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**COMMISSION FOR BASIC SYSTEMS**  
OPEN PROGRAMME AREA GROUP ON  
INTEGRATED OBSERVING SYSTEMS

ITEM: 6.4

**IMPLEMENTATION-COORDINATION TEAM  
ON INTEGRATED OBSERVING SYSTEM  
(ICT-IOS)**  
*Eighth Session*

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GENEVA, SWITZERLAND, 7 – 10 APRIL 2014

**REPORTS OF THE OPAG-IOS EXPERT TEAMS AND RAPPORTEURS**

**REPORT OF THE EXPERT TEAM ON SATELLITE SYSTEMS (ET-SAT)**

*(Submitted by Jack Kaye (USA), Chair, ET-SAT)*

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**SUMMARY AND PURPOSE OF DOCUMENT**

This document provides a report of the work of the Expert Team on Satellite Systems (ET-SAT) since the seventh Session of the ICT-IOS, together with subsequent progress, and recommendations.

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**ACTION PROPOSED**

The Meeting is invited to note the information contained in this document when discussing how it organises its work and formulates its recommendations.

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**Appendix A** Terms of Reference of the Expert Team on Satellite Systems (ET-SAT)

**Appendix B** Updated Work Plan with status of the Expert Team on Satellite Systems (ET-SAT)

**Appendix C** Proposed changes to the Expert Team on Satellite Systems (ET-SAT) Terms of Reference

**Appendix D** Draft Recommendation to CBS on the Vision of the Space-Based Component of the WMO Integrated Global Observing System

## DISCUSSION

### 1. Introduction

The Expert Team on Satellite Systems (ET-SAT) had a face-to-face meeting from 28 to 30 May 2013 in Geneva. ([See ET-SAT-8 Final Report](#)). Since all participants, including the Chairman, were new in ET-SAT, the meeting was a first exposure to the WMO structure and to the ET-SAT Terms of Reference and work plan. The meeting focused on the development of the Architecture for Climate Monitoring from Space and on the space module of the WIGOS Observing System Capability Analysis and Review tool (OSCAR).

The Expert Team had then two virtual meetings on 21 January and on 11 February to address the Climate Architecture in more depth and to review the outcome of a study in preparation for the first meeting of the Joint Working Group on Climate of the Committee on Earth Observation Satellites (CEOS) and the Coordination Group for Meteorological Satellites (CGMS).

A virtual meeting was scheduled on 18 and 19 March to address the other points of the ET-SAT work plan, in particular to update the gap analysis in OSCAR, and to review and update the work plan itself. Unfortunately it could not be held by lack of availability of the participants.

### 2. Achievements

In relation to its Terms of Reference (ToR) that are copied in Appendix A for easy reference, ET-SAT achieved the following:

#### ToR (a):

ET-SAT was introduced to OSCAR, which is the main tool used by the WMO Space Programme to record the status of the space-based observing system and to perform a gap analysis. The meeting expressed support to the further development plan and updating procedure of OSCAR. The meeting recommended seeking convergence between OSCAR and the CEOS database of Missions, Instruments and Measurements (MIM).

A meeting dedicated to updating the gap analysis was scheduled before ICT-IOS-8 but had to be postponed. The gap analysis update thus remains outstanding.

#### ToR (b):

ET-SAT discussed the development of the Architecture for Climate Monitoring from Space, in particular the definition of the physical view of this architecture. It emphasized the requirement for continuity of climate observations, which entails not only avoiding gaps between consecutive measurement series but also ensuring compatibility between these series, which may be a challenge with the evolution of measurement technology. It recommended extending the inventory of Essential Climate Variables to Fundamental Climate Data Records (FCDRs). This recommendation was supported by CGMS at its 41<sup>st</sup> meeting (Tsukuba, Japan, July 2013).

