



CGMS-35, WMO-WP-10  
Prepared by GCOS  
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Discussed in Plenary

**GLOBAL CLIMATE OBSERVING SYSTEM:  
UPDATE**

*(Submitted by WMO for the GCOS Secretariat)*

This document presents a summary of recent developments in the Global Climate Observing System (GCOS) programme, particularly in the Atmospheric Observations Panel for Climate (AOPC), that are relevant to CGMS.

## GLOBAL CLIMATE OBSERVING SYSTEM (GCOS): UPDATE

### 1 GCOS Needs for Satellite-based Climate Monitoring

In 2006, GCOS provided supplemental detail to the space-based requirements of the *Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC* (GCOS-92, October 2004, the 'GCOS Implementation Plan') by issuing the document *Systematic Observation Requirements for Satellite-based Products for Climate* (hereafter called the 'Satellite Supplement').

#### WMO/CGMS Response to GCOS Requirements

CGMS-XXXIV adopted a preliminary response to the GCOS requirements through the WMO CBS Expert Team on Satellite Systems (ET-SAT-2), which:

- Supported the GCOS cross-cutting recommendations;
- Identified tentative lists of instruments potentially relevant to provide the observations needed for the generation of the required Fundamental Climate Data Records (FCDR) and climate products;
- Provided examples of the Critical Review based on the comparison of detailed GCOS requirements and observing capabilities, as available in the CEOS-WMO database;
- Suggested to update the GOS baseline in order to reflect the needs for long-term observations of additional variables for climate monitoring, and to update the Implementation Plan for the Evolution of the GOS accordingly;
- Highlighted potential areas where GCOS requirements for continuity may not be fulfilled according to currently available satellite plans;
- Suggested developing a dialogue with relevant GCOS panels in order to refine the requirements for FCDRs and provide a more detailed response.

CBS at its extraordinary session in November 2006 approved implementation of the nine cross-cutting recommendations formulated by GCOS in the Satellite Supplement; it requested the OPAG-IOS to commence an update of the GOS baseline of the space-based GOS up to 2025 as a new horizon, and expand its scope beyond WWW in order to include sustained observations of additional variables required for climate monitoring. In July 2007, ET-EGOS-3 on behalf of OPAG-IOS commenced this update, taking into account GCOS requirements.

In September 2007, ET-SAT-3 took another step in addressing GCOS needs by starting to work on improved access to historical satellite datasets through specific queries in the NASA Global Change Master Directory.

Furthermore, development and refinement of the high-level concept of a global network of Regional Specialized Satellite Centres (RSSC-CM) incorporates the requirements formulated in the GCOS Satellite Supplement. An implementation plan for the RSSC-CM is currently under development, led by EUMETSAT and WMO, with finalization planned for November 2007.

The GCOS Steering Committee and its Science Panels very much welcome the response provided by CGMS, and the continuing support by space agencies and the WMO Space Programme in putting forward the GCOS satellite requirements in all relevant fora.

Appreciation of this work was expressed by the Chairman of the GCOS Steering Committee in his statement to WMO Congress XV, which in turn welcomed the close and ongoing collaboration between WMO and GCOS on this matter.

The GCOS Secretariat and its Science Panels encourage the ET to continue its work, in collaboration with all relevant bodies. GCOS will continue to ensure that the importance of actions to enable WMO Members to monitor climate and help respond to climate change is broadly recognized.

### **CEOS Response to GCOS Requirements**

The Satellite Supplement also provided input needed by the Committee on Earth Observation Satellites (CEOS) in leading the preparation of a coordinated response by Parties to the UNFCCC with earth observation space agencies, to the requirements of the GCOS Implementation Plan. Such a response was requested by the Conference of the Parties (COP) to the UNFCCC in December 2004 through its decision 5/CP.10 and was submitted to COP in December 2006 through its Subsidiary Body for Scientific and Technological Advice (SBSTA) at the 25<sup>th</sup> session.

Collaboration between GCOS and CEOS has continued in 2007, mainly through strong support by the CEOS Chairman and Jean-Louis Fellous (CNES/ESA), who, in early 2007, has been nominated CEOS Executive Secretary (until the end of 2007).

In collaboration with GCOS, progress has been made in advancing the 59 actions in the CEOS response by identifying Climate Points of Contact within space agencies, by assigning actions to these Points of Contact, and by categorizing these actions into 21 actions with priority 1, 32 actions with priority 2, 5 actions with priority 3 (considered premature for the time being), 1 completed action, and 1 action considered premature.

