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**Twelfth Session of the GCOS/WCRP
Atmospheric Observation Panel for Climate (AOPC-XII)**

**CONSOLIDATED LIST OF CONCLUSIONS,
RECOMMENDATIONS AND ACTION ITEMS**

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GCOS/WCRP Atmospheric Observation Panel for Climate

AOPC-XII: CONSOLIDATED LIST OF CONCLUSIONS, RECOMMENDATIONS AND ACTION ITEMS

(Geneva, Switzerland, 3-7 April 2006)

1. The AOPC noted that the current meeting was the last under the Chairmanship of Dr Mike Manton, who would be retiring from the Panel after this session. It expressed its sincere thanks to Dr Manton for his many years of dedicated and enthusiastic leadership of the Panel and his unflagging support for GCOS and its objectives. The Panel welcomed Dr Adrian Simmons as the new Chairman and looked forward to working with him in meeting the objectives of the Panel.
2. The AOPC expressed its thanks to retiring members Drs. Philip Arkin and Raphael Okoola for their contributions to the panel during their terms as members. It furthermore expressed its appreciation to the retiring Chairman of the GCOS Steering Committee, Prof. Paul Mason, and welcomed Dr John Zillman as the incoming SC Chairman.
3. The AOPC welcomed the perspectives of Dr Zillman on the role of GCOS, including for example the need for GCOS to support climate monitoring, climate research, climate services and applications, and the development of international policy on climate issues, *inter alia* through the UNFCCC and the IPCC. It also noted Dr Zillman's emphasis on the need for GCOS to cooperate with programmes such as the World Climate Programme in order to broaden its reach to the user community.
4. The AOPC welcomed the overview of the objectives of the Group on Earth Observations (GEO) presented by the GEO Secretariat. It noted in particular the recognition by GEO of GCOS as being the climate component of the Global Earth Observation System of Systems (GEOSS), including WCRP contributions for the research aspects. The Panel encouraged GEO to continue to support the GCOS Implementation Plan in its future work plans and to assist GCOS in its efforts to consolidate the 'climate' societal benefit area of GEOSS.
5. The AOPC reviewed and amended the draft document 'Systematic Observation Requirements for Satellite-based Products for Climate', being prepared in consultation with WCRP and others to provide additional details to the requirements identified in the GCOS Implementation Plan. It expressed its appreciation to the experts who were contributing to this document and recognized the efforts of the GCOS Secretariat in coordinating its preparation. The Panel recommended that the document should explicitly recognize the importance of CGMS in meeting its own work agenda in support of these plans.

GSN and GUAN

6. The AOPC welcomed the completion and distribution of Certificates of Recognition for all stations in the GCOS Surface Network (GSN) and GCOS Upper-Air Network (GUAN), based on performance of the stations for the 2003-2004 period of operation. It noted the benefits of this activity in publicizing the GSN and GUAN networks and highlighting the responsibilities of the station operators. The Panel requested the Secretariat to repeat this activity for the 2005-2006 monitoring period, in cooperation with the CBS Lead Centre at the National Climatic Data Center (NCDC).
7. The AOPC noted the possible existence of historical upper-air data from the GUAN network that might not currently be included in the GUAN archive. It requested the GUAN Lead Centre (NCDC) to examine the International Global Radiosonde Archive (IGRA) database to investigate this issue and to initiate the incorporation of such data into the GUAN archive where that might be feasible.

8. The AOPC encouraged the Secretariat to take steps needed to ensure that the purposes and functions of GSN and GUAN are understood and incorporated appropriately in the activities of CBS and CCI and in the Regions.
9. The AOPC suggested that ties with CBS could be strengthened and requested the GCOS Director to liaise with the WWW Director to ensure the consolidation of appropriate ties.
10. The AOPC expressed its strong appreciation to the GSN Monitoring Centres at the Deutscher Wetterdienst (DWD) and Japan Meteorological Agency (JMA) for their efforts in monitoring the performance of the GSN and making the results available through their respective Web sites. It suggested that the impact of the performance results might be further enhanced by sending the summary maps directly to the GCOS Focal Points on a routine basis and request the MCs to explore this possibility, in cooperation with the GSN Lead Centre at NCDC.
11. The AOPC noted with appreciation the efforts being expended by the Lead Centres at JMA (including the Tokyo Climate Centre) and NCDC to pursue issues of inadequate performance at specific stations and commended them for engendering the improvements that were clearly being achieved through these efforts.
12. The AOPC expressed its appreciation to Australia (Bureau of Meteorology, BOM), Iran (Islamic Republic of Iran Meteorological Organization, IRIMO) and Morocco (Département de la météorologie nationale, DMN) for having agreed to join Japan (JMA) and the USA (NCDC) in the capacity of regional CBS Lead Centres for GCOS Data. It encouraged the establishment of additional Lead Centres where possible to assist in performing this valuable work in support of the GSN and GUAN, noting that the southern Africa and South America regions could benefit particularly well from the services of a Lead Centre. The Panel also suggested that the possibility of a Lead Centre for Antarctica be explored, perhaps in consultation with the WMO WG on Antarctic Matters.
13. The AOPC expressed particular thanks to the GSN Monitoring Centre at DWD for its many actions to increase the flow of CLIMAT reports and encouraged it to consider being formally designated as a full CBS Lead Centre for GSN Data.
14. The AOPC expressed its appreciation to ECMWF, NCDC and the Hadley Centre for their continuing support as GUAN Monitoring and/or Analysis Centres.
15. The AOPC requested the GSN and GUAN Monitoring Centres and the NCDC Archive to harmonize their data holdings at regular intervals to ensure that the archive contained the most complete set of data available at any time.
16. The AOPC expressed its appreciation to NCDC for the progress made in increasing the archive holdings for both GSN and GUAN and looked forward to the eventual achievement of a complete, identifiable and accessible archive for these data. It recommended that all GSN data in the Global Historical Climatology Network (GHCN) be incorporated into the GSN as soon as feasible.
17. The AOPC recommended that metadata on homogenization should be appropriately flagged in the GSN archive and that the Web-accessible GSN dataset should contain homogenized time series. It encouraged CCI to continue to promote the homogenization of historical daily data, including the organization of expert meetings to refine homogenization techniques and of training workshops to promote the preparation of homogenized datasets.
18. The AOPC noted that there remain a substantial number of regions from which there are no historical GSN data archived in the WDC. It requested the Secretariat to liaise with relevant WMO Commissions to investigate the potential for formal WMO mechanisms, such as the Regional Association Working Groups on Climate-Related Matters, to be used to convince WMO Members of the benefits and need to provide these data.

