WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

OPAG ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON EVOLUTION OF THE GLOBAL OBSERVING SYSTEM
Second Session

Geneva, Switzerland, 10-14 July 2006

FINAL REPORT

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 2nd meeting of the Expert Team on Evolution of the Global Observing System (ET-EGOS) was held in the WMO building in Geneva from 10 to 14 July 2006.

The ET considered reports from various activities related to its work including: THORPEX, International Polar Year, AMDAR Panel, EUCOS, Commission for Climatology and GCOS. The ET discussed these reports and revised its own work plan and actions list accordingly.

The ET reviewed the status of the WMO/CEOS database of user requirements for observations and of observing system capabilities. It approved a significant change to the structure of the database, namely the inclusion of a "breakthrough level" for all user requirements. It defined detailed actions for the review and updating of the database. The ET then reviewed the Statements of Guidance (SOGs) in 11 application areas. In each case, it either approved the proposed new version or agreed actions needed to prepare an updated version. For climate monitoring, the ET agreed that it was no longer necessary to develop a SOG through the CBS Rolling Review of Requirements process, as the necessary guidance was already available through the GCOS Adequacy Reports and Implementation Plan.

The ET reviewed progress on studies through which real and hypothetical changes to the GOS are assessed for their impact on NWP performance. Several conclusions from the report of the Alpbach workshop on NWP impact studies (2004) were confirmed by the recent results, and none was contradicted. The ET also reviewed and approved plans to organize the next such workshop in early 2008.

The ET reviewed the Implementation Plan for Evolution of surface- and space-based sub-systems of the Global Observing System (EGOS-IP) and prepared a revised draft of the Plan for consideration by IOS-ICT. This review took note of comments from other bodies, including ET-SAT and ET-AWS. The ET also considered reports on the evolution of the GOS in some WMO Regions. The ET perceived that there are currently problems in communicating the EGOS-IP and its action items to WMO Members. To address this, the ET prepared an outline of a "Supplementary Note" of expanded information on how specific items from the IP could be implemented in the Regions. The ET also conducted a check to ensure that, where the GCOS Implementation Plan calls for action by CBS, appropriate actions have been identified in EGOS-IP. The results of this check are recorded in the report.

The current EGOS-IP represents considerable progress and is already serving a useful purpose. However, it falls short of being a comprehensive document and complete planning tool, comparable with (for example) the GCOS Implementation Plan. This difference reflects largely the differences in resources devoted to the two activities. The ET suggested that the next phase of work should aim towards a more comprehensive IP and associated activity, noting the resource implications of such a decision.

The ET noted recent proposals towards enhanced integration between WMO observing systems. The ET stressed the need to ensure continued focus, during such integration, on the importance of the basic programmes for which CBS is currently responsible. The ET noted the creation of an EC Task Team on this topic. It provided some comments on the Terms of Reference of the Task Team and offered some advice on the role that the ET-EGOS might play in work towards integrated WMO observing systems.

The ET considered revisions of its work plan, with related actions, to cover the period 2007-8 and prepared input on this and other issues from the ET to the forthcoming meetings of ICT-IOS and CBS-Ext.(06).

1. ORGANIZATION OF THE SESSION

The Expert Team on Evolution of the Global Observing system was held in the WMO building in Geneva from 10 to 14 July 2006. The list of participants is given in Annex I.

1.1 Opening of the meeting

The meeting was opened at 10.00 a.m. on Monday 10 July 2006 by Dr Jack Hayes, Director of the World Weather Watch. On behalf of the Secretary General of WMO, Dr Hayes welcomed the participants to Geneva on the occasion of the second session of the CBS Expert Team on Evolution on the Global Observing System (ET-EGOS). He advised the session that the Global Observing System is absolutely crucial with regard to the societal needs for weather, water and climate information. Examples of how society is impacted can be seen through the devastation and loss of life during Hurricane Katrina and the Indian Ocean tsunami. Dr Hayes stressed that as rapidly changing science, technology and observational system enhancements form a critical foundation which can bring positive impacts, this Expert Team should keep abreast of new initiatives. Additionally, given the current budget challenges NMHSs face, it is important to ensure that the current and the evolving observing system are sustainable with lower budgets. An important role for the Expert Team is to use innovative concepts such as smart integration initiatives to fill in the gaps in the observing system. Dr Hayes stressed that the Team should be results oriented, with the aim of the group to provide input for CBS, for ultimate input to Congress in May 2007.

1.2 Chairman of the meeting

Dr John Eyre, Chairman of ET-EGOS, chaired the meeting. Dr Eyre thanked Dr Hayes for his opening remarks. He was confident that the session would work hard to fulfill its obligations.

1.3 Adoption of the agenda

The agenda was adopted by the meeting with no changes. The agenda is given in Annex II.

1.4 Working arrangements

The meeting agreed on its working hours and adopted a tentative work plan for consideration of the various agenda items.

2. REPORTS FROM ET-EGOS ACTING CHAIRMAN AND FROM DIRECTOR WWW

2.1 The Chairman recalled the Terms of Reference and the Work Plan of the ET, as defined by CBS, and summarised the status of the ET's activities in relation to the Work Plan. Dr Eyre then summarised activities since ET-EGOS-1 in December 2005:

- The sixth session of the CBS Management Group (MG) endorsed the proposal of the Chairman of OPAG/IOS that Dr John Eyre assume the responsibilities of the ET-EGOS Chairman following the resignation of the former Chairman, Dr Paul Menzel.
- Dr Eyre had participated in a joint GCOS/CEOS meeting representing ET-EGOS, 9-11 January 2006. This meeting started to develop, based on the GCOS Implementation Plan, a more detailed document setting out GCOS requirements for satellite-based products, for consideration by CEOS, resulting in a report:

"Systematic Observation Requirements for Satellite-based Products for Climate Draft 1.1 for Open Review (14 April 2006)", available from: http://www.wmo.ch/web/gcos/gcoshome.html

- In February, the new Director of the World Weather Watch, Dr Jack Hayes, took up his post. Dr Hayes received a letter from Dr Menzel outlining the activities of ET-EGOS and their relevance to the future of the World Weather Watch, and discussing some resource issues that would need to be addressed if the Implementation Plan for the Evolution of the GOS (EGOS-IP) is to achieve its objectives.
- The Chairman had received copies of the reports from meetings of two other WMO expert teams: the ET on Satellites (ET-SAT) and the ET on Automatic Weather Stations (ET-AWS). Extracts from these reports on issues of relevance to ET-EGOS were prepared as documents for consideration at ET-EGOS-2.
- He had alerted the Director of the WMO Space Programme to issues arising in EUMETSAT preparations for Meteosat Third Generation, specifically discussions concerning requirements for observations of lightning and whether these might be made most cost-effectively from space-based or ground-based systems. The relevant section of EGOS-IP, and related WMO guidance to CGMS on this issue, should be re-visited in the light of these new developments.
- He had alerted the Director of the WMO Space Programme to issues arising in EUMETSAT post-EPS activities concerning the vertical layering used in the WMO/CEOS database. (See also section 5.2 of this report.)

The Chairman suggested that the ET had a clear mandate and set of tasks given to it by CBS. The ET would need to pursue these actively and provide a report on achievements, first to the CBS/ICT meeting in September 2006 and then to CBS at its session in November 2006. Amongst these tasks, the following challenges were of particular importance:

- The ET should revise the IP-EGOS, so that it is factually up to date and contained the most current thinking on the way forward, in time for the next meeting of CBS. This timescale would restrict the IP to its current scope, style and format.
- The ET should consider whether this would be sufficient for the next phase of work on the Evolution of the GOS, and make recommendations to CBS accordingly. The current EGOS-IP represents considerable progress and is already serving a useful purpose. However, it falls short of being a comprehensive document and complete planning tool, comparable with (for example) the GCOS Implementation Plan. This difference reflects largely the differences in resources devoted to the two activities. The ET should consider recommending to CBS that the next phase of work should aim towards a more comprehensive IP and associated activity, drawing attention to the resource implications of such a decision.
- The ET-EGOS should take note of recent proposals towards enhanced integration between WMO observing systems and assess the implications of these moves for future ET-EGOS activities and related activities of other groups.
- The ET should give consideration to other aspects of its future work. It should propose key elements of a future Work Plan for consideration by CBS.

2.2 The Director of WWW presented a report to the group. He commented that, for evolution of the observation system, strategic initiatives are essential for long-term growth. He alerted the ET to a particularly challenging issue that had been discussed at EC-LVIII, namely an approved document entitled 'Towards enhanced integration between the WMO observing systems'. In this document the Executive Council noted that WMO observing systems for meteorology, climatology, hydrology and related fields such as agrometeorology, aeronautical and marine meteorology, oceanography and the atmospheric environment had similarities and common cross-cutting

elements. The Council felt that there was a potential for an increased level of interoperability between the various systems and the potential for more efficient use of resources. Dr Hayes emphasized that this was a very important issue, and one that this ET needs to become actively involved with as the concept develops. He advised the group that trust, teamwork and innovative ideas would be needed to achieve the targeted objective. He also emphasized that it was important to communicate clearly to observing system managers that the focus of observation system integration is primarily interoperability and that system "owners" would retain control of their particular components of an integrated observing system. Dr Hayes advised that an Executive Council Task Team on the Integration of the WMO Observation Systems has been established for the purpose of developing a comprehensive report of this subject to be presented to Council. The secretariat support to this Task Team would be led by Drs Hayes, Hinsman and Schiessl and a small panel of international experts to develop the report. The ET considered this issue further later in the meeting – see section 8.3 of this report.

3. REVIEW OF ACTIONS FROM PREVIOUS MEETING

The ET discussed in detail the 11 actions items carried over from ET-EGOS-1. Most actions had been completed, and the ET expressed satisfaction with this result. However several actions are still ongoing, and the meeting decided how to progress with these tasks, and included them in the list of actions from this session. Annex V provides detailed comments on each of the action items from ET-EGOS-1, including consideration of future activities required on the actions that are ongoing. Annex VI provides a full list of actions arising from ET-EGOS-2, organized under the headings of the ET's Terms of Reference and Work Plan. These are in addition to the extensive set of actions implied by the Implementation Plan for the Evolution of the GOS (Annex III).

4. REVIEW OF ACTIVITIES RELATED TO ET-EGOS

4.1 The OPAG/IOS Chairman, Dr Jim Purdom, had prepared a report for the guidance of the Expert Team. Based on the recommendations by CBS MG-6 (April 2006), he underlined a number of issues that should be addressed in ET-EGOS activities.

The activities of the OPAG-DPFS Rapporteur on the Impact of Changes to GOS on NWP had been merged into those of the OPAG-IOS Co-Rapporteurs on Scientific Evaluation of OSEs and OSSEs, who will also now report to OPAG-DPFS.

The ET noted the following tasks from the report of the President of CBS to EC-LVIII:

- to monitor and foster the progress on EGOS-IP in close cooperation with the regional associations and technical commissions concerned with particular attention to the developing countries;
- to interact more closely on observational issues with CAS and the EC Working Group on Antarctic Meteorology in accordance with planned THORPEX and IPY activities.

The ET considered the guidance from the OPAG/IOS Chairman and developed appropriate action items.

The meeting also noted comments of the OPAG-IOS Chairman related to the enhanced integration of the WMO Observing Systems and the establishment of an EC Task Team on the Integration of the WMO Observation Systems by the recent session EC-LVIII. In particular, the ET noted that the OPAG-IOS Chairman stressed the need to assure that the core of the WMO observing system is maintained as the highest priority. The strategic implications of this may be far

reaching and could lead to the WWW and the WMO Space Programme being merged into a WMO Integrated Observing System along with the smaller, less significant observing systems. The WWW and WMO Space Program are core to user needs, and subsuming them into something where “all are equal” or “treated as equal” would not be wise. The ET discussed and supported this view.

4.2 Recent activities within the THORPEX Programme were summarized, based mainly on input provided by Dr Purdom. The ET was informed of the establishment of a THORPEX Observing Systems Working Group, to be co-chaired by Dr Purdom. The potential importance of THORPEX to the Implementation Plan activities of the ET-EGOS was also stressed. In particular, it noted the areas of common interest between the activities of ET-EGOS and those of the THORPEX Working Groups on (1) Observing Systems (OS WG) and (2) Data Assimilation and Observation Strategies (DOAS WG). The ET discussed the THORPEX intent that “the roles of OS/DAOS WGs and ET-EGOS should be clarified concerning issues of common interest to avoid potential duplication”. The ET suggested that the primary responsibility of the THORPEX WGs should be for observing systems and strategies for the THORPEX experiment, whereas ET-EGOS had a remit covering operational systems. However, ET-EGOS welcomed advice from THORPEX concerning operational systems where relevant to the success of THORPEX or to potential future evolution of the GOS. The ET reviewed the Terms of Reference of the THORPEX OS-WG. The potential was noted for duplication on the organisation of OSEs and OSSEs between ET-EGOS and THORPEX OS/DAOS WGs. However, no significant problems were anticipated in practice because of the involvement of key personnel in both activities.

The ET also noted the preparations for the Second THORPEX International Science Symposium in Landshut, Germany, 4-8 December 2006.

4.3 The meeting was informed by Dr Eduard Sarukhanian, Special Adviser to the Secretary-General on IPY 2007-2008 on current status of the IPY preparation. It recognized substantial progress made during last two years by the international scientific community had resulted in preparation of more than 200 project proposals for IPY of which at least half would significantly improve the observational networks for atmosphere, ocean and cryosphere in polar regions. It noted the establishment of the Sub-Committee on Observations by the IPY Joint Committee as an important step to evaluate the observational requirements contained in IPY project proposals in order to identify gaps in project observing facilities to be filled by special observing systems or special data and products. In this context it was mentioned that adaptive AMDAR data could play an important role. The meeting noted another important task relevant to ET-EGOS activity is to identify which IPY projects are designed to contribute to the development of observing systems that would last beyond the IPY period.

Recognizing the important role that IPY will play in the improvement of the global observing systems in polar regions and in the development of advanced NWP, the meeting agreed that it would be highly desirable to ensure that an exchange of observational data during the IPY will be conducted as much as possible in near real-time. The ET agreed that OPAG-ISS should be informed on this requirement accordingly. The meeting also agreed that for future activities of the ET-EGOS it would be helpful to review the results of gap analysis envisaged by the IPY Subcommittee on Observations as well as to make analysis of legacy observing systems planned to be established during the IPY.

4.4 The ET noted that since its previous meeting Mr Michael Berechree had been appointed to the position of AMDAR Panel Technical Coordinator. The meeting was informed that AMDAR coverage has continued to expand in many areas resulting in over 200,000 observations per day being exchanged over the GTS. The well-developed operational AMDAR programmes, such as that of the US, Australia, South Africa and E-AMDAR, are continuing to provide observations over many data sparse areas. It was noted that the AMDAR Panel will continue to support the IPY

2007-2008 with the extension of operational AMDAR programmes over the Arctic and Antarctica regions.

The development and refining of the E-AMDAR data optimisation scheme continues to show positive benefits. It was also noted that the US and Australia are planning to develop appropriate optimisation systems and that the AMDAR Panel is intending to investigate a global approach to data optimisation at the next AMDAR Panel meeting. The AMDAR Panel Chairman, Mr Frank Grooters, noted the involvement of Airbus Industries who, in collaboration with the AMDAR Panel, are planning to study a solution for the adaptation and installation on Airbus aircraft of the ARINC 620 V4 software package and the WVSSII sensor. WVSSII evaluation trials will commence during 2006 in the US and Europe. It was also reported that, because of the current constraints imposed by the TAMDAR system provider, the free exchange of TAMDAR data on the GTS is a more complicated data issue.

A trial of FM94 BUFR to CREX encoding of AMDAR data is still in the early stages of development. Communication infrastructure in the developing countries is often unable to handle BUFR messages. The development of CREX will help overcome this problem. Australia and the Netherlands have offered to undertake this trial. The AMDAR Panel Chairman further noted that the AMDAR visual display system, a modified NOAA/ESRL/GSD developed AMDAR display tool, should be available to ASECNA countries later this year or early next year. ASECNA has agreed to set up a test site in Dakar to run the visual display system during a trial period. The AMDAR Panel has requested ET-EGOS to define the user requirements for AMDAR data, such as the optimum vertical and horizontal resolutions for NWP. (See Annex V Action 5b.)

