

WMO SPACE PROGRAMME

(Submitted by WMO)

Summary and purpose of document

To inform CGMS Members of the establishment
and status of the WMO Space Programme

ACTION PROPOSED

CGMS Members to note the status in the development of the WMO Space Programme and comment as appropriate.

- Appendices:**
- A. Preliminary draft WMO Space Programme
 - B. Review of WMO Satellite Activities
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DISCUSSION

1. Since CGMS XXIX, there has been a series of events that has led to the establishment of a new WMO Space Programme. The new WMO Space Programme will officially become effective on 1 January 2004 with the initiation of the Fourteenth Financial Period based on the Sixth Long-Term Plan for which a draft will be reviewed and approved by the WMO Congress in May 2003. In preparing for the formal start of the WMO Space Programme in 2004, many preliminary activities are already underway. The following information provides background to the establishment of the WMO Space Programme and planned preparatory work leading up to 1 January 2004.

Background

2. In February 2002, the second session of the Consultative Meetings on High-Level Policy on Satellite Matters reviewed a proposal to enhance coordination within the expanded space-based component of the Global Observing System (GOS). The second session discussed a range of measures to strengthen coordination. It agreed that it was a generally accepted fact that in recent years the role and use of the operational meteorological satellites - as well as the Research and Development environmental satellites (R&D satellites) - have grown significantly in WMO Programmes. The constant growth in the number and capabilities of national and international satellite systems, both operational and R&D, including their complexity, corresponding high cost and interactions with other WMO global systems (i.e., Global Data Processing and the Global Telecommunications Systems) required that WMO review the structure through which it interacted with those entities providing satellite systems.

3. The second session noted that inclusion of R&D satellite systems into the space-based component of the GOS more than double the need for external coordination mechanisms. Firstly, there were unique coordination needs between WMO and R&D space agencies. Secondly, there were coordination needs between operational and R&D space agencies in such areas as frequency coordination, orbit coordination including equator crossing-times, standardization of data formats, standardization of user stations. The issue of increased external coordination is further addressed in WMO WP-23 that proposes an expansion of the CGMS Membership to include those R&D space agencies contributing to the space-based component of the GOS as full CGMS Members (**See WMO WP-23**).

4. In addition to the external coordination needs, the second session agreed that there must be a comparable internal WMO structure. At present, there is a small Satellite Activities Office whose primary focus has been coordination between WMO and the operational meteorological satellite operators, and coordination between the various WMO and supported programmes.

5. The second session noted that the necessary coordination with the R&D space agencies had emerged slowly during the second half of the last decade and was now placing greater demands on many WMO and supported programmes, e.g., GCOS, WCRP, HWR, GAW, JCOMM, etc. To better satisfy the needs of all WMO and supported programmes for satellite data, products and services from both operational and R&D satellites and in consideration of the increasing role of both types of satellites, the second session felt it appropriate to propose an expansion of the present mechanisms for coordination within the WMO structure and cooperation between WMO and the operators of operational meteorological satellites and R&D satellites.

6. The second session felt that it was important that the internal structure within WMO be expanded and strengthened. The expanded structure must be constituted so as to allow WMO to have a single focus point for satellite matters for all WMO and supported programmes. The supported programmes included the: World Weather Watch Programme, World Climate Programme, World Climate Research Programme, Global Climate Observing System, Hydrology and Water Resources Programme, Atmospheric Research and Environment Programme, Education and Training Programme and the Technical Cooperation Programme.

7. Since the Commission for Basic Systems had primary responsibility for the present space-based component of the GOS, it must also retain this responsibility as the GOS expands. Thus, its Open Programme Area Groups (and associated expert teams) must respond to the requirements of the other supported programmes in formulating the system design for the expanded GOS. The system design must be formalized within the Manual and Guide for the GOS and presented to the expanded CGMS.

8. Implementation of both the external and internal cooperation and coordination mechanisms were of equal importance if WMO were to provide the international perspective in constituting an efficient and effective space-based system comprised of operational meteorological and R&D satellites that provided the satellite data, product and services to meet the needs of all WMO supported programmes.

9. The second session agreed that there was a pressing need to strengthen coordination especially in light of the recent expansion to include R&D satellite missions as part of the space-based component of the GOS. While it would be a decision of CGMS whether it expanded its remit, it appeared that such an expansion would be timely and opportune and would be likely to be supported by CGMS members. The second session thus concentrated on the WMO interface with external coordination mechanisms. In so doing, it was convinced that it was very advantageous for the satellite agencies to have effective linkages into the WMO structure and a central focal point in the WMO Secretariat for Satellite Activities.