19. The AOPC noted the presentation that demonstrated minimal impacts of siting effects on the temperature trends observed at a number of selected stations. It recognized the benefits of including photographic siting metadata where available but reiterated that it did not consider a programme of obtaining detailed photographs for all stations to be a high priority at this time.
20. The AOPC looked forward to the strengthening and completion of efforts by the appropriate WMO Commissions (CBS, CCI, CIMO) to develop a standard and consistent approach to providing metadata for surface and upper-air measurements.
21. The AOPC welcomed the many positive results and recommendations of the second CBS/GCOS Expert Meeting on Coordination of the GSN and GUAN (EMCGG-2, Asheville, USA, 28-30 September 2005). It expressed its appreciation to CBS and the WWW Secretariat for their cooperation in organizing the session and to NCDC for hosting it.
22. The AOPC welcomed the continuing progress in revitalizing GUAN and GSN stations with the assistance of the US GCOS Program and several other WMO Members.
23. The AOPC noted the positive results of the recent informal meeting of representatives from the CBS Lead Centres for GCOS Data (Geneva, 27-31 March 2006). It suggested the continuation of such sessions as appropriate, possibly in combination with additional Expert Meetings on the Coordination of the GSN and GUAN, which should occur on a 2-3 year time scale.
24. The AOPC recommended that the GCOS Technical Support Projects provide routine reports on their activities to the WMO Regional Associations, through the appropriate GCOS Rapporteurs.
25. Bearing in mind the risks enumerated by CCI in the use of Automated Weather Stations (AWSs) for climate purposes, the AOPC agreed that it was generally inappropriate for GCOS to fund or promote the installation of AWSs at GSN sites. The Panel reiterated the request to all countries that the operation of manual observing stations for GSN and GUAN be continued for as long as possible.
26. The AOPC recognized the benefits of the GCOS Regional Workshops in stimulating action to improve data submission and in encouraging countries to offer their services as Lead Centres for GCOS Data.
27. The AOPC looked forward to the completion of the updated Guide to Climatological Practices and recommended that it be fully harmonized with the recently-published Handbook on CLIMAT and CLIMAT TEMP Bulletins. The Panel reiterated the value of these messages for quality control purposes and for generating some specific climate products, as agreed also at the recent EMCGG-2 meeting in Asheville, USA.
28. The AOPC noted the progress made by the research community, including members of the Working Group on Temperature Trends (WG-TT), in resolving the apparent inconsistencies between temperature trends in the free atmosphere and those at the surface. It thanked the WG-TT for its contributions to these scientific advances and agreed that the group could now be disbanded.
29. The AOPC noted with appreciation the initiative of NOAA with GCOS to design and promote the establishment of an atmospheric reference network focused on high-quality upper-air observations, preferably at existing sites where feasible. It noted in particular the initial steps taken at the workshop in Boulder in February 2005 and the plans for a follow-up workshop on 'Reference Upper Air Observations for the Global Climate Observing System: Potential Technologies and Networks' to be held in Seattle in May 2006. In order to provide an international framework for the establishment and support for such a reference network, the AOPC agreed to establish a Working Group on Atmospheric Reference Observations (WG-ARO), with Terms of Reference and initial membership as described in Attachment 1.

30. The AOPC noted with appreciation the progress made by M. Rusticucci in contacting several countries in South America regarding performance issues for their GSN and GUAN stations. It welcomed especially the release of historical data from a number of stations and the positive signs for obtaining additional data. The Panel encouraged Dr Rusticucci to continue these efforts, through collaboration with the relevant GCOS Focal Points and other appropriate contacts.
31. The AOPC requested the Secretariat to explore the possibility of engaging Chile as a Lead Centre for the South America region.
32. The AOPC expressed its appreciation to Brazil for providing telecommunications assistance in obtaining data from the San Cristobal GUAN station in the Galapagos Islands. It requested the Secretariat to follow up the contacts made with Brazil to investigate the possibility of obtaining the needed historical data from its GSN stations, noting the earlier requests from the WMO Secretary-General and emphasizing the availability of national and international mechanisms for digitizing data where needed.
33. The AOPC commended the progress being made in the CLARIS (Europe-South America Network for Climate Change Assessment and Impact Studies) project to assemble data from a number of countries in South America. It encouraged additional countries to contribute data to this effort and to make them openly available for climate monitoring purposes.
34. The AOPC endorsed the recommendations of the Advisory Group on GSN and GUAN (AGG) made during the session, including the statements on climatological normals and replacement of GSN sites presented in Attachment 2.
35. The AOPC requested the AGG to establish additional time series of indicators that would demonstrate progress in improving the performance of the GSN and GUAN.
36. The AOPC welcomed the efforts in data rescue being carried out under the International Environmental Data Rescue Organization (IEDRO) initiative and encouraged its continuation. It suggested that contact should be maintained with the WCP Data Rescue (DARE) project as needed to ensure maximum effectiveness of both efforts.
37. The AOPC expressed its appreciation to the Director of ACMAD for briefing the session on the status of archived data for Africa at the Centre and clarifying the opportunity for its recovery. It recommended the development of a detailed proposal for the digitization and analysis of these data through the WCP DARE project, emphasizing the need to make the data for at least GSN stations openly available through the GSN archive. The Panel also suggested that one or more climate extremes workshops be organized at which representatives of the various countries could use the digitized data for carrying out analyses.
38. The AOPC noted that considerable data from Africa had been submitted to NCDC for digitization in a previous exercise that had apparently not yet resulted in all of the data being returned to the submitting country. It requested Tom Peterson to investigate this issue in collaboration with WCP to try to resolve any outstanding issues.
39. The AOPC noted that countries have a greater motivation to release climate data when they have the capability to analyse and use those data. It recommended that there should be continuing activity, for example through START and/or CCI, to enhance the capability of developing countries to analyze daily climate data.
40. The AOPC welcomed the update on CCI structure presented by the Chairman of the Open Programme Area Group on Climate Data and Data Management. It noted the complementary roles of GCOS for global networks and CCI for regional and national networks, with the GCOS baseline networks providing the large-scale context for the interpretation and calibration of the regional-scale networks. The Panel looked forward to continuing collaboration with CCI through appropriate joint meetings and workshops and ongoing cooperation between the WCP and GCOS secretariats.

