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World Meteorological Organization

COMMISSION FOR BASIC SYSTEMS

OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

**Implementation and Coordination Team on
Integrated Observing Systems (ICT-IOS) Tenth Session**

5 – 8 February, 2018



FINAL REPORT

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MEETING AGENDA

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- 6.8 Radiofrequencies matters (SG-RFC)
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7. Observing System Design and Evolution

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- 7.3 Use of OSCAR for the RRR
- 7.4 Review of observing systems network design guidance based on the approved principles
- 7.5 Comments and amendments to the CIMO Document on the "Competency Framework for Observing Programme and Network Planning".

8. PREPARATION OF OPAG-IOS INPUT TO CBS PROCESS THROUGH CBS TECO

- 8.1 Consideration of reorganisation of WMO Technical Commissions
- 8.2 Consideration of new regulatory and guidance materials
- 8.3 Work Plans
- 8.4 OPAG IOS input to the CBS Operating Plan 2016-2019
- 8.5 Input and Recommendations for the CBS Regulatory and Guidance process, incl. CBS TECO 2018

9. ANY OTHER BUSINESS

10. CLOSURE OF THE SESSION

EXECUTIVE SUMMARY

The tenth session of the CBS, Open Programme Area Group on Integrated Observing Systems (OPAG-IOS), Implementation and Coordination Team on Integrated Observing Systems (ICT-IOS) was held over 5 to 8 February, 2018 at the WMO headquarters, Geneva Switzerland. The session was chaired by Dr Anthony Rea, Australia, and followed the meeting of the OPAG-IOS, Inter-Programme Expert Team on Observing System Design and Evolution (IPET-OSDE) which was held over 29 January to 1 February, 2018.

The primary focus for the meeting was the discussion and deliberation on the various key activities and priorities associated with CBS, the OPAG-IOS and its working groups, with an emphasis on preparations for input to the upcoming CBS Technical Conference 2018 (Geneva, Switzerland, 26-29 March 2018), the CBS Management Group 18th Session (Geneva, 29 March 2018), and the 70th Session of the WMO Executive Council (Geneva, 20-29 June 2018). The various representatives of WMO programmes, expert teams and other technical commissions provided input to the session on the status of the observing systems of the WMO Integrated Global Observing System (WIGOS) and reported on the progress made by the experts teams related to their operation and maintenance at the international level.

Additionally, the meeting was informed about the status and progress made on the WIGOS Pre-operational Phase, including the development of the concept of the Regional Basic Observing Network (RBON), the progress made on the development of the 2040 Vision for WIGOS and on the integration of GOS related regulatory and guidance materials under WIGOS. The ICT also considered its role and required collaboration associated with the implementation plans of the Component Observing Systems of WIGOS (GAW, GCW, WHOS, GCOS, GOOS).

Other important items that were addressed during the meeting were, the continuing development of the Observing Systems Capability Analysis and Review (OSCAR) system that supports the WMO Rolling Review of Requirements, the status of the "Competency Framework for Observing Programme and Network Planning" prepared by CIMO and the implications of technological and societal changes on the future of the meteorological enterprise, and for ICT-IOS, the future impacts on observing systems.

GENERAL SUMMARY

1. ORGANIZATION OF THE SESSION

1.1 Opening of the meeting

1.1.1 The tenth session of the Commission for Basic Systems, Open Programme Area Group (OPAG-IOS), Implementation and Coordination Team on Integrated Observing Systems was opened at 9am on the 5th February 2018, at the WMO headquarters in Geneva, Switzerland by the Chair of the ICT, Dr Anthony Rea, Australia.

1.1.2 Mr Fernando Belda, Director of the Observing and Information Systems Department welcomed participants on behalf of the WMO Secretary General, emphasising the importance of the meeting ahead of the CBS Technical Conference to be held at the end of March 2018, and an opportunity for the ICT to formulate its inputs relating to recommended decisions to be made by CBS for consideration and approval of the WMO Executive Council (EC-70, June 2018) and Congress (Cg-18, 2019). Mr Belda also reminded the team of the importance of the ongoing development of WIGOS, supported by the WMO Observing Systems Capability Analysis and Review system (OSCAR) and the need for more efforts in the area of capacity development and training to assist WMO members in evolving and improving the capabilities of WIGOS component observing systems.

1.2 Adoption of the agenda

1.2.1 The agenda for the meeting was discussed and agreed to be adopted as above.

1.3 Working arrangements

1.3.1 The Chair outlined the working arrangements for the session, with the team agreeing to meet predominantly in plenary and to undertake some work on various topics and aspects as groups in breakout sessions during the week under Agenda Item 8.

1.3.2 The list of participants in the session are provided with **Annex I**.

1.3.3 The tables of issues, decisions and recommendations agreed by the ICT are provided within **Annex II**.

2. REPORT OF THE CHAIRPERSON

2.1 Report of the Chairperson

2.1.1 The Chair of the ICT-IOS reported to the session on progress with regard to the OPAG-IOS work plan and the various actions that have been agreed according to the outcome of the 16th CBS session (CBS-16, Guangzhou, China, Nov. 2016), and guidance of the CBS Management Group.

2.1.2 He recalled that, at CBS-16, the Commission reviewed the Action Plans of the various Expert Teams within the Open Programme Area Groups (OPAGs), agreed on new Terms of Reference for the OPAG on Integrated Observing Systems (OPAG-IOS) and decided on new Terms of Reference of the Implementation Coordination Team on Integrated Observing Systems (ICT-IOS).

2.1.3 CBS-16 also decided on the Chairs of the various Expert Teams and tasked the Management Group to decide on their membership. Dr Rea invited the various Chairs of the Expert Teams to check the list of Decisions and Recommendations of CBS-16 that directly relate to OPAG-IOS (see Appendix 2 of ICT-IOS-10 document no. 2.1) and take necessary steps for expected actions to be undertaken. In particular, ICT-IOS is invited to respond to the following CBS-16 Decisions as follows:

- Decision 17 (CBS-16): to advise on the potential for developing and providing a freely available open-source OSCAR-compatible software package that could be implemented at the national level;

- Decision 19 (CBS-16): to consider mechanism for identifying experts to contribute to the training effort concerning OPAG IOS issues;
- Decision 21 (CBS-16): to review draft RBON Regulatory and Guidance material prepared by WIGOS PO and WIGOS Editorial board; and
- Decision 33 (CBS-16): All Expert Teams to act according to their Work Plans.

2.1.4 The Chair recalled that the CBS Management Group met for its 17th session in Geneva, Switzerland from 27 February to 1 March 2017 and followed up with a number of teleconferences at various occasions. At the CBS-MG-17, the Management Group decided on the Teams' membership. Approved work plans of the CBS Expert Teams are provided in Annex IV of the CBS-MG-17 final report.

2.1.5 Dr Rea also recalled that the ICT-IOS had a series of teleconferences and agreed on a number of actions to take into account CBS-16 outcomes together with the guidance from the CBS Management Group (see item 2.2.1 for review of action arising from the teleconferences).

2.1.6 The ICT-IOS also agreed on series of draft Decisions and Recommendations to be promoted through the CBS process with the view to have drafts submitted to the 70th and 18th Sessions of the Executive Council (EC-70, June 2018) and the World Meteorological Congress (Cg-18, 2019) as appropriate. The Action Plan for developing draft OPAG-IOS Decisions and Recommendations to be submitted through CBS Process was discussed and refined during this ICT-IOS meeting. He explained about the CBS process for submitting draft decisions and recommendations to EC-70 and Cg-18 is explained.

2.1.7 Dr Rea also noted that the CBS President has requested ICT-IOS (and all OPAGs) to consider the implications of technological and societal changes on the future of the meteorological enterprise, and for ICT-IOS, the future impacts on observing systems. This issue was discussed during the meeting under item 7.2.2.

2.2 Workplan

2.2.1 Review of actions items from ICT-IOS-9

2.2.1.1 The Team agreed that the actions from ICT-IOS-9 didn't have to be reviewed in detail as most had been completed, and the remaining ones were now either obsolete or integrated in the OPAG IOS Workplan, following the renewal of ICT-IOS by the CBS-16 and approval of updated OPAG IOS Workplan by the CBS Management Group at its 17th Session (Geneva, Switzerland, March 2017).

2.2.2 Review of outcomes from ICT-IOS Teleconferences

2.2.2.1 The meeting reviewed pending actions from the series of ICT-IOS Teleconference that were organized since the renewal of ICT-IOS per CBS-16 decisions and guidance of the CBS Management Group. Status of actions as reviewed was updated in the corresponding file in the Alfresco shared space.

2.2.3 Decisions and Recommendations of CBS-16 impacting on the OPAG IOS Workplan

2.2.3.1 The meeting reviewed and took note of the Decisions and Recommendations of CBS-16 that are relevant to OPAG IOS, and the resulting impact on the work plans of OPAG-IOS and its Expert Teams. These were considered in subsequent discussion during the meeting.

2.2.4 Issues to be brought forward to the CBS Regulatory and Guidance process (introduction)

2.2.4.1 The Secretariat briefly introduced the requirement for the OPAG IOS to contribute to the CBS Regulatory and Guidance process in advance of the 70th and 18th Sessions of the Executive Council (EC-70, June 2018) and the World Meteorological Congress (Cg-18, 2019) Sessions respectively. One key milestone in this process will be the CBS Technical Conference (CBS TECO 2018), which will take place in Geneva, from 26 to 29 March 2018, followed by an extended meeting of the CBS Management Group on 29 March 2018. It is expected that the

draft Decisions and Resolutions to be submitted to Cg-18 will first be reviewed by EC-70 in the form of Recommendation to Cg-18. Draft EC-70 Recommendations will be developed in the meantime and reviewed by CBS TECO 2018 for Experts' feedback, and by the CBS Management Group for consideration of such feedback, and consolidation of written material.

3. WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS)

3.1 WIGOS Pre-Operational Phase Status and Issues

3.1.1 Dr Lars Peter Riishojgaard, the Secretariat, addressed the team briefly on the status of the WIGOS Pre-operational phase and expressed his appreciation on behalf of ICG-WIGOS for the involvement of the ICT-IOS and its expert teams in supporting development in several key activity areas as outlined in item 3.2.

3.2 Progress of ICT-IOS on Support to WIGOS Pre-operational Phase

3.2.1 Mr Igor Zahumensky, the Secretariat, made a presentation to the session on progress made on several key activities in which the ICT-IOS and expert teams of the ICT-IOS were most closely involved.

3.2.1 Development of the RBON Concept

3.2.1.1 Since the endorsement by EC-68 (2016) of the RBON concept, the ICG-WIGOS through its WIGOS Editorial Board (WEdB) has been working on drafting related provisions for the RBON within section 3.2, Design, Planning and Evolution, of the Manual on WIGOS. As part of the draft Manual on WIGOS (edition 2019), this section will be submitted for approval by Cg-18 in 2019 along with new regulations associated with the WIGOS Data Quality Monitoring System (WDQMS) and those associated with the transition of the Manual on the GOS to the Manual on WIGOS.

3.2.1.2 The review process of the draft Manual on WIGOS will be as follows:

- 1) A technical review undertaken by all WMO technical commissions, over March to June, 2018;
- 2) Review by WMO Members over October to December 2018;
- 3) Review by ICG-WIGOS prior to its finalisation in January 2019; and
- 4) Approval by Cg-18 in 2019.

3.2.1.3 The meeting agreed on the following aspects related to the development of the RBON:

- The related principles and regulations of RBON should be presented at the upcoming CBS TECO and submitted to the CBS Management Group for its endorsement;
- The encouragement of the exchange of hourly and higher frequency data should be emphasised through the definition of the RBON;
- The team would consider and review the current draft of RBON material in a Breakout Group later during the session – the results of which are provided in **Annex VII**.

3.2.2 Progress on 2040 Vision for WIGOS

3.2.2.1 The meeting was informed by Dr Erik Andersson on the progress that had been made on developing the 2040 Vision for WIGOS under the leadership and direction of the ICG-WIGOS with input from CBS OPAG IOS Expert Teams, and the IPET-OSDE in particular

3.2.2.2 Following preliminary work initiated in 2015 for the satellite component of WIGOS and in 2016 for the surface-based component with contribution of IPET-OSDE, an integrated overall draft "Vision" documented was being developed by a drafting group lead by the ICG-WIGOS Co-Chairs and with continued involvement of the lead authors of the surface- and space-based contributions.

3.2.2.3 ICG-WIGOS-7 (Geneva, Switzerland, 15-17 January 2018) provided guidance on how to improve the document, e.g. better refer to cryosphere observations and GCW requirements, atmospheric composition and hydrology requirements, the role of partner organizations, etc.

3.2.2.4 Two more iterations of the review of the draft Vision are planned by teleconference (mid. February and mid. March). The draft will then be frozen for its submission to EC-70 and information document and for the Executive Council to note work in progress. John Eyre and Frank Grooters will continue to contribute to the discussion on behalf of the IPET-OSDE. Between EC-70 and Cg-18, the draft Vision will be submitted for review by a wider audience.

3.2.2.5 The team would consider and review the current draft of 2040 Vision material in a Breakout Group later during the session – the results of which are provided in **Annex VII**.

3.2.3 Transition of Manual on the GOS (WMO-No. 544) into the Manual on WIGOS (WMO-No. 1160)

3.2.3.1 The meeting was briefed by Mr Zahumensky and Mr Goldstraw on the progress made in the transition of the Manual on the GOS to the Manual on WIGOS by the WEDB with input from ET-SBO. This process was focused in particular on the removal of obsolete material and updating other materials to ensure consistency with WIGOS regulations and the developing RBON concept. The review process is specified in 3.2.1.2 above.

3.3 Review of Implementation Plans of Component Observing Systems

3.3.1 The Meeting discussed the need to review the various Implementation Plans (EGOS-IP, GCOS, GCW, GFCS, GAW) and prepare a synthesis document for the Members to understand what CBS is doing to address these various plans. In particular, this involves (i) looking at the actions from GCOS, GCW and GAW and identify those actions relevant to CBS and WIGOS, which may be missing from the EGOS-IP and could be proposed for consideration in a revised version of the EGOS-IP (or new WIGOS IP), and (ii) cross referencing the other actions from the GCOS, GAW and GCW IPs with those of the EGOS-IP. The Team agreed that it was important to undertake the effort, and noted that the issue has been discussed at the IPET-OSDE-3 meeting (Geneva, January 2018). The Team concurred with the recommendations of IPET-OSDE, which are provided in Annex IX of IPET-OSDE-3 final report, and requested the Secretariat to commit appropriate resources for this work.

3.3.2 The Team also agreed that some immediate actions may arise from the exercise, and that such actions could feed into some interim implementation plan before the future WIGOS IP is adopted around 2023.

3.3.3 The ICT agreed to the resolution of Issue 3.3.1, *Review of Implementation Plans of WIGOS Component Observing Systems*, as tabled in **Annex II**.

3.4 Plan for developing the future WIGOS Implementation Plan

3.4.1 The Team recalled the need to eventually develop an Implementation Plan for WIGOS to respond to the WIGOS Vision 2040, once adopted by Cg-18. The future WIGOS Implementation Plan (WIGOS-IP) will be developed after Cg-18 with the goal to have it adopted by Cg-19 in 2023.

3.4.2 The Team also noted and concurred with IPET-OSDE proposal regarding the planning for the development of the future WIGOS-IP. In particular, IPET-OSDE-3 has proposed a number of activities, and milestones, which are provided in **Annex III**.

3.4.3 The IPET-OSDE was invited to discuss and agree on the list of required activities, and to identify the actors who will have to undertake them.

3.4.4 The ICT agreed to the resolution of Issue 3.4.1, *Develop plan for developing the future Implementation Plan for the evolution of WIGOS (WIGOS-IP) responding to the Vision of WIGOS in 2040*, as tabled in **Annex II**.

4. STATUS OF THE SURFACE BASED COMPONENT OF THE GOS

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

4.1.1 Mr Dean Lockett, the Secretariat presented the current status of the RBSN and the RBCN of the WMO Global Observing System, based on the information derived from the OSCAR/Surface and the results of the World Weather Watch monitoring programme.

4.1.2 The meeting noted that, while the required details of the observational programmes provided by these stations operated by WMO Members were previously given in WMO Publication No. 9, Volume A, Observing Stations and WMO Catalogue of Radiosondes, since 2 May 2016 this information was now catalogued within the WMO OSCAR Surface system, available online at: <https://oscar.wmo.int/surface/>

4.1.3 This meant that, as a result of the developing nature of the use of OSCAR/Surface for station metadata, the station totals of the RBSN and the RBCN for 2018 as reported to the Team, and based on information from OSCAR/Surface did not accurately reflect the currently approved networks from the WMO Regional Association sessions and, therefore, the report served to highlight some of the issues with the quality of the networks metadata currently in OSCAR/Surface.

4.1.4 Additionally, it appeared that basis for reporting the status of these networks to ICT-IOI and CBS in the past was not well documented and relied to some extent on the availability of data from the stations at standard hours of reporting. This functionality was not yet readily available from OSCAR/Surface and the WIGOS Data Quality Monitoring System.

4.1.5 Other issues highlighted included:

- 1) The need to analyse and determine requirements for future reporting of the status of the RBSN, the RBCN and the RBON with respect to both their definition by Regional Associations and the quality and availability of reporting of observations.
- 2) There was a need to make an assessment of the requirements for assessing the quality of metadata in OSCAR/Surface, both with respect to the sites and metadata network and including the availability and accuracy of historical information.
- 3) Whilst it was possible to report the status of networks through the OSCAR Surface interface, there appeared to be some limitations to reporting specific attributes of networks that may be required for reporting purposes, e.g. those stations of a particular network that report at a particular time.

4.1.6 From the WWW quantity monitoring undertaken in October 2017, the following issues were highlighted:

- The percentage of surface reports from Antarctica dropped markedly in 2012 and has remained at about the same level since then. The percentage of reports from Region II has declined by ten percentage points since 2015 (over the same period Region IV showed a drop of four percentage points).
- Both Region I and Region III show a decline in the percentage of upper-air observations received of 16 percentage points since 2015.
- Stations are expected to produce one CLIMAT report each month for every station in the Regional Basic Climate Networks. Despite a rise in 2016, between 2015 and 2017 Region III showed a drop of 14 percentage points in the percentage of CLIMAT reports received.

4.1.7 The ICT agreed to the resolution of Issue 4.1.1, *Issues with the quality of metadata and the use of OSCAR Surface to monitor and report the status of the RBSN and the RBCN and other networks*, as tabled in **Annex II**.

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

4.2.1 Mr Tim Oakley, Secretariat, presented document 4.2 on behalf of GCOS. He focused on the 2017 performance statistics from the GCOS Surface Reference Network (GSN) and the GCOS Upper-Air Network (GUAN), highlighting the fact that in several regions these networks were further deteriorating, as monitored against the GCOS requirements, and comparing back to 2011.

4.2.2 The meeting was introduced to the new GCOS Implementation Plan (2016) which included many actions across the Atmospheric, Ocean and Terrestrial domains which were relevant to CBS. Of particular interest was the four task-teams working on the GUAN requirements, a concept for a GCOS Surface Reference Network, the use of weather radar data for climate monitoring and defining the data user requirements for the new lightning ECV.

4.2.3 Details of a recent GCOS/WIGOS regional workshop in Fiji (Oct 2017) was presented to the meeting, along with a plan for a similar workshop in a sub-region of Africa in 2018.

4.2.4 The meeting was also informed about the work of the CBS-LC-GCOS and the plans for the next biennial meeting in Asheville, USA (10th - 14th Sept, 2018).

4.2.5 The ICT-IOS was requested to consider how best to assist in the following:

- 1) Recognise that GSN & GUAN monitoring is showing a decline in performance, most notably in RA-I and South Pacific Islands.
- 2) Promote, and support where possible, the work of the 4 AOPC Task Teams.
- 3) Support the GCOS proposal that the GUAN requirements need to be updated, in-line with the tiered network system (reference-baseline-comprehensive).
- 4) Acknowledge the output from the Regional workshops, in collaboration with WIGOS.
- 5) Support the proposed next biennial meeting of CBS-LC-GCOS in Asheville, United States (Sept 2018).

4.2.6 The session expressed its concern regarding the degradation of the GCOS networks over Africa, given that NWP centres are increasingly providing NWP products to support climate monitoring and other applications and so even limited observations losses were significant. The meeting agreed that this issue should be raised as a significant issue at CBS by the ICT-IOS, in addition to a similar issue regarding the sharing of observations on the GTS.

4.3 Marine and Oceanographic Observations

4.3.1 During last intersessional period, JCOMM has continued to develop and redefine targets and performance indicators for the marine and oceanographic observations programmes and associate programmes in line with requirements set by EGOS-IP, WIGOS-IP, GCOS-IP, as well as GFCS. The plenary welcomed Key Performance Indicators (KPIs) in use and those for further development by JCOMM.

4.3.2 On behalf of Scientific Officer, Ms. Champika Gallage, Dr. Long Jiang, Technical Coordinator for the Data Buoy Cooperation Panel (DBCP) and OceanSITES reported on the performance of the marine and oceanographic observations. Dr Jiang further invited the plenary to draw attention to major progress, issues/challenges for respective observing programmes.

4.3.3 The ICT noted there are seven programmes coordinated by and associated with JCOMM. They are:

JCOMM programmes

- 1) DBCP—Data Buoy Cooperation Panel
- 2) OceanSITES—Ocean Sustained Interdisciplinary Timeseries Environment Observation System
- 3) SOT—Ships Observing Team (Including the Voluntary Observing Ships Programme—VOS, Automated Shipboard Aerological Programme-ASAP and the Ships of Opportunity Programme--SOOP)
- 4) GLOSS—Global Sea Level Observing System

JCOMM associate programmes

- 5) Argo profiling float programme
- 6) GO-SHIP—Global Ocean Ship-based Hydrographic Investigations Programme
- 7) IOCCP—International Ocean Carbon Coordination Project

4.3.4 The overall performance of the marine and oceanographic observations has been positive and encouraging in the past intersessional period. For example, amount and coverage of the global drifters have been stable above the designed targets. The Argo floats programme has been expanding capacity in geographic reach, coverage, and density as well as sampling depth and six more BGC variables. The SOT has been working with the International Maritime Organization (IMO) to invite wider participation of the shipping community in the ship-based marine observing activities for improved data availability for safety at sea and climate monitoring.