The Secretariat undertook a study to characterize the FCDRs potentially provided by the CGMS planned satellite missions, as an input to the physical architecture. ET-SAT reviewed the progress and the outcome of this study, which was then presented to the joint CEOS-CGMS working group on climate (Darmstadt, Germany, 5-7 March 2014). The CEOS-CGMS working group however was not prepared to deviate from the work plan initially defined by CEOS which focuses on the inventory of ECV products and excludes for the moment any activity regarding the observing system design.

ET-SAT noted the suggestions already collected regarding updates to be brought to the Vision for the GOS in 2025 and recommended that a new Vision be developed for the space-based component, looking towards 2040.

ET-SAT was informed on the progress of the Global Space-based Inter-calibration System (GSICS).

ET-SAT provided guidance on the finalization of the draft new material proposed for inclusion in the new version of the Guide to Instruments and Methods of Observation (CIMO Guide, New Part on Satellite Observation). This material was subsequently finalized, reviewed by the CIMO Guide Editorial Board, and is currently published on line for open review before its submission to the CIMO session in July 2014 for approval.

ToR (c, d): Not yet addressed.

ToR (e): ET-SAT-8 was briefed on the outcome of SG-RFC and the progress of space weather activities.

ToR (f): ET-SAT-8 has held a joint session with ET-SUP.

### **3. Issues**

In addition to the issues covered by Recommendations in Section 4, the Expert Team on Satellite Systems (ET-SAT) has identified the following issues for consideration by the ICT-IOS:

3.1 ET-SAT noted some commonality between the space module of OSCAR and the CEOS MIM database. It recommended coordinating efforts with CEOS in order to take advantage of the complementary features of these tools while ensuring that agencies are not solicited twice to provide similar information. The issue is now complicated by the planned transfer of OSCAR to Meteo-Swiss and the subsequent separation of the key personnel in charge of OSCAR development, which had the effect of putting the developments on hold. (Note: by the time of ET-SAT-8, the Secretariat team in charge of OSCAR was not informed that a decision had been made to transfer OSCAR to Meteo-Swiss).

3.2 The Joint CEOS-CGMS Working Group on Climate was initially identified as the main structure that would support the WMO, CEOS, CGMS collaboration on the development of the climate monitoring architecture. There are doubts however that this structure will be able to address the full scope of activities expected by WMO, including the design of the space-based observing system.

#### **4. Recommendations**

The ET-SAT is proposing the following recommendation to the ICT-IOS and the CBS-Ext.(2014):

Recommendation – Vision of the Space-Based Component of the WMO Integrated Global Observing System (See Appendix D)

#### **5. Proposal for the Terms of reference of the Expert Team / the Rapporteur**

It has proven difficult to mobilize ET-SAT members for face-to-face or web meetings, and to follow up the agreed actions. Several reasons may explain this difficulty:

- There may be a perception that similar discussions are being held in several fora, in particular within CEOS and CGMS.
- Reducing the duration of meetings, although intended to facilitate participation by saving time and money, has the adverse effect of concentrating many topics on a busy agenda without enough time to address issues in depth;
- The membership of ET-SAT has included, for the first time, representatives of organizations that had never been involved in ET-SAT in the past (JAXA, CSA, DLR, CNES), which is a very positive evolution. However, since the longstanding participating agencies had nominated new delegates as well all the ET-SAT participants happened to be new, which made it challenging for the team to catch up with the ongoing tasks, to reach a shared understanding of the scope of the work to be done and its articulation with other international initiatives;
- ET-SAT was established with the principle that it would be self-funded by the participating organizations; this may negatively impact on the level of priority assigned by agencies to their participation in ET-SAT;
- The role of vice-chair, who could perhaps contribute to the animation of the team. is not understood (actually the ET-SAT vice-chair was not able to participate in ET-SAT).

In order to clarify the role of ET-SAT, namely with respect to CGMS and CEOS, it is suggested to reword the ToR as indicated in Appendix C.

It is furthermore suggested:

- To propose a funding for meeting participants like for other expert teams;
- To extend the duration of meetings to the required length.

#### **6. Work plan**

The updated ET-SAT work plan with status for the period 2012-2014 is in Appendix B.

