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**INFORMATION DOCUMENT**

**GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)  
PLANNING AND IMPLEMENTATION, 2015**

Summary. The Global Climate Observing System reports regularly on its activities to its four sponsor organizations: WMO, ICSU, UNEP and the Intergovernmental Oceanographic Commission of UNESCO.



## **Introduction - The Concept of the GCOS Programme**

As an outcome of the Second World Climate Conference, the GCOS was established in 1992 to ensure that the observation and information needed to address climate-related issues are obtained and made available to all potential users. The goal of GCOS is that contributing observing systems together provide comprehensive information on the total climate system, involving a multidisciplinary range of physical, chemical, and biological properties and atmospheric, oceanic, hydrologic, cryospheric and terrestrial processes. GCOS is jointly sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Environment Programme (UNEP), and the International Council for Science (ICSU).

The 50 GCOS Essential Climate Variables (ECVs), set out in the GCOS Implementation Plan, are required to support the work of the sponsoring organizations, but also the work of UNFCCC and the IPCC. ECVs are both technically and economically feasible for systematic observation. It is these variables for which international exchange is required as a matter of priority for both current and historical observations.

The contributing systems include the climate-observing components of the IOC-led Global Ocean Observing System (GOOS), the FAO-led Global Terrestrial Observing System (GTOS), and the WMO Global Observing System (GOS) and Global Atmosphere Watch (GAW). A number of other research and operational systems in the domains of ocean, atmosphere, and land provide important contributions to GCOS as well. The observations themselves may be ground-based, or from airborne or satellite systems. GCOS is both supported by and supports the international scientific community, and the World Climate Research Programme (WCRP) co-sponsors the expert panels set up by GCOS for the atmospheric, oceanic and terrestrial domains (the Atmospheric Observation Panel for Climate – AOPC, the Terrestrial Observation Panel for Climate – TOPC, and the Ocean Observations Panel for Climate – OOPC). The composite observing system designated as the GCOS serves as the climate observation component of the Global Earth Observation System of Systems (GEOSS).

At the sixty-sixth session of WMO's Executive Council, it was recognized that a strengthened GCOS will be a core contribution to the successful implementation of the Global Framework for Climate Services (GFCs) and its observations and monitoring pillar.

## **Addressing the need for observation requirements for climate change adaptation and mitigation**

From 26-28 February 2013, GCOS, in cooperation with UNEP, the IOC of UNESCO and the Department of Energy and Climate Change (DECC) of the United Kingdom, brought together about 45 participants for a Workshop on Observations Adaptation to Climate Variability and Change at the headquarters of the German Meteorological Service (DWD) in Offenbach, Germany. Participants included representatives of the GCOS community and representatives of sectors in which adaptation to climate change and variability is an important concern. The goals of the workshop were to produce statements on the adequacy of observations, to identify requirements for observations to support climate services and research, and to provide strategic guidance on steps the GCOS programme should take in the coming years to address the needs for observations for adaptation to climate variability and change. To meet these goals, focus was set on cross-cutting issues, including risk management, early warning systems, research, modelling and assessment, and data rescue. The workshop further considered perspectives from various different fields that will be strongly impacted by climate change adaptation, including water resource management, coastal zone management, health, forestry, agriculture, energy, and transport sectors. As most of the adaptation actions will take place at a local and sub-national level, climate information used to support development, implementation and monitoring of such activities will be needed at the same level, though possibly with different requirements for each sector for which adaptation is a concern.

In regard to adequacy of observations to support climate adaptation services and research, workshop participants emphasized first and foremost the need to present existing information in forms of relevance to users, taking into account in particular relevant spatial and temporal scales. The development of products to support adaptation planning, as well as research related to climate adaptation, must be carried forward in close consultation with practitioners. In addition, participants noted a need for much better information on data availability, quality, uncertainty, and limits of applicability, and they recognized the need to establish and improve mechanisms to provide both access to data and information regarding data contents.

