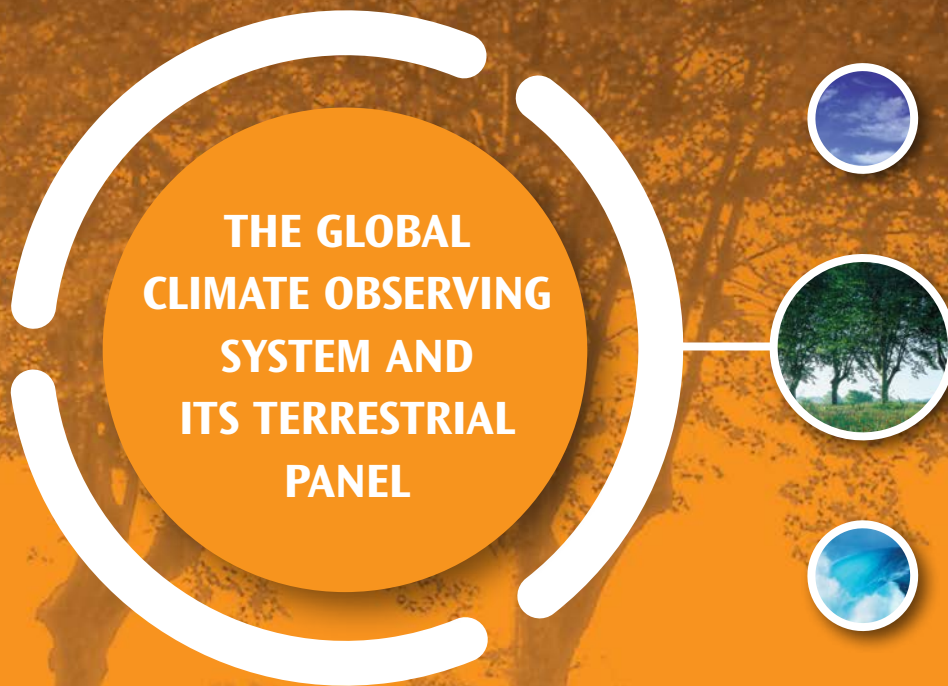




GCOS

GLOBAL CLIMATE OBSERVING SYSTEM



<http://gcos.wmo.int>



ICSU
International Council for Science



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 an outcome of the Second World Climate Conference and was established in 1992.



GCOS addresses the total climate system, including physical, chemical and biological properties, and atmospheric, oceanic, terrestrial, hydrological and cryospheric components. Climate observations must be sustained and enhanced so that users may:

- Detect further climate change and determine its causes;
- Model and predict the climate system;
- Assess impacts of climate variability and change;
- Monitor the effectiveness of policies for mitigating climate change;
- Support adaptation to climate change;
- Develop climate information services;
- Promote sustainable national economic development; and
- Meet the requirements of the United Nations Framework Convention on Climate Change (UNFCCC) and other international conventions and agreements.

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 and air-quality



monitoring. The contributing systems include the climate-observing components of the Global Ocean Observation System, led by the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural

Organization (UNESCO), and the Global Observing System and Global Atmosphere Watch of the World Meteorological Organization (WMO). A number of other research and operational systems provide important contributions. The composite observing system designated as GCOS serves as the climate-observation component of the Global Earth Observation System of Systems. The observations themselves may be ground-based or provided by airborne or satellite systems.

GCOS experts introduced the widely accepted concept of Essential Climate Variables (ECVs). ECVs are considered to be the minimum set of variables needed to describe the Earth's climate system and should be observed on a global scale.

Three science panels have been established by the GCOS Steering Committee to define the observations needed in each of **the three main global domains – atmosphere, oceans and land** – to prepare specific programme elements and to make recommendations for implementation. The three science panels are:

- The Atmospheric Observation Panel for Climate (AOPC);
- The Ocean Observations Panel for Climate (OOPC); and
- The Terrestrial Observation Panel for Climate (TOPC).



GCOS is both supported by and supports the international scientific community, so the three science panels are therefore co-sponsored by the **World Climate Research Programme (WCRP)**.

WCRP works with the three GCOS panels to achieve, in particular, its objectives of assessing and improving the accuracy of climate predictions.

