

G GLOBAL
C CLIMATE
O OBSERVING
S SYSTEM



WMO



of UNESCO



UNEP



ICSU

WORLD METEOROLOGICAL
ORGANIZATION

INTERGOVERNMENTAL
OCEANOGRAPHIC COMMISSION

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

CONCLUSIONS AND RECOMMENDATIONS

(Geneva, 21-25 April 2008)

**GCOS – 122
WCRP 9/2008
(WMO/TD No. 1436)**

UNITED NATIONS
ENVIRONMENT PROGRAMME

INTERNATIONAL COUNCIL FOR
SCIENCE

© World Meteorological Organization, 2008

The right of publication in print, electronic and any other form and in any language is reserved by WMO. Short extracts from WMO publications may be reproduced without authorization provided that the complete source is clearly indicated. Editorial correspondence and requests to publish, reproduce or translate this publication (articles) in part or in whole should be addressed to:

Chairperson, Publications Board
World Meteorological Organization (WMO)
7 bis, avenue de la Paix
P.O. Box No. 2300
CH-1211 Geneva 2, Switzerland

Tel.: +41 (0)22 730 84 03
Fax: +41 (0)22 730 80 40
E-mail: Publications@wmo.int

NOTE

The designations employed in WMO publications and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of WMO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Opinions expressed in WMO publications are those of the authors and do not necessarily reflect those of WMO. The mention of specific companies or products does not imply that they are endorsed or recommended by WMO in preference to others of a similar nature which are not mentioned or advertised.

This document (or report) is not an official publication of WMO and has not been subjected to its standard editorial procedures. The views expressed herein do not necessarily have the endorsement of the Organization.

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

CONCLUSIONS AND RECOMMENDATIONS

(Geneva, 21-25 April 2008)

**GCOS – 122
WCRP 9/2008
(WMO/TD No. 1436)**

(Intentionally blank)

GCOS/WCRP Atmospheric Observation Panel for Climate

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

(Geneva, Switzerland, 21-25 April 2008)

GCOS Strategic Planning, UNFCCC, Secretariat issues (agenda¹ item 3)

1. AOPC noted the initiation of planning for a comprehensive report on progress against the GCOS Implementation Plan, upon request from UNFCCC SBSTA, for submission by April 2009. It requested its Members to support the Chairman in collecting information required to prepare this report. It noted that additional information for the 2009 report would mainly come from three sources: (i) performance reports from GCOS monitoring centres and partner observing systems, (ii) information on national activities related to systematic observation, due by 15 September 2008, and (iii) results from the Sydney workshop "Future Climate Change Research and Observations: GCOS, WCRP and IGBP Learning from the IPCC Fourth Assessment".
2. AOPC noted that the Sydney workshop and subsequent report (GCOS-117) were also being taken into account in WCRP planning, and encouraged coordination between the forthcoming assessment of the GCOS Implementation Plan and the strategic planning process of WCRP.
3. AOPC expressed its gratitude to Christina Lief (NCDC) for assisting the GCOS Secretariat in updating its website in June 2007 (<http://gcos.wmo.int>).
4. AOPC noted the announcement of departure by the Director of the GCOS Secretariat, Dr David Goodrich, effective on 2 July 2008. The Panel expressed its gratitude for Dr Goodrich's distinctive efforts in the GCOS Secretariat, and wished him well in his new position in the NOAA Climate Office. It also welcomed the announcement that Dr Alexander Karpov, currently Director of the WIGOS Planning Office, would serve as interim director of the Secretariat until a longer-term replacement assumes office.

GSN and GUAN (agenda item 4)

5. As follow-up to AOPC-XIII Recommendation 17 on the issue of CLIMAT TEMP reports no longer being needed for climate monitoring purposes, AOPC was informed by Dr Omar Baddour (WCDMP) that discussions within the CCI Management Group led to the conclusion that there were no other potential users of CLIMAT TEMP reports, thus confirming the view of AOPC that their generation was no longer needed for climate purposes. AOPC noted that this issue would be discussed at WMO EC-LX in June 2008, with a view to discontinue operational arrangements related to CLIMAT TEMP messages, and that instrument suppliers would also be informed.
6. AOPC noted the update of GSN and GUAN station lists as per 1 February 2008 and the very high consistency achieved between these lists and the Regional Baseline Climatological Network (RBCN) list maintained by WMO World Weather Watch. It recommended continuing close collaboration between GCOS and WMO in updating station lists in a consistent manner.
7. AOPC noted the reports from the GSN Monitoring Centres at DWD and JMA and welcomed the steady increase in total CLIMAT reception rate from GSN stations from 70% in late 2005 to 80% in the 2nd half of 2007. It drew attention to the persisting differences in reception between the different WMO Regions, as well as the minor differences in

¹ Meeting agenda given in Annex III.

reception between DWD and JMA, and encouraged the Centres to continue their collaborative efforts in helping to improve the situation. AOPC noted that the improvement in data receipt is also due in no small measure to the dedicated efforts of the nine CBS Lead Centres for GCOS data (hereafter called 'CBS Lead Centres').

8. AOPC requested the GSN Monitoring Centres at DWD and JMA to produce a joint summary of common errors in the generation of CLIMAT reports, with a view to disseminate this summary to all CBS Lead Centres and WMO Members through GCOS National Focal Points.
9. The Panel remains concerned about the problems still evident in the transmission of data on the GTS, as identified by the CBS Lead Centres and the GPCC. AOPC encouraged the WWW and WMO Members to remedy the situation, for example by working with designated national focal points for the GTS. AOPC also recommended that the CBS Lead Centres and GPCC liaise with the Working Group on the Planning and Implementation of the WWW in WMO Regions to address specific problems in the relay of CLIMAT messages as well as daily data on the GTS. It invited the WMO WIS secretariat to provide the Panel with a more comprehensive assessment of the current situation and future prospects at its next session.
10. AOPC was concerned that some Members of WMO had still not designated focal points for GCOS, and that some of the designated focal points were not responsive. It recommended CBS to consider whether a review of the designation of focal points on observing-system issues by Members, possibly by establishing a single point of contact, would help facilitate interaction between WMO Members and the Secretariat, stressing the importance of preserving the responsibility of focal points for GSN and GUAN data in any proposed new arrangement.
11. AOPC thanked Dr Matt Menne for his report on behalf of the Lead, Analysis and Archive Centre for GSN and GUAN at NCDC ('Archive Centre') and congratulated all named contributors for their progress made over the last few years in the receipt and archiving of GSN and GUAN data. The Panel encouraged NCDC to continue their efforts.
12. AOPC noted with interest the direct linkage of the Archive Centre to allow (near) real time access to data archives of individual countries (Australia, Canada, Iran) and the transmission of regular updates by others (Cyprus, Estonia, Latvia, Uzbekistan). AOPC encouraged additional countries to follow these examples. It stressed that such arrangements followed the example given by the WIS and the data exchange principles set up in the wider GEOSS context, and recommended that CBS Lead Centres liaise with the Archive Centre to set up similar arrangements.
13. AOPC noted with satisfaction the progress made by CBS Lead Centres in ensuring the provision and transmission of GSN and GUAN data. It acknowledged the important role played by the GCOS Implementation Project Manager, Mr Richard Thigpen, in this effort and encouraged the Centres and the Project Manager to continue the excellent work that has been done so far.
14. AOPC expressed its gratitude to the IRIMO and in particular the CBS Lead Centre representative Mina Jabbari for hosting the first CBS Lead Centres coordination meeting, and to the donors supporting the meeting. It endorsed the suggestion made by the first coordination meeting that such meetings be held at intervals of about two years.
15. AOPC welcomed the progress made in the revitalization projects addressing the GSN and GUAN networks, and expressed thanks to the GCOS Implementation Project Manager, and the donors for making this progress possible.
16. AOPC welcomed the presentation by Dr Miroslav Ondras on the perspectives of the WMO Observing Systems Department and reemphasized the importance of the successful work

of the CBS Lead Centres, as evidenced by the station reporting statistics presented by the GCOS Monitoring and Analysis Centres. It requested the Secretariat to draw the attention of both the GCOS Coordination Mechanism and CBS to the results of the Tehran workshop.

17. AOPC endorsed the recommendations made by AGG (see Annex I).
18. AOPC recognized the importance of proper and consistent station description/ metadata across all GCOS networks, including accurate station location and photographs. It noted the potential of visualization tools, such as Google Earth, in the integrated display of station data and metadata. It thus requested that:
 - a. the Secretariat provide a consistent list of metadata required for GSN and GUAN sites to CBS Lead Centres, based on information in GCOS-73 and WCDMP-53.
 - b. CBS continue improving the accuracy of station locations in WMO Vol. A down to the order of 10m
 - c. GSN and GUAN station data and maps be displayed, if possible along with appropriate metadata, in appropriate visualization tools

The Panel agreed to return to this issue at its next session, taking into account the work done by CIMO and ISO towards developing a standard classification scheme for stations.