Satellite Issues

41. The AOPC welcomed the positive response of CGMS-XXXIII to the recommendations of AOPC-XI. It noted in particular the actions being taken by CGMS members to take steps needed to make their archived satellite data usable for climate studies, recognizing the benefits of the iterative process between reprocessing of the data and reanalyses.
42. The AOPC reiterated the desirability of developing globally-consistent fields of atmospheric motion vectors and welcomed the progress being made by Eumetsat and JMA toward this end.
43. The AOPC welcomed the Global Space-based Inter-Calibration System (GSICS) initiative being developed under the leadership of CGMS and the WMO Space Programme. The goal of GSICS is to achieve operational inter-calibration of the space component of the World Weather Watch's Global Observing System that addresses the climate, weather forecasting and other environmental needs of WMO Members. GSICS also includes requirements for reference sites to validate satellite observations. The Panel offered to cooperate in this effort and looked forward to an update on progress at its next session.
44. The AOPC recommended the continuation of international evaluation and benchmarking activities of existing geophysical products, notably surface albedo and the retrieval of cloud and aerosol properties.
45. The AOPC welcomed the pilot project carried out by Eumetsat to derive a spatially-consistent land-surface albedo product from five different geostationary satellites over a limited time period, with a view to subsequently inviting other satellite operators to share the load of carrying out the work needed to process the entire data record. It commended this as a model approach to developing the globally-consistent climate records needed for all parameters and encouraged its continuation.
46. Recognizing the benefits of hyperspectral IR sounders for generating climate data sets, the AOPC emphasized the desirability of ensuring the availability of sufficient instruments to allow the determination of diurnal variability in these products.
47. The AOPC commended the progress being made at the Eumetsat Climate Monitoring Satellite Application Facility (CM-SAF) and expressed its appreciation for the opportunity to interact closely with the SAF through participation in its regular user consultation workshops. The Panel noted in particular the product intercomparison activities being carried out through various workshops and working groups and strongly encouraged their continuation. It also welcomed the close interaction between the CM-SAF and other related SAFs in the SAF network.
48. The AOPC expressed its support for the objectives of the CM-SAF Continued Development and Operations Phase (CDOP) for 2007-2012. It welcomed especially the planned backward extensions in time and spatial extension to global scale for many of its products, in accordance with recommendations from the joint Eumetsat/GCOS/WMO workshops in 2004 and 2005.
49. The AOPC recognized the benefits and capabilities of GPS radio occultation for obtaining homogeneous climate records, especially in the stratosphere, and emphasized the need for continuation of the relevant measurement capabilities.

Atmospheric Forcing

50. The AOPC was encouraged by the initial progress in the GEMS project that, *inter alia*, is developing a capability for global monitoring of the ECVs related to atmospheric composition. It noted that instruments on the AURA and ENVISAT satellites were providing measurements

of reactive species important for tropospheric air quality, while expressing concern about the current lack of provision for follow-on missions that would maintain this emerging capability.

51. The AOPC noted the progress in the WMO/GAW Global Atmospheric CO₂&CH₄ Monitoring Network, including development of a 5-year strategic plan. It encouraged the continuation of efforts to develop the capability to monitor N₂O.
52. The AOPC noted with appreciation the work of the World Data Centre for Greenhouse Gases (WDCGG) of JMA in archiving and analyzing greenhouse gas data under the recently-agreed arrangement between WMO/GAW and GCOS.
53. The AOPC recognized the benefits of clear outreach material to highlight the positive developments in many of the networks in fora such as the UNFCCC. It encouraged the GCOS Secretariat to consider the development of such material in cooperation with the network operators.
54. The AOPC noted the extensive coverage of the *in situ* network of stations for monitoring total ozone, while recognizing the need for additional stations to achieve improved global coverage, particularly in the southern hemisphere. It also noted that while the satellite network needed to identify the vertical structure of ozone on a global basis was adequate at present, the missions needed to ensure continuation of this coverage were not assured. The Panel encouraged the space agencies to address this issue.
55. The AOPC requested the GAW and GCOS Secretariats to investigate designating the GAW Total Ozone Network as the major component of a GCOS Total Ozone Network.
56. The AOPC noted with appreciation the document and information provided by Dr Bill Rossow, Chairman of the GEWEX Radiation Panel (GRP), on strategies for monitoring radiation and related atmospheric variables. The following conclusions were agreed in light of the associated discussion:
 - The most effective strategy for monitoring the top-of-atmosphere (TOA) radiation budget is through a multi-track process, utilising at least one broadband radiometer in conjunction with data from a range of visible, near-IR, IR and microwave instruments flown for other purposes in both geostationary and polar orbits. This would provide important, independent cross-checks in what is a minimal system that supports studies to improve understanding of the processes causing variability and changes in the Earth Radiation Budget (ERB). Such a strategy would require the space agencies to ensure that at least one broadband instrument is in orbit at any one time, although the overall system would be more accurate and robust if more than one such instrument were flown continuously. Indeed, adherence to the GCOS Climate Monitoring Principles would require a period of overlap between successive missions even if the minimal strategy were applied.
 - Monitoring of the ERB requires monitoring of the solar flux with an accuracy of at least 1 W/m², and this requires spectrally-resolved measurements to infer the total solar irradiance (TSI). Current satellite plans do not ensure that the TSI will be adequately monitored over the coming decades.
 - Successful implementation of the strategy for monitoring the ERB, including the TSI, will require a comprehensive program of cross-calibration and intercomparison among all the space agencies involved in the operation of the full constellation of relevant satellites. The AOPC is confident that implementation by CGMS of the proposed GSICS programme will fulfill this requirement.
 - The AOPC emphasized the importance of an active and effective archive system for Baseline Surface Radiation Network (BSRN) data. It requested the Secretariat to assist the WCRP secretariat in the resolution of uncertainties in the present arrangements.

- The AOPC endorsed the BSRN strategy to measure a range of relevant variables at BSRN sites including radiation, aerosol, cloud, and basic meteorological data, to ensure that effective analysis of the global surface radiation budget (SRB), including satellite data, can be developed. It is anticipated that BSRN sites will become part of the overall global reference network promoted in the GCOS Implementation Plan.
- The AOPC strongly endorsed the analysis arrangements for BSRN, which have the GRP providing the forum for international comparison of SRB analyses and techniques while recognizing the primary role of NASA Langley in providing continuing analysis of the SRB.
- The AOPC commended the progress made by the International Satellite Cloud Climatology Project (ISCCP) over the last two decades. It recommended that continuing operation of the ISCCP analysis system should be transferred to an operational group with an appropriate mandate and expertise, and that such a group should maintain an effective relationship with the relevant research community through the GRP.
- The AOPC encouraged the research community, through WCRP, to continue activities that will eventually lead to the routine monitoring of the 3-dimensional structure of clouds.
- The AOPC recognized that comprehensive physical and chemical measurements of aerosols remain in the research agenda. However, basic physical properties such as aerosol optical depth can now be collected routinely, and these measurements should be taken at all BSRN sites.

