WORLD METEOROLOGICAL ORGANIZATION
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COMMISSION FOR BASIC SYSTEMS
OPEN PROGRAMME AREA GROUP ON INTEGRATED OBSERVING SYSTEMS

EXPERT TEAM ON SATELLITE SYSTEMS
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OUTCOME OF WMO MEETINGS OF RELEVANCE TO ET-SAT

(Submitted by the Secretariat)

Summary and Purpose of Document

This document highlights the outcomes of satellite-related deliberations of :
- The WMO Executive Council (EC),
- The Consultative Meetings on High-level Policy on Satellite Matters (CM)
- The Commission for Instruments and Methods of Observation (CIMO),
- The Commission for Basic Systems (CBS).

The attention of ET-SAT members is raised to the opportunity to provide feedback, at the 17th session of the Congress, on the draft resolution on the WMO Policy for International Exchange of Climate Data and Products to support the implementation of the GFCS. This draft resolution is provided separately in ET-SAT-9/Doc.2(2).

ACTION PROPOSED

The Expert Team is invited to take note.

APPENDICES

A. Draft recommendation on the preparation for new satellite systems
B. Proposed responsibility within CBS for the oversight and review of OSCAR
C. Observing systems network design principles
D. Topics for NWP impact studies relevant to the evolution of global observing systems

REFERENCES:

- Final report of the 12th Consultative Meeting on High-level Policy on Satellite Matters
- Final report of the 66th session of the Executive Council
- Provisional report of the 16th Commission for Instruments and Methods of Observation
- Provisional report of the 2014 Extraordinary session of CBS

OUTCOME OF WMO MEETINGS OF RELEVANCE TO ET-SAT

1. 12th Session of Consultative Meetings on High-level Policy on Satellite Matters (CM-12)

The CM-12 was held in Geneva on Saturday 21 June 2014, in conjunction with the 66th Executive Council session. The agenda was focused on the architecture for climate monitoring from space and related data policy issues, and on the socio-economic benefits of satellite programmes. Its recommendations were brought to the attention of the Council.

Climate data policy: The CM session expressed strong support to the general approach to international exchange of climate data and products contained in the WMO Executive Council Draft Resolution on climate data policy and its Annex (See Appendix). It underlined however the specific challenges of the generation and long-term preservation of satellite-based climate data records. The consultative meeting also emphasized the potential for inclusion of other observations, in addition to those mentioned as "climate relevant essential data" in the annex to the draft resolution. There was thus general agreement that CEOS and CGMS space agencies should be given an opportunity to provide comments on the Draft Resolution including agencies' views regarding the data policy both for sensor data (e.g., radiances) and for derived, higher-level products.

Climate architecture: In the context of the Architecture for Climate Monitoring from Space, WMO should take a leading role in developing user case studies showing the relevance of satellites in support of GFCS priorities.

Socio-economic benefit of satellite programmes: The CM session strongly encouraged WMO to broaden its regular assessment of the impact of observing systems on user applications in considering areas beyond numerical weather prediction. This could be done either by broadening the scope of the highly successful series of WMO impact workshops (e.g. Sedona 2012), or by arranging similar but separate events for other application areas.

Commercial initiatives: The session recommended that a task team be formed under the ICT-IOS to elaborate the issue of emerging commercial providers in the development and operations of satellite observations, and possible implications on global coordination and on data exchange (implementation of WMO Resolution 40). Input from the NWP community and the World Weather Open Science Conference should be considered. The task team should present its results to the 17th session of the WMO Congress.

CM meetings: The Secretary General was encouraged to host the CM in conjunction with meetings of the WMO Bureau or other events as appropriate to facilitate strong participation of Agency Executives from the satellite operators in the CM. The outcome of CM meetings should also inform the Space Programme reports to the EC or Congress.

2. 66th Session of the WMO Executive Council (EC-66)

The EC-66 was held from 12 to 27 June 2014. Among the decisions taken the Council has:

(a) Invited China to confirm the deployment of FY-3 satellites on the early morning orbit and encouraged Members to strengthen their cooperation with CMA in terms of sharing satellite data and related products and technologies;

(b) Invited the USA to take appropriate measures to mitigate the risk of gap in the transition from Suomi-NPP to JPSS-1 and JPSS-2 satellites;

(c) Urged EUMETSAT and its Members to decide the EPS Second Generation in due time to ensure continuity after the EPS programme;

(d) Urged satellite operators to contribute to the SATURN user readiness portal the information relevant to the new generation of meteorological satellites;

(e) Requested the Secretary-General to prepare a four-year plan to frame the activities of Members in Space Weather service delivery and to establish a Trust Fund;

(f) Adopted draft Resolution 4.4/5 Schedule of Consultative Meetings on High-Level Policy on Satellite Matters, recommending to convene future CM sessions in advance of EC or Congress, for example in conjunction with WMO Bureau meetings as initially foreseen.