4.3.5 However, the plenary noted funding remains an issue for the marine observations community, as most programmes rely heavily on volatile scientific research funds. BUFR migration is still challenging particularly for buoy operators (mainly moored buoys). The plenary urged the DBCP and JCOMM to explore possibilities and mechanisms to facilitate smooth and reliable BUFR transition for Members. The Arctic Eurasian region is under-investigated due to harsh environment and climate.

4.3.6 The plenary welcomed DBCP efforts to address GHRSSST and Wave Measurement and encouraged DBCP and other programmes to look into new technology. The plenary discussed OceanOBS'19 and invited JCOMM and associate programmes to link with and contribute to the event.

4.3.7 The plenary appreciated JCOMMOPS in maintaining and integrating metadata in compliance with WIGOS metadata standards with its web-based facility, and encouraged JCOMMOPS to better incorporate and interface with all marine observing programmes.

4.3.8 More details on marine observations were covered at C-MAR 6.6 report.

4.4 CryoNet of the Global Cryosphere Watch (GCW)

4.4.1 GCW will request EC-70, through EC PHORS, to, formally, establish the Global Cryosphere Watch surface observing network, which currently contains about 150 stations. With the network established, GCW will enter its pre-operational phase, as a cross cutting, end to end programme. GCW will request the 18th World Meteorological Congress to approve the pre-operational phase.

4.4.2 The observing component of the Global Cryosphere Watch is one of the four components of WIGOS. The GCW Surface Observing Network consists of CryoNet station, contributing stations and affiliated networks. Regulatory material regarding GCW is available and maintained up to date in the Manual on WIGOS (WMO No 1160). The latest updates will be made in Q1, 2018. The most important change is the introduction of the term "cluster" replacing the previous term of "site".

4.4.3 Snow Measurement Best Practices Guide has been developed in cooperation with CIMO, for inclusion in the newly proposed Volume II, Measurement of Cryosphere Variables, of the CIMO Guide, WMO No.-8.

4.4.4 In collaboration with IPET-CM, GCW is pursuing the development of a BUFR Template for Snow Water Equivalent (SWE), and will actively pursue the broader exchange of available SWE data, by Members.

4.5 Roundtable on regional issues

4.5.1 The team discussed several regional issues that had been highlighted by team members ahead of the meeting and which are summarised within **Annex IV**.

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

5.1 Operational Component

5.1.1 WMO Secretariat reported the status of the space-based component of the Global Observing System (GOS) 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.

5.1.2 The Team agreed that the last few years showed substantial improvements with regard to space-based observations. In addition, the core of GEO and Polar Orbiting satellites is relatively stable.

5.1.3 The Team expressed concerns about the risk in radio occultation observation with regard to the maturity of profiles to be assimilated into the NWP model.

5.1.4 The Team also discussed the procedure for gap analysis based on the Space component of the Vision for WIGOS 2040. The following recommendation was agreed to be submitted to CBS TECO: *WMO and CGMS (through its working group III) to define and adopt a formal process for detecting and addressing gaps in the space-based component of WIGOS. This should include risk assessment and contingency planning.*

5.1.5 The ICT agreed to the resolution of Issue 5.1.1, *Strengthening collaboration with CGMS regarding Risk Assessment and Gap Analysis*, as tabled in **Annex II**

5.2 Research Component

5.2.1 The Team stressed the need for data users to take note of existing research missions and to take advantage of the corresponding data.

5.3 Global satellite intercalibration

5.3.1 WMO Secretariat reported that the Global Space-based Inter-Calibration System (GSICS) was initiated in 2005 by WMO together with the Coordination Group for Meteorological Satellites (CGMS) for ensuring consistent accuracy among space-based observations from operational weather and environmental satellites of the Global Observing System (GOS) for climate monitoring, weather forecasting, and environmental applications. The GSICS develops common methodologies and implements operational procedures to ensure quality and comparability of satellite measurements taken at different times and locations, by different instruments, operated by various satellite agencies.

5.3.2 The Team recognized that this is achieved through a comprehensive calibration strategy which involves: 1) monitoring instrument performances, 2) operational inter-calibration of satellite instruments, 3) tying the measurements to absolute references and standards, and 4) recalibration of archived data. The resulting inter-comparisons achieve inter-calibration when the measurements are traceable to absolute references and standards. GSICS contributes to the integration of satellite data within the WMO Integrated Global Observing Systems (WIGOS).

5.3.3 The Team further recognized that GSICS activities are overseen by a GSICS Executive Panel assisted by a Research Working Group (GRWG) and a Data management Working Group (GDWG), and the status will be reported to CGMS annual meeting. The progress will be shared with ET-SAT and IPET-SUP through WMO Secretariat.

5.4 Satellite data accessibility

5.4.1 This item was discussed under agenda item 6.4.

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

6.1 Report of IPET-OSDE

6.1.1 The chair of the Inter Programme Expert Team on Observing System Design and Evolution (IPET-OSDE), Erik Andersson (ECMWF) reported on outcome of the Third Session of IPET-OSDE, which took place in Geneva the week prior to this ICT-IO meeting. In particular, it was the first opportunity the IPET-OSDE met after its re-instatement by CBS-16 in November 2016 with new membership. He draw the Team's attention to the following activities and achievements since IPET-OSDE-2 (April 2016) that are relevant to our work:

- The 6th workshop on the impacts of various observing systems on NWP was held in Shanghai, 10-13 May 2016. The workshop was very successful, with important contributions from participating experts in the field of observation impact assessment. Plans for a 7th WMO workshop were discussed at IPET-OSDE-3. See item 6.7 for details.
- John Eyre has represented IPET-OSDE and the CBS in the activities of the Working Group on GRUAN (WG-GRUAN). He attended the GRUAN 9th Implementation-Coordination Meeting (ICM-9), at FMI, Helsinki, 12-16 June 2017. One of the take-home messages from the workshop was the complementary nature of surface-based and space-based observations, for cal/val of each other, deserves more attention in future. The next meeting (ICM-10) is planned to take place in Potsdam, 23-27 April 2018.
- Work has continued since IPET-OSDE-2 on gathering material for the Review of Progress against the Actions in the Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP). A sub-group of the IPET-OSDE devised a questionnaire (using SurveyMonkey) that has been used for the first time in 2017 to collect feedback from the National Focal Points (NFPs). A summary of the feedback collected in this way will be presented at the meeting. The interactions with the NFPs were reviewed and discussed at IPET-OSDE-3. See also item 7.1.
- Progress has been made in the review of RRR Application Areas for Climate. There is now agreement that requirements will be recorded for two Climate-related AAs: Climate Monitoring and Climate Science. The pre-existing WCRP-related AAs have been marked 'historical' in the data base. IPET-OSDE-3 proposed changes to the list of Application Areas, and the Team concurred with such changes.
- A new Point of Contact (PoC) for the Application Area on Nowcasting and very short-range forecasting (Alexander Kann, ZAMG, Austria) has been recruited, and we are glad to welcome him in this role.
- The Vision for WIGOS in 2040 is being drafted under the leadership of the WIGOS Programme Office for submission to Cg-18 in 2019. An IPET-OSDE drafting group meeting for the "Vision for WIGOS Surface-Based Observing Components in 2040" was held in Offenbach, Germany, 23-25 August, 2016. The output of this meeting was provided to a Workshop on the "Vision for WIGOS in 2040: surface-based perspective" held in Geneva, 18-20 October 2016. During 2017, the drafted material resulting from that workshop was merged with the Vision of the space-based component into one single coherent document, which is currently under review by WIGOS teams. IPET-OSDE will continue to be involved in reviewing and finalising this important document. IPET-OSDE-3 discussed how to transition from the Vision for Global Observing Systems in 2025, and its associated implementation plan (the EGOS-IP), to the new WIGOS framework with its Vision for WIGOS in 2040 and the development of a future WIGOS-IP.
- Significant progress has been made towards the consolidation of variables naming conventions used in OSCAR/Surface and OSCAR/Requirements, using the WIGOS Metadata standard as a reference. A large degree of commonality exists between the three lists. A relatively small number of variables have been identified as either missing in one or two of the lists, or used with a different meaning or interpretation. An ad-hoc task team led by John Eyre has consulted with relevant domain experts, in an attempt to resolve discrepancies where they exist. IPET-OSDE-3 reviewed this work, and agreed that it should continue.
- Following the preparation of a set of WIGOS "Principles" for Observing Network Design (OND) by the IPET-OSDE, these Principles became part of the Manual on WIGOS, which was subsequently approved by the WMO 17th Congress in May-June 2015. Guidance addressing the OND Principles, also prepared by IPET-OSDE, was endorsed by CBS-16 (Guangzhou, China, November 2016) as part of the WIGOS Guide, now published as WMO No. 1165. IPET-OSDE-3 discussed requirements for updates to either the OND Principles and/or Guidelines.

- IPET-OSDE-3, also gave particular attention to the following issues:
 - The continuation and extension of the OSCAR facility, in particular with a view of better supporting gap analysis.
 - Further strengthening and promotion of the RRR process, and continued engagement with representatives from the WIGOS Application Areas.
 - Safeguarding of WMO's well established data sharing principles, ensuring that these principles lead to extended and enhanced global exchange of observations to meet the WIGOS future needs.
 - Ensuring progress on Actions in EGOS-IP. It should be the role of IPET-OSDE, with the support of OPAG-IOS and WIGOS as a whole, not only to monitor progress but also actively to promote it.
 - Looking ahead, developing plans for a future WIGOS-IP.
 - Recommendations to take forward to ICT-IO-10 and CBS, taking into account the information gathered at the 6th WMO workshop on the impact of various observing systems on NWP', the updated SoGs prepared for this meeting, and the outcome of our discussions.

6.1.2 The Team was also pleased to hear about an ECMWF article on 'How to evolve the global observing systems' written by Dr Andersson, and available from the ECMWF Website . The Team agreed that this article can be used widely to promote the activities of IPET-OSDE.

6.1.3 Based on the outcome of IPET-OSDE-3, the Team reviewed, discussed and decided on a number of issues for which ICT-IO-10 decisions and recommendations were required. These are reflected in **Annexes II** and **V**:

6.2 Report of ET-SBO

6.2.1 Mr Stuart Goldstraw, United Kingdom of Great Britain and Northern Ireland, reported on the progress made by the Expert Team on Surface-Based Observations, which held its first meeting (ET-SBO-3) of the current CBS inter-sessional period in Geneva over the 20 - 23 June 2017. The main purpose of the meeting was to bring all members of the ET, especially the many new members, to a common level of understanding of the purpose of the team and key objectives and activities within the work plan. Mr Goldstraw noted that close relationships with other expert teams in WMO are essential to the success of ET-SBO and selection of some ET Members has been undertaken to ensure cross-team engagement. This was most notable in terms of shared membership with WIGOS Task Teams and CIMO expert teams.

6.2.2 The following aspects of the ET-SBO work plan and associated activities were highlighted:

- The team was requested to review a draft of the Vision for WIGOS 2040, and feedback was provided on the surface-based component in July 2017.
- The team was contributing to the task under WIGOS to integrate the GOS regulatory material into the WIGOS regulatory material through participation of the Chair of ET-SBO to the working meetings of the WIGOS Editorial Board as an invited expert. The ET-SBO contribution to the development of RBON regulatory material, to be included in the Manual on WIGOS, was another activity to which ET-SBO was contributing in the same way.
- The ET-SBO had also adopted an activity to assist and provide support for the process to develop WIGOS guidance on AWS operation under the coordination of the ICG-WIGOS, however this activity would be delayed whilst other higher priority activities in this area were first addressed.
- The work plan of ET-SBO included an activity to establish and manage a component of the WIGOS Information Resource (WIR) in the form of a forum for the exchange of information and best practices between member experts on observing systems

development and operation. This work plan item had been put on hold until the revised WMO extranet has been implemented, as any solution will be closely linked to the revised WMO extranet.

- During ET-SBO-3 a number of issues were highlighted by regional representatives, some of which require escalation to CBS and some of which the team might address under its work plan. Additionally, the process of undertaking the review of the status of implementation of the actions of the EGOS-IP by the team had raised a number of issues with operational delivery. The team had developed a task in the work plan to better coordinate the provision and resolution of these type of issues raised by members in line with the proposed work on the WIR.
- The team, led by Ms Minna Huuskonen, FMI, had undertaken a review and provided input on the status of implementation of the various EGOS-IP actions assigned to ET-SBO for reporting to IPET-OSDE. Under this process, a number of baselines had been established for some actions and future reports by the team would reference progress made against these baselines.
- ET-SBO expected to continue to review the progress on relevant actions of the EGOS-IP and in the future identify specific tasks to assist members in improving progress made on their implementation, as it was doing in relation to the study on optimisation of the radiosonde network.
- In relation to this activity and following endorsement from CBS-XVI to proceed with the work plan, the task lead had recommended a slightly revised approach should be taken to the study to first ensure that members were willing to even contemplate changes to radiosonde network operational practices. Therefore, an additional step had been added to the outline plan approved by ICT-IOS-9 in the form of a questionnaire to Members to ascertain their current situation and obtain their views, ideas and concerns with respect to radiosonde operations and their willingness to consider changes to the existing regulations. The results of the survey would be analysed in the first quarter of 2018 to determine if the original plan was validated. In addition the ET-SBO would work with the C-SEIS team within IPET-OSDE to ensure the study was adequately supported with required NWP observing system impact studies.
- The team was considering the outputs from the recent GRUAN technical meeting which highlighted the importance and a likely recommendation from the GRUAN community that ground checks of radiosonde humidity should to be made at both 0% and 100% specific humidity. The ET-SBO would undertake a task to consider how relevant regulatory and guidance material is currently formulated with a view to strengthening this if required.
- The strong overlap between TT-WDQMS and ET-SBO work programme and membership had resulted in a number of GOS requirements for improved data quality monitoring being delivered by TT-WDQMS activities. It was expected that the ET-SBO would later consider how to play a role in defining the requirements for and assisting in the establishment of tasks that enable Regional WIGOS Centres (RWCs) supporting the improvement in the land surface-based component of the GOS from a WDQMS point of view.
- At ET-SBO-3, the issue was raised relating to the fact that there appeared to be confusion among members relating to the use of the correct geode model, which was essential for the optimal use of radiosonde data by NWP and surface pressure measurements. Whilst it was clear that adequate guidance material on the use of appropriate geode models exists, it appeared there was a need for it to be more unambiguously defined within the WIGOS Metadata Standard and supported by consolidated guidance and notes. It was recommended that this work should be addressed by ICT-IOS.

- While the team had defined within the plan requirements to develop methodologies for the analysis of OSCAR/Surface metadata content to determine its validity, work on this task was yet to commence.
- Team Member, Ms Pei Chong, China had represented CBS as a member of the organising committee for the WMO International Conference on Automatic Weather Stations (ICAWS-2017).
- The ICT agreed to the resolution of Issues 6.2.1 to 6.2.6, as tabled in **Annex II**.

6.3 Report of ET-SAT

6.3.1 Dr Jack Kaye, United States of America, provided a summary of the Expert Team on Satellite Systems (ET-SAT) activities new and ongoing since ICT-IOS-9, and in light of the ET-SAT-11 session held in Geneva, Switzerland in April 2017.

6.3.2 A Key activity of the team was to deliver a follow-up discussion of the Space-based components of the WMO Integrated Global Observing System (WIGOS) Vision in 2040 (WIGOS/Vision 2040). The Team reviewed the first draft of the WIGOS Vision/Space 2040 and provided comments for updating, and it was presented at the 45th Meeting of the Coordination Group for Meteorological Satellites (CGMS-45) in June 2017. Since CGMS-45, ET-SAT chair and WMO Secretariat have been working together for its major revision through a couple of ad-hoc teleconferences, and the latest version was presented at the EUMETSAT Meteorological Satellite Conference in October 2017 for inviting comments from conference participants.

6.3.3 The Team also discussed the progress in developments of the space module of the Observing System Capability and Analysis and Review tool (OSCAR/Space), and its long-term maintenance that should facilitate its use in support of future gap analysis studies.

6.3.4 The Team were invited to review and update the status of the identified critical issues on space-based global observing system to be discussed in CGMS-45 for risk assessment and gap analysis on global continuity. The following items, identified as risky in the previous document for CGMS-43, were reviewed for updating:

- a) Geostationary coverage of Indian Ocean;
- b) Transition to GOES-R in South America;
- c) Geostationary infrared sounding (hyperspectral on some slots);
- d) Imagery and sounding on early morning orbit;
- e) Continuity of afternoon primary missions;
- f) Radio-occultation;
- g) Altimetry;
- h) Active ocean surface wind measurement (scatterometer wind data);
- i) Earth Radiation Budget;
- j) Limb sounding.

6.3.5 The Team recognized that four items; a), b), d), and e) were considered no longer an issue: a) Coverage ensured by the concurrence of several satellites (i.e. Meteosat-8, INSAT-3D, Electro-L N2 and FY-2) with providing redundancy for contingency and data availability satisfactory; b) NOAA has undertaken to disseminate selected GOES-R images by GNC-A; d) FY-3E will be launched in 2018; e) The p.m. orbit is served by three satellite series, JPSS, Meteor-M and FY-3, that provide redundancy as a safeguard against large service interruptions.

6.4 Report of IPET-SUP

6.4.1 Mr Stephen English, United Kingdom of Great Britain and Northern Ireland presented the report of the Inter-Programme Expert Team on Satellite Utilization and Products (ET-SUP).

6.4.2 The third Session of the Inter-Programme Expert Team on Satellite Utilization and Products (IPET-SUP-3) met at WMO HQ 2-5 May 2017. This was the first meeting under the chairmanship of Stephen English (Chair) and Fang Xiang (Vice-Chair). The membership of the team had changed significantly since IPETSUP-2, with some very valuable additions.

6.4.3 IPET-SUP has made significant progress over the past two years, including:

- 1) A survey was carried out in the period 8 Feb – 15 Mar 2016, with more than 200 responses received. The results were presented and discussed at IPET-SUP-3;
- 2) IPET-SUP continued to provide input to the initial Vision for the WIGOS space-based components in 2040;
- 3) Regional satellite data requirements groups were active in RA I, II, III/IV and V and reported to IPET-SUP regularly. Development of progress indicators on satellite data dissemination, including for DBNet, was on-going;
- 4) Participation in relevant fora, helping to focus the WMO survey on these topics and interaction with CEOS as appropriate;
- 5) Best practices for achieving user readiness (Reference User Readiness Project) were published; Next-generation of OSCAR/Space, Product Access Guide and SATURN were now online;
- 6) The team continued to develop and manage the SCOPE-Nowcasting initiative, with four pilot projects underway;
- 7) VLab 2015-2019 strategy was updated and a number of user preparedness events had been completed;
- 8) Continued to provide input on the WIGOS Vision 2040;
- 9) A communications plan was drafted and reviewed at IPET-SUP-3 and the team had renewed engagement with JCOMM.

6.4.4 The IPET-SUP continued to coordinate or maintain the following outputs and activities:

- Guidance:
 - WMO Best Practices to Achieve User Readiness for New Meteorological Satellites
 - WMO Guideline on Satellite Skills and Knowledge for Operational Meteorologists
 - Guide to the Direct Broadcast Network for Near Real-Time Relay of LEO Satellite Data
- Structured dialogue between satellite data users and satellite operators in WMO Regions
- Case studies for Establishing an Architecture for Climate Monitoring from Space (joint WMO - European Commission report)
- A successful training programme (VLab)
- Online resources such as the Satellite User Readiness Navigator (SATURN)

6.4.5 The ICT agreed to the resolution of Issues 6.4.1, *Effective use of new generation geostationary satellites*, and 6.4.2, *Emerging data issues: consideration of new observation types in the WMO Integrated Global Observing System*, as tabled in **Annex II**.

6.5 Report of ET-ABO

6.5.1 Dr Curtis Marshall, United States of America, provided a summary of the Expert Team on Aircraft-Based Observing Systems (ET-ABO) activities new and ongoing since ICT-IO-9, and in light of the ET-ABO-3 session held in Jakarta, Indonesia in May 2017.

6.5.2 A Key activity of the team was the ongoing development and formalization of the IATA-WMO Collaborative AMDAR Programme (IWCAP), and specifically, the development of the IWCAP, Concept of Operation (ConOps). The ConOps will describe in detail how the two organizations might work together in the future based on a collaborative regional and global

approach to the operation of the AMDAR programme and the delivery of aircraft-based observations. The development of the IWCAP has previously received approval from EC, and the associated ConOps and Implementation Plan are being prepared for endorsement by the upcoming CBS TECO, EC 70 and, later, Congress, in Summer 2019. In the interim, WMO RA VI had formally endorsed the collaboration and ConOps, agreeing to work towards operation under the collaboration by January 2019, subject to formal establishment of the IWCAP by the partner organizations. This matter was further considered by the session under agenda item 8.5, including the expected requirements for reporting to CBS and addressing the matter at the CBS Technical Conference in March.

6.5.3 Other ongoing activities of the Team that had been progressed included:

- 1) establishment of the Global Data Centre for Aircraft Based Observations (GDC-ABO) in collaboration with the USA;
- 2) enhancement of data quality monitoring functions by the Lead Centre for ABO;
- 3) establishment of ABO metadata within OSCAR Surface; and
- 4) facilitating regional workshops for the establishment of AMDAR programs in NMHSs where such programs do not currently exist.

6.5.4 Further details on the activities of the team were presented to the session within the ET-ABO work plan, supported by the budget of the AMDAR Trust Fund.

6.5.5 The ICT agreed to the resolution of Issue 6.5.1, *Requirements for ABO NWP impact studies and assessment*, as tabled in **Annex II**.

6.6 Report of the Coordinator on Marine Observing Systems (C-MAR)

6.6.1 The Coordinator on Marine Observing Systems (C-MAR), Mr Jon Turton (United Kingdom) reported via Teleconference on issues related to the implementation of marine meteorological and oceanographic observing systems, as undertaken by the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) Observations Programme Area (OPA). The JCOMM OCG is responsible for the technical coordination of ocean observing networks, capitalizing on cross-network synergies. Hence, OCG coordinates with and responds to other groups who are charged with setting requirements for ocean observations, in particular the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS) through the Ocean Observations Panel for Climate (OOPC).

