



GCOS

GLOBAL CLIMATE OBSERVING SYSTEM

THE GLOBAL CLIMATE OBSERVING SYSTEM AND ITS OCEAN PANEL



<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 (GOOS), led by the Intergovernmental Oceanographic Commission (IOC) 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



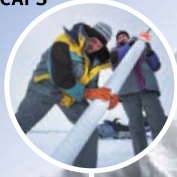
PERMAFROST



SEA-ICE



ICE SHEETS,
GLACIERS &
ICE CAPS



SNOW COVER

TEMPERATURE,
SALINITY



CARBON DIOXIDE PARTIAL
PRESSURE, OCEAN ACIDITY



SURFACE



SEA - SURFACE SALINITY,
PHYTOPLANKTON

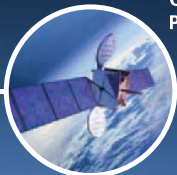
SUB-SURFACE



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



GCOS • GOOS • WCRP

OOPC

Ocean
Observations
Panel for
Climate

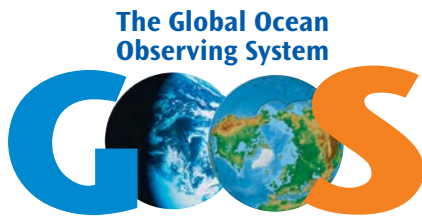
The Ocean Observations Panel for Climate (OOPC) is a scientific expert advisory group charged with making recommendations for a sustained global ocean observing system for climate in support of the goals of GCOS, GOOS and WCRP. The Panel provides scientific advice to the Joint WMO/IOC Commission for Oceanography and Marine Meteorology (JCOMM) and aids in the development of strategies for evaluation and evolution of the system. It supports global ocean observing activities by interested parties through liaison and advocacy for the agreed observing plans.

OOPC activities are coordinated through a five-year workplan, which is updated annually and contributes to both GCOS and GOOS planning and reporting, as well as providing the necessary advice and feedback to WCRP and JCOMM.



Key activities are:

- **Setting requirements for Essential Climate/Ocean Variables** and metrics of sustained ocean observing system performance against variable requirements.
- **Evaluating ocean observing network design**, status and development of implementation metrics (working with JCOMM).
- **Evaluating products and information**, such as Ocean Indices, and other products dependent on ocean observations.
- **Systems-based evaluations** to guide the design, expansion and evolution of the sustainable ocean observing system.



Like GCOS, GOOS is sponsored by WMO, IOC, the United Nations Environment Programme (UNEP) and the International Council for Science (ICSU). GOOS is a collaborative system of sustained observations, which:

- Are built on requirements for Essential Ocean Variables (EOVs);
- Combine in situ and satellite observations;
- Combine operational and research elements;
- Are linked to data-management and product-generation activities;
- Are global-scale and coastal.

OOPC is the Physics and Climate Panel of GOOS and works with the newer GOOS Biogeochemistry and Biology Panels (established in 2013/2014) to set requirements for sustained observations of the ocean and review their implementation, with regard to:

- Early warning for ocean-related hazards;
- Climate predictions and projections;
- Ecosystem assessment and management;
- Good ocean governance based on sound science – ensuring a healthy ocean and a healthy blue economy.

History

In 1978, recognizing the key role of the ocean in climate, WCRP, the Scientific Committee on Oceanic Research and IOC established the Committee on Climate Changes and the Ocean (CCCCO). In 1990, CCCO, together with the Joint Scientific Committee of WCRP, established an Ocean Observation System Development Panel (OOSDP) to develop the scientific basis for an ocean observing system for climate. The GCOS Steering Committee incorporated the recommendations of the OOSDP report into GCOS plans as the ocean component of GCOS and agreed to implement the system in cooperation with GOOS. The current sustained global ocean observing system for climate is **jointly the global component of GOOS and the ocean component of GCOS**. The OOSDP final report, *Scientific Design for the Common Module of the GOOS and the GCOS – An Ocean Observing System for Climate*, was published in March 1995. OOPC was formed to follow up on the work of OOSDP, and was established in 1996.



Achievements

The OceanObs conferences are major events in the ocean community every 10 years. OOPC was instrumental in coordinating the first two conferences.

OceanObs'99 created a consensus within the ocean observing communities to undertake an internationally coordinated sustained global ocean observing system for physical climate and ocean carbon, the details of which were subsequently agreed and presented in the first GCOS implementation plan. The Conference was an important milestone in the development of the sustained ocean observing system. OceanObs built a consensus and commitment to implement what had hitherto been a conceptual plan. The US National Oceanic and Atmospheric Administration (NOAA) took the outcome as a blueprint for its work and for establishing targets. The Conference heralded a change in paradigm for real-time free and open exchange of data – perhaps one of the most significant outcomes. Satellite and in situ observing components were considered as elements working together to achieve targets. Argo was introduced and other parts of the system adjusted. The relative cost-effectiveness of all contributions was tested (see <http://unesdoc.unesco.org/images/0012/001205/120594Eo.pdf>).