GCOS addresses the need for global coverage and timeliness of data, for example, through the promotion of **ECVs** and the formulation of the **GCOS Climate Monitoring Principles**. The concept was adopted by the Conference of the Parties to the UNFCCC. The Panels' expertise is essential for assessing the capabilities, gaps and deficiencies of current climate-observing systems. Their work and discussions contribute directly to the regular reports to the UNFCCC about the status of global climate-observing capacities.



United Nations
Framework Convention on
Climate Change

SEA - SURFACE
TEMPERATURE,
TEMPERATURE,
OCEAN COLOUR



TEMPERATURE,
WATER VAPOUR,
TRACE SPECIES



SEA LEVEL, SEA STATE,
SURFACE CURRENT



TEMPERATURE, WIND,
WATER VAPOUR, OZONE



CARBON

LAKES



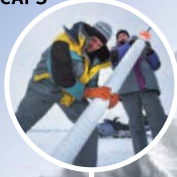
PERMAFROST



SEA-ICE



ICE SHEETS,
GLACIERS &
ICE CAPS

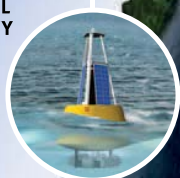


SNOW COVER

TEMPERATURE,
SALINITY



CARBON DIOXIDE PARTIAL
PRESSURE, OCEAN ACIDITY



SURFACE



SEA - SURFACE SALINITY,
PHYTOPLANKTON

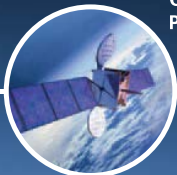
SUB-SURFACE



NUTRIENTS, TRACERS,
OCEAN ACIDITY,
CARBON DIOXIDE
PARTIAL PRESSURE

OCEAN CURRENT,
OXYGEN

**CLOUD PROPERTIES,
PRECIPITATION**



**EARTH RADIATION
BUDGET**



**ALBEDO, SURFACE
RADIATION BUDGET**



**WIND SPEED &
DIRECTION**



**FIRE DISTURBANCE,
LAND COVER**



WATER VAPOUR



**OZONE & AEROSOL,
SUPPORTED BY THEIR
PRECURSORS**



**AIR TEMPERATURE,
PRESSURE**



**ABOVE-GROUND BIOMASS,
FAPAR, LEAF AREA INDEX**



**CARBON DIOXIDE,
METHANE & OTHER
LONG-LIVED
GREENHOUSE GASES**



**RIVER DISCHARGE,
WATER USE**



SOIL MOISTURE



GROUNDWATER



The Terrestrial Observation Panel for Climate (TOPC) was set up to develop a balanced and integrated system of in situ, air- and spaceborne observations of the terrestrial ecosystem. The Panel focuses on the identification of terrestrial observation requirements, assisting the establishment of observing networks for climate, providing guidance on observation standards and norms, facilitating access to ECV and climate data and information and its assimilation, and promoting climate studies and assessments.

Key activities are:

- Assessing the current state of the terrestrial component of the global observing system for climate and identifying its gaps and inadequacies in present observing systems and designs to ensure long-term monitoring;
- Reviewing and monitoring the adequacy of terrestrial observing networks, such as the Global Terrestrial Networks (GTNs), and promoting their integration and development in order to measure and exchange ECV and climate data and information;
- Identifying measurable terrestrial key variables that control the physical, biological and chemical processes affecting climate and are indicators of climate change; and
- Coordinating activities with other global observing systems, panels and task groups to ensure the consistency of requirements with overall programmes.



Achievements:

Milestones for the Terrestrial Observation Panel for Climate

In 1994, TOPC was established as a joint observation panel sponsored by the then-named Scientific and Technical Committee of GCOS, and the Scientific and Technical Planning Group for GTOS (hosted by FAO). The following year, GCOS and GTOS published the **Plan for Terrestrial Climate-related Observations (Version 1.0)**, which presented a minimum set of terrestrial requirements for GCOS and the climate change requirements for GTOS. An updated Version 2.0 was published two years later.

