

The State of the Global Climate and WMO's role in Coordinating the Global Observing System



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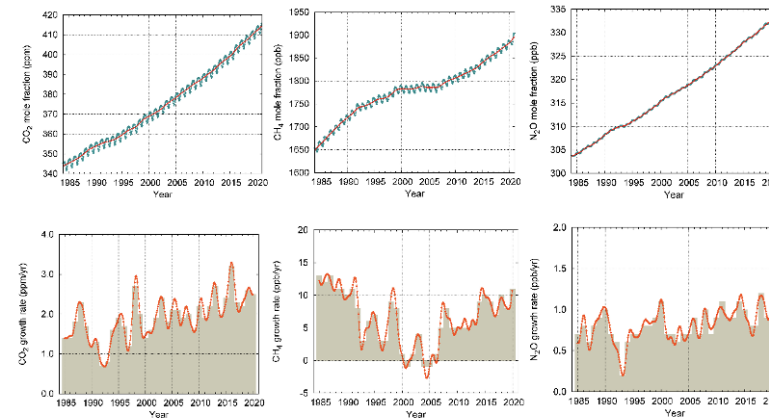
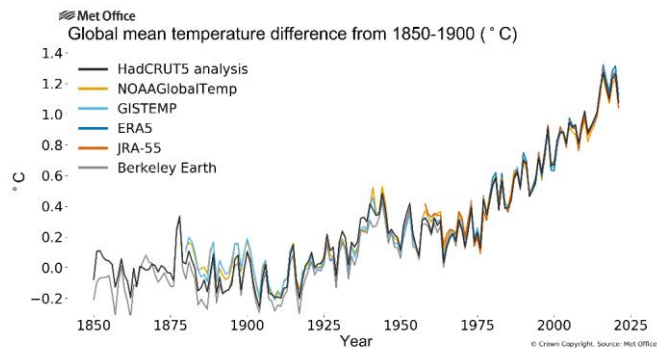
World Meteorological Organization

Organisation météorologique mondiale

Overview

- Provisional State of Climate 2021
- GCOS Status Report
- Developments at WMO Congress
 - Data Policy
 - Global Basic Observing Network
 - Systematic Observations Financing Facility

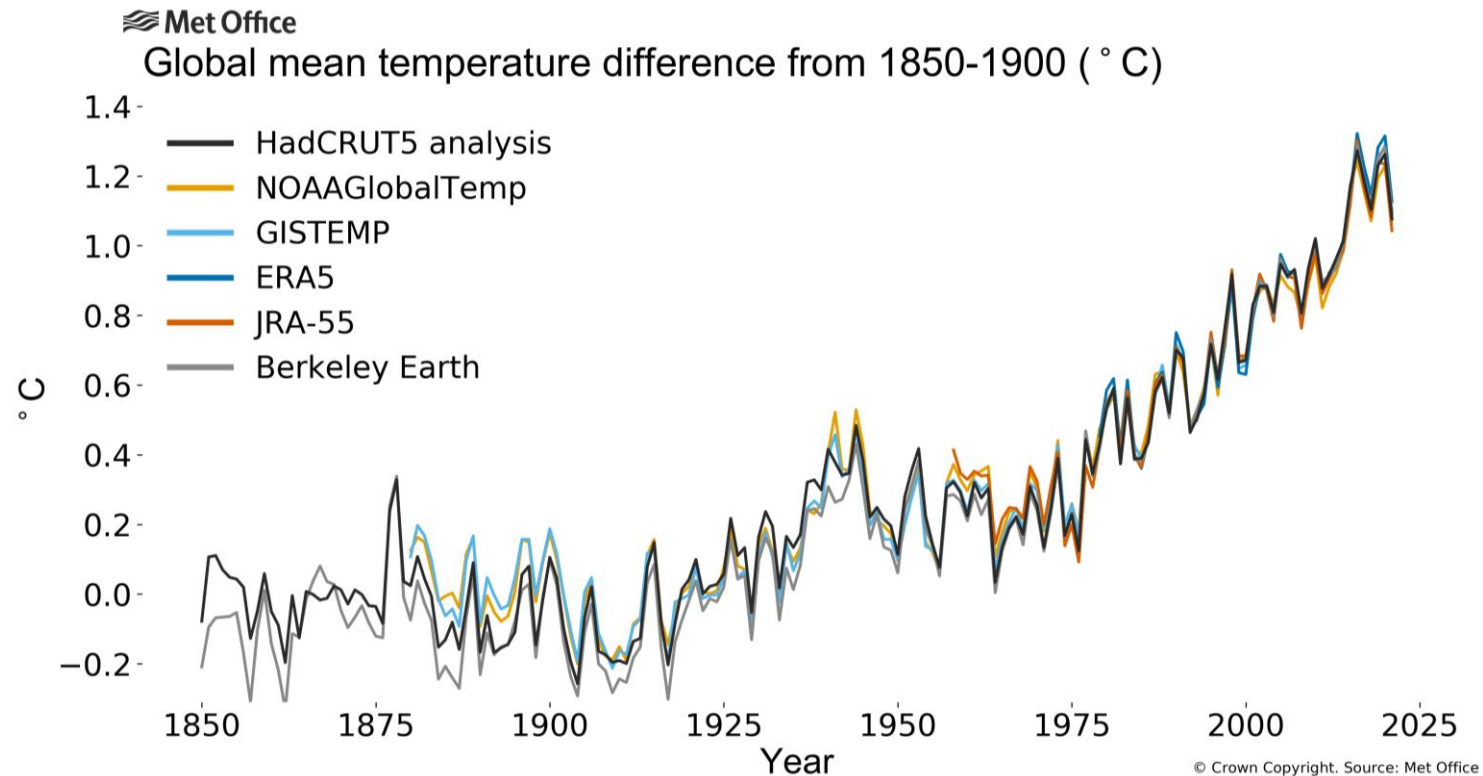
Provisional State of Global Climate 2021



