WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

OPAG ON INTEGRATED OBSERVING SYSTEMS

IMPLEMENTATION/COORDINATION TEAM ON THE GLOBAL OBSERVING SYSTEM

THIRD SESSION

FINAL REPORT

GENEVA, SWITZERLAND, 6 – 10 SEPTEMBER 2004

WMO General Regulations 42 and 43

Regulation 42

Recommendations of working groups shall have no status within the Organization until they have been approved by the responsible constituent body. In the case of joint working groups, the recommendations must be concurred with by the presidents of the constituent bodies concerned before being submitted to the designated constituent body.

Regulation 43

In the case of a recommendation made by a working group between sessions of the responsible constituent body, either in a session of a working group or by correspondence, the president of the body may, as an exceptional measure, approve the recommendation on behalf of the constituent body when the matter is, in his opinion, urgent, and does not appear to imply new obligations for Members. He may then submit this recommendation for adoption by the Executive Council or to the President of the Organization for action in accordance with Regulation 9(5).

EXECUTIVE SUMMARY

The third session of the CBS Implementation and Coordination Team for Integrated Observing Systems convened on Monday, 6 September 2004 at WMO Headquarters, Geneva, Switzerland. Prof. Hong Yan welcomed the members on behalf of the Secretary-General of WMO. He stressed the importance of the present meeting in shaping the future of the observations systems within WMO.

The Chairman presented his report. He noted that the ICT has several tasks that are addressed through the OPAG's three expert teams and Rapporteur's. The Chairman also reported on several changes that have occurred within CBS since the second session. He also provided a summary of the many activities since the second session if the ICT-IOS.

The Rapporteurs of each Regional Association presented reports on the performance and status of the GOS in their respective Regions.

The ICT received a report on Monitoring Statistics during 2004. The results showed relatively stable levels of receipt of SYNOP and TEMP reports over the last four years, although some variation was noted. SHIP and AIREP/AMDAR reports also remained fairly stable during the same period, however BUOY reports showed an increase.

The ICT heard reports concerning the efforts of its ET dealing with Automatic Weather Stations to organize a credible quality control programme for AWSs. In addition, the team had proposed specifications for the reporting of AWS data using binary codes and had collaborated with CIMO in reviewing the requirements for accuracy of instruments used on AWSs.

ET-SSUP reported on the activities carried out to improve satellite system utilization. Particularly impressive was the growing strength and impact of the CGMS/WMO Virtual Laboratory for Education and Training in Satellite Meteorology (VL) activities. Another success story was the rapid evolution of the Advanced Dissemination Methods (ADM).

There has been much progress on the Observational Data Requirements and Redesign of the Global Observing System. ET-ODRRGOS has been working on the three main tasks it has been set by CBS, including continuing the Rolling Requirements Review (RRR) and suggesting changes in the GOS to fill gaps identified by the RRR. Most importantly the ET has finalized the Implementation Plan for the Evolution of the GOS. The Implementation Plan was reviewed and revisions made by ICT-IOS and the final Implementation Plan will be submitted to CBS-XIII for approval.

ICT reviewed the GOS performance in the Regions and in particular monitoring results regarding frequency, accuracy and geographic coverage provided by RBSN and RBCN and GCOS networks.

A detailed review of the draft of the Manual on the GOS, Volume II (Regional Aspects) was undertaken and an updated version will be submitted to Regional Associations for approval.

The ICT was advised on recent work on implementing the recommendations of the Rapporteur on Volume A of WMO Publication No. 9. A design specification has been prepared, and a version of the application was presented to the meeting.

The ICT received a report on the AMDAR programme. The request for training of AMDAR data users in a wide range of operational applications was discussed, and it was recommended to develop a training concept for use of AMDAR data.

The ICT reviewed the Terms of Reference of the Rapporteurs/Coordinators on GOS matters assigned by their Regional Associations, and developed proposals for improving the fulfillment of their responsibilities and dissemination of information on IOS matters within the regions.

The Meeting adjourned on 10 September 2004 at 12.00 noon.

1. ORGANIZATION OF THE SESSION

1.1 Opening of the meeting

The third session of the CBS Implementation and Coordination Team for Integrated Observing Systems was convened by OPAG Chairman, Dr James Purdom at 09:30 a.m. on Monday, 6 September 2004 at the WMO Headquarters, Geneva, Switzerland.

Prof. Hong Yan welcomed the members on behalf of the Secretary-General of WMO. He stressed the importance of the present meeting in assisting in the development of the redesign of the GOS. He also noted that the ICT consisted of distinguished experts who would assure a constructive outcome. He wished the participants well with their busy work schedule during the week.

1.2 Adoption of the agenda

The ICT adopted the agenda as contained in Annex I.

1.3 Working arrangements

The meeting agreed on working arrangements and adopted a tentative work plan for consideration of the various agenda items (See Annex II). The chairman announced that he intended to adhere rigidly to the work plan, starting each session precisely on time and ending on time. He further stated that it was his intention to leave a substantial time for drafting the final report of the meeting and the document for CBS XIII, which would be the definitive result of the meeting.

2. REPORTS

2.1 Report of the Chairman

The OPAG Chair expressed his appreciation to the Chairs of the expert teams and Rapporteurs for their hard work during the period that had resulted in a number of important accomplishments. He particularly noted the substantial progress with regard to their respective terms of reference. He commented on changes have occurred within CBS and the OPAG IOS since CBS Ext 2002. Within the OPAG IOS, he welcomed the new Rapporteur for GCOS, the new Rapporteur for OSE and OSSEs, the new Regional Rapporteurs, and the newly established Rapporteur for AMDAR. With sadness the Chair reported the death of Mr Harald Daan, Rapporteur for Volume A; a replacement is being sought.

The chairman reported on results from CBS-Ext 2002, Cg-XIV, CBS MG Meeting, CGMS XXXII and EC LVII. At CBS, progress made since its twelfth session was reviewed and the Commission consolidated its two-year work programme based on the relevant sections of the Fifth and draft Sixth WMO Long-term Plans and on relevant decisions of the Executive Council, and taking into account the detailed discussions held during the reports of the various OPAGS. The main areas to be addressed by the OPAG IOS ICT, ETs and Rapporteurs were approved.

At Cg-XIV, 2003 comments were provided concerning GOS and redesign issues and Congress pointed to the urgency of the development of an implementation plan with timelines. Congress elevated Satellite Activities to status of Major WMO Programme, with CBS taking the lead responsibility for the WMO Space Programme. Two areas of impact on the OPAG IOS are: 1) representation by appropriate R&D satellite operators in the relevant ET and ICT within the OPAG; and 2) a new Expert Team on Satellite Systems to be added to OPAG IOS. The Terms of Reference have been established for the new ET and nominations for team members from space agencies are being sought through the WMO Space Programme. The GCOS Climate Monitoring Principles were also accepted by Congress.

At the CBS-Management Group Meeting in Langen, Germany, the MG reviewed the work plans of the expert teams and Rapporteurs to and agreed on the work program within OPAG-IOS until CBS-XIII. The MG considered the outcome and follow-up of the Earth Observation Summit. Several items of the TORs of the ad hoc Group on Earth Observations (GEO) and the GEO Sub-groups were strongly related to the WWW, especially with respect to the redesign of the GOS (Subgroup on Architecture), and data management functions and the FWIS development (Subgroup on Data Utilization). The momentum created by the EOS should highly benefit the implementation of the WWW, provided that the WWW, as a unique global system, be adequately promoted. Since the MG Meeting the OPAG IOS provided relevant reference materials to the relevant GEO Sub-groups: 1) The vision for the evolution of the GOS to 2015; and, 2) Recommendations developed for the evolution of the space- and surface-based components of the GOS;

The OPAG Chair reported that CBS is working in close coordination with CAS on THORPEX, that he is a member of the THORPEX Implementation Team, and discussed the potential impact of THORPEX on all CBS OPAGs activities. The THORPEX Implementation Plan is under development, with four core programs that make up THORPEX – Predictability and Dynamical Processes; Observing Systems; Data Assimilation and Observing Strategies; and Social and Economic Applications. Each of those programs has several tasks that need to be carried out as the program evolves. The OPAG IOS Chair is actively engaged in the development of portions of the plan that deal with Observing Systems, and Data Assimilation and Observing Strategies.

The Chair spoke of the importance of the Third WMO Workshop on the Impact of Various Observing Systems on NWP that was held in Alpbach, Austria earlier in the year. At the workshop, scientists from lead centers across the globe addressed advances in NWP for both global and regional scale modeling with focus on advanced observing system impacts. Workshops such as this are vital to GOS evolution activities.

At CGMS XXXII, the Role of R&D satellites in redesign of GOS was adopted. Also, CGMS Members requested representation in observer status on the THORPEX ICSC with a Rapporteur for that purpose. It is expected that results from THORPEX will help guide the utilization of satellite data and future satellite roles as part of the Global Observing System. In addition, at CGMS, the success of the European ATOVS Retransmission Service was discussed. Since that time, the OPAG Chair has been pursuing the possibility of extending such activity globally. Near real time access to ATOVS data are important for GDPS centers as well as other WMO Members with NWP capability. Access to near real time ATOVS data are also important for WMO activities such as implementation planning for the redesign (evolution) of the GOS and THORPEX. Since CGMS, the OPAG Chair met with several Member representatives at EC-LVI and the Director of EUMETSAT to discuss this activity. It was agreed that CGMS Members, with help from EUMETSAT, would form local consortiums to develop regional ATOVS Retransmission Services in conjunction with EARS. This activity should be focused within the WMO Space Programme.

2.2 Report on GEO Activities and Developments

2.2.1 The session was informed that at the invitation of the United States of America, on 31 July 2003 in Washington DC, thirty-three nations, and the European Commission, joined together at the first Earth Observation Summit (EOS-I) to adopt a Declaration that called for action in strengthening global cooperation on Earth observations. The purpose of the Summit was to:

> "Promote the development of a comprehensive, coordinated, and sustained Earth observation system of systems among governments and the international community to understand and address global environmental and economic challenges; and begin a process to develop a conceptual framework and implementation plan for building this comprehensive, coordinated, and sustained Earth observation system or systems."

2.2.2 To this end, the Summit participants launched an ad hoc Group on Earth Observations (GEO), with the goal of furthering the creation of a comprehensive, coordinated, and sustained Earth observing system or systems. The group, co-chaired by the United States, the European Commission, Japan, and South Africa, and joined by more than 21 international and intergovernmental organizations, began its work by organizing five Sub-Groups, as well as a secretariat to support its activities. In order to promote the development of the now named Global Earth Observing System of Systems (GEOSS), GEO decided that a document describing the GEOSS framework and an associated 10-Year Implementation Plan would be developed.

2.2.3 The session noted that the document describing the GEOSS framework (referred to as the Framework Document) for the 10-Year Implementation Plan was presented for adoption at the second Earth Observation Summit (EOS-II) attended at the ministerial-level, in Tokyo, Japan on 25 April 2004, and the 10-Year Implementation Plan itself would be presented for adoption at the third Earth Observation Summit (EOS-III) hosted by the European Commission to be held 16 February 2005 in Brussels.

2.2.4 The session noted that four sessions of GEO had been held followed by the second Earth Observation Summit (EOS-II). The session noted that GEO-2, which met in Baveno, Italy, 28-29 November 2003, had agreed with the following recommendation concerning its architecture:

> "GEOSS should be a system of systems supplemented by new observing components as and where required. This architecture would allow existing individual observing systems, e.g., WMO's WWW GOS, to remain within their mandates as well as providing for new observing components. The architecture would require a new interface between individual observing components as well as a new component to exchange and disseminate observational data between those components. GEO members and participating organizations would need to agree upon a global interoperability specification to which all individual observing components would adhere. GEOSS would contain the necessary network structure to make available all required observations to satisfy the Data Utilization Model."

EOS-II

2.2.5 The session noted that a Communiqué stating approval of the Framework Document, pointing the way forward in the GEO effort, and encouraging broad participation in and support for the GEO effort, was approved at EOS-II on 25 April 2004. It was also agreed that the framework document should also consist of: a high-level synopsis of the GEO effort for senior policymakers; a description of the GEOSS purpose and expected benefits; and a broad framework for developing the 10-year Implementation Plan.

Future Development of GEOSS

2.2.6 The session noted that EC-LVI had adopted Resolution 9 on the Global Earth Observation System of Systems (GEOSS) in affirming its full support for the GEO process and resulting GEOSS. In reviewing the GEOSS Resolution approved by EC-LVI, the session noted that it specifically requested the technical commissions, as well as the Consultative Meetings on High-level Policy on Satellite Matters, to rapidly evaluate the draft Implementation Plan, to provide advice as necessary to ensure that the existing World Weather Watch Global Observing System, Global Atmosphere Watch, World Hydrological Cycle Observing System, Global Climate Observing System, Global Ocean Observing System, Global Terrestrial Observing System and other related observing systems are developed in a mode that is compatible with the Ten-Year Implementation Plan; and, when the Plan is finalized, to provide advice as to how the WMO-coordinated systems should operate within the framework of the Plan. The session also noted that there would be a GEO Special Session on Governance to be hosted by the European Commission 27-28 September 2004 in Brussels.

2.3 Report on the WMO Space Programme

2.3.1 The session was informed of activities related to the WMO Space Programme. A brief summary of several meetings including the establishment of the WMO Space Programme as a major cross cutting WMO Programme at the Fourteenth WMO Congress, the fourth session of the WMO Consultative Meetings on High-level Policy on Satellite Matters and the fifty-sixth session of the WMO Executive Council was presented. Finally, the session was briefed on current activities within the WMO Space Programme relevant to implementation of the World Weather Watch.

2.3.2 The session noted that the fifty-sixth session of the WMO Executive Council (EC-LVI) had endorsed a proposal towards the development of the space component of an integrated WMO global observing system. EC-LVI looked forward to CBS development in consultation with all other relevant WMO and co-sponsored bodies, of the space-based component of the integrated WMO global observing system on the basis of space-based observation components for three earth-system domains and two cross-cutting sets of requirements.

2.3.3 The session noted that near term activities and plans for the WMO Space Programme included those for: a WMO Space Programme Trust Fund; the organizational structure of the WMO Space Programme Office; the evolution of the space-based component of the GOS; an International Geostationary Laboratory (IGeoLab); a common framework for calibration and inter-calibration; increased real time access to satellite data through the establishment of several Advanced Dissemination Methods; a master data format for satellite data (BUFR); a Global Education and Science Network; and training using the CGMS/WMO Virtual Laboratory for Education and Training in Satellite Meteorology.

3. RBSN PERFORMANCE MONITORING RESULTS AND IMPLEMENTATION TRENDS

3.1 The session discussed the WWW monitoring results. It was noted that the percentage of SYNOP reports available at MTN centres in comparison with the number of reports required from RBSN stations was about 76 per cent during the period 2002-2004, with a variation of one per cent over the period. There were still deficiencies in the availability of SYNOP reports from areas in Region I (52 per cent availability in July 2004), in Region III (57 per cent) and in Region V (68 per cent).