10. Thus, the second session suggested that WMO conduct its own review of its internal coordination of Satellite Activities to ensure that it was optimum for the present and perceived future needs as well as providing an appropriate framework for efficient interaction with external mechanisms. This review must take into consideration the emphasis that WMO placed on the contribution satellite systems were making to WMO and supported programmes and the large expenditures by those space agencies contributing to the space-based component of the WMO GOS. In light of its discussion, the second session encouraged the Secretariat in consultation with the President of CBS and others, as appropriate, to explore the full range of options, including that of a WMO Space Programme. A preliminary draft WMO Space Programme, as presented to the second session, is contained in Appendix A to this document. The structure and content as contained in Appendix A served as the starting point for the Secretariat review which was submitted for consideration by EC-LIV. The second session felt that it was appropriate to provide more detail than shown in Appendix A to make it clear as to the structure, scope and linkages implied in any new WMO Space Programme. The second session also agreed that the present structure was insufficient to respond to the new demands resulting from the expansion of the space-based component of the GOS to include the R&D constellation. In order for WMO to take advantage of the new technologies to better serve its Members, it was of primary importance to enhance the coordination. The second session agreed that such a review must also lead to enhancement of the WMO interface with external mechanisms. The conclusions of the review should be reported to the forthcoming Executive Council in June 2002.

EC-LIV and the WMO Space Programme

11. The fifty fourth session of the WMO Executive Council noted that the second session of the Consultative Meetings on High-Level Policy on Satellite Matters (CM-2) reviewed a proposal related to enhanced coordination within a future space-based component of the GOS.

12. The Executive Council was informed that CM-2 had suggested WMO conduct a review of WMO Satellite Activities to ensure it was optimum for the present and perceived future needs. The WMO Satellite Activities Programme must provide for an appropriate framework for efficient interaction both internally within WMO as well as with external coordination mechanisms such as the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS). This review should take into consideration the emphasis that WMO placed on the contribution environmental satellite systems were making to WMO and its

supported programmes and the large expenditures by those space agencies contributing to the space-based component of the WWW's GOS. CM-2 also agreed that the present programme was insufficient to respond to the new demands resulting from the expansion of the space-based component of the GOS to include the R&D constellation. In order for WMO to take advantage of the new technologies to serve its Members better, it was of primary importance to enhance coordination. CM-2 agreed that such a review must also lead to enhancement of the WMO interface with external coordination mechanisms.

Review of WMO Satellite Activities

13. The fifty fourth session of the WMO Executive Council noted that as requested by CM-2, a review had been performed as contained in Appendix B to this document. It agreed that the review clearly demonstrated significant growth during the last decade in all areas for which WMO Satellite Activities had responsibilities. The recent agreement by the Executive Council at its fifty-third session to expand the space-based component of the GOS to include appropriate Research and Development environmental satellite missions was a landmark decision. The implications of the expansion were immense to WMO Members with a corresponding increase in responsibility for the WMO Satellite Activities. The Executive Council also noted the tremendous impact resulting from just two sessions of the Consultative Meetings on High-Level Policy on Satellite Matters. It was also convinced that the now established dialogue between WMO and the environmental satellite communities participating in the Consultative Meetings had matured rapidly to the great benefit of all and must be institutionalized.

14. The Executive Council agreed that the WMO Satellite Activities had grown and that it was appropriate **to establish a WMO Space Programme as a matter of priority**. The scope, goals and objectives of the new programme must respond to the tremendous growth in the utilization of environmental satellite data, product and services within the expanded space-based component of the GOS that now included appropriate Research and Development environmental satellite missions. Thus, the Executive Council asked the Secretary-General to make appropriate proposals in the 6LTP and Programme and Budget to be submitted for consideration by the WMO Congress. It also suggested that the WMO Congress consider ways to institutionalize the Consultative Meetings on High-Level Policy on Satellite Matters in order to establish more formally the dialogue and participation of environmental satellite agencies in WMO matters. In considering the important contributions made by environmental satellite systems to WMO and its supported programmes as well as the large expenditures by the space agencies, the Executive Council felt it appropriate that the overall responsibility for the new WMO Space Programme should be assigned to CBS and the new "institutionalized" Consultative Meetings on High-Level Policy on Satellite Matters. Since the Consultative Meetings were attended by the Directors of agencies operating environmental satellites, the Council felt that the assignment of joint lead responsibility could be conducive to support for the WMO Space Programme by the satellite operating agencies. Such support on the part of the satellite operators could complement the WMO commitment established by a WMO Space Programme and assist the new Space Office with specific projects and initiatives as appropriate.