Provisional State of Global Climate 2021 - Temperature

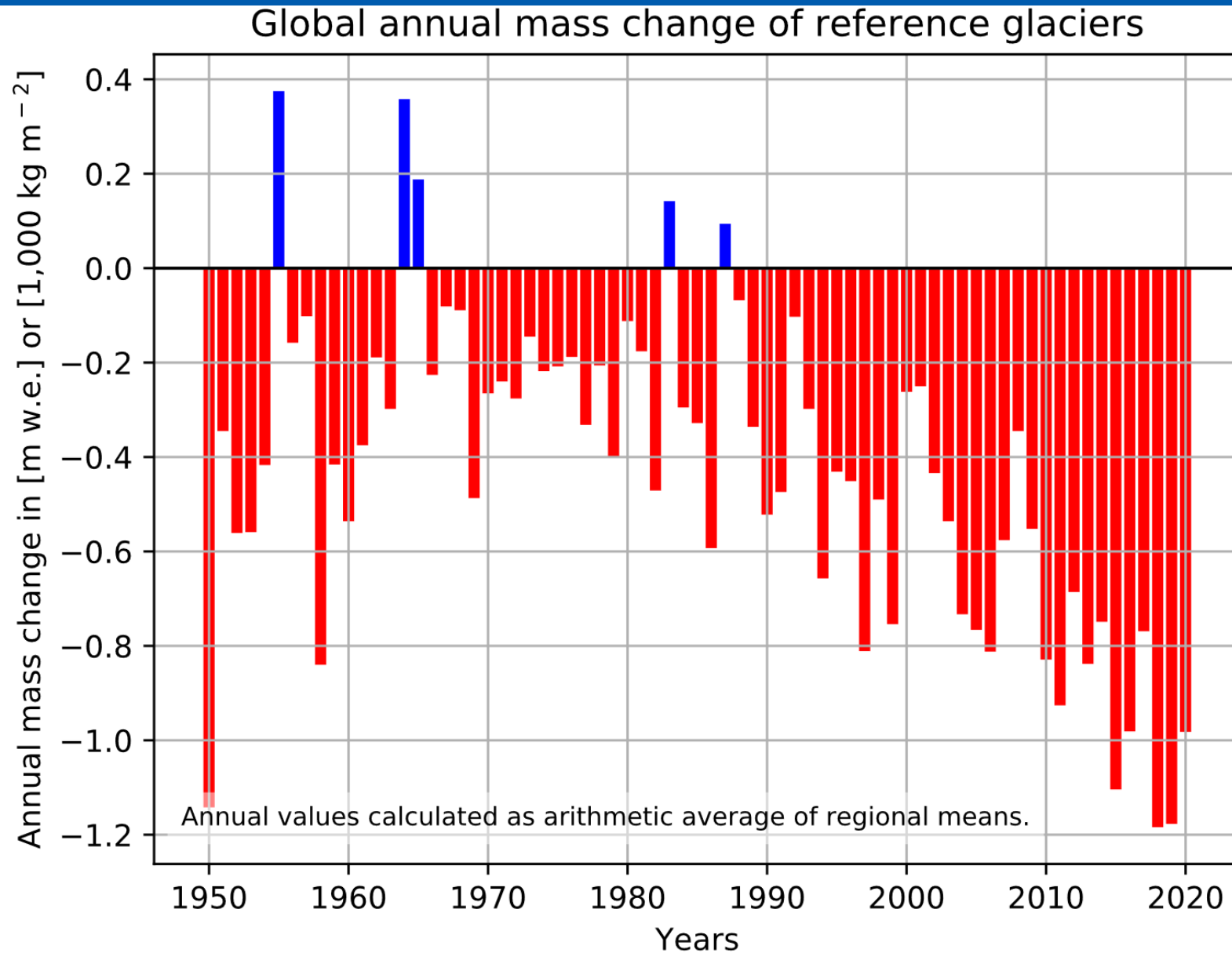
- 2021 (January-September) 1.08 ± 0.13 °C above 1850-1900 (pre-industrial)
- Likely to be 5th -7th warmest year on record, making the past 7 years the warmest 7 on record
- Based on 4 data sets and 2 reanalyses

