WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

OPAG ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON EVOLUTION OF THE GLOBAL OBSERVING SYSTEM
Third Session

Geneva, Switzerland, 9-13 July 2007

FINAL REPORT
(17 August 2007)

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).

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EXECUTIVE SUMMARY

The 3rd meeting of the Expert Team on Evolution of the Global Observing System (ET-EGOS) was held in the WMO building in Geneva from 9 to 13 July 2007.

The ET considered decisions and guidance from other WMO bodies concerning the WMO Integrated Global Observing System (WIGOS). It prepared some suggestions for the development of pilot projects that might form part of the WIGOS Implementation Plan.

The ET considered reports from various activities related to its work including: GEO/GEOSS, GAW, WWRP-THORPEX, International Polar Year (IPY), AMMA, AMDAR Panel and GCOS. Concerning IPY, the ET recommended closer liaison with the IPY data coordinator. Concerning GAW, it welcomed the link to the GAW technical Strategic Plan for 2008-2015 and the development of a WIGOS GOS/GAW pilot project under CBS/CAS. Concerning AMMA, the ET recommended that the leadership of the current AMMA management group be progressively taken over by ASECNA on behalf of the West African NMHSs involved in AMMA and that ASECNA should work with two or three NWP centres to carry out detailed monitoring of AMMA radiosondes. Concerning AMDAR, the ET noted several requests for assistance from the AMDAR Panel to CBS and recommended that these should be considered further and should be forwarded to Chair OPAG/IOS. Concerning GCOS, the ET: reaffirmed the need for reliable operation of GUAN stations on the Indian subcontinent and supported GCOS efforts in the area; recommended that the GCOS Secretariat lead an action to inquire into the possible cessation of CLIMAT TEMP messages; supported development of the proposal for the GRUAN and welcomed the offer of Lindenberg Observatory as a Lead Centre for GRUAN for an initial “pilot phase”.

The ET reviewed the status of the WMO/CEOS database of user requirements for observations and of observing system capabilities. It defined detailed actions for the review and updating of the database. The ET then reviewed the status of Statements of Guidance (SOGs) in 12 application areas. In each case, it either approved the proposed new version or agreed actions needed to prepare an updated version.

The ET reviewed progress on studies through which real and hypothetical changes to the GOS are assessed for their impact on NWP performance. The ET was pleased to note good progress on preparing the 4th WMO Workshop on “The impact of various observing systems on numerical weather prediction” in Geneva, 3-5 March 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 version, as a record of recent progress and next actions. This review took note of comments from other bodies, including from CIMO representatives. The ET also considered reports on the responses to EGOS-IP in all WMO Regions.

The ET discussed the need to update the Vision for the GOS. It was informed of the outcomes of a recent Workshop on Re-design and Optimization of the space-based GOS (OPT-2, Geneva, June 2007), which had considered a new “Gap Analysis” for the space-based GOS and had provided input for an updated Vision for the GOS. The ET prepared a preliminary draft of a “Vision for the GOS in 2025” and proposed a schedule of activities, involving itself and other CBS ETs, to prepare a revised Vision for consideration by CBS in 2008/9.

As requested by CBS Ext (2006), the ET discussed the potential of long-range ground-based remote sensing lightning detection systems as a cost-effective solution to improve coverage in data sparse regions. It agreed that such systems were suitable candidates for the GOS and that they should be included in the EGOS-IP and the “Vision for the GOS in 2025”.

GENERAL SUMMARY

1. ORGANIZATION OF THE SESSION

1.1. Opening of the meeting

The third session of the Expert Team on Evolution of the Global Observing System (ET-EGOS) was held in the WMO building in Geneva from 9 to 13 July 2007. Professor Hong Yan, Deputy Secretary-General opened the meeting on behalf of the Secretary General of WMO. He referred to the outcomes of the Fifteenth WMO Congress relevant to the GOS and emphasized the role of ET-EGOS in the work towards enhanced integration between the WMO observing systems.

Dr Eyre, Chairman of ET-EGOS, thanked Professor Hong Yan for his opening remarks. He was confident that the session would work hard to fulfil its obligations.

The list of participants is given in Annex I.

1.2. Adoption of the agenda

The ET-EGOS adopted the Agenda for the meeting, which is reproduced at the beginning of this report.

1.3. Working arrangements

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

2. REPORT OF THE CHAIRMAN

2.1. Dr Eyre recalled the Terms of Reference (TOR) and the Work Plan of ET-EGOS and reported on activities related to the work of the ET since the last meeting, ET-EGOS-2, 10-14 July 2006. He also sets out some of the key challenges for ET-EGOS-3 and beyond.

2.2. The meeting of ICT-IOS, 11-15 September 2006, had accepted the proposed work plan of ET-EGOS with two significant changes:

- The “Vision for the GOS” was in need of review, and ET-EGOS was asked to work with other IOS ETs to prepare an updated Vision;

- The proposal to develop a more comprehensive Implementation Plan for the Evolution of the GOS (EGOS-IP) was not accepted by ICT-IOS, who recommended that the EGOS-IP should retain its current form and that regular updates of the EGOS-IP document should continue as a record of progress, but that these should not be presented to Members as a revised plan.

With these changes the proposed work plan was accepted at CBS Extraordinary session in 2006, with a few additions (see Abridged final reports with resolutions and recommendations of the CBS Extraordinary session, Seoul, 9-16 November 2006, WMO-No. 1017).

2.3. Since ET-EGOS-2, substantial progress had been made on improving links to application areas; three new application “Points of Contacts” had been appointed: Nowcasting and VSRF – Dr Stan-Sion (National Meteorological Administration, Romania); Seasonal and Inter-Annual Forecasting – Dr Landman (South African Weather Service); Aeronautical Meteorology – Dr Shun (Hong Kong Observatory). Other new members joining ET-EGOS were: Dr Riishojgaard

(NASA/GSFC), representing the USA; Dr Dibbern (Deutscher Wetterdienst), representing EUMETNET/EUCOS; Dr Menne (NOAA/NESDIS), OPAG/IOS rapporteur on GCOS.

3. REVIEW OF ACTIONS

3.1. Progress on actions from ET-EGOS-2 was reviewed and many actions were closed. Open actions were considered later in the meeting and several were modified. These, together with additional actions decided at ET-EGOS-3, are listed in Annex V.

4. WMO HIGH-LEVEL ACTIVITIES RELEVANT TO ET- EGOS AND OPAG-IOS

4.1. Guidance from Chair of OPAG-IOS

4.1.1. The ET considered the written guidance for the meeting from the Chair of OPAG-IOS, Dr Purdom. He updated the ET on the outcomes relevant to the ET's work from meetings in the last year: CBS Ext (Nov 2006), WIGOS concept meeting (Jan 2007), THORPEX ICSC (April 2007), WMO Congress and Executive Council (May 2007), CBS Management Group (CBS MG-7, June 2007) and the Optimization Workshop for the space-based component of the GOS (OPT-2, June 2007). In particular, he drew attention to the outcomes of the CBS MG concerning WIGOS, AMDAR and IPY, and he asked the ET to take note of the following MG decisions:

- to consider new ways of measuring the effectiveness of the GOS,
- to participate and continue to support studies of observation targeting strategies based on THORPEX, AMMA and IPY results,
- with other IOS ETs and rapporteurs and following the guidance of EGOS-IP, to pursue, especially in developing countries a wider use of observing systems that are less dependent on infrastructure, expertise and funding,
- with ET-AWS, to promote the use of automatic weather observing systems that enable cost-effective real-time measurements comparable with data from conventional systems, of quality and reliability suitable for operational use,
- to establish national points of contact responsible for reporting progress and plans in their country related to EGOS-IP,
- with other IOS ETs and rapporteurs and in coordination with WG PIW to promote implementation/evolution of the GOS in the regions through sustainable functioning of RBSNs/RBCNs and keeping under continuous review related regional requirements.

4.2. WIGOS

4.2.1. Dr Hayes, Director of the WWW, presented relevant decisions and guidance of Fifteenth WMO Congress, Fifty-ninth Executive Council and the Seventh session of the CBS Management Group as regards the WMO Integrated Global Observing System. He requested the ET to address the objectives of the integration process as laid down in Cg-XV/PINK 7.4(3) with a view of:

- Assessment of the WIGOS concepts;
- Further specification of the proposed roadmap;
- Providing guidance for the development of concepts and plans for Pilot projects; and
- Starting the preparation for the WIGOS Implementation Plan.

4.2.2. Director of AREP, Dr Barrie briefed the group on GAW, an important component of WIGOS. He presented to the chairman the GAW Strategic Plan for 2008-2015 (WMO TD NO. 1384)

developed by the Open Programme Area Group on Atmospheric Chemistry and Environmental Pollution for the Commission for Atmospheric Science. This technical implementation plan clearly defines the GAW programme and can be used as a reference document in ensuring strong links between GOS and GAW. It was pointed out that GAW is framed within the context the IGOS Theme Report on Integrated Global Atmospheric Chemistry Observations (IGACO) (WMO TD No. 1235) and implements recommendations in Chapter 5 of that strategy. The main difference between this new GAW strategic plan and earlier ones is that GAW is concerned with integration of all components of the observing system including aircraft and satellite observations with attention paid to data quality, data management and the evolving WMO Information System

4.2.3. Following the ET Chair proposal, an ad-hoc group was established to address the above issues, concentrating on the development of a proposal for pilot projects. The results of the ad-hoc group and conclusions of the ET are presented in Annex IV.

4.3. GEO/GEOSS activities

4.3.1. The ET reviewed a summary of GEO/GEOSS activities since the second session of ET-EGOS held in July 2006. The meeting noted that with regard to the GEO Work Plan for 2006, WMO either led or contributed to more than 36 of the 96 GEO 2006 Work Plan tasks including the development of GEONETCast and specific tasks related to weather, water, climate and disasters. For the GEO Work Plan for 2007-2009, the meeting noted that WMO is contributing to 40 of the 80 Tasks, including leading 15 Tasks including a new Task for the WMO Information System (WIS).

4.3.2. The meeting was informed that the CBS MG-7 had requested the CBS President and Secretariat to develop appropriate communication to the GEO Secretariat covering the following CBS concerns:

(a) Need by WMO Members to better understand the benefit to NMHSs;

(b) Need to better understand the development and implementation strategy;

(c) GEO Branding of WMO Member products.

4.3.3. The meeting also noted that WMO has registered eight component systems into the GEOSS Registry thus taking the first steps towards making WMO data and information available through the GEOSS Interoperability arrangements to the global community. These systems were GAW, WIS, WWW GOS, GCOS, GTOS, GTNH, WHYCOS, and GOOS. The meeting also noted the analysis of the WMO Strategic Plan that demonstrated seven of the WMO's 11 Expected Results were directly related to GEO Tasks to which the WMO will either lead or contribute.

5. REVIEW OF OTHER ACTIVITIES RELATED TO ET- EGOS AND OPAG-IOS

5.1. THORPEX activities

5.1.1. ET-EGOS is well connected to THORPEX activities through Chair OPAG/IOS, Chair ET-EGOS and Rapporteur for global OSEs and OSSEs (Dr Purdom, Dr Eyre and Dr Pailleux, respectively) who are members of various Thorpex committees. No substantive results from THORPEX work were yet available to inform ET-EGOS activities, but contacts would be maintained and, in particular, THORPEX-related work would be well represented at the forthcoming Workshop on Impact Studies (see section 8.2).

5.2. IPY activities

5.2.1. The ET noted substantial progress made by WMO/ICSU Joint Committee for IPY and its Sub-Committees as well as the Inter-commission Task Group on IPY and technical commissions on preparation of the IPY implementation stage that had started on 1 March 2007. The ET reiterated the need to exchange observational data obtained within IPY projects in near-real time mode. Taking into account that not all IPY data have corresponding formats for transmission through GTS, the meeting recommended that IPY data could, if necessary, be distributed via email (as it is done in AMMA project), noting that RTHs have abilities to accept data through this channel.

5.2.2. The meeting recommended that more close connection should be established with IPY data coordinator Mr Godoy (Norwegian Meteorological Institute) who is responsible for monitoring of IPY operational geophysical data flows. The meeting felt that it would be highly desirable if data coordinator could prepare and publish an IPY data inventory to inform NWP centres what data are available.

5.2.3. Considering the issue of IPY legacy, the meeting recognized the need of close cooperation between ET-EGOS and IPY bodies dealing with the legacy of new observing systems established during IPY. However, the meeting expressed the opinion that it would be more appropriate to work on this matter when observing systems proposed in IPY projects will be definitely set up.

5.2.4. The meeting recommended that Chair maintains close contacts with IPY Subcommittee on Observations through Dr Sarukhanian, Special Adviser to Secretary-General on IPY

5.3. AMMA activities

5.3.1. The AMMA campaign showed that the primary radiosonde problems for West Africa are supply of consumables and communications. It showed also that it was possible to achieve a very good radiosonde network through a management group able to deal promptly with infrastructure and consumables.

5.3.2. It is recommended that the leadership of the current AMMA management group is progressively taken over by ASECNA on behalf of the West African NMHSs involved in AMMA. ASECNA should work with two or three NWP monitoring centres able to carry out a detailed monitoring of AMMA radiosondes. The first tasks to be performed by the new ASECNA-led group are:

(a) To put on the GTS the remaining radiosonde sites which are operated now, but do not reach the GTS;

(b) To follow the monitoring results and react promptly to identified problems by contacting the people operating the radiosonde site;

(c) To look for funding solutions for consumables and infrastructure maintenance beyond 2008.

5.4. AMDAR activities

5.4.1. Since the 2nd Session of ET-EGOS the global AMDAR programme has continued to make progress on implementing national and regional AMDAR programmes and to improve overall global AMDAR data coverage. The AMDAR Programme now exchanges approximately 220,000 to 250,000 observations per day on the GTS.

5.4.2. Many of the AMDAR points of contact within the NMHSs are aviation forecasters with little background in Observations or NWP. The AMDAR Panel requested assistance from ET-EGOS to

help develop other relevant contacts within the NMHSs to better assist with the development of national and regional AMDAR programs.

5.4.3. Unlike other GOS observing systems, AMDAR is not owned or operated by a NMHS or Member. The AMDAR Panel requested ET-EGOS to encourage those AMDAR Panel Members that have or are intending to implement an AMDAR programme to develop AMDAR data agreements with their national and/or regional airline(s).