3.2 The percentage of TEMP reports available at MTN centres was about 63 per cent during the period 2002-2004, with a variation of one per cent over the period. The availability of TEMP reports was relatively satisfactory for the eastern and southern parts of Region II, the northern part of Region IV, some countries in Region V and the western part of Region VI. The availability of TEMP reports was generally insufficient for most of the other parts of the world.

3.3 There was no major evolution in the availability of SHIP reports during the period 2000-2004. The number of TEMP SHIP reports in July 2004 reached 23. The number of BUOY reports has increased from 8094 to 14079 from 2000 to 2004. The number of AIREP reports varied between 3149 (February 2002) and 4484 (July 2004). The numbers of character coded AMDAR reports ranged from 21385 (July 2001) to 15101 (July 2004). The monitoring of BUFR aircraft reports within the SMM started in 2004. The number of character-coded and BUFR aircraft reports was 105117 in July 2004. It should be understood that BUFR reports may contain up to several hundred observations. Except for AIREP and BUOY reports, a large part of the reports from mobile stations were issued from the Northern Hemisphere.

3.4 The ICT responded to the request from CBS -Ext 02 to consider providing further monitoring information on the performance of the RBSN against the "practical target" of the commitment of Members in addition to those against the ideal target. The recommendation had also requested that known permanent departures of observing systems from the RBSN specification be included in the RBSN listing.

3.5 The ICT considered that Vol. A was the appropriate place to record information on the observing system, and noted that the redesigned electronic Vol. A would provide a more

responsive and timely facility to document the status of observing systems, including required metadata.

3.6 The ICT also felt that it was important to record the performance against the ideal target for the RBSN to emphasize the high priority assigned by the global community to that base-line network. Any systematic shortcomings should be taken as indications of the need for a response by the international community. Nevertheless, the ICT also noted that some tables of the performance against "expected" numbers of observations are already included in the Annual Status Reports on the WWW, although no maps are presented. The ICT suggested that some maps showing the performance against these expected numbers be made available in the monitoring reports on the WMO web site, and possibly in the hard copy Status Report. Members would then have access to such figures.

4. REVIEW OF THE GOS PERFORMANCE IN THE REGIONS

The Rapporteurs/Coordinators on Regional Aspects of the GOS informed the meeting on the implementation of observing programmes in their respective regions.

4.1 Report on the GOS in Region I

The latest SMM shows that 64% of the 611 African surface stations performed at least 8 daily surface observations at synoptic hours and 10% carried out observations at the four main synoptic hours. One relevant item to note particularly related to the performance of the surface component of the RBSN is the reduction of the number of silent stations to the level of 5% (26 stations. Many stations, which remained silent for many years are being reactivated and rehabilitated in war regions and in other data sparse areas of Nigeria, Guinea, Ethiopia, and Sierra Leonne.

Despite the substantial increase in the number of stations making some observations (176 or 28%), the availability of surface observations coming out of Africa remains among the lowest on the GTS.

It is recommended that further efforts should be made to improve the accomplishment of the complete observing programmes in Africa by deploying automatic weather station and upgrading the data transmission facilities in the national weather centres.

The availability of TEMP reports is not satisfactory. More data-sparse areas were created during the last two years over some parts of Africa due mainly to the reduction of observing programmes from 3 or 2 observations a day to only one observation a day and also to many stations becoming silent stations main reasons are responsible for this situations (1) the hydrogen generation facilities in many stations obsolete are degraded and (2) the continuing financial difficulties faced by many countries to acquire the necessary consumables, such as balloons, sondes and hydrogen production components.

It is proposed to strongly encourage the use of AMDAR technologies through the implementation of the emerging regional AMDAR programmes (as the targeted programme for ASECNA) and the planned AMDAR programmes in Morocco, Kenya and Egypt. The success of these implementation activities will be based on the results of the forthcoming OSE on African AMDAR.

Africa has benefited from the PUMA project that allows the NMHSs to improve the ground equipment to receive satellite data and products. The first EUMETCAST reception stations have been installed in Pretoria and Niamey. After the EUMETCAST testing the NMHSs will soon be able to gain access to the MSG data for the monitoring of the state of the environment.

4.2 Report on the GOS in Region II

The availability of SYNOP from RBSN stations has increased but the availability of TEMP was still not satisfactory in Region II. 2003 annual monitoring results showed that the availability of RBSN in RA II was 86% for SYNOP reports and 59% for TEMP reports. October 2003 annual monitoring results also showed that among the RBSN stations, 88 SYNOP stations and 43 TEMP (part A) stations, which had been implemented, were "silent".

The implementation rate of RBCN was improved but still not satisfactory in Region II. Annual monitoring results showed that in 2003 the availability of RBCN in RA II was 65% for CLIMAT reports and 61% for CLIMAT TEMP reports.

A new RBSN and RBCN list was proposed by the Rapporteur on the Regional Aspects of the GOS, which had been reviewed by the fourth session of the working group on planning and implementation of WWW of RA II and will be submitted to the next session of the Regional Association for approval.

Some progress has been made in Marine Observing System, especially in Argo programme, in Japan, the Republic of Korea and China.

With regard to AMDAR observation in Region II, Saudi Arabia, Hong Kong China, United Arab Emirates, Russian Federation, Oman and Egypt have carried out or are planning to carry out their own programs. The availability of AMDAR reports in Region II continued to be low In overall. It is suggested that more workshops should be organized in RA II to train experts and discuss how to participate the AMDAR programme.

The strategic plan for the Enhancement of National Meteorological Services (NMSs) in Regional Association II (Asia 2001-2004, which was approved by the twelfth session of Regional Association II was under review and will be updated by the next RA II session.

RAII Members have benefited from both operational satellites like NOAA, METEOR, GMS, the FY series of satellites and R & D satellites. The number of satellite receivers deployed in RAII have increased during recent years and the major improvement in the Region since 1992 has been in the area of the low-resolution polar-orbiting receiver that resulted in an increase of 100 receivers.

4.3 Report on the GOS in Region III

With regard to the availability of synoptic data coming out of the Region III, the major monitoring exercises show that 63% of the 435 stations comprising the surface component of the RBSN are reported on the GTS. However some nighttime telecommunication problems persist for many stations in the region (30%).

The meeting noted that 35 surface stations not listed in Volume A are in fact implemented. Despite the increase in the number of upper air station (including 15 station not listed in Volume A), still the availability of TEMP report from RA III, remain very low (45% of the 58 station). This situation results from the persistent of financial and technical shortcomings in the region. Noteworthy efforts have been made by Brazil in improving the performance of the national component of the RBSN, where eight (8) new upper air stations have been implemented.

The establishment of the AMDAR regional programme is under way in the region. Already some various training activities are carried out in relation with some regional airline (LAN Chile). The deployment of MSG receiving station will help the region to improve the observation capacities to track the west moving tropical disturbances.

Much use is made in RAIII of the geostationary GOES and METEOSAT satellites as well as of low-orbit satellites such as NOAA, TERRA MODIS, AQUA MODIS and SCD. Meteorological

imagery continues to be important in local applications because most tropical disturbances move westwards from the Atlantic Ocean to South America. Implementation of MSG components will contribute a great deal to the development of new satellite products.

4.4 Report on the GOS in Region IV

The current RBSN in Region IV is comprised of 512 surface stations, 142 upper-air stations and 25 automatic marine stations. The overall status in the region remains stable. According to the results of monitoring carried out in 2003, 88 per cent of the total number of RBSN surface stations had provided more than 50% of expected SYNOP reports and 30 stations provided less than 50% of expected reports. The number of ¨silent¨ stations increased to 33 stations (29 in 2002). One of the reasons for silent stations is that some countries with the WAFS-METLAB system are not able to configure it correctly to send the requested messages, like SYNOP, CLIMAT or CLIMAT TEMP. Another reason for silent stations are continuing telecommunications problems in some countries.

The availability of upper-air data in 2003 indicated that 89 per cent of the total number of RBSN upper-air stations were providing at least 50% of expected reports. Some countries have problems with the transmission of the CLIMAT-TEMP reports, it is recommended that resolve your transmission problems.

The first WWVSII humidity/water-vapour sensor was installed and certified in a aircraft of the United States of America; likewise, Canada had several discussions with airlines to obtain aircraft observations over the country.

In 2003 the European Commission approved a project to construct and install four new digital weather radars in Barbados, Belize, Guyana and Trinidad and Tobago. Jamaica, the Dominican Republic, Guadeloupe, Martinique and French Guyana have a radar. Considerations will be given to integrating existing radars in Puerto Rico and St. Maarten in the network. The Caribbean Meteorological Organization has initiated discussions towards the installation of a radar in the Cayman Islands, but not as part of this project.

One of the major positive changes in the last two years has been the operational introduction of the WAFS-METLAB system in Central America and some Caribbean Countries and Flash Flood Guidance system in Central America.

Information on various parameters, that are available on websites, such as rain rate, water vapour content, visible, infrared and water vapour images, winds from GOES TRMM, QuickSCAT are used by several Meteorological services. More specific products like fire detection and precipitation estimation are also used in operational work of NMHSs.

4.5 Report on the GOS in Region V

The number of reports for surface and upper air observations have increased over the past five years and again showed a small increase in the last year. The number of SYNOP reports received from RA-V during the 2003 monitoring period increased from 1089 per day in 2002 to 1100 in 2003. The number of TEMP reports stayed steady at 111 per day.

The Regional Basic Climatological Network (RBCN) comprised 192 CLIMAT stations and 77 CLIMAT TEMP stations in October 2003, representing a slight increase in numbers over the original network established in 2002. The October 2003 monitoring report shows an availability of 76% for CLIMAT reports and 83% for CLIMAT TEMP reports. Both the GSN and GUAN are operating at relatively high levels. During 2003 the availability of GSN reports were mostly in the range 75-80%, a slight improvement over 2002 and the availability of GUAN reports is nearly 80% from the 37 stations. The data were of high quality.

AMDAR provides a valuable addition to the observing network in the Region and there is an active programme seeing to expand the number of aircraft reporting. French Polynesia is examining the possibility of collecting AMDAR in central-south Pacific.

A new challenge in satellite systems is the phase-out, starting in 2005 of the analogue WEFAX transmissions and the replacement with the digital LRIT signal. Funding will be needed to make this transition, and although proposals are being prepared, no funding or replacement project is yet assured.

Information on parameters such as rain rate and liquid water content from the ATOVS, SSM/I and TRMM microwave instruments are available on several Web sites and used by some NMHSs in the region. Satellite measurements of surface wind speed and direction from the SeaWinds instrument on QuikSCAT instrument are also proving very valuable in operational meteorology. The Region recommends that an instrument providing this functionality (scatterometer winds) be an ongoing component of the space-based sub-system. While information from research and development satellites has great potential for the region, there are major challenges in the effective development of this potential, particularly in the promotion of new capabilities, developing awareness, training in the use of the data, and in effective access to the data.

4.6 Report on the GOS in Region VI

The overall position in Region VI remains stable and is operating at a generally acceptable level though there remain specific elements or sub-regions where the outcome remains below the agreed target levels; however there is an active effort to attempt to improve the situation further by addressing the shortfalls on a case by case basis. The number of marine surface observations (primarily from the VOS fleet) continues to reduce, and we are looking towards additional drifting buoy and/ or ship-borne AWS to help recover the situation.

The Region noted the benefits from improved availability of AMDAR reports and the continued developments from the space-based systems, especially the availability from some of the R&D platforms (such as QuickSCAT). The EUMETSAT ATOVS Retransmission Service has brought particular benefits by making observations available much earlier.

The major positive change in the last two years has been the operational introduction of EUCOS (EUMETNET Composite Observing System) which currently comprises 19 members, with others expressing interest in joining EUMETNET/EUCOS. EUCOS provides: an integrated approach to delivering observations; some financial support to help member's operational stations meet WMO standards; regional reviews of observation systems to identify and implement optimal reporting/networks and sponsors, or leads its member's involvement in, investigations and experiments such as A-TRec (benefits from targeted observations) and the effective integration of satellite and surface/ remote sensing systems. EUCOS activities seek to enhance the available observations where necessary, as in the proposed Marine Surface network which, if adopted this autumn, will increase by about 100 the number of drifting buoys in data sparse areas of the North Atlantic to offset the reduction in VOS observations.

Many of the regional Members have the capability of providing more frequent and / or data from other systems/networks; but it is essential that clear guidance is provided early to avoid wasted effort, in defining from the potential information available for global dissemination as against that for local/regional use as well as clearly establishing agreed protocols for data exchange. Without such input, it is unlikely that the full benefits will be realized in the near future.

4.7 Coordination Activities of Rapporteurs/Coordinators on Regional Aspects of the GOS

The opportunity was taken for the Regional Rapporteurs/Coordinators (henceforth referred to in this report as Regional Rapporteurs) to meet to discuss the means for carrying out

their roles both within their Regional Association and in their contribution to the work of the OPAG on IOS. The Rapporteurs reviewed the Terms of Reference assigned by their Regional Associations, shared advice on carrying out their responsibilities and noted some ways of improving the dissemination of information on GOS matters within their regions.

The Rapporteurs noted that there were significant differences in their Terms of Reference and that there were elements in those from other regions that were useful in defining the role of the Rapporteurs. The Rapporteurs agreed to review their own TOR with a view to proposing revised versions to the Chair of their respective WG on Planning and Implementation of WWW. It was recognized that there were differences in roles among the regions but agreed that it would assist in clarifying roles if there were consistency in expressing the tasks that were common to all regions. The Rapporteurs also noted some elements that were missing in some or all of the TORs and agreed that these should be included in the revised TORs (either as new tasks or modifications to existing wording) to be prepared for consideration by their WG on WWW. These were:

- Liaison with other Rapporteurs and sub-groups in the Region on matters relevant to the GOS, including training matters, to ensure coordination of matters relating to the GOS;
- Ongoing monitoring of the performance of the GOS in their region;
- A reference to the observing system to include both surface-based and space-based observations;
- Responsibility for coordinating Regional Association input to plans for the evolution of the GOS;
- Coordination of the implementation of agreed plans with other Regional Rapporteurs on Observations and the Chair and other members of the OPAG on IOS;
- Acting as the focal point for the region in maintaining regulatory material related to the GOS (including WMO Publication no. 9, Vol. A and the Manual on the GOS).

The meeting of Rapporteurs also discussed the procedures followed in their regions and suggested ways to effectively carry out their assigned tasks and facilitate dissemination within their region of information on developments in the GOS. These included:

- The annual reports on activities prepared for the Chair of the WG on WWW in their region should also be provided to members of the OPAG on IOS and to the relevant area of the Secretariat;
- Plans for their activities prepared for the Chair of the WG on WWW should be provided to members of the OPAG on IOS and to the relevant area of the Secretariat;
- To actively use the National Focal Points (NFP) designated by Members as a source of information (questionnaires, surveys) for technical information, noting that it would be appropriate to send requests through the PR with a copy to the NFP if there may be policy issues. E-mail is generally acceptable in most cases;
- Use of the Secretariat and Regional Offices for advice and assistance with conveying information to or seeking information from Member countries;
- Preparation by the Secretariat of procedures followed in formulating the RBSN and RBCN (see Annex IV);
- To assist in ongoing monitoring of the GOS in the region, the Secretariat should provide the Regional Rapporteurs with copies of requests from Members for minor changes to the RBSN and RBCN.