Met Office
Global mean temperature
difference from 1850-1900 (°C)



Provisional State of Global Climate 2021 - Glaciers

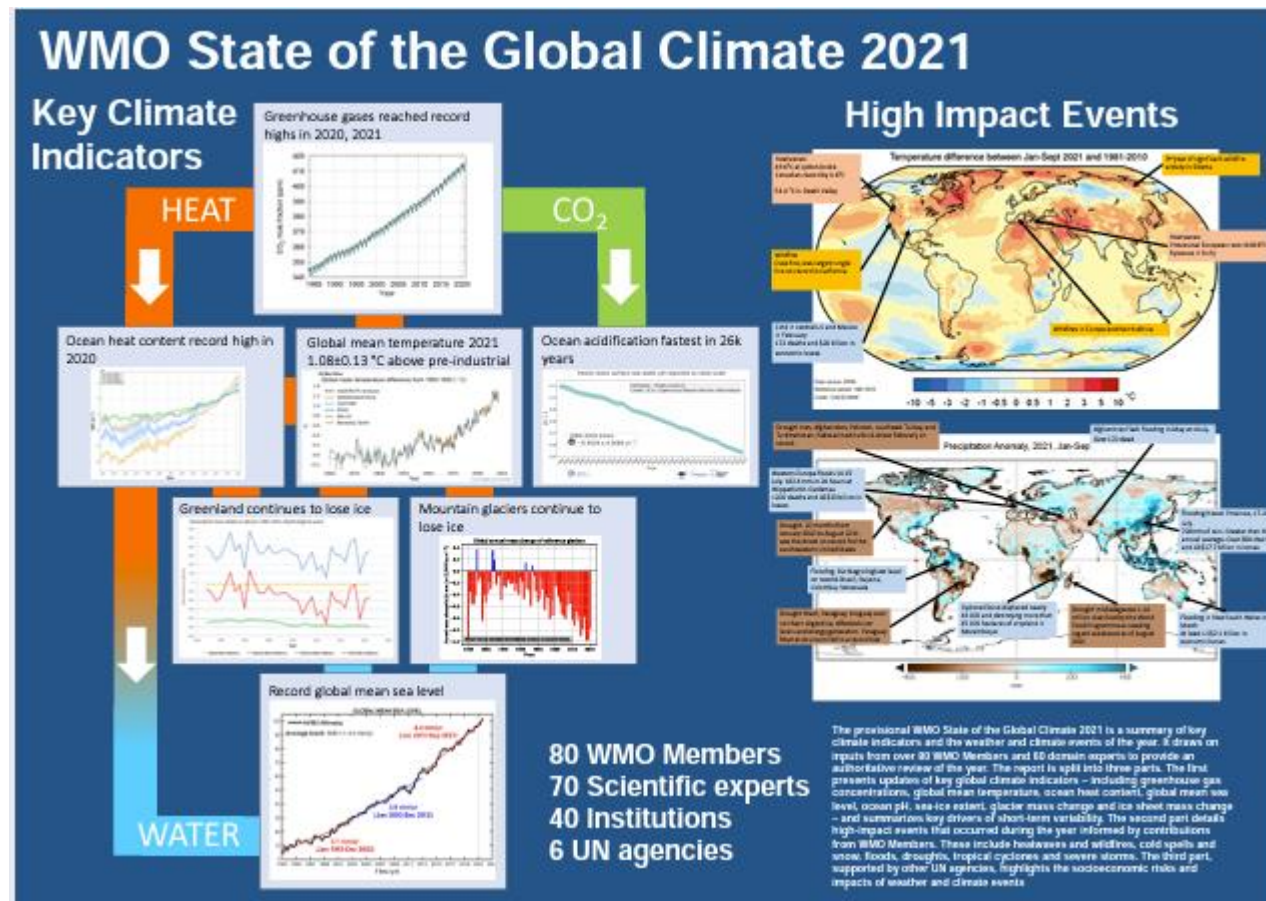
- Mass balance of reference glaciers reported by WGMS
- Negative mass balance for the 33rd consecutive year
- Average annual loss since 2015 is over 1 m w.e.
- Fifth largest loss on record