4.5 Mr Stuart Goldstraw reported on recent EUCOS developments. He advised that the EUCOS programme continues to expand and will move into a new programme phase in 2007-11, subject to final EUMETNET Council approval in September 2006. The E-AMDAR Programme will continue to deliver twelve million observations a year in 2007 and 2008 but greater efforts will be placed on improving the distribution of data reports, especially in data sparse areas. The E-ASAP Programme will expand towards the intermediate goal of 5000 radiosonde ascents per year being made available from the North Atlantic on the GTS by HH+100. The E-SURFMAR Programme will continue to deploy additional drifting buoys and ship borne AWS and expects to reach the stated threshold user requirement for surface pressure reports in the North Atlantic and Mediterranean by the end of 2008. A high resolution radiosonde reporting sequence in BUFR has been developed and will be operationally introduced during the early part of the next programme phase. The EURORISK PREVIEW data targeting project will continue with the demonstration system being operated during 2008. The details of the remainder of the EUCOS Studies Programme for 2007-11 have not been finalised but are expected to include a follow up Space Terrestrial Study once MetOp is operational and high resolution radiosonde data are available.

4.6.1 Dr Raino Heino provided a summary of the WMO Commission for Climatology (CCl) activities related to the ET-EGOS. One of the goals of CCl is to stimulate, understand and coordinate international technical activity to obtain and apply climate information and knowledge in support of sustainable social-economic development and environmental protection.

CCl advises and guides the activities of the World Climate Programme (WCP) through the World Climate Data and Monitoring Programme (WCDMP) and the World Climate Applications and Services Programme (WCASP), and also provides support to many activities under the framework of the Climate Agenda. The ET was informed that at its fourteenth session (Beijing, 3-10 November 2005) CCl decided on its new structure comprising four Open Area Programme Groups (OPAGs) to carry out its priority activities as follows:

OPAG 1: Climate Data and Data Management
OPAG 2: Monitoring and Analysis of Climate Variability and Change

OPAG 3: Climate Information and Prediction Services (CLIPS)
OPAG 4: Climate Applications and Services

The terms of reference and the membership of each OPAG are available on the new CCl Web-page.

4.6.2 Dr Stephan Bojinski briefed the ET on the results of a GCOS analysis of data exchange problems in atmospheric and hydrological networks (GCOS-96, WMO/TD No. 1255), based on information from monitoring and archive centres dealing with climate-relevant data. The analysis was carried out in response to a request from the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) at its 18th session in June 2003, and was presented in its full form to SBSTA-22 in May 2005. It included components of WMO World Weather Watch, the GCOS baseline networks, and GAW. He reminded the group of a recommendation by the CBS Management Group (CBS MG-5, April 2005, paragraph 3.1.4), which invited the ET, as well as the CBS Rapporteur on GCOS Matters, to collaborate with GCOS in addressing the issues raised in this analysis.

The ET-EGOS agreed to follow this recommendation and to act in line with relevant actions of the GCOS Implementation Plan, which ask technical commissions to ensure timely and quality-controlled flow of Essential Climate Variable data to international data centres.

4.6.3 Dr David Goodrich, Director of the GCOS Secretariat, briefed the ET on developments toward establishment of a GCOS Reference Upper-Air Network. This is a proposed network of 30 to 40 high-quality upper-air stations that would serve as a reference network for both satellite and in-situ measurements (e.g. GUAN) and provide long-term, high-quality records of several of the upper-air essential climate variables (ECVs). It was also intended to measure a large suite of co-related climate variables to characterize the full properties of the atmospheric column at each station. Dr Goodrich advised the ET that the report of the Workshop on Reference Upper-Air Observations for the Global Climate Observing System, held in Seattle in May 2006, was now available for comment and requested the ET to bring any comments to his attention. The ET expressed concern that any upgrading of stations to the level of a reference station could take resources from the GUAN network, and as a result the number of GUAN stations might be reduced. Dr Goodrich acknowledged that this was an issue, but that it was being addressed and that in fact it was most likely that additional upper-air stations would be implemented as a result of this initiative.

5. USER REQUIREMENTS AND OBSERVING SYSTEM CAPABILITIES DATABASE

5.1 The session reviewed the status of the WMO/CEOS database on User Requirements and Observing Capabilities that included:

- the latest expected performances for observing capabilities in the Global Observing System, both surface and space-based components.
- observational data requirements for several application areas from WMO and WMO-supported programmes.

The session acknowledged that the database was a very useful reference for WMO Members as well as providing guidance for designing observing system upgrades. It was understood that requirements were stated in the database in a global sense, regardless of any geographical implementation; for some applications the required coverage may not be global and the threshold and goal values may need some tuning to local climate characteristics. The session recommended that “Climate” requirements from GCOS and WCRP all appear under “GCOS”, however listing in sequence those related to GCOS/AOPC, GCOS/OOPC, GCOS/TOPC and

WCRP. It was noted that the database addresses user requirements for observing many aspects of the atmosphere, ocean and Earth's surface, but not point-observations such as the airport observations required by ICAO.

5.2 The meeting reviewed the process for maintaining and updating the Database. It discussed the concept of "breakthrough", as introduced by EUMETSAT in its preparation process for future satellite missions. The "breakthrough" level is an intermediate value between "threshold" and "goal" which, if achieved, would result in a significant improvement for the targeted application. The breakthrough level is expected to be more appropriate than the "goal" from a cost-benefit point of view. ET-EGOS agreed to introduce this new concept in the database, which would entail a minor change of structure but would require new input from experts in all application areas. As a consequence, the Critical Review charts would be adapted with a new colour code as indicated below:

Threshold	Breakthrough	Goal
yellow	blue	red

The session stressed the importance of regularly updating the database and recommended that sufficient resources be made available among WMO Members to provide input and among the WMO Secretariat to implement and maintain the database. A procedure shall be established to describe this process on the basis of the draft procedure provided by the Secretariat. The procedure shall clarify the scope of the timestamp of each requirement (date of modification, or review, or endorsement by ET-EGOS).

Input shall be requested from all application areas in order to systematically review and update the "threshold" and "goal" values and to populate this new "breakthrough" field. It was agreed to update as a priority the list of points of contacts (Guardians) for each application, and invite them to review the list of geophysical parameters (e.g. skin/bulk SST).

The ET also discussed whether the vertical layering used for the 3D fields represented by the database was the most appropriate. Although there may be good scientific grounds for adopting alternative layering (e.g. free troposphere and PBL, in place of upper and lower troposphere), the ET agreed that the advantages in doing so for the RRR process as a whole would be small and therefore decided not to recommend such a change at this time.

6. ROLLING REVIEW OF REQUIREMENTS AND STATEMENTS OF GUIDANCE

6.1.1 The Chairman presented an overview of the current Statements of Guidance (SOGs) in 10 applications areas and the non-approved Climate Monitoring SOG. He reiterated the purpose of the SOGs, and advised how the SOGs emerge from the Rolling Review of Requirements (RRR) process following a four-stage process. He also stated the SOGs are one of the main inputs feeding into the development of the EGOS-IP. However he noted that there are still important issues identified in the SOGs that are not addressed in the EGOS-IP, and some application areas that are not well represented in the EGOS-IP. He requested that these need to be considered by the ET.

6.1.2 ET-EGOS was informed of the outcome of the first meeting of the Expert-Team on Satellite Systems (ET-SAT 1) on 5-9 December 2005 regarding the review of the RRR process and of the SOGs in particular.

The respective roles of ET-EGOS, ET-SUP and ET-SAT were recalled: while key tasks of ET-EGOS are to collate observation requirements and to supervise the development of SOGs, ET-

SAT addresses the response to these requirements by space-based systems, and ET-SUP addresses the utilization issues for these systems (user information and training, data access, products and applications).

ET-SAT had commented on the progress for each type of observation, as a result of recent development of satellite programmes and plans. In particular, attention was raised to the progress expected with GOES-R in the 2012 timeframe for determination of cloud characteristics, wind vectors, temperature and humidity profiles, lightning detection and sea surface temperature. ET-SAT had also recalled the capability of LEO satellites for WV polar wind derivation, and of scatterometers for soil moisture monitoring.

The session agreed that ET-SAT comments on the SOG should be forwarded to the respective points of contacts of each application area to be used as appropriate when updating the SOGs.

6.2.1 SOG for Global NWP

The SOG for Global NWP was reviewed by Dr Eyre, who proposed no change to the overall structure of the currently approved version (dated December 2003) but a few changes to the details, including:

- revised goals for the timeliness of most observations,
- the contribution of future geo sounders to the observation of wind,
- the expected relative performance of scatterometers and polarimetric microwave imagers for observations of ocean surface wind,
- the role of passive microwave imagers for observations of SST,
- planned soil moisture products from operational scatterometers,
- improved in situ observations over the ocean.

These updates were accepted by the meeting and Dr Eyre will produce a revised SOG document by November 2006.

6.2.2 SOG for Regional NWP

The SOGs for regional NWP were reviewed by Dr Jean Pailleux who proposed a few local modifications related to both upper-air and surface observing systems, without changing the overall structure of the document. These updates were accepted by the meeting and Dr Pailleux will produce the new SOG document before September 2006.

6.2.3 SOG for Synoptic Meteorology

Minor revisions to the Synoptic Meteorology SOG were made by Dr Herbert Puempel to bring it up-to-date. However, the ET was advised that as the last revision to this SOG was made in April 2001, it would be necessary to carry out a comprehensive revision of this SOG. It is necessary to identify the appropriate the Programme to accept ownership of this SOG, and in particular to find an expert to be responsible for keeping this SOG up to date. It was suggested that it may be the appropriate for PWS to accept ownership of this SOG.

6.2.4 SOG for Nowcasting and VSRF

Dr Puempel provided a suggested revision to the Nowcasting SOG. He advised that even though it had last been revised in April 2002, it would appear to only require minor revisions in a few areas. These include more accurate observation of short-term precipitation, better ability to provide lightning detection, both temporal and spatial, and improvements in the measurement of soil moisture. These revisions have been made in the new draft that was presented to the ET. Dr

Puempel also suggested that the responsibility for this SOG might be passed to the proposed ET on Nowcasting that is planned to be formed in the OPAG on Public Weather Services. The ET-EGOS will advise OPAG-PWS of this suggestion.

6.2.5 SOG for Seasonal and Inter-annual Forecasts

The meeting was informed that the Expert Team on Long-Range Forecasting (ET-LRF) held at ECMWF in April 2006 had reviewed and made suggested updates to the SIAF SOG. The ET expressed its gratitude to ET-LRF for this work. Several changes had been made, and these were endorsed by the ET. However the ET felt that the statement regarding in situ observations of the ocean needed to be modified; the coverage of SST data over large areas of the Earth is in fact better than stated.

6.2.6 SOG for Aeronautical Meteorology

Dr Puempel presented a revised version of the Aeronautical SOG. This revision has been prepared to reflect the observational needs of aeronautical meteorology to prepare forecasts and warnings for aviation. Point observations required for landing, take-off and ATC purposes of Runway Visual Range, QNH, significant weather and cloud ceiling height according to ICAO regulations are now subject to more stringent criteria, depending on the type of operation at individual airports. (Note: requirements for these point-observations are not included in the WMO/CEOS database.) In addition turbulence by incipient convection needs to be emphasized. In addition there is a requirement for better detection and prediction from space systems of gravity waves.

6.2.7 SOG for Climate Monitoring

Dr Hans Teunissen reviewed the history of the SOGs for Monitoring Climate Variability and Monitoring Climate Change. These had been developed under leadership of the GCOS Atmospheric Observation Panel for Climate (AOPC) with input from various sectors of the climate community (e.g. WCRP, WCP and CCl). They were presented to ET-ODRRGOS-6 in late 2003 and had been modified at the tenth session of AOPC (April 2004) in response to suggestions from the ET. ET-ODRRGOS-7 (July 2004) noted these updates and agreed that 'ownership' of these SOGs within WMO should be transferred to CCl. In the meantime, GCOS had led completion of the 'Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC' (GCOS-92, October 2004, the 'GIP') following a request from the Conference of the Parties (COP) to the UN Framework Convention on Climate Change in late 2003. The GIP had been developed to address the findings of the 'Second Report on the Adequacy of the Global Observing System for Climate in Support of the UNFCCC (GCOS-82, April 2003), through extensive consultation with the climate community and a formal open review process. The GIP had been endorsed by COP-10 in December 2004 and by WMO Executive Council in June 2005 and had been accepted by the international Group on Earth Observations as the climate component of the GEOSS ten-year implementation plan. It contained 131 implementing actions for the global climate observing system of which more than ninety involved WMO technical commissions and/or programmes as 'agents for implementation'. The relevant commissions, including CBS, had strongly supported the GIP and agreed to participate fully in implementing the relevant actions. In particular, CBS-XIII (February 2005) had requested the OPAG-IOS to provide advice on how CBS could best respond to the relevant actions, and to work with GCOS to identify the relationship between the GIP and the EGOS-IP.

In view of these developments, the ET agreed that it was not necessary to develop a SOG for Climate Monitoring (covering Climate Change and Climate Variability) via the CBS RRR process, as this guidance was already available through the GCOS Adequacy Reports and Implementation Plan. The ET invited CCl to identify any other climate application areas not

adequately covered by the GCOS work, to develop observational user requirements for them and then to develop appropriate SOGs and to present them to ET-EGOS for consideration. The ET was informed that CCl has prepared guidance material in the following areas:

- Climate Observation Networks and Systems
- Metadata and Homogeneity
- Data Rescue

6.2.8 SOG for Ocean Applications

The JCOMM representative, Mr Etienne Charpentier, presented a status of the JCOMM SOG. JCOMM-II requested that this work be pursued with ET-EGOS, through one or more experts designated by the co-Presidents, and that the existing SOG relating to marine user requirements be updated, published as a JCOMM technical report and widely distributed. The Commission also requested the Services Programme Area Coordinator to ensure that eventually a clear set of observational data requirements to support marine meteorological and operational oceanographic products and services be finalized and included in the CEOS/WMO database. Dr Eric Lindstrom, NASA, had recently been designated by JCOMM Co-Presidents as its satellite expert within its Observations Programme Area. He has reviewed the SOG that was presented to ET-EGOS at this meeting.

There are four major application areas relevant to JCOMM: (a) Numerical Weather Prediction, NWP, (b) Ocean Mesoscale Forecast, OMF, (c) Seasonal to Inter-annual Forecast, SIA, and (d) Coastal Marine Services. NWP uses the marine meteorological parameters to initialise the numerical models, and the SST distribution becomes one of the most important boundary condition. OMF and SIA predict future ocean status using numerical models, but the former target is higher frequency components (a week to a month) of ocean variability and the latter the lower frequency components (seasonal and inter-annual).

NWP and SIA application areas are described in other SOGs. Also, the ocean community has produced a widely-agreed and endorsed plan for the next five to ten years incorporated in the Implementation Plan for the Global Observing System for Climate in Support of UNFCCC (GCOS-92).

Ocean Mesoscale Forecast is now designed and implemented by a GOOS/GCOS OOPC pilot project, Global Ocean Data Assimilation Experiment (GODAE). Integrating existing and near future ocean observation systems, near-operational ocean mesoscale forecast is or will be conducted in the GODAE project. The demonstration phase of GODAE started in 2003.

Coastal Marine Services include the traditional tasks of the JCOMM community. However, the social needs have increased and become diversified, which forces JCOMM community to redesign the observing systems including backbone global systems (e.g., GOOS/Coastal Ocean Observing Panel).

After discussion, the following approach was suggested for updating the JCOMM SOG:

(i) Request JCOMM to nominate a PoC on user requirements of ocean applications, and a PoC on observing system cababilities for ocean in-situ systems;
(ii) Update the CEOS/WMO database to reflect (a) recent changes in user requirement (e.g. Tsunami monitoring), and (b) dramatic progress in recent years regarding instrument performances of in situ components, and in particular with regard to horizontal distribution of observing networks (e.g. drifting buoys, moored buoys, Argo floats);

(iii) Conduct Rolling Review of Requirements (RRR) process and make use of the critical review charts while taking existing JCOMM metrics into account;
(iv) Consider the JCOMM/OCG phased-in implementation plan;
(v) Provide a gap analysis, including the requirement for long term sustainability of the observational networks;
(vi) Provide an updated version of JCOMM SOG by mid-2007.

The ET-EGOS thanked JCOMM for its recent efforts in updating the SOG and for engaging in a renewed process for further improving it.

