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COMMISSION FOR BASIC SYSTEMS

OPAG ON INTEGRATED OBSERVING SYSTEMS

NINTH SESSION OF THE IMPLEMENTATION-COORDINATION TEAM ON INTEGRATED OBSERVING SYSTEM (ICT-IOS-9)

Geneva, Switzerland, 18-21 April, 2016

FINAL REPORT

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EXECUTIVE SUMMARY

The Ninth Session of the CBS, Open Programme Area Group on Integrated Observing Systems (OPAG-IOS), Implementation-Coordination Team on Integrated Observing System (ICT-IOS) was held in Geneva, Switzerland at the headquarters of WMO over 18-21 April 2016. The primary focus of this team meeting was for the various expert teams and rapporteurs to provide their reports of progress on their work plans and activities over the inter-sessional period to the session and for the ICT-IOS to formulate its reporting to CBS at its 16th Session (November 2016), including its proposed working structure and Expert Teams' work plans for the coming CBS inter-sessional period 2017-2020.

The session also received reports from experts, regional representatives and focal points on the status of the various observing system components of WIGOS and the GOS and the results of monitoring of these systems and networks. Overall, the team was pleased to be informed that the performance and status of the Regional Basic Synoptic and Regional Basic Climate Networks (RBSN and RBCN) had been relatively stable. The session also noted the remarkable and rapid development of Global Cryosphere Watch and the CryoNet over the last 4 years.

As one of the leading bodies within WMO for the development and implementation of the WMO Integrated Observing System (WIGOS) along with the Inter-Commission Coordination Group on WIGOS (ICG-WIGOS), the session also considered progress made on WIGOS development, the WIGOS priorities of WMO Congress for the WIGOS Pre-operational Phase during the current inter-sessional period of Congress and the expected contribution of the OPAG-IOS during this phase. While the ICT-IOS agreed during this session with the recommendation of ICG-WIGOS and the CBS Management Group that there was no longer a requirement for the continuation of the Inter-Programme Expert Team on WIGOS Framework Implementation Matters (IPET-WIFI) and its sub-groups beyond 2016, ICT-IOS would continue to prioritise tasks and activities within teams so as to ensure full support for WIGOS implementation. This would include contributions in the key priority areas such as OSCAR development, regulatory and guidance development, revision and modernisation of quality monitoring practices and the establishment of the WIGOS Regional Basic Observing Network supported by Regional WIGOS Centres.

Another high priority focus for the session was the consolidation of plans to develop the Vision for WIGOS for 2040 and, in particular to develop plans and a roadmap for the surface-based component of WIGOS, building on and later to be harmonized with the work that had already been commenced by the space community in developing a draft of the Vision for the space-based component of WIGOS.

In preparation for the next session of CBS and the coming inter-sessional period, the ICT-IOS undertook a thorough review of the structure of the OPAG and the terms of reference and work plans of its expert teams and coordinators and made plans for the finalisation of its reporting to CBS over the coming months.

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GENERAL SUMMARY

1 ORGANIZATION OF THE SESSION

1.1 Opening of the meeting

1.1.1 The Ninth Session of the Implementation and Coordination Team on Integrated Observing Systems (ICT-IOS) was opened by the Chair of the team, Dr Jochen Dibbern, Germany, at 10am on the 18 April 2016 at the WMO headquarters in Geneva, Switzerland. Dr Dibbern welcomed all participants and thanked them for their various contributions to the work of the ICT-IOS team and its working groups over the current CBS inter-sessional period and for their contribution to the Document Plan of the session. Dr Dibbern also thanked the Co-chair of the team, Mr Anthony Rea, Australia, for his contribution and assistance in managing the work of the OPAG. Mr Rea was unable to attend the meeting in person but joined the meeting by remote-conferencing throughout the session.

1.1.2 Dr Wenjian Zhang welcomed participants to WMO on behalf of the WMO Secretary General and also thanked ICT-IOS team members and expert team chairs for their excellent ongoing work within the OPAG. Dr Zhang also thanked the team for having taken a leading role, in partnership with ICG-WIGOS, in the development and implementation of the WIGOS framework through various activities and contributions. There was an expectation that this level of leadership and involvement in WIGOS activities would continue through the coming WIGOS Preoperational Phase over 2016 – 2019 and particularly in those priority areas as determined by WMO Congress (Cg-XVI). Dr Zhang also mentioned the new activity to develop the Vision for WIGOS for 2040, which had been commenced by the Space-based component of WIGOS and should now be extended to consider and include the development of the Vision for the Surface-based component. In addition to considering these issues and activities, Dr Zhang observed that the team expected to dedicate significant time to making preparations for reporting to the Commission for Basic Systems (CBS) Sixteenth Session, which was planned to be held in November, 2016 in China.

1.1.3 The list of participants that attended the session is provided within Annex I.

1.2 Adoption of the agenda

1.2.1 The Chair directed the session to review the proposed agenda for the session, which was adopted without change and as outlined above in this report.

1.3 Working arrangements

1.3.1 It was agreed that the proposed working arrangement for the session as described in Document 1.3 should be adopted and that the team should aim to finalise its proceedings by the afternoon of 21 April.

1.3.2 The team held breakout sessions, with the participants divided into groups meeting in parallel in each session to consider the following topics. The results of these breakout group discussions are provided within the report as indicated.

Group	Group/Topic	Lead	Outcome
1	Terms of Reference of the Expert Teams, and their future workplans.	Mr Stuart Goldstraw (UK)	See Annexes VII and VIII
2	Group 2 – CBS-16 preparations, including draft OPAG-IOS text to be submitted to CBS-16, and draft Recommendations.	Dr Jochen Dibbern.	See Annex III
3	Group 3 – Review of the regional reports, and consideration of related recommendations to CBS-16	Mr Jose Arimatea de Sousa Brito (Brazil)	See Annex III
4	Group 4 – Approval process and roadmap concerning WIGOS Pre-	Dr Jochen Dibbern	See Annex IV

	Operational Phase.		

Table 1: Breakout groups established during the ICT-IOS-9 Session

2 REPORT OF THE CHAIRMAN

2.1 Report of the Chairman

2.1.1 The Co-Chairs of ICT-IOS, Dr Dibbern (Germany) and Mr Anthony Rea (Australia) summarized the activities of the OPAG since the eighth Session of the ICT-IOS in April 2014. This included feedback from the CBS-Ext(2014) Session in Asuncion, Paraguay, September 2014, Congress 17, May/June 2015 and the CBS Management Group Meeting, Geneva, February 2016 and focused on directives and recommendations on how to better respond to WIGOS and other WMO high priorities and activities.

2.1.2 In response to decisions and guidance from the above mentioned sessions of CBS and Congress, the following activities and actions were discussed:

- All OPAG-IOS Expert Teams will continue to support WIGOS activities during the preoperational phase.
- In response to the request of CBS-Ext(14) to develop a new Vision of the WIGOS in 2040, a workshop was conducted in November 2015, involving ET-SAT and key stakeholder groups, to develop the "Vision for the Space-Based Component of WIGOS in 2040". The resulting draft document was discussed at the second session of the CBS/OPAG-IOS Inter-Programme Expert Team on Observing System Design and Evolution (IPET-OSDE-2, April 2016). IPET-OSDE-2 also discussed the next steps for the development of the vision of the surface-based component of WIGOS (see item 7 of this report) and the consolidation of the surface-based and space-based components.
- The development of the WMO Observing Systems Capability Analysis and Review Tool (OSCAR) had progressed as a component of the WIGOS Information Resource (WIR) and was now the unique repository of requirements for all WMO Application Areas and capabilities for WMO component observing systems. While the surface-based component of OSCAR (OSCAR/Surface) was still under development, it was expected to become operational on 2 May 2016, with a transition period leading to it becoming the new repository for the observing system metadata associated with WMO Volume A. It was agreed that maintaining the integrity of the information within OSCAR requires ongoing resources commitment and significant expertise and knowledge of the subject area and, therefore, the meeting agreed with to consider and finalise the draft recommendation relating to the matter and submitted by IPET-OSDE.
- The development of WIGOS guidance material was recognized by Congress as an urgent activity to be advance under the coordination of the WIGOS-Project Office. OPAG-IOS Expert Teams would be expected to contribute to this activity with the first version of the Guide to WIGOS to be available in July 2016.
- Subsequent to CBS Ext(14), both ET-SAT and IPET-SUP had been operating under their revised Terms of References, which have provided greater clarity on their responsibilities and also provided a focus for interactions with other groups and stakeholders. In particular, for ET-SAT, this had resulted in appreciation of the related activities in CGMS and CEOS and narrowing and clarifying the role of the team; for IPET-SUP, the new ToR had resulted in recognition of the cross-programme nature of satellite utilization under WIGOS and facilitated the building of connections to other programmes and technical commissions.
- Access to radiofrequency spectrum remained a significant issue for WMO with increasing demand for bandwidth by commercial operators putting pressure on the spectrum for remote sensing, satellite downlink, radar and short-range radio communication.

- The Chair reported to ICT-IOS on outcomes from the last CBS Management Group Meeting (February, 2016), including the important decisions that:
    - so as to improve the information flow and facilitate the involvement of other Technical Commissions and Members on radio frequency issues, the Steering Group on Radio-Frequency Coordination (SG-RFC) would continue to report to OPAG-IOS but, in addition, the chair of the SG should become an associate member of the CBS Management Group;
    - the activities of the Inter-Programme Expert Team on WIGOS Framework Implementation Matters (IPET-WIFI) should be either integrated into the Inter-Commission Coordination Group on the WMO Integrated Global Observing System (ICG-WIGOS) and its working groups, or else delegated to other CBS expert teams, leading to the cessation of IPET-WIFI and its sub-groups following CBS-16 (November 2016);
    - that an IPET on Operational Weather Radar should be established under the management of CIMO and CIMO/CBS joint resourcing and guidance; and
    - to support the establishment of a WIGOS Editorial Board to ensure review and harmonization of all contributions to WIGOS regulatory material from the various relevant Technical Commissions and their work groups and Programmes.

2.2 Review of actions items from ICT-IOS-8

2.2.1 The Chair led the meeting through a review of the Action List from the 8th session of ICT-IOS, updating the list with the current status of actions and determining which had been completed. The revised and updated list, including the new actions from ICT-IOS-9, is provided within Annex II.

3 WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

3.1.1 Dr Lars Peter Riishojgaard, WMO, presented Document 3(1) to the session, providing the participants with background information on the progress made in the implementation of WIGOS and the decisions that had been made in relation to WIGOS priorities for development and implementation in the WIGOS Pre-operational Phase as delegated by WMO Congress (Cg-XVI, 2015).

3.2 WIGOS Pre-Operational Phase priorities

3.2.1 The session was informed about the WIGOS Pre-Operational Phase (WPOP) priorities that were defined by Cg-XVI:

(a) National WIGOS implementation;

(b) WIGOS Regulatory Material complemented with necessary guidance material to assist Members with the implementation of the WIGOS technical regulations;

(c) Further development of the WIGOS Information Resource (WIR), with special emphasis on the operational deployment of the OSCAR databases;

(d) Development and implementation of the WIGOS Data Quality Monitoring System;

(e) Concept development and initial establishment of Regional WIGOS Centres.

3.2.2 In consideration of the many aspects and activities related to the WPOP, ICT-IOS decided to develop and maintain a table of ICT-IOS deliverables to the WIGOS Preoperational Phase, which was developed during the session and is provided within Annex IV. (Action S9/3.1 ICT-IOS; Ongoing)

3.3 Support of ICT-IOS to WIGOS pre-operational phase

3.3.1 Regulatory and Guidance Materials

3.3.1.1 In relation to development of WIGOS regulatory and guidance materials, ICT-IOS was requested to ensure that it should undertake work in this area being mindful that:

- the Manual on GOS would eventually be fully integrated into, and become part of, the manual on WIGOS;
- The RBCN and RBSN would eventually be replaced by the WIGOS Regional Basic Observing Network (RBON), a concept that would be developed over the coming inter-sessional period and for which a workshop was planned to take place in Geneva in May 2016;
- the Guide to WIGOS was being developed, focusing initially on guidance supporting OSCAR/Surface, the WIGOS Metadata Standard and WIGOS Station Identifiers and would be submitted to EC-68 for review and approval – while these were the high priority areas for provision of guidance other aspects might be considered also, or else further refined and submitted for approval to EC-69; and
- The newly formed WIGOS Editorial Board would meet for the first time in June 2016 to consider proposed WIGOS regulatory material.

3.3.2 WIGOS Data Quality Monitoring System

3.3.2.1 The meeting was informed that while the development of the WIGOS Data Quality Monitoring System (WDQMS) would initially focus on development and provision of a framework for the monitoring of observing system data quality and quantity for those systems and elements that were more readily supported by automated, real-time monitoring processes, the WDQMS would also later support the monitoring of observational data elements for all WIGOS component observing systems and data types, including monitoring in delayed mode.

3.3.2.2 The WDQMS framework would consist of three fundamental components, namely 1) the monitoring component, 2) the quality evaluation component, and 3) the incident management component.

3.3.2.3 Initially, the concept of the WDQMS framework would be developed and formalized through initial work and pilot projects associated with the surface-based component of the GOS in collaboration with some Members and partners such as the European Centre for Medium-Range Weather Forecasts (ECMWF), the NOAA, National Center for Environmental Prediction (NCEP) and Deutscher Wetterdienst (DWD).

3.3.2.4 While the traditional and critical role played by Numerical Weather Prediction (NWP) centers in real-time monitoring would be enhanced under the WDQMS, it would be necessary to develop the functions and roles of Regional WIGOS Centres so as to meet expected requirements for additional monitoring and also to support the procedures and processes associated with the quality evaluation and incident management components of the system.

3.3.2.5 Work had begun by the WIGOS Project Office, supported by the CBS/OPAG-IOS Expert Team on Surface Based Observation (ET-SBO), on the development of a WDQMS demonstration project in Africa that would be led by Kenya in partnership with other regional nations and was expected to commence in mid-2016.

3.3.3 Regional WIGOS Centres

3.3.3.1 Regional WIGOS Centres (RWC) would have a critical role in the operation of the WDQMS and in monitoring and maintain OSCAR, including basic quality control, quality evaluation and operation of the Incident Management System. Generally, the maintenance and functionality of RWCs would be developed by Regional Associations (RAs) and support the national implementation of WIGOS. The role of TCs and bodies like ICT-IOS would be to develop and document technical procedures associated with elements such as the WDQMS and OSCAR.

3.3.4 WIGOS Information Resource and OSCAR, including transition from Volume A

3.3.4.1 ICT-IOS was informed that there were significant challenges in the further development of OSCAR/Surface, including the transition to its use for definition of

maintenance of WMO Volume A, the transition to RBON from the RBSN, RBCN and the definition and provision of the capabilities of surface-based observing systems.

3.3.4.2 In relation to OSCAR/Requirements, there were currently inconsistencies in the definition of Application Areas, whether on the WMO Website [1] or in OSCAR/Requirements[2],which has been a source of confusion. For example, there are still instances where requirements are specified for the purposes of monitoring rather than the specification of requirements by those entities (Application Areas) that actually make use of the observational data within applications. Also, in OSCAR/Requirements, some of the Application Areas are historical, and others belong to co-sponsored programmes or other Organizations than the WMO. The Secretariat was requested to investigate how to better reflect historical, programmatic, and Application Areas user requirements in the OSCAR/Requirements, and how to best display the information in OSCAR/Requirements. (Action S9/3.2.4 Secretariat; asap)

3.3.4.3 ICT-IOS was invited to consider how it might contribute to the development and implementation of WIGOS metadata activities in line with ICG-WIGOS and the Planning for the WIGOS Pre-Operational Phase (PWPP). The session agreed that it was critical that WIGOS metadata for weather radars should be submitted by Members to OSCAR via the WMO Weather Radar Database (http://wrd.mgm.gov.tr/) and that WIGOS metadata for marine meteorological and oceanographic observing systems should be submitted via JCOMMOPS. ICT-IOS agreed to submit a recommendation to CBS to request support for these activities by Members.

3.3.5 National implementation of WIGOS

3.3.5.1 At the most fundamental level, WIGOS would rely on WMO Members to support its development, implementation and maintenance, supported by RWCs. Additionally, Members and RWCs would require support from the TCs to help develop procedures and guidance material that support the technical aspects of metadata quality control and assurance and the monitoring of observational and metadata. Members would be able to make use of OSCAR/Surface as a means for planning and the cataloguing and identification of national stations.

Proposal for WIGOS Station Identifiers

3.3.5.2 Mr Stephen Foreman, the Secretariat, presented Document 3(2) to the session, providing information on the status and further development of the concept and operation of WIGOS Station Identifiers.

3.3.5.3 ICT-IOS noted that WIGOS station identifiers were intended to provide a link between observations and the metadata associated with the conditions under which the observations were made. Each WIGOS station identifier would only be associated with one station or platform (called an "observing facility" in WIGOS metadata terminology); unlike previous numbering schemes, if a land station was relocated or a new drifting buoy deployed it would not be permissible to re-use the station identifier. However, in order to maintain a link with historic station identifiers it would be possible for a single observing facility to be associated with more than one WIGOS station identifier.

3.3.5.4 The form of WIGOS station identifiers was defined in Attachment 2.1 of the Manual on WIGOS. Provision had been made to map all known series of station identifiers onto WIGOS station identifiers, and draft guidance to Members on how to allocate WIGOS station identifiers to new observing facilities was being developed at http://wis.wmo.int/page=WIGOS-Identifiers.

3.3.5.5 ICT-IOS members agreed to provide feedback on the guidance on WIGOS station identifiers to the secretariat by 30 April 2016 so that it could be considered in the preparation of documentation for CBS-16. (Action S9/3.2 ICT-IOS; 30 Apr. 2016)

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[1] http://www.wmo.int/pages/prog/www/OSY/GOS-RRR.html#SOG

[2] https://www.wmo-sat.info/oscar/applicationareas

3.3.5.6 ICT-IOS supported the recommendation in the guidance on allocating WIGOS station identifiers that Members should not create additional WIGOS station identifiers for stations that had already been allocated an identifier under a previous scheme (for example a World Weather Watch station five digit number). ICT-IOS also supported the recommendation that where an existing identifier had been issued to a station, that identifier should be recorded in TDCF reports from that station using the data descriptor relevant to that type of identifier.

3.3.5.7 ICT-IOS also recommended that Members should decide which of the WIGOS station identifiers associated with an observing facility should be considered as the primary identifier for that station and to include that identifier using the descriptor for WIGOS station identifiers in all reports in TDCF from that station. This dual reporting would provide continuity between historic and future reports.

3.3.5.8 To support these recommendations and the guidance that had been developed, ICT-IOS agreed that a more detailed policy and recommendations on the use of station identifiers by Members should be developed by the team and submitted to ICG-WIGOS to consider for adoption as WIGOS guidance. (Action S9/3.2 Secretariat, ICT-IOS; Sep. 2016)

4 STATUS OF THE SURFACE BASED COMPONENT OF THE GOS

The session was provided with several presentations on the current status of implementation of surface-based component of GOS and WIGOS observing networks.

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

4.1.1 Mr Etienne Charpentier, WMO Secretariat, presented Document 4.1, which provided a summary of the status and performance of the regional basic networks, the RBSN and the RBCN. The following points and conclusions were made:

- The degradation in performance of the upper air component of the RBSN in Region VI in early 2014 was related to the temporary reduction in the program of the Russian Federation.

- It was pointed out that statistics for AWS sites in both RA II and RA III were much lower than meeting participants suggested existed. It appeared that this arose from the fact that Members in these regions did not register all AWS as sites within Volume and contributing to the RBSN. The Secretariat was requested to analyse the AWS network status in RA-II and RA-III and check with ICT-IOS regional contacts for correctness. **(Action Secretariat; asap)**

- The team agreed that the various discrepancies and uncertainty in the status and definition of networks demonstrated clearly the importance of the transition to OSCAR and an expectation that such monitoring and reporting will be greatly improved in the future as a result. Based on this, ICT-IOS requested that the team should work with the secretariat to review and revise the format of monitoring and status reports submitted to ICT-IOS so that future reports for surface-based networks should be: 1) based on information from OSCAR/Surface; and 2) provide information on quality and availability based on hourly resolution of observations for surface synoptic stations. **(Action S9/4.1 Secretariat, ICT-IOS; 2018)**

4.2 GCOS Surface Network and Upper-air Networks (GSN/GUAN/GRUAN)

4.2.1 Mr Tim Oakley, GCOS Network Manager, presented the key points from Document 4.2 on the GCOS Surface Network (GSN), GCOS Upper Air Network (GUAN) and GCOS Reference Upper Air Network (GRUAN). He highlighted the performance of these networks in 2015 (plus in relation to 2011 – 14), projects undertaken through the GCOS Cooperation Mechanism (GCM) addressing the priority areas and any particular issues to be addressed by ICT-IOS.

4.2.2 The poor performance of the GCOS networks in Region I (Africa), significantly worse than any other of the WMO Regions, is an ongoing concern and emphasises the significant challenges for sustained, systematic observations in this Region. GCM projects are primarily targeted at Region I, but available, and sustained funding, is not sufficient to make any significant improvements in the annual performance statistics.

4.2.3 Items for particular attention of the meeting were; the updated 2016 GSN and GUAN station lists, the process and timeline of the new GCOS Implementation Plan and the bi-annual meeting of the GCOS lead-centres (CBS-LC-GCOS).

4.2.4 The meeting noted the proposed changes to the GSN and GUAN station lists for 2016.

4.2.5 The meeting supported the recommendation for ongoing support by CBS of the CBS lead-centres for GCOS (CBS-LC-GCOS) and, in particular, the plans for the next bi-annual meeting in September 2016 (UK).

4.3 Marine and Oceanographic Observations

4.3.1 Dr Long Jiang (WMO Secretariat) presented Document 4.3 to the session, providing a summary of the status of marine and oceanographic networks and observations performance. The following discussion points and conclusions were made:

- Based on results of studies that have demonstrated a positive impact from the increased ASAP coverage over the North Atlantic under EUMETNET E-ASAP, the session agreed that:
    - Evidence and documentation of results of impact studies on ASAP should be consolidated. **(Action Erik Andersson; end Jun. 2016)**
    - A **recommendation be made to CBS** that, noting the positive impact of ASAP in the North Atlantic, Members should be encouraged to increase ASAP coverage in ocean areas so as to complement other sources of upper air data.
- **A report to CBS-16 should be made to inform CBS** that, based on Recommendation 18 (CBS Ext. (2014)) calling for the undertaking of impact studies of surface drifters with barometers, the results, demonstrating a positive impact, appear to have been beneficial and had likely arrested the reduction in deployment of these systems.
- The session was informed that the EUMETNET/E-SURFMAR programme had put in place a tender for AWS for future deployment on VOS ships. The Team agreed that other Members should be encouraged to collaborate in this European effort, facilitating standardization of AWS systems and their observations from ships. **(Recommendation to CBS-16)**
- The Team noted that JCOMM is revising its implementation targets, and performance indicators in close cooperation with the GCOS/OOPC.
- The Team requested the Secretariat to include information on data availability of marine and ocean observation in future reports made to ICT-IOS. **(Action Secretariat; 2018)**
- The Team recommended to address the TPOS-2020 required engagement of Members in EC-68 relevant preparatory document. **(Action Secretariat; asap)**

4.4 CryoNet of the Global Cryosphere Watch (GCW)

4.4.1 Mr Barry Goodison made a presentation to the session on the development and status of the CryoNet of the Global Cryosphere Watch (GCW). He noted that Cg-17 included WMO Polar and High Mountain Activities as one of the seven priorities contained in the WMO Strategic Plan for 2016-2019. Further, EC-67 asked EC-PHORS to continue to guide the implementation of GCW, with one priority being to establish CryoNet, the GCW core, standardized observing network, and the GCW Portal to access cryospheric metadata and data. The updated GCW Working Structure, which will be submitted to EC-PHORS-7 (early 2017) for approval was presented; descriptions of each team and their membership may be found at http://globalcryospherewatch.org/about/teams.html. See details in Annex IX.

