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GCOS SECOND ADEQUACY REPORT AND IMPLEMENTATION PLAN: BACKGROUND

A first report on the adequacy of the global observing system for climate in providing the systematic climate observations required by the United Nations Framework Convention on Climate Change (UNFCCC) was submitted to the Conference of the Parties (COP) of the UNFCCC at their fourth meeting in 1998. In 2001, recognizing that the COP, individual Parties of the UNFCCC and various intergovernmental and international agencies had undertaken a range of actions to address the reported inadequacies, the Subsidiary Body for Scientific and Technological Advice (SBSTA) to the COP endorsed the preparation of a second report on the adequacy of the global observing systems for climate to meet their needs and also those of the Intergovernmental Panel on Climate Change (IPCC). The goals of this Second Adequacy Report[1] were to determine what progress had been made in implementing climate observing networks and systems since the first report; determine the degree to which these networks met with scientific requirements and conformed with associated observing principles; and to assess how well these systems, together with new and emerging methods of observation, met the needs of the UNFCCC. The preparation of the report, organized by the Global Climate Observing System (GCOS) Secretariat working in partnership with the other global observing systems and on behalf of its Sponsors, involved a wide range of experts from the scientific and observational communities as well as an open review process.

Four overarching conclusions arose in the Second Adequacy Report. These relate to:

- Free and unrestricted exchange and availability of the Essential Climate Variables (ECV) required for global-scale climate monitoring. These ECVs are listed in Table 1 below;
- Availability of integrated global climate-quality products and improvement and maintenance of the global networks and satellites sustaining these products;
- Internationally accepted standards for terrestrial data and products;
- System improvements and capacity building in developing countries, especially in the least developed countries and small island developing States (SIDS).

[1] "The Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC", April 2003, GCOS-82, WMO/TD No. 1143, available at http://www.wmo.ch/web/gcos/gcoshome.html; an executive summary of the report is also available on the WMO website in English, French, Russian and Spanish as GCOS-82 (ES), WMO/TD No. 1143

In the ocean domain, the Second Adequacy Report designated as a first priority the full implementation of the initial ocean climate observing system designed by the ocean community. It found that the implementation will involve making existing *in situ* and satellite activities adhere to climate standards as well as the phased introduction of the essential enhancements. Continued support of climate research and technology programmes for the oceans were also recognized as necessary to ensure efficiency and effectiveness, and to promote development of capabilities for those climate variables that cannot currently be observed globally. This need was noted as particularly acute for remote locations and for improved understanding of the ocean ecosystems and those processes that contribute to uncertainty in estimates of climate change.

Further findings of the report on the ocean domain were:

- Satellites are needed because they are the dominant source of ocean-surface data, with *in situ* networks providing necessary complementary information. High quality and continuity are the primary requirements for satellite observations. Sustained support for remote wind, topography, sea-ice, sea-surface temperature and ocean-colour measurements remains a pressing issue.

- Global deployment of the surface data-buoy array and of the Argo-float programme, in conjunction with the rest of the comprehensive surface and upper-ocean temperature and salinity networks, is needed for monitoring of heat and freshwater storage and transport, to test the ocean component in climate models, and for climate change detection and attribution.

- Establishment of a sparse network of global-ocean reference stations is essential for providing the climate-quality time series required for model testing, climate change detection, calibration of air-sea flux estimates and technology development.

- Enhancement and extension of the global baseline and regional sea-level network record is needed for climate change detection and the assessment of impacts.

- The measurement of the state and change of carbon sources and sinks in the ocean is important for determining the nature of the global carbon cycle, for future scenario projections and for a full understanding of potential mitigation strategies.

- Measurements of the full-depth ocean are a critical contribution to characterizing ocean climate variability and change, providing a capacity for monitoring the oceanic uptake of heat, freshwater and carbon dioxide and improving the chances of early identification of abrupt climate change arising from deep ocean processes. Regular, full-depth ocean surveys and surface altimetry are needed.

