The information material reflecting the outcomes of the different tracks of SOFF consultations can be accessed at the SOFF website.[1] In addition, the technical products prepared by the SOFF working groups can be made available upon request.

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

Executive Summary

The goal of SOFF is to strengthen local and global resilient development and climate adaptation through improved observing systems that lead to better weather forecasts and climate services.[2]

Basic weather and climate observations underpin weather forecasts, early warning systems, and climate services locally and globally. There are currently significant gaps in the international exchange of these observations, especially in the Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

In 2019, the World Meteorological Congress and its 193 member countries and territories agreed to establish the Global Basic Observing Network (GBON). GBON sets out a clear obligation for all WMO Members to acquire and internationally share the most essential surface-based observational data. However, many countries will need substantial investments and strengthened capacity to achieve and maintain compliance with the GBON requirements.

SOFF will support countries, with a focus on LDCs and SIDS, to meet the GBON requirements. Investing in GBON in low- and middle-income countries is extremely cost-effective. The World Bank estimates that for every US dollar invested in GBON in these countries, at least 25 US dollars in socio-economic return could be realized. The potential benefits of full GBON implementation in the countries with the largest gaps in data sharing are assessed to be around USD 5 billion per year.[3]

SOFF will contribute to the improvement of weather forecasts and climate analysis products that are freely available to all countries. The improved forecasts are critical for managing extreme weather events and will benefit all sectors, especially those that rely heavily on weather and climate services. Improved climate analysis products will help countries understand the adaptation challenges they will face and prepare and respond accordingly with proactive, and systematic approaches to adaptation, including better risk management and anticipatory action. In addition, the expected up-to-20-fold increase of data internationally shared by LDCs and SIDS will improve the quality of forecasts globally, especially medium to long-range forecasts, with benefits for all countries, in all sectors.

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[2] A climate service is a decision aid derived from climate information that assists individuals and organizations in society to make improved ex-ante decision-making. A climate service requires appropriate and iterative engagement to produce a timely advisory that end-users can comprehend, and which can aid their decision-making and enable early action and preparedness. Climate services need to be provided to users in a seamless manner and, most of all, need to respond to user requirements. As indicated by the well-known adage "climate is what you expect and weather is what you get" used to distinguish between the climate and weather, climate information prepares the users for the weather they will experience. For most users climate and weather are mutually interchangeable. It is, therefore, imperative for climate and weather services to operate in close tandem, so as to be seamless to the end-user. Taken from: WMO Bulletin Vol 62 (Special Issue) – 2013. Available at: https://public.wmo.int/en/bulletin/what-do-we-mean-climate-services.

[3] 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.

SOFF will provide technical and financial assistance in new ways. First, SOFF will apply an optimal and internationally agreed global design and metric to guide investments – the GBON requirements. Second, SOFF will focus on international data sharing as a measure of success. Third, it will provide support for data sharing over the long term, using results-based grants that will contribute to operations and maintenance costs, in recognition of the global public good created by sharing observations. Past investments in meteorological capacity, often supported by the international community through time-bound projects, have not, in many instances, yielded lasting benefits because of inadequate budgets for operations and maintenance of observation infrastructure. The SOFF grants to LDCs and SIDS for capital investments and operations and maintenance will enable the benefits of investments in observational capacity to be sustained with both local and global benefits.

The creation of SOFF is a commitment and priority action of the Alliance for Hydromet Development. The aim is to integrate SOFF into an existing multilateral organization or platform, rather than establish it as a new institution. SOFF is an ambitious undertaking. It envisions bringing 67 SIDS and LDCs into GBON compliance and providing on-demand SOFF readiness support to other developing countries over an initial five-year period with estimated funding needs of USD 400 million. Sustaining the capacity over time is expected to require USD 50 million per year subsequently. The intention is to announce SOFF at the 26th Conference of the Parties of the United Nations Framework Convention on Climate Change (COP 26) in November 2021 with an envisioned pledging target of USD 200 million, and another USD 200 million to be raised subsequently.

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List of Acronyms

AOSIS ..... Alliance of Small Island States
CIF ..... Climate Investment Funds
COP 26 ..... UNFCCC 26th Conference of the Parties
CREWS ..... Climate Risk and Early Warning Systems Initiative
CSI ..... Country Support Initiative
DWD ..... German Weather Service
ECMWF ..... European Centre for Medium-Range Weather Forecasts
GCA ..... Global Center on Adaptation
GCF ..... Green Climate Fund
GCOS ..... Global Climate Observing System
GEF ..... Global Environment Facility
GBON ..... Global Basic Observing Network
HMEI ..... Hydro-Meteorological Equipment Industry
JMA ..... Japan Meteorological Agency
LDCs ..... Least Developed Countries
NCEP ..... United States National Centers for Environmental Prediction
NWP ..... Numerical Weather Prediction
OECD ODA ..... OECD Official Development Assistance
REAP ..... Risk-Informed Early Action Partnership
RMR ..... Resource Mobilization Report
SIDS ..... Small Island Developing States
SOFF ..... Systematic Observations Financing Facility
UN MPTF ..... United Nations Multi-Partner Trust Fund
UNEP ..... United Nations Environment Programme
UNDP ..... United Nations Development Programme
V20 ..... Vulnerable 20 Group
WDQMS ..... WMO Integrated Global Observing System Data Quality Monitoring System
WIGOS ..... WMO Integrated Global Observing System
WMO ..... World Meteorological Organization

1. The Context

1.1 The importance of hydromet

Hydromet development and action – the provision of weather forecasts, early warnings and climate services and of the weather, water and climate observations that underpin those services – is at the core of bold and effective action on three essential global agreements*:*

- The Paris Agreement includes the goal to strengthen systematic observation of the climate system and early warning systems;
- The Sendai Framework aims to substantially increase availability and access to multi-hazard early warning systems and disaster risk information and assessments;
- The Sustainable Development Goals stress the importance of environmental monitoring and stewardship in support of ending poverty and hunger, providing affordable clean water and energy, and strengthening human and institutional capacity on climate change mitigation, adaptation, and early warning.

Improving the ability to forecast the weather and predict the changing climate is crucial to save lives, protect the livelihoods of the most vulnerable and bring benefits in global productivity necessary for green recovery from the COVID-19 pandemic. Weather forecasting and climate prediction capabilities are essential to managing risks effectively, understanding adaptation and resilient development needs and planning accordingly with systematic and anticipatory action.

The benefits from better prediction are measurable and significant. The World Bank estimates that the global minimum socio-economic benefits of weather prediction are about USD 162 billion annually[4] (see Figure 1). Each extra day of reliable warnings contributes to additional lives saved and enormous economic benefits, as does improved reliability of longer-term prediction of climate change and its impacts. Improving accuracy and lead-time of prediction across all time ranges matters, from short-term weather forecasts to long-term climate projections. It matters for proactive and early action on extreme weather, such as determining when to move emergency supplies or evacuate populations in advance of a tropical cyclone; planning when to plant and irrigate crops; managing supply and demand for solar and wind energy; preparing for the impact of El Niño and La Niña on water availability for operation of dams and hydropower plants; preventing dengue fever and desert locust outbreaks; or preparing for heatwaves.

[4] 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.

Figure 1. Minimum annual socio-economic benefits of weather prediction: Disaster management and optimized production
Source: Adapted from Kull et al., 2021.

Weather and climate observations from the whole globe are needed for weather forecasts, early warning systems, and climate services everywhere. Climate services can be depicted in a "value chain" linking the data inputs to the production and delivery of services to user decisions and better adaptation to climate change and resilient development outcomes (Figure 2).[5] The process starts with the collection of weather and climate observations. These data are internationally exchanged and integrated into global prediction models and climate reanalysis (see Box 1) run by WMO Global Producing Centers.[6] These models provide estimates of the current and future weather and climate everywhere on the globe, including in the locations where the observations were originally collected. Reliable, real-time access to surface-based observational data from the entire world is critical to the quality of the output from these models. Much attention has been paid to improving weather and climate models, strengthening early warning capacity and helping potential users and communities to access and benefit from weather and climate information. So far, not enough has been done to ensure the data underpinning the whole system are effectively collected and internationally shared. Improving the foundation of the "value chain" is critical to obtain the benefits from investments in the rest of the chain.

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[5] WMO, World Bank, GFDRR and USAID (2015). *Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services*. World Meteorological Organization, World Bank, Global Facility for Disaster Reduction and Recovery, United States Agency for International Development, WMO-No. 1153, Geneva, Switzerland.

[6] WMO Global Producing Centers (GCP) provide WMO Members with a range of forecast products based on their global models for both medium-range and seasonal ensemble forecasts. The forecast products offered by the GPC depend on a constant flow of high-quality space-based and surface- based real-time observations from the entire world. These form an integral part of the WMO Global Data-Processing and Forecasting System. Through the WMO designation process, Global Producing Centres for Long-Range Forecasts adhere to well-defined standards in data processing, which helps to create consistency across the network and enhances the usability of fixed forecast production cycles. They also have standard sets of forecast products and WMO-defined verification standards for 'retrospective forecasts' – test forecasts that are made about past weather events that are then used to assess how accurate models are in making forecasts.

Figure 2. Weather and climate data underpin weather forecasts, early warnings and climate information and ultimately the value it creates for society.
Source: Adapted from Country Hydromet Diagnostics prototype, WMO 2020.

The role of surface-based data is vital, despite the growing contribution of satellite observations and the advances in weather and climate modeling. Surface-based observations are essential to measuring certain weather and climate parameters that cannot be reliably measured from space and they also play a vital role in the ground-truthing, calibration and validation of satellite data.[7] These observations also remain critical for the analysis of climate trends and predictions using what is known as "climate reanalysis" (see Box 1).

Box 1. Linking the past with the future in climate monitoring and prediction: The role of surface-based observations in "climate reanalysis"

It is today more vital than ever that we have long and reliable historical records of the Earth's climate. Weather and climate are inextricably linked as disciplines, and the respective monitoring and prediction efforts are based on many of the same observations and on the same modeling and data assimilation systems. But observations are not uniformly spread across the world, meaning there are overlapping data in some areas and gaps in others. In addition, older datasets tend to be less complete than recent records. Climate reanalysis addresses these problems. It combines observations made in the past using the physics of today's weather models to deliver a complete and consistent picture of past weather. The weather data of the past can be likened to a series of jigsaw puzzles with pieces missing in some places and overlapping in others. The pieces available are observations from weather stations, weather balloons, aircrafts, ships, satellites, and other sources.

Reanalysis is like a smart machine that uses the weather model to combine and process all the information from those pieces for historical climate monitoring and as a basis for the calibration of climate prediction systems. Using the laws of physics, it is able to blend overlapping pieces and recreate pieces that are missing in a consistent way thus restoring the complete puzzle. The reanalysis delivers a global picture of the weather and climate of the past as closely as possible for each hour. The data produced by reanalysis are widely used and provide many kinds of information not only about the atmosphere such as temperature, wind and precipitation but also about the ocean and the land surface. Thus, reanalysis represents a comprehensive, historical record of the earth's climate. It can provide an accurate method to monitor how fast it is changing and serves as a key building block for climate prediction.[8]

But despite all the scientific advances in modeling and the help which reanalysis offers in improving predictions, it remains true that missing observations translate into lower reanalysis quality. This, in turn, means a less robust basis for local climate prediction.