Means for conveying information to the Regions are:

- Reports to the Chair of the WG on WWW;
- Reports to the NFPs;
- Participation in the meetings of the WG on WWW;
- Reports via e-mail or, on very significant issues, formal letters to Members through the Secretariat;
- Inclusion of news items in Regional newsletters where these exist;

- Addition of information to the relevant Regional section of the WMO web page;
- Use of web pages, including possible establishment of Regional Association web pages.

Note: The work of the Rapporteurs on GOS would be helped by the nomination and active involvement of NFPs. Lists of the NFPs on GCOS, Volume A and the RBSN are maintained by the Secretariat and will be provided to the Rapporteurs.

5. REVIEW OF OTHER IN-SITU SYSTEMS (AIRCRAFT, MARINE, etc.)

5.1 Aircraft Systems, including AMDAR

The ICT noted that in accordance with the CBS Management Group decision, a Rapporteur on AMDAR activities within the CBS OPAG-IOS was nominated with the task to review and report on activities related to the integration of AMDAR into WWW operations and to study the required training activities relevant to AMDAR.

In his report, the Rapporteur recalled that the averaged number of observations exchanged daily on the GTS had increased from 140,000 in 2002 to nearly 200,000 in 2004. Although a large portion of these AMDAR data were obtained over Europe and North America, work is proceeding to develop new operational programmes and/or programmes of targeted observations in data sparse regions. New AMDAR programmes had become operational in Saudi Arabia, Hong Kong China and Japan. Canada is very close to going operational in the second half of 2004. Of interest were also a series of newly planned or developing programmes such as the targeted programme for ASECNA in collaboration with E-AMDAR. Work continues on the development of new AMDAR systems in China, Chile, Argentina and the United Arab Emirates. It was noted that a number of countries continue to consider or plan programme developments including Hungary, Poland, Morocco, Russian Federation, Oman and Egypt. It also noted that India was the latest country to commence planning a programme with support being provided by the AMDAR Panel.

The ICT was informed that a new, sophisticated onboard software standard had been approved and that changes to the BUFR code which had been accepted by CBS in 2002 had been successfully tested. It was also informed that alternative AMDAR systems for smaller regional aircraft had started operational evaluation trials.

The ICT noted that further steps had been taken to integrate AMDAR into WWW operations and was pleased to note that the AMDAR Panel had organised technical training workshops for ASECNA and in South Africa and the United Arab Emirates and was planning for additional technical training in Hungary, South America, Russia, Arab League States, Asia and Morocco.

The ICT was made aware that the requests for educating AMDAR data users in the wide range of operational applications could not be covered by the AMDAR Panel and that these requests need the support of the Regional Associations and CBS. The ICT recommended development of a training concept for the use of AMDAR data. A draft resolution to be approved by CBS-XIII was proposed (see Annex V).

5.2 Marine Systems

The ICT received a summary report on marine observing systems that had been derived from information provided to and data collected by the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM). Statistics had been prepared and presented by the Observations Programme Area (OPA) within JCOMM reflecting the status of the various observation networks supporting the international marine program.

5.2.1 *Status of Programme*

Data Buoy Programme

There is a target to maintain as of 2005 a network of 1250 drifting buoys in the world oceans, all measuring Sea Surface Temperature (SST) and sea surface velocity. The number of drifting buoys of these 1250 that will be measuring air pressure is still under discussion. Present discussions suggest that a target of some 600 barometer drifting buoys in extra tropical regions might be achievable. While the Panel is presently maintaining a network of about 80 drifting buoys equipped with barometer in the Southern Ocean, a 500km x 500km resolution would require to maintain about 300 units operational between South of 40S and the Antarctic sea-ice zone. In June 2004, DBCP monitored 945 drifting buoys.

As far as moored buoys in the high seas are concerned, i.e. excluding coastal buoys, the following operational programmes are in place; TAO Array in the Equatorial Pacific Ocean (70 buoys), PIRATA Array in the Equatorial Atlantic Ocean (12 buoys) and Indian National Data Buoy Programme (10 buoys). The reports from these programmes are transmitted in BUOY code. In addition there are more than 200 moored buoys and sea stations which transmit in SHIP format (e.g. USA, Canada, EGOS) accounting for more than 50% of the total number of SHIP reports issued on GTS

Ship Of Opportunity Programme

During the period January to December 2003, about 19000 drops were committed to SOOP by the participant. There is a continuing decline in the number of probes committed to the programme. Some 14017 drops were assigned to Upper Ocean Thermal (UOT) lines. About 18425 probes are needed for UOT lines per year when Argo programme, which is complementary to SOOP in this regard, will be fully implemented. 675 Argo floats were operational in January and 1087 in December for a target of 3000 floats by 2006.

Voluntary Observing Ship Programme

In recent years there has been a significant decrease in the number of VOS participants due in part to the increases in ship size and reductions in crew numbers. There has also been a recent trend among some National Meteorological Agencies to reduce the level of Port Met Officer support provided to VOS, with consequent changes to ship inspection regimes, which is also likely to impact on future VOS data quality.

At the end of 2003, 6605 Selected, Supplementary and Auxiliary ships reported on GTS in SHIP format. Most ships report atmospheric pressure, SST, air temperature, near surface humidity, wind, air pressure tendency, cloud and weather information and wave data. About 200 000 reports were received from the GTS in SHIP format at the end of 2003. It should be noted, however that reports from Selected, Supplementary and Auxiliary ships account for less than half of all SHIP-format reports received (43% in June 2004) the remainder deriving from moored buoys, oil rigs and platforms, etc.

VOSCLIM

The VOS Climate Project (VOSClim) builds on the activities previously undertaken in the VSOP-North Atlantic Project during the late 1980’s and early 1990's. Its primary objective is to recruit a global subset of the VOS, which will provide high quality marine data (in both real time and delayed mode) and associated metadata. This data set will provide a reference for air-sea flux computations and be used in support of global climate change studies. It will also be used for the assessment of observational biases in different instruments, and possible bias adjustment of observations from the VOS fleet. The target minimum was 200 ships, which has not yet been met. As of July 2004, 110 ships of 9 countries were participating in VOSClim.

The Automated Shipboard Aerological Programme

The number of radio-soundings taken within the framework of the ASAP averages around 5500 soundings annually in the period 1995 to 2003. 4444 soundings were made in 2003. The geographical distribution of ASAP soundings in 2003 corresponds approximately to those of 2002, mainly over the North Atlantic Ocean for the European meteorological forecast. There are fairly large fluctuations from year-to-year, mainly through the influence of enhanced activities in specific observational programmes such as FASTEX in 1997. Year 2003 showed a decrease of 14% in the number of soundings compared to 2002, and it is the second lowest number of soundings in the last 9 years (minimum in 2000 with 4416 soundings). This decrease can largely be ascribed to a large decrease in the number of soundings carried out by the United States, but a slight decrease in the German ASAP activity also played a part. The total number of ASAP units operated in 2003 was 18. In June 2004 soundings were made from 14 different ships.

6. AUTOMATIC WEATHER STATIONS

The ET-AWS identified priority activities for the next intersessional period. It was agreed that periodic review of the BUFR-CREX coding requirements for AWS must be accomplished. It was acknowledged that observational platforms change for many reasons and existing data management and reporting techniques would also require change. This requires a more frequent exchange of information between the ET-AWS and the ET-DR&C. As ET members identify or are informed of the need for change to encoding or reporting of AWS data the team(s) will need to reconcile each identified problem. Due to the diverse nature of AWS, regular coordination, throughout the intersessional period is necessary between CBS, CCl, JCOMM, CIMO, GCOS, and AMDAR. Based on the proposals presented by the members, the meeting agreed to the future work plan as described below:

(1) The ET-AWS, jointly with CCl, JCOMM, CIMO, GCOS and AMDAR develop the guidelines for AWS quality control procedures for future publication to all appropriate WMO documents;
(2) The ET-AWS, jointly with CCl, JCOMM, CIMO, GCOS and AMDAR, develop standards for a basic set of variables to be reported by AWS installations;
(3) The ET-AWS will develop practical examples based on the standards developed for AWS metadata;
(4) The ET-AWS, jointly with HMEI and CIMO will develop a procedure whereby users can access information on how various AWS parameters are computed. This development will be addressed as part of the metadata needs and the Future WMO Information System;
(5) The ET-AWS, during the next intersessional period, will routinely review and document the need for updating and maintaining related AWS performance and quality control standards, as well as, all related AWS code templates and descriptor tables.

7. STATUS OF SATELLITE SYSTEM UTILIZATION AND PRODUCTS

The ICT was informed that in the period 2003-2004, several items where the Expert Team on Satellite System Utilization and Products (ET-SSUP) had been active in the past have evolved in very positive ways. Recommendations stemming from the rolling evaluation of the Biennial Questionnaire for the WMO Strategy to Improve Satellite System Utilization have been utilized by WMO, RMTCs and Space Agencies. Particularly impressive was the growing strength and impact of the CGMS/WMO Virtual Laboratory for Education and Training in Satellite Meteorology (VL) activities. Another success story was the rapid evolution of the Advanced (formerly called “Alternative”) Dissemination Methods (ADM). ADMs have grown from a conceptual design by ET-SSUP to fully-fledged services. They have and are being implemented for practical and technical reasons by combining different data streams into a single broadband service over commercial telecommunication satellites.

During the past two years the ET-SSUP met once for its fifth session in Geneva, Switzerland from 28 June to 2 July 2004. The session made a preliminary analysis of the Biennial Questionnaire 2004, with the aim to publish consolidated results and recommendation by the end of the year. The Expert Team also addressed matters relating to the three cornerstones of satellite meteorology:

- Data Access:
  - Refinement of ADM issues including IGDDS (Integrated Global Data Dissemination System), paying particular attention to the extension of retransmission services for ATOVS radiation fields;
  - Definition of a comparable data content for polar and geostationary satellite missions;

- Data Use:
  - Establishment of networks or consortia with shared responsibilities, activities and services to realize NMHSs' computer programming requirements and/or to overcome their limitations in availability of application software and methods;
  - Most required but not yet available satellite data products;
  - Furthering activities with the Public Weather Service Programme;
- Education and Training:
  - Advancement of VL through the organization of a high-profile global training event in the framework of the VL activities;
  - Request by Omani National Meteorological Service jointly with the Sultan Qaboos University to be considered as a "Centre of Excellence" within the VL.

Finally, ET-SSUP adapted the strategy to improve satellite system utilization to the period 2004-2006, proposed the future work programme for ET-SSUP (see Annex VII) and compiled an extended action list including the recommendations made during the session.

8. REDESIGN OF THE GLOBAL OBSERVING SYSTEM

8.1 The activities of the Expert Team (ET) on Observational Data Requirements and Redesign of the Global Observing System (GOS) since the last ICT were summarized. The ET-ODRRGOS has been focused on: (a) updating the data bases of user requirements and observing system capabilities, (b) monitoring the outcomes from the Workshop on Impact of Various Observing Systems on Numerical Weather Prediction (held March 2004) and the implications for the redesign of the GOS, (c) reviewing the observing system capabilities and user requirements and the associated statements of guidance with applications area experts, (d) reviewing the THORPEX Implementation Plan, (e) finalizing a draft Implementation Plan for the Evolution of the GOS that was started at the last ET-ODRRGOS meeting, and (f) preparing input for the Commission for Basic Systems (CBS) meeting in February 2005. The ET-ODRRGOS realized substantial progress in all areas: the implementation plan for evolution of the GOS was finalized; user requirements for several applications areas (e.g. atmospheric chemistry, hydrology, agro-meteorology, seasonal to interannual forecasting) and the statement of guidance concerning GOS capabilities for meeting them were updated, the THORPEX relationship to the ET-ODRRGOS was defined; and the ET's future work plan was projected. The ET-ODRRGOS also offered some suggestions for revision of the Terms of Reference along with a name change to ET on Evolution of the GOS.

8.2 In the ET-ODRRGOS Implementation Plan for Evolution of the GOS, (see Annex VI) recommendations were stated with progress noted and next actions identified. For many of the ET-ODRRGOS recommendations, agreement was noted with recommendations found in the GCOS Implementation Plan.

8.2.1 For the space-based sub-system of the GOS, the ET-ODRRGOS Implementation Plan recommends building upon the known plans of the operational and R&D satellite operators and

emphasizes the importance of rigorous calibration of remotely sensed radiances as well as improved spatial, spectral, temporal, radiometric accuracies. The wind profiling and global precipitation measurement missions were singled out for their importance to the GOS. Implementation of most of these recommendations will be realized through the WMO Space Programme working with space agencies, via CGMS.

8.2.2 For the surface-based sub-system of the GOS the ET-ODRRGOS Implementation Plan recommends more complete and timely data distribution; improved data coding; enhanced AMDAR and AMDAR especially over data sparse areas; optimized rawinsonde distribution and launches; improved upper tropospheric and lower stratospheric moisture measurements; operational use of targeted observations; inclusion of ground based GPS, radars, and wind profilers; increased oceanic coverage through expanded Automated Ship balloon observations, drifting buoys, and ARGO; and development of some new observing technologies. Implementation for these recommendations relies on various paths of action that include (but are not limited to): (i) CBS working through Regional Rapporteurs to urge all Members with the existing observing capabilities to distribute full information content as quickly as possible; (ii) OPAG-IOS chair in consultation with the chairs of the Regional Working Group on Planning and Implementation of WWW to ensure that operators and managers of regional observing systems are made aware of GOS requirements; (iii) CBS via the OPAG IOS to collaborate with other WMO commissions such as CIMO and CCl, (iv) CBS via OPAG-IOS to maintain liaison and ensure targeting strategies developed by EUMETNET and THORPEX are made available; (v) CBS via OPAG-IOS to monitor progress under AMDAR Programme realized with TAMDAR and AFIRS; and (vi) CBS via OPAG-IOS to evolve ocean observing system with JCOMM help.

8.2.3 The plan also includes some general recommendations relevant to NWP interactions with data from the evolving GOS, one with regard to further study of observing system design, and a final recommendation on training and utilization that is essential for realization of benefit from the evolved GOS.

8.3 It was suggested to the ICT that there is a need for a WMO Workshop on the Implementation and Utilization of Long Term Climate Observations. It was agreed that such a workshop should be organized by the Atmospheric Observations Panel for Climate and Expert Team on Observational Data Requirements and Redesign of the Global Observing System. Participants are expected to come from all the major data centres that are active in the area of long term climate monitoring studies. The workshop would likely take place in the last quarter of 2005.

9. CLIMATOLOGICAL OBSERVATIONS AND GCOS NETWORKS

9.1 Availability of CLIMAT and CLIMAT TEMP Reports

The Annual Global Monitoring (AGM) of the WWW is a monitoring exercise carried out by about 90 centres, including 14 MTN centres, once a year from 1 to 15 October. Information on the AGM is available on the WMO server under http://www.wmo.ch/web/www/ois/monitor/monitor-home.htm.

The MTN centres received in total:

- 62 per cent of the CLIMAT reports expected from the RBCNs in October 2002 and 2003;
- 71 per cent of the CLIMAT TEMP reports expected from the RBCNs in October 2002 and 67 per cent in October 2003.