4.4.2 The group was referred to the GCW website (http://globalcryospherewatch.org) for details and background documents on the GCW.

The following discussion points and conclusions were made:

- There was a requirement for closer cooperation and collaboration between GCW teams and the WIGOS Project Office in order to identify the GCW guidance materials that might be incorporated into the Guide to WIGOS.
- The recruitment of the GCW Project Officer by WMO was in progress and expected to be finalised later in 2016.
- The session noted the remarkable and rapid development of GCW and the CryoNet over the last 4 years, aided by voluntary contributions from Members and despite limited availablability of finance from the WMO Regular Budget. Much of this success was due to the movtivation of the research community to contribute and also as a result of regional activities aimed at increasing the participation in GCW and based on synergy of the requirements of the GCW and NMHSs.
- It was agreed that GCW implementation would benefit from further and greater engagement with other TCs (e.g. JCOMM, CAS) and RAs (e.g. RA II).
- An issue remained with the lack of standards/formats for the exchange of observations on the GTS in real-time.
- It was expected that the regulations for operation of the CryoNet of the GCW would be developed as a contribution to the Manual on WIGOS.
- The Team agreed that a **recommendation should be made to CBS** to encourage Members that operate stations in cold areas such as high mountain and polar regions to nominate national GCW focal points to WMO who might assist in the development of the GCW surface observing network.
- The ICT-IOS requested that the Secretariat should monitor and in the future report to the ICT-IOS on the status of CryoNet stations. **(Action Secretariat; 2018)**

4.5 Roundtable on regional issues

4.5.1 Representatives of Regional Associations to the session provided a summary of Documents 4(1) to 4(6) on the status of the implementation of the surface-based component of GOS in each WMO region. The following discussion points and conclusions were made:

Region I (report presented by Henry Karanja, Kenya)

- During Cg-16 session, RA-I had noted that the establishment and maintenance of a Regional Basic Synoptic Network (RBSN) of surface and upper-air synoptic stations, constituted one of the most important obligations of Members and that the high cost of

running upper air stations was cited as a reason for issues with silent stations and the low number of upper air stations which were operational.

- The RA had stressed that the highest priority for each Member in the Region should be to: (a) Improve and restore surface and upper-air observational capabilities of the RBSN/RBCN; and (b) To improve data quality, regularity, and coverage of surface observations of the RBSN/RBCN.

Region II (report presented by Jun Yang, China)

- There were substantial differences between countries in relation to data policy and the approach to capacity development.

- The RA had placed an emphais on development of the AMDAR programme in the region in had undertaken several activities to promote the benefits of the programme. There were differences in data policies relating to AMDAR that might be resulting in available data not being share on the GTS and these should be investigated to determine a solution.

Region III (report presented by Jose Arimatea de Sousa Brito, Brazil)

- The RA III was undertaking work towards defining and establishing Regional WIGOS Centres (RWC) based on a range of functions that might be delegated to Members with centres capable of undertaking such function.

- More regional resources were being committed to capacity development and it was suggested that this should be complemented by training and guidance as a component of the Regional WIGOS Implementation Plan.

Region IV (report presented by Jay Lawrimore, USA)

- It was noted that, in Region IV, substantial improvements had been made in the implementation and maintenance of the RBSN over the past decade.

Region V (report presented by Russell Stringer, Australia)

- At the RA-V Regional Association Session in Jakarta, Indonesia (May 2015), the RA agreed on its strategic plan and priorities, in particular with regard to the development and implementation of WIS and WIGOS under the Working Group on Infrastructure.

- The RA had placed a strategic focus on several key aspects of observing systems development, including aircraft and satellite observations and quality management.

- In recent years, the Australian and New Zealand AMDAR fleets had been substantially expanded and both these countries had also introduced or extended their radar wind profiler observing networks.

- Samoa had commissioned a radar wind profiler in 2012 thanks to the assistance of the Japanese government.

- A RA-II/RA-V joint project for weather radar data exchange had been established.

Region VI (report presented by Dr Dibbern, on behalf of Dr. Dieter Schröder, Chair of WG-TDI in RA-VI)

- Migration to Table Driven Code Forms (TDCF) had been a prominent issue for the region and the redesign of RBSN/RBCN that had been agreed by the RA had not progressed as expected.

- Wind turbine interference to weather radar operations is a critical issue for the region and a need to develop a policy to ensure that there must be a separation of at least 50km between new proposed wind turbine sites and existing weather radar systems.

4.5.2 Given that Members should be reporting observations on an hourly basis, based on the regulations in the Manual on WIGOS and in lined with the relevant action of the EGOS-IP, future monitoring and reporting of network performance should be undertaken to reflect this. (Action; Secretariat; 2018) The ICT-IOS agreed that future regulation should be proposed for adoption by Cg-18) so as to make hourly reporting of surface data mandatory under the RBON and that this intention should be communicated at coming RA sessions so as to ensure compliance by Members.

4.5.3 During the meeting, a breakout group of regional representatives discussed the above issues and suggested a range of initiatives and recommendations to be considered for presentation to CBS. These are documented within Annex III.

Status of the surface-based sub-system of the GOS in the Antarctic

4.5.4 Mr Etienne Charpentier, WMO Secretariat, presented Document 4(7) to the session, providing a summary report on the status of the surface-based sub-system of the GOS in the Antarctic (AntON).

Performance Monitoring Results

4.5.5 Mr Stephen Foreman, WMO Secretariat, presented Document 4(8) to the session, providing a summary reports on the results of the World Weather Watch quantitative monitoring for October 2015.

4.5.6 ICT-IOS was pleased to see that following many years when the percentage of upper air reports remained steady, there were indications that there had been an improvement in performance in 2015.

4.5.7 ICT-IOS noted the information provided on the migration to Table Driven Code Forms, and the formation of a Task Team by the CBS Management Group to address errors in migrated reports. It concluded that future significant changes of this nature and impact should be better coordinated and managed through:

a) The appointment of a dedicated team to oversee the implementation;

b) Stressing to Members the importance of conformance to the change in regulations;

c) Ensuring the involvement of regional associations in the implementation of the change;

d) Ensuring a monitoring process and direct feedback mechanism are established to inform individual Members of their lack of progress and of errors in the implementation of the change; and

e) Clear identification and communication of the reason for the change and the expected benefits to Members.

5 STATUS OF THE SPACE-BASED COMPONENT OF THE GOS

5.1 Mr Stephan Bojinski, WMO Secretariat, presented Document 5 to the session, providing a summary of the various aspects and issues that had confronted the satellite community and the space-based component of the GOS during the inter-sessional period, including operational geostationary satellites, operational polar-orbiting sun-synchronous satellites, additional operational missions on appropriate orbits, operational pathfinders and technology demonstrators, and polar and GEO platforms/instruments for space weather. The report highlighted new satellite launches since 2014, the extent to which the Vision for the space-based GOS in 2025 is fulfilled, and pointed to key gaps in the meeting of requirements of Applications Areas and users of satellite data and products.

6 REPORTS OF THE OPAG-IOS EXPERT TEAMS AND RAPPORTEURS

6.1 Report of IPET-OSDE

6.1.1 Mr John Eyre, Chair of the Inter-Programme Expert Team on Observing System Design and Evolution (IPET-OSDE), presented Document 6.1 to the session, providing a report on the activities and achievements of the IPET over the inter-sessional period. The Team was informed that:

- The IPET had continued to receive input from the Points of Contacts of Applications Areas on the various aspects of the requirements and Statements of Guidance as a contribution to the Rolling Review of Requirements and also on the status of the actions of the EGOS-IP.

- The IPET had overseen the work of the Secretariat in maintaining the Space component of OSCAR and the development of OSCAR/Surface.

- Members had been requested by the Secretariat in March 2016 to provide feedback on the status of the implementation of the EGOS-IP and the IPET had made a preliminary assessment on the limited feedback received.

- The findings of the Pilot Project of ET-SBO in support of EGOS-IP Action G10 on the revision of launch times of radiosondes, and the findings of the NWP "Impact" workshop will be further elaborated by ET-SBO and discussed by OPAG IOS in the view to possibly formulate recommendations to CBS Ext.(2018)".

- Preparations were well advanced for the 6th Workshop Workshop on "The impact of various observing systems on NWP", to be held in Shanghai, China, 10-14 May 2016.

- A letter to PRs, promoting activities on EGOS-IP Actions, had been drafted and further revised at IPET-OSDE-2.

- IPET-OSDE-2 reviewed progress by the space community in developing an initial draft of the Vision for WIGOS in 2040 for the space-based component and provided comment and feedback through the workshop. The IPET had also proposed a way forward for the development of the Vision for the surface-based component of WIGOS. (See item 7 below.)

- Work on the development of the Observing Network Design (OND) Principles had been progressed with their publication in the new Manual for WIGOS, approved by the WMO 17th Congress in May-June 2015. This had been continued with work done to prepare high-level guidance material on how these Principles should be interpreted and implemented. During the Second IPET-OSDE, Workshop on Observing System Network Design (OSDW-2, February 2015), participants continued to refine this guidance material with the intention of it becoming part of the future Guide on WIGOS. Over 2015, the document had been further revised before being considered by IPET-OSDE-2 and another revision of the draft guidance material is planned to be completed by June 2016 before its submission to CBS-16.

6.1.2 The Team discussed an issue that had been raised at IPET-OSDE regarding how WIGOS should best incorporate those observations networks that are managed by other organizations, for example, such as those managed under the Sustaining Antarctic Observing Networks (SAON) under the Arctic Council. The Team agreed that ICT-IOS should make a request to ICG-WIGOS at its next meeting to clarify how WIGOS would work with partner organizations such as SAON. (Action; Ch-ICT-IOS; Jan 2017)

6.1.3 The various issues related to Observing System Design and Evolution were reported and discussed in more detail under item 7 below.

6.2 Report of IPET-WIFI

6.2.1 Dr Jochen Dibbern, Chair of IPET-WIFI, presented Document 6.2, the report of the Terms of Reference for Inter-Programme Expert Team on WIGOS Framework Implementation Matters. He informed the meeting that the main task of the IPET was to give technical advice and guidance for the WIGOS Framework Implementation on GOS-related areas. The work was organized initially through three Sub-Groups on Regulatory Material, Metadata and Quality Management. At CBS Ext(2014), the Terms of Reference were updated, to establish an additional Sub-Group on OSCAR Development.

6.2.2 The Sub-Group on Metadata contributed to the development of the WIGOS Metadata Standard and further verified that metadata for relevant observing systems were incorporated. The Sub-Group worked to develop and test initial XML schemas to transfer station observation metadata from a national database (DWD) into OSCAR Surface.

6.2.3 After the first meeting of the newly formed ICG-WIGOS Sub-Group on the WIGOS Data Quality Monitoring System (SG-WDQMS), the work of the Sub-Group on Quality Management was integrated into this new group.

6.2.4 The Sub-Group on OSCAR Development was formed after CBS-Ext(2014) to provide support to the WIGOS Project Office (WPO) in the development and implementation of OSCAR. The group participated in the Beta test phase of OSCAR/Surface and reviewed the draft transition plan form WMO Vol A to OSCAR/Surface. The meeting was informed that a pilot project was being carried out in collaboration between WPO and Deutscher Wetterdienst (DWD) on the automated machine-to-machine transfer of metadata.

6.2.5 The Chair of IPET-WIFI informed the meeting on the recommendation that all of the IPET-WIFI activities should be fully integrated into ICG-WIGOS teams or other CBS expert teams after CBS-16 and that the IPET-WIFI be discontinued. This proposal was supported by ICG-WIGOS at its 5th Session and by the CBS Management Group 16th Session. ICT-IOS agreed to the proposed integration and discussed how the IPET-WIFI activities can be fully integrated into the various sub-groups and activities of ICG-WIGOS. The team undertook to revise the table of roles and responsibilities for the different CBS teams in the support of the WIGOS Pre-operational Phase and OSCAR development. A revised and updated version of the table is given in Annex IV.

6.2.6 Mr Russell Stringer, Vice-Chair of IPET-WIFI, then provided the meeting with an updated on progress of the Sub-Group on Regulatory Material (SG-RM) following its recent meeting 14-15 April.

6.2.7 Mr Stringer informed the meeting that SG-RM had several contributions still under consideration, hence completed drafts for the updated Manual on the GOS and Guide to the GOS were not yet ready to present to ICT-IOS for approval. He explained that material under consideration included new text for:

a) Aircraft Meteorological Stations for the Manual and also for the Guide;

b) Weather Radar Stations, Automatic Weather Stations and Radar Wind Profiler Stations for the Manual;

c) Voluntary Observing Ships scheme, for the Guide, that had already been approved by JCOMM; and

d) An updated description of the approval processes for additions and updates to the Manual on the GOS.

6.2.8 It was noted that earlier drafts of material had been reviewed in a series of Webex teleconferences leading to updated versions, however there were further aspect that needed attention. Some general observations included tendencies for the material to contain many duplications of regulations already included in other regulatory material, a tendency to include excessive technical detail, that elaborative words explaining "why" and "how" tended to be excessive, that the relative size of components was somewhat out of proportion, and that there were departures from good formulation of "shall" and "should" clauses. All of these challenges were understandable given the context of regulatory material composed by technical experts in isolation from other regulatory material already in existence.

6.2.9 The meeting was informed of plans for SG-RM to hold weekly WebEx teleconferences over the next six weeks up to mid-June, to finalise the review of all the identified material. That would leave about two weeks for ICT-IOS to review and accept the drafts before the end of June. ICT-IOS agreed that it would review the draft updates to the Manual on the GOS and Guide to the GOS out of session when they were finalized by SG-RM. (Action ICT-IOS, end-June 2016) The ICT-IOS should then ensure that the required recommendations to CBS should be made for proposed adoption of the regulatory materials. (Action ICT-IOS; end-June 2016)

6.2.10 There was some discussion about a proposal that the guidance material on Aircraft Meteorological Stations be published as a separate technical document rather than an element of the Guide to the GOS, due to its length of about 160 pages. It was concluded that the material could be presented to and approved by CBS as a separate document with a title such as "Guide to Aircraft Meteorological Stations" and achieve the same status as if it were an element of the Guide to the GOS. It was noted that, in either case, in the future it would be linked as an element of the WIGOS Guide; also, that the challenge of achieving translation would be the same however it is presented. Therefore, ICT-IOS requested ET-ABO to:

1. revise the guidance material on ABO for preparation for publication as a stand alone guidance document, referenced in the GOS Guide and later included in the WIGOS Guide; **(Action Ch-ET-ABO; Sep 2016)**

2. revise the current text in the Guide to the GOS on Aero Met. Stations to reference the new Guidance material. **(Action Ch-ET-ABO; mid-June 2016)**

6.2.11 In relation to the issue of large items of guidance material, the ICT-IOC requested the Chair to take the issue to the WIGOS Editorial Board and request resolution and policy. (Action, Ch-ICT-IOS; asap)

6.3 Report of ET-SBO

6.3.1 The Chair of the Expert Team on Surface Based Observations, Mr Stuart Goldstraw, United Kingdom of Great Britain and Northern Ireland, presented Document 6.3 to the session, providing a summary report on the progress and achievements of the expert team over the inter-sessional period and particularly since the previous session of ICT-IOS. Mr Goldstraw reported the following achievements of the Team:

- The Team held its second session over 5-8 October in Tokyo, Japan, at the kind invitation and hosting of the Japan Meteorological Agency (JMA), in a joint session with the CIMO Expert Team on Operational Remote Sensing Technologies (ET-ORST).

- ET-SBO had undertaken the first critical steps in the early development of concepts and a framework for the WIGOS Data Quality Monitoring System (WDQMS) that had now been transferred to ICG-WIGOS and the Task Team on the WDQMS. ET-SBO organised and coordinated the first two CBS/WIGOS workshops on the quality monitoring system, which were held in December 2014 and 2015. ET-SBO would retain a role in the

establishment of a pilot project on the operation of a quality evaluation and incident management system in northeast Africa, expected to commence in the 2nd half of 2016, and also in developing the new WDQMS for the surface based land component of the GOS.

- ET-SBO had contributed to the development of OSCAR through the provision of expertise and advice on the methods for utilising observing system metadata to determine the capabilities of observing systems. In particular, advice has been provided for weather radar and radar wind profiler systems, based on the work done by the team in defining metadata models for these observing systems. This work benefited from the previous work ET-SBO had done in surveying Members on the status and plans for future implementation of radar wind profiler systems, documented in WIGOS Technical Report 2014-03, Evaluation of WMO-CBS Wind Profiler Survey.

- ET-SBO formed a sub-group of the team to work on developing new regulations for the operation of weather radar, AWS and radar wind profiler systems and in December 2014, held a sub-group meeting at WMO, where these regulatory materials were compiled into a first draft. The resulting regulations have been revised over the past eighteen months and the submitted to the IPET-WIFI/Sub-Group on Regulatory Material in early 2016 for further review and assessment for submission to CBS for approval. (See Item 6.2 for more information and related actions.)

- ET-SBO collaborated with the CIMO/ET-ORST in the continued maintenance of the WMO Weather Radar Database (WRD), operated on behalf of WMO by the Turkish State Meteorological Service (TSMS) and had overseen the improvement of the database with several requested enhancements made by TSMS during the period. The WRD will in the future effectively become a component of OSCAR/Surface, being the interface for the provision of weather radar metadata by Members. ET-SBO and the Secretariat established the mechnism by which Member Focal Points on Weather Radar Metadata are notified to update the WRD on a quarterly basis.

- Also in collaboration with CIMO/ET-ORST, ET-SBO had contributed to the concept and development of terms of reference for an Inter-Programme Expert Team on Operational Weather Radar (IPET-OWR), to be formed under CIMO and under the joint guidance and resourcing of both CIMO and CBS. Both TC Management Groups have agreed with this proposal and the team is expected to be formed in the coming few months with an expectation to hold its first session in the latter half of 2016.

- Following on from the Workshop on weather radar data exchange held in April 2013, ET-SBO had established a small Task Team on Weather Radar Data Exchange (TT-WRDE) responsible for developing and standardising the international data model and format for exchange of weather radar data as a vital step in contributing to Action G48 (wider international exchange of weather radar data) of the EGOS-IP. A work plan for the TT was developed and a brief teleconference to review the plan was held in 2015. A meeting of the task team has been scheduled and would take place in late July 2016 in Boulder, USA. The work of this team is expected to be transferred to the IPET-OWR once it is formed.

- In response to EGOS-IP Action G10 (optimisation of the radiosonde network) and following discussions and initial planning at its second session, ET-SBO had developed a draft plan for a project aimed at assessing evidence of the impact of a potential change to the radiosonde network configuration based on complementary optimisation with the AMDAR observing system. The proposal was submitted and reviewed at the second

session of IPET-OSDE and further plans made to advance the project, initially after presentation of the concept at the upcoming Sixth WMO Workshop on the Impact of Various Observing Systems on NWP (Shanghai, May 2016).

6.3.2 The following issues raised by ET-SBO were discussed and related actions agreed:

- While the number of Members contributing metadata to the WRD has increased over the past few years, it was evident that many Members were yet to commit to the practice of providing these metadata, including some Member with large weather radar networks. Given the intention that the WRD will be used as the interface for provision of WIGOS metadata in support of OSCAR/Surface, it will be critical that Members provide their weather radar metadata to the WRD and, therefore, this practice should be strengthened through an appropriately worded **recommendation to the CBS-16**. The Team agreed to also include the submission of marine observing stations metadata to OSCAR through JCOMMOPS in the draft recommendation in Annex III.

- The Team agreed in principle with the ET-SBO proposal for the proposed experiment on Action G10, and requested the ET-SBO Chair to have it discussed at the NWP "impact" workshop for its feedback. **(Action; S. Goldstraw; asap)**. A side meeting at the NWP "impact" workshop could also be organized to discuss the proposal. The Team requested ET-SBO to further elaborate the proposal with the aim to submit a more mature proposal for the establishment of a pilot project to CBS-16, which might include the establishment of an IPET-OSDE or ET-SBO task team and questionnaire to be sent to potential candidates. The Team agreed that the following aspects should be considered in the proposal (a) regional aspects and perspectives (b) benefits to Nowcasting (i.e. not only NWP), (c) cost-benefit aspects, and (d) flexibility of some Members for making [automated] radio-sondes on demand. **(Action; ET-SBO; Sep 2016)**

- The Team recognized that in addition to addressing activities related to the development of WIGOS, ET-SBO should also maintain a focus on technologies where Members are heavily invested and investing, e.g. weather radars, AWS, radiosondes. Additionally, the operational regulation of GNSS and lightning detection systems should be a priority for ET-SBO to consider over the coming inter-sessional period and there was also a need to address requirements and potential in relation to voluntary provision of observations and data by citizens, i.e. "crowd sourcing". It was suggested that expert team work plans for the coming inter-sessional period should be developed well in advance of the CBS session to ensure that Members were able to determine which of their experts were best suited to contribute to the work of the various teams of the OPAG.

6.4 Report of ET-SAT

6.4.1 The Chair of ET-SAT, Jack Kaye, United States of America, described achievements over the inter-sessional period, in particular the development of an initial draft Vision for the WIGOS space-based components in 2040 and input to WIGOS implementation (OSCAR/Space and guidance material).

6.4.2 The team had also developed a definition of "space", upon invitation of the UN Office of Outer Space Affairs (OOSA), as an input for discussion within the Committee on the Peaceful Use of Outer Space (COPUOS). It was agreed that this definition (Space: the unlimited part of the universe including the upper atmosphere and extending above the atmosphere) should be submitted by ICT-IOS for endorsement by CBS. (Action; Secretariat, ET-SAT, Sep. 2016)

6.4.3 A detailed 2016-2019 work plan was proposed, and no changes to the terms of reference suggested.

6.5 Report of IPET-SUP

6.5.1 The Chair of IPET-SUP, Mr Anthony Rea, summarized achievements of the Team since 2014, which include commissioning a survey on the use of satellite data by WMO members; input to the initial Vision for the WIGOS Space-based Components for 2040; establishment of Regional satellite data requirements groups, now active in RA I, II, III/IV and V; development of progress indicators on satellite data dissemination, including for DBNet; a report on case studies highlighting the value of satellite data for climate-related activities; review and guidance to OSCAR/Space; launch of the Satellite User readiness Portal (SATURN) and maintenance of other online resources to assist Members in satellite data utilization; continuing progress with SCOPE-Nowcasting initiative, with four pilot projects underway; and development of the VLab 2015-2019 strategy.

6.5.2 Mr Rea informed the session that he attended the ET-SAT session in November 2015 and a joint meeting with ET-SAT was planned for April 2017.

6.5.3 In relation to the Vision for the WIGOS Space-based Component for 2040, the Team agreed that IPET-SUP should research case studies into the possible requirements for satellite observations of hydrological and nowcasting applications areas.

6.5.4 The IPET also agreed with the requirement for ongoing resources to support OSCAR/Space and the need to seek such support through the proposed recommendation to CBS-16.

