

## **GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)**

*(Submitted by WMO)*

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### **Summary and purpose of document**

This document presents a brief summary of some recent developments in the Global Climate Observing System (GCOS) programme relevant to CGMS.

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### **ACTION PROPOSED**

The session is invited to note the information contained in this document.

- Appendices:**
- A. Resolution 9 (Cg-XIV) – GCOS Climate Monitoring Principles
  - B. Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC, Summary of Conclusions

## **DISCUSSION**

### **1. GCOS Climate Monitoring Principles**

CGMS-XXX considered the Climate Monitoring Principles developed by GCOS, which had been expanded to include particular emphasis on satellite missions dedicated to long-term climate monitoring, and suggested that a drafting committee consider a rewording of some of the principles. This committee (J. Purdom, P. Menzel and J. Schmetz) cooperated with the GCOS Secretariat in developing a revised set of Principles which were supported by the third session of the WMO Consultative Meetings on High-level Policy on Satellite Matters (February 2003), which nevertheless noted that satellite missions not specifically dedicated to long-term climate monitoring should be expected only to strive toward their achievement to the extent possible. The 'GCOS Climate Monitoring Principles' were then presented to the Fourteenth session of the WMO Congress (May 2003), which adopted them through its Resolution 9 (Cg-XIV) (see Annex I). The Principles will be included in the next update of the UNFCCC Reporting Guidelines on Global Climate Observing Systems, as well as being presented to the other GCOS Sponsors for endorsement. GCOS welcomes the cooperation of CGMS in finalizing these guidelines for climate monitoring and the efforts being undertaken by the space agencies to adhere to them.

### **2. 'Second Adequacy Report' and Integrated Global Climate Products**

The 'Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC' (the 'Second Adequacy Report' or '2AR', GCOS-82) was completed in April and presented to the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) at its Eighteenth Session (June 2003), for subsequent submission to the Conference of the Parties (COP) in December. Both the full report and an Executive Summary, as well as a draft of the 'Technical Supplement' to the Report, can be found on the GCOS Web site ([www.wmo.ch/web/gcos/gcoshome.html](http://www.wmo.ch/web/gcos/gcoshome.html)). A Summary of Conclusions is attached as Appendix B. Of particular note for CGMS is Recommendation 2 in the Summary concerning the need to develop integrated global climate products, including those largely dependent on satellite observations. This derives from the specific 2AR conclusions that:

"Parties with responsibility for space agencies should support the long-term operation of Earth observation satellites; ensure that homogeneous climate data and integrated products are produced; and strive to make them available to all Parties" and

"Such Parties should support an internationally-coordinated approach to the development of an initial set of integrated global climate products" related to the variables in item 2 of the Summary.

CGMS members are and will be crucial players in developing such products and GCOS looks forward to cooperating closely with them in the planning and implementation of these products.

GCOS has begun the process of developing a 5-10 year Implementation Plan based, *inter alia*, on the findings of the 2AR, with a first draft to be available for open review by March 2004.

### **3. AOPC-IX**

The Ninth Session of the Atmospheric Observations Panel for Climate (AOPC) was held in Asheville, USA from 23-27 June 2003. J. Schmetz informed the session of developments relating to CGMS, including the request from CGMS-XXX (Action 30.28) to consider the consolidated list of metadata for satellite observations with respect to its adequacy for AOPC

applications. The AOPC concurred with this list. The session was also informed of activities to develop global albedo products, for example, and very much welcomed this activity (see also Section 2. above), as indicated by the following conclusion:

“The AOPC welcomed efforts by the operational space agencies to incorporate climate requirements into their planning and activities, including archiving of data and metadata and reprocessing of archived data in a globally consistent manner. It noted in particular the progress demonstrated by recent studies of surface albedo and looked forward to the eventual development of operational monitoring products. The Panel looked forward to continuing cooperation with the space agencies in defining and establishing the satellite component of the GCOS baseline networks.”

The Panel also noted the specific efforts by EUMETSAT to develop additional climate products through its support for the Satellite Applications Facility on Climate Monitoring (CM-SAF) and looked forward to cooperating in a workshop planned toward this end.