5.4.4. Many of the AMDAR Panel members have recognized that data optimization is an essential component of an operational programme. The AMDAR Panel requested the assistance from ET-EGOS to help operational AMDAR programs develop better forecasting and NWP requirements for their AMDAR data optimization system(s).

5.4.5. The AMDAR Panel also requested assistance from CBS to help maintain the essential programme of AMDAR training workshops which have been crucial in the development of national and regional AMDAR programs.

5.4.6. The AMDAR Panel as part of its work plan will work towards the development of a water vapour sensor and an AMDAR software solution as standard part numbers for all aircraft makes and models. With the assistance from WMO the AMDAR Panel will request WMO Members to work with aircraft manufacturer and their local airline industry to include AMDAR software and water vapour hardware as a standard option for all future aircraft purchases.

5.4.7. The AMDAR Panel requested assistance from ET-EGOS members to help develop the business case for AMDAR and for the inclusion of water vapour sensors with generic software solution for all major aircraft makes and models.

5.4.8. The ET noted these requests from the AMDAR Panel and agreed to carry them forward through the report of the ET-EGOS Chair to the OPAG-IOS Chair.

5.5. GCOS activities

5.5.1. The CBS Rapporteur on GCOS Matters provided an update to the ET on several items for discussion at the session, including:

(i) The Satellite Supplement to the GCOS Implementation Plan and relevant follow-up action;

(ii) Update to the GCOS Implementation Plan in 2009;

(iii) New CBS Lead Centres for GCOS data;

(iv) Implementation of GSN and GUAN;

(v) Relevance of CLIMAT TEMP reports;

(vi) Progress towards establishing the GCOS Reference Upper-Air Network;

(vii) Update of GCOS observation requirements; and

(viii) Relation between the IP-EGOS and the GCOS IP.

5.5.2. The ET reaffirmed the need for the reliable operation of GUAN stations on the Indian subcontinent. It supported the ongoing efforts by the GCOS programme to secure an agreement with India related to the full establishment of GUAN candidate stations, including improved instrumentation, and recommended the continuation of this dialogue.

5.5.3. Based on the recommendation of the ET, GCOS Secretariat agreed to draft, with help from CBS Rapporteur on GCOS matters and in collaboration with WMO WWW, a letter to Members announcing that the calculation and transmission of CLIMAT TEMP messages is no longer required for GCOS purposes and inquiring on possible consequence for other user communities.

5.5.4. The ET supported the development of the proposal for the GRUAN. It welcomed the offer by German Meteorological Service to serve, at its Lindenberg Observatory, as a Lead Centre for GRUAN for an initial 'pilot phase'. The ET recommended that this Lead Centre, in consultation with appropriate CBS and CIMO expert teams, GSICS panels and other relevant partners, develop the operational procedures and observing practices of the GRUAN for the inclusion in the Manual and Guide on the GOS. The ET also stressed that the GRUAN and GSICS activities maintain a close dialogue on matters of common interest.

6. USER REQUIREMENTS AND OBSERVING SYSTEM CAPABILITIES

6.1. Review and update the database of User Requirements and Observing System Capabilities

6.1.1. The meeting reviewed the status of the WMO/CEOS database of observational user requirements and observing system capabilities including a description of breakthrough and proposed changes to the database. The meeting recalled that its second session (ET-EGOS-2) had discussed the concept of "breakthrough". The "breakthrough" level is an intermediate value between "threshold" and "goal" that, 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-2 had agreed to introduce this new concept in the database, which entailed a minor change of structure but required new input from experts in all application areas. Members of the ET agreed to review all WMO observational data requirements for each application area.

6.1.2. Members of the ET agreed to review the present list of user estimates of expected observing system performances. In particular, the members of the ET agreed to update and/or validate all the expected performances for in situ systems noting that expected performances for space-based systems would be updated by ET-SAT.

6.1.3. With introduction of breakthrough values for URs, there is now the opportunity to review threshold requirements. It was agreed that, in some cases, they are currently too stringent. They would imply that some observations that are known to make a significant contribution to an application would still not be recognized as useful.

6.1.4. The ET considered actions to support the quality and utility of the User Requirements and Observing System Capabilities information within the WMO-CEOS database and agreed on the following conclusions:

(a) The most convenient and workable means of distributing copies of the database, or subsets as relevant, was in the form of Excel spreadsheets. These could be extracted from the database, but how to process the returned alterations would need to be considered further;

(b) The list of new parameters included in the GCOS user requirements were noted, but on balance it was thought better not to "lead" other application areas by prompting them to consider their requirements for the same parameters;

(c) Observing System Capabilities had been partly updated (space based components, ocean/marine components) but needed attention in other areas.

(d) The four sequential steps of the RRR process do not seem to be rolling. A timetable for a regular (annual) cycle is needed to:

- Review the user requirements (Point Of Contact for each application area);
- Review the observing system capabilities (see Annex V for details);
- Complete the critical review to identify gaps (WMO Secretariat to assist in case of need);
- Consequently provide the objective input to support the review of SOGs (Point Of Contact for each application area);

(e) In the immediate future a round of reviews of user requirements is needed (other than for the Global NWP and GCOS application areas), particularly to insert required values in the new "breakthrough" columns in place of the current default values;

(f) A timetable of September 30 for updates to the database would be useful, as it would allow updated material to be compiled and circulated by the end of October in time for a range of upcoming meetings. However, updates provided after this date would continue to be useful.

6.1.5 The meeting was informed of the timetable for the update of the database and issuance of the next version for 2007. It was anticipated that the next CD ROM version of the database would be available on 31 October 2007 and thus all inputs for the 2007 version should be available to the Secretariat by 30 September 2007

7. ROLLING REVIEW OF REQUIREMENTS AND STATEMENTS OF GUIDANCE

7.1. Overview of Statements of Guidance (SoG)

7.1.1. The Chairman recalled the elements of the Rolling Review of Requirements (RRR) process, of which the SoGs are the outcome. The SoGs, describing how well surface-based and space-based observing systems meet WMO user requirements in several application areas, are available through a set of web-based documentation http://www.wmo.int/pages/prog/sat/Refdocuments.html. The status and updating of SoGs for 12 application areas were then considered in detail. During this process the meeting considered the draft SoGs submitted by the application Points of Contact (PoC) and any comments on these or previous drafts that had been received since ET-EGOS-2. These included comments on the SoGs submitted by CIMO representatives, Mr B Y Lee and Mr J P van Meulen. Some of those will be acted on in updates of relevant SoGs and some will be passed to ET-SUP by the chair of the ET.

7.1.2. The ET emphasized that SOGs were essentially "gap analyses". All PoCs are encouraged to develop the SoGs so that they provide clear messages concerning the key gaps between URs and planned OSCs.

7.2. Status of individual Statements of Guidance and recommended update strategy

7.2.1. Global NWP

(a) Proposed updates to the December 2003 version of the SoG for Global NWP were considered at ET-EGOS-2 in July 2006. These updates were consolidated in a revised version of the SoG, which was submitted to the WMO Secretariat in January 2007. Since this version was distributed to ET-EGOS members, other issues had been raised:

- Should the SoG be updated to comment on the maturity of aerosol assimilation in NWP? It was agreed to reconsider the statements here.

- Should the requirements for global NWP cover sub-surface ocean temperature and salinity? This depends on the definition of the forecast period for global NWP, which the current SoG (introduction) defines as "out to 10 days". It was agreed to extend this range to at least 15 days, at which effects of sub-surface fields are agreed to become important. This would then leave no effective gap in requirements between those covered by "global NWP" and those covered by "seasonal and inter-annual forecasting".

(b) It was agreed to update the SoG to take account of these points, and also several issues raised by CIMO representatives.

7.2.2. Regional NWP

(a) Starting from the document updated in summer 2006, a small set of revisions was performed by Dr Pailleux on the paper documenting the regional SoG (mainly aiming at making the document more accurate). These revisions will be used together with other suggestions or comments (coming from the ET-EGOS, and also from outside experts) in order to produce a final version for September 2007, to be agreed by the chairman and put on the WMO web. One aspect to consider is to make the gap analysis for Quantitative Precipitation Estimates (QPE) with respect to the observational needs (in terms of raingauges, radars or others).

7.2.3. Synoptic meteorology

(a) The current SoG for this application was updated by Dr Puempel in June 2006. No progress had subsequently been made, as a new PoC for this application had yet to be identified. The ET agreed that there were important direct applications of observations in operational meteorology that were not adequately captured under other application headings, but it questioned whether "synoptic meteorology" was still an appropriate title. It suggested the name "General Weather Forecasting" to capture the group of activities within which operational forecasters make direct use of observations, but which are not captured under "nowcasting and Very Short Range Forecasting (VSRF)". It agreed to propose this change to OPAG/PWS and to invite them to nominate an appropriate PoC for this application

7.2.4. Aeronautical meteorology

(a) Aviation Meteorology is a highly specialized branch of Nowcasting and VSRF for a clearly defined user community. Some data requirements are of a purely local und user-focussed nature and may be outside the remit of an integrated global observing system (e.g. Runway Visual Range measurements, cloud base height measurements at a resolution of 15 m in the boundary layer).

(b) Other requirements are for very high resolution data with a basically global scope, such as very detailed information on winds (for wind shear detection) at all levels from near-ground to the lower stratosphere, visibility in the boundary layer for VFR flights, turbulence and icing again at layers throughout the lower to middle troposphere.

(c) Data sources with good overall performance in terms of coverage, horizontal and vertical resolution are rare. While quantitative information from space-based systems easily fulfils the requirements for global coverage (temperatures, to a lesser extent winds and moisture), their horizontal resolution could be termed as between threshold and breakthrough, but their vertical resolution invariably is insufficient.

(d) AMDAR winds and temperatures are beginning to acquire a satisfactory level of coverage over the Northern Hemisphere for en-route data, the highly useful profiles are still limited to some of the busier aviation centres, mostly North America, Europe and smaller parts of Asia and southern Africa.

(e) For crucial data near the surface (the most critical stages of flight are still final approach, landing and take-off) winds from Doppler WXR, Mesonets and Lidars /Profilers) are only available at some very-high traffic airports, and lacking at a majority of developing-country airports.

(f) Information on turbulence and icing can be deduced from space based imagery, in particular VIS, near Infrared and (for severe turbulence related to stratospheric intrusions near the jet and in steepening gravity waves) form Water Vapour channels and multi-channel imagery. Some of these products prove highly useful, but require post-processing and intense training of forecasters.

(g) Information on super cooled liquid water content is currently not available from any data source at the required accuracy and vertical resolution (the information is needed for Air Traffic control to avoid high-risk levels in the assigning of holding pattern), nor is there any reliable source of information on drop size spectra, which are crucial for the estimation of icing severity.

(h) First multi-spectral products (near-infrared) to detect super cooled liquid water in cloud tops are promising, but are susceptible to fail where higher ice cloud is present.

(i) For the detection of volcanic ash clouds, similar differencing techniques of near-infrared channels are proving highly useful, and techniques to identify the presence of SO2 are helpful in tracing the gaseous part of volcanic eruptions, with a risk of misinterpretation where ash cloud and SO2 cloud embark on different trajectories (typical for Plinian eruptions). However, apart from seismic and ultrasound networks (which are patchy), detection from space is still the data source with the best overall coverage.

(j) The current version of the SOG is planed to be updated by the end of July 2007

7.2.5. Atmospheric chemistry

(a) No change was made in the SoG since last version.

7.2.6. Ocean applications

(a) The JCOMM Representative presented the status of the JCOMM SoG for Ocean Applications. The meeting noted with appreciation that much efforts had been made since the last ET-EGOS meeting to update the SoG taking into account the most recent developments in the JCOMM community in terms of (i) user requirements, and (ii) dramatic development of the marine in situ observing systems (e.g. drifting buoys, Argo profiling floats, VOSClim fleet, tropical moorings).

(b) The nominated PoC on user requirements, Dr Donlon, chairperson of the JCOMM Services Coordination Group, has been working extensively within the Services Programme Area of JCOMM and its Expert Teams on developing an Observations User Requirement Document for JCOMM services (URD) consistent with the RRR process. The document is focusing on met-ocean forecast systems, which includes (i) ocean mesoscale forecast, (ii) met-ocean products and services (e.g., wind waves and storm surges, marine accident and emergency response, and sea ice services). However, the document is still in draft form. It is showing different approaches for these applications, and is lacking some of the required variables for the database.

(c) The nominated focal point for providing estimates of instrument performances, Ms Viola, JCOMMOPS, has been conducting a study and appropriate data have been provided to the WMO/CEOS database. An updated version (draft) of the SoG for Ocean Applications was presented to this ET-EGOS Session.

(d) The ET agreed that the lack of global in situ wave observations was an identified gap that had to be addressed in order to meet the requirements for maritime safety services. In situ wave observations are particularly needed for (i) assimilation into offshore wave forecast models, (ii) validation of wave forecast models, (iii) calibration/validation of satellite wave sensors, and (iv) description of the ocean wave climate and its variability on seasonal to decadal time scales. The meeting agreed to add an item in this regard in the implementation plan for the evolution of the GOS (action, ET-EGOS). Other identified gaps to be included in the plan comprise the need for high temporal in situ SST data, and the increase of the VOSClim fleet. Regarding ocean surface topography, the meeting agreed that the potential gap in terms of sustainability should be considered with regard to approved satellite missions and recommended JCOMM to update the SoG accordingly.

(e) After discussion, the meeting made the following recommendations (i) JCOMM to include all the required fields (threshold, goal, and breakthrough values for the five required parameters) for all required observing variables and to submit the data to WMO/CEOS database, (ii) JCOMM to conduct again the RRR process based on those requirements and recently updated instrument performances and update the SoG accordingly. The meeting recommended that the new SoG should stress on gap analysis and include a summary of that analysis. A JCOMM approved version should be submitted to the ET-EGOS Chair by the end of 2007.