[7] See Annex III: Joint statement of the major European meteorological institutions (ECMWF, EUMETNET, EUMETSAT) and WMO in support of SOFF.

[8] Text adapted from ECMWF, 2020. *Factsheet: Re-analysis*. Available at: https://www.ecmwf.int/en/about/media-centre/focus/2020/fact-sheet-reanalysis

1.2 The problem

Missing foundational surface-based weather and climate observations in developing countries, with all of the attendant loss in prediction accuracy and in socio-economic benefits, can be framed around four interlinked problems:

- An **input problem**: Critical surface-based observations that are necessary for weather and climate prediction are not being collected and/or internationally shared in many parts of the world;
- An **output and outcome problem**: The resulting weather and climate predictions are not as accurate and robust as they could and should be, and they, in turn, lead to sub-optimal policy, investment and early warning decisions and outcomes;
- A **sustainability problem**: The assets and capacity created by investments in basic observations have not proved to be sustainable; and
- A **delivery problem**: The approach used for delivering assistance to developing countries to strengthen and maintain their observation systems has frequently been ineffective.

1.2.1 The input problem

In many developing countries, and especially in SIDS and LDCs, the surface-based data sharing gaps are particularly severe. While modeling capabilities have substantially increased over the last decades – millions of lines of computer code running on some of the fastest supercomputers available, ingesting tens of millions of observations from space and land every day – the availability of the surface-based data that feed these models from around the globe is limited. Figures 3 and 4 below show the capabilities of national observing networks measured against the requirements for the GBON (see section 1.3 below) for the two categories of surface-based observations (land-based and upper-air observations). Blue shades indicate areas that are either close to or currently meeting GBON requirements. Red shades indicate areas that are farther from meeting the GBON requirements. The maps show that SIDS and LDCs are currently far from meeting the GBON requirements and this can largely be attributed to a lack of infrastructure and capacity. As mentioned above, this situation not only has direct impacts on the quality of weather and climate prediction in countries (see Box 2) with data gaps but also globally.

Box 2. Lack of observations, poor forecasts and devastating impact. The example of Cyclone Nargis

On May 2, 2008, a category 4 cyclone slammed into Myanmar causing some USD 12b in property damage, almost 140,000 fatalities and displacement of some 800,000 people. Weather forecasters tracking the cyclone had initially predicted the storm would make landfall in Bangladesh, but it veered unexpectedly to the east and intensified from a category 1 storm to a category 4 in just 24 hours. While numerous factors combined caused the catastrophic destruction in Myanmar, ex-post analysis attributes the lack of observations as one of the significant causes of the inaccurate forecasts for the cyclone. Myanmar lacked a weather network that could predict cyclones, and many citizens doubted the weather reports because of the unreliability of previous storm forecasts.

Figure 3. This map shows the horizontal resolution[9] of surface observations based on stations actively reporting in January 2020. Source: WMO Secretariat

(Blue shades are close to or currently meeting GBON requirements, Red shades are farther from meeting GBON requirements)

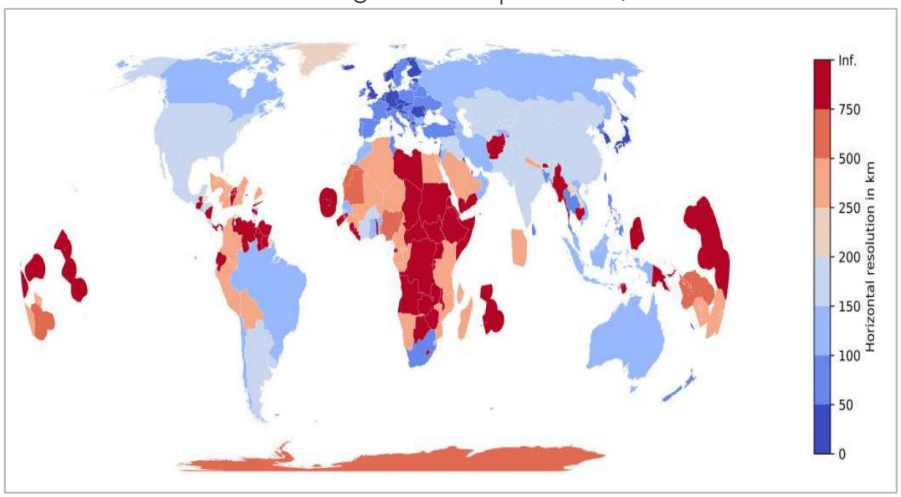
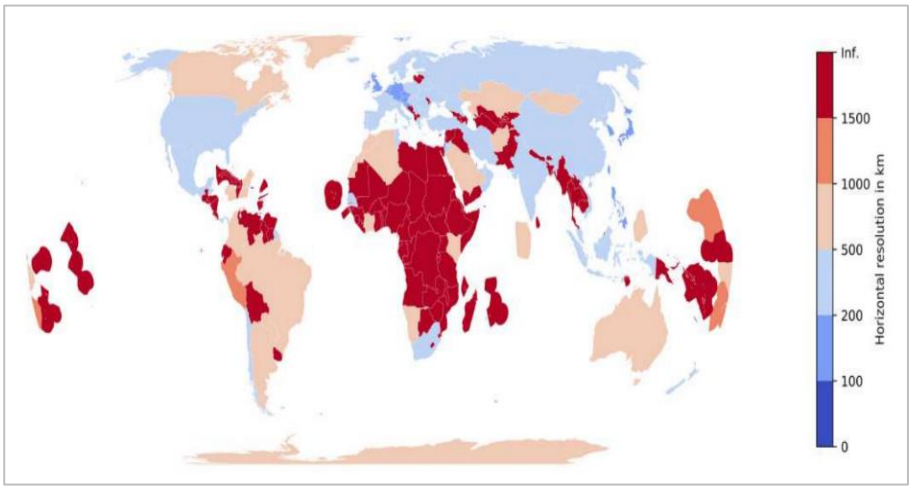


Figure 4. This map shows the horizontal resolution (see Footnote 9) of upper air observations based on stations actively reporting in January 2020. Source: WMO Secretariat.

(Blue shades are close to or currently meeting GBON requirements, Red shades are farther from meeting GBON requirements)



In many cases, the situation is not only bad, it is getting worse. For example, the European Centre for Medium-Range Weather Forecasts (ECMWF) observed a dramatic decrease in the number of shared upper air observations from radiosondes (the most important surface-based data for weather prediction models) of almost 50% in Africa from January 2015 to January 2020. The situation further deteriorated after January 2020 due to the impact of COVID-19.

[9] Horizontal resolution is a measure of the geographic density (average horizontal spacing of individual stations) of the observing network. The lower the distance measured in Km between stations, the higher is the resolution of the GBON network.

1.2.2 The output and outcome problem

Weather and climate prediction know no national boundaries. Local observations are important for local purposes, but their full value is only realized when globally shared. For instance, for a 24-hour forecast, observations taken over a relatively small area – e.g., located within 1,000 km from the region of interest – will be the most important ones.[10] However, prediction beyond 4 to 5 days for any location requires observations from the whole globe. (See Box 3).

Due to a lack of surface-based weather and climate observations from many parts of the world, today's weather and climate prediction models fall short of their potential in terms of the quality of their predictions. Such gaps in data collection and sharing amount to lost opportunities and increasing challenges for governments, the private sector, and civil society to deliver the best possible warnings, monitor information and act proactively to help save lives and support economic development. Therefore, it is in all countries' self-interest to ensure that weather and climate observations are collected and – importantly – internationally shared.

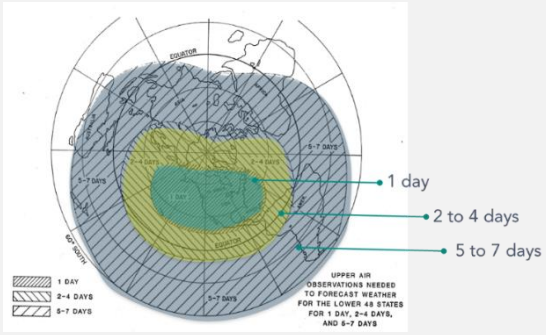
Providing meteorological observations is typically seen as the responsibility of individual countries. However, the information obtained from the data collected has implications at regional and global scales. Inefficiencies arise when countries are not able to collect and share their observational data due to resource and capacity constraints for the development and operation of their observing networks. Sometimes the data are not being shared because countries are not collecting them, while in other cases, the data are collected but not shared. The quality of the whole system is reduced as a result.

The most effective path for countries to improve the quality of their national weather and climate prediction is to generate and share national observations for assimilation into global models, and then use the output of those models as the basis for national climate services. Lack of local observational data weakens the effectiveness of local area models directly, but the same lack of data also weakens local model effectiveness indirectly, since the local models then draw on lower-quality output from global weather prediction models, a critical input for effective national forecasting.

[10] 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

Box 3. Weather and climate prediction know no national boundaries – improving the quality of weather forecasts, early warnings and climate services is a global endeavor

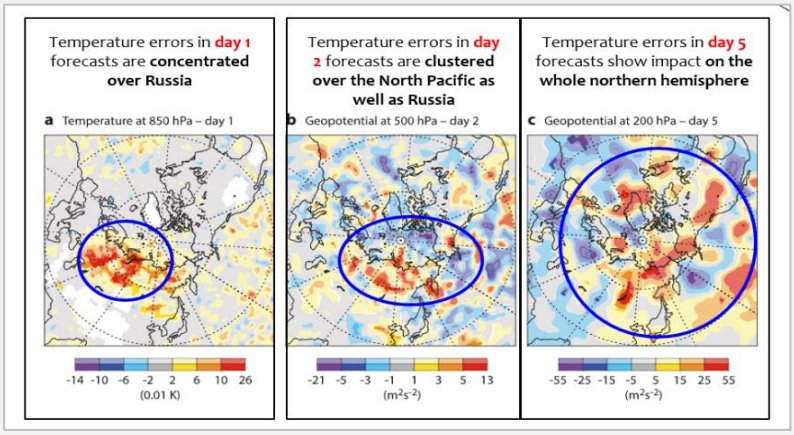
The graph below illustrates that reliable prediction beyond 4 days for the US requires observations from the whole world. ECMWF has documented cases in which the lack of observations in and around Papua New Guinea (PNG) affects the quality of forecasting in Europe. Because the data from, for example, PNG feed into the global weather forecasting models, which in turn are used as a foundation for the local weather forecasts in PNG and elsewhere in the world, there are benefits not only for PNG but also for the rest of the world, including other developing countries in the Pacific and beyond.