OceanObs'09 demonstrated the scientific and societal benefits of the sustained ocean observing system and began the process of expanding the range of communities working together to



undertake more comprehensive and sustained ocean observations in order to develop an integrated-multidisciplinary observing system from the open ocean to the coast. It also led to the development of the Framework for Ocean Observing to facilitate the selection and implementation of new EOVs (for more information, see <http://www.oceanobsog.net/>).

Development of the ECVs by OOPC, in unison with AOPC and TOPC, was a consolidation of requirements under GCOS for the benefit, among others, of the Parties to the UNFCCC, members of GCOS's sponsoring organizations and the satellite community (for example, the Committee on Earth Observation Satellites). Arguably, this was one of the most significant contributions of the GCOS expert panels and one that is still going strong today.

OOPC was involved, with partners, in many activities that led to agreements concerning the different components of the observing programmes, including:

- 1997: A review of the **Global Sea Level Observing System** and the roles of tide gauges and altimetry.
- 1997: Formation of the **Global Ocean Data Assimilation Experiment (GODAE)**. GODAE introduced real-time operational ocean analysis and forecasting to the global community and became an influential force in the remote-sensing community, allowing requirements to be articulated across all timescales.
- 1998: A review of the **Expendable Bathythermograph (XBT) Ship-of-Opportunity Programme SOOP**, taking account of the complementary plans of the International Argo Programme
- 1999: Establishment of the **OceanSITES moored time-series initiative**.
- 2000: Development of the **International Argo Array of profiling floats** began. Argo was initiated by GODAE and the WCRP Climate Variability and Predictability (CLIVAR) Project, but the overarching support of OOPC was critical, since it enabled the facilitation of an intergovernmental agreement on deployment (particularly with the South Pacific nations) and data exchange through IOC and WMO. Argo is arguably one of the greatest achievements of the ocean observing community.
- 2000: Co-sponsorship of a workshop on the Indian Ocean, held in Perth, Australia, that led ultimately to the creation of a regional alliance to support **GOOS in the Indian Ocean (IOGOOS)**.
- 2001: A review of the **Tropical Moored Buoy Array**.

- 2002: Formation of the **GODAE (now Global) High Resolution Sea Surface Temperature (GHRSSST)** project; OOPC's indirect sponsorship was vital to bringing climate-change considerations into the plan.
- 2007: The **Global Ocean Shipboard Hydrography Programme (GO-SHIP)** spawned by the World Ocean Circulation Experiment and CLIVAR research programmes.

More recently, OOPC has been involved in **systems-based reviews** of the observing system, some of which are developing into finite-lifetime development projects.

- 2011: A workshop on the deep ocean was held, which led to the broader GOOS community being engaged in developing the **Deep Ocean Observing Strategy** (www.ioc-goos.org/doos). The Strategy articulates the requirements for, and approaches to, systematic observations of the deep ocean. There are plans to form a finite-lifetime (six-year) project to take the Strategy forward.
- 2014: Precipitated by challenges in sustaining key components of the **Tropical Pacific Observing System (TPOS)**, OOPC, with NOAA and the Japan Agency for Marine-Earth Science and Technology, coordinated a workshop to evaluate the requirements for, and approaches to, observing the Tropical Pacific. It was noted that requirements had evolved since the current observing system was designed some 30 years ago. In addition, new observing networks had been implemented (routine satellite observations, Argo Array) and emerging technologies showed some potential (profiling moorings, gliders and wave gliders). The Workshop recommended the formation of a finite-lifetime TPOS 2020 project (established in 2014) to oversee the transformation of the TPOS to become more robust, integrated and sustainable (for more information, see www.tpos2020.org).



Chairs of the OOPC

1996–2002	Neville SMITH (Australia)
2003–2008	D.E. (Ed) HARRISON (USA)
2010–2012	Eric LINDSTROM (USA)
2013–2015	Mark BOURASSA (USA) and Toshio SUGA (Japan)
2016–present	Mark BOURASSA (USA) and Bernadette SLOYAN (Australia)

Key elements of the OOPC terms of reference

- **Assessing, reviewing and prioritizing requirements** for sustained ocean observations of physical ocean Essential Climate Variables for the Global Climate Observing System, Essential Ocean Variables for the Global Ocean Observing System, and sustained observing requirements for the World Climate Research Programme.
- **Coordinating observing networks** with the Joint WMO/IOC Commission for Oceanography and Marine Meteorology Observation Coordination Group, Global Ocean Observing System Regional Alliances and other relevant bodies.
- **Evaluating Data and Information Management** status and requirements.
- **Developing a process for ongoing evaluation** of the observing system in liaison with users of the data, including the modelling community.
- **Reporting to the Global Climate Observing System Steering Committee, the Global Ocean Observing System Steering Committee and the World Climate Research Programme Data Advisory Council** on progress in implementing ocean observations for key physical and climate variables.



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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

