

## **AOPC-XI: CONSOLIDATED LIST OF CONCLUSIONS, RECOMMENDATIONS AND ACTION ITEMS**

*(Geneva, Switzerland, 11-15 April 2005)*

1. The AOPC noted the pending completion of the series of ten workshops in the GCOS Regional Workshop Programme and the associated Regional Action Plans. It emphasized the need for follow-on activities, such as technical workshops, that promote best-practice in the collection, quality control and analysis of GSN and GUAN data in each region.
2. The AOPC offered to work with the Secretariat and the Monitoring and Analysis Centres to produce a report for the GCOS Cooperation Mechanism outlining the status of GSN and GUAN and identifying priority projects to enhance the network performance.
3. The AOPC requested the Chairman and Secretariat to ensure that the GCOS implementation plan is adequately represented in the GEO work programme.

### *GSN and GUAN*

4. The AOPC requested the Secretariat to ensure that all GCOS Monitoring and Analysis Centres had fully implemented the 2005 updates to the station lists.
5. The Panel noted with appreciation the development of a poster by Tom Peterson demonstrating clearly the performance of the GSN. It requested that this poster be publicized at the next SBSTA session and at WMO EC-LVII in June 2005, as well as at other appropriate venues.
6. The AOPC noted that all but some 60-80 of the nearly 1000 stations in the GSN were producing at least some form of observational data for distribution on the GTS. It requested the GSN Lead Centre (NCDC) to provide a list of those stations apparently silent for use in ongoing revitalization efforts for the GSN.
7. The AOPC noted with appreciation the monthly performance maps for receipt of CLIMAT messages being produced at the GSN Analysis Centre (NCDC). It requested the Analysis Centre and the GSN Monitoring Centre (DWD) to collaborate as needed to make similar products routinely available on the GSNMC Web site. It furthermore requested that these products be distributed regularly to all Focal Points for GCOS data and to other appropriate recipients as a means of highlighting network performance and as a step in stimulating remedial actions where needed.
8. The AOPC noted with appreciation the ongoing initiative at the GSN-GUAN Analysis Centre (NCDC) in the Network Performance Indicators project. It encouraged the continuation of this activity with a view to developing an additional resource for routine assessment of GSN and GUAN performance and status.
9. The AOPC reiterated the importance of comprehensive metadata for all GSN and GUAN stations and urged continuation of the efforts in CCI and CBS to standardize the formats for such metadata. It noted that site photographs could be included in the metadata of GSN sites at which revitalization activities have been carried out. While site photographs are an important aspect of station metadata, a major project just to obtain photographs of all GSN sites is not a high priority because it would not resolve queries on the value of individual sites to the historical climate record.
10. The AOPC welcomed the offer of the GSN Analysis Centre (NCDC) and CRU (Climate Research Unit, University of East Anglia) to carry out overlap studies using data from Pitcairn Island and Ponta Delgada, and looked forward to the results of this work.