Source: WMO Secretariat, 2021.

The value of observations beyond national boundaries: The example of radiosondes

Balloon-borne radiosondes are critical for numerical weather prediction, forecasting, climate studies and calibration of satellite data. This was demonstrated clearly in 2015 when Russia had to cut its radiosonde programme from two ascents per day to one. The ECMWF analysis pictured in the charts below shows how significantly those reductions in radiosondes impacted forecast performance far beyond Russia (darker colors indicate greater impact on performance).

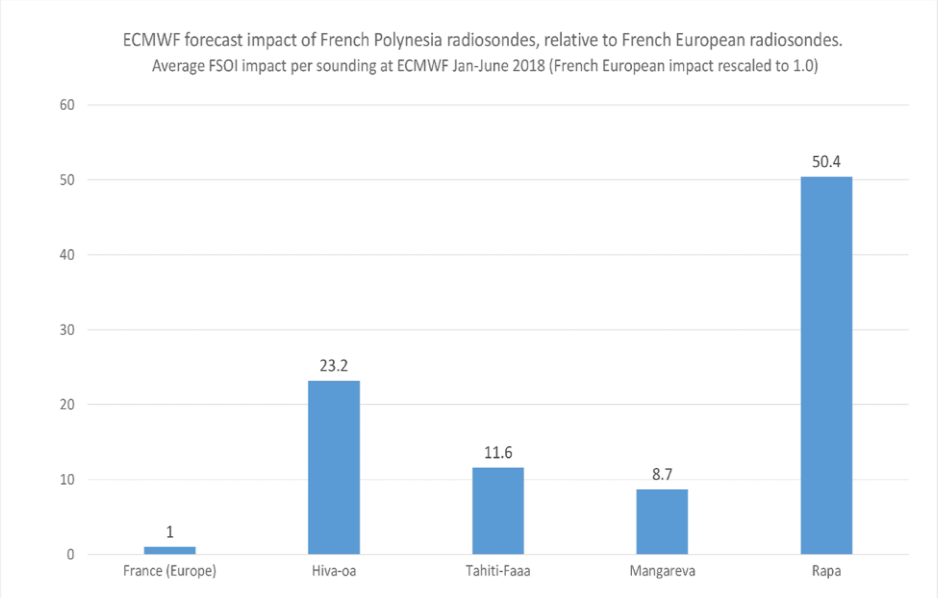


Source: Adapted from ECMWF

Investing in observations at the right place: The Pacific example

The impact of improving surface-based observations varies across regions. While all observations are important, strengthening observing systems is more important in some geographical areas with low observational density than in those with high density. It is estimated that benefits from having additional observations are greatest in low-density areas, i.e., Africa, Antarctica, South America, and the South-West Pacific, while impact per additional observation is lowest for Europe, where density is highest. This suggests that it is most urgent to invest in improved observations in the former

regions. Single surface-based observing stations from islands or remote land areas are also of vital importance. The graph below shows that the impact on forecast accuracy of an additional radiosonde flown over French Polynesia is up to 50 times higher than for French radiosondes flown over Europe.



Source: Adapted from ECMWF

1.2.3 The sustainability problem

Past investments to strengthen weather and climate observing capacity, supported by the international community through time-bound projects, have not, in many instances, yielded lasting benefits. There are two main reasons for this. First, traditional development projects are typically prioritized to respond to national priorities. While a country-driven approach is important, it is not enough for investments in observing systems as it ignores the trans-boundary nature of weather and climate prediction. Second, the typical development project finances only infrastructure investments while countries are expected to cover costs related to the operation and maintenance of their observing systems. This expectation has, to a large extent, proved to be unrealistic, as experience with internationally financed projects has demonstrated again and again, especially in LDCs and SIDS. After project completion, many countries have found it difficult to operate and maintain the infrastructure and this has quickly translated into a loss of capacity.[11] This holds especially for countries with large geographic areas (and hence large observing remits) and limited national financial resources (low Gross Domestic Product - GDP) (see Box 4).

[11] SOFF Working Group on financing mechanism and opportunities: Analysis of Alliance Members Hydromet funding. Available upon request.

Box 4. Financing of observing systems in LDCs and SIDS today - unsustainable

A comparison of Switzerland to Kiribati illustrates the need to fundamentally change the financing model for observations in LDCs and SIDS. Switzerland (approximate area: 41,000 km^2; approximate GDP: USD 700 billion) spends roughly USD 20 million annually, i.e., less than 0.003% of its GDP, on its observing network. A similar share of GDP spending for observations for Kiribati (approximate area: 3,500,000 km^2 if the surrounding Exclusive Economic Zone is included for a fair comparison of observational responsibility; approximate GDP: USD 200 million) would amount to less than USD 6,000 annually, far less than the cost of even a single Automated Weather Station. While this comparison uses two extreme cases, it illustrates an essential part of the sustainability problem of maintaining observing networks in SIDS and LDCs. These countries would need to spend a much larger share of their GDP for maintaining their observational networks to meet the GBON requirements than more prosperous ones.

The value to the global community of observations is independent of the income level of the country where the data are generated, and the forecast impact of observations tends to be higher in developing countries where today significant data gaps exist. In addition, the costs of maintaining an observing system meeting global standards in a country like Kiribati are higher than in Switzerland. The global public good that results when a country like Kiribati invests in, and operates and maintains, an observing system, creates a strong case for international support.

1.2.4 The delivery problem

Major climate and development finance institutions recognize that closing the gap on basic observations is critical, that this will require substantial additional investment and, importantly, that it will require a new way of providing financial and technical support (see Box 5). Effective collaboration and coordination among the several scientific, financial, and operational partners involved in strengthening the weather and climate observing system has proved to be challenging. This has translated into fragmentation and inefficiencies in the design and implementation of projects in support of better observing systems, resulting in increasing gaps in observations sharing despite substantial investments.

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 financing model, the creation of SOFF is a commitment of the Alliance. Along with many other international partners, the members of the Alliance have substantially contributed to the development of SOFF (see Section 6.1 on consultation milestones).

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.[12]

[12] See more on the Alliance for Hydromet Development here: https://public.wmo.int/en/our-mandate/how-we-do-it/partnerships/wmo-office-of-development-partnerships

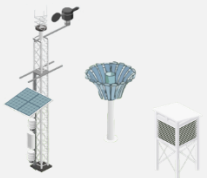
1.3 The opportunity

In June 2019, the 18th World Meteorological Congress and its 193 countries and territories approved the Global Basic Observing Network (GBON) concept. The GBON paves the way for an overhaul of the international exchange of observational data. GBON addresses the most essential data requirements of global weather and climate prediction models that are not met by satellite systems. GBON delivers essential data for the WMO Integrated Global Observing System (WIGOS) and the Global Climate Observing System (GCOS). Both, WIGOS and GCOS are global coordination and collaboration frameworks aiming at enhancing understanding of our earth and climate system and facilitating the production of weather and climate services, through the provision of more and better observations. They are a system of systems – with GBON foundational for the entire system.

Based on a globally optimal design, GBON puts clear requirements on countries for collecting and internationally sharing surface-based observations of the most essential weather and climate variables, i.e., atmospheric pressure, temperature, humidity, wind speed, precipitation, and snow depth (see Box 6). It is based on the principle of global free and unrestricted data-sharing and collaboration among nations for a critical global public good.

Box 6. GBON technical requirements and types of observations

The detailed GBON technical requirements were approved by the WMO Commission for Observation, Infrastructure, and Information Systems in November 2020[13] and will be submitted to WMO Extraordinary Congress for formal approval in October 2021.

Type of observations		Requirements
 Surface land-based observations	For surface-based land observations, weather stations are used. These are typically Automated Weather Stations that measure basic surface variables such as atmospheric pressure, temperature and humidity, and where applicable snow cover.	Members must operate surface land observing stations measuring atmospheric pressure, air temperature, humidity, horizontal wind, precipitation and snow depth, at a horizontal resolution of 200km or higher, and data must be reported hourly. Members with networks operating at higher horizontal resolution must report their observations either at the full resolution of the network or at a minimum resolution of 100km, whichever is higher.
 Upper-air land-based observations	For upper-air land-based observations, weather balloons are used. These are typically, but not exclusively, radiosonde stations that provide profiles of atmospheric temperature and humidity along with wind speed and direction, ranging from the surface up to an altitude of about 30 km, at a required minimum resolution and time-frame.	Members must operate a set of upper-air stations over land that observe temperature, humidity and horizontal wind profiles, with a vertical resolution of 100m or higher, twice a day or better, up to a level of 30hPa (pressure level in the atmosphere corresponding to roughly 22km altitude) or higher, with a horizontal resolution of 500km or higher.

[13] Draft GBON Regulatory Material in WMO Commission for Observation, Infrastructure and Information Systems, Recommendation 2. Available at: https://meetings.wmo.int/INFCOM-1/English/Forms/AllItems.aspx?RootFolder=%2FINFCOM%2D1%2FEnglish%2F2%2E%20PROVISIONAL%20REPORT%20%28Approved%20documents%29&FolderCTID=0x01200017BCAC15E9D18846906D60DDAA23289A&View=%7B0442DDE1%2D38CE%2D49E5%2DABDF%2D94882DF645A2%7D

1.4 The benefits

Closing the GBON gap is highly beneficial and economically efficient. There is a triple dividend of avoided losses, direct economic benefits and other socio-economic benefits not counted in the previous two. Most importantly, the potential benefits directly attributed to the full implementation of GBON in those countries with the largest data-sharing gaps are assessed to be around USD 5 billion per year. According to the World Bank, for every dollar invested in GBON in these countries, at least 25 US dollars in socio-economic return could be realized (see Box 7). Moreover, these investments provide the foundation to realize the USD 162 billion of estimated minimum annual benefits of weather and climate prediction noted in Section 1.1. These are very aggregate estimates, based on many assumptions. But it is clear from numerous examples around the globe that the improvements in predictions which are possible with improvements in observations will save and improve the lives of people. While all regions would benefit from these improvements, regions with significant populations but limited observation networks would benefit the most, particularly Africa.

Box 7. A triple dividend of investments in weather forecasts, early warnings and climate information. Foundational weather and climate observations are essential to fully realize these benefits

First dividend: Avoided losses

Reliable and accurate early warning systems that save lives and assets are worth at least ten times their cost. Just a 24-hour warning of a coming storm or heatwave can cut the ensuing damage by 30 percent.[14] Potential global disaster management benefits are estimated at USD 66 billion per year.[15]

Second dividend: Optimizing production

About USD 96 billion[16] are the estimated annual benefits of improved economic production through the application of weather forecasting in highly weather-sensitive sectors including agriculture, water, energy, transportation and construction.