## APPENDIX A

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

Last updated: 03/04/2013

(Approved by CBS-XV)

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

**UPDATED WORK PLAN WITH STATUS FOR THE EXPERT TEAM ON SATELLITE SYSTEMS (ET-SAT) FOR THE PERIOD 2012-2014**

Objective	Outcome	Deliverable	Status as of March 2014
1. Asses actual and planned capabilities of operational and R&D satellites constituting the space-based component of WIGOS and their adequacy to meet WMO requirements	1.1 Provide current and comprehensive information on satellite actual and planned capabilities for use by Members as a reference	Updates on current/planned satellite missions captured in OSCAR	<ul style="list-style-type: none"> <li>- Updates provided at ET-SAT meeting in 2013 included in OSCAR/space (<a href="http://www.wmo.int/oscar/space">www.wmo.int/oscar/space</a>)</li> <li>- ET-SAT to update the assessments of satellite plans (open)</li> <li>- Plans for Switzerland to host OSCAR in the future</li> </ul>
	1.2 Awareness of actual/anticipated gaps, as a basis to trigger contingency actions or stimulate additional plans	Updated gap analysis (assessment of actual/anticipated gaps with respect to the GOS Manual)	<ul style="list-style-type: none"> <li>- EC-65 resolution on gaps in essential observations</li> <li>- Opportunities for FY-3 mission on early morning orbit are being studied by CMA.</li> </ul>
	1.3 Progress on actions identified in the Implementation Plan of Evolution of GOS (space aspects) to implement the Vision for WIGOS	Report on actions of the EGOS-IP (chapter 6)	<ul style="list-style-type: none"> <li>- Chapter 6 (space-based observation) of IP-EGOS reviewed by ET-SAT was approved by CBS-XV and EC-65.</li> <li>- ET-SAT has collected some update on the implementation.</li> </ul>
2. Provide technical advice on implementation of integrated satellite observing systems	2.1 Ensure that the Vision provides a relevant, ambitious, but achievable high-level goal for evolution.	Proposed updates to the Vision of GOS (space aspects)	<ul style="list-style-type: none"> <li>- Inputs for updating the Vision <a href="http://www.wmo.int/pages/prog/www/OSY/Documentation/Vision2025.html">http://www.wmo.int/pages/prog/www/OSY/Documentation/Vision2025.html</a>.</li> <li>- Still need to refine the specification as concerns e.g. atmospheric composition, radio-occultation, space weather.</li> </ul>
	2.2 Input to the definition of the climate monitoring architecture, actions on agency side	Input on the definition of the Architecture for Climate Monitoring from Space	Strategy document is published. A study was completed with ET-SAT guidance on space capabilities for FCDRs as input to the CEOS-CGMS WG on Climate (WIGOS IP tasks 2.1.2 / 3.1.2)
	2.3 Improved integrated planning of the operational constellations in the space-based component	Inputs to WIGOS TT on Regulatory Material,	<ul style="list-style-type: none"> <li>- New GOS Manual Chapter 4 is published: <a href="http://library.wmo.int/opac/index.php?lvl=notice_display&amp;id=3856">http://library.wmo.int/opac/index.php?lvl=notice_display&amp;id=3856</a> ,</li> <li>- WIGOS Manual Chapter 4 is under review</li> </ul>
	2.4 Provide guidance on standardization and interoperability	<p>Oversight of GSICS</p> <p>Guidance on standardization of satellite sensors,</p> <p>Guidance on integration</p>	<ul style="list-style-type: none"> <li>- CIMO Guide Draft Part III on satellite observations, reviewed by ET-SAT, is under open review before submission to CIMO in July 2014 for approval : <a href="http://www.wmo.int/pages/prog/www/IMO/P/publications/CIMO-Guide/CIMO-Guide_Prelim-2014Ed.html">http://www.wmo.int/pages/prog/www/IMO/P/publications/CIMO-Guide/CIMO-Guide_Prelim-2014Ed.html</a></li> <li>- GSICS Vision issued in Nov. 2013: <a href="http://www.wmo.int/pages/prog/sat/docu">http://www.wmo.int/pages/prog/sat/docu</a></li> </ul>