7.2.7. Agrometeorology

(a) Weather data are needed on a regular basis by the agriculture, forestry and fisheries sectors for both strategic and tactical applications. These data assist the land management agencies in a variety of projects such as monitoring air quality, rating fire danger, and providing information for research applications. The collection of agrometeorological data is critical for producing agricultural advisory products (bulletins, warnings), developing and running crop weather-yield and soil moisture models, and verifying (ground truth) satellite observations especially precipitation. The ground observations needed for agricultural meteorology include the basic variables (air temperature, precipitation, relative humidity, wind speed/direction), Soil moisture and soil temperature, Solar radiation, data on snowmelt, phenology, and aeolian sedimentation loads. Satellite observations on the following elements are also needed: Leaf area index (LAI), vegetation type and cover, fires, frost, soil moisture, solar radiation, precipitation, and phenology.

(b) The ET requested that an analysis of gaps should be provided for next version of this document by the Management Group (MG) of the Commission of Agricultural Meteorology. The MG will next meet in the first half of 2008.

7.2.8. Hydrology and water resources

(a) At the outset it was pointed out that the “Hydrology Requirements” presented in the document were based on the requirements expressed by Terrestrial Observation Panel on Climate (TOPC) (GCOS, 1997) and endorsed by an expert meeting on the Establishment of a Global Terrestrial Network – Hydrology (GTN-H). These have also been discussed in detail in the integrated Water Cycle Observations (IGWCO) theme of the IGOS Partners in 2004. It was mentioned however, that despite the efforts to bring the space observations in hydrology into mainstream in the activities of CHy, the Commission is still in the process of setting up a mechanism to look into this issue. It was also pointed out that the process of getting the inputs

from the Water Management user groups is also under way and during the next session of the CHy the issue would be discussed in details and a new update on the SOG would be provided thereafter. It was also mentioned that at present there is no mechanism to fully identify the gaps between the requirements of hydrology and the GOS capabilities.

(b) The requirement of following parameters was described. Surface Water Discharge, Surface water storage fluxes, Ground water fluxes, Precipitation (liquid/solid), Isotope signatures, Evaporation, Vapour pressure / Relative humidity, Soil moisture/Soil wetness, Snow cover, depth, and water equivalent and glaciers, Land surface temperature, Vegetation type and NDVI, Short-wave and Long-wave outgoing radiation at TOA, Biogeochemical (BGC) fluxes from land to ocean, Water Use. Examples of products that can be developed on the basis of these selected variables were provided.

(c) Precipitation depth and type are routinely observed on an hourly to daily basis at synoptic weather stations but there are large regional differences in coverage; spatial and temporal coverage of rainfall observations is improving using ground radar techniques. Terrestrial measurements of evaporation are declining in terms of spatial coverage; flux towers numbers are very limited, with data not readily available on a global scale.

(d) Gravimetric measurements of changes in large aquifers from GRACE and GOCE are still to be used operationally.

(e) In most fields of applications, satellite information has not been used operationally for hydrological purposes. Focus needs to be laid on the integration of in-situ and space based observations for hydrological applications in a comparable space and time domain and of acceptable accuracy.

(f) The process to update the SoG would be set up during the next meeting of the Advisory Working Group of CHy in February 2008 and hopefully accomplished during the next session of the Commission for Hydrology scheduled for the fourth quarter of 2008.

7.2.9. Climate monitoring (GCOS)

(a) See Section 5.5 for the discussion on this item.

7.2.10. Nowcasting and VSRF

(a) Currently Nowcasting and VSRF mostly address high-impact weather events affecting major population centres or crucial infrastructure or mass events.

(b) Techniques used are high-resolution models (requirements mirror regional NWP), dense surface networks (outflow boundaries, gust fronts, near-surface effects such as snow drifts, icing, sand and dust), weather radar networks, in particular Doppler radars (for wind information), and dual polarization (ice/liquid water discrimination), and increasingly satellite products, multi-spectral and difference images of multi-spectral sensors, derived products such as Atmospheric Motion Winds, surface wind over water etc.

(c) Crucial elements for further improvements are:

- Wider availability of weather radar networks, lightning detection networks;
- High update rates and higher horizontal resolution of satellite imagery;
- Soils moisture, leaf area products;

- Near-surface winds (speed and direction) over land (in-situ networks, (dual-) doppler radars.

(d) Currently most space-based systems have comfortably reached the breakthrough threshold, and some are getting close to target. Gaps exist in high latitudes (lack of GEO coverage), surface parameters, and temporal coverage for some LEO based products, where long gaps between overpasses may stretch timely detection reliability.

(e) For surface based systems (Mesonets, radars) breakthrough in terms of surface coverage is limited to high-density areas in developed countries, and even for those the use of “data of opportunity” such as private / industry networks and secondary use of e.g. air traffic radars with weather extractors are suggested as a cost-effective means of improving coverage.

(f) For the near-to medium term, a stronger “weather sensitivity” of societies with extreme population density and “stressed infrastructure in traffic, water supply, waste water/drainage and energy supply (in particular renewable energy sources) will require multi-parameter risk appraisal which will include “unspectacular” weather events , for which a more refined detection technique may become necessary than for the “high-profile” events such as violent storms, tropical cyclones or major snow storms.

(g) The ET agreed to refer these points to the PoC for this application area, so that they could be addressed in the next update of the SoG.

7.2.11. Seasonal and inter-annual forecasting

(a) The SOG on seasonal and inter-annual (SIA) forecasts was updated in 2006 by the Expert Team on Infrastructure for Long-Range Forecasts in consultation with other experts in the field. The current version of the SOG was recently brought up-to-date by Willem Landman who is the Point of Contact for SIA forecasts.

(b) The SOG for SIA forecasts builds on the requirements for global NWP and represents in addition those variables that are known to be important for initialising models or for testing and validating models. These are mainly the ocean surface and sub-surface parameters, such as temperature, salinity and ocean current, but also the parameters describing the land surface conditions. The document concludes with the summary highlighting current deficiencies and lack of data required for SIA forecast activities

7.2.12. Climate (other aspects – CCl)

(a) Mr Heino, Chair of the CCl OPAG1 (Climate Data and Data Management), presented the status of Climate application SoG, which was requested by ET-EGOS-2. CCl ET on Observing Requirements and Standards for Climate (ET-ORSC) discussed the issue in its meeting in March 2007 and concluded that possible new SoGs will be studied under the guidance of the OPAG1 chair together with the CCl-OPAG4 (Climate Applications and Services). In the meantime, the CCl has prepared several Guideline Statements. These publications, together with the new CCl Guide, will constitute the basis to prepare the SoGs in question. Further inquiries to CCl-OPAG4-ETs are being made and the SoGs, if any, will be presented for the consideration of the next ET-EGOS meeting.

(b) There are four expert teams under CCl-OPAG4 dealing with climate applications in the sectors health, energy, tourism and urban and building climatology. Additionally, CCl-OPAG3 (Climate Information and Prediction Services CLIPS) consists of rapporteurs on climate applications in water and agriculture. The climate application sectors can be grouped as “technical applications” (e.g., energy) and “bio applications (e.g., health, tourism), while some of them have

an overlap with technical and bio aspects (e.g., building climatology). The climate requirements of application sectors is primarily in terms of information and prediction services that feed into decision making and climate related risk management strategies within their specific domains. The application sectors by themselves may not be in a position to determine the observing system requirements. There is therefore a clear need for close liaison between climate service providers and the users to identify the climate products, and the observing system requirements for generating such products. This may be addressed as a cross-cutting issue between the CCl OPAG3 and OPAG4.

8. OBSERVING SYSTEM STUDIES

8.1. Summary of recent OSEs/OSSEs

8.1.1. A summary of the main current projects related to impact studies (OSE, OSSE) was given by Dr Pailleux, co-rapporteur on the subject. The main projects are: (i) the set of OSEs triggered by EUCOS and performed in Europe; (ii) the major OSSE initiative in USA, which involves also ECMWF for nature run production; (iii) the observation studies related to AMMA. It was also mentioned that the current period 2006-2007 is exceptionally active in terms of introduction of new observations into operational data assimilation schemes. This activity leads directly to an evaluation of each of these new observing systems (terrestrial GPS networks, GPS radio-occultation data from several satellites, advanced infra-red sounders).

8.2. Planning for next CBS OSE/OSSE Workshop

8.2.1. A workshop is planned on impact studies (OSE, OSSE), to be held in WMO headquarters (Geneva) on March 3-5th 2008. The status of the preparation was given by Dr Pailleux who is leading the organizing committee. Dr Ondráš will replace Dr Karpov inside the organising committee representing WMO Secretariat. A draft scientific programme and a draft budget will be prepared for September 2007, by Dr Pailleux, in consultation with Dr Ondráš.

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

9.1. Review of progress and actions on the surface-based sub-system of the GOS

9.1.1. Dr Böttger reviewed the action list from the previous meeting of ET-EGOS on the evolution of the surface based component of the GOS. He noted that while some significant progress had been made with actions related to aircraft and marine data, progress had been slow in other areas. The ET agreed that new action items need to be formulated with a focus towards specific results to be achieved during the coming intersessional period. The structure of the document was to be maintained for another year, when it is expected that a new vision for the evolution of the GOS will be formulated, which will also require a major revision of the related action items. Following further review and discussion at the meeting, the updated version of the EGOS-IP is presented in Annex II, Section 2.

9.2. Review of progress and actions on the space-based sub-system of the GOS

9.2.1. Mr Lafeuille presented the space-based part of the EGOS-IP. Since ET-EGOS-2, this had been reviewed by ET-SAT-2 in September 2006, and had been recently updated in order to reflect the latest progress made on several actions at the Workshop on re-design and optimization of the space-based GOS that was held 2 weeks before the session. (see 9.5.3 – 9.5.6)

9.2.2. Mr Lafeuille underlined in particular the successful implementation of recommendations on Calibration (S1) through the GSICS project, and LEO data timeliness (S5) through the RARS, and the substantial progress achieved through the optimization workshops with regard to

complementary polar systems (Concern 2), LEO temporal coverage (S6), LEO Sea Surface wind (S7) and LEO altimeter (S8). He reported that GEO Sounders (S3), GEO Orbital Spacing (S4), LEO Earth Radiation Budget (S9), GPM (S11), Radio-occultation (S12), and GEO sub-mm (S13) were also being considered with a lot of attention but required further effort to progress significantly.

9.2.3. Following further review and discussion at the meeting, the updated version of the EGOS-IP is presented in Annex II, section 3.

9.3. Review of progress and actions concerning IP-EGOS in the WMO regions

9.3.1. The ET agreed that the review of progress would require more resources within the Secretariat to pursue these actions effectively and recommended that Secretariat to explore ways of using consultancy to work with national focal point of each country.

Regional Association I

9.3.2. Mr Saloum presented the current status and the evolution of the GOS in RA I.

9.3.3. The ET was informed that the fourteen session of RA-I (February 2007, Burkina-Faso) had adopted the CBS recommendations for the evolution of the GOS. In preparing its Strategic Plan, RA-I considered four relevant recommendations for surface sub-systems (among the twenty-two indicated in the EGOS-IP) to carry and support actions to evolve the GOS in Africa as follows:

1 G1: Data coverage and distribution

1.1 Ensuring adequate distribution of the RBSN and RBCN stations. RA-I has recognized the need and the necessity to distribute good SYNOP data from operational surface observing stations which are not currently exchanged internationally. In application of the action relevant to this sub-system, 1-) 126 surface stations carried full synoptic surface observing programme (eight daily SYNOP) and were added to the list of the new RBSN comprising a total of 739 surface stations; 2-) 92 CLIMAT stations were added to the new RBCN made of 728 stations.

1.2 Upgrading radio sounding equipments in stations in West Africa. With regard to the upper air component of the RBSN, it is worth noting the addition of five new upper air stations created by AMMA. Also, AMMA has enabled the re-activation of several stations through upgrading the radio sounding equipment in seventeen (17) upper-air stations in West Africa. However the Association was concerned about the sustainability of AMMA stations after the project and that it should be ensured. The Association agreed to the following recommendation:

- A study-analysis be carried out to identify which of the stations are absolutely necessary after AMMA and make all efforts to maintain the relevant stations and a programme of action be implemented with all avenues possible to be considered, in particular: (i) RA I Members should also make all efforts to maintain the rehabilitated sites and sustained the new stations of AMMA; and (ii) ASECNA should confirm commitment for upper-air stations after AMMA.

1.3 The exchange of the other relevant data reports. RA-I has urged Members to distribute, as quickly as possible, certain types of observations made routinely in near real-time, but not distributed worldwide such as the PILOT reports and

including regular aviation observations (METAR, SPECI, high resolution Radar observations, AWSs, Buoys Hourly SYNOP)

2 G9 AMDAR

2.1 AMDAR technology was considered by RA-I to contribute efficiently to the evolution of the GOS in Africa. The last session of RA-I stressed the full use of AMDAR ascent/descent data at major airports. Thus high priority was given by the Region in the achievement by the end of 2007 of the implementation of a full operational AMDAR programme in West and Central Africa.

3 G20 More profiles in Tropics

3.1 Temperature, wind and if possible the humidity profile measurements (from radiosondes, PILOT balloons and aircraft) should be enhanced in the tropical belt, in particular over Africa. Some preliminary OSEs have already been performed with AMMA data captured on the GTS. There are a lot of ideas and plans for testing all the observing systems.

4. G 21 AWS

4.1 The XIV-RA I considered the use of Automatic Weather Observing Systems as a new technology to promote the implementation/evolution of the GOS in Africa.

Regional Association III

9.3.4. Mr Torres presented the current status and the evolution of the GOS in RA III.

9.3.5. The technical limitations, such as the reception and decoding of AMDAR data prevent Members of the Region benefiting from additional upper-air information. An AMDAR Workshop for South America would be necessary to establish a plan for new national programs.

9.3.6. The perspective in the improvement of the GOS in RA III were closely related with:

(a) As a way of improving the net GSN and GUAN as for the provision and the sustainability of CLIMAT and CLIMAT/TEMP messages, a Regional Seminar was constructed in the Buenos Aires, Argentina, in October 2006 with the participation of representative of the countries of the Region.

(b) The activities associated with the implementation of the GCOS Technical Support Projects that will be carry out within the region during 2007 include to visit of some GUAN and GSN stations in Region.

(c) The activities of technical support by GCOS could include maintenance and repair of equipments to activate silent stations or to include new ones.