Third dividend: Other economic, social and environmental benefits

There is a wide range of benefits generated by improved disaster risk management, many of which were not considered in the above global assessment of economic benefits, such as increased business and capital investment, fiscal stability and reduced future debt exposure, and ecosystem-based co-benefits.[17]

Achieving sustained compliance with the GBON requirements will require substantial investments, strengthened capacity and long-term resources for operation and maintenance in many countries. Figure 5 shows that in order to close their GBON gaps, the observations

[14] Global Commission on Adaptation. 2019. *Adapt now: A global call for leadership on climate resilience.* Available at: https://gca.org/reports/adapt-now-a-global-call-for-leadership-on-climate-resilience/

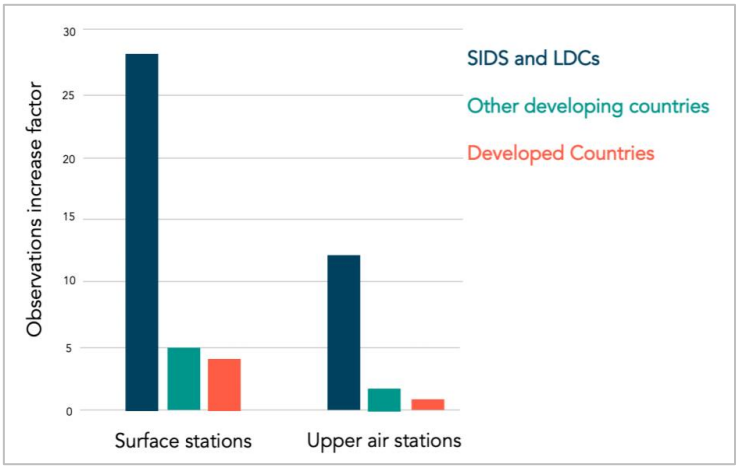
[15] Kull, Daniel Werner; Riishojgaard, Lars Peter; Eyre, John M.; Varley, Robert Andrew. 2021. *The Value of Surface-based Meteorological Observation Data (English).* Washington, D.C.: World Bank Group. Available at: http://documents.worldbank.org/curated/en/192461614151036836/The-Value-of-Surface-based-Meteorological-Observation-Data

[16] Ibid

[17] Ibid

in LDCs and SIDS need to increase 28 times over their current levels for surface stations and 12 times for upper air stations. These multiples are much higher than for other developing countries and for developed countries. Experience indicates that LDCs and SIDS would need concerted international support to close these gaps.

Figure 5. The expected relative increase in observations (surface and upper air) if all countries comply with the GBON requirements. SIDS and LDCs require by far the largest increase in shared observation to achieve GBON compliance. Source: WMO Secretariat, 2020.



2. Systematic Observations Financing Facility (SOFF): Basic Design

2.1 SOFF value proposition

SOFF is a dedicated financing mechanism whose creation is spearheaded by WMO in collaboration with a wide range of organizations, including all members of the Alliance for Hydromet Development. It will provide grants and technical assistance to countries that need support for the long-term generation and international exchange of basic surface-based weather and climate observations as stated by the GBON requirements (See Section 1.3 above).

SOFF will address the shortfalls of the current model to provide assistance for basic observations through three basic features. First, SOFF will apply an optimal and internationally agreed global design and metric to guide investments – the GBON requirements. Second, SOFF will focus on data sharing as a measure of success. Third, it will provide support over the long term, using results-based grant finance to contribute to operations and maintenance costs, in recognition of the global public good created by these observations.

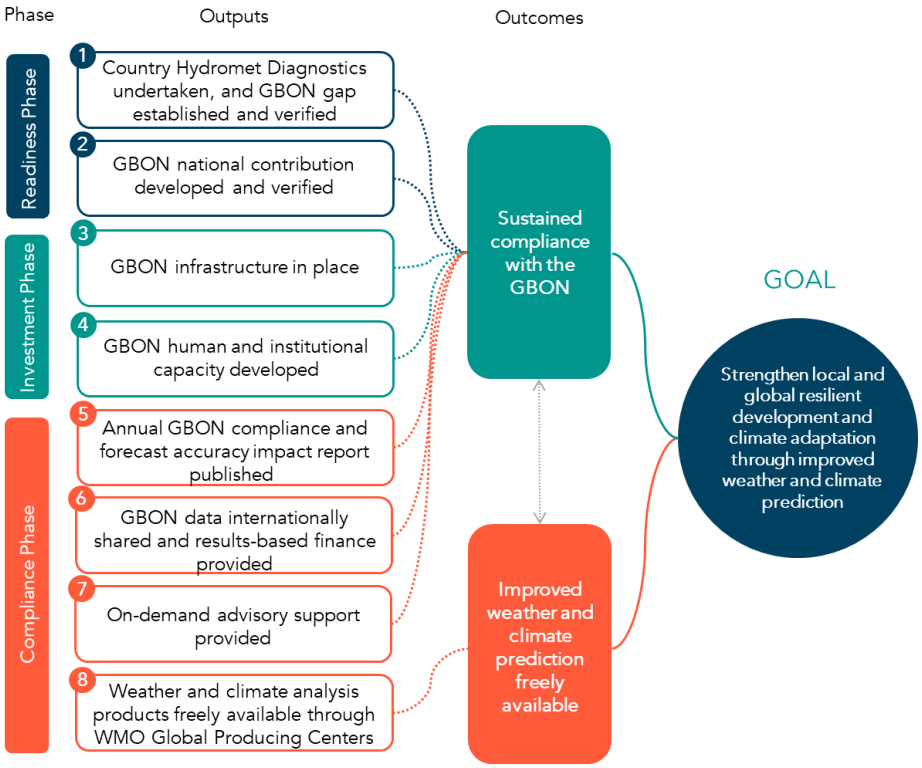
The grant and long-term nature of SOFF support for SIDS and LDCs is justified by the global public goods dimension of recipient countries' contribution to GBON; by their very limited institutional and fiscal capacity; and by the high vulnerability of SIDS and LDCs to extreme

events and the impacts of climate change. Moreover, it is consistent with the global call on all developed countries and climate finance providers to increase the level of grant finance to support the most vulnerable (call led by the COP26 UK – Presidency).[18]

2.2 SOFF results framework

The overall goal of SOFF is to strengthen local and global resilient development and climate adaptation through improved weather and climate prediction. SOFF will contribute to this goal through two outcomes: sustained compliance with the GBON, and access to freely available improved weather and climate prediction products. Figure 6 presents an overview of the basic elements of the SOFF results framework.

Figure 6. SOFF Results Framework



2.3 SOFF operational design

The provision of inputs and creation of SOFF outputs are organized in three delivery phases: a readiness phase, an investment phase, and a compliance phase. Inputs are provided by the SOFF operational partners (see Section 2.4) – WMO as SOFF technical authority and verification partner; major development and climate finance partners as SOFF implementing entities; the Country Support Initiative (CSI) as the SOFF advisory mechanism and WMO

[18] UK COP26 Presidency. Priorities for public climate finance in the year ahead. 2021. https://2nsbq1gn1rl23zol93eyrccj-wpengine.netdna-ssl.com/wp-content/uploads/2021/01/PRIORITIES-FOR-PUBLIC-CLIMATE-FINANCE-IN-THE-YEAR-AHEAD.pdf

Global Producing Centres (the Centres that provide WMO Members with a range of forecast products based on their global prediction models).

While countries will receive tailored and differentiated support, all countries accessing investment and compliance support from the Facility will be required to start with the Readiness phase. This will ensure that SOFF investments are based on the requirements of GBON and are based on an integrated assessment of the country's broader hydromet development needs.

2.3.1 Readiness phase

In the Readiness phase, the country's hydromet status will be assessed, its GBON gap defined, and a plan to close the gap developed. The Readiness phase will deliver two outputs:

Output 1. Country Hydromet Diagnostics undertaken and GBON gap assessed and verified
The Country Hydromet Diagnostics assessment (see Box 8) will play a foundational role in fostering a coordinated and prioritized support programme to a country's hydromet development, beyond GBON. The assessment will provide the analytical basis to help ensure that SOFF support is embedded into larger national hydromet development programmes and projects which are supported by international development and climate finance partners. As part of this assessment, the country's GBON gap will be defined. This GBON gap assessment will produce a country inventory for the number and types of observing stations that need to be established, upgraded, and/or rehabilitated, as well as the required human and institutional capacity and financing needed to install, operate, and sustain a national observing network compliant with the GBON requirements.

Box 8. What is the Country Hydromet Diagnostics?

The Country Hydromet Diagnostics is a tool and an approach to assessing National Meteorological Services and their contribution to high-quality weather, climate, hydrological, and environmental information services and warnings. The tool provides a standardized and practical way to analyze the most critical elements of the hydromet value chain. One of the elements assessed is the country's GBON gap. For each element, maturity levels are assessed, indicating where additional focus and support are needed. The assessments are undertaken by peer meteorological services from other countries. The Diagnostics aims to inform policy and hydromet investment decision-making by providing the analytical foundation needed for better targeted and more coherent investments. The Country Hydromet Diagnostics tool is being developed with the members of the Alliance for Hydromet development, spearheaded and technically guided by WMO.[19]

Output 2. GBON national contribution developed and verified
Countries will be supported in developing their GBON national contribution to meet GBON requirements, i.e., a detailed plan to achieve compliance with the GBON requirements,

[19] 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_0.pdf?jhqBE7uwAdUxz02CR2415AQ6Iomh9FtK

based on the capacity and infrastructure assessment undertaken through the Country Hydromet Diagnostics. The national GBON contribution will be verified by WMO as the SOFF technical authority. The verification of the national contribution will be a requirement for receiving SOFF support in the investment and compliance phases.

2.3.2 Investment phase

The Investment phase will support countries through SOFF-funded infrastructure and capacity development investments to achieve GBON compliance in line with the verified national contribution. The Investment phase support will be provided in collaboration with SOFF implementing entities and usually be embedded in their broad-gauged hydromet and early warning projects and programmes. This phase will deliver two outputs:

Output 3. GBON infrastructure in place
Observation infrastructure, telecommunications, and other needed equipment for GBON compliance will be acquired and installed.

Output 4. GBON human and institutional capacity developed
Capacity will be developed to operate and maintain the observing network.

2.3.3 Compliance phase

In the Compliance phase, SOFF will provide support to enable sustained GBON data sharing compliance and to facilitate access to improved weather forecasts and climate analysis products. The Compliance phase will deliver four outputs:

Output 5. Annual GBON compliance and impact report developed

The SOFF Secretariat will work with WMO technical authority and WMO Global Producing Centres in developing an annual report composed of two sub-sections:

- **Report on countries' GBON compliance**. The annual report will provide the status of both the individual countries' compliance status and the overall SOFF implementation progress against the targets established.

- **Report on the impact of improved observations in forecast performance in SOFF supported countries and globally.** The report will assess the improvement of weather forecast performance linked to improved observations sharing. The report will also provide feedback on the quality of observations.

Output 6. GBON data internationally shared and results-based finance provided
Results-based finance will be provided to cover 75% of standardized and averaged operation and maintenance costs to sustain GBON data sharing compliance. Results-based finance will be provided for each compliant station, using a tolerance threshold (e.g., >95% of GBON requirements met is considered as compliant). Resources will be directly transferred to countries' national meteorological institution responsible for the operation and maintenance

of the national GBON. Support to sustain GBON compliance will be provided on a long-term basis, as long as a country remains in SIDS or LDC status.