6.5.5 A detailed 2016-2019 work plan was proposed, and no changes to the terms of reference suggested.

6.6 Report of ET-ABO

6.6.1 ICT-IOS noted the report on the progress and achievements made in the inter-sessional period by the ET-ABO on the Aircraft Based Observation Programme (ABOP), which were presented to the session by the Chair of the expert team, Mr Frank Grooters, the Netherlands.

6.6.2 40 Airlines, operating over 4000 AMDAR-equipped aircraft are participating in the 11 national and regional AMDAR programmes, producing more than 700,000 observations per day. These data produced by the AMDAR programme are supplemented by ICAO regulated aircraft based observations (Aircraft Reports), which make up less that 10% of aircraft based observations data volume.

6.6.3 The basic AMDAR system provides air temperature and wind information, with around 140 aircraft also providing water vapour information and around 600 aircraft equipped to report measurements of atmospheric turbulence (Eddy Dissipation Rate – EDR and Derived Equivalent Vertical Gust – DEVG).

6.6.4 The governance, the programmatic structure, including the management of the AMDAR Trust Fund and the technical and scientific developments, continued to be managed jointly by CBS ET-ABO and the CIMO Expert Team on Aircraft-based Observations. Together, these two teams and their work programmes are referred to as the Aircraft Based Observations programme (ABOP).

6.6.5 A Joint Meeting of the CBS ET-ABO and the CIMO ET-AO was held in Casablanca, Morocco, over 7-11 December 2015.

6.6.6 The ET-ABO has committed resources to supporting the development of Aircraft Based Observations Regional Implementation Plans (A-RIP) for WMO Regions in consultation with WMO Regional Associations and in line with CBS and Congress direction. The development of A-RIPs is one of the major components in the ABOP Strategy and Implementation Plan (A-SIP).

6.6.7 Argentina and Brazil are reported to be in the process of developing national AMDAR programmes with their respective national airlines and, as a result of the recent workshops held in Africa in 2015, Kenya and Morocco have started the development of national AMDAR programmes.

6.6.8 In cooperation with E-AMDAR and Météo France, the ABOP supported the development and implementation of AMDAR Onboard Software for the Air France Boeing B777 fleet (67 aircraft), based on the WMO AMDAR Onboard Software specification. ET-ABO had agreed to support the provision of data over WMO Region I for one year from this fleet and also the new E-AMDAR British Airways B777 fleet (58 aircraft), which would greatly increase the coverage of AMDAR data over Africa. The ET-ABO had recommended to IPET-OSDE to request NWP centres to undertake studies on these new data over Africa and to make an assessment of the impact on NWP applications over WMO Region I and globally.

6.6.9 The ET-ABO Sub-group on Regulatory Material (SG-RM) has drafted an update on Aircraft Meteorological Stations for the relevant sections in the Manual on the GOS (WMO No.544) and the Guide to the GOS (WMO No. 488). The review and final approval will follow the roadmap developed by WMO for the update of the GOS Manual and the Guide (including ABO), aiming at the submission of the materials for adoption at CBS-16, November 2016.

6.6.10 The ET-ABO organized and delivered two regional workshops on AMDAR in WMO Region I: for the Eastern, Central and Southern regions of Africa in Nairobi, Kenya (June 2015); and for the Western and Northern regions of Africa in Casablanca, Morocco (December 2015).

6.6.11 In close cooperation with and support by the ET-ABO, an on-line AMDAR Learning Module was developed and operationally implemented by COMET® (UCAR, USA).

6.6.12 AMDAR was presented at the 3rd Session of the African Ministerial Conference on Meteorology (AMCOMET, February 2015) and was selected as one of the Flagship Programmes (FPr-3) under Strategic Pillar 3 of the Integrated African Strategy on Meteorology.

6.6.13 ET-ABO continued the publication of (currently) ten volumes of the WMO AMDAR Observing System Newsletter.

6.6.14 ET-ABO supported a study and the publication in the Bulletin of the AMS of two papers on the (current) impact and (future) benefits of AMDAR observations in operational forecasting.

6.6.15 Expressions of Interest for the development and establishment of an ABO Global Data Centre (ABO-GDC) were evaluated based on a set of requirements and terms of reference developed by ET-ABO. After having sought and assessed expressions of interest to fulfil this role from several candidate centres, the Team determined that the NOAA/Meteorological Assimilation Data Ingest System (MADIS) system appeared to be immediately capable of meeting most requirements. After discussions between the Secretariat and representatives of ET-ABO and NOAA, it was agreed at the Joint Meeting by ET-ABO that the MADIS system should be recommended to CBS and NOAA to undertake the role of WMO/CBS ABO Global Data Centre. This would be subject to the following process and steps:

a) In consultation with NOAA/MADIS, ET-ABO to develop Terms of Reference for the ABO-GDC based on the specification of requirements that had been developed by ET-ABO; (Action; ET-ABO; Jun. 2016)

b) WMO and NOAA to exchange letters confirming that NOAA/MADIS agreed to take on this role, subject to approval and designation by CBS-16 and confirmation by WMO EC; (Action; ET-ABO, Secretariat; Aug. 2016)

c) Subject to completion of steps a) and b), ICT-IOS to compile a recommendation by CBS-16 to be considered by WMO EC (2017).

6.6.16 ICT-IOS agreed to support the recommendation to CBS and the above process.

6.6.17 Considering the high quality of aircraft based observations, the long record of observations of more than two decades now and the expectation of the designation of a

global data centre for ABO, the ET-ABO recommended to ICT-IOS that it requests an assessment of requirements for aircraft-based observations in support of climate applications, such as the GFCS, through the RRR process.

6.6.18 ET-ABO conducted consultation with ICAO and the Wold Areas Forecast Centres (WAFCs) on the future requirements for aircraft observations in support of aeronautical meteorology through the holding of a workshop in October 2015. An outcome was that the WAFCs undertook to review the Statement of Guidance of the RRR with respect to their requirements and consider how ICAO regulated aircraft reports (e.g. AIREPs, ADS-C) might contribute to meeting these requirements taking into consideration availability of WMO AMDAR observations.

6.6.19 While ICAO regulated Aircraft Reports have been recognized as a valuable source of aircraft based observations, the quality and inconsistency of such data was problematic and there was a need to work with ICAO and national Air Traffic Control centres to better manage its quality control and its provision to WMO for transmission on the GTS, which is the responsibility of the WAFCs under ICAO regulation. ET-ABO would continue to work with ICAO and CAeM to this end and recommended to ICT-IOS that it request support from CBS for improved collaboration between WMO, CAeM, ICAO and IATA in support of provision and use of aircraft based observations.

6.6.20 An update to the ToR of the ET-ABO was proposed, better reflecting the harmonized tasks and work plans of both the CBS ET-ABO and the CIMO ET-AO.

6.6.21 A recommendation to CBS-16 was drafted (provided in Annex III) on the "Designation of a WMO aircraft based observations global data center and (in collaboration with CAeM) seek strong support and promotion by ICAO and IATA for the WMO global data center, participation in the WMO AMDAR programme and the provision of aircraft based observations by the Air Transport Industry".

6.6.22 The meeting discussed the use of ABO data by NWP centres and ICT-IOS requested R-SEIS and the Chair of IPET-OSDE to check with NWP Centres whether thinning of AMDAR data is still being undertaken (and required) in data assimilation, and confirm which elements of AMDAR data are actually being used. (Action; R-SEIS; end June 2016)

6.6.23 The question was also raised as to the status of the Canadian AMDAR programme and whether there were plans for its recovery, noting that Canada was one of the leading AMDAR programme several years ago. The ICT-IOS requested the Chair of ET-ABO to request the Focal Point for the Canada AMDAR programme to report on the status and future plans for the progamme and to consider providing a brief document on the issues that had led to the deterioration of the programme so as others could learn from this experience. (Action Ch-ET-ABO; end 2016)

6.7 Report of the Rapporteur on Marine Observing Systems (R-MAR)

6.7.1 Mr Jon Turton, United Kingdom of Great Britain and Northern Ireland, vice chair for WIGOS at the JCOMM Observations Coordination Group reported on Marine Observing Systems. The Team noted status details of the observing networks was summarized in Document 4.3.

6.7.2 The Team noted that the OCG had developed a five year work plan for 2015-2020 for coordinated and synthesized ocean observations, taking into account of guidance of the WMO and IOC, and JCOMM management committee. Mr Turton reminded the Team of the timeline for the Implementation Plan for the Global Climate Observing System (GCOS-IP) in 2016, the Fifth Session of JCOMM (October 2017), OceanObs19, and the process for the Tropical Pacific Observing System (TPOS2020).

6.7.3 The OCG with Ocean Observations Panel for Climate, developed network specifications for each network to describe their capability in relation to the Essential Ocean Variables (EOVs) and performance metrics. The next steps will be to develop cross-network metrics based on relevant variables. This practice aims to be consistent with the WMO Rolling Review of Requirements (RRR). As vice chair for WIGOS at OCG, Jon introduced WIGOS to the OCG-7, particularly to the oceanographic community, where WIGOS metadata for marine/ocean platforms will be identified.

6.7.4 The Team noted that a small number of High Resolution SST drifters are deployed for improved calibration/validation of satellite derived SST, and ERMETSAT will announce an Invitation to Tender (ITT) for an HRSST drifter pilot project.

6.7.5 It was also noted that WIS/GTS telecommunication can only be conducted in agreed BUFR format, but were not widely used by the research-oriented community, where netCDF was used. Therefore, there is a possible need to develop netCDF to BUFR converters. Due to the fact that only NMHSs have direct access to the GTS, OCG is encouraging the use of ERRDAP for data integration.

6.7.6 It was reported that JCOMM would make a contribution to the WIGOS Pre-operational Priorities (2016-2019), particularly in relation to the WIGOS Regional Centres (WRCs) and regulatory materials. For WRCs, Jon Turton reported of the current JCOMM Regional Instrument Centres (RMICs) at the NCOSM, Tianjin, China and NDBC, Gulfport, USA in their respective capacity to contribute in the region. For regulatory materials, Jon drew attention to the recommendations by a consultant that there needs to be a clear delegation by both WMO and IOC for maintenance of documentation and guidance regarding oceanographic observations and marine meteorological observations.

6.7.7 The Team noted that there appeared to be a case where moored buoy data was proposed to be withheld from distribution on the GTS so as to prevent their data assimilation by NWP centres, apparently to later compare with NWP output so as to independently assess the impact of these data. Although the Team thought this was unlikely, JCOMM/DBCP was invited to reinforce the requirement for free and unrestricted exchange of all data. (Action; JCOMM/DBCP; Oct 2016)

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

6.8.1 Mr Erik Andersson, ECMWF, presented Document 6.8, the Report of the Co-rapporteurs on Scientific Evaluation of Impact Studies Undertaken by NWP Centres on behalf of the two co-rapporteurs, himself, and Dr Joshiaki Sato, Japan. The session was informed that:

- The rapporteurs continued to monitor the results of observing system experiments and studies that were undertaken by global and national NWP centres and provided a summary within the report as an annex.
- Through attendance at meetings and the input of reports, the rapporteurs had contributed to various expert teams and the ICT-IOS in accordance with the ToRs.
- Planning for the upcoming Workshop on the Impact of Various Observing Systems on NWP, to take place over 10-13 May in Shanghai, China, was well in hand and the program was provided within the report to the session.

6.8.2 The session discussed the outcomes of several OSEs and the question was raised as to whether the results and publications relating to these studies were available to all WMO Members. The Rapporteurs were requested by ICT-IOS to seek to ensure that results and reports of impact studies can be shared with all WMO Members. (Action, R-SEIS, Secretariat, Jun. 2016)

6.8.3 The Team discussed several issues related to the work of the rapporteurs, concurred with their recommendations and decided to repor to make the following recommendations to CBS-16:

- continued development and research of adjoint-based observation impact assessment tools, as a complement to traditional OSEs;
- OSEs to be undertaken that support the optimisation of regional composite networks; and

- NMHSs to conduct OSEs and OSSEs to address the specific science questions, as updated based on the outcomes of the session and as listed in the table in Annex V.

6.8.4 The rapporteurs proposed updated Terms of Reference for the R-SEIS, as provided within Annex VII.

6.9 Radio-frequency Matters (SG-RFC)

6.9.1 Mr José Arimatéa de Sousa Brito, Chair of the Steering Group on Radio-Frequency Coordination (SG-RFC), presented Document 6.9 to the session on the activities and outcomes of the group over the inter-sessional period and reported that:

- Given inter-disciplinary nature of the work of the SG-RFC, the CBS-MG had proposed that, while it should continue to be situated within the OPAG-IOS working structure, the Chair of the Steering Group should have associate membership of the CBS-MG in order to be able to more directly report on and raise issues on RFC of wider importance and impact.

- The Steering Group had met twice since the eighth session of the ICT, both having a strong focus on discussions and consolidation of the WMO position on the Agenda Items of the World Radiocommunication Conference (WRC-15) that took place in November 2015, where, thanks to the intense participation of experts from Members and organizations as well as the support from the Secretariat, the preparation was excellent, resulting in very positive outcome for the meteorological and earth observation communities.

- The Steering Group had also dealt with several other radiofrequency coordination issues in several areas, including Space Weather, S-Band Radars, Oceanographic Radars, MetSat/EESS, Lightning Detection, Wind Profilers, as well as the coordination of related activities with partner organizations as GEO, SFCG, CGMS and Eumetnet.

- For the next Radiocommunication Conference (WRC-19), at least sixteen agenda items were identified, of which eight will most likely be of interest to WMO, although it will also be necessary to monitor some of the other issues where affected bands have not yet been identified or specified.

- WRC-23 also already has three issues of interest to WMO, the main one being the identification of frequency for space weather activities which was triggered by SG-RFC.

- More specifically and among other matters, the SG-RFC had:

    - facilitated the inclusion of Space Weather frequency needs to be addressed at WRC-23;

    - Successfully defended the C Band used for GTS broadcasting;

    - Published the Guide to participation in RFC (WMO No.1159), started work on updating the Handbook and contributed to relevant sections of the Radio Regulations;

    - Ensured representation at various meetings of relevant international radio-frequency regulation organizations; and

    - contributed to a GEO task focusing on C Band broadcast and RLAN (5GHz) issues and recently assisting GEO community on issues associated with Ocean Radar.

The Team agreed with the following recommendations of the SG-RFC:

- To incorporate into the WIGOS manual & guides the relevant guidance materials developed by the Sterring Group.

- To ensure that relevant observing system radio-frequency details were able to be recorded in OSCAR for both the surface and space-based (e.g. information on microwave sensor frequencies should be made searchable in OSCAR/Space in a user-friendly way, like the satellite telecommunication frequencies, to provide a more convenient support to radio-frequency management) components, that such elements were populated by Members and that suitable points of contact were maintained to ensure such metadata provided the correct technical and operational characteristics of instruments and systems. The Team requested the Secretariat to make sure such requirements are taken into account in the OSCAR project. **(Action; Secretariat; asap)** The SG-RFC was also invited to provide its requirements in this regard to the Secretariat. **(Action; SG-RFC; asap)**

- That WIGOS national and regional implementations plans should include radiofrequency elements aimed at educating Members and national telecommunication authorities on the importance of availability of electromagnetic spectrum for meteorology and Earth observations applications.

- To **submit to CBS-16 the draft Recommendation** proposed by the SG-RFC on Radiofrequency Matters as provided within Annex III.

6.9.2 The Team noted that the joint WMO/ITU Handbook "Use of radio spectrum for meteorology: weather, water and climate monitoring and prediction", is available free of charge from the WMO website.

7 OBSERVING SYSTEM DESIGN AND EVOLUTION

Mr John Eyre presented Document 7 to the session, providing the various developments and issues associated with Observing System Design and Evolution and the WMO Rolling Review of Requirements.

7.1 Status of actions of the Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP)

7.1.1 The process of reviewing progress against EGOS-IP Actions has been found, in general, to be more difficult than it was for the previous version of EGOS-IP. This is because the scope of many of the Actions is now broader. As a consequence, IPET-OSDE has decided to organise the Action review by nominating one person or group as the "owner" of each Action. The "owner" is responsible for collating information, which is then used to summarise a statement of progress.

7.1.2 At IPET-OSDE-2 (April 2016), the Team reviewed progress on EGOS-IP Actions, including the operation of the new approach to reporting against Actions. The new process appears to be working very well for some Actions and less well for others. The Team identified a number of actions for improving the report on progress and the process for generating/updating it. These actions will be taken forward as part of the normal work of the Team. The Team agreed that an annual cycle for the monitoring of progress on EGOS-IP Actions is needed.

7.1.3 The role of IPET-OSDE, with the support of OPAG-IOS and WIGOS as a whole, not only to monitor progress against the Actions in EGOS-IP but actively to promote it. Experience with the old EGOS-IP (responding to the old Vision for the GOS in 2015) was that response to EGOS-IP Actions was good in several areas, including space-based observations (via the WMO Space Programme), ocean observations (via JCOMM) and aircraft observations (via the AMDAR Programme). However progress was relatively slow in areas dependent on action by WMO Members and Regions. A network of National Focal Points (NFPs) was established to facilitate reporting by Members against the Actions in EGOS-IP.

7.1.4 At IPET-OSDE-2, the IPET-OSDE considered the role of EGOS-IP National Focal Points (NFPs) and their annual reports, in feeding into the overall progress of monitoring progress on EGOS-IP. The Team received and discussed some feedback and analysis of the NFP reports for 2014 and 2015. IPET-OSDE agreed:

- that there is a need to give feedback to the NFPs, in order to encourage their efforts;
- that there is a lack of awareness and understanding of some EGOS-IP Actions by some Members, and this must be addressed to order to enhance WIGOS implementation in the Regions. WIGOS PO is invited to consider further efforts that could be made in this area;
- to establish a small sub-group to work on the issue during the inter-sessional period. The Group should in particular consider improving the explanations of the questions being asked to NFPs and using an e-survey to facilitate input of information.

7.1.5 ICT-IOS endorsed these decisions.

7.1.6 At IPET-OSDE-2, the Team reviewed and revised a draft of a letter to Permanent Representatives (PRs) explaining the role of their organisation in the implementation of EGOS-IP. It agreed that the new version of the document should be finalized by the Secretariat and the Chair, and then used for communicating with PRs. The letter should be distributed before CBS-16, and also in a way that promotes a clear understanding for PRs when they also receive material about the new WIGOS technical regulations and the new Guide to WIGOS. ICT-IOS noted and supported this activity and requested that the Secretariat should discuss internally regarding the best time and method for issuing the OSDE letter on EGOS-IP before CBS-16. (Action; Secretariat; asap)

7.1.7 ICT-IOS also noted that errors had been noted in the translations into Spanish and French of EGOS-IP and that the CBS-MG has invited WMO experts to review and proof-read the translated WMO documents. The Team recommended raising this issue at CBS-16, inviting the Secretary General to take appropriate action, and inviting Members to possibly assist in this regard on a voluntary basis.

7.2 Use of OSCAR for the RRR

7.2.1 This item was discussed throughout the session under other items and it was agreed that the key aspect was that the development of OSCAR should be resourced sufficiently so as to ensure that the requirements and tools for undertaking the Rolling Review of Requirements were able to be developed and implemented within the OSCAR system.

7.2.2 The Team discussed the status of the OSCAR/Space system and agreed that, based on the current table of responsibility approved by CBS Ext. (2014), the ICT-IOS was responsible for approving the release of OSCAR/Space version 2 and requested the Secretariat to take action to finalise its testing, review and release based on an appropriate implementation schedule.

7.3 Development of observing systems network design guidance based on the approved principles

7.3.1 Following the preparation of a set of WIGOS "Principles" for Observing Network Design (OND) by the IPET-OSDE-1, and their endorsement by ICT-IOS-8, these Principles became part of the Manual on WIGOS, which was subsequently approved by the WMO 17th Congress in May-June 2015.

7.3.2 The 2nd ad hoc Workshop of the IPET-OSDE on Observing System Design (OSDW-2, 2-4 February 2015) took the Principles approved by Congress as its starting point and continued work to prepare high-level guidance material on how these Principles should be interpreted and implemented. Following OSDW-2, participants continued to refine this guidance material with the intention of its becoming part of the Guide on WIGOS, resulting in a version that was considered by IPET-OSDE-2.

7.3.3 At IPET-OSDE-2, the Team agreed that the OND guidance materials needed some further editing, and requested Stephan Klink (Germany) to lead the effort of finalizing the document by the end of June 2016. The Team requested the ICT-IOS to clarify the roadmap for further developing and approving the guidance materials. The Team also invited the ICT-IOS-9 to propose the proper mechanism for having the OND guidance approved according to foreseen availability of such materials.

7.3.4 OSDW-2 discussed the scope of the guidance material that it was developing in the context of the wider WIGOS guidance material. It also discussed which strands of OND guidance material are needed within the WIGOS Guide, e.g. by observing network, application area, technology, region, etc. OSDW-2 participants decided to focus on the generic OND guidance. This was based on the assumption that other guidance material either exists or will be developed.

7.3.5 OSDW-2 noted that the final detailed structure of the WIGOS Guide is not known yet. However, the structure of Guide should mirror the structure of the Manual. This situation did not prevent the Workshop making progress on the development of OND guidance to be included in the Guide. There may be material for which it is unclear whether it is sufficiently generic for this layer of guidance, or whether it is more specific (i.e. to particular observing programmes, observing systems or applications) and so more appropriate to lower layers of guidance. It was agreed that, if in doubt, the material should be retained for the time being within the generic guidance; it could be moved to other sections of the WIGOS Guide later, if necessary.

7.3.6 ICT-IOS-9 advised that the scope and structure of the WIGOS guidance material would in future be reviewed by the new WIGOS Editorial Board, which would advise on how existing guidance material should be organised and on where new material was needed. ICT-IOS also considered the roadmap for further elaboration of WIGOS guidance material.

7.3.7 ICT-IOS agreed on the following actions:

1. The OND guidance developed by the IPET-OSDE sub-group should be reviewed by the ICT-IOS by correspondence before submission to CBS-16. **(Action; ICT-IOS; end Jul. 2016)**

2. ICT-IOS should ensure the submission of the draft OND guidance to CBS-16 for approval. **(Action; ICT-IOS; early Sep. 2016)**

3. If approved by CBS, ICT-IOS should submit the draft OND guidance to the WIGOS Editorial Board for consideration for its review, submission to ICG-WIGOS (2017) and possible inclusion in the Guide to WIGOS. **(Action; ICT-IOS; end 2016)**

7.4 Comments and amendments to the CIMO Document on the "Competency Framework for Observing Programme and Network Planning".

7.4.1 Document 7.4 was presented to the session by the Secretariat, providing a summary of the work undertaken by the CIMO Task Team on Competencies to develop competencies for staff making meteorological measurements and observations, and performing maintenance and calibration of instruments for use as guidance by NMHSs and training institutes.

7.4.2 This work had resulted in the drafting of 4 competency frameworks for: Meteorological Observations, Instrumentation, Calibration and Observing Programme and Network Planning, which were provided to the session within Information document 10. These frameworks had been submitted to representatives of the Education and Training Programme, and Regional Training Centres for review, based on which the Task Team was developing the final set of competencies to be then submitted to CIMO MG for endorsement.

7.4.3 The meeting was invited to consider the competency frameworks and provide advice/specific proposals for amendments to be provided to the CIMO Task Team and to confirm that it supports the document to be finalized and published by CIMO, or to indicate whether it prefers to take the lead in further developing the document and publishing it.