According to the needs expressed in the GCOS Implementation Plan and its Satellite Supplement, GCOS acknowledges the appropriateness of the actions coordinated by each of the entities involved (e. g., CEOS, CGMS, WMO Space Programme) related to the coordination of satellite systems and the use of satellite observations. GCOS looks forward to future efforts to enhance this coordination.

## **2 GCOS/WCRP Atmospheric Observations Panel for Climate (AOPC) – 13<sup>th</sup> session**

The Thirteenth Session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC-XII) was held in Geneva, Switzerland from 23-27 April 2007. J. Schmetz, with support from S. Bojinski, informed the session of the constructive response of CGMS-XXXIV to the GCOS satellite-based requirements for climate, including recommendations from AOPC-XII in April 2006. At AOPC-XIII, the following CGMS-relevant conclusions and recommendations were agreed:

### **GCOS Reference Upper-air Network (GRUAN) and GSICS**

- (i) [...] AOPC noted the final report on the “GCOS Reference Upper-air Network: Justification, instrumentation, ...” (GCOS-112) as an important step towards establishing a GCOS Reference Upper-Air Network (GRUAN). It noted that a number of agencies had offered to take a lead role in furthering the establishment of the network, in response to a request for expressions of interest in acting as a Lead Centre for the network. The AOPC noted in

particular the very positive response from DWD in offering the resources needed to establish such a GRUAN Lead Centre at Lindenberg, Germany.

- (ii) In light of all the responses received, the AOPC recommended that the DWD offer be accepted for an initial period or 'pilot phase' during which the GRUAN concept could be further refined in cooperation with all partners, and leading to the establishment of an initial network with a limited number of stations. It also suggested that this refinement should be done in cooperation with the AOPC Working Group on Atmospheric Reference Observations (WG-ARO; Chair: Peter Thorne), which would continue to represent the interests of the AOPC in this initiative. [...]
- (iii) The AOPC reaffirmed the importance to the success of GRUAN of *in situ* observations throughout the atmospheric column. The Panel recognized the broad spectrum of opinions both within and outside the working group on the issues of launch scheduling and affordable reference-quality radiosondes. It recommended that the GRUAN network start with the highest-quality currently-operational radiosondes, mixed with periodic higher-quality reference radiosondes, and/or dual launches consisting of different radiosonde models. For immediate scheduling issues, the Panel recommended that GSICS (Global Space-based Inter-Calibration System) be engaged to assess the likely utility and operation of coincident launches. In view of the importance of these issues, the AOPC requested that the WG-ARO prepare, in collaboration with relevant parties including the GRUAN Lead Centre, a report on these issues for consideration at AOPC-XV in April 2009.
- (iv) The AOPC agreed with the WG-ARO that the GRUAN concept, and particularly the utility of reference-type observations, are not yet well publicized. The Panel would welcome the WG-ARO commissioning a journal paper (e.g. BAMS or EOS) outlining the concept and illustrating the utility of reference-type observations. Toward this end, examples on validation of AIRS radiances at ARM sites and IASI radiances at European observatories could be considered, in addition to examples presented at the recent session of the American Meteorological Society. Such a paper should provide additional momentum in support of the work of the new GRUAN Lead Centre.
- (v) The AOPC concurred with the WG-ARO view that data management issues for GRUAN have not been adequately considered to date. The major challenge here is to create collocation databases. The Panel recommended that the WG-ARO and the GRUAN Lead Centre consider lessons learned from GSICS and similar efforts such as those at NESDIS to create collocation databases. The AOPC reaffirmed the importance of making the data freely available in easy-to-use formats and as close to real-time as possible, to cater to all potential users including the operational community.
- (vi) The AOPC recognized that the GSICS and GRUAN activities are complementary and that more collaboration is needed between these activities. The Panel recommended that representatives from GSICS and GRUAN participate in each others' planning activities at a relevant level.
- (vii) In recognition of the importance of truly independent validation, the AOPC recommended that if GRUAN is successfully implemented, GSICS should strongly consider withholding at least some of the GRUAN sites from its

calibration/validation activities to permit those sites to be used as independent checks.