Output 7. On-demand advisory support provided
Advisory support on GBON operation and maintenance and facilitating access to improved weather and climate prediction products will be provided through peer-to-peer collaboration via the CSI (see Section 2.4.2).

Output 8. Weather and climate analysis products freely available
These products will be provided by WMO Global Producing Centres (see Section 2.4.4).

2.4 SOFF operational partners

2.4.1 WMO technical authority

WMO will be the SOFF technical authority and verification partner. WMO will be responsible for verifying the GBON national contribution and the achievement of GBON compliance. Verification of the GBON national contribution and the corresponding plan on how to close the GBON gap will trigger SOFF investment support. Annual verification of GBON compliance will trigger results-based finance for the contribution to operations and maintenance costs. The verification function will be performed by the WMO Secretariat, guided by the WMO Commission for Observation, Infrastructure and Information Systems (Box 9).

Box 9. WMO Integrated Global Observing System Data Quality Monitoring System (WDQMS)

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. The current operational version of the webtool monitors the availability and quality of observational data based on near-real-time monitoring information from the four participating global Numerical Weather Prediction (NWP) centres: the German Weather Service (DWD), the ECMWF, the Japan Meteorological Agency (JMA) and the United States National Centers for Environmental Prediction (NCEP). Information provided by this system was used as input for the assessment of the global GBON gap (see Figures 3 and 4). Due to the recent decline in the amount of observational data caused by the COVID-19, the average availability of data over January 2020 was used as a measure of whether a given station was reporting data internationally. The WDQMS will be the monitoring system used by WMO as the SOFF technical authority to monitor GBON compliance for the results-based finance support provided to beneficiary countries. The tool can be accessed at https://wdqms.wmo.int.

2.4.2 Country Support Initiative

The CSI will provide the SOFF advisory function. The CSI is the WMO member-to-member advisory services mechanism to provide standardized, hands-on, peer-to-peer technical assistance to support countries and the SOFF implementing entities in achieving and maintaining GBON compliance. The CSI harnesses the technical expertise from the national

meteorological services of WMO Members. CSI advisory services will be funded through SOFF resources and provided on a cost-recovery basis.

The CSI advisory services will be fully integrated into the SOFF. In 2019, the World Meteorological Congress decided to establish the CSI with its own governance structure, including a Steering Committee comprised of funding partners as decision-makers and a Secretariat accountable to the funding partners.[20] To avoid institutional fragmentation and reduce costs, the CSI will be merged with the SOFF. The scope of CSI advisory services will be tailored to SOFF needs, including Country Hydromet Diagnostics assessments and technical advice provided to beneficiary countries and SOFF implementing entities on the development of the GBON national contribution, the integration of SOFF into projects funded by the implementing entities, and hands-on support during the investment and compliance phase as outlined above. The SOFF Secretariat will handle the administrative aspects of the CSI. The SOFF funding needs (see Section 5) include the resource needs for the SOFF CSI advisory function.

2.4.3 SOFF implementing entities

Major development partners (Multilateral Development Banks and selected UN organizations) are expected to become SOFF implementing entities. SOFF will not have its own accreditation process for implementing entities as it will work with partners already accredited to global environment and climate funds, and specifically to the institution that will host the SOFF (see Section 3.3). SOFF implementing entities will blend SOFF funding with their own concessional and non-concessional resources and ensure that the SOFF outputs are linked with larger projects addressing other areas of the hydromet value chain and climate adaptation and resilience.

The role of the implementing entities ends once the outputs of the investment phase (see Section 2.3.2) are achieved and countries are ready to enter the compliance phase where results-based finance will be transferred directly to countries.

2.4.4 WMO Global Producing Centres

The WMO Global Producing Centres will support SOFF in a variety of ways. WMO Global Producing Centers will contribute to maximizing the SOFF benefits for countries by providing free access to their improved weather and climate analysis products. They will also provide feedback on the quality of observations and measure the improvement of weather forecasts linked to improved observations from SOFF beneficiary countries.

[20] 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

2.5 SOFF beneficiaries

In its initial five-year implementation period, SOFF will prioritize its support to SIDS and LDCs because they have both the largest observation and capacity gaps and the most significant financial constraints to implement GBON and maintain sustained compliance. All other OECD Official Development Assistance (OECD ODA) eligible countries will be eligible to draw on SOFF Readiness Phase support. This will allow them to assess their GBON gap and, in collaboration with development and climate finance partners and national sources of financing, strive to achieve GBON compliance. The full list of SOFF beneficiary countries is provided in Annex II.

3. SOFF institutional setup

3.1 A foundational and complementary partnership

SOFF focuses on the upstream observational data required to create a solid foundation for downstream investments related to disaster risk management, resilient development, adaptation to climate change and green recovery from the COVID-19 pandemic. SOFF supports and increases the effectiveness of investments made by governments, international development and climate finance partners and the private sector – for investments already made and for increasing climate and resilient development investments expected in the future.[21]

The most direct benefit from SOFF is for investments in better weather forecasts, early warning systems and climate services. The members of the Alliance for Hydromet Development have a current hydromet investment portfolio that amounts to about USD 2.5 billion.[22] Trends from some Alliance members' programmatic plans indicate that hydromet investments are expected to continue growing in the future (see Box 10). SOFF will support the robust foundation on which these investments rely.

[21] Based on available data sources, the required global adaptation finance need is projected to be USD 180 billion annually from 2020-2030. Source: Global Commission on Adaptation, 2019. Adapt now, a global call for leadership on climate resilience. Available at: https://gca.org/reports/adapt-now-a-global-call-for-leadership-on-climate-resilience/; and USD 50 billion annually for Non-Annex I countries (UNFCCC list of developing countries) to achieve their nationally determined contributions (UNEP, 2020. Adaptation Gap Report 2020). Available at: https://www.unep.org/resources/adaptation-gap-report-2020.

[22] This figure represents the active portfolio of hydromet investments from Alliance members and it was estimated as part of the technical analysis performed by the SOFF working group on SOFF design and funding opportunities. The technical report is available upon request.

Box 10. Alliance member plans for expanded hydromet investments

As an example, the Green Climate Fund is expecting that its hydromet portfolio will exceed USD 2.2 billion by 2030, about 150% more than the current portfolio. The World Bank Group's Action Plan on Climate Change Adaptation and Resilience aims by 2025 to expand access to high-quality hydrometeorological data and Early Warning Systems for an additional 250 million people in at least 30 developing countries, and to support 100 national agencies with improved meteorological, hydrological, and flood forecasting systems. UNEP expects an increasing number of hydromet-dedicated projects and United Nations Development Programme (UNDP) expects a 50% increase of investments going to hydromet by 2030. The Adaptation Fund and GEF expect a steady upward trend for their hydromet funding with about 20% of their adaptation portfolios dedicated to hydromet funding in the coming years.

These investments provide downstream hydromet support, which effectiveness largely depends on the upstream support that will be provided by the SOFF.

Beyond the direct benefits of better observations for hydromet investments, resulting improvements in local weather and climate services will enhance the effectiveness of internationally supported public and private investments in many sectors, including agriculture and insurance. For example, the InsuResilience Global Partnership[23] and its partners will benefit from improvements in the quality of global weather forecast and climate prediction model products achieved through the implementation of GBON. Improved data availability is also vital for the validation and calibration of satellite data largely used by InsuResilience and its insurance partners. SOFF is closely partnering with InsuResilience to ensure its activities fully take advantage of the achieved improvements in weather forecast and climate prediction products.

SOFF also provides foundational support to the Risk-Informed Early Action Partnership (REAP) that aims to drive a systemic shift towards early action to reduce the impacts of disasters, as well as to the Climate Risk and Early Warning Systems Initiative (CREWS) Initiative. SOFF will contribute to the provision of upstream weather and climate data and prediction products for evidence-based risk-informed early action pursued under REAP and CREWS. Major development institutions that are also REAP partners will be SOFF implementing entities. This will ensure that GBON infrastructure and long-term data-sharing translate into improved early warnings and climate services foundational to achieve REAP early action targets.

3.2 SOFF basic institutional elements

The basic SOFF institutional design requires a financing platform with a Trustee, a specialized Secretariat, and a Steering Committee.

[23] The InsuResilience Global Partnership for Climate and Disaster Risk Finance and Insurance Solutions was launched at the 2017 UN Climate Conference in Bonn. Since its launch, more than 75 members have joined the Partnership. The Partnership aims to strengthen the resilience of developing countries and protect the lives and livelihoods of poor and vulnerable people against the impacts of disasters. See https://www.insuresilience.org.

SOFF will bundle the contributions from the SOFF funding partners in a multi-donor trust fund or a financial intermediary fund. A trustee with a solid track record of managing large multi-donor funds is expected to provide the fiduciary function of the SOFF. The trustee will commit, transfer and use the funds as decided by the Steering Committee and provide regular reports to the steering committee on the financial status of the trust fund. The selection of the trustee will be determined by the selected SOFF host.

The Steering Committee will be the decision-making body of the Facility. It will be composed of funding partners, representatives of beneficiary countries and potentially other observers. It will oversee the overall activities of the Facility, approve and amend the SOFF governance document, approve operational guidelines and ensure that the operations of the Facility are consistent with its mandate and objective. It will approve overall funding allocations and country requests.

SOFF will require a highly specialized secretariat, able to coordinate and ensure that the diverse functions and partners of SOFF work coherently as needed. The SOFF Secretariat will be accountable to the Steering Committee. It will support the work and decision-making of the Steering Committee, receive and review support requests, administer the CSI advisory function, report to the Steering Committee and the trustee on progress based on information provided by the SOFF operational partners, and coordinate the production of, and issue, the annual SOFF compliance and impact report. Specific functions of the Secretariat might be outsourced to partner organizations.

Additional institutional elements could be added, including a multi-stakeholder advisory board. The final institutional arrangements, including where the Secretariat will be hosted, will depend on the selected SOFF host institution.

3.3 SOFF integration into an existing mechanism

While SOFF will become a dedicated mechanism, it does not aim to become a new institution. The objective is to integrate SOFF into an existing (and, if necessary, expanded) international development and climate finance institution or mechanism. Guided by the SOFF working groups (see Section 6 on consultations), five institutional host options were originally identified: Adaptation Fund, Climate Investment Funds (CIF), CREWS initiative, Global Environment Facility (GEF), and Green Climate Fund (GCF). Two additional host options have since emerged: Global Center on Adaptation (GCA), and United Nations Environment Programme (UNEP) with the UN Multi-Partner Trust Fund (UN MPTF) as trustee. All of these options are currently being explored in an in-depth manner. Based on a number of criteria (see Box 11) exploratory discussions have been held with the secretariats or managements of the potential host organizations. The current assessment of each option is briefly summarized below.