7.4.4 The ICT agreed that the members of ICT-IOS should review the CIMO competency framework document and provide their comments to the Chair. (Action; ICT-IOS; end Jun. 2016) The Chair would then compile these comments and submit any suggested or proposed amendments to the document to the CIMO President along with any suggestions regarding their transition to guidance material. (Action; Ch-ICT-IOS; end Jul. 2016)

7.5 New 2040 Vision for the global observing system(s)

7.5.1 The Vision for the Global Observing System in 2025 ("Vision 2025") to which the EGOS-IP responds, was completed in 2009. The Vision 2025 has played a useful role; it has been used widely within the WMO community and in discussions with partners, to provide a concise and easily intelligible statement of the types of developments in observing systems that would best serve the needs of WMO Members.

7.5.2 The Vision 2025 has been used by the WMO Space Programme in its interactions, on behalf of WMO Members, with space agencies through CGMS and other forums. Although this has been very valuable, the role of the Vision 2025 for this specific purpose has now become more limited, because of the long lead times for developing satellite programmes.

7.5.3 Following discussion at IPET-OSDE-1 and ICT-IOS-8 (April 2014), it was agreed that a new vision for the observing system components of WIGOS in 2040 should be developed. This issue has been taken forward chiefly through activities of the Secretariat within the WMO Space Programme and under the leadership of ET-SAT, and substantial progress has been made. There is now a complete draft of the Vision for the space-based component of WIGOS in 2040 (hereafter called "Vision 2040 Space").

7.5.4 At IPET-OSDE-2, the Team reviewed this version of the Vision 2040 Space and the roadmap, and also comments received on this version from other groups (Presidents of TCs meeting, 19-20 January 2016; Consultative Meeting on High-level Policy on Satellite Matters, CM-13, 28-29 January 2016; IPET-SUP-2, 23-26 February 2016). The Team provided further comments and proposed (minor) revisions to the Vision. The Team agreed that this Vision should be presented to CBS-16, and requested ICT-IOS-9 to consider the subsequent process for review, revision and approval of the new Vision.

7.5.5 In light of progress and plans concerning the Vision 2040 Space, at IPET-OSDE-2 the Team considered what related activities to propose in relation to the surface-based component. The Team agreed to initiate a development parallel to that for the space-based component, targeting 2040. However, it noted the current Vision 2025 contains many items that would need only minor revision, and so a vision for 2040 might be considered as an update on the Vision 2025, together with a vision for expected strands of development during the period 2025 to 2040. The Team decided to establish an

IPET-OSDE sub-group for drafting the Vision 2040 Surface. The Team agreed that the core members of the sub-group should meet, possibly in Offenbach (Germany), in September 2016, to develop a first draft of the Vision 2040 Surface.

7.5.6 The Team proposed that the draft Vision 2040 Surface should be submitted to CBS-16. It was noted that EC-69 (2017) was an important milestone to report on work in progress, which might be a draft of the "Vision for WIGOS observing systems in 2040", i.e. a document integrating the visions for the surface-based and space-based components. The Team also agreed that all WIGOS component observing systems (GOS, GAW, GCW, WHOS) and co-sponsored observing systems (GCOS, GOOS) should be engaged in preparing and reviewing the "Vision for WIGOS observing systems in 2040". ICT-IOS agreed that the draft Vision 2040 Surface should be presented to CBS-16.

7.5.7 ICT-IOS was invited to consider these proposals and to agree on a roadmap for:

- taking forward the Vision 2040 Space and the Vision 2040 Surface to CBS-16,
- combining these two components into an integrated "Vision for WIGOS observing system components in 2040", and
- the subsequent review and approval process.

7.5.8 The ICT-IOS proposed roadmap is provided in Annex IV. (Action; ICT-IOS; Jun. 2016)

7.5.9 ICT-IOS noted and supported these proposals. It discussed the details of the roadmaps for further review and updating of the Vision 2040 Space and Vision 2040 Surface and for combining the two components. ICT-IOS also agreed that the integrated "Vision for WIGOS observing system components in 2040" should be a short document (~10 pages).

8 PREPARATION OF OPAG-IOS INPUT FOR CBS-16

Following the breakout sessions (see table 1 under paragraph 1.3) and resuming in plenary, the Chair of ICT-IOS led the team through various aspects and issues to be considered in relation to the reporting of the ICT to CBS-16 and the formulation of the OPAG and its teams for the next inter-sessional period of CBS.

8.1 Consideration of the need for an IPET-WIFI

8.1.1 The session was informed that, under the new structure of ICG-WIGOS as put in place at its 5th session (Jan 2016), it was now possible for all WIGOS related activities and tasks of the IPET-WIFI to be accommodated and addressed by ICG-WIGOS and its task teams. In particular, the activities of IPET-WIFI should be addressed by ICG-WIGOS directly, the tasks and activities of the Sub-Group on Regulatory Material should be addressed by the WIGOS Editorial Board, activities and tasks related to quality management & monitoring should be addressed by the Task Team on the WIGOS Data Quality Monitoring System and tasks and activities related to metadata and OSCAR development should be addressed by the Task Team on OSCAR Development (to commence activities in 2017). Another task team on Data and Partnerships would be tasked with WIGOS activities related to data policy, "big data" and "crowd sourcing" and inter-organizational and external partnerships relating to data sharing and observing system operation.

8.1.2 Based on this, the ICG-WIGOS had recommended to the CBS-MG that, at the next session of CBS, the IPET-WIFI and its sub-groups could be discontinued. The Team concurred with the proposal of the ICG-WIGOS and the CBS-MG that the IPET-WIFI could be discontinued, and its tasks transferred to the ICG-WIGOS under its current and future structures. This recommendation should be submitted to CBS-16 as part of the new proposed OPAG IOS working structure.

8.2 Consideration of the need for a new Expert Team on Weather Radars

8.2.1 The Chair advised that, based on a decision by Cg-17 to request CIMO to develop a mechanism for the international coordination of weather radar activities and standards, a recommendation by the joint meeting of ET-SBO and CIMO/ET-ORST (October 2015) to form an inter-commission and inter-programme team to address this request and the decisions of CBS and CIMO Management Groups to adopt this recommendation, CIMO had elected to form the Inter-Programme Expert Team on Operational Weather Radars at its 14th session in April 2016. This IPET would be initially and immediately formed under CIMO, based on the terms of reference adopted by CIMO as provided in Annex VI, jointly coordinated by CIMO and CBS and consisting of experts transferred from both TCs. It was agreed by CIMO-MG that the mechanism for coordination of the team's activities should be facilitated by the Chair of the IPET reporting to ICT-IOS. It was expected that this team would be established in the next couple of months and meet for the first time either later in 2016 or early 2017. It was agreed that this would be reported to CBS-16.

8.3 Terms of Reference of the Expert Teams

8.3.1 The Chair informed the Team that, prior to the meeting, the Chair had circulated a draft proposed revised structure of the OPAG-IOS, revised and updated Terms of References and team work plans to Chairs and requested their review and feedback prior to and during the meeting by way of the submitted reports of the Chairs and Rapporteurs. During the meeting, breakout group no. 1 had further considered the Terms of Reference of the teams and rapporteurs expected to form the OPAG-IOS to be proposed to CBS.

8.3.2 It was agreed that these ToR should be further refined by the Chair and Secretariat prior to their provision in the Final Report of the Session. The proposed structure of the OPAG-IOS and the Terms of Reference of the teams and rapporteurs are provided within Annex VII.

8.4 Terms of Reference of Rapporteurs

8.4.1 The proposed Terms of Reference for Coordinators (previously Rapporteurs) of OPAG-IOS are provided within Annex VII.

8.5 Work Plans

8.5.1 The Chair requested that the Chairs and Rapporteurs ensure that work plans are finalised for submission to CBS by end of June 2016 (Action Chairs & Rapporteurs, end June 2016).

8.5.2 The proposed Work Plans as submitted by Chairs to ICT-IOS-9 are provided within Annex VIII.

8.6 Input and Recommendations for CBS-16

8.6.1 The list of agreed and proposed draft recommendations to be made to CBS by ICT-IOS is provided within Annex III. It was agreed that this list and proposed drafts of recommendations would be used by ICT-IOS and the Secretariat as a basis for input by the ICT-IOS to CBS-16 and would be further reviewed, revised and refined by the Team and the Secretariat prior to the CBS session in November 2016.

9 ANY OTHER BUSINESS

No other business was raised.

10 CLOSURE OF THE SESSION

The Chair of ICT-IOS thanked all participants and the Secretariat for their work and input to the session and closed the meeting around 4pm on 21 April 2016.

ANNEX I

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ANNEX II

ACTIONS LIST FOR ICT-IOS-9

No.	Session / Ref.	Action item	By whom	Deadline	Status, comments
1	S8/4.1.7	to fix noted discrepancies (e.g. Brazil) in future performance monitoring reports	Secretariat	ICT-IOS-9	
2	S8/4.1.8	to make a proposal at the next ICT-IOS meeting regarding new suites of monitoring tables, which ought to be produced to reflect modern NWP observation monitoring systems (thereby to consider including statistics on the hourly reporting in the monitoring report)	Secretariat	ICT-IOS-9	Covered under WIGOS report for ICT-IOS-9 ICT-IOS-7 agenda item 4 to discuss
3	S8/4.2.3 (iii)	to arrange for organization of the 5th CBS Lead Centre for GCOS Meeting in October 2015 (venue to be decided)	Secretariat	Oct. 2015	To be discussed at ICT-IOS-9 (GCOS)
4	S8/4.2.14	to propose a new CBS representative in the AOPC WG on GRUAN	Chair ICT-IOS	ASAP	4/4/2016: John Eyre was and will continue to be involved. Stuart Goldstraw will participate at ICM-8.
5	S8/4.2.15	to pass the recommendation that WIGOS and GRUAN should actively pursue GRUAN expansion in the tropics and in Africa and South America to the AOPC	CBS rep. in AOPC WG on GRUAN	ASAP	Better connections are needed between GRUAN and CBS CBS can articulate requirements but GRUAN is essentially a volunteer system CBS rep. designated by ICT-IOS Chair per action 13. 14/7/2014: John Eyre asked clarifications from Chair ICT-IOS 14/8/2014: J. Dibbern suggested to pass it to AOPC WG on GRUAN at next meeting
6	S8/4.4.7	to develop a formal Recommendation to CBS Ext.(2014) regarding the reporting of snow and no snow conditions	Chair ICT-IOS	End May 2014	Good progress. Code table entry changed. No Rec. but CBS Ext.(2014) agreed to facilitate reporting zero snow depth by suggesting that those Members using TAC nationally might consider using the unallocated entry 000 of code table 3889 to indicate zero snow depth, so that the information would be available when national reports are converted to TDCF
7	S8/5.4.2	to remind Members, in his report to CBS, that for a space-based observing system (incl. operational and R&D satellites) to be a contributor to WIGOS, it is essential that its data are made available to the WMO community and in a timely manner	ICT-IOS Chair	Sep. 2014	4/4/2016: Recognized by CBS Ext.(2014) (item 2.5.8 of general summary) and in WIGOS Technical Regulations Part I (Draft Version 0.8) item 4.1.2.3

8	S8/6.2.3(9)	to invite IPET-OSDE Chair to present cost-benefit studies at the forthcoming ICG-WIGOS meeting in 2015	Secretariat	Jan-17	Open Discussed at IPET-OSDE-2 To be discussed at the NWP "Impact" Workshop in May 2016 WIGOS PO to consider adding an agenda item about this at 2017 ICG-WIGOS meeting
9	S8/6.3.3(4)	to consider possibilities for joint meetings and collaboration with CIMO teams as appropriate	ET-SBO Chair	Ongoing	CBS ET-ABO and CIMO ET-AO have had joint meetings This is now ongoing/routine work
10	S8/6.3.3(6)	The Team requested the ET-SBO to prioritize EGOS-IP G10, to review the potential to improve the global radiosonde network to take account of all application areas.	ET-SBO	ASAP	Stuart to report at ICT-IOS-9
11	S8/6.4.3(2)	to submit such a proposal to CBS Ext.(2014) for organizing ET-SAT meetings side by side with CGMS meetings with reduced membership and limited (DSA) funding for core members, and with ToR focusing on operational issues.	Chair ICT-IOS	Sep. 2014	Next ET-SAT meeting will address this. Difficult to add things to CGMS meetings Joint ET-SAT / IPET-SUP meetings proposed 4/4/2016: CBS Ext. (2014) recognized the complementary role of ET-SAT, IPET-SUP and CGMS, and agreed on new Terms of Reference of ET-SAT
12	S8/6.5.4(1)	to undertake revision of the Manual on GOS, and related WMO guidance material, in relation to volcanic ash, taking into consideration especially practices and procedures related to use of satellite products	ET-SUP	mid. 2015	Discussed at IPET-OSDE-2 Discussion still ongoing Premature to revise WIGOS guidance materials Which Manual (GDPFS, WIGOS) should include this ? There is a WIGOS responsibility taking into account ICAO rules; but CAeM to propose way forward. Current collaboration with ICAO is not ideal but ICOA has established a Met. Panel WMO Secretariat to have an internal discussion about the issue. Jitze van der Meulen to also address the issue 4/4/2016: Initial results of volcanic ash retrieval algorithm intercomparison are available http://www.wmo.int/pages/prog/sat/documents/SCOPE-NWC-PP2_VAIntercompWSReport2015.pdf); final analysis and conclusion planned for mid-2017); until then, it is premature to revise WMO guidance material regarding satellite-based volcanic ash products

13	S8/6.5.4(2)	to consider the development of a mechanism and associated standards and procedures that will allow Members to be able to seek high temporal resolution satellite information from the satellite operators, leading up to and in the event of emergency situations such as Typhoon Hiyan	ET-SUP	Jun-14	ICT-IOS-9 to consider that under ET-SAT/IPET-SUP 4/4/2016: Mechanisms under development, no standard recommended: rapid scan satellite services are discussed by IPET-SUP in support of tropical cyclone and severe weather warning services, as part of the SCOPE-Nowcasting mechanism, and the Region-based satellite user requirements groups; there are new opportunities for targeted rapid scan using new-generation geostationary imagers (such as on Himawari-8); IPET-SUP also recognized that RSMCs are in place to invoke high-temporal resolution satellite information in case of tropical cyclones and other severe weather events. An important first step to define such a mechanism was taken during the Joint RA-II/V Workshop on WIGOS for Disaster Risk Reduction in Jakarta, Oct 2015. Pilot project established in RA-II/RA-V between JMA and the Bureau of Meteorology to test the tasking of Himawari-8 rapid scan by another agency.
14	S8/6.6.4(2)	to consider how to improve and optimise data coverage taking into consideration the low impact of observation in some areas and at some airports due to oversupply of redundant data	ET-ABO	Ongoing	ET-ABO has been working on it.
15	S8/6.7.9	to undertake further studies to clarify the impact of ASAP, and thereby to better understand the impact per cost of the ASAP measurements in relation to other systems	IPET-OSDE	2016	14/7/2014: Joyn Eyre suggested ASAP impact to be added by R-SEIS in the list of science questions
16	S9/3.1	Maintain a table of ICT-IOS deliverables to the WIGOS Preoperational Phase (annex to ICT-IOS-9 report)	Action Ch-ICT-IOS	Ongoing	
17	S9/3.2	To investigate how to better reflect historical, programmatic, and AA user requirements in the OSCAR/Requirements, and how to display the information in OSCAR/Requirements	Secr	asap	
18	S9/3.2	ICT IOS Members to review the System of WIGOS Identifiers document on the WIS Wiki (http://wis.wmo.int/page=WIGOS-Identifiers) and provide feedback to Steve Foreman	ICT-IOS Team members;	30-Apr	

19	S9/3.2	Secretariat to draft a (one-page) summary policy on WIGOS Identifiers. ICT-IOS to Review and provide feedback on WIGOS Identifiers Policy. ICT-IOS Chair to present the policy and report to ICG-WIGOS TT on WIGOS Data Partnership	Secretariat ICT-IOS/Sub-Group Ch-ICT-IOS	Sep. 2016 Sep. 2016	
20	S9/4.1	RA-II, RA-III RBSN/AWS statistics: Secretariat to analyse AWS network status in RA-II and RA-III and check with ICT-IOS regional contacts for correctness	Secretariat	asap	
21	S9/4.1	Review and revise the format and content of monitoring reports submitted to ICT-IOS (2018) in the context of WIGOS and OSCAR development. In the future, include provision of monitoring results based on hourly reporting.	Secretariat, ICT-IOS	2018	
22	S9/4.3	Consolidate evidence and documentation of results of impact studies on ASAP.	Erik Andersson	end of June 2016	
23	S9/4.3	Noting E-ASAP prioritization of ASAP soundings from Northern routes where the storms develop, R-SEIS was invited to propose verification with impact studies	R-SEIS	end June 2016	
24	S9/4.3	Secretariat to check the situation with JCOMMOPS and BAS and correct status information if needed, or to provide guidance in order to make sure with BAS that the data from BAS ships are actually being reported on the GTS.	Secretariat	asap	
25	S9/4.3	Secretariat to make information on data availability available in the next ICT-IOS meeting status report	Secretariat	2018	
26	S9/4.3	The Team recommended to address the TPOS-2020 required engagement of Members in EC-68 relevant preparatory document	Secretariat	asap	
27	S9/4.4	Secretariat to also monitor and report to next ICT-IOS meeting and onwards on the status of CryoNet stations.	Secretariat	2018	
28	S9/4.5	Members are strongly urged have their surface-based observing systems to be reporting on hourly basis as per EGOS-IP. Future monitoring should be adjusted accordingly.	Secretariat	2018	

29	S9/6.1	ICT-IOS to request ICG-WIGOS at its next meeting to clarify how WIGOS is going to work with partner organizations, including SAON.	Ch-ICT-IOS	Jan. 2017	
30	S9/6.2	ICT-IOS to review regulatory and guidance material after its finalisation by IPET-WIFI/SG-RM. ICT-IOS to complete recommendation to CBS based on finalised regulatory and guidance material submitted by IPET-WIFI/SG-RM	ICT-IOS by corresp. Secr., ICT-IOS	mid-June 2016 end June 2016	
31	S9/6.2	ET-ABO to revise the guidance material on ABO for preparation for publication as a stand alone guidance document, referenced in the GOS Guide (to be endorsed by CBS-16), and later included in the WIGOS Guide. ET-ABO to revise the current text in the Guide to the GOS on Aero Met. Stations to reference the new Guidance material.	Ch-ET-ABO Ch-ET-ABO	early Sep. 2016 mid-June 2016	
32	S9/6.2	Chair the bring the issue of publication and translation of large guidance materials to the WIGOS Editorial Board and request resolution/policy	Ch-ICT-IOS	asap	
33	S9/6.3	In relation to EGOS-IP G10: ET-SBO to develop a proposal for a study or experiment in relation to the adaptation of the radiosonde programme for various considerations including optimization with ABO/AMDAR observations. ET-SBO Chair to arrange to have proposal discussed at the NWP impact workshop and feedback provided to ET-SBO. ET-SBO to further review and revise the proposal prior to its submission to CBS.	Ch-ET-SBO Ch-ET-SBO Ch-ET-SBO	Apr-16 May-16 Sep-16	
34	S9/6.4	Definition of Space and update of relevant WMO Technical Regulations	Secr., ET-SAT		
35	S9/6.5	Case studies for hydrological and nowcasting to be developed within the next two years	IPET-SUP	2018	

36	S9/6.6	ET-ABO to develop Terms of Reference for the ABOP Global Data Centre. ET-ABO and the Secretariat to finalise agreement between WMO and NOAA re MADIS undertaking to be ABO-GDC. ICT-IOS to prepare recommendation by CBS to delegate MADIS as the WMO Global Data Centre for ABO.	ET-ABO ET-ABO, Secretariat ICT-IOS	Jun 2016 Aug 2016 Sep 2016	
37	S9/6.6	OSDE to request relevant Application Areas to consider requirements for aircraft based observations in support of climate applications.	ICT-OSDE	IPET-OSDE-3	
38	S9/6.6	Check with NWP Centres whether thinning of AMDAR data is still being undertaken (and required) in data assimilation, and confirm what AMDAR data are actually being used.	R-SEIS, Ch-IPET-OSDE	end June 2016	
39	S9/6.6	ET-ABO to request the FP of Canada to address lessons learned in relation to issues with problems encountered with ongoing viability of the AMDAR program (i.e. Canada).	Ch-ET-ABO	end 2016	
40	S9/6.7	The Team noted the case of some moored buoy data where the data was proposed to be withheld by NWP centres from their data assimilation although the data are routinely being distributed in real-time on GTS. JCOMM/DBCP is invited to reinforce the need for free and unrestricted data exchange.	DBCP	Oct. 2016	
41	S9/6.8	Ensure that results and reports of impact studies can be shared with all WMO Members	R-SEIS & Secr.	Jun-16 (& ongoing)	
42	S9/6.9	Secretariat to make sure requirements for metadata on observing system RF are able to be stored in OSCAR for both surface-based and space-based observing systems and that these are populated, particularly for space-based systems (e.g. information on radio frequency concerning SMOS micro-wave sensors is missing in OSCAR/Space, while there are noted interference problems) The SG-RFC is to be invited to provide its requirements in this regard to the Secretariat.	Secretariat SG-RFC	asap	

43	S9/7.1	Secretariat to discuss internally regarding the best time and method for issuing the OSDE letter on action of the EGOS-IP before CBS-16	Secretariat	asap	
44	S9/7.3	The OND guidance developed by the IPET-OSDE sub-group should be reviewed by the ICT-IOS by correspondence before submission to CBS-16 Submit draft OND guidance to CBS-16 Submit draft OND guidance to WIGOS Editorial Board	ICT-IOS ICT-IOS ICT-IOS	end July 2016 early Sept. 2016 end 2016	
45	S9/7.4	ICT-IOS Members to review the CIMO competency framework document and to provide their comments to the Chair. Chair to compile those comments and submit an updated version of the document to the CIMO President	ICT-IOS Ch-ICT-IOS	end June 2016 end July 2016	
46	S9/7.5	IPET-OSDE and ICT-IOS to work towards the development of a consolidated Vision for WIGOS in 2040, in accordance with the initial roadmap within Annex IV, Contribution of OPAG-IOS to WIGOS Pre-Operational Phase.	IPET-OSDE, ICT-IOS	See Annex IV.	
47	S9/8.2	ICT-IOS to implement a mechanism (core membership of ECT-IOS) for Chair of CIMO/IPET-OWR to report to ICT-IOS.	Ch-ICT-IOS	Jul-16	
48	S9/8.4	Ch-ICT-IOS to invite the ICG-WIGOS Editorial Board to consider a mechanism to facilitate provision of new regulations and guidance to be conveyed from TCs to the board and to determine how the review and revision process might function.	Ch-ICT-IOS	Jun-16	
49	S9/8.5	ETs to review & finalize their work plans, and submit them to the Chair and the Secretariat ET-SBO and ET-ABO Chairs to provide their revised and updated work plans to ICT-IOS	ET & IPET Chairs ET-SBO & ET-ABO Chairs	Apr-16 mid-June 2016	
50	S9/8.3	Ch-ICT-IOS and the Secretariat to finalize the proposed new ToRs of OPAG IOS working structure	Chair & Secr.	asap	

51	S9/8.5	Chairs and Rapporteurs to ensure that work plans are finalised for submission to CBS by end of June 2016	Chairs & Rapporteurs	end June 2016	
52	S9/8.6	According to the current table of responsibility approved by CBS Ext. (2014), the ICT-IOS approved the release of OSCAR/Space v2, and requested the Secretariat to act accordingly and decide on the implementation schedule	Secretariat	asap	