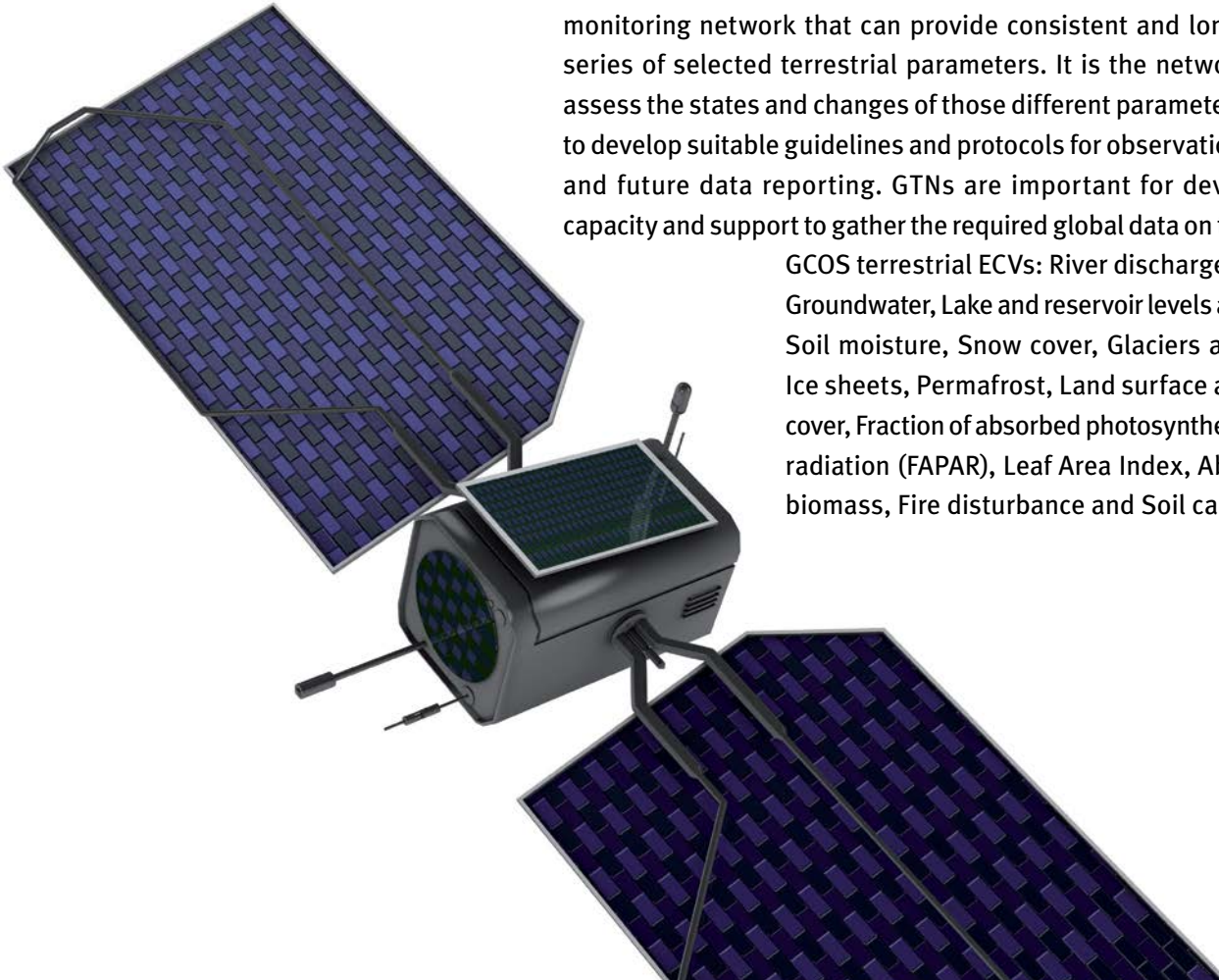
A major milestone in meeting TOPC objectives was the completion of the **Second Report on the Adequacy of the Current Climate Observing System** in 2003. The document identified the needs and gaps in the current climate-observing system and presented Parties to the UNFCCC with a strong need to develop a strategy to observe and monitor key climate variables in the domains of land, atmosphere and ocean. The subsequent **GCOS Implementation Plan**, published in 2004, introduced the concept of the GCOS ECVs and aimed to eliminate gaps by providing requirements for climate observations needed to support the goals of UNFCCC. TOPC provided the information and actions for the terrestrial climate components. A follow-up and updated Implementation Plan was presented by GCOS in 2010.



The establishment of Global Terrestrial Networks (GTNs)

The mission of GCOS is that all users have access to climate observations, data records and information that they require to address pressing climate-related concerns. These users include individuals, national and international organizations, institutions and agencies. TOPC and supporting sponsors started developing the concept of GTNs in 1997, when experts on terrestrial observation networks decided that GCOS and GTOS should generate complete and coherent datasets on global terrestrial ecosystems through international research collaboration.