Considering the outcome of CM-12, the Council encouraged the initiatives taken within the WMO Space Programme to work with GCOS and the GFCS office on consolidating user requirements for space-based climate products and services in identifying user cases from GFCS priority areas, as a contribution to the Architecture for Climate Monitoring from space.

Regarding the WMO Policy for International Exchange of Climate Data and Products to support the implementation of the GFCS, from the perspective of the architecture for climate monitoring from space, the Council requested the Secretary-General to inform space agencies of this draft resolution so that their feedback could be provided at Cg-17 through Members connected with the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS), among others.

In order to document the socio-economic benefits of satellite programmes, the Council recommended further workshops on the assessment of the impact of observing systems, but encouraged broadening the assessment to user applications beyond numerical weather prediction.

3. Commission for Instruments and Methods of Observation

The sixteenth session of the Commission for Instruments and Methods of Observation was held in St Petersburg, Russian Federation, from 10 to 16 July 2014.

SI traceability: In view of the key role played by traceability of observations in many application areas, especially in climate for the assessment of climate variability and changes, the Commission was pleased to note the progress in developing a CIMO strategy to improve the traceability of instrument calibrations. The Commission recalled that the ultimate goal was to ensure proper traceability of observations to the International System of Units (SI) through an uninterrupted calibration chain of the instruments.

CIMO Guide: The Commission appreciated that expert teams and other experts provided substantial contributions to the update of the CIMO Guide, which had been posted on the WMO/IMOP website for Members to review. It noted that the Chapter on satellite observation had been replaced by seven totally new chapters comprising the new Part III of the CIMO Guide. Taking into account the result of the review, the Commission approved the Provisional 2014 Edition of the CIMO Guide[1] and recommended its publication. The Commission encouraged Members to provide in-kind support and/or contribute to the CIMO Trust Fund to support further translation of the CIMO Guide.

[1] http://www.wmo.int/pages/prog/www/IMOP/publications/CIMO-Guide/Provisional2014Edition.html

4. Commission for Basic Systems

The Extraordinary session 2014 of the Commission for Basic Systems (CBS-Ext(2014)) was held in Asunción, Paraguay, from 8 to 12 September 2014. Among its main decisions related to satellite matters, the session:

- Approved the new terms of reference of the ET-SAT and IPET-SUP;

- Welcomed the initiative to develop a new Vision of WIGOS component observing systems in 2040. It encouraged IPET-OSDE, in consultation with ET-SAT, ET-SUP and other groups, to update the space-based component of the current Vision taking into account the advances in remote-sensing and satellite technology, the increasing maturity of space applications (e.g. to air quality, hydrology, and cryosphere monitoring), the diversity of orbits and mission concepts required for a balanced and robust space-based observing system;

- Recommended that the WMO Space Programme provides a report to the Seventeenth Congress on the status of the Architecture for climate monitoring from space, from an end-to-end perspective;

- Adopted Draft Recommendation 2.5/1- Preparation for new satellite systems to be submitted to Cg-17 (See Appendix A);

- Recommended that the Coordination Group on Satellite Data Requirements for Region III and Region IV (SDR) monitor the GOES-N,O,P to GOES-R, S transition and coordinate the related activities;

- Noted the outline of the strategy for improved availability and accessibility of satellite products that had been presented to CGMS (See ET-SAT-9/Doc.2 (3)) and recommended refining this strategy in consultation with ET-SAT, ET-SUP, and OPAG ISS with a view to submit it to the sixteenth session of CBS. In particular, it welcomed the steps taken to develop the Direct Readout Acquisition and Relay of Satellite Data (DRARS) which will follow and enhance the Regional ATOVS Retransmission Services (RARS), and recommended to complete a Guide on DRARS as part of the WIS reference documentation.