AOPC-IX also acknowledged CGMS participation in the further development of the GCOS Climate Monitoring Principles, as well as related results and actions from CGMS-XXX:

“The AOPC expressed its appreciation for the cooperation of CGMS in development of the GCOS Climate Monitoring Principles, which had been formally endorsed through a Resolution of the WMO Congress at its Fourteenth session in May, 2003. It noted with satisfaction that CGMS had initiated a number of actions at its thirtieth session which would assist in meeting the objectives of the Principles. The Panel noted in particular the CGMS proposal to organize a workshop on developing an inventory of sensor calibrations and looked forward to participating in this activity as appropriate.”

#### **4. Conclusions**

GCOS welcomes the increasing cooperation with CGMS and its members in defining and establishing the satellite component of the GCOS baseline networks, including the observational infrastructure and the development of the integrated global climate products needed by its users. It looks forward to continuing and expanding this cooperation in the future.

The session is invited to take note of the information contained in this report.

**Resolution 9 (Cg-XIV) – GCOS CLIMATE MONITORING PRINCIPLES**

**THE CONGRESS,**

**NOTING** Resolution 10 (Cg-XIV) – Global Climate Observing System,

**RECOGNIZING** the stringent requirements on long-term observations of the climate system to ensure their adequacy for climate applications,

**ADOPTS** the GCOS Climate Monitoring Principles for effective monitoring of the climate system, as presented in the annex to this resolution.

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Annex: 1

## **Annex to Resolution 9 (Cg-XIV)**

### **GCOS CLIMATE MONITORING PRINCIPLES**

*Effective monitoring systems for climate should adhere to the following principles\*:*

1. The impact of new systems or changes to existing systems should be assessed prior to implementation.
2. A suitable period of overlap for new and old observing systems is required.
3. The details and history of local conditions, instruments, operating procedures, data processing algorithms and other factors pertinent to interpreting data (i.e., metadata) should be documented and treated with the same care as the data themselves.
4. The quality and homogeneity of data should be regularly assessed as a part of routine operations.
5. Consideration of the needs for environmental and climate-monitoring products and assessments, such as IPCC assessments, should be integrated into national, regional and global observing priorities.
6. Operation of historically-uninterrupted stations and observing systems should be maintained.
7. High priority for additional observations should be focused on data-poor regions, poorly-observed parameters, regions sensitive to change, and key measurements with inadequate temporal resolution.
8. Long-term requirements, including appropriate sampling frequencies, should be specified to network designers, operators and instrument engineers at the outset of system design and implementation.
9. The conversion of research observing systems to long-term operations in a carefully-planned manner should be promoted.
10. Data management systems that facilitate access, use and interpretation of data and products should be included as essential elements of climate monitoring systems.

Furthermore, operators of satellite systems for monitoring climate need to:

- (a) *Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system; and*
- (b) *Take steps to sample the Earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be resolved.*

*Thus satellite systems for climate monitoring should adhere to the following specific principles:*

11. Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained.

\* The 10 basic principles were adopted (in paraphrased form) by the Conference of the Parties to the UNFCCC through Decision 5/CP.5 of COP-5 at Bonn in November, 1999.

12. A suitable period of overlap for new and old satellite systems should be ensured for a period adequate to determine inter-satellite biases and maintain the homogeneity and consistency of time-series observations.
13. Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured.
14. Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national metrology institute, should be ensured.
15. On-board calibration adequate for climate system observations should be ensured and associated instrument characteristics monitored.
16. Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate.
17. Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed-mode analysis, should be established and maintained.
18. Use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when these exist on de-commissioned satellites.
19. Complementary in situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation.
20. Random errors and time-dependent biases in satellite observations and derived products should be identified.

**SECOND REPORT ON THE ADEQUACY OF THE GLOBAL OBSERVING  
SYSTEMS FOR CLIMATE IN SUPPORT OF THE UNFCCC**  
*Summary of Conclusions*

The Second Report on the Adequacy of the Global Observing Systems for Climate was prepared in response to UNFCCC decision 5/CP.5 and endorsement by the WMO Executive Council and by the UNFCCC Subsidiary Body on Scientific and Technological Advice (SBSTA) at its 15<sup>th</sup> session (November 2001). The goals of the Report are to:

- Determine what progress has been made in implementing climate observing networks and systems since the First Adequacy Report in 1998;
- Determine the degree to which these systems meet with scientific requirements and conform with associated observing principles; and
- Assess how well the current systems, together with new and emerging methods of observation, will meet the needs of the Convention.