11. The AOPC noted the plans being developed for a second CBS/GCOS Expert Meeting on Coordination of the GSN and GUAN (September 2005) and expressed its appreciation to NCDC for its offer to host the session.
12. The AOPC noted the significant progress achieved by the GSN Lead Centre at JMA in contacting countries in RA-II regarding problems in receipt of CLIMAT reports, and encouraged the continuation of this work. The Panel recognized the large efforts required for this activity and expressed its strong appreciation to the JMA for supporting this work on behalf of GCOS. The Panel reiterated the potential benefits of nominating additional Lead Centres on a regional basis as a means of sharing the load.
13. The AOPC recommended that countries should continue to calculate mean monthly climate statistics in the future as they have in the past, in order to avoid introducing undesirable inhomogeneities into the records. The Panel noted that it is relatively straightforward to use the CLIREP software to achieve this result.
14. The AOPC recommended that the current WMO 'Climatological Standard Normals' period (1961-1990) be retained for all calculation of anomalies in CLIMAT messages.
15. The AOPC reiterated the importance of the ready availability of designated GSN datasets. It welcomed the efforts at the GSN Archive (NCDC) to make these available through the GHCN-Daily and GHCN-Monthly datasets, noting that this should be completed by the fourth quarter of 2005.
16. The AOPC noted the limited but significant progress in obtaining historical GSN data through the contacts with focal points being carried out by the GSN Lead Centre at NCDC. The Panel encouraged the Lead Centre to extend this effort to the investigation of problems in receipt of monthly CLIMAT messages, as authorized by the terms of reference for the CBS Lead Centres. The Panel recognized the large efforts required for this activity and expressed its strong appreciation to NCDC for supporting this work on behalf of GCOS.
17. The AOPC endorsed the plans to remind all Members of the need to submit historical GSN data to the GSN Archive through a WMO EC Resolution and subsequent letter to all Members.
18. The AOPC emphasized the need to identify problems at existing GSN stations as a first step in revitalization efforts, and stressed that these efforts should be focused on known problems at specific sites.
19. The AOPC welcomed the offer of Carolina Vera to investigate problems and potential solutions with GSN and GUAN in Brazil and neighbouring countries. It suggested that GCOS explore cooperation with the CLIVAR office in Buenos Aires to identify problems in other parts of South America.
20. The AOPC noted the report of the Advisory Group on GSN and GUAN (AGG) and endorsed the recommendations of the group developed during this session (Annex).
21. The AOPC welcomed the progress in revitalizing GUAN stations and expressed its strong appreciation to the US and other partners (Australia, NZ, South Africa, UK) for supporting this initiative.
22. The AOPC requested that performance statistics be kept for all sites at which revitalization efforts have been made. In particular, time series showing the impact of the revitalization efforts should be maintained and publicized as a means of demonstrating the effectiveness of adequate support for revitalization efforts, with a view to solidifying and enhancing such support.

23. The AOPC agreed that the minimum height requirement for humidity measurements at GUAN stations should be reduced to 300 mb. The requirement to reach the tropopause should be retained as a target requirement for selected stations.
24. The AOPC welcomed the report provided by the Chairman (Peter Thorne) of the Working Group on Reconciliation of Surface and Free Atmosphere Temperature Trends (WG-TT). The Panel requested the WG-TT to continue to work with NOAA and other relevant groups to design and implement a Reference Upper-Air Network taking research-quality observations at a subset of GUAN sites.
25. The AOPC noted the results from the first NOAA workshop on Climate Requirements for Upper-Air Observations and looked forward to the next workshop on instrumentation to be held in Seattle later in 2005. It welcomed the invitation of NOAA to the AOPC Chairman and the WG-TT Chairman to serve on the advisory committee for the second workshop
26. The AOPC welcomed the Hadley Centre study (by Mark McCarthy) on optimization of GUAN station distribution on a global basis. It urged continuation of this effort, taking account of the overall purpose of GUAN including calibration for comprehensive networks and for space-borne instruments. The Panel also suggested preparation of a publication on this work, in cooperation with the AGG, to provide a formal scientific framework for the design of the GUAN.
27. The AOPC requested that the GCOS Archive for GUAN be formally expanded to incorporate the data held at both the World Data Centre-Asheville (NCDC) and the GUAN Analysis Centre (Hadley Centre). Raw and quality-controlled daily radiosonde (TEMP) data would be available from the WDC-Asheville, while quality-controlled, homogeneous monthly data obtained from CLIMAT TEMPS and other available sources would be made available through the Hadley Centre, subject to confirmation of the open availability of these data through contact between the Chairman and the Hadley Centre.
28. The AOPC welcomed the presentation on GCOS-related activities in South America presented by Carolina Vera. It fully supported the proposals for enhancement of the GUAN network and improving access to the daily database from GCOS stations, as identified in the GCOS Regional Action Plan (RAP) for South America. The Panel urged the implementation of these and other GCOS-related projects as soon as possible.
29. The AOPC encouraged regions to monitor progress on enhancement of the GSN and GUAN under their RAPs and requested that AOPC be kept informed on such progress.
30. The AOPC welcomed the presentation by Oleg Pokrovsky on the assessment of the optimal distribution of GUAN in Russia. It agreed that further such assessments on a regional basis would be useful, while noting the importance of including information on neighbouring stations from other countries on the optimal distribution in a given country.
31. The AOPC noted the efforts in the Russian Federation in re-designing the upper-air network in northeast Asia, noting especially the importance of sites located on the Arctic coast (e.g. Taymir, Chukotka Peninsula). The Panel looked forward to the potential of this activity to improve the composition of the GUAN network in the region in the future.