6.6.2 Mr Turton also particularly reported on decisions and recommendations of the fifth Session of JCOMM, which are related to WIGOS.

6.6.3 Following the 8th Session of OCG (Qingdao, China, 22 to 25 May 2017) the Observations Programme Area (OPA) Vision for the new JCOMM Intersessional Period and Observations Coordination Group (OCG) Work Plan for 2015-2020 were proposed and updated respectively. They were then endorsed by JCOMM-5 (Geneva, Switzerland, 25-29 October 2017) through Decisions 7.1/1 (JCOMM-5) and 7.1/2(JCOMM-5) respectively. The goal of the Work plan is to achieve synergies across observing networks, and advance intersessional activities, taking into account key milestones such as OceanObs19, etc. The Work Plan is designed in line with the Framework for Ocean Observing (FOO, 2009) and complementary to that of the OOPC.

6.6.4 Mr Turton also explained that an important development during the last year has been the development of the JCOMM Observing System Report Card for 2016 (see <http://www.jcommops.org/reportcard/>). This was prepared for the JCOMM-V session and outlined the status of the ocean observing system in 2016 and its primary applications. The intention is that the report card will be produced annually with the 2017 Report Card to be prepared during spring 2018.

6.6.5 The Team noted that the JCOMM in situ Observations Programme Support Centre (JCOMMOPS – www.jcommops.org) is acting as a key global facility providing operational support to implementation of marine and ocean observing systems. The Team agreed that

JCOMMOPS was a key function contributing to WIGOS, which should be sustained. It noted that a review of JCOMMOPS is underway with expectation to have it completed by the fall of 2018.

6.6.6 The Team reviewed, discussed and agreed on some proposed decisions and recommendations. There are reflected in **Annexes II** and **V**:

- Reducing number of VOS classifications;
- Integration of WMO No. 47 in the WIGOS Metadata Standard; and
- Transfer of regulatory and guidance material relevant to marine meteorological observations from the GOS material to WIGOS material.

6.7 Report of the Coordinators on Scientific Evaluation of Impact Studies undertaken by NWP Centres (C-SEIS)

6.7.1 Mr Sid Boukabara, United States of America, and Ms Seiyong Park, Republic of Korea, provided the report of the Coordinators on Scientific Evaluation of Impact Studies undertaken by NWP Centres (C-SEIS).

6.7.2 The report presented a list of potential impact studies that had been reviewed and revised by the IPET-OSDE at its 3rd session prior to the ICT-IOS meeting. The list comprised those studies previously agreed by ICT-IOS that were still to be addressed and some newly proposed studies to be considered. The ICT-IOS revised the list and agreed on its formulation as provided in **Annex IX**.

6.7.3 The ICT-IOS discussed the preparations being made by C-SEIS and IPET-OSDE and gave its support to the plans that had been made for the 7th workshop on "Impact of Various Observing Systems on NWP", planned for spring 2020 and hosted by the Korea Meteorological Administration.

6.7.4 The ICT agreed to the resolution of Issue 6.7.1, *Science questions related to observing system impact studies and organisation of the next workshop*, as tabled in **Annex II**.

6.8 Radiofrequencies matters (SG-RFC)

6.8.1 ICT-IOS noted the following activities of the SG-RFC :

- the successful publication of the Radio Frequency Handbook¹ in 2017 in close cooperation with the International Telecommunications Union (ITU). This Handbook is available in six United Nations languages.
- the Joint WMO/ITU seminar held in 2017 which provides an opportunity to present the need to ensure the protection of the use of radio spectrum and to safeguard frequencies for meteorological services, including the work on climate monitoring and forecasting and to face to the increasing pressure on the use of radio spectrum in particular from wireless technology and other applications.
- the success for the meteorological community during the World Radiocommunications Conferences (WRC) in 2012 and 2015 where the decisions taken were fully in line with WMO positions and hence ensured the protection of meteorological systems and applications. These positive results are essentially based on the involvement of WMO and the important work and efforts made during the whole study periods by the WMO representatives, in ITU, but also in the active participations in the regional organizations.
- the progress in development of the WMO position to the WRC-19. It further noted the importance of preparation for WRC-23 in relation to space weather sensors and to possible new allocation to the Earth exploration-satellite (active) service for spaceborne radar sounders. Work regarding these two issues was initiated in framework of the

¹ Handbook on the Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction (WMO-No. 1197) - https://library.wmo.int/opac/index.php?lvl=notice_display&id=20006#.WtmdEK6WaHs

preparation for WRC-15 which highlights the long term outlook that must be maintained for SG-RFC.

6.8.2 The meeting also noted and concurred with a proposed new resolution on SG-RFC for Congress to consider based on the draft CBS recommendation (see issue #6.8 in **Annex II** and **Annex X**). In light of the discussion, ICT-IOS made the following decisions:

- 1) Noting the importance of regional participation in ITU regional body session and the need for regional WMO coordination as exemplified by Eumetfreq, ICT-IOS tasked SG-RFC to review the proposed resolution on SG-RFC "Urges (2)" to emphasise this.
- 2) Recommend that RA WIGOS groups include a Regional Focal Point for RFC matters.
- 3) Update the WIGOS Manual and Guide to include the new Guide to participation in Radio Frequency Coordination (WMO No 1159) and update the reference to the Handbook on Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction (WMO- No. 1197)
- 4) The meeting noted a couple of points of particular concern regarding the impact of competition for spectrum:
 - in the 401 to 406 MHz (i.e. radiosondes and DCP usage) and the request for use part of this frequency band for command and control of non-GSO satellites with short duration missions (i.e. nano and pico satellites), even though some of these systems will benefit WMO activity, the cost to operations of meteorological aids cannot be justified,
 - in several frequency bands considered for the future development of International Mobile Telecommunications (IMT) and in particular :
 - constraints that may occurred for the future deployment of Earth station for the Earth exploration satellite systems (space to Earth) in the band 25.5 – 27 GHz
 - compatibility between IMT unwanted emission and Earth exploration satellite (passive) systems in the frequency bands 23.6-24 GHz, 31.5-31.8 GHz, 36-37 GHz, 50.2-50.4 GHz, 52.6 - 54.25 GHz and 86-92 GHz.

6.9 Report of CIMO/IPET-OWR

6.9.1 Mr Dean Lockett, the Secretariat, presented document 6.9 to the meeting providing a report by the Chair of the CIMO Inter-Programme Expert Team on Operational Weather Radars, Mr Daniel Michelson, Canada, of progress by the team, which is formed under CIMO and jointly managed by CBS and CIMO.

6.9.2 The IPET's first session was held over 13-17 March 2017 at the Japan Meteorological Agency in Tokyo where the initial work plan was elaborated and finalized, with several important deliverables scheduled during 2017.

6.9.3 The following issues, activities and achievements were highlighted

Radar Data Exchange

- The previous activity of the CBS ET-SBO and its Task Team on Weather Radar Data Exchange (TT-WRDE) that addresses radar data representation and exchange had been well-advance by the IPET, with the ultimate objective to propose a single global standard data representation for weather radar, and also recommend data exchange methods. These deliverables were on track and comprised:
 - i. Information model for radial radar and lidar data. Specifies what information should be represented.
 - ii. Data model for radial radar and lidar data. Specifies how the information should be represented.
 - iii. CfRadial2 Data File Format. Specifies a Climate and Forecasting Conventions version 2 (CF2) compliant file-format representation for data in radial coordinates.

- iv. WMO Member Use of the CfRadial2 File Format. Advises WMO Members on how to use CfRadial2 to represent their data (for exchange).
- v. Weather Radar Data Exchange Methods. Provides an overview of data exchange mechanisms and guidance on exchange of weather-radar data.
- Deliverables 1-4 are in document form and near completion. Item 5, was still under development. Software implementation was also underway, with reference outputs expected during 2018.
- The IPET would now take the important step to engage with CBS OPAG-ISS scheduled for 2018.
- This short document outlines data exchange methods in a weather-radar context,

Metadata Management

- IPET-OWR contributed to the Ad-Hoc Workshop on Weather Radar Metadata (WMDS), 19-21 June 2017 in Locarno, Switzerland. This workshop provided the opportunity to synchronize metadata from several sources in a WIGOS context. Such sources are the information model addressed above, EUMETNET OPERA, OSCAR/Surface, and the WMO Weather Radar Database. IPET-OWR has in its work plan tasks related to metadata management and contributing to OSCAR, and these expect to be guided by the outcomes of the TT-WMD-6 Workshop in Zurich, 27-29 November, 2017.

Development of Guidance on Operational Weather Radars

- In IPET-OWR's work plan, the emphasis is on drafting advice and guidance on a wide range of topics related to weather radar. A high-level document has already been prepared on weather-radar network design and applications. The work on guidance will be focused through the development of the "Weather Radar Best Practices Guide (BPG)", which will highlight the need for an end-to-end approach to weather radar deployment, operations, and data quality/processing in relation to user requirements.
- Guidance on interference is also under preparation in terms of policy. Two types of interference are identified: radio interference (e.g. radio-LAN) and that caused by proximity to wind turbines.

Interaction with ISO

- During 2017, a joint ISO-WMO standard for weather radar was drafted with direct input from IPET-OWR members. This was now being finalised through the ISO review procedures. This initial standard was expected to be the first part of two, and focussed on defining a weather radar system with an emphasis on requirements and standards for radar hardware. WMO and ISO now envisage developing, through a strong interaction with IPET-OWR, Part 2 of the standard that would address data quality and data processing issues.

7. OBSERVING SYSTEM DESIGN AND EVOLUTION

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

7.1.1 The Team considered ongoing and new matters relating to the design and evolution of observing systems, particularly focusing on the status of actions of the CBS Implementation Plan for the Evolution of the Global Observing System (EGOS-IP, adopted by EC-65 in 2012).

7.1.2 The Team noted that IPET-OSDE-3 has undertaken a comprehensive review of the status of EGOS-IP actions, reflected in Annex XIV for IPET-OSDE-3 final report.

7.1.3 The Team noted with concern that some of the EGOS-IP Actions had not resulted in progress, and even showed decline, and in particular:

- Action G11 (improvements – Improve quality, availability and sustainability of GUAN, ensuring maintenance of the existing network, and data quality) whereby a substantial decline of GUAN has been noted in particular in tropical regions;
- Action G18 (Processing & exchange of profiler data – Ensure, as far as possible, the required processing and the exchange of profiler data for local, regional and global use. When profiler data can be produced more frequently than 1 hour, a dataset containing only hourly observations can be exchanged globally following the WIS principles)
- Action S20 (MW imagers for SST – Ensure availability of microwave imagers with all necessary channels to monitor SST) whereby WMO should continue to raise the importance MW imager missions with CGMS and CEOS
- Action S29 (Sounders for atmospheric chemistry) whereby WMO should re-state the importance of sounders for atmospheric chemistry with both CGMS and CEOS

7.1.4 The Team also noted that some of the EGOS-IP Actions are out of date and obsolete. The Team agreed that such Action could be ignored as part of the exercise to monitor their status.

7.1.5 With regard to availability of the future WIGOS IP in all WMO languages, the Team recalled that translation errors has been noted in the current EGOS-IP, and advised that steps ought to be taken to avoid having such errors in the future WIGOS IP, which should therefore be given a WMO number and be edited accordingly by the Secretariat.

7.2 Rolling Review of Requirements

7.2.1 Observing System Requirements for Urban Forecasting

7.2.1.1 The meeting was informed that in response to Decision 41 (EC-69), an urban expert task team (ETT) tasked to write the Guide for Urban Integrated Hydrometeorological, Climate and Environmental Services and a focal points group within WMO Secretariat to assist with its development were established.

7.2.1.2 The first face to face meeting of the ETT will be in Reading, UK on 26-29 January 2018. The first version of the IUWECS Guide is expected to be prepared and presented to EC-70 in June 2018.

7.2.1.3 Observing system requirements for urban forecasting and services are a natural and important part of the IUWECS Guide (see Appendices 1&2). Two experts Mr. Reinhard Spengler (Reinhard.Spengler@dwd.de) and Dr. Bert Heusinkveld (bert.heusinkveld@wur.nl), as recommended by CBS and CIMO respectively, are included into the ETT as the responsible authors for writing urban observations part of the IUWECS Guide.

7.2.1.4 Urban areas have typically been relatively poorly served with respect to observations by NMHSs as the urban environment creates challenges for siting instruments following WMO standard guidelines. Although WMO has published guidance for siting some instruments in urban areas (WMO 2012), typically most sources of canopy layer meteorological data within urban areas are not operated by NHMS. Also, typically, a number of other agencies collect observations in urban areas that are critical for the development of an IUWECS.

7.2.1.5 However, often there are insufficient observations and/or they are not representative of the appropriate area of interest. Thus to develop an IUWECS the observational network would need in most cases to be enhanced. In addition, attention needs to be directed to the footprint of the various observational systems to identify gaps relative to the urban characteristics.

7.2.1.6 The meeting was informed that the IPET-OSDE had addressed this issue during its recent session and had determined that:

- 1) There were one or more existing application areas where requirements for observations to support urban forecasting could be added or strengthened; and

- 2) There appeared to be a requirement for a new application area that the IPET had suggested might be called: "Land" and would be parallel in scope to the Oceans application area, supporting requirements for applications such as agriculture, fire risk management, land and urban flood forecasting, etc. Such an application area might also include observational requirements to support additional Urban Forecasting applications that were not covered in other existing application areas.

7.2.1.2 7 The ICT agreed to the actions associated with issue 7.2.2.1, Observing System Requirements for Urban Forecasting, as tabled in **Annex II**.

7.2.2 Implications of technological and societal changes

7.2.2.1 At the request of the President of CBS, the team discussed and determined a list of potential implications for observing systems design and operation based on potential future technological and societal changes. The summary of this discussion is provided within **Annex VIII** and would be conveyed to CBS by the Chair of ICT-IOS.

7.3 Use of OSCAR for the RRR

7.3.1 The meeting noted that IPET-OSDE-3 has discussed the user of OSCAR for the Rolling Review of Requirements (RRR), including in support of gap analysis. It concurred with the proposal from IPET-OSDE as described in Annex XVIII of IPET-OSDE-3 final report.

7.3.2 The Team noted the challenge of considering all sources of observations, incl. satellite data for gap analysis, and agreed that the tool developed within OSCAR ought not to be called "gap analysis" but preferably "analysis tool using OSCAR". A number of caveats will have to be highlighted within the future tool to warn users about the purpose of the tools, the assumptions made, and how to properly interpret the delivered information. The Team advised that users ought to register in order to use the tool.

7.3.3 The ICT agreed to the resolution of Issue 7.3.1, *Proposed gap analysis using OSCAR*, as tabled in **Annex II**.

7.4 Review of observing systems network design guidance based on the approved principles

7.4.1 The Team discussed whether there was a need to update the Observing Network Design (OND) guidance of the WIGOS Guide. It noted that changes can always be made to the Guidance according to the ICG-WIGOS process. It agreed that the OND Principles are in a good stage of maturity but recognized that they are not well embraced in WIGOS community.

7.4.2 The Team also recalled that the ICG-WIGOS Task Team on Public Private Partnership (TT-PPP) has developed a document, which includes guidance on data sharing with the private sector. It requested the IPET-OSDE to review this document in the view to possibly propose changes to the OND Guidance for consistency with ICG-WIGOS PPP document.

7.4.3 The Team agreed that changes and clarifications could be introduced with regard to the following areas:

- Concept of tiered observing network, with different levels of quality (example of GCOS material that could be used) – to be done by next IPET-OSDE meeting
- Data sharing and partnership with the private sector; suggesting how data policy should be captured in procurement of observations from the private sector, for better sharing with NMHSs.
- Make OND Principles and Guidance more widely used. This to be communicated at CBS TECO, and addition of related training needs.

Action: 7.4	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	to review this document in the view to possibly propose changes to the OND	IPET-OSDE	Feb. 2018

	Guidance for consistency with ICG-WIGOS PPP document		
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7.5 Comments and amendments to the CIMO Document on the "Competency Framework for Observing Programme and Network Planning".

7.5.1 The Team recalled that at its previous meeting it had reviewed a draft "Competency Framework for Observing Programme and Network Planning" prepared by CIMO. The document has been slightly updated by CIMO, and the Team reviewed it again, and made the following comments:

- On performing gap analysis using OSCAR: there should be a mention that other tools ought also to be used.
- How competencies are measured, and corrective action taken. Regional Associations should make sure that people are properly training.
- How can people be receiving the required training.
- Document will be good material for the Regional Instrument Centres.

7.5.2 The Team invited CIMO and the WMO Education and Training Programme to take into account the competency framework document, and look at how competency gaps can be addressed.

7.5.3 The ICT agreed to the resolution of Issue 7.5.1, *Competency Framework for Observing Programme and Network Planning*, as tabled in **Annex II**.

8. PREPARATION OF OPAG-IOS INPUT TO CBS PROCESS THROUGH CBS TECO

8.1 Consideration of reorganisation of WMO Technical Commissions

8.1.1 The Team noted information on the WMO reform process, including reorganization of the Technical Commissions. Noting the likely plan to establish a basic infrastructure commission, the Team agreed that CBS and its OPAG IOS was relatively well prepared for the foreseen future changes.

8.1.2 The type of activities that the OPAG IOS is undertaking will have to continue in the future structure, and the ICT-IOS work plan will have to be transitioned to the work programme of the future Commission on basic infrastructure, and continue until the 2020 timeframe. It was also noted that ICG-WIGOS has identified activities which will be important to continue. The Team saw such changes as an opportunity to improve how things works and are coordinated.

8.1.3 The Team agreed that the CBS TECO 2018 should be used as a useful mechanism to communicate with CBS members about foreseen changes.

8.1.4 Team noted that it will be informed about developments, but in the meantime, the OPAG IOS Expert Teams were requested to focus on their work plans.

8.2 Consideration of new regulatory and guidance materials

8.2.1 The meeting was informed about the progress being made related to development of and improvements to regulations and guidance, chiefly being undertaken through the work of the ICG-WIGOS, the WIGOS Project Office and the WEdB in collaboration with several OPAG-IOS teams, which included:

- 1) development of regulations relating to the definition and operation of the RBON;
- 2) modernisation and integration of regulatory material of the GOS into WIGOS regulatory material;
- 3) integration of regulations relating to WDQMS; and

4) development of guidance materials under the work plan of the CIMO/IPET-OWR

8.2.2 The ICT-IOS agreed that it was a high priority for the OPAG to support these developments.

8.3 Work Plans

8.3.1 The Team noted that the ICT-IOS Workplan is constituted of the set of the OPAG IOS expert team work plans as decided by the CBS Management Group, updated according to CBS-16 outcome.

8.3.2 The Team requested the expert team chairs to keep their work plans under review and update the status column according to progress.

8.4 OPAG IOS input to the CBS Operating Plan 2016-2019

8.4.1 The team recalled that OPAG IOS input to the CBS Operating Plan was discussed and decided since CBS-16 by means of teleconference and had in specific actions being incorporated into the document, Decisions and Recommendations where OPAG-IOS is Requested to Undertake Action, provided in Annex 2 to the Report of the Chair (Doc. 2.1 of the Document Plan).

8.4.2 It requested the Expert Team Chairs to consider these decisions and recommendations when planning and executing their work plans.

8.5 Input and Recommendations for the CBS Regulatory and Guidance process, incl. CBS TECO 2018

8.5.1 In preparation for the finalisation of this agenda item, the session agreed to discuss and deliberate in breakout groups, on particular issues relating to the input and recommendations to be made at the upcoming CBS Technical Conference and management group meeting in March 2018. The topics and outcomes from these breakout groups are provided in **Annex VII**.

8.5.2 Returning to plenary, the session discussed document 8.5(1) prepared by the Secretariat that addresses the ICT-IOS, Action Plan for Developing Draft OPAG-IOS Decisions and Recommendations to be Submitted Through CBS Process, Item 7, Recommendations on implementing and integrating emerging observing systems (e.g. new satellite technologies, aircraft, surface GPS) in the Regions.

Actions to be taken to make better use of satellite information and products

8.5.3 WMO Space Programme engages with a range of user groups and satellite data providers, as well as satellite training centres, to enhance the use of satellite data and products. It supports the five international science working groups on winds, sounding, radio occultation, clouds, and precipitation, and regularly links their expertise with user needs for information and training. WMO Space Programme is also leading efforts to develop guidance material for training on space weather matters, and maintains online portals to guide users in accessing and utilizing satellite data (Product Access Guide, Satellite User Readiness Navigator (SATURN)). Together with CGMS operators it supports the Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) which, through 13 centres of excellence, delivered in 2016 alone 122 training events for over 4000 participants, largely through distance learning.

8.5.4 The VLab infrastructure (online meeting software, web presence) and proceedings (management meetings etc) is maintained by a technical support officer who is funded through a WMO VLab Trust Fund. Satellite providers in CGMS provide annual financial contributions to keep the Fund operational, however, a broader diversity of donor contributions by Members would strengthen robustness of the Fund, and help support training activities for a wider range of WMO Application Areas (e.g., climate, marine meteorology). Members are invited to consider financial contributions to the fund (on the order of 10K CHF per year; around 80K CHF / year are currently funded).

8.5.5 The ICT agreed to the resolution of Issue 8.5.1, *Sustained funding of the VLab Technical support officer*, as tabled in **Annex II**.

IATA-WMO Collaboration on AMDAR

8.5.6 The Secretariat reported that the following actions had been taken in relation to the IATA-WMO Working Arrangement on possible future collaboration on the AMDAR programme:

- WMO and IATA secretariat representatives met in Geneva in December 2016 and agreed on the possibility to collaborate on the further development and operation of the AMDAR programme.
- Representatives of the IATA secretariat met with the WMO ET-ABO Leadership in Silver Spring, USA in February 2017 and agreed to work together on developing the terms of reference and Concept of Operations for the IATA-WMO Collaborative AMDAR Programme (IWCAP).
- From April 2017, a consultant was contracted to the ABO programme to coordinate development of the ConOps document.
- In May 2017, EC-69 approved document and Decision 12.2(2)/1 endorsing the collaboration and approving the establishment of a Working Arrangement between the two organizations to work towards defining the terms of reference and Concept of Operations for the IWCAP.
- The third session of CBS/OPAG-IOS/ET-ABO (May 2017, Jakarta, Indonesia) discussed and endorsed the proposed collaboration and the content of the developing ConOps.
- The IATA-WMO Working Arrangement was formally established in July 2017.
- ET-ABO and IATA have continued working on the IWCAP ConOps and produced the IATA-WMO Collaboration on the AMDAR Programme Proposed Concept of Operations, Draft – Version: 22 December 2017, which was provided as Information Document 6.5(1).