ANNEX III

LIST OF RECOMMENDATIONS TO BE MADE TO CBS-16

No.	Agenda Item	Recommendation	Comments
1	4.3	Noting the positive impact of ASAP in the North Atlantic, encourage Members to increase ASAP coverage in other regions so as to complement other sources of upper air data.	Reference: EUMETNET report of E-ASAP programme in the North Atlantic (ask Stephan Klink for exact reference)
2	4.3	CBS-16 to note that Recommendation 18 (CBS Ext. (2014)) and impact studies have been beneficial for avoiding a substantial drop in the number of surface drifters with barometers.	Add references below Note outcome of Shanghai NWP "impact" workshop Centurioni L., A. Horányi, C. Cardinali, E. Charpentier and R. Lumpkin, 2016: A global observing system for Measuring Sea Level Atmospheric Pressure: Effects and Impacts on Numerical Weather Prediction. Manuscript accepted to the Bulletin of the American Meteorological Society. A. Horányi A., C. Cardinali and L. Centurioni, 2016: The global numerical weather prediction impact of mean sea level pressure observations from drifting buoys. Manuscript submitted to the Quarterly Journal of the Royal Meteorological Society. A Horányi A. and C. Cardinali: The impact of mean sea level pressure observations from drifting buoys. Report of the WMO/DBCP-ECWMF project entitled "Study in the Impact of Sea Level Pressure from Drifters on Numerical Weather Prediction".
3	4.3	Example of E-SURFMAR which made an international tender for AWS on VOS ships. Other members encouraged to join the European effort, facilitating standardization of observing systems and observations from ships as well as maintenance by PMOs.	Ref. JCOMM SOT report
4	4.4	GCW	Noting the positive impact of snow depth data collected in Europe on NWP, using the BUFR template 3 07 101 (Snow observation), adopted by CBS Ext. (2014), encourage Members to exchange snow depth data in other regions (especially RA-II, RA-IV). Taking into account CryoNet as WIGOS component observing system, encourage Members that operate stations in the cold regions such as high mountain and polar regions to nominate the national GCW focal points who would take part in the development of the GCW surface observing network.
5	4.5	The role of Regional Associations, and practical support to Members is needed with regard to transition to TDCs. Regional working groups should also play a key role with regard to providing training on transition to TDC.	RA-VI established a Task Team for transition to TDC, tasked in particular to organize a training course; partnership between developed and developing countries; encoding/decoding software was developed and offered as well as support provided during implementation of TDC. However, further efforts should be made to speed up the transition to TDC in eastern and southeastern part of RA-VI. Other RAs are encouraged to establish similar Task Teams to assure transition to TDC. The role of Regional Associations, and practical support to Members is needed with regard

			to transition to TDCs. Regional working groups should also play a key role with regard to providing training on transition to TDC.
6	4.5	Report to CBS-16 that more regional resources are being committed to Capacity Building (e.g. RA-III)	Check with outcome of the other breakout group (Jose)
7	6.1	Radiosonde launch time issue	The findings of the Pilot Project of ET-SBO in support of EGOS-IP Action G10 on the revision of launch times of radiosondes, and the findings of the NWP "Impact" workshop will be further elaborated by ET-SBO and discussed by OPAG IOS in the view to possibly formulate recommendations to CBS Ext.(2018)".
8	6.1	OSCAR resourcing for OSCAR content management Recommendation to be updated for seeking contributions to WIGOS Trust Fund earmarked to OSCAR, and secondment from a WMO Member. Recommendation to make it clear that the WMO is responsible for updating content. (See draft below.)	Draft Recommendation
9	6.2, 8.1	IPET-WIFI to be dissolved and its activities integrated into ICT-WIGOS and its Sub-Groups.	See text delivered to the CBS-MG
10	6.2	ICT-IOS recommendation on approval of regulatory and guidance material for the GOS.	Based on finalisation by IPET-WIFI/SG-RM and related teams.
11	6.3	Members to be strongly encouraged to provide metadata: weather radar metadata for all radar stations to the WRD; and submission of marine observing stations metadata to OSCAR through JCOMMOPS.	Draft Recommendation Should not be limited to WRs for which data are exchanged internationally.
12	6.4	ET-SBO proposal for a study/project on radiosonde network adaptation.	Same as EGOS-IP Action G10 Pilot above
13	6.4	Definition of what constitutes "Space" to be recommended to CBS	1. Upper atmosphere in Meteoterm and WMO N°182 : upper atmosphere SOURCE: International Meteorological Vocabulary, WMO - No. 182 RELIABILITY: Confirmed DEFINITION: The general term applied to the atmosphere above the mesopause. DEFINITION SOURCE: International Meteorological Vocabulary, WMO - No. 182

			2. Definition of space agreed by ET-SAT on 8 December 2015 (WEBEX) after discussing ET-SAT-10/Doc.06: *The unlimited part of the universe starting with the upper atmosphere and extending above the atmosphere*. This definition was submitted to UN-OOSA (attachment)
14	6.6	In relation to ABO/AMDAR: NOAA/MADIS to be delegated as the WMO Data Centre for Aircraft Based Observations CBS to request CAeM to request ICAO and IATA promotion and use of the ABO Data Centre and to support airline collaboration and cooperation in the provision of ABO and the development of AMDAR.	Draft recommendation below. See also action for ET-ABO to develop ToR for DC-ABO.
15	6.7	R-MAR	CBS to recognize the importance for Members to implement marine observing systems and address the JCOMM implementation targets
16	6.8	Encourage continued development and research of adjoint-based observation impact assessment tools, as a complement to traditional OSEs. Encourage OSEs for the optimisation of regional composite networks Encourage NMHSs to conduct OSEs and OSSEs to address the specific science questions.	Observation impact studies provide a wealth of information of relevance to the evolution of the GOS. The traditional OSE and OSSE techniques are complemented by new adjoint and ensemble-based approaches that help inform network design activities and investment. Priority should be given to studies that address the identified science questions. Observation impact assessment for longer-range forecasting and non-NWP application areas are also proposed in the list of science questions.
17	6.8	List of OSEs, OSSEs to be undertaken by NWP centres over 2017-2020.	Erik to provide the updated list
18	6.9	Reinforce the importance of CBS to address RF protection matters.	Draft Recommendation below
19	7.1	Team noted with concern that there was a few translation errors in the EGOS-IP (Spanish, French). The Team noted that the CBS-MG has invited WMO experts to review and proof-read the translated WMO documents. The Team recommended to raise this issue at CBS-16, inviting the Secretary General to take appropriate action, and inviting Members	CBS to recognize the high level status of the EGOS-IP Encourage to provide a translation in Arabic.

		to possibly assist in this regard on a voluntary basis	
20	7.3	Endorse OND guidance material, and request ICG-WIGOS to decide on the process for having OND guidance to be included in WIGOS guidance material	
21	7.5	Submission of the Draft Vision for WIGOS in 2040	CBS to note work in progress, and commend OPAG IOS for its efforts to develop the drafts of the Space- and Surface-based Visions. Agrees to give ownership to ICG-WIGOS Request OPAG IOS to contribute to the further development of the vision, in the view to have it adopted by Cg-18.
22	8.2	Formation of the CIMO/IPET-OWR and the transfer of CBS radar experts to this team.	CBS to be informed about the decision of CIMO, reporting of the decision to EC and the mechanism by which ICT-IOS will interact with the IPET.
23	8.3, 8.4, 8.5	Final ToRs, work plans of ETs and Rapporteurs of ICT-IOS to be submitted to CBS	
24	8.6	The table of responsibility of OPAG IOS Teams with regard to OSCAR will have to be revised by CBS-16	
25	8.6	OSCAR/Space v2	CBS to note and recognize the importance of the new functionality of OSCAR/Space v2, which includes improved objective assessment of the satellite instrument capabilities to measure certain geophysical variables. The assessment is based on generic rules to be discussed, reviewed and approved by satellite experts. CBS also to recognize the work achieved by the Space Programme. According to the current table of responsibility approved by CBS Ext. (2014), the ICT-IOS approved the release of OSCAR/Space v2, and has requested the Secretariat to act accordingly and decide on the implementation schedule.
26	4.5	See also outcome of the Breakout group on the regional aspects	Regional Associations to take into account GCW requirements, and advise how they can contribute to and support GCW contributing observing stations and CryoNet Sites/Stations (one of the 4 WIGOS component observing systems). Regional Associations to advise on regional practices concerning the exchange of GCW observations. WIGOS Regional Centres to also take into account what support they can provide to the GCW. Members are invited to review the list of RBSN/RBCN (RBON in the future) in their countries and propose those stations that comply with the GCW minimum requirements, and could therefore be included in the GCW observing network as contributing stations. GCW will then be invited to evaluate these stations proposed for inclusion according to the

			GCW approval process. Recommendation on training on key OPAG IOS issues needed (on the basis of the breakout group recs.)

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Draft RECOMMENDATION to CBS - OSCAR maintenance and resourcing

Noting:

- the importance to WIGOS of the Observing System Capabilities Analysis and Review tool (OSCAR), and of its three components: OSCAR/Requirements, OSCAR/Space and OSCAR/Surface,
- the key role already played by OSCAR/Requirements and OSCAR/Space in providing information on user requirements for observations and on space-based observing capabilities for many purposes within WMO activities, including their crucial roles in support the Rolling Review of Requirements (RRR) process,
- the recent successful development of OSCAR/Surface, providing information on surface-based observing capabilities, and its current and expanding role as the repository for the station metadata of WMO surface-based observing systems,
- the potential of OSCAR to provide useful information to the WIGOS Data Quality Data Monitoring System (WDQMS),
- the requirements for submitting and maintaining information in OSCAR through existing and foreseen enhanced mechanisms in particular with Application Area Focal Points for OSCAR/Requirements, OSCAR/Surface Focal Points for the surface-based observing systems they operate, and Space Programme mechanisms for OSCAR/Space

Recognizing:

- the commitment of MeteoSwiss to develop, and maintain the software infrastructure of OSCAR/Surface,
- the need for the Secretariat to monitor and maintain the content and quality of these databases, and to expand them and keep them up to date,

ICT-IOS recommends to CBS that:

- Secretary General to commit sufficient resources within the Secretariat for the maintenance and development of the three components of OSCAR (OSCAR/Surface, OSCAR/Space, OSCAR/Requirements).
- Members to support the Secretariat in this role by offering secondments, and financial resources to the WIGOS Trust Fund (earmarked for OSCAR)

DRAFT RECOMMENDATION NO. ??? (CBS-16)

DESIGNATION OF A WMO AIRCRAFT BASED OBSERVATIONS (ABO) GLOBAL DATA CENTER (AGDC)

THE COMMISSION FOR BASIC SYSTEMS,

Noting that:

(1) the WMO AMDAR observing system, as the primary component of the Aircraft Based Observing System, is considered to be a critical source of upper-air observations in support of the Global Observing System;

(2) the data provided is of excellent quality and is recognised as being of great benefit to the meteorological and aviation communities and related operational application areas;

(3) numerous studies and scientific papers attest to the quality and positive impact of such data;

(4) the quality of the data provided by the WMO AMDAR observing system should be maintained, guaranteed and managed;

Recognizing:

(1) the interest shown by the NOAA Meteorological Assimilation Data Ingest System (MADIS) for collaborating in the WMO AMDAR Programme;

(2) the need for enhanced collaboration with other organizations such as IATA and ICAO, and recognition of their contributions with regard to the provision, maintenance and use of aircraft observations by the air transport industry;

Considering that:

(1) while the benefits of aircraft based observations and AMDAR data are widely appreciated by the weather forecasting and aviation services communities, they are often not as well appreciated or understood by the Air Transport Industry;

(2) therefore, the aircraft based observations and AMDAR data are probably not as well promoted and used as is possible; and

(3) therefore, the expansion and enhancement of aircraft based observations, that is expected to provide even greater benefit, does not see the progress as well as the rapidity as was expected.

Recommends that:

(1) The designation of the NOAA Meteorological Assimilation Data Ingest System (MADIS) as the WMO Aircraft Based Observations (ABO) Global Data Centre (AGDC) with Terms of Reference in Annex to this Recommendation; and

(2) CBS, in collaboration with the Commission for Aeronautical Meteorology to seek the strong support and promotion by ICAO and IATA of the AGDC, their participation in the WMO AMDAR programme and the provision of aircraft based observations by the Air Transport Industry.

Invites the ICAO and IATA:

(1) to participate in the WMO AMDAR Programme; and
(2) to enhance the provision of aircraft-based observations by the air transport industry.

Requests the Secretary-General:

(1) to invite MADIS to host the WMO Aircraft Based Observations Global Data Center; and

(2) to invite ICAO and IATA to collaborate in the WMO AMDAR Programme.

Annex To Recommendation:

FUNCTIONAL REQUIREMENTS OF THE WMO AIRCRAFT-BASED OBSERVATIONS DATA CENTER

Functional Requirements of the WMO Aircraft-based Observations Data Center

Summary Requirements

Mandatory
Desirable
Operational Requirements
Detailed Requirements
1. ABO Data Reception, Processing and Database Archival
2. ABO Metadata Reception, QC and maintenance
3. ABO data and Metadata Data Users Interfaces
4. Quality Monitoring and Quality Assessment Documentation
5. Reception and Maintenance of Historical ABO Data
6. Reception and Archival of QM & QA Reports

10.1 Summary Requirements

10.1.1 Mandatory

A. Receive, decode, quality control (QC) and maintain a database archive of all Aircraft-Based Observations (ABO) bulletins received on the WMO Global Telecommunications System (GTS).
B. Receive, quality control and maintain a database archive of ABO metadata.
C. Provide an interface for provision of archived ABO data and metadata to Data Users.
D. Develop and maintain a historical record of data quality issues associated with ABO data.

10.1.2 Desirable

E. Retrieve and back-fill the database with globally available historical ABO data (as per item 1).
F. Reception and archival of Quality Monitoring and Quality Assessment reports, requiring provision of a method and interface for their provision.

10.1.3 Operational Requirements

1. Ensure a fail-safe backup of all data transacted with the ABO DC. (Desirable)
2. Ensure 99.9% operational availability, which may require establishment of a backup system with database replication. (Desirable)

10.2 Detailed Requirements

Requirements are designated as Mandatory (M) or Desirable (D).

A. ABO Data Reception, Processing and Database Archival

1. Receive via the GTS, decode, QC and maintain a database of the following data types:

1.1. WMO Aircraft Meteorological Data Relay (AMDAR) data submitted in WMO BUFR and FM42 bulletins; (M)
1.2. ICAO Automatic Dependent Surveillance Contract (ADS-C) data submitted in AIREP and BUFR formats; (M)
1.3. ICAO conventional AIREP data (D); and
1.4. Future new sources of ABO data such as ADS Broadcast (ADS-B) and Mode-S[3]. (D)

(see WMO Manual on Codes, WMO No. 306)

2. Requirements for quality control of each data type will be according to the WMO Guide to the GOS based on QC procedures yet to be defined but expected to incorporate the following (M):
   2.1. Meteorological variable checks:
      2.1.1. Value range
      2.1.2. Inter-variable consistency
      2.1.3. Temporal consistency
   2.2. Spatial and temporal checks:
      2.2.1. Positional consistency
      2.2.2. Timestamp validity
   2.3. Removal of duplicate reports and observations.
   2.4. Document the quality control process through uses of the quality indicator variables (items A.3.2-3).
3. Requirements for database archival and maintenance of data shall be to:
   3.1. Accommodate and archive in the database all observations and variables transmitted within the ABO data types identified in Detailed Requirement 1 above (M);
   3.2. Provide a (simple) quality indicator (QI) variable for each archived data variable according to a specification (to be defined) (M);
   3.3. Provide a secure interface for designated national program managers to allow modification of QI variables for selected ABO data (M);
   3.4. Provide the required key links to the ABO metadata so as to associate each variable with its metadata records; (M) and
   3.5. Accommodate the requirements for database and data security associated with provision of data via the data user interface (Summary Requirement C). (M)

B. ABO Metadata Reception, QC and maintenance

1. Receive ABO metadata from operational programmes based on the following requirements (M):
   1.1. Provision of an interface that allows programme managers or focal points to manually enter and maintain ABO metadata for the data types identified in 1 above; and/or alternatively,

[3] See: http://mode-s.knmi.nl/

1.2. Facilitate submission of metadata sets through an electronic transaction between the programme managers and the Data Center (e.g. email, ftp or upload a file containing the metadata); and/or alternatively,

1.3. The ABODC database will automatically interface with the WMO OSCAR/Surface database (currently under development) to obtain the ABO metadata; and/or alternatively,

1.4. The metadata will be received from the BUFR ABO data transmission.

2. Requirements for QC of ABO metadata will be, on update to (M):

2.1. Check for consistency/inconsistency with existing metadata; and

2.2. Automatically flag and document identified changes;

3. Requirements for maintenance of ABO metadata will be to:

3.1. Maintain a historical record of metadata and changes made (M).

3.2. Provide a means for the provision by operational programmes of historical metadata (D).

C. ABO data and Metadata Data Users Interfaces

1. The database will provide several secured, external registered user interfaces that will facilitate data provision to Data Users with the following functionality (M):

1.1. Manual interface providing a data download capability based on a limited (to be defined but expected to include limitations on data quantity and those restrictions imposed by C.2) data selection; and,

1.2. Automatically and routinely generated subscription service based on registered user requirements.

2. All interfaces will provide data accessibility based on user identity recognition and the following criteria (D):

2.1. Contractual obligations of WMO Members to their partner airlines to restrict specific data access to the public or specific users, which might include (D):

2.1.1. A time delay on public availability of data;

2.1.2. A time delay on availability to specific data users;

2.1.3. Non-availability of data to the public (default);

2.1.4. Non-availability of data to specific data users.

2.2. The required restrictions on data as defined at 2.1 above will be applicable with respect to the following database parameters (D):

2.2.1. Data type or source (Detailed Requirement A.1)

2.2.2. Airline; and

2.2.3. Observation time.

[e.g. all AMDAR data from airline X to be unavailable to all users until 48 hours after observation time.]

2.3 Data users to be automatically notified when data restrictions have been imposed. (D)

D. Quality Monitoring and Quality Assessment Documentation

1. Data quality issues that are notified by designated WMO Lead Centres or by NMHS observations program managers (OPM) are to be documented through the

maintenance of the data quality indicators (Detailed Requirement 1.3.2) associated with archived ABO data. (M)
[Achieved via Detailed Requirement A.3 - procedures to be defined.]

E. Reception and Maintenance of Historical ABO Data

1. Provide a standardised, semi-automated interface to the database allowing submission of historical data and metadata by NMHS OPM. (D)
   [e.g. XML/CSV formatted provision by NMHM OPM of data via FTP or email.]

F. Reception and Archival of QM & QA Reports

1. Reception and database archival of standard WMO Monitoring Center or Lead Center QM reports pertaining to ABO data. (D)
2. Provision of tailored QM data monitoring reports based on database interface query (Detailed Requirement C) by registered Data Users. (D)
3. Digital archival of information pertaining to quality assessment of ABO data [e.g. emails or reports received relating to data quality assessment of ABO data]. (D)

DRAFT RECOMMENDATION XXX (CBS-16)

RADIOFREQUENCY MATTERS

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) Res 29 (Cg-17). Radio frequencies for meteorological and related environmental activities

(2) Dec 5.1.1(x) EC-68 — Preserving the radio-frequency spectrum for meteorological and related environmental activities at WRC-19;

(3) Guide to participation in Radio Frequency Coordination (WMO No.1159)

(4) WMO/ITU Handbook on the "Use of radio spectrum for meteorology: weather, water and climate monitoring and prediction" (2008 edition)

…

Considering that:

(1) Considerable changes in staffing in NMHS and National Radio Regulators has taken place since the last joint ITU/WMO seminar on use of radio spectrum for meteorology: weather, water and climate monitoring and prediction was held in 2009

(2) That there have been considerable advances in the use of spectrum in meteorology and related activities

(3) Radio Regulators will be formulating national positions on the WRC-19 agenda during 2017

(4) That WMO and ITU have begun work on the review of the WMO/ITU Handbook on the "Use of radio spectrum for meteorology: weather, water and climate monitoring and prediction" (2008 edition)

Recommend to:

(1) work with ITU to conduct a joint WMO/ITU seminar in the latter half of 2017 to increase awareness of ITU processes for NMHS and of the important role of radio frequency spectrum to meteorology and related systems;

(2) work with ITU to complete the update of the WMO/ITU Handbook on the "Use of radio spectrum for meteorology: weather, water and climate monitoring and prediction" (2008 edition);

(3) Update the "Guide to participation in Radio Frequency Coordination" to assist Members on radio-frequency issues

Requests that the Secretary-General to facilitate implementation of this Recommendation.

Recommendation for the Submission of Weather Radar and Marine metadata to OSCAR

Noting:

Existing mechanism that are widely used (WRD, JCOMMOPS)

Acknowledging:

Contribution of Turkey, JCOMMOPS

Recommends:

Members and Focal Points to submit the metadata directly to the WRD and JCOMMOPS.

Recommendation on training on key OPAG IOS issues

- In which way training should be provided and for what ?
- Noting: many processes exist in WMO, and these should be used
- Noting: strong need in the regions for training in some key areas (annex)
- Need to harmonize across those mechanisms
- Request SG to include the required training in ETR
- List items for which training is needed in an Annex

10.3 Draft Recommendations to CBS Made By Breakout Group on Regional Issues

- Capacity development is required to assist regions to tackle the many and various new initiatives and expectations arising from various programmes and their plans such as EGOS-IP, WIS and WIGOS implementation plans, GCOS IP, GFCS aspirations, marine and oceans systems maintenance and developmen.
- In particular the following major initiatives affect all regions and will require support:
    - OSCAR/Surface, collection of metadata
    - Transition from RBSN/RBCN to RBON
    - Transition to the new system of WIGOS station identifiers
    - Definition and implementation of Regional WIGOS Centres
    - Emerging requirement for international exchange of weather radar data
    - Implementation of GCW stations and networks
- At the same time there is a need to sustain existing basic observing systems, placing demands on members and regions, such as:
    - Maintaining upper air programmes with ongoing consumable items;
    - Sustaining technical capabilities to operate and maintain facilities;
    - Finding the capacity to reactivate silent stations;
- ICT-IOS recommends that CBS should:
    - Provide training, for example conduct regional workshop, on the collection of metadata and its submission to OSCAR.
    - Provide training, for example conduct regional workshops, on understanding and using WIGOS station identifiers.
    - Continue to provide training and support for those members and regions still addressing the transition to TDCF.
    - Continue to provide training and support for members and regions on RF protection issues, with an emphasis on establishing relationships with relevant spectrum authorities at the national level.
    - Provide training and support for members and regions to facilitate the wider international exchange of weather radar data.
    - Organise inter-regional activities to share experience and best practices, particularly with respect to these major initiatives.
    - Strengthen its interaction with RAs by ensuring regional representation to CBS working groups.
    - Request the SG to foster closer collaboration between Secretariat staff having responsibilities for regional programmes and those having responsibilities for scientific and technical programmes where these responsibilities overlap.
    - Continue to support members and regions to sustain upper air programmes and reactivate silent stations, particularly in Region I, including assistance in the development of proposals for resource mobilization.