19. AOPC encouraged GCOS to be involved in traceability efforts under the auspices of CIMO, in particular in training on metrology for GSN, and in supporting the Regional Instrument/ Radiation Centers in the provision of calibrated reference/field instruments for GSN stations.
20. AOPC discussed the issue of the use of AWS and noted that automatic equipment was in some cases cheaper to purchase than manual equipment, although costs of maintenance also needed to be taken into account. AOPC agreed to continue to monitor the situation with regard to the implementation and use of AWSs. AOPC looked forward to a report of the views of CBS and CCI expert teams on this issue at its next session.
21. AOPC thanked Dr Matilde Rusticucci for her report on network issues in South America and was pleased to see the improvement. AOPC also recognized the difficulties encountered by the CBS Lead Centre in staying in good contact with many countries in the region. It encouraged the Secretariats of GCOS, WMO and other appropriate bodies to find innovative ways and means to improve the situation, including the improvement of telecommunication.
22. AOPC noted the meeting organized by the Ibero-American Network of Climate Change Offices (RIOCC) in Cartagena later in 2008 discussing implementation of the GCOS regional action plan for South America. AOPC encouraged representation by GCOS at this meeting to ensure improved collaboration between all those involved and raise awareness by all regional development stakeholders for GCOS issues in the region.
23. AOPC expressed the need for clarification as to the statement made by Chris Kummerow on behalf of the GEWEX Radiation Panel regarding the adequacy of past and current surface and upper-air humidity measurements for climate purposes. The Panel requested the Chair of AOPC to provide a response on behalf of the Panel, reflecting the views raised in its discussion of this topic. At the same time, the Panel welcomed the construction of a climate-quality surface humidity dataset for 1973-2003, and encouraged a careful resolution of the issues associated with this dataset within the scientific community.

GRUAN (agenda item 5)

24. AOPC welcomed the report by WG ARO and commended the work done so far on developing the GRUAN. It stressed that full consideration should be given by WG ARO to

ground-based remote sensing capabilities as well as to radiosonde capabilities, noting that a combination of both techniques will yield optimum results.

25. AOPC agreed that the Lindenberg meeting report be published as a GCOS report in due course.
26. AOPC endorsed the revised terms of reference of WG ARO in proviso that (i) the Panel has the final say in endorsing the GRUAN network composition, that (ii) the Lead Centre be requested to report at least twice a year to WG ARO, and that (iii) final copy editing be made. It also endorsed the proposed Membership of the Working Group and suggested adding the President of CIMO as a full member.
27. AOPC requested that WG ARO provide specifications for a reference radiosonde to HMEI with a view to vendors providing such sondes for the 2010 intercomparison.
28. AOPC recommended that radiosonde schedules at GRUAN sites be made at Local Solar Time (LST) but recognized that local operational constraints may lead to other launch schedules at some stations, which should not preclude these stations from being designated as GRUAN stations. Site operators should provide appropriate information on launch schedules to WG ARO.
29. AOPC recommended that GRUAN data policy should request sites to provide all data in a free and unrestricted manner (in accordance with WMO Resolution 40 (Cg-XII)), and if possible in real time, in order to be of maximum value for all applications, for example enabling the data to be monitored and assimilated in numerical weather prediction systems.
30. AOPC encouraged GCOS to be involved in intercomparisons under the auspices of CIMO, in particular through members of WG ARO and the GRUAN Lead Centre, taking note of the need for an objective selection of the reference instruments through the CIMO upper-air systems intercomparison campaign planned for 2010. It also encouraged these groups to take part in planning and conducting of the instrument intercomparisons relevant to climate monitoring and to the GCOS climate monitoring principles.

CCI issues (agenda item 5)

31. AOPC thanked Dr Raino Heino for his presentation on CCI issues and encouraged strengthening of the collaboration between GCOS and the expert teams under the CCI OPAGs 1 and 2 on relevant items. The Panel noted that GCOS and CCI are in full agreement on the importance of daily data for climate studies and commended collaboration in the effort to ask WMO Members to submit such data to international data centres. In several climate-related application areas and especially in return-period type studies, climate change scenarios should be taken into account in addition to using climate statistics based on previous (normal) periods.

Atmospheric forcing (agenda item 6)

32. AOPC appreciated the presentation by Dr James Butler on the GCOS comprehensive CO₂ and CH₄ networks as well as the baseline networks for ozone. It recognized the critical significance of the issue of rising CO₂ levels and noted the needs for reliable verification of regional CO₂ sources, sinks and transport processes. In order to address these needs, the Panel recommended expansion of the observing systems and enhanced reanalyses, as well as sustaining existing efforts in monitoring CO₂. It also stressed the need for an open data policy to make data available in real time and for enhanced participation in quality control measures, and encouraged GAW to continue to work with all partners towards this end.

33. AOPC noted a proposal, for possible assistance by GCOS, submitted by a research group at EMPA (Switzerland) responsible for the WMO-GAW World Calibration Centre for CH₄, O₃ and CO to support a greenhouse gas measurement upgrade at three GAW global stations in Kenya, Algeria and Indonesia. It requested the Secretariat to seek the view of the GAW Greenhouse Gas Scientific Advisory Group on this issue and to liaise with the Chairman of AOPC as to appropriate follow-up.
34. AOPC thanked Dr Geir Braathen for updating the session on the status of the GAW ozone networks now part of the GCOS baseline networks. The Panel commended the high data reception rates being achieved within the ozone network, and encouraged continuation of the efforts behind this.
35. AOPC noted the co-existence of multiple data centres for ozone data, providing a challenge for data providers in the formatting and submission of data to different centres, and encouraged WMO-GAW in its implementation of the IGACO Theme Report recommendation related to ozone to develop a one-stop point for submission and access to data. The Panel noted that the ultimate destination for all global ozone data is the WMO World Ozone and UV Radiation Data Centre in Toronto, Canada, but that requirements for access to data in near-real-time had led to other arrangements being set up.
36. AOPC and the GCOS Secretariat expressed their deep appreciation to Dr Gert König-Langlo and the Alfred-Wegener-Institut (AWI) in Bremerhaven, Germany, for taking on the role of the World Radiation Monitoring Centre, and for exploring ways to revitalize and refresh the functioning of the BSRN archive. The Panel recognized that the latter was important for ensuring maximum use of the data and fully supported the efforts of AWI to dedicate additional personnel resources to this effort. The Panel also noted that the large scientific expertise built up in the BSRN community could benefit the operation of other networks in GCOS.
37. AOPC noted the potentially great value for the scientific community of a wide range of radiation measurements taken on national levels, even though these were not all necessarily meeting the requirements for BSRN. These datasets were partly archived at the World Radiation Data Centre in St Petersburg (from more than 200 stations, with more than 30-year-long time series), and would be a discussion topic at the upcoming BSRN meeting. Full access to these data could provide a potential starting point towards a more comprehensive GCOS surface radiation network, contributing to the WMO Global Observing System as well as to the larger framework of the WIGOS.
38. AOPC recognized that considerable progress has been made by WMO-GAW in coordinating the diverse communities engaged in aerosol observations and recommends that GCOS support an "International Experts Workshop on Coordination of Global Aerosol Observations and Links to Users", to be held in early 2009 in Switzerland organized jointly with the GAW Scientific Advisory Group on Aerosols. One outcome of that workshop would be a plan for enhancing coordination, some suggestions for communications and suggestions for useful products or services.
39. AOPC was pleased to see an increase in data submitted to WDC-GG in terms of number of stations as well as number of data received per station and looked forward to a further report at the next meeting.

Satellite issues (agenda item 7)

40. AOPC welcomed the emphasis on climate needs as well as weather needs in the vision of the space-based GOS to 2025 and in the overall evolution of the WMO Global Observing System. It stressed the importance of ensuring that the development of the new vision and any update of the GCOS Implementation Plan be coherent.

41. AOPC welcomed the outcome of the first R/SSC-CM planning meeting held at EUMETSAT premises on 15-16 April 2008 and the advances made in the evolution of this process responding to GCOS space-based requirements. The Panel commended EUMETSAT for acting as the secretariat for this initiative.
42. AOPC recognized that the R/SSC-CM offered an important way in which the transition from the research context to a sustainable production context for ECV product generation can be achieved, and stressed the need to liaise with the relevant science communities. AOPC further recommended that the concept of R/SSC-CM be presented and discussed with the GEWEX Radiation Panel and the WCRP Observation and Assimilation Panel.
43. AOPC recognized the importance of fire detection for climate application and therefore welcomed the emphasis that CGMS placed on this topic.
44. AOPC were pleased to see the first results from GSICS, for example rapid identification of questionable instrument performance through intercomparison. AOPC welcomed the initiative under GSICS on standard instrument monitoring performance systems and stressed the need to explain the differences revealed both by this instrument monitoring and by the general intercomparisons carried out under GSICS.
45. AOPC stressed the importance of GPS radio occultation for the generation of climate datasets as well as for numerical weather prediction, and fully supported efforts to secure follow-on missions to those currently flying.
46. AOPC stressed the need for a publicly-accessible, high-level overview indicating the degree of ensured coverage of individual ECVs by satellite missions against time, e.g. by colour bar charts.
47. AOPC supported the conclusion of the CGMS focus group, based on the arguments presented to the session (in document 18), that it was for the time being not necessary to establish a new working group under CGMS dealing with climate and inter-calibration. AOPC however agreed to maintain an overview of the situation to ensure that institutional arrangements were sufficient to ensure the implementation of a suitably-calibrated climate observing system from space.
48. AOPC welcomed the presentations from EUMETSAT, NOAA and CMA presenting the work they are doing in support of the needs of climate monitoring and reiterated that satellite observations provide an essential building block for GCOS.
49. AOPC commended initiatives by space agencies to address GCOS needs by reprocessing of archived satellite data for the generation of ECV satellite products, and recommended that such initiatives be coordinated with existing processes, existing institutional arrangements, such as GSICS and the R/SSC-CMs, and within the context of the concerted response by CEOS agencies to GCOS requirements (CEOS response document "Satellite Observation of the Climate System", September 2006).
50. AOPC was pleased to be informed of the wide range of activities being undertaken by NOAA in the construction of climate records from satellite observations, and encouraged additional US agency support for sustaining these activities.
51. AOPC noted in particular that GCOS had previously (in GCOS-107) recognized AVHRR data as a unique fundamental climate record, and thus especially welcomed the plans to derive cloud, aerosol and polar-wind products from reprocessing the complete AVHRR record.
52. AOPC welcomed the notion of a maturity index for satellite-based climate datasets and products to be pursued by agencies, and encouraged NOAA to present its work on a

maturity index to other space agencies at the next session of CGMS. AOPC looked forward to a progress report on this matter at its next session.