8.5.7 The following steps and actions have been recommended by ET-ABO to progress the process towards developing a proposal for the establishment of the IWCAP:

- 1) The IWCAP ConOps to be developed for wide review by WMO and IATA stakeholders by end of 2017 (Done).
- 2) A Side Event on the IWCAP to be held at the 17th Session of the WMO Regional Association VI (February, 2018) and a Resolution to be made with an endorsement of the ConOps and commitment by RA VI to develop and implement the RA VI Regional AMDAR Programme over 2019-2020.
- 3) The Terms of Reference and Implementation Plan for the IWCAP to be drafted for submission to CBS TECO by February 2018.
- 4) The CBS TECO and CBS-MG to consider a recommendation to EC-70 to endorse the establishment of the IWCAP and to submit a recommendation to Cg to approve the establishment of an agreement with IATA on the IWCAP.
- 5) EC-70 to consider a CBS-recommended Resolution to endorse the establishment of the IWCAP and recommend its approval by Cg-18 (June 2018).
- 6) IATA expected to consider and approve the establishment based on endorsement of the IATA General Assembly in July 2018.
- 7) Cg-18 to consider approval of the establishment of the IWCAP in June 2019.
- 8) IWCA Commence Development in 2019 (Region VI)
- 9) IWCA Commence Operations in 2020 (Region VI)
- 10) Each RA to consider a decision to develop their Regional AMDAR Programme under the IWCAP.

8.5.8 The ICT-IOS considered the IATA-WMO collaboration in light of the work of the breakout group – see **Annex VII** - that discussed this matter and agreed on the following:

- While the Concept of Operations and the regional approach being proposed was sound, there were some issues that needed to be addressed, particularly pertaining to:
 - i. legal aspects of the proposed collaboration;
 - ii. the establishment of an entity or entities that could form business contracts and provide services to WMO members with agreed service levels;
 - iii. the possible perception of a monopolistic approach; and
 - iv. formulation of the costing model.
- A working group or task team should be established by CBS and later formalised by EC to:
 - i. Investigate and resolve the potential legal and other issues relating to the collaboration;
 - ii. Review and finalise the ConOps and other related documentation;
 - iii. Oversee the formulation of recommendations to EC-70 and Cg-18; and
 - iv. Oversee the final establishment of the IWCAP and its governance structure if and when approved to do so by Cg.

8.5.9 The ICT agreed to the resolution of Issue 8.5.2, *Consideration of Draft Recommendation for CBS to EC-70 in relation to IATA-WMO collaboration on AMDAR*, as tabled in **Annex II**.

Surface-based GNSS radio-occultation and exchange of such data

8.5.10 The meeting discussed several issues relating to the exchange of GNSS data, including:

- there was evidence that restrictions were being placed on exchange of such data in some countries due to agreements with private operators and data providers
- there may be a need for CBS and EC to emphasise a need to form agreements with data owners for WMO members to be able to exchange such data on a free and unrestricted basis or else to propose a requirement to be able to develop some more complex form of data policy.
- May be a need to recommend/conduct studies and global impact and wide-regional impacts to provide strong arguments for sharing GNSS data internationally.

8.5.11 The team agreed that this issue should be taken up in light of and in the resolution of other current issues relating to possible requirements to update Resolution 40, the exchange of high resolution and third-party observational data and the definition of the RBON.

Consideration of Request to CBS regarding OSCAR/Surface Open Source Software

8.5.12 Having considered the matter of the request to CBS to facilitate provision of an open-source, stand-alone version OSCAR/Surface for Members in Breakout Group 3 (**Annex VII**) and discussed it in plenary, the meeting decided that there currently did not appear to be the justification to make the recommendation to invest resources and overcome the various difficulties associated with seeking that the OSCAR/Surface project attempt to facilitate this request as a component of the development project.

8.5.13 ICT-IOS decided to recommend, to CBS Management Group, that Members should be advised to form a consortium to consider developing a stand-alone solution for national

management of sites metadata that is compatible with the WIGOS Metadata Standard and the OSCAR/Surface machine-machine interface.

Consideration of Meeting Requirements for Member Exchange of High Resolution Data

8.5.14 The meeting discussed the issue of the exchange by Members and availability of high resolution observational data required to support all applications areas and future requirements of the "Earth Observing System". The notes from this discussion are recorded in full within **Annex VII** under Breakout Group 5.

8.5.15 The team agreed that:

- there was both a current and anticipated future need to work towards ensuring that Members were aware of requirements and were prepared and able to make available through exchange, sufficiently high resolution data to meet the needs of data users and WMO applications areas.
- the current definitions within Resolution 40 and its first Annex were inadequate and likely needed revising to ensure that Members are not only encouraged to exchange required higher resolution observational data, but that they were also not discouraged from doing so based on a mistaken belief that the requirements expressed therein are maximal rather than a minimum requirement.
- Resolution 40, Annex 1 likely required revising to ensure that:
 - Definitions are correct; for example, data defined as Essential can really be exchanged "freely";
 - It caters for the management of 3rd party data;
 - Exchange of higher resolution data is required/encouraged;
 - References the RBON and the requirements for observations as established through the WMO Rolling Review of Requirements (RRR).
- The development of the definition of the RBON within WIGOS regulatory materials should be used as an opportunity to better link requirements for exchange of observational data, as defined within OSCAR through the RRR, with the identification of RBON stations and the associated requirements for the operation of such observing systems.

8.5.16 The team agreed on the following actions:

- 1) ICT-IOS would hold a side event at the upcoming CBS Technical Conference on the issue of meeting current and future requirements for exchange of high resolution observational data with a view to canvassing the opinion of Members on the matter and developing recommended actions to address it through EC and Congress.
- 2) ICT-IOS would establish a sub-group to assist with the process of formulating regulatory material on the RBON within the Manual on WIGOS so as to ensure that requirements for exchange of high resolution data from RBON observing systems is able to meet the current and future requirements of application areas.
- 3) ICT-IOS and the Secretariat will take action to ensure that the update of WIGOS regulatory material that impacts on requirements for observations from satellite systems is reviewed and approved by ICT-IOS and the relevant expert teams.

9. ANY OTHER BUSINESS

9.1 The ICT-IOS discussed the following additional items.

Observing System Change Management and Related Communications

9.2 The secretariat informed the meeting that the issues of change management and communications between Members and experts in relation to observing systems practice had

been raised in several recent WMO meetings. At the ET-SBO session (ET-SBO-3, June 2017), it was suggested that Members were unaware of requirements for informing WMO about changes to observing system and site operations, practices and programmes and that this might be better specified and managed under the WIGOS framework. Additionally, the ET-SBO agreed that some Members and experts had expressed a desire to be able to informally communicate with other experts on matters relating to observing system operations and practices and this might be best facilitated through WMO and WIGOS, perhaps via the WIGOS Information Resource. The matter was subsequently raised at the last ICG-WIGOS session (ICG-WIGOS-7, January 2018), which agreed that there was a requirement to address this more generally under the WIGOS framework.

9.3 The secretariat had undertaken some preliminary analysis of this matter and suggested that:

- While the Manual on WIGOS has provisions on change management in several chapters and sections, there are no references to practices or procedures for reporting and recording such information, apart from within the developing metadata repository in OSCAR.
- It is expected that OSCAR will provide the functionality for Members to formally register metadata relating to future changes to sites and site configuration (e.g. observations, reporting frequency, etc).
- It appears the Manual on the GOS makes no provision for formal reporting in relation to change management.
- The Manual on the GTS specifies provisions for the making of METNOs and WIFMAs, which provide advanced notification of changes to Volumes A (observing stations) and C (catalogue of bulletins and transmission programmes) and Volume D (shipping information) respectively.

9.4 Possible ways to address this issue might be:

- Adaptation to the requirements and functionality of WIGOS systems (e.g. OSCAR/Surface) to support change management functions and procedures.
- Future adaption and transition of the WIGOS Newsletter to routinely provide information to Members and data users on WIGOS observing systems changes to practices and operations.
- Development and implementation of online forums to support both formal and ad hoc communications with and between member operators, expert and data users in relation to observing systems operations, issues and changes.

9.5 The team agreed that this matter required addressing and that the ICT-IOS should take an action to do so in the second half of 2018, possibly through the formation of a sub-group tasked to undertake analysis and make recommendations in collaboration with ICG-WIGOS.

Feedback on the ICT-IOS Session, Working Arrangements

9.6 The team discussed the working arrangements for the session and agreed on the following possible changes to be made in the future:

- Each session might in the future include an item to introduce WMO to new team members and explain the mechanics, operations and practices of WMO and its constituent bodies.
- There was a requirement to have more time to commit to consideration of work plans and progress made by teams.
- While in the past, the holding of ICT-IOS and IPET-OSDE sessions back-to-back had some advantages, it was agreed that consideration should be given to separating these meetings in the future.

- The outcomes and purpose of the meeting might be better conveyed and specified to participants before the meeting.
- Participants should make a greater effort to provide documents in a more timely manner to allow review and reading by participants prior to the meeting.

10. CLOSURE OF THE SESSION

10.1 The Chair thanked all experts for their participation and contribution to the meeting and closed the session mid-afternoon of the 8 February, 2018.

Annex I - List Of Participants

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ANNEX II - Issues, Decisions and Recommendations of the ICT-IOS

Issue #3.3.1	Review of Implementation Plans of WIGOS Component Observing Systems		
Background	The CBS Management Group requested the OPAG-IOS to review the various Implementation Plans (e.g. EGOS-IP, GCOS-200, GCW-IP, GAW-IP) relevant to WIGOS component observing systems to ensure that all CBS-relevant actions, in any of these existing IPs, will be captured and presented in the future WIGOS-IP. A synthesis document should be prepared to reflect the findings of the review with recommendations, and a summary of what will have to be considered in the future WIGOS-IP.		
Rationale for the proposed decision/action or recommendation	Need to rationalize WMO response to the various implementation plans, feeding into the future WIGOS Implementation Plan (i.e. successor of EGOS-IP), responding to the WIGOS Vision 2040.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	to investigate whether some resources could be set aside for a consultant (to be recruited) to undertake the review of the various IPs in 2018	Secretariat	asap
	to undertake review of the various Implementation Plans	Consultant	June 2018
	To consider ICT-IOS and the consultant feedback when developing the work plan for developing the future WIGOS-IP	IPET-OSDE	Cg-18
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	to update the GCW Implementation Plan with consideration of CBS efforts and guidance	GCW Steering Committee	Cg-18
	to develop the WHOS Implementation Plan with consideration of CBS efforts and guidance	CHy	Cg-18
	to develop the new GOOS Implementation Plan with consideration of CBS efforts and guidance	JCOMM, OOPC	Cg-18
Issue #3.4.1	Develop plan for developing the future Implementation Plan for the evolution of WIGOS (WIGOS-IP) responding to the Vision of WIGOS in 2040		
Background	Following up from the current Implementation Plan for the Evolution of Global Observing System (EGOS-IP), which is responding to the Vision for the Global Observing System in 2025, there will be the need to develop a WIGOS Implementation Plan (WIGOS-IP), which will be responding to the WIGOS Vision 2040, once approved by XCg-18.		
Rationale for the proposed decision/action or recommendation	In compliance with the Manual on WIGOS (WMO No. 1160), Chapters 2.1 and 2.2 on (i) requirements and (ii) design, planning and evolution respectively, the Organization will have to undertake the Rolling Review of Requirements and particularly develop an Implementation Plan for the evolution of WIGOS (WIGOS-IP) responding to the Vision of WIGOS in 2040, and to replace the current Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP).		
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>

	Recommendation of CBS to EC-70 for initiating development of the WIGOS-IP according to the proposed plan	EC-70 through ICT-IOS-10, CBS TECO, CBS MG	Mar. 2018
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Issue #4.1.1	Issues with the quality of metadata and the use of OSCAR Surface to monitor and report the status of the RBSN and the RBCN and other networks.		
Background	<p>Given the identified issues with OSCAR Surface metadata quality and reporting networks status, it was suggested that the ICT-IOS might consider whether there is a need to put in place a team to undertake the following activities:</p> <ol style="list-style-type: none"> 1. Analyse the current status of the quality of the stations and networks metadata in OSCAR Surface; 2. Analyse the procedures and processes for maintaining OSCAR Surface metadata and determine if they are adequate to maintain metadata quality; 3. Analyse the current functionality of the OSCAR Surface interface and determine if it is adequate to measure and maintain metadata quality; 4. Analyse the current and expected future requirements for determining (defining), analysing and reporting networks metadata; 5. Analyse the required OSCAR Surface functionality to support requirements for determining, analysing and reporting networks status. 		
Decision(s)	There is a requirement to address existing and envisaged future issues associated with defining and reporting on network status in OSCAR Surface.		
Recommendation(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ICT-IOS-10 agreed that there is a requirement for ICT-IOS to instigate activities related to the quality management of OSCAR Surface stations and network metadata.	ICT-IOS	ICT-IOS-10
	Include in OPAG IOS workplan issues with the quality of metadata and the use of OSCAR Surface to monitor and report the status of the RBSN and the RBCN and other networks. ICT-IOS to consider at next telecon.	ICT-IOS	Mid-2018

Issue #5.1.1	Strengthening collaboration with CGMS regarding Risk Assessment and Gap Analysis		
Background	<p>The Coordination Group for Meteorological Satellites (CGMS) Working Group III (WG-III) is reviewing and updating the status of the identified critical issues on space-based global observing system, which is provided by the WMO Secretariat. This is to be discussed in CGMS Plenary for risk assessment and gap analysis on global continuity, based on the "Vision for the GOS in 2025".</p> <p>A WMO- CGMS workshop is planned for 30 April - 2 May 2018 to hash out the details of this process, i.e. to (i) define gaps, (ii) roles and responsibilities for identifying gaps, (iii) updating the CGMS contingency plan (drafted in 2007, but never formally adopted). The results should ultimately be reflected in an updated definition of the WMO Space Programme at Cg-18.</p>		
Rationale for the proposed decision/action or recommendation	In order to ensure the sustainability of the space-based global observing system, there is a need to achieve a sufficient discussion in CGMS for risk assessment and gap analysis on global continuity.		

Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To relay ICT-IOS recommendation with regard to risk assessment and gap analysis to CBS Management Group via CBS TECO 2018	ICT-IOS Chair	Apr. 2018
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	WMO and CGMS (through its working group III) to define and adopt a formal process for detecting and addressing gaps in the space-based component of WIGOS. This should include risk assessment and contingency planning.	Cg-18	2019

Issue #6.1.1	Draft WIGOS Guidance on Data Partnerships		
Background	WIGOS Task Team on the WIGOS Data and Partnerships (TT-PPP) drafted WIGOS Guidance on Data Partnerships		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	to have a look at the report from the WIGOS TT-PPP and to provide their feedback to WIGOS PO through the IPET-OSDE Chair and OPAG-IOS Chair	IPET-OSDE members	asap
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To consider as appendix of the WIGOS Guidance on Data Partnerships, some example draft clauses that Members could use in contract business. Example of such clauses could include requirements on: data processing to be part of the radio-sonde procurement contract as it is critical for data users to understand how data are being produced and that such data meet the user needs; ability to distribute data to other users.	TT-PPP	Feb. 2018

Issue #6.1.2	Support for Global Climate Observations		
Background	The Global System for Climate: Implementation Needs (GCOS-200) identifies the actions needed to improve global climate observations. This document highlights ongoing activities initiated by GCOS.		
Rationale for the decision/action or recommendation	The Status of the Global Observing System for Climate (GCOS-195) describes the gaps and needs of the global climate observing system.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>

	Surface Vision 2040: items from GCOS IP needed to be reflected in the Vision. Make sure that the space-based parts are covered properly in the Vision consistently with GCOS-IP (rec. to ICT-IOS to do that). We need to consider the timeline proposed by ICG-WIGOS; John to contribute.	IPET-OSDE	asap
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To consider both requirements and capabilities for GCOS concerning weather radar and lightning detection systems (in particular, what are the capabilities of radar or lightning to contribute to GCOS-IP? How do radar and lightning data contribute to building the climate record?)	GCOS	End 2018

Issue #6.1.3	Points of Contact of Application Areas		
Background	All Application Areas need a Point of Contact.		
Rationale for the decision/action or recommendation	<p>The Point of Contact is responsible for coordinating RRR activities for their Application Area with the user community of that area and to (i) collecting and compile observational user requirements and their entering into the OSCAR/Requirements, and (ii) doing a critical review and gap analysis and drafting the Statement of Guidance of the Application Area.</p> <p>PoCs are missing for some of the Application Areas, or the PoC expressed the wish to no longer undertake that role.</p>		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	Nominate PoC for Ocean Application Area	JOCMM	Mar. 2018
	Nominate new PoC for Global NWP	CBS/DPFS	Mar. 2018
	To make sure that their Application Area "owner", i.e. the relevant Commission or Expert Group, is agreeing with the proposed requirements in OSCAR/Requirements	All PoCs	Ongoing

Issue #6.1.4	OSCAR/Requirements updating procedure		
Background	The OSCAR/Requirements and OSCAR/Space updating and maintenance procedure is kept under review by the IPET-OSDE and ET-SAT respectively.		
Rationale for the decision/action or recommendation	Some changes are proposed to the OSCAR/Requirements procedure to reflect on the recommendations of the OSCAR Variables review group.		
Decision(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	ICT-IOS-10 approved proposed update of the OSCAR/Requirements updating and	ICT-IOS	Feb. 2018

	maintenance procedure as provided in Annex IX of IPET-OSDE-3 report		
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Issue #6.1.5	Evolution of OSCAR/Requirement		
Background	OSCAR/Requirements software and database to evolve in order to facilitate the undertaking of the RRR.		
Rationale for the decision/action or recommendation	A few possible evolutions of OSCAR/Requirements were identified and the IPET-OSDE is invited to discuss them and agree on which one(s) should be proposed.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ICT-IOS-10 concurred with the list of OSCAR/Requirements evolution(s)	IPET-OSDE-3	Jan. 2018
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To recommend list of desired evolutions of OSCAR/Requirements, and request the Secretariat to facilitate their development and implementation. To invite Members to contribute resources in support of development of the required changes.	CBS through ICT-IOS	Mar. 2018

Issue #6.1.6	Integration of lists of variables		
Background	To make proposals through appropriate governance for required changes in OSCAR, WIGOS Metadata Standard, and WMO Codes Lists		
Rationale for the decision/action or recommendation	Proposal with rationale will be expected from the List of Variables Review Group.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ICT-IOS-10 concurred with the approach of the Review Group, and plan, for updating lists of Variables in OSCAR. Review Group to finalize its work according to the plan	Variables review Group	Mid-2018
	To work in due course with MeteoSwiss for implementing required changes in OSCAR concerning lists of variables	Secretariat.	TBD
	To relay ICT-IOS recommendation to ICG-WIGOS TT-WMD regarding changes proposed to the WIGOS Metadata Standard, once Review Group makes final proposal	ICT-IOS Chair	Mid-2018
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To recommend implementing the changes proposed to the WIGOS Metadata Standard, once Review Group makes final proposal	ICG-WIGOS via TT-WMD	Mid-2018

Issue #6.1.7	OSCAR/Space as repository of WIGOS Metadata		
Background	OSCAR/Space is not currently a natural repository of WIGOS metadata		

	for space-based observing systems.		
Rationale for the decision/action or recommendation	A proper repository is needed for WIGOS metadata concerning space-based observing systems.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ET-SAT in consultation with IPET-SUP was requested to discuss the issue, in the view to have a recommendation made to ICT-IOS on the best way forward for managing WIGOS metadata concerning space-based observing systems (standard to be followed by partners and space agencies on a voluntary basis).	ET-SAT Chair	ICT- IOS- 11

Issue #6.1.8	Strengthening collaboration with CGMS regarding operations and evolution of OSCAR/Space		
Background	To achieve a sufficient maintenance and support for OSCAR/Space with keeping the database updated with information of sufficiently high quality, WMO would like to strengthen the cooperation with CGMS members and observers from other space agencies through newly established support groups, the OSCAR/Space Support Team (O/SST) and the OSCAR/Space Science and Technical Advisory team (O/SSAT), to ensure the sustainability of OSCAR/Space in the years to come. This scheme will lay the foundation of cooperation with CGMS for sustaining the OSCAR/Space updating process through provision of information on their satellite programmes by making use of the provided templates. A necessary budget and human resources will be allocated in accordance with the Decision 17 (CBS-16) on OSCAR Maintenance and Resourcing; where the Commission requested the Secretary General to facilitate maintenance and further development of the three components of OSCAR (OSCAR/Surface, OSCAR/Space, OSCAR/Requirements), and to actively solicit contributions from Members to this effort, for example in the form of secondments or financial resources to the WIGOS Trust Fund		
Rationale for the decision/action or recommendation	In order to ensure the sustainability of OSCAR/Space in the years to come, there is a need to achieve a sufficient maintenance and support for OSCAR/Space with keeping the database updated with information of sufficiently high quality.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To relay IPET-OSDE recommendation with regard to OSCAR/Space to CBS Management Group via CBS TECO 2018, and communicate about resource requirements.	ICT- IOS Chair	Apr. 2018
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	<ul style="list-style-type: none"> To strengthen the cooperation with CGMS members and observers from other space agencies through establishment of relevant advisory and support groups. To request Members and invite other interested parties to invest in OSCAR/Space 	Cg-18	2019

Issue #6.1.9	Plan for the evolution of OSCAR
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Background	Plan for the evolution of OSCAR in particular for the migration of OSCAR/Requirements with OSCAR/Surface within the MeteoSwiss IT infrastructure was presented to IPET-OSDE-3.		
Rationale for the decision/action or recommendation	The goal is to rationalize operations and long term maintenance of OSCAR, and undertake the software developments necessary for meeting the identified requirements.		
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To invite ICG-WIGOS to concur with the OSCAR development plan with consideration of the following priorities: (1) OSCAR/Surface operational use, (2) other evolutions of OSCAR/Surface, (3) tools and foundation for gap analysis	ICT-IOS Chair	asap