Workshop participants also noted that neither global climate models nor satellite-based observing systems are yet good enough to support decisions made at the local level in many infrastructure management sectors, and that further investments are needed to improve the ground-based network of primary hydrometeorological observations.

In regard to observation requirements for specific sectors, several common themes emerged. Participants generally noted that observations to support adaptation planning are often needed with higher spatial and temporal resolution than for other climate applications. Workshop participants further noted a need to focus efforts in regions where change is most rapid or variability is more pronounced, as well as in regions where the impact of climate on a sector is the largest and vulnerability is the highest. Depending on sector and purpose, participants noted a need to cover time scales ranging from weeks to centuries, and participants also noted the need to develop infrastructure to support data rescue. Participants also emphasized the importance of communicating the value of historical data as a public good and of promoting data rescue and data management as Essential Climate Tasks.

Finally, participants noted the need to support research initiatives such as UNEP's PROVIA and the International Council for Science (ICSU) Future Earth as well as the need to support investments in observations likely to meet future needs for long-term data.

Regarding strategic guidance for GCOS, participants recognized that the primary role of GCOS is to assess and communicate overall requirements, advice on implementation and reporting, and review and promote progress in the interest of supporting national economic development and research toward improved understanding, modelling and prediction of the climate system. Participants also acknowledged the development of the Global Framework for Climate Services (GFCS) and its leading role in improving feedback mechanisms between data providers and users through the User Interface Platform, as well as the role of GCOS in supporting the GFCS Observations and Monitoring pillar. Several participants noted the difficulty of working effectively within a complex array of international organizations with mandates that can be either ambiguous or overlapping. As such, there was recognition of a need to clarify responsibilities, define focal points for specific topics, build synergies, and generally strengthen cooperation among UN programmes, as well as to consider how GCOS can use its reporting systems through the World Meteorological Organization (WMO), the United Nations Framework Convention on Climate Change (UNFCCC), the IOC and others, to reach out to different communities.

Outcomes of the workshop will be used as inputs for the GCOS Status Report, which is scheduled to be published in 2015, and for the next Implementation Plan, which is scheduled to be published in 2016. The Implementation Plan will identify specific requirements for products as well as verifiable and costed actions, and both documents will address the full range of climate observation requirements, including needs for monitoring, assessing, and modelling the global climate system, as well as requirements for adaptation to variability and change, and the provision of services. Finally, in several cases, workshop participants suggested follow-up workshops focused on sector-specific requirements would be an appropriate next step.

GCOS and the Global Observations for Forest Cover and Land Dynamics (GOFC-GOLD) held a joint workshop on Observations for Climate Change Mitigation at the WMO headquarters in Geneva, Switzerland, from 5-7 May 2014. This workshop contributed to a better understanding of

the observations requirements for mitigation and suggested some revision to ECVs for serving needs of IPCC inventory guidelines. The goals of the workshop were: (1) develop a statement on the general adequacy of the observations coordinated by GCOS to support climate change mitigation and identify further work that may need to be undertaken in preparation for the next GCOS status report on the Global Observing Systems for Climate; (2) identify requirements needed for observations and their use in monitoring to support climate services addressing mitigation needs (especially in regard to the Agriculture, Forestry and other Land Uses (AFOLU) sector); (3) discuss strategic guidance on what steps both GCOS and GOFC-GOLD should take; and (4) provide guidance for technical communities, data producers and data users.

The experts discussed the need for improved observations to support mitigation, and anticipated that in future greater availability and higher resolution of observations would increase utility for mitigation purposes. Subsequent presentations and discussions addressed observational needs from different sectors, and regional perspectives. The experts highlighted the following mitigation issues that are likely to require the attention of the GCOS in future:

- (a) Review existing and consider new Essential Climate Variables (ECVs) that are related to climate change mitigation;
- (b) Identify and address gaps and requirements for observations to support their use in monitoring to support research into mitigation;
- (c) Provide guidance for technical communities to advise data producers (e.g., space agencies, observation networks) and data users (those involved in mitigation, and climate science community).

