

## **GCOS AND RELATED CLIMATE MATTERS**

*(Submitted by WMO)*

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### **Summary and Purpose of Document**

This document, prepared by GCOS, presents a summary of recent developments in the Global Climate Observing System (GCOS) and related climate matters relevant to CGMS.

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### **ACTION PROPOSED**

The session is invited to note the information presented and comment, as appropriate, particularly on the response of Space Agencies to the relevant Actions in the Implementation Plan.

- Appendices:**
- A. Actions from the Implementation Plan involving Space Agencies, CGMS and/or CEOS as 'Agents for Implementation'.
  - B. UNFCCC COP-10: Decision 5/CP.10
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## 1. IMPLEMENTATION PLAN FOR THE GLOBAL OBSERVING SYSTEM FOR CLIMATE

1. The *Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC* was completed under the leadership of GCOS, with broad input from the climate and related scientific communities. The Plan addresses the requirements identified in the *Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC* and, in particular, the Essential Climate Variables and their associated products defined therein. It takes into consideration existing global, regional and national plans, programmes and initiatives, including the plans of the recently-established Group on Earth Observations (GEO), and includes implementation priorities and resource requirements as well as indicators for measuring progress. The full Plan and its Executive Summary are available through the GCOS Web site ([www.wmo.int/web/gcos](http://www.wmo.int/web/gcos)).

2. The *Implementation Plan* calls for some 131 actions needed over the next 5 to 10 years to address the critical issues related to global observing systems for climate, namely: improving key satellite and *in situ* networks for atmospheric, oceanic and terrestrial observations; generating integrated global climate analysis products; enhancing the participation of least-developed countries and small island developing states; improving access to high-quality global data for essential climate variables; and strengthening national and international infrastructure. Some 42 of the items (see Appendix A) involve the Space Agencies of relevant Parties to the UNFCCC, CGMS and/or CEOS as 'Agents for Implementation', many in cooperation with the WMO Space Programme. A number of the actions focus on establishing and maintaining reliable, long-term satellite systems which adhere to the GCOS Climate Monitoring Principles, and on producing the desired global data products from the observations that these systems obtain. Several of these are summarized as Key Actions in the Executive Summary to the Plan and are directed specifically to the Parties to the UNFCCC, but are also relevant to CGMS members. Specifically:

**Key Action 10:** Parties need to ensure that their climate-observing activities which contribute to GCOS adhere to the GCOS Climate Monitoring Principles.

**Key Action 14:** Parties need to: (a) ensure the continued operation of satellite measurements of the Earth radiation budget and solar irradiance (e.g., the NASA Earth Radiation Budget Experiment); and (b) support research to extend and improve current capabilities for monitoring clouds as a high priority.

**Key Action 15:** Parties need to: (a) fully establish a baseline network for key greenhouse gases; (b) improve selected satellite observations of atmospheric constituents; and (c) extend existing networks to establish a global baseline network for atmospheric optical depth.

**Key Action 20:** Parties are urged to support the operational continuation of the satellite-based products given in Table 5. (*refers to: albedo; LAI; fAPAR; fire and burnt area; snow cover; DEMs of ice sheet surfaces and full glacier inventory; and land-cover characterization*)

**Key Action 23:** Parties are urged to adopt an internationally-coordinated approach to the development of integrated global climate products and to make them accessible to all Parties. As far as possible, these products should incorporate past data covering at least the last 30 years in order to serve as a reference for climate variability and change studies.

### UNFCCC SBSTA-21/COP-10

3. The *Implementation Plan* was presented to the tenth session of the UNFCCC Conference of the Parties (COP-10) in Buenos Aires, Argentina (6-17 December 2004) through its Subsidiary Body for Scientific and Technological Advice (SBSTA-21). COP-10 formally endorsed the Plan

through decision 5/CP.10 (see Appendix B). Paragraph 5 of that decision “Invites Parties that support space agencies involved in global observations to request these agencies to provide a coordinated response to the needs expressed in the implementation plan”. An initial response to that invitation has been coordinated by the CEOS Strategic Implementation Team (CEOS/SIT) and will be presented to SBSTA-23 in November-December 2005.

4. Many CGMS members are and will be crucial players in responding to the actions identified in the *Implementation Plan*. GCOS looks forward to cooperating closely with them in the implementation process.