15. The Executive Council also felt strongly that additional emphasis in the Programme and Budget for 2004-2007 be placed on education and training in satellite matters especially for data and products from Research and Development satellites.

Activities since EC LIV

16. Since the approval by EC LIV to establish a WMO Space Programme, as a matter of priority, a draft Sixth Long-Term Strategy (6LTP) and an associated Programme and Budget for 2004-2007 has been developed and is being prepared through the document preparation process for review by the Fourteenth WMO Congress that will meet in May 2003. The 6LTP will serve to assist WMO Members in knowing the goals of the WMO Space Programme. However, it only covers an eight year period and doesn't identify the role the satellite operators could undertake to

better implement the WMO Space Programme. This shortcoming would be covered under a WMO Space Programme Long-Term Strategy. In order to complement the 6LTP with a Long-Term Strategy, the Secretariat has started activities to prepare a draft strategy. In following the recommendation by EC-LIV, i.e. [satellite operators could] provide support for specific projects, EUMETSAT has agreed to support the WMO Secretariat in the development of a draft Long-Term Strategy under the overall direction of the WMO Satellite Activities Office. A consultant, Dr Roy Gibson (former Director-General of the European Space Agency) is currently assisting in the development of a draft WMO Space Programme Long-Term Strategy and this support by EUMETSAT is greatly appreciated.

17. It is anticipated that a first draft of the WMO Space Programme Long-Term Strategy will be submitted by the WMO Secretary-General for review at the next session of the Consultative Meetings on High-Level Policy on Satellite Matters tentatively scheduled for 3-4 February 2003 in Geneva, Switzerland. After completion of the Long-Term Strategy, an associated Implementation Plan will be prepared. The focus of both the Long-Term Strategy and Implementation Plan will be the involvement of the space agencies in a coordinated fashion with WMO's 6LTP and Programme and Budget 2004-2007.

WMO SPACE PROGRAMME (preliminary draft)

1. Objectives - Provide a strategic vision for WMO

Purpose and scope

To facilitate the development, operation and enhancement of the space-based components of the Global Observing System (GOS), Global Atmospheric Watch (GAW), Global Climate Observing System (GCOS) and the World Hydrological Cycle Observing System (WHYCOS).

Implementation of the enhanced space-based components of the GOS, GAW, GCOS and WHYCOS is through application of the concept that each Member country and appropriate international organization undertakes, according to its means, to meet certain responsibilities in the agreed globally cooperative scheme. The Programme's main functions are planning, organization and coordination of the facilities and arrangements at the global and regional levels, the design of observing networks, the standardization of observing and measuring techniques, the development and use of common communications and data management procedures, and the presentation of observations and processed information in a manner that is understood by all, regardless of language, and supporting activities that assist national Meteorological and Hydrological Services to fully participate in and obtain maximum benefits from the Programme.

2. Opportunities

In addition to the continuation of the meteorological satellite systems, the following R&D missions have the potential to make major contributions to the space-based components of the GOS, GAW, GCOS and WHYCOS:

- Global Precipitation Mission (GPM),
- Global Climate Observation Mission (GCOM),
- EOS series,
- ENVISAT,
- Jason series.

3. Interactions

The WMO Space Programme (WSP) interacts with the internal constituent body structures contained in the appropriate technical commissions, i.e., (CBS, CAS, CHy, CCI, CIMO, CAgM, CAeM and JCOMM and the WMO Executive Council's Consultative Meetings on High-Level Policy on Satellite Matters (CM). It also interacts with WMO supported programmes, i.e., WCRP and GOOS. Externally, the WMO Space Programme interacts with the Coordination Group for Meteorological Satellites (CGMS), the Committee on Earth Observation Satellites (CEOS), the Integrated Global Observing Strategy (IGOS), the Space Frequency Coordination Group (SFCG) and the International Precipitation Working Group (IPWG).