The analysis of the AGM results shows that the availability of CLIMAT and CLIMAT TEMP reports is not satisfactory. The density of reports received is particularly low in Region I for CLIMAT (26%) and CLIMAT TEMP reports (54%), and in Region IV for CLIMAT TEMP reports (45%). For these two Regions I and IV, there were major changes in the composition of the RBCNs for CLIMAT TEMP reports between 2002 and 2003.

The Special MTN Monitoring (SMM) is a monitoring exercise carried out by several MTN centres four times a year. Information on the SMM is available on the WMO server under http://www.wmo.ch/web/www/ois/monitor/monitor-home.htm. The analysis of the July 2004 SMM monitoring results is available on the WMO server under http://www.wmo.ch/web/www/ois/monitor/smm/sm047.htm. The analysis shows lower figures for the availability of the CLIMAT and CLIMAT TEMP reports at MTN centres for the SMM exercises than for the AGM exercises. This is mainly due to the fact that the AGM statistics include the availability of the reports at 14 MTN centres instead of three for the SMM, and that the pre-analysis of the SMM raw data made by Cairo systematically rejects the reports for which the format of presentation does not conform to the WMO standards. The monitoring of the exchange of CLIMAT and CLIMAT TEMP bulletins on the GTS shows major deficiencies in the application of WMO standards for the presentation of CLIMAT and CLIMAT TEMP bulletins. The WMO Secretariat investigated deficiencies in the application of WMO standards in the presentation of CLIMAT and CLIMAT TEMP bulletins.

9.2 Status of RBCNs

The ICT was advised that the Fourteenth Congress (Geneva, May 2003) welcomed the establishment of the Regional Basic Climatological Network (RBCN) in all WMO Regions and in the Antarctic, as the RBCN provided a strong justification for maintaining a minimum number of CLIMAT/CLIMAT TEMP reporting stations, and allowed a more effective and consistent performance monitoring. Realizing the continuing need to increase the overall availability of climatological data, Congress urged Members to ensure that their operational observing stations compiled and transmitted the CLIMAT/CLIMAT TEMP messages according to existing regulations.

Based on the approved list of stations in the RBCN (July 2004) all regions including the Antarctic comprise a total of 3107 stations. Out of these 2600 stations are listed as CLIMAT stations and 507 as CLIMAT TEMP stations. A relatively small number of stations have been deleted or added from the approved list of RBCN stations for all regions within the period July 2002-July 2004.

The meeting noted that the establishment of an RBCN in all WMO Regions and in the Antarctic, which are now included in the WWW monitoring, did allow a more effective and consistent monitoring of the availability of climatological data.

9.3 Status of GCOS Networks (GSN and GUAN)

The Chair of GCOS/WCRP Atmospheric Observation Panel for Climate (AOPC), Dr Mike Manton, informed the meeting on GCOS matters of common interest to the ET-ODRRGOS. While the initial link between the groups had been on the development of Statements of Guidance, the need to coordinate the implementation plans of CBS and GCOS now provided the main point of contact. A number of common issues appeared in the respective plans, such as the need for better measurement of water vapour and enhanced use of GPS data. The increasing use of data assimilation for climate-related reanalysis, as well as weather prediction, provided a further activity of mutual interest between the ET-ODRRGOS and AOPC. Potential issues associated with GEOSS and THORPEX were also discussed.

The Chair of AOPC also expressed deep gratitude to CBS for the establishment of CBS Lead Centres for GCOS Data, which provided the mechanism for direct feedback to operators on data collection at baseline networks. Dr Manton also informed the session of the plans of AOPC to investigate the concept of selecting a subset of GUAN as a GCOS reference network for highly accurate measurements of water vapour and stratospheric temperature. Sondes from this subset would be required routinely to reach 5 hPa and would include state-of-the-art water vapour instrumentation. Consistent with this approach, the AOPC had agreed that the minimum requirement for sounding height from the GUAN network in general should be 30 hPa, and had requested that this adjustment be incorporated in the next revision of the Guide to the GSN and GUAN (GCOS-73).

ICT appreciated the increasing coordination activities in the elaboration of meaningful observational requirements for various application areas, including GCOS. It however, stressed that planning and implementation of various specialized observing programmes and projects including field experiments like THORPEX would require special precautions and backup arrangements to avoid any distortion in the operational performance of the RBSN/RBCN which continue to be a unique backbone of observational programme for any applications.

The Rapporteur on GCOS matters informed the meeting that the overall availability of CLIMAT reports from the GSN stations had increased from 50-60% in 2001 to 60-70% in 2002/2003. The increase in overall availability was attributed mainly to the improvement in CLIMAT receipt in RA II (Asia) and RA VI (Europe). With regard to GUAN, availability of CLIMAT TEMP reports had also increased since 2001, but leveled off since 2002 at between 75 and 80 per cent. A GCOS Lead Centre had been established at Japan Meteorological Agency (JMA) for GSN and at NOAA's National Climatic Data Center (NCDC) for GSN and GUAN. Lead Centre terms of reference permit direct contact with GCOS focal points. NCDC, as a Lead Centre, had sent a request to NMHSs for provision of historical GSN data as well as for GUAN station metadata covering the period since 1990. Thirty countries had responded to the GSN request, eight of which had provided data. Six other countries were considering data reformats to honor the request or were checking on any restrictions for releasing the data. Twenty-four countries had responded to the GUAN metadata request and provided station history information for approximately 40 GUAN stations. A digital metadata archive was being updated using the new information provided in support of climate and GCOS network monitoring. Revitalization activities were being carried out at a number of high priority GUAN stations with support being provided by a number of members including the USA, Australia, New Zealand and the UK.

10. UPDATES OF THE GOS-RELATED REGULATORY MATERIAL

10.1. Update on the Manual of the GOS

The Rapporteur on the Regulatory Material reported on the work carried out during the intersessional period and introduced the proposed amended text of sections 1 – Africa (RA I), 2 – Asia (RA II) and 6 – Europe (RA VI) of Volume II of the Manual on the GOS (WMO No. 544).

All Regional Rapporteurs considered the current draft. It was noted that, generally, even the draft entries did not fully reflect the current developments. It was agreed that each Rapporteur would take away the points noted and prepare revised drafts for consideration at the next meetings of their Regional Associations, also sending copies of the draft to the Secretariat and to the Rapporteur on Regulatory Material. (See also Annex IV).

The ICT also felt that activities should be undertaken to review and update the Guide on the Global Observing System (WMO No. 488).

10.2 Update on the revised WMO Pub No. 9, Volume A

The ICT session was advised on the progress that has been made to implement the recommendations included in the report "Possible Improvements of WMO Publication No. 9 – Volume A", prepared by the late Mr Harald Daan, the IOS Rapporteur on Volume A.

The report gave a comprehensive account of the history of Volume A, its strengths and its weaknesses. It included details of improvements that should be made to Volume A to make it relevant to users in various application areas, including climatology, agrometeorology, meteorological research, atmospheric chemistry and hydrology.

To turn this report into a procedural plan, a User Specification has been developed, with input from CBS, IOS and ISY staff. Subsequently a detailed Design Specification was developed from the approved User Specification. This design specification took into account the

recommendations from the Rapporteur's report, plus additional requirements that had become apparent during the development of the Design Specification.

The Design Specification was then developed into a comprehensive database application, written in Access 2000. The multitude of tables required were produced and populated with data from the Rapporteur's Excel spreadsheet where applicable. Additional tables were produced from scratch, and populated. The historical entries obtained by the Rapporteur, some 15,000 in total and required for climatological applications, were also transformed into database format for eventual inclusion into the revised Volume A.

The session was shown a prototype of the new Volume A application, and was advised that this application is currently undergoing detailed trialing within WWW. The application will be further refined following this trial. It may however be preferably to migrate the new Volume A to an Oracle database, and WMO members are being approached for possible assistance. It may even be possible to revise a current station database developed in Oracle by a member for use within WWW. This is currently being investigated.

11. FUTURE COMPOSITE GOS AND ITS IMPACT ON DEVELOPING COUNTRIES

The ICT was informed about considerations for the evolution of the GOS in developing countries that have been identified in the ET-ODRRGOS Implementation Plan. In many areas of Africa, Asia, and Latin America (Regions I, II and III and some tropical areas between 25N and 25S), the current GOS system simply does not exist, whereas in other areas it could be improved. The evolution of the GOS in developing countries must address some of the issues that fall in three categories: (a) lack of public infrastructure such as electricity, telecommunication, transport facilities etc., (b) lack of expertise from people to do the job, training, etc., and (c) funding for equipment, consumables, spare parts, manpower, etc. Two additional aspects that also need to be considered are (d) use of the data and (e) production of the data. It is possible that some countries do not and will not be able to produce the data and will therefore only be users of data. To help developing countries produce data for international exchange, due consideration must be given to the three issues previously identified, i.e. public infrastructure, expertise and funding. Recommendations for addressing the evolution of the GOS in developing countries include:

- Examine whether automated stations could become viable, cost effective alternative to manned stations for the surface network in future;
- In data-sparse areas of the world, it may be more cost-effective to make full use of AMDAR ascent/descent data at major airports; however, the RAOB network still plays an important role in human forecasting;
- When changes are made to the climate observing systems, the GCOS Climate Monitoring Principles should be followed;
- High priority should be given to maintain the RAOB network with acceptable performance within data challenged regions.
- Prioritize where the needs are most pressing.

Some actions are planned including an OSE involving AMDAR in 2005/2006. Interest in THORPEX participation by RA I was also noted. The ICT encouraged implementation of the relevant EC recommendations regarding funding mechanisms for purchasing observing system equipment and consumables.

12. FUTURE WORK PROGRAMMES OF EXPERT TEAMS

The ICT reviewed the Work Plans of each Expert Team and recommended them for implementation. The ICT was also informed on the plans of the Rapporteurs/Coordinators on Regional aspects of the GOS. These plans are presented in Annex VII. The meeting also reviewed the proposed Terms of Reference of the new ET on Satellite Systems to be considered by CBS-XIII. These TORs, together with the TORs of the OPAG-IOS rapporteurs, are presented in Annex VII.

13. PREPARATION OF CBS-XIII, INCLUDING OPAG/IOS INPUT

The ICT considered the layout and substance of the document on OPAG-IOS activities to be submitted to CBS-XIII. It requested the ICT Chair in coordination with the Secretariat to provide the first draft of the document for the consideration by ICT members by ***1 November 2004***.

14. CLOSURE OF THE SESSION

There being no further business to come before the ICT, the chairman closed the session at 12.00 noon on Friday, 10 September 2004.

AGENDA

1. **ORGANIZATION OF THE SESSION**
   - 1.1 Opening of the meeting
   - 1.2 Adoption of the agenda
   - 1.3 Working arrangements

2. **REPORTS**
   - 2.1 Report of the Chairman
   - 2.2 Report on GEO Activities and Developments
   - 2.3 Report on the WMO Space Programme

3. **RBSN PERFORMANCE MONITORING RESULTS AND IMPLEMENTATION TRENDS**

4. **REVIEW OF THE GOS PERFORMANCE IN THE REGIONS**

5. **REVIEW OF OTHER IN-SITU SYSTEMS (MARINE, AIRCRAFT, etc.)**

6. **AUTOMATIC WEATHER STATIONS**

7. **REVIEW OF SATELLITE SYSTEM UTILIZATION AND PRODUCTS**

8. **REDESIGN OF THE GOS**

9. **CLIMATOLOGICAL OBSERVATIONS AND GCOS NETWORKS**
   - 9.1 Availability of CLIMAT and CLIMAT TEMP Reports
   - 9.2 Status of RBCNs
   - 9.3 Status of GCOS Networks (GSN and GUAN)

10. **UPDATES OF THE GOS-RELATED REGULATORY MATERIAL**

11. **FUTURE COMPOSITE GOS AND ITS IMPACT ON DEVELOPING COUNTRIES**

12. **FUTURE WORK PROGRAMMES OF EXPERT TEAMS**

13. **PREPARATION OF CBS-XIII INCLUDING OPAG/IOS INPUT**

14. **CLOSURE OF THE SESSION**

WORK PLAN

(CBS Implementation- Coordination Team on Integrated Observing System, Third Session, Geneva, 6-10 September 2004)

	Monday 6	**Tuesday 7**	**Wednesday 8**	**Thursday 9**	**Friday 10**
09h00 – 9h30 9h30 – 10h30	Registration Agenda Items 1 & 2	Agenda Item 5 Agenda item 6	Agenda Item 9	Agenda item 14 Drafting groups	Drafting groups
10h30 – 10h45	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
10h45 – 12h30	Agenda Item 2 (cont'd) Agenda Item 3	Agenda item 6 (cont'd) Agenda item 7	Agenda Item 10	Drafting groups	Approve Draft Final Report
12h30 – 13h30	Lunch	Lunch	Lunch	Lunch	Agenda Item 15
13h30 – 15h30	Agenda Item 4	Agenda item 7 (cont'd) Agenda item 8	Agenda Item 11 Agenda Item 12	Drafting groups	
Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break	
15h45 – 17h30	Agenda Item 4 (cont'd)	Agenda item 8 (cont'd)	Agenda Item 13	Drafting groups	

PROVISIONAL AGENDA

1. ORGANIZATION OF THE SESSION
   - 1.1 Opening of the meeting
   - 1.2 Adoption of the agenda
   - 1.3 Working arrangements

2. REPORTS
   - 2.1 Report of the Chairman
   - 2.2 Report on GEO
   - 2.3 Report on Space-based component of GOS
   - 2.3 Report on WMO Space Programme

3. REVIEW OF THE RBSNs
   - 3.3 RBSN Performance Monitoring Results and Implementation Trends

4. REVIEW OF THE GOS PERFORMANCE IN THE REGIONS

5. REVIEW OF OTHER IN-SITU SYSTEMS (Marine, Aircraft, etc.

6. AUTOMATIC WEATHER STATIONS

7. REVIEW OF SATELLITE SYSTEM UTILIZATION AND PRODUCTS

8. REDESIGN OF THE GOS

9. CLIMATOLOGICAL OBSERVATIONS AND GCOS NETWORKS
   - 9.1 RBCN performance Monitoring Results
   - 9.2 Status of GCOS Networks (GSN and GUAN)

10. UPDATES OF THE GOS-RELATED REGULATORY MATERIAL

11. FUTURE COMPOSITE GOS AND ITS IMPACT ON DEVELOPING COUNTRIES

12. FUTURE WORK PROGRAMMES OF EXPERT TEAMS

13. PREPARATION OF CBS-XIII INCLUDING OPAG/IOS INPUT

14. CLOSURE OF THE SESSION

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44Annex IV

Recommended procedures in formulating the RBSN and RBCN

The Rapporteur on the regional aspects of the GOS, in close cooperation with Members concerned, reviews and makes proposals regarding the design of observing systems in the Region, in particular the RBSN and the RBCN in the context of the WWW Programme in the WMO Long-term Plan.

For the purpose of the exercise of the composition of the RBSN and RBCN, it is recommended to use the objective criteria developed by the WG on Planning and Implementation of the WWW in RA VI for inclusion and exclusion of stations. It is noted that the RBCN includes the GCOS network.-

The Rapporteur in consultation with the Secretariat, submits the proposed lists of stations to be included in the RBSN and RBCN to the WG PIW in his Region for review and approval.