9.3.7. In view of the poor performance of the Observing System in South America, two projects have been proposed and submitted to the President RA III for consideration together with an implementation plan for surface-based sub system of the GOS in RA III, for consideration by members of the Working Group on Planning and Implementation of the WWW. The objectives of the project are:

(a) To improve the availability of information and of this form to reinforce the implementation of the GOS;

(b) To increase the quantity and quality of surface and upper-air meteorological data in the Region;

(c) To activate silent stations.

9.3.8. Following tasks will be performed to improve the surface and upper level network in RA III:

a) To establish the reasons of the deficiency in reception of CLIMAT and CLIMAT/TEMP In the CBS lead centre for GCOS in order to optimize the reception and improve the performance of GCOS network;

b) To increase the spatial resolution the GCOS network stations for regional studies of climate variability and climate change.

c) To improve the upper-level network of the region by the reactivation of silent or installation new upper-air stations.

9.3.9. The technical support project “Improvement of the net GUAN in Central and South America” is aimed at guaranteeing the operations of selected current upper-air stations. Some of them are already GUAN stations.

Regional Association II and V

9.3.10. Mr Stringer conveyed to the meeting the information provided by RA II Rapporteur on GOS, Mr Yongqing, on progress and actions concerning IP-EGOS in RA II. An Implementation Plan for Surface-Based Sub-Systems of the GOS in RA II has been drafted based on the plan from RA I, but will be further modified before being sent to the Secretariat. The plan will also be submitted to the RA II WG on PIW, fifth session which will be held in third quarter 2007, for review. Finally it will be submitted to the next RA II session which will be held in the next year for approval.

9.3.11. Mr Stringer also advised the meeting about progress in RA V, noting that the Fourteenth Session of RA V, held in May 2006, continued the Working Group on Planning and Implementation of the WWW in Region V (WG-PIW). Specific priorities given to that group were: enhanced access to and utilisation of satellite data; investigation of low cost lightning detection systems; and establishment of an affordable AMDAR programme for the Region. The Chair of the WG-PIW had prepared a commentary on relevant parts of the IP-EGOS to help guide plans and actions within RA V countries. A copy of that commentary was provided to the meeting, together with some observations about how that assisted plans and actions to take shape at a national level in Australia. It was noted that the implementation of many aspects of IP-EGOS ultimately rested on the understanding, motivation, capability and implementing actions undertaken at the national or Member level. Formulation of plans at a Regional Association level is by no means the end of the story. Mr Stringer also mentioned that a Southern Hemisphere Regional Committee (SHRC) for THORPEX had been formed and that several RA V countries were involved.

Regional Association IV and VI

9.3.12. Mr Klink reported to the meeting on progress and actions concerning IP-EGOS in Region IV by conveying information provided by Mr Stolz, RA IV Rapporteur on GOS. A reference document for the Implementation Plan for the Evolution of the GOS in the RA-IV was proposed in the Working group on Planning and Implementation of the WWW in Region IV, at the ad hoc meeting in Curacao, 26 March 2007. The conclusion about it was that 3 members (one from North America, one from the Caribbean countries and one from Central America) will review the document and will

propose changes related to the needs of each of the areas. The final document will be presented in the RA-IV meeting.

9.3.13. Mr Klink also informed the meeting about progress and actions concerning IP-EGOS in Region VI. At the fourteenth Session of Regional Association VI the Working Group on PIW in Region VI was re-established. In January 2007, a first meeting of the Coordinators/Rapporteurs of the WG-PIW was held at DWD in Langen, Germany. The meeting prepared a work plan for the Working Group which includes for the Subgroup on IOS to contribute to the implementation of the evolution of the GOS in Region VI. Results will be presented at the next WG-PIW meeting in 2008.

9.3.14. Furthermore Mr Klink briefly informed the meeting on recent developments of the EUCOS Operational Programme. The EUCOS Programme Phase 2007-2011 is divided in 2 parts. During the transition phase in 2007 and 2008 no new programmatic objectives will be set because amongst others the Space-Terrestrial Study on the impact of the different components of the observing system on the performance of regional NWP must be finalised first in 2007. On the consolidated results of these studies new programmatic objectives will be developed and throughout the second phase of the Programme 2009-2011 the revised EUCOS design will be implemented. As a first step the results of the ST-Study were discussed at the EUCOS Science Advisory Team meeting in May 2007 and recommendations for the EUCOS network design were drawn. On the basis of these recommendations EUCOS will carry out new OSEs on the upper-air network design in 2007/2008 with the goal to find the most efficient network design for regional NWP. Once a final report summarising the findings of the ST-Study and subsequent recommendations on the re-design of the upper-air network has passed the EUMETNET bodies ET-EGOS will be informed about these results in an appropriate manner. Regarding the current status of the EUCOS network Mr Klink stated that for the transition phase 2007-2008 no major changes are envisaged, except a slight increase in e.g. number of ASAP-units, drifting buoys or AMDAR-measurements. Concerning the surface marine part of the EUCOS network Mr Klink conveyed statements and plans agreed at the last E-SAT meeting. Surface marine observations generally and pressure measurements from the oceans particularly are considered as a very important input for NWP data assimilation. The EUCOS design of the oceanic segment is still far from the density threshold identified in 2004. At the end of IPY there is the chance to run an OSE since during IPY a lot of additional buoys will be deployed. Furthermore, the EUMETNET Surface Marine Programme is going to deploy more buoys in data sparse regions north of 60°N like the Norwegian Sea.

9.4. Review of additional requests from CBS

9.4.1. The ET discussed the potential of long range ground-based remote sensing lightning detection systems, such as the one proposed by the Met Office (UK), as a cost-effective solution to improve coverage in data sparse regions (including oceanic). It decided that such systems are suitable candidates for the inclusion in the GOS and decided to include reference to such systems in the EGOS-IP.

9.4.2. ET-EGOS also decided to include remote sensing lightning detection systems in the revised “Vision for the GOS in 2025” and to encourage Members to collaborate on the realization of a truly global system for sharing real time data with all Members.

9.5. Review plans for preparation of revised Vision for the GOS

9.5.1. Mr Lafeuille presented a Gap Analysis performed by the WMO Space Programme in order to evaluate the adequacy of existing and planned satellite observing capabilities with respect to relevant requirements. This analysis includes namely a compilation of the characteristics of 157 different space-based instruments and considers a typology of 29 instruments/missions for which the document records:

- definition of generic instrument characteristics;
- addressed geophysical parameters;
- assumed/suggested observing strategy;
- current and planned programmes until year 2020;
- comments on the situation as projected beyond 2020;
- recommendations.

9.5.2. The session acknowledged that this impressive amount of detailed information constituted an extremely valuable reference document and encouraged the WMO Space Programme to maintain it as updated information will become available. It was indicated that his information would be exploited to feed updates to the overall database on user requirements and observing capabilities. All ET-EGOS Members were invited to provide the WMO Space Programme with feed-back and updates as appropriate.

9.5.3. Mr Lafeuille presented the outcome of the workshop on Re-design and Optimization of the Space-based GOS that was organized as part of the response to CBS Ext.(06) that requested *"to commence an update of the baseline of the space-based GOS up to 2025 as a new horizon, and expand its scope beyond the World Weather Watch in order to include sustained observations of additional variables required for climate monitoring, and ultimately to address the needs of other WMO Programmes.*" The workshop was held on 21 and 22 June, with participants from operational and R&D space agencies: CMA, CNSA, ESA, EUMETSAT, JAXA, JMA, NASA, NOAA, USGS, as well as representatives of GCOS, of the Committee on Earth Observation (CEOS), the Chairman of OPAG-IOS, the Chairman of ET-EGOS, and the WMO Space Programme.

9.5.4. The workshop had emphasized the importance of developing a new vision of the GOS where observation of Essential Climate Variables (ECV) would be ensured through operational missions or otherwise long-term sustained missions rather than relying only on R&D missions with no plan for continuity. The workshop recommended in particular including the following changes into the space-based GOS baseline:

- Core operational infrared and microwave sounding on at least three well separated sun-synchronous orbital planes (mid-morning, early afternoon and early morning);
- Constellation of small satellites for radio-occultation sounding;
- Ocean altimetry constellation including at least one high-precision reference altimeter mission and two additional altimetry systems flying on higher inclination orbits;
- Absolute continuity for at least one broadband Short-wave/Long-wave radiometer for Earth radiation monitoring and one Total Solar Irradiance sensor in Low Earth Orbit (LEO) with complementary measurements in geostationary and LEO orbits;
- At least two scatterometers and two full polarization microwave imagers for sea surface wind;
- Further refinement of an observation strategy for atmospheric composition.

9.5.5. The workshop also considered a number of other missions addressed in the gap analysis (See Item 9.5.2), including e.g. global precipitation measurement. It recalled that global optimization of satellite mission planning could only be efficiently achieved if satellite operators could ensure data quality and timely availability. The workshop had suggested that ET-EGOS take the lead in developing the new vision for the GOS, with the support of ET-SAT and ET-SUP (to be convened on 3 to 7 September 2007).

9.5.6. ET-EGOS noted that the outcome of the workshop was an excellent basis to start developing a new vision for the space-based GOS. It noted that the definition of observation strategies for atmospheric sounding, for ocean surface topography, for ocean surface wind vector or for global precipitation were well advanced while for Earth Radiation Budget and atmospheric composition further interaction was needed with the relevant communities to confirm or refine the proposed approach. It was noted that a one-year time frame was available to refine these

proposals and to develop a new vision that could be forwarded to ICT-IOS for review and submission to the next CBS session.

9.5.7. The ET agreed on sequence of activities in preparing the "Vision for the GOS in 2025" as follows:

- Jul 07: first draft from ET-EGOS – Annex to meeting report
- 07-08: further consideration by ET-EGOS members
- 07-08: review and proposed updates by ET-SAT, ET-SUP, ET-AWS
- 07-08: presentation to other CBS bodies?
- Spring/summer 08: reconsider at ET-EGOS-4. Prepare version for ICT-IOS
- Sep 08: consideration by ICT-IOS
- Late 08 / early 09: consideration/approval by CBS
- 09: New version of GCOS-IP available
- Late 09 / 10: ET-EGOS restructures EGOS-IP in line with new Vision and taking account of new GCOS-IP

9.5.8. The ET prepared a preliminary draft Vision for the GOS in 2025 is presented in Annex III.

9.6. Update of the Implementation Plan Progress and Actions

9.6.1. The ET updated progress and actions related to EGOS-IP that is attached as Annex II.

10. PREPARATION FOR THE FORTHCOMING CBS MEETINGS

10.1. The ET was informed on preliminary arrangements for holding the meetings of the ICT-IOC expert teams to coordinate crosscutting inputs relevant to ICT-IOC and CBS-XIV. Reports provided to ICT-IOC should follow the template as in Annex VI.

10.2. The ET provisionally agreed that its next meeting should be preferably hold from 7 to 11 July 2008, date to be confirmed no later than January 2008.

11. ANY OTHER BUSINESS

11.1. The ET requested the ET-AWS to review the draft proposal of the "Vision for the GOS in 2025" and provide its comments and suggestion by May 2008.

11.2. The ET also requested the ET-AWS 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.

12. CLOSURE OF THE SESSION

12.1. The session closed on Friday, 13 July 2007 at 12:37 hours

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ANNEX I

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ANNEX II

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

(Version 1.4, July 2007)

CONTENTS

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, hydrology 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:** 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. Drifting buoy hourly pressure data now exchanged routinely, but little progress otherwise
>
> **New action July 2007:** ongoing activity.

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

> **Comment:** 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)
>
> **Update July 2007:** continuing activity, no information available to ET-EGOS at this stage. SYNOP code, and its BUFR implementation, are inadequate for the transmission of a variety of surface observations currently not exchanged on the GTS, but are of interest to application areas. In particular, snow cover and snowfall data, which are to some extent flowing on the GTS in the regions would be of interest for global applications.
>
> The global exchange of radar data will require substantial development work concerning data specification and formatting.
>
> **New action July 2007:** Based on inventory of new data, consideration should be given to the development of expanded BUFR templates for the exchange of these observations (WMO Secretariat to raise with ET-DRC)

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

> OPAGs IOS and ISS and JCOMM DMPA were encouraged to progress the development of an integrated metadata distribution system to support the needs of the GOS.

New action July 2007: ongoing action of ET-EGOS, to be reviewed in the light of the evolving WIS and WIGOS .

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

New action July 2007: ongoing action of ET-EGOS, to be reviewed in the light of the evolving WIS and WIGOS

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.

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.

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

To date only few radiosonde profile data in BUFR have been made available.

Update July 2007: ET-DRC developed a BUFR template for migration from FM 35 TEMP to BUFR template 309052 which allows the reporting of high resolution data points in the vertical including position and time for each level. At their recent session the ET-DRC also developed a BUFR template which allows the use of height in metres as vertical coordinate and the reporting additional information such as surface station measurements, cloud information, and type of instrumentation used (sensors, balloon etc).

New action July 2007: ongoing activity, WMO Secretariat to inform Members of available BUFR encoding/decoding software for use with validated BUFR templates.

(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 real-time.

Action July 2007: JCOMM and DBCP to pursue improvements of drifting buoy data timeliness especially in South Atlantic and South East Pacific (ongoing activity)

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.

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.

WWW monitoring activities should reflect the baseline systems requirements and provide suitable feedback to Members concerning their baseline systems commitments.

New action July 2007: (i) WMO Secretariat to pursue and adjust suitable monitoring practices

(ii) Next Workshop on impact studies to address the question of best mix of vertical atmospheric profiles to be obtained from different observing systems.

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. Impact studies have shown the benefit of high reaching radiosonde data.

COSMIC data are now in operational use at ECMWF, the Met Office and are actively tested at several NWP centres with a view towards using the data in operations. Impact of the data has been demonstrated

New action July 2007: Workshop to address the question of the best mix of observations required from radiosondes and satellites in the stratosphere for NWP, but also for GCOS purposes

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]

Comment: This 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.

Update July 2007: Canada recently re-introduced the transmission of ozone soundings from four stations in CREX. Sample data encoded in BUFR can be made available, e.g. by ECMWF.

Action July 2007: ongoing action, WMO Secretariat to remind Members 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 north-eastern 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.

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.

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.

Action July 2007: The Workshop on impact studies to address the feasibility and operational benefit of observation targeting.

Optimization of vertical profile distribution

G8. RAOBs - Optimize the distribution and the launch times of the radiosonde 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.

