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OPAG ON INTEGRATED OBSERVING SYSTEMS

IMPLEMENTATION/COORDINATION TEAM ON THE INTEGRATED OBSERVING SYSTEM

Seventh Session

Geneva, Switzerland, 18 – 22 June 2012

FINAL REPORT



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EXECUTIVE SUMMARY

The Seventh Session of the CBS OPAG on Integrated Observing Systems' Implementation and Coordination Team (ICT-IOS-7) was held at the WMO Headquarters in Geneva, Switzerland, from 22 June to 18 June 2012, and was chaired by Dr Lars Peter Riishojgaard (USA).

Taking into account that WIGOS been endorsed as one of the five high priorities within WMO for the next financial period and the leading role of CBS in the implementation of WIGOS as been endorsed by Cg-XVI, the ICT-IOS-7 discussed and endorsed specific actions to be taken within its area of responsibility to contribute to the WIGOS framework Implementation Plan (WIP).

The ICT-IOS-7 reviewed the status of both the surface-based and space-based components of the Global Observing System with emphasis on the monitoring results of RBSN/RBCN, GSN/GUAN/GRUAN performance, Marine and Oceanographic observations, Polar and Cryospheric observations. It also considered reports on the GOS performance in all WMO regions. The ICT-IOS-7 noted that there are still many issues regarding the implementation and operation of surface stations in some parts of the world.

The ICT-IOS-7 was briefed by all ET chairs and Rapporteurs on the activities carried out in accordance with their Terms of Reference (ToR) during intersessional period.

The ICT-IOS reviewed the latest version of the EGOS-IP and approved it with some minor changes included in a new version. It agreed that the latter version should be finalized by the Secretariat and submitted to CBS-XV for approval as a formal Recommendation. The ICT-IOS concurred with the draft Recommendation regarding the EGOS-IP as proposed in Annex V.

The ICT-IOS strongly supported the updated strategy for the Rolling Review of Requirements databases, recognized the resource implications, and concurred with a number of recommendations from ET-EGOS in this regard.

The ICT-IOS noted the successful Outcome and Recommendations of the WMO Workshop on the Impact of Various Observing Systems on NWP (Sedona, USA, 22-25 May 2012), and agreed to organize the Sixth workshop in 2016.

The meeting acknowledged the transfer of Steering Group on Radio Frequency Coordination (SG-RFC) from the OPAG ISS to OPAG IOS and agreed that the new location better reflects the nature of its activities. Despite the tremendous success of the SG-RFC to address its Terms of Reference, the ICT-IOS recalled the importance of the continuation of this work, as new threats emerge from powerful lobbies of the Information and Telecommunication industry that are avid to appropriate new frequency bands for the multimedia mobile application/services.

The proposals for the new structure of OPAG-IOS in the Intersessional Period following CBS-XV, including new ToR were discussed. Draft future workplans were presented. Special emphasis was placed on the involvement of the OPAG-IOS in the WMO five key strategic priority areas, namely GFCS, Aeronautical Meteorology, WIGOS&WIS, DRR and QMF. The ICT-IOS-7 also reviewed and approved the content of the document on OPAG-IOS activities to be submitted to CBS-XV for consideration and approval.

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GENERAL SUMMARY

1. ORGANIZATION OF THE SESSION

1.1 Opening of the meeting

1.1.1 The seventh session of the CBS Implementation and Coordination Team on the Integrated Observing Systems (ICT-IOS-7) was opened by its Chairman, Dr Lars Peter Riishojgaard (USA) at 9:00 hours on Monday, 18 June 2012 at the WMO Headquarters in Geneva, Switzerland.

1.1.2 Dr Wenjian Zhang, Director, WMO Observing and Information Systems Department, addressed the meeting on behalf of the Secretary-General of WMO. He welcomed the participants to Geneva and recalled that since the Cg-XVI this is the first meeting of the ICT-IOS. He emphasized that the current session should carefully review the implications of the Congress decisions regarding the WMO Strategic Planning for 2012 to 2015 in the context of the activities to be carried out within the CBS OPAG IOS.

1.1.3 Dr Zhang also recalled the decision of Congress to implement the WMO Integrated Global Observing System (WIGOS) as one of the five priority-funded activities together with the Global Framework for Climate Services (GFCS), Aviation meteorological services, Capacity-development for the developing and least developed countries, Disaster risk reduction, and implementation of and the WMO Information System. He underlined that those priorities are all relevant to the activities of the ICT-IOS. Dr Zhang also recalled the role of the Inter-Commission Coordination Group on WIGOS established by EC-63 to oversee the implementation of WIGOS. He specifically mentioned the progress made in the development of the first draft version of the WIGOS Implementation Plan which will be reviewed and hopefully approved by the Executive Council next week. Dr Zhang wished the session to make comprehensive recommendations for the upcoming CBS-XV on further development of both the surface and space-based components of the Global Observing System and on the implementation of WIGOS. He wished the participants every success in their deliberations and looked forward to seeing productive results of the meeting.

1.1.4 Dr Lars Peter Riishojgaard thanked Dr Zhang for his kind words and invited participants to contribute effectively to the deliberations of the meeting on various agenda items to ensure a valuable input to the forthcoming CBS session in September.

1.1.5 The list of participants is given in [Annex I](#).

1.2 Adoption of the agenda

The ICT-IOS adopted the [Agenda](#) for the meeting, which is reproduced at the beginning of this report.

1.3 Working arrangements

The ICT-IOS 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 The Chair briefed the meeting on major activities undertaken by OPAG-IOS since the Sixth Session on ICT-IOS (2010). The emphasis was put on the most important decisions regarding OPAG-IOS made by CBS-Ext. (10) and appropriate follow up activities undertaken by OPAG-IOS in response to these decisions.

2.2 The ICT-IOS agreed that work programme of OPAG-IOS should include additional goals and tasks based on the guidelines given by Congress and Executive Council especially related to WIGOS, GFCS and other WMO priority activities.

2.3 The Chair stressed that efforts should be made to allow a better participation of the Regional Association in the work of the OPAG IOS (see also paragraph 3.3 in this regard).

Database on Observing Systems Requirements and Observing Systems Capabilities (RRR Database)

2.4 The Secretariat reported on the status of the Database on Observing Systems Requirements and Observing Systems Capabilities (RRR Database), which is to become a component of the WIGOS Operational Information Resource. ICT-IOS reiterated that the Database is an essential tool for conducting the Rolling Review of Requirements, comprising the critical review, and providing a record of:

- quantitative observational user requirements for the WMO Application Areas in terms of space and time resolution, uncertainty, timeliness, and observing cycle;
- capabilities of observing systems, both surface- and space-based

2.5 The ICT-IOS recalled that the *ad hoc* sub-group based on the RRR Database had proposed a strategy for the evolution of the database, which was then endorsed by the CBS Extraordinary Session in 2010. Following subsequent discussions with the ET-EGOS and the *ad hoc* group on the Database, the strategy has been slightly updated. The ICT-IOS concurred with the architecture of the Database as summarized in Figure 1 below. Specifically, the ICT-IOS noted with appreciation the following developments that occurred since CBS-Ext.(10):

- The User Requirements part of the database has been redeveloped, and rationalized, and can now be directly updated by the Application Area focal points from the WMO website (<http://www.wmo-sat.info/db/>); the UR database is now widely used (50 visitors per week) although a number of Applications Areas need to have their user requirements updated;
- As concerns the space-based capabilities part of the database, given the absence of any firm proposal from a hosting agency to implement the CBS strategy, it was decided to design this database in accordance with the technical specifications agreed by CBS and to implement the database within the Secretariat without further delay, building on the successful experience of the Observation Requirement database. Building on the dossier on the Space-based GOS, the Space-based capabilities database will be available in Beta testing mode as the Satellite Observation Capabilities Review and Analysis Tool (SOCRAT, see www.wmo-sat.info/db2) by the end of June 2012;
- The Surface-based capabilities part has yet to be developed but Technical Specifications have been drafted, and potential contributors for the content approached (i.e. EUMETNET for capabilities of a sub-set of European surface observing stations, and JCOMMOPS for the *in situ* ocean observing stations) and negotiations initiated.

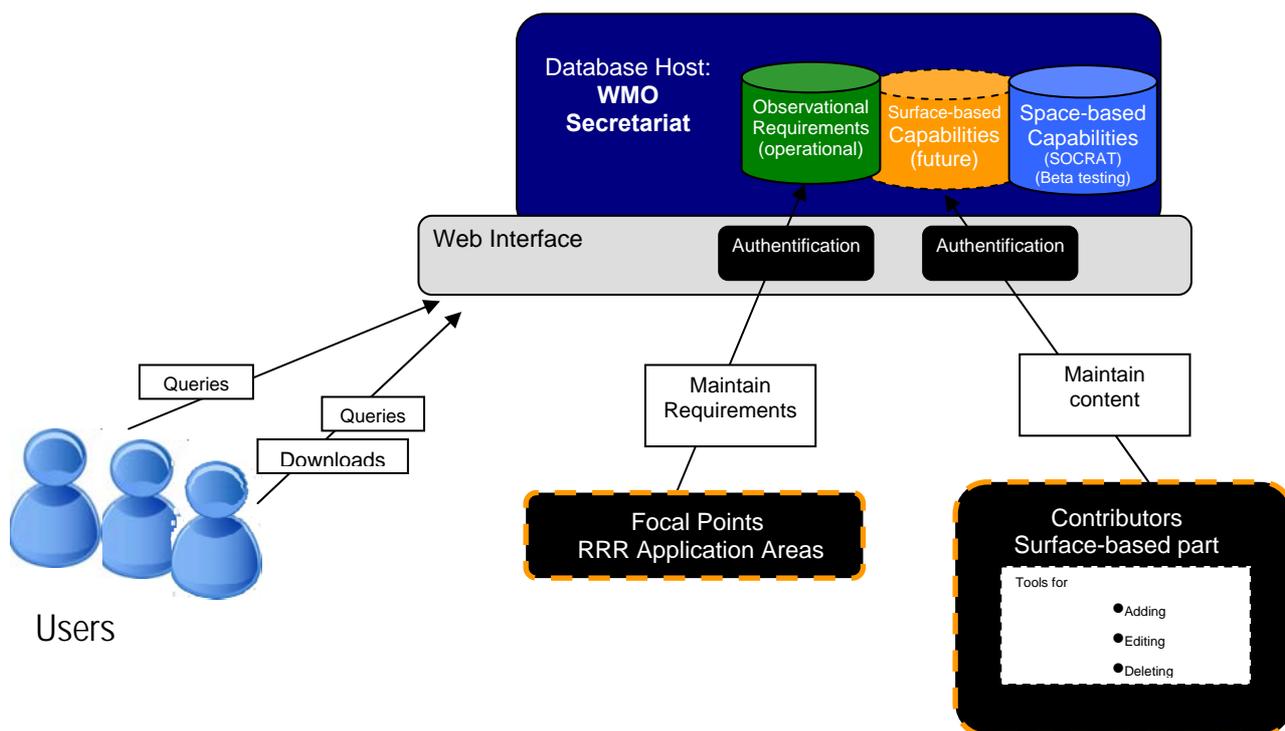


Figure 1: Architecture of the RRR Database

2.6 The ICT-IOS noted a few outstanding issues concerning the database as documented in Annex IX of the ET-EGOS-7 final report (http://www.wmo.int/pages/prog/www/OSY/Meetings/ET-EGOS_Geneva2012/DocPlan.html), and agreed with the proposed action plan.

2.7 The ICT-IOS strongly supported the updated strategy for the database as proposed by the Secretariat and ET-EGOS, recognized the resource implications, and concurred with the following approach for the surface-based capabilities database, i.e.

- Adopting the actual capabilities approach (as opposed to conducting a data-flow monitoring exercise);
- Linking the capabilities to the user requirements database to allow performing the critical review;
- Allowing national and programme focal points to manage content (password protected access);
- Discussion is needed on how to present the actual capabilities of surface-based observing stations (vs. potential ones), in particular as part of an expanded WMO No. 9, Volume A;
- Sustainability of the database should be ensured; the ICT-IOS proposed a Recommendation to CBS in this regard ([Annex X](#)).

2.8 Noting that the RRR (requirements and capabilities) Database also is a key element for evolution of observing systems within WIGOS, the ICT-IOS agreed that the following efforts should be undertaken to ensure its reliability and sustainability:

- Securing resources for IT maintenance and first level contents updating within the Secretariat;
- Promoting resource mobilization for the required development of the surface-based capabilities database;
- Seeking consultancy support for detailed updating and quality control;

- Promoting pro-active action for (i) the Application Area points of contact to maintain the requirements, (ii) Members to routinely update content of the surface-based capabilities, and (iii) the satellite operators to provide updates on space-based capabilities;
- Expert groups reviewing the assessments and gap analyses.

2.9 Noting the significant progress achieved in the development of the RRR Database and its principle role in the WIGOS implementation, ICT-IOS requested the Secretariat to make a presentation on the Database at the upcoming CBS-XV.

3. WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

3.1 The ICT-IOS-7 was briefed by the Secretariat about the decision by Cg-XVI (May 2011) to implement WIGOS during the next financial period and on the progress achieved since Cg-XVI. Special attention was given to the WIGOS Framework Implementation Plan (WIP) developed by ICG-WIGOS.

3.2 Dr M. Ondráš, from the WMO Secretariat made a presentation on the draft WIP submitted to EC-64 for consideration. In doing that, he provided a clear explanation on the purpose and scope of the WIP, time frame for implementation, the key WIGOS Implementation Activities, and support to the implementation expected from the OPAG-IOS. The activities relevant to the OPAG-IOS were highlighted.

3.3 The ICT-IOS expressed its concern at the large number of tasks assigned to the OPAG-IOS as well as to other TCs and to the Secretariat, given the limited resources available. It noted that this implies a risk that the WIGOS Implementation may extend beyond the 15th Financial Period. It further was noted that WIGOS Project Office will be established before EC-64 with one full-time staff only, however, there are plans to create a new position of WIGOS Project Manager in the near future.

3.4 The ICT-IOS further expressed its wish to further improve the clarity of WIP by developing a one-page diagram describing the WIGOS scope, components and linkages between them.

3.5 The ICT-IOS was of the opinion that EC-64 should be informed in more details about resources required and the need to update the current WIP draft following the discussions at ICT-IOS-7. It was agreed that the CBS President, Mr Fred Branski (USA), being also the Chairperson of ICG-WIGOS should bring this matter in his presentation at EC-64. The Chair of ICT-IOS was requested to make a proposal to CBS Management Group in this regard.

3.6 In support of the WIGOS Framework Implementation, the OPAG-IOS agreed to harmonize TOR of its future working structure with the WIP.

3.7 The ICT-IOS recognized that there is a need for a “concept of operations” for the various databases that will eventually be operated under WIGOS as part of the WIGOS Information Resource (how they interact, where the link points are ...), and recommended that this should be included in the WIGOS Functional Architecture.

4. STATUS OF THE SURFACE BASED COMPONENT OF THE GOS

4.1 Regional Basic Synoptic Network (RBSN) and Regional Basic Climatological Network (RBCN)

RBSN/RBCN

4.1.1 The Secretariat reported on the status of the two regional networks. ICT-IOS noted that in 2012 the status of implementation of the surface synoptic stations in the RBSN that perform the

complete observational programme (8 observations per day) varied from 35% in Region IV to 97% in Region VI, with a global average of 72%. It also noted the appreciable increase in the number of stations in Regions I and III following the Regional Association sessions during the period 2010-2012. Overall, the number of stations increased by 2% globally, continuing the positive trend witnessed during previous intersessional periods. The percentage of non-implemented stations (no observational programme) has also remained unchanged at 2% globally.

4.1.2 The ICT-IOS noted that as in the past 90% of globally established upper-air stations are included in the RBSNs. However, it noted that during the intersessional period the number of Radiosonde stations that perform two observations per day has decreased from 541 (in 2010) to 535 stations (in 2012), with an increase of 1% in the overall implementation. The percentage of non-implemented stations (no observational programme) decreased to 3% (23 stations) globally compared to 5% (36 stations) in 2010. It also noted that the number of Radio wind stations continues to drop. However, it was pleased to note the appreciable increase in the implementation of stations (performing at least one observation per day) in RA II which has resulted in a significant reduction in the percentage of stations (7%) not yet implemented or non-operational compared to 52% in 2010.

4.1.3 The ICT-IOS noted that in 2012 the number of RBCN stations globally comprised a total of 2840 CLIMAT reporting stations. There has been a slight decrease in the number of stations mainly in Regions I and III, following the Regional Association sessions during the intersessional period. Overall the implementation of climatological stations reporting CLIMAT remains at around 84%.

4.1.4 The ICT-IOS expressed concern that the implementation of surface stations in both Region I and III and upper-air stations in Region I, remains very low, and agreed that concentrated effort of the international community is needed to assist RA Members in implementation of stations and to reduce the number of stations without an observational programme. The team discussed the issue further and was advised that a number of manned stations particularly in Region III perform observations outside the main standard hours which are not captured in the analysis provided.

4.1.5 The ICT-IOS was also advised that although a number of AWSs are being established by all regions, most of these stations have not been allocated WMO station IDs. This has resulted in the non inclusion of these station data in the WMO Publication No. 9, Volume A, database. However, it was noted that this matter will be resolved once the WIGOS Operational Database is implemented providing for an expanded version of WMO Publication No. 9, Volume A, *Observing Stations*.

Performance Monitoring Results

4.1.6 ICT-IOS was presented with a study of the 2004 – 2011 AGM/IWM monitoring results which indicate that the percentage of SYNOP reports available at MTN centres in comparison with the number of reports required from the RBSN/AntON stations has progressively increased up to 83 percent in 2011. However, significant deficiencies in the availability of SYNOP reports from some Regions are indicated. In Region I (56 percent) and in Region III (70 percent) are noted.

4.1.7 In relation to the percentage of TEMP reports available at MTN centres in comparison with the number of reports required from the RBSN/AntON stations, the study also indicates a progressive increase reaching 75 percent in 2011. There are still significant deficiencies in the availability of reports from certain areas, in particular in Region I (29 percent) and in Region III (54 percent). Regional level variations also occur, for instance in Region I, the availability of TEMP reports decreased from 36 percent in 2004 to 29 percent in 2011.

4.1.8 The ICT-IOS noted that the percentage of CLIMAT reports available at MTN centres in comparison with the numbers of reports required from the RBCN/AntON stations remained around 72 percent. There were major deficiencies in the availability of CLIMAT reports from certain areas, in particular in Region I (29 percent).

4.1.9 The ICT-IOS was advised that in Region I, in addition to coding and message preparation deficiencies, the problems associated with availability of SYNOP, TEMP and CLIMAT reports are often associated with problems with communications, such as the fact that some countries do not have an operational message switching centre, and some centres do not have correctly implemented routing catalogues to ensure correct distribution of reports, in particular CLIMAT reports.

4.1.10 The ICT-IOS agreed that it would be useful to develop map products showing the status of GUAN, AMDAR, and ASAP on same map in order to review the composite upper air observing system, and how its various components complement each other.

STATUS OF SURFACE-BASED COMPONENT OF THE GOS IN THE REGIONS

4.1.11 The Secretariat, on behalf of the Regional Rapporteurs/Chairpersons on Working Group on Infrastructure, presented the Reports on the status of the surface-based component of the GOS in each their regions.

Region I

4.1.12 The ICT-IOS was informed that in spite of some progress, serious deficiencies still exist with improvements being made in the availability of synoptic and climatological data in the GTS with more than 60 percent of member countries in the region facing issues in the implementation, operation and maintenance of their national GOS facilities.

4.1.13 ICT-IOS was also informed that, based on the monitoring results of the AGM and SMM of the operation of the WWW (2011 and 2012), the availability of data from RBSN and RBCN has not improved since the last RA I session, and in fact deteriorated in some areas. Only 60 percent of SYNOP reports, 30 percent of TEMP reports and less than 60 percent of CLIMAT reports were available at the MTN centres. The number of reports has been constant for several years and the number and the quality of reports from the NMHSs have decreased significantly.

4.1.14 The ICT-IOS was made aware that many issues in RA I contributed to the low numbers of observational reports, including inadequate technological developments; the difficulties to establish stations in remote or inhabitable areas; inadequate funds to rehabilitate and maintain equipment; insufficient observational staffing some countries due to pressure by Governments to reduce its workforce; insufficiently trained technical staff to operate and maintain equipment; civil strife in some countries, and continuing telecommunications problems.

4.1.15 The ICT-IOS agreed that follow up and clarification of the findings is required in relation to the Rapporteur's report, which in contradiction to the monitoring results reported under 4.2.1 stated that:

- a) The lack of dynamism or activities of the Region I Coordination and Implementation working groups and/or of the CBS Lead Centres for GCOS and their designated area of responsibility, and of other mechanisms, have not allowed any operational improvement in the surface based sub-system of the GOS.
- b) There have been no follow up actions by the Rapporteurs and National Focal Points on migration to table-driven code forms (CREX, BUFR) in the framework of plans developed for generating and transmitting SYNOP, TEMP, PILOT and CLIMAT reports.
- c) Many Members have no concrete follow-up actions for development and improvement of their national component of the surface sub-system of the GOS.
- d) The deficiencies in the national data collection and regional data exchange have significantly increased.

- e) The idea of routing CLIMAT by “spraying”, meaning switching all received reports at an MTN centre to all connected MTN centres, may assist in more CLIMAT messages being distributed on the GTS. An update to routing catalogue may be required.
- f) The obsolescence of the RA I Working Group on the regional aspects of the WWW since 2007 needs to be re-examined.

Region II

4.1.16 The ICT-IOS was informed that during the intersessional period no significant changes occurred in the surface based sub system in the region. However, many Members have established networks of Automatic Weather Stations (AWS) and Automatic Rain Gauge Stations (ARGs), Lightning Detection Networks and Ground based GPS water vapour profiles. These networks might be included as a part of the RBSN/RBCN or at least they can be considered an augmentation of the conventional RBSN/ RBCN.

4.1.17 The ICT-IOS also noted that some Members have taken up modernization of surface observational networks and hence significant improvement in the GOS is expected soon in the region.

4.1.18 The ICT-IOS was reminded that the region consists of Members whose meteorological observing networks differ in density and quality. Based on the monitoring results of the AGM and SMM of the operation of the WWW (2011), the availability of data from RBSN and RBCN has shown a marginal improvement.

4.1.19 The ICT-IOS noted that:

- a) Members in the Region, specifically India and Maldives have made significant progress in the installation of additional automatic weather stations;
- b) Focus should be put on quality control procedures, metadata availability, integration of observational data and products and improving traceability of instruments in the region;
- c) Active cooperation with all members in the region is needed on the issue of silent stations;
- d) The integration of observing systems especially, RADAR and Ground Based Lightning Detection Networks etc. is required.

Region III

4.1.20 ICT-IOS was informed of the increased number of stations in the RBSN and RBCN following the last Regional Association session. Based on the monitoring results of the AGM and SMM of the operation of the WWW (2011), 70 percent of SYNOP reports, 54 percent of TEMP reports and 81 percent of CLIMAT reports were available at the MTN centres. The low numbers of observational reports is attributed to the lack of funds for maintenance of the equipments and insufficient technical personnel.

4.1.21 ICT-IOS also noted that many Members have or are in the process of establishing a network of Automatic Weather Stations (AWS) with Brazil, Chile and Colombia in the forefront.

4.1.22 It was also pointed out that the Region does not have an operational AMDAR network. As it is a priority to implement a program of Regional AMDAR, countries such as Brazil and Chile have offered to take the leadership in the establishment of this programme with the help of the WMO AMDAR Panel.

4.1.23 The ICT-IOS noted that:

- a) Further improvement in the exchange of data is required;
- b) Efforts to mobilize resources to maintain the surface-based networks in the Region should be continued;
- c) The assistance of the WMO AMDAR Panel is needed for the establishment of the AMDAR programme in the Region;
- d) A regional program is underway for full migration to FM-94 BUFR;
- e) A method be initiated to include all AWSs in the WMO Publication No. 9, Volume A, *Observing Stations*.

Region IV

4.1.24 ICT-IOS was informed that the document presented summarizes the activities, limited to the developing countries in the Region. Some Members, in particular, Mexico, the Caribbean countries and Central America have shown rapid changes in organization and technology. The area has investment plans which provide significant expansion of observational networks and radars.

4.1.25 ICT-IOS noted, the successful completion of the Mexico Regional AMDAR Workshop held in 2011. A plan adopted to advance the AeroMexico AMDAR Programme is an important outcome from the workshop.

4.1.26 The ICT-IOS noted that:

- a) In the past couple of years, significant investments in the infrastructure, particularly in meteorological stations and Radars, have been made by El Salvador. Similarly during the next 5 years, Costa Rica will invest heavily in the improvement of its infrastructure;
- b) The Cayman Islands Weather Radar project is expected to be completed by the end of this year.

Region V

4.1.27 ICT-IOS was informed that surface synoptic observations from the RBSN at the main standard hours have increased and are now achieving about 80 percent of expected observations overall, while Upper air observations increased slightly achieving about 70 percent of expected observations. CLIMAT reports reached around 80 percent of expected reports from stations.

4.1.28 ICT-IOS also noted, that the Regions Strategic Operating Plan 2012-15 includes amongst its identified priority areas "WIGOS is implemented" and "WIS is implemented" and that the Working Group on Infrastructure (WG-I) is currently addressing these priorities.

4.1.29 The ICT-IOS noted that:

- a) There is still a relatively large number of silent stations in the Region, some of which are manned stations performing observations outside the main standard hours;
- b) There is a large part of the upper-air stations making only one observation per day, and that there are sparsely covered areas in the south west Pacific;
- c) A number of activities to assist the migration to TDCF are being planned, including the possibility of supplying software if funding can be secured.

Region VI

4.1.30 The ICT-IOS was reminded of the planned redesign of a regional basic observing network and the establishment of a task team (TT-RRBON) by the 15th session of RA VI within its WG-TDI to achieve this important objective as a WIGOS Demonstration Project.

4.1.31 A short summary of the EUCOS sub-programmes and the associated surface and upper air networks within the EUMETNET community which is monitored by the EUCOS was presented to ICT-IOS. It noted that the operational quality monitoring service on a daily basis for RBSN stations in the Region helped to identify deficiencies in data quality and to improve this quality.

4.1.32 The ICT-IOS was also informed that within the different countries in RA VI there exist several other networks collecting meteorological or climate-related data, for example phenological data. These are mostly not exchanged on a regular basis with other NHMSs.

4.1.33 The ICT-IOS was pleased to note that E-AMDAR showed excellent performance throughout the year and achieved all targets on timeliness, total number of observations and total number of daily profiles within the EUCOS area.

4.1.34 The ICT-IOS noted that:

- a) There are still some deficiencies in the implementation and operation of the RBSN and RBCN in some countries in the Region, as identified during WMO monitoring exercises;
- b) The migration to TDCF is an issue for some Members due to the lack of resources for the migration process and that support is needed;
- c) High-resolution radiosonde data are now distributed by some Members of RA-VI in real-time via the GTS; however, they still do not seem to be used by the numerical weather prediction centers as much as they should be;
- d) There is a need to organize a regional WIGOS Workshop to support the WIGOS implementation in the Region and to foster the work of the TT RBN in reviewing RBSN and RBCN installations;
- e) There is a need to support the ongoing WIS implementation in the Region;
- f) Actions to improve the availability of SYNOP and TEMP data from some Members and connection to RMDCN be supported

Antarctica

4.1.35 The status of implementation of AntON surface and upper-air stations were reported to ICT-IOS. It noted that during the intersessional period, the level of implementation of the surface synoptic stations in the AntON (within Antarctica only) that perform the complete observational programme (8 observations per day) remained at 81 percent. 16 percent perform observations at the 4 main standard hours per day compared to 14 percent in 2010.