The Report concludes that there have been improvements in implementing the global observing systems for climate, especially in the use of satellite information and in the provision of some ocean observations. However, serious deficiencies remain in their ability to meet the identified needs. For example:

- Atmospheric networks are not operating with the required global coverage and quality;
- Ocean networks lack global coverage and commitment to sustained operation; and
- Global terrestrial networks remain to be fully implemented.

Based on the analysis in the Report, four overarching (and equally high priority) conclusions with accompanying recommendations for action have emerged.

1. ***Data Exchange and Standards:*** There is a need for intergovernmental and international agencies to sustain and strengthen existing intergovernmental mechanisms relating to climate data and products. In particular, for the terrestrial domain, there is a need to establish a mechanism to prepare guidance materials and develop agreements on standards and regulations for observing systems, data, and products. In all cases, adherence to the principles of free and unrestricted exchange of data should be strongly encouraged, particularly in relation to the designated Essential Climate Variables (see table below), which are both currently feasible for global implementation and have a high impact on UNFCCC requirements. Adherence to the GCOS Climate Monitoring Principles is an essential goal for all climate observations.

Domain	Essential Climate Variables
<b>Atmospheric</b> (over land, sea and ice)	<p><b>Surface:</b> Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour.</p> <p><b>Upper-air:</b> Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction, Water vapour, Cloud properties.</p> <p><b>Composition:</b> Carbon dioxide, Methane, Ozone, Other long-lived greenhouse gases<sup>1</sup>, Aerosol properties.</p>
<b>Oceanic</b>	<p><b>Surface:</b> Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Current, Ocean colour (for biological activity), Carbon dioxide partial pressure.</p> <p><b>Sub-surface:</b> Temperature, Salinity, Current, Nutrients, Carbon, Ocean tracers, Phytoplankton.</p>
<b>Terrestrial</b>	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.

2. **Integrated Global Climate Products:** Nations, in conjunction with the GCOS Sponsors and other international agencies, should institutionalize appropriate processes for generating and making available, on a sustained basis, a range of integrated climate-quality products relevant to the needs of the Convention, including those largely dependent upon satellite observations (see table below) and/or benefiting from the reanalysis of homogeneous historical data. In doing so, the relevant nations and intergovernmental agencies will need to address identified deficiencies in the underlying data and observing systems.

Domain	Variables largely dependent on satellite observations
<b>Atmospheric</b> (over land, sea and ice)	Precipitation, Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction (especially over the oceans), Water vapour, Cloud properties, Carbon dioxide, Ozone, Aerosol properties.
<b>Oceanic</b>	Sea-surface temperature, Sea level, Sea ice, Ocean colour (for biological activity).
<b>Terrestrial</b>	Snow cover, Glaciers and ice caps, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Fire disturbance.

<sup>1</sup> Including nitrous oxide (N<sub>2</sub>O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF<sub>6</sub>), and perfluorocarbons (PFCs).



3. **National Reporting to the UNFCCC:** SBSTA, in consultation with the GCOS Secretariat, should review the guidelines for national communications on research and systematic observation (Decision 4/CP.5) to include, *inter alia*, a specific requirement to report on the exchange of the Essential Climate Variables and associated products and on the submission of current and historical data and metadata to international data centres. All Parties are strongly urged to submit this information, as part of their national communications.

4. **Capacity-Building and System Improvements:** The full implementation of an integrated global observing system for climate, sustained on the basis of a mix of high-quality satellite and *in situ* measurements, dedicated infrastructure and targeted capacity-building, will require the strong commitment of all Nations. Furthermore, those Nations with the ability to do so are encouraged to contribute to a voluntary (non-UNFCCC) funding mechanism to support high-priority needs relating to global observing systems for climate in developing countries, especially the least developed countries, small island developing states, and some countries with economies in transition.

In addition, there is a continuing need for action on the priorities reflected in previous assessments and decisions, including:

- Full implementation of designated baseline observing systems;
- Rescue of historical data and metadata;
- Free and unrestricted exchange of data and their provision to international data centres;
- Development of national plans for systematic observation;
- Development and implementation of regional action plans for climate observing systems;
- Addressing the special needs of developing countries and some countries with economies in transition, particularly the least developed countries and the small island developing states;
- Use of climate data as input to decision-making processes.

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