The EUCOS plans for the redesign of the upper air network in Europe will address the issue of best mix of radiosonde and AMDAR profile data. Although EUCOS is focused on regional aspects for NWP in Europe, their findings may be applicable elsewhere.

New action July 2007: Next Workshop on impact studies to address the implication of RAOB network optimization for NWP.

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 2007: Existing programmes in Australia, Asia, Southern Africa, the USA and Europe continue to expand coverage both domestically and internationally. The Republic of Korea AMDAR Programme should become operational by mid 2007.

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

  Update July 2007: Discussions are still ongoing for the development and implementation of new ARINC 620V4 software. New technologies (TAMDAR) are nearing completion. Problems with TAMDAR data ownership are still to be solved. The upgraded of the AAA specification to support water vapour measurement and reporting is completed and a software package supporting some Boeing models is due to be completed by late 2007. The ADS-B system is under development and an ADS-C system operates over the North Atlantic and SW Pacific Ocean areas.

  New Action July 2007: The AMDAR Panel to prepare a work plan to develop a standardized software solution for larger aircraft makes and models. This will be a longer term perspective.

- Selective deployment of humidity/water vapour sensors;

  Update July 2007: WVSSII water vapour sensors installed on a number of UPS B757 freighter aircraft is undergoing additional operational testing before the release of a final report. E-AMDAR has commenced a European based WVSSII evaluation programme on 3 Lufthansa A319 aircraft, with the results expected to become available towards the end of 2007. Discussions are ongoing for the development and installation of the ARINC 620V4 software and WVSSII sensor on a number of commercial aircraft makes and models, including Airbus and Boeing.

  New action July 2007: (i) AMDAR Panel to make available and ET-EGOS to consider the evaluation reports of both trials.

  (ii) The AMDAR Panel to prepare a work plan to develop a standardized humidity sensor solution for larger aircraft makes and models. This again will be a longer term perspective.

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

  Update July 2007: E-AMDAR continues to provide targeted data into Southern Africa and is planning to provide some targeted data into India and Singapore as part of a data agreement. Work continues on the establishment of a substantial programme for the ASECNA area. Plans are under way to develop a pilot Regional Programme for the South West Pacific.

  New action July 2007: AMDAR Panel to continue exploring opportunities for providing additional observations and implement the plans.

- Use of optimization systems to improve cost effectiveness;

  Update July 2007: E-AMDAR continues to develop and refine its optimization schemes. Canada also has established an operational optimization scheme. The USA has conducted an investigation into the impact of an optimization system on the RUC model and are now planning to develop a system for the USA Programme. Australia is planning to develop an appropriate system in the near future.

  There is a need to specify, based on the advice from the various application areas, the GOS requirements for the optimization of data collection. This task will benefit from experience in some areas where optimization is in operation, e.g. E-AMDAR

  New action July 2007: (i) AMDAR Panel to continue with the development and the implementation of the optimization schemes.

  (ii) AMDAR Panel to request input via the WMO Secretariat from various application areas on the optimization requirements for AMDAR data collection

- Improvements in the monitoring, quality control;

  Update July 2007: 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 and that there are clear differences in the bias seen between ascent and descent profiles on many aircraft types. The AMDAR Panel Science Sub Group (SSG) is planning to conduct a study to investigate and develop a solution for these problems. The AMDAR Panel SSG is also planning to investigate and develop a solution for the poor wind quality derived from

aircraft at high latitudes that results from the use of magnetic heading, which is unreliable at these latitudes.

New action July 2007: Continuing activity of the AMDAR Panel.

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

  Update July 2007: Discussions continue with the provider of the TAMDAR system to allow for the provision of data free of charge to NMHSs.

  New action July 2007: The AMDAR Panel to develop a standard text on data ownership and usage which can serve as the basis of agreements between NMHSs and data providers.

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

  Update July 2007: The AMDAR Panel webpage is now operational and the new and updated AMDAR Panel Flyer has also been completed. Discussions are ongoing for the development and implementation of an operational stand alone AMDAR data visualization for the ASECNA group of countries. AMDAR Technical workshops have been formally requested by the Malaysia, Romania, Mexico and Kenya and interest has been expressed by Brazil, Bulgaria, India, Pakistan, Sri Lanka and the Russian Federation.

  New action July 2007: ongoing activity of the AMDAR Panel

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.

CBS urged Members to collect and exchange the ground-based GPS data. Members were to take the appropriate action to ensure that the data processing be standardized by November 2005.

GPS data message type in BUFR has been developed and approved. Ground-based GPS data are inserted on the GTS from Europe, by the Met Office in Exeter, UK, sample encoding information can be provided

New action July 2007: ongoing action, WMO Secretariat to remind Members that all available ground-based GPS data be made available in near-real time on the GTS.

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.

Update July 2007: The main concentration of the ASAP operations continues to be over the Northern Atlantic (5153 launches in 2006), an important contribution is also made by Japanese research ships operating primarily in the North Western Pacific areas and seas adjacent to Japan (938 launches in 2006). Fewer manual soundings are made by South Africa from ships sailing in the South Atlantic. Radio sondes generally provided better high vertical resolution information than the aircraft data (AMDAR) over the oceans. Radio sondes data are particularly needed for the calibration of the satellite products, especially in the North Pacific and the Southern Hemisphere. The SOT-IV asked the ECMWF to provide materials showing impact of radio-sonde data over the oceans. The transition of high vertical resolution data will be achieved by the migration from TEMP-SHIP to BUFR. However, this remains a concern because TEMP-SHIP files are much smaller and less expensive to transmit from ships via Inmarsat-C than BUFR reports. As long as there is no agreed template for ASAP radio sounding data of practicable file size the ASAP units should continue to transmit TEMP files. These files can be decoded to BUFR at the receiving Met Service and transmitted to the GTS in BUFR format. Further benefit of alphanumeric files is the option to transmit the data manually by e-mail, if required.

New action July 2007: (i) ET-EGOS to solicit, e.g. through impact studies, further guidance on the desirable coverage of ASAP soundings over the oceans. (ongoing activity, to be addressed at the Workshop)

(ii) SOT to continue efforts for achieving 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.

Iridium provides for high resolution data transmission and is global. Experiments still being conducted with small number of Argo profiling floats. Argos 3 generation is onboard METOP and provides 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 development in the USA. Iridium and other providers also offer substantially reduced telecoms tariffs, with no reduction in performance.

Update July 2007: The DBCP has established a DBCP drifter Iridium Pilot Project to evaluate the Iridium satellite data telecommunication system for use with drifting buoys. The Pilot Project is targeting the deployment of about 50 units in the world oceans in the period 2007/2008. Similarly, the SOT has also engaged in the evaluation of the Iridium system for use from VOS ships. Iridium, which is a global system, provides potentially the cost-effectiveness, telecommunication bandwidth and the timeliness needed for applications of ocean data. Iridium could also potentially solve the problem of transmitting in real-time high vertical resolution ASAP soundings to shore.

New action, July 2007: JCOMM to report on the developments of the DBCP and SOT Iridium Pilot Projects. ET-EGOS to propose pilot project for WIGOS to provide for high rate satellite data communication for marine observations.

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].

Update June 2007: Overall target for the tropical moorings under the JCOMM/OPA strategic work plan is for 76 moorings in the Tropical Pacific Ocean, 18 in the Tropical Atlantic Ocean, and 47 moorings in the Tropical Indian Ocean. Tropical Pacific Ocean array is complete. Implementation of the Indian Ocean Array continued; 15 moorings were in place in June 2007. Southwest (3 moorings) Northeast (4 moorings) and Southwest (1 mooring) extensions of the PIRATA array in the Tropical Atlantic ocean were implemented; 19 moorings were operation in the PIRATA array in June 2007. Operations and maintenance of most of the Tropical Pacific Ocean array has been transferred to an operational agency in USA. However, sustainability is still an issue for the rest of the network. Vandalism remains a concern.

New action, July 2007: JCOMM to continue working towards developing the Indian Ocean array and sustaining both the Indian Ocean and Atlantic Ocean arrays.

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.]

Update July 2007: DBCP maintains an array of about 1250 drifting buoys globally. About 450 of them report air pressure. It maintains an array of about 80 barometer drifters South of 40S. The JCOMM strategic work plan is targeting to install barometers on all operational 1250 drifters globally by 2010. This involves maintaining a network of about 300 drifters with barometers in the Southern Ocean. 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.

The number of drifting buoys making wind is insignificant. Global coverage of near surface wind observations is achieved through satellites. Cost of wind measuring drifters is twice as much as barometer drifters. Guidance is needed whether additional wind observations from drifters in the Southern Ocean would have a positive impact as part of a network already providing pressure observations at a horizontal resolution of 500km x 500 km. 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.

ET-EGOS endorsed the JCOMM/OPA strategic work plan for the DBCP. It was recommended to carry out any OSE concerning the impact of Arctic buoy observations after IPY.

New action July 2007: Next Workshop on impact studies to address the requirements for global coverage of wind observations from drifting buoys and provide guidance to JCOMM.

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.

Update July 2007: Argo network is now nearing completion with 2886 floats operational in June 2007 (96%) for a target of 3000. 22 countries and the European Union are participating in the effort. All operational floats report their data in real time. Most Argo national programs continue to be supported by research funding, which poses difficulties for sustaining the observations over decadal timescales. Mechanisms for long-term support are required. Support from operational agencies and users are needed to justify the long term funding. Regarding the XBT network managed by the SOOPIP under the JCOMM SOT, between 2004 and 2006 there has been a gradual decrease in the annual number of XBT observations transmitted in real-time to the national data centres, from just over 25,000 in 2004 to about 18,000 in 2006. The target for 2010 is to sample 26 high density ship lines (4 transects per year a high horizontal res.) and 25 frequently repeated ship lines (18 transects per year at low horizontal res.). Significant progress has been made in improving the quality of the XBT observations (automated systems, improved real time QC), and in enhancing the real-time transmission of XBT observations in high vertical resolution. USA is now developing software to permit the distribution of the XBT data in BUFR format. OOPC is now planning to organize a conference focused on global ocean observations, in about 2009, ten years after the OceanObs99 conference that defined the implementation strategy for the SOOPIP, Argo, and the Tropical moored buoy array in support of upper ocean thermal applications.

New action, July 2007: JCOMM is encouraged to continue its actions to ensure a sustained status for upper ocean thermal networks. JCOMM to solicit from operational users to document the benefits they gain from Argo data and ocean thermal profile data. Such information could be provided e.g. through monitoring statistics or impact studies.

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.

Update July 2007: After reviewing the requirements established by the WMO and NOAA for meteorological and oceanographic observations, 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.

There are currently 150 buoys deployed in the Arctic Ocean. For the International Polar Year, the Participants of the IABP plan to deploy over 170 buoys, which provide critical atmospheric, sea ice, and upper ocean hydrographic measurements on various space and time scales that cannot be obtained by other means. Challenges will be to maintain some of the momentum obtained during the IPY, and maintaining the array. The Eurasian side of the Arctic Ocean appears to be data sparse. With the reduction of the sea ice extend due to global warming, development of seasonal ice buoys is becoming essential.

New action July 2007: Impact of the expected increased Ice buoy deployment to be reviewed at next OSE/OSSE Workshop. Stress the importance of the IPY legacy.

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.

Information on the collection of additional profile data from aircraft and ASAP is provided under G9 and G14. In addition, the AMMA (African Monsoon Multidisciplinary Analysis) project in West Africa is operating 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.

An AMMA workshop was held in Météo France (Toulouse) during the first week of November 2006, with a special session dedicated to this topic. Some preliminary OSEs have been performed with AMMA data captured on the GTS.

New action July 2007: ET-EGOS to prioritize OSEs which are the most relevant for the evolution of GOS in Africa (to be addressed at the Workshop).

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.

New action July 2007: ongoing 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.

New action July 2007: The evolution of the AWS network needs to be addressed. OPAG/IOS needs to consider how best to carry this forward. ET-EGOS chair to liaise with ET-AWS chair on future co-operation.

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;
- Deep ocean time series reference stations (oceanSITES).

The OceanSITES is a worldwide system of long-term, deepwater reference stations measuring dozens of variables and monitoring the full depth of the ocean from air-sea interactions down to 5,000 meters. OceanSITES is installing meteorological instruments on most of its sites. While data are public for most of these southern ocean sites, the data are only being distributed in delayed mode.

- Lightning detection

Long-range ground-based remote sensing lightning detection systems have now an accepted role as a cost effective component of the evolving GOS. Such systems should be considered complementary to existing lightning detection systems for improving coverage in data sparse regions, including the oceans and polar areas.

New action July 2007:

(i) ET-EGOS chair to ensure that any impact studies for new technologies carried out by THORPEX or other groups are made available.

(ii) JCOMM to encourage OceanSITES to distribute their data in real-time.

(iii) ET-EGOS to include remote sensing lightning detection systems in the revised "Vision for the GOS in 2025" and WMO Secretariat to encourage Members to collaborate on the realization of a truly global system for sharing real time data with all Members.

NEW ACTIONS TO BE ADDED BASED ON NEW REQUIREMENTS SPECIFIED IN SEVERAL APPLICATION AREAS:

Develop in-situ wave observation capability. In situ wave observations are needed to meet the requirements for maritime safety services, and in particular for (i) assimilation into offshore wave forecast models, (ii) validation of wave forecast models, (iii) calibration/validation of satellite wave sensors, (iv) description of the ocean wave climate and its variability on seasonal to decadal time scales. Some coastal buoys are presently making directional wave observations and some open ocean buoys are making significant wave height measurements. However, practically none are reporting directional or spectral wave data from the open ocean. Observations are needed at a minimum, significant wave height, peak period and 1-D spectra, hourly in real-time, for assimilation into coupled atmosphere-ocean wave models for real-time forecasting activities, and subsequent verification.

Action July 2007: JCOMM to set up a Pilot Project with a view towards integrating the in-situ wave observation capability into WIGOS.

Increase time resolution of SST data (in-situ observations from drifters). Increased time resolution SST data, at least hourly, are needed in order to better resolve the diurnal cycle of the SST. In-situ SST data are being used by the GHRSST together with satellite data. Relatively minor technological developments should eventually permit to meet these requirements for all global drifters.

