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This report contains the text as adopted by Plenary and has been issued without formal editing.

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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE SESSION *(agenda item 1)*

1.1 The fourteenth session of the Commission for Instruments and Methods of Observations (CIMO) was held at the WMO Headquarters in Geneva, Switzerland, from 7 to 14 December 2006. The session was opened at 10 a.m. on 7 December 2006 by the acting president of the Commission, Mr R.P. Canterford.

1.2 The Secretary-General of WMO, Mr M.J. Jarraud, welcomed the participants of the session on behalf of the Organization. He expressed his appreciation to the acting president of CIMO, Mr Ray Canterford, for his leadership of the Commission; to Mr John Nash, vice-president of the Commission, as well as to the chairpersons and members of the CIMO Management Group, and all the experts and instrument manufacturers who had contributed to the outstanding work accomplished since the thirteenth session of CIMO.

1.3 Mr Jarraud reviewed some of the work achieved by the Commission aimed at ensuring accuracy, worldwide data compatibility and long-term stability of the WMO Integrated Observing System. He mentioned that the WMO Executive Council, reiterated the importance of CIMO as a cornerstone of WMO and he noted the essential role of the Instruments and Methods of Observation Programme for addressing a number of important tasks that are critical to the other technical commissions and to WMO's crosscutting programmes. He was pleased to note that the Commission's programme activities and deliverables had increased significantly on account of the new flexible working structure based on Open Programme Area Groups and their expert teams and that it was responsive to the needs of WMO's Members and user community. He stressed the need for strong interaction with the regional associations and encouraged an increased participation of experts from developing countries.

1.4 Mr Jarraud mentioned the significant improvement in the quality, reliability and compatibility of instruments, particularly with respect to radiosondes, rain gauges and pyrheliometers, which had been achieved through calibrations and effective intercomparisons. These activities, as well as the provision of technical assistance and training to developing countries contributed substantially to improving the homogeneity and compatibility of measurements, as well as the quality and availability of observational data. He emphasized that, training continued to be important for ensuring the uninterrupted operation of instruments, generation of quality data and for assuring traceability of measurements to international standards. He was pleased that the Commission had embarked upon vigorous training in upper-air observations, metrology and calibration issues and that significant advances had been made in terms of capacity building and training in the fields of instruments and methods of observation.

1.5 He pointed to individual topics that he believed worthy of special attention for the Commission. The forthcoming session of Congress would have to decide how to further develop the WMO Quality Management Framework. The Secretary-General encouraged the session to provide any relevant information to Congress, to develop procedures and to review the CIMO Guide, as necessary. Another topic of importance is to guarantee data quality, including worldwide compatibility and homogeneity, through the traceability of all measurements to the standards of the International System of Units (SI). In this context, he invited the Commission to consider developing a harmonized policy on traceability for WMO Members, through which each one would be able to demonstrate that calibration of basic meteorological instruments, and hence the measurement results generated thereby, are indeed traceable to the relevant SI standards. He encouraged the Commission to contribute to strengthening the capacities of the NMHSs, at a regional level, in the area of instruments and methods of observation, especially for developing countries, like for example by helping Regional Instrument and Regional Radiation Centres in building their own calibration laboratories and in implementing their own quality management system. Finally, he emphasized the importance of linking the plans of the Commission to the WMO Strategic Plan.

1.6 Mr Jarraud expressed his great appreciation that CIMO had been very proactive in fostering collaboration with other technical commissions, the relevant international organizations and the private instrument sector, in order to promote increased standardization and compatibility in instruments and methods of observation. He noted the considerable progress that had been made in enhancing WMO's collaboration with a number of international organizations during the intersessional period.

1.7 Mr Jarraud assured the Commission of his personal support to its work and expressed his confidence that the session would be conducted in the traditional spirit of cooperation and mutual understanding that had always been the hallmark of WMO and its constituent body sessions.

1.8 There were 109 participants at the session. These included representatives of 50 Members of WMO and of 4 international organizations. A complete list of participants attending the session is given in the Appendix to the present report.

