

WORLD METEOROLOGICAL ORGANIZATION

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

FIFTH SESSION

GENEVA, SWITZERLAND

26-29 APRIL 2010

FINAL REPORT



WMO General Regulations

Regulation 42

Recommendations of working groups shall have no status within the Organization until they have been approved by the responsible constituent body. In the case of joint working groups the recommendations must be concurred with by the presidents of the constituent bodies concerned before being submitted to the designated constituent body.

Regulation 43

In the case of a recommendation made by a working group between sessions of the responsible constituent body, either in a session of a working group or by correspondence, the president of the body may, as an exceptional measure, approve the recommendation on behalf of the constituent body when the matter is, in his opinion, urgent and does not appear to imply new obligations for Members. He may then submit this recommendation for adoption by the Executive Council or to the President of the Organization for action in accordance with Regulation 9(5).

EXECUTIVE SUMMARY

The fifth session of the Expert Team on Satellite Systems (ET-SAT) was convened in Geneva, Switzerland from 26 to 29 April 2010.

The primary objective of the session was to advance the work programme defined by the Commission for Basic Systems (CBS) and, in particular, to:

- Review planned capabilities of operational and R&D satellites and potential measures to be taken to ensure a smooth transition to the upcoming satellite generations;
 - Discuss the global coordination and planning issues for future missions to implement the Vision of the GOS in 2025, in particular in support of climate monitoring;
 - Investigate the potential for enhanced integration of space-based observation instruments, data and products, and advise on related actions in support of the WMO Integrated Global Observing Systems (WIGOS) and the Global Earth Observation System of Systems (GEOSS);
 - Review the emerging WMO activity in the area of Space Weather and advise on how to consolidate this activity for the benefit of the global community.
- With regard to the status and plans of the space-based GOS, the session:
 - Acknowledged significant advances of the plans of all participating agencies;
 - Stressed the need to assess the impact of the restructuring of the NPOESS Programme;
 - Recommended careful monitoring of the status of polar-orbiting missions in afternoon orbits;
 - Acknowledged that the transition of five geostationary series to new generations around 2015 was a unique situation that implied higher risk and would pose a challenge to the users; thereby agreed to share good practices and plans for user preparation;
 - Noted the very good progress towards an operational perspective for the following missions that are part of the Vision for the GOS in 2025: ocean surface altimetry; Radio-Occultation Sounding; ocean surface scatterometry; and encouraging steps taken for atmospheric chemistry and Earth Radiation Budget;
 - Underlined that such operational perspective was not yet planned for global precipitation measurement, wind profile by lidar, soil moisture/ocean salinity, or ocean colour, that are also part of the Vision for the GOS in 2025;
 - Welcomed the planned Highly Elliptical Orbit (HEO) missions that should demonstrate the benefit of HEO applications;
 - Recommended that "The Space-based Global Observing System in 2010 (GOS-2010)", a reference document referred to as the "Dossier", be made available in a database format and reaffirmed that WMO, with the support of its Members, should maintain a database containing requirements, surface-based capabilities and space-based capabilities; it suggested an initial evaluation of the use of DOORS or other tools to facilitate further handling and updating of this information.
 - With regard to the implementation strategy for the Vision for the GOS in 2025, the session:
 - Acknowledged the need for developing an architecture for the operational monitoring of climate and climate change from space, relying on a strong partnership between research and operational entities;
 - Recommended to perform a systematic analysis of the gaps with respect to the requirements associated with the ECVs, to provide a clear mapping to these

- requirements, building on the available Gap Analysis (Vol. III of the Dossier) and updating it as appropriate, and articulate the 2025 Vision with this analysis;
- Supported the proposal to hold a workshop on the understanding of the climate requirement for continuity, in order to analyze the implications of these requirements on space-based architecture for climate (for example necessary time overlap among consecutive missions, or in-orbit redundancy), and implications on the potential roles of R&D/Ops agencies in this respect
- With regard to the integration of space-based observations, the session:
 - Agreed to update the CIMO Guide (Chapter II, 8, Satellite Observations), as a reference documentation for non-satellite observing network managers;
 - Agreed that guidelines should be defined for the design of selected, mature instruments;
 - Agreed to adopt a standard terminology for instruments and parameters;
 - Strongly supported the activities undertaken in the Global Space-based Inter-calibration System (GSICS) to pursue integration of observations, in particular for climate monitoring, appreciated the substantial achievements of this projects and welcomed the orientations of its future work; ET-SAT underscored that challenging work remained to be done, and stressed the need for reliable, indisputable reference instruments, the need to verify and demonstrate their reliability; and the requirement for traceability to absolute standards, which will be facilitated with dedicated missions that provide such traceability;
 - Agreed that interaction with the ground-based Automatic Weather Station (AWS) network community was an opportunity to acquire ancillary information in support of satellite-based product validation and quality control, for instance in the context of SCOPE-CM; reciprocally the AWS community could benefit from observation monitoring from space;
 - Supported the activities of the Sustained Co-ordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM), encouraged its extension to terrestrial and/or oceanic pilot projects, and noted the readiness of NASA, and possibly CMA and ISRO, to contribute to SCOPE-CM through terrestrial ECV products, stressed furthermore that common algorithms, formal validation process, and transparent quality control where needed to move to the operational stage.
 - Regarding user information on satellite, instruments and data access, the session:
 - Recognized the need for comprehensive information describing where and how data are accessible, as well as all necessary ancillary information including ingest and pre-processing software for new generation satellites; took action to provide such information through web pages, with the understanding that the WMO web site will provide links to such web sites;
 - Agreed to help identify opportunities for the use of R&D mission data in operational applications, bearing in mind that near-real time accessibility is a key element for operational use; highlighted in particular the operational interest of new scatterometer missions and the future GPM.
 - The session strongly endorsed the initial WMO activities about Space Weather, including the establishment of the Inter-Programme Coordination Team on Space Weather (ICTSW), the definition of tasks of a Space Weather unit within the WMO Secretariat, the links established with other organizations involved in Space Weather, and the draft formulation of requirements for inclusion into the Rolling Requirements Review process; wished that resources be rapidly allocated by WMO Members to support these activities.
 - The session also noted the ongoing preparation for the World Radio Conference in 2012, including a draft position paper submitted for comments; recalled the need for

protection in several key frequency bands, including the new 275-3000 GHz frequency range which is expected to be important for a number of future instruments; furthermore noted some recent concern on Radio Frequency Interference at 1.4 GHz that affected SMOS terrestrial observations and had the potential to affect Aquarius and SMAP.



From left to right: Yang Jun, Jerome Lafeuille, Victor Saulskiy, A.S. Kiran Kumar, Lorenzo Sarlo, Lars Peter Riishojgaard, Michael Kalb, Tsengdar Lee, Tomoo Ohno. (Not on the picture: Antonio Rodriguez, Barbara Ryan, Bizzarro Bizzari, Isabelle Ruedi, Miroslav Ondras, Azusa Sakamoto, David Thomas.)

1. ORGANIZATION OF THE SESSION

1.1 Opening of the session

The fifth session of the Expert Team on Satellite Systems (ET-SAT) was opened at 09h00 on Monday, 26 April 2010, at the WMO Headquarters in Geneva, Switzerland.

Ms Barbara Ryan, Director of the Space Programme, welcomed the participants (See Appendix I) on behalf of the WMO Secretary-General. She underlined the importance of ET-SAT to advise the CBS on satellite matters with a satellite operator's perspective while ET-SUP was providing a users' perspective. She highlighted that ET-SAT was expected to play an important role towards the implementation of the space-based part of the revisited Global Observing System (GOS) that will address the challenges of climate and climate change monitoring and be an essential component of the WMO Integrated Global Observing Systems (WIGOS).