6.2.9 SOG for Agrometeorology

Dr Mannava Sivakumar advised that the current Agrometeorology SOG, last updated in July 2004, is still relevant and does not require any revision.

However Dr Sivakumar did make some observations on observational requirements for agrometeorology. He stated that agrometeorology is one of the fields of hydro-meteorology for which satellite data is extremely important. He also mentioned some other data types, which are crucial to agrometeorology, including snow melt, solar radiation and precipitation. However he advised that crucial parameters are soil moisture and soil temperature, preferably at very high resolution.

6.2.10 SOG for Hydrology and Water Resources

Mr G. Arduino presented a revised version of the Hydrology and water resources SOG. He advised that 11 hydrometerological variables with high observational priority have been identified, firstly at GCOS, 1997, and more recently at other meetings. These 11 variables are still identified in the current version as the variables with the highest observational priority.

He also advised that satellite data, such as from Landsat, AVHRR, and MODIS, is the only means for providing high resolution data in regions with inadequate or lacking in-situ observations. In addition it was stated that for this SOG it is a requirement that precipitation amount and type be routinely observed on an hourly to daily basis at synoptic weather stations. However there are large regional differences in coverage, both spatial and temporal. The coverage of rainfall observations is improving using ground radar techniques. Global scale observations from satellite borne radars as well as microwave imagers and sounders are routinely available, but quantitative precipitation observations from satellite measurements at present do not meet accuracy requirements. A number of additional satellite-derived variables are, or will be, extremely useful to hydrology, including but not limited to: precipitation rates and totals, latent and sensible heat, surface air temperature and humidity, and surface winds.

6.2.11 SOG for Atmospheric Chemistry

Dr Len Barrie, Chief of Environment Division of AREP, advised that the current SOG for Atmospheric Chemistry was last updated in July 2004. It is based on the IGACO Atmospheric Chemistry Theme Report/Strategy of IGOS that is being implemented under the leadership of WMO-GAW programme (WMO TD No. 1235, GAW Report #159), is still relevant and does not require any revision. The GAW Strategic Implementation Plan 2001-2007 (WMO TD No.1077 and WMO TD No. 1209, GAW Report #142 and 156) is being updated for 2008-2015 by the CAS OPAG for Environmental Pollution and Atmospheric Chemistry. Future revisions of the SOG for Atmospheric Chemistry will continue to be part of the responsibility of the GAW programme of AREP advised by CAS. It should be emphasized that GAW global network coordination focuses on 6 target groups of variables: ozone, ultraviolet radiation, greenhouse gases, aerosols, selected reactive gases and precipitation chemistry. In addition, EC LVIII (Parag. 3.3.1.6) recommended

the establishment of a Scientific Advisory Group for Radiation of the OPAC-EPAC under the Commission for Atmospheric Sciences (CAS) and, hence the GAW programme, to address the lack of oversight of WMO global radiation observations. This requires close cooperation with the WWW programme and the ET-EGOS.

7. OBSERVING SYSTEM STUDIES

7.1 Dr Pailleux presented a status report on OSEs and OSSEs. It highlighted some results, which have been obtained in the Numerical Weather Prediction (NWP) community since the last workshop (Alpbach, March 2004) where a comprehensive review of impact studies was performed. Several conclusions of the Alpbach workshop were confirmed by the recent results, and none was contradicted. Among those, the importance of microwave sounders on polar orbiting satellites and of the AMDAR system for the GOS was again stressed. The studies on the targeting techniques and the impact of targeted observations should not be given up: they currently produce mixed results. It was also noted that a new OSSE initiative has been launched, mainly by the USA, and the meeting expressed support for this initiative.

Some specific results, not available in Alpbach (2004), showed the importance for the future GOS of GPS radio-occultation systems, of GPS ground-based networks, and of wind observations over the polar caps provided by satellite imagers such as MODIS. For the future, the meeting recommended to use as much as possible campaigns, such as the THORPEX campaign, to test the impact of new technologies and new observations (including those deployed in a targeted mode). The idea was also to get as much as possible some “operational legacy” from the campaigns in terms of observing systems.

7.2. The meeting agreed to organise a workshop on impact studies (OSEs, OSSEs) during the first quarter of 2008, and also agreed to keep the workshop format similar to the first three workshops (Geneva 1997, Toulouse 2000 and Alpbach 2004). As the THORPEX programme is also deeply involved in the observation impact studies, close contacts will be maintained with the relevant working groups of THORPEX for organising this workshop. An organising committee has been created with Dr Pailleux and Dr Ko Koizumi (rapporteurs on OSEs), Dr Eyre and Dr Karpov. The following steps will be taken by Dr Pailleux:

- finalise the constitution of the organising committee (e.g. by involving a THORPEX representative);
- choose the exact dates and the venue; the first to be investigated is the WMO headquarters in Geneva.

7.3 Dr Horst Bőttger presented preliminary results from global observing system impact studies carried out at ECMWF (Dr Jean-Noel Thépaut and Mr Graeme Kelly) under contract with EUMETNET/EUCOS and EUMETSAT to assess the relative impact of terrestrial and space components of the Global Observing System (GOS) of the WMO. Experiments were run for two months each in winter and summer. The evaluation of the results is ongoing; final reports are expected to become available in early 2007.

Looking at the results from the winter experiments only, a significant positive impact on the performance of the global forecasting system over the northern hemisphere can be demonstrated for the full terrestrial observing system even in the presence of the complete space component of the GOS. Degrading the current terrestrial observing system has a negative impact on the overall forecast skill. The relative impact of the various subsystems and a more detailed analysis of the results for geographical regions will need to be confirmed in the light of the combined winter and summer results.

8. IMPLEMENTATION PLAN FOR EVOLUTION OF SPACE AND SURFACE-BASED COMPONENTS OF THE GOS

8.1.1 The session reviewed the proposed updates to the space-based component of the Implementation Plan for the Evolution of the GOS (EGOS-IP). Updates were mainly based on the following inputs:

- Review of the IP by ET-SAT-1 in December 2005, who updated in particular the information on the progress on implementation and proposed two new recommendations (S 21 and S 22) dealing with lightning detection and formation flying respectively.
- Specific suggestions made by the Chairman of ET-EGOS.
- Input from WMO Secretariat reflecting developments occurred in the last six months on satellite status and plans as well as actions taken by the WMO Space Programme in respect of calibration (GSICS), LEO sounding data access (RARS), demonstration flight of new sensors (IGEOLab) and overall coordination of the satellite configuration (CGMS-WMO Optimization Workshop).

Attention was paid to the consistency between the EGOS-IP and the GCOS Implementation Plan (GIP), and cross-references to GIP actions were included into the EGOS-IP when relevant. GCOS requirements for continuity of observations did not relate to the evolution of the GOS but should be recalled in the preamble of the EGOS-IP. Other GCOS actions called upon observation of ocean colour, sea ice, cryosphere and land cover that were not addressed in the EGOS-IP so far and the session agreed that this needed further consideration in view of potential inclusion in a further update of the EGOS-IP. A correspondence table between GIP Actions and EGOS-IP recommendations is included as Annex VIII of this report.

With reference to Recommendation S7 about LEO ocean surface wind and the corresponding action, and noting a recent ESA-funded study performed by the Met Office (UK), WMO Space Programme was asked to provide an analysis of current plans for scatterometer and polarimetric microwave imagery missions, and actions were placed to seek guidance from expert users on the impact on NWP applications and on ocean applications.

8.1.2 The session also reviewed the proposed updates to the surface-based part of EGOS-IP and suggested additional amendments.

The review of the consistency between the GCOS IP and the surface-based part of EGOS-IP highlighted a number of areas where new IP actions would be required. These were: the addition of an action to ensure the more comprehensive introduction of GCMPs to all Surface Climate Networks; the specific requirement to add water vapour to the list of variables to be exchanged; the introduction of a specific action to address the requirement for a GRAUN (GCOS Reference Upper Air Network) to be established; and the need to strengthen the snow reporting capabilities of the GOS. A correspondence table between GIP Actions and EGOS-IP recommendations is also included as Annex VIII of this report.

8.2.1 Mr Mahaman Saloum presented a summary of the GOS implementation in RA-I. He reported that the latest AGM showed a 9% decrease in the availability of both surface and upper-air observations coming out from the Region despite the reactivation of certain silent stations. The meeting noted the following activities with prospects for improvement of the GOS in Africa and related to the EGOS-IP:

- the activities associated with the implementation of the GCOS Technical Support Projects carried within the Region especially in Southern Africa (revitalization of GUAN stations) in west and central Africa with the supply of hydrogen generators.

- the planning of targeted AMDAR programme in ASECNA countries, with training activities in Morocco, Egypt and Kenya;
- the development and maintenance of a coordinated network of radiosonde, VHF/UHF, pilot balloon and GPS (total columnar water vapour) stations in association with other international research and development programs such as US ARM program, SCOUT balloon program, French AMMA/EGEE, German AMMA and SOLAS programs making use of varieties of specialized observing systems (radiosonde, dropsondes etc); US ARM, AMMA-EU, AMMA-France, AMMA-UK are the major contributing parties to the AMMA radio-sounding programme; countries are expected to ensure the sustainability of the production of high-quality data in central and west Africa at the end of the AMMA campaign.
- the submission to the upcoming meeting of the Regional Working Group on Planning and Implementation of WWW, the appropriate action and recommendations regarding data coverage, timely distribution, coding, baseline systems, the optimization of RAOB distribution and launches, improvement of observations over the continent and the use of new technologies (AWS)

8.2.2 Mr Gaston Torres advised the meeting of the current status and the evolution of the GOS in RA III. While some deficiencies in the implementation of the WWW in the region still persist, significant efforts have been made to automate the surface observing network.

Most of the problems faced by the GOS in RA III are due to the lack of adequate maintenance, the high costs of consumables and local budget restrictions. As a result of telecommunication shortcomings in some areas a significant amount of data collected are not injected into the GTS.

In spite of these problems, the RA III RBSN and RBCN implementation remained stable. The results of the monitor of the operation of the WWW in 2002-2005 from the annual global monitoring show the availability of SYNOP reports from the Regional Basic Synoptic Network (RBSN) stations decreased from 64 per cent to 58 per cent, while the availability of TEMP reports increased from 38 per cent to 47 per cent. The availability of CLIMAT and CLIMAT TEMP reports from Regional Basic Climatological Network (RBCN) stations oscillated around 71 and 62 per cent respectively.

Efforts have been to increase the number of AMDAR observations in the Region, especially in Chile and Brazil, however still without positive results. On the other hand most of the members are working in improving the data sources including Metadata and geoposition for meteorological stations with GPS system.

In general the activities that have been implemented in the Region III for the improvement of the GOS have been developed in those countries with major capacities and that have obtained support from their local governments.

8.2.3 Mr Russell Stringer advised that the fourteenth session of RA-V, which was held recently in May 2006, decided to continue its Working Group on Planning and Implementation of the World Weather Watch. The WG-PIW has responsibility for a broad range of tasks amongst which sits the integrated observing system (IOS), a task described as follows:

“Develop a regional action plan for the evolution of the GOS which addresses Member needs and priorities, and which is integrated into the WMO plan for integrated observations. Ensure the plan addresses:

a) Enhanced access to and utilization of a broader range of satellite data, through both direct reception and Advanced Dissemination Mechanisms such as SATAID and provision of appropriate training. (HIGH PRIORITY)

b) Investigation of low cost lightning detection systems as a complementary observing tool, with particular benefit for countries without weather watch radar. (HIGH PRIORITY)

c) Establishment of an affordable AMDAR programme for the Region to extend the coverage of aircraft reports over the region."

Attention was drawn to the word "affordable" that had been inserted in relation to establishment of an AMDAR program for the Region. It was further noted that the WG-PIW was given a membership that includes:

- A Co-rapporteur on Regional Aspects of the Integrated Observing Systems (IOS), with terms of reference that include:
  - (i) To coordinate the regional input to plans for the evolution of the GOS;
  - (ii) To represent the Region on the CBS Implementation/Coordination Team on Integrated Observing Systems, and coordinate the implementation of agreed plans with the Chairman and other members of the OPAG on IOS.
- Rapporteur on Regional Aspects of AMDAR; and
- A Rapporteur on Regional Aspects of GEOSS.

Mr Stringer summarised by noting the specific RA-V attention to access to and utilisation of satellite data, the establishment of an affordable AMDAR program for the Region and investigation of low cost lightning detection systems. He noted the intention to develop a regional action plan which is integrated into the broader WMO plan for evolution of the GOS, and noted the relevant Rapporteurs with whom it would be useful to maintain informal contact and discussion on relevant matters.

Mr Stringer also encouraged some discussion and clarification on the process for pursuing the implementation of the Implementation Plan, asking whether the primary task for this group is more related to the ongoing monitoring of requirements, capabilities and hence the optimum design and configuration for the GOS, and further asking whether the ICT-IOS has the primary role in relation to working with the Regional Associations towards implementation of the relevant parts of the Implementation Plan.

The meeting noted that Co-rapporteurs on Regional Aspects of the Integrated Observing Systems (IOS) from all regions would attend the next meeting of the CBS-OPAG-IOS Implementation/Coordination Team, and that it would be useful to suggest that these attendees to prepare a point-by-point report or response in relation to the Implementation Plan-EGOS.

8.2.4 A report on GOS implementation in RA IV had been prepared by Mr W. Stolz. There were still some problems in the implementation of the WWW in the Region. These were mostly attributable to problems with consumables, particularly with radiosondes and to issues with the maintenance of hydrogen generators.

The ET was advised that many Caribbean countries have been equipped with AWS stations through the SIDS-Caribbean Project, but that most of the data generated from these systems is not available on the GTS. Additionally AWS data from several Central American countries that is transmitted to Wallops Island does not appear to enter onto the GTS. The ET was informed that a suggestion was made at RA-IV in Costa Rica in 2005 for an expert to visit countries that are having problems, particularly countries with silent stations.

8.2.5 Whilst reviewing the input from the regional representatives, the ET perceived that there are currently problems in communicating the EGOS-IP action items to WMO Members. To address this situation the ET prepared a draft "Supplementary Note" of expanded information on how specific items from the IP could be implemented in the Regions. (See Annex IV).

8.3 The ET noted that the fifty-eighth session of the WMO Executive Council (June 2006) had established an Executive Council Task Team on the Integration of the WMO Observation Systems for the purpose of developing a comprehensive report on the integration of the WMO Observation Systems, which should help facilitate the decision making at the fifteenth WMO Congress (Cg-XV) in May 2007. (See also sections 2.2 and 4.1 of this report.) The Expert Team also noted that the fourteenth WMO Congress (Cg-XIV) (May 2003) had already assigned as an overall objective of the WMO Space Programme to review the space-based components of the various observation systems throughout WMO and WMO-supported Programmes with a view towards the development of an integrated space component of a WMO global observation system that would encompass the space components of all present observation systems. Since the work of the new EC Task Team included the surface and space-based components of a WMO global observation system, its membership included representatives from each Technical Commission, representatives from WMO co-sponsored Programmes, invited experts from Satellite Operators and was chaired by two members of the WMO Executive Council.

The ET stressed the need to ensure continued focus on the importance of these basic programmes, particularly when resources are hard to come by and at a time when their attention is on this issue.

In a discussion on interoperability of WMO observing systems, the meeting discussed the Terms of Reference of the Task Team on Integration of WMO Observation Systems, and commented that there were no references in the TORs to the observational requirements. The ET noted that there was a need to take into account the previously stated and collated observing system requirements that are essential in the integration process and that there is a large body of user requirement information now available for this purpose. Mr Saloum suggested that integration of the observing systems should take into account the full involvement of the regions in the realization of the EGOS-IP with particular attention through the participation of developing countries in the major OSEs and projects/experiments (THORPEX, GEOSS, AMMA, etc.) in close cooperation with WMO Technical Commissions, and through various support from sub-regional observing programmes in developed countries.

The ET also considered the request from the OPAG/IOS Chairman for advice on the role that the ET might play in work towards integrated WMO observing systems. The ET recalled that the user requirements and SOGs developed under the supervision of the ET represented a wide range of application areas, and that the EGOS-IP has a similar range. Thus the ET has a well-established practice of thinking across a broad range of observing system issues in an integrated way. This experience should prove a useful resource for the new initiative. The ET suggested that any high-level initiative on integration will need to be supported by detailed work on user requirements, observing system capabilities, etc., which ET-EGOS is well placed to perform; the ET could best serve the new initiative by continuing to play such a role. The ET also noted that the most demanding challenges of integration are likely to be in the fields of data distribution and data management, rather than in the observing systems themselves.