#### *Satellite Issues*

32. The AOPC noted with appreciation the sustained effort by JMA and EUMETSAT to reprocess Atmospheric Motion Vectors (AMVs) from satellite data for reanalysis at NWP centres. It recommended that other satellite operators pursue similar reprocessing with state-of-the-art AMV derivation methods (including quality indicators).

33. The AOPC recommended that satellite operators establish a process (e.g. via CGMS) to provide Level 1b products (i.e. navigated and calibrated radiances) needed for climate applications. In addition, priority Level 2 products (geophysical quantities) should be generated and reprocessed in the light of advanced understanding of the data characteristics.
34. The AOPC encouraged CGMS to pursue the development of enhanced cloud products including cloud microphysics, recognizing the GCOS requirement for improved cloud monitoring. It recommended in particular the evaluation of climate cloud products with advanced research satellite missions like Cloudsat.
35. The AOPC recommended that CGMS request its members to define and commence the development of a climate data set from hyperspectral IR instruments (AIRS, IASI, CrIS) that is substantially reduced in terms of data volume, in order to make climate processing of long time series tractable.
36. The AOPC recommended that CGMS invite satellite agencies to report on current efforts to establish and/or enhance global aerosol products suitable for climate applications.
37. The AOPC reiterated the importance of having independent observations and analyses of the Essential Climate Variables (ECVs) in order to be able to take maximum advantage of new observing technology. Only with independent information can confidence be given to data obtained by new systems.
38. The AOPC emphasized the importance of satellite agencies undertaking appropriate risk analyses of potential gaps and overlaps in mission continuity in order to assist in achieving the GCOS goals of sustained provision of satellite-based observations of ECVs.
39. The AOPC noted the results of the joint EUMETSAT/WMO/GCOS/CM-SAF (Climate Monitoring Satellite Application Facility) workshop in July 2004. It welcomed the efforts of the CM-SAF to identify and ultimately fulfill the needs of GCOS for integrated global climate products. The Panel noted that the SAFs are an appropriate mechanism for transitioning the results of pilot projects into long-term operational products, including for example global radiation budgets, cloud parameters, precipitation, surface albedo and aerosols. The Panel looked forward to the workshop follow-on meeting to be held in conjunction with the CM-SAF Users Workshop in September 2005 and suggested that Phil Arkin represent AOPC at the session. The Panel suggested in addition that the operational teams providing climate data should also have the capability to carry out appropriate scientific analyses as a means to ensure data and product quality.
40. The AOPC noted the importance of external evaluation and advice from user groups regarding satellite observations and products as these are developed, and encouraged the establishment of such external review or advisory groups for the SAFs as appropriate.
41. The AOPC reiterated the importance of comprehensive reference sites, such as the DOE ARM sites, and noted the need to consolidate a global network of such sites. It asked the Chairman, as a member of the WOAP, to explore the potential of the WCRP CEOP program to provide the framework for a network of reference sites over land and ocean.
42. The AOPC welcomed the review of the WMO Space Programme and its offer to assist in implementation of the IP.