The Secretariat on the recommendation of the WG PIW in the Region circulates the proposed lists of stations to Members for review and any amendments.

The Secretariat compiles the feedback and the amendments made by Members to their lists of Stations in the RBSN and RBCN and a draft proposal is submitted to the Regional Association (which meets once in 4 years) for consideration and inclusion in the RBSN and RBCN.

The Secretariat on the recommendation of the Regional Association circulates once again to Members the final draft of the proposed lists of stations to be included in the RBSN and RBCN for review and any amendments within a reasonable time frame.

The lists of stations on the RBSN and RBCN for the Region are then finalized by the Secretariat as an annex to the respective Resolutions of the Regional Association.

Certain minor changes in the RBSN and RBCN that do not affect the data requirements of the Region as a whole are inevitable from time to time. To provide a simple and rapid means of effecting changes proposed by the Members concerned, the following procedures shall be followed:

(a) The Regional Association authorizes the President of the Association to approve, at the request of the Member concerned and in consultation with the Secretary-General, minor changes to the RBSN and RBCN without a formal consultation of the Members of the Association, it being understood that any change of substance, i.e. one adversely affecting the density of the network or proposing a change in observational hours, would still require the formal agreement of Members through the adoption of a resolution by postal ballot;

(b) The Secretary-General shall notify all Members of WMO by circular letter of changes agreed with the president of the Association.

The RBSN and RBCN are reviewed and revised at each session of the Association by adopting a Resolution containing the current RBSN and RBCN networks. This Resolution is included in the report of the most recent session of the Association.

Annex V

DRAFT RESOLUTION x x (CBS-XIII)
REQUIRED TRAINING RELEVANT TO AMDAR

THE COMMISSION FOR BASIC SYSTEMS

Noting:
(1) That EC-LVI requested CBS and CAeM to initiate studies on required training activities relevant to AMDAR,
(2) That the CBS Management Group at its fourth session requested the OPAG-IOS to study the required training activities relevant to AMDAR data and develop proposals for training events.

Considering that the current status of data usage is that
(a) Much of the AMDAR data is available on the GTS, either in FM42-XI Ext. AMDAR character code or FM94-X Ext. BUFR code;
(b) BUFR encoder/decoder can be made available on request through WMO;
(c) A number of display systems are currently operational and available using the Internet, e.g.
  (i) the password protected FSL display system (http://acweb.fsl.noaa.gov/java),
  (ii) the similar EUCOS web site (http://www.eucos.net , also password protected),
  (iii) that a simple, windows based, stand alone display system is currently not available, but FSL and UK Met Office are working on solutions based on existing technology.

Recognizing that the required training relevant to AMDAR implies:
(a) Data formats and codes,
(b) Telecommunication and data distribution,
(c) Data management,
(d) Data presentation tools and utilization.

Decides:
(a) That for the maximum benefit to Members, a training concept for the usage of AMDAR data should be developed including an implementation plan. Training activities should comprise a number of approaches, including:
  (i) Regional or subregional training workshops and training seminars,
  (ii) Use of computer aided learning programmes including CD based self-educating programmes
  (iii) Integration into the training for basic upper-air data use.

(b) That a CAeM/CBS Task Team should be established to evaluate current activities such as the CGMS/WMO Virtual Lab for satellite data utilization, systems such as VISITView and prepare appropriate guidance.
(c) That the concept should be addressed through the „train the trainer“ approach.
(d) That consideration should be given in each Region to the development of a specialized Center of Excellence dealing with AMDAR matters within its RMTC structure.
(e) That the Regional Rapporteurs/Coordinators on Regional Aspects of the GOS, in consultation with the OPAG-IOS Rapporteur on AMDAR and other appropriate focal points in their Regions, should develop a questionnaire on the AMDAR training requirements and send it to Members.
(f) That WMO Members should formulate AMDAR training requirements for these Centers of Excellence in their Region.

Annex VI

IMPLEMENTATION PLAN FOR EVOLUTION OF SPACE AND GROUND-BASED SUB-SYSTEMS OF THE GOS (September 2004)

1. Background

1.1 The WMO/CBS/OPAG IOS Expert Team on Observational Data Requirements and Redesign of the Global Observing System (ET-ODRRGOS) has been given three main tasks: (a) to continue the Rolling Requirements Review (RRR), under which requirements for observations to meet the needs of all WMO Programmes are compared with the capabilities of present and planned observing systems to provide them, and; (b) to suggest changes in the Global Observing System (GOS) filling gaps identified by the RRR; and (c) to draft an implementation plan for the re-design (or more appropriately the evolution) of the GOS.

1.2 The significant findings of ET-ODRRGOS that have provided the basis for the implementation plan are:

a. The RRR is readily applied to a diversity of applications areas, provided the data base of user requirements and observing system capabilities is accurate;
b. Working with the Rapporteurs of Regional and Global Observing System Experiments (OSEs), it was found that hypothetical changes to the GOS can be explored in OSEs with NWP centre assistance, provided data assimilation procedures are well understood and impact studies are conducted in a statistically significant way. Further it was made apparent that Observing System Simulation Experiments (OSSEs) require huge human and computer resources and were beyond the available resources;
c. The future GOS should build upon existing sub-systems, both surface and space based, and capitalize on existing and new observing technologies not presently incorporated or fully exploited; each incremental addition to the GOS will be reflected in better data, products and services from the National Meteorological and Hydrological Services (NMHSs);
d. The scope of the next decade`s changes to the GOS will be so massive that new revolutionary approaches for science, data handling, product development, training, and utilization will be required. There is an urgent need to study comprehensive strategies for anticipating and evaluating changes to the GOS.

1.3 Several major accomplishments by the ET-ODRRGOS preceded the drafting of the Implementation Plan and influenced its content appreciably. They are:

a. Users Requirements and Observing System Capabilities were charted in ten application areas (after engaging experts in each area). The RRR was pursued, and Statements of Guidance were issued in all ten areas (available in WMO/TD 913, 992, 1052 and summarized in the final report of the July 2002 ET-ODRRGOS meeting).
b. Several Observing System Experiments were pursued to test possible re-configurations of the GOS (these are summarized in section 5 of this Annex).
c. Candidate Observing Systems (space-based and ground-based) for the coming decade were studied (reported in WMO/TD 1040).
d. Special challenges and issues concerning developing countries were considered and addressed (see section 4 of this Annex).
e. Recommendations for the evolution of space-based and surface-based sub-systems of the GOS were drafted and endorsed by CBS (available in the final report of the October 2002 ICT meeting).
f. A vision for the GOS of 2015 and beyond was drafted (available in section 7 of this Annex).

1.4 Beneficial input was received from the Expert Team on Satellite System Utilization and Products (ET-SSUP) stemming from their evaluations of the Biennial Questionnaire for the WMO Strategy to Improve Satellite System Utilization, training experiences with the CGMS/WMO Virtual Laboratory, and recommendations on Advanced Dissemination Methods (ADM). The Expert Team on Automatic Weather Systems (ET-AWS) offered guidance with regard to measurement standards and technology developments in ground based observations.

1.5 The resulting Implementation Plan for the Evolution of the GOS (available in section 3 of this Annex) presents a coherent approach for implementing the necessary changes to the space based and surface based sub-systems of the GOS so that the vision for the GOS of 2015 can be realized.

2. Recommendations for the Evolution of the GOS

2.1 The evolution of the GOS proposed by the ET-ODRRGOS is now framed in 47 recommendations detailed in Section 3. Those recommendations for evolution of the GOS reflect the Statements of Guidance produced in ten applications areas, results from regional Programmes (such as COSNA, EUCOS and NAOS), conclusions from the Toulouse and Alpbach Workshops on Impact of Various Observing Systems on NWP (see WMO/TD No. 1034 and 1228 respectively), and OSEs prompted by suggested changes to the GOS.

2.2 The 20 recommendations for the space based sub-system of the GOS (S1 – S20), with 9 for operational geostationary and polar orbiting and 11 for R&D satellites, build upon the known plans of the operational and R&D satellite operators and call for rigorous calibration of remotely sensed radiances as well as improved spatial, spectral, temporal, radiometric accuracies. The wind profiling and global precipitation measurement missions were singled out for their importance to the GOS. Implementation of most of these recommendations will be realized through the WMO Space Programme working with space agencies, via CGMS.

2.3 The 22 recommendations for the surface-based sub-system of the GOS (G1 – G22) include: more complete and timely data distribution; improved data coding; enhanced AMDAR and TAMDAR especially over data sparse areas; optimized rawinsonde distribution and launches; improved upper tropospheric and lower stratospheric moisture measurements; operational use of targeted observations; inclusion of ground based GPS, radars, and wind profilers; increased oceanic coverage through expanded Automated Ship balloon observations, drifting buoys, and ARGO; and development of some new observing technologies. Implementation for these recommendations relies on various paths of action that include (but are not limited to): (i) CBS working through Regional Rapporteurs to urge all Members with the existing observing capabilities to distribute full information content as quickly as possible; (ii) OPAG-IOS chair in consultation with the chairs of the Regional Working Group on Planning and Implementation of WWW to ensure that operators and managers of regional observing systems are made aware of GOS requirements; (iii) CBS via the OPAG IOS to collaborate with other WMO commissions such as CIMO and CCl, (iv) CBS via OPAG-IOS to maintain liaison and ensure targeting strategies developed by EUMETNET and THORPEX are made available; (v) CBS via OPAG-IOS to monitor progress under AMDAR Programme realized with TAMDAR and AFIRS; and (vi) CBS via OPAG-IOS to evolve ocean observing system with JCOMM help.

2.4 The original draft (with 42 recommendations) was endorsed by CBS in December 2002. At that time, CBS requested a draft implementation plan that is presented here.

2.5 The number of recommendations has been expanded to include 3 relevant to NWP interactions (N1 – N3) with data from the evolving GOS, one with regard to further study of observing system design (O1), and a final recommendation on training and utilization (T1) that is essential for realization of benefit from the evolved GOS.

3. Implementation Plan for the Evolution of GOS

3.1 Implementing Recommendations for Evolution of Space-Based Sub-system of GOS

Calibration

S1. Calibration - There should be more common spectral bands on GEO and LEO sensors to facilitate inter-comparison and calibration adjustments; globally distributed GEO sensors should be routinely inter-calibrated using a given LEO sensor and a succession of LEO sensors in a given orbit (even with out the benefit of overlap) should be routinely inter-calibrated with a given GEO sensor

Comment: A major issue for effective use of satellite data, especially for climate applications, is calibration. The advent of high spectral resolution infrared sensors will enhance accurate intercalibration.

Progress: CGMS-XXXI discussed GCOS Climate Monitoring Principles, inter-calibration of visible sensors, and inter-calibration of IR sensors on all GEOs with HIRS and AVHRR (reporting on the last item remains as a permanent action of CGMS). CGMS-XXXII considered improved infrared inter-calibration capabilities using AIRS data; the implications for GCOS Climate Monitoring Principles were discussed. CEOS hosted a calibration workshop in October 2004.

Next Action: WMO Space Programme to continue discussion with space agencies, via CGMS.

Schedule: Continue activity with current sensors and expand to IASI by CGMS in 2006.

GEO satellites

S2. GEO Imagers - Imagers of future geostationary satellites should have improved spatial and temporal resolution (appropriate to the phenomena being observed), in particular for those spectral bands relevant for depiction of rapidly developing small-scale events and retrieval of wind information.

Progress: All operators reported plans at CGMS: NOAA, EUMETSAT and Russia reported plans for a SEVIRI-like capability by 2015.

Next Action: WMO Space Programme to continue discussion with space agencies, via CGMS.

Schedule: Firm plans to reach this goal should be in place by CGMS in 2006.

S3. GEO Sounders - All meteorological geostationary satellites should be equipped with hyper-spectral infrared sensors for frequent temperature/humidity sounding as well as tracer wind profiling with adequately high resolution (horizontal, vertical and time).

Comment: This was to be demonstrated by GIFTS. However, for budgetary reasons, NASA has recently curtailed the GIFTS mission to assembly and vacuum test of an Engineering Design Unit; realization of a GIFTS demonstration in geostationary orbit is a task to be undertaken by the international community, possibly within the International Geostationary Laboratory (IGeoLab).

Progress: All operators reported plans at CGMS: NOAA has firm plans including this capability for the GOES-R series; EUMETSAT has it under consideration for the MTG series; China and India have plans for capability similar to current GOES sounder before 2010. CGMS endorsed the concept of the International Geostationary Laboratory (IGeoLab) that would be a joint undertaking to provide a platform for demonstrations from geostationary orbit of new sensors and capabilities. GIFTS is one of two systems being considered for IGeoLab.

Next Action: WMO Space Programme to coordinate pursuit of a GIFTS demonstration on IGeoLab with space agencies and to report plans at CGMS in 2005 (note Next Action on S-13).

Schedule: Plans from all space agencies for hyperspectral geostationary sounding should be in place by CGMS 2006.

S4. GEO Imagers and Sounders - To maximize the information available from the geostationary satellite systems, they should be placed “nominally” at a 60-degree sub-point separation across the equatorial belt. This will provide global coverage without serious loss of spatial resolution (with the exception of Polar Regions). In addition this provides for a more substantial backup capability should one satellite fail. In particular, continuity of coverage over the Indian Ocean region is of concern.

Comment: In recent years, contingency planning has maintained a 5-satellite system, but this is not a desirable long-term solution.

Next Action: WMO Space Programme to discuss with space agencies, via CGMS and WMO consultative meetings on high-level policy on satellite matters, the strategy for implementation with attention to the problems of achieving required system reliability and product accuracy.
Schedule: Plan should be available by CGMS in 2006

LEO satellites

S5. LEO data timeliness - More timely data are needed. Improved communication and processing systems should be explored to meet the timeliness requirements in some applications areas (e.g. Regional NWP).

Progress: EARS data are now available with a delay of less than 30 min; the data are used operationally at some NWP centres and planned at others. NPOESS plans are for data delivery in less than 30 min and thus consistent with this requirement.
Next Actions: WMO Space Programme to plan, with Members and CGMS, the development of Advanced Dissemination Methods (ADMs) and an Integrated Global Data Dissemination Service (IGDDS), to include (1) the extension and enhancement of EARS, (2) the implementation of similar systems, with a goal of achieving timely retransmission of local data sets covering the globe, (3) an equivalent system for NPP data, (4) expansion of EARS and equivalent systems to include IASI data, (5) establishment of equivalent systems for the LEO data from satellites of other agencies.
Schedule: Plan for IGDDS, including above elements, prepared by mid-2005, with goal for completion of phased implementation of global ATOVS retransmission service by mid-2006.

S6. LEO temporal coverage - Coordination of orbits for LEO missions is necessary to optimize temporal coverage while maintaining some orbit redundancy.

Progress: This is now the subject of a permanent action of CGMS.
Next Action: WMO Space Programme to collaborate with space agencies, via CGMS, on a target system that will be implemented and to take steps towards achieving it.
Schedule: Target system agreed upon by CGMS in 2006.