4. Structure

The WMO Space Programme functions on global, regional and national levels. It involves the design, implementation and further development of the operational meteorological and R&D satellites comprising the space-based components of the GOS, GAW, GCOS and WHYCOS into an integrated global system of environmental satellites. The integrated global system of environmental satellites, consisting of facilities and arrangements for making observations at stations on land and at sea, and from aircraft, meteorological and Research and Development satellites and other platforms. The space based components of the GOS, GAW, GCOS and WHYCOS consist of:

- (a) Operational satellites
 - Geostationary
 - Polar orbiting
- (b) Research and Development satellites

6. Education and Training

The WMO Space Programme is responsible for Education and Training in the use and applications of satellite data, product and services from both operational meteorological and R&D satellites.

7. Frequency allocations

The WMO Space Programme is responsible for protecting and managing radio-frequencies for meteorological activities for both operational meteorological and R&D satellites by pursuing WMO's requirements for stable, long-term allocations of suitable radio-frequency bands for its specific needs in close coordination with the related activities of ITU and with Members.

8. Codes & data formats

9. Communications

- Direct broadcast
- Alternative delivery means

10. Data collection

11. Ground segment

- (Operational and R&D)

12. WMO Supported Programmes

- World Weather Watch
- JCOMM
- WCP
- GCOS
- WCRP
- AREP
- Hydrology and Water Resources Programme
- Education and Training Programme
- Technical Cooperation Programme

Review of WMO Satellite Activities

Background

The second session of the Consultative Meetings on High-Level Policy on Satellite Matters (CM-2) discussed the need for enhanced coordination within WMO Satellite Activities. CM-2 agreed that there was a pressing need to strengthen coordination especially in light of the recent expansion to include R&D environmental satellite missions as part of the space-based component of the GOS. While it would be a decision of the Coordination Group for Meteorological Satellites (CGMS) whether it expanded its remit, it appeared that such an expansion would be timely and opportune and would likely be supported by CGMS members. CM-2 thus concentrated on the WMO interface with external coordination mechanisms. In doing so, it was convinced that it would be very advantageous for the environmental satellite agencies to have an effective and identifiable interface with WMO through a strong WMO Satellite Activities Programme.

Thus, CM-2 suggested that WMO conduct a review of its internal coordination of Satellite Activities to ensure that it was optimum for the present and perceived future needs as well as providing an appropriate framework for efficient interaction both internally within WMO as well as with external coordination mechanisms such as the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS). The review should take into consideration the emphasis that WMO placed on the contribution environmental satellite systems were making to WMO and its supported programmes and the large expenditures by those space agencies contributing to the space-based component of the WMO GOS.

Review

The WMO Satellite Activities Programme has seen tremendous growth during the last decade of the Twentieth Century. There were many factors contributing to this growth both internally and externally. The space-based component of the Global Observing System has increased in terms of the number of operational space agencies with the addition of the People's Republic of China, the number of operational geostationary satellites with the addition of the FY-2 series and the GOMS series and the number of ground receiving stations operated by WMO Members (around 600 stations in 1990 to now over 1400 stations). Associated with the new satellite missions have been new dissemination methods and formats such as the Meteorological Data Dissemination (MDD) followed by Advanced TOVS and now with the Low Rate Information Transmission (LRIT) on geostationary satellites.

In responding to the increased capacity and capabilities for the space segment, WMO Satellite Activities facilitated the development of the WMO Strategy for Education and Training in Satellite Matters. The training strategy has had a remarkable impact in the ability of WMO Members to exploit satellite data, product and services and has recently been expanded through the implementation of the Virtual Laboratory for Education and Training in Satellite Matters (VL). VL links together six specialized "centres of excellence" to provide continuous education and training. In order to ensure the efficient and effective operation of the VL, WMO facilitated the establishment of the VL Focus Group cosponsored with CGMS and on which it serves. Based on the success of the training strategy, a new Strategy to Improve Satellite System Utilization has also been facilitated by WMO Satellite Activities. The utilization strategy addresses all aspects of the complete utilization of satellite systems.

In order to influence decisions important to meteorological satellite systems, WMO has either joined or facilitated the establishment of several special interests groups including the Space Frequency Co-ordination Group, the International Winds Workshops, the International TOVS Working Group and the new International Precipitation Working Group.

The WMO mechanism for addressing satellite matters was initially the responsibility of the Executive Panel of Experts on Satellites. The Panel evolved into the CBS Working Group on Satellites which, due to the work structure adopted by CBS in 1998, became the remit of two Expert Teams, Observational Data Requirements and Redesign of the GOS, and Satellite System Utilization and Products. Due to the encouragement by the CGMS satellite operators, WMO has also established the Executive Council Consultative Meetings on High-Level Policy on Satellite Matters. Thus the initial WMO structure for policy level discussions has been re-established at the Executive Council level as well as a structure for technical discussions at the Technical Commission level. Within WMO Programmes and WMO co-sponsored Programmes, notably GCOS, GAW, HWR, WCP and WCRP, many satellite rapporteurs and groups have been established to provide assistance to WMO as well as to the satellite agencies.