53. AOPC thanked Dr Fengsheng Zhao for his presentation and commended CMA for the development of space-based observations for weather and climate, and the derivation of openly-available climate products. In particular, the Panel was pleased to learn that CMA is planning the launch of a high-resolution sounder in geostationary orbit.
54. AOPC thanked Dr Jörg Schulz for his presentation on the current and planned status of ERB observations from space, and stressed the need for complementary observations to properly understand the ERB, such as aerosol and cloud properties. In particular, satellite-derived information on the absorption properties of aerosols are urgently required to better constrain aerosol radiative forcing.
55. AOPC noted the discussion about the value for the solar constant derived from the TIM instrument on SORCE, which suggests a value 5 W/m^2 smaller than the figure of 1366 W/m^2 generally assumed and used in climate models. Such uncertainty highlights the need for ongoing, well-calibrated measurements of solar irradiance.
56. AOPC invited the GEWEX Radiation Panel to comment on the ERB observation strategy presented to the session. AOPC noted that more detailed specifications of instruments to measure ERB may be needed, for example the extent to which the far infrared range of the spectrum should be covered.
57. AOPC appreciated the efforts made by CEOS in addressing the atmospheric requirements expressed in the GCOS Implementation Plan (GCOS-92) and its Satellite Supplement (GCOS-107) and thanked Paul Mason in particular for helping represent GCOS interests in the liaison with CEOS. The Panel was pleased to see CEOS recognizing the critical role of CGMS and the R/SSC-CM initiative in supplying the first set of products in response to the GCOS requirements. AOPC also welcomed the evolution of the Virtual Constellation for atmospheric chemistry, which would in due course provide a set of additional ECV products.
58. AOPC recommended that data and product suppliers provide users with sufficient information to allow them to assess to what extent the datasets meet GCOS requirements, i.e. the climate-worthiness of the datasets. For this purpose, the suppliers should follow guidelines to be presented by GCOS prominently on its Secretariat website and on other websites as appropriate. The guidelines should eventually be applicable to radiosonde and other in situ data as well as to satellite data. They should be based on the GCOS Climate Monitoring Principles, and, where satellite data are concerned, the Satellite Supplement to the GCOS Implementation Plan (GCOS-107).
59. AOPC agreed with the guidelines presented by the Secretariat (see Annex II) but recommended that these guidelines also include version management of datasets. The guidelines may later be expanded to include a maturity index for datasets, once such a concept has been fully developed.

Terrestrial issues (agenda item 9)

60. AOPC were interested to learn of the revised focus and composition of the TOPC and thanked Han Dolman for his presentation. The Panel reassured TOPC of its full cooperation on matters of mutual interest.
61. AOPC expressed its gratitude to the European Commission JRC for agreeing to host another workshop involving cross-domain issues. Options for the theme of such a workshop were:

- a. Observe and analyze the surface component of the global carbon system: e.g., ocean colour and FAPAR, LAI on land (domains covered: Oceans, Terrestrial);
 - b. Study land-sea interactions, in particular in river estuaries; this should include the GEO coastal zone Community of Practice and the GOOS Coastal module (domains covered: Oceans, Terrestrial);
 - c. Climate and desertification: obtain better understanding of teleconnections between Sahel drought and e.g., SST (domains covered: Atmosphere, Oceans, Terrestrial) ; this should include liaison with AMMA for West Africa.
62. AOPC recommended that relevant institutions and coordinating mechanisms be consulted on some specific issues in order to identify a priority topic for such a workshop. The GCOS panel chairs will liaise with Dr Michel Verstraete on the outcome of this consultation process, and agree on a workshop topic within the next two months.

Cryospheric issues (agenda item 10)

63. AOPC thanked Dr John Cassano for his wide-ranging presentation which touched not only upon the challenges of climate observations in the polar regions, but also covered such important issues as regional reanalysis and use of the observed data in model validation. The particular problems of measurement of solid precipitation were noted. AOPC stressed the need to further develop the use of indirect measures of precipitation, such as reanalyses, advanced satellite observations and ice cores.
64. AOPC encouraged the relevant bodies to exploit all opportunities for additional observations in the polar regions, such as identified in Dr Cassano's presentation and the IPY legacy observations identified by the Inter-Commission Task Group on IPY. Specific and readily implementable recommendations were: (i) all AWSs report regularly through the GTS, (ii) revitalization of the Marambio GUAN station, and GSN sites at Leningradskaya, Russkaya, and Molodezhnaya.
65. AOPC was pleased to be informed that the University of Wisconsin at Madison (USA) were working on the reprocessing of CLIMAT messages for a selection of Antarctic GSN stations from their AWS network over the continent.
66. AOPC thanked Dr Eduard Sarukhanian for his report on the impressive progress made in the IPY projects. For similar international projects in the future, appropriate overarching data management structures should be part of the funding from the outset. The Panel welcomed the establishment of an ad-hoc group on the Global Cryosphere Watch (GCW) and will liaise with the group to the extent possible. The Panel stressed the need to ensure consistency of the plans for GCW with the assessment of the GCOS Implementation Plan to be developed over the coming year.
67. AOPC recognized the importance of an ongoing dialogue between all GCOS panels on cryospheric issues.

Marine issues (agenda item 8)

68. AOPC noted its ongoing concern about the lack of progress in developing national frameworks for sustaining the ocean observing system for climate, but commended the ocean research funding agencies, satellite agencies, and the European initiatives under GMES for continuing implementation progress.
69. AOPC noted that sampling of SST (and wind speed) by passive microwave satellite instruments was critical to extend the coverage provided by visible and infrared satellite instruments. It reaffirmed the ocean-domain requirement that space agencies, through

CEOS and other mechanisms, undertake efforts to ensure sustained operation of appropriate microwave instruments.

70. AOPC encouraged the work on monitoring sea-ice coverage as a key interface variable and reiterated the need for sea ice mass observations from advanced satellite instruments. AOPC noted the report on the highly unusual sea ice conditions in late summer 2007.
71. AOPC noted the request that the International Surface Pressure Databank (ISPD) be recognized by GCOS and the Chair agreed to report on this matter to the next session of the GCOS Steering Committee, along with a report on its discussion of guidelines on datasets and products (see item 58).
72. AOPC acknowledged the detailed reports from the WMO Secretariat and Dr Elizabeth Kent and colleagues on VOS and VOSCLIM issues. AOPC reaffirmed the great value of the VOS datasets for climate studies. This type of observation remains a key component of the climate observing system. The Panel stressed the need to maintain the operations of the VOS programme and adequate delivery of VOS data to international data centres.
73. The Panel noted with concern the decrease of data submissions by VOS ships and the impact of the recent masking schemes of the ship's identification, which resulted in difficulties with regard to quality monitoring and accessing the ship metadata. The Panel invited the JCOMM to take all available actions to address these issues, in particular to
- 1) Improve and integrate instrument best practices, for example through the JCOMM Pilot Project for WIGOS;
 - 2) Work with the shipping industry and their representatives (e.g., IMO, ICS, INTERCARGO, INTERTANKO) to minimize the effect of ship masking and to maintain up-to-date metadata;
 - 3) Make the VOS observations more cost-effective in terms of satellite data telecommunication (e.g., by the increased use of data compression for the transmission of the data from ship to shore);
 - 4) Respond to the loss of information on several variables that has resulted from the increased use of AWS in the VOS scheme (now about 200 ships equipped) by encouraging the manual observation required for some traditional variables.

74. AOPC acknowledged the utility of the ISPD as being an extremely valuable dataset for land and marine surface pressure information, and encouraged all nations and other bodies holding historical surface pressure data to provide these to the ISPD. AOPC furthermore encouraged that the ISPD data be made available to the World Data Centre for Meteorology at Asheville (NCDC) and other relevant international data centres.

Synthesized products and reanalysis issues (agenda item 11)

75. AOPC appreciated the contributions of more than 170 countries of precipitation data submitted to the GPCC archive, and welcomed in particular major contributions over the last year by Albania, Angola, Benin, Bhutan, Bosnia-Herzegovina, Botswana, Bulgaria, Chile, Cyprus, Georgia, Guyana, Iran, Mozambique, Peru, Portugal, USA, and Venezuela. The Panel encouraged all countries to regularly update their data submissions to GPCC.
76. AOPC noted that the letter prepared by the GCOS Secretariat asking WMO Members to submit sub-daily data to the international data centres was generic enough to be used for reference purposes when approaching NMHSs with specific requests for precipitation for the GPCC and historic surface pressure data for the ISPD.