S7. LEO Sea Surface Wind - Sea-surface wind data from R&D satellites should continue to be made available for operational use; 6-hourly coverage is required. In the NPOESS and METOP era, sea surface wind should be observed in a fully operational framework. Therefore it is urgent to assess whether the multi-polarisation passive MW radiometry is competitive with scatterometry.

Progress: 3 months of data has been made available to Windsat science team.
Next Action: WMO Space Programme, via CGMS, to request assessment of Windsat performance and to consider the implications for the evolved GOS.
Schedule: Assess Windsat performance by 2005. Assess implications and provide feedback to NOAA by 2005.

S8. LEO Altimeter - Missions for ocean topography should become an integral part of the operational system.

Progress: Agreement has been reached to proceed with JASON-2.
Next Action: WMO Space Programme to discuss with space agencies, via CGMS and WMO consultative meetings on high-level policy on satellite matters, the continuity of operational provision after JASON-2.
Schedule: Plans for operational follow-on should be reported at CGMS in 2006.

S9. LEO Earth Radiation Budget - Continuity of ERB type global measurements for climate records requires immediate planning to maintain broadband radiometers on at least one LEO satellite.

Comment: There are no current plans for ERB-like measurements after Aqua. There are also concerns about the continuity of absolute measurements of incoming solar radiation.
Next Action: WMO Space Programme to discuss with space agencies, via CGMS.
Schedule: Plans for continuity of capability should be available by CGMS in 2006.

R&D satellites

S10. LEO Doppler Winds - Wind profiles from Doppler lidar technology demonstration programme (such as Atmospheric Dynamics Mission - Aeolus) should be made available for initial operational testing; a follow-on long-standing technological programme is solicited to achieve improved coverage characteristics for operational implementation.

Comment: Plans for Aeolus demonstration are proceeding on schedule, but there are no plans for operational follow on.

Next Action: WMO Space Programme to discuss with space agencies, via CGMS and WMO consultative meetings on high-level policy on satellite matters, to assure demonstration with Aeolus and initiation of operational systems for wind profile measurement.

Schedule: To confirm plans for near real time (NRT) data distribution by CGMS in 2005. Plans for continuity of a Doppler Winds capability following Aeolus should be formed by CGMS in 2006.

S11. GPM - The concept of the Global Precipitation Measurement Missions (combining active precipitation measurements with a constellation of passive microwave imagers) should be supported and the data realized should be available for operational use, thereupon, arrangements should be sought to ensure long-term continuity to the system.

Progress: TRMM continues to provide valuable data for operational use. Early termination of TRMM after 2004 will adversely affect WMO members. At CGMS-XXXII, NASA, ESA and JAXA reported plans for a GPM mission in 2008. ESA's EGPM launch will be decided if and when this mission is selected.

Next Action: WMO Space Programme to continue discussions with space agencies, via CGMS.

Schedule: Plans should be reported at CGMS in 2006.

S12. RO-Sounders - The opportunities for a constellation of radio occultation sounders should be explored and operational implementation planned. International sharing of ground network systems (necessary for accurate positioning in real time) should be achieved to minimize development and running costs.

Progress: CHAMP and SAC-C data have been available to some centres but not in near real time (NRT). NWP OSE has shown positive impact with small number of occultations. Climate applications are being explored. There has been good progress in planning for NRT distribution of METOP/GRAS and COSMIC data.

Next Actions: WMO Space Programme to discuss with space agencies, via CGMS, (1) the proposal to develop a shared ground network system and (2) operational constellations following COSMIC.

Schedule: Plan for shared ground network should be available by CGMS in 2006. Plan for operational follow-on should be drafted by CGMS in 2006.

S13. GEO Sub-mm - An early demonstration mission on the applicability of sub-mm radiometry for precipitation estimation and cloud property definition from geostationary orbit should be provided, with a view to possible operational follow-on.

Progress: EUMETSAT, NESDIS and WMO prepared a paper for CGMS on the International Geostationary Laboratory (IGeoLab) that would be a joint undertaking to provide a platform for demonstrations from geostationary orbit of new sensors and capabilities. Geo sub-mm is one of two systems being considered for IGeoLab.

Next Action: WMO Space Programme to continue dialogue with space agencies, via CGMS

Schedule: Plan for IGeoLab should be drafted by CGMS in 2005.

S14. LEO MW - The capability to observe ocean salinity and soil moisture for weather and climate applications (possibly with limited horizontal resolution) should be demonstrated in a research mode (as with ESA's SMOS and NASA's OCE) for possible operational follow-on. Note that the horizontal resolution from these instruments is unlikely to be adequate for salinity in coastal zones and soil moisture on the mesoscale.

Recent Progress: ERS data sets have provided monthly global soil moisture maps since 1991 at 50 km resolution.

Next Action: WMO Space Programme to discuss with space agencies, via CGMS

Schedule: WMO Space Programme to report to ET following CGMS in 2006.

S15. LEO SAR - Data from SAR should be acquired from R&D satellite programmes and made available for operational observation of a range of geophysical parameters such as wave spectra, sea ice, land surface cover.

Next Action: WMO Space Programme to discuss with space agencies, via CGMS, (1) access by WMO members to ENVISAT SAR data, and (2) continuity of such missions.

Schedule: Assessment of status and plans completed by CGMS in 2006.

S16. LEO Aerosol - Data from process study missions on clouds and radiation as well as from R&D multi-purpose satellites addressing aerosol distribution and properties should be made available for operational use.

Progress: Cloudsat will carry a R&D aerosol instrument. NPOESS is adding an aerosol instrument. This issue has been referred to the CEOS SIT and CGMS.

Next Action: WMO Space Programme to continue discussion with space agencies, via CGMS and CEOS.

Schedule: Plans for data distribution should be drafted by CGMS in 2006. WMO SP to report to ET following CGMS in 2006.

S17. Cloud Lidar - Given the potential of cloud lidar systems to provide accurate measurements of cloud top height and to observe cloud base height in some instances (stratocumulus, for example), data from R&D satellites should be made available for operational use.

Next Action: WMO Space Programme to discuss with space agencies, via CGMS

Schedule: WMO Space Programme to report to ET following CGMS in 2005.

S18. LEO Far IR - An exploratory mission should be implemented, to collect spectral information in the Far IR region, with a view to improve understanding of water vapour spectroscopy (and its effects on the radiation budget) and the radiative properties of ice clouds.

Next Action: WMO Space Programme to discuss with space agencies, via CGMS

Schedule: WMO SP to report to ET following CGMS in 2005.

S19. Limb Sounders - Temperature profiles in the higher stratosphere from already planned missions oriented to atmospheric chemistry exploiting limb sounders should be made operationally available for environmental monitoring.

Next Action: WMO Space Programme to discuss with space agencies, via CGMS, progress/plans for distribution of data from MIPAS and SCIAMACHY on ENVISAT, from MLS and HIRDLS on AURA, and from similar instruments.

Schedule: Plans for data distribution should be documented by CGMS in 2006.

S20. Active Water Vapor Sensing - There is need for an exploratory mission demonstrating high-vertical resolution water vapour profiles by active remote sensing (for example by DIAL) for climate monitoring and, in combination with hyper-spectral passive sensing, for operational NWP.

Next Action: WMO Space Programme to discuss with space agencies, via CGMS.

Schedule: WMO Space Programme to report to ET following CGMS in 2005.

3.2 Implementing Recommendations for Evolution of Surface-Based Sub-system of GOS

Data coverage, distribution and coding

G1. Distribution - Some observations made routinely are not distributed in near real-time but are of interest for use in meteorological applications.

(a) Observations made with high temporal frequency should be distributed globally at least hourly.

Comment: Recent studies have shown that 4D-Var data assimilation systems or analysis systems with frequent update cycles can make excellent use of hourly data, e.g. from SYNOPs, buoys, profilers, and other automated systems, in particular Automatic Weather Systems (AWS).

Next Actions: CBS to urge WMO Members to implement this recommendation at the earliest possible date, no later than November 2005.

(b) Observational data that are useful for meteorological applications at other NMHSs should be exchanged internationally. Examples include high resolution radar measurements (i.e. products, both reflectivity and radial winds, where available) to provide information on precipitation and wind, surface observations, including those from local or regional mesonets, such as high spatial resolution precipitation networks, but also other observations, such as soil temperature and soil moisture, and observations from wave rider buoys. WMO Members summarize the data available in their regions and strive to make these data available via WMO real time or near-real-time information systems, whenever feasible.

Next Actions: Rapporteurs / Coordinators on Regional Aspects of the GOS, via letter from Secretariat, have been requested to provide information on data potentially available in this category. [The letter should request supply and alert potential users to plans]. ET-ODRRGOS in 2005 should review input and consider which potentially available data merit further action.

G2. Documentation - All observational data sources should be accompanied by good documentation including metadata, QC, and monitoring.

Next Actions: (1) WMO Secretariat to draft a letter to Members (NWP centres) requesting report of specific problems inhibiting effective use of available data. [In their responses Members will be asked to address problem areas for each data type. Reports should be specific and indicate what problems are preventing users from using data effectively.] (2) ET-ODRRGOS will review responses. (3) Based on the analysis of 1 and 2 above, such information should become accessible through a centralized WMO web portal (late 2005).

G3. Timeliness and Completeness - There should be a timely distribution of radiosonde observations with all observation points (not just mandatory levels) included in the message (together with the time and the position of each data point; information on instrument calibration prior to launch, and information on sensor type and sub-sensor type). Appropriate coding standards should be used to assure that the content (e.g. vertical resolution) of the original measurements, sufficient to meet the user requirements, is retained during transmission.

Comment: NWP OSEs have demonstrated the usefulness of full resolution data for NWP. The NWP OSE Workshop (Alpbach, 2004) reiterated the need for near real time distribution of full resolution RAOB data.

Next Actions: CBS to urge all Members with the existing capability of producing full vertical resolution sounding data to implement the transmission as soon as possible, starting in November 2005. Further CBS to ask all Members to generate, as soon as possible, sounding data in Table Driven Code Forms (BUFR or CREX), following the technical specifications defined by CBS in the Guidance for Migration (See http://www.wmo.ch/web/www/documents.html#CodeTables). In the interest of timely data delivery, the first BUFR (or CREX) message should be sent when level 100 hPa is reached and the second message should be sent when the whole sounding is completed (containing all observation points). The delivery of the profile data in several stages may be necessary to accommodate the interests of other application areas, such as nowcasting and aeronautical meteorology. Collaboration with CIMO and various code groups should be established.

G4. Baseline system - Provide comprehensive and uniform coverage with at least 12-hour frequency of temperature, wind, and moisture profiles over mid-latitude continental areas and coastal regions. In tropical regions the wind profile information is particularly important.

Comment: Regional forecasting systems continue to show benefit from a comprehensive and uniform coverage with at least 12-hour frequency of temperature, wind, and moisture profiles over mid-latitude continental areas and coastal regions. In tropical regions the wind profile information is considered to be of particular importance. At this stage the radiosonde and PILOT network still plays an important role in meeting these requirements (NWP OSE Workshop, Alpbach 2004). Profile data will continue to be collected from a mix of observing system components and will in the future be complemented by the utilization of satellite data over land. In Polar Regions, this need

has not been addressed, however the linkage between CBS, CAS's THORPEX, and the International Polar Year should give guidance for that data sparse region.
Next Action: OPAG-IOS chair in consultation with the chairs of the Regional Working Group on Planning and Implementation of WWW to ensure that operators and managers of regional observing systems are made aware of developments in this area (CBS in 2005).

G5. Stratospheric observations - Requirements for a stratospheric global observing system should be refined. The need for radiosonde, radiance, wind, and humidity data should be documented, noting the availability and required density of existing data sources, including GPS sounders, MODIS winds, and other satellite data.

Comment: NWP OSE Workshop, Alpbach, 2004, suggested that OSE results on the usefulness of stratospheric observations should be consolidated. It also noted that the COSMIC satellite mission likely would provide a substantial enhancement to the stratospheric observing system. Further, AOPC has noted that current in situ measurement capabilities for upper tropospheric and lower stratospheric water vapour are not meeting climate requirements and stressed need for further technology development.
Next Action: ET to initiate further OSEs to include the use of COSMIC data when available. Results of OSEs to be reviewed and consolidated at that stage (2008).

Broader use of ground based and in situ observations

G6. Ozone Sondes - Near real-time distribution of ozone sonde data is required for calibration and validation of newly launched instruments and for potential use in NWP. [This recommendation is supported by information from the Joint ECMWF / WMO expert team meeting on real time exchange of ground based ozone measurements, ECMWF, 17-18 October 1996, WMO NWP OSE Workshop, Alpbach 2004]

Next Action: CBS and CAS to request WMO Members making ozone profile measurements to place data on the GTS in near real time in BUFR/CREX format at the earliest possible date. Secretariat to inform Members of this requirement and request Members to inform WMO of their implementation plans (November 2005).

Moving towards operational use of targeted observations

G7. Targeted Observations - Observation targeting to improve the observation coverage in data sensitive areas for NWP should be transferred into operations once the methodology has matured. Non-linear methods in targeting have been studied and should also be considered. The operational framework for providing information on the sensitive areas and responding to such information needs to be developed.

Comment: The proof of the observation-targeting concept was given by US Weather Service in the northeastern Pacific winter storms and land-falling hurricane situations. THORPEX has declared observation targeting a core research activity in its implementation plan (2.3 ii), has successfully carried out jointly with EUCOS the NA-TreC campaign, and has benefited from the lessons learned from FASTEX.
Next Action: The OPAG-IOS Chair to maintain liaison and ensure targeting strategies developed by THORPEX are made available to the CBS.

Optimization of rawinsonde distribution and launches

G8. RAOBs - Optimize the distribution and the launch times of the rawinsonde sub-system (allowing flexible operation while preserving the GUAN network and taking into consideration regional climate requirements of the RBCN). Examples include avoiding duplication of Automated Ship-borne Aerological Program (ASAP) soundings whenever ships are near a fixed rawinsonde site (freeing resources for observations at critical times) and optimizing rawinsonde launches to meet the local forecasting requirements. [This recommendation is supported by information from the EUCOS Studies]

Comment: Observation targeting requires a flexible observing practice. THORPEX has included this concept in their considerations.
Next Actions: ET to follow the THORPEX Implementation Plan and to learn from the THORPEX experience. When appropriate ET to request Secretariat to inform Rapporteurs / Coordinators on

Regional Aspects of the GOS and managers of observing systems of the requirements for adapting to flexible observing practices including taking observations on demand, while safe-guarding the integrity of the baseline observing system.

Development of the AMDAR Programme

G9. AMDAR - AMDAR technology should provide more ascent/descent profiles, with improved vertical resolution, where vertical profile data from radiosondes and pilot balloons are sparse as well as into times that are currently not well observed such as 2300 to 0500 local times. [This recommendation is supported by information from the Toulouse report, ECMWF northern hemisphere AMDAR impact study, OSEs 4, 5, 8]

Progress: The AMDAR Panel plans to coordinate homogeneous coverage of AMDAR data over 24 hours over as many regions as possible and to improve the value of upper air data through a combination of:

- Expanding the number of operational national and regional programmes;
- Development and use of new onboard software and alternative AMDAR technologies;
- Selective deployment of humidity/water vapour sensors;
- Provision of targeted observations into data sparse areas and special weather situations;
- Use of optimisation systems to improve cost effectiveness;
- Improvements in the monitoring, quality control;
- Efforts to encourage and pursue the free exchange of data; and
- Improvements in user awareness & training plus operational forecasting tools & systems.