Terrestrial Issues

57. The AOPC welcomed the participation of TOPC member Dr Michel Verstraete at this session and noted with appreciation his presentation on issues of common interest to AOPC and TOPC. It agreed fully on the need for joint activities to address these issues and endorsed the establishment of a Working Group on Land-Surface/Atmosphere Issues (WG-LSA). The role of this working group will be to promote the coherent retrieval of surface and atmospheric ECVs (e.g., surface albedo, FAPAR, aerosols and thin cloud properties), consistent with and in direct support of the overarching goals of GCOS as described in the Implementation Plan and other applicable documents. Detailed Terms of Reference and membership of the WG-LSA are presented in Attachment 3. The Panel furthermore agreed on the establishment of an *ex officio* member from TOPC on AOPC and requested the Chairman to seek confirmation of such an arrangement from the GCOS Steering Committee.
58. The AOPC expressed its appreciation to the European Commission/Joint Research Centre for supporting the participation of Dr Verstraete at this session and hoped that such support could be continued for future joint activities between the TOPC and AOPC.
59. The AOPC emphasized the importance of snow properties to atmospheric analyses and prediction. It noted the urgent need for coordination of activities aimed at recovering historical snow cover and snow depth data, as well as for carrying out systematic intercomparisons of analysis and measurement techniques for these parameters. The Panel agreed that TOPC should be invited to join with AOPC to develop a programme of work on this topic.

Marine Issues

60. The AOPC expressed its appreciation for the progress reported by the Argo profiling-float programme and the surface drifting buoy programme, while noting that efforts need to be continued to enhance the percentage of drifting buoys that carry sea-level pressure sensors. Each programme has accomplished much greater global coverage than has previously been achieved, through concerted efforts by a diverse international effort. The entire marine community (research, operational and commercial) is contributing to implementing and sustaining the needed arrays.

61. The AOPC noted that the global ocean observing system continues to be supported primarily as the result of international coordination of efforts by individual principal investigators that are sponsored by national research programmes. It urged nations to sustain the full range of ocean climate observing efforts, including Argo and the surface drifting buoy programmes.
62. The AOPC welcomed N. Rayner (Hadley Centre) and T. Smith (NCDC) as the new co-chairs of the joint AOPC/OOPC Working Group on Sea Surface Temperature and Sea Ice and noted that a separate Sea Ice subgroup had been established under S. Anderson (EUMETSAT OSI-SAF). It looked forward to the results of product-intercomparison activities for SST and for sea-ice concentration and extent. The Panel noted with appreciation that the US National Oceanographic Data Center (NODC – K. Casey) had agreed to provide data server and comparison-tool development support.
63. The AOPC noted with interest the presentation on decadal and multi-decadal temperature trends in the upper ocean and ocean surface. There are coherent regions of statistically significant ocean warming and others of cooling over each ten- and twenty-year period of the post-1945 period as well as on the fifty-year time scale. Due to limited historical sampling away from the ocean surface and increasingly with depth, large areas of the sub-surface global ocean do not have statistically significant local trends over the past fifty years. The trends from decade-to-decade vary substantially and often are of large amplitude; trends over the satellite era (1979-present) are not typical of those over previous periods of similar duration. The Panel noted that the global ocean observing system called for in the GCOS IP, if sustained, would address the sampling needs for establishing both decadal and long-term world oceanic temperature trends, as well as providing dramatically better information about oceanic conditions in and somewhat below the ocean thermocline.
64. The AOPC welcomed the establishment of a pilot project to provide real-time metadata for ocean temperatures transmitted over the GTS, noting that success of the project would make this information more useful for NWP, for seasonal to inter-annual climate prediction, and for climate analysis and research. The Panel noted with appreciation the offer by China to host and support the needed global ocean metadata server.
65. The AOPC commended the Working Group on Surface Pressure (WG-SP) for establishing the sea-level pressure Web site and thanked NOAA for hosting it.
66. The AOPC requested the Chairman of the WG-SP to review the Terms of Reference and membership of the WG in consultation with the AOPC Chairman.

Synthesized Products and Reanalysis

67. The AOPC noted with appreciation the significant progress at the Global Precipitation Climatology Centre (GPCC) in enhancing the global precipitation data base and in developing and making available relevant climatological analysis products. The Panel encouraged GPCC to continue its efforts in maintaining and updating the database and related analyses in the future.
68. The AOPC noted the inherent inaccuracies associated with the measurement of precipitation at high latitudes from both satellites and *in situ* measurements. It emphasized the need to carry out new intercomparison studies for measurement of solid precipitation and urged WMO (CIMO, CBS) to pursue the possibility of carrying out this work.
69. The AOPC requested the TOPC to promote investigation of the apparently-changing relationship between precipitation and runoff, especially at high latitudes.
70. The AOPC welcomed the progress in preparing a new reanalysis from 1989 at ECMWF and noted the exploration of the potential for a European Regional Reanalysis. The Panel welcomed ECMWF's longer-term objective to carry out a new comprehensive reanalysis to replace and extend ERA-40 and encouraged continuation of these efforts.

71. The AOPC welcomed the completion of the JRA-25 reanalysis and commended the JMA for the quality of this work. It recognized in particular JMA's significant contribution in enhancing the basic database of meteorological data for reanalysis.
72. The AOPC welcomed the update provided by P. Arkin on US reanalysis activities and looked forward to opportunities for enhancing international cooperation.
73. The AOPC noted that while reanalysis has in the past been motivated primarily as a means of developing a homogeneous record for climate studies, the technique is increasingly being used to improve numerical prediction systems at seasonal and shorter time scales.
74. The AOPC noted the atmospheric reanalysis workshop being organized by ECMWF, in cooperation with GCOS and WCRP, for June 2006 and welcomed the support being provided for the meeting by the international Group on Earth Observations (GEO).
75. The AOPC expressed its appreciation to JMA and the Central Research Institute of the Electric Power Industry (CRIEPI) for preparing to organize an international reanalysis workshop in Japan toward the end of 2007. The Panel looked forward to cooperating as appropriate in this effort.
76. The AOPC requested the Chairman to liaise with the WCRP Observation and Assimilation Panel (WOAP) in the preparation of a paper on the value of continuing investment in reanalysis, including development of an internationally-shared database, for presentation to the next session of the Panel.