4.1.36 The ICT-IOS was also informed that 33 percent of Upper air stations in the AntON make 2 observations per day with 67 percent performing at least one observation per day.

4.1.37 The ICT-IOS noted that the implementation of climatological stations in the AntON (within Antarctica only) reporting CLIMAT is around 53 percent. The formation of AntON comprising of all operational stations in the Antarctica, all of which should produce climate messages is a possible reason for the high percentage of non established or non recorded number of climatological stations.

Other regional issues

4.1.38 The ICT-IOS noted with concern that the AMDAR observations were not mentioned in all of the regional reports submitted to this meeting, while they provide a substantial contribution to the observing system, gaps have been identified in certain regions, and efforts should be made to further develop AMDAR in the regions.

4.2 GCOS Surface Network and Upper-air Networks (GSN/GUAN/GRUAN)*Status of implementation of the GCOS Surface Network (GSN) and the GCOS Upper-Air Network (GUAN)*

4.2.1 The ICT-IOS noted that the combined efforts of the GCOS Implementation Manager and the nine CBS Lead Centres for GCOS resulted in a remarkable improvement in the number of CLIMAT reports received at the GCOS Archive Centre. This was achieved due to increase in the number of GSN stations submitting CLIMAT reports, from identifying and correcting CLIMAT message coding errors, and from troubleshooting issues with the GTS such as out of date routing catalogues. Consequently, the rate of CLIMAT receipt from GSN stations increased to over 80% percent globally, where it seems to have leveled off in recent years. The number of GUAN stations meeting the minimum performance requirements has also been increasing slowly and steadily during the last few years. However, there still remain large differences in the regional receipt rates, e.g. the percentage from Asia (RA II), Europe (RA VI) and North and Central America (RA IV) is at about 90 to 95%; the South West Pacific (RA V) and South America (RA III) is 80 to 90%; and, 60 to 70% for Africa (RA I).

Implementation of the GCOS Reference Upper-Air Network (GRUAN)

4.2.2 The ICT-IOS noted that implementation of GRUAN has progressed steadily over the past years and that GRUAN data have been flowing since summer 2011 through NOAA's National Climatic Data Centre (NCDC) to data users. The most recent Implementation and Coordination Meeting (ICM), inter alia, highlighted advances in bringing new data streams online within GRUAN and considered potential new sites for inclusion in GRUAN. This latter aspect has been the subject of a dedicated expert meeting to guide the expansion from the current 15 initial sites to eventually 30-40 sites as envisaged in the GCOS Implementation Plan. The meeting brought together experts from the main user communities of GRUAN data to develop the network design and expansion criteria.

4.2.3 Criteria for site assessment and certification, and the process for implementation, have also been developed and documented in the GRUAN Manual and Guide, which will be published later this year. The ICT-IOS noted that specific details of and information on GRUAN from the forthcoming GRUAN Manual and Guide planned to be included in WMO regulatory material (currently for GOS and CIMO, and ultimately for WIGOS).

4.2.4 The ICT-IOS noted that the role of WMO in GRUAN governance has been clarified following a meeting held under the auspices of the WMO Integrated Observing System (WIGOS) at WMO Headquarters in January 2012. Representatives of the WMO Technical Commissions (CBS, CIMO, CAS and CCI) are now officially represented at the Working Group on GRUAN, formerly called Working Group on Atmospheric Reference Observations. (The Working Group on Atmospheric Reference Observations has been renamed by the GCOS Atmospheric Observations Panel for Climate at its recent session in May 2012 to clarify that the Working Group's mandate is limited to guide GRUAN activities and that is not supposed to cover any other reference networks in future.) Further outcome of that expert meeting was that fully compliant GRUAN stations should provide an additional data stream of "near-real-time" data for assimilation in NWP models, which is not to be labeled as GRUAN data product.

4.2.5 The ICT-IOS noted that the CBS has not yet nominated its representative on the Working Group on GRUAN. The ICT-IOS requested the Chair to follow this up, and nominate a representative as soon as possible.

Daily climate summaries

4.2.6 ICT-IOS noted that the information available from SYNOP messages is incompatible with the long-term climate record based on CLIMAT messages due to different averaging periods. In particular, the extremes reported in SYNOP messages from different countries often do not comprise the whole 24-h period. The use of SYNOP data therefore results in a significant underestimating of extremes. Recognizing the demand for climate information on a daily basis and to ensure homogeneity of climate data series, ICT-IOS recommends including all daily max/min reports within the monthly CLIMAT message. This should become a mandatory part of the monthly CLIMAT message in BUFR code. The ICT-IOS requested the Rapporteur on GCOS matters, and the ET-AWS (or its successor) to prepare a draft BUFR template joint proposal, to be then submitted to the IPET-DRC.

4.3 Marine and Oceanographic Observations

4.3.1 The Secretariat reported on the status of marine and oceanographic observations, which implementation of the corresponding observing platforms is coordinated through the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM). Details are provided in ICT-IOS-7 preparatory document no. 4(3).

4.3.2 The Team agreed on the following key issues to be reported to the CBS, and to be considered under agenda item 8.4:

- Concerns regarding the percentage of completion of the initial composite ocean observing system, which has not increased substantially in the last few years, and remained at the level of about sixty-two percent;
- JCOMM Observations Programme Area (OPA) priority activities for the period 2012 to 2016 as decided at the fourth JCOMM Session (Yeosu, Republic of Korea, 23-31 May 2012);
- Impact of surface pressure observations from drifters on NWP, and outcome of the Fifth WMO Workshop on the impact of various observing systems on NWP (Sedona, AZ, USA, 22-25 May 2012) in this regard.

4.4 Polar and Cryospheric Observations

4.4.1 Dr. B. Goodison provided an update on Polar and Cryosphere Observations and relevant activities coordinated under by the Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS), with attention to the current status of the Global Cryosphere Watch and proposed actions to support polar and cryosphere surface based components of the GOS. The Antarctic Task Team of EC-PORS is responsible for advising on Antarctic observations. It was noted that Congress XVI decided that the name "Antarctic Observing Network (AntON)" be used for a description of the Antarctic network composed of surface and upper-air stations, including all GCOS (GSN and GUAN) and GAW stations. It has been proposed that ship and buoy observations should be part of AntON.

4.4.2 ICT-IOS noted that Cg-XVI requested EC and SG, with CBS and JCOMM, to investigate possible ways to reduce communication costs through an international forum of users of satellite data telecommunication systems. OPAG-IOS was asked to co-operate with OPAG-ISS to provide an up-date to EC-PORS on this request. Members should ensure that feedback is given to stations when NWP detects problems with data or its transmission. Members are requested to check to see if their stations are performing below expectations, and if they are, to take actions to improve performance where possible. All of the AntON and GCOS monitoring conducted by the British Antarctic Survey (BAS) as the GCOS Lead Centre for the Antarctic is available through the SCAR

website¹. BAS also monitors the GTS and their results are provided through the web². The efforts of BAS in supporting Antarctic observing were acknowledged.

4.4.3 ICT-IOS noted that Cg-XVI adopted Resolution 60 (Cg XVI) - Global Cryosphere Watch, and requested EC-PORS to oversee GCW's initial development and implementation. The first GCW Implementation Meeting, led by the EC-PORS GCW Task Team, successfully engaged participants from outside organizations as well as selected GCW focal points and produced actions for GCW implementation. A draft implementation plan is being finalized. It expands on the Implementation Strategy approved by Congress. All documentation and presentations of the First GCW Implementation Meeting are available on the web³. This report identifies several activities that are based on integrated observation and monitoring, requiring partnerships with others in order to be successful.

4.4.4 ICT-IOS noted that a major GCW initiative is the establishment of a comprehensive cryosphere observing network called "CryoNet", a network of reference sites or "super-sites" in cold climate regions, operating a sustained, standardized programme for observing and monitoring as many cryospheric variables as possible at each site. Initially, it will build on existing cryosphere observing programmes or add standardized cryospheric observations to existing facilities as part of super-site environmental observatories. ICT-IOS agreed to contribute to the identification of sites for the CryoNet, their instrumentation and observations, in the context of integrated monitoring, especially in the context of observations as part of the Global Cryosphere Watch.

4.4.5 ICT-IOS noted the request to support two other GCW initiatives. For permafrost, most of the international network of monitoring active layer thawing and measuring borehole temperatures have been installed and operated by the research community, led by the International Permafrost Association and GTN-P. Further discussion and action is needed regarding the operationalization of the permafrost temperature network and the installation of sites at meteorological stations where permafrost occurs, with the aim of strengthening the operational aspect of permafrost monitoring. A second need identified by GCW is the real-time exchange of snow depth data. Snow depth is now used routinely for assimilation into NWP modes and to generate daily satellite products of SWE. Real-time reporting and clarity in coding of no-snow is requested, in order to meet real-time operational requirements and research purposes supporting weather, climate, water and related environmental matters. ICT-IOS agreed to initiate, in collaboration with ICT-ISS, relevant activities to increase the real-time/near real-time exchange of surface based snow depth observations from synoptic and climate stations in support of GCW and Members' needs. It was also agreed that the Chair of ICT-IOS, or his representative, will serve as a point of contact with EC-PORS and GCW.

5. STATUS OF THE SPACE-BASED COMPONENT OF THE GOS

5.1 The Secretariat reported on the status of the space-based component of the Global Observing System (GOS) including: Operational geostationary satellites (GEO), Operational low-Earth orbit satellites (LEO), Research and Development (R&D) satellites, and the Global Space-based Intercalibration System (GSICS). It recalled that the status of current and planned satellites is available on the WMO website⁴.

Operational Component

5.2 The ICT-IOS noted that the GEO constellation is providing complete coverage, with fully operational satellites. Current plans for the coming decade will lead to considerably improved performance. Attention was raised to the transition to a new generation of geostationary satellites in the 2014-2016 time frame. The advent of several new generation satellites over a short period of time will offer great opportunities but will be associated with higher risks. It will pose particular

1 http://www.antarctica.ac.uk/met/jds/met/SCAR_oma.htm

2 http://www.antarctica.ac.uk/met/jds/met/AntON_SYN_2012.pdf

3 <http://www.wmo.int/pages/prog/www/OSY/Meetings/GCW-IM1/DocPlan.html>

4 <http://www.wmo.int/pages/prog/sat/satellitestatus.php>

challenges to the users as these new missions will provide considerable amounts of data of a new type, with new dissemination systems. Action is required to assist users with their readiness for these changes. (See ET-SUP Report and Annex XIV: Guideline for ensuring user readiness for new generation satellites).

5.3 The constellation of operational meteorological satellites in LEO sun-synchronous orbits includes both fully operational satellites in AM and PM orbit, and additional satellites providing complementary data and back-up capacity. A new generation satellite (Suomi-NPP) was launched by the United States in October 2011; this platform is providing hyperspectral IR soundings from the afternoon orbit. In addition, global microwave imager/sounder data are available from the United States military satellites on early morning orbits. The ICT-IOS noted that there was no clear signal regarding the long-term plans for the early-morning orbit programme, and that the continuity between Suomi-NPP and its follow-on JPSS-1 around 2016 was relying on a tight schedule.

Research Component

5.4 An increasing number of R&D satellites are used in support of operational activities for WMO programmes, in addition to their primary research or demonstration purposes. The ICT-IOS noted the recent launch of the first Global Climate Observing Mission/Water (GCOM-W1) by Japan; this platform will provide microwave imagery as part of the A-train. Several R&D programmes are evolving towards new operational components in accordance with the Vision for the GOS in 2025, in particular:

- Ocean surface altimetry is planned to reach an operational status with Jason-3 (to be launched in 2014), Jason CS (under consideration for continuity of service), and GMES/Sentinel-3;
- Radio-Occultation Sounding (ROS) with the inclusion of ROS aboard operational series and the decision by the United States to prepare a follow-on to the COSMIC constellation;
- Ocean surface scatterometry with Metop/ASCAT and plans for FY-3E/SWIMR, to be complemented by several R&D missions like Oceansat-2 and possibly GCOM-W2. Oceansat-2 scatterometer data are available in near-real time for operational use.

The ICT-IOS stressed the need to pursue the timely implementation of the planned missions.

Global satellite intercalibration

5.5 The ICT-IOS was informed that the main scope of the Global Space-based Inter-calibration System (GSICS) is the on-orbit instrument intercalibration against space-based or ground-based common references, as part of a comprehensive strategy involving also: pre-launch SI traceable instrument characterization and calibration, on-orbit instrument performance monitoring, tying the measurements to absolute calibration standards, and enabling recalibration of archived data. GSICS develops common methodologies, operational procedures and tools that are implemented and shared by GSICS member agencies in order to deliver products in accordance with community agreed best practices and standards. These GSICS products include operational calibration corrections, monitoring results, and related scientific and technical documentation. All GSICS data and products are made freely available through a range of data servers accessible from the GSICS portal: <http://gsics.wmo.int>.

5.6 The ICT-IOS noted that corrections for GOES, Meteosat, MTSAT and FY-2 geostationary imagers are now routinely produced using LEO hyperspectral infrared sounders (IASI, AIRS) as references. These products are planned to be declared pre-operational in September 2012. Methodological development is now centred on the calibration of solar and Microwave channels. GSICS has implemented an on-line catalogue of the GSICS calibration products, providing easy navigation and links to all GSICS products and related documentation. The catalogue and all data servers are accessible through the GSICS portal.

6. REPORTS OF THE OPAG-IOS EXPERT TEAMS AND RAPPORTEURS

6.1 Report of ET-AIR

Achievements

6.1.1 In relation to its Terms of Reference, the Expert Team on Aircraft-Based Observations (ET-AIR), in cooperation with the WMO AMDAR Panel made significant achievements, as detailed below:

- Over the intersessional period, ET-AIR has met conjointly with the AMDAR Panel in three sessions. Together, the ET and the Panel have developed and maintained a joint and harmonized work plan that has ensured significant achievements in the work programmes of both bodies and also coordinated with the Secretariat in the establishment of a Theme Leader for Aircraft Measurements within the CIMO OPAG on Standardization and Inter-comparisons. These bodies, working together, constitute what is referred to as the aircraft-based observations (AO) programme.
- Through attendance at Joint Meetings and the coordination of the work programme, the ET has been able to deliver on its requirement to report to CBS on progress on the AO programme and, through the ICT-IOS, will provide an updated report to the next CBS session in 2012.
- Under the AO programme, the transition from the AMDAR Panel to WWW and the CBS and CIMO Technical Commissions of the governance and programmatic structure supporting the Aircraft-based Observing System (AOS), has progressed to near completion, with a proposal to finalize this process made to this session of ICT-IOS. This proposal essentially comprises two final steps: 1) A request for full support from Congress for aircraft-based observations programme activities from the WMO regular budget (2015-2018); and, 2) Approval and finalization of the governance and programmatic structure under CBS and CIMO, including new terms of reference for the continuation of the management of the AMDAR Trust Fund after the cessation of activities of the AMDAR Panel.
- The WIGOS Pilot Project for AMDAR, which comprised six tasks, has progressed well over the intersessional period. In particular, a new BUFR Template for AMDAR has been developed, submitted to the IPET-DRC and approved through the fast-track process (2012). ET-AIR, in cooperation with the AMDAR Panel, has now put in place a work plan (incorporating both medium and long term plans) that incorporates a Core Activity for the Development and Maintenance of the AOS Quality Management System and, in line with this activity, a Workshop on Aircraft-based Observations Data Management was held 5-8 June 2012 in Geneva. The outcomes and recommendations of that workshop will lead to further development of the Quality Management System and Data Management Framework for the AOS. A provisional metadata set for AMDAR has been compiled, proposed and reviewed at the Workshop on AOS Data Management and plans have been made to finalize the metadata framework for AO. Considerable progress has been made in the validation of the WVSS-II water vapour sensor through inter-comparison with standard instrumentation on research aircraft, for which the results have been extremely promising and adding to evidence that the sensor meets requirements for wider operational implementation. Installations of the latest version of the sensor are well advanced in the USA and likely to occur shortly within the E-AMDAR and Australian AMDAR programmes. A Description of Work was developed for the development of a Generic AMDAR Software Specification and a WMO Special Services Agreement awarded to a consultant to complete the work. The SSA is currently underway and the new standard for AMDAR software is expected to be delivered in the 2nd half of 2012.
- In relation to AO data policy, the issue was considered in detail at the Workshop on Aircraft Observing System Data Management and it was determined that, although requiring more

formalization, Data Policy for the AMDAR Programme is compliant with the requirements of WMO Resolution 40.

- The ET has contributed to the activities associated with the Evolution of the GOS through participation in ET-EGOS meetings and within the development and review process for the new version of the EGOS-IP. The consolidated AO work programme now includes a task to provide input and assistance to ET-EGOS in the relevant aspects of the RRR process and to define the capabilities of the AOS for input into the Database of Observing Systems Capabilities.
- The Mexico Regional AMDAR Workshop was held in Mexico City over 6-8 November 2012 and was very successful and well organized by the host country. In addition to the opportunity to provide training and expertise to regional NMHS experts and regional airline representatives, an important outcome from the workshop was that a plan had been put in place to advance the AeroMexico AMDAR Programme and, subsequently, negotiations between the Airline, the Secretariat, ARINC and Servicio Meteorológico Nacional (SMN) had taken place with expectation for an operational programme in the 2nd half of 2012. The ET, in collaboration with the AMDAR Panel and the Secretariat, has now established a quarterly WMO AMDAR Panel Newsletter, with the first two volumes published in 2012. The newsletter was distributed by email and also made available online.

6.1.2 The ET-AIR Chair, Mr Frank Grooters (the Netherlands), also provided a report to ICT-IOS on other significant achievements in Aircraft-based Observations in addition to the work of the ET.

Issues

WMO Integrated Global Observing System (WIGOS) and WIGOS Framework Implementation Plan (WIP)

6.1.3 The ICT was informed that the integration of AMDAR into the WWW and the WIGOS through the WIGOS Pilot Project for AMDAR had followed a gradual and successful process and, with more work to be done, the remaining long-term tasks in the Pilot Project will become part of the ET-AIR Work Programme.

6.1.4 An issue was raised for the ET-AIR to be provided with direction on any further or additional requirements in relation to the WIGOS Pilot Project for AMDAR. The ET Chair was informed that the tasks under the WIGOS PP should be carried out through to completion and that any further additional work or requirements associated with WIGOS would be addressed through the WIP. The proposed updated Terms of Reference (ToR) for the ET addresses the contribution to WIGOS development and implementation.

Capacity Building

6.1.5 The AMDAR Panel has taken a strong role in AMDAR Programme expansion through the provision of training and workshops, such as the Regional AMDAR Workshop held in Mexico City, Mexico in November 2012 and it will be important that this role is continued in the future under changes being made and proposed to the AO programme and its governance. Taking into account this, the great potential for further expansion of the AMDAR Programme and the related actions of the CBS Implementation Plan for the Evolution of the GOS, ICT-IOS recommends that CBS ensures that training and outreach activities associated with and in support of AMDAR programme development are continued under the guidance of ET-AIR and utilizing appropriate support available from the Secretariat.

Towards Completion of Transition of AMDAR to WWW and Future Governance of Aircraft-based Observations

6.1.6 The ET-AIR Chair informed the ICT that, in relation to its ToR and, in particular, items a)

and b) associated with the integration of AMDAR into WIGOS and the governance of the AMDAR Programme, ET-AIR, in coordination with the AMDAR Panel and in consultation with CBS Management and the Secretariat, had developed a proposed structure and plan that would complete the transition of the AMDAR Programme and its governance under the WWW Programme by the end of 2012.

6.1.7 The proposed structure incorporates the continuation of ET-AIR and the creation of a new Expert Team under the CIMO Technical Commission as the preferred and recommended structural solution for governance and programme management, with the AMDAR Trust Fund to continue to be maintained so as to support the activities of the AMDAR Programme under the guidance of the two ETs and the administration and stewardship of the Secretariat.

6.1.8 The ICT-IOS agreed that these proposed changes, which incorporate the cessation of Panel activities at the close of the 15th Session of the AMDAR Panel in 2012, were also necessary to ensure that the Secretariat could continue to provide support for coordination of AO and AMDAR Programme activities.

Recommendations

6.1.9 ICT-IOS agreed with the transition of AMDAR into WWW and will:

- 1) Recommend to CBS that CBS provide support for the continuation of an Expert Team on Aircraft-Based Observations (ET-ABO) and maintenance of the AMDAR Trust Fund under the proposed governance and programmatic structure and the new Terms of Reference as presented in [Annex VIII](#);
- 2) Request that CBS Management and the Secretariat liaise with CIMO Management to seek appropriate CIMO support for undertaking a wider role in the aircraft-based observations work programme;
- 3) Request the AMDAR Panel Chairperson, Mr Frank Grooters (the Netherlands), to ensure that, by 1 September 2012, the AMDAR Panel Management Group and AMDAR Panel Members were informed about the proposed new governance and programmatic structure and the cessation of Panel activities.

6.2 Report of ET-AWS

Achievements

6.2.1 The Chair of ET-AWS, Mr Karl Monnik (Australia), reported that a revision had been completed of the AWS Functional Specifications (FS) that appears in Annex III.1 of the Guide to the GOS (WMO No. 488, 2010 ed.) based on input from users. In cooperation with IPET-DRC, BUFR/CREX descriptors were updated based on the latest version of the FS. BUFR Templates for key observation reports were also developed and refined. Where necessary IPET-DRC have developed and validated new descriptors, including the testing of extreme values. The BUFR template for n-minute AWS data was expanded to include ground temperature over a variety of surfaces covers.

6.2.2 ET-AWS noted that the linkage between WIS and WIGOS is established through Volume A, the list of surface based observing stations. ET-AWS considers the design of an enhanced Volume A with access to station, instrument, site and processing metadata to be an important objective for future work. This will facilitate interoperability, standardization and management of metadata in support of WIGOS.

6.2.3. A brief review of the "Guide to the GOS, section III (Surface-Based subsystem) Appendix III Automatic Station Metadata" was performed to ascertain that the document was current and provided sufficient detail. The level of detail was found adequate but an update was required. ET-AWS agreed to recommend to ICT-IOS that this task be pursued as it will contribute directly to WIGOS.

6.2.4. Considering the important role of data communications for AWS networks and WIGOS, ET-AWS endorsed a proposal originating as a recommendation from the JCOMM Pilot Project for WIGOS to establish an international Forum of users of satellite data telecommunication systems as proposed at CBS Ext(10). The Team noted the good progress made in this regards through the ICT-ISS. A preparatory workshop for establishing such a Forum was held in Toulouse, France from 23 to 24 April 2012.

6.2.5. Noting the range limitations of humidity sensors, and at the same time the need for data with low uncertainty at both extremes of the humidity range (fire weather, aviation and agricultural applications), ET-AWS recommended that CIMO evaluate by inter-comparison the performance of different humidity measurement systems at the extreme ends of humidity (<5% >95%) ranges.

6.2.6. Following the transition from a manual observations network to a largely automated network, gaps have been identified which impact on the network operations. This consists of (i) a capability gap due to the inability of current automated observations to detect human observed characteristics, and (ii) a business gap (costs to maintaining the equipment, staff skills). ET-AWS therefore sought further guidance from ICT-IOS on the required focus of the document before assigning a future priority to this task.

6.2.7. Recognizing the need for many WMO members to be in a position to make informed decisions regarding use or investment in external data (third party data), ET-AWS reported on the benefit of a draft guidance document prepared by the Australian Bureau of Meteorology to guide decision-making regarding use or investment in external data (third party data). A process of evaluating the value to the NMHS was presented which included aspects such as metadata, custodianship, formats and legal agreements. This has become increasingly important with the rapid expansion of privately funded meteorological networks in many countries.

Recommendations

6.2.8. ET-AWS-7 considered proposed changes to the Table of Functional Specifications for AWS in the Guide to the GOS. Many changes were considered during ET-AWS-6 in 2010 (see Final Report of ET-AWS-6). Since then some BUFR descriptors have been tested and validated, and are now ready for operational implementation. An updated table was considered by ET-AWS-7 and is now recommended by ICT-IOS-7 for consideration by the CBS-XV as a replacement in the Guide to the GOS (see [Annex VI](#)).

6.3 Report of ET-EGOS

Achievements

6.3.1 Dr John Eyre reported on the activities of the Expert Team on the Evolution of Global Observing Systems (ET-EGOS) since the fourteenth CBS Session (CBS-XIV, Dubrovnik, Croatia, 25 March–2 April 2009), where 3 ET-EGOS meetings have been held during the period. In the last two Sessions, focus was placed on the drafting of the Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP) responding to the Vision of the Global Observing System in 2025, as well as to plans for the WMO Integrated Global Observing System (WIGOS) needs. Wide community review was undertaken to achieve this goal.

6.3.2 The ICT-IOS noted the excellent progress of the ET-EGOS with regard to its Terms of Reference and, in particular, the following developments:

- Substantial progress and improvements regarding the RRR Database (see agenda item 2);
- Undertaking of the RRR for 12 Application Areas, and the consideration of interfaces with the Global Cryosphere Watch (GCW) and the Global Framework for Climate Services (GFCS); including critical review and gap analysis, consideration of the results from recent

impact studies, the review of the various Statements of Guidance, and consideration of the findings when drafting the new EGOS-IP;

- Guidance regarding the organization of the Fifth WMO Workshop on the Impact of Various Observing Systems on NWP (Sedona, USA, 22-25 May 2012);
- Drafting of the new EGOS-IP in wide consultation with the WMO Application Area experts, taking into account developments with respect to WIGOS;
- Advice and support provided to the Chairperson of OPAG-IOS on development and implementation of the WIGOS concept.

Issues

6.3.3 The ICT-IOS discussed some issues of interest to ET-EGOS regarding (i) the WMO Integrated Global Observing System (WIGOS) and WIGOS Framework Implementation Plan (WIP), (ii) initiation of activities for the Global Framework for Climate Services (GFCS), (iii) WMO Quality Management Framework (QMF), (iv) observational requirements for WMO Polar activities, including the Global Cryosphere Watch (GCW), and (v) Capacity Building. The consensus achieved in this regard is summarized in [Annex IV](#).

6.3.4 The ICT-IOS noted that there is an annual request to NFPs for reports on progress against EGOS-IP. In January 2013, ET-EGOS proposed to request reports against the new EGOS-IP, assuming it has been endorsed by CBS. Noting that this will be before its formal approval by EC, ICT-IOS agreed that this was still appropriate. The ICT-IOS recognized that there is a need to identify in the EGOS-IP those actions on which the Focal Points should be invited to focus when providing feedback on the EGOS-IP. The ICT-IOS also agreed that some consideration should eventually be given to the need for developing a coordination mechanism to follow up implementation of the observing systems, assist as needed, and provide feedback on national activities.

Recommendations

6.3.5 The ICT-IOS agreed to submit a formal Recommendation on the Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP) to the CBS-XV Session. The draft Recommendation is provided in [Annex V](#) (see also item 7).