The AMDAR Programme Implementation Table follows.

Programme Items	2005-2006	2008	2010
Operational programmes (Australia, E-AMDAR*, New Zealand, USA, South Africa)	Expanding	Stable	stable
Emerging programmes (Hong Kong China, Saudi Arabia, Japan, Canada, Central-western Africa)	Expanding	expanding/ stable	stable
Developing programmes (Chili, Argentina, UAE, Rep. of Korea, China)	First data	expanding	stable
Planned programmes (Eastern-central Europe#, Russian Federation, Oman, Egypt, Morocco, Kenya, Pakistan, India, Iran, Israel, Libya))		first data	expanding
Development software and technologies	work in progress	operational	stable
Humidity/water vapour sensors	operational trials	expanding	operational
Targeted data	Partly operational	expanding	expanding
Optimisation systems	Partly operational	expanding	expanding
Data monitoring, QC and data exchange	Ongoing	Ongoing	ongoing
Awareness and training	Ongoing	Ongoing	stable
Development of operational forecasting tools	in progress	operational	operational

* E-AMDAR currently: UK, France, Netherlands, Germany, Sweden
E-AMDAR emerging: Finland
E-AMDAR planned: Portugal, Spain, Iceland, Italy, Switzerland, Austria, Ireland, Belgium

Eastern-central Europe: Poland, Hungary, Rumania, Ukraine, Czech Republic

Next Actions: ET-ODRRGOS to continue to monitor progress of the AMDAR Programme in the above activities.

G10. Transmission of AMDAR reports - Optimize the transmission of AMDAR reports taking into account, en route coverage in data-sparse regions, vertical resolution of ascent/descent reports, and targeting related to the weather situation. [This recommendation is supported by information from the Toulouse and Alpbach NWP OSE Workshop reports, ECMWF northern hemisphere AMDAR impact study].

Comment: AMDAR coverage is both possible and sorely needed in several currently data-sparse regions, especially Africa and South America, Canadian arctic, northern Asia and most of the world's oceans. More T, U/V, Q profiles, but especially winds, are needed in the tropics. Moreover, the timing and location of reports, whose number is potentially very large, can be optimized while controlling communications costs.

Next Action: AMDAR Rapporteur to report progress to ET. Members in the Regions must assume responsibility of implementation.

G11. Humidity sensors on AMDAR - Further development and testing of water vapour sensing systems is strongly encouraged to supplement the temperature and wind reports from AMDAR. [This recommendation is supported by information from the Toulouse and Alpbach NWP OSE Workshop reports]

Progress: Demonstration of WVSS-2 is expected in 2004-05. This system employs an absolute measurement of water vapour content that is expected to be accurate from the ground to flight altitudes.

Next Action: AMDAR Rapporteur to report progress of AMDAR programme to ET.

Alternative AMDAR systems

G12. TAMDAR & AFIRS - To expand ascent/descent profile coverage to regional airports, the development of TAMDAR, and use of AFIRS should be monitored with a view towards operational use.

Comment: A range of systems including TAMDAR, AFIRS and MDS could supplement conventional AMDAR and radiosonde data by providing lower level en route observations and profiles over additional, regional airports not served by larger AMDAR compatible aircraft. Instrumentation would not necessarily be designed to function in the high troposphere and would therefore be less expensive.

Next Action: ET-ODRRGOS to review progress under AMDAR and EUCOS Programmes. First data from TAMDAR and AFIRS are expected in late 2004.

Atmospheric moisture measurements

G13. Ground GPS - Develop further the capability of ground-based GPS systems for the inference of vertically integrated moisture with an eye toward operational implementation. Ground based GPS processing (Zenith Total Delay and Precipitable Water, priority for ZTD) should be standardized to provide more consistent data sets. Data should be exchanged globally. [This recommendation is supported by information from the NWP OSE Workshop in Alpbach]

Comment: Such observations are currently made in Europe, North America and Asia. It is expected that the global coverage will expand over the coming years. The COSNA/SEG, NAOS, JMA reports provide useful background information.

Next Actions: CBS to urge Members to collect and exchange the ground-based GPS data. Members should take the appropriate action to ensure that the data processing be standardized by November 2005. Collaboration with CIMO should be established.

Regarding improved observations in ocean areas

G14. More profiles over oceans - Increase the availability of high vertical resolution temperature, humidity, and wind profiles over the oceans. Consider as options ASAP and dropsondes by designated aircraft.

Next Action: ET-ODRRGOS request a review from JCOMM on the current status and plans of ASAP.

G15. Telecommunications - Considering the expected increase in spatial and temporal resolution of *in situ* marine observing platforms (from include drifting buoys, profiling floats, XBTs for example) and the need for network management, the bandwidth of existing telecommunication systems should be increased (in both directions) or new relevant satellite telecommunications facilities should be established for timely collection and distribution.

Comment: The JCOMM Operations Plan provides background for actions in this area.
Next Action: ET-ODRRGOS request information on progress regarding distribution of increased temporal and spatial resolution in situ marine observations from JCOMM.

G16. Tropical moorings - For both NWP (wind) and climate variability/climate change (sub-surface temperature profiles), the tropical mooring array should be extended into the tropical Indian Ocean at resolution consistent with that presently achieved in the tropical Pacific and Atlantic Oceans. [The JCOMM Operations Plan provides background for actions in this area].

Next Action: ET-ODRRGOS request information on progress in extending the tropical mooring array from JCOMM.

G17. Drifting buoys - Adequate coverage of wind and surface pressure observations from drifting buoys in the Southern Ocean in areas between 40S and the Antarctic Circle should be assured using an adequate mix of SVPB (surface pressure) and WOTAN technology (surface wind). The pressure observations are a valuable complement to the high-density surface winds provided by satellite. [This recommendation is supported by information in the Toulouse NWP OSE Workshop Report and the ET-ODRRGOS OSE studies].

Comment: Plans from agencies other than JCOMM need to be considered.
Next Actions: (1) ET-ODRRGOS to request information from JCOMM on plans for preserving/enhancing the network. (2) ET-ODRRGOS to review requirement for surface pressure observations in ocean areas based in results of OSE studies (EUCOS)

G18. XBT and Argo - For Ocean Weather Forecasting purposes, improve timely delivery and distribute high vertical resolution data for sub-surface temperature/salinity profile data from XBTs and Argo floats.

Note: The JCOMM Operations Plan provides background for actions in this area.
Next Actions: (1) ET-ODDRGOS to request information on progress from JCOMM for the next ET-ODRRGOS meeting. (2) ET-ODRRGOS to review adequacy for WMO requirements.

G19. Ice buoys - For NWP purposes, coverage of ice buoys should be increased (500 km horizontal resolution is recommended) to provide surface air pressure and surface wind data.

Note: The JCOMM Operations Plan provides background for actions in this area.
Action: ET-ODRRGOS to request information on progress regarding ice buoys from JCOMM.

Improved observations over tropical land areas

G20. More profiles in Tropics - Temperature, wind and if possible humidity profile measurements (from radiosondes, PILOTs, and aircraft) should be enhanced in the tropical belt, in particular over Africa and tropical America.

Comment: There is evidence from recent impact studies with the radiosonde / PILOT balloon network over the Indonesian / Australian region that such data give a better depiction of winds in the tropics and occasionally strongly influence the adjacent mid-latitude regions.
Action: AMDAR and GCOS Rapporteurs to report to ET-ODRRGOS. CBS to urge Members to consider the re-activation of silent stations through a shared funding programme.

New Observing Technologies

G21. AWS - Noting the widespread adoption of AWS, (a) there should be coordinated planning that includes

- appropriate codes and reporting standards,

- global standard for quality management and the collection / sharing of metadata, and
- expanded range of measured parameters;

Next Action: ET-AWS to be asked to provide a summary of standards for coding and reporting, sharing of metadata, and advances in technology for ET-ODRRGOS.

(b) exact time of observation, as distinct from a notional time or time period, should be reported.

Next Action: Reporting formats should be reviewed to include the details of observation times; OPAG IOS Chair to bring this to the attention of the OPAG ISS ET on Data Representation and Codes (at CBS in 2005).

G22. New systems - In the context of THORPEX, the feasibility of new systems should be demonstrated as much as possible. These possible operational sub-systems include but are not limited to

- ground based interferometers and radiometers (e.g. microwave) that could provide continuous vertical profiles of temperature and humidity in selected areas;
- Unmanned Aeronautical Vehicles (UAVs);
- high altitude balloons;
- lidars.

Action: OPAG IOS Chair to liaise with the THORPEX ICSC and keep the relevant ETs informed. Collaboration with CIMO should be established.

3.3 Implementing Additional High Priority Recommendations for Evolution of the GOS

Interaction between NWP centres, data providers and users

N1. New data types - NWP centres should receive early (advance) information about and experience with new data types; this includes (a) early access to test data and observations during the cal/val phase to prepare for the operational use of the data and (b) information on the characteristics of the data and products (e.g. AMVs which may be representative of atmospheric layers rather than just one level over layers). [This recommendation is supported by information contained in the report from the Alpbach NWP OSE Workshop].

Comment: Data assimilation and modeling capabilities have grown and are under constant development to make optimal use of current and future observing systems.

Action: ET-ODRRGOS through OPAG-IOS chair and CBS/CGMS to encourage data producers to provide metadata on observations and observing systems as early as possible.

N2. Data from research satellites – R&D systems provide valuable data for NWP, which should be made available in a timely fashion. Research satellite data provide NWP centres with an excellent opportunity to prepare for new satellite data streams, which will become part of the operational global observing system. Effective learning of how to make use of new data types can best be achieved through operational use of any experimental data streams. [This recommendation is supported by information contained in the report from the Alpbach NWP OSE Workshop].

Action: WMO Space Programme, in coordination with ET-ODRRGOS, through CBS and CGMS, encourage operators of R&D satellites to provide early access to observations.

N3. Timely data delivery – Data processing and delivery systems should strive to meet NWP requirements of 30 minutes as much as possible.

Comment: The requirements for early delivery and frequent updates of forecast guidance have evolved over recent years. NWP centres have significantly reduced their data cut-off times at the expense of available observations in their data assimilation processes. Timeliness requirements for observational data are becoming more stringent for NWP centres. HH + 20 to 90 minute data cut-off times are currently applied for many NWP short-range runs. Late data can only be assimilated in update runs with long data collection times (several hours). Within the next few years, a data processing and delivery time of approximately 20 to 30 minutes is expected to be the operational

requirement used in medium and short-range forecasts. Any minute gained is useful because observation arrival drives the rest of the forecast production chain.
Action: WMO Space Programme, in coordination with ET-ODRRGOS, through CBS and CGMS, bring to the attention of data producers the more stringent timeliness requirements for observational data at NWP centres, (NWP OSE workshop, Alpbach 2004).

O1. Observing System Study - Support well-resourced studies of re-designed observing systems. This is an ongoing process.
Next Actions: ET to monitor and learn from EUCOS and THORPEX demonstration studies of observing system capabilities. Further EUCOS studies evaluating the relative importance and the impact of the ground-based and space-based sub-systems will soon be commissioned (2005). This will result in an information exchange through documentation and workshops as appropriate.

T1. Training and information exchange for GOS Utilization – Support for sustained training must be realized as a primary means to assist WMO Members towards full exploitation of surface-based and satellite-based sub-systems of the GOS. Training must address data access, data use, and training of trainers. Networks for information exchange toward improved utilization of the GOS must be encouraged.

Recent Progress: A review process has been initiated and will continue by the ET-SSUP with the issuance of a biennial questionnaire. Analysis of the questionnaire provides input to the CBS for WWW utilization.

Next Actions: For sustained training and education programme, CBS continue to solicit support from space agencies (e.g. WMO Space Programme for CGMS/WMO Virtual Laboratory) and also continue to solicit support from Members (e.g. capacity building training). WMO Space Programme, in collaboration with WMO Members and CGMS, continue to foster international groups and networks such as International ATOVS Working Group International Winds Working Group, and International Precipitation Working Group that provide fora for information and algorithm exchange.

4. Considerations for Evolution of the GOS in Developing Countries

4.1 In drafting this implementation plan, it was noted that redesign of the GOS included several special considerations and issues that involve developing countries. In many areas of Africa, Asia, and Latin America (Regions I, II, and III and some tropical areas between 25N and 25S), the current GOS provides no observations, whereas in other areas observations should be improved. When looking at candidate observing systems, consideration must be given not only to NWP but also to many other applications, including human forecasting. The evolution of the GOS in developing countries must address some of the issues that fall in three categories: (a) lack of public infrastructure such as electricity, telecommunication, transport facilities, etc., (b) lack of expertise from people to do the job, training, etc., and (c) funding for equipment, consumables, spare parts, manpower, etc. The lack of infrastructure and expertise may be the result of a lack of funding.

4.2 The evolution must take into account upgrading, restoring, substitution and capacity building (especially in the use of new technologies). Two aspects need to be considered: the data production and the data use. It is possible that some countries do not and will not be able to produce data and will therefore only be users of data. To help developing countries produce data for international exchange, due consideration must be given to the three issues previously identified i.e. public infrastructure, expertise and funding.

4.3 Possible approaches towards the redesign have been discussed. A first step should be to identify observing systems that are less dependent on local infrastructure. In some circumstances, these include satellite, AMDAR, dropsondes, and AWS. Nonetheless, a minimum set of reliable RAOBs is required as a backbone to the GUAN and RBCN; these are also used to validate the

satellite observations. Migration toward the table-driven codes (BUFR or CREX) as a reliable representation of the data is expected.

4.4 However, obtaining vertical profiles by AMDAR in many data sparse areas is worth testing. It must be recognized that AMDAR ascent/descent and enroute data will provide little stratospheric information and currently no humidity data (although humidity sensors are being tested). It is imperative that useful approaches be drafted for studying the impact of additional observations (e.g. AMDAR) in regions of scarce conventional observations (e.g. RAOBS) and discuss possible observing system experiments to explore enhancing the observations on these areas. More generally the role of developing countries in the THORPEX through the regional associations should be explored.

4.5 It was felt that capacity building in some countries needed further attention. Some countries have satellite-receiving stations or receive satellite data through the GTS, but lack the expertise to utilize the information to their benefit. Some countries are acquiring Doppler radar but need training on how to retrieve the information. For example, Region I has benefited with expanded access to conventional data and satellite imagery through the PUMA project. This type of project should be expanded to include other data types for routine application (synoptic, aviation, nowcasting).

4.6 If resources are available, the highest priority should go to (a) maintaining the RBSN and RBCN, noting that GSN and GUAN stations are part of the RBSN, and (b) to rehabilitate observing sites in critical locations.