The meeting considered that GCOS and GOFC-GOLD should:

**Action 1:** consider the relationship between ECVs (especially those related to biomass, land cover, fire, and soil carbon) and the IPCC greenhouse gas inventory guidance AFOLU, and suggest any revision to the ECV list in time for the next Implementation Plan.

**Action 2:** consider how ECVs relate to the remote sensing product list identified by the Space Data Coordination Group to support the Global Forest Observations Initiative (GFOI), and make any suggestions to revise the ECV list.

**Action 3:** investigate the possibility of generating a full global map of land use changes, tracking reported emissions data under the IPCC land use categories. The first step could focus on forest land and forest land changes.

**Action 4:** better coordinate with information important for mitigation (not covered within the current ECV context) on: (i) land management within the land use categories of IPCC, especially forest, agriculture, and livestock; (ii) drivers and agents of change; and (iii) economic indicators (e.g., infrastructure, settlements, GDP).

Potential opportunities exist to explore observation requirements for mitigation in the ocean also, for instance, the OOPC is involved in discussions with the GOOS panels on observations for Blue Carbon tracking, and assessing the role of coastal ecosystems in mitigation (both as carbon sinks, and as coastal protection).

GCOS held a workshop, in collaboration with IPCC and UNFCCC, on Enhancing observations to support preparedness and adaptation in a changing climate – Learning from the IPCC 5<sup>th</sup> Assessment Report, from 10-12 February 2015, UNFCCC Secretariat, Bonn, Germany. The workshop built on the findings of the WG II report to the IPCC AR5, and of identified strategic technical guidance from the GCOS Workshop on Observations for Adaptation to Climate Variability and Change. The event addressed observational needs in a number of sectors, currently in the focus of evolving climate services, such as on analysis needs for water, agriculture and food

security, disaster risk reduction, and health. It aimed to enhance systematic observations and related capacity, especially in developing countries, in light of the detection of observed impacts, exposure and vulnerability to climate change, and in support of assessing the risks of climate change and adaptation planning. It therefore aimed to further support the work on research and systematic observation under the SBSTA, and that of adaptation under the UNFCCC at large.

Need to develop a framework for going forward in this space, highlighting observations that are fit for purpose to underpin decision making. It was suggested that this should be developed through a set of case studies. A case study on Sea Level was agreed as a first priority, where the requirements for sea level information would be articulated, the delivery mechanisms, i.e. products and forecasts, would be discussed, and the observing system would be reviewed and recommendations for revised design could be made.

### **Supporting the development and improvement of the ocean observing system for climate**

OOPC delivers to both GCOS and GOOS through the implementation of a work plan, focused on articulation of requirements for variables, network design targets, and thematic observing system evaluations. Following a review of the Tropical Pacific Observing System in January 2014, GCOS worked with GOOS to support the establishment of the Tropical Pacific Observing System (TPOS) 2020 Project, which is now well underway. The aim of the Project is to transition the TPOS to a more robust, integrated and sustainable design and plan beyond 2020. The project has been established as an independent, finite lifetime project with a steering committee and a resources forum of the sponsoring agencies (chaired by Mc Craig McLean, US head of delegation to IOC). The Steering committee held its first meeting in Ansan, Korea, hosted by KIOST. A set of task teams have been established to carry out analyses and design work. A robust Tropical Pacific Observing System is essential for the delivery of seasonal forecasts in support of Climate Services. See further information at [www.tpos2020.org](http://www.tpos2020.org)

As OOPC expands its focus towards coastal issues, a next priority will be an evaluation of observation requirements of boundary currents and their interactions with the continental shelf. OOPC is also working on the articulation of requirements for observations of ECVs in shelf and coastal waters.