Provisional State of Global Climate 2021 – Poster

Earth Information Day
Poster Session (13:45-14:15)

Presented by:
Dr John Kennedy , UK MetOffice



https://unfccc.int/sites/default/files/resource/Earth_Information_Day_State%20of%20the%20global%20climate.pdf

Successful delivery and use of climate services depends on all elements in the value chain working properly

Climate-related infrastructure – must be designed and managed globally

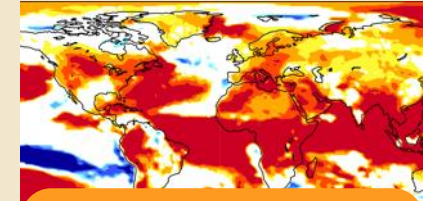
GCOS address observations and data exchange but is informed by the needs of the whole value chain



Observations from the entire globe



International exchange of observations



Global climate modelling

GLOBAL ACTIVITIES

LOCAL ACTIVITIES

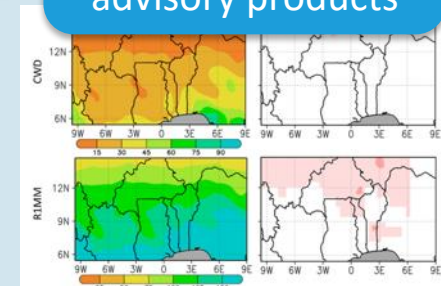
Effective decision making and action



Delivery of climate services



Local Data Processing, forecast, warning and advisory products



Last-mile activities undertaken at regional, national and local level

Many Improvements since 2016 including

Satellite observations have improved their coverage spatially, temporally and in terms of observed variables. Satellite data are accessible and well curated.

WMO and its Members ensure the required long-term monitoring, with established practices and instruments, for many ECVs.

Observations of atmospheric variables have further improved in the past decade thanks to new in situ observations from the ground and from commercial aircraft.

Most ground-based networks are well managed and archives appropriately stewarded.

GCOS and WMO are now working together to establish a reference network for atmospheric and land surface observations

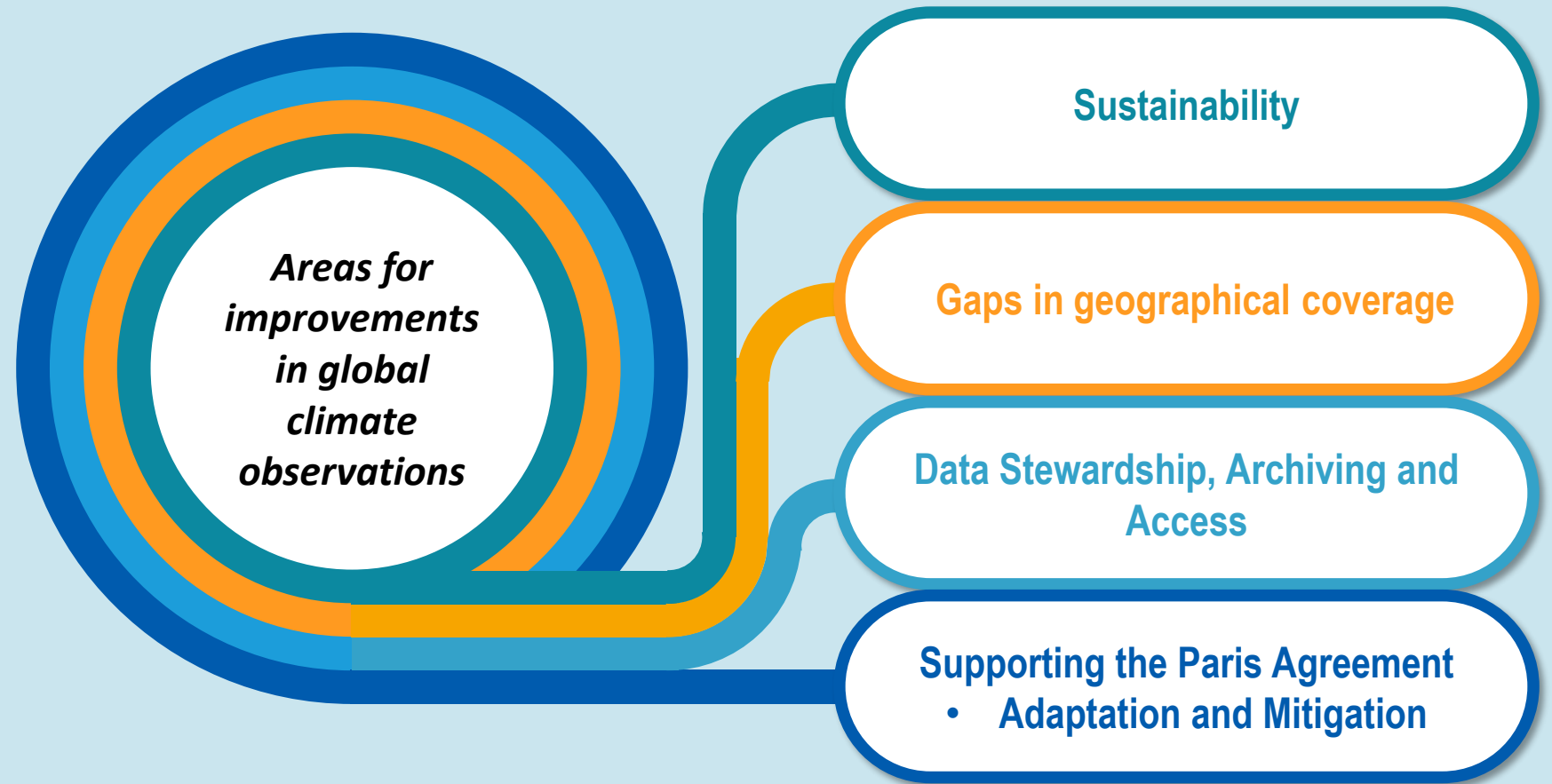
The ocean observing community is working on best practices for observations and data and metadata standards.