Other

77. The AOPC welcomed the update on the climate extremes workshops that had been carried out under the CCI/Clivar Expert Team on Climate Change Detection, Monitoring and Extremes, as well as through the Asia-Pacific Network on Global Change Research (APN). It was pleased to note that the workshops had been successful in combining a capacity-building exercise with state-of-the-art analysis of changes in extremes; that each workshop had produced a valuable, peer-reviewed journal article; that all the analyses had contributed to the global extremes article; and that this had been completed in time to contribute to the IPCC Fourth Assessment Report. The Panel recommended the continuation of this series of workshops, especially in conjunction with data rescue activities, noting that recently-rescued data could provide new insights into climate change and that analyses using these data could highlight the value of rescue and digitization.
78. The AOPC encouraged the preparation of a paper, under the leadership of M. Manton and with collaboration from the GCOS Panel Chairmen, outlining the justification and benefits of a small set of global climate indicators.
79. The AOPC noted the project underway in Australia to analyze paleoclimate data for the recent several hundred years and looked forward to its results.
80. The AOPC noted the current status of Panel activities related to the implementation of relevant actions from the GCOS Implementation Plan. It recommended that this status be regularly updated at future AOPC sessions, with presentations at those sessions clearly linked to the actions wherever possible.
81. The AOPC agreed that the next session of the AOPC would be held in Geneva, Switzerland from 23-27 April 2007.

GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC)
Working Group on Atmospheric Reference Observations
(WG-ARO)

The AOPC Working Group on Atmospheric Reference Observations (WG-ARO) has been established in recognition of the importance of reference quality observations of temperature and water vapour in the free atmosphere to enhancing the monitoring and understanding of climate variability and change. A number of national and international initiatives are being considered or have been started during the last few years and the AOPC aims to work with relevant agencies to provide international coordination and a framework for the associated monitoring and research activities as reflected in the terms of reference.

Terms of Reference

- To work with relevant agencies and programmes to define and promote a global network for long-term atmospheric multi-variable reference observations that makes optimal use of existing and planned infrastructure;
- To liaise with CGMS, the WMO Space Programme, CBS and CIMO on satellite and radiosonde calibration and validation issues, including reference instrumentation and metadata, especially through the Global Space-based Inter-Calibration System initiative;
- To promote the application of the GCOS Climate Monitoring Principles in observing systems used for climate purposes;
- To promote analyses and inter-comparisons of homogenized atmospheric climate data, especially temperature and water vapour, related to climate variability and change;
- To advise the AOPC on evolving requirements for data types for analysis of atmospheric trends;
- To report at least annually to AOPC on the activities of the Working Group, in particular on the results of current analyses and on advances in scientific understanding of climate variability and change in the free atmosphere.

Operation

The Working Group will generally correspond by e-mail and take advantage of relevant workshops and conferences to hold *ad hoc* meetings. Funding will be sought from time to time to hold special workshops or meetings of the group.

Chairman

Peter Thorne (Met Office, UK)

Membership

(To be confirmed)

Explanatory statements prepared by the AGG

1. Rationale for the 1961-90 period to continue as the designated baseline period

The current WMO 'Climatological Standard Normal' period is 1961-90. This is very unlikely to change until after the period 1991-2020 is completed. At workshops related to GSN and GUAN monitoring, there have been some discussions on whether there should be a move to 1971-2000. The AOPC recommends, particularly for GSN-related products and all surface-based data, that the period 1961-90 be retained until at least 2010. The IPCC Fourth Assessment Report (AR4, to appear in early 2007) will use 1961-90 as its base for all observational-based surface time series.

For upper-air products, base periods such as 1979-2003 are recommended, since reanalysis-based products are more reliable from 1979. IPCC AR4 will use this base period for comparisons of the various MSU time series. This greater reliability makes a replacement of the 1961-90 period with 1981-2010 very likely.

2. Replacement of GSN sites

The following paragraphs are for use as appropriate when countries they are considering modifications to their existing or new GSN station(s).

Guidelines for Selecting New GCOS Surface Network (GSN) Stations

The GCOS Surface Network (GSN) is made up of the best climate stations from all over the world. If one or more of the GSN stations in your country must change, please consider the following criteria when determining the best stations to recommend for inclusion in the GSN. Careful selection of new GSN stations can improve the GSN's ability to contribute to analysis and monitoring long-term climate change.

- *Climate change concerns.* There are a variety of factors that confound accurate long-term climate change analysis. These include urban warming (therefore stations in rural areas are preferable to stations in large urban areas) and station relocations and changes in instrumentation (therefore stations with as few moves and as few changes as possible in the type of instrumentation or observing practices are preferable).
- *Spatial considerations.* A new station does not necessarily have to be close to the old station it is replacing. It should however be reasonably far from any other GSN station (new GSN stations should be at least 350 km from the nearest existing GSN station unless there is a major difference in altitude). Consideration should be given to filling gaps in the GSN spatial coverage. It is therefore requested that countries contact the GCOS Secretariat to receive a map showing the location of all the GSN stations in their country as well as neighbouring countries, since the nearest station in this global network may be just across the border
- *Availability of long-term data.* One can not learn how climate of 2006 compares with the climate of 1906 if the station only started making observations in 1976. Therefore, stations with longer periods of record are preferable. In most areas of the world, 50 years of data should be considered a minimum, with much longer periods of record being preferable.
- *Availability of real-time data.* One of the obligations associated with being a GSN station is to transmit data, specifically CLIMAT messages, in near-real-time. While these monthly data do not need to be transmitted immediately on the first day of the new month, it is important to choose stations where these data will be able to be transmitted. Ideally these messages should be transmitted before the 8th day of the month; however, if waiting a few extra weeks for the CLIMAT reports means that an excellent station for climate change purposes could be included in the GSN, then that delay would certainly be acceptable.

GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC)

AOPC/TOPC Working Group on Land-Surface/Atmosphere Issues (WG-LSA)

The AOPC/TOPC Working Group on Land-Surface/Atmospheric Issues (WG-LSA) has been established to promote the coherent retrieval of surface and atmospheric Essential Climate Variables (e.g., surface albedo, fAPAR, aerosols and thin cloud properties), consistent with and in direct support of the overarching goals of GCOS as described in the Implementation Plan and other applicable documents.

Terms of Reference

- To promote the development of methods and tools to accurately retrieve both surface and atmospheric properties in a radiatively-consistent manner, the benchmarking of the relevant algorithms and the inter-comparison of the resulting ECV products;
- To promote the generation and distribution of time series of global ECV products, including their quality assessment and control, and to ensure their adequacy for climate and other applications, especially 4-dimensional data assimilation and reanalyses;
- To consider and recommend to AOPC and TOPC other activities that would be of interest to both the atmospheric and terrestrial communities, in particular with respect to emerging or additional ECVs, as well as other products and processes that could be of relevance to filling gaps in the current Implementation Plan or to address other climate change issues;
- To report at least annually to AOPC and TOPC on the activities of the WG-LSA.