1.2 Adoption of the agenda

The provisional agenda was adopted as contained in Appendix II.

1.3 Working arrangements for the session

The meeting agreed to address all the agenda items in plenary for the first two days, follow-up with break-out sessions on focussed issues as required during the following day, and to convene again as a plenary for the concluding session.

2. CHAIRMAN'S REPORT

After introduction of the participants, the ET-SAT Chairman, Dr Michael Kalb, expressed his views regarding the future work of the Expert Team. He expected the team to be creative and to provide innovative inputs. He emphasized that the composition of ET-SAT, which involved both R&D and operational satellite agencies from all parts of the world, was particularly appropriate to develop a response to climate observation needs based on cooperation and shared responsibility among the research and operations communities. As much had been said already on the Research to Operations Transition, or the Research and Operations partnership, he furthermore suggested that ET-SAT might be in a good position to define a framework reference and terminology that would capitalize a common understanding of these concepts among the various parties.

3. GUIDANCE FROM THE CHAIRPERSON OF OPAG IOS

Dr Lars-Peter Riishojgaard, Chairperson of the Open Programme Area Group on Integrated Observing Systems (OPAG IOS) briefed the session on the expected role of ET-SAT in the context of OPAG IOS. In particular, he urged ET-SAT to keep under review the WMO Vision for the GOS in 2025 and its implementation, with a particular view toward the balance between the use of operational assets on one hand and R&D assets on the other. He invited the members of the team to comment on the Vision from the perspective of their own agency. The comments from the team will be taken into account in the development of an Implementation Plan for the Evolution of the Global Observing System (IP-EGOS) which will be building on the Vision as well as on its potential future revisions. He invited ET-SAT to identify future R&D missions that, in addition to their research objectives, could provide useful data for operational users. He furthermore recommended that ET-SAT pays attention to the assessment of the space-based observing capabilities and the sustainability of the relevant databases that were an important element of the Rolling Requirements Review (RRR) process.

He informed the session on major relevant outcomes of sessions that he had attended as Chairperson of OPAG IOS, including CBS-XIV, the fifth session of the Expert Team on Evolution of

the Global Observing System (ET-EGOS) and the fifth session of the Expert Team on Satellite Systems (ET-SUP). ET-SUP had expressed high interest for data from new satellite missions, but raised concerns regarding the necessary information to access and use this data. ET-EGOS had discussed the need for Observing System Experiments (OSE) and Observing System Simulation Experiments (OSSE) to evaluate the impact of specific observation sources, and had recommended that new OSEs/OSSEs be considered by Members, including the following that ET-SAT may wish to comment on:

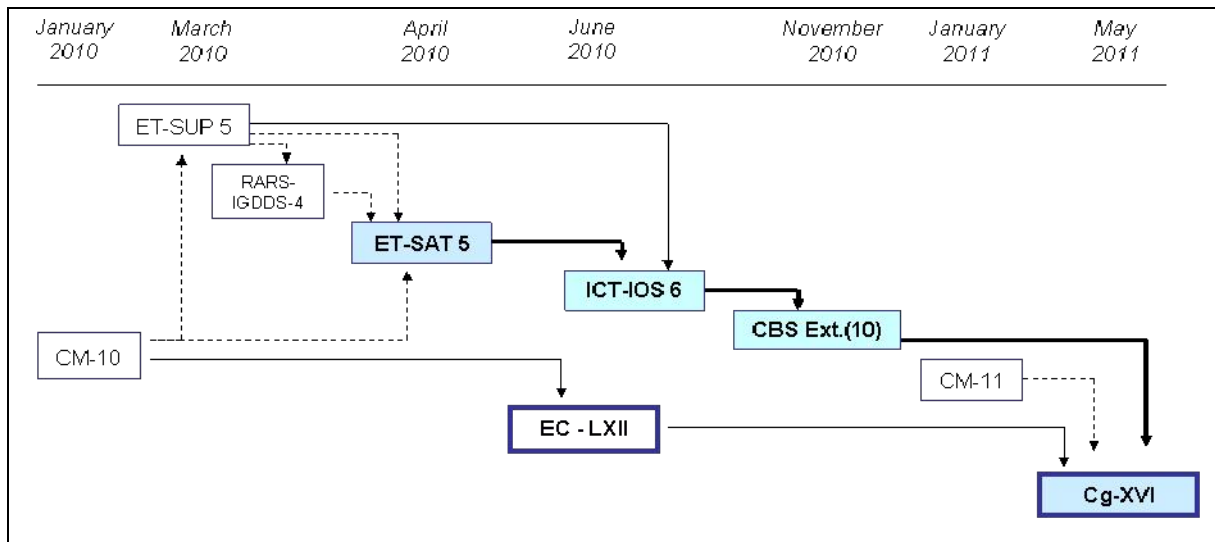
- In the presence of GPS-RO data, what radiosonde coverage is needed in the stratosphere? To which height, and for which latitude ranges? OSSEs are needed to assess saturation level for GPS-RO data.
- In the presence of dense satellite observation of ocean surface wind, what is the requirement for the density of in-situ surface pressure observations?
- OSSEs are needed to assess saturation level for GPS-RO data.

4. ET-SAT TERMS OF REFERENCE, WORK PROGRAMME

The Secretariat (J. Lafeuille) gave a brief introduction on the organization of the Secretariat and on the overall WMO governance structure, explaining how the outcome of ET-SAT was consolidated with the outcome of other OPAG IOS Expert Teams (such as ET-SUP and ET-EGOS) and presented to CBS, which in turn would inform the decisions made by the Executive Council and the Congress.

The meeting was reminded of the ET-SAT Terms of Reference defined by the fourteenth session of the Commission for Basic Systems (CBS-XIV) held in Dubrovnik, Croatia in March-April 2009, and of the work programme subsequently developed for ET-SAT by the CBS Management Group at its tenth meeting (CBS-MG-X) held in Geneva in June 2009. This work programme is defined for the period leading up to CBS-XV, which is expected to be held in the last quarter of 2012. An intermediate milestone will be the CBS Extraordinary session, to be held in November 2010 in Namibia.

The most relevant milestones for ET-SAT-5 were highlighted, as indicated in the figure below:



5. OUTCOME OF WMO MEETINGS INCLUDING CONSULTATIVE MEETINGS, EXECUTIVE COUNCIL AND CBS, WITH DIRECT RELEVANCE TO ET-SUP

The session reviewed relevant conclusions of the ninth and tenth sessions of the WMO Consultative Meetings on High-level Policy on Satellite Matters (CM-9 and CM-10), the fourteenth session of the Commission for Basic Systems (CBS-XIV) and the sixty-first Executive Council.

It was noted that CM had requested to publish information on the conditions of access to data from GOS contributing satellites, stressed the need for continuous geostationary coverage of South America, supported the inclusion of the Global Space-based Inter-calibration System (GSICS) as a Pilot Project for the WMO Integrated Global Observing System (WIGOS), and requested to advance integration of space-based observations at the level of product quality.

CBS finalized and endorsed the Vision of the GOS in 2025 that had been reviewed by ET-SUP and ET-SAT, adopted the VLab five-year strategy developed by the Virtual Laboratory Management Group (VLMG) and ET-SUP, confirmed the two new Centres of Excellence in Pretoria and Moscow, confirmed the value of a regular questionnaire to monitor the progress of satellite data availability and use, while recommending regional initiatives to address the issues revealed by such enquiries. CBS also supported the SCOPE-CM initiative and suggested future expansion of the concept to other areas of application of satellite data. It furthermore defined the Terms of Reference of an Inter-programme Coordination Team on Space Weather. All these initiatives were subsequently approved by the EC.