It was decided to expand the Argo program to the full water column and under sea ice, including biogeochemical variables.

Technological innovations have contributed to expanding the ocean observing system and its capability

Areas for improvements identified in the GCOS Status Report

- The report identifies four key areas where improvements are needed
- The GCOS Implementation plan to be published in 2022 will address these four areas.



The next GCOS Implementation Plan will be published in mid-2022

This report will be more focussed on implementing organisations, will prioritise, and will support the Paris agreement, Adaptation and Mitigation

Currently we are collecting contributions

There will be a public review in early 2022 – all interested parties should contribute

Provisional State of Global Climate 2021 – Poster

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Presented by:
Professor Han Dolman,
Chair GCOS Steering Committee

<https://unfccc.int/sites/default/files/resource/EarthInformationDay2021%20GCOS%20SR.pdf>

The poster, titled "Status of Global Climate Observations: The GCOS Status Report 2021", is a comprehensive overview of the global climate observing system. It features logos for the Global Climate Observing System (GCOS), WMO, IOC, International Science Council, and UN Environment. The main title is "Status of Global Climate Observations" with the subtitle "The GCOS Status Report 2021".

Summary of Adequacy of ECV Observations and Data Availability and Stewardship

As the impacts of a warming climate become more evident, there is an ever-increasing demand for more detailed information on climate change, both to explain and project changes and to help planning and implementing adaptation and mitigation.

GCOS has now released its latest report on the state of global climate observing system. The report identifies improvements in our observational capabilities and highlights outstanding issues and gaps. The findings are presented for each Essential Climate Variable (ECV) and specific action identified in the last GCOS Implementation Plan.

Since 2015, there have been many improvements but gaps remain.

GCOS regularly reviews the state of global climate observations and releases reports on its findings. This is the fifth time GCOS has prepared a full report on the state of global climate observations. GCOS Status reports are followed by an Implementation Plan that outlines the improvements that are needed in the global system. Work is already underway to produce the next GCOS Implementation Plan in 2022, responding to the findings of this 2021 Status Report.

The full report, in English, and the Executive Summary in all six UN languages is available from:
<https://gcos.wmo.int/en/gcos-status-report-2021>

Many Improvements since 2015

- Observations of atmospheric variables have further improved thanks to new in situ observations from the ground and from commercial aircraft. CCOS and WMO are now working together to establish a reference network for atmospheric and land surface observations.
- The ocean observing community is working on best practices for observations and data and metadata standards. It was decided to expand the Argo program to the full water column and under sea ice, including biogeochemical variables.
- Satellite observations have improved their coverage spatially, temporally and observed variables, data are accessible and well curated. WMO and its Members ensure the required long-term monitoring with established practices and instruments for many ECVs.
- Most ground-based networks are well managed and archives appropriately stewardled. Technological innovations have contributed to expanding the ocean observing system and its capability.