- (viii) The AOPC noted with appreciation the offer from the US to provide substantial support for an initial implementation workshop for the GRUAN network. The Panel suggested that the WG-ARO and the GRUAN Lead Centre organize such a meeting and include participation by representatives from the WG-ARO; the Lead Centre; the US DOE Atmospheric Radiation Measurement (ARM) programme; NCDC; NCAR; GSICS; CIMO; other candidate initial GRUAN sites; and others as deemed appropriate. The objective of the workshop would be to develop an implementation plan for the initial GRUAN which addresses the remit of the network and outstanding issues such as proof of concept, radiosonde details, formalization of practices, procedures and instrumentation, and data management. The workshop is planned for 26-28 February 2008, hosted by DWD in Lindenberg, Germany.

### **Satellite Issues**

- (ix) The AOPC recognized the important and complementary roles played by the Committee on Earth Observation Satellites (CEOS), the Coordination Group on Meteorological Satellites (CGMS) and the WMO Space Programme in responding to the GCOS requirements for space-based observations as expressed in the GCOS Implementation Plan and the Satellite Supplement. The Panel welcomed the recommendation from CGMS-34 for coordination among these entities to ensure that their responses are consistent and complementary.
- (x) The AOPC welcomed the recommendation from CGMS-34 that the International TOVS Working Group (ITWG) should foster international collaboration on the development of climate data records from TOVS and other long-term satellite series. The Panel suggested that the ITWG consider broadening the basis of its work through world-wide representative participation by experts working on improvement and analysis of both Fundamental and Thematic Climate Data Records (FCDRs and TCDRs).
- (xi) The AOPC noted the CGMS recommendation that satellite operators provide detailed information on instrument performance both in near-real-time and as quarterly assessment reports, particularly information on noise assessment and spectral response characteristics. The Panel confirmed the importance of this information for satellite climate applications. It noted with appreciation that GSICS is undertaking the creation of a repository of the required information and recommended that this be maintained as the sole authoritative source of such information.
- (xii) The AOPC welcomed the encouragement from CGMS to satellite operators to reprocess Atmospheric Motion Vectors (AMVs) in support of re-analysis, recognizing that some operators have already done so. The Panel noted in particular that the CEOS response to the GCOS Implementation Plan had stated that "The CEOS agencies will commit in 2007 to reprocessing the geostationary satellite data for reanalysis before the end of the decade". The Panel also took note of the efforts to produce AMVs over polar regions and expressed an interest in receiving reports on this in the future.

- (xiii) The AOPC noted the CGMS action to NOAA to report on reprocessing of AVHRR data for a new aerosol climatology over the oceans and looked forward to an update on progress at its next session. It suggested that this activity be considered along with the recent recommendation of the AOPC/TOPC Working Group on Land-Surface/Atmosphere issues (WG-LSA) that aerosol and surface properties be produced in a coherent manner, noting that this could be done in a future reprocessing of surface albedo and aerosol load over land.
- (xiv) The AOPC welcomed the CGMS recommendation that NASA, ESA, CNES and ISRO consider partnership arrangements to ensure the long-term continuity of altimeter missions, in view of the importance of establishing continuous sea-level monitoring from space.
- (xv) The AOPC reiterated the importance of the GCOS requirement for high-quality long-term measurement of the Earth radiation Budget and solar spectral irradiance by at least one polar-orbiting satellite system at any one time.
- (xvi) The AOPC welcomed the presentation by M. Goldberg on climate data products being developed at NOAA, recalling the many products that had specifically been identified in the GCOS Implementation Plan and the Satellite Supplement. The Panel strongly encouraged the continuation of this work, preferably through a stable, long-term climate product development programme. Such a programme could be coordinated with the establishment of a Regional/Specialized Satellite Centre on Climate Monitoring (R/SSC-CM) currently under consideration. The Panel emphasized the need to make the products, when sufficiently mature, freely and easily available to the user community.
- (xvii) The AOPC noted with appreciation the positive response to the GCOS Implementation Plan by WMO/CBS and the WMO Space Programme through the activities of the CBS Expert Teams (EGOS, SAT, SUP), and welcomed the ongoing cooperation with CEOS and CGMS. It reiterated the complementary role of these bodies and encouraged continuation of their productive collaboration in the coming year. The Panel noted the workshop on Redesign and Optimization of the WMO Space-based Global Observing System being organized for June 2007 and requested the Secretariat to ensure that AOPC's views were appropriately represented at this workshop.