6.3.6 The ICT-IOS concurred with the following recommendations from ET-EGOS (to be included in the OPAG-IOS document to the CBS-XV):

- RRR databases. ET-EGOS strongly supports the adjustments to the CBS approved strategy for the development and maintenance of the databases of user requirements and observing systems capabilities which support the RRR process (see the final report of ET-EGOS-7). However, it recognizes the significant recommitment of resources required to sustain these activities. Accordingly it recommends to CBS to ensure adequate resourcing of these activities for the next intersessional period.
- Interactive exchange with NFPs. ET-EGOS notes the improvements in obtaining useful feedback from NFPs on progress against EGOS-IP. In order to drive forward implementation activities in the next intersessional period, ET-EGOS recommends enhanced interactions with NFPs, including advice on problems encountered and the encouragement of links to successful activities. These activities will require resource mobilization.
- NWP impact studies workshop. ET-EGOS recommends organizing the 6th WMO Workshop on the Impact of Various Observing Systems on NWP in 2016, and requests CBS to support the allocation of appropriate resources for this event.

6.3.7 The ICT-IOS considered the proposals from the ET-EGOS regarding the new Terms of Reference of the ET-EGOS (or its successor) when discussing the future CBS OPAG IOS working structure. The new proposed Terms of Reference are taken into account when discussing the CBS

working structure under item 8.1.

6.3.8 The ICT-IOS concurred with the draft Work Plan for the ET-EGOS (or its successor) for the period 2012-2014 as proposed by the ET-EGOS. The proposed workplan is taken into account when discussing the workplans of the future CBS Expert Teams an agenda item 8.3.

6.4 Report of ET-SBR SO

Achievements

6.4.1 Mr Stuart Goldstraw (UK), ET-SBSRO Chair, briefed the meeting on the ET-SBSRO activities. Since ICT-IOS-6, ET-SBR SO met in Geneva in December 2011 (ET-SBR SO-2). This was a joint meeting with the CIMO ET on Operational Remote Sensing (ET-ORS). The final report of the joint meetings can be found at: <http://www.wmo.int/pages/prog/www/CBS-Reports/IOS-index.html>

6.4.2 Progress had been made on some work plan items but in a small number of cases no significant progress was reported. A review of the work plan was undertaken with revised expectations and dates for delivery set. However the limited availability of some ET members has severely restricted the progress with the work plan. This experience has highlighted the need for an improved definition of work plan items as well as clearly expressed expectations regarding the availability of ET members.

6.4.3 In relation to its Terms of Reference, ET-SBR SO has achieved the following:

6.4.4 The wind profiling radar survey is being finalized and the ET lead is awaiting confirmation of a web hosting facility by the Member. This is hoped to be completed within days of ICT-IOS-7. A revised approach to surveying has been decided upon. Rather than sending the whole questionnaire to the Member via the PR a request for a PoC within the NMHS has been selected as the chosen method. The ET lead will then contact the PoC and engage them in the survey. By establishing a strong ET / PoC link issues and questions of interpretation with respect to the survey can be answered and improved information flow between Members and the ET can be facilitated.

6.4.5 The Weather Radar Metadata Database, hosted by the Turkish State Meteorological Service, link to website: <<http://www.dmi.gov.tr>> now includes metadata on 513 radars from 49 countries. However it should be noted a number of Members with extensive Weather Radar networks have not yet included their metadata in the database. Nevertheless the number of users is growing and the two latest Members to upload their information were Azerbaijan and Uzbekistan. A letter of thanks has been sent from WMO to the Turkish State Meteorological Service for their support of this important global metadata database. The Turkish State Meteorological Service has confirmed its willingness to continue to resource the operation of the WMO radar database under the Principles of Operation agreed between WMO and TSMS.

6.4.6 In preparation for the population of the surface based observing system capabilities database work within the ET has been focused on the development of the methodology for assessing SBR SO system capabilities. Once this methodology is developed and published and the new capabilities database is established the population with SBR SO system performance will begin.

6.4.7 Some engagement with ET-EGOS and Secretariat to review the Application Areas SoGs has been undertaken although the nature of the reporting needs to be agreed for future reviews.

6.4.8 ET-SBR SO provided feedback during the development of the new EGOS-IP. ET-SBR SO felt the actions contained within the new EGOS-IP gave a very clear guidance regarding future priorities and this will be reflected in the proposed draft work plan for the new ET on Surface Based Observations.

6.4.9 ICT-IOS-7 supported the proposal for a workshop on the regional and global exchange of weather radar Doppler radial winds and reflectivity data. The proposed aims, objectives, and deliverables of the workshop can be found in [Annex VII](#). The provisional date for this workshop will be late November / early December 2012 in Exeter.

Issues

6.4.10 ET-SBRSO identified the following issues for consideration by ICT-IOS:

- Familiarity with WIGOS and the WIP are currently limited within ET-SBRSO and as such some future ET work time should be set aside to improve the understanding of WIGOS. As the delivery of a number of WIP outputs will be greatly assisted by ET activities it may be sensible to ensure the WIP communication and outreach plan, section 10, includes specific activities targeted at improving ET understanding. Now the WIGOS PO is being established and staffing levels are increasing the level of detailed engagement with WIGOS will be improved.
- It is assumed that ETs will play an important role in the development of guidance material for WIGOS as many of the SBRSO systems are either operated by 3rd party organizations or operated for multiple user communities or have little guidance material currently in place.
- ET-SBRSO welcomes the proposal to include safeguard guidance responsibilities within the remit of WIGOS. The current approach is valuable but with an increasing level of pressure on Members the formalization of guidance material and its subsequent maintenance will become increasingly important and so is fully supported. During ET-SBRSO-2 the issue of Wind Turbine interference impacting on the performance of Wind Profilers was highlighted. Whilst many Members have experience of Wind Turbine interference impacting on Weather Radars, it is clear that a more comprehensive guidance statement is now needed.
- ICT-IOS-6 requested 'for future ICT-IOS Meetings, ET-SBRSO should provide a report on the operational status of SBRSO systems'. A report on this subject has not been produced for ICT-IOS-7 and no progress has been made establishing a routine mechanism for monitoring the operational status of SBRSO systems due to a lack of resources. The draft ToR for the newly defined ET on Surface Based Observations (ET-SBO) explicitly includes reference to reporting operational status.
- ET-SBRSO required expertise in a wide range of technologies as well as operational management experience. To undertake its role effectively either a wider range of experts is required or access to a dedicated resource with a strong track record in a number of areas. The availability of experts with an in depth familiarity with existing components of the WWW OIS and associated information systems will be important to avoid duplication of effort in the development of guidance material. This will be considered in the selection of experts for the newly formed ET-SBO.

Recommendations

6.4.11 Whilst no specific CBS recommendations are requested, the ICT-IOS asked the Chair of OPAG-IOS to inform:

- CBS-XV of the upcoming workshop on the Regional and global exchange of weather radar data, noting this will focus on Doppler radial winds and reflectivity data;
- CBS-XV of the Wind Profiling Radar Questionnaire and highlight the new approach to gathering operational information.

6.5 Report of ET-SAT

Achievements

6.5.1 The Expert Team on Satellite Systems (ET-SAT) held two meetings since CBS Ext. (2010). The first meeting (ET-SAT 6) was held in Geneva on 12 to 15 April 2011. The second meeting (ET-SAT 7) was held in Geneva on 17 to 19 April 2012. Both meetings were under the chairmanship of Dr. Michael Kalb.

6.5.2 ET-SAT provided significant input toward the global planning of satellite missions to implement the Vision for the GOS in 2025, reviewed the space related aspects of the Implementation Plan of Evolution of the GOS, and provided corresponding advice to the ET-EGOS and the ICT-IOS on both the Implementation Plan and update of the Vision. Based on its analyses, ET-SAT recommended updates to current 2025 Vision, that emphasize the optimal configuration of the Geostationary constellation; the need for Multi-angle, multi-polarization visible/infrared imagery for monitoring of albedo and aerosols; need for more detailed reference specification by the relevant scientific community of a constellation for atmospheric composition, as a pre-requisite for useful for planning, that at minimum distinguishes between nadir and limb sounders; and specification of Radio-occultation constellation capability based on a minimum number of occultations per day, rather than numbers of GNSS RO receivers. ICT-IOS agreed that these suggestions should be recorded by ET-EGOS and that updating the Vision for Global Observing Systems should be part of the Terms of Reference of the IPET-OSDE in consultation with other OPAG/IOS Expert Teams.

6.5.3 ET-SAT defined a new “baseline” for the CGMS contribution to the GOS, which already fulfils a major part of the goals set in the Vision for the GOS in 2025. This new baseline was adopted by CGMS at its 39th meeting, in October 2011.

6.5.4 ET-SAT provided a thorough review of the satellite-related parts of the Implementation Plan for Evolution of Global Observing Systems (EGOS-IP), in particular its whole Chapter 6 dedicated to space-based observations. In reviewing this document, ET-SAT has focused its attention on ensuring that the actions provide a realistic and efficient way forward to implement the Vision.

6.5.5 ET-SAT reviewed a draft volume on Satellite Observations, to be proposed for inclusion into the CIMO Guide, in replacement of the “Satellite observation” chapter which dates back to more than 20 years. This draft volume addresses the principles of Earth observation from space, the various types of instruments and orbital systems, the main categories of Earth Observation programmes and the description of products to be derived from space-based observation.

6.5.6 ET-SAT reviewed in detail the implications of WIGOS for the Space Programme, and identified areas for further integration efforts, highlighting intercalibration of on-board satellite instruments, data management, satellite-derived products and composite products, global satellite planning, and exploiting complementary space and surface-based observations. In addition, ET-SAT suggested actions or activities that would have a practical impact on further integration of satellite observations, recommending that consideration be given to formally recognizing GSICS as a component of WIGOS component; and recognizing the need to define requirements for surface observations in support of calibration or validation of satellite observation products.

Recommendations

6.5.7 ET-SAT prepared a draft update of Part IV “Space-based Subsystem”, of the Manual on the Global Observing System (GOS), which specifies the main high-level capabilities of satellite systems to be operated in support of WMO Programmes, as a basis for the commitments of WMO Members through their Space Agencies. The update aligns the future manual with the new baseline agreed by CGMS. The draft update of the Manual is submitted to CBS-XV for consideration ([Annex IX](#)).

6.5.8 ET-SAT has kept under review the status and plans for satellite missions contributing to WMO global observing systems. The extensive information compiled, maintained, and made available on line as the Dossier on the space-based GOS has been migrated to a newly designed on-line database of space-based capabilities. ET-SAT took an active role in reviewing the capabilities database and provided guidance for its completion. It raised the issue of sustainability of the database, which is the subject of a specific recommendation submitted to the Commission ([Annex X](#)).

6.5.9 The Gap Analysis of space-based capabilities has been reviewed and its methodology has been refined by ET-SAT-7. As part of this review, ET-SAT performed a Gap Analysis to exercise this new capability. As an outcome of the analysis, several potential gaps were identified and are brought to the attention of the Commission, with a recommendation to address them ([Annex XI](#)).

6.5.10 ET-SAT has been kept apprised, by the Steering Group on Radio-Frequency Coordination, and has recognized the significance of radio-frequency spectrum protection for space-based observation, considering the vital needs of passive and active remote-sensing, and the Earth-to Space/Space-to Earth communications

6.6 Report of ET-SUP

Achievements

6.6.1 The Chairman of ET-SUP, Dr Luiz Machado (Brazil), reported on his Team's achievements and the issues it identified related to the utilization of satellite data and products by WMO Members.

6.6.2 Since 2010, the Team has advanced the WIGOS objectives of data access and delivery, quality management and monitoring, planning of observing systems, capacity building, and communication and outreach, through the following activities:

- Processed all phases of a 2010 questionnaire on satellite data use by WMO Members, took appropriate action based on its results, and developed, tested and launched, in May 2012, a revised, web-based survey on this topic
- Developed a *Procedure for Documenting Regional Requirements for Satellite Data Access and Exchange*, submitted as a Recommendation to CBS; ET-SUP successfully concluded the pilot project for developing RA III and IV satellite data requirements
- Documented the status of new satellites and prepared an inventory of pre-processing and analysis software tools in support of satellite applications. In order to improve the use of the new satellite generation by WMO Members, and to adequately prepare the user community, a *Guideline for Ensuring User Readiness for New Generation Satellites* has been submitted to CBS for adoption.
- Provided guidance on the development of an online Product Access Guide for harmonized access to satellite products;
- Promoted the definition of an initiative for Sustained Coordinated Processing of Environmental Satellite Data (SCOPE) for nowcasting and supported the SCOPE initiative for Climate Monitoring (SCOPE-CM).
- Provided feedback to the EGOS-IP and the Manual on the Global Observing System, from the satellite users' perspective
- Discussed important developments in user training and capacity building, including the Virtual Laboratory for Education and Training in Satellite Meteorology, the GOES-R Proving Ground

programme, activities of the Committee on Space Research (COSPAR), and in relation to space weather-related applications.

- Provided guidance for the re-design of the WMO Space Programme and VLab websites (<http://vlab.wmo.int>).

6.6.3 Details on these achievements can be found in document ICT-IOS-7/Doc. 6.6.

Issues

6.6.4 The following issues were noted:

- Getting real-time access to satellite data is a challenge for many users. ET-SUP has been addressing the need for improved information on the technical details of how to access satellite data from new satellites, including for instance early information in advance of the launch or during commissioning phase, as well as software pre-processing tools.
- Many VLab Centres of Excellence require assistance in order to fully meet agreed expectations (meeting regional training needs for satellite meteorology, etc). Some face severe resource constraints. The VLab Technical Support Officer function, vital to the day-to-day business of VLab, also requires sustained funding. To this end, in October 2011, WMO issued a call for support to all satellite operators in CGMS; however, the response thus far has been modest.
- When application areas have organized satellite expert groups, it is important for ET-SUP to establish proper linkages with these groups in order to adequately reflect the needs of these groups and benefit from their feedback and expertise without unnecessary duplication.

Recommendations

6.6.5 The ICT-IOS concurred with the following recommendations from ET-SUP:

- The candidature by DMN Morocco to host a new VLab Centre of Excellence in Casablanca, with EUMETSAT as sponsoring satellite operator, be endorsed by CBS.
- ET - SUP confirmed the need to monitor the progress of satellite data access and use by WMO Members and requested that members respond to the 2012 survey on this matter.
- ET-SUP recognized that many VLab Centres of Excellence require assistance, including from their satellite agency partners, in order to fully meet agreed expectations, and that the VLab Technical Support Officer function, vital to the day-to-day business of VLab, requires sustained funding.

6.6.6 The ICT-IOS agreed on the following draft CBS-XV recommendations:

- Procedure for Documenting Regional Requirements for Satellite Data Access and Exchange be adopted by CBS ([Annex XIII](#)).
- CBS Guideline for Ensuring User Readiness for New Generation Satellites be endorsed by CBS ([Annex XIV](#)).

6.7 Report of the Rapporteur on GCOS matters

6.7.1 The ICT-IOS noted that the input from the GCOS Rapporteur on GCOS matters, Mr Jay Lawrimore (USA), who could unfortunately not attend this meeting, has been considered under item 4.2 above, and reported upon by the Secretariat.

6.7.2 In the absence of the report from the Rapporteur, the Secretariat informed that the CBS Lead Centres for GCOS agreed on the new TOR and the new Areas of responsibilities ([Annex XVII](#)) that will be submitted to CBS-XV for consideration.

6.8 Report of the Co-Rapporteurs on Scientific Evaluation of Impact Studies undertaken by NWP Centres

Observing System Experiments (OSEs) and Observing Systems Simulation Experiments (OSSEs)

6.8.1 Mr Yoshiaki Sato (Japan) reported on recent progress on impact of the several observing systems in terms of benefit to Numerical Weather Prediction on behalf of the two Co-Rapporteurs on Scientific Evaluation of Impact Studies (SEIS), i.e. himself, and Dr Erik Andersson (ECMWF) who could not attend the meeting. He particularly reported on the main results from recent Observing System Experiments (OSEs), and Observing System Simulation Experiments (OSSEs) with emphasis on the future evolution of the GOS. These results are summarized in [Annex II](#).

6.8.2 Mr Sato also reported on a comprehensive proposal for OSEs and OSSEs of particular interest to ET-EGOS that has been developed as part of the preparations for the Fifth WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction. This new list of specific studies and science questions has been distributed widely as it formed part of the invitation to the workshop. The ICT-IOS concurred with the list, which is reproduced in [Annex III](#).

6.8.3 The Team noted with appreciation that the two SEIS Co-Rapporteurs had fulfilled all of their tasks in relation to their Terms of Reference.

6.8.4 The Team concurred with the following recommendations from ICT-IOS to the CBS-XV as proposed by the Co-Rapporteurs:

1. Encourage continued development and research of observation impact assessment tools (e.g. Forecast Sensitivity to Observations (FSO), Degrees of Freedom for Signal (DFS), ...), as a complement to traditional OSEs.
2. Encourage NMHSs to conduct OSEs and OSSEs to address the specific science questions listed in [Annex III](#);
3. Operators of regional NWP centres should explore the use of FSO diagnostics tools.

6.8.5 No changes were proposed by the regarding their Terms of Reference. A draft Work Plan for the Co-Rapporteurs for the period 2012-2014 has been included in the draft Work Plan for the IPET-OSDE.

Outcome and Recommendations of the WMO Workshop on the Impact of Various Observing Systems on NWP (Sedona, USA, 22-25 May 2012)

6.8.6 Mr Sato recalled that since 1997, a comprehensive review of the impact of the different operational observing systems has been carried out through the WMO Workshops on the Impact of Various Observing Systems on NWP and reports on their outcomes published (Geneva: 1997; Toulouse: 2000; Alpbach: 2004; Geneva: 2008). The series of workshops has proved very successful providing substantial input for reviewing the Statements of Guidance for Global and High-resolution NWP, the Vision of the GOS for 2025 and the EGOS IP.

6.8.7 Mr Sato then presented a preliminary report of the outcome and recommendations of the Fifth WMO Workshop on the impact of various observing systems on NWP, which was hosted by the Joint Center for Satellite Data Assimilation in Sedona, Arizona, USA, from 22 to 25 May 2012.

6.8.8 The workshop was attended by 56 experts on data assimilation and observation impact, representatives from space agencies and managers of observing networks from 13 countries. The Scientific Organization Committee was chaired by Dr Erik Andersson (ECMWF), and he Local

Organizing Committee was chaired by Dr. Lars Peter Riishojgaard, JCSDA. At the workshop the WMO Secretariat was represented by the Director of Observations and Information Systems, Dr Wenjian Zhang. The workshop was organized in three Sessions (see detailed programme on the WMO website⁵):

- 1) Global forecast impact studies,
- 2) Regional forecast impact studies, and
- 3) Scientific Questions.

6.8.9 There were 10-12 presentations in each Session, followed by discussion. The Session Chairs provided summary reports capturing the salient points, statements about observation impact and recommendations. These reports were reviewed and agreed by the workshop during its final day. The current workshop report is preliminary; it has been reviewed by the organizing committee. A final report will be provided in September 2012, subject to review by all Workshop participants.

6.8.10 The Team thanked the Scientific Organizing Committee, the Local Organizing Committee, and the Secretariat for their efforts in preparing and organizing the workshop, and particularly the Chair of the Scientific Organizing Committee, Dr Andersson.

6.8.11 The Team recognized that there are now various tools which are available to perform impact studies on a relatively cost-effective basis, and encouraged the operators of the observations programmes to propose specific questions on the impact of observations on NWP through the ET-EGOS (or its successor). The use of impact tools can also be regarded as a contribution to WIGOS implementation.

6.8.12 The Team agreed on the necessity to organize the Sixth workshop in 2016.

6.9 Report of the Rapporteur on GOS Regulatory material

6.9.1 Dr Alexander Vasilyev (Russian Federation), the Rapporteur on GOS Regulatory material briefed on the activities related to the development and updating of the regulatory material. He recalled that CBS-Ext. (2010), when reviewing the implications of WIGOS implementation on CBS activities, reiterated that the development of WIGOS Standards, and subsequent review, update and harmonization of the WMO regulatory material should be closely linked to the OPAG-IOS activities. Furthermore, Cg-XVI adopted the Resolution3 (Cg-XVI) – Global Observing System which stated that GOS will become one of the core components of WIGOS to be implemented in 2012-2015, and that evolution of the GOS will be closely linked with the development of WIGOS. ICT-IOS agreed that the existing procedure to update the GOS Manual and the Guide should be continued and noted with satisfaction that a new version of Part IV – Space-Based Subsystem of the GOS Manual was developed. It requested the Secretariat to submit to CBS-XV the appropriate document for approval.

6.9.2 The ICT-IOS agreed that to more fully meet new requirements in the development of WMO Regulatory material, including that for WIGOS, and to strengthen OPAG-IOS efforts to harmonize GOS regulatory material with the relevant documentation, the current function of a Rapporteur on GOS Regulatory material would not be sufficient. It agreed to delegate activities on the regulatory matters to the proposed new OPAG IOS Inter Programme Expert Team on WIGOS Framework Implementation matters (IPET-WIFI).

5 <http://www.wmo.int/pages/prog/www/OSY/Meetings/Wshop-Impact-NWP-5/index.html>

6.10 Radiofrequencies matters

Achievements

6.10.1 The meeting acknowledged the transfer of the Steering Group on Radio Frequency Coordination (SG-RFC) from the OPAG ISS to OPAG IOS and agreed that the new location better reflects the nature of its activities.

6.10.2 The Chair of SG-RFC, Mr Jose Arimatea de Sousa Brito (Brazil), made a presentation highlighting the achievements and issues since the last Session of CBS. The presentation largely focused on the preparation for and the participation of the WMO Team at the ITU World Radiocommunication Conference (WRC-12) that was held in Geneva (January/February, 2012).

6.10.3 He informed on the successful outcome of WRC-12 for WMO and for Earth Observation communities, which culminated with the protection of the frequencies currently used by these communities and the additional allocation of frequencies for meteorological applications. WRC-12 reinforced the commitment of previous World Radiocommunication Conferences to the special needs of meteorological and hydrological services ensuring that the necessary radiofrequency spectrum remained available, protected from interference from other applications/services. It was emphasized that such a success was due to the excellent work of SG-RFC group during the whole ITU-R working cycle and the concerted efforts during WRC-12.

6.10.4 Despite the tremendous success of the work of the group, the Chair of SG-RFC reminded the participants of the importance of the continuation of work, as new threats emerge from powerful lobbies of the Information and Telecommunication industry that are avid to grab new frequencies for the multimedia mobile application/services. He stressed that as the new World Radiocommunication Conference (WRC-15) will be held in 2015, less time is available for good preparation, taking into account the complexity of the WRC-15 Agenda, which contains up to 16 items of direct interest/concern to meteorological community. The WMO Position Paper must be ready by July 2014 for proper submission.

6.10.5 After explaining about the challenges ahead, the SG-RFC Chair requested all participants to help with the identification of experts willing to contribute, especially to support scientific and technical studies carried out by ITU-R to support or not new frequency allocations, possibility of frequency sharing, etc. He mentioned that the groups under ICT-IOS are very important source of required expertise.

6.10.6 The Chair also informed about other activities, such as the WMO contribution to GEO through Task IN-01-C4 Radio Frequency Protection, and the preparation of responses to national administrations launching public hearings for possible sharing of important frequency bands used by meteorological community (e. g. L-Band, for non- geostationary satellites).

6.10.7 ICT-IOS thanked all members of SG-RFC for the dedicated work during the whole ITU-R working cycle and during WRC-12. A special thanks was addressed to Mr Philippe Tristant (France), former Chair of SG-RFC, and Mr Gilles Fournier (Canada), vice- Chair of SG-RFC, for the dedication, competence and excellent work carried out for several years.

Recommendations

6.10.8 The ICT-IOS agreed on a draft CBS-XV Recommendation on Radio Frequencies for Meteorological and Related Environment Activities ([Annex XV](#)).

7. EVOLUTION OF THE GOS

7.1 New Implementation Plan for the Evolution of the Global Observing Systems

7.1.1 The Chair of the ET-EGOS, Dr John Eyre (United Kingdom) reported on the development of the new Implementation Plan for the Evolution of the Global Observing Systems (EGOS-IP), which is responding to the Vision of the GOS in 2025, as well as to WIGOS needs. He recalled that this has been a major focus of the ET-EGOS in the last two years, and the wide community review with Application Areas experts has been undertaken to produce the draft EGOS-IP.

7.1.2 The ICT-IOS reviewed the latest version v13.04 of the EGOS-IP and approved it with some minor changes included in a new version v13.06. It agreed on a draft **CBS-XV Recommendation on EGOS-IP** ([Annex V](#)). The ICT-IOS agreed that it was essential for the promotion of the EGOS-IP, and the implementation of its actions in the regions to have it translated in all WMO languages. While recognizing the substantial cost involved, the Team requested the Chair to negotiate with various partners (e.g. WMO Secretariat, WIGOS Trust Fund, AMDAR Panel) in order to identify and mobilize appropriate resources for this exercise. The Team welcomed the offer from the UK to contribute to this effort, and expressed its appreciation.

7.1.3 The ICT-IOS agreed that the ET-EGOS (or its successor) should now focus not only on monitoring progress with regard to the actions of the EGOS-IP but also on activities to promote such progress.

7.1.4 Taking into account the importance of the EGOS-IP for all WMO application areas and noting that the EGOS-IP is also the part of WIGOS reference documentation, the ICT-IOS strongly recommended translating the EGOS-IP into all formal WMO languages prior to CBS-XV. It therefore, requested the Secretariat to investigate resources and make appropriate arrangements for translation of the EGOS-IP.

7.1.5 The ET-EGOS Chair recalled the importance of NWP monitoring for looking at various aspects of the monitoring of the observing system, while the current responsibility for NWP monitoring is split between OPAS-IOS, OPAG-ISS and OPAG-DPFS, and monitoring is done at the national and regional levels. For example, the IPET-WIFI and its Sub-Group on Quality Monitoring could be invited to make recommendations in this regard. The Team requested the Chair of the ICT-IOS to refer this issue to the CBS Management Group.

7.1.6 The ICT-IOS noted that the ET-EGOS has agreed to develop a strategy for the communication of the new EGOS-IP to stakeholders as a mean to promote progress with regard to the actions in the EGOS-IP, and monitor the progress. An outline for such a strategy was proposed by the seventh Session of the ET-EGOS (see Annex IX of the final report of ET-EGOS-7). The ICT-IOS agreed with the approach proposed by ET-EGOS, and recommended that the ICG-WIGOS and its Task Team on WIGOS Implementation take the EGOS-IP communication strategy into account when developing the WIGOS Framework Implementation Plane communication strategy.

7.1.7 The ICT-IOS concurred with the action items proposed by the ET-EGOS-7 for the IOC-IOS Chair to undertake regarding outstanding issues concerning the RRR Database (collection of observation metadata, link of the RRR database with the WIGOS Information Resource, securing resources for the RRR database, involvement of the community for maintaining content of the RRR database). These are reflected in the ET-EGOS-7 final report in its Annex IX.

8. PREPARATION OF OPAG-IOS INPUT FOR CBS-XV

8.1 Terms of Reference of the Expert Teams

8.1.1 The ICT-IOS Chair presented proposals on the new working structure of the OPAG-IOS. During discussions, the emphasis was given to how best to respond to WIGOS implementation requirements and other developments in the OPAG-IOS activities.