The recent CM-10 session recommended giving greater visibility to space matters in WMO activity and discussed in depth the support of space-based activities for climate monitoring and the future Global Framework for Climate Services. It emphasized the complementary role of research and operational entities and activities, and discussed ways forward to improve global coordination of satellite programmes in this respect. In addition, information was given on the planned coordination among Canada, the Russian Federation and WMO for future programmes in Highly Elliptical Orbit (HEO) including the Arctica-M and the Polar Communications and Weather (PCW) missions.

6. STATUS OF ACTIONS FROM PREVIOUS ET-SAT MEETINGS

The session reviewed the status of actions agreed at previous ET-SAT meetings. It was noted that actions regarding the review of the Dossier on the GOS and finalization of the Vision of the GOS for 2025 had all been completed. The following actions were still outstanding:

- *Action ET-SAT 4.03: WMO Secretariat to seek confirmation from the EC that GMES data would be available to WMO Members as a contribution to the GOS. Although it was anticipated that the EU policy for GMES data would be open, it was not yet officially finalized. It was thus agreed to keep Action 4.03 open.*
- *Action ET-SAT 4.06: P. Albert to advise the Space Programme Office on the specifications for the development of databases replacing the current CEOS-WMO database in Microsoft Access™ and accommodate the Gap Analysis and related information on satellite instruments and missions.*

The status of the database and the Dossier were discussed under agenda item 7.2 and a new action was agreed. Action 4.06 was thus closed.

- *Action ET-SAT 4.09: WMO Space Programme Office to forward to all ET-SAT Members the "Draft requirements for AWS sensors"...; Action ET-SAT 4.10: ET-SAT Members to send comments on these draft requirements to the ET-SAT Chair; Action 4.11: ET-SAT Chair to consolidate these comments and forward them to the ET-AWS Chair.*

The latter three actions, that are linked, were addressed under agenda item 9.4 and a new action was agreed. Actions 4.09, 4.10 and 4.11 were thus closed.

7. CURRENT AND PLANNED SPACE-BASED OBSERVING CAPABILITIES

7.1 Update from participating agencies

Dr Yang Jun reported for CMA on the latest update of Chinese Fengyun Meteorological Satellite Programmes. Following the FY-3 A and FY-3 B pre-operational satellites, the polar orbiting satellite programme will include FY-3 C (2012), FY-3D (2014), FY-3E (2016), and FY-3F (2018) to be launched alternatively on an am and pm orbit. Instruments with enhanced capabilities are expected in FY-3C/D/E/F including improved imager (MERSI-II), improved Microwave humidity and temperature sounder (MWHS-II, MWTS-II) and Atmospheric Chemistry sounding instrument. An Infrared Hyperspectral Atmospheric Sounder (IHSAS) and a GNSS Radio-Occultation (GRO) sensor will also fly on FY-3D/E/F, and a Sea surface wind scatterometer on FY-3E. The new geostationary series will include FY-4A (2014), FY-4B (2017), and FY-4C (2019). The FY-4 programme has been approved, and the first FY-4 satellite shall carry a multi-spectral imager, an interferometric IR sounder, and a lightning mapper.

Mr Antonio Rodriguez reported for EUMETSAT that Meteosat-10 and 11 were planned for launch in 2012 and 2014, Metop-B and-C in 2012 and 2016. Meteosat Third Generation (MTG) is in the approval process; it will include VIS/IR imager and Lightning sensor on one platform, and IR and UVN (also referred to as GMES/Sentinel-4) sounders on a distinct platform. EPS Second Generation (EPS SG) is undergoing Phase A studies; the payload baseline for system definition includes: VII, IRS, MWS, MWI, "Multi-viewing, Multi-channel, Multi-Polarization Imager" (3MI), SCAT, RO, ERB, UVNS (also referred to as GMES/Sentinel 5), as well as DCS, S&R, SEM and Low Light Imager (LLI). It would include two satellites for a 14/15-year period of operations. EUMETSAT also contributes to the Jason-3 and Sentinel-3 missions that are planned for launch in 2013.

Dr A.S. Kiran Kumar briefed about current and planned ISRO missions. He highlighted that Oceansat-2 launched in September 2009 carries an ocean colour instrument, a conical scanner based scatterometer and a Radio Occultation atmospheric sounder. The validation phase is currently in progress. He informed on ongoing work to make the scatterometer data available to the global community through the National Remote Sensing Centre (NRSC) web site within three hours of observation. In addition, ISRO is working with EUMETSAT to make this data available through EUMETCast. The follow-on mission providing continuity to Resourcesat-1 will have enhanced features like improved radiometry and transmission of larger swath of Linear Imaging Self Scanner (LISS-4). This Resourcesat-2 is slated for launch in the third quarter of 2010. The INSAT-3D mission is getting ready for launch in December 2010. The follow-on mission and a ground spare for INSAT-3D are approved and the related work has started. The report addressed features of the C-band Radar Imaging Satellite. It also highlighted that the collaborative missions with CNES, SARAL/Altika and Megha-Tropiques, are progressing well towards launch within one year. Information was also provided about the work on a high resolution GEO Imager programme.

Mr Tomoo Ohno reported on JMA's plans for geostationary satellites. As of July 2010, MTSAT-2 will take over the operational imaging function from MTSAT-1R, MTSAT-2 will however not provide the dissemination services from space to MDUS/SDUS stations, since MTSAT-1R will disseminate the HRIT/LRIT image data acquired by MTSAT-2. Furthermore, MTSAT-1R will perform rapid scan over the Japan area (six months a year), and come back to operational observation during the maintenance period of JMA's ground equipments (one month a year) as well as in case of unavailability of MTSAT-2 for a long period. The next generation Himawari-8/9 is planned for launch in 2014 and 2016, and will include an advanced 16-channel imager.

Dr Tsengdar Lee reported on NASA's current existing mission status. Many of the missions are over ten years old. There will be some changes in A-Train including Aura relocation, CALIPSO pitch change and PARASOL exit. Anticipated changes include: Glory to take PARASOL's location, GCOM-W1 to join A-Train in 2012, and OCO-2 in February 2013. He presented the current planned launch dates for OCO-2, Glory, Aquarius, NPP, SMAP, ICESat-II,

GPM, and LDCM. He emphasized all foundational missions (Glory, Aquarius, NPP, LDCM, GPM) will normally be launched by mid 2013, and the four "Tier-I" decadal survey missions (SMAP, ICESat-II, DESDynI, CLARREO-1) will be launched in the 2012 – 2017 time frame. Other climate continuity missions under consideration include SAGE-III and GRACE-C. NASA also made available the Land, Atmosphere, Near-real-time Capability for EOS (LANCE) system as a new capability to disseminate NASA observation to application users in near-real-time. On space weather, NASA is making the helio-physics observations, including ACE, SOHO, STEREO, and SDO, available. Models and simulation results are also available through the Community Coordinated Modeling Center (CCMC).

Dr Michael Kalb provided an update on NOAA plans which include the establishment of a NOAA Climate Service. NOAA has engaged with WMO efforts to define a broad and useful international framework for Global Climate Services. It is reported that GOES-13 is replacing GOES-12 in the Eastern U.S. slot. In turn, GOES-12 replaces GOES-10 to provide coverage to South America. GOES-14 and 15 provide backup. GOES-R development is proceeding without significant issues. NOAA's current LEO (POES) satellites are for the most part fully operational. NOAA 19, launched in February 2009 is the last in the POES series.