Issue #6.1.10	Proposed gap analysis using OSCAR		
Background	IPET-OSDE-2 agreed to support the development of OSCAR/Analysis by providing a list of reports that could support the RRR process. A proposal of gap analysis using OSCAR was submitted to IPET-OSDE-3 for its review and concurrence.		
Rationale for the decision/action or recommendation	A relatively simple solution is being proposed (Annex XVIII of IPET-OSDE-3 report) as one of many other tools that can be used for gap analysis purposes (e.g. impact studies, expert knowledge) and meant to be used by experts knowing limitations of such tool.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To specify the proposed gap analysis proposal using OSCAR in the view to estimate the cost of and options for its development.	Secretariat	Once approved by ICG-WIGOS
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To submit IPET-OSDE proposal for gap analysis as described in Annex XVIII of IPET-OSDE-3 report to ICT-IOS and ICG-WIGOS for their review and possible approval.	ICG-WIGOS via ICT-IOS	Feb. 2018

Issue #6.1.11	Global exchange of data in support of global NWP		
Background	Statement of Guidance for Global Numerical Weather Prediction (GNWP) identified		
Rationale for the decision/action or recommendation	GNWP would potentially substantially improve forecast quality by assimilating at higher time and space resolutions additional observations, which are not currently being exchanged but exist (e.g. commercial data).		
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	to encourage the global exchange of data that is currently available Nationally or Regionally (sometimes commercially), in	Cg-18	2019

	<p>support of Global NWP at higher resolution, and the resulting needs for data from higher-density observing networks and higher temporal resolution, as well as observations of all relevant components of the Earth System, to enhance the forecast quality. Issue to be presented to TECO, MG and EC-70 (as INF.).</p> <p>Draft Cg-18 Resolution requesting Regional Associations Members <u>shall</u> take into account the requirements of Global NWP and other AAs when designing their RBONs. Those stations addressing GNWP requirements shall distribute data on hourly basis.</p>		
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Issue #6.1.11	Improved timeliness of radiosonde data in support of high-resolution NWP		
Background	Statement of Guidance for High-Resolution NWP identified the issue of timeliness of the radiosonde profile data		
Rationale for the proposed decision/action or recommendation	The SoG for High-resolution NWP has identified a gap in terms of timeliness of radiosonde data. The Team discussed the issue of proposing possible solutions through CBS for improving timely availability of upper air reports, for example by splitting the distribution of individual reports in two or more parts distributed as the profile is being made. This would allow critical parts of the profile to be received by NWP centres in a timely manner. It is to be noted that there would be implication concerning the coding of the reports and reporting practice. The Team discussed briefly about the best split to be recommended, whether based on when a certain level (e.g. 100 hPa) is reached, or whether based on some specific reporting frequency (e.g. every 30 minutes), but didn't come to a conclusion, and agreed that requirements has to be better captured first for both GNWP and HRNWP.		
Decision(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To consider the issue of timeliness of vertical profiles and to task ET-SBO to propose a solution on the best split.	ET-SBO	Feb 2018

Issue #6.1.16	Make sure that requirements for one and the same variable only has one source		
Background	For some variables there are duplicate requirements, coming from different sources.		
Rationale for the decision/action or recommendation	Firstly, several of the old and deprecated Application Areas are not application areas at all, but either programmes/projects (e.g. CLIC), committees/panels (e.g. Climate-AOPC) or scientific disciplines (e.g. Atmospheric Chemistry). These deprecated Application Areas ought to be removed, not only from the list of Application Areas, but also from the list of Requirements. For some variables, there exist requirements that originate with different sources. There is hence a large risk that these requirements will be contradicting. This is, for example, the case within the area that is the responsibility of GAW. Since GAW is the		

	network observing greenhouse gases (notably CO ₂ , CH ₄ and N ₂ O), reactive gases (notably O ₃ , NO, NO ₂ , CO, VOC, SO ₂), GAW and its Scientific Advisory Groups ought to be the sole source of requirements for these variables.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To invite CAS to decide that GAW and its Scientific Advisory Groups be the sole source of requirements for variables that are related to atmospheric composition (gases, aerosols) and UV radiation, within the AAs under GAW responsibility.	ICT- IOS Chair	Asap

Issue #6.1.24	To clearly identify procedure for incorporating ground based space weather observations into OSCAR/Surface.		
Background	Space Weather observations from the ground include solar observatories, ionospheric observations (GPS and non-GPS), magnetic observatories, traditionally provided by many organisations, in many cases not related to MET services.		
Rationale for the decision/action or recommendation	In order to incorporate ground-based space weather observations into OSCAR/Surface, the procedure should be developed, which includes several steps, such as, for example: to create templates for 3 types of observation (magnetic, ionosphere and solar); to identify the level of necessity and a procedure for issuing WIGOS ID numbers for non-WMO ground based platforms (i.e. solar observatories, geomagnetic observatories, GPS ground stations, etc.)		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To assist ICG-WIGOS Task Team on the WIGOS Metadata for updating the WIGOS Metadata Standard for compliance with Space Weather requirements	PoC	Cg-18
	To clarify requirements for issuing WIGOS IDs for surface-based Space Weather observing platforms	OPAG-ISS	IPET-OSDE-4
	to liaise with the PoC for Space Weather and assure that the WIGOS Metadata Standard complies with Space Weather observing systems characteristics	TT-WMD	Cg-18
	To consider proposed update of the WIGOS Metadata Standard complying with Space Weather observing systems requirements, and take steps to update OSCAR/Surface and its data model accordingly	OSCAR/Surface Project Committee	2020

Issue #6.1.25	Lack of resources to conduct a more detailed analysis of observational requirements and to develop a detailed SoG for the Climate Science Application Area.		
Background	Reduced financial and manpower resources in WCRP		
Rationale for the decision/action or recommendation	Climate Science is fundamental to ensure continuous progress and quality of climate services and support to policy making. Satellite and		

recommendation	in-situ observations are critical to support research in climate analysis and prediction (including numerical model development, reanalyses, climate predictions and projections).		
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To request Secretary General to identify resources to further review Climate Science requirements	EC-70	EC-70

Issue #6.1.26	Be able to undertake experiments to answer as many scientific questions as possible by influencing NWP centers to undertake these experiments or steer existing ones to also address these questions.		
Background	NWP Impact experiments tend to take a long time to execute. The reliance on the regular timeline of a workshop organization might not offer enough time to be able to influence the execution of the experiments.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ICT-IOS-10 concurred with (i) updated list of science questions, and (ii) composition of the Scientific Organizing Committee: <ul style="list-style-type: none"> • Sid Boukabara (NOAA, ET-SAT, C-SEIS), Chair • SeiYoung Park (KMA, C-SEIS, POC from local host), Co-chair • Erik Andersson (ECMWF, Chair of IPET-OSDE), • Lars Peter Riishojgaard (WMO/WIGOS-PO), • John Eyre (UKMO, IPET-OSDE), • Tom Auligne (UCAR), • Jianxia Guo (CMA) 	ICT-IOS-10	done
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	<ul style="list-style-type: none"> • -Share the information of the workshop scope and objectives and encourage the active participation of the NMHSs & NWP centres • -Engage early enough (mid 2018 is recommended) with NMHSs to conduct OSEs and OSSEs and other impact experiments, to address the specific science questions identified by the meeting 	SOC	<i>When the SOC is established (mid-2018)</i>

Issue #6.127	Members contributions toward implementing actions of the Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP), pending adopted of future WIGOS Implementation Plan (WIGOS-IP)		
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References	<ol style="list-style-type: none"> 1. Resolution 10 (EC-65) – adopting the EGOS-IP 2. ICT-IOS-10 final report (Geneva, 5-8 February 2018) 3. IPET-OSDE-3 final report (Geneva, 29 January – 1 February 2018) 		
Background	By monitoring status of Action of the EGOS-IP, some actions are showing slow or limited progress.		
Rationale for the proposed advice	<p>Need to communicate to the Permanent Representatives of WMO Members on why we have the EGOS-IP, and what are the benefits. The goal was to facilitate implementation of EGOS-IP Actions by Members by raising awareness and commitment of the Permanent Representatives in this regard.</p> <p>Pending development and adoption of the future WIGOS IP, which will be responding to the WIGOS Vision 2040, there is a need to assure appropriate evolution of global observing systems in order for WMO to be able to address critical gaps of Application Areas.</p>		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To define list of specific EGOS-IP Actions for inclusion in draft Cg-18 Decision, based on the outcome of the EGOS-IP review at IPET-OSDE-3 and the discussions at ICT-IOS-10.	E. Andersson	Mar. 2018
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To confirm its concurrence with the proposed EC-70 Recommendation, and adjust it as needed, in particular with consideration of CBS TECO 2018 feedback	CBS-MG	Mar. 2018
	Executive Council to Recommend to Congress to request Members and identified implementing agents to take steps to better address implementation of some specific EGOS-IP Actions (list TBD, see action above).	EC-70, Cg-18	Jun. 2018, 2019

Issue #6.1.29	Review of Implementation Plans of WIGOS Component Observing Systems
References	<ol style="list-style-type: none"> 1. Resolution 10 (EC-65) – adopting the EGOS-IP 2. ICT-IOS-10 final report (Geneva, 5-8 February 2018) 3. IPET-OSDE-3 final report (Geneva, 29 January – 1 February 2018)
Background	The CBS Management Group requested the OPAG-IOS to review the various Implementation Plans (e.g. EGOS-IP, GCOS-200, GCW-IP, GAW-IP) relevant to WIGOS component observing systems to ensure that all CBS-relevant actions, in any of these existing IPs, will be captured and presented in the future WIGOS-IP. A synthesis document should be prepared to reflect the findings of the review with recommendations, and a summary of what will have to be considered in the future WIGOS-IP.
Rationale	Need to rationalize WMO response to the various implementation plans, feeding into the future WIGOS Implementation Plan (i.e. successor of EGOS-IP), responding to the WIGOS Vision 2040.

Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	to investigate whether some resources could be set aside for a consultant (to be recruited) to undertake the review of the various IPs in 2018	Secretariat	asap
	to undertake review of the various Implementation Plans	Consultant	June 2018
	to consider ICT-IOS and the consultant feedback when developing the work plan for developing the new WIGOS-IP	IPET-OSDE	Cg-18
Recommendation(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	to invite GCW Steering Committee to update the GCW Implementation Plan with consideration of CBS efforts and guidance	CBS MG	Cg-18
	To invite CHy to develop the WHOS Implementation Plan with consideration of CBS efforts and guidance	CBS MG	Cg-18
	To invite JCOMM and OOPC to develop the new GOOS Implementation Plan with consideration of CBS efforts and guidance	CBS MG	Cg-18

Issue #6.1.30	Develop plan for developing the new Implementation Plans for the evolution of WIGOS Component Observing Systems (WIGOS-IP) responding to the Vision of WIGOS in 2040		
Background	Following up from the current Implementation Plan for the Evolution of Global Observing System (EGOS-IP), which is responding to the Vision for the Global Observing System in 2025, there will be the need to develop a WIGOS Implementation Plan (WIGOS-IP), which will be responding to the WIGOS Vision 2040, once approved by XCg-18.		
Rationale for the decision/action or recommendation	In compliance with the Manual on WIGOS (WMO No. 1160), Chapters 2.1 and 2.2 on (i) requirements and (ii) design, planning and evolution respectively, the Organization will have to undertake the Rolling Review of Requirements and particularly develop a new Implementation Plan for the evolution of WIGOS Component Observing Systems (WIGOS-IP) responding to the Vision of WIGOS in 2040, and to replace the current Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP).		
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	Recommendation of CBS to EC-70 for initiating development of plan for developing the new WIGOS-IP. WMO number to be associated with the future WIGOS IP.	EC-70 through ICT-IOS-10, CBS TECO, CBS MG	Mar. 2018

Issue #6.1.31	OND Principles: Increasing the awareness of the OND Principles, and their use by Members. Stressing the critical importance of data sharing of important data sets with demonstrated positive impact on NWP.		
Background	One of the main problems WMO is facing with regard to OND Principles is how to assure compliance with the Principles. Indeed, many Members don't have resources to make observing systems evolve in compliance with the Principles. Outreach efforts are needed. In the specific case of GNSS data in the US, data sharing is currently not possible, and actions should be taken to encourage Members to share all data according to the OND data sharing Principle in future.		
Rationale	Outreach efforts are needed with the national observing network		

	managers, and communication materials could be developed. Perhaps we could use good case studies where OND Principles have actually been used to design their observing networks. The Team agreed that we should be using CBS TECO 2018 for reinforcing the need on training regarding OPAG IOS issues, while making sure to include the OND principles in the list of required training topics. The Training Centres and the Regional Associations should also play a role in this regard. Impact studies have demonstrated positive impact of GNSS data, which is not always available for exchange between Members, as documented in the reports of the 5 th and 6 th workshops on the impact of various observing systems on NWP 2012 and 2016.		
Decision(s)	<i>What</i>	<i>By whom / to whom</i>	<i>Deadline</i>
	ICT-IOS-10 decided inclusion of the OND Principles in training regarding OPAG IOS issues. ICT-IOS needs to decide on most appropriate way to make this effective	ICT-IOS	Apr. 2018
	To bring to CBS-TECO the issue about wider sharing of data such as GNSS data, stressing the positive impact that has been documented in studies reported to the 5 th and 6 th workshops on observation impact in NWP and formulate a Cg-18 decision in this regard for: <ul style="list-style-type: none"> Facilitating international exchange of the data, perhaps through a revision of Resolution 40 (Cg-12). For example, there is no definition in Res. 40 (Cg-12) on what is Essential and Additional; it is up to each member to decide which data are distributed under these categories. Consideration of the possibility to commit surface-based GNSS radio-occultation observing stations to RBON. RBON Technical Regulations should provide for each Region to be able to make commitment on such data, which will be distributed internationally. A possible recommendation to Cg-18 could therefore include that each region will be requested to include surface based GNSS data in their RBON data set. Members, when they negotiate contracts with third parties, should also be encouraged to assure that the data are globally exchanged over the GTS. 	ICT-IOS Chair	Mar. 2018

Issue #6.2.1	Relaunching EGOS-IP Action G10 by ET-SBO		
Background	Planning to implement action G10 has been delayed. The need to confirm the enthusiasm of the Members for such a study to be implemented was deemed an important point. Now broad (but not universal) support for G10 has been identified.		
Rationale for the proposed decision/action or recommendation	It is necessary to closely link the work with the Members to undertake the field evaluation with the work of the science community to understand the impact on Application area skill of the change in observing practice. Therefore close work with C-SEIS is essential.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ET-SBO (TO) to work with active Members to determine what	ET-SBO	2018

	reconfiguration is possible		
	ET-SBO to work with C-SEIS to understand the minimum change needed to evaluate impact + reformulate the S11 science question	ET-SBO, C-CEIS	2018
	NWP impact assessment undertaken	NWP centres based on request by C-CEIS	2019
	Impact assessment reports presented at 2020 workshop on obs impacts on NWP	NWP centres based on request by C-CEIS	2020

Issue #6.2.2	Improving understanding of WIGOS & Incident Management		
Background	WIGOS training programmes are led by the WIGOS Project Office. Part of the new ethos is to implement Incident Management in a more systematic manner within the operational observing networks. However the understanding of Incident Management is varied across the Members.		
Rationale for the proposed decision/action or recommendation	To improve the compliance with the provisions in the Manual on WIGOS it may be necessary to implement a systematic training programme to improve understanding of incident management as mandated in the Manual on WIGOS. This cannot be undertaken by ICT-IOS and its teams alone and building an ETR led training programme would be the correct approach. We should raise the profile at CBS TECO to ensure buy in.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To work with Education and Training Programme (ETR) and promote implementation of a systematic ETR-led training programme to improve understanding of incident management as mandated in the Manual on WIGOS (note: it requires Regional WIGOS Centres to be established in the first place)	ICT-IOS Chair / WIGOS PO	March 2018

Issue #6.2.3	Traceability to Standards and access to Calibration Facilities		
Background	Feedback from the Regions presented at ET-SBO-3 highlighted the ongoing need for improvements in the traceability of measurements and access to calibration facilities, especially in RA I and RA III.		
Rationale for the proposed decision/action or recommendation	CIMO have the clear responsibility for the provision of traceable measurements and undertake the management oversight of the RICs. A request to CIMO may highlight an already known issue but equally may encourage further efforts in this area.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	Chair ICT-IOS to invite the CBS President to write to CIMO Pres to highlight the findings from recent requests for feedback from Members with regard to traceability to standards and access to calibration facilities	ICT-IOS Chair	Apr. 2018

Issue #6.2.4	Utilising the correct Geode		
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Background	It has long been recognised that using the correct geode enables upper air profiles to be utilised effectively in NWP. However guidance for the use of this correct Geode is a little confusing and not all location devices default to the using of this regulated setting as standard.		
Rationale for the proposed decision/action or recommendation	The Manual on WIGOS unambiguously refers (current provision 3.3.1.3) to mandated the use of World Geodetic System 1984 WGS84 and its Earth Geodetic Model (EGM96). Guidance may be needed to highlight that modern location reference devices do not all default to the use of this earth model.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	With regard to utilising the correct Geode, review existing guidance material and if necessary suggest changes.	ET-SBO, CIMO Ed Board, TT-WEdB	ICG-WIGOS (Jan 2019)
	With regard to utilising the correct Geode, highlight need to check settings on position devices to ensure correct model is selected when confirming location of observing station.	ICT-IOS Chair	CBS TECO March 2018

Issue #6.2.5	ET-SBO Access to Lightning Observations Expertise		
Background	Although an important operational observation neither ET-SBO nor CIMO's ET-ORST have been able to secure an active lightning observation system expert. This is limiting the work both teams are able to undertake.		
Rationale for the proposed decision/action or recommendation	We have seen the growing importance of lightning observations within the user community . Additionally the operational deployment of space based lightning imagery systems requires careful consideration of how surface based systems should be operated to ensure an integrated approach to lightning observing capabilities. It takes time for experts to become 'educated' in the ways of WMO and so calling for lightning experts now will enable us to adequately prepare for the future work programme.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	to seek CBS MG's authorization for ET-SBO to contact appropriate bodies to seek membership to team of operational lightning observations experts	Chair, ICT-IOS	Apr. 2018

Issue #6.2.6	Radiosonde Observations - High Resolution BUFR Reporting		
Background	The migration to BUFR reporting has enabled the 4D reporting of radiosonde observations in 'HiRes BUFR Reports'. This has demonstrated improved benefit to NWP Centres. Progress has been steady but many members have still not migrated to the new format.		
Rationale for the proposed decision/action or recommendation	Migration from old to new reporting methodologies is making progress, however reminding Members of the importance of providing 'HiRes BUFR Reports' may enable momentum with the migration to be maintained. CBS TECO 2018 offers a forum for the current status to be highlighted, listing the Members who have made the migration.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To present the current status (Feb 2018) of migration of upper air observations to BUFR, both graphically and in statistical form at CBS TECO 2018 to ensure Members remain aware the migration task is still no complete	ICT-IOS Chair	March 2018

Recommendation(s)	What	To whom (e.g. EC-70, Cg-18, ...)	Time frame
		Encourage Members to continue the migration to high resolution BUFR reporting of radiosonde observations exchanged on the GTS.	At EC & ICG-WIGOS and other suitable forums

Issue #6.4.1	Effective use of new generation geostationary satellites		
Background	<p>Two very important and historic satellite launches have recently occurred: GOES-16 and FY4-A. GOES-16 carries the first spaceborne lightning imager, and FY4-A carries the first geostationary hyperspectral sounder, and the second lightning imager. They also carry imaging capability of SEVIRI (or better) quality as envisaged in the WMO Vision 2025. It was therefore appropriate that IPET-SUP consider user readiness to take advantage of the opportunities, and whether there are any barriers to delivering the benefits that these new satellites should provide.</p> <p>It was noted that GOES-16 was providing excellent support to users of imagery products, but that there were issues in support, including operational continuity, for users of quantitative products for meteorology, notably Atmospheric Motion Vectors (AMVs), Clear Sky Radiances (CSRs) and All Sky Radiances (ASRs). For FY-4A it was noted that more information on data dissemination plans (formats, products) is required. It is important to recognise the growing value of geostationary products for quantitative applications, especially NWP and climate, and to ensure that product lists reflect this.</p>		
Rationale for the proposed decision/action or recommendation	It is important to stress the requirement for operational continuity of key products such as AMVs, CSRs and where appropriate ASRs from geostationary satellites, and to follow past recommendations in overlap of products from old and new satellites.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To note the need for operational continuity of AMV and CSRs from operational geostationary satellites, and coordinate preparation of WMO Working Paper to CGMS-46	ICT-IOS Chair	ICT-IOS-10
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To raise this issue in a WMO working paper to CGMS-46	CGMS-46	June 2018

Issue #6.4.2	Emerging data issues: consideration of new observation types in the WMO Integrated Global Observing System		
Background	IPET-SUP are beginning to consider the implications for an Integrated Observing System on the deployment or acquisition of observations whose advantage is high spatial and temporal coverage and whose disadvantage may be quality. Examples include so called citizen observations (e.g. from mobile phones) or deployment of large numbers of Cubesats (e.g. TROPICS). How in practise users will be able to take advantage of the potential of these innovations could be a topic for IPET-SUP-4.		
Rationale for the proposed decision/action or recommendation	Users may not be ready for new types of observation that could become numerous in the near future.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>

	Increase user readiness for new types of observation from Cubesats.	IPET-SUP Chair	2019
	Facilitate liaison of satellite users with Cubesat community, through workshops and conferences	Secr.	2020

Issue #6.5.1	Requirements for ABO NWP impact studies and assessment		
Background	Given the investment the ABOP has made/will make in provision of ABO in some data-sparse areas, including over Africa, the Southwest Pacific and the Caribbean, the ICT-IOS considered whether adequate NWP impacts studies have been or can be made to assess their impact.		
Rationale for the proposed decision/action or recommendation	This will aid in the decision on whether to continue to support provision of these observations in the future.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	The C-CEIS to coordinate and report on impact studies relating to ABO in data-sparse areas.	C-SEIS	ICT-IOS-11