77. AOPC commended the efforts by GPCC in generating precipitation climatology products and stressed the need for publication of these products in peer-reviewed journals in order to enhance their acceptance and use in the scientific community.
78. AOPC expressed its gratitude to DWD for supporting the GPCC over almost 20 years and requested the Secretariat to prepare a letter of acknowledgement to DWD through the WMO Secretary-General. In this connection, it further requested the Secretariat, in collaboration with GPCC and WMO, to explore ways and means to formally recognize the GPCC within the WMO structure.
79. AOPC thanked JMA, CRIEPI and the University of Tokyo for the excellent arrangements made in hosting the 3rd WCRP Reanalysis Conference which fostered interaction and fruitful discussion on reanalysis. It further thanked the other sponsors of the event. The Panel was pleased to learn about new reanalysis activities starting in the US and Japan, and the progress of the ECMWF ERA-Interim reanalysis.
80. AOPC encouraged both atmospheric and ocean communities to progress towards better understanding of the differences in time-scale, in the nature of observations and in physical constraints in both domains and the implications for coupled atmosphere-ocean analyses. The Panel further encouraged reanalysis centres to promote technical development towards coupled atmosphere-ocean reanalyses.

Climate information for regional adaptation (agenda items 12.4-12.5)

81. AOPC noted the importance of observations to underpin effective adaptation measures to climate change, as summarized in the GCOS contribution to the UNFCCC SBSTA Nairobi Work Programme. The Panel recognized the important contribution of the Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative to climate applications via the ISPD and historical reanalyses. Noting recent discussions at the level of the WCRP Joint Scientific Committee, AOPC recommended that in this regard, a two-track approach similar to that of WCRP be followed by GCOS, including efforts to a) better understand of the needs of the adaptation community, and b) demonstrate to the adaptation community the value of the climate observational record and the capability of existing climate observing systems.
82. AOPC welcomed the planned joint GCOS-WCRP-CLPA workshops in ten regions of the world, which were considered to be an important step for raising awareness for the regional needs for adaptation, as well as for GCOS to better understand the regional requirements for observations.
83. For the development of effective adaptation strategies, AOPC recalled the key importance of reliable seasonal forecast products tailored for societal sectors, such as agriculture and health. This and other work in support of adaptation relies on the rescue of national and regional historical datasets, and the regular reporting of sub-daily meteorological and hydrological data to international data centres (see items 76, 87 and 88).
84. AOPC invited the GCOS Steering Committee to provide further guidance on the future strategy of GCOS in providing and exploiting the data required for adaptation, while offering the full range of expertise of the Panel to assist the Steering Committee in its deliberations.
85. Nevertheless, AOPC reiterated that its core activities devoted to the global observation of climate remained paramount to underpin the full range of climate applications, including adaptation to climate change.
86. AOPC welcomed the CLARIS La Plata Basin project as an important initiative with strong user interaction, which will demonstrate how climate data may be used in the adaptation process in South America. It expected that lessons learnt from this project would be

applicable to a broad range of user communities in other parts of the world. The Panel encouraged efforts to make the data collected in the project available to international data centres and looked forward to an update on progress of the project at its next session.

Climate indices, Data rescue (agenda items 12.1-12.3)

87. AOPC welcomed the efforts of the WCDMP in rescuing and digitizing climate records and the fact that many developing countries were adopting WMO standardized Climate Data Management Systems (CDMSs) which helped accelerate the digitization efforts and the dissemination of data. It stressed that everything should be done in order to improve infrastructure and procedures, and to ensure that steps are taken so that rescuing historical data uses the appropriate technology for automated digitization of historical records. AOPC looked forward to further GCOS-CCI collaboration in future undertakings involving climate data and metadata.
88. AOPC commended the WMO MEDARE initiative, focussing on data rescue and digitization in the Mediterranean basin, and noted with satisfaction that this initiative was based on the GCOS Regional Action Plan for the Mediterranean. The Panel was pleased to be informed of the results of the MEDARE workshop, and firmly endorsed the conclusions of the workshop. The Panel welcomed the end-to-end approach taken in this initiative, which addressed the value chain from climate data rescue to climate indices and their applications, thereby raising higher interest with participating countries.
89. AOPC similarly welcomed the end-to-end approach recommended by the CCI OPAG2 Expert Team on Climate Change Detection and Indices (ET-CCDI) when designing capacity building workshops and seminars for developing countries. This approach, implemented through WCDMP, foresees that training events cover the whole chain of data rescue climate data management, and the analysis of climate extremes.
90. AOPC recommended that the Working Group on Surface Pressure and ACRE liaise with WCDMP regarding the coordination of international data rescue.

Palaeoclimate issues (agenda item 13)

91. AOPC appreciated Phil Jones' update on some palaeoclimatic research activities, in particular the palaeoclimatic reconstruction challenge project. Palaeoclimatic data are a key part of the overall climate data record and the Panel looked forward to future updates on progress in this field.

Next session

92. AOPC agreed that its next session (AOPC-XV) would be held from 27 April to 1 May 2009 in Geneva.

Annexes:

- I. AGG Recommendations
- II. Guideline for the generation of satellite-based datasets and products meeting GCOS requirements
- III. Agenda
- IV. List of Participants
- V. Glossary of Acronyms

Minutes and Recommendations from the Advisory Group on GSN and GUAN (AGG) Meeting at AOPC-XIV, 21 April 2008

AGG Members attending: Phil Jones, David Parker, Dick Thigpen, Stephan Bojinski, Mohan Abayasekara

Also attending: Adrian Simmons, Tobias Fuchs, Matthew Menne, David Goodrich

Agenda

1. Where might additional GSN sites be located?
2. Where might additional GUAN stations be useful?
3. Should AGG try to ensure each country has at least one GSN or GUAN station?
4. How can AGG or AOPC respond to requests from Lead Centre's for advice on problems, such as a lack of focal points in some countries?
5. Some Lead Centres have asked for guidance on metadata and its formats .
6. A station in Turkey has been moved but without overlap of measurements. What advice can AGG or AOPC give?
7. Priorities for prospective projects for Dick Thigpen.
8. Google Earth and the GSN/GUAN networks

Discussion

Issue 1: Where might additional GSN sites be located?

The original GSN network was developed in 1997, but has evolved over the last ten years. During recent previous meetings of AOPC, AGG has always intended to take an overall look at the network to see if improvements can or should be made. Dick Thigpen drew up a list of poorly represented regions of the world and the group discussed the appropriate contacts that should be made to see if the GSN could be expanded. The discussion is linked to countries and focal points that need to be contacted.

United States

Matthew Menne to look into whether the following sites can be designated as GSN sites:

1. The far SW of the Aleutian Islands chain [possibility Shemya (used to be 70414)].
2. Midway Islands (used to be 91066).
3. 3 sites in Micronesia (Truk, 91334; Koror, 91408 and Majuro, 91376).

Also, NCDC in its role as Lead Centre for North America to contact Cuba about a possible GSN site in the far west of the country (e.g., Cabo San Antonio, which used to be 78310).

United Kingdom

Initially there needs to be clarification on who is the current focal point for the UK [N.B.: Aidan Green of the UK Met Office is willing to fulfil this role]

Possible UK-run locations that AGG wishes to be added to the GSN list are:

1. Grytviken, South Georgia (# 88903)– the site has a long record, but was closed. An AWS has been installed by BAS, so contact with Jonathan Shanklin would be profitable. **This has already been done – see document 4.1 to AOPC-XIV.**
2. Mount Pleasant Airfield, Falkland Islands. This site is a GUAN station (# 88889), but would profitably be an addition to the GSN.

Solomon Islands

Honiara – Dick to approach the Lead Centre in Australia

Democratic Republic of the Congo

Dick has tried several contacts, but conditions in the country mean it is likely that nothing will be realised in the next year or two.

Belize/Honduras

The Atlantic coast of both countries is lacking GSN stations. Dick will approach the focal points to see if one station can be given GSN status. The airport site in the capital of Belize is a possibility.

The Horn of Africa

The political situation in Somalia makes this impossible, so Dick is tasked with approaching Djibouti to see if the site in this country can become a GSN.

Yemen

AGG moved onto some discussions Dick has had with the Permanent Representative of Yemen to WMO, related to the site at Aden. The long records are available in the UK (in the archives of the UK Met Office) for the site. Phil Jones has the long monthly records for this site digitized and will forward these to Dick for sending on. It is hoped that these will enable the Aden site to be incorporated into the GSN. It is also likely that the daily pressure records for the site have been digitized by Rob Allan (UK Met Office). Phil Jones will investigate whether this is the case. [N.B. These records have not yet been digitized by Rob Allan]

Franz Joseph Land

There used to be a site on these islands (# 20046). Tobias Fuchs to contact the Russian Focal Point to see if a GSN designation can be given to a location on these islands if one is currently operating.

Greenland

There is an AWS site at the Summit Ice Core location in Central Greenland (# 04416). Tobias Fuchs to contact the Focal Point at DMI. Phil Jones to contact the University of Copenhagen about AWS sites that may be operating at other ice core drill sites on the large island.

Borneo

Australian Lead Centre to contact the Indonesian Focal Point to see if one or two more sites in Kalimantan can be designated GSN sites. There are already at least two GSN sites in the Malaysian part of Borneo.

China

There is a gap on maps in SW China. Phil Jones believes there is a station in the required location and will investigate this with a Chinese colleague.

Iceland

Iceland is now sending CLIMAT messages for the two previously silent GSN stations, 04013 and 04048.