The NPOESS restructuring is of major significance to the global constellation. Under the restructuring NASA and NOAA will be responsible for acquisition and development of the afternoon polar orbit henceforth referred to as JPSS; the Department of Defence (DOD) will be solely responsible for acquisition of the early morning satellite, which nominally could be covered with the remaining DMSP 19 and 20 satellites. However, DOD is soliciting broader continued community interest and requirements for inclusion of VIIRS, MIS and SEM, and may also consider other sensors. NOAA acknowledges EUMETSAT's continuing partnership in providing its METOP in the mid-morning orbit. NOAA acknowledges the planned partnership with Japan, whose AMSR-2 on GCOM-W will replace MIS in the afternoon orbit as part of the JPSS. NPP is anticipated for a launch in the last quarter of 2011. VIIRS and ATMS have completed integration on NPP; CrIS completed thermal vacuum tests without significant issues, and OMPS rework and retesting is underway. The first JPSS satellite (formerly NPOESS C1) is expected to be launch-ready in 2015. Observations planned for the PM orbit for NPOESS will be maintained under JPSS: VIIRS, CrIS, ATMS, OMPS and CERES.

Dr Kalb also provided updates on DSCOVR, JASON-2/3, COSMIC II, and reported on discussions with JAXA and ISRO related to collaboration in the acquisition, processing and distribution of ocean scatterometer and ocean colour data.

Dr Victor Saulskiy reported on the status of Meteor-M1 and the plans of ROSHYDROMET for Meteor-M2/3, Meteor-MP1/2/3, Electro-L1/2, Arctica-M1/2, and Electro-M1/2. The commissioning of Meteor-M1 is still ongoing but many images are already received and used by SRC Planeta of ROSHYDROMET. Recent images were displayed at ET-SAT-5, which illustrated their potential application to the monitoring of global cloud coverage, ice coverage, volcanic ash plume spreading, floods and other environmental emergency situations. Within the next two to three years, the Russian Federation plans to launch new meteorological satellites of the (polar-orbiting) Meteor-M and (geostationary) Electro-L types. A new generation of polar-orbiting satellites, Meteor-MP, is planned by 2014, and a new generation of geostationary satellites Electro-M by 2016. These new generations will have enhanced and diversified payloads to meet future requirements. The Highly Elliptical Orbit (HEO) satellites Arctica-M1/2 are planned for launch by 2014 and 2015 with a multispectral VIS/IR imager and a helio-geophysical suite.

In the light of the updates provided by its members, ET-SAT acknowledged the significant overall progress of satellite missions and plans since the last meeting. It was also stressed that the restructuring of the NPOESS programme was a major change and could have a significant impact on the gap analysis conducted on earlier assumptions, in particular as concerns the early morning orbit mission for which very little information was available at the moment. The WMO Secretariat was encouraged to seek clarification from the USA about whether and how their new plans would modify the planned contribution of the USA to the GOS. This information would be an essential

input to update the gap analysis and to allow the community to develop an appropriate Implementation Plan for the new GOS Vision.

7.2 Dossier on the Space-based Global Observing System

A brief status was drawn of the latest issue of the reference documentation titled “The Space-based Global Observing System in 2010 (GOS-2010)”. This documentation, referred to as the “Dossier”, is maintained by WMO with input from space agencies, in collaboration with the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS). The Dossier includes five volumes that can be downloaded from the WMO web site: <http://www.wmo.int/pages/prog/sat/Refdocuments.html#spacebasedgos> . The first volume was also published as a Technical Document (WMO-TD No.1513 / SP-7) for distribution to selected WMO Members.

The meeting underlined the valuable amount of information compiled in the Dossier, which was very useful reference documentation. It agreed that agencies should support the regular updating process of its Volume I (Programmes) and Volume II (Instruments) in supplying information as required. It also recalled the need for ET-SAT, as a team, to regularly review the Gap Analysis (Volume III) as an input to the Implementation Plan for Evolution of the GOS. The meeting was informed of ongoing actions towards harmonizing the sets of requirements of the various applications, with a view to facilitate their synthesis.

The meeting noted however with concern that the information contained in the Dossier was currently not available in a database format and that the sustainability of the current WMO database of requirements and observing capabilities was currently not guaranteed. It reaffirmed the view that WMO, with the support of its Members, should maintain such a database for requirements, surface-based capabilities and space-based capabilities, and should take advantage of the CEOS Mission, Instruments and Measurements (MIM) database if it is reliable enough. A proposal was made to evaluate the use of the Dynamic Object Oriented Requirements Systems (DOORS) tool to manage the texts, graphics and tables of the Dossier and link them to a relational database system.

Action ET-SAT 5.1: EUMETSAT (A. Rodriguez) to perform an initial evaluation of the use of DOORS or other tools to support the migration of the information contained in the Dossier to a suitable requirements management system, and facilitate its further handling and updating. (End September 2010)

7.3 Continuity and transition issues

The Secretariat presented a preliminary synthesis on the potential continuity and transition issues that may arise in the next five years for the space-based Global Observing System. While the geostationary component seemed well established and robust, the situation of the operational polar-orbiting configuration should be monitored carefully because:

- After NOAA-19, the afternoon orbit will only rely on new generation satellites;
- Information is not widely distributed as concerns the access to these new satellites.

The meeting was informed of the outcome of ET-SUP regarding the impact, for the users, of the transition to new generations of geostationary and Low-Earth Orbit operational satellites. It was acknowledged that the quasi-simultaneous transition of five geostationary series to new generations was a unique situation that implied some higher risk for the operators and would pose a real challenge to the users. NOAA has undertaken the Proving Ground project to prepare for GOES-R/S/T. EUMETSAT intends to set up a project to prepare for the use of MTG. The importance of providing proxy datasets was stressed. ET-SAT Members agreed to share their good practices and plans for user preparation, and to consider the strategy to be proposed by ET-SUP in this respect.

Action ET-SAT 5.2: ET-SAT Members to report at the next ET-SAT meeting on their activities, plans or lessons learnt regarding the support to the user community in preparation for the migration to new generations of satellites, and possible risk reduction measures. (Due date: ET-SAT-6.)

The meeting also reviewed the status of new missions and the opportunities for facilitating the transition of R&D missions to an operational status when relevant. It noted that for the five following missions, there was good progress towards an operational framework:

- Ocean surface altimetry is planned to reach an operational status with Jason-3 and GMES/Sentinel-3, complemented by research missions;
- Radio-Occultation Sounding is well on track with the inclusion of ROS aboard several operational series and the recent decision of NOAA to prepare a COSMIC follow-on;
- Ocean surface scatterometry is in progress, with Metop/ASCAT and FY-3E/SWMR, and several R&D missions like Oceansat-2, HY-2A, and possibly GCOM-W2. Oceansat-2 scatterometer data will be available in near-real time for operational use;
- Atmospheric chemistry is starting to be addressed in an operational framework with FY-3D/E/F, MTG/Sentinel 4, EPS-SG/Sentinel 5;
- Earth Radiation Budget is also starting to be addressed operationally, with ERM-SIM on FY-3A/C/E and CERES on NPP and possible follow-on.

On the other hand there was still no firm plan to evolve the following missions towards an operational framework:

- Global Precipitation: TRMM data are regularly used and highly beneficial to operational users, TRMM operation was extended, GPM is being prepared but there is unfortunately no follow-on planned to the GPM mission for the time being;
- Ocean colour: missions are in the formulating stage.

As concerns operational pathfinders and demonstrators, the following was noted:

- Wind profile by lidar: ADM/Aeolus demonstration is planned by ESA, and preoperational use is prepared by NWP community. Further preparation is needed before defining an operational follow-on, which would require dedicated platforms on specific orbit;
- Soil Moisture/Ocean salinity: several demonstration missions are engaged or planned. Further preparation is needed before defining an operational follow-on;
- Highly Elliptical Orbit (HEO): the planned missions by Canada and Russian Federation should demonstrate the benefit of HEO to a number of applications including meteorology, climate and environment monitoring.

These elements should be taken into account in the Implementation Plan for the GOS Vision.