#### *Atmospheric Forcing*

43. The AOPC welcomed the presentation on the measurement and analysis of the ERB from Bruce Wielicki.

44. Recognizing the strong need for reference-quality radiation measurements over the open ocean, the AOPC reiterated its support for the OceanSites air-sea flux mooring programme. This programme aspires to establish about 30 reference moorings around the global ocean and would provide essential information to complement the BSRN land-based measurements.
45. The AOPC welcomed the presentation by Jim Butler reviewing the GAW greenhouse gas networks. For CO<sub>2</sub> measurements over the ocean, it recommended that the GAW community strengthen links with the ocean carbon community with a view to expanding the GAW networks into this domain.
46. The AOPC encouraged the strengthening of links between the GAW community and the atmospheric climate analysis and modeling communities, to ensure that the valuable observations being obtained through GAW (e.g. CO<sub>2</sub>, CH<sub>4</sub>) are used to full advantage in climate diagnostic and prediction/projection studies.
47. The AOPC agreed to the establishment of an ad-hoc Working Group to develop an agreement that would identify the terms under which the GAW CO<sub>2</sub>/CH<sub>4</sub> networks would be designated as a major component of the GCOS comprehensive network for CO<sub>2</sub> and CH<sub>4</sub>. It requested the Chairman and the Secretariat (H. Teunissen) to represent GCOS on this WG and noted that Jim Butler and the GAW Secretariat (L. Barrie) would represent GAW. A draft agreement would be prepared for June 2005 with a view to submission of a final document to the GCOS Steering Committee and the CAS WG-Environmental Pollution and Atmospheric Chemistry at their next sessions.
48. The AOPC welcomed the activity in GAW to develop a global network for N<sub>2</sub>O and strongly encouraged its continuation, noting the identification of N<sub>2</sub>O as an ECV in the 2AR.
49. The AOPC was pleased to note the progress in increasing data submission to the World Data Centre for Greenhouse Gases (WDCGG, JMA) and encouraged continuation of the monitoring and publication of such information on the WDCGG Web site.
50. The AOPC welcomed the progress, highlighted in the report of Ellsworth Dutton, in enhancing the global representativeness of the BSRN.
51. The AOPC noted the activity in the BSRN community to study long-term trends in surface radiation. In view of general community interest in problems such as 'global dimming', it encouraged BSRN to publish the results of its trend analyses. The Panel recognized the great value of the BSRN archive of high-quality observations over the last decade or more and asked the Chairman to confirm that there is sustained support for the BSRN archive.
52. The AOPC noted the progress in GAW and in the IGACO project toward development of comprehensive aerosol and ozone networks.

#### *Marine Issues*

53. The AOPC welcomed the review by Phil Arkin and Ed Harrison of oceanic and atmospheric anomalies since AOPC-X. It noted that these anomalies did not have the large-scale characteristics normally associated with El Niño periods of air-sea interaction, in that the traditional equatorial Pacific anomalies away from the international dateline were all less than one standard deviation when seasonally smoothed. This period is worthy of further study to clarify the class of event that it represented.
54. The AOPC welcomed the report from the Chairman of the OOPC (Ed Harrison). It noted in particular the plans for deployment of spar buoys at specific reference sites in the ocean and recommended that the planned buoys should monitor as many of the GCOS ECVs as technically possible (e.g. sea surface temperature, near-surface air temperature and

dewpoint, air-sea fluxes, mean sea level pressure, and tropospheric profiles of temperature and water vapour), to the precisions and accuracies stipulated in the GCOS Implementation Plan. These observations are particularly important in data-sparse parts of the Southern Hemisphere.

55. The AOPC welcomed the report on the status of global SST analysis from the Chairman (Richard Reynolds) of the AOPC/OOPC Working Group on Sea-Surface Temperature and Sea Ice (WG-SST/SI). It noted in particular the information on the apparent bias in SST estimated from AVHRR observations that occurs late in the lifetime of some satellites. Recalling that Outgoing Long-wave Radiation (OLR) estimated from AVHRR also exhibits various systematic errors associated with the lifetime of these satellites, the AOPC recommended that the appropriate SST and OLR algorithm developers be encouraged to investigate this issue with a view to identifying possible corrections. The Panel also reiterated the importance of overlap of satellite missions, in accordance with the GCOS Climate Monitoring Principles.
56. The AOPC noted the efforts of the Chairman of the WG-SST/SI to clarify differences in the quality control procedures of the various groups routinely generating global SST analyses. The Panel recommended the convening of a workshop to bring together these groups, suggesting that planning for such a workshop could be associated with the MARCdat-II Workshop scheduled for 17-20 October in Exeter, UK.
57. The AOPC noted the review of past and planned activities of the JCOMM Expert Team on Sea Ice and recommended that the WG-SST/SI maintain strong linkages with this group.
58. The AOPC noted the opportunities presented by the International Polar Year (IPY) initiative to provide a focus for the organization of projects related to sea ice. It requested the WG-SST/SI to maintain close contact with the WMO/ICSU Joint Committee for IPY in order to take maximum advantage of these opportunities.
59. The AOPC noted the continuing importance of a healthy VOS program as the link with the historical record of marine surface conditions (including air-sea flux estimates) and encouraged the JCOMM to take appropriate steps to address the factors that limit the program at present.
60. The AOPC noted the progress made by the VOSclim project and the support by WMO in developing an electronic data base for metadata in WMO Publication 47. The Panel encouraged JCOMM to take action to bring the number of VOSclim ships to at least the minimum target of 200 by the end of 2006.
61. The AOPC noted the progress in implementation of the OceanSites reference mooring programme and enhancement of the Global Tropical Mooring Programme in the Atlantic and into the Indian Ocean. The Panel encouraged continued progress toward the agreed objectives of each effort.
62. The AOPC welcomed the progress toward global implementation of the surface drifting buoy network, noting that the initial goal of 1250 drifters was expected to be reached by the end of 2005. It noted with appreciation the dramatic improvement in global coverage achieved by this program over the past decade.
63. The AOPC commended the AOPC/OOPC Working Group on Surface Pressure (WG-SP) on their substantial progress over the past year and expressed its full support for their ambitious plans for the coming year.