Brazil/Peru

The group also discussed possible enhancements in these two countries, and Dick would continue to investigate possibilities.

Issue 2: Where might additional GUAN stations be useful?

Discussion on GUAN was briefer than for the GSN. The discussion enabled the group to designate the priority for reinstating sites for operational use. The highest priority is for Luanda, Angola. Lower priority sites are Khartoum, Sudan and Rarotonga, Cook Islands.

Tobias Fuchs would contact the Spanish Met Service to see if the site at La Coruña could become a GUAN site, so that there is no longer a significant gap in the region.

The meeting noted the following:

1. San Cristobal in the Galapagos Is. is functioning.
2. Lima, Peru is still not functioning.
3. The site in the north of the Philippines is not working because of a lack of sondes. Dick Thigpen will supply these when there are some resources.

Issue 3: Should AGG try to ensure each country has at least one GSN or GUAN station?

Not all countries have a GSN or a GUAN network station, and may feel left out of these major GCOS initiatives. It was also felt that when countries did have a GSN station, their basic reporting for all CLIMAT messages tended to improve. Whilst there is no scientific rationale (the networks were developed based on geographic distance requirements) for each country to be involved in each network, Dick Thigpen would develop a list of all reasonable sized countries without a GSN station, and AGG (or its chair) will go through the list to see if any can be incorporated.

Issue 4: How can AGG or AOPC respond to requests from Lead Centres for advice on problems, such as a lack of focal points (FPs) in some countries?

There are a number of FPs, representing different areas, in many Met Services. In the long run, CBS are intending to rationalize these so that there is one FP to cover the whole range of possible actions, including those from GCOS that relate to the GSN and GUAN. AGG endorsed this initiative.

In the interim, AGG recommends that the GCOS Secretariat send brief emails to all GCOS FPs every month or so, sending the web pages of the network reporting rates from the DWD/JMA (for GSN) and ECMWF/NCDC (for GUAN) to each GCOS FP. These emails should also include the contact details of all CBS Lead Centres and their areas of responsibility. This would serve four purposes: (1) it would make FPs aware of their reception rates at the monitoring centre; (2) it would make the Secretariat aware of their email reception rates (through email bounces), (3) it should engender greater involvement in the GCOS initiatives, and (4) it would potentially improve communication between CBS Lead Centres and FPs. Email bounces would be forwarded to Mohan Abayasekara.

Issue 5: Some Lead Centres have asked for guidance on metadata and its formats

NCDC has formats for GUAN metadata, but there are no such guidelines for the GSN. The Lead Centres for the networks have been undertaking some assessment of the surface networks in some regions. Photographs have been taken of a number of stations from the 8 cardinal points of the compass. There is much relevant guidance in WCDMP-53 (which resulted from a meeting in Spain in 2003).

It could be useful to update the Guide to the GCOS and GUAN networks (GCOS-73).

The Commission for Climatology are due to publish their revised Guide to Climatological Practices, and AGG and AOPC hope that this will be available soon.

Recommendation is for the GCOS Secretariat to develop GSN metadata guidelines based on WCDMP-53 and GCOS-73.

Issue 6: A station in Turkey has been moved but without overlap of measurements. What advice can AGG or AOPC give?

The Turkish station at Istanbul (Goztepe, 17062) has been moved to a new location, but without any overlap in measurements. AGG was requested by the Turkish FP (Mesut Demircan) for information and ideas about how to combine the old and the new data. The group said that this was best done by using overlap comparisons with neighbouring stations in the region of the site. Phil Jones would contact a Turkish colleague (Serhat Sensoy who works in the Turkish Met Service) to discuss these possibilities.

Issue 7: Priorities for prospective projects for Dick Thigpen

The highest priority item for GUAN is the renovation of the site in Luanda, Angola. There are a number of high priority items for GSN. In terms of network improvement, the highest priorities relate to Angola, Ecuador and Madagascar.

Issue 8: Google Earth and the GSN/GUAN networks

Stephan Bojinski presented some work that was undertaken to illustrate mapping the GSN and GUAN coupled with Google Earth. Whilst this would be a useful addition to the GCOS web page, the group felt that the lack in accuracy of the site locations (generally only to the nearest minute) means that it should not go live until these are much more accurate. AOPC should therefore recommend to CBS that they pursue their intention to develop more detailed co-ordinates for all locations.

Once improvements to the locations have been achieved, the web page would be further enhanced if the links to the stations could also be linked to simple plots of the time series of a number of the GCOS ECVs.

Guideline for the generation of satellite-based datasets and products meeting GCOS requirements

**GCOS Secretariat
Draft (8 April 2008)**

(Doc. 23 of AOPC-XIV, with underscoring edits from the session)

1. Introduction

This document provides a short summary of GCOS requirements for satellite-based climate monitoring that can serve as a guideline for the generation of satellite-based datasets and derived products in order to meet the requirements for climate monitoring and the long-term aspects of climate research. Requirements have been addressed by the Global Climate Observing System (GCOS) in the GCOS Implementation Plan (GCOS-92, 2004) and in more detail in its Satellite Supplement (GCOS-107, 2006).

These guidelines are intended to help space agencies and other relevant institutions in the way they process and analyze datasets obtained from satellite instruments, to subsequently generate Essential Climate Variable (ECV) products.

As noted in GCOS-107, satellite observing systems should, for the purpose of climate monitoring, adhere to the GCOS Climate Monitoring Principles (see annex) to the greatest extent possible. Datasets obtained from such satellite systems ("Fundamental Climate Data Records, FCDRs") will be of maximum value for monitoring the state of the Earth's climate, through, e.g., trend analyses, assimilation in climate models, use in reanalyses, and validation of model outputs. Satellite systems include both instruments with plans for sustained operation and continuity, as well as instruments mainly intended to support research interests of limited duration.

It is recognized that, given the complexity of some ECV-related products, additional expertise and guidance may be needed for the generation of FCDRs and ECV satellite products, depending on the specifics of each case and application.

2. Background

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* (GCOS-107, September 2006, hereafter called the 'Satellite Supplement').

The GCOS Steering Committee, at its 15th session in October 2007, requested "the GCOS Secretariat, in collaboration with the GCOS science panels, to develop guidelines for datasets and products meeting GCOS requirements, in response to the needs of [...] space agencies."

Before that, the GCOS Atmospheric Observation Panel for Climate, at its 13th session in April 2007, had 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 need for guidelines to support such a recognition process has been identified by space agencies, for example, in the context of defining roles and responsibilities of the emerging WMO Regional/Specialized Satellite Centres for Climate Monitoring (R/SSC-CM).

3. The Satellite Supplement (GCOS-107)

The Satellite Supplement stated requirements for datasets and products addressing 25 ECVs (see Annex I) with a major satellite component, as well as nine cross-cutting needs, for the purpose of systematic observation of climate from space. The document made indications in terms of expected accuracy, stability and resolution of ECV satellite products. It also included indications for the Fundamental Climate Data Records (FCDRs) required for the generation of products, relevant satellite instruments, necessary involvement of expert groups, supplemental needs for non-FCDR-type data records, and other application areas of ECV satellite products.

As such, the Satellite Supplement already provides a substantial body of guidance for the generation of datasets and products with the intention to meet GCOS requirements. These requirements are being updated by GCOS science panels on a regular basis, with involvement of relevant expert groups as appropriate. In addition, given the complexity of the climate variability and, in part, limited knowledge of the expected variability of ECVs over space and time, several caveats apply to the use of requirements as such (cf. page 6). For example, it is possible that a combination of data records from two satellite instruments, neither of which meeting any of the requirements given in the Satellite Supplement, could usefully meet the needs for climate monitoring if applied together in careful analysis.

4. Guideline

A guideline for the generation and subsequent recognition of FCDRs and derived ECV satellite products by GCOS is given by adherence to the following:

- Fundamentally, the GCOS Climate Monitoring Principles, in particular those specific to satellite systems (see Annex II)
- In expanded form, the Satellite Supplement (see Annex III); wherever target requirements for particular ECV satellite products are given in the Satellite Supplement, it is expected that the producer as well as the user of these products will be able to judge whether the product meets these requirements, provided adequate documentation (metadata etc.) is available

In line with the GCMPs and the Satellite Supplement, GCOS recommends particular attention to the following needs related to the generation of ECV satellite products:

- Full description of all steps in the generation of datasets and products, including algorithms used, specific FCDRs used, and characteristics and outcomes of validation activities, for example by publication in peer-reviewed journals.
- Statement of expected accuracy, stability and resolution (time, space) of the product
- Arrangements for access to the datasets, products and all documentation.

- Particular attention to long-term stability and homogeneity of the product
- Full application of all appropriate calibration/validation activities that would enhance product quality
- Global coverage where appropriate
- Timeliness of data release to the user community to enable monitoring activities
- Facility for user feedback

Experience with historical satellite data records has shown that continuous, cyclical improvement of the quality of datasets and product is generally needed, since historical records usually have challenges in terms of homogeneity.