2. ORGANIZATION OF THE SESSION *(agenda item 2)*

2.1 CONSIDERATION OF THE REPORT ON CREDENTIALS *(agenda item 2.1)*

The Commission received the report on credentials of the representative of the Secretary-General taking into account the documents received prior and during the session. The Commission unanimously accepted the report. In accordance with General Regulation 22, the Commission decided that it would not be necessary to establish a Credentials Committee.

2.2 ADOPTION OF THE AGENDA *(agenda item 2.2)*

The provisional agenda was adopted by the session.

2.3 ESTABLISHMENT OF COMMITTEES *(agenda item 2.3)*

2.3.1 In accordance with Regulation 24 of the WMO General Regulations, the Commission made the following decisions:

Nomination Committee

2.3.2 A Nomination Committee was established consisting of the Principal Delegates of Egypt, China, Argentina, Malaysia and Latvia. The Principal Delegate of China was requested to serve as Chairperson.

Working Committee and Working Method

2.3.3 In accordance with the positive experience made by other WMO constituent body meetings, the Commission agreed to conduct its business in plenary meetings only. No working committee was established. All plenaries would be chaired by members of the CIMO Management Group. The General Plenary would be chaired by the president, Mr R.P. Canterford and by the vice-president, Mr J. Nash, for the consideration of items 1 to 3 and 8 to 14. Plenary A would be chaired by Mr J. van der Meulen and Mr K.H. Klapheck and would consider the items 4 and 5. Plenary B would be chaired by Mr R. Dombrowsky and Mr H. Zhou and would consider the items 6 and 7.

Drafting Committee

2.3.4 It was decided that the session would not establish a Drafting Committee for the whole session, but that an ad-hoc Drafting Committee could be established for special items, as required.

Coordination Committee

2.3.5 As stipulated by General Regulations 24 and 28, a Coordination Committee was set up to ensure proper coordination of the session and would comprise the president of CIMO, the co-chairs of all the plenaries and the representatives of the Secretary-General.

2.3.6 The session agreed to extend the Terms of Reference of the Coordination Committee to conduct the selection of the chairpersons and rapporteurs of the OPAG teams and CIMO coordinators.

2.4 OTHER ORGANIZATIONAL MATTERS *(agenda item 2.4)*

2.4.1 The session agreed upon the working hours.

2.4.2 It was agreed that summarized minutes of the plenary meetings would not need to be prepared, unless specially required for a particular item.

2.4.3 The session was informed on the document approval procedure.

2.4.4 Mr R. Naili (Algeria) was appointed Rapporteur on Previous Recommendations of the Commission (agenda item 11).

3. REPORT BY THE PRESIDENT OF THE COMMISSION *(agenda item 3)*

3.1 The Commission noted with appreciation the report presented by Mr R.P. Canterford (Australia), the acting president of CIMO, on the Commission's activities since the thirteenth session of the Commission for Instruments and Methods of Observation.

3.2 At the thirteenth session, Mr S.K. Srivastava (India) and Mr R.P Canterford (Australia) were elected president and vice-president of the Commission respectively. Shortly after that session, Mr Srivastava resigned as president, and at the request of the Secretary-General, in accordance with the WMO Regulations, Mr Canterford agreed to undertake the position of acting president. Mr J. Nash (United Kingdom) was subsequently elected, by correspondence, as the vice-president.

3.3 The Commission expressed its appreciation for the unprecedented amount of the work done in the intersessional period and thanked the acting president, the vice-president, the co-chairpersons of the OPAGs, members of the expert team and those that provided considerable expertise in undertaking the intercomparison of instruments. The Commission also thanked those Members that hosted meetings and experiments.

3.4 The Commission welcomed the actions taken by the acting president that contributed to the progress of the Commission since its thirteenth session, in particular covering the work of subsidiary bodies of CIMO. The Commission invited its president to pursue his efforts regarding coordination of CIMO activities with the Commission as well as with other Technical Commissions. The Commission expressed support to the president in his efforts to arrange for the Commission to further address issues of utmost importance to the Commission, WMO and NMHSs.