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ANNEX IV

CONTRIBUTION OF OPAG-IOS TO WIGOS PRE-OPERATIONAL PHASE

Issue	Milestones	Approval procedure	Remarks
Amendments to the Manual and Guide to the GOS	1. Review status at ICT-IOS-9 2. Deliver final version until end of June 2016 3. Draft recommendation to CBS-16 4. EC-69 (2017) endorsement	IPET-WIFI SG-RM → CBS-16 →EC (2017)	
OND Guidance material	1. Draft from OSDW-2 reviewed at IPET-OSDE-2 and ICT-IOS-9 2. Complete update by IPET-OSDE Sub Group June 2016 3. Approved by email by ICT-IOS 4. Draft recommendation to CBS-16 5. ICG-WIGOS-6 (March 2017) 6. EC-69 (2017) endorsement	IPET-OSDE →ICT-IOS-9 →CBS-16 →ICG-WIGOS Editorial Board →EC (2017)	
Vision 2040 for space based obs systems	1. Workshop in Nov 2015 2. Discussion at IPET-OSDE-2 3. Presentation to CGMS June 2016 4. Preparation of document for CBS-16 5. Presentation to CIMO-TECO Sept 2016 6. Wider consultation process (polar space task group of EC-PHORS, Sept 2016, CEOS, …) 7. CBS-16 for further comments 8. Preparation of consolidated version for ICG-WIGOS-6 9. ICG-WIGOS-6 (March 2017) 10. ET-SAT update version April 2017 11. EC-69 (2017) status report 12. CGMS 2017 status report	IPET-OSDE →CIMO-TECO →CBS-16 →ICG-WIGOS-6	ET-SAT is the owner of the process until it goes to ICG-WIGOS
Vision 2040 for surface based	1. Placeholder document for CBS-	IPET-OSDE →WIGOS-PO	Owner IPET-OSDE

obs systems	16 2. Drafting Group Meeting of IPET-OSDE members in Sept 2016 3. CIMO-TECO Sept 2016 presentation of status, plans and key topics 4. Workshop with WIGOS component system representatives in Oct 2016 – preparation of Inf. Document for CBS-16 5. CBS-16 for further comments 6. GCW Steering Group in Jan 2017 7. PTC-2017 status information 8. ICG-WIGOS-6 (March 2017) 9. EC-69 (2017)	→CBS-16 → ICG-WIGOS-6	for the Sept Workshop, afterwards ICG-WIGOS
Final combined vision for WIGOS component observing system in 2040	1. After ICG-WIGOS-6 draft of combined version, April/May 2017 2. EC-69 (2017) 3. Joint development workshop of combined version June/July 2017 4. Review by TCs and other WMO stakeholders 5. ICG-WIGOS-7 (March 2018) 6. CGMS 2018 7. EC-70 (2018)	ICG-WIGOS-6 →EC (2017)	Owned by ICG-WIGOS
RBON concept and the Manual on WIGOS[4]	1. Workshop in May 2017 (IPET-WIFI, WIGOS-PO, GCOS, RAs) 2. Draft recommendation to CBS-16 3. ICG-WIGOS-6 (Jan 2017) 4. Regional Association	IPET-WIFI →WIGOS-PO →ICG-WIGOS-6	

[4] See more details in the Appendix of : https://www.wmo.int/pages/prog/www/WIGOS-WIS/meetings/ICG-WIGOS-5/ICG-WIGOS-5_Doc-5.2(1)_WRM.docx

	consultation 5. EC-69 (2017) 6. ICG-WIGOS-7 (2018) 7. EC-70 (2018) 8. Cg-18 (2019)		
WDQMS	1. Input from ET-SBO to the work of TT-WDQMS		
OSCAR 1. Space 2. Surface 3. Analysis RQs	Secretariat will formulate a proposal		

ANNEX V

PROPOSED SCIENCE QUESTIONS TO BE ADDRESSED FOR OBSERVING SYSTEM DESIGN

(As Updated by ICT-IOS-9, 21 April 2016)

Short name: Full name	Science question
Surface-based	
S1Marine: Surface pressure and winds over ocean	What density of surface pressure observations over ocean is needed to complement high-density surface wind observations from satellites? What is the required coverage of SCAT winds?
S2AMDAR: Coverage of AMDAR	What are the priorities for expansion of the AMDAR network? Assess the impact regionally, specifically also in the in the tropics where profiling coverage is sparse. Provide guidance for AMDAR optimisation. Evaluate the impact of MODE-S data in high-resolution NWP.
S3Radar: Radar observations	What are the impacts of current radar observations, including wind profiles, radial winds and reflectivities?
S4Strat: In situ observations of the stratosphere	What network of in situ profiling observations is needed in the stratosphere to complement current satellite observations (including radio occultation)? Assessments addressing the Tropics are encouraged.
S5PBL: Observations of the PBL for regional and high-resolution NWP	What should be the focus of improvements for observations of the planetary boundary layer (PBL) in support of regional and high-resolution NWP? Which variables and what space-time resolution?
S6GCW: High elevation surface observing stations	Estimate the actual and potential impacts of high elevation meteorological data from the high mountain regions, specifically 4000m or more above sea level.
Space-based	
S7SatLand: Satellite sounding over land and ice	What is the impact of new developments in the assimilation of radiance data over land, snow and sea ice?
S8Sounders: Impact of multiple satellite sounders	What benefits are found when data from more than one passive sounder are available from satellites in complementary orbits, e.g. the current unprecedented availability of hyper-spectral sounders?
S9AMVs: Atmospheric Motion Vectors	Based on evidence from current AMV impacts, which AMV characteristics should be enhanced for the next generation of GEO satellites? What are the impacts of recent new types of AMVs such as MISR-AMV?

General	
S10UA: Regional upper-air network design studies	Upper-air network design studies such as those that have been performed for the European composite observing system (EUCOS) are required also in other Regions, especially in Region I where the basic networks are under pressure. Assessments of recent changes in the networks, including the impact of launching radiosondes once per day or at non-synoptic times.
S11AdjEns: Application of adjoint and ensemble methods	What insights can be gained from adjoint and ensemble-based impact measures tailored for applications such as severe weather, aviation and energy? Specific impact metrics may be required.
S12Ocean: Impact in ocean-coupled assimilation	Which ocean observations are particularly important for NWP? Investigate the role of ocean observations in coupled atmosphere-ocean data assimilation with a focus on the 7-14 day range.
S13Land: Impact in land-coupled assimilation	Which land-surface observations are particularly important for NWP at all forecast time ranges? Investigate the role of surface observations in coupled atmosphere-land data assimilation with a focus on the 7-14 day range.
S14 Time frequency	What is the required time frequency of observations? Consider AMDAR, GEO satellites and ground-based remote sensing observations (such as Doppler radar, wind profiler, ground based GNSS receivers) for regional and global NWP.
S15 Atmospheric composition	Study observation impact in atmospheric composition and air quality application and the impact of atmospheric composition observations (e.g. aerosol) on NWP.
S16 OSSEs	Observing system simulation experiments are encouraged in support of satellite system design criteria such as orbit optimization for GPS-RO satellites, or configurations for hypersperspectral IR sounders on geostationary orbit.

Table 1: Proposed science questions to be addressed for observing system design

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ANNEX VI

TERMS OF REFERENCE OF THE CIMO INTER-PROGRAMME EXPERT TEAM ON OPERATIONAL WEATHER RADARS (IPET-OWR)

As approved by CIMO-MG-14, April 2016

Within the WIGOS framework, under the governance of CIMO and the joint guidance of CIMO and CBS, act as the WMO primary working group on operational weather radars (S, C and X band) with responsibility to:

1) Develop and propose regulatory and guidance material on:

    a. Standardization of, and regulations and guidance on, systems requirements and specifications, quality control, maintenance and operation, data processing algorithms, data products and data quality monitoring;

    b. Response to requirements of data users; and

    c. Training and capacity development.

2) Contribute to development of methods, models and formats for the international exchange of weather radar data and metadata.

3) Provide advice on network design.

4) Provide guidance on radio-frequency allocation and protection.

5) Review and report on potential operational developing and emerging weather radar research and technologies.

6) Collaborate with other international and regional organizations on relevant matters, particularly including international standards organizations and research bodies and associations.

7) Collaborate with and respond to the requests of WMO constituent bodies, as appropriate.

8) Develop and document proposals for the activities of the Inter Programme Expert Team.

9) Report on issues, activities and progress to CIMO and CBS.

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ANNEX VII

PROPOSED STRUCTURE AND TERMS OF REFERENCE OF THE OPAG-IOS

Proposed Teams of the OPAG-IOS

1. Implementation-Coordination Team on Integrated Observing System (ICT-IOS)
2. Inter-Programme Expert Team on Observing System Design and Evolution (IPET-OSDE)
3. Expert Team on Aircraft Based Observing Systems (ET-ABO)
4. Steering Group on Radio-Frequency Coordination (SG-RFC)
5. Expert Team on Surface Based Observing Systems (ET-SBO)
6. Coordinator on Marine Observing Systems (C-MAR)
7. Coordinators on Scientific Evaluation of Impact Studies Undertaken by NWP Centres (C-SEIS)
8. Expert Team on Satellite Systems (ET-SAT)
9. Inter-Programme Expert Team on Satellite Utilization and Products (IPET-SUP)

Terms of Reference of Teams and Coordinators

TERMS OF REFERENCE FOR THE IMPLEMENTATION-COORDINATION TEAM ON INTEGRATED OBSERVING SYSTEM (ICT-IOS)

(Proposed by ICT-IOS-9, April 2016)

(a) Contribute to the implementation of the WMO Integrated Global Observing System (WIGOS), in response to WMO Strategic Planning, and guidance from CBS, 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-Programme Expert Teams, Steering Groups and Coordinators, provide advice to the work of these groups and report on results to the Commission for Basic Systems; in particular with regard to Capacity Development Strategy and the WMO Programme for the Least Developed Countries.

(c) In cooperation with CIMO, give guidance to the CIMO IPET on Operational Weather Radar.

(d) Monitor, report and make recommendations regarding the development of the composite observing systems under WIGOS and their capability to meet the requirements of all relevant WMO and co-sponsored programmes; and contribute to the WIGOS priority areas of the pre-operational phase.

(e) Review deficiencies in coverage and performance, including cost-effectiveness, of the existing GOS; make proposals to improve the availability and coverage of data to meet stated requirements; monitor and report on progress in the evolution of the GOS; coordinate with the GCOS implementation activities.

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

(g) Coordinate and assess impact studies and provide recommendations and guidance on the evolution of global and regional observing networks.

(h) Contribute to strengthening the collaboration between CBS and the regional associations, by increasing engagement with regional experts.

(i) To coordinate as needed CBS observations implementation aspects of the GEOSS Implementation Plan and report to the Management Group on activities that can contribute to the development and implementation of GEOSS.

TERMS OF REFERENCE OF THE WMO CBS OPAG-IOS INTER-PROGRAMME EXPERT TEAM ON OBSERVING SYSTEM DESIGN AND EVOLUTION (IPET-OSDE)

(Proposed by ICT-IOS-9, April 2016)

(a) Under the direction of the Chairperson of the OPAG-IOS, undertake tasks and provide advice on and support for the implementation of the WIGOS framework and the priority activities of the WIGOS pre-operational phase; in particular:

(i) Review and report on the observational data requirements of application areas within the scope of WIGOS;

(ii) 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;

(iii) Carry out the rolling requirements review of application areas leading to Statements of Guidance concerning the extent to which present and planned observing systems meet user requirements for observations;

(iv) 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;

(v) Carry out impact studies of real and hypothetical changes to observing systems with the assistance of NWP centres;

(vi) Monitor and report progress against 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;

(vii) Support ICG-WIGOS in the preparation of a "Vision for the observing system components of WIGOS in 2040";

(viii) Contribute to further elaboration of WIGOS guidance regarding observing network design; and

(ix) Promote activities which enhance progress against the Implementation Plan for Evolution of Global Observing Systems;

(b) Prepare documents to assist Members, Technical Commissions, and Regional Associations, summarizing the results from the above activities.

(c) Provide advice and support to the Chairperson of OPAG-IOS, and report on all activities relevant to its Terms of Reference.

TERMS OF REFERENCE OF THE EXPERT TEAM ON AIRCRAFT BASED OBSERVING SYSTEMS (ET-ABO)

(Proposed by ICT-IOS-9, April 2016)

(a) Under the direction of the Chairperson of the OPAG-IOS, undertake tasks and provide advice on and support for the implementation of the WIGOS framework and the priority activities of the WIGOS pre-operational phase.

(b) In collaboration with the CIMO Expert Team on Aircraft-based Observations, manage and coordinate the Aircraft Based Observations (ABO) programme, including the development and implementation of the ET-ABO work plan and the budget for the corresponding expenditure of the AMDAR Trust Fund in line with its ToR.

(c) Provide technical and scientific resources in support of further development of the Aircraft Based Observing System and assist in ABO training and outreach activities, and contribute to the CIMO ET-AO Activities.

(d) Oversee and assist in the maintenance, enhancement and optimization of the Aircraft Based Observing System, including the AMDAR observing system, in line with the requirements of Members and the recommendations and actions of the EGOS-IP.

(e) Coordinate the development and maintenance of the ABO quality monitoring system as a component of the WIGOS Data Quality Monitoring System.

(f) Coordinate with and report to the work groups of CBS and other Technical Commissions as appropriate and relevant to the ET-ABO work plan and as directed by the Chairperson of the OPAG-IOS.

(g) Provide advice and support to the Chairperson of OPAG-IOS, and report on all activities relevant to its Terms of Reference.

TERMS OF REFERENCE FOR STEERING GROUP ON RADIO-FREQUENCY COORDINATION (SG-RFC)

(Proposed by ICT-IOS-9, April 2016)

(a) Under the direction of the Chairperson of the OPAG-IOS, undertake tasks and provide advice on and support for the implementation of the WIGOS framework and the priority activities of the WIGOS pre-operational phase.

(b) 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.

(c) Coordinate with WMO Members, with the assistance of the WMO Secretariat, to:

(i) Ensure the availability 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; and

(iii) Identify the future use of the radio-frequency spectrum for meteorological purpose.

(d) 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.

(e) Prepare and coordinate proposals and advice to WMO Members on radio regulation matters pertaining to meteorological activities in ITU Radiocommunication Study Groups, radiocommunication Assemblies (RA), World Radiocommunication Conferences (WRC) and related global and regional preparatory meetings.

(f) Facilitate the cooperation among 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; and

(ii) Sharing the same frequency bands between various radiocommunication services.

(g) 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).

(h) Assist WMO Members, upon request, on issues related to the assigment of frequency bands to radiocommunication systems.

(i) 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 activitiesin particular review and propose updates to the WMO Guide to participation in Radio Frequency Coordination (WMO No.1159), and the WMO/ITU Handbook on the "Use of radio spectrum for meteorology: weather, water and climate monitoring and prediction”.

(j) Provide advice and support to the Chairperson of OPAG-IOS, and report on all activities relevant to its Terms of Reference.

TERMS OF REFERENCE OF THE EXPERT TEAM ON SURFACE-BASED OBSERVING SYSTEMS (ET-SBO)

(Proposed by ICT-IOS-9, April 2016)

(a) Under the direction of the Chairperson of the OPAG-IOS, undertake tasks and provide advice on and support for the implementation of the WIGOS framework and the priority activities of the WIGOS pre-operational phase.

(b) Develop and update relevant elements of the WIGOS Regulatory and Guidance materials, including the Manual and the Guide to the GOS and incorporating WIGOS data quality monitoring system recommendations.

(c) Monitor and assess the status of operational and planned surface-based observing systems and advise how Members could submit related information inin OSCAR/Surface.

(d) In collaboration with IPET-OSDE, assess the contribution of current and planned SBO systems to meeting user requirements for all Application Areas.

(e) Contribute to the delivery of those EGOS-IP actions identified as priorities by 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) Provide advice and support to the Chairperson of OPAG-IOS, and report on all activities relevant to its Terms of Reference.

TERMS OF REFERENCE OF THE COORDINATOR ON MARINE OBSERVING SYSTEMS (C-MAR)

(Proposed by ICT-IOS-9, April 2016)

(a) Under the direction of the Chairperson of the OPAG-IOS, undertake tasks and provide advice on and support for the implementation of the WIGOS framework and the priority activities of the WIGOS pre-operational phase.

(b) Collect information on the status of marine (i.e. marine meteorological and oceanographic) observations from the JCOMM approved sources.

(c) 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.

(d) Liaise with the RRR point of contact for Ocean Applications concerning user requirements and gap analysis.

(e) Keep abreast of developments in marine observing systems and advise the Chairperson of ICT-IOS on coordinated assessment and implementation developments.

(f) Provide advice and support to the Chairpersons of OPAG-IOS and IPET-OSDE, and report on all activities relevant to its Terms of Reference.

TERMS OF REFERENCE FOR COORDINATORS ON SCIENTIFIC EVALUATION OF IMPACT STUDIES UNDERTAKEN BY NWP CENTRES (C-SEIS)

(Proposed by ICT-IOS-9, April 2016)

(a) Under the direction of the Chairperson of the OPAG-IOS, undertake tasks and provide advice on and support for the implementation of the WIGOS framework and the priority activities of the WIGOS pre-operational phase.

(b) 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.

(c) Organize regular workshops on the Impact of Various Observing Systems on Numerical Weather Prediction and chair the organizing committee.

(d) Provide input to the ICT-IOS and the IPET-OSDE relevant for the evolution of the WIGOS observing system components.

(e) Provide advice and support to the Chairperson of OPAG-IOS, and report on all activities relevant to its Terms of Reference.

TERMS OF REFERENCE FOR THE EXPERT TEAM ON SATELLITE SYSTEMS (ET-SAT)

(Proposed by ICT-IOS-9, April 2016)

(a) Under the direction of the Chairperson of the OPAG-IOS, undertake tasks and provide advice on and support for the implementation of the WIGOS framework and the priority activities of the WIGOS pre-operational phase.

(b) Assess and document, in the framework of the WMO Rolling Review of Requirements, the actual and planned capabilities of operational and R&D satellites constituting the space-based component of WIGOS and their adequacy to meet the WMO requirements for satellite data and products. This will be achieved in considering the information provided by participating agencies as well as the outcome of the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS), including e.g. the progress of CEOS constellations. The feedback from WMO should be communicated to CGMS and CEOS.

(c) Provide technical advice with respect to both operational and R&D environmental satellites to assist in the implementation of integrated WMO-coordinated observing systems.

(d) Assess progress of R&D and demonstration satellite systems, and identify opportunities and/or problem areas concerning satellite technology and plans.

(e) Coordinate with IPET-SUP and other relevant teams on satellite related matters.

(f) Provide advice and support to the Chairperson of OPAG-IOS, and report on all activities relevant to its Terms of Reference.

TERMS OF REFERENCE FOR THE INTER-PROGRAMME EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS (IPET-SUP)

(Proposed by ICT-IOS-9, April 2016)

(a) Under the direction of the Chairperson of the OPAG-IOS, undertake tasks and provide advice on and support for the implementation of the WIGOS framework and the priority activities of the WIGOS pre-operational phase.

(b) 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.

(c) Coordinate with ET-SAT and IPET-OSDE on the evolution of the space-based component of Global Observing Systems.

(d) 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 groups, regional associations and with WIS activities.

(e) 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.

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

(g) Promote development and harmonization of satellite data and products responding to WMO Members' needs, and develop and update relevant elements of the WIGOS Regulatory and Guidance materials, including the Manual and the Guide to the GOS, and the WIGOS Data Quality Monitoring System.

(h) 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 2015-2019 Virtual Laboratory Training Strategy.

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

(j) 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, including support to resource mobilization activities.

(k) Coordinate with WMO Technical Commissions and Programmes, including co-sponsored Programmes, activities related to satellite utilization and products, through ex-officio membership on the Team.

(l) Provide advice and support to the Chairperson of OPAG-IOS, and report on all activities relevant to its Terms of Reference.

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ANNEX VIII

PROPOSED WORK PLANS OF THE TEAMS AND COORDINATORS OF THE ICT-IOS FOR THE NEXT CBS INTER-SESSIONAL PERIOD

1) UPDATED WORK PLAN WITH STATUS FOR THE INTER PROGRAMME EXPERT TEAM ON OBSERVING SYSTEM DESIGN AND EVOLUTION (IPET-OSDE) FOR THE PERIOD 2012-2016

(Workplan as decided by IPET-OSDE-1, April 2014; status of tasks as of 16 April 2016)

Id	***Priority***	***Objective***	***Outcome***	***Deliverable***	***Activity***	***Leader***	***Due***	***OtherETs***	***Effort***	***Status Report***
1	1	To contribute to the implementation of WIGOS, including WIGOS Manual, and provide relevant advice and support to the chairperson of ICT-IOS	Address relevant items of WIGOS Implementation Activities agreed by Congress XVI, and then ICG-WIGOS	Relevant WIP activities addressed	Meeting	Chair IPET-OSDE	Ongoing	ICG-WIGOS, IPET-WIFI		OND Principles included in WIGOS Manual OND Guidance addressing the Principles almost complete Vision 2040 Space well developed and reviewed at IPET-OSDE-2 Vision 2040 Surface preparation initiated at IPET-OSDE-2
2	1	Survey and collate user requirements for observations for WMO and WMO-sponsored programmes	Review and update WMO database of observational user requirements, through Points of Contact for application areas.	OSCAR/Requirements up to date	Review by FPs	Chair IPET-OSDE	Ongoing / Annual review			Ongoing; PoCs regularly contacted for updates

Id	Priority	Objective	Outcome	Deliverable	Activity	Leader	Due	OtherETs	Effort	Status Report
3	1	Survey and collate observing systems capabilities for surface-based and space-based systems that are components or candidate components of WIGOS	Review and update WMO database of observing system capabilities, in collaboration with other OPAG IOS ETs and other Technical Commissions as appropriate.	OSCAR/Space & OSCAR/Surface up to date	Review by Members (coordination via NFPs)	Chair IPET-OSDE	Ongoing / Annual review	ICT-IOS, ET-ABO, ET-SBO, ICG-WIGOS/TT-WMD		Ongoing for space-based, and recorded in OSCAR/Space. Ongoing for surface-based through new developments with OSCAR/Surface, to be used when operational in 2016
4	1	Maintain Rolling Review of Requirements (RRR) for observations in several application areas, using subject area experts, including appropriate liaison with Technical Commissions and programmes and co-sponsored programmes (e.g. CAS, JCOMM, CAeM, CAgM, CHy, CCl, GCOS, GFCS, and GCW)	Continue RRR process for the listed application areas and expand to new areas as required: review and update as necessary Statements of Guidance on the extent to which present/ planned observing system capabilities meet user requirements, through Points of Contact on application areas.	Statements of Guidance for all Application Areas	Application Area Contact Points; Meeting	Chair IPET-OSDE	Ongoing / Annual review			Ongoing; some SoG reviewed. Overall review done by IPET-OSDE-1 and IPET-OSDE-2. Some updates to user requirements and SoGs made during the period.
5	1	Prepare and maintain reviews of observation impact studies undertaken by NWP centres and provide information for consideration by IPET-OSDE and OPAG-IOS	Rapporteurs on Impact Studies and NWP experts, review results of impact studies relevant to the evolution of observing systems. Organize and hold next NWP Impact Studies Workshop in 2016.	Findings of impact studies	Impact studies	Rapporteurs on Scientific Evaluation of Impact Studies undertaken by NWP Centres	2016: workshop			Report of the 5th NWP "Impact" workshop (Sedona, 2012) published. Ongoing: recent findings, and proposals for new impact

Id	Priority	Objective	Outcome	Deliverable	Activity	Leader	Due	OtherETs	Effort	Status Report
										studies discussed at IPET-OSDE1 and approved by CBS Ext.(2014). Preparations well advanced for 6th workshop (Shanghai, May 2016)
6	1	Promote CBS activities in support of GCOS goals	Review the implications of the progress on the GCOS Implementation Plan for the activities of CBS. Bring relevant issues to the attention of the IPET-OSDE	RRR consistent with GCOS	Meeting	Rapporteur on GCOS matters	~~2013~~ 2016			Ongoing interactions between IPET-OSDE Chair and GCOS.
7	1	Promote CBS activities in support of GFCS goals	Review the implications of the GFCS IP for the activities of CBS. Bring relevant issues to the attention of the IPET-OSDE	RRR consistent with GFCS	Meeting	Chair IPET-OSDE	2016			Relevant activities reviewed at IPET-OSDE1. GCOS/GFCS interaction encouraged.
8	1	Promote CBS activities in support of GCW goals	Review the implications for the activities of CBS of the GCW developments, including the GCW Implementation Strategy, and the Cryosphere theme report for the IGOS partnership. Bring relevant issues to the attention of the IPET-OSDE	RRR consistent with GCW	Meeting	Chair IPET-OSDE	2016			Relevant activities reviewed at IPET-OSDE-1 and IPET-OSDE-2. CBS CWP submitted to the AOS1.