8. IMPLEMENTING THE VISION OF THE GOS IN 2025

8.1 Towards an Architecture for the Operational Monitoring of Climate and Climate Change from Space

A position paper was presented by the Secretariat, advocating an architecture for the operational monitoring of climate and climate change from space. Monitoring the climate variables is a prerequisite to understand the evolution of climate in order to alleviate or prepare for its impact; this was reinforced in the context of the Global Framework for Climate Services (GFCS) decided at the World Climate Conference Three (WCC-3). Space-based observation has an essential role in this respect. This was recognized by the WMO Executive Council when it adopted the Vision of the GOS in 2025 that calls for significantly enhanced and diversified space-based missions to monitor

climate variables in addition to the historical core operational meteorological missions. Given the important contribution of R&D programmes to climate observation, compounded with the increasing convergence of operational and research activities, the future space-based observing system has to rely on a strong partnership between research and operational entities.

Materializing the Vision of the GOS in 2025 therefore requires defining and implementing an architecture through a mechanism that accounts for the different roles and responsibilities of the respective entities while responding to the essential need for continuous and sustained operation. It was suggested that a framework document be developed to address this issue.

The session expressed agreement with the proposed concept paper.

The participants discussed the possibility of a metrics that would reflect improvements over time of our ability to measure climate signals and monitor change, in the same way as the 500 mb geopotential height anomaly correlation which has proven to be useful (even if imperfect) proxy measure of improvements in medium range weather forecasting over the last couple decades. The participants discussed whether, in the case of climate, improvements in our capabilities over time might be expressed indirectly in terms of the reduction of the uncertainty estimates in model climate predictions, and in which satellite data play a critical role in validation.

8.2 Contingency Concept for Climate Monitoring Missions

In response to earlier deliberations of CGMS that called for a contingency planning workshop regarding “the new missions implied by the Vision for the GOS in 2025”, the meeting was invited to consider the continuity requirements of critical climate monitoring missions, as compared with the continuity requirements of operational meteorological applications. It was recalled that the CGMS had adopted a Global Contingency Plan primarily addressing issues related to assuring continuity of operational missions; the back-up arrangements that have been implemented among satellite providers and operators both nationally and internationally over the last 20 years are a success story of CGMS. Similarly, the WMO Executive Council has agreed that assured continuity is especially vital for the climate mission, and that accordingly there should be no gap in the satellite climate data record; concerted contingency planning is needed to enable international cooperation in mitigation and recovery where continuity of the climate observing is at risk. It has been stated in previous venues (e.g. Workshop on the Re-design and Optimization of the Space-based GOS, June 2007) that although continuity is a strong requirement for climate, depending on the parameters this could be understood differently from the operational continuity requirement (hence the proposed wording “sustained operation”). It would be helpful to clarify these requirements in view of the significant implications it could have, for example, on the decision by a single nation or consortium to re-launch a satellite or maintain in-orbit back-up, or launch a satellite in advance to ensure an overlap with its predecessor. For instance it was highlighted that the five dimensions of requirements of the RRR process do not directly address long-term continuity, the stability, or the distinction between accuracy and precision, all of which have great significance in the context of a long term climate observing mission.

The Team supported the proposal to hold a workshop that would specifically focus **on developing a full understanding of the special climate requirement for continuity and on definition of possible contingency approaches tailored to these special requirements.**

It was recognized that contingency planning can only be meaningfully and productively discussed with respect to a nominal or reference architecture. Such an architecture, however, has yet to be defined, since the Vision for the GOS in 2025 only contains a high-level description of it.

Furthermore, the Team felt that the climate community must also prioritize the parameters, Essential Climate Variables and other specific geophysical measurements, for which continuity is perhaps more essential than others, with respect to specific applications, time scales and contingency scenarios. It was agreed that such a prioritization to fill the gaps must follow a

systematic and comprehensive gap analysis between climate observing requirements, on one hand, and actual and planned space-based capabilities, on the other hand. It was acknowledged that the Dossier is most valuable in this respect since (in Volume IV of the Dossier) it analyzes what capabilities can be used for each parameter, and (in Volume III of the Dossier) it draws a Gap Analysis for these capabilities. It was suggested, however, that the mapping to ECVs is not direct and visible enough in the Dossier.

In summary, the following approach was recommended for such a workshop:

- As a prerequisite, perform a systematic analysis of the gaps with respect to the requirements associated with the ECVs, provide a clear mapping to these requirements, building on the available Gap Analysis (Volume III of the Dossier) and updating it as appropriate, and articulate the 2025 Vision with this analysis;
- Invite the climate community to further clarify the requirements for continuity, identifying priority parameters when relevant;
- Analyze the implications of these requirements on space-based architecture for climate, for example in terms of necessary time overlap among consecutive missions, or in-orbit redundancy;
- Discuss the implications of these requirements on potential roles of R&D and operational agencies, bearing in mind the realistic levels of commitments that can be expected to meet these requirements, depending on the R&D or operational entities.

The workshop would invite representatives of the climate community (including GCOS, SCOPE-CM), space agencies of CGMS and/or CEOS, including representatives of the CEOS Virtual Constellations. Although some agencies may feel more involved than others owing to their different range of activities, ET-SAT members expressed general support along these lines.

Action ET-SAT 5.3: The Secretariat to initiate an update of the Gap Analysis and provide a mapping with respect to the ECVs and related requirements. (November 2010)

Action ET-SAT 5.4: The ET-SAT Chair (M. Kalb) and the Secretariat (J. Lafeuille) will draft a proposal for the workshop (scope, objectives, target participants, key issues, proposed time frame and venue, agenda, organizing committee...) for review and comments by ET-SAT members. (End June 2010)

The Team recognized that the same satellite instruments developed originally for weather are increasingly being adapted to support both climate and weather missions on the same spacecraft. In some cases, additional instruments designed expressly to support climate observing also are being accommodated on the same spacecraft. These assets may also be required to support other national interests. The Team's discussions highlighted the potential difficulty inherent to the management of multi-application missions and potentially competing priorities. Any risk analysis and contingency planning related to assuring a sustained climate observing programme, or development of a robust climate observing architecture must account realistically for the fact that other non-climate interests may likely take precedence over implementation of climate contingency actions. Independently operated climate and operational missions and spacecraft would mitigate this risk.

Finally, ET-SAT underlined that the following points should be paid particular attention to for implementing the Vision for the GOS in 2025:

- Effective distribution of geostationary locations along the Earth equator;

- Effective distribution and control of Equatorial Crossing Times of sun-synchronous operational satellites;
- Enhancement of inter-calibration and validation activities;
- Harmonization of satellite data, and smooth transition to future advanced standards;
- Modernization and enhancement of ground infrastructure (especially in developing countries) as necessary to adapt to the rapid change of the space segment and the growing impact of satellite use.

9. INTEGRATION OF SPACE-BASED OBSERVATIONS

9.1 Overall Integration Approach and Update on WIGOS

Noting that the Commission for Basic Systems has tasked ET-SUP and ET-SAT to provide advice and support on development and implementation of the concept of the [WMO Integrated Observing Systems](#) (WIGOS), the meeting was provided with a short update on WIGOS, as background information for discussion on integration of space-based observations. The WIGOS Vision calls for an integrated, coordinated and comprehensive observing system to satisfy the evolving observing requirements of WMO Members in delivering their weather, climate, water and related environmental services in a cost-effective and sustained manner. It recalls the three key areas of standardization identified by WIGOS: instruments and methods of observation, information infrastructure, and end product quality assurance. WIGOS is currently in a Proof of Concept Phase and is expected to enter its Implementation Phase after endorsement by the next WMO Congress in May 2011. It was clarified that the aims of WIGOS include standardization at three levels (instrument data, data management, end-product quality) and to foster the implementation of a Quality Management System for each of its components. While the WIGOS development strategy is still being finalized for submission to the WMO Congress, many of the “data management” aspects are already addressed by the WIS project.