Action July 2007: DBCP to develop the technology, pursue its implementation and report to ET-EGOS

Develop and consolidate the VOSClim fleet. Climate variability and predictability applications require better quality data from the VOS fleet (better QC and flags, additional metadata). The fleet is currently comprised of about 220 ships but not all of them do report the required additional parameters and could increase the frequency of observations by using more automated systems together with the recording of traditional variables that can only be observed manually. The SOT has recommended increasing the number of ships participating in the VOSClim fleet which is now targeting a total of 250 ships. At the same time, efforts should be made to increase the number of observations and the number of VOS ships recording the additional parameters required by the VOSClim.

Action July 2007: SOT to seek additional commitments from WMO Members and to report back to ET-EGOS.

Develop operational procedures for the GRUAN. The proposal for the GCOS Reference Upper Air Network (GRUAN) has been endorsed by the AOPC. The Lead Centre for the GRUAN will develop operational procedures in consultation with appropriate CBS and CIMO expert team, GSICS and other relevant partners.

Action July 2007: GCOS to keep ET-EGOS informed about the progress

Maintain and expand the Baseline Surface Radiation Network to obtain global coverage. Data are used for climate monitoring and provide valuable observations for the validation of earth radiation budget satellite data.

Action July 2007: WMO Secretariat to seek commitment from Members to provide continuity for these measurements.

Provide surface data for calibration and inter-comparison with satellite data. The hydrology applications, but also GCOS, will benefit from in-situ observation parameters such as snow cover, snowfall, snow cover water content, soil moisture and run-off data to be used in combination with satellite data.

Action July 2007: Points of Contact for Hydrology and GCOS to provide an inventory of observation requirements to ET-EGOS via the Secretariat.

Improve the accuracy of precipitation estimates from remotely sensing systems. This applies in particular to rain estimates from satellites and weather radar.

Action July 2007: ET-EGOS chair to bring this to the attention of ET-SAT and the developers working on the algorithms to exploit radar measurements**.**

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 fulfil 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.

> **Progress**: The issue of GEO-LEO optimization was raised by WMO at the "CGMS-WMO optimization workshop" held with CGMS satellite operators on 28-29 August 2006. The workshop has reviewed the planned locations of geostationary satellites and proposed to take advantage of additional satellite capabilities to increase robustness of the geostationary constellation.
>
> **New Action:** To bear in mind the desirable balance between GEO and LEO components in future global planning activities.

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.

> **Progress**: Global optimization of the satellite mission plans was recognized as an important objective and has led to convene the first WMO/CGMS Optimization workshop mentioned above. It was central to the scope of the Re-design and Optimization workshop convened by WMO on 21-22 June 2007.
>
> **New action:** To refine and adopt a new vision for the GOS in 2025 that would provide guidance on how individual agencies' plans can best contribute to a globally optimized system, e.g. in defining thematic constellations as is currently considered for altimetry.

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: The Global Space-based Inter-Calibration System (GSICS) has been established to ensure comparability of satellite measurements provided through different instruments and satellite programmes and to tie these measurements to absolute references. GSICS activities will ultimately 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. The GSICS Implementation Plan was adopted at the GSICS Implementation Meeting on 23 June 2006 and endorsed by CGMS 34 in November 2006. A GSICS Executive Panel was nominated, led by Dr Mitch Goldberg from NOAA, as well as a GSICS Research Working Group and a GSICS Data Working Group. All groups had at least one meeting already. The Executive Panel has agreed on a first Operation Plan for 2007. LEO to LEO intercalibration is performed on a routine basis by NOAA. A common procedure is being developed and will be implemented by the end of 2007 by each operator of geostationary satellite in order to perform GEO to LEO IR intercalibration in a similar way. Hyperspectral sensors such as MODIS and IASI will be taken as the references in order to account for differences in Spectral Response Functions of the various broadband instrument channels. A GSICS website was established (http://www.wmo.int/pages/prog/sat/Calibration.html)

Next Action: To pursue the implementation of GSICS with the expectation that GEO to LEO IR intercalibration becomes operational early 2008, and then extended to visible channels.

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). Further improved imaging capabilities are being planned for the future generation (GOES-R, MTG, MTSAT-FO, FY-4).

New action: WMO Space Programme will continue discussions with space agencies, via CGMS, especially with IMD and JMA.

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. Based on the experience gained from classical IR sounding from GEO satellites and from hyper-spectral Infrared sounding from LEO satellites, the impact of hyper-spectral sensors on GEO satellites is expected to be very positive. In addition, in order to optimize this impact, it would be useful to proceed with a direct demonstration mission based e.g. on the USA's GIFTS development in advance of the planned operational series.

Progress: EUMETSAT has included IRS in its baseline for the MTG series around 2016; CMA has plans for its FY-4/Optical series by 2012; NOAA is re-considering options for a hyperspectral sounding instrument on the GOES-R series; JMA is exploring the possibility of such development for MTSAT-Follow-on. For the meantime, opportunities for international cooperation on a demonstration mission are being explored by CGMS in the context of the International Geostationary Laboratory (IGeoLab), noting a flight opportunity for GIFTS on board of the geostationary satellite "ELEKTRO-L 2" planned for launch in 2010, but there remains a funding issue to manufacture a space qualified instrument on the basis of the current engineering model.

New action: To encourage geostationary satellite operators to confirm and implement their plans for GEO hyperspectral instruments; to pursue in the meantime the IGeoLab proposal for a demonstration or pre-operational hyperspectral sounding mission from the GEO orbit.

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. This issue was addressed as part of the gap analysis at the GOS re-design and optimization workshop, although no precise recommendation was formulated at that stage.

New action: WMO Space Programme to develop and propose to CGMS a geostationary coverage scheme where inter-satellite separation would not exceed 60° longitude.

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. A RARS has started operations in Asia-Pacific area, and testing has begun for a RARS in South-America. Following the global RARS workshops held in Darmstadt in December 2004, in Geneva in December 2005 and in September 2006, a RARS Implementation Group was set up and held its first meeting on 3-4 July 2007. The primary goal is to achieve quasi-global coverage for timely retransmission of ATOVS datasets. Preliminary contacts with the South African Weather Service indicate a potential for extending the coverage towards South Africa and surrounding seas. 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,..).

New action: 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 collaborates with space agencies, via CGMS, towards a target system defining both nominal and contingency planning in the AM and PM polar-orbits. This was addressed by the GOS Re-design and Optimization workshop on 21-22 June 2007, where a recommendation was made for a 3-orbit configuration, with 4-hour nominal separation between ECT, and back-up.

New action: To formulate a 3-orbit configuration for core LEO sun-synchronous missions, as part of the new vision for the GOS in 2025.

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: For scatterometry, ERS-2 scatterometer has been followed by ASCAT on METOP, sea surface wind is thus being observed in an operational framework since 2007.

There are plans for a scatterometer aboard the Indian Oceansat-2 and the Chinese HY-2 series, although data availability still needs confirmation.

As concerns MWI, 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 this technology will not be competitive with scatterometry at low wind speed, good information is available at high wind speed.

The revised NPOESS baseline includes a microwave imager/sounder (MIS) expected to provide wind speed and direction information at sea surface starting with NPOESS-C2 in 2016.

The GOS Re-design and Optimization workshop recommended maintaining at least 2 scatterometers and 2 full polarimetric microwave imaging missions in order to achieve both sufficient accuracy and coverage.

New action: The recommended configuration should be included into the new vision for the GOS in 2025, and brought to the attention of CGMS 35.

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). Jason-1 continues to provide global ocean topography data to the NWP community. ESA has plans for a Sentinel-3 ocean mission that will include an altimeter. Observation strategy for altimetry was addressed at the GOS Re-design and Optimization workshop mentioned above. Large agreement of the community was achieved around the concept of a constellation for Ocean Surface Topography including at least one reference altimetry mission plus 2 additional altimeter systems on higher inclination to ensure global coverage.

New action: WMO Space Programme to continue to work with CGMS Satellite operators and CEOS Constellation on Ocean Surface Topography in order to confirm the plans and ensure continuity of at least one reference altimetry mission plus 2 additional altimeter systems on higher inclination to ensure global coverage.

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 and FY-3B will have a prototype Earth Radiation Budget Unit (ERBU) in 2007. Either NPP or the first NPOESS satellite (likely launch in 2013) are expected to carry the CERES instrument. An observation strategy was proposed by the GOS Re-design and Optimization workshop, based on one LEO broad-band multi-angle viewing

radiometer, collocated cloud/aerosol/water vapour measurements, complementary geostationary diurnal cycle information, as well as Total Solar Irradiance measurement.

New action: To confirm or refine the recommended observation strategy with support of GCOS and the science community and to work with satellite operators towards its implementation.

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 with a launch now planned for June 2009, and ESA and ECMWF are developing software for the assimilation of Doppler winds into NWP models. There are currently no plans 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. Preliminary considerations for a preparatory mission based on ADM-Aeolus were mentioned at the ESA/ESTEC ADM-Aeolus workshop on 25-27 September 2006.

New action: WMO Space Programme will continue to 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 further discussed by CGMS satellite operators in 2007.

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. Timely implementation of the GPM mission was identified as an action in the GEO work plan. CEOS has launched a "Global Precipitation Constellation" initiative in order to coordinate efforts to take advantage of existing instruments while preparing the GPM mission.

New action: WMO Space Programme to continue to support initiatives for the timely implementation of GPM.

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: SAC-C, CHAMP and COSMIC data have been successfully used in an operational context and the use of METOP/GRAS is being prepared. NWP OSEs have shown positive impact with small number of occultations. Climate applications are being explored. The GOS Re-design and optimization workshop clearly recommended planning constellations of small satellites with radio-occultation sensors. Upon proposal by WMO, CGMS-34 took an action to explore opportunities for cooperation on ground support network.

New action: Plan for a constellation providing operational follow-on to COSMIC should be discussed by CGMS in 2007.

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.

Studies on GEO MW have continued in the context of IGeoLab. A GEO MW IGeoLab Focus Group workshop was held in April 2007 in Beijing and proposed to investigate two scenarios for consideration by CGMS 35, one based on filled aperture antenna and the other based on synthetic aperture antenna. Choice between the two technologies is also linked to the relative priority given to the detection of precipitation and rapid vertical sounding.

New action: WMO Space Programme will continue supporting this IGeoLab action and subsequent 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 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 2009.

New action: 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, and 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. Continuity of ESA SAR mission is considered as part of the Sentinel programme.

New action: WMO Space Programme to continue 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.

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) has added APS, an aerosol polarimetry sensor. ESA and JAXA are preparing the Earthcare (cloud/aerosol mission) for launch in 2012.

New action WMO Space Programme will continue discussions with space agencies, via CGMS, CM, and via CEOS Constellation for Atmospheric Composition, 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). ADM;-Aeolus is expected to contribute to cloud measurements.

New action: 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.

New action: 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.

New action: 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.

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.

New action: WMO Space Programme will continue to monitor the issue 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, Aura, CloudSat (2006) and CALIPSO (2006), soon to by joined by 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.

New action: 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.

New action: WMO Space Programme to discuss with space agencies, via CGMS

Additional recommendations for Climate Monitoring

Long-term continuity of observations shall be ensured for the following Essential Climate Variables, which are not addressed within the recommendations above:

- Ocean colour (GIP, Action O18)
- Sea ice (GIP, Action O23)
- Cryosphere (GIP, Action T14)
- Land cover (GIP, Action T24)

Detailed requirements for these observations are contained in the Satellite Supplement to the GCOS Implementation Plan (GIP) “GCOS Systematic Observations Requirements for Satellite-based Products for Climate” (GCOS-107, September 2006, WMO/TD N°1338)

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
ASCAT	Advanced Scatterometer
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
CALIOP	Cloud Aerosol Lidar with Orthogonal Polarization
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
CMA	China Meteorological Administration
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-EGOS	Expert Team (ET) on the Evolution of the Global Observing System (EGOS)
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
FY-4	Feng Yun-4 (Chinese geostationary satellite series)
GAW	Global Atmosphere Watch
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GEO	Geostationary Orbit Satellite

GIFTS	Geosynchronous Imaging Fourier Transform Spectrometer
GLAS	Geoscience Laser Altimeter System
GMES	Global Monitoring of Environment and Security
GNSS	Global Navigation Satellite System
GOES	Geostationary Operational Environmental Satellite
GOME	Global Ozone Monitoring Experiment
GOS	Global Observing System
GPM	Global Precipitation Measurement
GRAS	GNSS Receiver for Atmospheric Sounding
GSICS	Global Space-based Inter-Calibration System
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
IGEOLab	International Geostationary Laboratory for demonstration missions
IGOSS	Integrated Global Ocean Services System
IMD	India Meteorological Department
IOC	Intergovernmental Oceanographic Commission
IOS	IGOSS Observing System
IP	Implementation Plan
ISRO	Indian Space Research Organization
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
LIS	Lightning Imaging Sensor
MDS	Meteorological Data System
MERIS	Medium Resolution Imaging Spectrometer
METOP	Meteorological Operational Satellite (EUMETSAT)
MIPAS	Michelson Interferometer for Passive Instrument Sounding
MLS	Microwave Limb Sounder
MODIS	Moderate Resolution Imaging Spectroradiometer
MTG	Meteosat Third Generation
MTSAT-FO	Multi-purpose Transport Satellite Follow-On
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
VIIRS	Visible Infrared Imager Radiometer Suite
WIGOS	WMO Integrated Global Observing System
WMO	World Meteorological Organization
WOTAN	Wind Observation Through Ambient Noise
WVSS	Water Vapour Sensing System
WWWW	World Weather Watch
XBT	Expendable Bathy Thermograph
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 III

VISION FOR THE GOS IN 2025

Initial draft proposal form ET-EGOS
as of July 2007

Role of the GOS

In 2025, the GOS will continue to provide effective global collaboration in the collection and exchange of observations to meet the needs of Members. It will continue to be implemented through a composite and increasingly complementary system of observing systems.