Box 11. Criteria for the selection of the SOFF institutional host

- **Mandate and scope**: thematic relevance, global geographic reach, and ability to support SOFF beneficiary countries.
- **Financial contributions:** ability to receive contributions from bilateral and multilateral partners, and potentially the private sector and philanthropies.
- **Transfer-out:** ability to transfer financial resources to multiple partners, in particular, the SOFF envisaged implementing entities for the investment phase, and directly to countries for the results-based payments in the compliance phase.
- **Specialized Secretariat**: ability to host a specialized Secretariat and flexibility in the arrangements, e.g., the possibility to co-host and/or partner with other organizations for the delivery of selected Secretariat functions.
- **Complexity**: administrative and governance requirements for SOFF establishment and operation.

3.3.1 Initial assessment of host options[24]

Adaptation Fund: SOFF could be established as a parallel trust fund under the Adaptation Fund. The mandates are fully aligned, with SOFF being foundational to deliver on the Adaptation Fund mandate. The Adaptation Fund can accommodate financial contributions from different sources and has significant experience in transferring out resources to implementing entities, including multilateral partners. The SOFF secretariat function could be accommodated within an expanded Adaptation Fund Secretariat. The decision about potentially hosting SOFF would require a Board decision, possibly supported by UNFCCC guidance. If a UNFCCC COP decision is required, this would delay the establishment of SOFF.

Climate Investment Funds (CIF): SOFF could become a new dedicated program under the CIF's Strategic Climate Fund (SCF). The CIF focus on specific areas of climate action that require dedicated support and a global partnership fits the purpose of SOFF. SOFF would build on and leverage all CIF programs and in particular the Pilot Program for Climate Resilience and it is fully in line with the CIF's focus on building climate resilience through investments in, among others, infrastructure (including hydromet infrastructure) and climate data analytics. Currently, the CIF work only with 6 MDBs.[25] Expansion to include a limited number of additional implementing entities (more MDBs and selected UN agencies) would require amendments to the governance framework, subject to the approval of the SCF Trust Fund Committee. Results-based financing transfers would need to be managed through approved implementing entities. An expanded CIF Secretariat with the relevant skills can perform the administrative functions required to deliver on SOFF. Contracting out selected technical functions to other partners might be possible. Scope, objectives and eligibility

[24] For any SOFF option that is a Financial and Intermediary Fund (FIF) hosted by the World Bank, internal review by World Bank management and World Bank Board approval is needed.
[25] African Development Bank. Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, International Finance Corporation, and World Bank.

criteria for any new SCF Programme would need to be recommended by the CIF Secretariat (in consultation with the MDBs, the Trustee and other key stakeholders) and approved by the SCF Trust Fund Committee.

CREWS Initiative: SOFF fully complements CREWS and provides the foundation for effective CREWS investments. WMO has informed the CREWS Steering Committee regarding the planned creation of SOFF, and the CREWS Secretariat has been part of the SOFF Working Group. At the Steering Committee's twelfth meeting, WMO presented the option for potential integration of SOFF within CREWS. SOFF could be incorporated as a new window under a substantially expanded CREWS. This would require increasing the number of Implementing Partners for this window to include MDBs and selected UN organizations, and would require an expanded Secretariat to accommodate the SOFF Secretariat. The CREWS Steering Committee decided to organize an inter-sessional meeting in the first quarter of 2021 to follow up on the discussions regarding SOFF to understand the opportunities and implications for the CREWS Initiative.

Global Center on Adaptation (GCA): SOFF could be hosted by the GCA, with the trustee and Secretariat administrative functions either provided directly by GCA or in collaboration with an international organization with a track record of managing multi-donor trust funds. SOFF would become a GCA flagship initiative underpinning effective adaptation work globally, with the GCA priority regions for action being aligned with SOFF beneficiary regions (Africa, Asia and Pacific, Latin America and the Caribbean). In this context, SOFF would also provide a strong footing for the recently launched Africa Adaptation Acceleration Program, spearheaded by the African Development Bank and the GCA with the target to mobilize USD 25 billion. The GCA host option would provide the flexibility to fully operationalize the SOFF as envisaged, with the acknowledgment that GCA is still a young and rapidly growing organization focusing on innovation for adaptation. It would take advantage of the visibility, influence and reach of the Center. The establishment of SOFF under this option might be less complex than several other options. It would require a decision by the GCA Executive Management.

Global Environment Facility (GEF): SOFF could be established as a new window or new programme under the GEF's Special Climate Change Fund (SCCF). Ringfencing of SOFF resources would be possible. The SOFF Secretariat could be housed within the GEF Secretariat with some potential flexibility for partial transfer-out of specific Secretariat functions. The decision about the potential SOFF window lies with the LDCF/SCCF Council, to be supported by UNFCCC guidance. The upcoming LDCF/SCCF Council meeting, either in June or December 2021, would need to endorse in principle the SOFF window/programme. If a final decision would need to wait until 2022, it would create a major delay for the establishment of the SOFF.

Green Climate Fund (GCF): SOFF could become a special programme within the GCF, building on the REDD+ pilot programme experience. GCF is already the largest provider of grant finance for climate services and early warning projects and works with major development and climate finance institutions expected to be SOFF implementing entities. GCF is already investing in GBON infrastructure and the SOFF has been identified as crucial

to ensure the sustainability of these projects (see Box 12). However, establishing SOFF within the GCF would be a complex and - very likely - lengthy undertaking, taking into consideration the need for a UNFCCC COP decision and consequent GCF Board decision. It would also imply the inclusion of new operational elements within the GCF, in particular the establishment of a specialized SOFF Secretariat and the introduction of a mechanism to provide results-based and long-term finance to countries beyond GCF investment projects.

Box 12. Two recently approved GCF projects demonstrate the importance of SOFF

In October 2020, the Twenty-seventh meeting of the GCF Board (B.27) approved two projects which noted the critical role that GBON and SOFF will need to play in order to achieve long-term sustainability of investments in early warning and climate services. These projects, one in Liberia[26] and the other in five Pacific island countries[27] highlighted the need for enhancing climate services to foster resilient development. The GCF Secretariat and the Independent Technical Advisory Panel assessment of these two initiatives[28] considered that compliance with GBON standards was an innovative approach that strengthened the projects' value proposition. They defined SOFF as a key financial mechanism required to address the fundamental mismatch between the current country-based financing of basic observations and the value of these observations as a global public good by providing long-term finance and technical assistance.

United Nations Environment Programme (UNEP) with UN Multi-Partner Trust Fund (UN MPTF): SOFF could be established as a UN Multi-Partner Facility with the SOFF Secretariat hosted by UNEP and fiduciary management provided by the UN MPTF Office (Trustee). As the UN center of expertise on pooled financing mechanisms, the UN MPTF office has a strong track record with implementing programmes in 139 Countries. This includes experience with direct transfer of resources to UN and multi-lateral partners, and to countries for results-based financing and other innovative financing models and a possibility to pool financial resources from diverse sources. The SOFF configuration would work similarly to those for the Partnership for Action on Green Economy, the UN Programme on Reducing Emissions from Deforestation and Forest Degradation (USD 340 million), the newly established Global Fund for Coral Reefs, and another existing UN MPTFs. The Facility could be quickly operational based on existing, pre-cleared Standard Legal Agreements in place between the Trustee (UN MPTF Office), UNEP, OECD DAC Donors, non-DAC middle income and developing country donors, private philanthropies and private companies.

3.3.2 Firming up SOFF host and institutional arrangements

The final decision on the SOFF host option and the SOFF institutional set-up will be taken in collaboration with the potential SOFF funding partners. Early feedback is sought from the potential funders on the proposed options. The objective is to identify the host institution by the second SOFF Funders' Forum meeting, expected to take place in early July 2021. The

[26] https://www.greenclimate.fund/project/sap018
[27] https://www.greenclimate.fund/document/enhancing-climate-information-and-knowledge-services-resilience-5-island-countries-pacific
[28] https://www.greenclimate.fund/sites/default/files/document/gcf-b27-02-add15.pdf and https://www.greenclimate.fund/sites/default/files/document/gcf-b27-02-add07.pdf

final configuration of the different institutional and governance aspects of SOFF will depend on the selected host institution.

4. SOFF implementation – a phased approach

This section presents preliminary indications as to how start up and implementation issues will be managed. The approach will be presented in greater detail at the Second Funders' Forum.

4.1 How will resources be deployed?

The SOFF steering committee is expected to set detailed resource allocation priority criteria.

In the Readiness Phase, through the CSI, the peer reviewers will draw on SOFF funds to cover the cost of their contribution to the Country Hydromet Diagnostics and advisory support (see Section 2.3.1). As the Readiness Phase involves standardized advisory services activities, a standardized funding cap for all countries is envisaged.

In the Investment Phase, SOFF implementing partners (see Section 2.4.3) will draw on SOFF resources on behalf of beneficiary countries and integrate and blend these grant resources into their broader concessional and non-concessional financing operations. The definition of countries' Investment phase resource allocation will be determined by the verified GBON national contribution (see Section 2.3.2).

In the Compliance Phase, SOFF will make an annual grant contribution to help cover 75 percent of the operation and maintenance costs of each GBON-compliant station in the recipient country. This contribution will be directly transferred on an annual basis from the Trustee to the national meteorological service responsible for operating and maintaining the national GBON after compliance has been verified by the SOFF technical authority.

4.2 SOFF implementation milestones and targets

As the world's efforts are focused on the COVID-19 green recovery and increasing ambition on adaptation to climate change, securing a solid evidence-based foundation for the hundreds of USD expected to be spent is imperative. With that urgency in mind, SOFF establishes a highly ambitious target of achieving GBON compliance in all SIDS and LDCs in a five-year initial implementation period and then subsequently contributing to the costs for sustained GBON data sharing compliance on an annual basis. It is acknowledged that the implementation of SOFF activities in many SIDS and LDCs, in particular in fragile and conflict-affected states, will pose many challenges. Recognizing that the ambitious SOFF target for the initial five-year implementation period may not be fully achieved in all countries due to some specific country situations, or to other reasons outside the control of the initiative, the achievement of GBON compliance in those target countries may happen after the initial implementation period.

Specific implementation targets are shown in Table 1. More definitive SOFF implementation milestones and targets will be provided for the second meeting of the SOFF Funders' Forum.

Table 1. Preliminary SOFF implementation targets and milestones

	SOFF implementation milestones	Estimated Funding Needs USD	Outputs
SOFF initial implementation period	67[29] SIDS and LDCs brought to GBON compliance	400 M	At least 20-fold increase of exchanged observations from surface stations At least 10-fold increase of exchanged observations from upper-air
	Additional OECD ODA eligible countries supported through SOFF Readiness Phase		
SOFF second implementation period	Results based support for operation and maintenance of GBON compliance in SIDS and LDCs	50 M per year	Continuous international data sharing of the full GBON network in SIDS and LDCs
	Potential extension of GBON to other weather and climate observation domains	TBD	TBD

4.3 SOFF monitoring and evaluation

SOFF will monitor and evaluate progress in three ways.