Id	***Priority***	***Objective***	***Outcome***	***Deliverable***	***Activity***	***Leader***	***Due***	***OtherETs***	***Effort***	***Status Report***
9	1	Monitor progress and actions by Members and partner Organizations per the approved Implementation Plan for the Evolution of the global observing systems (EGOS-IP), fully responding to the "Vision for the GOS in 2025",and promote activities in support of progress	Seek feedback from National Focal Points, Expert Teams, relevant Technical Commissions, and other groups on the implementation of EGOS-IP, and keep the EGOS-IP progress report up to date. Initiate and monitor activities which promote progress.	EGOS-IP progress report	Survey with FPs, TCs; meeting	Chair IPET-OSDE	Ongoing / Annual review			Ongoing. Feedback against the new EGOS-IP requested to the NFPs for 2013, 2014 and 2015. 2013 input reviewed at IPET-OSDE-1. 2014 and 2015 input reviewed by IPET-OSDE-2. New feedback by EGOS-IP action "owners" reviewed by IPET-OSDE-2.
10	1	Propose guidance regarding observing system network design principles	Draft guidance document on network design (to be further discussed at IPET-OSDE-1 in 2014)	Guidance document on network design	Meeting	Chair IPET-OSDE	~~End 2013~~ 2014			2 workshops organized in Nov. 2013 and Feb. 2015. OND Principles approved with WIGOS Manual. Draft OND guidance almost complete.

2) WORK PLAN FOR THE SUB-GROUP ON RADIO-FREQUENCY COORDINATION (SG-RFC) FOR THE PERIOD 2012-2015

Id	***Priority***	***Objective***	***Outcome***	***Deliverable(s)***	***Activity***	***Leader***	***Due***	***OtherETs***	***Effort***
1	1	Represent WMOs needs at ITU WRC-12.	Radio Regulations ensure WMO observing and communications systems have uninterrupted access to necessary frequencies	WMO Position Paper on WRC-12 Agenda.	Support to secretariat representation at WRC-12	Chair	Jan/Feb 2012		
2	1	WRC-15	Radio Regulations ensure WMO observing and communications systems have uninterrupted access to necessary frequencies	WMO Position Paper on WRC-15 Agenda.	• Representation at Conference Preparations meetings for WRC-15 • Preparation of a preliminary position paper on WRC-15 agenda, maintain and update for final submission to WRC-15. • Organization of studies and submission of contributions supporting the WMO position at ITU-R Working Parties involved) • Participation in ITU-R study groups and JTG • Representation of WMO at ITU-R Regional Organizations meetings.	Chair	Various times throughout the period. WRC-15 scheduled for Nov 2015		
3	1	Monitor and address Spectrum issues related to meteorological and Earth exploration applications/systems	Present and future meteorological and related needs for spectrum are met		• Participation in ITU-R study groups and working parties. • Participate in national activities in support of ITU-R processes.	• Chair • Focal points (See Attachment 1)	On-going	• ICT-IOS, • ET-WISC, • ET-CTS • CIMO	

Id	***Priority***	***Objective***	***Outcome***	***Deliverable(s)***	***Activity***	***Leader***	***Due***	***OtherETs***	***Effort***
4	2	Establishment of a WMO Strategy on radio-frequency protection for meteorology and related environmental	Improved ability of NMHSs to ensure national spectrum policies incorporate meteorological and related needs for spectrum	Strategy paper for consideration of EC-65	• Preparation of draft strategy • Review by SG-RFC and submission to CBS • Consideration by EC-65	• Secretariat • Chair • Secretariat	EC-65		
5	2	Establishment of a guide for NMHS on participation in radio frequency coordination processes	Improved ability of NMHSs to participate in national and international spectrum policy and management processes	Guide to Participation in Radio-frequency Coordination (WMO-No. 1159)	• Prepare draft guide, • Review by SG-RFC • Review by CBS • Review by Cg-17 • Publish	• Secretariat • Chair • Secretariat •	EC-65		
6	2	Monitor ITU-R regional organization activities and represent WMO issues where possible	Regional organizations decisions take into account WMO's needs	Regional organization representation for WMO	• Bring to the attention of SG-RFC any regional issues affecting WMO and vice versa	• Focal points, see attachment 3	On going		
7	2	Cooperation with other organizational entities such as GEO, SFCG, CGMS	WMO needs are taken into consideration of other environmental related activities	Participation and representation of WMO	• Bring to the attention of SG-RFC any issues from other earth observations related organizations affecting WMO and vice versa	• Focal points, see attachment 2	On going		

3) DRAFT WORK PLAN FOR THE EXPERT TEAM ON SURFACE-BASED OBSERVING SYSTEMS (ET-SBO) FOR THE PERIOD 2017 – 2020 (VERSION 0.1)
(Generated at ICT-IOS-9 April 2016)

No.	Task	Deliverable/Activity	Due	Responsible	Status	Comment
1.	**Helping WIGOS Succeed** Agreed ToR: Contribute to the implementation of WIGOS by undertaking those tasks assigned to it by the OPAG IOS Chair as part of the WIGOS pre-operational phase priority activities. Notes: ToR Changes made by CBS-MG and supported by ET. Activities will support the 5 priority areas for WIGOS defined by Congress.	Address relevant items of WIGOS Pre-Operational Phase Activities assigned to ET-SBO, details to be forthcoming during work plan period, see individual task sheets for more detail.	Ongoing	**Co-ordination Lead:** Chair ET-SBO for overall delivery with lead and contributors for each task identified		
1.1		Detailed tasks	TBD	**Task Lead:** TBD **Task Contributors:** TBD		
2.	**Improving Technical Documents** Draft ToR: Develop and update relevant elements of the WIGOS Regulatory and Guidance materials, including the Manual and the Guide to the GOS *and incorporating WIGOS data quality monitoring system recommendations*.	Review and update the technical regulations and associated guidance material. Priority technologies to be defined early in new intersessional period but will definitely include Radiosonde and will likely include lightning detection systems & GNSS systems.	In time for WIGOS approvals mechanism	**Task Lead:** TBD **Task Contributors:** TBD		
2.1	Notes: Changes proposed to ToR to remove specific reference to technologies in the ToR.	Update the Radiosonde regulatory material currently recorded in the Manual on the GOS WMO No.544 and Guide to the GOS WMO No. 488	Draft material generated 2017 and passed to WIGOS EB in 2018	**Task Lead:** TBD **Task Contributors:** TBD		30 working days to be assigned to this task.

No.	Task	Deliverable/Activity	Due	Responsible	Status	Comment
2.2		Other tasks to be identified	TBD	**Task Lead:** TBD **Task Contributors:** TBD		Likely to include a review of lightning detection systems and GNSS based measurement systems
3.	**<u>Status of Implementation</u>** Draft ToR: Monitor and assess the status of operational and planned surface-based observing systems and ensure this is adequately described in OSCAR/Surface and associated observational metadata databases. Notes: Minor modification of ToR to reflect the use of OSCAR/Surface as the official source of observational metadata.	Establish and implement a review mechanism to enable regular assessment of the status of the ET-SBO technology implementation, as described in OSCAR/Surface can be reports against assigned EGOS-IP Actions	Ongoing / Annual review	**Task Lead:** TBD **Task Contributors:** TBD		60 days provisionally allocated to this action.
3.1		Make recommendations to OSCAR/Surface 'maintenance and development' team for the further enhancement of OSCAR/Surface to improve its functionality	Ongoing	**Task Lead:** TBD **Task Contributors:** TBD		
3.2		Further tasks to be confirmed	TBD	**Task Lead:** TBD **Task Contributors:** TBD		
4.	**<u>Meeting User Requirements</u>** Agreed ToR: In collaboration with IPET-OSDE, assess the contribution of current and planned SBO systems to meeting user requirements for all Application Areas; Notes: No change to ToR.	Provide expert input and reports to IPET-OSDE on the suitability of each observing system in meeting each Application areas requirement	Ongoing	**Task Lead:** TBD **Task Contributors:** TBD		
4.1		Contribute to the evolutionary development of the Vision for the	2017 and	**Task Lead:** TBD **Task Contributors:**		

No.	Task	Deliverable/Activity	Due	Responsible	Status	Comment
		GOS, being led by IPET-OSDE		TBD		
5.	**<u>Delivering the EGOS-IP</u>** Draft ToR: Facilitate the delivery of those EGOS-IP actions identified as priorities by OPAG-IOS, including the identification as appropriate of the technical support required for project implementation plans, including guidance materials, technical specifications and project documentation for resource mobilization activities; Notes: ToR now includes new CBS-MG ToR 8	**Identify EGOS-IP Actions for ET-SBO as lead co-ordination body.**		**Co-ordination Lead: TBD**		
5.1		Co-ordinate delivery of EGOS-IP Action G10 – Optimising the global radiosonde schedule See EGOS-IP G10 for details.	Ongoing	**Task Lead:** (Tim Oakley) **Task Contributors:** (RongKang Yang)		Significant consultation with RAs, TCs etc needed.
5.2		Other actions to be identified.	TBD	**Task Lead:** TBD **Task Contributors:** TBD		
6.	**<u>Promoting Best Practice</u>** Agreed ToR: Monitor the status of operational networks of SBO systems, promote best practice among WMO Members and provide advice on operational matters; Note: No change to ToR from previous inter-sessional period.	Establish an improved source for technical advice documents "The SBO Portal" as part of the WIGOS Information Resource. Populate Portal with national best practice documents. Respond to requests for advice from members	Ongoing	**Task Lead:** TBD **Task Contributors:** TBD		
6.1		**Specific tasks to be included at a later date.**	TBD	**Task Lead:** TBD **Task Contributors:** TBD		

No.	Task	Deliverable/Activity	Due	Responsible	Status	Comment
8.	**<u>Reporting Progress to ICT-IOS</u>** Agreed ToR: Provide advice and support to the Chairperson of OPAG-IOS on the implementation of the WIGOS pre-operational phase priority activities. Note: This is the reporting mechanism	Deliver progress reports and recommendations for changes to operating practices, technical documents and guidance to ICT-IOS during inter-sessional period.	2018 and 2020	**Task Lead: Chair ET-SBO**		
8.1		Deliver contribution to ICT-IOS-10.	April 2018 (tbc)	Chair ET-SBO with review of report by all members.		

4) CBS EXPERT TEAM ON AIRCRAFT-BASED OBSERVING SYSTEMS (ET-ABO) WORK PLAN FOR THE PERIOD 2016-17
(Draft Version 2016.1 – To be updated by ET-ABO for 2017-2020 and for new ToR, before submission to CBS)

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
1	(a)	Compile ET-ABO work plan and budget.	1. 2016 WP & Budget 2. 2017 WP & Budget		Ch/ET-ABO	Q4 2013	Ongoing	2	Work Plan, Ann. Budget 2016,2017	• Plan & Budget 2015 approved.
2	(a)	Meetings of ET-ABO		Hold a meeting, 2nd half of 2017. Requirements: • Agenda (Ch-ET-ABO); • Meeting Form (SO/ARO) • Meeting Q4 2017	Ch/ET-ABO	Q1 2015	Ongoing	1	Agenda, Meeting Form, Meeting	• ET-ABO-1 held in Sep 2013 • ET-ABO-2 held jointly with ET-AO in Dec 2015
3	(b)	Establishment of ABO Metadata (national, international)	Incorporate metadata specification into draft Reg. Material		S.Taylor, SO/ARO	Q2 2013	Q4 2016	2	Metadata definition incorporated into WIGOS Reg. Mat.	This task is now incorporated into Task 28.
			ABO metadata management in OSCAR 1. Assist in and contribute to the establishment of a system for ABO metadata management in OSCAR. 2. Contribute to documentation/guidance of OSCAR		S.Taylor, SO/ARO	Q2 2014	Q4 2016	1	ABO global metadata management system in OSCAR	• Requirements for ABO metadata management and capabilities have been compiled. • Input to development of OSCAR system for ABO metadata has been provided.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
4	(b)	Establish ABO Data Centre	1. Finalise agreement with NOAA/MADIS (NOAA to submit offer letter to WMO SG) 2. ET-ABO Management to refine and finalize text for submission to CBS via ICT-IOS 3. Submit proposal to ICT-IOS, CBS 4. Establish agreement between WMO and NOAA for the operation of the ABO-DC	NOAA Meteorological Assimilated Data Ingest System (MADIS) was identified as a strong candidate for ABO-DC May require both establishment and ongoing funding support.	1. S. Pritchett, Ch ET-ABO, SO/ARO 2. ET-ABO Management 3. S. Pritchett, Ch/ET-ABO, Secretariat-SO/ARO	Q1 2013	Q4 2016	2	ABO Data Centre	• Initial approaches made to prospective centers (Q3 2013) • Set of requirements finalized • Discussions & meetings with NOAA re MADIS on-going. • Draft text for submission to CBS via ICT-IOS presented at ET-ABO-2
5	(b)	Document ABO QMS		Include: • Recomm. from Workshop on DM	J.v.d.Meulen, ET-ABO	2012	Q4 2016	2	ABO QM Documented in WMO Reg. Mat.	This task is now incorporated into Task 28.
6	(b)	Revise and update ABO Data QC and QM procedures		Include: • Relevant recomm. From Workshop on DM • Use of flags • Policy on ICAO data QM • Spec. of QC by DPCs/NMSHSs • Reqs for NWP • Radiosonde comparison	J.v.d.Meulen, D.Body	Q4 2013	Q4 2016	2	QC Procedures updated in WIGOS Reg. Mat.	This task is now incorporated into Task 28.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
		Improve QC and management of ADS Data	Collaborate with ICAO on Air-Report data management: 1. Ensure input through ICAO Met. Panel groups. 2. Approach ICAO re possible ADS-B ES to report met data		Ch-ET-ABO, SO/ARO	Q4 2013	Ongoing	1	1. Representaton at ICAO Met. Panel 2. Outcome reported to ET-ABO.	• WAFC representatives to ET-ABO identified, added as assoc. members.
			Continue to monitor progress on ICAO/WMO workshop outcomes and actions, and assist where required. 1. Follow up meeting with ICAO and WAFC reps in March 2016 2. WAFC reps to revise WMO RRR SoG on Aero Met.		1. SO/ARO, Ch-ET-ABO 2. M. Strahan, C. Tyson	1. Q1 2015 2. Q4 2015	1. Q1 2016 2. Q4 2016	1	1. Report to ET-ABO on outcome of follow up meeting 2. Possible input to Aero Met. SoG	• Workshop held with representatives of ICAO and WAFCs in October 2015

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			Develop plans to ensure WMO Members comply with ICAO requirements for provision of ICAO ABO on GTS	1. Develop plan for ADS-C and AIREP migration to BUFR on GTS. 2. Develop guidance on QC 3. Implement unique aircraft ID for Air-Reps in OSCAR 4. Investigate a WMO data processing centre with each WAFC responsible for QC of ABO. 5. Develop plan for ADS-C data processing by WAFC center delegates 6. Ensure that all Members collaborate with their NCAAs for all ADS-C and Mode-S EHS/MRAR met data to WAFCs and GTS.	1. Ch-ET-ABO, J.Meulen 2. SO/ARO 3. S.Taylor, Ch-ET-ABO 4. Ch-ET-ABO, SO/ARO 5. Ch-ET-ABO SO/ARO 6. SO/ARO, ET-ABO	Q1 2016	Ongoing	2	1. Plan 2. QC Guidance 3. Unique IDs implemented 4. DPCs for ICAO ABO established 5. As for 4. 6. Letter to PRs once regulations and guidance established.	
7	(c)	Coordinate with CIMO ET-AO on Scientific & Technical Matters	1. Coord. finalization of 2016-17 WP.		Ch-ET-ABO, SO/ARO	2012	Ongoing	2	Harmonised Work Plan & Budget for the ABO Program.	• Joint meeting of ET-ABO/ET-AO held in Dec 2015

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
8	(c)	AF B777 Software Dev.	1. Finalise implentation and software roll out.	1. Combined action with ET-AO	Ch/ET-ABO, SO/ARO, Ch-ET-AO, S.Stringer (E-AMDAR PM)	2012	Q2 2016	2	AF B777 AMDAR Software application AF B777 AMDAR data on GTS	• S/W developed by Air France Q3 2015. • 67 AFR B777 equipped for AMDAR • AFR B777 reporting in boxes 1 (Pacific), 3 (Atlantic) and 5 (Africa). • QC of operational data by E-AMDAR ongoing
10	(d)	Mexico Prog Implement.	1. Monitor contract & data 2. Seek extension of contract for 2017-18 funded by SMN Mexico		SO/ARO	2012	Q4 2017	2	Contract extended Data from AeroMexico B737-700 aircraft	• Program started operations in Oct 2014 • ARINC Contract est. July 2014 • Est. contract paid Jan 2015 • Monthly billing comm. from Jan 2015.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
11	(d)	Employ AMDAR Dev. Officer (ADO)	1. Negotiate with EUMETNET for 0.5 persons working with E-AMDAR for WMO ABO. 2. Manage contract	If progress with E-AMDAR appointment in Q1 2016 stalls, seek to employ an ADO at half-time under appropriate WMO appointment.	SO/ARO, Ch/ET-ABO, GF	Q1 2013	Q4 2017	2	Job Description, ADO employed.	• Mr Stig Carlberg was employed as ADO over period July 2013 through January 2015. • Mr Carlberg completed contract in Jan 2015. • Expectation is that a continuing arrangement will be made with a technical consultant to provide technical support for regional and global AMDAR development.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
12	(d)	Develop Global & Regional ABOP Imp. Plans	ABOP Strategy & Implementation Plan (A-SIP)	This may incorporate the following: • WVSS Implementation • Letter to airlines based on consideration of Data Coverage & Airline Targeting study; • Letter to PRs of relevant countries based on consideration of Data Coverage & Airline Targeting study; • Letter to RAs. • Update A-SIP to version covering 2016-2020 including WVM Integration into Existing Avionics and Airframes, and WVM as Standard Accessory on Commercial Aircraft As well as the turbulence IP.	SO/ARO, Ch/ET-ABO, Vc/ET-ABO	Q1 2013	Q4 2016	1	1. A-SIP Completed and published; 2. Draft A-RIP Template completed. 3. A-SIP ver. 2016 in Q1 2016 for approval by CBS ICT-IOS in April	Ver. 2015.1 COMPLETED Changes for version 2016 discussed and agreed at ET-ABO-2 held jointly with ET-AO in Dec 2015

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			Development of Region I ABOP Regional Implementation Plan	• Possible that these plans can be developed in coordination with RA sessions. • Work with RA I on: 1) A-RIP in WIGOS-IP, 2) Form RA I work group. • Meet with AMCOMET Project Officer • Quarterly meetings of Region I work group. • Participate in Int. Aviation Conf. April 2016. • Maintain A-RIP	SO/ARO, G.Ilboudo, F.Mosetlho, ADO	Q2 2013	Q4 2017	2	1. Region I A-RIP 2. Participation at RA I session in Feb 2015 3. Establishment of a leadership group on AMDAR with collaboration of RA I 4. 4 meetings per year	• Mature draft A-RIP has been produced. • Item on RA I RECO on AMDAR was presented by SO/ARO (Feb 2015). • AMDAR adopted as AMCOMET Project.
			Region I Regional AMDAR Workshops	• Schedule first in 1st half of 2015, likely to be held in Kenya in April. • Possible 2nd workshop to be held in Morocco in 2nd half of 2015 possibly in conjunction with joint meeting of ETs.	ET-ABO, SO/ARO, J.Ngamini, RA I FPs	Q2 2013	Q4 2015	5	• AMDAR Workshop held in Kenya • AMDAR Workshop held in Morocco	• Workshop held in Kenia, June 2015 for Eastern, Central and Southern Africa • Workshop held in Morocco, Dec 2015 for Western and Northern Africa COMPLETED

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			AFIRS Trial in RA I	Investigate and, if feasible, implement a trial of AFIRS data provision within RA I.	G Ilboudo, ET-ABO, SO/ARO	Q1 2014	Q4 2016	2	1. Data from trial obtained and analysed. 2. Report to ET-ABO and CBS.	• Consulted with FlyHt and obtained quotation – expect to go ahead in 2016. • Activity included in draft A-RIP.
			E-AMDAR Data Provision Trial Region I	• Investigate and if feasible request E-AMDAR to provide all possible AMDAR data over Region I for a one year period. • Ensure all Region I Members are aware of the trial. • Ensure an impact assessment is undertaken • Seek collaboration with Region I Members for continuation of data provision beyond the trial. • Extend scope to include data from AFR & BAW B777s.	ET-ABO, SO/ARO	Q4 2014	Q2 2017	1	1. E-AMDAR AMDAR data made available for one year. 2. Region I Members reports on impact of data. 3. (NWP) Impact assessment on supplementary data.	• Estimated costing has been provided by E-AMDAR (4K per annum) excluding AF & BAW B777s • Activity has been included in the draft A-RIP • • AFR and BAW B777s have started reporting AMDAR data
			Development of Region II ABOP Regional Implementation Plan	• Seek the nomination of an ET-ABO Lead for Region II • Engage further with RA-II on AMDAR at its 16th Session in 2016	ADO, SO/ARO, RA II ET-ABO Lead	Q2 2013	Q4 2016	2	Region II A-RIP	• RA II has adopted Resolution 16 (RA II-15) for the establishment of Pilot Project for AMDAR due for completion in December 2016.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			Development of Region III ABOP Regional Implementation Plan	• Possibility of US led planning workshop for RA-III/RA-IV in Q2/ Q3 2016 from which a planning committee combining RA-III and RA-IV could emerge with the goal to finalize the implementation plan and develop a way forward	ADO, SO/ARO, J.Horler, S. Pritchett	Q2 2013	Q4 2016	2	Region III A-RIP	• No significant progress on A-RIP • AMDAR was presented at RA III session in Sep 2014 – rapporteur on AMDAR was appointed.
			Development of Region IV ABOP Regional Implementation Plan	• Possibility of US led planning workshop for RA-III/RA-IV in Q2/ Q3 2016 from which a planning committee combining RA-III and RA-IV could emerge with the goal to finalize the implementation plan and develop a way forward	ADO, SO/ARO, G.Fournier, S. Pritchett	Q2 2013	Q4 2016	2	Region IV A-RIP	• Draft A-RIP has been developed. • RA has been contacted and request for review of A-RIP made.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			Development of Region V ABOP Regional Implementation Plan	RA V TT-AO under RA V WG on infrastructure to consider adapting the draft A-RIP RA V ET-ABO Lead to work with RA V TT-AO towards expansion of TT-AO and an update of A-RIP in 2016	ADO, SO/ARO, D. Body	Q2 2013	Q4 2016	2	Region V A-RIP	• Draft A-RIP has been developed. • R. Stringer (Lead WG on Infrastructure) presented ET-ABO coordination plans to the RA Session in May 2014 • A TT-AO was formed as part of RA V WG on Infrastructure • TT-AO currently updating status of ABO in RA V • Draft A-RIP might be adopted by TT-AO •
			Development of Region VI ABOP Regional Implementation Plan		ADO, SO/ARO, S.Stringer	Q2 2013	Q4 2016	2	Region VI A-RIP	• Draft A-RIP has been developed. • RA VI has been contacted and request for review of A-RIP made. • WMO and EUMETNET have agreed on collaboration on AMDAR international regional development under their MoU.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			Request collaboration with RAs	Collaborate with RAs towards adoption of A-RIPs.	ET-ABO Region Leads, SO/ARO	Q4 2013	Q4 2016	2	• Correspondence to Pres. RAs compiled and sent.	• ET-ABO Regional Leads have corresponded with relevant working group leaders and other members of RAs.
			Request collaboration with NMHSs	1. List of target NMHSs (based on target airlines) to be compiled; 2. Ch-ET-ABO to write to PRs of NMHS to request collaboration on programme development 3. Letter to 10 target NMHS in 2016	Ch-ET-ABO, SO/ARO	Q4 2013	Q4 2016	2	Letters to target NMHSs compiled and sent.	• Letter was sent to all PRs in Q1 2014 • CBS approved RA collaborative process (ext-2014)