Annexes:

I: ECVs largely dependent upon satellite observations

II: GCOS Climate Monitoring Principles

III: Satellite Supplement (GCOS-107) – Summary of Requirements

Agenda

(NOTE: A meeting of the Advisory Group on GSN/GUAN (AGG) will be held on 21 April (Monday), from 9.00 to 12.30, to deal with issues of composition and performance of the GSN and GUAN. The full AOPC session starts at 14.00 and ends on Friday at 15.30.)

| Item | Doc. No. | Presenter(s) |
|---|--------------|--------------------|
| Monday 21 April | | |
| 14.00 – 17.30 | | |
| 1. Opening of the Meeting | | |
| 1.1 Welcome and introductions | [INF.1] | Simmons, WMO |
| 1.2 Adoption of Agenda | [1] | Simmons |
| 1.3 Conduct of the Meeting | | Bojinski |
| 2. Report from the AOPC Chair | | |
| - Review of activities since AOPC-XIII | [2] | Simmons |
| - Issues and objectives for the meeting | | |
| - Review of Actions from AOPC-XIII | [2a] | Simmons, Bojinski |
| 3. Report of GCOS Director | | |
| - Overview of Secretariat activities | [3] | Goodrich |
| - Issues related to WMO Congress, UNFCCC, GEO Summit, Sydney workshop, World Bank Proposal, GRUAN, WCRP | | |
| 4. GSN and GUAN | | |
| 4.1 Update from GCOS Secretariat: GSN, GUAN and Interaction with CBS | [4] | Bojinski, Thigpen |
| 4.2 Report from GSN Monitoring Centre (JMA) GSN Monitoring Centre – Status and Results | [5a] [5b] | Onogi Fuchs |
| 17.30 Reception – WMO Attique | | |
| Tuesday 22 April | | |
| 09.00 – 12.30 | | |
| 5. Other Atmospheric Networks and Issues | | |
| 5.1 Report from WG-ARO: Development of GRUAN | [12] | Thorne |
| 4. GSN and GUAN (continued) | | |
| 4.3 Report from NCDC Lead/Analysis/Archive Centre | [6] | Menne |
| 4.4 Report from CBS Lead Centres | [7] | Thigpen |
| 4.6 Report from WMO Observing Systems Division | [9] | Ondras |
| 4.7 Report from AGG (Network composition, related issues) | | Jones, Secretariat |
| 4.8 Report from the GCOS Implementation Project Manager | [10] | Thigpen |
| 4.9 Network issues in South America | [11] | Rusticucci |
| 12.30 – 14.00 LUNCH | | |

| | | |
|--|---------------|-----------------------|
| 14.00 – 17.30 | | |
| 5. Other Atmospheric Networks and Issues (continued) | | |
| 5.2 WMO CCI issues, CCI OPAGs 1 & 2 in particular | [13] | Heino |
| 6. Atmospheric forcing | | |
| 6.1 CO ₂ -CH ₄ Comprehensive Networks and Ozone Baseline Networks | [14] | Butler |
| 6.2 Baseline Surface Radiation Network and Archive | [15] | König-Langlo |
| 6.3 Establishment of a global observing network for aerosols | [16] | Barrie, Baltensperger |
| 6.4 Activities of the World Data Centre for Greenhouse Gases (WDCGG) | [16a] | Onogi |
| 19.00 Group Dinner at Café du Soleil | | |
| Wednesday 23 April | | |
| 9.00 – 12.30 | | |
| 7. Satellite issues, data and products | | |
| 7.1 Progress in CEOS Response to GCOS Satellite Req's | [17] | Goldberg |
| 7.5 Update from WMO Space Programme Vision of the Space-based GOS to 2025 | [21] [21a] | Lafeuille |
| 7.2 Report on CGMS-XXXV: - CGMS matters relevant to climate observations - Considerations on new Int'l WG on Climate and Calibration | [18] | Schmetz |
| 7.3 EUMETSAT Activities related to Climate Monitoring | [19] | Schmetz |
| 7.4 Climate product development by NOAA | [20] | Barnet |
| 12.30 – 14.00 LUNCH | | |
| 14.00 – 17.30 | | |
| 7. Satellite issues, data and products (continued) | | |
| 7.6 Development of satellite products by CMA | [22] | Zhao |
| 7.7 Review of observation strategy/vision for Earth Radiation Budget | [22a] | Schulz |
| 7.8 Development of GCOS guidelines for datasets and Products | [23] | Secretariat |
| 9. Terrestrial Issues | | |
| 9.0 Report from TOPC | [28a] | Dolman |
| 9.1 WG on Land-Surface/Atmosphere Issues | [28] | Verstraete, Dolman |
| Thursday 24 April | | |
| 9.00 – 12.30 | | |

| | | |
|--|---------------|----------------------------------|
| 8. Marine Issues | | |
| 8.1 Report from OOPC | [24] | Harrison |
| 8.2 Report from SST/Sea Ice Working Group | [25] | Harrison (for Rayner) |
| 8.3 Report from Surface Pressure Working Group | [26] | Parker (for Allan) |
| 8.4 Voluntary Observing Ships Issues Surface Meteorological Data Collection from VOS | [27] [27a] | Charpentier Parker (for Kent) |
| 10. Cryospheric Issues | | |
| 10.1 Atmospheric observations in Polar Regions | [35] | Cassano |
| 10.2 Status of IPY implementation | [36] | Sarukhanian |
| 12. Climate indices, Data rescue, Climate Information for Regional Adaptation | | |
| 12.4 Role of Observations in Support of Adaptation | [34] | Westermeyer |
| 12.30 – 14.00 LUNCH | | |
| 14.00 – 17.30 | | |
| 11. Synthesized products | | |
| 11.1 High-resolution precipitation dataset | [29] | Fuchs |
| 11.2 Reanalysis issues - Report on 3 rd WCRP int'l conference on reanalysis | [30] | Onogi |
| 12. Climate indices, Data rescue, Climate Information for Regional Adaptation (continued) | | |
| 12.1 Climate extremes workshops | [31] | Menne (for Peterson) |
| 12.2 AOPC/OOPC Climate indices - Status of CCI ET-CCDI work, and ocean indices | [32] | Harrison |
| 12.3 WCDMP Data Rescue Update | [33] | Baddour, Heino, Peterson |
| 12.5 Climate Information for Regional Adaptation – Examples from South America | [34a] | Rusticucci |
| 13. Palaeoclimatic Data | | |
| 13.1 Assessment of palaeodata | [37] | Jones |
| Friday 25 April (end of session at 15.30) | | |
| 9.00 – 12.30 | | |
| Summary session | | |
| 14. Review of AOPC-related Actions from GCOS IP - 2009 Comprehensive Report | [38] | Simmons, Secretariat |
| 15. Reports of task groups | | |
| 12.30 – 14.00 LUNCH | | |
| 14.00 – 15.30 | | |
| 16. Summary of decisions and actions | | |
| 17. AOB, Next session | | |
| 18. Closure of the meeting | | |

List of Participants

| Members | |
|---|---|
| <p>Dr Adrian SIMMONS (Chair) ECMWF Shinfield Park READING RG2 9AX United Kingdom</p> | <p>Tel: +44 118 949 9700 Fax: +44 118 986 9450 E-mail: Adrian.Simmons@ecmwf.int</p> |
| <p>Dr James BUTLER NOAA/ESRL, R/GMD1 325 Broadway BOULDER, CO 80305 USA</p> | <p>Tel: +1 303 497 6898 Fax: +1 303 492 6975 E-mail: James.H.Butler@noaa.gov</p> |
| <p>Mr Tobias FUCHS Deutscher Wetterdienst Global Precipitation Climatology Centre (GPCC) Kaiserleistrasse 42 D-63067 OFFENBACH Germany</p> | <p>Tel.: +49 69 8062 2872 Fax: +49 69 8062 3987 E-mail: Tobias.Fuchs@dwd.de</p> |
| <p>Dr D.E. (Ed) HARRISON Pacific Marine Environmental Laboratory NOAA/PMEL/OCRD 7600 Sand Point Way NE SEATTLE, WA 98115 USA</p> | <p>Tel: +1 206 526 6225 Fax: +1 206 526 6744 E-mail: d.e.harrison@noaa.gov</p> |
| <p>Dr Raino HEINO (CCI) Climate Research Finnish Meteorological Institute P.O. Box 503 FI-00101 HELSINKI Finland</p> | <p>Tel: +358 9 1929 4120 Fax: +358 9 1929 3503 E-mail: raino.heino@fmi.fi</p> |
| <p>Prof. Philip JONES Climatic Research Unit University of East Anglia NORWICH NR4 7TJ UK</p> | <p>Tel: +44 1 603 592 090 Fax: +44 1 603 507 784 E-mail: p.jones@uea.ac.uk</p> |
| <p>Dr Matthew MENNE National Environmental Satellite, Data and Information Service (NOAA-NESDIS) NCDC NOAA (E/CC21) Federal Building 514 151 Patton Avenue ASHEVILLE, NC 28801-5001 USA</p> | <p>Tel.: +1 828 271 4449 Fax: + 828 271 4328 E-mail: Matthew.Menne@noaa.gov</p> |