The Commission furthermore made a number of decisions related to integrated observing systems:

- Approved a first version of WIGOS Regulatory Material, including the Manual on WIGOS, and its chapter on space-based observing system.
- Assigned responsibilities for overseeing the contents of OSCAR (See Appendix B)
- Endorsed Observing Systems Network Design Principles (See Appendix C)
- Agreed a list of topics for NWP impact studies relevant to the evolution of global observing systems (See Appendix D)

5. Conclusions

ET-SAT is invited to note this report, as reference for future discussions and actions.

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DRAFT RECOMMENDATION 2.5/1 (CBS-EXT.(2014))

PREPARATION FOR NEW SATELLITE SYSTEMS

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) That the transition to the operation of new satellite systems enables significant enhancements of products and services delivered by WMO Members;

(2) That the implementation of such new satellite systems in operational schemes has a major impact on user infrastructure, systems, applications and services, and generally requires coordinated actions at the scientific, technical, financial, organizational and educational levels;

(3) That timely and careful preparation is essential to avoid any disruption of operations upon transition to a new system, and instead to take advantage of the new capabilities as early as possible to provide a better service to the users;

Noting further:

(1) That new generation geostationary systems are being implemented or planned to be implemented in the 2015-2020 timeframe by Japan, China, the United States, the Republic of Korea, the Russian Federation and EUMETSAT;

(2) That other new generation systems are being developed for implementation in polar orbit and other orbit types in the coming decade;

Recalling:

(1) The Guidelines for Ensuring User Readiness for New Generation Satellites adopted by the Commission for Basic Systems at its fifteenth session;

(2) The Satellite User Readiness Navigator (SATURN) implemented by the WMO Secretariat, which is a portal providing a unique entry point to updated technical information from satellite operators related to the new systems;

(3) The Observing System Capability Analysis and Review tool (OSCAR), which is part of the WIGOS Information Resource and contains comprehensive information on space-based systems of relevance to WMO activities;

(4) Resolution 12 adopted by the Executive Council at its sixty-fifth session (Res.12 EC-65) on Regional Requirements for Satellite Data Access and Exchange;

Strongly recommends to all concerned WMO Members to set up user preparation projects in advance of the launches of new satellite systems, in accordance with the CBS Guidelines for Ensuring User Readiness for New Generation Satellites;

Urges the satellite operators to provide regular and timely updates on their new systems through appropriate means and in particular through inputs to SATURN and OSCAR;

Requests the CBS, through the Expert Team on Satellite Systems (ET-SAT) and the Inter-Programme Expert Team on Satellite Utilization and Products (IPET-SUP), the regional associations, through their appropriate expert groups on satellite data access and exchange, the

Consultative Meetings on High-level Policy on Satellite Matters (CM), and the Secretariat to take appropriate actions in collaboration with satellite operators to raise awareness among WMO Members and to facilitate a seamless transition to new satellite systems;

Requests the Secretary-General to communicate this Recommendation to all Members and submit it for consideration by the seventeenth Congress**.**

PROPOSED RESPONSIBILITY WITHIN CBS FOR THE OVERSIGHT AND REVIEW OF OSCAR

CBS Team	***Role***	***Reporting to***
ICT-IOS	Lead	ICG-WIGOS
IPET-WIFI	1) Overall coordination and leadership at the technical level 2) Regulatory Materials and metadata required in liaison with ICG-WIGOS and its dedicated Task Teams	ICT-IOS
IPET-OSDE	1) Functional requirements with regard to the tools required for the RRR process 2) Review content required for the RRR process including the observational requirements from application areas	IPET-WIFI
ET-SAT	Space-based observing systems capabilities (programmatic and technical updates)	IPET-WIFI
ET-SUP	Space-based observing systems capabilities (user assessments)	IPET-WIFI
ET-ABO	Aircraft-based observing systems capabilities	IPET-WIFI
ET-SBO	Surface-based observing systems capabilities	IPET-WIFI

Note: The Inter-Programme Coordination Team on Space Weather (ICTSW) which is not purely a CBS team as it is reporting to CBS and CAeM in parallel, is responsible for overseeing the space weather observing capabilities (surface- and space-based).

OBSERVING SYSTEMS NETWORK DESIGN PRINCIPLES

Members should follow the following principles when designing and evolving their observing system networks:

1. SERVING MANY APPLICATION AREAS
Observing networks should be designed to meet the requirements of multiple application areas within WMO and WMO co-sponsored Programmes.

2. MEETING USER REQUIREMENTS
Observing networks should be designed to address stated user requirements, in terms of the geophysical variables to be observed and the space-time resolution, uncertainty, timeliness and stability needed.