In this context, the Secretariat presented an analysis of the implications of the WIGOS approach for satellite observations and applications. Scope for further integration was identified at several levels:

- Satellite instrument characteristics and inter-calibration,
- Satellite data management,
- Satellite-derived products and composite products,
- Global satellite planning, as well as
- The complementary role of space and surface-based observations.

This analysis was discussed under items 9.2 to 9.6 below.

9.2 Guidelines on Instrument Harmonization

The meeting was introduced to the Guide on Instruments and Methods of Observation (CIMO Guide), its purpose and its updating procedure. The Guide includes a Chapter on Satellite Observation (Part II, Chapter 8) which dates back from 1996. While its theoretical aspects are still valid, the instruments given for illustration need to be updated, with the inclusion of recent technologies such as hyperspectral sensors, radio-occultation, etc. It was clarified that the target audience of this material is the “network managers” of surface-based observing systems. The main purpose is to give an overview of space-based capabilities to facilitate the design or the upgrade of observing systems taking due account of the complementary possibilities of space and surface-based systems. The scope is thus information for non-specialist, detailed material for satellite specialists would only be referred to in an Annex.

The meeting found that such update of the CIMO Guide (Part II, Chapter 8) was needed and agreed to assist in reviewing the updates.

Action ET-SAT 5.5: Space Programme Office to circulate a draft detailed outline of Chapter II.8 of the CIMO Guide for review by all ET-SAT Members. (End May 2010)

Action ET-SAT 5.6: ET-SAT Members to review the draft outline. (End July 2010)

Action ET-SAT 5.7: Space Programme Office to circulate a draft update of Chapter II.8 of the CIMO Guide for review by all ET-SAT Members. (December 2010)

Action ET-SAT 5.8: ET-SAT Members to review the draft update. (one month before ET-SAT-6)

The Team discussed the steps to be taken on harmonization of space-based instruments, with a view toward improving integration of space-based observations. Harmonization among instruments will greatly facilitate creation of merged homogeneous data sets, optimize development and sharing of consistent processing methods and tools, minimize performance risk and cost, and facilitate back-up arrangements. The last decade has seen a significant trend toward harmonization across space-based observing spectral channel selections among both LEO and GEO, and in terms of shared data and product processing. This needs to continue and to be encouraged. It was agreed that some guidelines for the design of instruments would facilitate harmonization and could be helpful, especially for agencies that don't have a long experience. This would be relevant for selected, mature instruments. A starting point for such guidelines would be the description of "representative characteristics of instruments" contained in the Appendix to ET-SAT-5/Doc. 9.2(1).

Furthermore, a standard terminology should be adopted for instruments and parameters, as proposed in the Appendix to ET-SAT-5/Doc. 9.2(1). Once adopted by ET-SAT, this terminology should be proposed as a standard (recommended practice) in the wider GEO framework.

Action ET-SAT 5.9: Space Programme Office to circulate the proposed definitions of instrument categories and of parameters, for review by ET-SAT members. (End May 2010)

Action ET-SAT 5.10: The WMO Secretariat to invite CIMO to comment on the proposed definitions of instrument categories and of parameters. (End July TBC)

Action ET-SAT 5.11: Space Programme Office to circulate a draft of instrument guidelines based on the representative characteristics of selected instruments, for review by ET-SAT members. (one month before ET-SAT-6)

9.3 Inter-calibration (GSICS)

An update was given on the Global Space-based Inter-calibration System (GSICS), which is recognized as a Pilot Project for WIGOS. (See: "<http://gsics.wmo.int>"). The GSICS initiative currently involves CMA, CNES, EUMETSAT, ISRO, JMA, KMA, NASA, NIST and NOAA (leading the GSICS Coordination Centre), with JAXA participating as an Observer; collaboration is maintained with the Committee on Earth Observation Satellites and its Working Group on Calibration and Validation. GSICS aims at improving the calibration of satellite instruments, performing inter-calibration among concurrent or consecutive instruments measuring similar entities, providing traceability to reference instruments and absolute references if possible, monitoring instruments and accounting for anomalies of discrepancies observed with a view to solve them. GSICS is developing a community-agreed methodology, common procedures and tools, and shares all calibration data and products. Initial focus has been on infrared imagers using hyperspectral infrared sounders (IASI, AIRS) as references, and corrections for all geostationary imagers are now routinely produced. Work is now extending to Visible and Microwave instruments. A second GSICS Users' Workshop will be convened in September 2010 to update interested users and seek feedback from them.

ET-SAT considered that GSICS activity was essential to pursue integration of observations. In particular, GSICS is a key to the use of satellite data for climate change monitoring, since this application requires that inter-calibration errors be brought down well below the decadal trend of the measured parameters. GSICS can also provide NWP centres with a useful independent bias assessment. ET-SAT thus strongly supported the efforts undertaken in GSICS, as well as the orientations for future work. There have been remarkable achievements so far but much remains to be done. Attention was raised to the need for reliable, indisputable reference instruments, and the need to verify and demonstrate their reliability. This question does not seem to be solved for Visible or Microwave channels, nor for older datasets. In addition, there is a requirement for traceability to absolute standards, which will be facilitated with dedicated missions that provide such traceability. ET-SAT expressed the wish that ultimately all space agencies involved in Earth observation could join and participate in GSICS.

9.4 Space-Surface Integration

The meeting discussed the possible interactions between space and surface-based observing networks, and in particular the possible use of ground-based Automatic Weather Station networks to provide ground-truth measurements in support of the derivation of space-based observation products, or the mutual benefit that could be expected from the comparison of space-based observation with measurements from the GCOS Reference Upper-Air Network (GRUAN).

It was agreed that this was an important opportunity for the satellite community to acquire additional ancillary information in support of satellite-based product validation and quality control for instance in the context of SCOPE-CM. Furthermore the AWS community could benefit from observation monitoring from space.

Action ET-SAT 5.12: CMA (Yang Jun) and ISRO (A.S. Kiran Kumar) to work towards consolidating an initial list of requirements for AWS sensors to contribute to the validation and ground truth of space-based observation (with reference to CBS/OPAG-IOS/ ET-SAT/SUP-4/Doc. 18.1, Annex), by December 2010 in consultation with ET-SAT and ET-SUP members.

Action ET-SAT 5.13: WMO Secretariat to request from the ET-AWS an updated list of geophysical parameters currently available from AWS and radiosonde, with measurement accuracy, spatial and temporal resolution. (End June 2010)

9.5 Data Integration

The meeting noted that integration of observation data was ongoing through the WIS project. With a view of full and wide interoperability and efficient data handling, WIS fosters the implementation of agreed data representation and metadata standards, and catalogue search standards. Three focused actions for space-based data are contributing to the WIS:

- IGDDS
- RARS
- Task Force on Codes

As discussed at IGDDS-IG-4, there is a scope for further harmonization or standardization of direct broadcast transmission frequencies and protocols, since new direct broadcast services in X-band tend to depart from the CGMS agreed HRPT and HRIT standards.

9.6 Product Integration (Including SCOPE-CM Issues)

A report was provided on the sustained coordinated processing of environmental satellite data for climate monitoring (SCOPE-CM).

The meeting supported the SCOPE-CM effort and encouraged its extension to terrestrial and/or oceanic pilot projects. NASA could support the production of terrestrial ECVs with Landsat data and products.

Action ET-SAT 5.14: NASA (T. Lee) to provide a point of contact to contribute to SCOPE-CM for Land Cover products. (End May 2010)

Action ET-SAT 5.15: CMA (Yang Jun) and ISRO (A.S. Kiran Kumar), to consider possible further contribution to SCOPE-CM and communicate their interest to WMO Space Programme (B. Ryan) (20 May 2010).