| | |
|---|--|
| Mr Kazutoshi ONOGI Numerical Prediction Division Japan Meteorological Division 1-3-4, Ote-machi, Chiyoda-Ku TOKYO 100-8122 Japan | Tel.: + 81 3 3212 8341 Fax: + 81 3 3221 8406 E-mail: konogi@naps.kishou.go.jp |
| Mr David PARKER Met Office Hadley Centre FitzRoy Road EXETER, EX1 3PB UK | Tel: +44 1392 886649 Fax: +44 1392 885681 E-mail: david.parker@metoffice.gov.uk |
| Dr Matilde RUSTICUCCI (Ms) DCAO/FCEN – Universidad de Buenos Aires 2do. Piso, Pab. II Ciudad Universitaria 1428 BUENOS AIRES Argentina | Tel: +54 11 4576 3364 Fax: +54 11 4576 3356 E-mail: mati@at.fcen.uba.ar |
| Dr Johannes SCHMETZ Meteorological Division EUMETSAT Am Kavalleriesand 31 D-64295 DARMSTADT Germany | Tel.: +49 6151 807 590 Fax: +49 6151 807 838 E-mail: Johannes.Schmetz@eumetsat.int |
| Dr Michel VERSTRAETE Institute for Environment and Sustainability, DG-JRC Via Fermi, 2749 I-21020 ISPRA (VA) Italy | Tel: +39 03 32 78 5507 Fax: +39 03 32 78 9073 E-mail: michel.verstraete@jrc.it |
| Prof. ZHAO Fengsheng National Satellite Meteorological Center China Meteorological Organization (CMA) 46 Zhongguancun Nandajie BEIJING 1000081 China | Tel.: +8610 68409340 Fax: +8610 68409340 E-mail: fszhao@nsmc.cma.gov.cn |
| Other Participants | |
| Dr Christopher BARNET Physical Scientist Integrated Observing System Science and product Development Team (IOSSPDT) World Weather Building, Room 712 5200 Auth Road CAMP SPRINGS, MARYLAND, MD 20746 USA | Tel.: +301 316 5011 Fax: +301 763 8580 E-mail: chris.barnet@noaa.gov |
| Dr John CASSANO University of Colorado 216 UCB BOULDER, CO 80309 USA | Tel.: +1 303 492 2221 Fax: +1 303 492 1149 E-mail: john.cassano@colorado.edu |

| | |
|---|---|
| <p>Prof. Han DOLMAN Faculteit der Aard-en Levenswetenschappen Vrije Universiteit Amsterdam De Boelelaan 1085 1081 HV AMSTERDAM Netherlands</p> | <p>Tel.: + 31 20 59 87 358 Fax: + 31 20 59 89 940 E-mail: han.dolman@falw.vu.nl</p> |
| <p>Dr Gert KÖNIG-LANGLO Alfred-Wegener Institute Busse Strasse 24 D-27570 BREMERHAVEN Germany</p> | <p>Tel: +49 471 4831 1806 Fax: +49 471 4831 1794 E-mail: Gert.Koenig-Langlo@awi.de</p> |
| <p>Dr Jörg SCHULZ Deutscher Wetterdienst Satellite Application Facility on Climate Monitoring Post box 100465 63004 OFFENBACH Germany</p> | <p>Tel.: +49 69 8062 4927 Fax: +49 69 8062 4955 E-mail: joerg.schulz@dwd.de</p> |
| <p>Dr Gabriela SEIZ Federal Office of Meteorology and Climatology MeteoSwiss Kraehbuehlstrasse 58 CH-8044 ZURICH Switzerland</p> | <p>Tel.: +41 44 256 95 39 Fax: +41 44 256 9278 E-mail: gabriela.seiz@meteoschweiz.ch</p> |
| <p>Dr Peter THORNE Met Office Hadley Centre FitzRoy Road EXETER EX1 3 PB United Kingdom</p> | <p>Tel.: +44 1392 886552 Fax: +44 1392 885681 E-mail: peter.thorne@metoffice.gov.uk</p> |
| <p>Mr Bruce SUMNER HMEI Secretariat c/o WMO P.O. Box 2300 1211 GENEVA 2 Switzerland</p> | <p>Tel.: +4122 730 8334 Fax: +4122 730 8340 E-mail: hmei@wmo.int</p> |
| <p>Ms Christine CHARSTONE HMEI Secretariat c/o WMO P.O. Box 2300 1211 GENEVA 2 Switzerland</p> | <p>Tel.: +4122 730 8334 Fax: +4122 730 8340 E-mail: hmei@wmo.int</p> |
| <p>WMO Secretariat</p> | |
| <p>Dr Leonard BARRIE Director, Research Department WMO, P.O. Box 2300 1211 GENEVA 2 Switzerland</p> | <p>Tel.: +41 22 730 8240 Fax: +41 22 730 8049 E-mail: LBarrie@wmo.int</p> |

| | |
|---|---|
| Dr Ghassem R. ASRAR Director, JSC/WCRP WMO, P.O. Box 2300 1211 GENEVA 2 Switzerland | Tel.: +41 22 730 8246 Fax: +41 22 730 8036 E-mail: GAsrar@wmo.int |
| Dr Donald HINSMAN Director Observing and Information Systems Department WMO, P.O. Box 2300 1211 GENEVA 2 Switzerland | Tel.: +41 22 730 8285 Fax: +41 22 730 8181 E-mail: DHinsman@wmo.int |
| Dr Miroslav ONDRAS Chief, Observing Systems Division Observing and Information Systems Department WMO, P.O. Box 2300 1211 GENEVA 2 Switzerland | Tel.: +41 22 730 8409 Fax: +41 22 730 8021 E-mail: MOndras@wmo.int |
| Dr Omar BADDOUR Chief, Data Management Applications Division Observing and Information Systems Department WMO, P.O. Box 2300 1211 GENEVA 2 Switzerland | Tel: +41 22 730 8268 Fax: E-mail: OBaddour@wmo.int |
| Mr Jerome LAFEUILLE Space Programme Office Observing and Information Systems Department WMO, P.O. Box 2300 1211 GENEVA 2 Switzerland | Tel.: +41 22 730 8228 Fax: + E-mail: Jlafeuille@wmo.int |
| Dr Geir BRAATHEN Senior Scientific Officer, RES/ARE WMO, P.O. Box 2300 1211 GENEVA 2 Switzerland | Tel.: +41 22 730 8235 Fax: +41 22 730 8049 E-mail: Gbraathen@wmo.int |
| Mr Etienne CHARPENTIER Observing Systems Division Observing and Information Systems Department WMO, P.O. Box 2300 1211 GENEVA 2 Switzerland | Tel.: +41 22 730 8223 Fax: +41 22 730 8021 E-mail: Echarpentier@wmo.int |
| GCOS Secretariat | |
| Dr David GOODRICH Director, GCOS Secretariat c/o WMO, P.O. Box 2300 1211 GENEVA 2, Switzerland | Tel: +41 22 730 8275 Fax: +41 22 730 8052 E-mail: DGoodrich@wmo.int |

| | |
|--|--|
| Dr William WESTERMEYER GCOS Secretariat c/o WMO, P.O. Box 2300 1211 GENEVA 2, Switzerland | Tel: +41 22 730 8083 Fax: +41 22 730 8052 E-mail: WWestermeyer@wmo.int |
| Dr Stephan BOJINSKI GCOS Secretariat c/o WMO, P.O. Box 2300 1211 GENEVA 2, Switzerland | Tel: +41 22 730 8150 Fax: +41 22 730 8052 E-mail: SBojinski@wmo.int |
| Mr Richard THIGPEN GCOS Secretariat c/o WMO, P.O. Box 2300 1211 GENEVA 2, Switzerland | Tel: +41 22 730 8068 Fax: +41 22 730 8052 E-mail: RThigpen@wmo.int |
| Ms Stefanie LORENZ GCOS Secretariat c/o WMO, P.O. Box 2300 1211 GENEVA 2, Switzerland | Tel: +41 22 730 8423 Fax: +41 22 730 8052 E-mail: Slorenz@wmo.int |

Glossary of Acronyms

| | |
|----------|--|
| ACRE | ATMOSPHERIC CIRCULATION RECONSTRUCTIONS OVER THE EARTH |
| AGG | AOPC ADVISORY GROUP ON GSN AND GUAN |
| AMMA | AFRICAN MONSOON MULTIDISCIPLINARY ANALYSES |
| AOPC | ATMOSPHERIC OBSERVATION PANEL FOR CLIMATE (GCOS/WCRP) |
| AVHRR | ADVANCED VERY HIGH RESOLUTION RADIOMETER (NOAA) |
| AWI | ALFRED-WEGENER-INSTITUT (GERMANY) |
| AWS | AUTOMATIC WEATHER STATION |
| BAS | BRITISH ANTARCTIC SURVEY |
| BSRN | BASELINE SURFACE RADIATION NETWORK |
| CBS | COMMISSION FOR BASIC SYSTEMS (WMO) |
| CCL | COMMISSION FOR CLIMATOLOGY (WMO) |
| CDMS | CLIMATE DATA MANAGEMENT SYSTEM |
| CEOS | COMMITTEE ON EARTH OBSERVATION SATELLITES |
| CGMS | COORDINATION GROUP FOR METEOROLOGICAL SATELLITES |
| CIMO | COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION (WMO) |
| CLARIS | EUROPE-SOUTH AMERICA NETWORK FOR CLIMATE CHANGE ASSESSMENT AND IMPACT STUDIES |
| CLPA | CLIMATE PREDICTION AND ADAPTATION BRANCH (OF WMO CLIMATE AND WATER DEPARTMENT) |
| CMA | CHINA METEOROLOGICAL ADMINISTRATION |
| CRIEPI | CENTRAL RESEARCH INSTITUTE FOR ELECTRIC POWER INDUSTRY (JAPAN) |
| DMI | DANISH METEOROLOGICAL INSTITUTE |
| DWD | DEUTSCHER WETTERDIENST (GERMANY) |
| EC | WMO EXECUTIVE COUNCIL |
| ECMWF | EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS |
| ECV | ESSENTIAL CLIMATE VARIABLE (AS DEFINED BY GCOS SECOND ADEQUACY REPORT (GCOS-82)) |
| EMPA | SWISS FEDERAL LABORATORIES FOR MATERIALS TESTING AND RESEARCH |
| ERB | EARTH RADIATION BUDGET |
| ET-CCDI | EXPERT TEAM ON CLIMATE CHANGE DETECTION AND INDICES (WMO CCL) |
| EUMETSAT | EUROPEAN ORGANISATION FOR THE EXPLOITATION OF METEOROLOGICAL SATELLITES |
| FAPAR | FRACTION OF ABSORBED PHOTOSYNTHETICALLY ACTIVE RADIATION |
| FCDR | FUNDAMENTAL CLIMATE DATA RECORD |
| FP | FOCAL POINT |
| GAW | GLOBAL ATMOSPHERE WATCH (WMO) |
| GCOS | GLOBAL CLIMATE OBSERVING SYSTEM |
| GCMP | GCOS CLIMATE MONITORING PRINCIPLES |
| GCW | GLOBAL CRYOSPHERE WATCH |
| GEO | GROUP ON EARTH OBSERVATIONS |
| GEOSS | GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS |
| GEWEX | GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (WCRP) |
| GOOS | GLOBAL OCEAN OBSERVING SYSTEM |
| GOS | GLOBAL OBSERVING SYSTEM (WMO) |
| GPCC | GLOBAL PRECIPITATION CLIMATOLOGY CENTRE |
| GPS | GLOBAL POSITIONING SYSTEM |
| GRUAN | GCOS REFERENCE UPPER AIR NETWORK |
| GSICS | GLOBAL SPACE-BASED INTERCALIBRATION SYSTEM |