8.4 Mr Rainer Dombrowsky, the ET-AWS Chairman, made a presentation, advising the ET of some items it may wish to incorporate into the IP to reflect more clearly some AWS concerns and issues. He suggested that timelines and deadlines be added to the IP. Also he requested that some mention of traceability be included. In addition he suggested the inclusion in the IP of the requirement for a low-powered, low-cost communications network. He also advised that ET-AWS

felt that the introduction to the IP could contain more information on the processes that led to the IP, and that the introduction should also included some details on timelines. The ET thanked ET-AWS for its comments and advised that the section in the IP dealing with AWS, namely section G21, had been framed at a highly abstract level and could usefully be expanded into several new detailed recommendations drawing on feedback from ET-AWS. The ET agreed to request from ET-AWS more specific guidance on how present/planned developments concerning AWS might be better reflected in the EGOS-IP.

8.5 Based on the proposed updates to EGOS-IP presented and discussed under 8.1 above, and also the additional considerations arising from 8.2-8.4, the ET prepared updated versions of the sections of the IP covering the surface-based and space-based components of the GOS (Annex III, sections 2 and 3). It was agreed that the introduction of the IP, covering the background to the IP and its scope, required some updating (and a draft was provided by the Chairman subsequent to the meeting – Annex III, section 1). It was also agreed to retain the section of the IP on considerations for evolution of the GOS in developing countries, with some minor revision (Annex III, section 4). Section 5, containing a "Vision for the GOS in 2015", has been retained unchanged. It was agreed to remove other sections of the previously published version of the IP, as they were not considered to be helpful in communicating the IP to its main intended audience. Annex III therefore contains a complete revised draft of the EGOS-IP as proposed by ET-EGOS.

The ET agreed that it was important to implement version control for the EGOS–IP. It was decided to approach the WMO Publications Unit to obtain information on how the required version control could best be achieved. It was also decided that only the officially approved version of the IP be published on the web.

9. PREPARATION FOR THE UPCOMING ICT/IOS AND INPUT MATERIAL TO CBS-Ext.(06)

9.1 The ET reviewed a proposed layout of the ET-EGOS report to be presented to ICT-IOS (see Annex VII). It was agreed that the OPAG/IOS Chairman should be invited to comment on the content, as he may have some specific requirements from ET-EGOS that he might wish to present at ICT-IOS. The ET also agreed that a major input to ICT-IOS would be the revised/updated version of EGOS-IP. When reviewing its Work Plan in conjunction with its Terms of Reference, the ET agreed to recommend keeping its Terms of Reference in force. It therefore requested ET-EGOS Chairman to submit this proposal to ICT-IOS and CBS-Ext.(06) for endorsement.

10. OTHER BUSINESS

The ET felt that it would be necessary to hold two more meeting of this ET between Congress next year and the subsequent CBS session. Concerning a date and venue for the next ET-EGOS session, it was decided that there are many advantages of being able to contact relevant WMO Secretariat staff, particularly Directors, during the ET session. Thus the ET suggests that its next session be held in Geneva, probably during the summer of 2007.

11. CLOSURE OF THE SESSION

The session concluded at 1.00 p.m. on Friday 14 July 2006.

ANNEX I

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ANNEX II

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 of the Director of WWW

3. REVIEW OF ACTIONS

4. REVIEW OF ACTIVITIES RELATED TO ET- EGOS

4.1 Guidance from the Chair of OPAG/IOS
4.2 Recent developments in THORPEX
4.3 Observational programme of IPY activities
4.4 Recent developments with AMDAR
4.5 Recent developments in EUCOS
4.6 Recent developments with CCl and GCOS

5. USER REQUIREMENTS AND OBSERVING SYSTEM CAPABILITIES

5.1 Report on status of User Requirements and Observing System Capabilities database
5.2 Review of strategy to update User Requirements database

6. ROLLING REVIEW OF REQUIREMENTS AND STATEMENTS OF GUIDANCE

6.1 Overview of Statements of Guidance
6.2 Status of individual Statements of Guidance and development of update plans

7. OBSERVING SYSTEM STUDIES

7.1 Summary of recent OSEs/OSSEs activity
7.2 Planning for next CBS OSE/OSSE Workshop

8. IMPLEMENTATION PLAN FOR EVOLUTION OF THE GOS (IP-EGOS)

8.1 Review of progress and actions on Evolution of the Space-based and Surface Based Sub-System of the GOS Evolution

8.2 Summary of progress and actions in WMO Regions on the Evolution of the GOS
8.3 EC-LVIII activities relevant to the Implementation Plan
8.4 ET-AWS comments on the Implementation Plan
8.5 Update of the Implementation Plan and Next Actions

9. PREPARATION FOR THE UPCOMING ICT/IOS AND INPUT MATERIAL TO CBS-Ext.(06)

10. ANY OTHER BUSINESS

11. CLOSURE OF THE SESSION

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ANNEX III

WORLD METEOROLOGICAL ORGANIZATION

WORLD WEATHER WATCH

IMPLEMENTATION PLAN FOR EVOLUTION OF SPACE AND SURFACE-BASED SUB-SYSTEMS OF THE GOS

Developed by the CBS Open Programme Area Group on the Integrated Observing Systems (OPAG-IOS)

Revision of WMO TD N° 1267

Version 1.3, 10 August 2006

Document Change Record

Version	Date	Reviewed by	Nature of changes
Draft	July 2004	ET-ODRRGOS	First redaction
Revised draft	Sept. 2004	ICT	Minor revision
Version 1	Feb. 2005	CBS XIII	CBS endorsement and approval for publication as WMO TD N° 1267.
Version 1.1	July 2006	ET-SUP1, ET-SAT1, ET-EGOS1, CM-6	Consolidation of changes to Section 3.1 (space-based GOS): Updated comments and progress, Addition of 2 Concerns Addition of 2 Recommendations S21 and S22
Version 1.2	30 July 2006		Edits by J.Eyre in the course of preparing the final version of the report of ET-EGOS-2
Version 1.3	10 August 2006		Edits by J.Eyre, based on comments by J.Lafeuille, to move “Vision” to Annex B and changes to Annex A.

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IMPLEMENTATION PLAN FOR THE EVOLUTION OF THE SURFACE- AND SPACE-BASED SUB-SYSTEMS OF THE GOS

1. Introduction

1.1 This Implementation Plan has been prepared by the WMO/CBS/OPAG-IOS Expert Team on the Evolution of the Global Observing System (ET-EGOS, formerly the Expert Team on Observational Data Requirements and Redesign of the Global Observing System, ET-ODRRGOS).

1.2 The Plan is prepared and updated in the following way:

1.2.1 Using the CBS Rolling Review of Requirements (RRR) process, user requirements for observations are compared with the capabilities of present and planned observing systems to provide them. Both user requirements and observing system capabilities are collated in a comprehensive, systematic and quantitative way in the WMO/CEOS database, which attempts to capture observational requirements to meet the needs of all WMO programmes. The comparison of user requirements with observing system capabilities for a given "application area" is called a "Critical Review". The output of the Critical Review process is reviewed by experts in the relevant application and used to prepare a Statement of Guidance (SOG), the main aim of which is to draw attention to the most important gaps between user requirements and observing system capabilities, in the context of the application. This has been done systematically for (currently) 11 "application areas": global NWP, regional NWP, synoptic meteorology, nowcasting and very short range forecasting, seasonal and inter-annual forecasting, aeronautical meteorology, climate monitoring, ocean applications, agrometeorology, hyrodology and water resources, and atmospheric chemistry. Thus a wide range of applications within WMO programmes have already been addressed. The latest versions of SOGs are available through the WMO web site.

1.2.2 The "gap-analysis" provided by these SOGs is then reviewed by ET-EGOS. The key issues emerging from them are used to formulate recommendations for action and, following endorsement by CBS, these recommendations form the basis of an Implementation Plan (IP), through which progress to meet the recommendation is recorded and appropriate actions are proposed. The IP is a living document and is reviewed regularly to take account of progress in implementation, and of changes in user requirements and observing system networks and technologies.

1.2.3 In drafting the IP, ET-EGOS has been guided by the vision for the GOS in 2015, as adopted by CBS (CBS Extr., Cairns, 1-12 December 2002). This vision is recalled in Annex B.

1.3 The IP is also informed from a number of other sources:

1.3.1 ET-EGOS works closely with the CBS Rapporteurs on Global and Regional Observing System Experiments (OSEs) to take note of conclusions emerging from impact studies, through which real and hypothetical changes to the GOS are assessed for their impact on NWP performance. In particular ET-EGOS takes note of the conclusions of the WMO-sponsored Workshops on "the Impact of Various Observing Systems on NWP". The conclusions of the workshops in Toulouse (2000) and Alpbach (2004) are recorded in WMO/TDs 1034 and 1228 respectively. In addition, ET-EGOS commissions impact studies to answer specific questions when necessary.

1.3.2 ET-EGOS takes note of developments in observing system technology. Candidate observing systems (space-based and surface-based) for the coming decade were studied and reported in WMO/TD 1040.

1.3.3 The IP is informed by advice from a number of other bodies including: other CBS Expert Teams, the World Weather Watch Programme, the WMO Space Programme, JCOMM, the WMO AMDAR Panel, GCOS and representatives of the WMO Regions.

1.3.4 The scope and assumptions of the IP are as follows:

- It addresses both surface-based and space-based sub-systems of the GOS.
- It responds to observational requirements of all WMO programmes to which the GOS might reasonably be expected to contribute.
- It responds to a vision of the GOS in 2015 and beyond as set out in section 5.
- It envisages that the future GOS will build upon existing sub-systems, both surface- and space-based, and will 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).
- It responds to those elements of the GCOS Implementation Plan which call for action by WMO Members (through CBS) or by the WMO Space Programme. (A cross-check between the GCOS Implementation Plan and this IP has been performed.)
- It takes note of the GAW Strategic Implementation Plan but does not attempt to duplicate its actions.
- It does not explicitly express the need for aspects of continuity of current observing systems – it is concerned primarily with evolution rather than continuity. However it is recognized that aspects of continuity of observing systems are of key importance for many applications, including operational weather forecasting and climate monitoring.
- It recognises the special challenges and issues concerning developing countries (see section 4).

1.5 In preparing this IP it has become clear the scope of changes required to the GOS in the next decade are massive and will need new approaches for science, data handling, product development, training and utilization.

1.6 The IP currently contains a set of 44 recommendations, each with corresponding comments on progress and accompanying actions. There are 22 recommendations for the surface-based sub-system of the GOS (see section 2) and 22 for the space-based sub-system of the GOS (see section 3).

2. 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 AWS.
>
> **Completed Action:** CBS to urge WMO Members to implement this recommendation at the earliest possible date.
>
> **Update July 2006:** Done (ref CBS-XIII Report); drifting buoy hourly pressure data now exchanged routinely.
>
> **New Action July 2006:** OPAG/IOS to identify improved approaches for promoting responses to this recommendation.

(b) Observational data that are useful for meteorological applications at other NMSs 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 in regions where these data are collected should make them available via WMO real time or near-real-time information systems, whenever feasible.

> **Continuing Action July 2006:** CBS Secretariat to request Regional Rapporteurs to provide information on additional data potentially available from Regions.
>
> **Update December 2005:** CBS agreed that the Commission working through Regional Rapporteurs, would urge all Members with existing operational observing capabilities and networks to distribute their full information content as quickly as possible. CBS further agreed that the OPAG-IOS Chairman, in consultation with the Chairs of the regional Working Group on Planning and Implementation of the WWW, should ensure that operators and managers of regional observing systems were made aware of GOS requirements (CBS-XIII Report)
>
> **New Action July 2006:** ET-EGOS to review requested information and identify new data to be for exchange.
>
> **New Action July 2006:** Request JCOMM to work with members to overcome the 'SHIP' call sign issue to ensure that quality monitoring and feedback activities can continue to be undertaken.

(c) The need for good metadata exchange in support of observational data, sometimes in real time, is essential.

New Action July 2006: Encourage OPAGs IOS and ISS and JCOMM DMPA to progress the development of an integrated metadata distribution system to support the needs of the GOS.

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

Update December 2005: The Implementation Plan was sent to Members, initial useful feedback was received from Regional Rapporteurs.

Continuing Action: WMO Secretariat to draft a letter to Members (NWP centres) requesting report of specific problems inhibiting effective use of available observational data. Responses need to address problem areas for each data type.

New Action July 2006: CBS Secretariat to write to Members reminding them of the guidance material that is available.

G3. Timeliness and Completeness

(a) There should be a timely distribution of radiosonde observations with all observation points 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.

Completed Action: CBS to urge all Members 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 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.

Update December 2005: CBS encouraged Members with existing observing capabilities and networks to distribute their full information content as quickly as possible (CBS XIII Report).

Update December 2005: EUCOS has taken an initiative to encourage operators of radiosonde stations to generate and transmit their data in BUFR, in addition to the TEMP message. First data in BUFR to become available by late 2006.

Update July 2006: To date radiosonde profile data in BUFR have not been made available.

New Action July 2006: Re-iterate request to all Members to make high resolution TEMP data available in BUFR as soon as possible.

(b) The timely availability of ocean observations for meteorological use is very important.

Comment: The DBCP noted that the drifting buoy data timeliness was poor in a number of ocean areas as less than 50% of the data collected by Argos through its global system were received in real time. Whereas elsewhere more than 80% was received in realtime.

New Action July 2006: JCOMM and DBCP to pursue improvements of drifting buoy data timeliness especially in South Atlantic and South East Pacific.

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 import.

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 are now and will in future, to an increasing extent, be provided from a mix of observing system components and will 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 IPY should give guidance for that data sparse region.

Completed Action: OPAG-IOS Chairman 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 these requirements.

Update December 2005: Members have been suitably informed of these requirements through CBS (CBS XIII Report). This is more easily achievable where sub Regional programmes, such as EUCOS, or large national programmes exist. However it is acknowledged this is more of a challenge with a collection of small national programmes.

New Action July 2006: WMO/GCOS Secretariat to write to Members reminding them of the importance of the GSN & GUAN in its contribution to the GOS and supply operating practice recommendations.

G5. Stratospheric observations - Requirements for a stratospheric global observing system should be refined (document need for radiosondes, radiances, wind data, humidity data, 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 mission likely will provide a substantial enhancement to the stratospheric observing system. Further, AOPC has noted that current in situ measurement capabilities for UT and LS water vapour are not meeting climate requirements and stressed need for further development.

Continuing Action July 2006: ET-EGOS to initiate further OSEs to include the use of COSMIC and other data when available. Results of OSEs to be reviewed and consolidated at that stage (2008).

Update December 2005: CBS reiterated the great value of experiments in the redesign process and encouraged leading NWP centres and relevant scientific groups to continue their efforts in that area. A review of EUCOS impact studies was presented at the ET-

EGOS session (December 2005, further OSE results will be reviewed at ET-EGOS July 2006).

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. [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]

Continuing 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).

Update December 2005: This action requires close inter-commission co-ordination between CAS and CBS to be facilitated by the WMO Secretariat. GAW meeting Payerne October 2005 stressed importance of real time distribution of ozone data and total column ozone data on the GTS. BUFR formats have been developed and Members are encouraged to make use of them for data exchange.

New Action July 2006: Members to be reminded that all available ozone soundings be made available in near-real time on the GTS.

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. Negative targeting, to release resources for use elsewhere in the GOS are also of value.

Comment: The proof of the observation targeting concept was given by US Weather Service in the northeastern Pacific for winter storms. 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.

Ongoing Action: The OPAG-IOS Chairman to maintain liaison and ensure targeting strategies developed by THORPEX are made available to the CBS.

Update December 2005: CBS XIII requested the OPAG-IOS to maintain liaison and to ensure that targeting methodologies developed by programmes such as EUMETNET and targeting strategies developed by programmes such as THORPEX were carried through to operational implementation. A targeting campaign for the Atlantic and Europe is planned for nine months in 2008. It will be run as a EUMETNET/EUCOS activity carried out under the joint EUMETNET / European Commission funded EURORISK PREVIEW Programme. A short targeting campaign will be undertaken as part of the Greenland Flow Distortion experiment with sensitive area predications provided by the Met Office and ECMWF.