Operation and Membership

The Working Group will initially be led and co-chaired by Michel Verstraete (TOPC) and Johannes Schmetz (AOPC), who will develop and coordinate strategies and work plans to carry out the tasks mentioned above. Specific task groups, composed of a small number of ad hoc experts, may be formed to ensure progress on specific variables or issues, as and when needed. The AOPC recognizes that a number of ECVs and geophysical processes of climate significance could and should be addressed through such a mechanism, but recommends that the Working Group initially focus its attention on a specific, well-defined problem with a view to solidifying collaboration and demonstrating progress. One such issue could be the retrieval of land-surface albedo and atmospheric aerosol properties and the exploitation of these ECVs in climate analyses, climate modeling and reanalyses.

ANNEX 1

LIST OF PARTICIPANTS

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LIST OF GCOS PUBLICATIONS*

- GCOS-1**
(WMO/TD-No. 493) Report of the first session of the Joint Scientific and Technical Committee for GCOS (Geneva, Switzerland, April 13-15, 1992)
- GCOS-2**
(WMO/TD-No. 551) Report of the second session of the Joint Scientific and Technical Committee for GCOS (Washington DC, USA, January 11-14, 1993)
- GCOS-3**
(WMO/TD-No. 590) Report of the third session of the Joint Scientific and Technical Committee for GCOS (Abingdon, UK, November 1-3, 1993)
- GCOS-4**
(WMO/TD-No. 637) Report of the fourth session of the Joint Scientific and Technical Committee for GCOS (Hamburg, Germany, September 19-22, 1994)
- GCOS-5**
(WMO/TD-No. 639) Report of the GCOS Data System Task Group (Offenbach, Germany, March 22-25, 1994)
- GCOS-6**
(WMO/TD-No. 640) Report of the GCOS Atmospheric Observation Panel, first session (Hamburg, Germany, April 25-28, 1994)
- GCOS-7**
(WMO/TD No. 641) Report of the GCOS Space-based Observation Task Group (Darmstadt, Germany, May 3-6, 1994)
- GCOS-8**
(WMO/TD No. 642)
(UNEP/EAP.MR/94-9) Report of the GCOS/GTOS Terrestrial Observation Panel, first session (Arlington, VA, USA, June 28-30, 1994)
- GCOS-9**
(WMO/TD-No. 643) Report of the GCOS Working Group on Socio-economic Benefits, first session (Washington DC, USA, August 1-3, 1994)
- GCOS-10**
(WMO/TD-No. 666) Summary of the GCOS Plan, Version 1.0, April 1995
- GCOS-11**
(WMO/TD-No. 673) Report of the GCOS Data and Information Management Panel, first session (Washington DC, USA, February 7-10, 1995)
- GCOS-12**
(WMO/TD-No. 674) The Socio-economic Benefits of Climate Forecasts: Literature Review and Recommendations (Report prepared by the GCOS Working Group on Socio-economic Benefits), April 1995
- GCOS-13**
(WMO/TD-No. 677) GCOS Data and Information Management Plan, Version 1.0, April 1995
- GCOS-14**
(WMO/TD-No. 681) Plan for the Global Climate Observing System (GCOS), Version 1.0, May 1995
- GCOS-15**
(WMO/TD-No. 684) GCOS Plan for Space-based Observations, Version 1.0, June 1995
- GCOS-16**
(WMO/TD-No. 685) GCOS Guide to Satellite Instruments for Climate, June 1995
- GCOS-17**
(WMO/TD-No. 696) Report of the GCOS Atmospheric Observation Panel, second session (Tokyo, Japan, March 20-23, 1995)

*GCOS publications may be accessed through the GCOS website at:
<http://www.wmo.int/pages/prog/gcos>

- GCOS-18**
(WMO/TD-No. 697)
(UNEP/EAP.MR/95-10) Report of the GCOS/GTOS Terrestrial Observation Panel, second session (London, UK, April 19-21, 1995)
- GCOS-19**
(WMO/TD-No. 709) Report of the GCOS Data Centre Implementation/Co-ordination Meeting (Offenbach, Germany, June 27-29, 1995)
- GCOS-20**
(WMO/TD-No. 720) GCOS Observation Programme for Atmospheric Constituents: Background, Status and Action Plan, September 1995
- GCOS-21**
(WMO/TD-No. 721)
(UNEP/EAP.TR/95-07) GCOS/GTOS Plan for Terrestrial Climate-related Observations, version 1.0, November 1995
- GCOS-22**
(WMO/TD-No. 722) Report of the fifth session of the Joint Scientific and Technical Committee for GCOS (Hakone, Japan, October 16-19, 1995)
- GCOS-23**
(WMO/TD-No. 754)
(UNEP/DEIA/MR.96-6)
(FAO GTOS-1) Report of the GCOS/GTOS Terrestrial Observation Panel for Climate, third session (Cape Town, South Africa, March 19-22, 1996)
- GCOS-24**
(WMO/TD-No. 768)
(UNESCO/IOC) Report of the Joint GCOS/GOOS/WCRP Ocean Observations Panel for Climate, first session (Miami, Florida, USA, March 25-27, 1996)
- GCOS-25**
(WMO/TD-No. 765)
(UNEP/DEIA/MR.96-5) Report of the GCOS Data and Information Management Panel, second session (Ottawa, Ontario, Canada, May 14-17, 1996)
- GCOS-26**
(WMO/TD-No. 766) Report of the Joint CCI/CBS Expert Meeting on the GCOS Surface Network (Norwich, UK, March 25-27, 1996)
- GCOS-27**
(WMO/TD-No. 772)
(UNEP/DEIA/MR.96-7) Report of the Expert Meeting on Hydrological Data for Global Observing Systems (Geneva, Switzerland, April 29-May 1, 1996)
- GCOS-28**
(WMO/TD-No. 793)
(UNEP/DEIA/MR.97-3) *In Situ* Observations for the Global Observing Systems (Geneva, Switzerland, September 10-13, 1996)
- GCOS-29**
(WMO/TD-No. 794)
(UNEP/DEIA/MR.97-4) Report of the Global Observing Systems Space Panel, second session (Geneva, Switzerland, October 16-18, 1996)
- GCOS-30**
(WMO/TD-No. 795) Report of the sixth session of the Joint Scientific and Technical Committee for GCOS (Victoria, British Columbia, Canada, October 28-November 1, 1996)
- GCOS-31**
(WMO/TD-No. 803) Proceedings of the fifth meeting of the TAO Implementation Panel (TIP-5) (Goa, India, November 18-21, 1996)