### *Synthesized Products and Reanalysis*

64. The AOPC expressed its strong appreciation to the GPCC for completing the development of a high-resolution, long-term climatology of global precipitation and for making this openly available through its Web site. The Panel encouraged the GPCC to continue its efforts to collect additional data to update the climatology and fill remaining gaps, and to develop additional reanalyses for extended periods. It also encouraged the WMO and GCOS Secretariats to provide the maximum possible assistance in acquisition of the necessary data.
65. The AOPC welcomed the review of precipitation products by Phil Arkin and encouraged the development of global and continental-scale precipitation data sets including:
  - reanalysis of global precipitation for the period from 1988 - present, with extension back to 1979 if feasible, to permit improved description of phenomena related to major modes of climate variability as well as decadal variations and trends;
  - reconstruction of oceanic precipitation back to 1950, and further if possible, to permit the examination of longer time scale variations and trends; and
  - an intensive 'Program of Evaluation of the newly available High Resolution Precipitation Products' (PEHRPP) with the objective of identifying synergies and opportunities for improvement and of defining the data sets necessary to extend them (or some improved versions) back to the early 1990s.
66. The AOPC welcomed the presentation by Phil Arkin on US reanalysis activities and noted the US plan to create a Community Reanalysis System.
67. The AOPC welcomed the results from the JRA-25 reanalysis project, noting the anticipated completion of the project by end 2005. It also welcomed the plans to make the results of the reanalysis openly available on a data server.
68. The AOPC encouraged continuation of the international collaboration to develop a historical observational data set for global reanalysis.
69. The AOPC reiterated the value of global reanalyses being carried out sequentially by the major centres that have already invested in this process. It encouraged the exchange of information and experience among these centres to ensure continuing improvement of global reanalysis.
70. The AOPC noted the establishment of the new WCRP Observations and Assimilation Panel (WOAP). It looked forward to full cooperation with this group through, *inter alia*, the membership of the AOPC Chairman on WOAP. The Panel anticipated that this mechanism would promote the international cooperation necessary to optimize continuing improvement of global reanalysis.

### *Other*

71. The AOPC welcomed the progress in organizing Regional Climate Change workshops to promote the analysis of extreme climate events, especially in developing regions, and the many positive results coming from them. It encouraged continuation of this approach as an excellent means of capacity building, as well as producing regional analyses for use in IPCC assessments
72. The AOPC endorsed the proposal by Chris Folland to establish a Climate Indices Web site. It requested the Chairs of AOPC and OOPC to cooperate with him in developing clear terms of reference and criteria for the indices to be used.

73. The AOPC recognized the great value of the NCDC paleoclimate archive and recommended that all paleoclimate data, including original measurements and reconstructions, should be lodged in the archive.
74. The AOPC agreed that the next session of the AOPC would be held in Geneva, Switzerland from 3-7 April 2006.