## **2. GCOS/WCRP ATMOSPHERIC OBSERVATIONS PANEL FOR CLIMATE (AOPC) – ELEVENTH SESSION**

5. The Eleventh Session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC) was held in Geneva, Switzerland from 11-15 April 2005. Dr J. Schmetz informed the session of the results from CGMS-XXXII, noting especially the deliberations and recommendations of Working Group II on Satellite Products. Regarding the possible establishment of a reference Satellite Upper-Air Network discussed at that session, the AOPC reiterated that its recommendation at AOPC-X (April 2004) was not intended to initiate the establishment of such a network per se, but to suggest that if it were pursued, this should be done by building on existing stations (e.g. GUAN) to the extent feasible and appropriate. The AOPC supports such an initiative provided that routine operations at any GUAN stations are not adversely affected, noting that high accuracy is the overarching requirement.

6. At AOPC-XI, the following CGMS-relevant conclusions and recommendations were agreed:

33. The AOPC recommended that satellite operators establish a process (e.g., via CGMS) to provide Level 1b products (i.e., navigated and calibrated radiances) needed for climate applications. In addition, priority Level 2 products (geophysical quantities) should be generated and reprocessed in the light of advanced understanding of the data characteristics.
34. The AOPC encouraged CGMS to pursue the development of enhanced cloud products including cloud microphysics, recognizing the GCOS requirement for improved cloud monitoring. It recommended in particular the evaluation of climate cloud products with advanced research satellite missions like Cloudsat.
35. The AOPC recommended that CGMS requests its members to define and commence the development of a climate data set from hyperspectral IR instruments (AIRS, IASI, CrIS) that is substantially reduced in terms of data volume, in order to make climate processing of long time series tractable.
36. The AOPC recommended that CGMS invite satellite agencies to report on current efforts to establish and/or enhance global aerosol products suitable for climate applications.
37. The AOPC reiterated the importance of having independent observations and analyses of the Essential Climate Variables (ECVs) in order to be able to take maximum advantage of new observing technology. Only with independent information can confidence be given to data obtained by new systems.
38. The AOPC emphasized the importance of satellite agencies undertaking appropriate risk analyses of potential gaps and overlaps in mission continuity in order to assist in achieving the GCOS goals of sustained provision of satellite-based observations of ECVs.

39. The AOPC noted the results of the joint EUMETSAT/WMO/GCOS/CM-SAF (Climate Monitoring Satellite Application Facility) workshop in July 2004. It welcomed the efforts of the CM-SAF to identify and ultimately fulfil the needs of GCOS for integrated global climate products. The Panel noted that the SAFs are an appropriate mechanism for transitioning the results of pilot projects into long-term operational products, including for example global radiation budgets, cloud parameters, precipitation, surface albedo and aerosols. The Panel looked forward to the workshop follow-on meeting to be held in conjunction with the CM-SAF Users Workshop in September 2005 [..... It furthermore] suggested that the operational teams providing climate data should also have the capability to carry out appropriate scientific analyses as a means to ensure data and product quality.

6. Regarding Item 39, the AOPC Chairman represented the Panel at the CM-SAF session in Nuremberg, Germany (1-2 September 2005). Johannes Schmetz (AOPC Panel member) also participated, along with other representatives from EUMETSAT, the SAF projects, other satellite operators and climate research experts. The purpose of the meeting was to review progress since the July 2004 session, including results of the pilot experiments identified there, and to discuss the evolution of the SAF network with respect to global climate monitoring in its next phase (2007-2012). With regard to the re-calibration and intercalibration of satellite data, the meeting agreed that satellite operators should be requested to make an effort to re-calibrate archived satellite data to make them usable for climate studies, and that this could be proposed as an action on satellite operators at the next CGMS meeting.