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			RA V Air Niuguini FlyHt/AFIRS Project	Objective is to implement (3) Air Niugini aircraft and fund data for 1 year and ensuring future continutation. 1. Investigate options for equipping Air Niugine aircraft for reporting. 2. Determine requirements and means for data processing for GTS transmission 3. Implement project. 4. Investigate options for future funding.	D.Body	Q1 2015	Q4 2016	2	ABO Data for SW Pacific	• Initial investigations have been made. • Offer provided by FlyHt • Proposal has been prepared by ADO. • Initiative has been delayed until 2016 due to excessive cost of software.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			Consultancy for AMDAR expansion & enhancement project	Project initiated during 2014 in consultation with WMO Development and Regional Activities to formulate business case materials and comms strategy for AMDAR program development. 1. Develop statement of work. 2. Undertake tendering process in WMO Sec. 3. Contract consultant and provide subject matter expertise.	SO/ARO, ET-ABO	Q2 2014	Q1 2015	4	1. Roadmap and Funding proposal supporting AMDAR expansion 2. Business cases tailored to various stakeholders. 3. Communications Strategy	• Consultancy firm Dalberg was contracted. • Roadmap and Funding proposal has been delivered. • Draft Comms strategy and business cases have been delivered. COMPLETED
			Hold meetings of regional FPs and ABOP/RA working groups at least 4 times a year per Region	4 WebEx meetings for each region to be held in 2016	ET-ABO-MG, Region Leads, SO/ARO	Q1 2016	Q4 2016	1	4 WebEx meetings for each region to be held in 2016	
13	(d)	Polar ABO	Investigate and monitor potential sources of ABO over polar regions.		G. Fournier	Q3 2013	Ongoing	2		• Ch-ET-ABO provided report to EC-PORS (24-28 Feb. 2014)

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
15	(d)	Optimise Existing Program Coverage	Determine existing potential coverage, capacity to provide the additional potential data & cost of doing so.	AMDAR Program Managers to provide potential vertical profile coverage. SO/ARO to make request.	ET-ABO, Operational Program FPs	Q1 2013	Q4 2016	2	Report to ET-ABO	• Program managers were requested to provide details of pot. Supplementary data • E-AMDAR have identified potential to provide supplementary data. This will be incorporated in Region I A-RIP under task 12 & financed below. • USA is taking steps to increase AMDAR over Americas in support of data losses from gaps in sat. coverage.
			1. Investigate WMO ability to admin. MoUs between NMHSs 2. WMO Sec. to establish MoU system and Trust budget line for sup. data provision.		SO/ARO	Q2 2013	Q4 2016	2	Report to ET-ABO	• MoU between WMO & EUMETNET for Supp. AMDAR data over Africa will be est. in 2016 – will serve as precedent.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			Fund supplementary agreed data provision activities	Expect to fund the following in 2016/17: • Region I E-AMDAR data prov. • Region I E-AMDAR B777 • PAC Flight Ent. System data prov. Trial.	ET-ABO-MG, SO/ARO	Q1 2016	Ongoing	2	Supplementary ABO data on the GTS.	
17	(d)	Attend meetings of relevance to global AMDAR dev.	• Attend E-AMDAR ET meetings. • Establish collaboration with ICAO Met Panel, IATA FOSTF, AMS forums/events	This may include: • 2 E-AMDAR TAG meetings per annum; • Participation in ICAO meetings • Others.	SO/ARO, ET/ABO	Q2 2013	Ongoing	2	Meetings attended. Reports produced for ET-ABO and Secretariat	• D.Lockett attended E-AMDAR ET, Nov 2015
18	(e)	Papers on Impact of AMDAR Data	1. Publish 2 papers on AMDAR data impact.	1. Papers about to be published in BAMS in 2016.	SO/ARO, ET-ABO Review Team	2012	Q2 2016	4	2 published papers	• Papers accepted to be published in BAMS in Q1 or Q2 2016. • Papers merged and published as WIGOS TR No 2015-01 (July 2015) • Consolidated papers also published in the University of Wisconsin-Madison, Space Science and Engineering Center library

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
19	(e)	AMDAR Impacts and Benefits Documentation	Benefits for Aviation Document	1. Finalize and publish report as WIGOS TR	Ch/ET-ABO, SO/ARO	Q1 2013	Q2 2016	2	1. SSA with selected Consultant and delivery of benefits document	• SSA Appointed Feb 2014 completion has been delayed due to complexity • SSA Extended to include provision of modeling study on fuel burn. • SSA completed (Sep 2015).
			Publish Flyers on AMDAR Program Benefits	Develop 3 new short flyers on AMDAR benefits to/from: 1. Aviation 2. Meteorology 3. Water vapour measurement Draft flyers 2 and 3 to be further refined and then published	ET-ABO, ADO, SO/ARO	Q1 2014	Q4 2016	1	Flyers published	• Flyer on AMDAR benefits to aviation has been completed and published in Aug 2014 • Drafts of flyers 2 and 3 have been completed by ADO.
			Develop a generic business case document for ABO & AMDAR/WVM.	Develop a generic business case document for ABO & AMDAR/WVM.	F.Besson, A.Hoff,	Q1 2016	Q4 2016	0	BC Document for WVM.	
20	(e)	AMDAR Training Module	Investigate requirement for extension or new module on AMDAR data availability and use.		C.Weiss, ET-ABO	Q1 2016	Q4 2016	1		• 1st AMDAR COMET Training Module was released in Q1 2015.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
21	(e)	Attend Relevant Aviation Meetings	Attend AEEC Data Link Users Forum, twice per year by turns held in the US and in Europe	ET-ABO to assist ET-AO in holding 1-day seminar on ABO as part of Avionics Vendor conference at AEEC DLUF in Europe in 2016	Ch-ET-AO, Ch-ET-ABO, SO-ARO	Q4 2013	Ongoing	2	Attend meetings; report to ET-ABO; 1-day workshop on AMDAR/AO at AEEC DLUF in Europe in 2016	• S.Taylor attended AEEC Gen. Session, Prague 2015. • S.Pritchett attended DLUF Feb. 2015
			Collaborate with IATA FOSTF on support for WMO ABO activities		Ch-ET-ABO, H.Sonnabend, SO/ARO	Q1 2016	Ongoing	0	Representation at next FOSTF meeting.	
22	(e)	WMO AMDAR Newsletter	• Produce NewslettersVols11 &12 (2016) • Produce Newsletters 13 & 14 (2017)		C.Weiss, ET-ABO, AMDAR FPs, SO/ARO	Q1 2015	Ongoing	2	• Newsletter Vol 11 & Vol12 • Newsletter Vol 13 & Vol 14	• Vol 9 and Vol 10 published (2015).
23	(e)	Global AMDAR Program Development Workshops and Seminars	Hold 2 AMDAR/ABO workshops per year. 1. RA-III/IV joint AMDAR workshop in 2016 2. AMDAR Workshop for the Middle East and central Asia in 2016 or 2017 (e.g. Qatar or India)	• Possible RA-V AMDAR workshop in 2017 in Indonesia	ET-ABO	Q2 2013	Ongoing	2	1. Region III-IV Workshop 2. Region II Workshop	• Middle-East Workshop postponed until 2016 • NOAA to provide $75K USD to support RA III-IV regional workshop & Development
24	(e)	Maintain & Develop WMO ABO and AMDAR Websites	Operational programmes to produce a technical description of their programmes for the website	1. SO/ARO to develop a template 2. Operational programme managers to provide the input.	SO/ARO, Op. Programme Managers	Q4 2013	Q4 2016	2	AMDAR Programme Technical Descriptions published online.	• Template developed. • E-AMDAR implemented

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
			Investigate Cross-promotion from Av. Org. Websites 1. SO/ARO to contact N.Halsey to investigate possibilities for ICAO website X-promotion; 2. SO/ARO to contact H-R Sonnabend to investigate possibilities for IATA website X-promotion		SO/ARO	Q4 2013	Q4 2016	1	X-promotion on ICAO and IATA websites	• No progress due to other priorities
			Update of WMO Maintained Websites	• SO/ARO to ensure that new WMO public WWW site maintains AMDAR presence and news site. • SO/ARO to investigate possibilities for alt. hosting of ABOP wiki in new WMO Extranet.	SO/ARO	Q1 2016	Q4 2016	0	ABO & AMDAR new websites and extranet sites.	
25	(f)	Provide input to ICG-WIGOS/TT-WMD	Attend TT-WMD Meetings		S.Taylor, SO/ARO	Q1 2013	Ongoing	2	Determine req. for input to TT-WMD	• Commenced • S.Taylor attended TT-WMD-4, Oct 2015

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
26	(f)	Provide input to ICG-WIGOS/TT-WRM	Attend TT-WRM Meetings		J.v.d.Meulen	Q1 2012	Ongoing	2	Determine req. for input to TT-WRM	• Sessions and remote meetings have been attended by J.v.d.Meulen • Last session was in January 2014
27	(f)	Contribute to the WMO/CBS RRR Process	• WAFCs to review AeM SoG.	Continuous process	SO/ARO, ET-ABO	2012	Ongoing	2	Input in RRR Database SoR Document/ input in RRR OSC Database	• SO/ARO and S.Taylor provided requirement specification for determination of aircraft systems capabilities.
28	(f)	Revision of AMDAR Regulatory Material in WIGOS context	1. Revise current status. 2. Develop plan for update process. 3. Meeting of SG-RM (Dec 2014) 4. Consolidation of draft material for ET-ABO-2	• Develop new ABO input to the Manual on the GOS and Guide to the GOS • Finalise input through the CBS process. • Incorporate metadata specification into draft Reg. Material • Inc guidance on ABO QMS (Task 5) • Inc. guidance on Data QC and QM procedures	ADO; J.v.d.Meulen, Ch-ET-ABO, A.Hoff, D.Body SO/ARO to form review team on Reg. Mat.	Q3 2013	Q4 2016	2	1. Plan for integration of AMDAR RM into WIGOS RM. 2. Commence and complete update of Reg. Mat. in Man. on WIGOS and Man. on GOS	• Review team met as Sub-Group on Regulatory Material in December 2014 • Produced initial draft of ABO content for Manual on GOS and Guide to GOS. • Initial draft presented at Joint ET-ABO/ET-AO meeting in December 2015 • WebEx meeting have been ongoing towards refinement of the RMs.

No.	ToR	Task	Sub-tasks	Description	Responsible	Commence	Complete	Status	Deliverables/ Activities	Progress
29	(f)	Report to ICT-IOS and CBS on work plan tasks and outcomes	1. Report to IPET-OSDE in April 2016 2. Report to ICT-IOS in April 2016 3. Assist in reporting to CBS.	Ensure reporting on: • Reg. Material • Updated ToR • Resolution for CBS on Data Centre • Resolution for CBS on collaboration with CAeM & ICAO	Ch-ET-ABO	Q1 2016	Q4 2016		1. Report to ICT-IOS 2. Input to report to CBS.	•

5) PROPOSED EXPERT TEAM ON SATELLITE SYSTEMS (ET-SAT) WORK PROGRAMME FOR THE PERIOD 2016-2019 (LAST UPDATE: 29 FEB 2016)

(this work plan is to be presented to the OPAG-IOS Chair, then updated by the Team to assign responsibilities, deadlines, and indicate status)

No.	Task (ToR)	Deliverable/Activity	Due	Responsible	Status	Comment
1	Assess and document, in the framework of the WMO Rolling Review of Requirements, the actual and planned capabilities of operational and R&D satellites constituting the space-based component of WIGOS and their adequacy to meet the WMO requirements for satellite data and products. This will be achieved in considering the information provided by participating agencies as well as the outcome of CGMS and CEOS, including e.g. the progress of CEOS constellations; the feedback from WMO should be communicated to CGMS and CEOS.	Guide the development and maintenance of OSCAR/Space Serve as beta-testing group of OSCAR/Space version 2.0 Perform gap analyses (i) in the CGMS baseline, (ii) against the Vision of the GOS/ WIGOS space-based component systems, to inform WMO Members on a regular basis Perform gap analyses in areas of specific or evolving interest to WMO, such as hydrology, atmospheric composition, space weather	Continuous 1 April – 31 May 2016	ET-SAT and WMO Secretariat	WMO Secretariat to release OSCAR/Space Version 2.0 in May 2016 Options for long-term maintenance of OSCAR/Space under development	
2	Provide technical advice on implementation of integrated satellite observing systems	Guide the development of the Vision of the WIGOS space-based component systems in 2040, in coordination with IPET-OSDE; Support WMO information needs on satellite systems, including CBS and WMO Programme guidance material (e.g., Manual on WIGOS)	Continuous until late 2018, as required Continuous	ET-SAT and WMO SP Secretariat	Developed first draft of Vision, for discussion by CM-13 and IPET-SUP-2 (Jan/Feb 2016)	
3	Assess progress of R&D and demonstration satellite systems, and identify opportunities and/or problem areas concerning satellite technology and plans	Present and discuss novel sensor, mission or space technology concepts and their potential utility to WMO Discuss radio frequency issues and highlight them to the SG-RFC as appropriate Keep abreast of developments regarding private operators of basic satellite systems, and provide guidance to WMO	2016 onwards	ET-SAT and WMO SP Secretariat		

4	Coordinate with IPET-SUP and other relevant CBS teams on satellite related matters	Joint session on Vision 2040 and OSCAR/Space Version 2.0 in 2017	3-7 Apr 2017 (tentative)			

6) NEW PROPOSED WORK PLAN FOR THE INTER PROGRAMME EXPERT TEAM ON SATELLITE UTILIZATION AND PRODUCTS (ERROR! REFERENCE SOURCE NOT FOUND.**) FOR THE PERIOD 2016-2019**

No.	Task (ToR)	Deliverable/Activity	Due	Responsible	Status
1	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	Quadrennial survey Analysis of responses Findings and recommendations Advice to Regional Associations on follow-up actions WMO document for publication Next survey	Feb 2016 Apr 2016 Apr 2016 Sep 2016 Jan 2017 2020	WMO SP Secretariat and IPET-SUP	Survey carried out in the period 8 Feb – 15 Mar 2016; More than 400 responses received
2	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;	Contribute to the evolving EGOS IP, the Manual on the GOS, WIGOS Regulatory Material, the Vision for the WIGOS component systems 2040, and the WIGOS IP Support WMO Programmes (both operational and research) in their satellite data and product-related needs, with focus on marine meteorology and oceanography, climate, hydrology, and atmospheric composition	As required Continuous	IPET - SUP and WMO SP Secretariat	IPET-SUP provided input to the initial Vision for the WIGOS space-based components in 2040

3	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 groups, regional associations and with WIS activities	Promote the development and maintenance of Regional Satellite Data Requirements Groups and satellite data requirements in all Regions, as appropriate Promote activities to advance the Satellite Data Dissemination Strategy: - Information and guidance - Data requirements - Enhancing data availability - Description and Registration - Dissemination and User Access Encourage and assist Regional Satellite Data Requirements Coordination Groups in carrying out Region-based user surveys	2016 onwards	IPET - SUP and WMO SP Secretariat, with assistance from Int'l WGs IGDDS and RARS implementation groups	Regional Groups active in RA I, II, III/IV Development of progress indicators ongoing, including for DBNet Ongoing
4	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;	Review of relevance and availability of R&D satellite data, based on global/regional requirements; Strengthen interaction with R&D agencies in the area of altimetry, soil moisture, precipitation, and climate Make recommendations for improved availability, information and training, especially for developing countries Collect case studies to demonstrate the value of satellite data for hydrological applications	Ongoing 2017	IPET - SUP and WMO SP Secretariat	Participation in relevant fora, focus WMO survey on these topics and interaction with CEOS as appropriate

5	Review, and assist in addressing, the needs of WMO Members and regional associations for information regarding satellite capabilities and in particular access to and utilization of satellite data and products;	Maintain OSCAR/Space and a list of satellite data access points, processing and analysis software tools on WMO webpage Support activities to achieve user readiness for the new generation of meteorological satellites, including the development of guidelines for users and satellite operators	2016/2 (continued yearly)	IPET - SUP and WMO SP Secretariat	Best practices for achieving user readiness (Reference User Readiness Project) published; Next-generation of OSCAR/ Space, Product Access Guide and SATURN online
6	Promote development and harmonization of satellite data and products responding to WMO Members' needs, and develop and update relevant elements of the WIGOS regulatory and guidance materials, including the Manual and the Guide to the GOS and the WIGOS quality data monitoring system	Provide guidance to Sustained Co-ordinated Processing of Environmental Satellite Data (SCOPE) for Climate Monitoring as a key contribution to the architecture for climate monitoring from space. Continue to develop and promote the SCOPE-Nowcasting, initiative and support the work of the coordinating group. Collaborate with WIGOS, WIS and CGMS on developing data format and metadata standards, as well as procedures for monitoring satellite data availability and quality Promote the exploitation of commonalities of instruments on the new meteorological satellites in generation of product and training material	2016-2018	IPET - SUP and WMO SP Secretariat, SCOPE-CM Executive Panel, and SCOPE-Nowcasting Coordination Group	SCOPE-CM IP under review Four Pilot Projects in progress

7	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 2015–2019 Virtual Laboratory Training Strategy;	Regular reviews of the VLab status, activities and plans (training resources, courses, meetings, newsletters); Support existing VLab CoEs and the establishment of new ones; Provide guidance to meet users' needs, especially from less developed Members and for the next generation of satellites; Explore training partnerships Contribution to training resource development	Continuous activity	VLMG, WMO SP Office and IPET-SUP	VLab 2015-2019 strategy updated Events on user preparedness planned Joint COSPAR/VLab training event on space weather planned for August 2016
8	Holding joint and/or overlapping meetings with ET-SAT as appropriate, to facilitate interaction between users and providers of satellite systems, data and products	Plan for joint session of ET-SAT and IPET-SUP in 2017	2017/4	WMO SP Office	
9	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, including support to resource mobilization activities;	As above Exchange meeting reports Engage with ET-SAT on specific issues as required, such as developing the Vision for WIGOS space-based component systems in 2040	Ongoing	WMO SP Office, IPET-SUP Chair	
10	Coordinate with WMO Technical Commissions and Programmes, including co-sponsored Programmes, activities related to satellite utilization and products, through ex-officio membership on the Team	Increase engagement with WMO Technical Commissions, including JCOMM, CCl and CHy Develop and implement communications strategy	Ongoing 2015/4	IPET-SUP Chair and WMO SP Office IPET-SUP Chair	

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ANNEX IX

LATEST DEVELOPMENTS OF THE GLOBAL CRYOSPHERE WATCH (GCW)

The session was informed that pre-operational testing of CryoNet is in progress with the set of 36 sites approved by Cg-17. The main objective of the pre-operational test is to apply and evaluate the CryoNet concept and establish data interoperability with the GCW Portal. This has resulted in updates to the CryoNet concept of stations and sites and the procedure for accepting new stations, including CryoNet station and site requirements (see http://globalcryospherewatch.org/cryonet/site_types.html and related pages). This will require related WMO and WIGOS documents/manuals to be updated. The updated list of CryoNet stations/sites will be submitted for approval to the GCW Steering Group, EC-PHORS, CBS and EC-68. Work has been initiated on the preparation of a 30-40 page GCW Guide to Cryospheric Practices and then a more comprehensive Manual of Best Practices. In-situ and satellite-based observations would be included. A draft outline of the Guide is expected to be available for CBS in November and a draft of the guide by end of 2016 for review by WMO and Partner communities. Drafts of the components will be posted on the GCW website as "Draft for Comments" seeking community feedback.

The efforts of the Snow Watch Team of the Integrated Products WG to improve the real-time flow and access to in situ snow measurements (e.g. non-reporting of snow depths by some countries) and the reporting of zero snow depth (see: http://globalcryospherewatch.org/reference/documents/files/snowwatch_snowreporting_handout.pdf) were noted. Noting the positive impact on NWP code of snow data collected in Europe using the BUFR template 3 07 101 (Snow observation), adopted by CBS-ext.(2014), GCW requests CBS to encourage Members to exchange snow data in other regions, especially RA II and RA IV. "Snow anomaly trackers" by Finland (FMI) and Canada (CMC) were developed for GCW for monitoring daily changes on the hemispheric scale; see http://globalcryospherewatch.org/satellites/trackers.html. Regional snow trackers are under discussion to support, among others, Polar Regional Climate Centres.

It was noted that the Snow Watch Team fostered a very valuable assessment of the maturity and accuracy of snow products through the intercomparison project "SnowPEx", which is supported by ESA. With this perspective in mind, it has developed an initial inventory of snow products that is available online. The inventory includes three categories: (1) Satellite-derived snow products and datasets, (2) Analyses, reanalyses and reanalysis-driven snow products and datasets, and (3) In situ snow products and datasets. GCW's mandate is to be an authoritative source of cryospheric information for many users including the proposed Polar Regional Climate Centres. Therefore the inventory provides users with some guidance about the suitability of snow products and datasets for various applications.

Currently metadata are routinely harvested by the GCW Data Portal from several international data centres. Work on the integration of data from CryoNet stations/sites was initiated, including tests conducted with three CryoNet sites: Weissfluhjoch-Davos (Switzerland), Sonnblick (Austria) and Sodankylä (Finland). Based on this experience first versions of the GCW Data Portal Interoperability Guidelines and GCW Data Portal Operations Manual have been developed. The formulation of GCW observational requirements is an ongoing process. They will draw from various sets of existing user requirements and will be vetted by the scientific community. They will become part of the WMO Rolling Review of Requirements (RRR) and will be accessible through the Observing Systems Capability Analysis and Review Tool (OSCAR), which has a cryosphere theme. A discussion of users of GCW data and products ensued, especially the efforts of the EU FP7 project CryoLand on assessing user needs for snow and land ice and demonstrated the range and complexity of needs of cryosphere users. In addition to the observational requirements listed on the GCW Website, the Polar Space Task Group (PSTG) is compiling user requirements. They are available on the PSTG website. Finally, the importance of terminology within the cryosphere community and with other disciplines was emphasized. The

Terminology Team continues to expand the GCW cryosphere glossary and it now has over 2900 entries from 21 sources, with over 1600 unique terms. It is available online at http://globalcryospherewatch.org/reference/glossary.php.

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