As can be seen above, WMO Satellite Activities has already increased in responsibilities and the potential for continued growth in each of the above areas is large. New organizations have indicated interest in becoming a meteorological satellite agency. There will be four satellite agencies with operational polar orbit meteorological satellites (NOAA/NESDIS, EUMETSAT, People's Republic of China and the Russian Federation). The new satellite systems will utilize different direct broadcast services (e.g. AHRPT), different frequencies (S and X band) and different formats including alternative data dissemination methods implying increased complexity and costs for ground receiving stations. The Low Rate Picture Transmission (LRPT) service from polar orbiting satellites will become operational in the second half of this decade.

The recent agreement by the fifty-third session of the Executive Council to expand the space-based component of the GOS to include appropriate Research and Development (R&D) environmental satellite missions was a landmark decision. The inclusion of R&D environmental satellite systems into the space-based component of GOS would more than double the need for external coordination mechanisms as well as the responsibilities for the WMO Satellite Activities. Firstly, there will be unique coordination needs between WMO and R&D space agencies. Secondly, there will be coordination needs between operational and R&D space agencies in such areas as frequency coordination, orbit coordination, standardization of data formats, and standardization of user stations.

Each aspect described above that relates to the present operational meteorological satellite systems applies equally as well for the R&D environmental satellite missions. For example, WMO has already been formally informed that the European Space Agency's ENVISAT and all present and relevant future NASA missions including TRMM, Terra, Aqua, GPM and NPP should be considered as part of the space-based component of the GOS. Additionally, NASDA and the Russian Space Agency made similar declarations at CM-2.

Satellite mission coordination is paramount for many aspects including equator crossing times, frequency broadcasts and data formats. The number of frequency allocations to be protected within the ITU context will be greatly increased as well as the need for increased coordination with WMO. WMO will need to be involved in the early stages of the development of appropriate codes for R&D instruments as their data will be widely used by many WMO programmes as well as potentially transition onto operational meteorological satellites. CGMS is considering an expansion of its membership to include appropriate R&D agencies. Ground receiving station operators for the new R&D environmental satellite missions will need the same interactions with WMO as the present meteorological stations. Appropriate education and training in order to be able to exploit new data streams from R&D environmental satellite missions will double the present demand while there are expectations that the R&D agency would bear some of the financial responsibilities. The R&D environmental satellite agencies will benefit from demonstrations of the operational utility of their data by WMO Members.

In order to fully exploit the R&D data, WMO Members will require access as well as appropriate tools and how to utilize them. At its fifty-third session, the Executive Council identified the need for regional workshops to establish a dialogue between R&D space agencies and WMO Members as

to the means to access and exploit R&D data especially in developing countries. For example, advances and enhancements for follow-on phases for the Preparation for the Use of MSG in Africa (PUMA) project will depend on R&D mission experiences such as Global Precipitation Measurement (GPM) Mission.

From a WMO perspective, it must be involved in the evaluation of the utility of R&D data in terms of which should transition onto operational meteorological satellite systems. At its fifty-third session, the Executive Council noted the need to identify those R&D instruments that were of potential operational utility such that they should transition to operational satellites and thus provide for continuity of data not expected from R&D data. Identification of such instruments would be accomplished through regional workshops whose purpose would be to provide the basis for sufficient justification to enable the operational space agencies to obtain the necessary resources. The workshops would allow an evolution of the space-based component of the Global Observing System that would help characterize the total Earth and climate system on a variety of time and space scales and would also provide for the effective transition of research to operational platforms based on the progression of scientific understanding and maturity of required technologies.

Since many of the R&D instruments will be of great interest to applications in WMO programmes beyond traditional weather forecasting, e.g. atmospheric chemistry, hydrology, climate change, land use, agrometeorology, oceanography, etc., there will be a need for increased coordination and interactions with relevant WMO bodies such as technical commissions, science steering committees, working groups and panels, etc.

Taking into account that the present WMO Satellite Activities programme only addresses the above aspects in the context of operational meteorological satellites, it is essential to develop a comprehensive WMO Space Programme with expanded emphasis on all WMO scientific and technical programme activities.