- GCOS-32**
(WMO/TD-No. 796) GCOS/GTOS Plan for Terrestrial Climate-related Observations, version 2.0, June 1997
- GCOS-33**
(WMO/TD-No. 798) GHOST - Global Hierarchical Observing Strategy, March 1997
- GCOS-34**
(WMO/TD-No. 799) Initial Selection of a GCOS Surface Network, February 1997
- GCOS-35**
(WMO/TD-No. 839) Report of the second Joint CCI/CBS Meeting on the GCOS Surface Network (De Bilt, The Netherlands, June 25-27, 1997)
- GCOS-36**
(WMO/TD-No. 844)
(UNESCO/IOC) Report of the Joint GCOS/GOOS/WCRP Ocean Observations Panel for Climate, second session (Cape Town, South Africa, February 11-13, 1997)
- GCOS-37**
(WMO/TD-No. 845)
(GOOS-10) & (GTOS-9) Report of the Global Observing Systems Space Panel, third session (Paris, France, May 27-30, 1997)
- GCOS-38**
(WMO/TD-846)
(GTOS-10) Report of the Meeting of Experts on Ecological Networks (Guernica, Spain, June 17-20, 1997)
- GCOS-39**
(WMO/TD-No. 847)
(GOOS-11) & (GTOS-11)
(UNEP/DEIA/MR.97-8) Report of the GCOS/GOOS/GTOS Joint Data and Information Management Panel, third session (Tokyo, Japan, July 15-18, 1997)
- GCOS-40**
(WMO/TD-No. 848) Report of the GCOS/WCRP Atmospheric Observation Panel for Climate, third session (Reading, UK, August 19-22, 1997)
- GCOS-41**
(WMO/TD-No. 849) Report of the Joint GCOS/GOOS/WCRP Ocean Observations Panel for Climate (OOPC) Ocean Climate Time-Series Workshop, (Baltimore, (GOOS-33), MD, USA, March 18-20, 1997)
- GCOS-42**
(WMO/TD-No. 857) Report of the seventh session of the Joint Scientific and Technical Committee for GCOS (Eindhoven, The Netherlands, September 22-26, 1997)
- GCOS-43a**
(GOOS-36) TAO Implementation Panel, sixth session (Reading, U.K., November 4-6, 1997)
- GCOS-43b**
(GOOS-55) International Sea Level Workshop (Honolulu, Hawaii, USA, June 10-11, 1997)
- GCOS-44**
(GOOS-61) Report of the Joint GCOS/GOOS/WCRP Ocean Observations Panel for Climate (OOPC), third session (Grasse, France, April 6-8, 1998)
- GCOS-45**
(WMO/TD-No. 922)
(GOOS-58) & (GTOS-16)
(UNEP/DEIA/MR.98-6) Report of the Joint Meeting of the GCOS/WCRP Atmospheric Observation Panel for Climate and the GCOS/GOOS/GTOS Joint Data and Information Management Panel, fourth session (Honolulu, Hawaii, USA, April 28-May 1, 1998)

- GCOS-46**
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- GCOS-47**
(WMO/TD-No. 941)
(GOOS-67) (GTOS-20) Report of the Global Observing Systems Space Panel, fourth session, (College Park, Maryland, USA, October 22-23, 1998)
- GCOS-48** Report on the Adequacy of the Global Climate Observing Systems (United Nations Framework Convention on Climate Change, November 2-13 1998, Buenos Aires, Argentina)
- GCOS-49**
(GOOS-64) Implementation of Global Ocean Observations for GOOS/GCOS, first session (Sydney, Australia, March 4-7, 1998)
- GCOS-50**
(GOOS-65) Implementation of Global Ocean Observations for GOOS/GCOS, second session (Paris, France, November 30, 1998)
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(GOOS-66) Global Ocean Observations for GOOS/GCOS: An Action Plan for Existing Bodies and Mechanisms
- GCOS-52**
(GOOS-68) TAO Implementation Panel, seventh session (Abidjan, Ivory Coast, November 11-13, 1998)
- GCOS-53**
(WMO/TD-No. 958) GCOS Surface Network (GSN) Monitoring Centre Implementation Meeting (Offenbach, Germany, January 19-20, 1999)
- GCOS-54**
(WMO/TD-No. 953) Report of the eighth session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS (Geneva, Switzerland, February 9-12, 1999)
- GCOS-55** Report of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC), fifth session (Silver Spring, MD, USA, April 20-23, 1999)
- GCOS-56**
(GOOS-75) Special Report of the Joint GCOS/GOOS/WCRP Ocean Observations Panel for Climate (OOPC), fourth session (May 17, 1999); The CLIVAR Upper Ocean Panel (UOP), fourth session (May 21, 1999); A Joint Planning Meeting of the OOPC and the UOP for the OCEANOBS99 Conference (Woods Hole, MA, USA, May 18-20, 1999)
- GCOS-57**
(WMO/TD-No. 978)
(GOOS-79) Report of the OOPC/AOPC Workshop on Global Sea Surface Temperature Data Sets (Palisades, N.Y., USA, November 2-4, 1998)
- GCOS-58**
(GOOS-71) Report of the sixth session of the IOC Group of Experts on the Global Sea Level Climate Observing System (GLOSS)
- GCOS-59**
(GTOS-22) Report of the GCOS/GTOS Terrestrial Observation Panel for Climate, fifth session (Birmingham, UK, July 27-30, 1999)
- GCOS-60**
(WMO/TD-No. 1004)
(GOOS-70) GCOS/GOOS/GTOS Joint Data and Information Management Plan, Version 1.0, May 2000

- GCOS-61**
(WMO/TD-No. 1031) Report of the ninth session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS (Beijing, China, September 12-14, 2000)
- GCOS-62**
(WMO/TD-No. 1038) Report of the Pacific Islands Regional Implementation Workshop on Improving Global Climate Observing Systems (Apia, Samoa, August 14-15, 2000)
- GCOS-63**
(WMO/TD-No. 1047)
(GTOS-26) Establishment of a Global Hydrological Observation Network for Climate. Report of the GCOS/GTOS/HWRP Expert Meeting (Geisenheim, Germany, June 26-30, 2000)
- GCOS-64**
(GOOS-107) Report of the eighth session of the TAO Implementation Panel (TIP-8) (St. Raphael, France, October 15, 1999)
- GCOS-65**
(WMO/TD-No. 1055) Report of the sixth session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC) (Geneva, Switzerland, April 10-13, 2000)
- GCOS-66**
(GOOS-108) Report of the ninth session of the TAO Implementation Panel (TIP-9) (Perth, Australia, November 16-17, 2000)
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(WMO/TD-No. 1072) GCOS Implementation Strategy: Implementing GCOS in the New Millennium
- GCOS-68**
(WMO/TD-No. 1093) Report of the seventh session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC) (Geneva, Switzerland, April 30-3 May, 2001)
- GCOS-69**
(GOOS-98) Report of the fifth session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Bergen, Norway, June 20-23, 2000
- GCOS-70**
(GOOS-113) Report of the sixth session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Melbourne, Australia, May 2-5, 2001
- GCOS-71**
(WMO/TD-No. 1099)
(GTOS-29) Report of the GCOS/GTOS/HWRP Expert Meeting on the Implementation of a Global Terrestrial Network - Hydrology (GTN-H), Koblenz, Germany, June 21-22, 2001
- GCOS-72**
(GOOS-116) Report of the seventh session of the IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Honolulu, April 26-27, 2001
- GCOS-73**
(WMO/TD-No. 1106) Manual on the GCOS Surface and Upper-Air Networks: GSN and GUAN, April 2002
- GCOS-74**
(WMO/TD-No. 1109) Report of the GCOS Regional Workshop for Eastern and Southern Africa on Improving Observing Systems for Climate, Kisumu, Kenya, October 3-5, 2001
- GCOS-75**
(WMO/TD-No. 1124) Summary Report of the tenth session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS, Farnham, UK, April 15-19, 2002
- GCOS-76**
(WMO/TD-No. 1125) Report of the eighth session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC), Wokingham, UK, May 20-24, 2002