Issue #6.7.1	Science questions related to observing system impact studies and organisation of the next workshop		
Background	<p>The C-SEIS and IPET-OSDE provide support for activities relating to observation impact experiments to answer as many scientific questions as possible by influencing NWP centers to undertake these experiments or steer existing ones to also address these questions.</p> <p>NWP Impact experiments tend to take a long time to execute. The reliance on the regular timeline of a workshop organization might not offer enough time to be able to influence the execution of the experiments.</p>		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	<ol style="list-style-type: none"> agreed on the updated list of science questions provided in Annex IX. Agreed to the recommend composition of the Scientific Organizing Committee comprising: <ul style="list-style-type: none"> Sid Boukabara (NOAA, ET-SAT, C-SEIS), Chair SeiYoung Park (KMA, C-SEIS, POC from local host), Co-chair Erik Andersson (ECMWF, Chair of IPET-OSDE), Lars Peter Riishojgaard (WMO/WIGOS-PO), John Eyre (UKMO, IPET-OSDE), Tom Auligne (UCAR), Jianxia Guo (CMA) 	ICT-IOS	ICT-IOS-10 (completed)
	1. Share the information of the workshop scope and objectives and encourage	C-CEIS, SOC, IPET-OSDE	CT-IOS-11

	<p>the active participation of the NMHSs & NWP centres – should be shared with: OPAG-DPFS, ET-SBO, ET-SAT, ET-ABO, and IPET-OWR</p> <ol style="list-style-type: none"> 2. Engage early enough (mid 2018 is recommended) with NMHSs to conduct OSEs and OSSEs and other impact experiments, to address the specific science questions identified by the meeting 3. Coordinate the organisation of the next workshop on Impacts of Observing Systems on NWP (PRK, 2020) according to IPET-OSDE-3 plan. 4. Produce report on impacts workshop. 5. Report to ICT-IOS on outcomes of workshop. <p>(Commence once the SOC is established, mid-2018)</p>		
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	ICT-IOS to report to CBS on the composition of the agreed list of science questions and the organization of the next impacts workshop,	CBS	CBS TECO (March 2018)

Issue # 6.6.1	Reducing number of VOS classifications
Background	<p>JCOMM-5 adopted Recommendation 7.3/2 (JCOMM-5) on reducing the number of VOS classifications to the three proposed by the JCOMM Ship Observations Team (SOT).</p> <p>SOT was requested to fully define the new classes, propose required changes to VOS metadata formats, reporting procedures for PMOs, and make proposals on how the new third party ships should be administered and supported in the future. It was also requested to develop and propose the required changes in WMO-No. 544, WMO-No. 488, and WMO-No. 306.</p>
Rationale for the proposed decision/action or recommendation	<p>Once JCOMM – through SOT – will have made a proposal on the reduction of the number of VOS Classes, CBS will be invited to accept the changes proposed and corresponding changes to relevant technical regulations under responsibility of CBS: (i) WMO-No. 544 and WMO-No. 488 and their transition to WMO-No. 1160 and WMO-No. 1165 respectively and (ii) amendments to the code tables of the Manual on Codes, Vol I.2 (WMO-No. 306) using the “Simple (Fast-track) procedure” of Resolution 12 (EC-68).</p>

Recommendation(s)	What	To whom (e.g. EC-70, Cg-18, ...)	Time frame
	To invite JCOMM to finalize its proposal for reducing the number of VOS Classes	JCOMM	
To concur with proposal from JCOMM on the reduction of VOS Classes, and make recommendation to update relevant regulatory and guidance material accordingly.	Cg-18		Cg-18

Issue # 6.6.2	Integration of WMO No. 47 in the WIGOS Metadata Standard		
Background	JCOMM-5 adopted Recommendation 7.3/3 (JCOMM-5) on the Freezing of publication WMO-No.47, and migrating the corresponding metadata to the WIGOS metadata structures.		
Rationale for the proposed decision/action or recommendation	Recommendation 7.3/3 (JCOMM-5) recommended the Executive Council to (1) approve the freezing and archival of publication WMO-No. 47, at version 4.2, and discontinue the publication; (2) approve the submission of ship metadata from Members directly to JCOMMOPS, and (3) approve the full integration of publication WMO-No. 47 within the WIGOS Metadata Standard, and the transfer of WMO-No. 47 Database to OSCAR/Surface, via JCOMMOPS. Assistance from CBS may be needed in this regard.		
Decision(s)	What	By whom	Deadline
	To invite the CBS representative in the ICG-WIGOS Task Team on Metadata to assist JCOMM in integrating metadata elements from WMO No. 47 into the WIGOS Metadata Standard.	ICT-IOS chair	
Recommendation(s)	What	To whom (e.g. EC-70, Cg-18, ...)	Time frame
	To recommend updating the WIGOS Metadata Standard in order to fully integrate WMO No. 47 in it	ICG-WIGOS	Cg-18

Issue # 6.6.3	Transfer of regulatory and guidance material relevant to marine meteorological observations from the GOS material to WIGOS material		
Background	JCOMM-5 adopted Decision 9.5(1)/1 (JCOMM-5) on the contribution of JCOMM to WIGOS Regulatory and Guidance Material.		
Rationale for the proposed decision/action or recommendation	<p>Decision 9.5(1)/1 (JCOMM-5) concurred with Recommendation 4 (CBS-16) to transfer regulatory and guidance material related to the WMO Voluntary Observing Ship (VOS) Scheme to GOS/WIGOS material. This Recommendation was then adopted by EC-69 through Resolution 3 (WMO EC-69).</p> <p>Decision 9.5(1)/1 (JCOMM-5) also requested the JCOMM Observations Programme Area (OPA) to (1) assist CBS in transferring regulatory and guidance material relevant to marine meteorological observations from the GOS material to WIGOS material, and to propose update to such material if necessary; and (2) assist the Commission for Instruments and Methods of Observations (CIMO) to review and propose update to the marine observations related sections of WMO-No. 8, taking into account WIGOS needs.</p>		

Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To coordinate with JCOMM and other CBS experts, and assist the WIGOS Editorial Board for the transfer of regulatory and guidance material relevant to marine meteorological observations from the GOS material to WIGOS material is made in consultation with C-MAR	C-MAR	End 2018
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To make sure that the transfer of regulatory and guidance material relevant to marine meteorological observations from the GOS material to WIGOS material is made in consultation with C-MAR	WIGOS EdB	Cg-18

Issue #6.8.1	Draft CBS recommendation for preserving the radio-frequency spectrum for meteorological and related environmental activities at the World Radiocommunication Conference 2019		
Background	Update of existing decision		
Rationale for the proposed decision/action or recommendation	Needs to elaborate, to communicate and to obtain supports regarding the WMO positions for WRC-19 and WRC-23 agenda items with major interests for WMO.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ICT-IOS-10 concurred with proposed recommendation	ICT-IOS	ICT-IOS-10 (completed)
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	Draft resolutions on frequency matters	EC-70 and Cg-18	EC-70, Cg-18

Issue #7.2.2.1	Observing System Requirements for Urban Forecasting		
Background	<p>The WMO Urban Expert Task Team (ETT) is working for writing the Guide for Integrated Urban Weather, Environment and Climate Services (IUWECS).</p> <p>The ETT meeting was held in Reading on 26-29 January 2018.</p> <p>The concept note for the IUWECS Guide is attached. Urban observations are a natural part of the Guide.</p> <p>A draft version of the structure of the IUWECS Guide it also enclosed.</p> <p>From OBS/CIMO/WIGOS (as it was recommended) CBS: Reinhard Spengler (Reinhard.Spengler@dwd.de) and CIMO: Bert Heusinkveld (bert.heusinkveld@wur.nl) are involved.</p> <p>Mr R. Spengler has drafted contributions to section 4.2 and 4.3 of the IUWECS draft version.</p>		
Rationale for the proposed decision/action or recommendation	Need for CBS and CIMO to be involved and provide the two Commissions and WIGOS perspective in the writing of the Guide for Integrated Urban Weather, Environment and Climate Services.		

Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	Draft of Guide for Integrated Urban Weather, Environment and Climate Services (IUWECS) to be circulated to IPET-OSDE members for review.	Secretariat	End-April 2018
	Explore the validity and utility of the creation of a new "Land" Application Area	IPET-OSDE	ICT-IOS-11

Issue #7.3.1	Proposed gap analysis using OSCAR		
Background	IPET-OSDE-2 agreed to support the development of OSCAR/Analysis by providing a list of reports that could support the RRR process. A proposal of gap analysis using OSCAR was proposed by IPET-OSDE-3.		
Rationale for the proposed decision/action or recommendation	A relatively simple solution is being proposed (Annex XVIII of IPET-OSDE-3 final report) as one of many other tools that can be used for gap analysis purposes (e.g. impact studies, expert knowledge) and meant to be used by experts knowing limitations of such tool.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To specify the proposed gap analysis proposal using OSCAR in the view to estimate the cost of and options for its development.	Secretariat	Once approved by ICG-WIGOS
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	To concur with and submit ICT-IOS proposal for gap analysis as described in Annex XVIII of IPET-OSDE-3 final report to ICG-WIGOS for its review and possible approval.	ICG-WIGOS	Feb. 2018

Issue #7.5.1	Competency Framework for Observing Programme and Network Planning
Background	<p>The draft "Competency Framework for Observing Programme and Network Planning" document is the result of 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.</p> <p>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 ICT-IOS-9 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.</p> <p>ICT-IOS-9 reviewed the competency frameworks and confirmed that it supported the document to be finalized and published by CIMO. While ICT-IOS members were invited to comment on the document after the meeting, no comments have been received by ICT-IOS Chair since ICT-IOS-9.</p>

Rationale for the proposed decision/action or recommendation	Draft Competency Framework for Observing Programme and Network Planning was developed by CIMO. ICT-IOS reviewed and concurred with the document without changes.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	To inform CIMO President about OPAG-IOS concurrence with the "Competency Framework for Observing Programme and Network Planning" document, and agreement that it should be "owned/managed" by CIMO, thereby inviting CIMO President to take steps for its publication (together with the other 3 related competency sets) as appropriate.	A. Rea	asap

Issue #8.5.1	Sustained funding of the VLab Technical support officer		
Background	WMO SP together with CGMS operators supports the Virtual Laboratory for Education and Training in Satellite Meteorology (VLab) which, through 13 centres of excellence, delivered in 2016 alone 122 training events on satellite data, products and applications for over 4000 participants, largely through distance learning, and mainly focussing on nowcasting and weather forecasting. Satellite providers in CGMS provide annual financial contributions to keep the Fund operational (at about 80K CHF / year).		
Rationale for the proposed decision/action or recommendation	Satellite providers in CGMS provide annual financial contributions to keep the Fund operational, however, a broader diversity of donor contributions by Members would strengthen robustness of the Fund, and help support training activities for a wider range of WMO Application Areas (e.g., climate, marine meteorology).		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ICT-IOS to compose and submit a draft recommendation to EC-70 through the CBS process.	ICT-IOS	ICT-IOS-10 (completed)
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	Members to consider provide financial contributions to the WMO VLab Trust Fund	EC-70	2018

Issue #8.5.2	Consideration of Draft Recommendation for CBS to EC-70 in relation to IATA-WMO collaboration on AMDAR		
Background	The ET-ABO proposes to draft a recommendation to be considered for adoption by CBS for a resolution of EC to endorse the IWCAP Concept of Operations and to recommend to Cg-18 to approve the formal collaborative arrangement.		
Rationale for the proposed decision/action or recommendation	The Resolution would confirm EC endorsement of the proposed Concept of Operations for the IATA-WMO Collaboration on AMDAR, the proposed Terms of Reference of the collaboration and the draft Implementation Plan for Establishment of the IATA-WMO Collaborative AMDAR Programme and recommend to Congress to approve the establishment of a Working Arrangement and supporting agreement between WMO and IATA.		
Decision(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ICT-IOS agreed on the process for developing the IWCAP and the	ICT-IOS	ICT-IOS-10

	actions and proposed recommendations below.		
	<ol style="list-style-type: none"> 1) Continue with development of the IWCAP ConOps; 2) Develop the draft ToR and Implementation Plan for the IWCAP. 3) Recommend CBS-MG to form a task team on the IWCAP. 4) Develop the draft recommendation for CBS-MG to EC (based on Background above). 	ET-ABO, ICT- IOS, Secretariat	CBS TECO, End-March 2018
Recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	<ol style="list-style-type: none"> 1) ICT-IOS to recommend a Resolution to EC on the IWCAP 2) ICT-IOS to request formation of a Task Team on the IWCAP to work on the establishment of the IWCAP – to be formalised as an EC working group at EC-70 	CBS	CBS TECO, Mar 2018
	<ol style="list-style-type: none"> 1) To endorse the IWCAP and make a recommendation to Cg-18 to approve its ConOps, ToR and Implementation Plan. 2) To form a working group or TT to establish the IWCAP. 	EC	EC-70

Issue #6.8	Draft CBS recommendation for preserving the radio-frequency spectrum for meteorological and related environmental activities at the World Radiocommunication Conference 2019		
Background	Update of existing decision		
Rationale for the proposed decision/action or recommendation	Needs to elaborate, to communicate and to obtain supports regarding the WMO positions for WRC-19 and WRC-23 agenda items with major interests for WMO.		
Proposed decision(s)/ action(s)	<i>What</i>	<i>By whom</i>	<i>Deadline</i>
	ICT-IOS concurred with proposed draft Recommendation (Annex X)	ICT-IOS	ICT-IOS-10 (completed)
Proposed recommendation(s)	<i>What</i>	<i>To whom (e.g. EC-70, Cg-18, ...)</i>	<i>Time frame</i>
	Draft resolutions on frequency matters (Annex X)	EC-70 and Cg-18	EC-70, Cg-18

Annex III – Details of Milestones and Activities to Be Undertaken to Develop the WIGOS-IP

Table 1: Milestones to be considered when planning the development of the WIGOS-IP

Date	Milestone	Progress
Feb. 2018	ICT-IOS-10	Reviews and concurs with the plan for developing the WIGOS-IP (may suggest some adjustments)
Mar. 2018	CBS TECO	Reviews the plan for developing the WIGOS-IP and provide feedback
Mar. 2018	CBS MG	Reviews and concurs with the plan for developing the WIGOS-IP (may suggest some adjustments)
Mid 2018	EC-70	Notes plan for developing the WIGOS-IP
Mid 2019	Cg-18	WIGOS Vision 2040 adopted together with plan for developing the WIGOS-IP
Mid 2020	EC-72	Notes progress and provide further guidance
Mid 2021	EC-73	Notes progress and provide further guidance
End 2021		First draft available for wide consultation
Beginning 2022		Wide consultation of first draft with Technical Commissions, Regional Associations and partner organizations
Mid 2022	EC-74	Submission to EC-74 for its noting and concurrence to submit to Cg-19
End 2022		Second draft available
Mid 2023	Cg-19	WIGOS-IP approved by Cg-19

Table 2: Activities to be considered when planning the development of the WIGOS-IP

No.	Activity	Achieved through²	Outcome	Due date
1	Reviewing the list of WMO Application Areas and update it as necessary in order to align with WMO's mandate to respond to societal needs in weather, water, climate, environment and cryosphere;		List of Application Areas	End 2019
2	Working with experts in each Application Area to adjust database and methodology (e.g. for consideration of multiple time scales) and update the observational user requirements recorded in OSCAR;		OSCAR/Requirements up to date	End 2020 and then ongoing
3	Look at specific seamless prediction requirements (across applications contributing to global earth prediction systems, and across temporal scales) and define how such requirements can be considered in the Rolling Review of		Seamless prediction requirements identified	End 2020 and then ongoing

² To be completed by IPET-OSDE-3

No.	Activity	Achieved through ²	Outcome	Due date
	Requirements framework;			
4	Working with Members and other relevant partners (e.g. Space Agencies) and groups (e.g. CGMS, CEOS) to make sure that the capabilities of surface- and space-based observing systems as recorded in OSCAR/Surface and OSCAR/Space reflect the reality of the observing systems implemented and operated by Members;		OSCAR/Space and OSCAR/Surface up to date and accurate	End 2020 and then ongoing
5	Working with operational centres to get the most accurate assessment through the WIGOS Data Quality Monitoring System (WDQMS) about observational data that are effectively being exchanged routinely through WMO (e.g. to address gaps in terms of timeliness, uncertainty, and space/time resolutions);		Data available to end users assessed through WDQMS	End 2020 and then ongoing
6	Reviewing results of impact studies and promoting new ones as necessary, paying particular attention to the requirements for seamless prediction and high impact weather and climate prediction;		List of recommended impact studies	Mid 2020 (EC-72) then ongoing
7	Conducting critical review and gap analysis for each of the WMO Application Area and update the Statements of Guidance taking into account the results of the impact studies;		Statements of Guidance up to date	End 2021
8	Conducting impact per cost studies concerning observing systems;		Impact per cost study completed	Mid 2021 (EC-73)
9	Investigate how big data, crowdsourcing and other sources of observations from the private sector, the general public and third parties could be used in complement to traditional sources of high quality (reference) observations, and whether investment of NMHSs in such traditional observing systems could and should be adjusted accordingly; develop corresponding strategy and guidelines. Perform assessment of quality of third party data and communicate results to decision makers (e.g. build on GAW's efforts in this regard)		Strategy and plan for using big data, crowdsourcing and other sources of observations from the private sector, the general public and third parties.	Mid 2021 (EC-73)
10	Review emerging technologies and identify how their use could be made more operational		Guidance on use of emerging technologies	Mid 2021 (EC-73)
10	Take steps to facilitate (i) better integration of <i>in situ</i> , remote sensing data and other products to be assimilated by models of various		Strategy and plan for integration of <i>in situ</i> and remote sensing data	Mid 2022 (EC-74)

No.	Activity	Achieved through ²	Outcome	Due date
	Application Areas;			
11	Elaborate strategies and guide Members for observing network design, based on the OND Principles (see chapter 2.2.2.1 of WMO No. 1160), paying particular attention to the requirements of seamless prediction and high impact weather and climate prediction. Provide guidance on optimization of existing networks, upgrade of equipment, and combination of existing infrastructures.		Strategy and guidance to Members on Observing Network Design	Mid 2022 (EC-74)
12	Promote partnership with other organizations, private sector and third parties to further develop observing networks in the regions		Guidance on how to develop partnerships	Mid 2022 (EC-74)
13	Identify Urban observations needs for urban services that meet the special needs of cities through a combination of dense observation networks, high-resolution forecasts, multi-hazard early warning systems, and climate services. Develop a strategy and guidance to Members regarding Urban observations building on existing efforts and material delivered to Cg-18 in this regard.		<ul style="list-style-type: none"> - Urban observations needs identified - Strategy and guidance to Member on Urban Observations 	Mid 2022 (EC-74)
14	Promote development of the CryoNet consistent with the Observing Network Design (OND) Principles to maximize impact of cryospheric observations on relevant Application Areas;		<ul style="list-style-type: none"> - Relevant impact studies completed - Plan for CryoNet network design 	Mid 2022 (EC-74)
15	Develop observing networks implementation metrics to monitor their level of completeness; develop metrics for assessing overall capability of a Country with regard to its surface-based observing system;		<ul style="list-style-type: none"> - Observing Network Implementation metrics - Country capability metric 	Mid 2022 (EC-74)
16	Communicating and advertising the WIGOS-IP and its benefits to Members and encourage them to take action in order to fill the identified priority gaps; Communicate with Members about the need and benefits on integrated observing systems, and value of high quality observing systems for planning, climate adaption, emergency response and disaster risk reduction Develop communication strategy with Members about the need and benefits on integrated observing systems, and value of high quality observing systems for reference purposes.		WIGOS-IP communication plan	End 2023
17	Monitor implementation by Members of the actions of the WIGOS-IP and		Status of actions of WIGOS-IP known	2024 and

No.	Activity	Achieved through ²	Outcome	Due date
	consider further recommendations to be made to Members through WMO Executive Bodies for accelerating implementation of the actions of the WIGOS-IP;		with recommendations	ongoing
18	On the basis of the outcome of the above activities, and taking into account other existing implementation plans (e.g. WIGOS, GAW, GCW) for consistency, and priorities of the Organization, elaborating the new GCOS-IP through the GCOS science panels and wide public consultation;		GCOS-IP	Mid 2021 (first draft for wide consultation) End 2022 Final version (present to UNFCCC COP)
19	Communicating and advertising the new GCOS-IP and its benefits to Members and other relevant observing agencies encourage them to take action in order to fill the identified priority gaps;		GCOS-IP communication plan	Start 2023
20	Monitor implementation of the actions of the GCOS-IP and consider further recommendations accelerating implementation of the actions of the GCOS-IP;		Status of actions of GCOS-IP known with recommendations	2023 and ongoing
21	Establish GCOS Surface Reference Network		Plans and design complete	Initial operation 2020
22	Establish globally consistent radar networks		Data requirements and standards	Initial design 2020
23	Ensure all data is discoverable, open and freely accessible to all users.		Data access information	2023
24	Implementation of HydroHubs' main components (mainly WHYCOS, WHOS)		Enhancement of Hydrometry networks and capacity building; Collected data visible and accessible on the WHOS system	2020

ANNEX IV - Regional Issues Highlighted from ICT-IOS-9 And ICT-IOS-10**Region I**

Meeting	Issues	Comments ICT-IOS-10
ICT-IOS-9	<ul style="list-style-type: none"> 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: <ol style="list-style-type: none"> Improve and restore surface and upper-air observational capabilities of the RBSN/RBCN; and To improve data quality, regularity, and coverage of surface observations of the RBSN/RBCN. 	
ICT-IOS-10		

Region II

Meeting	Issues	Comments ICT-IOS-10
ICT-IOS-9	<ul style="list-style-type: none"> There were substantial differences between countries in relation to data policy and the approach to capacity development. The RA had placed an emphasis 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. 	
ICT-IOS-10		

Region III

Meeting	Issues	Comments ICT-IOS-10
ICT-IOS-9	<ul style="list-style-type: none"> 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.	
ICT-IOS-10		

Region IV

Meeting	Issues	Comments ICT-IOS-10
ICT-IOS-9	<ul style="list-style-type: none"> It was noted that, in Region IV, substantial improvements had been made in the implementation and maintenance of the RBSN over the past decade. 	<ul style="list-style-type: none">
ICT-IOS-10	<ul style="list-style-type: none"> Curtis Marshall <ul style="list-style-type: none"> Sustain the greatly expanded AMDAR data provided by the US ABO Program over the long-term. Adapt a common global framework for procurement of third-party/private sector data and harmonize it with a modified Resolution 40. 	