8.1.2 Finally, ICT-IOS agreed on the future working structure and respective ToR that is reproduced in [Annex XII](#) and will be submitted to CBS-XV for consideration.

8.2 Terms of Reference of Rapporteurs

8.2.1 See item 8.1 above.

8.3 Work Plans

8.3.1 The ICT-IOS noted the draft workplans provided by the Chairs of the Expert Teams for their respective Teams, and recommended that these be taken into account by the new Chairs of the new Expert Teams after CBS-XV as appropriate.

8.4 Input and Recommendations for CBS-XV

8.4.1 ICT-IOS discussed the preparation of documentation for CBS-XV. It reviewed and approved the content of the document on OPAG IOS activities to be submitted to CBS-XV for consideration and approval. It was further decided that based on ICT-IOS-7 Final Report, the Secretariat should prepare draft working documents to be submitted for the final editing by the ICT-IOS Chairperson and Co-Chairperson who would also coordinate this work with the ET Chairs and Rapporteurs, if necessary.

9. ANY OTHER BUSINESS

Proposal by ICT-ISS for expanding the number of station identifiers

9.1 The ICT-IOS considered the options presented by ICT-ISS for expanding the number of station identifiers available for international exchange of observations. It concurred with the proposal of ICT-ISS to extend the scheme already created within the Table Driven Code Forms for automatic weather stations to create “universal station identifiers”. This allows operators of observing systems to be identified (such as NHMS or International Organizations). These organizations can then issue station numbers to uniquely identify their observing stations. The extension to the scheme allows operators to define a character string to assist with identification of the station; this additional element is not part of the unique identification of the station, but should still be unique for stations in the operator’s observing system.

9.2 The ICT-IOS requested the Chair of ICT-IOS to refer a recommendations to the CBS Management Group that, to increase the number of observations available to Members, it would be beneficial to allow some organizations to register directly to be able to issue station identifiers, for example organizations that operate in several countries. Organizations issuing station identifiers would need to give assurances about the quality management processes used within the observing system. This would need a change to the Manual on the GOS that currently states that (apart from for Antarctica), PRs are the only authority for issuing station identifiers.

9.3 ICT-IOS agreed that it would be useful to include in the “operator identifier” a World Weather Watch identifier and requested the OPAG-IOS Chair to discuss this issue with the CBS Management Group before further decision is made in this regard. Several options are available,

and ICT-IOS will define the scheme to be used at the same time as writing the updates to the Manual on GOS that introduce the concept of operators of observing systems.

9.4 ICT-IOS supported the recommendation of ICT-ISS that it was not appropriate to increase the number of station identifiers available to Members reporting only in Traditional Alphanumeric Codes.

10. CLOSURE OF THE SESSION

10.1 The Co-chair of the ICT-IOS, Mr Jochen Dibbern (Germany) thanked all participants on behalf of the Chair for their valuable contributions during the intersessional period, and during this meeting, as well as the Secretariat for its support during the meeting. The session closed at 12:12 hours on Friday, 22 June 2012.

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SUMMARY OF RECENT FINDINGS REGARDING OBSERVING SYSTEM EXPERIMENTS (OSES) AND OBSERVING SYSTEM SIMULATION EXPERIMENTS (OSSES)

1. **Adjoint-based sensitivity to forecast error:** Results obtained with adjoint-based sensitivity tools are receiving increasing attention. Bar charts showing the relative importance of each component of the GOS are produced by several NWP centres on a regular basis. The results are based on the observation sensitivity with respect to (typically) 24-hour forecast error measured in terms of dry or moist total energy. With the adjoint technique, the impacts of all observations are computed simultaneously from one single execution of the system, for one chosen measure of forecast error, allowing results to be aggregated easily according to data type, location, satellite sounding channel, or other attributes. The technique is economical as compared with running multiple data denial OSEs, but its accuracy is generally limited to forecast ranges of 1-3 days.
2. Despite differences in the assimilation algorithms and forecast models, the impacts of the major observation types are generally similar comparing results from different global NWP systems. However, regional details and other aspects of the results can differ substantially. Large forecast error reductions (beneficial impacts) are provided by satellite radiances (AMSU-A, IASI and AIRS), radio occultation, geostationary satellite winds, radiosondes and aircraft. Other observation types provide smaller impacts individually, but their combined impact is also significant.
3. In a recent report (Joo et al. 2012), using the Met Office NWP system, the observation impacts of various observations are compared, with emphasis on space-based observations. Satellite data are found to account for 64% of short-range global forecast error reduction, the remaining 36% being due to assimilation of surface-based observation types. Metop-A data are measured as having the largest impact of any individual satellite platform due to the complement of Metop's sensors (IASI, ASCAT and GRAS). Microwave (e.g. AMSU) and hyper-spectral infrared (e.g. IASI and AIRS) sounding techniques are found to have the largest total impacts; however, the GPS radio occultation technique was measured as having the largest observation impact per sounding.
4. With this technique it is possible to arbitrary define subsets of observations in order to assess and compare their impacts. In a study for EUCOS, the Met Office (UK) demonstrated that for a large number of AMDAR observations from the London airports the measurable impact is relatively low on global model scale, whereas there is a relatively high impact of fewer observations from the more remote Shannon airport in Ireland. A second study contrasted the impact of E-ASAP soundings in the North Atlantic with that of 20 remote island radiosonde stations and a similar number of European continental land-based stations. The results showed a very positive impact of ASAP soundings and remote-island soundings in comparison to the land-based stations in Europe. These results have been confirmed by performing the equivalent study based on the ECMWF NWP system.
5. The adjoint data assimilation systems of NASA/GMAO and ECMWF have been used to examine the impact of ConcordIASI dropsonde data on 24-hour forecasts over the southern polar region during September-December 2010. ConcordIASI is a multi-year international project (led by Meteo-France) whose objectives include improving analyses and forecasts over Polar Regions. The field phase of ConcordIASI during Austral spring 2010 provided unprecedented meteorological data coverage over the southern polar region, with dropsondes launched from 19 super-pressure balloons providing over 30,000 measurements of wind, temperature and humidity at levels up to 60 hPa over a three-month period. The dropsonde impact was compared with that of other in-situ and satellite observing systems. Results show that the dropsondes, which are relatively few in number

compared with most other data types, have a small positive impact in an overall sense, but a relatively large positive impact per observation. Dropsonde temperature observations pole ward of 80°S and below 400 hPa had the largest impacts.

6. **Observation impact tool for ensemble Kalman filters.** The Center for Weather Forecast and Climate Studies from the National Institute for Space Research (CPTEC/INPE, Brazil) is developing and testing a Local Ensemble Transform Kalman Filter (LETKF), to include the .capability to evaluate observation impacts based on the approach of Liu and Kalnay (2008; QJRM, 134, 1327-1355). NCEP (Washington) have conducted tropical cyclone case studies using this methodology, concluding that upper air soundings are the most important observation type for Tropical Cyclone forecasting.
7. **The international Joint OSSE:** OSSEs are a powerful tool to assess the potential impact on the NWP forecast skill of planned or hypothetical future observing systems. Over the last several years an international Joint OSSE collaboration has emerged (Masutani et al. 2007 and Riishojgaard et al. 2011,) centred on the use of NASA's and NOAA's data assimilation systems. A 13-month Nature Run provided by ECMWF (Andersson and Masutani 2010) has undergone extensive validation. Simulated observations have been generated from the Nature Run. These observations include simulated errors of both instruments and representativeness. The simulated observations with added observation errors are suitable for initial OSSE applications by the community of researchers and investigators.
8. An additional very high-quality nature run simulation of a hurricane in the Tropical Atlantic has been generated, using the ARW-WRF model with 1 km horizontal resolution, 60 vertical levels, and the latest physical parameterizations. The simulation is not based on a real storm, but rather one that is produced within the 6-month Joint OSSE Nature Run. The structure of the cyclone has been validated in comparison to a number of observational diagnostics: the pressure-wind relationship, the outward slope of the eye wall, the decay of wind with height along the radius of maximum winds, the inflow depth and temperature structure of the boundary layer, and the distribution of convective versus stratiform precipitation. High resolution OSSEs based on this Nature Run will follow.
9. The Global Wind Observing Sounder (GWOS) concept, which is being developed by NASA, is expected to provide global wind profile observations with high vertical resolution, precision, and accuracy. The assimilation of space based Doppler wind Lidar from the GWOS concept is being conducted in the OSSEs at the Joint Center for Satellite and Data Assimilation (JCSDA). The impact of different pairs of telescopes has been assessed in terms of meteorological analyses and forecasts. The impacts from the different pairs of the GWOS telescopes were assessed by comparing the forecast results through 120 hours. In this OSSE study, a control simulation utilizing all of the data types assimilated in the operational GSI/GFS system was compared to three OSSE simulation which added lidar wind data from the different pairs of telescopes (one-, two-, and four-look), respectively. The results show that assimilation of the Lidar data from the GWOS (whatever one-, two-, or four-“look”) can improve the NCEP GFS wind and mass fields forecasts. Larger benefits are found in the southern hemisphere, although a significant positive impact is also found in the northern hemisphere.
10. **Advanced IR sounders in regional models:** Atmospheric temperature and water vapour information are the key parameters needed in the regional numerical weather prediction (NWP) model for accurate convective storm forecasting. Radar measurements have been used widely in the regional NWP model and have demonstrated very useful resource, however, radar provides useful information mostly when the storm is initiated. In the earlier stage of the storm, the clear sky atmosphere is dynamically unstable, the spatial, temporal and vertical distributions of the atmospheric temperature and moisture information in pre-convection environment are important for NWP. The AIRS, IASI and CrIS advance sounder instruments provide temperature and moisture profiles with high vertical resolution and good accuracy; both AIRS single field-of-view soundings and science team sounding

product are used in the regional WRF (Weather Research and Forecasting) model with 3DVAR, Ensemble Kalman Filter (EnKF), and 4DVAR assimilation techniques. The AIRS soundings were applied to severe storms such as convective precipitation and hurricane for forecast improvement. Results show that AIRS soundings with both WRF (Weather Research and Forecasting)/3DVAR and WRF/DART (data assimilation research test bed) assimilation and forecast systems improve the hurricane track and intensity forecasts, AIRS soundings also improve the precipitation forecast with 4DVAR assimilation technique.

11. **Radio occultation data:** The Global Positioning System (GPS) radio occultation (RO) technique has emerged as a powerful and relatively inexpensive approach for sounding the global atmosphere in all weather. On average, COSMIC-1,2,4,5,6, GRAS, GRACE-A, TERRA-SAR-X, C-NOFS and SAC-C provide 1,000 – 1,200 GPS RO soundings per day. The data distribution is relatively uniform around the globe with relatively less density in the tropics. RO sounding is able to penetrate clouds and precipitation with virtually no impact on its accuracy. With its ability to take measurements over the ocean, where there are few traditional observations, GPS RO soundings have demonstrated significant NWP impact. In particular, it has been shown that GPS RO soundings provide valuable information on the moisture in the tropical lower troposphere, which is crucial for the development of tropical storms. Taiwan and the U.S. Navy are planning the COSMIC follow-on mission, (COSMIC-II), which promises to provide 8,000 to 10,000 GPS RO soundings per day. A second GRAS instrument will become operational with the launch of Metop-B in May 2012.
12. **Use of the Chinese FY-3A and 3B data:** Xiang Wang et al. (AMS 2011) compared measured radiances from FY-3A and AMSU-A against simulated radiances calculated from coincident profile measurements of temperature and humidity from COSMIC. Excellent agreement was found between FY-3A and COSMIC GPS RO data, similar to that between AMSU-A and COSMIC GPS data. It can therefore be concluded that FY-3A and AMSU-A data are of similar quality. This has been confirmed by William Bell and co-workers at ECMWF who have monitored the quality of FY-3A data within the operational 4D-Var system at ECMWF. The corrections developed at ECMWF (Lu et al, JTECHA, Nov 2011) for the passband shifts and radiometer non-linearity achieved FY-3A MWTS data quality equivalent to AMSU-A. This data delivered positive impact when added to a full ECMWF system. Similar, but not identical, corrections were later (March 2011) implemented in the ground processing systems at CMA. Unfortunately, the FY-3A MWTS data quality does not quite match that achieved previously at ECMWF and forecast impacts from this data stream has proved to be slightly negative. Operational assimilation at ECMWF has, therefore, been postponed until these issues can be resolved. ECMWF and CMA will continue to work together to resolve these.
13. The Japan Meteorological Agency (JMA) also conducted an OSE for FY-3A MWTS data for August 2011 by using low resolution version of JMA global data assimilation system as an initial assessment. The departure statistics showed the data quality was similar to or slightly better than that of NOAA18 AMSU-A. The OSE result showed positive impact on temperature forecast.
14. Initial indications from the FY-3B instruments, assessed at ECMWF during September 2011- March 2012. are that the data is generally of good quality and forecast impacts are neutral when measured against a full ECMWF system.
15. **Accuracy of humidity observations from aircraft:** EUCOS have initiated studies of the impact of the Tropospheric Airborne Meteorological Data Reporting (TAMDAR) network, operated by AirDat LLC. TAMDAR measures humidity, pressure, temperature, winds, icing and turbulence by commercial airlines along the flight routes. The data is licensed by AirDat at a charge and EUMETNET have negotiated access for European OSEs. Several European NWP systems will be run over a North American domain focusing on assessing the humidity impact. In previous studies, TAMDAR measurements have been assimilated into the WRF-based RTFDDA (4D-Var) system for the CONUS domain at 12-km and 4-km

resolutions. Case studies focused on episodes of warm season rainfall, with positive results reported.

16. **Impact of Radar reflectivity and ground based GPS:** JMA has been operating 20 C-band radars in Japan. The reflectivity data was used for estimating relative humidity (RH) profiles and the RH retrievals were assimilated in mesoscale data assimilation system. By assimilating the RH data, displacement error was much reduced and water vapour profiles of initial conditions were improved. Precipitable Water (PW) can be estimated from ground-based GPS observations. In Japan, such GPS PW can be obtained from a nationwide permanent GPS network which is called GPS Earth Observation NETwork (GEONET). The GEONET is operated by the Geospatial Information Authority of Japan. The number of the GEONET GPS sites is about 1,200. JMA has been using the GPS PW from GEONET in the operational mesoscale data assimilation system since October, 2009. For the global data, the international GNSS Service (IGS) operates a global network of ground-based GPS stations continuously for GPS satellite tracking, and provides GPS observation data via its FTP server. Result show that the estimated GPS PW is close to the one estimated by radiosonde observation. The impact of the GPS PW data on JMA's global four-dimensional variational data assimilation system has been evaluated. Assimilation of the GPS PW brought positive impact compared without the GPS PW in the geopotential height forecast at 500 hPa.
17. Accurate information of the spatial distribution and temporal variations of water vapour is essential for the study of short-term severe weather phenomena, such as localized heavy rainfalls that often cause serious damages during the summer season on the Korean Peninsula. In particular, a good description of the initial conditions for the three-dimensional water vapor field is crucial for the simulation of convective systems and situations leading to heavy rainfall events in numerical model. Since the emergence of a new technique to retrieve an amount of atmospheric water vapour from ground-based GPS observation, numerous meteorological studies using precipitable water (PW), slant wet delay (SWD) and zenith total delay (ZTD) derived from GPS measurements have been conducted and showing encouraging results in various fields of meteorology, especially for improving moisture fields of numerical weather prediction from development (Kuo et al. 1993) to operational use (Gutman et al. 2003). The impact of ground-based GPS-PW and ZTD assimilation on a rainfall forecast has been examined. A series of assimilation experiments were performed using the WRF (Weather Research and Forecasting) model and its three-dimensional data assimilation (WRF 3DVAR) system. PW and ZTD data derived from 39 GPS sites over the Korean Peninsula is assimilated with cold-start and cycling techniques. The results show that the assimilation of GPS-PW is effective in reducing the error of PW in the initial condition. Both negative bias and the rms error of the PW contained in original analysis (background) are significantly reduced after the assimilation of GPS-PW. The improved moisture field in initial conditions benefits the forecast of rainfall initiation at the right time and intensity.
18. **Composite LEO/GEO Winds:** The composite LEO/GEO winds are distributed by CIMSS. The data complements data gaps between GEO atmospheric motion vectors (AMV) and LEO polar AMV. NRL showed the positive impact with their adjoint based sensitivity study and started operational use of November 2010. The assimilation test was conducted at JMA with the low resolution version of the global data assimilation system and the result also showed the positive impact.
19. **Impact of targeting:** "Targeted observations" refers to the selection of additional, specially chosen observations to be assimilated into operational numerical weather prediction models. Observation locations are chosen in order to improve forecasts of high-impact weather events of importance to society. Examples include dropwindsondes launched from aircraft or balloons, additional rawinsonde ascents, remotely sensed observations, and the inclusion of enhanced regular satellite observations (such as radiances or winds) that may

normally be excluded from data assimilation due to routine thinning or quality control procedures.

20. The emphasis of the THORPEX DAOS group has been on the evaluation of the impact of observations, including targeted observations, based on results from field experiments (ATReC, AMMA, IPY, T-PARC), OSEs and OSSEs. Their comprehensive report has recently become available (Targeted observations for improving NWP: An overview, by Majumdar et al., WWRP/THORPEX No. 15). The main outcomes from these impact studies may be summarized as follows:
- The value of extra-tropical targeted data has been found to be positive but small on average
 - Observations taken in sensitive areas have more value than observations deployed randomly
 - Past experiment do not provide evidence of major impact obtained from just a few observations (when averaged over a large sample of cases)
 - There are limitations to the current assimilation methods to be able to detect the small signal associated with precursors of meteorological systems
 - The methods employed to identify sensitive areas do not appear to be a major problem
 - Additional observations around tropical cyclones have proven to be useful
 - Benefit may be obtained from regional (versus highly localized) and systematic targeting during low predictability flow regimes on a continuous basis (days or weeks) and/or via adaptive processing and data selection of satellite data.

The mechanisms behind how TC forecast can be improved further by targeted observations are being investigated.

PROPOSED TOPICS FOR NWP IMPACT STUDIES RELEVANT TO THE EVOLUTION OF GLOBAL OBSERVING SYSTEMS

A comprehensive proposal for OSEs and OSSEs of particular interest to ET-EGOS has been developed as part of the preparations for the fifth workshop on the Impact of Various Observing Systems on Numerical Weather Prediction. This new list of specific studies and science questions has been distributed widely as it formed part of the invitation to the workshop. The list is shown here in the table below.

Short name: Full name	Science question
Surface-based	
S1MarinePs: Surface pressure over ocean	What density of surface pressure observations over ocean is needed to complement high-density surface wind observations from satellites? Suggestions: (a) network density reduction OSE in N. Atlantic, (b) southern oceans OSSE.
S2Strat: In situ observations of the stratosphere	What network of in situ observations is needed in the stratosphere to complement current satellite observations (including radio occultation)? What about the tropics?
S3AMDAR: Coverage of AMDAR	What is the impact of current AMDAR observations? What are the priorities for expansion of the network?
S4ASAP: Coverage of ASAP	What is the impact of current coverage of profiles from the Automated Shipboard Aerological Programme (ASAP)? How might coverage be optimized for a given level of resources?
S5Radar: Radar observations	What are the impacts of current radar observations, including radial winds and reflectivities?
Space-based	
S6RO: Radio occultation saturation	At what level, in terms of profiles per day, does the impact of radio occultation observations start to saturate?
S7SatLand: Satellite radiances over land	What is the impact of new developments in the assimilation of radiance data over land?
S8Sounders: Impact of multiple satellite sounders	What benefits are found when data from more than one passive sounder are available from satellite in complementary orbits, e.g. multiple AMSU-As, AIRS + IASI?
S9AMVs: AMVs	What impacts are currently found from AMVs?
General	
S10Thinning: Data density and data thinning	What impacts/benefits are found from data density/thinning strategies from various observation types?

S11PBL: Observations of the PBL for regional / high-resolution NWP	What should be the focus of improvements for observations of the PBL in support of regional/high-resolution NWP? Which variables and what space-time resolution?
S12UA: EUCOS-like upper air OSEs	Can EUCOS-like upper air studies be performed for other regions?
S13AdjEns: Regional application and adjoint and ensemble methods	What insights can be gained from more tailored use of adjoint- and ensemble-based measures of observation impact, for example, in the tropics or at the meso-scale where metrics other than global energy may be appropriate?
S14ExtRange: Impact of observations on extended range forecasts	Which observations are particularly important for the 7-14 day forecast range?
S15Targeting: Targeted observations	What do experiments on targeted observations tell us about observing system design?
S16aAMMA, S16bIPY: AMMA and IPY legacy	What impacts/benefits could be expected by sustained components of the AMMA and IPY special observing systems?

ICT-IOS CONSENSUS REGARDING ISSUES RAISED BY THE ET-EGOS

- 1) **Integrated Global Observing System (WIGOS) and WIGOS Framework Implementation Plan (WIP)**
 - (a) The Team agreed that the work of ET-EGOS will continue along the current lines, but with continued expansion into the “new” Application Areas for WIGOS, e.g. climate applications within GFCS, and elaboration of requirements and gaps in Application Areas for which the analysis is less mature, e.g. atmospheric composition, oceans, hydrology, and agricultural meteorology. ET-EGOS (or its successor, depending on the outcome of the next CBS Session) will thus continue to focus primarily on collecting, vetting and documenting observational requirements for all WIGOS Application Areas and will have primary responsibility for the Rolling Review of Requirements (RRR). This will include activities related to the Implementation Plan on the Evolution of Global Observing Systems (EGOS-IP), and particularly the monitoring of progress against the plan, and proactive pursuance of its actions.
 - (b) Many of the integrating activities that are promoted by WIGOS, such as the development of standards for observational metadata, will not be included in the ET-EGOS Work Plan and it appears likely that responsibility for these areas will be given to an Expert Team yet to be created.
 - (c) The following will have to be considered in order to ensure complementary roles of the EGOS-IP and the WIP; (i) the EGOS Implementation Plan will focus on the long term evolution of WIGOS component observing systems, while the WIP will focus on the integration of these components; (ii) avoiding duplication between the EGOS-IP and the WIP; and identify required regulations, processes, and implementation activities; and (iii) addressing the GFCS requirements.
 - (d) Noting the importance of the RRR process, and its supporting databases within the WIGOS framework, the Team suggested (i) a more prominent and higher priority role for EGOS-IP in the activities described at Regional and National/Sub-regional level; and (ii) the importance of feedback to CBS on any departures between user requirements identified at regional/national level and those documented in the RRR database (in place of or in addition to any regional/national activities on user requirements for observations).
 - (e) There is a need to update documentation on the RRR process: on the WMO web site, and in GOS/WIGOS manuals and guides.
 - (f) The WIGOS Implementation Plan should be renamed WIGOS framework Implementation Plan (WIP);
 - (g) The Team also considered the relationship between the EGOS-IP and the several other plans and development strategies for WMO component observing systems. A need was identified within WIGOS planning for a diagrammatic representation showing all such plans and the relationship between them. It was noted that the EGOS-IP invokes the actions of some other plans through cross-references to them.
- 2) **Observational requirements for the Global Framework for Climate Services (GFCS)**
 - (h) The Team agreed that the ET-EGOS (or its successor) should consider through the RRR process additional requirements for observations in response to applications covered by GFCS. The Team recognized that the GFCS development is a long process, and that no specific requirements have been submitted by the GFCS to the RRR and the EGOS-IP yet. The Team stressed that a direct and routine dialogue will have to be established in the

GFCS framework with those operational agents who directly use the observations for elaborating the products and services that the end users need.

3) WMO Quality Management Framework (QMF)

- (i) Issues dealing with quality control have to respond to WIGOS needs and Quality Management Framework (QMF) requirements, and should be addressed by the ICG-WIGOS, ICT-IO5, and other Technical Commissions as appropriate, but not in any detail in the EGOS-IP. An OPAG IO5 Expert Team should take responsibility for implementation of WMO QMF across WMO component observing systems.

4) Observational requirements for WMO Polar activities, including the Global Cryosphere Watch (GCW)

- (j) The practice for reporting "Snow" and "No snow" in FM-12 SYNOP reports will have to be addressed, for example by using BUFR, which allows to avoid the reporting ambiguity;
- (k) The scope of GCW is very different from RRR Application Areas. GCW concerns many applications and could also be treated as a component observing system (e.g. similar to how AMDAR is treated in the RRR context). Also GCW extends to service provision whereas the RRR process deals only with Application Areas that have direct requirements for observations;
- (l) ET-EGOS-7 has requested the Points of Contact (PoCs) of all application areas to review how requirements for cryospheric variables and observations in polar regions are taken into account in the user requirements database and in their SoGs. Review of GCW plans may also reveal new Application Areas that should be included in the RRR process. ET-EGOS-7 also requested the Secretariat to investigate adding a new Cryosphere "Theme" in the database to facilitate management of the cryosphere observational user requirements in the database.
- (m) The PoC for GCW was requested to identify the key GCW documents of interest to the ET-EGOS (e.g. IGOS Cryosphere Theme document. Implementation Plan, Regional groups documents), and ET-EGOS members were requested to review them.

5) Capacity Building.

- (n) A section on considerations for the evolution of observing systems in developing countries has been included by the Team in the EGOS-IP. The proposed action is for National Meteorological and Hydrological Services (NMHSs) with Regional Associations (RAs) and regional training centres, the Commission for Basic Systems (CBS), and the Commission on Climatology (CCI) in collaboration with international programmes (initiation and supervision to be led by the RAs, including timetable) to establish capacity building strategies in developing countries. This may include establishing training programmes through engagement within the targeted country, e.g. data management and observing practices.

DRAFT RECOMMENDATION XXX (CBS-XV)
THE IMPLEMENTATION PLAN FOR THE EVOLUTION OF GLOBAL OBSERVING SYSTEMS
(EGOS-IP)

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

- (1) The Vision for the Global Observing System (GOS) in 2025 approved by the Sixty-First Session of the Executive Council through Resolution 6 (EC LXI);
- (2) Resolution 3 (Cg-XVI) – Global Observing System;
- (3) Resolution 10 (Cg-XVI) – Global Atmosphere Watch;
- (4) Resolution 14 (Cg-XVI) – World Hydrological Cycle Observing System;
- (5) Resolution 29 (Cg-XVI) – Global Climate Observing System;
- (6) Resolution 48 (Cg-XVI) – Implementation of the Global Framework for Climate Services;
- (7) Resolution 50 (Cg-XVI) – Implementation of the WMO Integrated Global Observing System (WIGOS);
- (8) Resolution 55 (Cg-XVI) – Antarctic Observing Network;
- (9) Resolution 60 (Cg-XVI) – Global Cryosphere Watch;
- (10) The Final Report of the Seventh Session of the CBS Implementation/Coordination Team on Integrated Observing Systems (ICT-IOS) based on recommendations from the CBS Expert Team on the Evolution of Global Observing Systems;

Considering:

- (1) The need for surface and space-based observations to address the requirements of WMO application areas;
- (2) The need to consider WIGOS and GFCS requirements and implementation aspects regarding the evolution of global observing systems, WMO priorities, and cost-effectiveness of observing systems;
- (3) The need to provide Members with clear and focused guidelines and recommended actions in order to stimulate cost-effective evolution of the observing systems to address in an integrated way the requirements of WMO programmes and co-sponsored programmes;

Recognizing:

- (1) The importance of global observing systems to address all the requirements of WMO application areas;
- (2) The quantitative observational user requirements documented in the WMO Database;
- (3) The critical review performed by experts in each WMO application area, and the identified observational gaps as documented in Statements of Guidance of those application areas;
- (4) The wide CBS lead consultation process with the Technical Commissions, Regional Associations, Programmes, co-sponsored Programmes, and relevant experts leading to the drafting and review of the draft Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP) based on the Statements of Guidance, WMO priorities, and cost-effectiveness;

Recommends that:

- (1) The Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP) provided in the Annex to this Recommendation be adopted;
- (2) Members, in collaboration with partner organizations, and identified agents in the EGOS-IP to address the actions listed in the EGOS-IP;
- (3) Members to continue to nominate National Focal Points tasked to monitor the implementation of the EGOS-IP nationally, report on implementation issues, and provide feedback to the CBS through the Secretariat;
- (4) The Technical Commissions, and Regional Associations to take the EGOS-IP into account in their work programmes, and promote its effective implementation;

Requests that the Secretary-General to bring the EGOS-IP to the attention of Members and identified agents.