Issues Identified in the Status Report

- Sustainability:** Long-term continuity of some satellite observations in key regions, in all months, observations have been a major success, there are gaps in coverage by data and other climate and ocean observations. Sustained funding is needed. Most ocean and coastal observations are not funded by short-term funding mechanisms. Short-term funding mechanisms are not sufficient to support the long-term needs of the data. More extensive successful projects have not led to fully new data and improvements. Most of the projects in development need to be supported on observations have not led to sustainable long-term improvements in the observational capacity of these countries due to lack of resources and plans.
- Gaps in Geographical Coverage:** In situ observations for almost all ECVs are consistently deficient over certain regions, most notably parts of Africa, South America, Southeast Asia, the Southern Ocean, and land-covered regions, a situation that has not improved since the GCOS 2015 Status Report. 3 GCOS Regional Workshops have looked at why some regions have problems in making sufficient observations. These issues include:
 - For small nations (e.g. Pacific SIDS) the costs of observations may be beyond the resources available nationally.
 - Lack of planning or resources for foreseeable expenses.
 - Lack of trained staff and poor staff retention.
 - Poor understanding of all national benefits of observations.
 Large gaps still exist in ocean observations. Scientific methods are critical to monitor and forecast the climate system, continental boundaries, the polar oceans and marginal seas, remote areas, and ice.
- Supporting the Paris Agreement:** Current ECVs and ECV products can provide adaptation indicators for the GST. Developed, at national level to add value to NAPs, through assessment of climate hazards and vulnerabilities, assisting in identification of adaptation options implementation, and in management, monitoring and evaluation. Mitigation: Atmospheric concentrations of GHG can be used to support emission inventories, detect sources, validate national emissions and renewables and monitor the complete carbon cycle. Measurements can also support some mitigation efforts, particularly those using forests and land use. Climate Science: Improving our understanding of climate cycles of carbon, water and energy will improve our projections of future climate.
- Data Stewardship, Archiving and Access:** Satellite data and most ground-based networks have well curated data archives with long term support. This is not true for all ECV. Data Archives are needed for all ECV that:
 - have sustainable, long-term, adequate funding;
 - have clear requirements that will ensure a consistent approach among the data centres;
 - should be open and freely available to all users;
 - perform quality monitoring and ongoing reprocessing of data where new techniques or observations become available;
 - support data rescue that allows data series to be extended into the past and provide open access to this data.

GCOS.wmo.int @gcos_un 110201

International exchange of data is a major purpose of WMO WMO Convention, Art. 2 b

What does it take to do this?

- I. Requirements and gap analysis;
- II. Outreach and advocacy – analyzing and explaining benefits of data exchange to stakeholders;
- III. **Data policy** – general commitment of national governments to exchange certain data for certain purpose(s);
 - WMO Unified Data Policy;
- IV. **Regulatory material** – agreement on specifics of data exchange (what, when, where, how, ...);
 - Global Basic Observing Network;
- V. **Financial and technical support if needed;** capacity development;



• Systematic Observations Financing Facility;
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The World Meteorological Congress approved three linked strategic infrastructure initiatives

WMO Unified Data Policy

- Increased international exchange of observations by all Members (GBON)
- Return of high-quality model output to all Members

Global Basic Observing Network

- Example of regulatory implementation of data policy
- Increased exchange of observations by all Members, **facilitated by both Data Policy and SOFF**