GTNs contribute to the observation of terrestrial ECVs by combining in situ, air- and spaceborne observations, field measurements and the development of global models for the purpose of operating a strong monitoring network that can provide consistent and long-term data series of selected terrestrial parameters. It is the networks' goal to assess the states and changes of those different parameters/ECVs and to develop suitable guidelines and protocols for observation standards and future data reporting. GTNs are important for developing the capacity and support to gather the required global data on the following GCOS terrestrial ECVs: River discharge, Water use, Groundwater, Lake and reservoir levels and volumes, Soil moisture, Snow cover, Glaciers and ice caps, Ice sheets, Permafrost, Land surface albedo, Land cover, Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf Area Index, Above-ground biomass, Fire disturbance and Soil carbon.





- 1998 **Establishment of the Global Terrestrial Network for Glaciers (GTN-G)** – directly aligned with the establishment of the World Glacier Monitoring Service (WGMS), GTN-G has been run jointly since 2009 by WGMS, the US National Snow and Ice Data Centre and the Global Land Ice Measurements from Space Initiative, implementing global observations for the ECVs Glaciers and Ice Caps by compiling standardized observations, monitoring protocols and methods on glacier distribution and their changes over time.
- 1999 **Establishment of the Global Terrestrial Network for Permafrost (GTN-P)** – developed by the International Permafrost Association under the auspices of GCOS and GTOS, experts identified the Permafrost thermal state and the Permafrost active layer as key permafrost ECVs for monitoring the cryospheric changes in surface climate over time.
- 2001 **Establishment of the Global Terrestrial Network for Hydrology (GTN-H)** – established as a baseline network in joint cooperation with GCOS, the Climate and Water Department of WMO and GTOS, with the long-term goal of linking existing networks and systems for integrated observations of the global water cycle.
- 2005 **Establishment of the Global Terrestrial Network for Rivers (GTN-R)** – established as a contribution to the Implementation Plan of GCOS and GTN-H that aims at improving access to near-real-time river discharge data around the world, capturing the majority of the freshwater flux into the oceans.
- 2009 **Establishment of the Global Terrestrial Network for Lakes (GTN-L)** – hosted by the State Hydrological Institute of the Russian Federation, GTN-L was developed as a baseline network in support of UNFCCC, and is a joint project of GCOS, the Climate and Water Department of WMO and GTOS, with the long-term goal of observing lake areas and levels, water-body temperatures and ice thickness. It is an integrated component of GTN-H.



Chairs of the TOPC

1994–1996	John TOWNSHED (USA)
1997–2001	Josef CILHAR (Canada)
2002–2006	Alan BELWARD (United Kingdom)
2007–2012	Han DOLMAN (Netherlands)
2013–present	Konrad STEFFEN (Switzerland)

Terms of reference (as of October 2014)

Recognizing the need for specific and technical input concerning terrestrial observation for climate purposes, the sponsoring organizations of GCOS have established TOPC with the following terms of reference:

1. To define the requirements for long-term monitoring of terrestrial properties for climate and climate change.
2. To liaise with relevant research and operational communities to identify measurable terrestrial properties and attributes, which:
 - Control the physical, biological and chemical processes affecting climate;
 - Are themselves affected by climate change, are indicators of climate change and provide information on impacts of climate change.



3. To assess and monitor the adequacy of terrestrial observing networks (in situ, satellite-based), promote their integration and the development of their capacity to measure terrestrial properties and exchange climate data and information.
4. To identify gaps in present systems and design, promote and periodically revise plans for a long-term systematic observing system that fills these gaps, makes the data available and better serves the needs of research and operational communities.
5. To coordinate activities with other global observing system panels and task groups to ensure consistency of requirements with the overall programmes.
6. Publish and update GCOS/GTOS studies and planning documents.
7. To liaise with the other GCOS panels (AOPC and OOPC), WCRP steering groups, and other relevant entities such as the WMO technical commissions and the Committee on Earth Observation Satellites on terrestrial climate-observing-system issues and to other GTOS panels, where relevant.
8. Carry out agreed assignments from the GCOS and GTOS Steering Committees.
9. Report regularly to the GCOS and GTOS Steering Committees on issues related to the terrestrial component of GCOS.



GLOBAL CLIMATE OBSERVING SYSTEM

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GCOS is a joint undertaking of 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).



ICSU
International Council for Science