***Regional/Specialized Satellite Centres on Climate Monitoring (R/SSC-CM)***

- (xviii) The AOPC fully endorsed the concept and overall structure of a Regional/Specialized Satellite Centre on Climate Monitoring (R/SSC-CM) as presented at the session. It expressed its appreciation to EUMETSAT, the WMO Space Programme and other partners for their efforts in developing this response to one of the key requests of the GCOS Implementation Plan and the Satellite Supplement. The Panel noted that care should be taken to ensure that the R/SSC-CM is appropriately incorporated into the WMO structure, and suggested that it might be managed in a way similar to that being used for the GSICS. The AOPC strongly encouraged the continuation of this effort and looked forward to an update on progress at its next session.



- (xix) The AOPC recognized that it could be beneficial for GCOS to develop a process through which it might formally or informally recognize products that meet the requirements expressed in the Second Adequacy Report and the Implementation Plan. As an example, it was suggested that a data set might be formally recognized once it had been described in the peer-reviewed literature and made freely available to users. The Panel requested the Chairman to bring this to the attention of the GCOS Steering Committee for consideration at its next session.
- (xx) The AOPC noted with great appreciation the major progress in planning and implementation of the GSICS initiative, following its initiation under the leadership of CGMS and the WMO Space Programme. It emphasized the need to ensure that adequate resources are made available to continue this work and strongly encouraged the relevant space agencies to make the necessary resources available. The Panel supported in particular the concept of a joint NOAA-NIST-NASA National Calibration Centre as a sustained US contribution to GSICS. It noted the potential for synergy between GSICS and an eventual GRUAN and encouraged the relevant parties to coordinate their activities as appropriate. The Panel also noted the potential benefits of coordination between GSICS and an R/SSC-CM and suggested that this could be pursued through overlapping membership in the two groups and co-sponsoring of periodic scientific meetings on the generation of satellite-based Essential Climate Variables.

***Terrestrial and Coupled Issues (Albedo, Aerosols, Soil moisture, Snow cover)***

- (xxi) The AOPC welcomed the presentation and report by the Co-Chairs of the joint AOPC/TOPC Working Group on Land Surface Albedo (WG-LSA) on the establishment and first session of the group. It expressed appreciation to the Co-Chairs for organizing the session, the Joint Research Centre of the European Commission for hosting it, and to the home institutions of the attendees for supporting their participation and contributions to this venture. The Panel noted that a number of recommendations contained in the report of the first meeting could best be addressed through the WCRP and requested that the report be brought to the attention of the WCRP Observations and Assimilation Panel (WOAP) and the WCRP Modelling Panel (WMP) at their next sessions.
- (xxii) The AOPC concurred with the finding that small differences or slight biases between many currently available products such as surface albedo can have significant impact on model results and applications based on these products. These discrepancies likely reflect inconsistencies in reflectance measurements and hinder the coherent, accurate retrieval of other land-surface properties such as leaf-area index, for example, and should be investigated further. The Panel reiterated the importance of long-term intercomparisons of surface albedo products and recommended that such work be undertaken as soon as funding permits, possibly within the framework of the AOPC/TOPC Working Group on Land-Surface/Atmosphere Issues.
- (xxiii) The AOPC noted the wide diversity of aerosol models used by different communities (e.g. weather forecasting and climate modelling, atmospheric corrections in remote sensing, atmospheric versus oceanic applications, radiative versus chemical applications), as well as the diversity of observation

programmes and methods, both remote-sensing and *in situ*. The Panel strongly encouraged the development of a coordinated set of aerosol models and properties that would adequately serve the needs of these communities and fully exploit the latest advances in retrieval methods to provide aerosol descriptions that can be cross-referenced or universally applied across disciplines.

- (xxiv) The AOPC recognized the importance of soil moisture for climate system monitoring and recommended that it be formally included as an Essential Climate Variable (ECV) in any future update of the ECV list.
- (xxv) The AOPC noted the WG-LSA observation regarding the difficulty in monitoring a number of quantities related to snow cover. Although the issues concerned might be taken up most appropriately by WCRP, the Panel recalled that three specific items related to snow cover had been identified in the GCOS Implementation Plan, with both AOPC and TOPC being included among the suggested agents for implementation. The Panel therefore agreed to reconsider this topic at its next session.