| | |
|------------|---|
| GSN | GCOS SURFACE NETWORK |
| GTS | GLOBAL TELECOMMUNICATION SYSTEM (WWW) |
| GUAN | GCOS UPPER-AIR NETWORK |
| HMEI | ASSOCIATION OF HYDRO-METEOROLOGICAL EQUIPMENT INDUSTRY |
| ICS | INTERNATIONAL CHAMBER OF SHIPPING |
| IGACO | INTEGRATED GLOBAL ATMOSPHERIC CHEMISTRY OBSERVATIONS |
| IGBP | INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME |
| IMO | INTERNATIONAL MARITIME ORGANIZATION |
| INTERCARGO | INTERNATIONAL ASSOCIATION OF DRY CARGO SHIPOWNERS |
| INTERTANKO | INTERNATIONAL ASSOCIATION OF INDEPENDENT TANKERS OWNERS |
| IPCC | INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE |
| IPY | INTERNATIONAL POLAR YEAR |
| IRIMO | ISLAMIC REPUBLIC OF IRAN METEOROLOGICAL ORGANIZATION |
| ISO | INTERNATIONAL ORGANIZATION FOR STANDARDIZATION |
| ISPD | INTERNATIONAL SURFACE PRESSURE DATABANK |
| JCOMM | JOINT TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY |
| JMA | JAPAN METEOROLOGICAL AGENCY |
| JRC | JOINT RESEARCH CENTRE (EUROPEAN COMMISSION) |
| LAI | LEAF AREA INDEX |
| LST | LOCAL SOLAR TIME |
| MEDARE | MEDITERRANEAN DATA RESCUE INITIATIVE (WMO) |
| NCDC | NATIONAL CLIMATIC DATA CENTER (NOAA) |
| NMHS | NATIONAL METEOROLOGICAL OR HYDROLOGICAL SERVICE |
| NOAA | NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (USA) |
| OOPC | OCEAN OBSERVATIONS PANEL FOR CLIMATE |
| OPAG | OPEN PROGRAMME AREA GROUP |
| RBCN | REGIONAL BASIC CLIMATOLOGICAL NETWORKS (WWW/GOS) |
| RIOCC | IBERO-AMERICAN NETWORK OF CLIMATE CHANGE OFFICES |
| R/SSC-CM | REGIONAL/SPECIALIZED SATELLITE CENTRES FOR CLIMATE MONITORING (WMO) |
| SBSTA | SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE (UNFCCC/COP) |
| SORCE | SOLAR RADIATION AND CLIMATE EXPERIMENT |
| SST | SEA-SURFACE TEMPERATURE |
| TIM | TOTAL IRRADIANCE MONITOR INSTRUMENT (NASA) |
| TOPC | TERRESTRIAL OBSERVATION PANEL FOR CLIMATE |
| UNFCCC | UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE |
| VOS | VOLUNTARY OBSERVING SHIP |
| VOSCLIM | VOLUNTARY OBSERVING SHIP CLIMATE PROJECT |
| WCDMP | WORLD CLIMATE DATA AND MONITORING PROGRAMME (WMO) |
| WCRP | WORLD CLIMATE RESEARCH PROGRAMME |
| WDC-GG | WORLD DATA CENTRE FOR GREENHOUSE GASES |
| WG ARO | AOPC WORKING GROUP ON ATMOSPHERIC REFERENCE OBSERVATIONS |
| WIGOS | WMO INTEGRATED GLOBAL OBSERVING SYSTEMS |
| WIS | WMO INFORMATION SYSTEM |
| WMO | WORLD METEOROLOGICAL ORGANIZATION |
| WWW | WORLD WEATHER WATCH (WMO) |

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) and Information Management Panel, fourth session (Honolulu, Hawaii, USA, April 28-May 1, 1998)

- GCOS-46**
(GTOS-15) Report of the GCOS/GTOS Terrestrial Observation Panel for Climate, fourth session (Corvallis, USA, May 26-29, 1998)
- 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)
- GCOS-51**
(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)
- GCOS-67**
(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 Atmospheric Observation Panel for Climate (AOPC), Geneva, Switzerland, April 3-7, 2006
(WMO/TD-No. 1374)
- GCOS-106** Report of the GCOS Regional Workshop for the Mediterranean Basin, Marrakech, Morocco, November 22-24, 2005
(WMO/TD-No. 1337)
- GCOS-107** Systematic Observation Requirements for Satellite-Based Products for Climate
(WMO/TD-No. 1338)
- GCOS-108** Climate Information for Development Needs an Action Plan for Africa, Report and Implementation Strategy, Addis Ababa, Ethiopia, 18-21 April 2006
(WMO/TD-No. 1358)
- GCOS-109** Summary report of the fourteenth session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS, Geneva, Switzerland 10-12 October 2006
(WMO/TD-No 1363)
- GCOS-110** Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), Eleventh Session, Tokyo, Japan 16-20 May 2006
(WMO/TD-No. 1370)
(GOOS No. 154)
(WCRP No.)
- GCOS-111** Summary Report of the ninth session of the GTOS/GCOS Terrestrial Observation Panel for Climate, Ispra, Italy 28-29 March 2006
(WMO/TD-No. 1371)
(GTOS No. 43)
- GCOS-112** GCOS Reference Upper-Air Network (GRUAN): Justification, requirements, siting and instrumentation options
(WMO/TD-No. 1379)
- GCOS-113** Report of the Third Meeting of the GCOS Cooperation Board (Geneva, Switzerland, 27 April 2007)
(WMO/TD-No. 1396)
- GCOS-114** Thirteenth Session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC-XIII) – Consolidated List of Conclusions, Recommendations and Action Items (Geneva, Switzerland, 23-27 April 2007)
(WMO/TD-No. 1407)
- GCOS-115** Report of the Third Meeting of the GTN-H Coordination Panel (Koblenz, Germany, 17-19 September 2007)
(WMO/TD-No. 1408)
- GCOS-116** Report of the Fifteenth Session of the WMO-IOC-UNEP-ICSU Steering Committee for GCOS (Paris, France, 16-19 October 2007)
(WMO/TD-No. 1415)
- GCOS-117** Future Climate Change Research and Observations: GCOS, WCRP and IGBP Learning from the IPCC Fourth Assessment Report (4-6 October 2007)
(WMO/TD-No. 1418)
- GCOS-118** Summary Report of the Tenth Session of the GTOS/GCOS Terrestrial Observation Panel for Climate (Rome, Italy, 15-16 November 2007)
(WMO/TD-No. 1421)
(in preparation)

- GCOS-119**
(WMO/TD-No. 1424) Report of the Implementation Strategy Meeting for Central America and the Caribbean (Belize City, 28-30 January 2008)
- GCOS-120**
(GOOS-No.) Report on the Meeting of "IOC Group of Experts on the Global Sea Level Observing System (GLOSS), tenth session (Paris, France, 6-8 June 2007)
- GCOS-121**
(WMO/TD-No. 1435) GCOS Reference Upper Air Network (GRUAN). Report of the GRUAN Implementation Meeting (Lindenberg, Germany, 26-28 February 2008)
- GCOS-122**
(WCRP 9/2008)
(WMO/TD-No. 1436) Fourteenth Session of the GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC-XIV) – Conclusions and Recommendations (Geneva, Switzerland, 21-25 April 2008)

(Intentionally blank)

GCOS Secretariat
Global Climate Observing System
c/o World Meteorological Organization
7 bis, Avenue de la Paix
P.O. Box No. 2300
CH-1211 Geneva 2, Switzerland
Tel: +41 22 730 8275/8067
Fax: +41 22 730 8052
Email: gcospo@wmo.int