Attention was raised to the need for common algorithms when global products are resulting from different sources. ET-SAT also recommended a transparent quality control to provide confidence in the reliability of the data, instead of the current "self-assessment". This appears essential to move from the current Pilot Project stage to an operational stage, which should be a short-term objective.

The meeting also considered the extension of the SCOPE concept for the sustained generation of satellite-based products in support of other applications such as ocean applications, nowcasting, and precipitation estimates.

10. USER INFORMATION AND DATA ACCESS

The meeting was informed of the outcome of ET-SUP regarding data access issues. In particular, ET-SUP has stressed that in order to take advantage of new satellite series it was essential to make available comprehensive information describing where and how data are accessible, as well as all necessary ancillary information including ingest and pre-processing software for new generation satellites. If such information is available on a web site, the WMO-CGMS on line satellite tables provide a convenient portal with links to such web sites:

Action ET-SAT 5.16: ET-SAT Chair and Space Programme Office to prepare guidelines describing the desired contents of information that should be made available and forward this request to satellite agencies contributing to the GOS. (End June 2010)

Action ET-SAT 5.17: ET-SAT members to provide links to web pages containing the required information on data access and related aspects. (November 2010)

Use of R&D data in operational applications

ET-SAT wished to encourage the use of R&D mission data in operational applications when relevant, and agreed to help identify opportunities in this respect. It was recalled that near-real time accessibility is a key element for operational use.

Particular interest was already expressed by the users and by CM-10 for scatterometer data from Oceansat-2, and in the future for HY-2A and possibly GCOM-W2. The meeting commended ISRO and EUMETSAT for the steps being taken to reduce the data latency of Oceansat-2 through the use of an additional ground station in Svalbard. The meeting also expressed the wish that CNSA and the SOA would make HY-2A data available in near-real time as a contribution to the global community.

The GPM mission was seen as potentially having a high interest for operational users, provided that data could be made available in timely fashion.

Action ET-SAT 5.18: WMO Secretariat (B. Ryan) will send a query to all R&D space agencies contributing to the GOS about potential relevance of their R&D missions

for operational users, as well as data distribution plans when available. (End May 2010)

The information collected will be communicated to ET-SUP or published on line if appropriate, and feedback will be sought from the users.

11. SPACE WEATHER

Space Weather events have a critical impact on a number of activities and infrastructures, and in particular on environmental satellites, aviation and satellite navigation services. The meeting was informed of the steps taken by WMO concerning Space Weather, since the decision of the sixtieth WMO Executive Council to initiate activities in support of the international coordination of efforts in this area.

An update was provided on the establishment of the Inter-Programme Coordination Team on Space Weather (ICTSW), the anticipated creation of a Space Weather unit within the WMO Secretariat relying on voluntary resources contributed by WMO Members, the links established with other organizations involved in Space Weather, and the initial actions taken regarding the inclusion of Space Weather observing requirements into the Rolling Requirements Review process.

ET-SAT strongly endorsed these activities and wished that resources be rapidly allocated by WMO Members to support these activities.

As concerns the relevance of HEO missions for Space Weather observations, it was noted that the GGAK instrument planned for Electro-L was also considered for Arctica-M.

12. UPDATE ON RADIO-FREQUENCY PROTECTION MATTERS

ET-SAT members were reminded of current discussions within ITU regarding the protection of radio-electric frequencies, which is highly needed to secure space-based remote-sensing and spacecraft operations. A summary was given on ongoing actions in preparation for the World Radio Conference in 2012, including a draft position paper submitted to CGMS-37 for comments. The paper emphasizes the need for protection in several key frequency bands, including the new 275-3000 GHz frequency range which is expected to be important for a number of future instruments.

The meeting also noted some recent concern on RFI at 1.4 GHz that affected SMOS terrestrial observations and had the potential to affect Aquarius and SMAP.

Action ET-SAT 5.19: ET-SAT members to coordinate with the relevant point of contact for frequency management within their agencies and supporting national authorities in order to ensure that feedback is provided on the proposed position for WRC-12 (CGMS-37 WMO-WP-01) as agreed at CGMS-37, and to advocate this position at WRC-12. (End May 2010)

13. ANY OTHER BUSINESS

OSE/OSSE

ET-SAT recognizes the use of Observing System Experiments (OSE) and/or Observing System Simulation Experiments (OSSE) is important to document the impact of measurements on operational application (e.g. NWP).

ET-SAT recognizes that the loss of a satellite or the loss of an instrument may have significant impact on operations. OSE is an important tool in documenting the potential impact (data withdraw experiment).

Every OSSE experiment is expensive because of the expertise, computing system, and models. The international partners should share the resource and expertise as much as possible.

- Satellite Agencies should share OSSE results as soon as the research is consolidated (confirmed).
- Satellite Agencies should work with assimilation centres, such as ECMWF, to assess the impact.

The new missions' system under development by the space agencies should provide/use proxy or simulated data to international partners as soon as possible to facilitate the OSSEs.

14. REVIEW AND ADOPTION OF THE DRAFT REPORT

The summary report of the meeting was reviewed and adopted by the session, subject to editorial finalization by the Secretariat in consultation with the Chairman.

15. DATE AND PLACE OF NEXT MEETING

Taking into account the agreed actions and relevant milestones, it was suggested that the next ET-SAT meeting be held tentatively in April - early May 2011 and that work should be pursued by correspondence and by teleconferences as appropriate during the intersession period. It was suggested to hold part of the session jointly with ET-SUP.

16. CLOSURE OF THE MEETING

The Chairman thanked the participants for the constructive discussions. The session was closed at 12:30 on Thursday, 29 April 2010.

APPENDIX I

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AGENDA

- 1. ORGANIZATION OF THE SESSION**
 - 1.1 Opening of the session
 - 1.2 Adoption of the agenda
 - 1.3 Working arrangements for the session
 - 2. CHAIRMAN'S REPORT**
 - 3. GUIDANCE FROM THE CHAIRPERSON OF OPAG IOS**
 - 4. ET-SAT TERMS OF REFERENCE AND WORK PROGRAMME**
 - 5. OUTCOME OF WMO MEETINGS INCLUDING CONSULTATIVE MEETINGS, EXECUTIVE COUNCIL AND CBS, WITH DIRECT RELEVANCE TO ET-SAT**
 - 6. STATUS OF ACTIONS FROM PREVIOUS ET-SAT MEETINGS**
 - 7. CURRENT AND PLANNED SPACE-BASED OBSERVING CAPABILITIES**
 - 7.1 UPDATES FROM PARTICIPATING AGENCIES
 - 7.2 DOSSIER ON THE SPACE-BASED GOS
 - 7.3 CONTINUITY AND TRANSITION ISSUES
 - 8. IMPLEMENTING THE VISION OF THE GOS IN 2025**
 - 8.1 TOWARDS AN ARCHITECTURE FOR THE OPERATIONAL MONITORING OF CLIMATE AND CLIMATE CHANGE FROM SPACE
 - 8.2 CONTINGENCY CONCEPT FOR CLIMATE MONITORING MISSIONS
 - 9. INTEGRATION OF SPACE-BASED OBSERVATIONS**
 - 9.1 OVERALL INTEGRATION APPROACH AND UPDATE ON WIGOS
 - 9.2 GUIDELINES ON INSTRUMENT HARMONIZATION
 - 9.3 INTERCALIBRATION (GSICS)
 - 9.4 SPACE-SURFACE INTEGRATION
 - 9.5 DATA INTEGRATION
 - 9.6 PRODUCT INTEGRATION (INCLUDING SCOPE-CM ISSUES)
 - 10. USER INFORMATION AND DATA ACCESS**
 - 10.1 OUTCOME OF ET-SUP
 - 10.2 USER TRAINING, INFORMATION AND OUTREACH
 - 11. SPACE WEATHER**
 - 12. UPDATE ON RADIO-FREQUENCY PROTECTION MATTERS**
 - 13. ANY OTHER BUSINESS**
 - 14. REVIEW AND ADOPTION OF THE DRAFT REPORT**
 - 15. DATE AND PLACE OF NEXT MEETING**
 - 16. CLOSURE OF THE MEETING**
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APPENDIX III