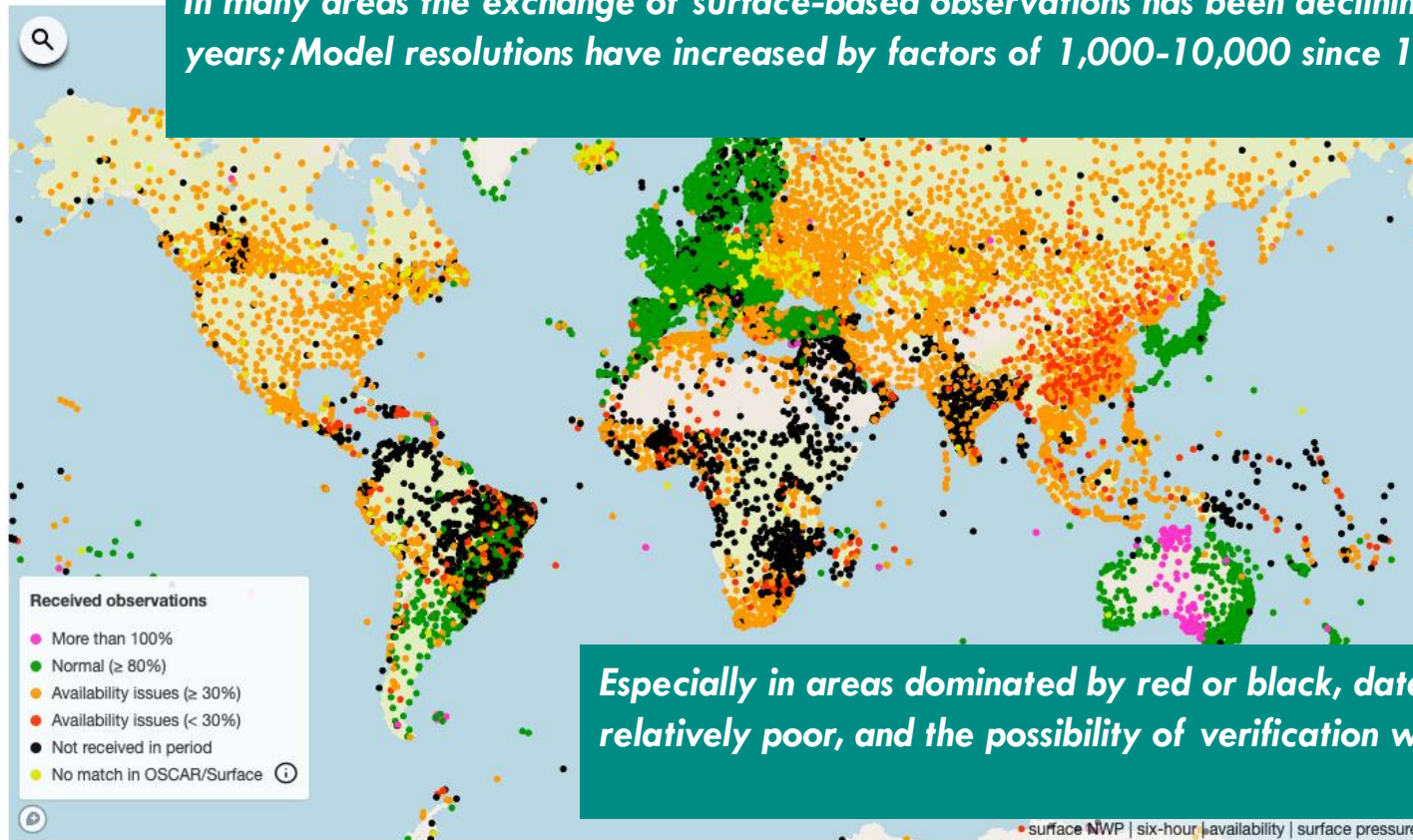
Systematic Observations Financing Facility

- Technical and financial support for GBON implementation where it is most needed
- Building on GBON regulations



GBON – a historic WMO initiative to address a persistent problem: Lack of adequate observational data coverage over many parts of the globe

In many areas the exchange of surface-based observations has been declining in recent years; Model resolutions have increased by factors of 1,000-10,000 since 1995!



Especially in areas dominated by red or black, data quality will be relatively poor, and the possibility of verification will be limited



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Surface pressure observations received by global NWP Centers on October 25 2021, 12Z)

(source: [WIGOS Data Quality Monitoring System](#))

Systematic Observations Financing Facility (SOFF)

SOFF Launch Event at COP26

1815 to 1900 BST/ GMT

Nordic Pavilion



Find out more about SOFF in our communication and knowledge products available here:

<https://alliancehydromet.org/systematic-observations-financing-facility/>



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Systematic Observations Financing Facility - SOFF
A new way of financing basic observations

Challenge

Extreme weather and climate
Weather forecasts and climate prediction crucial for better decisions
Real-time weather observations essential from the entire globe
Basic surface-based observational data missing - It is not only bad, it is getting worse
Current financing model not sustainable

- 50%

Decrease of radiosonde observations in Africa from 2015 to 2020



Opportunity

World Meteorological Congress 2019 landmark agreement
193 countries and territories established the Global Basic Observing Network (GBON)
International obligation to acquire and exchange essential surface-based observational data
Clear requirements for investments in surface-based observations

I:26

Socio-economic return of investments in GBON

Solution

Closing the GBON gap requires substantial investments and capacity
Many countries need support
SOFF provides financial and technical assistance in new ways

IOX

More data shared from upper air stations

20X

More data shared from surface stations

Readiness	<ul style="list-style-type: none"> Country Hydromet Diagnostics to assess country hydromet status Define national GBON gap Develop plan to close the GBON gap
Investment	<ul style="list-style-type: none"> Close the GBON gap Make GBON capital investments Strengthen GBON human and institutional capacity
Compliance	<ul style="list-style-type: none"> Support sustained GBON compliance Contribute to operation and maintenance costs via results-based finance Enable access to improved weather and climate products On-demand technical assistance and knowledge support