Annex 1 to Recommendation No. XXX (CBS-XV)

IMPLEMENTATION PLAN FOR THE EVOLUTION OF GLOBAL OBSERVING SYSTEMS

ICT-IOS-7 approved version v13.06 is available from the WMO ftp site at:

ftp://ftp.wmo.int/Documents/PublicWeb/www/gos/egos-ip/EGOS-IP_V13.06.doc

**DRAFT RECOMMENDATION XXX (CBS-XV)
REVISED FUNCTIONAL SPECIFICATIONS FOR AUTOMATIC WEATHER STATIONS**

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

- (1) The request of CBS-Ext.(06) to revise automatic weather station (AWS) functional specifications,
- (2) The Expert Team on Requirements for Data from Automatic Weather Stations (ET-AWS) Work Plan 2009-2012 to revise AWS functional specifications,

Considering that the AWS functional specifications have been reviewed and updated based on the inputs and proposals of other technical commissions,

Recommends that the revised Functional Specifications for Automatic Weather Stations (see Annex) be approved,

Requests the Secretary-General to make arrangements for publication of the revised functional specifications in the *Guide to the Global Observing System* (WMO-No. 488).

Annex to Recommendation No. XXX (CBS-XV)

Functional Specifications for Automatic Weather Stations
(NOTE: Updated table entries and notes are shown in bold text)

VARIABLE ¹⁾	Maximum Effective Range ²⁾	Minimum Reported Resolution ³⁾	Mode of Observation ⁴⁾	BUFR / CREX ⁵⁾	Status ⁵⁾
ATMOSPHERIC PRESSURE					
Atmospheric Pressure	500 – 1080 hPa	10 Pa	I, V	0 10 004	OP
TEMPERATURE ⁹⁾					
Ambient air temperature (over specified surface) ¹⁴⁾	-80 °C – +60 °C	0.1 K	I, V	0 12 101	OP
Dew-point temperature ¹⁴⁾	-80 °C – +60 °C	0.1 K	I, V	0 12 103	OP
Ground (surface) temperature (over specified surface) ¹⁴⁾	-80 °C – +80 °C	0.1 K	I, V	0 12 120	VAL
Soil temperature ¹⁴⁾	-50 °C – +50 °C	0.1 K	I, V	0 12 130	OP
Snow temperature ¹⁴⁾	-80 °C – 0 °C	0.1 K	I, V	0 12 131	VAL
Water temperature - river, lake, sea, well	-2 °C – +100 °C	0.1 K	I, V	0 13 082 or 0 22 043	OP OP
HUMIDITY ⁹⁾					
Relative humidity	0 – 100%	1%	I, V	0 13 003	OP
Mass mixing ratio	0 – 100%	1%	I, V	0 13 110	VAL
Soil moisture	0 – 10 ³ g kg ⁻¹	1 g kg ⁻¹	I, V	0 13 111	VAL
Water vapour pressure	0 – 100 hPa	10 Pa	I, V	0 13 004	OP
Evaporation/evapotranspiration	0 – 0.25 m	0.1 kg m ⁻² 0.0001 m	T	2 01 130 0 13 033 2 01 000	OP
Object wetness duration	0 – 86 400 s	1 s	T	0 13 112	VAL
WIND					
Direction	0 ^{11,13)} ; 1° – 360°	1°	I, V	0 11 001	OP
Speed	0 – 75 m s ⁻¹	0.1 m s ⁻¹	I, V	0 11 002	OP
Gust Speed	0 – 150 m s ⁻¹	0.1 m s ⁻¹	I, V	0 11 041	OP
X,Y component of wind vector Z component of wind vector (horizontal and vertical profile)	-150 – 150 m s ⁻¹ -40 – 40 m s ⁻¹	0.1 m s ⁻¹	I, V	0 11 003 0 11 004 0 11 006	OP OP OP
Turbulence type (Low levels and wake vortex) ¹⁶⁾	up to 15 types	BUFR Table Not specified yet	I, V	-	N
Turbulence intensity ¹⁶⁾	up to 15 types	BUFR Table Not specified yet	I, V	-	N
RADIATION ⁶⁾					
Sunshine duration	0 – 86 400 s	60 s	T	0 14 031	OP
Background luminance	0 – 1·10⁵ Cd m ⁻²	1 Cd m ⁻²	I, V	0 14 056	VAL
Global downward solar radiation	0 – 1·10⁸ J m ⁻²	1·10² J m ⁻²	I, T, V	0 14 028	OP
Global upward solar radiation	-1·10⁸ – 0 J m ⁻²	1·10² J m ⁻²	I, T, V	0 14 052	VAL
Diffuse solar radiation	0 – 1·10⁸ J m ⁻²	1·10² J m ⁻²	I, T, V	0 14 029	OP
Direct solar radiation	0 – 1·10⁸ J m ⁻²	1·10² J m ⁻²	I, T, V	0 14 030	OP
Downward long-wave radiation	0 – 6·10⁷ J m ⁻²	1·10³ J m ⁻²	I, T, V	0 14 002	OP
Upward long-wave radiation	-6·10⁷ – 0 J m ⁻²	1·10³ J m ⁻²	I, T, V	0 14 002	OP
Net radiation	-1·10⁸ – 1·10⁸ J m ⁻²	1·10² J m ⁻²	I, T, V	0 14 053	VAL
UV-B radiation ⁸⁾	0 – 26·10⁴ J m ⁻²	1 J m ⁻²	I, T, V	0 14 072	VAL
Photosynthetically active radiation ²²⁾	0 – 6·10⁷ J m ⁻²	1·10³ J m ⁻²	I, T, V	0 14 054	VAL
Surface albedo	0 – 100%	1%	I, V	0 14 019	OP
Soil heat Flux	-1·10⁸ – 1·10⁸ J m ⁻²	1·10² J m ⁻²	I, T, V	0 14 057	VAL

CLOUDS					
Cloud base height	0 – 30 km	10 m	I, V	0 20 013	OP
Cloud top height	0 – 30 km	10 m	I, V	0 20 014	OP
Cloud type, convective vs. other types	up to 30 classes	BUFR Table	I	0 20 012	OP
Cloud hydrometeor concentration	1 – 700 hydrometeors dm ⁻³	1 hydrometeor dm ⁻³	I, V	0 20 130	VAL
Effective radius of cloud hydrometeors	2·10 ⁻⁵ – 32·10 ⁻⁵ m	2·10 ⁻⁵ m	I, V	0 20 131	VAL
Cloud liquid water content	1·10 ⁻⁵ –1.4·10 ⁻² kg m ⁻³	1·10 ⁻⁵ kg m ⁻³	I, V	0 20 132	VAL
Optical depth within each layer	Not specified yet	Not specified yet	I, V	-	N
Optical depth of fog	Not specified yet	Not specified yet	I, V	-	N
Height of inversion					
	0 – 1 000 m	10 m	I, V	0 20 093	VAL
Cloud cover	0 – 100%	1%	I, V	0 20 010	OP
Cloud amount	0 – 8/8	1/8	I, V	0 20 011	OP
PRECIPITATION					
Accumulation ⁷⁾	0 – 1600 mm	0.1 kg m ⁻² , 0.0001 m	T	0 13 011	OP
Depth of fresh snowfall	0 – 1000 cm	0.001 m	T	0 13 118	VAL
Duration	up to 86 400 s	60 s	T	0 26 020	OP
Size of precipitating element ¹⁷⁾	1·10 ⁻³ – 0.25 m	1·10 ⁻³ m	I, V	0 13 058 0 20 066	OP
Intensity - quantitative	0 – 2000 mm h ⁻¹	0.1 kg m ⁻² s ⁻¹ , 0.1 mm h ⁻¹	I, V	0 13 155	OP
Type	up to 30 types	BUFR Table	I, V	0 20 021	OP
Rate of ice accretion	0 – 1 kg dm ⁻² h ⁻¹	1·10 ⁻³ kg dm ⁻² h ⁻¹	I, V	0 13 114	VAL
OBSCURATIONS					
Obscuration type	up to 30 types	BUFR Table	I, V	0 20 025	OP
Hydrometeor type	up to 30 types	BUFR Table	I, V	0 20 025	OP
Lithometeor type	up to 30 types	BUFR Table	I, V	0 20 025	OP
Hydrometeor radius	2·10 ⁻⁵ – 32·10 ⁻⁵ m	2·10 ⁻⁵ m	I, V	0 20 133	VAL
Extinction coefficient	0 – 1 m ⁻¹	0.00001 m⁻¹	I, V	0 15 029	VAL
Meteorological Optical Range ¹⁰⁾	1 – 100 000 m	1 m	I, V	0 15 051	VAL
Runway visual range	1 – 4 000 m	1 m	I, V	0 20 061	OP
Other weather type	up to 18 types	BUFR Table	I, V	0 20 023	OP
LIGHTNING					
Lightning rates of discharge	0 – 4 500 000 h⁻¹	1 h⁻¹	I, V	0 20 126	VAL
Lightning discharge type (cloud to cloud, cloud to surface)	3 types	BUFR Code Table	I, V	0 20 023	OP
Lightning discharge polarity	2 types	BUFR Code Table	I, V	0 20 119	VAL
Lightning discharge energy	Not specified yet	Not specified yet	I, V	-	N
Lightning - distance from station	0 – 2·10⁵ m	10 ³ m	I, V	0 20 127	VAL
Lightning - direction from station	1° – 360°	1 degree	I, V	0 20 128	VAL
HYDROLOGIC AND MARINE OBSERVATIONS					
Flow discharge – river	0 – 2.5·10 ⁵ m ³ s ⁻¹	0.1 m ³ s ⁻¹	I, V	0 23 040	VAL
Flow discharge – well	0 – 50 m ³ s ⁻¹	0.001 m ³ s ⁻¹	I, V	0 23 041	VAL
Ground water level	0 – 1 800 m	0.01 m	I, V	0 13 074	VAL
Ice surface temperature ¹⁴⁾	-80 °C – +0 °C	0.5 K	I, V	0 12 132	VAL
Ice thickness - river, lake ¹⁵⁾	0 – 50 m	0.01 m	I, V	0 08 029 0 13 115	VAL
Ice thickness - glacier, sea ¹⁵⁾	0 – 4 270 m	1 m	I, V	0 08 029 0 13 115	VAL

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Ice thickness ¹⁸⁾	0 – 3 m	0.015 m	T	2 01 133 2 02 129 0 20 031 2 02 000 2 01 000	OP
Water level	0 – 100 m	0.01 m	I, V	0 13 071 0 13 072	OP OP
Wave height	0 – 50 m	0.1 m	V	0 22 021	OP
Wave period ¹⁸⁾	0 – 100 s	1 s	V	2 01 129 0 22 011 2 01 000	OP
Wave direction	0 ¹³⁾ ; 1 – 360 degrees	1 degree	V	0 22 001	OP
1D spectral wave energy density ¹⁸⁾	0 – 5x10 ⁵ m ² Hz ⁻¹	10 ⁻³ m ² Hz ⁻¹	V, T	2 01 135 0 22 069 2 01 000	OP
2D spectral wave energy density ¹⁸⁾	0 – 5x10 ⁵ m ² Hz ⁻¹	10 ⁻³ m ² Hz ⁻¹	V, T	2 01 135 0 22 069 2 01 000	OP
Water practical salinity ¹⁸⁾	0 – 400 psu ¹²	10 ⁻³ psu	I, V	2 01 130 0 22 064 2 01 000	OP
Water conductivity ¹⁸⁾	0 – 600 S m ⁻¹	10 ⁻⁶ S m ⁻¹	I, V	2 01 132 0 22 066 2 01 000	OP
Water pressure ¹⁸⁾ ¹⁹⁾	0 – 11x10 ⁷ Pa	100 Pa	I, V	2 07 001 0 22 065 2 07 000	OP
Ice mass	0 – 50 kg m ⁻¹	0.5 kg m ⁻¹ (on 32 mm rod)	T	0 20 135	VAL
Snow density (liquid water content)	100 – 700 kg m ⁻³	1 kg m ⁻³	T	0 13 117	VAL
Tidal elevation with respect to local chart datum ¹⁸⁾	-10 – +30 m	0.001 m	I, V	2 01 129 0 22 038 2 01 000	OP
Tidal elevation with respect to national land datum ¹⁸⁾	-10 – +30 m	0.001 m	I, V	2 01 129 0 22 037 2 01 000	OP
Meteorological residual tidal elevation (surge or offset) ¹⁸⁾ ²⁰⁾	-10 – +16m	0.001 m	I, V	0 22 040	OP
Ocean Current - Direction	0 ¹³⁾ ; 1° – 360°	1°	I, V	0 22 004 or 0 22 005	OP
Ocean Current - Speed	0 – 10 m s ⁻¹	0.01 m s ⁻¹	I, V	0 22 031 or 0 22 032	OP
OTHER SURFACE VARIABLES					
Runway conditions	up to 10 types	BUFR Table	I, V	0 20 085	OP
Braking action/friction coefficient	up to 7 types	BUFR Table	I, V	0 20 089	OP
State of ground	up to 30 types	BUFR Table	I, V	0 20 062	OP
Type of surface specified	up to 15 types	BUFR Table	I, V	0 08 010	OP
Snow depth	0 – 25 m	0.01 m	T	0 13 013	OP
OTHER					
Gamma radiation dose rate ¹²⁾	1 – 10 ³ nSv h ⁻¹	0.1 nSv h ⁻¹	I, T	0 24 014	VAL
Categories of stability	9 types	BUFR Table	I, V	0 13 041	OP

Notes:

1. Name of variable, in line with WMO vocabulary and Technical Regulations.
2. Maximum Effective Range - Maximum range of measuring capability; units traceable to SI.
3. Minimum Reported Resolution – Lower resolution of reporting is not permitted.
4. Mode of Observation – Type of data being reported:
 - I: Instantaneous – 1-minute value (instantaneous as defined in WMO-No. 8, **Appendix VI.2**);

V: Variability – Average (mean), Standard Deviation, Maximum, Minimum, Range, Median, etc. of samples – those reported depend upon meteorological variable;

T: Total – Integrated value over defined period; maximum 24 hours for all parameters except radiation which requires a maximum of one hour (exception, see note 6), and precipitation accumulation (6 hours maximum). **The relevant element descriptor shall be preceded by a time period descriptor 0 04 024 (in hours) or 0 04 025 (in minutes).**

A: Average (mean) value.

5. BUFR/CREX descriptors for representation of the listed variables;

OP: Operational descriptors of BUFR/CREX Table B, Version Number 14 and subsequent versions.

VAL: Descriptors which became operational on 2 May 2012 (BUFR/CREX Table B. Version Number 18).

N: Not yet specified requirements.

6. Radiation energy amounts are given over a 24-hour period.

7. **Liquid water equivalent.** Maximum interval: 6 hours.

8. Definition of UV-B according to WMO-No. 8 (Vol. 1, Chapter on Radiation). **Descriptor 0 14 072 (Global UV irradiation) was recommended for validation in September 2008, revised in July 2010.**

9. Humidity related variables (*i.e.* dew point temperature) expressed as temperature are collected under temperature.

10. MOR uniquely related to "extinction coefficient", σ , by $MOR = -\ln(5\%)/\sigma$.

11. Direction to indicate 0 (zero) if speed = 0.

12. **Absolute Salinity ($kg.kg^{-1}$) is now being used for ocean applications (IOC Res XXV-7). However, salinity that is reported to national oceanographic data centres remains the Practical Salinity (psu). Ocean water is about 35 psu. Lake Assal (Djibouti) is the most saline body of water on earth with 348 psu salt concentration.**

13. Calm.

14. **Temperature data represented by 0 12 101, 0 12 103, 0 12 113, 0 12 120, 0 12 130, 0 12 131 and 0 12 132 shall be reported with precision in hundredths of a degree even if they are measured with the accuracy in tenths of a degree. This requirement is based on the fact that conversion from the Kelvin to the Celsius scale has often resulted into distortion of the data values. Temperature t (in degrees Celsius) shall be converted into temperature T (in degrees Kelvin) using equation: $T = t + 273.15$.**

15. **Ice thickness 0 13 115 shall be preceded by 0 08 029 (Surface type) set to 11, 12, 13 or 14 to specify river, lake, sea or glacier, respectively.**

16. **If the UNIT is specified as "BUFR Table", the BUFR descriptor cannot be proposed without the content of the table being available.**

17. **0 13 058 (Size of precipitation element) is capable to express size of any precipitation element, apart from hailstones. Size of hailstones shall be represented by 0 20 066.**

18. **These requirements being confirmed, it has to be noted that the selected descriptors are suitable for the normal operating conditions and shall be combined with appropriate operator descriptors to allow representation of the extreme values or the requested high precision.**

19. **Operator 2 07 Y is recommended to be used with Water pressure 0 22 065 (Pa, -3, 0, 17), if the data are produced in BUFR, Edition 4. The same result, *i.e.* change to (Pa, -2, 0, 21) would be obtained by the combined use of the less sophisticated operators 201Y and 202Y:**

2 01 132

2 02 129

0 22 065 Reported value of "Water pressure"

2 02 000

2 01 000

20. **The following sequence is to be used to change data width and reference value of 0 22 040 (m, 3, -5000, 14) to become (m, 3, -10000, 15):**

2 01 129

2 03 015

0 22 040 New reference value = -10000

2 03 255

0 22 040 Reported value of "Meteorological residual tidal elevation"

2 01 000

2 03 000

- 21. Gamma radiation dose rate 0 24 014 is intended to be used for reporting of this element under normal conditions, nuclear accidents excluded.**
 - 22. Photosynthetically active radiation (PAR). Various forms of the electromagnetic energy flux in the 400 – 700 nm wavelength range, either as integrated spectra or using different weighting functions. For example converted to the photosynthetic photon flux (PPF) in quanta per second per square meter, or mole of quanta per second per square meter or microeinsteins per second per square meter. Approximate conversion is $1 \text{ J m}^{-2} \text{ s}^{-1}$ equivalent to $5 \mu\text{E m}^{-2} \text{ s}^{-1}$ based on a mean wavelength of 550 nm.**
-

DRAFT AIMS, OBJECTIVES AND DELIVERABLES FOR A WORKSHOP ON THE REGIONAL AND GLOBAL EXCHANGE OF WEATHER RADAR DATA

1. Introduction

The conclusions and recommendations of the Fourth WMO Workshop on the impact of various observing systems on Numerical Weather Predictions identified the global exchange of Weather Radar radial winds and reflectivity data as a high priority. This need is also reflected in action G45 of the new EGOS-IP. To contribute to the delivery of this EGOS-IP action a Workshop on Weather Radar data exchange is proposed. Discussion with WMO Secretariat suggest, assuming ICT-IOS endorsement, this workshop could be held in late November/ early December 2012.

2. Workshop Definition

Title: Workshop on the regional and global exchange of weather radar data

1) Scope

Noting the range of Weather Radar data types and products, the scope of the workshop will be limited to the exchange of Doppler radial wind and reflectivity data types.

2) Aims:

- a) Define weather radar data to be exchanged at regional and global levels;
- b) Propose formats and frequency of exchange of those data; and;
- c) Agree the next steps needed to enable the regional and global exchange of these data.

3) Workshop Objectives:

- a) Review the current and likely future requirements for regional and global weather radar data exchange, period of consideration 2012 to 2025;
- b) Review the current extent and operational status of regional and global data exchange being undertaken;
- c) Review the current regional and global data exchange models in operation;
- d) Review alternative regional and global data exchange models in operation in other observing system areas;
- e) Improve community understanding of the range of Weather Radar Network operators and their respective relationships with WMO Members;
- f) Identify current and likely future constraints on regional and global data exchange from Weather Radar Network operators. Areas of constraint could include: Data Ownership; Data Policy; Data Volumes; Data Quality;
- g) Recommend data model(s) for regional and global weather radar data exchange based on an improved understanding of requirements, capabilities and constraints;
- h) Recommend pilot study cases for regional and global weather radar data exchange using recommended data model(s) to demonstrate how constraints could be overcome.

4) Workshop Deliverables:

- a) A consolidated set of current and future data requirements for the regional and global weather radar data exchange;
- b) A recommended set of data models to be used for Weather Radar Data Exchange;
- c) A plan for a pilot study/studies to demonstrate the methodology for sustained operational regional and global data exchange;
- d) A series of next steps actions to facilitate the regional and global exchange of Weather Radar Data.

5) Workshop Participant Areas (suitable names to be added)

- Global NWP Centre Representative(s)
- Regional NWP Centre Representative(s)
- Climate Monitoring Community Representative(s)
- CHy Representative
- CIMO RQQI Project Representative
- THORPEX Representative
- RA Representatives and Members where Wx Radar Data Exchange between members is currently occurring, there is ambition for exchange to begin and where no plans are currently in place
- WMO Weather Radar Metadata Database Representative
- EUMETNET OPERA Representative
- BALTRAD Representative
- WMO WIS Representative
- CBS/ISS/ET-DRC Representative
- Satellite data exchange service provider(s)
- Other significant data exchange community representatives
- HMEI representative(s)

6) Additional Information

Proposed date of Workshop: late November / early December 2012.

Duration of workshop: Three days.

Location of workshop: Exeter.

Copy of action G48 of the new EGOS-IP (Ver13.06):

Action G48

Action: Define weather radar data to be exchanged at regional and global levels, propose frequency of exchange of those data and develop a weather radar data processing framework, in concert with development of products based on national, regional, global requirements.

Who: CBS (leading the action), CIMO, CHy in coordination with NMSs/NMHSs, agencies operating weather radars, in collaboration with RAs.

Time-frame: Continuous.

Performance indicator: Volume of radar data which are exchanged globally and regionally.

PROPOSAL TO CBS-XV ON THE TRANSITION OF AMDAR TO WWW AIRCRAFT-BASED OBSERVATIONS

Background

The WMO AMDAR Panel came into existence under its original Terms of Reference in March 1998 with the following underlying mandate:

The Panel is recognized as a body within the WMO structure, with the endorsement of the WMO Executive Council, fostering active cooperation among Members in the implementation and operation of AMDAR as a component of the WWW Composite Observing System.

Background information on the AMDAR Panel and its current Terms of Reference are available at: <http://www.wmo.int/amdar/AMDARPanel.html>

Whilst WMO has played a key role in providing the AMDAR Panel with administrative support through the Secretariat and in the administration of the AMDAR Trust Fund, both WMO and the Panel have agreed that eventually, once considered by the Panel to be operational, with standards well-defined, the AMDAR system and the governance and programme that supports it, should be fully integrated into WMO under the World Weather Watch Programme and managed by the CBS and CIMO Technical Commissions.

Both the Panel and the Secretariat have made all the necessary arrangements and steps for this process to be near completion and, at the Joint Meeting of the AMDAR Panel and the CBS Expert Team on Aircraft-based Observations in Quebec City, Canada in November 2011, it was agreed that the AMDAR Panel Chairman and the AMDAR Panel Management Group (APMG), should consult with the Secretariat, CBS and CIMO in order to develop and finalize an appropriate governance and programmatic structure and a timeline for the integration process that will ensure that the work of the Panel and its work programme continues in line with WMO Member requirements.

At the 3rd session of the AMDAR Panel Management Group, held in Silver Spring, USA in early 2012, the APMG consulted with Dr Frederick Branski (President CBS) and Dr Lars-Peter Riishøjgaard (Chair ICT-IOS) and reached the following decision:

The APMG agreed to work through a process that might allow a proposal for completion of the transition and a new governance structure under the WWW to be presented to the AMDAR Panel 15th Session in November 2012 and to possibly come into effect immediately following this meeting. In order to achieve this and ensure a viable proposal is made, the APMG would, under advice from the Secretariat and the Technical Commissions management, make recommendations and proposals as appropriate to ICT-IOS (May 2012) and CBS-XV (Sep 2012). The APMG would work with Secretariat in ensuring that Panel Members were advised and consulted regarding the transition process in advance of the next Panel Meeting.

A draft proposal for a new programmatic structure for the governance of the aircraft-based observations system under the World Watch Programme, to be managed by the WMO Technical Commissions and the WMO Secretariat on behalf of WMO Members was presented for consideration by CBS.

Aircraft-based Observations Programme Governance Transition

Original Governance Structure

The original governance and programmatic structure of the AMDAR Observing system under the

AMDAR Panel is shown in Figure 1 below.

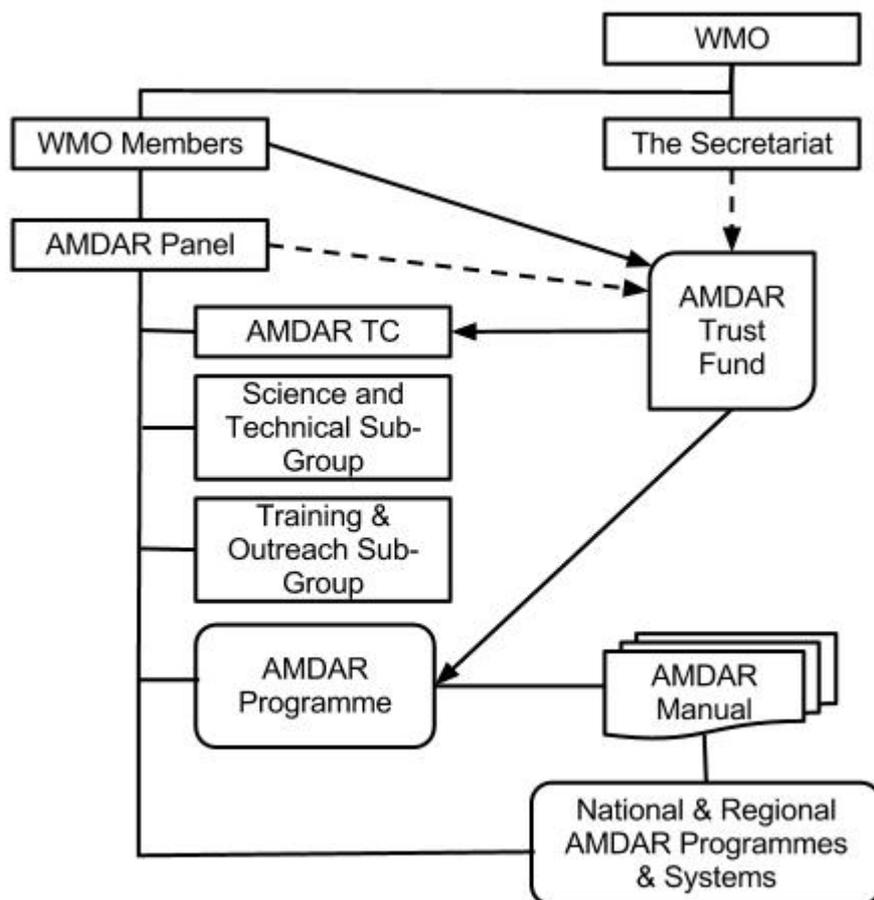


Figure 1: Governance and programmatic structure before integration into WMO. Solid arrows represent funding support and dashed arrows represent funding management.

