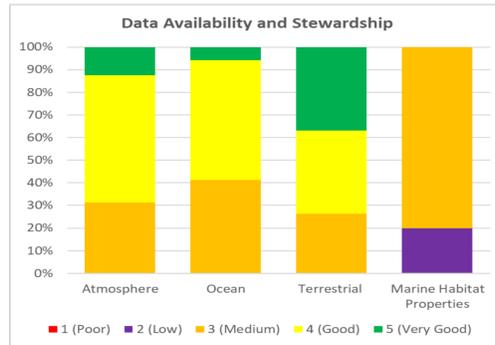
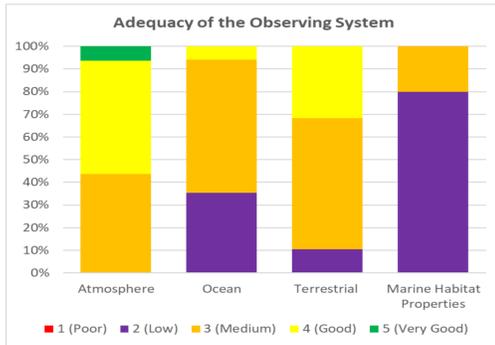
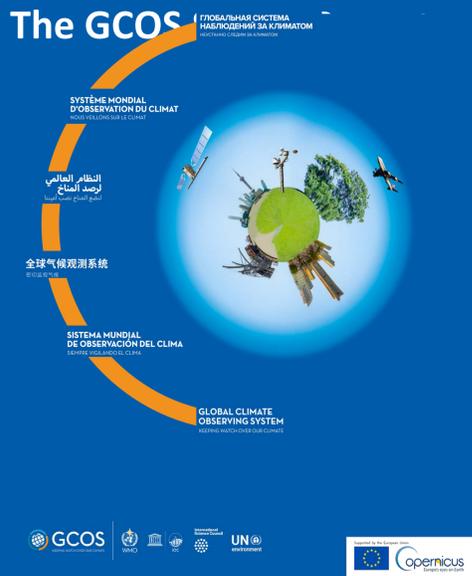


Status of Global Climate Observations

The GCOS Status Report 2021

The Global Climate Observing System 2021: The GCOS



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.

Many improvements since 2015

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

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 stewarded.

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

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. GCOS-239

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>

Sustainability

Long-term continuity of some satellite observations is not assured. While satellite observations have been a major success, there are gaps:

- No assured continuity for Aeolus (wind profiles), cloud radar and lidar on research satellites. High-inclination altimetry and high-latitude sea-ice thickness monitoring is at risk.

Sustained funding is needed. Most ocean and terrestrial observations are supported through short-term funding with a typical lifetime of a few years leaving the development of long-term records vulnerable.

Many otherwise successful projects have not led to long-term sustained improvements. - most of the projects in developing countries with a component on observations have not led to sustainable long-term improvements in the observational capacity of these countries due to lack of resources and planning.



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 ice-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 far exceed the resources available nationally;
- Lack of planning or reserves for foreseeable expenses;
- Lack of trained staff and poor staff retention;
- Poor understanding of the national benefits of observations.

Large gaps still exist in ocean observations. Subsurface measurements are critical to monitor and forecast the climate system. continental boundaries, the polar oceans and marginal seas remain an issue



Supporting the Paris Agreement

- Adaptation**
- 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 removals 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 when 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