### **3. GCOS STEERING COMMITTEE – THIRTEENTH SESSION**

7. The Thirteenth Session of the GCOS Steering Committee was held in St Petersburg, Russian Federation, from 5 to 8 October 2005. Draft conclusions relevant to CGMS were as follows:

- The SC noted with appreciation the work of CGMS on climate-related satellite matters and encouraged AOPC to continue to liaise with CGMS through WMO. It noted in particular the benefit to reanalysis and other climate activities of CGMS developing a framework for the development and reprocessing of Level 1b and Level 2 satellite products.
- The SC noted with appreciation the EUMETSAT initiative in holding the Second EUMETSAT-WMO-GCOS Meeting on the Contribution of the SAF Network to Global Climate Monitoring. It encouraged the Secretariat and the Panels to promote links between SAF experts and relevant GCOS working groups in order to foster the development of homogeneous global climate products with known uncertainty estimates.
- The SC noted with appreciation the invitation from WCRP for all three Panel Chairs to serve on the WCRP Observation & Assimilation Panel (WOAP). It furthermore welcomed the generally encouraging response of space agencies to the request from WCRP (developed by WOAP) to ensure that satellite observations required for sustained homogeneous global climate products are available.
- The SC recognized the need for more detailed specification of requirements for integrated global climate products based on the ECVs and welcomed the draft document that had been prepared for CEOS-19 in November 2005. It requested members to review the document further and provide comments to the Secretariat by 21 October for inclusion into the final document.

### **4. WCRP ISSUES**

7. The *Implementation Plan* fully covers WCRP needs for sustained measurements and also identifies some variables for which sustained measurements are sought (e.g., soil moisture) subject to research demonstration of their viability. The full needs of WCRP also include one-off

research missions which the IP does not cover and which realistically cannot be captured in a single long lasting set of requirements. In addition to sustained measurements, the plan notes the importance of process studies for research needs but does not detail this aspect. The above needs are best reviewed in specific documents updated at appropriate intervals.

8. At the previous CGMS session, WCRP presented a specific plan for the development of global climate products by systematic reprocessing of global observations over the last 30 years. It responds to one of the general recommendations of the *Implementation Plan* and is being prepared jointly with GCOS, as part of the WCRP COPES (Coordinated Observation and Prediction of the Earth System) strategy. This project has been endorsed by the new WCRP Observation and Assimilation Panel (WOAP) and will be developed during the coming year, seeking the contribution of agencies involved in global observations for climate.

## **5. CONCLUSIONS**

9. GCOS welcomes the continuing 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.

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

**IMPLEMENTATION PLAN FOR THE GLOBAL OBSERVING SYSTEM FOR CLIMATE  
IN SUPPORT OF THE UNFCCC**

**List of Actions (left column) and 'Agents for Implementation' (right column)  
for which 'Agents' are Space Agencies, CGMS, and/or CEOS  
(Total: 42)**

<p><b>C10</b> Ensure continuity and over-lap of key satellite sensors; recording and archiving of all satellite meta-data; maintaining currently adopted data formats for all archived data; providing data service systems that ensure accessibility; undertaking reprocessing of all data relevant to climate for inclusion in integrated climate analyses and reanalyses.</p>	<p>Parties operating satellite systems.</p>
<p><b>C21</b> Develop modern distributed data services that can handle the increasing volumes of data and which can allow feedback to observing network management.</p>	<p>Parties' national services committing to International Data Centre operation and high data volume providers such as Space Agencies through appropriate technical commissions and international programmes.</p>
<p><b>A7</b> Ensure stable operation and processing of relevant operational satellite instruments for precipitation and the continuity of associated products.</p>	<p>Space Agencies through CGMS and CEOS with WMO Space Programme and GCOS.</p>
<p><b>A11</b> Ensure continuous operation of AM and PM satellite scatterometer or equivalent observations.</p>	<p>Space Agencies through CGMS and CEOS with WMO Space Programme and GCOS.</p>
<p><b>A19</b> Continue the system of satellites following the GCMPs to enable the continuation of MSU-like radiance data.</p>	<p>Space Agencies.</p>
<p><b>A20</b> GPS RO measurements should be made available in real time, incorporated into operational data streams, and sustained over the long-term. Protocols need to be developed for exchange and distribution of data.</p>	<p>Space Agencies, in cooperation with CGMS, WMO CBS, the WMO Space Programme and AOPC.</p>
<p><b>A22</b> Ensure continuation of a climate data record of visible and infrared radiances, e.g., from the International Satellite Cloud Climatology Project, and include additional data streams as they become available.</p>	<p>Space Agencies, for processing.</p>
<p><b>A23</b> Research to improve cloud property observations in three dimensions.</p>	<p>Parties' national research and Space Agencies in cooperation with the WCRP.</p>
<p><b>A24</b> Ensure continuation of Earth Radiation Budget observations.</p>	<p>Space Agencies, coordinated through WMO Space Programme, CEOS and CGMS.</p>

## A25

Establish a plan for and implement a consistent surface- and satellite-based global observing system for the atmospheric composition ECVs, based on common standards and procedures, and encourage data submission to WDCs.