1.1.1 Current Structure Within WMO

Over the past 5 years, the AMDAR Panel, ET-AIR and the Secretariat have undertaken and completed the following activities towards integration of the AMDAR Programme into WMO:

1. Move the responsibility for AMDAR from the WMO Commission for Aeronautical Meteorological (CAeM) to the Commission for Basic Systems (CBS). (Completed)
2. Creation of a new Aircraft Observation Unit (AIR) within the WMO Observing Systems Division (OSD), with the responsibilities for aircraft-based observations. With the newly created AMDAR Technical Co-ordinator position in the WMO Secretariat as the lead for AIR. (Completed)
3. Establish a new Expert Team on Aircraft-based Observations (ET-AIR). (Completed)
4. The inclusion of AMDAR experts in the Commission for Instruments and Methods of Observations (CIMO) working structure, Upgrading the Global Upper-Air Network (Completed)
5. The provision in the WMO Secretariat's regular budget for the AMDAR Technical Coordinator (2012 – 2015). (Completed)

The final step that was agreed upon to complete the integration was to seek for full support for AMDAR activities to be funded from the WMO regular budget. (2015-2018).

These steps have now led to the development of a governance and programmatic structure within WMO (not including the AMDAR Panel) as depicted in Figure 2, which includes the formation of a CBS Expert Team on Aircraft-based Observations under OPAG-IOS and the appointment of a Theme Lead on Aircraft Measurements within CIMO under the OPAG-SI. Work has commenced

on the integration of AMDAR manuals and reference material into WWW manuals and guides.

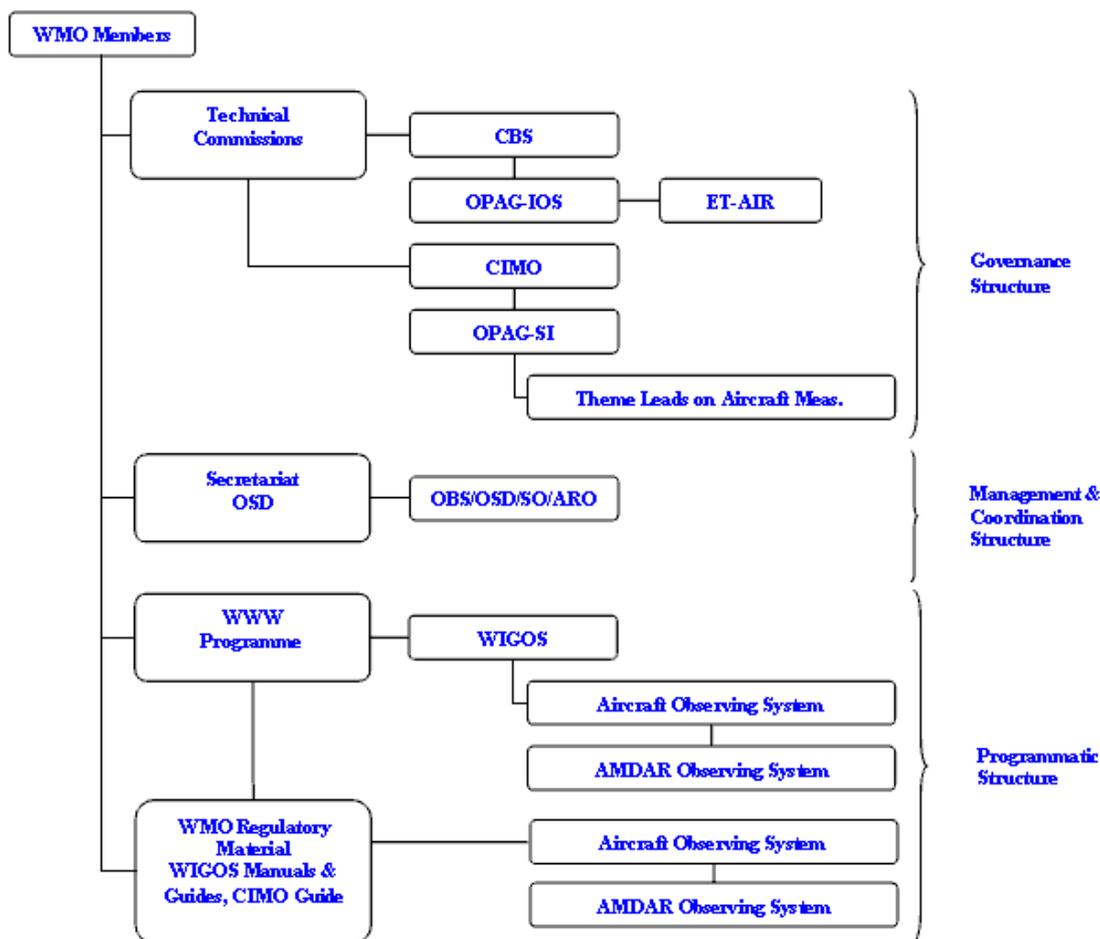


Figure 2: Current aircraft-based observing system governance and programmatic structure within the WWW Programme.

Issues with the Current Structure

The AMDAR Panel Management Group (Session 3, 2012), in seeking to address the concerns of the AMDAR Panel regarding the transition and integration process, which inevitably would lead to the cessation of AMDAR Panel activities, identified the following aims and requirements of the governance and programmatic structure within WWW:

The new structure should ensure that:

1. The existing operational aircraft-based observing system continues to be developed and maintained;
2. A programmatic structure is developed that will allow the system to continue to develop in line with the CBS Implementation Plan for the Evolution of the Global Observing System;
3. The work programme of the AMDAR Panel, which is defined within the [Aircraft Observing System Programme Plan](#) continues to be addressed under the new structure, in line with Member requirements and under agreement with the appropriate WMO Technical Commissions management and processes; and,
4. The AMDAR Trust Fund continues to support the development of the AMDAR observing system and associated activities into the future, including the implementation of water vapour and turbulence measurement.

The following issues with the current structure were identified:

1. The Panel Members believe that it is important that Members, particularly those with operational AMDAR programmes, should have the capacity to meet in one forum or another on at least an annual basis and that, given that CBS teams tend to meet on a biennial basis, the current structure might not allow this;
2. The Panel Members want to preserve the arrangement whereby Members can attend relevant meetings at the cost of their organization;
3. The structure does not define the terms for the management of the AMDAR Trust Fund;
4. There appears to be insufficient representation within CIMO, particularly given the importance of the development and implementation of water vapour sensing and turbulence measurement within the AMDAR system.

Proposed Governance and Programmatic Structure

In order to address the issues identified above, the AMDAR Panel Management Group and its Members put forward the following proposal for an altered structure and new conceptual Terms of Reference for the proposed structural elements, as depicted in Figure 3 below. The chief differences between this structure and the one depicted in Figure 2, are: the proposed creation of a new Expert Team within CIMO, in place of the Theme Leader; the confirmation of the continuation of the operation of the AMDAR Trust Fund in support of the aircraft-based observations work programme under new Terms of Reference; and, the role of the two Expert Teams under their respective work programmes continuing the work programme of the AMDAR Panel under the coordination of the Secretariat within the Observing Systems Division.

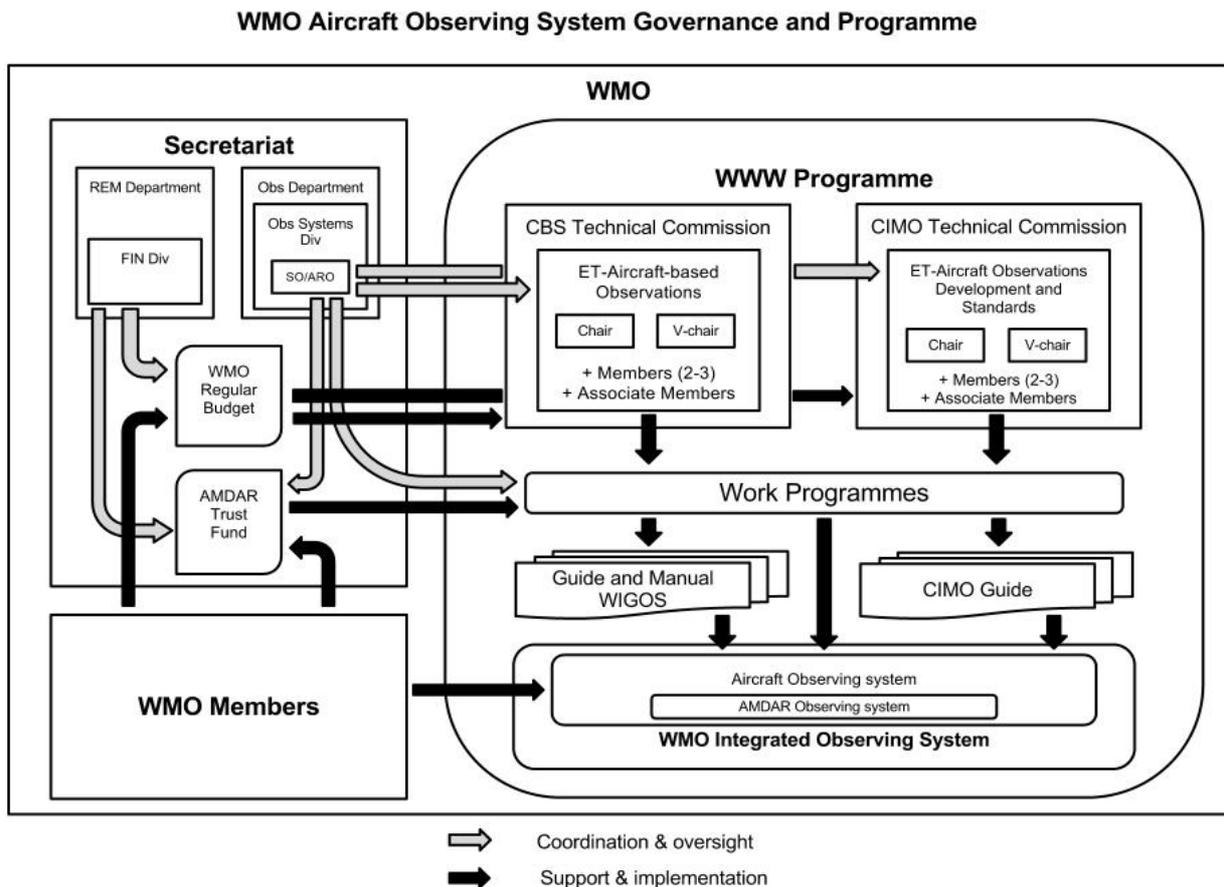


Figure 3: Proposed aircraft-based observing system governance and programmatic structure.

Addressing the Issues

The proposed structure addresses the issues as identified above in the following ways:

1. The creation of an Expert Team under CIMO will allow the role of the AMDAR Panel to be split between two Expert Teams, with the CBS team taking on the aircraft-based observations programme development role (see below), whilst the CIMO team should have responsibility for the more technical and standards-related aspects. Envisaging that the two teams would meet every 2nd year in alternative years, this will allow those Members with an interest in meeting annually to attend both meetings. With a division of the work programme in this way and more formal responsibilities falling to a second ET, this arrangement will also cut down on the coordinative and administrative load of the Secretariat;
2. It is expected that, within the limitations of reasonable logistics and resources, Members will be able to continue to have representation at ET Meetings, at the expense of their own organization as is consistent with current arrangement for attending Panel meetings;
3. A concept for new Terms of Reference for the AMDAR Trust Fund are defined below;
4. The imbalance in CIMO representation in relation to aircraft-based observations is addressed.

Proposed Process for Completion of the Transition of AMDAR to WWW

Until such time as CIMO has been consulted and agreed to the proposed final governance and programmatic structure, it will be necessary to retain the current structure with the responsibility for programme management and operation of the AMDAR Trust Fund within CBS under the following Terms of Reference and with the associated envisaged activities and tasks.

ToR	Activities and Tasks
Oversee and assist in the enhancement and optimization of the aircraft-based observing system in line with the requirements of Members and the recommendations and actions of the EGOS-IP.	Extend global AMDAR coverage, particularly over upper air data sparse and developing areas; Address the requirement for national, regional and global optimization; Extend AMDAR Programme to GA aircraft and coverage of regional airports.
Oversee the development and maintenance of the aircraft-based observations Quality Management System.	Implement a Quality Management Framework for AMDAR that incorporates standardization across national programmes, taking into account: 1) Data management; 2) Metadata management; 3) Quality control for metrological systems; 4) Systems and data monitoring and evaluation. Develop a National and Global Aircraft-based Observations Data Management Framework; Standardize AMDAR software function across avionics systems and optional sensors (e.g. water vapour) across aircraft; Manage the data processing and quality assurance for other sources of aircraft data transmitted on the GTS including data provided through ICAO; Develop and maintain regulatory material within the Manual and Guide to the GOS.
Oversee the scientific and technical development and maintenance of the aircraft-based observing system ⁶	Oversee the technical development and implementation of: <ul style="list-style-type: none"> • water vapour sensing measurement; • turbulence measurement; • icing indication.

⁶ This part of the Terms of Reference would ideally be undertaken by CIMO in a proposed expanded support role for the aircraft-based observing system.

	<p>Review science, communications and technology developments associated with the aircraft-based observing system;</p> <p>Manage risks and opportunities associated with new and developing technologies in avionics, communications and metrology;</p> <p>Communicate to the Commission the latest developments in AMDAR and other aircraft-based observational platforms.</p>
Assist and provide support for training and outreach activities to support promotion and development of the aircraft-based observing system.	<p>Develop methods and material for promoting aircraft-based observations and the AMDAR Programme;</p> <p>Represent WMO and its Members at relevant aviation and avionics forums.</p> <p>Conduct training and outreach activities in support of promotion and development of aircraft-based observations and the AMDAR Programme.</p>
Provide advice and support to the Chairperson of OPAG-IO on the implementation of the WIGOS framework and its operational aspects.	Address relevant items of WIGOS Implementation Activities, agreed by EC-WG/WIGOS-WIS-2.
Manage the work programme for the aircraft-based observations programme and the budget for the corresponding expenditure of the AMDAR Trust Fund in line with its ToR.	<p>Develop and maintain an annual work programme;</p> <p>Develop and maintain an annual budget for expenditure of the AMDAR Trust Fund in line with its ToR.</p>

Proposed Terms of Reference for Operation of the AMDAR Trust Fund

1. The AMDAR Trust Fund is a Trust Fund within the provisions of Articles 9.7, 9.8 and 9.9 of the WMO Financial Regulations (1991 edition);
2. The unit of account shall be the Swiss Franc. When commitments are made, the appropriate funds will be converted, as necessary, to the currency of commitment in at least the amount of the commitment.
3. The income of the AMDAR Trust Fund will include:
 - a. Annual voluntary contributions;
 - b. Funds deposited for specific purposes, hereafter referred to as deposits;
 - c. Other contributions;
 - d. Interest on investments as may be made by the Secretary-General in accordance with the provisions of Financial Regulation 12.2; and
 - e. Miscellaneous income.
4. Expenditure of the Trust Fund should be based on the budget for expenditure supporting the work programme of aircraft-based observations programme, as developed by the aircraft-based observations programme management;
5. Approval of requisitions for all expenditure from the AMDAR Trust Fund must be approved by the delegate of the SG within the Secretariat;
6. Expenditure of the AMDAR Trust Fund outside of the budget supporting the work programme must be approved by the delegate of the WMO SG and the aircraft-based observations programme management;
7. The funds will be used to:
 - a. Assist in the establishment and operation of programmes of automated meteorological reporting from aircraft;
 - b. Meet appropriate administrative costs incurred by WMO in providing support to the aircraft-based observations work programme activities;
 - c. Meet other administrative costs including such items as meetings and consultants;
 - d. Purchase specified items of equipment and software; and

- e. Support other activities required to meet the ToR and work programme.
8. Where required by their internal regulations, individual contributors to the AMDAR Fund may wish to negotiate additional conditions governing the application, conditions of deposit and disbursement of funds. Such additional conditions shall not inhibit the efficient and proper use of the AMDAR Trust Fund nor modify the intent of the Fund. They shall require the acceptance in writing by the aircraft-based observations programme management and the Secretary-General of WMO or his delegate;
9. All funds credited to the AMDAR Trust Fund, including those for VCP purposes, shall be subject to these Terms of Reference;
10. In line with the request of Cg-XVI, the Secretariat should continue to seek contributions to the AMDAR Trust Fund from Members on an annual basis in support of technical developments and capacity-building related to aircraft-based observations programme; and,
11. The AMDAR Trust Fund will be closed when all remaining funds are exhausted.

The following process and timeline is suggested in order to complete a transition to the proposed final structure.

1. Submission of proposal to CBS-XV (Sep 2012) [ICT-IOS Chair and Secretariat]
2. Cessation of AMDAR Panel (Nov 2012, Session 15) [AMDAR Panel Chair]
3. Meeting (Session 4) of CBS ET-Aircraft-based Observations (2013)
4. Finalization of CIMO role and structure in support of aircraft-based observing system, CIMO-XVI (2014)

If this process is successfully completed, then the Terms of Reference of each CBS and CIMO team would be subsequently redefined and defined as appropriate.

DRAFT RECOMMENDATION XXX (CBS-XV)

**AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM*
(WMO-No. 544), VOLUME I**

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

- (1) The report of the seventh Meeting of the Expert Team on Satellite Systems (17-19 April 2012),
- (2) The report of the Meeting of the Implementation Coordination Team on Integrated Observing Systems vices (18-22 June 2012),

CONSIDERING the requirement that for maintaining the accuracy of these documents, the need for periodic review is necessary to accommodate timely updates,

RECOMMENDS that the following amendment to the *Manual on the Global Observing System* (WMO-No. 544) be adopted for use:

- Volume Part IV: Space-based Sub-system should be replaced with the text contained in Annex to the present recommendation.

Annex to Recommendation No. xxx (CBS-XV)

PART IV: SPACE-BASED SUB-SYSTEM

1 COMPOSITION OF THE SUB-SYSTEM

The main elements of the space-based sub-system are:

- a. An Earth observation space segment:
 - i) Operational satellites on Geostationary Earth Orbit (GEO);
 - ii) Operational satellites on distributed, sun-synchronous, Low Earth Orbits (LEO);
 - iii) Other operational/sustained satellites or instruments on appropriate orbits;
 - iv) Research and development (R&D) satellites.
- b. A space-based intercalibration system.
- c. Associated ground segment for data reception, dissemination, and stewardship.
- d. A user segment.

NOTES:

1. Information on the detailed characteristics and capabilities of current and planned systems of environmental satellites of the GOS is contained in the Database on Space-based Observation Capabilities, which is available on line: <http://www.wmo.int/sat> .

(Note: the direct link will be indicated when the database is officially released. Information is currently available in the Dossier on the Space-based GOS that can be downloaded from the same website, and on the "Satellite Status" pages: <http://www.wmo.int/pages/prog/sat/satellitestatus.php>

2. Information on the principles of remote sensing from space and on the derivation of geophysical variables from space-based measurements can be found in the Guide on Instruments and Methods of Observations, Part IV (*being developed*).

2. IMPLEMENTATION OF THE SUB-SYSTEM

2.1 General

2.1.1 Requirements: Operators of environmental satellites should meet, to the extent possible, the uncertainty, timeliness, temporal resolution, spatial resolution, and coverage requirements of the GOS as defined in the Rolling Requirements Review (RRR) process described in Part II of this Manual, and recorded in the requirements database: <http://www.wmo-sat.info/db>.

2.1.2 Technical coordination: Members operating satellites should ensure the greatest possible compatibility between their different systems, through following recommended Coordination Group for Meteorological Satellites (CGMS) practices, and publish details of the technical characteristics of their instrumentation, data processing and transmissions, as well as the dissemination schedules.

2.1.3 Continuity: A period of overlap of new and old satellite systems should be ensured to determine inter-satellite biases and maintain the homogeneity and consistency of time series observations, unless reliable transfer standards are available.

2.1.4 Contingency arrangements: The satellite operators, working together under the auspices of the CGMS or otherwise, should ensure the continuity of operation, and the data dissemination and distribution services of the operational satellites within the sub-system.

2.1.5 Data collection platforms:

- (i) Members operating satellites with a capability to receive data from Data Collection Platforms (DCP) should maintain technical and operational co-ordination under the auspices of CGMS in order to ensure compatibility.
- (ii) A number of "international" DCP channels should be identical on all geostationary satellites to allow movement of mobile platforms across their individual footprints.
- (ii) The satellite operators should publish details of the technical characteristics and operational procedures of their data-collection missions, including the admission and certification procedures.

2.2 Operational satellites on Geostationary Earth Orbit

2.2.1 Missions

The following capability should be provided:

- a) Multispectral visible and infrared imagery;
- b) Infrared sounding;
- c) Lightning mapping;
- d) Data collection from in-situ observing systems;
- e) Space environment monitoring;
- f) Other capabilities as appropriate, e.g. Broadband and spectral visible and infrared (for Earth radiation budget estimates), high spectral resolution UV sounding (for atmospheric composition), high-spectral resolution visible and infrared imaging (for ocean color), solar activity monitoring.

2.2.2 The constellation of satellites in geostationary orbit should provide full disc imagery at least every 15 minutes, throughout a field of view between 60° S and 60° N. This implies the availability of at least six operational geostationary satellites located at evenly distributed longitudes, with in-orbit redundancy. On-demand rapid-scan capabilities should be implemented where feasible.

2.2.3 For the imagery mission the availability rate of rectified and calibrated data should be at least 99 percent as a target. Contingency plans, involving the use of in-orbit stand-by flight models and rapid call up of replacement systems and launches, should be in place in order to achieve continuity.

2.3 Operational spacecraft on distributed sun-synchronous Low Earth Orbits

2.3.1 Missions

The following capability should be provided on several, distributed orbital planes:

- a) Multispectral visible and infrared imagery;
- b) Infrared sounding;
- c) Microwave imagery;
- d) Microwave sounding;
- e) Scatterometry (for ocean surface winds);
- f) Radar altimetry (for ocean surface topography);
- g) Radio-occultation sounding;
- h) Broadband visible and infrared radiometry for Earth radiation budget measurements;
- i) Passive UV sounding (for atmospheric composition monitoring);

- j) Space environment monitoring including particle detection and magnetic field measurement;
- k) Solar activity monitoring;
- l) Data collection from in-situ observing systems;
- m) Direct broadcast;
- n) Other capabilities as appropriate.

2.3.2 The orbital configuration of satellites in sun-synchronous orbits should enable to provide global coverage for Visible, Infrared and microwave imagery and Infrared and microwave sounding, which represents the core meteorological mission, at least six times per day with a regular temporal sampling. This will require sun-synchronous satellites operated along three orbital planes: one ante-meridian (a.m.) orbit with a descending equatorial crossing around 9:30 Local Solar Time (LST), one post-meridian (p.m.) orbit with an ascending equatorial crossing around 13:30 LST, and one early-morning orbit with an ascending equatorial crossing around 17:30 LST. There should be at least one operational satellite on each of these planes, with redundancy on the am and pm orbits.

2.3.3 At least two of these satellites, one in am and one in pm, should perform Infrared sounding with a hyperspectral sensor.

2.3.4 At least two satellites, one in am and one in pm, should be equipped with radio-occultation receivers;

2.3.5 At least two satellites, on well separated orbits, should be equipped with wind scatterometers;

2.3.6 At least two satellites, one in am and one in pm, should perform broadband Visible/Infrared Earth radiation monitoring;

2.3.7 At least two sun-synchronous satellites, on well separated orbits, should be equipped with altimeter packages for global ocean surface topography monitoring.

2.3.8 Data from these satellites should be acquired on a global basis, without temporal gaps for blind orbits, and delivered to users to meet timeliness requirements.

2.3.9 The constellation should be designed to achieve a high level of robustness allowing the delivery of imagery and sounding data from at least three polar orbiting planes, in a.m., p.m. and early morning orbit, on not less than 99 percent of occasions. This implies provisions for ground segment, instrument and satellite redundancy, and rapid call up of replacement launches or a.m. and p.m. spares.

2.4 Other operational/sustained spacecraft on appropriate Low Earth Orbits

2.4.1 Missions

The following capability should be provided:

- a) High-precision radar altimetry (for ocean surface topography);
- b) Radio-occultation sounding from non sun-synchronous orbits;
- c) Total solar irradiance;
- d) Dual-angle view infrared imagery (for high-accuracy sea surface temperature measurement);
- e) Narrow-band Visible and Near Infrared imagers for ocean color, vegetation and aerosol monitoring;
- f) High-spatial resolution multispectral Visible and Infrared imagery.

- 2.4.2 Altimetry mission on high-precision, inclined orbit should complement the two altimetry missions in sun-synchronous orbits to build a robust ocean surface topography constellation;
- 2.4.3 A constellation of dedicated spacecraft with radio-occultation sensors on appropriate orbits should complement the radio-occultation missions on sun-synchronous orbits;
- 2.4.4 At least one satellite should perform downward solar irradiance monitoring, with provisions for overlap between consecutive missions in order to maintain measurement continuity;
- 2.4.5 A sun-synchronous spacecraft should be maintained on an a.m. orbit with high-accuracy Infrared imagery to provide reference measurements of sea surface temperature;
- 2.4.6 Continuity should be provided for at least one narrow-band Visible and Near Infrared imager on a sun-synchronous a.m. orbit to monitor ocean color, vegetation and aerosols;
- 2.4.7 Several sun-synchronous satellites in a.m. orbit should be equipped with high-resolution (10-m class) multispectral Visible / Infrared imagers to build a constellation providing sufficient coverage of the land surface.

2.5 Research and Development satellites

2.5.1 Purposes: The main purposes of research and development satellites are:

- (i) To support scientific investigations on atmospheric, oceanic, and other environment related processes,
- (ii) To test or demonstrate new or improved sensors and satellite systems in preparation for new generations of operational capabilities to meet WMO observational requirements.

2.5.2 Missions: Observing capabilities should be provided to enable for instance the following:

- (i) Observation of the parameters necessary to understand and model the water cycle, the carbon cycle, the energy budget and the chemical processes of the atmosphere;
- (i) Pathfinders for future operational missions should include for instance: precipitation radars, Doppler lidars, low-frequency microwave radiometers, geostationary microwave imagers and sounders, geostationary narrow-band Visible and Near Infrared imagers, gravimetric sensors, and imagery missions in high-inclination highly elliptical orbits.

2.5.3 Although neither long term continuity of service nor a reliable replacement policy are assured, research and development satellites also provide, in many cases, information of great value for operational use. To this purpose, and in order to promote the early use of new types of data in an operational environment, provisions shall be made when relevant to enable near-real time data availability.

2.6 Inter-calibration system

2.6.1 Operators of environmental satellites should perform rigorous prelaunch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a National Metrology Institute.

2.6.2 After launch, all passive instruments should be inter-calibrated on a routine basis against reference instruments or calibration targets, using established and documented methodologies.