3. MEETING NATIONAL, REGIONAL AND GLOBAL REQUIREMENTS
Observing networks designed to meet national needs should also take into account the needs of the WMO at the regional and global levels.

4. DESIGNING APPROPRIATELY SPACED NETWORKS
Where high-level user requirements imply a need for spatial and temporal uniformity of observations, network design should also take account of other user requirements, such as the representativeness and usefulness of the observations.

5. DESIGNING COST-EFFECTIVE NETWORKS
Observing networks should be designed to make the most cost-effective use of available resources. This will include the use of composite observing networks.

6. ACHIEVING HOMOGENEITY IN OBSERVATIONAL DATA
Observing networks should be designed so that the level of homogeneity of the delivered observational data meets the needs of the intended applications.

7. DESIGNING THROUGH A TIERED APPROACH
Observing network design should use a tiered structure, through which information from reference observations of high quality can be transferred to and used to improve the quality and utility of other observations.

8. DESIGNING RELIABLE AND STABLE NETWORKS
Observing networks should be designed to be reliable and stable.

9. MAKING OBSERVATIONAL DATA AVAILABLE
Observing networks should be designed and should evolve in such a way as to ensure that the observations are made available to other WMO Members, at space-time resolutions and with a timeliness to meet the needs of regional and global applications.

10. PROVIDING INFORMATION SO THAT THE OBSERVATIONS CAN BE INTERPRETED
Observing networks should be designed and operated in such a way that the details and history of instruments, their environments and operating conditions, their data processing procedures and other factors pertinent to the understanding and interpretation of the observational data (i.e. metadata) are documented and treated with the same care as the data themselves.

11. ACHIEVING SUSTAINABLE NETWORKS

Improvements in sustained availability of observations should be promoted through the design and funding of networks that are sustainable in the long-term including, where appropriate, through the transition of research systems to operational status.

12. MANAGING CHANGE

The design of new observing networks and changes to existing networks should ensure adequate consistency, quality and continuity of observations across the transition from the old system to the new.

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

Short name: Full name	**Science question**
	Surface-based
S1MarinePs: Surface pressure over ocean	What density of surface pressure observations over ocean is needed to complement high-density surface wind observations from satellites
S2AMDAR: Coverage of AMDAR	What are the priorities for expansion of the AMDAR network? How does the impact vary over the globe? Provide guidance for AMDAR optimisation.
S3Radar: Radar observations	What are the impacts of current radar observations, including radial winds and reflectivities?
S4Strat: In situ observations of the stratosphere	What network of in situ observations is needed in the stratosphere to complement current satellite observations (including radio occultation)? What about the tropics?
S5PBL: Observations of the PBL for regional and high-resolution NWP	What should be the focus of improvements for observations of the planetary boundary layer (PBL) in support of regional and high-resolution NWP? Which variables and what space-time resolution?
	Space-based
S6SatLand: Satellite sounding over land and ice	What is the impact of new developments in the assimilation of radiance data over land and sea ice?
S7Sounders: Impact of multiple satellite sounders	What benefits are found when data from more than one passive sounder are available from satellites in complementary orbits, e.g. the current unprecedented availability of four hyper-spectral sounders?
S8AMVs: Atmospheric Motion Vectors	Based on evidence from current AMV impacts, which AMV characteristics should be enhanced for the next generation of GEO satellites? What are the impacts of recent new types of AMVs such as MISR-AMV?
	General
S9UA: 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.

S10AdjEns: 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.
S11Ocean: Impact in ocean-coupled assimilation	Which ocean observations are particularly important for NWP? Investigate the role of ocean observations in coupled atmosphere-ocean data assimilation with a focus on the 7-14 day range.
S12Land: Impact in land-coupled assimilation	Which land-surface observations are particularly important for NWP at all time ranges? Investigate the role of surface observations in coupled atmosphere-land data assimilation with a focus on the 7-14 day range.
S13 Time frequency	What is the required time frequency of observations? Consider AMDAR, GEO satellites and ground-based remote sensing observations (such as Doppler radar, wind profiler, ground based GNSS receivers) for regional and global NWP.
S14 Atmospheric composition	Study observation impact in atmospheric composition and air quality applications.
S15 OSSEs	Observing system simulation experiments are encouraged in support of satellite system design criteria such as orbit optimization for GPS-RO satellites, or configurations for hypersperspectral IR sounders on geostationary orbit.