First, an annual GBON compliance and SOFF impact report will be issued (see Section 2.3.3):

Second, SOFF will follow a deliberate adaptive and learning process. SOFF implementation will be continuously assessed and, as required, adjustments will be proposed to the SOFF Steering Committee. A self-assessment of SOFF is planned in the third year of operation.

Third, an independent external evaluation is envisaged in the fourth year of the initial implementation period. Based on the results of the evaluation and lessons learned, SOFF operational design can be further adjusted for subsequent funding periods.

[29] The number of SIDS and LDC beneficiary countries in 2020 was 68, based on the list of ODA recipients also classified as LDCs and SIDS. The SOFF funding needs were calculated based on this figure. However, as countries graduate from the OECD ODA countries list or from the LDC and SIDS status, SOFF eligibility will be updated accordingly. Since Angola graduated from LDC status as of 2021, 67 countries are now classified as SIDS and LDCs - see Annex II. As SOFF becomes operational, the list of beneficiary countries will be reviewed on an annual basis.

4.4 SOFF adaptation and evolution

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 will leverage the ongoing activities of WMO constituent bodies such as the WMO Commission for Observation, Infrastructure and Information Systems. This includes in particular monitoring and assessment of evolving observing technologies and weather and climate prediction modeling capabilities. It will allow SOFF to find ways to minimize the annual costs of operating and maintaining the GBON without endangering the quality of observations and the outputs of weather and climate prediction models locally and globally.

As part of the GBON international agreement, the 193 WMO Members are committed to keeping implementation options of GBON under ongoing review, including potential amendments to the GBON regulatory framework, to address technological and environmental developments. This includes the environmental impact of observing technologies; ways to stimulate the development of new observing technologies; development of guidance material regarding the optimal mix of technologies to meet GBON requirements under various geographic constraints; and potential future paths of evolution for GBON into domains and disciplines beyond its current scope.

4.5 Risks and risk mitigation strategy

It is acknowledged that SOFF implementation will be confronted with various challenges and risks, including political, institutional, technical and financial. SOFF has been developed through a highly consultative process (see Section 6) that considered potential challenges and risks in the development of the SOFF concept and design. SOFF operational policy and guidelines on risks assessment and management will depend on the selected host institution and the policies in place. An overview of the overall SOFF risks assessment and management will be presented at the second meeting of the SOFF Funders' Forum.

5. SOFF funding needs

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. This includes the estimated costs of support across the three SOFF support phases (Readiness, Investment and Compliance), as well as management costs. After the initial five-year implementation period, sustaining GBON in SIDS and LDCs and its international data-sharing over time is expected to require USD 50 million per year.[30] The required annual funding needs will be raised through intermittent replenishment consultations (every 3-5 years). It is envisioned to mobilize USD 200 million by COP26 and to secure the remaining resources for the initial five-year period in 2022.

[30] The exact amounts required annually for compliance support will depend on the experience with SOFF implementation and on how many LDCs and ODA-eligible SIDS graduate from their current status.

The SOFF funding needs as presented in Table 2 have been established using various sources. They are based on the data from the WMO Integrated Global Observing Data Quality Monitoring System (WDQMS), the corresponding GBON gap analysis, the requirements to close the GBON gap produced by SOFF Working Group 2, and SOFF Working Group 3 technical reports on SOFF institutional and operational options and funding needs.[31] SOFF funding needs are based on experts' opinions and estimations of costs of achieving sustained GBON compliance. The costs are based on rough averaged global unit costs and rounded numbers of required stations to close the GBON gap.[32] It is understood that costs will vary among countries, yet it is expected that the actual costs will remain of a similar order of magnitude.

Table 2. Estimated funding needs for the first five-year implementation period

Readiness Phase USD 14 M	To deliver on SOFF outputs 1 and 2 for all SIDS and LDCs and estimated 50% of remaining OECD ODA eligible countries, i.e. Country Hydromet Diagnostics undertaken including national GBON gap established and verified; and GBON national contribution developed and verified.
Investment Phase USD 256 M	To deliver on SOFF outputs 3 and 4, i.e., investments in infrastructure, institutional, and human capacity to close the GBON gap in all SIDS and LDCs.[33]
Compliance phase USD 120 M	To deliver on SOFF outputs 5 to 8, i.e., annual GBON compliance and impact report published; annual GBON results-based finance delivered for GBON compliant SIDS and LDCs; on-demand GBON advisory support provided; weather and climate analysis products available.
Management USD 10 M	Estimated costs to cover the costs of the Secretariat and the Trustee. Final costs will depend on the chosen institutional platform. SOFF is expected to operate as a lean facility.
SOFF Funding Needs for the initial implementation period – USD 400 M	
SOFF Funding Needs after initial five-year implementation period – USD 50 M per year	

[31] SOFF Working Group 3. 2020. Technical products: Informing SOFF design and SOFF funding needs and opportunities. Access to these products can be provided upon request.

[32] The total GBON network in SIDS and LDCs as per the draft GBON minimal mandatory requirements corresponds to roughly 2300 surface and upper-air stations, out of which only 154 stations are reporting (as of January 2020).

[33] This includes an estimated implementing agency fee of about 7.5%. This is an average estimation based on the implementing entities fees applied by the GCF, GEF and AF, which vary based on the size of the grant. The final fee will depend of the SOFF chosen financing platform.

6. The SOFF journey so far and the way forward

From the early days of exploring the SOFF concept, SOFF development has been a multi-partner and multi-stakeholder initiative. The consultation process will continue throughout SOFF development and implementation periods.

6.1 Major milestones

Immediately after approval of the GBON concept by the 18th World Meteorological Congress in June 2019, a group of like-minded partners came together in July 2019 for an initial SOFF concept workshop in Geneva. Based on the workshop outcomes, an initial SOFF concept note was produced by the workshop participants in October 2019.

The initial SOFF concept note was circulated within the expert community of development and climate finance partners and generated broader interest in SOFF, leading to the commitment of the Alliance for Hydromet Development in December 2019 to "seeking innovative ways to finance developing country surface-based observations, aiming at the creation of a Systematic Observations Financing Facility that recognizes the economic value of observations as a global public good".[34]

The next step on the SOFF journey was a workshop hosted by the WMO President in February 2020 in Offenbach, Germany. The workshop brought together 45 participants from countries, finance institutions and technical partners that agreed to establish five multi-partner working groups to further flesh out critical elements of the SOFF concept.

The five SOFF Working Groups engaged in intense work. More than 30 international organizations were represented in these groups and delivered the technical outputs that shaped the SOFF concept and design by September 2020.

In October 2020 the WMO Executive Council decided to pursue the development of SOFF in a manner that would allow for it to be announced at COP26.

Following the October 2020 WMO Executive Council approval, the five working groups were merged into a single SOFF Working Group. This Group as well as the members of the Alliance for Hydromet Development contributed and validated the SOFF roadmap to COP26.

Looking then ahead to COP26, the SOFF roadmap (Figure 6) is structured across three objectives: secure funder, recipient and partner commitment and further engagement of stakeholders in a consultative manner; define SOFF institutional arrangements including host option and further advance SOFF design; and target mobilization of initial USD 200 M commitments by COP26.

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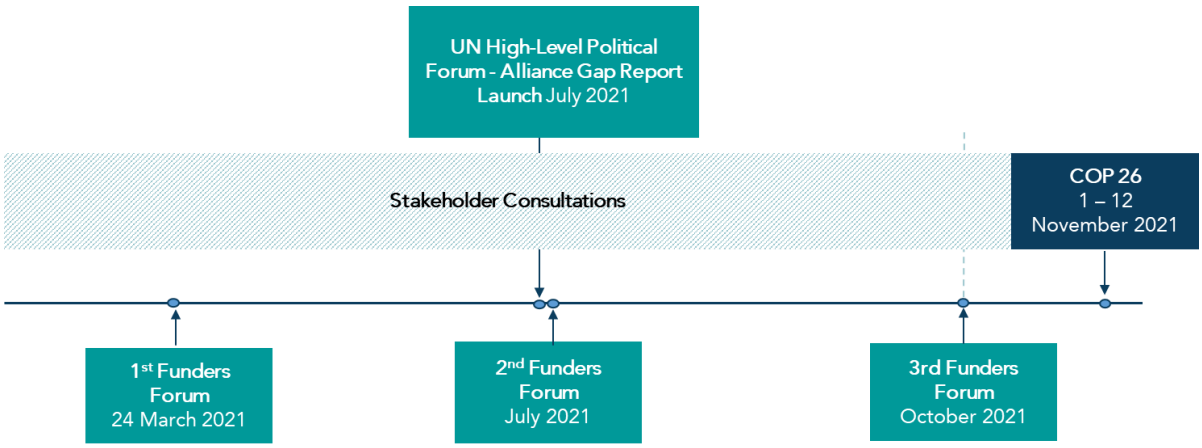
[34] Alliance for Hydromet Development declaration. Available at: https://ane4bf-datap1.s3-eu-west-1.amazonaws.com/wmocms/s3fs-public/ckeditor/files/Alliance_for_Hydromet_Development_Declaration.pdf?MK76pyj0R4sEbJb3c90y.W6S7km7PAEN

Figure 7. SOFF preparation timeline to COP26



As a transition measure, until SOFF is up-and-running, WMO is providing support to Alliance members to "GBON-proof" investments previously made or currently being prepared. For example, in collaboration with UNDP and Malawi, investments already made are being analyzed as to what it will take for the installed observation infrastructure to internationally exchange data per the GBON requirements. (See Box 12 on GCF projects for further information.)

Additional meetings with the Working Group and with the members of the Alliance for Hydromet Development will take place until COP26. This will ensure continued multi-stakeholder expert guidance for the final SOFF institutional and operational design.

6.2 Country consultations

SOFF has been developed in close collaboration and consultation with partners, countries and stakeholders to ensure that their needs are fully reflected in the design of SOFF. Country consultations have been undertaken under different tracks and will continue in the future.

WMO Members

The Presidents of WMO Regional Associations have played an important role in shaping the SOFF concept from a beneficiary country perspective, including by attending the above-mentioned workshops (Presidents Africa, South America, Europe) and the SOFF Working Groups (Presidents Africa, Europe). SOFF was presented and discussed, with views and ideas solicited for the design, at the Regional Association annual meetings for Europe, South America and North/Central America and Caribbean regions. This led to the adoption of formal decisions of these regions, committing the regional members to support SOFF development and resource mobilization. The annual meetings of the remaining regions (Africa, Asia and South-West Pacific) will take place in the coming months and SOFF will be presented and discussed.

WMO community

European Meteorological Organizations statement of support: As a result of the engagement with European meteorological institutions, a public statement in support of SOFF was signed on 2 October 2020 by these organizations at a side event of the WMO Executive Council.[35] European governments, development banks, the European Commission as well as all multilateral climate and environment financing institutions are called upon to consider funding SOFF (see Annex III).