Region V

Meeting	Issues	Comments ICT-IOS-10
ICT-IOS-9	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Stephan Bojinski <ul style="list-style-type: none"> On 18 Jan 2018, Japan Meteorological Agency (JMA) launched the new international HimawariRequest satellite service for RA II and RA V, in collaboration with the Australian Bureau of Meteorology. HimawariRequest allows users of Himawari-8/9 satellite data to request Target Area observations covering a 1000kmx1000km area every 2.5 minutes. Target Area observations provide more accurate tracking and better insight into severe events, for example tropical cyclones or volcanic eruptions, and thus contribute to reducing the impact of natural disasters in RA II and RA V. HimawariRequest is a direct outcome of a recommendation by the Joint RA II/RA V Workshop on WIGOS for Disaster Risk Reduction held in October 2015 in Jakarta, Indonesia, and subsequent

		discussions within the WMO Space Programme and its Inter-Programme Expert Team on Satellite Utilization and Products (IPET-SUP). More information on HimawariRequest: JMA Press Release http://www.jma.go.jp/jma/jma-eng/satellite/news/himawari89/20180118_HimawariRequest.pdf
ICT-IOS-10	<ul style="list-style-type: none"> • Stephan Bojinski <ul style="list-style-type: none"> ◦ RA V Task Team on Satellite Utilization not yet formalized and representative of the Region ◦ RA V Task Team on Satellite Utilization meeting during 9th Asia-Oceania Meteorological Satellite Users Confernece (6-11 Oct 2018, Jakarta) needs funding. 	

Region VI

Meeting	Issues	Comments ICT-IOS-10
ICT-IOS-9	<ul style="list-style-type: none"> • 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. • 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 	<ul style="list-style-type: none"> • Alec ALLAIX <ul style="list-style-type: none"> ◦ The issue is relevant however the coordination between wind turbines and weather radar is not stictly based on a separation distance of 50 km. • Ercan Büyükbaş <ul style="list-style-type: none"> ◦ These issues stated in the report are still relevant, and my comments are as follows for Turkey, my country, and Region VI: 1) Migration to TDCF have been fully completed in Turkey, but not by all Members in Region VI. Some efforts are still needed to have full achievement in the Region VI. 2) It is obvious that to be able to meet the regional requirements and to get more benefit from the different type observing systems there is a need for redesign of existing regional RBSN/RBCN as a new Regional Basic Observing Network (RBON). To establish RBON in Region VI in accordance with

	<p>that this intention should be communicated at coming RA sessions so as to ensure compliance by Members.</p> <ul style="list-style-type: none"> • 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 of ICT-IOS-9 report. 	<p>general concept prepared by WIGOS PO will be an important agenda item of the next intersessional period of RA-VI. 3) Although there is a guidance document prepared by CIMO regarding the effect of the wind turbines on weather radar operations, it is not sufficient to protect the weather radars from the getting increased threat of wind turbines. In Turkey, we developed and issued a legislation based on the guidance of CIMO, but this keeps the wind turbines 5 km away from radars. Unfortunately this is not a perfect solution, but provides some limited protection. 4) Another getting increased problem in Turkey and Region VI is the interference to weather radars caused by R-LAN. In particular C-Band radars have been suffered by this interference problem. NMHSs should keep close cooperation with national frequency allocation authority to overcome this frequency problem.</p> <ul style="list-style-type: none"> • Erik Andersson <ul style="list-style-type: none"> ○ This is relevant for any quantitative use of radar reflectivities or rainrates. Eg. for assimilation in NWP of radar-derived rainfall intensity, at a regional/continental scale. Wind turbines create errors in the rainfall data. • Stephen English <ul style="list-style-type: none"> ○ TDCF migration: main issue has been uncertainty over timescale and incomplete and at times error prone migration. RFI issues are much broader concern than weather radar.
<p>ICT-IOS-10</p>	<ul style="list-style-type: none"> • Alec ALLAIX <ul style="list-style-type: none"> ○ Interference from WiFi equipments on weather radar (C-Band) • Ercan Büyükbaş <ul style="list-style-type: none"> ○ Forcing by third parties to remove the observing stations to another place; decreasing the representativeness and data quality due to the distortion of the environment of the observation site 	

	<ul style="list-style-type: none"> ○ as a result of the urbanization ○ Data transmission and powering problem in remote areas, in particular mountainous areas, seas and oceans ○ Vandalism to the systems in remote sites ○ High cost of the supply of observing systems, spare part and maintenance as well ○ Lack of the qualified staff for the maintenance of the observing systems ● Erik Andersson <ul style="list-style-type: none"> ○ Preventing assimilation of radar-derived rainfall intensity estimates at regional scale. ○ Europe falling behind the US, where such estimates have been produced with good quality for many years ○ Reduced quality of regional data assimilation for the initialisation of NWP models over Europe ○ This affects NWP verification of precipitation too. The surface based station network is not sufficiently dense. Radar, of good quality would be a good complement. ● Stephen English <ul style="list-style-type: none"> ○ Loss of resources and expertise due to government austerity programmes ○ Scalability ○ Slow down in growth of HPC improvement ○ Radio frequency interference ○ Uncertainty over future observation sharing 	
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ANNEX V - List of Items to Be Addressed by ICT-IOS at CBS TECO 2018 and CBS Management Group, March 2018

Item No.	ICT-IOS-10 Agenda Item/Source	Team	Issue & Task	Requirement for presentation at CBS TECO	TECO Documents for consideration by CBS MG	Responsible person/group	Responsible Secretariat Officer
1	OPAG-IOS Action Plan, 2.2.4, issue 6.1.18	WPO, IPET-OSDE	<p>Formulation of the Vision 2040 & Development of the WIGOS IP</p> <p>Develop plan for developing the new Implementation Plans for the evolution of WIGOS Component Observing Systems (WIGOS-IP) responding to the Vision of WIGOS in 2040</p>	<p>TECO Agenda Item:</p> <ul style="list-style-type: none"> Present plans for development of Vision and WIGOS-IP 	<p>Separate document with Recommendation from EC to Cg with</p> <ol style="list-style-type: none"> Approve the Vision 2040 Approve the plan for dev. Of WIGOS-IP. 	LP Riishojhaard	WIGOS PO
2	OPAG-IOS Action Plan, 2.2.4	WPO, WEdB	<p>Updated and New regulatory material</p> <ul style="list-style-type: none"> Submission of draft RBON regulations Integration of Manual on GOS to WIGOS regulatory material <p>ACTION: E. Charpentier to remind ICT-IOS members regarding review of RBON regulations before TECO.</p>	TECO Agenda item on RBON.	<ul style="list-style-type: none"> RBON: Document for information to CBS? M&G to GOS: Decision on approval of integration Recommendation from EC to Cg 	LP Riishojhaard, WIGOS/EdB	WIGOS PO

Item No.	ICT-IOS-10 Agenda Item/Source	Team	Issue & Task	Requirement for presentation at CBS TECO	TECO Documents for consideration by CBS MG	Responsible person/group	Responsible Secretariat Officer
3	OPAG-IOS Action Plan, 2.2.4		<p>Recommendations on contribution of Members to WIGOS Implementation pending integrated Implementation Plan for WIGOS Component Observing Systems</p> <ul style="list-style-type: none"> • review to be undertaken by a consultant. Becomes a reference point for members in regard to evolving their own networks • no need to consult with other IPs in relation to other networks. 	Presented as part of Chairs Presentation	Presented as part of Chairs Report	A. Rea	E. Charpentier
4	OPAG-IOS Action Plan, 2.2.4		<p>WIGOS OSCAR Machine-Machine interface with OSCAR at the national level. Secretariat to draft a recommendation for CBS and EC. API should be completed by Cg-18.</p> <ol style="list-style-type: none"> 1. Members to be encouraged to use M2M rather than HUI. AR: Recommendation to come from the ICT-IOS. Pilot is underway led by WPO. Members will have to develop their own software to facilitate M2M. 2. ICT-IOS to recommend to CBS that if Members wish to develop a stand-alone national metadata management tool, they collaborate together to do so. 	Included in presentation to TECO.	<p>Include in Chair's report document with:</p> <p>Recommendation to EC for Cg for items 1 and 2.</p>	E. Charpentier	E. Charpentier

Item No.	ICT-IOS-10 Agenda Item/Source	Team	Issue & Task	Requirement for presentation at CBS TECO	TECO Documents for consideration by CBS MG	Responsible person/group	Responsible Secretariat Officer
17	ICT-IOS, Item 8.5		ICT-IOS decided to recommend to CBS Management Group, that Members should be advised to form a consortium to consider developing a stand-alone solution for national management of sites metadata that is compatible with the WIGOS Metadata Standard and the OSCAR/Surface machine-machine interface.		Address in Report of Chair	A. Rea, Chair ICT-IOS	E. Charpentier
5	OPAG-IOS Action Plan, 2.2.4, 6.7	IPET-OSDE, C-SEIS	Reviewing and updating of science questions for impact assessment for Observing System Design and Evolution		Include in Chair's report with draft Decision for EC	C-SEIS	E. Charpentier
6	ICT-IOS-10, 5.1	ET-SAT	Strengthening collaboration with CGMS regarding Risk Assessment and Gap Analysis		Include in Chair's report with recommendation to EC and later Cg-18?	ET-SAT	T. Korino
7	OPAG-IOS Action Plan, 2.2.4	SG-RFC	Radio Frequency Coordination and the agreed WMO position going into WRC-19	TECO full Agenda Item	Document with Recommendation to EC	Alec Alaix, SG-RFC	D. Thomas

Item No.	ICT-IOS-10 Agenda Item/Source	Team	Issue & Task	Requirement for presentation at CBS TECO	TECO Documents for consideration by CBS MG	Responsible person/group	Responsible Secretariat Officer
8	OPAG-IOS Action Plan, 2.2.4, Issue 8.5.2	ET-ABO,	<p>Recommendations on implementing and integrating emerging observing systems (e.g. new satellite technologies, aircraft, surface GPS) in the Regions</p> <ul style="list-style-type: none"> • AMDAR: Recommendation to EC on Endorsement of IWCAP and Recommendation to establish a Task Team to coordinate implementation of the IATA-WMO collaboration. Request decision by CBS to establish a Task Team to later be consolidated by EC. • ? 	<p>AMDAR:</p> <ul style="list-style-type: none"> • Full agenda item on Day 1 of TECO presented by C. Marshall and rep. of IATA. 	<p>AMDAR:</p> <ul style="list-style-type: none"> • Document with Recommendation to EC re. IATA-WMO Collaboration on AMDAR and (re)estab. of task team (see attachment 1) • Decision to estab. task team. 	C. Marshall, ET-ABO	D. Lockett
9	OPAG-IOS Action Plan, 2.2.4, Item 8.5, Issue 8.5.1	IPET-SUP	<p>Recommendations on assessing the uptake and utilization of observational products by members</p> <ul style="list-style-type: none"> • Members to consider providing financial contributions to the WMO VLab Trust Fund 		<p>Chair's report or separate document?</p> <p>ICT-IOS to compose and submit a draft recommendation to EC-70 through the CBS process.</p>	IPET-SUP	S. Bojinski

Item No.	ICT-IOS-10 Agenda Item/Source	Team	Issue & Task	Requirement for presentation at CBS TECO	TECO Documents for consideration by CBS MG	Responsible person/group	Responsible Secretariat Officer
10	OPAG-IOS Action Plan, 2.2.4, 6.2	ET-SBO	<p>Ensure following items are included under Chair Report to CBS TECO and CBS-MG</p> <ol style="list-style-type: none"> 1) Utilising the correct Geode (Issue 6-2-4) – requires a request to ICG-WIGOS 2) Traceability to Standards and access to Calibration Facilities (Issue 6.2.3) – requires a request to CIMO 3) ET-SBO Access to Lightning Observations Expertise (Issue 6.2.5) 4) Radiosonde Observations - High Resolution BUFR Reporting (Issue 6.2.6) 	Poss	<p>Include in Chair's report document</p> <ul style="list-style-type: none"> • 1), 2), 3) Include in Document to CBS-MG – Decision by CBS-MG • 4) – Recommended Resol. to EC <p>ACTION: DL to consult with CBS TT on this issue (S. Klink) .</p>	S. Goldstraw, A. Rea	D. Lockett
11	ICT-IOS-10, 7.2.2	ICT-IOS	<p>Chairs Report on OPAG-IOS</p> <p>To be included in presentation to TECO:</p> <ul style="list-style-type: none"> • EGOS-IP and future WIGOS-IP inc. review of various IPs. • Degradation of Surface Networks • Impacts Workshop • ET-SBO Issues • Implications of technological and societal changes (Annex VIII) • Radiosonde BUFR issue. <p>Other items to be included in either presentation or document:</p> <ul style="list-style-type: none"> • OSCAR M-M interface • OSCAR/Surface stand-alone software recommendation of ICT-IOS 	TECO full agenda item	Document	A. Rea	E. Charpentier

Item No.	ICT-IOS-10 Agenda Item/Source	Team	Issue & Task	Requirement for presentation at CBS TECO	TECO Documents for consideration by CBS MG	Responsible person/group	Responsible Secretariat Officer
12	ICT-IOS-10, issues 6.1.10, issue 6.1.19	ICT-IOS, IPET-OSDE	Res 40 and data availability issue and Global exchange of data in support of NWP OND Principles: Increasing the awareness of the OND Principles, and their use by Members. Stressing the critical importance of data sharing of important data sets with demonstrated positive impact on NWP.	TECO full agenda item	Separate Document Propose Cg-18 Resolution (through EC-70 Recommendation)	A. Rea	E. Charpentier
13	ICT-IOS-10, issue 6.1.4	ICT-IOS, IPET-OSDE	Evolution of OSCAR/Requirement		OPAG IOS Chair report, MG Decision	A. Rea	E. Charpentier
14	ICT-IOS-10, issue 6.1.14	ICT-IOS, IPET-OSDE	Lack of resources to conduct a more detailed analysis of observational requirements and to develop a detailed SoG for the Climate Science Application Area.		OPAG IOS Chair report, Propose EC-70 decision	M. Rixen	E. Charpentier,
15	ICT-IOS-10, issue 6.1.16		Members contributions toward implementing actions of the Implementation Plan for the Evolution of Global Observing Systems (EGOS-IP), pending adopted of future WIGOS Implementation Plan (WIGOS-IP)		OPAG IOS Chair report, Propose Cg-18 Resolution (through EC-70 Recommendation)	A. Rea	E. Charpentier
16	ICT-IOS-10, issue 6.6.1		Reducing number of VOS classifications		OPAG IOS Chair report, Propose Cg-18 Resolution (through EC-70 Recommendation, and request to JCOMM)	A. Rea	C. Gallage

Attachment 1 – Draft recommendation of CBS to EC-70 on the IATA-WMO Collaboration on AMDAR

The following proposed draft Resolution by EC to be considered for recommendation by CBS, will advance the requested action made in Decision 12.2(2)/1 (EC-69) on the Potential Future Collaboration of WMO and IATA on the Operation and Development of the AMDAR Programme, which endorsed the establishment of a Working Arrangement between WMO and IATA under which the two organizations would work together to develop the terms of reference and concept of operations for future collaboration on AMDAR.

Draft Resolution X.X(n)/N (EC-70) ESTABLISHMENT OF THE IATA-WMO COLLABORATIVE AMDAR PROGRAMME

THE EXECUTIVE COUNCIL,

Recalling Decision 12.2(2)/1 (EC-69), Potential Future Collaboration of WMO and IATA on the Operation and Development of the AMDAR Programme, which endorsed the establishment of a Working Arrangement between WMO and IATA under which the two organizations would work together to develop the terms of reference and concept of operations for future collaboration on AMDAR,

Noting that a Working Arrangement has been established between IATA and WMO in July 2017 regarding cooperation relative to matters of the automated measurement and transmission of meteorological (MET) data from an aircraft platform, currently operational as the WMO Aircraft Meteorological Data Relay (AMDAR) programme and recognized as a key component of the WMO Global Observing System,

Noting also Decision 12.2(2)/1 requested the Secretary-General, in coordination with the president of the Commission for Basic Systems, to work with IATA to further finalize and establish the Working Arrangement between WMO and IATA and to subsequently develop the concept of operations for the future possible collaboration of WMO and IATA on the operation and development of the AMDAR Programme,

Noting further Decision 3.2(5)/1 (RA VI-17) in which the RA VI endorsed the proposed IATA-WMO Collaboration on AMDAR under the proposed Concept of Operations and Decided that, subject to IATA and WMO entering into a formal collaboration on AMDAR based on a recommendation of the Executive Council (EC-70) in June 2018 and decision by Cg-XVIII in 2019, RA VI will compile its requirements for AMDAR observations by July 2018 with a view to beginning development of the WMO Region VI AMDAR Programme under the IATA-WMO Collaboration in January 2019 and potentially beginning operation of the programme in January 2020;

Having examined the draft proposed Concept of Operations for the IATA-WMO Collaboration on AMDAR, the proposed Terms of Reference of the collaboration and the draft Implementation Plan for Establishment of the IATA-WMO Collaborative AMDAR Programme,

Having considered the implications of the Concept of Operations in committing WMO to coordinating the establishment and maintenance of national, regional and global requirements for AMDAR observations and the resources for their provision and management,

Having been informed that IATA will play a leading role in ensuring that the agreed required AMDAR observations are provided efficiently and economically through coordination with its member airlines and the wider aviation industry,

Convinced that the collaboration will lead to the expansion and enhancement of the WMO AMDAR observing system globally and, as a result, bring increased and further benefits to meteorological applications and improvement to forecasting skills and services to aviation;

Endorses the proposed IATA-WMO Collaboration on AMDAR under the proposed Concept of Operations, the proposed Terms of Reference of the collaboration and the draft Implementation Plan for Establishment of the IATA-WMO Collaborative AMDAR Programme;

Recommends that Congress approves the establishment of a Working Arrangement and supporting agreement between WMO and IATA to implement and operate the AMDAR programme under the proposed Concept of Operations, the proposed Terms of Reference of the collaboration and the draft Implementation Plan for Establishment of the IATA-WMO Collaborative AMDAR Programme and potentially beginning operation in January 2020;

Requests the Secretary-General, the Executive Council and the Commission for Basic Systems to continue to coordinate the process of informing and seeking the endorsement of the Concept of Operations of the IATA-WMO Collaboration on AMDAR among all RAs;

ANNEX VI - List of Possible Side Events for CBS TECO 2018

1. Impacts workshop
 2. WDQMS and Data availability for NWP applications
 3. OSCAR and RRR Process Explanation
 4. Integration of sat. / surf. Systems e.g. GPM / Radar inter-calibration
 5. Status of space-based component of the GOS
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ANNEX VII - Reports of Breakout Session of ICT-IOS-10

Breakout Group Topics

1. Recommendations on implementing and integrating emerging observing systems – considering the IATA-WMO Collaboration on AMDAR.
2. Recommendations on assessing the uptake and utilization of observational products by members.
3. Open source OSCAR software
4. Review of RBON material WIGOS Regulatory and Guidance material (incl. integration of GOS material, RBON)
5. Encouraging sharing of HR and additional data – addressed in plenary.

Group 1 Report - Recommendations on implementing and integrating emerging observing systems – considering the IATA-WMO Collaboration on AMDAR.

1. Regional processes and resourcing to gather requirements and running operations.
 - This is definitely a risk.
2. Consideration of framework for costing as a potential monopoly.
 - Legal aspect have to be dealt with be both organizations. Expect this will be addressed over Feb-Mar 2018.
3. J. Dibbern: 3 aspects to consider:
 - a. A statement and approval from WMO Legal Counsel is required.
 - b. Technical Coordinator position must be maintained in WMO. - Should be highlighted more in the CONOPs.
 - c. It will be necessary to maintain the AMDAR Trust to support ongoing activities related to AMDAR and ABO.
- Transition is an issue that must be carefully addressed:
 - Will be an IP issue with EUMETNET that will be overseen by Steve Stringer (E-AMDAR PM)
 - A WMO work group will need to be established to negotiate with a similar IATA entity to establish the inter-org. agreement and the governance structure. This group must consider:
 - Data policy.
 - Costing framework.
 - Etc.

- Action: Resolution to include a request to establish a TT under CBS and then have formalised at EC.
- Not included in the CONOPs is the full costing structure.
- A global cost-sharing model should also be considered.
 - Has been discussed in WMO that eventually the members could agree to adopt a costing structure based on additional regular budget funding to support the global AMDAR programme.
- Regional capabilities?
 - Do regions have the capacity to come together to facilitate the production of requirements.

Group 2 Report - Recommendations on assessing the uptake and utilization of observational products by members.

Summary

This Break out group was asked to consider the question, “How do we measure the uptake of utilization of data and data products by Members. ”” And more specifically “Can the ET-SUP or EGOS-IP survey be adapted to measure this?”. The input to the discussion was paper 8.5(3).

The group considered this to be an important activity and that the IPETSUP survey could be adapted .This resulted in this Recommendation: The BOG2 recommends that the Chairs of OSDE and IPETSUP consider submitting a joint survey, largely based on an extension of the 4 yearly IPETSUP survey.

Summary of supporting discussion.

For ease of reference items are numbered:

1. What do we mean by uptake and utilization?
 - There are two aspects: a) how many users are there for different observation types/networks; b) how are these observations being used.
 - If an observation type is not widely accessed / used we need to understand why. Therefore the survey should give the opportunity to provide additional information.
 - The group noted we need to double check this is not already being done elsewhere in or outside WMO.
2. Suitability of existing surveys
 - The EGOS-IP survey is primarily addressed to providers of national observation systems and focusses on change management. It therefore covers the evolution of the networks and progress on actions in the plan.
 - IPETSUP survey addresses what satellite datasets are being used, and what is limiting their uptake or stopping use (e.g. lack of access, information, skills, software tools)
 - The group concluded IPETSUP survey could be extended to cover a broader set of observations. This could be a joint OSDE and IPETSUP survey. Additional questions would be needed to be added to the existing survey, but with some broad similarities.

3. Development of a survey

The group then discussed in more detail aspects and requirements for the survey. In time available this could not be an exhaustive discussion, but it may provide useful pointers.