2.6.3 Spacecraft with at least one high-quality Hyperspectral Infrared instrument should be maintained in a LEO orbit to provide reference measurements for intercalibration of operational Infrared instruments respectively in geostationary or LEO orbit. Advantage should be taken of satellite collocation to perform instrument intercalibration.

2.6.4 A range of ground-based calibration targets should be maintained, with precise characterization, in order to support routine Visible channel calibration operations.

2.7 Associated ground segments

2.7.1 Members operating environmental observation satellites should make satellite data available to other Members over the WMO Information System (WIS) in accordance with WIS data management practices, and shall inform the Members of the means of obtaining these data through catalogue entries and metadata enabling their meaningful use.

2.7.2 Receiving and processing facilities should provide for the reception of remote-sensing and DCP data from operational satellites and for the processing of quality-controlled environmental observation information, with a view of further near-real time distribution.

2.7.3 Satellite data archives should include Level 1B, together with all relevant metadata pertaining to the location, orbit and calibration procedures used. The archiving system should be capable of providing on-line access to the archive catalogue with a browse facility, and description of data formats, and allowing users to download data.

2.7.4 Data dissemination

All operational environmental observation satellite systems should ensure near-real-time data dissemination of the appropriate data sets, per the requirement of Members, either by direct broadcast or re-broadcast via telecommunication satellites.

2.7.5 In particular, the operational sun-synchronous satellites providing the core meteorological imaging and sounding mission should have Direct Broadcast capability as follows:

- (i) Direct broadcast frequencies, modulations, and formats should allow a particular user to acquire data from either satellite by a single antenna and signal processing hardware. To the extent possible, the frequency bands allocated to Meteorological Satellites should be used.
- (ii) Direct broadcast should be provided through a high data rate stream, such as the High Resolution Picture Transmission (HRPT) or its evolution, to provide meteorological centres with all the data required for numerical weather prediction (NWP), Nowcasting, and other real-time applications;
- (iii) If possible, a low data rate stream should also be provided, such as the Low Rate Picture Transmission (LRPT), to convey an essential volume of data to users with lower connectivity or low-cost receiving stations.

2.7.6 Re-broadcast via telecommunication satellites⁷ should complement and supplement direct broadcast services, to facilitate access to integrated data streams including data from different satellites, non-satellite data and geophysical products.

2.7.6 Data stewardship

It is essential to preserve long term, raw data records and ancillary data required for their calibration, reprocessing them as appropriate, with the necessary traceability information to achieve consistent Fundamental Climate Data Records. Operators of environmental satellites should provide full description of all steps taken in the generation of satellite products, including algorithms used, specific satellite datasets used, and characteristics and outcomes of validation activities.

2.8 User Segment

2.8.1 Users' stations

2.8.1.1 All Members should endeavour to install and maintain in their territory at least one system enabling access to digital data from both LEO and geostationary operational satellite constellations, either a receiver of re-broadcast service providing the required information in an integrated way, or a combination of dedicated direct readout stations.

Formerly referred to as “Advanced dissemination methods” (ADM), this technique generally uses Digital Video Broadcast (DVB) standard or its evolution.

2.8.1.2 Members requiring access to data from research and development satellites will need to download these data from the appropriate servers, or install a relevant re-broadcast service providing the required information, or install an appropriate direct broadcast user station, if the R&D satellite has such direct broadcast capability.

2.8.1.3 Data-collection platforms: In order to extend the GOS by the use of the data-collection and relay capability of the environmental observation satellites, Members should establish fixed or moving DCP systems, in particular to cover data-sparse areas.

2.8.2 Education and Training

2.8.2.1 Centres of Excellence

Support should be provided to education and training of instructors in the use of satellite data and capabilities e.g. at specialized Regional Meteorological Training Centres (RMTCs) or other training institutes designated as Centres of Excellence (CoE) in satellite meteorology, in order to build up expertise and facilities at a number of regional growth points.

2.8.2.2 Training strategy

Individual environmental satellite operators should focus their assistance, to the extent possible, on one or more of these CoEs within their service areas and contribute to the Virtual Laboratory (VLab) for Training and Education in Satellite Meteorology. The aim of the Education and Training strategy implemented through the VLab is to systematically improve the use of satellite data for meteorology, operational hydrology, and climate applications, with a focus on meeting the needs of developing countries.

2.8.2.3 User preparation to new systems

For smooth transition to new satellite capabilities, provisions should be made for appropriate preparation of the users through training, guidance to upgrade receiving equipment and processing software, and information and tools to facilitate the development and testing of applications. In addition to working through the VLab, Members should, as appropriate, exploit partnerships with organizations providing education and training in environmental satellite applications, depending on their specific needs.

3 OBSERVATIONS FROM SPACE

3.1 Observed variables

Satellite systems should provide quantitative data and qualitative information enabling, independently, as a constellation, or in conjunction with surface-based observations, the determination of:

- (i) Three-dimension fields of atmospheric temperature and humidity;
- (ii) Temperature of sea and land surfaces;
- (iii) Wind fields at the ocean surface and aloft;
- (iv) Cloud properties (amount, type, top height, top temperature, and water content);
- (v) Radiation balance;
- (vi) Precipitation;
- (vii) Lightning detection;
- (viii) Ozone concentration (Total column and vertical profile);
- (ix) Greenhouse gases;
- (ix) Aerosol concentration and properties
- (x) Volcanic ash cloud monitoring;
- (xi) Vegetation characterization;
- (xii) Flood and forest fire monitoring;
- (xiii) Snow and ice cover;
- (xiv) Ocean color;
- (xv) Wave height, direction and spectra;
- (xvi) Sea level and surface currents;

- (xvii) Sea ice monitoring;
- (xviii) Solar activity;
- (xix) Space environment (Electric and magnetic field, particle flows, electron content)

NOTES:

1. Information on the principles of Earth Observation from space and on the different types of space-based instruments can be found in the Guide on Instruments and Methods of Observations, Part IV *(being developed)*.
 2. The WMO Database on Space-based Observing Capabilities provides an indication of the main instruments that are relevant for each specific variable observable from space, as well as the potential performance of each instrument technique for the relevant variables. *(To be released in September 2012)*
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DRAFT RECOMMENDATION XXX (CBS-XV)

**IMPLEMENTATION AND SUSTAINABILITY OF THE DATABASE OF OBSERVATION
REQUIREMENTS AND OBSERVING CAPABILITIES**

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

- (1) The pivotal role of the RRR database in the RRR process within WIGOS
- (2) The need to maintain quantitative observational user requirements for the WMO Application Areas;
- (3) The benefit of maintaining a unique reference source of information on evolving satellite plans in support of global coordination of the space-based observing system, and in support of user studies and projects;
- (4) The benefit of recording the capabilities of space- and surface- based observing systems, in order to perform critical review by comparing those capabilities with the user requirements, and identify gaps;
- (5) The scope of this database which includes potentially all WMO programmes and co-sponsored programmes, including new fields of activities such as Space Weather.

Considering that:

- (1) It is critical to ensure sustainability and reliability of such type of complex information,
- (2) This must rely on collaborative efforts of satellite operators, expert groups, and the Secretariat, under the guidance of CBS;

Recommends that:

- (1) Resources be assigned with high priority within the Secretariat to complete the software development and, on a sustained basis, for technical maintenance, first level contents updating, and -through consultancy – for technical level updating and quality control, as a key WIGOS activity.
- (2) Members, OPAG-IOS expert teams, satellite operators including ET-SAT and CGMS Members, support the database updating process through submitting inputs and providing reviews and feedback.

DRAFT RECOMMENDATION XXX (CBS-XV)

ACTIONS TOWARDS AVOIDING ESSENTIAL GAPS IN SPACE-BASED OBSERVATION

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

The crucial importance of space-based observations, which provide the far major part of input data to NWP and play a unique role for global climate monitoring

Considering that:

- (1) With the lack of plan for a follow-on to the current DMSP programme, a gap is anticipated by 2020 for imagery and sounding missions on the early morning orbit.
- (2) The requirement for hyperspectral infrared sounding from geostationary orbit will not be accommodated on all geostationary positions in the coming decade according to current plans, but that the possibility to implement such capability through alternative ways, including through free flyers, can be explored.
- (3) There is no path towards an operational follow-on of the planned Global Precipitation Measurement (GPM) precipitation radar mission, which is expected to play an important role for global climate monitoring, operational hydrology and tropical cyclone monitoring, building on the TRMM mission successfully operated over 14 years.
- (4) The long-term continuity of upward radiation measurements at the top of atmosphere is not planned on the afternoon orbit after the first JPSS mission.
- (5) There is no long-term plan for limb sounders to monitor stratospheric ozone and greenhouse gases.

Urges Members to take initiatives and develop plans to fill such gaps.

Recommends that the CGMS continues to monitor the plans with the support of the CBS/ET-SAT and coordinate efforts towards a comprehensive, robust and optimized space-based observing system.

ANNEX XII

PROPOSED CHANGES TO THE OPAG IOS WORKING STRUCTURE

1) TERMS OF REFERENCE OF THE OPAG ON THE INTEGRATED OBSERVING SYSTEM (OPAG-IOS)

The existing CBS ToR – Resolution 2 (Cg-XVI) – are amended by adding the following paragraph:

The OPAG-IOS to contribute to the development, planning and implementation of WIGOS Framework and coordinate with the ICG-WIGOS.

2) TERMS OF REFERENCE OF THE IMPLEMENTATION COORDINATION TEAM ON INTEGRATED OBSERVING SYSTEMS (ICT-IOS)

The Implementation Coordination Team on Integrated Observing Systems (ICT-IOS) shall:

(a) Contribute to the implementation of the WMO Integrated Global Observing System (WIGOS), in response to guidance from ICG-WIGOS and in coordination with other relevant WMO Programmes and TCs; Provide relevant advice and support to the President of CBS;

(b) Coordinate the work of the OPAG-IOS Expert Teams, Inter-Program Expert Teams, Steering Groups and Rapporteurs and report on results to the Commission for Basic Systems;

(c) Monitor, report and make recommendations regarding the utilization of the composite observing systems under WIGOS and their capability to meet the requirements of all relevant WMO and co-sponsored programmes.

(d) Review deficiencies in coverage and performance of the existing GOS; make proposals to improve the availability of data to meet stated requirements; monitor and report on progress in the evolution of the GOS;

(e) Coordinate and consolidate the development of standardized high quality observing practices and prepare related recommendations;

(f) Assess the impacts of introducing new technology systems into the GOS on the status of regional observing networks, particularly those affecting the role of developing countries;

(g) Consider and report on the issues of costing, joint funding and management of the GOS;

(h) Contribute to strengthening the collaboration between CBS and the regional associations, by providing advice on possible solutions for newly identified requirements.

(i) Coordinate the work of the Steering Group on Radio Frequency Coordination and report results, issues and provide recommendations regarding the work of this Group to

the Commission for Basic Systems

3) TERMS OF REFERENCE OF THE INTER PROGRAMME EXPERT TEAM ON WIGOS FRAMEWORK IMPLEMENTATION MATTERS (IPET-WIFI)

In accordance with guidance and recommendations of Cg-XVI, EC-64, CBS-XV and ICG-WIGOS, the Inter Programme Expert Team on WIGOS Framework Implementation Matters (IPET WIFI) and its sub-groups shall:

1. Address integration aspects of WIGOS as defined in the WIGOS Framework Implementation Plan;
2. Provide technical advice, guidance, practices and procedures for WIGOS Framework Implementation; with priorities to be given to:
 - a. WIGOS Regulatory Material (such as WIGOS Manual, GOS Manual and Guide), in collaboration with the relevant WMO Programs and TCs;
 - b. Standards for basic WIGOS metadata(e.g., those agreed for international exchange and for WIGOS Operational DB), including the access to WIGOS metadata;
 - c. WIGOS Quality Management Framework, including monitoring;
 - d. WIGOS Information Resource, i.e. WIGOS databases, web portal
 - e. In collaboration with CIMO, development of Guidance for WIGOS standards and best practices:
 - f. Capacity development, education and outreach strategy;
3. At the outset the IPET WIFI will is envisaged to encompass four sub-groups:
 - a. SG on Regulatory Material;
 - b. SG on Metadata (expert to be proposed by CIMO);
 - c. SG on QM;
 - d. SG on Information resource.

4) INTER-PROGRAMME EXPERT TEAM ON THE OBSERVING SYSTEM DESIGN AND EVOLUTION (IPET-OSDE):

The Inter-Programme Expert Team on the Observing System Design and Evolution (IPET-OSDE) shall:

- (a) Review and report on the observational data requirements of application areas⁸ within the scope of WIGOS;
- (b) Review and report on the capability of both surface-based and space-based systems that are components or candidate components of the evolving observing systems within the scope of WIGOS;
- (c) Carry out the rolling requirements review of application areas covered by (a) using application area experts and leading to Statements of Guidance concerning the extent to which present and planned observing systems meet user requirements

8 WMO Application Areas include Global Numerical Weather Prediction (NWP), High Resolution NWP, Nowcasting and Very Short Range Forecasting (NVSRF), Seasonal to Inter-Annual Climate Prediction (SIAF), Aeronautical Meteorology, Atmospheric Chemistry, Ocean Applications, Agricultural Meteorology, Hydrology and Water Resources, Climate monitoring (GCOS), Climate applications (other aspects, CCI), Space Weather, and GTOS (non GCOS requirements of GTOS)

for observations;

- (d) Review the implications of the Statements of Guidance concerning the strengths and deficiencies in the existing observing systems and evaluate the capabilities of new observing systems and possibilities for improvements and efficiencies;
- (e) Carry out impact studies of real and hypothetical changes to observing systems with the assistance of NWP centres;
- (f) Monitor and report progress against the new version of the Implementation Plan for Evolution of Global Observing Systems, based on the “Vision for the GOS in 2025”; identify new actions as necessary, taking into account developments within WIGOS, including those of the observations and monitoring pillar of the GFCS;
- (g) Promote activities which enhance progress against the Implementation Plan for Evolution of Global Observing Systems;
- (h) Propose updates to the “Vision for the GOS in 2025”, in response to evolving user requirements and observing system capabilities;
- (i) Propose guidance regarding observing system network design principles;
- (j) Prepare documents to assist Members, Technical Commissions, and Regional Associations, summarizing the results from the above activities;
- (k) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS.

5) EXPERT TEAM ON SURFACE BASED OBSERVING SYSTEMS (ET-SBO)

The Expert Team on Surface Based Observing Systems (ET-SBO) shall:

- (a) Contribute to the implementation of WIGOS by undertaking those tasks assigned to it by the OPAG IOS Chair from the WIGOS Framework Implementation Plan.
- (b) Develop and update relevant elements of the Manual and the Guide on the GOS in the context of WIGOS, with initial priority on weather radar and AWSs.
- (c) Monitor and assess the status of planned and operational surface-based observing systems and ensure this is adequately described in [Volume A and metadata database(s) of Members’ observing system capabilities].
- (d) In collaboration with IPET-OSDE, assess the contribution of current and planned SBO systems to meeting user requirements for all Application Areas.
- (e) Facilitate the delivery of those EGOS-IP actions identified as priorities for OPAG IOS.
- (f) Monitor the status of operational networks of SBO systems, promote best practice among WMO Members and provide advice on operational matters.
- (g) Assess the potential contribution of new and emerging SBO technologies in meeting the Vision for the GOS in 2025, in collaboration with CIMO.
- (h) Provide advice and support to the Chairperson of OPAG-IOS on the implementation of the WIGOS framework and its operational aspects.

6) EXPERT TEAM ON SATELLITE SYSTEMS (ET-SAT)

The Expert Team on Satellite Systems (ET-SAT) shall:

- (a) Assist CBS in assessing the status of implementation of the space-based subsystem of WIGOS and the adequacy of implementation plans for meeting established requirements for satellite data and products;
- (b) Provide technical advice with respect to both operational and R&D environmental satellites to assist in the implementation of integrated WMO-coordinated observing systems;
- (c) Identify and assess opportunities and/or problem areas concerning satellite technology and plans of relevant satellite operators, and inform CBS timely and comprehensively through the ICT-IOS;
- (d) Assess the prospects, plans and progress of R&D and demonstration satellite systems, technologies and mission with regard to their operational use or transition to operational service.
- (e) Coordinate with other relevant CBS Teams on satellite related issues, programs, systems and technologies.
- (f) Coordinate with ET-SUP with a view to making recommendations and receiving input on matters, such as the exchange, management, and archiving of satellite data and products, radio frequency utilization, as well as education and training and other appropriate capacity-building measures related to the use of satellite data in all WMO Programmes.
- (g) Hold joint and/or overlapping meetings as appropriate with ET-SUP, to facilitate interaction between users and providers of satellite systems, data and products

7) EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS (ET-SUP)

The Expert Team on Satellite Utilization and Products (ET-SUP) shall:

- (a) Monitor the progress of satellite data availability and use by WMO Members, related issues and expectations, with the aim to publish findings and recommendations in a WMO document;
- (b) Provide advice and support to the development and implementation of WIGOS, from a satellite user's perspective and coordinate with ET-SAT and IPET-OSDE on the evolution of the space-based component of Global Observing Systems;
- (c) Initiate and promote activities to improve the availability of operational and R&D satellite data according to user needs, monitor these activities in close coordination with the relevant working group(s) and with WIS activities;
- (d) Review present and future R&D satellite data and products including their availability and potential applications, and provide advice with a view of increased utilization by

WMO Members;

(e) Review, and assist in addressing, the needs of WMO Members for information regarding satellite capabilities, and in particular access to and utilization of satellite data and products;

(f) Promote development and harmonization of satellite data and products responding to WMO Members' needs;

(g) Keep under review the needs of WMO Members for training in satellite meteorology and related fields, and engage with the Management Group of the Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) to address these needs, towards full utilization of satellite data from operational and R&D satellites, in accordance with the 2009-2013 Virtual Laboratory Training Strategy;

h) Holding joint and/or overlapping meetings with ET-SAT as appropriate, to facilitate interaction between users and providers of satellite systems, data and products.

i) Coordinate with ET-SAT with a view to making recommendations and receiving input on matters, such as the exchange, management, and archiving of satellite data and products, radio frequency utilization, as well as education and training and other appropriate capacity-building measures related to the use of satellite data in all WMO Programmes.

8) EXPERT TEAM ON AIRCRAFT BASED OBSERVING SYSTEMS (ET-ABO)

(a) Manage the programme for the aircraft observing system and the budget for the corresponding expenditure of the AMDAR Trust Fund in line with its ToR

(b) Oversee the development and maintenance of the aircraft observations Quality Management System.

(c) Oversee the scientific and technical development and maintenance of the aircraft observing system

(d) Oversee and assist in the enhancement and optimization of the aircraft observing system in line with the requirements of Members and the recommendations and actions of the EGOS-IP.

(e) Assist and provide support for training and outreach activities to support promotion and further development of the aircraft observing system

(f) Provide advice and support to the Chairperson of OPAG-IOS on the implementation of the WIGOS framework and its operational aspects

9) STEERING GROUP ON RADIOFREQUENCIES COORDINATION (SG-RFC)

(a) Keep under review allocations of radio frequency bands and frequency assignments of systems and applications for meteorological activities including their operational

requirements (telecommunications, instruments, sensors, etc.) and research purposes, in close coordination with other technical commissions, especially CIMO, and the CBS/OPAG-ISS;

- (b) Coordinate with WMO Members, with the assistance of the WMO Secretariat, to:
 - (i) Ensure the proper allocation of radio-frequency spectrum to meteorological and other environment monitoring radiocommunication services;
 - (ii) Ensure the proper notification and registration of frequency assignments used for meteorological purpose;
 - (iii) Determine their future use of the radio-frequency spectrum for meteorological purpose;

- (c) Keep abreast of the activities of the Radiocommunication Sector of the International Telecommunication Union (ITU-R), and in particular of the Radiocommunication Study Groups, on radio frequency matters pertaining to meteorological activities, and represent WMO in ITU-R work;

- (d) Prepare and coordinate proposals and advice to WMO Members on radio regulation matters pertaining to meteorological activities with a view to ITU Radiocommunication Study Groups, Radiocommunication Assemblies (RA), World Radiocommunication Conferences (WRC) and related global and regional preparatory meetings;

- (e) Facilitate the cooperation between WMO Members for the use of frequency bands allocated to meteorological and environment monitoring radiocommunication services with respect to:
 - (i) Coordination of radio-frequency spectrum use and frequency assignments between countries;
 - (ii) Sharing the same frequency bands between various radiocommunication services (e.g. meteorological aids and meteorological-satellite services (to provide compatibility between radiosondes and data collection platforms));

- (f) Facilitate the coordination of WMO frequency use activities with other international organizations which address radio spectrum management issues, including specialized organizations (e.g. CGMS, the Space Frequency Coordination Group (SFCG)) and regional telecommunication organizations, such as the European Conference of Postal and Telecommunications Administrations (CEPT), the Inter-American Telecommunication Commission (CITEL), the Asia-Pacific Telecommunity (APT), the Regional Commonwealth in the Field of Communications (RCC); the African Telecommunication Union (ATU), and the Arab Spectrum Management Group (ASMG);

- (g) Assist WMO Members, upon request, in coordination of frequency assignments of radiocommunication systems sharing a frequency band with meteorological radiocommunication systems in the ITU;

- (h) Increase the understanding of NMHS role in radio frequency coordination and the importance of the close collaboration with the ITU Radiocommunication Sector (ITU-R) and the Telecommunication Development Sector (ITU-D) in the accomplishment of the WMO priority activities, in particular GFCS, WIGOS and WIS.

10) RAPPORTEURS ON SCIENTIFIC EVALUATION OF IMPACT STUDIES (R-SEIS)

The Rapporteurs on Scientific Evaluation of Impact Studies (R-SEIS) shall:

- a) Prepare and maintain reviews of OSEs, OSSEs and other observational data impact studies undertaken by various NWP centres around the globe and provide information for consideration by the OPAG on IOS;
- b) Organize the Sixth Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction in 2016 and Chair the organizing committee;
- c) Provide input to the ICT-IOS and the IPET-OSDE regarding the evolution of the WIGOS observing system components;
- d) Provide advice and support to the Chairperson of OPAG on IOS on implementation of WIGOS.

11) RAPPORTEUR ON MARINE OBSERVING SYSTEMS (R-MAR)

The Rapporteur on Marine Observing Systems (R-MAR) shall:

- (a) Collect information on the status of marine (i.e. marine meteorological and oceanographic) observations from the JCOMM approved sources;
- (b) Liaise with appropriate JCOMM Expert Teams, Groups, Observation Panels (DBCP, SOT, GLOSS), and associated Programmes (Argo, IOCCP, OceanSITES) to ensure that the actions from the EGOS-IP are being addressed and that JCOMM Implementation Goals are being considered by the OPAG IOS;
- (c) Provide input to the Chair of OPAG-IOS and Chair of IPET-OSDE on issues related to the implementation of marine observing systems, and their contribution to WIGOS Implementation;
- (d) Liaise with the RRR point of contact for Ocean Applications concerning user requirements and gap analysis;
- (f) Keep abreast of developments in marine observing systems and advise on coordinated assessment and implementation developments;

DRAFT RECOMMENDATION XXX (CBS-XV)

PROCEDURE FOR DOCUMENTING REGIONAL REQUIREMENTS FOR SATELLITE DATA ACCESS AND EXCHANGE

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The challenges of access to satellite data in light of the dramatic expected increase in the volume of satellite data and products available over the next 5-10 years, while user surveys show that actual access often remains well below expectations,

(2) The regional diversity of needs and capabilities of the various types of users, requiring different data access solutions (e.g., high-speed vs. low-rate),

(3) The recommendation by Cg-XVI that CBS consider among its priorities “to organize the formulation of data requirements and the dialogue between data users and providers.”

(4) The conclusions of CBS Ext. (2010) which stated that “*considering the positive outcome of the RAs III/IV Satellite Data Requirements workshop, the Commission encouraged a similar approach in other Regions where satellite data access is a limiting factor*” (4.2.25, Abridged Final Report, General Summary),

(5) The value of maintaining a documented set of requirements for access to and exchange of data from existing satellites on the basis of WMO Regions,

CONSIDERING:

(1) The Satellite Data Requirements Task Team established in Region III and IV with key support by NOAA and INPE to define and document satellite data requirements, has been successful in strengthening the partnership between data user and providers in these Regions,

(2) The RA I Dissemination Expert Group established by WMO and EUMETSAT, building on the EUMETSAT Africa User Forum, has proven to be an efficient mechanism to advise EUMETSAT on how to adjust the dissemination contents of EUMETCast to best meet the needs of RA I users,

(3) The RA II Pilot Project on the development of support for NMHSs in the areas of satellite data, products and training has identified the need to review the priority requirements for data and products best responding to regional users needs,

(4) Existing fora to define requirements for access and exchange of satellite data, such as the Asia-Pacific Satellite Data Exchange and Utilisation (APSDEU) and the North America Europe Data Exchange (NADEX) meetings, specifically addressing NWP data requirements,

(4) That a common approach to defining such requirements would facilitate their consideration in the context of the Integrated Global Data Dissemination Strategy (IGDDS), as part of the WIS,

(5) This Procedure could serve as a model for establishing regional requirements for other types of data within the WIGOS,

RECOMMENDS THAT:

The Procedure for Documenting Regional Requirements for Satellite Data Access and Exchange be adopted as a guidance in all Regions,

REQUESTS that the Secretary-General:

Inform all Presidents of Regional Association of the Procedure, with an encouragement to implement it through regional task teams, in coordination with the Space Programme, and including an indication for the possibility for potential support;

Inform all CGMS Members of the Procedure, encouraging its use at the regional level, including the solicitation for support to regional task teams.

Annex 1 to Recommendation No. 4.1/6 (CBS-15)

PROCEDURE FOR DOCUMENTING REGIONAL REQUIREMENTS FOR SATELLITE DATA ACCESS AND EXCHANGE

Preamble

The development of a set of requirements for satellite data access and exchange in each of the WMO Regions requires interactions between data providers, product producers, the data users in interaction with the stakeholders and end users. This can best be accomplished if the process is coordinated within the WMO framework and clear guidelines are defined, based on experiences and lessons learnt from pilot initiatives.

The present procedure is proposed to be followed to develop a set of satellite data requirements that reflects the needs of a Region in the areas of interest of WMO Programmes and co-sponsored Programmes⁹.

The needs depend on the climatological context and the regional socio-economic priorities. The feasibility of the requirements also depends on the available data and information sources, the telecommunication infrastructure and the capabilities of the NMHS itself, which include subject matter expertise, tools, and software. Therefore the requirements should best be formulated at the regional level. The requirements should also be regularly reviewed to adapt to evolving needs and capabilities.

⁹ For example, the Global Climate Observing System, the World Climate Research Programme, the Global Ocean Observing System, the Intergovernmental Panel on Climate Change

Scope

1. The primary scope of this procedure is to identify and document the needs of a Region in the areas of interest of WMO Programmes and co-sponsored Programmes for access and exchange of satellite observation data and derived products. The needs of a Region represent the collective needs of WMO Members in order to fulfill their national or international role in support of protection of life and property and other socio-economic benefits.
2. Depending on the other mechanisms existing in each specific region, a later update of the data requirements could encompass the expression of non-satellite data requirements – e.g. surface-based observations or model outputs. The additional complexities of non-satellite data requirements and applications, providers and dissemination pathways are not considered in this first version of the Procedure. However, in the long run, such a comprehensive approach should be encouraged.
3. This process should consider both operational and non-operational satellite data, taking advantage of research and demonstration satellite missions.