As GCOS looks towards the next GCOS Implementation Plan, priority areas for focus in the ocean section will likely be:

- 1) The Development of the Deep Ocean Observing System requirements and network targets, in collaboration with GOOS, to track the role of the lower half of the ocean in climate. For instance, GCOS is watching the development of Deep Argo floats, and the current pilot deployments underway, with interest. Considering the advances in our understanding of the ocean from the Argo array, Deep Argo has the potential to similarly unlock the climate of the deep ocean.
- 2) Requirements for observations at the ice-ocean interface and the development of network targets to monitor the interactions between the ocean, ice shelves and sea ice. Technological advancements mean that sustained observations in this challenging region are now feasible.
- 3) The potential to work more broadly with GOOS panels for biogeochemistry and biology to develop observations for impacts and adaptation in the ocean space, including ocean acidification and food security.

## The GCOS Cooperation Mechanism – Activities in Regions

The GCOS Cooperation Mechanism was established to identify and make the most efficient use of resources available for improving climate observing systems in developing countries, particularly to enable them to collect exchange and utilize data on a continuing basis. In recent years, several countries have provided funds and participated on the GCOS Cooperation Mechanism Donor Board. The GCOS sponsors are constantly seeking additional countries that are willing to participate towards the goal of improved climate observing networks in developing countries. Since 2005, the GCOS Cooperation Mechanism has received and distributed over USD 3 million in support of the GCOS networks, primarily for the atmospheric domain through the GCOS Surface Network (GSN) and the GCOS Upper-Air Network (GUAN). The support provided has been wide-ranging and covers all aspects of the observing system life-cycle. Projects of particular relevance have been:

- (a) The supply of radiosondes and balloons (to Dar Es Salam, Tanzania; Gan, Maldives; Khartoum, Sudan; Rarotonga, Cook Islands; Vacoas, Mauritius and Yeveran, Armenia), which was made possible through funding from Japan, Switzerland and the UK;
- (b) The renovation of surface climate stations in Madagascar, including the comprehensive training of local technicians in the support and maintenance of these systems and new equipment for the surface climate network in Angola and Democratic Republic of Congo, which was made possible through the funding from The Netherlands;
- (c) The repair and service of the hydrogen generator in support of the upper-air observations at Gan, Maldives and Harare, Zimbabwe, which was made possible through funding from Germany and the UK;
- (d) The renovation of the telecommunication system in the Democratic Republic of Congo and Zambia;
- (e) The provision of a consultant, based in Africa, to focus on improving the data availability from the GSN and GUAN stations in the Region and working on high priority projects.

While the GCOS Cooperation Mechanism is currently focussed on atmospheric observation capability, there is potential to broaden this mechanism to ocean observations; particularly in support of measuring ECVs in the coastal space, such as tide gauges for improved observations of sea level.

### References:

GCOS Programme Review - Synthesis Report, Geneva, Switzerland, March 2014 (available in all 6 languages)

GCOS Workshop on Observations for Adaptation to Climate Variability and Change, Offenbach, Germany, 26–28 February 2013

Report of the joint GCOS/GOFC-GOLD Workshop on Observations for Climate Change Mitigation, Geneva, Switzerland, 5–7 May 2014

Draft Report of the GCOS Workshop, in collaboration with IPCC and UNFCCC, Enhancing observations to support preparedness and adaptation in a changing climate – Learning from the IPCC 5th Assessment Report, 10-12 February 2015, UNFCCC Secretariat, Bonn, Germany (Final Report will be available here: <http://www.wmo.int/pages/prog/gcos/index.php?name=Publications>)

TPOS 2020 Website, including report of the first SC meeting and monthly updates:  
[www.tpos2020.org](http://www.tpos2020.org)

Website of all published GCOS Reports:  
<http://www.wmo.int/pages/prog/gcos/index.php?name=Publications>

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