Update December 2005: The THORPEX Implementation Plan stipulates that the concept of interactivity will be tested in the TIGGE (THORPEX Interactive Grand Global Ensemble)

framework. Observation targeting is expected to benefit from the large ensemble size available in TIGGE, from which some methods of sensitive area prediction may benefit. The exploration of innovative uses (e.g. targeting) of operational observing systems is part of the planned THORPEX observing system tests. DSG, in letter dated 19 July 2005, to President CBS advised him of the EC recommendation to organize a joint workshop between CBS and CAS to investigate the concept of targeted (adaptive) observing systems.

New Action July 2006: ET-EGOS to ensure Targeting Campaign results are presented at the next OSE/OSSE Workshop.

Optimization of vertical profile distribution

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). 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. [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. ET to follow the THORPEX Implementation Plan and to learn from the THORPEX experience whilst remembering the importance of safe-guarding the integrity of the baseline observing system.

Update July 2006: E-ASAP Programme now implementing rules to stop duplication near land based radiosonde stations.

New Action July 2006: OPAG IOS Chairman to keep ET-EGOS informed of developments in THORPEX and other areas including 'negative targeting' methodologies.

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.

Comment: This recommendation is supported by information from the Toulouse and Alpbach NWP Workshop reports and by the ECMWF northern hemisphere AMDAR impact study. The AMDAR Panel objective is 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;

  Update July 2006: Southern African programme now fully operational. Plans are developed for Eastern Europe and the Far East.

- Development and use of new onboard software and alternative AMDAR technologies;

  Update July 2006: Various discussions are ongoing for the development of new ARINC 620 V4 software. New technologies (TAMDAR) are nearing completion. Some problems remain to be solved regarding data ownership. The ADS-B system is under development and an ADS-C system operates over the North Atlantic and SW Pacific Ocean areas.

- Selective deployment of humidity/water vapour sensors;

Update July 2006: WVSSII water vapour sensors have been installed on 25 UPS B757 freighter aircraft and are undergoing further operational evaluation. E-AMDAR will undertake a European based WVSSII evaluation program, first results are expected to become available towards the end of 2006. Airbus Industries plans to undertake a study for the development and installation of the ARINC 620 V4 software and WVSSII sensor for the entire Airbus family.

New Action July 2006: ET-EGOS to evaluate the quality of WVSSII sensor data from E-AMDAR trial when available.

- Provision of additional observations into data sparse areas and special weather situations;

Update July 2006: Formal arrangements have been completed for E-AMDAR to provide targeted data for Southern Africa. Work continues on the establishment of a substantial program for the ASECNA area. E-AMDAR has concluded a contract with UPS for the provision of night time AMDAR data over Europe.

- Use of optimization systems to improve cost effectiveness;

Update July 2006: E-AMDAR continues to develop and refine its optimization schemes. Canada also has established an operational optimization scheme. The US and Australia are planning to develop appropriate systems in the near future. The AMDAR Panel and SITA have started investigating a global solution for AMDAR optimisation and distribution.

- Improvements in the monitoring, quality control;

Update July 2006: All monitoring centres have made substantial improvements to their AMDAR data quality monitoring systems A series of studies have shown that temperature data quality is very clearly linked to individual aircraft types and models. Additionally, clear differences in bias are seen between ascent and descent profiles on many aircraft. The AMDAR Panel Science Sub Group is committed to investigate the causes of both problems. Very poor wind quality derived from aircraft at high latitudes is a result of the use of magnetic heading, which is completely unusable at these latitudes.

- Efforts to encourage and pursue the free exchange of data;

Update July 2006: Discussions continue with the provider of the TAMDAR system to allow for the provision of data free of charge.

- Improvements in user awareness & training plus operational forecasting tools & systems

Update July 2006: A CBS AMDAR Rapporteur was appointed with particular responsibilities in awareness and operational training. An AMDAR awareness questionnaire was distributed to the WMO Member States and the results were reviewed. A technical seminar was held in Bucharest and a 3-day workshop was held in Budapest in 2005 with 13 participating countries from Central and Eastern Europe. Workshops have been formally requested by the Croatia and Kenya and interest was expressed by Brazil, Bulgaria, India, Mexico, Pakistan, Sri Lanka and the Russian Federation.

New Action July 2006: The AMDAR Panel to provide those Members States who responded to the questionnaire with an AMDAR information package.

Atmospheric moisture measurements

G13. Ground-based GPS measurements for total water vapour - Develop further the capability of ground-based GPS systems for the inference of vertically integrated moisture towards operational implementation. Ground-based GPS processing (ZTD and PW, priority for ZTD) should be standardized to provide more consistent data sets. Data should be exchanged globally. [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 historical COSNA/SEG, NAOS, JMA reports provide useful background information.

Continuing Action: 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.

Update December 2005: No action has been implemented. Cost Action 716 Final Report on "Exploitation of ground-based GPS" provides background. GPS data message type in BUFR has been developed and approved. EUMETNET E-GVAP Programme is taking the results of the Cost Action 716 into an operational implementation phase.

New Action July 2006: Request Members to provide status of BUFR implementation for GPS water vapour data exchange.

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.

Completed Action: ET-EGOS request a review from JCOMM on the current status and plans of ASAP by end of 2004.

Update July 2006: SOT/ASAPP has been attempting to increase the global coverage of ASAP ships but has had difficulty doing so due, mainly, to the high cost associated with operating such systems. However, the North Atlantic and Mediterranean is now better covered thanks to continuing efforts of the E-ASAP Programme, which is also targeting ships operating in sensitive areas for weather prediction. Three new E-ASAP units were procured and installed during 2004/2005 and by 2005 a total of 17 E-ASAP ships had produced 4200 upper air messages. During the next phase of the E-ASAP programmes development (2007-2011) the objective is to produce 5800 upper air soundings from 18 ships. It is also planned to increase the level of managerial and operational integration of national ASAP units into the programme. In addition E-ASAP aims to contribute to the World Weather Watch by providing up to 10% of additional soundings outside of the European (EUCOS) areas of direct interest, and also makes contributions to the Ekofisk and OWS Mike oceanic upper air platforms. Results of the E-ASAP OSE on the impact of ASAPs in the Atlantic will be available in 2006. High telecommunication costs do prevent from transmitting the high resolution data in real-time in BUFR format. ASAP monitoring continues to be routinely performed by ECMWF and Météo-France. The WRAP (World Re-occurring ASAP Programme) was officially terminated in April 2005 because of the difficulties in maintaining a viable and cost effective service.

New Action July 2006: JCOMM requested to investigate and pursue new ASAP Programmes in ocean areas with poor radiosonde coverage.

New Action July 2006: To request transmission of higher resolution ASAP data in either BUFR or CREX.

G15. Improvements in marine observation 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.

Completed Action: ET-EGOS to request information on progress regarding distribution of increased temporal and spatial resolution in situ marine observations from JCOMM.

Update July 2006: Iridium provides for high resolution data transmission and is global. Experiments still being conducted with small number of Argo profiling floats and drifting buoys (Arctic). Argos 3 generation will be onboard METOP, July 2006, and will provide higher bandwidth and downlink capability. High resolution XBT data collected via Inmarsat are made available through Global Temperature and Salinity Profile Programme (GTSPP). BUFR distribution of high resolution XBT data is under investigation in the USA. Iridium and other providers also offer substantially reduced telecoms tariffs, with no reduction in performance. As approximately 50% of the current cost of operating a drifting buoy is the telecoms costs these new providers potentially offer significant savings, which could in turn be re-invested in the GOS by the NMHSs.

New Action July 2006: JCOMM to pursue the use of higher satellite data transmission rates to increase volume of data that can be made available.

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].

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

Update July 2006: Progress towards the establishment of an Indian Ocean moored buoy array was made with the deployment of an initial 4 surface ATLAS moorings and one subsurface ADCP mooring in October/November 2004. These moorings complement previously established JAMSTEC TRITON and ADCP moorings. Three to four additional ATLAS mooring deployments are planned for late 2006 and early 2007. In addition to traditional wind and sub-surface temperature sensors, all Indian Ocean moorings have near-surface (10 m) current meters and subsurface salinity sensors. One ATLAS mooring has OceanSITES flux enhancements, which include long-wave radiation, barometric pressure, and additional subsurface current meters; one other OceanSITES ATLAS mooring is planned as part of the 2006-07 expansion. Vandalism remains a concern. Enhancements to the PIRATA array in 2005 included the addition of 3 sites offshore of Brazil. Two additional PIRATA sites will be deployed off North Africa in 2006. Four sites in TAO and three in PIRATA will gain OceanSITES flux enhancements in 2006. Surface salinity will become a standard measurement on all TAO sites by 2007.

New Action July 2006: JCOMM requested to provide further update on progress

New Action July 2006, JCOMM to be encouraged to extend the Tropical Moorings Array in the Tropical Atlantic and Indian Oceans and obtain a sustained operation.

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. [Recommendation is supported by information in the Toulouse NWP OSE Workshop Report and the ET-EGOS OSE studies.]

Comment: Plans from agencies other than JCOMM need to be considered.

Completed Actions: ET-EGOS to request information from JCOMM on plans for preserving/enhancing the network.

Update July 2006: DBCP maintains an array of about 1250 drifting buoys globally. About 350 of them report air pressure. It maintains an array of about 80 barometer drifters South of 40S. JCOMM/OCG and DBCP have plans to eventually increase this number to 300. Hourly air pressure data are recorded by the instruments and distributed on GTS. Efforts are being made in SouthEast Pacific, and the South Atlantic to improve data timeliness by installing and/or connecting of Argos receiving stations to the Argos System. Wind drifters with WOTAN technology are deployed in small quantities and in conjunction with hurricanes. There are no plans to increase substantially the number of such drifters unless strong requirements are expressed by the users with an indication of the network density and targeted areas.

New Action July 2006: ET-EGOS to request a specific OSE to study the impact of varying the density of surface pressure observations in the North Atlantic, in order to provide guidance on the optimal density of the Southern Ocean drifting buoy network.

G18. XBT and Argo - For Ocean Weather Forecasting purposes, improve timely delivery and distribution of 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.

Completed Action: ET-EGOS to request information on progress from JCOMM for the next ET-EGOS meeting.

Update July 2006: Most XBT data now distributed in real-time within a few hours (low resolution in BATHY). BUFR distribution of high resolution XBT data still under investigation by SOT/SOOPIP. Cost estimate for required developments is being made. Argo data in high resolution distributed in NetCDF format through GDACs mostly within 24 h. New BUFR template for GTS distribution of profiling float data has been approved by ET/DRC, Oman, December 2005. Argo Data Management Team is now working on its implementation (e.g. Japan, Australia) and will evaluate progress at its October 2006 meeting.

Argo has developed very rapidly and has an operational array in place now with contributions from 24 countries and the European Union. Most countries have had interim funding from mainly research sources for the first phase of Argo. Now that the array is almost complete many of them are trying to move to new, more sustained funding sources. This is a cause of some uncertainty because it implies countries making a long term commitment to Argo and many countries do not have clearly defined mechanisms for doing this. On the other hand, 50% of the resources are from US sources and are secured for the period 2006-2010.

New Action July 2006: OOPC to update of the requirements required by for upper ocean thermal data.

New Action July 2006: JCOMM encouraged to ensure a sustained status for upper ocean thermal networks.

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

Note: The JCOMM Operations Plan provides background for actions in this area.

Completed Action: ET-EGOS to request information on progress regarding ice buoys from JCOMM.

Update July 2006: After reviewing the requirements established by the WMO and NOAA for meteorological and oceanographic observations (e.g. *von Storch and Zwiers, 2001; and http://ioc.unesco.org/goos/docs/act_pl/act_pla2.htm), it was determined that the IABP will strive for a spatial resolution of 250 km for the IABP buoy network. About 190 buoys are needed to achieve this resolution. On the other hand, the WCRP-SCAR International Programme for Antarctic Buoys (IPAB) is still targeting 500km*500km horizontal resolution in the sea-ice zone while actual resolution is actually substantially lower.

New Action July 2006: Impact of the expected increased Ice buoy deployment to be reviewed at next OSE/OSSE Workshop.

Improved observations over tropical land areas

G20. More profiles in Tropics - Temperature, wind and if possible the 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.

Ongoing Action: AMDAR Panel to report to ET. CBS to urge Members to consider activation of silent stations through a shared funding programme.

Update December 2006: Information on the collection of additional profile data from aircraft is provided under G9. In addition, the AMMA (African Monsoon Multidisciplinary Analysis) project in West Africa is expected to operate at various stages and during field phases a number of additional TEMP and PILOT stations. The AMMA Programme provides an opportunity for impact studies and subsequent network design. Sustaining an operational network in the region will be a challenging task.

New Action July 2006: ET-EGOS to continue to monitor the observing system over western Africa during the various stages of AMMA, relevant reports should be requested from the AMMA.

New Observing Technologies

G21. AWS - Noting the widespread adoption of AWS and their importance in the measurement of ECVs,
(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;
- ensuring recommended practices are complied with.

Next action: ET-AWS to be asked to summarize advances in AWS technology for ET-EGOS, and to formulate how the operational implementation of this technology might be formulated and promoted within the EGOS-IP.

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

Continuing Action: Reporting formats should be reviewed to include the details of observation times, OPAG-IOS Chairman to bring this to the attention of the OPAG ISS ET on Data representation and codes (at CBS in 2005).

Update December 2005: No meeting of ET-AWS has been held yet to discuss and review advances in technology. Next ET-AWS should be tasked to do this (fourth session of ET-AWS planned for mid-2006).

New Issue and Action July 2006: The evolution of the AWS network needs to be addressed. OPAG/IOS needs to consider how best to carry this forward.

New Action July 2006: OPAG-IOS Chairman to write to OPAG-ISS Chairman to encourage progress with the development of new BUFR/CREX Templates for AWS as requested by ET-AWS.

New Action July 2006: ET-EGOS Chairman to ask WMO Space Programme to encourage provision of low cost broadband telecoms for AWS from Satellites.

G22. **New systems** - 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;
- TAMDAR;
- Ocean Gliders.

New Action July 06: ET-EGOS to ensure any impact studies for new technologies carried out by THORPEX or other groups are made available.

3. Evolution of space-based sub-system of GOS

A balanced GOS - Concern 1 - LEO/GEO balance

There has been commendable progress in planning for future operational geostationary satellites. In addition to the plans of China, EUMETSAT, India, Japan, Russian Federation and USA, WMO has been informed of the plans of the Republic of Korea to provide geostationary satellites. The Republic of Korea has made a formal declaration to WMO and is now considered part of the space-based component of the GOS. These developments increase the probability of good coverage of imagery and sounding data from this orbit, together with options for adequate back-up in case of failure. On the other hand, current plans for LEO missions are unlikely to fulfill all identified requirements. It would be timely for the WMO Space Programme and/or CGMS to study the balance between polar and geostationary systems and to advise if there is scope for optimizing this balance between the two systems in the long term.

> **Next Actions**: WMO has convened a "CGMS-WMO optimization workshop" with CGMS satellite operators on 28-29 August 2006. The workshop will review the planned locations of geostationary satellites as well as the equatorial crossing times of the sun-synchronous polar-orbiting satellites, with their respective payloads. The issue of GEO-LEO optimization will be brought forward.

A balanced GOS - Concern 2 – Achieving complementary polar satellite systems

EUMETSAT has recently initiated planning for the post-EPS era (i.e., first element in orbit in ~2019) through a thorough assessment of the user requirements for all observations that might usefully be made from low earth orbit. This is to be complemented with a remote sensing assessment of the missions needed to meet these requirements. It is expected that some of these missions will be implemented through satellite missions/systems provided by EUMETSAT, whilst other "missions" may be achieved by cooperation with other partners (e.g., NOAA/EUMETSAT Joint Polar System, complementarity with GMES missions, or acquisition of data in partnership with other space agencies). Through this process, the goals of GEOSS could be greatly advanced. WMO Space Programme Office is encouraged to consider how this process might best be facilitated, to discuss any obstacles to progress, and to identify short-term opportunities for engagement with this process. In addition, noting the polar plans of China and the Russian Federation, WMO Space Programme should also extend coordination efforts to include these agencies.

> Next actions: This will be addressed at the CGMS Optimization workshop mentioned above.

