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

This document was prepared by the GCOS Secretariat, Dr Carolin Richter, Director, for presentation to the IOC Assembly at its 27th Session, Paris, France, 26 June–5 July 2013.

The Global Climate Observing System (GCOS) is an internationally coordinated network of observing systems and a programme of activities that support and improve the network.

It is designed to meet evolving national and international requirements for climate observations. GCOS was established in 1992 as an outcome of the Second World Climate Conference. GCOS is 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), introduced in the GCOS Implementation Plan, up-dated in 2010, are required to support the work of the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) (Table 1). All ECVs are technically and economically feasible for systematic observation. It is these variables for which international exchange is required for both current and historical observations.

Table 1: Essential Climate Variables that are both currently feasible for global implementation and have a high impact on UNFCCC requirements

Domain	GCOS Essential Climate Variables
Atmospheric (over land, sea and ice)	Surface ¹ : Air temperature, Wind speed and direction, Water vapour, Pressure, Precipitation, Surface radiation budget. Upper-air ² : Temperature, Wind speed and direction, Water vapour, Cloud properties, Earth radiation budget (including solar irradiance). Composition : Carbon dioxide, Methane, and other long-lived greenhouse gases ³ , Ozone and Aerosol, supported by their precursors ⁴
Oceanic	Surface ⁵ : Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Surface current, Ocean colour, Carbon dioxide partial pressure, Ocean acidity, Phytoplankton. Sub-surface : Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers.
Terrestrial	River discharge, Water use, Groundwater, Lakes, Snow cover, Glaciers and ice caps, Ice sheets, Permafrost, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Above-ground biomass, Soil carbon, Fire disturbance, Soil moisture.

Many observing systems contribute to the GCOS network of global observing systems for climate. In many cases they also serve other functions, such as weather forecasting or air-quality monitoring.

The contributing systems include the climate-observing components of the IOC-led Global Ocean Observation System (GOOS), the Global Terrestrial Observing System (GTOS) led by the United Nations Food and Agriculture Organization (FAO), and the WMO Global Observing System (GOS) and Global Atmosphere Watch (GAW). A number of other research and operational systems provide important contributions.

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

¹ Including measurements at standardized, but globally varying heights in close proximity to the surface.

² Up to the stratopause

³ Including N₂O, CFCs, HCFCs, HFCs, SF₆ and PFCs.

⁴ In particular NO₂, SO₂, HCHO and CO.

⁵ Including measurements within the surface mixed layer, usually within the upper 15 m.

Climate Research Programme (WCRP) co-sponsors the expert panels set up by GCOS for the atmospheric, oceanic and terrestrial domains. The composite observing system designated as GCOS serves as the climate-observation component of the Global Earth Observation System of Systems (GEOSS).

GCOS Work Plan 2013–2016 - Next steps of the GCOS improvement and assessment cycle

There are in total 138 actions identified in the 2010 updated Implementation Plan for the Global Observing System for Climate in Support of the United Nations Framework Convention on Climate Change (UNFCCC) which address many of the needs for climate observations in support of the Global Framework for Climate Services (GFCS). For the ocean domain, 41 actions have been identified and progress of implementation will be assessed in the coming two years. Observations and monitoring constitute one of the essential pillars of the GFCS.

At the 37th session of the Subsidiary Body for Scientific and Technical Advice (SBSTA) of the UNFCCC in November 2012, GCOS was invited to submit a Third Adequacy Report to SBSTA in 2015, and a new Implementation Plan in 2016, with a draft of the latter encouraged to be provided one year before.

The GCOS programme has started on the process of producing reports on progress and adequacy of climate observation. The new plan should identify not only verifiable and costed actions as previously but also specific requirements for data products to meet the needs for adaptation to variability and change and for provision of services, in addition to those for assessment and mitigation of climate change. The content will be based on input from a review of actions set out in the 2010 updated Implementation Plan, from the recent WMO-IOC-UNEP sponsored Workshop on Observations for Adaptation to Climate Variability and Change (26–28 February 2013, Offenbach, Germany), from the fifth IPCC Assessment process through one or more workshops that include participation of lead authors from Working Group 1 and Working Group 2 and other experts, from the 2014 National Communications to UNFCCC, from panel chairs and panel members as well as calling on one or several writing-team meetings, consultations and a public review.

GCOS Expert Panels

The GCOS Expert Panels for Land, Atmosphere and Oceans are discussing the observations needed in each of the main global domains (atmosphere, ocean, and land), to prepare specific programme elements and to make recommendations for implementation.

The GCOS-GTOS-WCRP Terrestrial Observation Panel for Climate (TOPC) had held its fifteenth session from 6 to 7 March 2013, at WMO, in Geneva, and the GCOS-WCRP Atmospheric Observation Panel for Climate (AOPC), which met for its 18th session from 2 to 5 April 2013, at WMO, Geneva.

The technical secretariat for the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), has moved from IOC, Paris, to the GCOS Secretariat at WMO, Geneva. Dr Mark Bourassa (Florida State University, USA) and Dr Toshio Suga (JAMSTEC and Tohoku University, Japan) have been appointed as co-chairs of OOPC. The previous chairman of the OOPC, Dr Eric Lindstrom (NASA, USA), has been selected to become co-chair of the Global Ocean Observing System (GOOS) Steering Committee. Under the GOOS Framework for Ocean Observing, GOOS will develop as an integrated, multidisciplinary observing system with a strengthened focus on delivery of products for societal applications.

The Ocean Observations Panel for Climate will resume its activities and re-assemble in September 2013. The panel will discuss its expanded role in the GOOS Framework to oversee the physics variables, and develop a work plan for the coming 3-5 years. Key tasks for the panel are coordinating a review of the Tropical Pacific Observing System, providing input to the review of the

GCOS Implementation Plan, reviewing the upper ocean thermal observing system, and identifying requirements for observations of western boundary currents. The ocean climate panel is also expected to expand its focus to the coastal ocean and shelf seas.

OOPC will need to focus on the evolving GOOS [Framework for Ocean Observing](#) (IOC/INF-1284), the WMO Integrated Global Observing System (WIGOS) and the related information systems, e.g., WMO Information System (WIS).

All three GCOS Panels liaise closely with space agencies on dedicated space-based observations for climate, in particular through the Committee on Earth Observation Satellites (CEOS), the Coordination Group for Meteorological Satellites (CGMS), the WMO Space Programme and their development of the architecture for climate monitoring from space.

GCOS Programme Review

The GCOS programme has had substantial success in the past 20 years, but several new developments and some emerging issues have given rise to the need to re-examine the mandate and terms of reference of GCOS. The GCOS Steering Committee at its 19th session in 2011 welcomed an independent review of GCOS and appreciated the willingness of WMO to take the lead in seeking to carry this out in 2013. The review board held its first meeting from 26 to 27 March 2013 and is chaired by Mr Wolfgang Kusch, former president of the Deutscher Wetterdienst (DWD), Germany. The board is comprised of individual experts nominated by each of the sponsoring organizations. IOC-nominated experts on the review board are Dr Masao Fukasawa, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan, and Dr Isabelle Niang, Université de Dakar, Senegal.

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