Parties' national services, research agencies and Space Agencies, under the guidance of WMO GAW in coordination with AOPC.

## A26

Develop and implement a comprehensive plan to observe the vertical profiles of GHGs, ozone and aerosols utilizing commercial and research aircraft, pilotless aircraft, balloon systems, kites, ground-based lidars and satellites.

Parties' national services, research agencies and Space Agencies, under the guidance of WMO GAW in coordination with AOPC.

## A27

Establish the GCOS/GAW baseline network for CO<sub>2</sub> and CH<sub>4</sub>, and fill the gaps.

Parties' national services, research agencies and Space Agencies under the guidance of WMO GAW and its Scientific Advisory Group for Greenhouse Gases in cooperation with the AOPC.

## A31

Develop and implement a coordinated strategy to monitor and analyze the distribution of aerosols and aerosol properties.

Parties' national services, research agencies and Space Agencies, with guidance from AOPC in cooperation with WMO GAW, WCRP, IGBP.

## A32

Develop and implement a strategy to enable use of satellite data on atmospheric composition for climate by scientific users, regardless of source.

Space Agencies, in conjunction with CEOS and CGMS, IGOS-P, and WMO Space Programme.

## O3

Promote and facilitate research and development (new improved technologies in particular), in support of the global ocean observing system for climate.

Parties' national ocean research programmes and Space Agencies, in cooperation with GOOS, GCOS, and WCRP.

## O7

IGOS-P Ocean Theme Team to publish update of the Ocean Theme and, as appropriate, restating the satellite requirements and explicitly noting requirements for climate.

IGOS-P through WMO Space Programme, CGMS, CEOS in consultation with OOPC and GCOS.

## O9

Ensure a continuous mix of polar orbiting and geostationary IR measurements combined with passive microwave coverage. To link with the comprehensive *in situ* networks noted in O10.

Space Agencies coordinated through CGMS, CEOS, and WMO Space Programme.

## O12

Ensure continuous coverage from one high-precision altimeter and two lower-precision but higher-resolution altimeters.

Space Agencies with coordination through CGMS, CEOS, and WMO Space Programme.

## O16

Research programmes to demonstrate feasibility of utilizing satellite data to help resolve global fields of SSS.

Space Agencies in collaboration with the ocean research community.

## O18

Implement plans for a sustained and continuous deployment of ocean colour satellite sensors together with research and analysis.

Space Agencies through the IGOS-P and in consultation with the IOCCG.

## O23

Ensure sustained satellite (microwave, SAR, visible and IR) operations: improve the *in situ* observations from sea-ice buoys, visual surveys (SOOP and Aircraft), and ULS. Implement observations in the Arctic and Antarctic.

Parties' national services, research programmes and Space Agencies, coordinated through the WMO Space Programme, IGOS-P Cryosphere Theme, CGMS, and CEOS; National services for *in situ* systems coordinated through JCOMM.

## O29

Develop and implement a pilot project designed to assemble the *in situ* and satellite altimetry data into a composite data set and to assimilate the data into models and to create climate variability and trend analyses.

Parties' national ocean research programmes and space programmes through GODAE.

## T6

Submit weekly/monthly lake level/area data for the 150 GTN-L lakes to the International Data Centre; submission of weekly/monthly altimeter-derived lake levels by Space Agencies to the International Data Centre.

National Hydrological Services, through WMO CHy; Space Agencies; the new global lake information data centre.

## T8

Submit weekly surface and sub-surface water temperature, date of freeze-up and date of break-up of 150 priority lakes in GTN-L.

National Hydrological Services; Space Agencies in response to request from TOPC through the WMO.

## T11

Obtain integrated analyses of snow cover over both hemispheres.

Space Agencies through CliC and IGOS-P Cryosphere, with advice from TOPC and AOPC.

## T14

Ensure continuity of current spaceborne cryosphere missions.

Space agencies, in cooperation with IGOS-P Cryosphere.

## T18

Test prototype algorithms to retrieve the directional hemispherical reflectance factor (or black sky albedo) from geostationary satellites on a daily and global basis.

Space Agencies, especially EUMETSAT, in cooperation with the algorithm developers and the CEOS WGCV.