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. GCOS Implementation Plan (GIP) Action C10 calls for continuity and overlap of key satellite sensors. The advent of high spectral resolution infrared sensors (AIRS, IASI, CrIS) will enhance accurate intercalibration. Also regarding visible intercalibration, MODIS offers very comprehensive onboard shortwave solar diffuser, solar diffuser stability monitor, spectral radiometric calibration facility, that can be considered for inter-comparison with geosynchronous satellite data at visible

wavelengths. MERIS appears to have merit in this area due to its programmable spectral capability, if implemented. GOES-R selected ABI channels have been selected to be compatible with VIIRS on NPOESS. This only deals with optical sensors, and other sensor types (e.g., active, passive, MW) should be considered.

Progress: CGMS XXXIII (Tokyo, November 2005) supported the strategy defined at the WMO Workshop (Darmstadt, July 2005) for a Global Space-based Inter-Calibration System (GSICS) that is intended to ensure comparability of satellite measurements provided through different instruments and satellite programmes and to tie these measurements to absolute references. GSICS activities will include: regular processing of VIS-IR-MW radiances from co-located scenes of GEO and LEO satellites, with common software tools as well as: pre-launch instrument characterization; on-orbit calibration against on-board, space or earth-based references; calibration sites and field campaigns; radiative transfer modelling. A GSICS Implementation Plan was issued in April 2006 and was formally endorsed at the GSICS Implementation Meeting convened by WMO (Geneva, 23 June 2006). The 58th WMO Executive Council underlined the importance of GSICS and was happy to note that China, Japan, Russian Federation and the United States as well as EUMETSAT were engaged to contribute to GSICS. The GSICS Implementation meeting nominated a GSICS Executive Panel, led by Dr Mitch Goldberg from NOAA.

Next Action: A GSICS operation plan will be prepared with the aim to start initial operations in the first half of 2007.

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: The following geostationary satellite operators have reported at CGMS that they will have at least SEVIRI-like capability by 2015: NOAA (2012), EUMETSAT (present), Russian Federation (2007), and CMA (2012).

Next Actions: WMO Space Programme will continue discussions with space agencies, via CGMS, especially with IMD and JMA. This will be addressed at the CGMS Optimization workshop mentioned above.

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: Instruments of this type in geosynchronous orbit are high priority enhancements to the Global Observing System (GOS) for meeting existing user requirements in numerical weather prediction (NWP), nowcasting, hydrology and other applications areas.

Progress: All operators reported plans at CGMS in 2005: NOAA has firm plans including this capability for the GOES-R series by 2012; EUMETSAT has it under consideration for the MTG series around 2016; China for its FY-4 series by 2012. For the meantime, 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. Roshydromet and Roskosmos are considering with the USA the possibility to install GIFTS on board of the geostationary satellite "ELEKTRO-L 2" planned for launch in 2010. There remains however a funding issue to manufacture a space qualified instrument on the basis of the current engineering model.

Next Actions: The IGEOLAB GIFTS proposal and the plans for operational hyperspectral sounding from the GEO orbit will be reviewed at CGMS XXXIV (November 2006, Shangai).

S4. GEO System Orbital Spacing - 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.

Progress: WMO Space Programme continues to discuss with space agencies, via CGMS and WMO Consultative Meetings on High-level Policy on Satellite Matters, the strategy for implementation towards a nominal configuration with attention to the problems of achieving required system reliability and product accuracy.

Next Actions: This issue will be addressed at the CGMS optimization workshop mentioned above.

LEO satellites

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

Progress: The successful EUMETSAT ATOVS Retransmission Service (EARS) has been renamed the EUMETSAT Advanced Retransmission Service and will carry AVHRR and ASCAT products in addition to ATOVS. EARS ATOVS data are now available with a delay of less than 30 minutes; the data are used operationally at some NWP centres and planned at others. Planning has begun for other Regional ATOVS Retransmission Systems (RARS) in Asia, Australia, and South America. Following the global RARS Workshops held in Darmstadt in December 2004 and Geneva in December 2005, a new RARS workshop is planned on 1-2 September 2006 with a primary goal of achieving timely retransmission of local ATOVS data sets that would all together cover the globe. The RARS approach is expected to be expanded to IASI and other time-critical data, including an equivalent system for NPP data.

NPOESS initial plans are for 80% of global data acquisition in less than 15 min and would thus be consistent with the stated timeliness requirements for NWP, provided that provisions are made for the timely redistribution of these data towards NWP centres.

As regards polar winds, plans are being developed to improve the timeliness through the use of direct broadcast imagery received at high-latitude stations.

Additionally, ERS-2 GOME and scatterometer data are now available in near real time (within 30 minutes) in the coverage region of ESA (e.g., Europe and North Atlantic) and cooperating ground stations.(e.g., Beijing, Perth,..).

Next Actions: WMO Space Programme to pursue further actions to implement RARS at a global scale and to encourage the implementation of similar plans to allow the derivation of polar winds with improved timeliness

S6. LEO temporal coverage - Coordination of orbits for operational 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. WMO Space Programme will collaborate with space agencies, via CGMS, on a target system that will be implemented and to take steps towards achieving it. Matters related for contingency planning in the AM and PM polar-orbits will be included

Next Actions: This will be addressed at the CGMS Optimization workshop mentioned above. Target system to be 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.

Comment: GCOS (GIP, Action A11) calls for continuous operation of AM and PM satellite scatterometers or equivalent. QuikScat scatterometer data have been available to the NWP community since 1999, and will continue through the life of QuikScat (NASA has no current plans for a successor SeaWinds scatterometer). Oceansat-2 has scatterometer capability that may be made available to the world community (this availability needs to be confirmed). The relative performance of the multi-polarisation passive MW radiometry versus scatterometry requires further assessment.

Progress: ERS-2 scatterometer will be followed by ASCAT on METOP, sea surface wind will thus be observed in an operational framework from 2006 onwards.
The revised NPOESS baseline includes a microwave imager/sounder to provide wind speed and direction information at sea surface starting with NPOESS-C2 in 2016.

Three months of data has been made available to Windsat science team. Windsat data have been distributed to several NWP centres in 2005. Early assessments of its polarimetric capabilities to provide information on sea surface wind direction suggest that, while good information is available at high wind speed, this technology will not be competitive with scatterometry at low wind speed

Next Actions: WMO Space Programme to take note of recent WindSat performance studies, to assess implications to the GOS and provide feedback to NOAA in 2006. This shall be discussed at CGMS XXXIV in 2006.

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

Comment: GCOS (GIP, Action O12) requires continuous coverage from one high-precision altimeter and two lower-precision but higher-resolution altimeters.

Progress: Agreement has been reached to proceed with Jason-2 (2008). TOPEX/Poseidon and Jason-1 continue to provide global ocean topography data to the NWP community. ESA has plans for a Sentinel-3 ocean mission that will include an altimeter.

Next Actions: 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. This will be addressed at the CGMS Optimization workshop mentioned above. 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: Plans for ERB-like measurements after Aqua remain uncertain. There are also concerns about the continuity of absolute measurements of incoming solar radiation. This is a high priority item for GCOS (GIP, Action A24).

Progress: FY-3A will have a prototype Earth radiation budget instrument in 2007. The first NPOESS satellite is scheduled to carry the CERES instrument (likely launch in 2013).

Next Actions: Continuity before and after NPOESS-C1 will be addressed at the CGMS Optimization workshop mentioned above. WMO Space Programme will express concern at CGMS XXXIV if the risk of a gap is confirmed.

R&D satellites

S10. LEO Doppler Winds - Wind profiles from Doppler lidar technology demonstration programmes (such as ADM-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.

Progress: Plans for ADM-Aeolus demonstration are proceeding on schedule, and ESA and ECMWF are developing software for the assimilation of Doppler winds into NWP models. There are currently no plan for either a preparatory mission or an operational follow on. EUMETSAT is considering the requirements for observations of the 3D wind field as part of their planning for post-EPS missions.
Next Actions: WMO Space Programme will discuss with space agencies, via CGMS and WMO Consultative Meetings on High-level Policy on Satellite Matters, to ensure that the demonstration with ADM-Aeolus can be followed by a transition to operational systems for wind profile measurement. Plans for continuity of a Doppler Winds capability following ADM-Aeolus should be discussed by CGMS satellite operators in 2006 WMO Space Programme participates in an ESA/ESTEC ADM-Aeolus workshop on 25-27 September 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.

Comment: GCOS (GIP Action A7) requires stable operation of relevant operational satellite instruments for precipitation and associated products.

Progress: TRMM continues to provide valuable data for operational use. Early termination of TRMM after 2004 was averted after user community appeals for its continuation. NASA has assured continued operation into 2009. In 2005, ESA's European GPM was not selected as the next Earth Explorer Mission. At the fifth International planning workshop WMO expressed it support and its readiness to facilitate

partnerships to expand the GPM constellation. It was recognized that ISRO's Megha-tropique has a passive microwave capability that is not yet part of the GOS but could be useful in the GPM constellation (availability needs to be confirmed). Other R&D and operational satellites in polar orbit may contribute to the constellation with their microwave radiometers. GPM was addressed at the 6th Consultative Meeting (Buenos Aires, January 2006) and its importance was stressed. The GPM core satellite is now planned for launch in December 2012.

Next Actions: WMO Space Programme is continuing discussions with space agencies, via CGMS and at CM, regarding plans for GPM. The GEO workplan 2006 includes an action, co-led by CEOS and WMO, to advocate the timely implementation of the GPM mission.

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

Comment: GCOS (GIP Action A20) requires sustained, operational, real-time availability of GPS RO measurements.

Progress: CHAMP and SAC-C data have been available to some centres. NWP OSEs have shown positive impact with small number of occultations. Climate applications are being explored. Near real time dissemination of CHAMP data is planned for 2006. Plans for near real time distribution of METOP/GRAS and COSMIC data are also in place for 2006.

Next Actions: Plan for operational follow-on to COSMIC should be discussed by CGMS in 2006. Plans for a shared ground support network should be initiated by CGMS in 2006

S13. GEO Sub-mm for precipitation and cloud observation- 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: Geo sub-mm is one of two systems being considered for IGeoLab. A task team evaluated the IGeoLab possibilities for a Geostationary Observatory for Microwave Atmospheric Sounding (GOMAS) as well as other possible instruments. This type of instrument in geosynchronous orbit is high priority for meeting existing user requirements in numerical weather prediction (NWP), nowcasting, hydrology and other applications areas.
GOMAS was not accepted by ESA as a core Explorer mission. Alternative projects may be discussed at CGMS XXXIV.

Next Actions: WMO Space Programme will continue dialogue with space agencies, via CGMS.

S14. LEO soil moisture and ocean salinity - 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 Aqua and Hydros, and NASA/CONAE Aquarius/SAC-D) 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.

Progress: ERS scatterometer data sets have provided monthly global soil moisture maps since 1991 at 50 km resolution. EUMETSAT plan an operational global NRT soil moisture

product from Metop/ASCAT data. WindSat and AMSR-E are being studied for possible utility of 6 and 10 GHz measurements for soil moisture for sparsely vegetated surfaces. SMOS is scheduled for launch in late 2007. Aquarius is scheduled for launch in 2008 and Hydros in 2009.

Next Actions: WMO Space Programme will discuss at CGMS progress and options for provision of soil moisture and salinity products including real time delivery of soil moisture products for NWP.

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.

Progress: The wave spectra from ENVISAT are available in near real time from an ESA ftp server. CSA's RADARSAT data are used in deriving ice products by the National Ice Center.

Next Actions: WMO Space Programme to discuss with space agencies, via CGMS, (1) broader access by WMO Members to ENVISAT SAR data, (2) availability of SAR data from other agencies, and (3) continuity of such missions. Assessment of status and plans should be 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.

Comment: Terra and Aqua carry the MODIS sensor that is providing global aerosol products over ocean and most land regions of the world at 10 km spatial resolution. Additional R&D satellites currently providing aerosol optical thickness and optical properties include Terra/MISR, PARASOL, EP-TOMS, and Aura/OMI. CALIPSO carries an R&D lidar for monitoring the vertical distribution of aerosols along the orbital ground track of the spacecraft, which is in the A-train orbit along with Aqua, PARASOL, CloudSat, and Aura. NASA's Glory mission (2008) as well as NPOESS has added APS, an aerosol polarimetry sensor. ESA and JAXA are preparing the Earthcare (cloud/aerosol mission) for launch in 2012.

Next Actions WMO Space Programme will continue discussions with space agencies, via CGMS and at CM, regarding availability of these data for operational use.

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.

Comment: GLAS data are currently able to determine vertical distribution of cloud top altitude along the nadir ground track of ICESat, but this spacecraft operates in ~100 day epochs and is not continuous. CALIOP on CALIPSO should make these data routinely available in the A-train orbit (Aqua, PARASOL, CloudSat, and Aura).

Next Actions WMO Space Programme will discuss with space agencies, via CGMS and at CM, near real time operational use of these data and operational follow-on planning.

S18. Recommendation S18 is to be found in Section "Process studies" below

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.

Progress: MIPAS and SCIAMACHY data are available in near real time from the ESA ftp server. NPP is scheduled to carry OMPS with ozone limb sounding in 2010.

Next Actions: WMO Space Programme will 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.

S20. Active Water Vapour Sensing - There is need for a demonstration mission of the potential of 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 Actions: WMO Space Programme will discuss with space agencies, via CGMS.

S21. Lightning Observation – There is a requirement for global observations of lightning. Several initiatives for operational space-based implementation exist. These should be encouraged to fruition.

Comment: NASA's observations of lightning from OrbView-1/OTD and TRMM/LIS have demonstrated that 90% of lightning occurs over land, and that it is heavily tied to deep convection. In addition to its importance in severe storms and warnings for safety, lightning is an importance source of NO_X and thus contributes to elevated levels of tropospheric ozone. The vision for the space-based component of the GOS approved by the Extraordinary session of CBS in 2002 included GEO lightning under the need for "Several R&D satellites serving WMO Members".

Progress: The dynamics of lightning occurrence and its importance for nowcasting has been recognized by NOAA that plans to include a lightning sensor on GOES-R and CMA that plans a lightning mapper on FY-4. It is under consideration by EUMETSAT for MTG however EUMETSAT are reviewing requirements and implementation options for lightning observations and the potential role of ground-based observations to meet requirements is being re-assessed.

Next Actions: WMO Space Programme will discuss with space agencies, via CGMS.

S22. Formation Flying – Advantages of formation flying need to be investigated.

Comment: NASA has already demonstrated both a morning constellation (involving Landsat 7, EO-1, SAC-C, and Terra) and an afternoon constellation (Aqua, PARASOL, and Aura, soon to be joined by CloudSat (2006), CALIPSO (2006), and OCO (2008)). These multi-agency and multi-country constellations demonstrate the added value of coordination of Earth observations to make a polar orbiting system greater than the sum of the parts, but able to launch when sensors and spacecraft are ready and available.

Next Actions: The utility of data from sensors flying in formation need to be assessed. WMO Space Programme will discuss with space agencies, via CGMS

Process studies

In reviewing the Implementation Plan for the Evolution of the Global Observing System, and not withstanding other potential requirements, the need for following process study mission was identified:

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 Actions WMO Space Programme to discuss with space agencies, via CGMS

4. Considerations for evolution of the GOS in developing countries

4.1 In preparing 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 *en route* 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 Capacity building in some countries needs 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). Developments through the AMMA project offer a proposing route forward in some parts of Region I, and special attention should be paid to maintaining the selected parts of the network once the AMMA project has concluded.

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 were 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, 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-sparse regions.