- GCOS-77**
(GOOS-122) International Workshop for Review of the Tropical Moored Buoy Network, September 10-12, 2001, Seattle, Washington, USA. Workshop Report
- GCOS-78**
(WMO/TD-No. 1126) Report of the GCOS Regional Workshop for Central America and the Caribbean. "Observing Climate from Weather Extremes to Coral Reefs", San José, Costa Rica, March 19-21, 2002 (disponible también en español)
- GCOS-79**
(WMO/TD-No. 1133) Interim Report to the sixteenth session of the Subsidiary Body for Scientific and Technological Advice of the UNFCCC by the Global Climate Observing System, Bonn, Germany, June 5-14, 2002
- GCOS-80**
(WMO/TD-No.1140) Report of the GCOS Regional Workshop for East and Southeast Asia on Improving Observing Systems for Climate, Singapore, September 16-18, 2002
- GCOS-81**
(GOOS-124) Seventh session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Kiel, Germany, June 5-8, 2002
- GCOS-82**
(WMO/TD-No.1143) Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC
- GCOS-82 (ES)**
(WMO/TD-No.1176) Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC – Executive Summary
- GCOS-83**
(WMO/TD-No.1155)
(GTOS-33) Report of the Global Terrestrial Network - Hydrology (GTN-H) Coordination Panel Meeting, Toronto, Canada, November 21-22, 2002
- GCOS-84**
(WMO/TD-No.1156)
(GTOS-32) Report of the GCOS/GTOS/HWRP Expert Meeting on Hydrological Data for Global Studies, Toronto, Canada, November 18-20, 2002
- GCOS-85**
(WMO/TD-No.1167) Report of the GCOS Regional Workshop for Western and Central Africa on Improving Observing Systems for Climate, Niamey, Niger, March 27-29, 2003 (disponible en français)
- GCOS-86**
(WMO/TD-No.1183) Report of the GCOS Regional Workshop for South America on Improving Observing Systems for Climate, Santiago, Chile, October 14-16, 2003 (disponible también en español)
- GCOS-87**
(WMO/TD-No.1189) Summary Report of the eleventh session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS, Melbourne, Australia, April 7-10, 2003
- GCOS-88**
(WMO/TD-No. 1190) Conclusions from the ninth session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC), Asheville, NC, USA, June 23-27, 2003
- GCOS-89**
(GOOS-140) Report of the Eighth session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Ottawa, Canada, September 3-6, 2003
- GCOS-90**
(GOOS-141) IOC Group of Experts on the Global Sea Level Observing System (GLOSS), eighth session, Paris, France, October 13 and 16-17, 2003

- GCOS-90bis** Report of the GCOS/GTOS Terrestrial Observation Panel for Climate (TOPC), seventh session, Rome, Italy, December 16-18, 2003
- GCOS-91**
(WMO/TD-No.1221) Summary Report of the twelfth session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS, Geneva, Switzerland, March 15-19, 2004
- GCOS-91bis** Conclusions from the tenth session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC), Geneva, Switzerland, April 19-23, 2004
- GCOS-92**
(WMO/TD-No.1219) Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC
- GCOS-92 (ES)**
(WMO/TD-No.1244) Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC – Executive Summary
- GCOS-93**
(WMO/TD-No.1238)
GTOS-35 Summary Report of the eighth session of the GTOS/GCOS Terrestrial Observation Panel for Climate, Ispra, Italy, April 6-7, 2004
- GCOS-94**
(WMO/TD-No.1248) Report of the GCOS Regional Workshop for Central Asia on Improving Observing Systems for Climate, Almaty, Kazakhstan, May 24-26, 2004 (имеется также на русском языке)
- GCOS-95**
(GOOS-143) Report of the ninth session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Southampton, UK, June 7-10, 2004
- GCOS-96**
(WMO/TD-No. 1255) Analysis of Data Exchange Problems in Global Atmospheric and Hydrological Networks
- GCOS-97**
(WMO/TD-No. 1259) Report of the GCOS Regional Workshop for South and Southwest Asia on Improving Observing Systems for Climate, New Delhi, India, October 11-13, 2004
- GCOS-98**
(GOOS-146) Progress with the Initial Ocean Climate Observing System: A Report to the UNFCCC – April 2005
- GCOS-99**
(GOOS-149) IOC Group of Experts on the Global Sea Level Observing System (GLOSS), ninth session, Paris, France, February 24-25, 2005
- GCOS-100**
(WMO/TD-No. 1283) Report of the GCOS Regional Workshop for Eastern and Central Europe on Improving Observing Systems for Climate, Leipzig, Germany, April 26-28, 2005
- GCOS-101**
(WMO/TD-No. 1298)
(GTOS-37) Report of the 2nd Meeting of the GTN-H Coordination Panel, Koblenz, Germany, July 4-5, 2005
- GCOS-102** Conclusions from the eleventh session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC), Geneva, Switzerland, April 11-15, 2005
- GCOS-103**
(WMO/TDN-No 1341) Summary report of the thirteenth session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS, St Petersburg, Russian Federation, 5-8 October 2005

- GCOS-104** Report of the tenth session of the Joint GCOS-GOOS-WCRP Ocean
Observations Panel for Climate Tenth, Geneva, Switzerland,
May 9-12, 2005
(GOOS-150) Session Final Report
- GCOS-105** Conclusions from the Twelfth Session of the GCOS/WCRP
(WMO/TD-No. 1374) Atmospheric Observation Panel for Climate (AOPC), Geneva, Switzerland,
April 3-7, 2006
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