1. In terms of broad general trends:

- The WWW/GOS is expected to evolve to a WIGOS that will integrate its current functionalities together with other observing systems which are not dedicated to the weather forecasting (climate monitoring, oceanography, chemistry, hydrology, weather and climate research). Provision shall be made for continuity of observations of all operational weather variables and Essential Climate Variables, adhering to GCOS climate monitoring principles.
- This implies that more meteorological observing platforms will be shared by instruments for different applications, then more meteorological observations will be performed on “platforms of opportunities”, or using some infrastructures which have been set up for non-meteorological purposes (like GPS surface stations, or the possibility to measure the rainfall rate from the attenuation of the mobile phone radio electric signals).
- The trend to develop fully automatic observing systems will be confirmed (for example likely to affect the radiosondes as well).
- Some level of targeted observations should be achieved in 2025, but there is still a lot of uncertainty on what level can be achieved. Targeting will not be just “putting more observations in sensitive areas or around special weather events”: it will involve a close interaction between “observation performing” and “assimilation” (for example an adaptative data selection scheme taking into account the local meteorological situation and all the available satellite data, before deciding what to use in the assimilation process). It may also involve an earlier selection during the data collection process.
- In 2025, a much larger amount of surface observations is expected to be exchanged globally (such as radar or GPS surface network data).
- An improved calibration ensuring data consistency and reference to absolute standards is expected.
- Sustainability of essential components of the GOS will be secured with many of the R&D systems integrated as operational systems

2. In terms of space-based observing systems:

At least 6 operational geostationary satellites:

- With no more than 60° longitude difference between neighbouring locations
- All with IR/VIS multi-spectral imager
- All with IR hyper-spectral sounder

Operational polar-orbiting sun-synchronous satellites on 3 orbital planes (around 13:30, 17:30, 21:30 ECT) with redundancy

- All with IR/VIS multi-spectral imager
- All with MW sounder
- All with IR hyper-spectral sounder

Other satellites on appropriate orbits (not excluding the geostationary and polar orbits above) contributing to operational observations for weather and climate on a long-term basis:

- Two sun-synchronous satellites with scatterometer
- Two sun-synchronous satellites with conical scanning full polarimetric MW imager
- At least two sun-synchronous satellites with narrow-band VIS/NIR imagers for ocean colour and vegetation
- Constellation of high-resolution VIS/IR imagers for Land Surface Imaging
- Constellation of clusters of small satellites for radio occultation (RO)
- A constellation for altimetry including two altimeters on sun-synchronous orbits and a high-precision reference altimeter system avoiding tidal aliasing
- Constellation of LEO satellites for precipitation measurements through combined use of active instrument in a low inclination orbit and passive microwave instruments on several high-inclination orbit
- Constellation of sensors for Earth Radiation Budget including at least one broad-band multi-angle viewing radiometer in LEO and a Total Irradiance sensor, together with auxiliary LEO measurements and geostationary sensors (TBD)
- A constellation of instruments/missions to address atmospheric compositions
- Optionally geostationary lightning detection
- Optionally satellites in Highly Elliptical Orbit (HEO) ensuring Polar Regions coverage

Several R&D satellites and operational pathfinders including

- LEO with wind Doppler lidar
- GEO microwave
- LEO Low-frequency microwave radiometer addressing salinity and soil moisture

Improved availability and timeliness through operational cooperation among agencies.

3. In terms of surface-based observing systems:

- **Radiosondes**: optimized utilization, especially in terms of horizontal coverage, which will decrease in data dense areas; supplemented by AMDAR ascent/descents for most of the airports worldwide; supplemented also by profilers for some atmospheric layers. Radiosonde data disseminated at higher vertical resolution than now.
- **GUAN**: a subset of radiosonde stations to be maintained for climate monitoring. A GCOS Reference Upper Air Network (GRUAN) to serve as a reference network for other radiosonde sites, calibration and validation of satellite records and other applications.
- **Aircraft data**: aircraft instruments able to observe humidity in addition to temperature and wind; available from most airports worldwide and able to replace radiosondes near most of these airports. Data available also on small aircrafts flying on short distances. Could be supplemented by UAVs, but not on a regular basis (maybe to help targeting strategies).
- **Surface observations**: larger variety of surface networks (e.g.: road network); multi-applications networks; higher level of reliability and availability.
- **GSN:** a subset of surface stations to be maintained for climate monitoring.

- **Radar** observing systems will produce the same products as now but with an increased data coverage; used by more applications (even global NWP may assimilate radar data with some benefits).
- **Profilers** will be developed and used by more and more applications; a large variety of techniques to be used (lidars, radars, microwave instruments…); these observing techniques to be developed into a consistent network of remote-sensing observations, integrated with other surface networks.
- **GPS** receiver networks will be developed, and locally used (by tomography techniques) to measure also the vertical structure of the humidity field (complementing then radiosondes and aircraft).
- **Long range lightning detection systems** will provide cost-effective, homogenized, global data with a location accuracy of about 2 km, significantly improving coverage in data sparse regions including oceanic and polar areas.
- **Marine observations**. Sustained systems providing high temporal and vertical (sub-surface) resolution data using two-way high data rate satellite data telecommunication systems to collect the in situ observational data; cost-effective multi-purpose in situ observing platforms; new observing technology (e.g. ocean gliders)
- **Atmospheric composition.** Surface-based observations of atmospheric composition (including balloon-borne and aircraft measurements) will be provided by an integrated three-dimensional global atmospheric chemistry measurement network, with a complementary satellite component. New measurement strategies will be combined to provide near real time data delivery.
- **Hydrology.** The surface based observations of hydrological parameters at the global level are expected to diminish however, the exchange of data within the river basins would substantially increase.

ANNEX IV

WMO Integrated Global Observing System (WIGOS)

1. Introduction

The ET-EGOS was invited to address the objectives of the process for developing WIGOS as set out in Cg-XV/PINK 7.4(3), with a view to:

- Assessment of the WIGOS concepts;
- Further specification of the proposed roadmap;
- Providing guidance for the development of concepts and plans for pilot projects;
- Starting the preparation for the WIGOS Implementation Plan.

ET-EGOS discussed its role within the WIGOS development process. It stressed the importance of ensuring that initial projects have easily understandable benefits for WMO Members, and hence the advantage in focusing the projects on specific improvements in the availability of observations in response to identified user requirements. ET-EGOS appreciated that many of the long-term benefits of WIGOS would come from improvements in high-level system architecture and data management. The proposals for initial projects do not focus on these aspects. However, ET-EGOS expects the proposed pilot projects to be good vehicles for developments in improved architectures and procedures, in concert with WIS developments.

It is proposed to initiate pilot projects under four headings:

- Improved access to observations of atmospheric composition
- Improved access to marine observations
- Improved access to aircraft observations
- Improved access to observations for the hydrological user community

2. Improved access to observations of atmospheric composition

The emphasis currently of GAW is mainly on surface monitoring of the atmospheric composition. However, the mandate of GAW includes the integration of satellite and aircraft observations with surface measurements, as well as the integration of chemical data and numerical models. GAW observations are archived and made available by World Data Centres. The purpose of these is to collect and archive processed GAW data, to make them publicly available, and to provide support in the quality assurance, analysis and interpretation of these data for scientific advances and policy decisions. There is a growing need for the near real time data delivery, which GAW is addressing.

The services for operational, time-critical applications in atmospheric chemistry need to be defined and coordinated so that GAW and other environmental observational data are available to users online and when possible, in near real time. It is expected that integrated weather/climate-chemistry modelling systems will provide new classes of products and also improve the quality of conventional weather forecasting. Such systems require enhancement of global near real time transmission of chemical observations to support the assimilation component of the forecasting systems.

Pilot project 2.1 Improve the dissemination of ozone (total column, profiles and surface) and aerosol observations on the GTS/WIS.
Motivation: Ozone and aerosol observations from the GAW network are needed for ingestion into atmospheric models, via data assimilation techniques, in support of improved forecasts of weather,

surface UV and air quality. To be useful, the data must be disseminated in near real time, which will benefit in addition such products as the Ozone Bulletins. This project will contribute to the design of activities that enhance the transfer of GAW data in near real time through GTS/WIS in partnership with the GAW Expert Team on Near Real Time Data Transfer (ET-NRT CDT). This project supports Task 6.1 of the GAW Strategic Plan and Recommendation G6 of the EGOS-IP. The project will be carried out in collaboration with GEMS.
Goal: To expand significantly the number of stations submitting ozone and aerosol observations to operational users in near real time via GTS/WIS.

Pilot project 2.2 Map the current situation of GAW data providers and review the existing services and tools.
Motivation: Considering the increasing number of stations reporting data, and an increasing number of parameters on which data are reported, the burden on both data submitters and the data centres needs to be reduced. This needs to be reconciled with the need to extend the amount of metadata. In addition data providers are often submitting data to many different data centres that may require different formats. This project will provide a quantitative understanding of the different databases/formats the data providers need to support. The information will be used for simplification of data submission procedures.
A review of provided services and tools is also necessary. The assessment performed within the GSE PROMOTE project on ozone, UV, greenhouse gases, and air quality services can be used as background information for developing services.
The users of data will benefit as they will have access to more data and better services as a result of simplified submission procedures.
This project supports the GAW Strategic Plan. It will be carried out in collaboration with PROMOTE (ESA) and DLR.
Goal: To simplify the data submission processes of data providers in order to increase the submission of data, preferably in near real time, for better access by data users.

Pilot project 2.3 Develop a Vision for a satellite constellation for atmospheric composition
Motivation: Space based observations are an important component of an integrated global atmospheric chemistry observing system. They are especially beneficial in providing information in remote areas, particularly over oceans and continental areas where there are gaps in GAW's surface-based monitoring network. Satellite observations of atmospheric composition are expensive. It is beyond the resources of any one Member or agency to provide the observations needed to meet stated user requirements; requirements will only be met through coordinated planning of an international constellation of satellite missions/instruments.
This need was identified at the Workshop on the Re-design and optimization of the space-based GOS (OPT-2, Geneva, June 2007) and supports the IGACO strategy and Tasks 3.13 and 3.16 of the GAW Strategic Plan.
Goal: To create a high-level Vision of the constellation of satellite missions/instruments for atmospheric composition, through collaboration between GAW, WMO Space Programme and CEOS.

3. Improved access to marine observations

Pilot project 3.1 Promote the interoperability of ocean data systems with the WMO Information System (WIS) in close cooperation with the ocean community.
Motivation: This should eventually permit access to meteorological and oceanographic data to serve a number of applications, including climate in an integrated way via the WIS, hence facilitating access to properly documented and standardized data-sets.
The case will have to be made with the oceanographic community in order to show the benefit of such an integration to ocean data users. Some of the existing observing systems that are not currently reporting onto the GTS will also be encouraged to submit their data in real time through the WIS. (This should be easier to realize than with the current GTS because of a more variety of available formats and the possibility of the WIS to consider specific data exchange policies).

Pilot project 3.2 Establish a pilot project for the data collection of ocean observations using new satellite data telecommunication systems (e.g. Iridium).
Motivation: Such technological innovation will address identified deficiencies of the current observing system better to meet the requirements of a number of applications in a cost effective way by (i) permitting the distribution of high temporal and/or vertical resolution data, and (ii) improving data timeliness.
Initiatives have already started with the JCOMM Data Buoy Cooperation Panel and the Ship Observations Team, but integration with other ocean or land based observing systems can be promoted (e.g. OceanSITES, Argo).

Pilot project 3.3 Establish a pilot project for in situ wave observations to meet the requirements maritime safety services and develop a costed justification for the users of marine services products for increasing such measurements globally.
Motivation: In situ wave observations are particularly needed for (i) assimilation into offshore wave forecast models, (ii) validation of wave forecast models, (iii) calibration/validation of satellite wave sensors, (iv) description of the ocean wave climate and its variability on seasonal to decadal time scales, and (v) understanding the role of waves in the coupled ocean-atmosphere system, and their inclusion in weather and climate models.
This will involve new technology developments for making cost-effective wave observations from drifting and moored buoys.

Pilot project 3.4 Promote the documentation and integration of best practices and standards being used amongst the meteorological and oceanographic communities.
Motivation: Common standards for instruments and methods of observations will better serve the applications thanks to consistent and better quality data being fed into the models.

4. Improved access to aircraft observations

The existing ADMAR programme is delivering operational data on the GTS on a regular basis. These data are currently being used beneficially by global and regional NWP and in subjective nowcasting and VSRF. The programme is managed by the AMDAR Panel in cooperation with the WMO Secretariat.

Following decisions by Cg-XIV and Cg-XV as well as EC-LVII and EC-LVIII, CAeM is ready to hand over responsibility for the programme to CBS, where it logically belongs being an operational observing programme. The full integration of AMDAR into a composite observing system will permit optimization of the ground based upper air observing system. In order to ensure the continued success of the programme, a stable management and funding base are required, as the current funding arrangements through the AMDAR Trust Fund is not considered a reliable long-term solution. To this effect, the following steps are proposed:

Pilot project 4.1 Develop a costed justification for the inclusion of water vapour sensors (after successful completion of tests) with a generic software solution for all major aircraft types and models, with special emphasis on short-haul and commuter planes.
This case will compare the cost of the generic software development, hardware and certification for sensor installation and the cost of installing, maintaining, monitoring and calibrating the sensors to the cost of conventional profile data, the impact of a widespread availability of such profile data on VSRF and Nowcasting, and the potential savings by reducing or not having to install conventional radiosondes near participating airports.

Pilot project 4.2 Develop a costed justification for the aviation industry for cost sharing on the development of a generic AMDAR software solution able to run on all major aircraft types, models and avionics systems.
This study will analyze the improvements to terminal aerodrome forecast, winds around aerodromes for optimization of arrival managers, and frequent updates of upper-level wind forecasts based on increased, universal availability of AMDAR data. This study would be presented to IATA, ICAO and projects such as NGATS and SESAR, who are currently in the process of designing the ATM concepts for the 2025 time frame, with a further presentation to regional airline associations in Asia.

5. Improved information for the hydrological user community

Pilot project 5.1 Improve the international exchange of rainfall radar and in situ precipitation observations through WIS.
Motivation: Over many populated land areas, weather radar represents the best source of information on precipitation, particularly when combined with in situ observations. However, the distribution of these data is often restricted within national boundaries. Great benefit could be derived for hydrological and other applications if observations made by weather radars currently in place were made available to a wider community in a timely manner and using convenient formats and data exchange mechanisms.
The project would respond to identified gaps in the observations available to meet the needs of a number of user applications, including hydrology. It responds to Recommendation G1(b) in the EGOS-IP.