ANNEX A

ACRONYMS

4DVAR	Four-Dimensional Variational Assimilation
ADM-Aeolus	Atmospheric Dynamics Mission (ESA)
AES	Atmospheric Environment Service (Canada)
AFIRS	Automated Flight Information Reporting System
AIRS	Advanced Infra-red Sounder
AMDAR	Aircraft Meteorological Data Delay
AMSU	Advanced Microwave Sounding Unit
AMV	Atmospheric Motion Vector
AOPC	Atmospheric Observation Panel for Climate
Argo	Array for Real-time Geostrofic Oceanography
ASAP	Automated Shipboard Aerological Programme
ATOVS	Advanced TIROS Operational Vertical Sounder
AVHRR	Advanced Very High Resolution Radiometer
AWS	Automatic Weather Station
BUFR	Binary Universal Form for the Representation of Meteorological Data
CAS	Commission for Atmospheric Sciences
CBS	Commission for Basic Systems
CGMS	Coordination Group for Meteorological Satellites
CHAMP	CHAllenging Minisatellite Payload
CIMO	Commission for Instruments and Methods of Observation
COSMIC	Constellation Observing System for Meteorology, Ionosphere and Climate
COSNA	Composite Observing System for the North Atlantic
CREX	Character Form for the Representation and Exchange of Data
DIAL	Differential Absorption Lidar
E-AMDAR	EUMETNET-AMDAR
EARS	EUMETSAT ATOVS (now Advanced) Retransmission Service
ECMWF	European Centre for Medium-Range Weather Forecasts
EGPM	European (contribution to) Global Precipitation Measurement
ERB	Earth Radiation Budget
ESA	European Space Agency
ET-SSUP	Expert Team (ET) on Satellite Systems Utilization and Products (SSUP)
EUCOS	EUMETNET Composite Observing System
EUMETNET	European Meteorological Services Network
FASTEX	Fronts and Atlantic Storm Track Experiment
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GEO	Geostationary Orbit Satellite
GIFTS	Geosynchronous Imaging Fourier Transform Spectrometer
GNSS	Global Navigation Satellite System
GOES	Geostationary Operational Environmental Satellite
GOS	Global Observing System
GPM	Global Precipitation Measurement
GRAS	GNSS Receiver for Atmospheric Sounding
GSN	GCOS Surface Network

GTS	Global Telecommunication System
GUAN	GCOS Upper-Air Network
HIRDLS	High Resolution Dynamic Limb Sounder
HIRS	High Resolution Infra-red Sounder
IASI	Infra-red Atmospheric Sounding Interferometer
IGDDS	Integrated Global Data Dissemination Service
IGOSS	Integrated Global Ocean Services System
IOC	Intergovernmental Oceanographic Commission
IOS	IGOSS Observing System
JASON	Ocean surface topography mission
JAXA	Japan Aerospace Exploration Agency
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JMA	Japan Meteorological Agency
LEO	Low Earth Orbit
MDS	Meteorological Data System
METOP	Meteorological Operational Satellite (EUMETSAT)
MIPAS	Michelson Interferometer for Passive Instrument Sounding
MLS	Microwave Limb Sounder
MODIS	Moderate Resolution Imaging Spectroradiometer
NAOS	North Atlantic Ocean Stations
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data and Information Service
NMHSs	National Meteorological and Hydrological Service(s)
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Program
NRT	Near-Real Time
NWP	Numerical Weather Prediction
OPAG	Open Programme Area Group
OSE	Observing System Experiments
PUMA	Preparation for the Use of Meteosat Second Generation (MSG) in Africa
R&D	Research and Development (satellite)
RAOB	Radiosonde Observations
RBCN	Regional Basic Climatological Network
RRR	Rolling Requirements Review
SAC-C	Earth-observation satellite (CONAE, Argentina)
SAR	Synthetic Aperture Radar
SCHIAMACHY	Scanning Imaging Absorption Spectrometer for Instrumental Cartography
SEG	Scientific Evaluation Group of COSNA
SEVIRI	Spinning Enhanced Visible and Infrared Imager
SMOS	Soil Moisture and Ocean Salinity satellite
SVPB	Surface Velocity Program Barometer drifter
TAMDAR	Tropospheric Airborne Meteorological Data Reporting
THORPEX	The Observing System Research and Predictability EXperiment

TRMM	Tropical Rainfall Measuring Mission
UAV	Unmanned Aerial Vehicle
VCP	Voluntary Co-operation Programme
WMO	World Meteorological Organization
WOTAN	Wind Observation Through Ambient Noise
WVSS	Water Vapour Sensing System
WWWW	World Weather Watch
XBT	Expendable BathyThermograph
ZTD	Zenith Total Delay

ANNEX B

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, as adopted by CBS (CBS Extr., Cairns, 1-12 December 2002).

For the space-based sub-system, there would be:

6 operational GEOs
- all with multi-spectral imager (IR/VIS)
- some with hyper-spectral sounder (IR)

4 operational LEOs
- optimally spaced in time
- all with multi-spectral imager (MW/IR/VIS/UV)
- all with sounder (MW)
- three with hyper-spectral 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 of small satellites for radio occultation (RO)
- LEO with wind lidar
- LEO with active and passive microwave precipitation instruments
- LEO and GEO with advanced hyper-spectral capabilities
- GEO lightning
- possibly GEO microwave

All with improved inter-calibration and operational continuity.

For the surface-based sub-system, there would be:

Automation to enable
- targeting of observations in data sensitive areas
- optimal operation of
    - o radiosondes
    - o ASAP systems
    - o aircraft in flight

Radiosondes
- optimized utilization
- stable and functioning RBSN, RBCN and GUAN
- supplemented by
    - o AMDAR ascent/descent
    - o ground-based GPS water vapour information
    - o wind profilers
    - o satellite soundings
- 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

ANNEX IV

Outline of supplementary notes for WMO Members on addressing relevant aspects of the Implementation Plan for the Evolution of the Space and Surface-based Sub-systems of the GOS (WMO TD-No. 1267).

The Implementation Plan for the Evolution of the Space and Surface-based Sub-systems of the GOS (EGOS-IP) contains a list of 44 recommendations. Each recommendation is accompanied by an action or actions that call upon a range of bodies to undertake the action (including the "WMO Space Programme", "CBS", various "Rapporteurs", "WMO Secretariat", "Expert Team on Evolution of the GOS", "CBS OPAG-IOS Chairman", "Regional Working Groups on Planning and Implementation of the WWW", "CAS", and the "Expert Team on AWS").

A number of actions identify "WMO Members" as the parties to achieve the recommended change to the GOS, or to be in some way associated with the effort to achieve that change. The relevant recommendations and actions are summarised below together with various elaborative notes intended to assist WMO Members to interpret and carry out the actions.

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 AWS.

Completed Action: CBS to urge WMO Members to implement this recommendation at the earliest possible date.

Update July 2006: Done (ref CBS-XIII Report); drifting buoy hourly pressure data now exchanged routinely.

New Action July 2006: OPAG/IOS to identify improved approaches for promoting responses to this recommendation.

(…….. some comment re technical regulations… need to update them…clarify the basic importance of 3 hourly, plus supplementary benefit of hourly synops to be provided as capacity allows?….)

G3. Timeliness and Completeness

(a) There should be a timely distribution of radiosonde observations with all observation points 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.

Completed Action: CBS to urge all Members 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 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.

Update December 2005: CBS encouraged Members with existing observing capabilities and networks to distribute their full information content as quickly as possible (CBS XIII Report).

Update December 2005: EUCOS has taken an initiative to encourage operators of radiosonde stations to generate and transmit their data in BUFR, in addition to the TEMP message. First data in BUFR to become available by late 2006.

Update July 2006: To date radiosonde profile data in BUFR have not been made available.

New Action July 2006: Re-iterate request to all Members to make high resolution TEMP data available in BUFR as soon as possible.

A point of contact for information on relevant code formats is ……

A point of contact who can provide information about and demonstrate their operational delivery of radiosonde sounding data in BUFR or CREX format is ……

As further background, the overall WMO effort to migrate to table driven code formats requires Members to adopt ….. formats for exchange of all data by ….. (target… is there a specific target for radiosonde data?)

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. [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]

Continuing 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).

Update December 2005: This action requires close inter-commission co-ordination between CAS and CBS to be facilitated by the WMO Secretariat. GAW meeting Payerne October 2005 stressed importance of real time distribution of ozone data and total column ozone data on the GTS. BUFR formats have been developed and Members are encouraged to make use of them for data exchange.

New Action July 2006: Members to be reminded that all available ozone soundings be made available in near-real time on the GTS.

A point of contact for information on relevant code formats is ……

A point of contact who can provide information about and demonstrate their operational delivery of ozone sounding data in BUFR or CREX format is ……

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.

Comment: This recommendation is supported by information from the Toulouse and Alpbach NWP Workshop reports and by the ECMWF northern hemisphere AMDAR impact study. The AMDAR Panel objective is 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 activities (see EGOS-IP for full list)

A point of contact who can provide further information about systems already in operations is the AMDAR Panel Technical Coordinator:

Michael Berechree
M.Berechree@bom.gov.au
+61 3 9669 4255

Such systems provide a mechanism to selectively collect only part of the potentially available data stream from aircraft operating in a given area.

G13. Ground-based GPS measurements for total water vapour - Develop further the capability of ground-based GPS systems for the inference of vertically integrated moisture towards operational implementation. Ground-based GPS processing (ZTD and PW, priority for ZTD) should be standardized to provide more consistent data sets. Data should be exchanged globally. [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 historical COSNA/SEG, NAOS, JMA reports provide useful background information.

Continuing Action: 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.

Update December 2005: No action has been implemented. Cost Action 716 Final Report on "Exploitation of ground-based GPS" provides background. GPS data message type in BUFR has been developed and approved. EUMETNET E-GVAP Programme is taking the results of the Cost Action 716 into an operational implementation phase.

New Action July 2006: Request Members to provide status of BUFR implementation for GPS water vapour data exchange.

A contact who can provide technical background, including specific detail on the standardised GPS processing, is …….

G20. More profiles in Tropics - Temperature, wind and if possible the 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.

Ongoing Action: AMDAR Panel to report to ET. CBS to urge Members to consider activation of silent stations through a shared funding programme.

Update December 2006: Information on the collection of additional profile data from aircraft is provided under G9. In addition, the AMMA (African Monsoon Multidisciplinary Analysis) project in West Africa is expected to operate at various stages and during field phases a number of additional TEMP and PILOT stations. The AMMA Programme provides an opportunity for impact studies and subsequent network design. Sustaining an operational network in the region will be a challenging task.

New Action July 2006: ET-EGOS to continue to monitor the observing system over western Africa during the various stages of AMMA, relevant reports should be requested from the AMMA.

Some examples of funding programs and how they have enabled re-activation of silent stations…….

Further general comments on enabling WMO Members to implement changes in their contributions to the GOS

1. Participation in projects/experiments to demonstrate and motivate the adoption of changes to observing systems:

In relation to new systems, it is often helpful to witness the feasibility and usefulness of an operational system before committing the resources needed to within a Nation Meteorological and Hydrological Service. One means of doing this is through participation in projects or experiments that demonstrate the new system.

AMDAR: a common means of demonstration is to fund the reporting of AMDAR observations from AMDAR enabled aircraft, that otherwise would not reported at a given location.

GPS water vapour: …..

2. Collaboration with other WMO Members to form a grouping or sub-Regional program to implement cost-effective changes to observing systems:

There are many examples of countries working together to more efficiently tackle changes to observations programs, including EUCOS and ASECNA. It may be possible for the WMO Secretariat to assist such groupings to come together and shape plans that enable the Members to better achieve their desired observations programs.

Most of the above specific actions could be tackled by a grouping of countries in a manner that required less resources than for each country to tackle alone.

ANNEX V

RESULTS OF ACTIONS FROM PREVIOUS MEETINGS

Action 1a - Secretariat to facilitate quarterly contact within ET-EGOS. Closed. Ongoing regular contact between ET members is being facilitated by the Secretariat.
Action 1b - Request for to increase resources for the Secretariat. Closed.
New Actions:

- WWW Dept. will develop a process to ensure ground-based observing system performance feedback gets to the appropriate Region and/or Member so that needed actions can be identified and addressed. D/WWW will work with D/SAT to set up process similar that used for satellite-based observing system feedback. WWW will provide status report in three months. Lead: WWW Dept. Estimated Completion Date: February 2007.
- WWW Dept. will develop strategy for transforming EGOS-IP into a more comprehensive plan – incorporating strengths observed in the GCOS Implementation plan without losing the focus on Member needs it presently has. Lead: WWW Dept. Estimated Completion Date: July 2007.

Action 1c -Provide acronym list for IP. Closed. The requested acronym list for the EGOS-IP is now on the ET-EGOS website, ready for incorporation into the next version of the IP.

Action 2 - Obtain update from CIMO on in situ observation capabilities for characterizing UT and LS temperature and moisture. This action is continuing. R. Stringer briefly reported on relevant information available from CIMO and sought guidance on what was required to complete this action. He conveyed that CIMO had recently released the preliminary 7th edition of the Guide to Meteorological Instruments and Methods of Observation (WMO No. 8) including an updated comprehensive description of the Measurement of Upper Air Pressure, Temperature and Humidity (Chapter 12). That chapter provides tables quantifying radiosonde performance, including capabilities in the observation of upper tropospheric and lower stratospheric temperature and humidity. It was also noted that CIMO had undertaken a radiosonde intercomparison in February 2005 in Mauritius and that a comprehensive Final Report would soon be published. That report would show that radiosonde manufacture and performance had taken a big leap forward in recent years.

The Chairman advised R. Stringer that the ultimate aim of this action was to update the database of observing system capabilities globally, against the 34 homogeneous areas.

Action 3 - Request response from regional rapporteurs on progress with regard to the recommendations in the IP. This action is completed. Letter sent by J. Purdom as requested. Secretariat will approach the rapporteurs routinely to receive updates concerning responses to EGOS-IP as appropriate to their region.

Action 4 - Review and update CEOS/WMO database. This action is continuing. R. Stringer reported that this remained a work in progress. The Chairman conveyed some further background to the task: that the aim was to determine the actual density of observations achieved (as captured in the CBS monitoring statistics) across the 34 homogeneous areas.

Action 5a - Study the impact of all AMDAR data over southern and central Africa in Global NWP. This is still open. There is still a requirement to study the impact of all AMDAR data over southern and central Africa in Global NWP.

Action 5b - Get feedback from Met Office regarding requirements for vertical resolution in AMDAR observations. This is continuing. Non-layer averaged values of all AMDAR data, temperature, wind and humidity elements should be supplied. The temperature and humidity data are processed together and so both parameters should be provided at the same vertical frequency. The maximum vertical resolution of data that can be used is equivalent to the number of layers in the model up to the level AMDAR equipped aircraft operate. This varies between NWP centres, currently being up to ~40 in this vertical domain of the atmosphere. A further study of these errors and the impact on maximum vertical resolution reporting is being produced by the Met Office (UK).

Action 5c - Study the sensitivity to density (spatial and temporal) of in situ sea surface observations. This is still open. Requested OSSE will be done. Chairman will coordinate with Steve Lord, NCEP.

Action 6 - Complete planning for a CBS/CAS expert meeting on optimized and targeted observations. This action is closed. Following discussion by experts at CAS and within the THORPEX community it is suggested that a joint CAS/CBS ET meeting on Targeting Observing is not yet required. However a close watching brief on developments will be maintained and OPAG IOS Chairman informed once a meeting would be appropriate. The results discussed at the 2nd THORPEX Scientific Symposium will inform this watching brief.

Action 7 – Obtain PoG and SoG contacts. This is still open**.** Letter asking for Points of Contact and persons to take ownership of SOGs in 10 application areas was sent in February 2006. No replies received. Still open and reviewed and updated at ET-EGOS-2. (See Annex VI.)

Action 8 - Establish contact with Chair of IPY Observing Working Group. This is closed. See Section 4.3 of this Report for more information.

Action 9 - Contact OSE rapporteurs to start planning next NWP OSE Workshop. This action is closed. Planning for next OSE Workshop has started, and this ET will be able to make further progress.

Action 10 - Request CAS to look into options for sustaining the AMMA network. This action is closed**.** D/WWW verified President of CAS had sent a letter to the President of CBS proposing dialogue to look into options for sustaining AMMA network.

- New Action: D/WWW will contact Presidents of CBS and CAS to see if discussion on sustaining AMMA observational capability has taken place and report back to ET EGOS. Lead: WWW Dept. Estimated Completion Date: 31 July 2006.

Action 11 - Secretariat to contact JCOMM regarding issues to sustain Argo network. This action is closed. The meeting was informed by JCOMM representative that the Argo programme was still a Pilot Project that is now approaching its target of 3000 operational floats. In June 2006 there were nearly 2500 operational floats reporting their data freely from the world oceans. The programme is associated with JCOMM but is not formally part of it. Argo needs to complete the array and to sustain it long enough in order to demonstrate its value. JCOMM is following these developments with interest. The meeting agreed to close this action while stressing the required sustainability of the network.