- a. The group noted misunderstandings of survey questions in some past surveys can make interpretation of results difficult. This can be partly addressed through an accurate translation, and ambiguous questions should be avoided.
- b. The group noted the need to define the audience for the survey. It is important to establish which sector they come from and ensure analysis is not biased by a disproportionate response from a specific sector.
- c. The survey could cover observing systems for multiple earth system components: atmosphere, ocean, land, cryosphere, composition.
- d. It could cover global, regional and national data.
- e. In addition to rather general questions questions could be added on very specific data types, which could include:
 - ABO (aka AMDAR)
 - RADAR ... but what level of detail to ask about
 - Ground based GNSS
- f. The survey should ask specifically about national requirements not currently met.
- g. The survey should ask specifically about observations that are available but are not currently used, and follow up with questions to establish the reasons.
- h. In addition to asking about the users own requirements the survey could also ask if they have observations they are not currently sharing, but are willing to share. If this is case, the survey needs to ask for details.
- i. Users need to know what is in the catalogue for GTS to request data to be delivered. However this isn't a physical or online catalogue yet for all observations. So some observations may be available, but not accessed by users who are left with an unmet requirement. Also users should receive GTS change notifications. However network owners do not consistently send such change notifications. The survey could ask questions about experiences of receiving change notifications? There is a "blog"/bulletin type information service. The survey can ask if this is used. In addition the survey can ask about other mechanisms do people use to get information?
- j. In addition to receiving GTS observations the survey could ask about other mechanisms to share/receive data e.g. bilateral arrangements.
- k. The question was raised whether there other ways to a survey to capture this information? This question was asked, but not answered but it could be considered.
- l. The group agreed that how a survey is presented matters: e.g. language barriers, level of formality. A personalised email can be more effective than a formal letter to focal point.
- m. The survey should ask about data format preferences. Are difficulties with formatting limiting uptake for some observation types.

Other point.

We should learn from other surveys. NASA did survey of other federal agencies to see what they would find useful. Jack Kaye will look into whether it is possible to provide information about this as a guide, the EGOS-IP and IPETSUP surveys should also be circulated. All this can be used to guide best practise in survey design. We should seek information on any past comparable exercises and learn from them.

Group 3 Report - Open source OSCAR software

1. Group to discuss requirements
2. Recommend a way forward. If deemed feasible then recommend accountability and high level actions

Issues:

- There are apparently 3 issues relating to this (perceived) requirement:
 - 1) Members want to be able to use OSCAR locally to manage their own metadata
 - This could be related to an operational issue whereby they do not want to rely on a centralised source that they don't control in operational practices.
 - Recognise that there will likely be a need for a software module that allow "pseudo-automated" compilation of metadata for provision to OSCAR via the machine to machine interface. This may partially meet some member requirements or concerns. But this does not meet a requirement for a fully-functional (e.g. historisation, monitoring, etc) stand-alone national OSCAR system.
 - 2) Members have stated a potential issue with using a centralised platform (solely) to manage their own metadata.
 - 3) Members have stated a potential issue that they might not be able to provide some parts of the WMDS because of restriction in allowing another country to be provided with these data.
- Have a WIGOS MDS
- IP is associated with the OSCAR system is an issue for Meteo Suisse (or according to them).
- Issues with providing stand-alone solutions
 - 1) Difficult and costly to maintain
 - 2) Creates compatibility issues between member and WMO versions of OSCAR potentially meaning WMO/OSCAR is not accurate.
 - 3) IP issue with 3rd party developer?
- Recommended steps for ICT-IOS to address this issue:
 - 1) Request clarification on specific member requirements that are to be addressed by this provision of software, including how many members would like or really required this. Undertake a targeted survey to determine this?
 - 2) Request clarification from Meteo Suisse on their issues – is it IP, resource, technical difficulty principle, all the above?
 - 3) Suggest that CBS/ICG-WIGOS educates members on the timeline for implementation and the functionality of the machine to machine interface and

whether solutions will be offered to enable members without national metadata databases to use the M2M interface.

- 4) Consider acceleration of timeline for delivery of M2M.

Group 4 Report - Review of RBON material WIGOS Regulatory and Guidance material (incl. integration of GOS material, RBON)

The Chair of ET-SBO was involved in drafting of WIGOS regulatory and guidance material and participated in the meeting and teleconferences of the WIGOS Editorial Board in January 2018. The proposed new text of the WIGOS regulatory material was discussed in the break out group. In general the amended text was accepted, minor improvements were discussed and the chair of ET-SBO will bring this to the attention of the WIGOS Editorial Board.

Group 5 Report - Encouraging sharing of HR and additional data – addressed in plenary.

Encouraging sharing of HR and additional data – how to address.

- Options for discussion might be:
 - Possible change to the Annex 1 to Resolution 40
 - Complementary resolution covering NWP requirements (surface and space)
 - Address via definition of the RBON
 - Communications to members on requirements, utilisation and benefits
 - GNSS data availability (see 8.5(1)).
- W. Zhang: Expectation that NWP applications will move to a global earth modelling system.
 - This means the earth observing system (EOS) must be improved to provide the required resolution of observations to support it.
 - WMO Members are willing to follow regulations and actions dictated by WMO.
 - When RBON is defined members will be willing to strengthen the EOS based on this definition and its requirements
 - Capabilities of surface systems is not well known and needs to be surveyed and defined in OSCAR.
 - A. Rea: What is the best way to encourage and urge members to exchange data? - Perhaps a resolution to urge members through reference to requirements for NWP in particular?
 - W. Zhang:

- RBON and its regulations offers the best way forward.
- Need to be clear about requirements
- J. Dibbern : WIGOS through RBON should highlight requirements for particular applications. International exchange should be a requirement to be defined as a RBON station. This is the vehicle combined with a Resolution. A. Rea: But this doesn't cover satellite observations. Perhaps a different resolution is required.
- W. Zhang: Allow stations to be defined as planned for the future to see the evolution of RBON.
 - Res 40 Annex should be rewritten to include RBON. It can be updated regularly according to changing and evolving requirements. Satellite observations should be brought into this.
 - 3 RA sessions this year: RA III and RA V in 2nd half of 2018.
 - Resolution at EC possible? A draft revision should be available for consideration. Check for past changes and precedent.
 - Will be difficult as the construction of RBON is very different to how the concept of Res 40 is established.
- For Satellite data exchange:
 - Chapter 4 of MoW has provisions for addressing requirements for sat. data.
- **Summary of possible future actions and requirements**
 - Ensure establishment of RBON addresses requirements for provision of data to meet requirements of Application Areas.
 - Make change to Res 40 Annex 1 to refer to RBON.
 - Resolution to EC to change Annex and highlight requirements to migrate to meeting requirements for data exchange via the Manual on WIGOS and to implement RBON.
- **ICT-IOS Actions:**
 - ICT-IOS to organise Side Event at CBS on possible change to Res 40, Annex 1.
 - ICT-IOS to establish a sub-group to work on Revision of the Annex for RBON to address requirements for exchange of data:
 - S.Goldstraw, Anthony, Jochen, Jack, Steve, Curtis, Erik

Annex VIII - Implications Of Technological And Societal Changes - Discussion On Anticipated Developments Over The Next 10 Years

- Satellite Systems
 - Will become easier and cheaper to launch satellite systems
 - Will be opportunities to have payloads on private systems at least as demonstrations/research.
 - Smaller sat. systems will increase in number and provide opportunities for met system deployment.
 - Multiple smaller sat. systems/constellations may reduce risk to satellite missions due to redundancy.
 - Requirements for quality and stability might be off-traded for ability to deploy systems and sensors more quickly and more widely. Systematic calibration issues present difficulties for application areas, e.g. NWP. May require high quality reference systems to be deployed.
 - Possible development and availability of high-dwell deployments over the poles.
 - Expectations re. growth in space program members?: Possibly in some countries (Russia, Korea, UAE, Brazil).
 - More sustainability of Earth system measurements (beyond meteorology) from space, strongly supported e.g., by European Copernicus programme (and its Expansion) and the Chinese space programme (CMA, CNSA)
- Surface Systems
 - Similar issue with satellites re. proliferation of sensors and systems of lower quality that will require referencing against lower-density higher quality networks – need to handle tiered quality networks.
 - JCOMM funding issue needs to be addressed – could go either way.
 - Improved monitoring will lead to requirement/possibility to address under-performance by some regions and members. Requires careful management.
 - Requirement to manage DRR and associated monitoring events
 - Prediction of impact
 - Post-measurement of impact
 - Copernicus program to provide support for this
 - Increased collaboration required and expected to increase within and for Region I.
 - Consideration of additional or alternatives to BUFR as standard for data exchange.
 - Tools based on FSO to support network optimisation for tropical system / convective scale monitoring and prediction – risks associated with this.
 - Short range forecasts will become more critical to forecasting service. Closure of gap between nowcast and SR forecast – leads to requirement for high resolution observations.

- Private sector engagement: likely to be improved and more important to provision of and meeting requirements for observations. Partnerships will be mutual beneficial – e.g. in energy sector.
- Observations can come from other platforms such as cars which in turn will require forecast applications and services, e.g. to support automated, driverless vehicles. Can be based on partnerships with car manufacturers.
- Benefits of data being shared and freely available will be acknowledged and become prevalent.
- Value of and restriction of sharing of environmental data might be an issue related to national security requirements, e.g. data over national airspace.
- Inter-coupling of earth systems will enhance connectivity within applications leading to an impact on complexity of design of observational systems.
- RF and communications issues:
 - satellite communications will drive down costs of observations from and over remote areas.
 - Management of large data volumes.
 - Ongoing issues with RF access. Anticipate continued issues with interference in passive bands.
 - Require ability to negotiate data agreements with private entities.
 - General adoption of open data policies by most satellite operators: recent examples are European Copernicus and plans for Canadian RADARSAT continuity mission
 - HAPs are being looked at by Thales Alenia, Google, for EO and comms
- Marine Systems
 - Glider system deployment to increase
 - Drone deployment to increase – possible transition from research to operations.
 - Fixed line oceanic communications to be utilised to support observing systems.
 - Discussions with IMO to ensure ship designs support provision of observing systems.
 - Cruise liners and container ships to support provision of observations.
 - XBT to be phased out in favour of Argo. Argo obs. suite to expand beyond temperature.
 - Wave observations and winds (derive from sonar spectral analysis) from drift bouys with GPS.
 - HF radar for coastal and wave observations
- Aircraft obs
 - HR T & Wind data from surveillance systems such as ADS-B, Mode S
 - Availability of turbulence and humidity from AMDAR
 - Reduced AMDAR and ABO comms costs due to sat. comms, WIFI and cockpit systems.

- Data availability from operational UAV and other automated or remote controlled systems is possible/likely.
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ANNEX IX - Science Questions Requiring NWP Impact Assessments for Observing System Design and Evolutions

Short name: Full name	Science question
Surface-based	
S1 AMDAR: Coverage of AMDAR	"Encourage studies of impact assessment of AMDAR and MODE-S in data-sparse regions. Examples include for instance (1) trade space studies between additional vertical profiles over land versus en route data over the oceans, and (2) increasing measurements over poles versus tropics. Provide general guidance for AMDAR extension priorities"
S2 Radar: Radar observations	What are the impacts of current radar observations, particularly radar polarization, but also wind profiles, radial winds and reflectivity?
S3 PBL: 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?
S4 HighElev: High elevation surface observing stations	Estimate the actual and potential impacts of high elevation meteorological data from the high mountain regions, for example using OSSE, OSE or FSOI, on appropriate environmental models.
Space-based	
S5 SatLand: 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?
S6 Sounders: Impact of multiple satellite sounders	What benefits are found when data from more than one passive sounder are available from satellites in complementary orbits?
S7 AMVs: Atmospheric Motion Vectors	Which AMV characteristics (temporal resolution, height, etc.) should be enhanced from the next generation of satellites (such as Geo)?
General	
S8 UA: 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.
S9 Sfc and Sat : Impact of satellite observing capabilities on the design of the surface-	What is the impact of the increasing capabilities of space-based observing systems on the design and evolution of surface-based observing systems? With special emphasis on the impact on network design in areas with very sparse

based observing systems	surface-based networks. Examples include (1) For marine observing systems: What density of surface pressure observations over the ocean is needed to complement high-density surface wind observations from satellites? And (2) For upper air observations: 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.
S10 AdjEns: 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.
S11 Ocean: Impact in ocean-coupled assimilation	Which ocean observations are particularly important for NWP? Investigate the role of ocean observations, in particular profile observations provided for example by the moored buoy arrays, in coupled atmosphere-ocean data assimilation with a focus on the 7-14 day range.
S12 Land: 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.
S13 Data frequency/Timeliness	Assess the impact of increased frequency and/or timeliness/latency of observations? Consider the case of AMDAR, radiosonde, GEO satellites AMVs and ground-based remote sensing observations (such as Doppler radar, wind profiler, ground based GNSS receivers) for regional and global NWP.
S14 Atmospheric composition	Study observation impact in atmospheric composition and air quality application and the impact of atmospheric composition observations (e.g. aerosol) on NWP.
S15 OSSEs	Observing system simulation experiments are encouraged in support of satellite system design criteria such as orbit optimization for GNSS-RO satellites, or for emerging technology sensors (such as Geo-based hypersperspectral IR or MW sounders, Small/Cube satellites, etc).
S16 Impact Assessment for Seasonal And Climate Applications	Observational Impact Studies are encouraged for extended range prediction systems, especially using coupled models. These could be used to investigate ways to optimize the design of climate observing systems networks.
S17 Ground-Based GNSS	Promote undertaking impact studies to assess the impact of ground-based GNSS on NWP. This will help measure the potential need to exchange data internationally. In addition to regional impacts, global impacts or at least wide-regional impacts are encouraged.

ANNEX X – Draft Recommendation on Radio-Frequencies

Draft CBS recommendation

RADIO FREQUENCIES FOR METEOROLOGICAL AND RELATED ENVIRONMENTAL ACTIVITIES .

THE WORLD METEOROLOGICAL CONGRESS,

Recalling:

- (1) Resolution 29 (Cg-17) - Radio frequencies for meteorological and related environmental activities,
- (2) Decision 33 (EC-69) - Preserving the radio-frequency spectrum for meteorological and related environmental activities at the World Radiocommunication Conference 2019,
- (3) Decision 22 (CBS-16) - Preserving the radio-frequency spectrum for meteorological and related environmental activities at the World Radiocommunication Conference 2019;

Considering:

- (1) The prime importance of the specific radiocommunication services for meteorological and related environmental activities required for the detection and early warning of hazards and the prevention and mitigation of natural and technological (human-induced) disasters, the safety of life and property, the protection of the environment, climate change studies and scientific research,
- (2) The importance of information provided by the Earth-exploration systems including meteorological systems for a wide range of economic activities such as agriculture, transportation, construction and tourism,
- (3) The crucial importance of the allocation of suitable radio-frequency bands for the operation of surface-based meteorological observing systems, including in particular radiosondes, weather radars and wind profiler radars,
- (4) The crucial importance of the allocation of suitable radio-frequency bands for the operation of meteorological and research and development satellites, including remote-sensing, data collection and data distribution links,

Stressing that some radio-frequency bands are a unique natural resource due to their special characteristics and natural radiation enabling space-borne passive sensing of the atmosphere and the Earth surface, which deserve adequate allocation to the Earth-exploration satellite service (passive) and absolute protection from interference,

Expresses its serious concern at the continuing threat to several radio-frequency bands allocated to the meteorological aids, meteorological-satellite, Earth-exploration satellite and radiolocation (weather and wind profiler radars) services posed by the development of other radiocommunication services;

Requests the Commission for Basic Systems to pursue the continuous review of regulatory and technical matters related to radio frequencies for operational and research meteorological and related environmental activities, and preparation of guidance and information for National Meteorological and Hydrological Services, in coordination with other technical commissions especially the Commission for Instruments and Methods of Observation, and in liaison with other relevant international bodies, in particular the Coordination Group for Meteorological Satellites;

Urges all Members to do their utmost to ensure the availability and protection of suitable radiofrequency bands required for meteorological and related environmental operations and research, and in particular:

- (1) To ensure that their national radiocommunication administrations are fully aware of the importance of and requirements for radio frequencies for meteorological and related activities, and to seek their support in the ITU World Radiocommunication Conferences and Radiocommunication Sector (ITU-R) activities;
- (2) To participate actively in the national, regional and international activities on relevant radiocommunication regulatory issues and, in particular, to involve experts from their Services in the work of relevant regional telecommunication organizations and of ITU-R, especially ITU-R Study Groups 5 and 7 on Terrestrial (including radiolocation) and Science Services, respectively;
- (3) To register adequately with their national radiocommunication administrations all radiocommunication stations and radio frequencies used for meteorological and related environmental operations and research;

Appeals to the International Telecommunication Union and its Member Administrations:

- (1) To ensure the availability and absolute protection of the radio-frequency bands which, due to their special physical characteristics, are a unique natural resource for spaceborne passive sensing of the atmosphere and the Earth surface and are of crucial importance for weather, water and climate research and operations;
- (2) To give due consideration to the WMO requirements for radio-frequency allocations and regulatory provisions for meteorological and related environmental operations and research;
- (3) To pay special attention to the WMO positions related to the WRC agenda, in the light of Appeals (1) and (2) above;

Requests the Secretary-General:

- (1) To bring the present resolution to the attention of all concerned, including the International Telecommunication Union;
- (2) To pursue as a matter of high priority the coordination role of the Secretariat in radiofrequency matters, especially with ITU-R, including participation of WMO in ITU-R Radiocommunication Study Groups, conference preparatory meetings and World Radiocommunication Conferences;
- (3) To facilitate the coordination between National Meteorological and Hydrological Services and their national radiocommunication administrations, particularly in preparing for the ITU World Radiocommunication Conferences, by providing appropriate information and documentation;
- (4) To assist the Commission for Basic Systems in the implementation of the present resolution.

Note: This resolution replaces Resolution 29 (Cg-17), which is no longer in force.

ANNEX to Draft CBS Recommendation

Resolution 29 (Cg-17)

RADIO FREQUENCIES FOR METEOROLOGICAL AND RELATED ENVIRONMENTAL ACTIVITIES

THE WORLD METEOROLOGICAL CONGRESS,

Noting:

- (1) The WMO Strategic and Operating Plans,
- (2) Resolution 4 (Cg-XV) – Radio frequencies for meteorological and related environmental activities,
- (3) The current radio-frequency allocations and regulatory provisions related to the meteorological aids, meteorological satellite, Earth-exploration satellite and radiolocation (weather and wind profiler radars) services in the Radio Regulations of the International Telecommunication Union (ITU),
- (4) The outcome of the ITU World Radiocommunication Conferences (WRCs),
- (5) The agenda of the forthcoming ITU World Radiocommunication Conference and related WMO positions submitted during the ITU preparatory process to WRCs,

Considering:

- (1) The prime importance of the specific radiocommunication services for meteorological and related environmental activities required for the detection and early warning of hazards and the prevention and mitigation of natural and technological (human-induced) disasters, the safety of life and property, the protection of the environment, climate change studies and scientific research,
- (2) The importance of information provided by the Earth-exploration systems including meteorological systems for a wide range of economic activities such as agriculture, transportation, construction and tourism,
- (3) The crucial importance of the allocation of suitable radio-frequency bands for the operation of surface-based meteorological observing systems, including in particular radiosondes, weather radars and wind profiler radars,
- (4) The crucial importance of the allocation of suitable radio-frequency bands for the operation of meteorological and research and development satellites, including remote-sensing, data collection and data distribution links,

Stressing that some radio-frequency bands are a unique natural resource due to their special characteristics and natural radiation enabling space-borne passive sensing of the atmosphere and the Earth surface, which deserve adequate allocation to the Earth-exploration satellite service (passive) and absolute protection from interference,

Expresses its serious concern at the continuing threat to several radio-frequency bands allocated to the meteorological aids, meteorological-satellite, Earth-exploration satellite and radiolocation (weather and wind profiler radars) services posed by the development of other radiocommunication services;

Requests the Commission for Basic Systems to pursue the continuous review of regulatory and technical matters related to radio frequencies for operational and research meteorological and related environmental activities, and preparation of guidance and information for National Meteorological and Hydrological Services, in coordination with other technical commissions, especially the Commission for

Instruments and Methods of Observation, and in liaison with other relevant international bodies, in particular the Coordination Group for Meteorological Satellites;

Urges all Members to do their utmost to ensure the availability and protection of suitable radiofrequency bands required for meteorological and related environmental operations and research, and in particular:

- (1) To ensure that their national radiocommunication administrations are fully aware of the importance of and requirements for radio frequencies for meteorological and related activities, and to seek their support in the ITU World Radiocommunication Conferences and Radiocommunication Sector (ITU-R) activities;
- (2) To participate actively in the national, regional and international activities on relevant radiocommunication regulatory issues and, in particular, to involve experts from their Services in the work of relevant regional telecommunication organizations and of ITU-R, especially ITU-R Study Groups 5 and 7 on Terrestrial (including radiolocation) and Science Services, respectively;
- (3) To register adequately with their national radiocommunication administrations all radiocommunication stations and radio frequencies used for meteorological and related environmental operations and research;

Appeals to the International Telecommunication Union and its Member Administrations:

- (1) To ensure the availability and absolute protection of the radio-frequency bands which, due to their special physical characteristics, are a unique natural resource for spaceborne passive sensing of the atmosphere and the Earth surface and are of crucial importance for weather, water and climate research and operations;
- (2) To give due consideration to the WMO requirements for radio-frequency allocations and regulatory provisions for meteorological and related environmental operations and research;
- (3) To pay special attention to the WMO positions related to the WRC agenda, in the light of Appeals (1) and (2) above;

Requests the Secretary-General:

- (1) To bring the present resolution to the attention of all concerned, including the International Telecommunication Union;
- (2) To pursue as a matter of high priority the coordination role of the Secretariat in radiofrequency matters, especially with ITU-R, including participation of WMO in ITU-R Radiocommunication Study Groups, conference preparatory meetings and World Radiocommunication Conferences;
- (3) To facilitate the coordination between National Meteorological and Hydrological Services and their national radiocommunication administrations, particularly in preparing for the ITU World Radiocommunication Conferences, by providing appropriate information and documentation;
- (4) To assist the Commission for Basic Systems in the implementation of the present resolution.

Note: This resolution replaces Resolution 4 (Cg-XV), which is no longer in force.