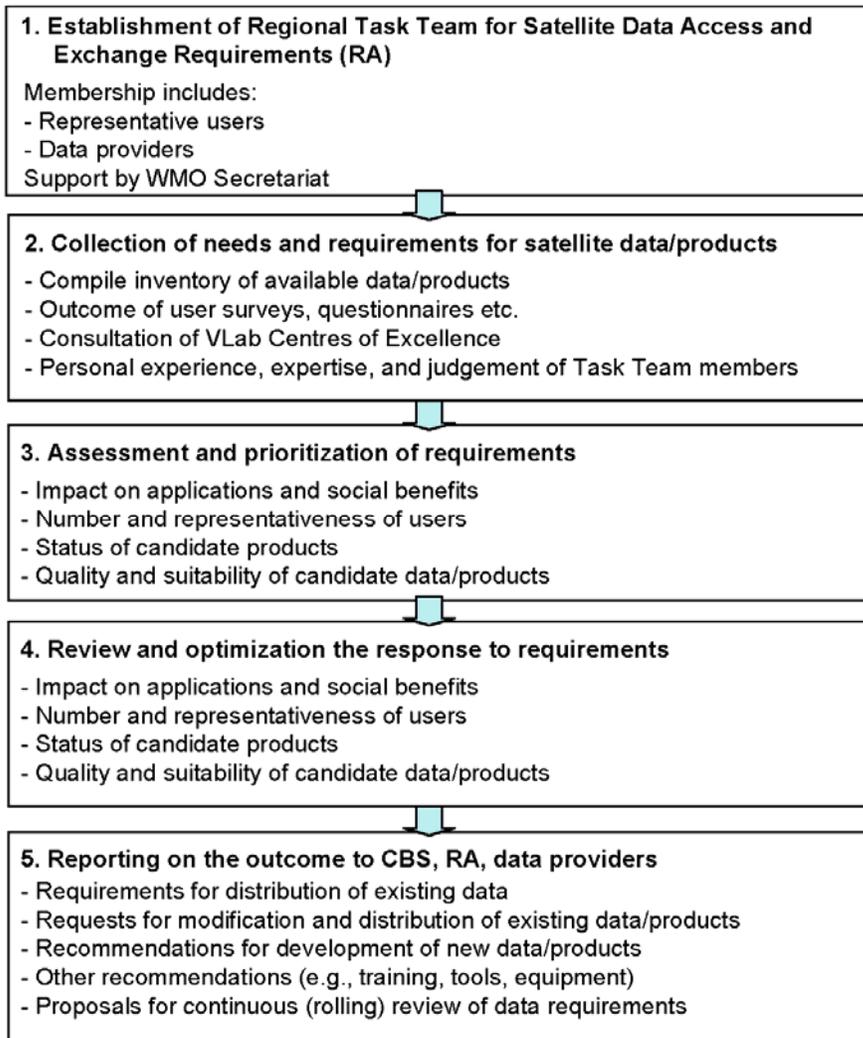
Establishment of a Regional Task Team for Satellite Data Access and Exchange Requirements

4. A Regional Task Team for Satellite Data Access and Exchange Requirements is initiated by the relevant Regional Association President and established under the technical guidance of CBS and supported by the WMO Secretariat.
5. Members of the Task Team are drawn from those experts nominated as being available for the role by Permanent Representatives. The Task Team lead shall be a space based applications specialist in the region (e.g., member of ET-SUP¹⁰, VLab CoE¹¹ representative). As far as practical, the Task Team membership should reflect the sub-regional diversity and the different fields of expertise involved in WMO Programmes and co-sponsored Programmes. The Task Team members should – collectively – strive to represent the interest of the whole Region including WMO Members who have no direct representative in the Task Team.
6. Representatives of the main satellite data providers for the Region shall be invited to participate in Task Team activities.
7. The Task Team shall be supported by the WMO Secretariat (through the Space Programme, the Regional Programme, and other Programmes as appropriate).
8. Terms of Reference of the Task Team are decided by the Regional Association, based on a common template maintained by the WMO Secretariat. The common template sets the scope, purpose, duration, methodology and reporting scheme of the Task Team.

Workflow: Tasks to be performed to develop and document an initial set of regional requirements for satellite data access and exchange

¹⁰ Expert Team on Satellite Utilization and Products, governed by the WMO Commission for Basic Systems Implementation/Coordination Team on the Integrated Observing System

¹¹ Centre of Excellence for Education and Training in the WMO-CGMS Virtual Laboratory for Education and Training in Satellite Meteorology (VLab)



Task Team Activities

9. The Task Team identifies the data already available through the existing services (GTS, Internet, bilateral FTP transmission, Direct Readout, multi-mission broadcast services such as GEONETCast, etc.). Data and products shall be classified by categories of variables and derived products.
10. The Task Team, with help of WMO Secretariat and data providers, gathers information on existing products and related inventories, as for example the WMO Product Access Guide and space agencies' product catalogues.
11. The Task team reviews the potential sources of regional needs for satellite data access including: the outcome of WMO surveys on availability and use of satellite data; input from regional Centres of Excellence; personal experience, expertise and judgment of the Task Team Members and other available documents such as the Earth Observation priorities identified by the Group on Earth Observation (GEO) for the various Societal Benefit Areas (SBA) and community-based requirements documented in GCOS and IGOS theme reports.

12. The Task Team undertakes further information gathering, such as surveys, as required to ensure that views of WMO Members in the Region are adequately represented.
13. The Task Team analyzes the requirements for each relevant category of product, and identifies which requirements are not adequately met by existing services. The unmet requirements are prioritized, taking into account:
 - The applications supported and their impact
 - The number and representativeness of the users
 - The status of the required data or products
 - The quality and suitability of the required data or products.
14. The WMO Secretariat convenes a workshop, in the Region, with the Task Team and, as required, other data providers, and specialists in the use of satellite data. In this workshop with users and providers, the prioritized list of unmet requirements is reviewed in order to define the optimal response, taking into account the technical options and capabilities available for data distribution, and the capacity of users.
15. In conclusion the Task Team formulates recommendations pertaining to:
 - Existing data/products (with detailed references) to be included in existing distribution services (e.g., new product on DVB-S service) or moving a product from one service to another (e.g., Internet product to be put in LRIT) or assigning lower priority to an existing product (or removing it if obsolete).
 - Amendments of existing products or development of new products
 - Evolution (upgrade, or consolidating) of data dissemination means, or other (e.g. training, tools, user equipment)
 - Short-term action plan to implement these recommendations
16. Based on this agreed set of requirements, data providers will strive to accommodate these in their operational dissemination procedure. This phase requires active collaboration between the users and data providers in order to test the operational procedures to deliver and use the data/products.
17. The short-term implementation actions are undertaken by the Task Team, calling on additional experts if necessary. The requirements list is updated accordingly.
18. In addition to these tasks, the Task Team is invited to provide feedback to WMO on the global observational requirements registered in the WMO Rolling Review of Requirements database.
19. The Task Team prepares a final report including the latest status of requirements, the status of implementation actions, and a proposal for the regular review of the requirements in the longer term. The final report is provided to the relevant Regional Association bodies and to WMO CBS.
20. The Task Team is then disbanded by the Regional Association.

Practical guidelines

21. WMO Secretariat provides one template for two purposes: identifying existing satellite data and products available from satellite operators, and identifying user requirements for such data and products. The template can include for instance: Product Name, Provider, Data characteristics (e.g., spatial resolution, accuracy, spectral range, length of record), Format, Geographical area, Frequency, Format expected in the Future, Final Size (compressed), Basic Application, Priority, Timeliness (min), Required data rate (kb/s).
22. The Task Team leader supports the communication within the team and organizes its work. The Task Team shall use appropriate tools to support collaborative work

(web page, Google doc, teleconferences or web meetings) and maintain version control of the data requirements document to facilitate consultation and feedback from the regional user community.

23. In terms of its schedule, the Task Team aims to:
- within 6 months after its establishment, complete a first draft version of the regional satellite data requirements,
 - within 2 months thereafter, hold the review workshop,
 - within 3 months thereafter, finalize the first version of the Regional Satellite Data Requirements based on consensus among all the Task Team members (both users and providers),
 - Complete its Task within 12 months in total.

Maintain the Regional Requirements for Satellite Data Access and Exchange

24. Once the Regional Requirements for Satellite Data Access and Exchange have been established, they need to be maintained on a routine, regular, long-term basis by an appropriate Regional mechanism. This could for example be a standing Regional Requirements Coordination Group. It is up to the WMO Regional Association to decide upon such a mechanism.
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**CBS GUIDELINE
FOR ENSURING USER READINESS FOR NEW GENERATION SATELLITES**

Noting:

- (1) The essential importance of data from geostationary and low-earth orbiting satellites for operational activities of WMO Members;
- (2) The planned introduction of several new generation geostationary satellite series by operators in the 2014-2018 timeframe, affecting all WMO Regions;
- (3) The experience of extensive user preparedness projects undertaken by different satellite operators, e.g. the NOAA Proving Ground programme for GOES-R and JPSS missions, or the Prepare the Use of MSG in Africa (PUMA) project of EUMETSAT in RA I for Meteosat Second Generation;
- (4) The Manual on GOS stipulating that, *“for smooth transition to new satellite capabilities, provisions should be made for appropriate preparation of the users through training, guidance to upgrade receiving equipment and processing software, and information and tools to facilitate the development and testing of applications”*¹²;
- (5) That the provisions of the Manual on the GOS are applicable to all satellite operators contributing to the Global Observing System;

Considering that optimal utilization of new operational satellite systems should be assured and the risk of disruption for operational users be mitigated;

The CBS recommends that:

All WMO Members and satellite operators assist users in preparing them for using the new generation of operational satellites, through the following activities:

- (1) Establishing and maintaining a dialogue between providers of the new generation satellites and prospective users, and raising awareness on new capabilities through user conferences, workshops and test beds;
- (2) Maintaining portals for updated information on development status of the new systems, instrument and data format specifications, and technical documentation;
- (3) User training, including the development of training material and training events, through the satellite provider–training centre partnerships established in the WMO-CGMS Virtual Laboratory, and other established mechanisms such as COMET, MetEd, and EUMETTrain;
- (4) Development of learning and decision-support tools, demonstrating the added value of new products;
- (5) Provision of proxy data sets, tools, and products;
- (6) Indication of the maturity status of products (operational, development, experimental);
- (7) Guidance on the transition of receiving hardware;
- (8) Planning a parallel dissemination in old and new dissemination formats or protocols;

¹² Manual on the GOS, Part IV: Space-based Subsystem, updated version submitted to CBS for adoption.

- (9) Planning an appropriate overlap period between the operation of current and new satellites to allow intercomparison and validation of products, smooth migration of operational applications and downstream service delivery;
- (10) Consider using multi-mission dissemination systems to allow for flexibility in accommodating new data streams, without the technical, financial, and schedule constraints related to setting up a receiving facility specific to the new satellite system;
- (11) Establishment by each concerned NMHS or other operational user organization, of a user readiness project focused on the introduction of new satellite data streams into operations (to be initiated ~5 years prior to launch);
- (12) Supporting user community-building through collaborative mechanisms, such as regular online briefings and social media.

Background Information to the CBS Guideline for

Ensuring User Readiness for New Generation Satellites

Scope

This Guideline is intended to ensure the readiness of satellite data and product users for taking advantage of the new generation of satellites planned for operation in the coming decades, in consistency with the Vision for the Global Observing System (GOS). In particular, in the timeframe 2014-2017, the introduction of a series of new generation geostationary satellites, such as by NOAA/NASA, JMA, CMA, KMA and EUMETSAT, will lead to a drastic increase in spectral, spatial and time resolution of data, affecting all WMO Regions. A smooth transition to the use of these new capabilities as soon as they are operational requires planning for adequate data reception technology, processing and analysis tools, and user training. Such planning measures are essential to continue, and strengthen, satellite-based information services for the societal benefit of WMO Members.

Why plan for user readiness and training?

When the US NOAA launched the Second Generation Geostationary Orbit Environmental Satellite (GOES) series were launched starting in 1994, the satellites became operational, but weather forecasters lagged in receiving all of the imagery in the office and were not adequately trained on image interpretation. Lessons drawn from this experience have led to improved user preparation for later generations of GOES satellites, for example through regular user conferences, which improved user awareness, fostered community-building, and spurred training activities. In support of the GOES-R series to be launched in 2015, a comprehensive "Proving Ground" programme has been in place since 2008 to ensure that the benefits of the GOES-R system be realized by operational centres, forecasters and research institutes as soon as the satellite is launched and operational.

The Prepare the Use of MSG in Africa (PUMA) project and its successor activities demonstrated benefits of EUMETSAT Meteosat Second Generation (MSG) data for users in RA I, and allowed for the successful transition from the First Generation of METEOSAT to MSG. This project included awareness raising, survey of potential

applications and socio-economic impact, fund raising, the installation of data reception and processing infrastructure, and training to forecasters. The first Meteosat Third Generation (MTG) satellite, due for launch in 2018, is in the planning stage and NMHSs, scientific institutions and experts are involved in defining future mission products and other aspects of the ground segment, including training. All lessons learned in the transition to MSG can only enhance the training and use of MTG data.

JMA plans to launch Himawari-8 and -9, the follow-on geostationary satellites to MTSAT-2, in 2014 and 2016 respectively, with imager payload similar to the GOES-R series. JMA are providing proxy data simulating imagery from these satellites for preparing their uptake by the user community. CMA is planning to launch its new generation FY-4A satellite in 2015, with the first geostationary hyperspectral sensor. With KMA (GEO-KOMPSAT) also embarking on the preparation of new generation geostationary satellites within this decade, the need to prepare users of these satellites in RA II and RA V well in advance is a very important issue.

Key Issues for Ensuring User Readiness

On the user side, whether specialized or less specialized one using only products, it is anticipated that in the near future important changes will be needed in hardware, software and people specialization. Several changes can be planned ahead of time, for example for the new generation of polar-orbiting satellite systems, direct readout may require using X-band to be able to deliver large amount of data; new data storage and processing capability will be required, as well as new generation software for novel applications combining multiple channels, and specialized visualization systems properly dimensioned to deal with image sizes, number of channels and high temporal resolution.

1. Satellite Data Reception Systems

The data rate available from new satellite generations will evolve from less than one Mbps to several tens of Mbps, consequently the system will need more powerful data processing and require new data storage devices. Direct readout users will need to change reception station systems and the processing chain. Furthermore, in order to exploit the range of expected new products with increased resolution, product users will also need to upgrade their systems to the level necessary to handle this expanded data source. This has also an impact on telecommunications networks and bandwidths, and planning is therefore required on which data and products shall be retransmitted on which networks, taking into account the requirements of each regional user community. In each region and for each user community, sufficient preparation to new reception systems shall be foreseen. Satellite providers should consider using advanced, multi-mission dissemination systems, such as EUMETCast, CMACast or GEONETCast, as a risk reduction measure to secure the dissemination of at least a subset of new data without imposing to the user to set up right away a dedicated, complex and expensive receiving facility at the time of the launch of the new satellite, and to ensure maximum user uptake.

2. Processing Systems and Software

Pre-processing software should be made available as freeware by satellite operators, facilitating and reducing users' investments in the new system and allow earlier uptake.

Software tools for data analysis, integration and visualization also may need to be upgraded. Such software resources should be documented and listed in the WMO Space Programme Software and Data Access Guide developed under the guidance of ET-SUP.

Satellite providers should make available proxy datasets, simulating the instrument output of the new generation satellite, in time in order for users to test the adequacy and readiness of their processing environment.

The development of specific open source software for satellite data assimilation is encouraged (see [Fourth WMO Workshop on the Impact of Various Observing Systems on NWP, for a discussion about the impact of instruments in NWP models, 2008](#)).

3. Product Generation and Validation

There is a need to concentrate financial, technical and human resources to develop, process and validate products that are more and more complex and require increasing expertise and processing capabilities. The users relying only on derived products will need detailed, transparent information on these products (e.g., through proxy data and metadata) to evaluate their fitness for purpose in advance of satellite system operation, in order to be able to use them with confidence. International science groups, such as the International Working Groups for Winds, TOVS, Precipitation and Radio Occultation, have a key role in providing guidance on these issues.

For data assimilation, guidance should be given to select, in the case of hyperspectral sounding, the most appropriate channels for assimilation for a specific synoptic and region. Also, for this category of data, formats should follow WMO/international standards. Data/products delivered should contain metadata following the WMO core metadata profile developed by the WIS and internationally agreed formats recognized by WMO (BUFR, NetCDF, HDF). New formats such as GeoTIFF, well adapted to Geographical Information Systems, should be analyzed ahead of time in consultation with the user community and appropriate WMO expert teams.

Major new products should be listed and properly documented in satellite operators' catalogues and linked to the WMO Satellite Product Access Guide to facilitate their access and use by WMO Members.

4. User Awareness and Training

The WMO CBS Expert Team on Satellite Utilization and Products (ET-SUP) recommended at its sixth session in December 2011 that *“all satellite operators include comprehensive training programmes into the mission statements, for user preparation and capacity building pre- and post-launch. The concept for a generalized satellite proving ground should be developed. (Rec.6.19).”*

From the users point of view, particularly the less specialized one or product-only users, new satellite products will be most useful if users have sufficient knowledge and understanding of the satellite, data reception, data processing, the physical basis of the products, and their specific use, the data quality and limitations, and the tools to use and process the data. There is a hierarchy of training ranging from data reception to product awareness, the more complex training involving the satellite algorithm developers. User

training should be provided, as appropriate, through the satellite provider–training centre partnerships established in the WMO-CGMS Virtual Laboratory, and using other established mechanisms such as COMET, MetEd, and EUMETrain.

DRAFT RECOMMENDATION XXX (CBS-XV)

RADIO FREQUENCIES FOR METEOROLOGICAL AND RELATED ENVIRONMENTAL ACTIVITIES

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

- (1) Resolution 4 (Cg-XV) – Radio Frequencies for Meteorological and Related Environmental activities,
- (2) Resolution X (EC-64) – Radio Frequencies for Meteorological and Related Environmental Activities

Considering that:

- (1) Radio frequency coordination is an essential cross cutting function of all WMO observing systems.
- (2) The ITU World Radiocommunication Conference 2015 (WRC-15) will address many issues that on one hand provide opportunities for the further development of meteorological systems AND on the other hand could affect the long term sustainability of essential observing systems that underlie WMO Members core activities and new initiatives such as the GFCS
- (3) The significant success at WRC-12 was achieved due to active participation of representatives from all regional organizations

Recommends that:

- (1) All WMO Programmes and Technical Commissions should be aware of the important role of radio frequency coordination and its participation in activities of the SG-RFC as well as global, regional and national spectrum management processes;
- (2) All Members be aware of radio frequency coordination and support the participation of relevant experts in activities of the SG-RFC as well as in world-wide, regional and national spectrum management processes;
- (3) Members should endeavor to have experts on meteorological observations and systems to participate in national delegations to regional and global ITU-R meetings, in particular those related to the World Radiocommunication Conferences.

Requests that the Secretary-General to continue to place a high priority on supporting radiofrequency coordination activities, including proactively increasing the awareness of Members and partner organizations on the important role of CBS in this area and to encourage Members to support this activity.

ANNEX XVI

ACTION ITEMS ARISING FROM THE ICT-IOS-7 MEETING

No.	Ref.	Action Item	By	Deadline
1	2.9	To make a presentation on the RRR Database at the upcoming CBS-XV 1.1.2	Secretariat	Sept. 2012
2	3.5	To make a proposal to CBS Management Group regarding the CBS President (being also the Chairperson of ICG-WIGOS), to bring to the attention of EC-64 in his presentation more details about resources required and the need to update the current WIP draft following the discussions at ICT-IOS-7.	ICT-IOS Chair	23 June 2012
3	4.2.5	To nominate a CBS representative on the Working Group on GRUAN	ICT-IOS Chair	ASAP
4	4.2.6	To prepare a draft BUFR template joint proposal, to be then submitted to the IPET-DRC regarding the need for daily climate messages	Rapporteur on GCOS matters, & ET-SBO	
5	6.1.9(1)	To liaise with CIMO Management to seek appropriate CIMO support for undertaking a wider role in the aircraft-based observations work programme;	CBS MG & Secretariat	2015
6	6.1.9(2)	To ensure that, by 1 September 2012, the AMDAR Panel Management Group and AMDAR Panel Members are informed about the proposed new governance and programmatic structure and the cessation of Panel activities.	AMDAR Panel Chair	1 Sept. 2012
7	6.3.4	To consider the need for developing a coordination mechanism to follow up implementation of the observing systems, assist as needed, and provide feedback on national activities.	IPET-OSDE	2015
8	6.3.6(3)	To support the allocation of appropriate resources for organizing the 6 th WMO Workshop on the Impact of Various Observing Systems on NWP in 2016	CBS	Sept. 2012
9	6.4.11(1)	To inform CBS of the upcoming workshop on the Regional and global exchange of weather radar data, noting this will focus on Doppler radial winds and reflectivity data	ICT-IOS Chair	Sept. 2012
10	6.4.11(2)	To inform CBS of the Wind Profiling Radar Questionnaire and highlight the new approach to gathering operational information.	ICT-IOS-Chair	Sept. 2012
11	6.9.1	To submit to CBS-XV the appropriate document for approval (new version of Part IV – Space-Based Subsystem of the GOS Manual)	Secretariat	Sept. 2012
12	6.10.5	To help with the identification of experts willing to contribute to Radiofrequency issues, specially to support scientific and technical studies carried out by ITU-R to support or not new frequency allocations, possibility of frequency sharing, etc.	ICT-IOS members	ASAP
13	7.1.2	To negotiate with various partners (e.g. WMO Secretariat, WIGOS Trust Fund, AMDAR Panel) in order to identify an mobilize appropriate resources for the translation of the EGOS-IP in all WMO languages	ICT-IOS Chair	ASAP

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No.	Ref.	Action Item	By	Deadline
14	7.1.4	To investigate making appropriate resources available for translating the EGOS-IP in all WMO languages, and make appropriate arrangements for translation of the EGOS-IP.	Secretariat	ASAP
15	7.1.5	To refer to the Management Group the issue of the importance of NWP monitoring for looking at various aspects of the monitoring of the observing system, while the current responsibility for NWP monitoring is split between OPAS-IOS, OPAG-ISS and OPAG-DPFS, and monitoring is done at the national and regional levels. For example, the IPET-WIFI and its Sub-Group on Quality Monitoring could be invited to make recommendations in this regard.	ICT-IOS Chair	23 June 2012
16	7.1.6	To take the EGOS-IP communication strategy into account when developing the WIGOS Framework Implementation Plane communication strategy.	ICG-WIGOS (and TT-WIP)	ASAP
17	7.1.7	To undertake the actions proposed by ET-EGOS-7 regarding outstanding issues concerning the RRR Database (collection of observation metadata, link of the RRR database with the WIGOS Information Resource, securing resources for the RRR database, involvement of the community for maintaining content of the RRR database). These are reflected in the ET-EGOS-7 final report in its Annex IX.	IOC-IOS Chair	2014
18	9.2	To refer a recommendations to the CBS Management Group that, to increase the number of observations available to Members, it would be beneficial to allow some organizations to register directly to be able to issue station identifiers, for example organizations that operate in several countries.	Chair of ICT-IOS	22 June 2012
19	9.3	To discuss with the CBS Management Group the issue of including in the “operator identifier” a World Weather Watch identifier before further decision is made in this regard	ICT-IOS Chair	ASAP

**REVISED TERMS OF REFERENCE
OF THE CBS LEAD CENTERS FOR GCOS FOR SUBMISSION TO CBS-XIV**

REVISED TERMS OF REFERENCE OF THE CBS LEAD CENTERS FOR GCOS
(Proposal of CBS-LC-GCOS-3 to be submitted to CBS-XV)

In support of the Global Framework for Climate Services, especially by improving quality and sustainability of climate data, the Lead Centres for GCOS will:

1. Diagnose problems in ~~the Regional Basic Climatological Networks (RBCNs) and the Antarctic Observing Network (AntON), with the emphasis on~~ the GSN and GUAN, by using the ~~available~~ monitoring reports, ~~such as those~~ produced by the GCOS Monitoring and Analysis Centers ~~and major WMO NWP Centres~~;
2. Liaise with nominated National Focal Points for GCOS and related Climatological Data, and other responsible officials, to ~~rectify identified problems so as to~~ improve data and meta data availability and quality;
3. Coordinate activities with other GCOS Centers and/or other ~~WMO~~ Centers as appropriate;
4. ~~Monitor and r~~Report to CBS and GCOS on actions taken, progress achieved, concerns and recommendations on a yearly basis in a time frame that corresponds to planned AOPC and CBS meetings;
5. Assist AOPC in the ~~revisions~~design of GSN and GUAN ~~and Regions in the design of RBCNs/AntONstations~~;
6. Assist the WMO Secretariat in maintaining the list of National Focal Points for GCOS and related Climatological Data.

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AREAS OF RESPONSIBILITIES OF THE CBS LEAD CENTERS FOR GCOS

(Proposal of CBS-LC-GCOS-3 to be submitted to CBS-XV)

- **Morocco (RA I)** is responsible for ~~GSN and GUAN S~~ stations in: Algeria, Benin, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Congo, **Comoros Island**, Côte d'Ivoire, Egypt, Gabon, Ghana, Gambia, Guinea, Guinea Bissau, Guinea Equatorial, Liberia, Libyan Arab Jamahiriya, Madagascar, Mali, Niger, Nigeria, Mauritania, Morocco, Senegal, Sierra Leone, Sao Tome and Principe, Sudan, Togo, Tunisia.
- **Mozambique (RA I)** is responsible for ~~GSN and GUAN S~~ stations in: Angola, Botswana, Burundi, Canary Island, Comoros Island, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, the Ocean Islands (St. Helena Island, Ascension Island, Martin de Vivies, Iles Crozet, Iles Kerguelen), Rwanda, Seychelles, Somalia, South Africa, Swaziland, Uganda, United Republic of Tanzania, Zambia, Zimbabwe.
- **Iran (RA II and part of RA VI)** is responsible for ~~GSN and GUAN S~~ stations in: Afghanistan, Armenia, Azerbaijan, Bahrain, India, Iran, Jordan, Kazakhstan, Kyrgyzstan, Maldives, Nepal, Oman, Pakistan, Qatar, Russian Federation, Saudi Arabia, Sri Lanka, Syria, Tajikistan, Turkey, United Arab Emirates, Yemen.
- **Japan (RA II)** is responsible for ~~GSN and GUAN S~~ stations in: Brunei, Cambodia, China, Hong Kong China, Japan, Laos, Malaysia, Mongolia, Myanmar, Philippines, Republic of Korea, Singapore, Thailand, Vietnam.
- **Chile (RA III)** is responsible for all ~~GSN and GUAN S~~ stations in RA III.
- **USA (RA IV)** is responsible for most ~~GSN and GUAN S~~ stations in RA IV plus Hawaii.
- **Australia (RA V)** is responsible for most **stations in** RA V, except those countries noted for Japan and Hawaii (USA).
- **Germany (RA VI)** is responsible for most **stations in** RA VI, except those countries noted for Iran.
- **UK (British Antarctic Survey)** is responsible for ~~all GSN and GUAN~~ stations in Antarctica.

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