## T19

Obtain *in situ* calibration/validation measurements and collocated albedo products from all Space Agencies generating such products.

Space Agencies in cooperation with CEOS/WGCV.

## T20

Identify the most appropriate satellite derived albedo for specific climate models.

CEOS WGCV, in cooperation with GEWEX and the Project for Intercomparison of Land-surface Parameterization Schemes.

## T21

Implement globally coordinated and linked data processing to retrieve the directional hemispherical reflectance factor (or black sky albedo) from geostationary satellites on a daily and global basis from archived (and current) satellite data.

Space Agencies, through the CGMS and WMO Space Programme.

## T23

Produce reliable accepted methods for land-cover map accuracy assessment.

CEOS WGCV, in collaboration with GOFD-GOLD and GLCN.



T24

Commit to continuous 10-30m resolution optical satellite systems with data acquisition strategies at least equivalent to the Landsat 7 mission for land cover.

Space Agencies.

T25

Develop an in situ reference network and apply CEOS WGCV validation protocols for land cover.

Parties' national services, research institutes and Space Agencies, in cooperation with GOF-C-GOLD, CEOS/WGCV, FAO GLCN and the GTOS web-based data system TEMS.

T26

Generate annual products documenting global land-cover characteristics at resolutions between 250m and 1km, according to internationally-agreed standards and accompanied by statistical descriptions of the maps' accuracy.

Parties' national services, research institutes and Space Agencies through GLCN in collaboration with GOF-C-GOLD research partners, and the IGOS land theme (IGOL).

T27

Generate maps documenting global land cover at resolutions between 10m and 30m every 5 years, according to internationally-agreed standards and accompanied by statistical descriptions of the maps' accuracy.

Space Agencies, in cooperation with GCOS, GTOS, GLCN and other members of CEOS.

T28

Make fAPAR and LAI products available as gridded products at 250m to 1km resolution.

Space Agencies, coordinated through CEOS WGCV, with advice from GCOS/GTOS.

T29

Establish a calibration/validation network of *in situ* observing sites for fAPAR and LAI (reference sites).

Parties' national and regional research centres, in cooperation with Space Agencies coordinated by CEOS WGCV, GCOS and GTOS.

T30

Evaluate the various LAI satellite products and benchmark against ground truth to arrive at an agreed operational product.

Parties' national and regional research centres, in cooperation with Space Agencies and CEOS WGCV and TOPC.

T32

Reanalyze the historical fire disturbance satellite data (1982 to present).

Space Agencies, working with research groups coordinated by GOF-C-GOLD.

T33

Continue the generation of active fire and burnt area products.

Space Agencies, in collaboration with GOF-C-GOLD.

T34

Apply CEOS WGCV and GOF-C-GOLD validation protocol to fire disturbance data.

Space Agencies and research organizations.

T37

Develop an experimental soil-moisture product from existing networks and satellite observations.

Parties' national services and research programmes, through IGWCO and TOPC in collaboration with Space Agencies.

**Decision 5/CP.10**

**Implementation of the global observing system for climate**

*The Conference of the Parties,*

*Having considered* the recommendations of the Subsidiary Body for Scientific and Technological Advice at its twenty-first-session,

1. *Expresses its appreciation* to the Global Climate Observing System for preparing the *Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC* (hereinafter referred to as the implementation plan);

2. *Welcomes* the emphasis given in the implementation plan to enhancing the participation of developing countries, in particular the least developed countries and small island developing States, in the global observing system for climate;

3. *Encourages* Parties to strengthen their efforts to address the priorities identified in the implementation plan, and to implement the priority elements in the regional action plans relating to the global observing systems for climate;

4. *Encourages* Parties to enhance their work and collaboration on observation of the essential climate variables and on development of climate products to support the needs of the Convention, including through participation in the Global Climate Observing System cooperation mechanism;

5. *Invites Parties* that support space agencies involved in global observations to request these agencies to provide a coordinated response to the needs expressed in the implementation plan;

6. *Requests* the secretariat of the Global Climate Observing System to provide information to the Subsidiary Body for Scientific and Technological Advice at its twenty-third session (November-December 2005) and, as required, at subsequent sessions, on how the actions identified in the implementation plan are being implemented.

*6<sup>th</sup> plenary meeting  
17-18 December 2004*