Pilot project 5.2 Improve the dissemination of global and regional snow analyses.
Motivation: Snow plays a crucial role in the hydrological cycle in many countries and regions. Analyses of snow cover, derived from various satellite and in situ data sources are available from some centres, but their dissemination is not widespread, and hence their quality is not well understood and their utility is not well developed.
The project would seek (1) to advertise and promote the availability of global and regional snow cover products, (2) to promote their assessment and comparison and (3) to foster their enhanced operational use for a range of applications including hydrology.

Pilot project 5.3 Promote the use of satellite-based systems and products for the estimation of soil moisture.
Motivation: Uncertainties in estimates of soil moisture, at regional and national scale, represent a major weakness in the observational data available to hydrological users. Planned satellite soil moisture products (e.g. from ASCAT on MetOp, from AMSR on Aqua, from SMOS and from Aquarius) offer substantial improvements.
The project would respond to identified gaps in the observations available to meet the needs of a number of user applications, including hydrology. It responds to Recommendation S14 in the EGOS-IP.

Pilot project 5.4 Harmonize standards for establishment, operation and maintenance of WHYCOS stations.
Motivation: Individual WHYCOS components are addressing the needs of the Member countries sharing a particular river basin. One of the reasons for the lack of exchange of hydrological data and information is the concerns about the quality of data collected by different agencies in the river basins. Harmonized standards for the establishment, operation and maintenance of hydrological data will encourage the exchange of hydrological data and at the same time develop confidence among the countries to reach water allocation agreements.

ANNEX V

ACTIONS RESULTING FROM ET-EGOS-3

WMO/CBS ET-EGOS

Terms of Reference (TOR), Work Plan (WP), short-term objectives (OBJ) and ACTIONS

TOR

(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;
(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);
(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;

WP

1. *Update CEOS/WMO data bases of user requirements and observing system capabilities and include user reviewed R&D expected performances (upon receiving information from data users and data producers).*
2. *Expand user requirements database to include "break-through" values.*
3. *Continue Rolling Review of Requirements for ten application areas and expand to new areas as required.*
4. *Work with application area Points-of-Contact to update Statements of Guidance.*

I. USER REQUIREMENTS (URs) AND STATEMENTS OF GUIDANCE (SOGs)

I (a) 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 – Dr Eyre

- *Update SOG for comments from ET-EGOS-3 Oct 07*
- *Review URs – Dr Riishojgaard – Sep 07*
- *Update URs – Dr Eyre – Oct 07*

Regional NWP CBS – Dr Pailleux

- *Update URs to take account of EUMETSAT post-MSG and post-EPS work and updates for GNWP – Nov 07*
- *Update SOG for comments from ET-EGOS-3 – Nov 07*

Synoptic Meteorology CBS / Mr Legrand -> who?
- Reconsider application name – Dr Eyre/ Ms Kootval – Oct 07
- Find new PoC - Dr Eyre/ Ms Kootval - Oct 07
- Update URs
- Update SOG

Nowcasting and VSRF CBS / A. Stan-Sion
- Comments from ET to PoC – Dr Eyre
- Update URs, including taking account of EUMETSAT post-MSG and post-EPS work
- Update SOG for comments for ET-EGOS-3

Seasonal/Inter-Annual Forecast CBS/ W. Landman
- Comments from ET to PoC – Dr Eyre
- Update URs
- Update SOG for comments from ET-EGOS-3

Aeronautical Meteorology CAeM / Dr. Shun + Dr Puempel
- Update URs (DONE)
- Update SOG for comments from ET-EGOS-3

Atmospheric Chemistry CAS / Dr Barrie
- Update URs
- SOG confirmed

Ocean Applications JCOMM / Mr Donlon (Mr Charpentier)
- Update URs including to take account of new structure for applications, and EUMETSAT post-EPS work – Dec 07
- Following consideration of JCOMM/OCG phased implementation plan and gap analysis, update SOG – Dec 07

Agrometeorology CAgM / M. Sivakumar
- Update URs
- Update SoG for comments from ET-EGOS-3- autumn 2008

Hydrology CHy / W. Grabs
- Update URs
- Update SOG – Apr 08

Climate Monitoring GCOS Office / Dr Menne
-

Other Climate applications CCl / Mr Heino / WCASP
- Agree homogeneous application areas – Dec 07
- Create URs
- Perform Critical Review
- Create SOG(s)

General
- Review all revised SoGs – Dr Eyre
- Refer revised SoGs to appropriate "owners" for endorsement – Dr Eyre
- Refer some CIMO comments to ET-SUP – Dr Eyre
- Forward ET-SAT comments on SOGs to identified PoCs (WWW/OSY) - WMO Space Programme, by Aug 07.

II. OBSERVING SYSTEM CAPABILITIES (OSCs)

II (a) Noting that OSCs have recently been partly updated (space based components, ocean/marine components), complete the review and update by September 2007 as follows:

- *Dr Riishojgaard will provide comments to the ET-EGOS Chair on the recently updated space-based Observing System Capabilities;*
- *Mr Stringer will pursue updates for remaining elements, seeking input from relevant experts including:*
  - *AMDAR FL and AMDAR P: AMDAR Panel Technical Coordinator;*
  - *Raobs, Pilot and GUAN: active experts in CIMO;*
  - *Sfc obs and GSN: active experts in CIMO;*
  - *RADAR: active experts in CIMO;*
  - *WND P 449 and WND P 915: active experts in CIMO;*

  and using CBS monitoring statistics to review horizontal resolution.

II (b) Annual review:

- *ET-SAT for space-based elements, via WMO Space Programme*
- *Ms Viola (JCOMM) for ocean/marine elements*
- *AMDAR Panel TC for AMDAR elements*
- *Mr Stringer for other surface-based observations*

III. OTHER TORS

TOR

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

WP

5. Review with Rapporteurs and NWP experts the progress concerning OSE guidance for evolution of GOS.
6. Organize and hold next NWP Impact Studies Workshop in early 2008.

III (a) (Action deleted.)

III (b) Study the impact of all AMDAR data over tropical Africa in Global NWP, with special attention to AMMA data - Dr Pailleux, to trigger OSEs in context of OSE Workshop – Sep 07

III (c) Advise on requirements for vertical resolution in AMDAR observations and in particular layer averaging for humidity – Mr Klink / Mr Goldstraw to communicate results of completed UK Met Office study to AMDAR Panel, by Sep 07

III (d) Study the sensitivity to density (spatial and temporal) of in situ sea surface observations (pressure and wind) in an OSSE. – Dr Pailleux, to consider at OSE Workshop – Mar 08

TOR

(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;

WP

7. Initiate actions, monitor and assure progress on Implementation Plan for the Evolution of the GOS (EGOS-IP) and coordinate this activity with the Rapporteurs/Coordinators on the Regional aspects of the GOS (2005). Prepare a summary of progress on EGOS-IP.

III (e) Secure more resources for Secretariat, to enable pursuit of IP actions regarding ground based sub-component of GOS. - Chairman to discuss with D/WWW.

III (f) 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.

III (g) Improve interaction between ET-EGOS and ET-AWS concerning EGOS-IP - Chairman to invite ET-AWS to comment and contribute to EGOS-IP and to participate in next ET-EGOS, Oct 07.

III (h) Assess the impact on applications of having 1 scatterometer plus 1 or 2 polarimetric microwave imagers, rather than 2 scatterometers (see EGOS-IP S7)
- Comment on this in the context of the review of the Revised Vision for the GOS - Mr Charpentier to refer draft Vision to JCOMM.

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

III (i) Chairman to report to ICT/CBS on all ET activities – summer 08

TOR
(h) Other activities

WP
8. Maintain and improve ET-EGOS web pages.

III (j) WWW Dept to update as necessary. ET members to review every 3 months, and report back any problems.

WP
9. 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.

Note: See actions on communication of IP, above.

IV. NEW ISSUES (July 06)

WP
10. Interaction between ET-EGOS and IPY: Take actions to ensure near real-time distribution of IPY observations where possible; review results of observation gap analysis performed by IPY SC on Observations.

IV (a) Obtain near real-time distribution of IPY observations where possible – Dr Eyre to maintain liaison with IPY with Dr Sarukhanian

WP
11. Support Chair of ICT/IOS on preparation of a Brochure on the evolution of the GOS.

IV (b) Further action awaiting further request from Chair, OPAG/IOS

WP
12. Support activities of the EC Task Team on Integrated WMO Observing Systems.

IV (c) ET-EGOS to provide support as requested

WP
13. Review proposal for GCOS Reference Upper Air Network.
Note: Done, Dec 06.

WP
14. Improve interaction between GOS performance statistics and EGOS-IP.
Note: Done. Recommendations submitted to CBS-Ext.(06).

V. NEW ISSUES (from ICT-IOS, Sep 06)

WP
15. With other IOS ETs, prepare updated vision for the GOS.
Draft prepared Jul 07. Version for ICT to be prepared Jul 08.

VI. NEW ISSUES (from CBS, Nov 06)

VI (a) Requested Members to supply a point of contact responsible for reporting progress and plans in their country related to EGOS-IP;
Responsible: Secretariat (circular letter the Permanent Representatives of Member countries with WMO)
Deadline (for letter): Sep 07

VI (b) Requested OPAG IOS in collaboration with OPAG-ISS to review the existing process for gathering, producing and presenting performance summary statistics for the surface-based sub-system of the GOS and examine possibilities for more meaningful ways of providing this information to Members;
Responsible: Dr Pailleux, Mr Stringer, Dr Menne in collaboration with Secretariat
Deadline: Feb/Mar 08

VI (c) Requested OPAG IOS in view of the current operational requirements for timely delivery of RBSN data, especially for NWP, to include more stringent delivery targets in the monitoring of data availability on the GOS. This includes considering a 30 minute cut-off for surface data and less than two hour cut-off for upper-air data;
Responsible: Secretariat to request monitoring centres to support
Deadline: Oct 07

VI (d) Requested the Secretariat to gather information from Members on progress and plans in their country related to EGOS-IP, with a focus on those activities not covered through established mechanisms, e.g. WMO Space Programme, AMDAR Panel, JCOMM;
Responsible: Secretariat

VI (e) Requested the Secretariat to advise OPAG-IOS on appropriate mechanisms for issue of reports on progress and plans of Members related to EGOS-IP;
Responsible: Secretariat in collaboration with the ET Chair
Deadline: Dec 07

VI (f) Requested OPAG-IOS to analyze information on progress and plans supplied by Members related to EGOS-IP, and to summarize progress;
Responsible: Secretariat, in collaboration with nominated ET-EGOS reps
Deadline: yearly

VI (g) Requested ET-EGOS to consider the potential of long-range ground based remote sensing lightning detection system as a cost effective component of the evolving GOS. Such systems should be considered complementary to existing lightning detection systems for improving coverage in data sparse regions (including oceanic and polar areas);
Note: Done – added to EGOS-IP and to draft Vision for the GOS to 2025.

VI (h) Requested CBS, in collaboration with CAS, CIMO and other relevant commissions and programmes within WMO to consider the development of a strategy to sustain key components of AMMA, IPY and THORPEX observational networks beyond the end of their respective experiments;
Note: Action as below

VII. NEW ACTIONS, July 07

VII (a) Make available IPY data in near-real time. (Use e-mail for data collection and then input into GTS.)
Responsible: see above
Deadline: Mid 2008

VII (b) IPY data coordinator should be linked to CBS.
Responsible: Secretariat via Dr Sarukhanian
Deadline: Nov 07

VII (c) Current AMMA management group to be progressively taken over by ASECNA on behalf of the West African NMHSs involved in AMMA. ASECNA should work with two or three NWP monitoring centres able to carry out a detailed monitoring of AMMA radiosondes. The first tasks to be performed by the new ASECNA-led group be:
(a) To put on the GTS the remaining radiosonde sites which are operated now, but do not reach the GTS;
(b) To follow the monitoring results and react promptly to identified problems by contacting the people operating the radiosonde site;
(c) To look for funding solutions for consumables and infrastructure maintenance beyond 2008.
Responsible: ET Chair in collaboration with Secretariat and ASECNA

VII (d) Define TOR of points of contact (PoC) for application areas und updating Statements of Guidance (Gap analysis) for Observational requirements.
Responsible: ET Chair
Deadline: Oct 07

VII (e) Define procedures for update (validation and approval) of SOGs.
Responsible: ET Chair
Deadline: Oct 07

VII (f) Define TOR of national focal points responsible for reporting progress and plans related to the EGOS-IP.
Responsible: Sec in consultation with ET Chair
Deadline: Sep 07

VII (g) Request PoCs for application areas and updating Statements of Guidance (Gap analysis) for Observational requirements to review and update the database of user requirements and observing system capabilities.
Responsible: Dr Eyre to inform Focal points
Deadline: Oct 07

VII (h) Future version of the SOGs should be provided in track changes against the previous version.
Responsible: Dr Eyre to inform Focal points
Deadline: yearly

VII (i) Review and update supplementary notes on EGOS-IP actions.
Responsible: Mr Stringer.
Deadline: Oct 07

VII (j) Review Gap Analysis performed by WMO Space Programme and
Responsible: ET members.
Deadline: Mar 08

VII (k) Review draft “Vision for the GOS in 2025” and provide comments to Chair ET-EGOS.
Responsible: All ET members
Deadline: Mar 08

VII (l) Confirm dates for ET-EGOS-4
Responsible: ET Chair + Secretariat.
Deadline: Jan 08

VII (m) Refer draft “Vision for the GOS in 2025” to other ETs for comment.
Responsible: Secretariat
Deadline: Aug 07

ANNEX VI

Template for reporting to ICT-IOS

(a) Introduction (executive summary of no more than half a page);

(b) Achievements (main deliverables in a bulleted form and linked to the TOR as approved by the CBS-XIII);

(c) Issues (problems encountered and risks identified);

(d) Recommendations (any proposal/conclusion of the ET-EGOS requiring financial support or implementation action by Members, proposals for Secretariat action and proposals requiring coordination with other CBS expert teams or rapporteurs or other WMO bodies should be recorded as recommendation to CBS-XIV and submitted to the ICT-IOS for prior consideration);

(e) Future Work Plan (proposal of high priorities areas to be address by the ET in future within the overall framework of the WMO Strategic Plan).