WMO data policy conference: SOFF was prominently featured at the WMO global public consultation on the new WMO data policy 16-19 November 2020.[36] The WMO Data Conference was convened with the aim to develop a common understanding across all relevant sectors of society of the importance and arrangements for the international exchange of observations for monitoring and prediction of the Earth System. The event was attended by over 1000 participants from diverse sectors. The Conference allowed collecting important inputs for the design of the SOFF.

Additional consultations with SOFF beneficiary countries

"Road-testing" of the Country Hydromet Diagnostics: Eighteen countries are currently participating in the "road-testing" of the Diagnostics, including the assessment of their GBON gap, in two roles – as a peer reviewer and as a country being reviewed. "Road-testing" is supported and fully financed by eight members of the Alliance for Hydromet Development. The "road-testing" results will be critical to further shape the Country Hydromet Diagnostics tool and ensure it fulfills its intended objectives as part of the SOFF Readiness phase. Results will be presented in the first Hydromet Gap Report to be issued by the Alliance in July 2021 at the occasion of the UN High-Level Political Forum.

Country groups: Tailored consultation will take place with specific country groups, including the Least Developed Country Group (LDCs Group), the Alliance of Small Island States (AOSIS), the African Group of Negotiators, and the Vulnerable 20 Group (V20) Tailored discussions with the Members of the groups are envisaged to take place in the coming months. The Chairs of the LDC Group, African Group of Negotiators and AOSIS have already confirmed their interest in championing SOFF and continuing to engage in the development and creation of the Facility.

UNFCCC: The UNFCCC Regional Climate Weeks and their ministerial sessions provide an opportunity to engage with the civil society in the beneficiary regions.

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[35] The statement of support of the European Meteorological Institutions is available at: https://public.wmo.int/en/media/press-release/support-grows-systematic-observations-financing-facility

[36] The Conference summary statement is available at: https://meetings.wmo.int/WMO-Data-Conference/_layouts/15/mobile/dispforma.aspx?List=3edbcd41%2D6017%2D4216%2D9964%2D34696b816f3a&ID=34&RootFolder=%2FWMO%2DData%2DConference%2FSitePages

Other consultations with national governmental and non-governmental actors: Consultations with the Caribbean Region took place in December 2020 facilitated by the Varysian platform.[37] A consultation with the Latin America region will take place in March 2021, and a Varysian SOFF global webinar for additional country consultations is planned for the coming months.

6.3 Private sector consultations

One of the five SOFF Working Groups created at the February 2020 workshop was tasked to explore the value of GBON to the private sector, with a focus on the insurance industry. The group included the Insurance Development Forum (IDF), InsuResilience, African Risk Capacity, the Coalition for Climate Resilient Investment, Wills Towers Watson, Munich Climate Insurance Initiative, Lloyd's of London and Oasis Loss Modelling Framework. Based on the findings of the group an information brief was produced[38] outlining the benefits of GBON to the insurance industry.

Consultations with the association of Hydro-Meteorological Equipment Industry (HMEI):[39] An initial discussion with the Chair of HMEI took place on February 2021. It was agreed to develop a structured dialogue with HMEI, as part of the SOFF development phase as well as during implementation. The initial consultations are expected to take place between April and June 2021 and to focus on three topics:

- **SOFF implementation**: private sector experience in establishing, operating and maintaining basic observing systems in SIDS and LDCs;
- **Business models and public-private partnerships:** exploring options for public-private business models for building and operating basic observing systems;
- **Technology and technical specifications**: including standardized tender specifications for Automatic Weather Stations.

6.4 General public consultations

As part of the stakeholder consultation process, it is envisaged to have an open web-based consultation in June 2021, where any interested stakeholder will have the opportunity to provide comments and suggestions to improve the SOFF concept and design.

6.5 SOFF Funders' Forum meetings

Three SOFF Funders' Forum meetings are envisaged before COP26. The first Forum meeting, for which this report provides the basis, is taking place on 24 March 2021. The 2nd

[37] More information on Varysian is available at: https://www.varysian.com/about

[38] SOFF Information Brief, October 2020. The value of GBON: Exploring the Insurance Sector. Available at: https://library.wmo.int/doc_num.php?explnum_id=10379

[39] HMEI is accredited to the WMO and other UN organizations and actively facilitates interaction and communication between its members and international and national organizations, both governmental and private, for the mutual benefit of all parties. More information at: https://www.hmei.org/

Funders' Forum meeting is scheduled to take place in early July, immediately following the launch of the first Hydromet Gap report - issued by the Alliance for Hydromet - in the context of the UN High-Level Political Forum. The third and last meeting is expected to be a pledging session for SOFF initial financial commitments, scheduled for mid-October. Since all meetings will have to be virtual and hence of limited length, a fourth meeting may have to be scheduled between the second meeting and the pledging session, if that is necessary to ensure a successful outcome before COP26. Consultations with potential funders, partners and SOFF stakeholders, including beneficiary countries, the private sector, Civil Society Organizations, and the scientific and technical community, will be continued throughout as outlined above.

Documentation and the agenda for the Forum meetings following the 1st Funders' Forum will be handled flexibly, depending on the emerging needs and priorities. The current plan is to structure the discussions at the two next Funders' Forum meetings as follows:

- **For the 2nd Forum a draft Resource Mobilization Report (RMR) will be prepared** following broadly the structure of the report prepared for the 1st Funders' Forum meeting; the RMR and the second meeting will seek to address all issues and questions raised in the first meeting and during consultations, with a special focus on SOFF implementation aspect.

- **For the 3rd Forum (and pledging conference) a final draft RMR will be submitted** for approval. Prior informal consultations may be conducted to ensure that there are no major outstanding issues regarding the RMR that need to be resolved at the third meeting.

Annex I – SOFF further information

- SOFF webpage

- SOFF Communication products
  - Executive summary
  - Brochure – English, French
  - Infographic – English, French, Spanish, Arabic, Chinese, Russian
  - SOFF video – English, French, Spanish subtitles, Arabic subtitles, Chinese subtitles, Russian subtitles

- SOFF Information briefs and blogs
  - The value of Surface-Based Meteorological Observation Data: Costs and benefits of the Global Basic Observing Network
  - The gaps in the Global Basic Observing Network (GBON)
  - The Systematic Observations Financing Facility: How will it work?
  - The value of GBON: Exploring the Insurance Sector
  - It's critical that we invest in better global weather and climate observations

- SOFF FAQs

- SOFF Global Facilitators

- SOFF in the news
  - Why We Need Better Weather Forecasts
  - It's critical that we invest in better global weather and climate observations
  - Climate adaptation Summit 2021. The Systematic Observations Financing Facility: Filling the data gaps for effective adaptation investments
  - New UNEP programme to support climate resilience in Pacific Islands through early warning systems
  - Support grows for Systematic Observations Financing Facility – The Joint statement of support of the European meteorological institutions
  - Climate Investment Funds joins the Alliance for Hydromet Development
  - Alliance for Hydromet Development launched – The Alliance Declaration

Annex II - SOFF eligible countries

	Region[40]	Country	Grouping[41]
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[42]	LDC

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

[41] 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.

[42] 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.

32	South Asia	Nepal	LDC
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[43]	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

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

71	Sub-Saharan Africa	Congo	Other ODA recipient
72	Sub-Saharan Africa	Côte d'Ivoire	Other ODA recipient
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 III - Joint statement of the major European meteorological institutions (ECMWF, EUMETNET, EUMETSAT) and WMO in support of SOFF.

Joint statement of European meteorological institutions and the World Meteorological Organization in support of the creation of the Systematic Observations Financing Facility

2nd October 2020

We – the European meteorological institutions and the World Meteorological Organization (WMO) – strongly welcome the creation of the Systematic Observations Financing Facility (SOFF). With this statement, we want to convey the importance of European support for the SOFF.

The goal of the SOFF is to strengthen climate adaptation and resilience to respond to the increased frequency, severity and impact of weather and climate events by contributing to improved weather forecasts and climate services. The quality of these services depends decisively on a homogenic global distribution of surface-based observations. This will protect lives, property and reduce poverty, creating benefits for all citizens across the globe, in particular the most vulnerable.

The SOFF will substantially improve the timely and spatial availability of the most essential surface-based meteorological data in developing countries, contributing to internationally exchanged meteorological High Value Datasets. Surface-based observations are critical to maximize the benefits of increasingly available satellite data, including for validating global climate records derived from satellite observations.

Today, the inhomogeneity across the globe in both network density and volume of surface-based observations internationally exchanged is striking. The COVID-19 crisis further decreased the availability of observational data, showing the vulnerability of the global observing system and the urgent need to increase its resilience.

The SOFF will enable developing countries to deliver their contribution to the Global Basic Observing Network (GBON) as approved by the 18th World Meteorological Congress in 2019. At the UNFCCC COP25, the Subsidiary Body for Scientific and Technological Advice welcomed the development of the GBON and re-emphasized the need of sustained funding to meet the essential needs for global observations.

The SOFF builds on the successful experience of the European Composite Observing System and its overarching network design, which has proven to be cost-effective and impactful. The SOFF benefits from the expertise of European meteorological offices through the provision of technical advice by the WMO Country Support Initiative.

The SOFF will provide financial and technical assistance in new ways. First, SOFF support is based on internationally agreed, quantitative metrics that guide investments in basic surface-based observations – the GBON. Second, the SOFF will shift from short-term capital investments to the provision of long-term observational data exchange as a measure of success. It will contribute to cover operating and maintenance costs of a country's basic observation infrastructure through results-based finance. Third, the SOFF will create local benefits while delivering on a global public good – improving global weather forecasts and climate information for all nations.

The creation of the SOFF is a joint commitment and a priority action of the Alliance for Hydromet Development. The Alliance brings together major international development banks, multilateral climate and environment funds and UN organizations, aiming at uniting efforts to boost developing country capacity for high-quality weather forecasts, early warning systems, and climate information. The development of the SOFF is at advanced stages and the aspirational goal is to announce it at UNFCCC COP26.

Given the paramount importance of developing country basic observations, we are asking European governments, European development banks, the European Commission as well as all multilateral climate and environment financing institutions to consider funding the SOFF.

European Center for Medium-Range Weather Forecasts (ECMWF)

Gen. Isp. G.A. Silvio Cau (President Council)

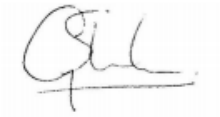
Dr Florence Rabier (Director-General)

European Meteorological Network (EUMETNET)

Dr Peter Binder (President)

Mr Eric Petermann (Executive Director)

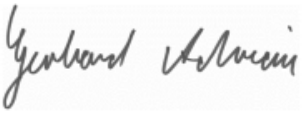
European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)



Prof Gerard van der Steenhoven
(Council Chairman)

Mr Alain Ratier (Director-General)

World Meteorological Organization (WMO)



Prof Gerhard Adrian
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