Objective	Outcome	Deliverable	Status as of March 2014
			<a href="#">ments/GSICS_Vision-for-GSICS-in-2020s.pdf</a> - Dual use of observation systems (meteorology and space weather) will be addressed at the COSMIC Data Users' Workshop in October 2014 <a href="http://www.cosmic.ucar.edu/workshop_2014/index.html">http://www.cosmic.ucar.edu/workshop_2014/index.html</a>
3. Assess progress of R&D and demonstration satellite systems, and identify opportunities and/or problem areas concerning satellite technology and plans	3.1 Enhance operational benefit of new technologies,	Assess R&D and demonstration satellite systems with regard to their operational use or their transition to operational service	ET-SAT guidelines on Transition from R&D to Operations were endorsed by ICT-IOS in Sept 2008.  Still to be addressed in this period.
	3.2 Leverage research on operational needs	Identify research/development needs	Open
4. Coordinate with ET-SUP and other relevant CBS teams on satellite related matters	4.1 Active user-provider dialogue for optimal use of available capabilities	Information and response on data access, product development, capacity building, and related matters	ET-SAT provided input to data access information. See draft CIMO Guide above.
	4.2 Coordination with SG-RFC on radio frequency utilization for timely protection of the necessary spectrum	Provide feedback on draft WMO position	ET-SAT was kept informed of SG-RFC activity
	4.3 Coordination with ICTSW on space weather observations, products	Feedback on space-based observation of Space Weather	ET-SAT is kept informed of ICTSW activity

## **APPENDIX C**

### **PROPOSED CHANGES TO THE TERMS OF REFERENCE OF THE EXPERT TEAM ON SATELLITE SYSTEMS (ET-SAT)**

1. Assess the actual and planned capabilities of operational and R&D satellites constituting the space-based component of WIGOS and their adequacy to meet WMO requirements. To this end, ET-SAT should consider the information provided by participating agencies as well as the outcome of CGMS and CEOS, including e.g. the progress of CEOS constellations. It should communicate the feedback from CBS to CGMS and CEOS.
2. Provide technical advice on implementation of integrated satellite observing systems.
3. Assess progress of R&D and demonstration satellite systems, and identify opportunities and/or problem areas concerning satellite technology and plans
4. Coordinate with ET-SUP and other relevant CBS teams on satellite related matters.

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**APPENDIX D**

**DRAFT RECOMMENDATION NO. ??? (CBS-EXT.(2014))**

**VISION OF THE SPACE-BASED COMPONENT OF THE WMO INTEGRATED  
GLOBAL OBSERVING SYSTEM**

THE COMMISSION FOR BASIC SYSTEMS,

**Noting:**

- (1) The Vision for the Global Observing System in 2025 recommended by CBS-14 and adopted by EC-61 in June 2009;
- (2) The suggestions made by ET-EGOS-5, CBS-14 and ET-SAT-7 for updating this Vision;

**Considering:**

- (1) The lessons learnt from R&D and demonstration missions since 2009;
- (2) The advances in remote-sensing, telecommunications and satellite technology;
- (3) The typical lifecycle of satellite programmes, including mission analysis and approval, design, development, manufacturing and operations, which span over several decades for operational satellite series and, subsequently, the need to look more than twenty years ahead in order to provide guidance at an early planning stage;
- (4) The on-going effort to specify space-based observation for atmospheric chemistry;
- (5) The emerging potential of space capabilities to support hydrology;
- (6) The progress made in defining observation requirements for space weather;
- (7) The increasing attention given to traceability of space-based observations;

**Recommends that:**

The expert teams under the Open Programme Area Group on Integrated Observing Systems (OPAG IOS) develop a “Vision of the Space-based Component of the WMO Integrated Global Observing System in 2040”, for submission to the next regular session of the CBS, in order to take into account evolving requirements, new technological opportunities, emerging national capabilities, and the outcome of the most recent impact studies.