ANNEX VI

ACTIONS RESULTING FROM ET-EGOS-2

In this Annex, the Actions List of ET-EGOS has been organised according to the Terms of Reference and Work Plan of the ET.

Terms of Reference, *Work Plan*, short-term objectives and actions

[Last updated, 10 August 2006]

(a) Update and report on observational data requirements of the WWW as well as other WMO and international programmes supported by WMO;
(b) Review and report on the capability of both ground-based and space-based systems that are candidate components of the evolving composite GOS;

4b. Update CEOS/WMO data bases of user requirements and observing system capabilities and include user reviewed R&D expected performances (regularly during 2005-2006, upon receiving information from data users and data producers).

USER REQUIREMENTS (URs)

For each application area, confirm or nominate a Point-of-Contact (PoC) for the Rolling Review of Requirements (RRR) process, to update the URs as appropriate, and to maintain the Statement of Guidance (SOG) for that application area

Global NWP — CBS - J. Eyre
- Update URs to take account of EUMETSAT post-EPS work
- Update SOG

Regional NWP — CBS - F. Rabier / J Pailleux
- Update URs to take account of EUMETSAT post-MSG and post-EPS work
- Update SOG

Synoptic Meteorology — CBS / E. Legrand -> who?
- Find new PoC (from PWS?) - J.Eyre/H.Puempel to progress
- Update URs
- Confirm or update SOG

Nowcasting and VSRF — CBS / PoC tbd
- Find new PoC (from PWS?) - J.Eyre/H.Puempel to progress
- Update URs, including taking account of EUMETSAT post-MSG and post-EPS work
- Confirm or update SOG

Seasonal/Inter-Annual F. — CBS/(PoC tbd via ch. OPAG DPFS)
- Find new PoC (W.Landman?) –confirm with B.Strauss
- Update URs
- Confirm or update SOG

Aeronautical Meteorology — CAeM / H. Puempel -> who?
- Confirm new PoC
- Update URs
- Confirm or update SOG

Atmospheric Chemistry — CAS / L. Barrie
- Update URs
- SOG confirmed

Ocean Applications JCOMM / E.Charpentier
- Find new pocs for (i) URs and SOG (ii) OSCs for ocean in situ
- Update URs including to take account of: recent changes in UR (e.g. Tsunami monitoring), EUMETSAT post-EPS work
- Following action on OSCs (see below), conduct RRR
- Following consideration of JCOMM/OCG phased implementation plan and gap analysis, update SOG

Agro-meteorology CAgM / M. Sivakumar
Update URs
SOG confirmed

Hydrology CHy / W. Grabs
Update URs
Confirm or update SOG

Climate Monitoring GCOS Office /H.Teunissen
Update URs
(SOG via GCOS adequacy report – ET-EGOS to respond to GCOS IP) On SOG web page for Climate Monitoring, point to GCOS Adequacy reports and IP
Check response to GCOS IP actions on CBS

Other Climate applications CCl / R. Heino
Agree homogeneous application areas
Create URs
Perform Critical Review
Create SOG(s)

OBSERVING SYSTEM CAPABILITIES (OSCs)

Obtain update from CIMO on in situ OSCs for characterizing upper tropospheric and lower stratospheric temperature and moisture.
- R.Stringer, Aug 06

Review recent ET-SAT updates to space-based OSCs
- J.Eyre to lead, Mar 07

Review and update database of ground-based OSCs
- R.Stringer to lead, Mar 07

Assure consistency with recent CBS monitoring statistics on horiz res
- R.Stringer, Mar 07

Update OSCs for ocean in situ, to take account of improved instrument and network performances
- E.Charpentier, Nov 06?

OTHER DATA BASE ISSUES

Include capability for “break-through” values in database
- WMO Space Programme, by Dec 06

Request updated UR and OSC information from identified PoCs
- WMO Space Programme, by Dec 06

Forward ET-SAT comments on SOGs to identified PoCs.
- WMO Space Programme, by Dec 06

(c) Carry out the rolling requirements review of several application areas using subject area experts (including atmospheric chemistry through liaison with CAS, marine meteorology and oceanography through liaison with JCOMM, aeronautical meteorology through liaison with CAeM, agrometeorology through liaison with CAgM, hydrology through liaison with CHy, and climate variability and change detection through liaison with CCl and GCOS);

4c. Continue Rolling Review of Requirements for ten application areas and expand to new areas as advised by CBS (2006).

See 4a above.

(d) Review the implications of the Statements of Guidance concerning the strengths and deficiencies in the existing GOS and evaluate the capabilities of new observing systems and possibilities for improvements and efficiencies in the GOS; taking particular care to examine the implications of changes in observing technology, in particular changes to automated techniques (such as Automated Surface Observing Stations), on the effectiveness of all WMO Programmes, and report on major consequences in a timely fashion;

4d. Work with application area Points-of-Contact to update Statements of Guidance (during 2005-2006).

See 4a above.

(e) Carry out studies of hypothetical changes to the GOS with the assistance of NWP centres;

4e. Review with Rapporteurs and NWP experts the progress concerning OSE guidance for evolution of GOS, taking into account EUCOS, African AMDAR studies and other related studies (2006).

Study the impact of all AMDAR data over southern and central Africa in Global NWP
- J.Pailleux, to consider whether early study is justified and, if so, to engage NWP centres. Aim to complete studies by Dec 07.

Advise on requirements for vertical resolution in AMDAR observations and in particular layer averaging for humidity
– S.Goldstraw to communicate results of completed UK Met Offfice study to AMDAR Panel, by Oct 06 (?)

Study the sensitivity to density (spatial and temporal) of in situ sea surface observations (pressure and wind) in an OSSE.
Feedback from P.Menzel, 2 Feb 06: Positive response from S.Lord, 20 Dec 05).
– J.Eyre to discuss with S.Lord, Aug 06

Organise next NWP OSE Workshop for 2008
- J.Pailleux to lead with Organising Committee: finalise organising committee; select dates and venue, by Oct 06

Impact studies for AMMA
- J.Pailleux to propose appropriate impact studies, Oct 06

Impact of surface pressure obs in S.Hem

- J.Pailleux to propose appropriate study based on denial of N.Hem data, Oct 06

(f) Maintain and update the Implementation Plan for Evolution of the GOS, taking into account developments with respect to GEOSS; monitor progress against the Plan, report progress and updated Plan through ICT-IOS to CBS;

4f. Initiate actions, monitor and assure progress on Implementation Plan and coordinate this activity with the Rapporteurs/Coordinators on the Regional aspects of the GOS (2005). Prepare a summary of implementation aspects (2006)

.

Secure more resources for Secretariat, to enable pursuit of IP actions regarding ground based sub-component of GOS.
- Chairman to make recommendation to CBS via ICT. Sep 06.

Transform EGOS-IP into more complete Plan.
- WWW Dept to develop strategy for transforming EGOS-IP into a more comprehensive plan, incorporating strengths observed in GCOS IP without losing focus on Member needs I presently has. Lead: WWW Dept. Estimated completion date: Jul 07.

Monitor responses from regional rapporteurs on progress with regard to the recommendations in the IP concerning ground based sub component of the GOS as appropriate to their region.
- WWW Dept to continue to monitor responses and to report quarterly.

Improve communication of IP to regions
- Chairman to propose to ICT the ideas in Annex IV of ET-EGOS-2 report, Sep 06

Sustain the AMMA network beyond the end of the AMMA experiment. – D/WWW to contact Presidents of CBS and CAS to see if discussion on sustaining the AMMA network has taken place and report back to ET-EGOS. Estimated completion date: 31 July 2006.

Improve interaction between ET-EGOS and ET-AWS concerning EGOS-IP
- Chairman to ET-AWS comments on EGOS-IP, Oct 06

Assess the impact on applications of having 1 scatterometer plus 1 or 2 polarimetric microwave imagers , rather than 2 scatterometers (see EGOS-IP S7)
- WMO Space Programme to provide analysis of planned insruments and missions
- J.Eyre, E.Charpentier to seek guidance from expert users in NWP and ocean applications, Oct 06

Table driven codes to communicate (inter alia) high-resolution radiosonde data.
- Chairman to contact Chairman CT-MTDCF to coordinate migration strategy issues relevant to this item of EGOS-IP. Oct 06.

Formulate statement on lightning detection for G/B part of IP
- J.Eyre, S.Goldstraw to propose suitable statement, Mar 07

(g) Prepare a document to assist Members, summarizing the results from the above activities.

- Chairman to report to ICT on relevant activities: revised IP, proposals for communication of IP to the Regions, Sep 06

(x) Other activities

4a. 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 (2005-2006).

- WWW Dept to update, as necessary.
ET members to review every 3 months, and report back any problems.

4h. Follow up on CBS approved recommendations for the evolution to the GOS with particular attention to the developing countries, develop a summary of these activities (2006).

See actions on communication of IP, 4f

NEW ISSUES

Interaction between ET-EGOS and IPY

Obtain near real-time distribution of IPY observations where possible
- Chairman to request Chairman OPAG/IOS to raise with OPAG/ISS. Oct 06.

Review results of observation gap analysis performed by IPY SC on Observations
- Chairman to make request to Chairman IPY SC. Oct 06

Brochure on EGOS

- Chairman to discuss with Chairman OPAG/IOS, Sep 06

EC Task Team on Integrated WMO Observing Systems

ET-EGOS to provide summary of how ET-EGOS might contribute to work on Integrated WMO Obs Systems and feedback on Task Team TORs – text in ET-EGOS-2 report
- Chairman to report to ICT, Sep 06

GCOS issues

Review proposal GCOS Reference Upper air Network
- ET-EGOS members to comment, via Chairman ET-EGOS, to GCOS Office by Nov 06

Interaction between GOS performance statistics and EGOS-IP

- Noting the work of WWW Dept to ensure feedback on performance of surface-based observing system to appropriate Regions/Members, ET-EGOS should develop a mechanism to ensure that this process informs and interacts appropriately with actions in EGOS-IP. The mechanism for achieving this to be discussed with IOS-ICT, Sept 06.

ANNEX VII

ET-EGOS – REPORT TO ICT-IOS

Draft of content

Introduction

Summary of collaboration with related activities

- THORPEX, IPY, AMDAR, EUCOS, GCOS, …

Rolling Review of Requirements process

- Progress on database of user requirements and observing system capabilities
- Progress on Statements of Guidance

Observing system impact studies

- Summary of progress
- Plans for next Workshop

Implementation Plan for the Evolution of the GOS

- Progress, including latest version of IP as annex

Proposals for next phase of ET-EGOS activities, 2007-8

- RRR process
    - continue and improve process to increase activity of Points of Contact and links to application experts à improved database content, improved SOGs
- Observing system impact studies
    - continue to montor progress at NWP centres
    - plan and hold next Workshop, early 2008
- Implementation Plan
    - IP to become more comprehensive, and to become a true “plan” of planned activities to improve the GOS, cf. GCOS IP
    - in the context of the new WMO integrated observing system
    - needs major increase in effort, e.g. high-level consultancies

Integrated Observing System

Work Plan

- ET-EGOS Work Plan for 2007-2008

ANNEX VIII

CORRESPONDENCE BETWEEN SATELLITE-RELATED ACTIONS IN THE GCOS IMPLEMENTATION PLAN AND RECOMMENDATIONS IN THE IMPLEMENTATION PLAN FOR THE EVOLUTION OF THE GOS

Action in the GCOS Implementation Plan (related to space-based observation)	**Corresponding EGOS-IP Recommendation**
C10 Ensure continuity and over-lap of key satellite sensors; recording and archiving of all satellite meta-data; maintaining currently adopted data formats for all archived data; providing data service systems that ensure accessibility; undertaking reprocessing of all data relevant to climate for inclusion in integrated climate analyses and reanalyses.	S1
A7 Ensure stable operation and processing of relevant operational satellite instruments for precipitation and the continuity of associated products.	S11
A11 Ensure continuous operation of AM and PM satellite scatterometer or equivalent observations.	S7
A19 Continue the system of satellites following the GCMPs to enable the continuation of MSU-like radiance data.	Addresses continuity of the GOS rather than its evolution
A20 GPS RO measurements should be made available in real time, incorporated into operational data streams, and sustained over the long-term. Protocols need to be developed for exchange and distribution of data.	S12
A22 Ensure continuation of a climate data record of visible and infrared radiances, e.g., from the International Satellite Cloud Climatology Project, and include additional data streams as they become available.	Addresses continuity of the GOS rather than its evolution
A 23 Research to improve cloud property observations in three dimensions	Research, in relation with S13, S16, S17, S18
A 24 Ensure continuation of Earth Radiation Budget observations.	S9
A 25 Establish a plan for and implement a consistent surface- and satellite-based global observing system for the atmospheric composition ECVs, based on common standards and procedures, and encourage data submission to WDCs.	Partly addressed by S 19
A 26 Develop and implement a comprehensive plan to observe the vertical profiles of GHGs, ozone and aerosols utilizing commercial and research aircraft, pilotless aircraft, balloon systems, kites, ground-based lidars and satellites	Partly addressed by S 19
A 27 Establish the GCOS/GAW baseline network for CO2 and CH4 and fill the gaps	Partly addressed by S 19
A 31 Develop and implement a coordinated strategy to monitor and analyze the distribution of aerosols and aerosol properties.	Partly addressed by S 16

O9 Ensure a continuous mix of polar orbiting and geostationary IR measurements combined with passive microwave coverage. [for SST]	Addresses continuity of the GOS rather than its evolution
O12 Ensure continuous coverage from one high-precision altimeter and two lower-precision but higher-resolution altimeters.	S8
O18 Implement plans for a sustained and continuous deployment of ocean colour satellite sensors together with research and analysis.	Not currently addressed
O23 Ensure sustained satellite (microwave, SAR, visible and IR) operations: improve the *in situ* observations from sea-ice buoys, visual surveys (SOOP and Aircraft), and ULS. Implement observations in the Arctic and Antarctic.	[sea ice] Not currently addressed
T14 Ensure continuity of current spaceborne cryosphere missions.	Not currently addressed
T24 Commit to continuous 10-30m resolution optical satellite systems with data acquisition strategies at least equivalent to the Landsat 7 mission for land cover.	Not currently addressed

CORRESPONDENCE BETWEEN SURFACE-RELATED ACTIONS IN THE GCOS IMPLEMENTATION PLAN AND RECOMMENDATIONS IN THE IMPLEMENTATION PLAN FOR THE EVOLUTION OF THE GOS

Action in the GCOS Implementation Plan (related to surface-based observation).	**Corresponding IEGOS-IP recommendation**
C11 – Prepare the data sets and metadata, including historic data records, for climate analyses and reanalyses	Not applicable
C18 – Develop standards and procedures for meta-data and its storage and exchange	G1 and G2
C19 – Ensure timely, efficient and quality controlled flow of all ECV data to International Data Centres	G1 and G3
C20 – Ensure that data policies facilitate the exchange and archiving of all ECV data	Not applicable
C21 – Develop modern distributed data services that can hanlde the increasing volumes of data nad which can allow feedback to observing network management	Not applicable
A1 – Detailed analysis of causes of GSN faults, followed by full implementation of the GSN	G3 and G4
A2 – Obtain major progress in implementation and systematic operation of the full WWW/GOS RBSN in compliance with the GCMPs	CBS / GCOS action required for clarification
A3 – Apply the GCMPs to all surface climate networks	New EGOS IP action is required
A4 – Develop guidelines and procedures for the transition from manual to automatic surface observing stations that incorporates the GCMPs	G21
A10 – Ensure availability of 3 hourly mean sea level pressure and wind speed and direction data from GSN stations	G3

A12 – Submit water vapour data from national netwroks to the International Data Centres	New EGOS IP action is required
A15 – Complete implementation of GUAN, including infrastructure and data management	G4
A16 – Specify and implement a Reference Network of high altitude, high quality radiosondes, including operational requirements and data management, archiving and analysis	New EGOS IP action is required
A17 – Improve implementation of the WWW/GOS radiosnde network compatible wit the GCMPs and in full compliance with coding conventions	G3, G4 and G8
A18 – Submit meta-data records and inter-comparisons from radiosonde observations to International Data Centres	G2 and G3
A21 – Develop standards and protocols for exchange of data from networks of grounds-based GPS receivers	G13
O34 – Undertake a project to develop an international standard for ocean meta-data	Not applicable
T10 – Strengthen and maintain existing snow cover and snow fall observing sites and recover historical data	New EGOS IP action is required