4.7 Finally, the following recommendations should be taken into account when addressing the evolution of the GOS in developing countries:

- Define geographical areas using advanced techniques to help identify where priority should be if additional funding was available;
- Encourage regional associations in concert with CBS to define trial field experiments over data sparse areas, for a limited time, to evaluate how additional data would contribute to improve performance at the regional and global scale. A clearly demonstrated impact might make it easier to agree on some coordinated funding mechanism for areas concerned including funding from GEF (Global Environmental Facilities) for climate stations;
- Examine whether automated stations could become a viable, cost effective alternative to manned stations for the surface network in the future;
- In data-sparse areas of the world, it may be more cost-effective to make full use of AMDAR ascent/descent data at major airports; however the RAOB network still plays an important role in human forecasting;
- When changes are made to the climate observing systems, the GCOS Climate Monitoring Principles should be followed;
- The telecommunication problems should be referred to the OPAG on ISS and looked at as a priority;
- Prioritize where the needs are most pressing for VCP or other funding.
- High priority should be given by the region and secretariat to maintain a minimum RAOB network with acceptable performance within data challenged regions.

5. OSEs supporting the implementation plan recommendations and actions

In course of the development a global approach to redesign of the GOS, the ET-ODRRGOS kept under permanent review the impact assessments studies being conducted by NWP centres under regional programmes such as COSNA, EUCOS and NAOS. The ET-ODRRGOS found that findings of COSNA, EUCOS and NAOS as well as conclusions and recommendations of The Toulouse and Alpbach Workshops on Impact of Various Observing Systems on NWP provided essential input to the redesign process of the GOS. However, the ET-ODRRGOS strongly supported the workshop recommendation that impact studies should be

carried out for a sufficiently long period, preferably in each of four seasons and that the statistical significance of the results should be established. In addition, the ET ODRRGOS suggested nine OSEs for consideration by NWP centres and asked the OSE/OSSE Rapporteurs (Jean Pailleux and Nobuo Sato) to engage as many as possible in this work. Good response was received and results are coming in. The OSEs and the initial results from the contributing NWP centres are listed below:

5.1. Impact of hourly versus 6-hourly surface pressures. Using 4DVAR assimilation ECMWF found positive impact especially over the north Atlantic and southern oceans.

5.2. Impact of denial of radiosonde data globally above the tropopause. The Canadian AES report found positive impact from RAOB data above the tropopause.

5.3. Information content of the Siberian radiosonde network and its changes during last decades. The Main Geophysical Observatory in St Petersburg found that information content was ascending until 1985, descending thereafter. NCEP related a decrease in performance of 500 hPa height analysis over NA to a decrease in Siberian RAOBs.

5.4. Impact of AMDAR data over Africa through data denial in a 4D-Var analysis and forecasting system. ECMWF showed that denial over NH of observations below 350 hPa has large significant impact in summer and winter. Investigation of African AMDAR impact is pending at MeteoFrance.

5.5. Impact of tropical radiosonde data. Met Office varied the density of SE Asia RAOBs used in assimilation and produced high impact on winds at all levels with occasional propagation of impact to mid-latitudes. Temperature and wind information is the most important potential measurements from AMDAR in less well-observed tropical areas (e.g. Africa, Central America).

5.6. Impact of three LEO AMSU-like sounders (NOAA –15, - 16, and -17 plus AQUA). ECMWF showed large positive impact from two AMSUs over one MSU. Met Office showed positive impact of three over two AMSU when NOAA-17 was added to the GOS.

5.7. Impact of AIRS data. ECMWF found that addition of one AIRS to a baseline observing system without satellites showed more impact than addition of one AMSU. Further, AIRS impact on the full GOS was positive (but initially small).

5.8. Impact of better than 3 hourly ascent descent AMDAR data. Preliminary NH AMDAR ascent/descent impact suggests positive effect of higher frequency data. EUCOS arranged higher frequency observations in 2003 to enable this study by Met Office and ECMWF.

5.9. Impact of polar winds from MODIS water vapor imagery. Initial 30-day impact study at ECMWF and NASA DAO showed that forecasts of the geopotential height for the Arctic, Northern Hemisphere extratropics, and Antarctica are improved significantly. Subsequent usage at more than ten NWP centres has confirmed positive impact of MODIS polar WV winds.

6. Time of Update for Statements of Guidance

Global Numerical Weather Prediction (Dec 2003)
Numerical Weather Prediction (Jan 2004)
Synoptic Meteorology (Apr 2001)
Nowcasting and Very Short Range Forecasting (Apr 2001)
Seasonal to Inter-annual Forecasts (Nov 2003)
Aeronautical Meteorology (Nov 2003)
Atmospheric Chemistry (Jul 2004)
JCOMM Ocean Applications Areas (Jan 2002)
Agrometeorology (Jul 2004)
Hydrology (Jul 2004)

7. Vision for the GOS in 2015

In drafting the recommendations for an evolved GOS and then the implementation plan, the ET was guided by the following vision for the GOS in 2015 and beyond.

For the Space based Sub-system, there will be

6 operational GEOs

- all with multispectral imager (IR/VIS)
- some with hyperspectral sounder (IR)

4 operational LEOs

- optimally spaced in time
- all with multispectral imager (MW/IR/VIS/UV)
- all with sounder (MW)
- three with hyperspectral sounder (IR)
- all with radio occultation (RO)
- two with altimeter
- three with conical scan MW or scatterometer

Several R&D satellites serving WMO members

- Constellation small satellites for radio occultation (RO)
- LEO with wind lidar
- LEO with active and passive microwave precipitation instruments
- LEO and GEO with advanced hyperspectral capabilities
- GEO lightning
- Possibly GEO microwave

All with improved intercalibration and operational continuity.

For the Surface based Sub-system, there will be

Automation to enable

- targeting of observations in data sensitive areas
- optimal operation of
    - radiosondes
    - ASAP systems
    - aircraft in flight

Rawinsondes

- optimized utilization
- stable and functioning RBSN, RBCN, and GUAN
- supplemented by
    - AMDAR ascent/descent
    - ground based GPS water vapor information
    - wind profilers
    - satellite soundings
- rawinsondes automatically launched
- computerized data processing
- real-time data transmission
- high vertical resolution

Commercial aircraft observations

- of temperature & wind plus humidity on some aircraft
- in-flight and ascent/descent data
- high temporal resolution
- available from most airports including currently data void airports in Asia, Africa and South America.
- possibly supplemented with UAVs

Surface observations

- stable and functioning RBSN, RBCN, and GSN
- automated systems

- land sensors at high spatial resolution, supporting local applications such as road weather
- ocean platforms (ship, buoys, profiling floats, moorings) in adequate number to complement satellite measurements

Radar observing systems measuring

- radial winds
- hydrometeor distribution and size
- precipitation phase, rate, and accumulation
- multiple cloud layers, including base and top height.

Data collection and transmission

- digital in a highly compressed form
- entirely computerized data processing
- role of humans in observing chain reduced to minimum
- information technology in all areas of life will provide new opportunities for obtaining and communicating observations
- for satellite data in particular
    - use of ADM including regional/special DCPC in the context of FWIS
    - DB for special local applications in need on minimal time delay and as backup

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Annex VII

FUTURE WORK PROGRAMMES OF THE EXPERT TEAMS, OPAG-IOS RAPPORTEURS AND REGIONAL RAPPORTEURS/COORDINATORS ON REGIONAL ASPECTS OF THE GOS

ET-SSUP WORK PLAN FOR 2005-2006

SUP-5 agreed that the following future work programme should be presented to CBS-XIII for consideration for the work of ET-SSUP after CBS-XIII:

- In following the Rolling Review for the Strategy to Improve Satellite System Utilization, analyze the 2005 biennial questionnaire, compile a list of recommended actions based on that analysis and prepare a new TD, including a summary analysis from the Virtual Laboratory for Satellite Data Utilization's Centres of Excellence;
- Extend the regional Advanced Dissemination Methods (ADM) concept and principles to an Integrated Global Data Dissemination Service (IGDDS) for operational and R&D satellites, in close coordination with the Co-ordination Group for Meteorological Satellites' (CGMS) standing Working Group on this issue and with WMO's Future Weather Information System (FWIS) activities aimed at harmonizing the services to the maximum extent possible;
- Review present and future R&D satellite data and products including their availability and applications in view of better utilization by WMO Members;
- Represent WMO Member needs to the CGMS/WMO Virtual Laboratory for Satellite Data Utilization (VL) in relevant areas, including:
    - Training events, in particular the high profile global training event, aiming at further increasing the number of staff and their skills in full utilization of satellite data, from both operational and R&D satellite data.
    - Help ensure Members have access to training materials and courses, as well as provide advice on ways to access data, products, and algorithms from both operational and R&D satellites.
    - With the VL Focus Group, evaluate the success and needs of the VL components and suggest strategies for improving VL performance.
    - Begin preparation for global high profile global training event to take place in 2006 or 2007.
- Prepare documents to assist Members, summarizing the results from the above activities.

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ET-AWS WORK PLAN FOR 2005-2006

The ET-AWS identified priority activities for the next intersessional period. It was agreed that periodic review of the BUFR-CREX coding requirements for AWS must be accomplished. It was acknowledged that observational platforms change for many reasons and existing data management and reporting techniques would also require change. This requires a more frequent exchange of information between the ET-AWS and the ET-DR&C. As ET members identify or are informed of the need for change to encoding or reporting of AWS data the team(s) will need to reconcile each identified problem. Due to the diverse nature of AWS, regular coordination, throughout the intersessional period is necessary between CBS, CCl, JCOMM, CIMO, GCOS, and AMDAR. Based on the proposals presented by the members, the meeting agreed to the future work plan as described below:

- The ET-AWS, jointly with CCl, JCOMM, CIMO, GCOS and AMDAR develop the guidelines for AWS quality control procedures for future publication to all appropriate WMO documents;

- The ET-AWS, jointly with CCl, JCOMM, CIMO, GCOS and AMDAR, develop standards for a basic set of variables to be reported by AWS installations;

- The ET-AWS will develop practical examples based on the standards developed for AWS metadata;

- The ET-AWS, jointly with HMEI and CIMO will develop a procedure whereby users can access information on how various AWS parameters are computed. This development will be addressed as part of the metadata needs and the Future WMO Information System,

- The ET-AWS, during the next intersessional period, will routinely review and document the need for updating and maintaining related AWS performance and quality control standards, as well as, all related AWS code templates and descriptor tables.

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ET-ODRRGOS WORK PLAN for 2005-2006

1. Post on ET web page (a) members, (b) final reports from meetings, (c) Rolling Requirements Review (RRR) process description, (d) updated SoGs, (d) WMO TDs written by ET, (e) Implementation Plan for GOS Evolution, and (f) six monthly progress reports on action list and work plan.

2. Continue updating CEOS/WMO data bases of user requirements and observing system capabilities and include user reviewed R&D expected performances.

3. Continue Rolling Review of Requirements for ten application areas and expand to new areas as advised by CBS.

4. Work with application area Points of Contact to update Statements of Guidance.

5. Review with Rapporteurs and NWP experts the progress concerning OSE guidance for evolution of GOS (attention to EUCOS, African AMDAR studies and others).

6 Initiate actions, monitor and assure progress on Implementation Plan and coordinate this activity with the Rapporteurs/Coordinators on the Regional aspects of the GOS

7. Continue interactions with THORPEX

8. Follow up on CBS approved recommendations for the evolution to the GOS (with particular attention to the developing countries).

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ET-SAT SUGGESTED TERMS OF REFERENCE

Terms of Reference for ET-SAT (OPAG-IOS Expert Team on Satellite Systems)

The ET-SAT is established under the CBS OPAG-IOS

(a) To provide technical advice with respect to both operational and R&D environmental satellites to assist in the integration of WMO-coordinated observing systems;

(b) To advise CBS on matters requiring feedback to the WMO Consultative Meetings on High-Level Policy on Satellite Matters;

(c) To assess the observation, collection, and analysis systems relating to the use of operational and R&D environmental satellites contributing, or with the potential to contribute, to the space-based sub-system of the GOS, and to suggest improvements of system capabilities, particularly with respect to developing countries;

(d) To assist CBS in assessing the status of implementation of the space-based sub-system of the GOS and the adequacy of plans for implementation for meeting established requirements for satellite data and products;

(e) To make recommendations with respect to the transition of relevant R&D instruments to operational environmental satellites;

(f) To coordinate with other relevant Teams of CBS with a view to making recommendations on matters, such as the exchange, management, and archiving of satellite data and products, radio frequency utilization, as well as education an training and other appropriate capacity building measures related to satellite meteorology;

(g) To identify and assess opportunities and/or problem areas concerning satellite technology and plans of relevant satellite operators, and inform CBS timely and comprehensively;

Membership of the ET-SAT

ET-SAT should be comprised of representatives from space agencies and satellite operators participating in the WMO Consultative Meetings on High-Level Policy on Satellite Matters and contributing to, or with the potential to contribute, to the space-based component of the GOS. Participation in the work of ET-SAT would be at no cost to WMO.

TERMS OF REFERENCE OF THE RAPPORTEUR ON AMDAR ACTIVITIES

- Through liaison with CAeM and the AMDAR panel, review and report to the OPAG/IOS on the activities related to the integration of AMDAR into www operations,

- To study the required training activities relevant to the AMDAR data in areas where they are not currently available and develop proposals for training events including the cost estimates.

TERMS OF REFERENCE OF THE RAPPORTEUR ON GCOS MATTERS

Continue the preparation and maintenance of reviews of observing systems that are being designed under the auspices of GCOS (e.g., GUAN, GSN and space-based observing systems (GOSSP and CGMS)) and provide feedback to Members in maintaining the quality of the networks.

TERMS OF REFERENCE OF THE RAPPORTEUR ON REGULATORY MATERIAL

Review and update regulatory and guidance material on the GOS, as required, and make recommendations for amendments.

TERMS OF REFERENCE OF THE RAPPORTEURS ON SCIENTIFIC EVALUATION OF OSEs AND OSSEs

Prepare and maintain reviews of OSEs and OSSEs that are being undertaken by various NWP Centres around the globe and provide information for consideration by the OPAG/IOS.

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ACTIONS FOR RAPPORTEURS/COORDINATORS ON REGIONAL ASPECTS OF THE GOS

a) Regional Rapporteurs will inform the Members in their Region, in line with agreed regional protocols, of the key outcomes of this meeting (OPAG-IOS/ICT 2004), specifically to include:

- the potential of VL and Centres of Excellence (VL access through WMO Space Programme accessible through the WMO website http://www.wmo.int)

- AMDAR data access possibilities and training concepts, (password protected display systems are accessible through http://acweb.fsl.noaa.gov/java and http://www.eucos.net). Passwords can be made available to WMO Members on request.

- the development of a Draft Implementation Plan for the Evolution of the GOS and the impact on their Region, (http://www.wmo.ch/web/www/OSY/GOS.html - under development)

- activities within the OPAG IOS ETs and other Regions that are of interest to their Region

- the need to develop/improve the use of Focal Point structure. (http://www.wmo.ch/web/www/OSY/GOS.html - under development)

b) Regional Rapporteurs will prepare and submit for consideration / approval at the next meeting of their Regional Association:

- revised Terms of Reference

- revised entry for Manual on GOS, Volume II,

- updated RBSN and RBCN lists, (working in association with Members and the Secretariat).

c) Undertake activities referred to in the section of the Report of the ICT Meeting (2004) concerning “Coordination of Activities of Rapporteurs/Coordinators on Regional Aspects of the GOS”

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