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The Global Climate Observing System (GCOS) was established in 1992 by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission of UNESCO (IOC), the United Nations Environment Programme (UNEP) and the International Science Council (ISC) to coordinate global climate observations and facilitate their development and improvement. GCOS has since then identified and updated a set of variables that, when observed, should provide the necessary information to understand, model, and predict climate and to plan policies for mitigation and adaptation strategies for all countries. Observations are important for supporting parties with setting and evaluating their Nationally Determined Contributions (NDCs), transparency and the global stocktake under the Paris agreement. The status of the observations of these variables, called Essential Climate Variables (ECV), are monitored by GCOS which publishes regular status reports describing the status of the system for observing the Earth's climate. GCOS is now in the process of completing the next GCOS Status Report, the 5th of these series. The entire report has been subject to public review. It will be published in October 2021 and will be followed by an Implementation Plan to be published in 2022 that will present priority actions to improve the global climate observing system and address any gaps identified in the Status Report.

GCOS Status Report presents an assessment of the status of the observing system with respect to the ECVs, the information provided by WGClimate for satellite observations, as well as a discussion on the energy budget and the carbon and water cycles which considers how well the earth system climate cycles can be closed and monitored by the current observations of ECV. The report also briefly considers how the observations can be used to address adaptation and extremes.

The assessment provided in the Status Report refers to 2016, when the GCOS Implementation Plan was published. The Report shows progress in many areas such as: (1) satellite observations, which have improved their coverage both spatially, temporally and in terms of observed variables; (2) observations of atmospheric variables, thanks to new in situ observations from the ground and commercial aircraft; (3) good management and data stewardship of most ground-based networks; (4) development of ocean global networks, with agreement on best practices for observations, data and metadata standards. GCOS and WMO are now working together to establish a reference network for atmospheric and land surface meteorological observations, which will be the surface equivalent to the GRUAN.

However, the GCOS Status Report also identifies many areas that need improvement and adequate and sustainable funding to support this: (1) gaps in the satellite-based observations include the lower tropospheric ozone and an instrument that measures stratospheric CH_4 profiles globally; (2) most ocean observations and terrestrial observations are supported through short-term research projects leaving the development of long-term records vulnerable; (3) global coverage for almost all the in situ atmospheric and terrestrial ECVs is deficient over certain regions, most notably parts of Africa, South America, Southeast Asia, the Southern Ocean, and ice-covered regions. Gaps for the ocean observations concern the deep ocean, as well as the artic regions and the boundary and coastal zones.

One clear message from the GCOS Regional Workshops held in the last years is that most of the projects in developing countries that have a component devoted to observations have not led to sustainable long-term improvements in the observational capacity of these countries. These workshops have contributed to the development of WMO’s Global Basic Observing Network concept (GBON), which will provide essential meteorological observations that support

Numerical Weather Prediction (NWP) and Climate models and reanalysis, and which will be designed, defined and monitored at the global level. WMO is currently working with partner organizations from the development and climate finance communities to establish a Systematic Observations Financing Facility (SOFF) that, if successful, will provide financial and technical support for the implementation and operation of GBON to those members who would not otherwise be able to implement their contributions to this network.

With the support of the UNFCCC (Decision 19/CP.22 and Draft conclusions proposed by the Chair FCCC/SBSTA/2019/L.15) the GCOS Steering Committee decided to prepare its 4th GCOS Implementation Plan for publication in mid-2022 in time for consideration at the UNFCCC COP 27. Decision 4 of GCOS SC 28 decided the draft outline of the Implementation Plan and established an editorial board to oversee its production. This latest Implementation Plan aims to focus more on key actions needed by the various actors active in climate observations rather than a long list of individual actions by independent ECVs. Actions in this plan will be broader than before and encompassing several separate activities, which can involve several domains (terrestrial, atmospheric and ocean). The identification of Actions will draw, amongst others, from the findings of the GCOS Status Report, as well as other reports of relevance, such as the most recent IPCC reports, the WMO State of Global Climate 2020, and the consultation with GCOS experts. The Implementation Plan will be subject to a public review, similarly to the GCOS Status Report.