The Second Adequacy Report was submitted to the SBSTA at its eighteenth session in June 2003, and accepted by the COP at its ninth session in December 2003. The SBSTA specifically recognized the importance and current weakness of ocean observations. This led the COP, as a part of decision 11/CP.9, to specifically invite the GCOS secretariat, in conjunction with the Global Ocean Observation System (GOOS) Project Office, to provide information to SBSTA at its 22nd session in June 2005 on progress in implementing the initial ocean climate observing system.

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

Domain	Essential Climate Variables
Atmospheric (over land, sea and ice)	**Surface:** Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour. **Upper-air:** Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction, Water vapour, Cloud properties. **Composition:** Carbon dioxide, Methane, Ozone, Other long-lived greenhouse gases, Aerosol properties.
Oceanic	**Surface:** Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Current, Ocean colour (for biological activity), Carbon dioxide partial pressure. **Sub-surface:** Temperature, Salinity, Current, Nutrients, Carbon, Ocean tracers, Phytoplankton.
Terrestrial	River discharge, Water use, Ground water, Lake levels, Snow cover, Glaciers and ice caps, Permafrost and seasonally-frozen ground, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Biomass, Fire disturbance.

At the ninth session of the COP, through decision 11/CP.9, the COP also asked GCOS to coordinate the development of a phased five- to ten-year implementation plan for the integrated global observing systems for climate, using a mix of high-quality satellite and *in situ* measurements, dedicated infrastructure and targeted capacity-building. The plan is to draw on the Second Adequacy Report and to consider the views of Parties of the UNFCCC on the Report. In preparing the plan, GCOS has been asked to:

- Consider existing global, regional and national plans, programmes and initiatives;
- Consult extensively with a broad and representative range of scientists and data users, including the conduct an open review of the implementation plan;
- Collaborate closely with the ad hoc Group on Earth Observations in developing their respective implementation plan;
- Identify implementation priorities, resource requirements and funding options
- Include indicators for measuring its implementation;

The goal of the Plan is to map out ways to realizing a comprehensive observing system:

- To characterize the state of the global climate system and its variability.
- To monitor the forcing of the climate system, including both natural and anthropogenic contributions.

- To support the attribution of the causes of climate change.
- To support the prediction of global climate change.
- To project global climate change information down to regional and local scales.
- To characterize extreme events important in impact assessment and adaptation, and to assess risk and vulnerability.

Observing Climate requires an integrated strategy of land, oceanic, and atmospheric observations from both *in situ* and remote-sensing platforms, which then must be transformed to information and products, with spatial and temporal requirements varying with the specific application. Adequate global observing systems for climate will be made up of instruments at ground stations and on ships, buoys, floats, ocean profilers, balloons, samplers, aircraft and satellites, since no single technology can provide all the needed information. Information on where and how the observations are taken (metadata) is also required, as are historical and paleoclimatic records to establish baselines and set the context for the interpretation of trends and variability.

The strategy for providing the climate data and products must be both technically and fiscally feasible now and for the future. While the strategy is dependent on national efforts, success will be achieved only through internationally-coordinated action. The strategy must initially focus on the global nature of the requirements but at the same time, its data and products must also be relevant to regional and local requirements. In the case of the monitoring of extreme events, which can be inherently of a small scale and/or high frequency, the optimum strategy must enable global estimates of such phenomena.

The strategy for GCOS implementation depends upon close cooperation with many different organizations and agencies with complementary responsibilities, including the international observing programmes such as the World Weather Watch Global Observing System (GOS) and the Global Atmosphere Watch (GAW) of the WMO; GOOS; and the Global Terrestrial Observing System (GTOS) and their sponsors. These organizations, together with GCOS and other relevant bodies including the Space Agencies and the international research programmes, form the Integrated Global Observing Strategy (IGOS) Partnership for the definition, development and implementation of an integrated global observing strategy. Each of the observing system partners is interested in observation for a wide range of users, not only climate. Therefore GCOS works with them to ensure that they are fully aware of the climate requirements and to help ensure that those requirements are met.

GCOS was requested to submit the final implementation plan to SBSTA at its twenty-first session, at the end of 2004. The plan has recently entered an open review period, which will close in July 2004. Once the comments have been evaluated and incorporated, the plan will be published by November 2004, for submission to the twenty-first session of the SBSTA.