SOFF Targets

68

SIDS and LDCs supported to become GBON compliant and accessing improved weather and climate products

5

Year initial implementation period

\$ 400

Million mobilized

SOFF operational partners

WMO - Technical Authority and Verification
Implementing entities - Managing investments
WMO Country Support Initiative - Technical advice
Global Producing Centres - Knowledge

3 novel features


- Investments guided by internationally agreed metrics - GBON
- Data exchange instead of capital investments used as measure of success
- Local benefits created while providing a global public good

The creation of the SOFF is spearheaded by the World Meteorological Organization in collaboration with a wide range of international organizations, including the members of the Alliance for 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.

Filling the Data Gap: Global Basic Observing Network (GBON) and Systematic Observations Financing Facility (SOFF)

Earth Information Day
Poster Session (13:45-14:15)

Presented by:
Dr Lars Peter Riishojgaard,
Director Earth Systems WMO



WORLD METEOROLOGICAL ORGANIZATION

GLOBAL BASIC OBSERVING NETWORK (GBON) AND SYSTEMATIC OBSERVATIONS FINANCING FACILITY (SOFF)

Meeting the Systematic Observation objectives under the Paris Agreement

Lars Peter Riishojgaard,¹ Lorena Santamaria-Rojas,² WMO Secretariat




Figure 1. Meteorological Value Chain

Weather and climate services depend on a functioning meteorological value chain

Currently the initial links in the chain (acquisition and international exchange of observations) are weak in many areas, especially SIDS and LDC. The map below shows that the availability of observations is highly inconsistent across the globe. Areas with red (sporadic data), black dots (no data), or without dots (no observing stations) are problematic. This negatively impacts early warning systems and disaster preparedness.

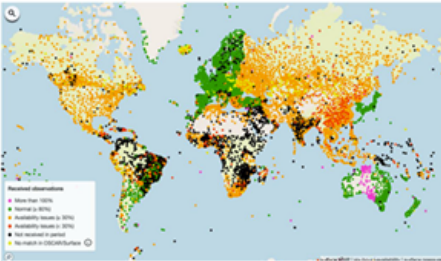


Figure 2. Surface pressure observations exchanged internationally, October 25, 18Z

Insufficient observational data coverage remains a serious issue in many parts of the world




Figure 3. Observing network density, January 2020

WMO's recent approval of the **GBON** represents a historic, binding commitment of all 193 WMO Member states and territories to the international exchange of observations specified in technical regulations. However, many countries, especially SIDS and LDCs, remain far from meeting GBON requirements (red colors; dark red indicates far from compliance).

Action under the Paris agreement must be carried out based on the best available science (Article 4); without observations, no science!

The lack of adequate observational data coverage negatively impacts the quality of climate analysis products, especially locally where observations are missing. These products are used as a basis for climate monitoring and climate prediction, also to provide detailed local prediction via downscaling. Without high-quality climate prediction it will be impossible to take meaningful climate adaptation measures.

Lack of observational data linked to lack of local resources (similarity between Fig. 3 and Fig. 4)




Figure 4. "Ability to pay for observations" (GDP divided by surface area)

SOFF: Providing essential support for GBON

Countries with few resources relative to the size of the area they have to observe (low GDP per unit surface area, dark colors) are expected to have difficulties implementing GBON. By the measure shown here, the most affluent countries are more than a million times wealthier than the poorest.

SOFF is a dedicated mechanism providing long-term grants and technical assistance to support the implementation and sustained operation of GBON. SOFF focuses exclusively on the initial links of the meteorological value chain, working in partnership with other development initiatives that focus on other links in the chain.

SOFF is a UN coalition fund with WMO, UNDP and UNEP as founding partners.

SOFF will deploy a global approach with sustained international data exchange as a measure of success. It will provide innovative finance for sustainable GBON compliance and enhance technical competency and coordination.

GBON and SOFF responding to COP26 ambition and science targets: Support from UNFCCC Parties will be necessary for GBON and SOFF to materialize

SBSTA Research and Systematic Observation informal note (May-June 2021) includes:

- Welcome the activities (...) and acknowledge the ongoing efforts in relation to (...) WMO Global Basic Observing Network (GBON);
- Also encourage Parties and relevant organizations to support the WMO Systematic Observations Financing Facility in order to support and sustain implementation of GBON in developing countries, including the LDCs and SIDS

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<https://unfccc.int/sites/default/files/resource/Earth%20Information%20Day%20GBON-SOFF%20rev1.pdf>

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Thank you