SUMMARY OF ACTIONS

Ref. No.	Action	Actionees & Due Dates
ET-SAT 5.1	EUMETSAT (A. Rodriguez) to perform an initial evaluation of the use of DOORS or other tools to support the migration of the information contained in the Dossier to a suitable requirements management system, and facilitate its further handling and updating. (End September 2010)	EUMETSAT End September 2010
ET-SAT 5.2	ET-SAT members to report at the next ET-SAT meeting on their activities, plans or lessons learnt regarding the support to the user community in preparation for the migration to new generations of satellites, and possible risk reduction measures. (Due date: ET-SAT-6.)	ET-SAT members ET-SAT-6
ET-SAT 5.3	The Secretariat to initiate an update of the Gap Analysis and provide a mapping with respect to the ECVs and related requirements (November 2010)	WMO Secretariat November 2010
ET-SAT 5.4	The ET-SAT Chair (M. Kalb) and the Secretariat (J. Lafeuille) will draft a proposal for the workshop (scope, objectives, target participants, key issues, proposed time frame and venue, agenda, organizing committee...) for review and comments by ET-SAT members. (End June 2010)	ET-SAT Chair and the Secretariat End June 2010
ET-SAT 5.5	Space Programme Office to circulate a draft detailed outline of Chapter II.8 of the CIMO Guide for review by all ET-SAT Members. (End May 2010)	Space Programme Office End May 2010
ET-SAT 5.6	ET-SAT Members to review the draft outline. (End July 2010)	ET -SAT members End July 2010
ET-SAT 5.7	Space Programme Office to circulate a draft update of Chapter II.8 of the CIMO Guide for review by all ET-SAT members. (December 2010)	Space Programme Office December 2010
ET-SAT 5.8	ET-SAT members to review the draft update. (one month before ET-SAT-6)	ET-SAT members one month before ET-SAT-6
ET-SAT 5.9	Space Programme Office to circulate the proposed definitions of instrument categories and of parameters, for review by ET-SAT members. (End May 2010)	Space Programme office End May 2010
ET-SAT 5.10	The WMO Secretariat to invite CIMO to comment on the proposed definitions of instrument categories and of parameters. (End July TBC)	CIMO End July TBC
ET-SAT 5.11	Space Programme Office to circulate a draft of instrument guidelines based on the representative characteristics of selected instruments, for review by ET-SAT members. (one month before ET-SAT-6)	Space Programme Office one month before ET-SAT-6
ET-SAT 5.12	CMA (Yang Jun) and ISRO (A.S. Kiran Kumar) to work towards consolidating an initial list of requirements for AWS sensors to contribute to the validation and ground truth of space-based observation (with reference to CBS/OPAG-IO/ ET-SAT/SUP-4/Doc.18.1, Annex), by December 2010 in consultation with ET-SAT and ET-SUP members.	CMA and ISRO December 2010

APPENDIX III, p. 2

ET-SAT 5.13	WMO Secretariat to request from the ET-AWS an updated list of geophysical parameters currently available from AWS and radiosonde, with measurement accuracy, spatial and temporal resolution. (End June 2010)	WMO Secretariat End June 2010
ET-SAT 5.14	NASA (T. Lee) to provide a point of contact to contribute to SCOPE-CM for Land Cover products. (End May 2010)	NASA End May 2010
ET-SAT 5.15	CMA (Yang Jun) and ISRO (A.S. Kiran Kumar), to consider possible further contribution to SCOPE-CM and communicate their interest to WMO Space Programme (B. Ryan) (20 May 2010).	CMA and ISRO 20 May 2010
ET-SAT 5.16	ET-SAT Chair AND Space Programme Office to prepare guidelines describing the desired contents of information that should be made available and forward this request to satellite agencies contributing to the GOS (End June 2010)	ET-SAT Chair and Space Programme Office End June 2010
ET-SAT 5.17	ET-SAT members to provide links to web pages containing the required information on data access and related aspects. (November 2010)	ET-SAT members November 2010
ET-SAT 5.18	WMO Secretariat (B. Ryan) will send a query to all R&D space agencies contributing to the GOS about potential relevance of their R&D missions for operational users, as well as data distribution plans when available. (End May 2010)	WMO Secretariat End May 2010
ET-SAT 5.19	ET-SAT members to coordinate with the relevant point of contact for frequency management within their agencies and supporting national authorities in order to ensure that feedback is provided on the proposed position for WRC-12 (CGMS-37 WMO-WP-01) as agreed at CGMS-37, and to advocate this position at WRC-12. (End May 2010)	ET-SAT members End May 2010

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

(As adopted by CBS-XIV)

- (a) Provide technical advice with respect to both operational and R&D environmental satellites to assist in the integration of WMO-coordinated observing systems;
- (b) Advise CBS through ICT-IOS on matters requiring feedback to the WMO Consultative Meetings on High-level Policy on Satellite Matters;
- (c) Assess the observation, collection, and analysis systems relating to the use of operational and R&D environmental satellites contributing, or with the potential to contribute, to the space-based subsystem of the GOS, and to suggest improvements of system capabilities, particularly with respect to developing countries;
- (d) Assist CBS in assessing the status of implementation of the space-based subsystem of the GOS and the adequacy of plans for implementation for meeting established requirements for satellite data and products;
- (e) Make recommendations with respect to the transition of relevant R&D instruments to operational environmental satellites;
- (f) Coordinate with other relevant CBS teams with a view to making recommendations 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 satellite meteorology;
- (g) 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;
- (h) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

APPENDIX V

ET-SAT WORK PROGRAMME ASSIGNED BY THE CBS MANAGEMENT GROUP

	Task	Deliverable/Activity	Source Committee	Source id	Due	Responsible	Status
1	To contribute to the development and implementation of concept of WIGOS and provide relevant advice and support to the chairperson of ICT-IOS	Advice on integration of operational and R&D environmental satellites within WIGOS and in particular: - Intercalibration, including GSICS WPP - Satellite instrument standardization	CBS-XIV	12.2.3	2010/4 2011/4		
2	Review capabilities of operational and R&D satellites	Update on current/planned satellite missions Update of the Gap Analysis of the space-based component of the GOS Identification of opportunities and/or problem areas concerning satellite plans	CBS-XIV	12.2.3	2010/2 (continuing yearly)		
3	Assist CBS on coordinating global planning of satellite missions to implement the Vision for the GOS in 2025	Review the Implementation Plan of Evolution of the GOS (space aspects) Advise on implementation of the Vision for the GOS, as concerns space-based aspects and observation strategies	CBS-XIV	12.2.3	2010/2 (Continuing yearly)		
4	Make recommendations with respect of transition of relevant R&D instruments to operational environmental satellites	Recommendations on opportunities for transition of relevant R&D missions to operations Recommendations for increased use of R&D mission data	CBS-XIV	12.2.3	2010/4 (continuing)		
5	Assess system capabilities for access and use of environmental satellites in particular in developing countries (with ET-SUP)	Assessment of capabilities and suggestions for improvements	CBS-XIV	12.2.3	2011/2		
6	Space Weather	Input to the Inter-programme Coordination Team on Space Weather	CBS-XIV	12.2.3	2010/2 (continuing yearly)		
7	Advise CBS on other relevant matters	Advice on radio frequency utilization	CBS-XIV	12.2.3	2010/3		