3.5 The other issues raised in the report requiring actions and decisions were dealt with under the relevant agenda items.

4. INSTRUMENTS AND METHODS OF OBSERVATION FOR SURFACE MEASUREMENTS *(agenda item 4)*

4.1 SURFACE TECHNOLOGY AND MEASUREMENT TECHNIQUES *(agenda item 4.1)*

4.1.1 The Commission thanked Mr Jitze P. van der Meulen (Netherlands), the co-chairperson of the OPAG-SURFACE and the chairperson of the Expert Team on Surface Technology and Measurement Techniques (ET-ST&MT) for his report.

4.1.2 The Commission noted the concern of the climate community with a fast deployment of automatic weather observing systems and requested the OPAG-SURFACE, in cooperation with CCl, CBS, and GCOS to update the guidelines and procedures for the transition from manned to automatic weather stations.

4.1.3 In the area of developing standards for automation of visual and subjective observation, the Commission noted that due to the multi-sensor use and the wide variety of applied algorithms, defining one single standard methodology was not feasible at this time. This statement holds especially for those subjective observations, not derived from primary measurements but based on estimations and where performance optimization is achieved by tuning parameters based on local climate.

4.1.4 The Commission noted that useful progress had been made in the automation of visual observations, and recognized that the CIMO Guide Edition 7 advised on the automation of visual observations. It was expected that digital cameras and image recognition technology would continue to be used for cloud cover observation. It was recognized that the TDCFs provided an opportunity to report more effectively on cloud types and weather observations. In addition, changes in the cloud observation method, particularly for low and high clouds, may be facilitated by integration of satellite and radar data into the observation.

4.1.5 The Commission noted that current ground temperature observing methods were largely affected by radiation, resulting in measurement errors. It was suggested that the relevant ET should study this issue of exposure of sensors. As well, remote infrared sensing technology could be introduced to solve the problems of surface observations.

4.1.6 The Commission noted that ultrasonic wind measurement was increasingly being put into operation. It was suggested that a uniform calculation procedure should be adopted for averaging the wind vector, measured by such sensors. It was expected that the measurement range and stability of ultrasonic wind measuring instruments could be improved to encompass strong winds and to be applied under harsh environments such as freezing temperatures, fog and corrosion by salt atmospheres.

4.1.7 The Commission noted that implementation of standards for individual input parameters and algorithm processing is more likely if manufacturers would consider publishing their algorithms. However, the Commission welcomed the alternative to publishing algorithms that would use tables or matrices to define the relationship between input sensor data elements and output data elements. The Commission requested the Hydro-Meteorological Equipment Industry Association (HMEI) to assist the OPAG-SURFACE in development of matrices.

4.1.8 To guarantee compatibility of different operational automated systems for visual and subjective observations, the Commission requested Members to ensure that those instruments should be calibrated against “standard” instruments that have smaller uncertainties and are traceable to international standards.

4.1.9 The Commission noted that the ET-ST&MT had developed a table of subjective observations containing a detailed overview of specific observational types and the technologies to automate these measurements and requested the OPAG-SURFACE to make it available through the CIMO Web Portal and to facilitate its insertion into a next update of the WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8) (CIMO Guide).

4.1.10 The Commission noted the lack of standardization practices for measurements in cold climates and mountain regions, especially in icing conditions. It recognized that instrument performance suitable for this harsh environment is not related to icing condition and that instrument design does not take into account differences between meteorological and instrumental icing. The Commission requested the OPAG-SURFACE to address this issue and specify relevant practices in the CIMO Guide, and adopted Recommendation 1 (CIMO-XIV) — Measurements in severe icing conditions.

4.1.11 The Commission noted difficulties of most of the instruments to provide reliable information in harsh climate conditions. It requested the OPAG-SURFACE to provide recommendations to manufacturers on performance standards for instruments deployed to harsh climate and collaborate with manufacturers in developing instruments that can withstand extreme conditions that accompany events such as hurricanes and can provide quality data. The Commission recognized the need for collaboration with HMEI, so that instruments provided by manufacturers for measurement in harsh environments become more reliable and conform both to the requirements recommended by CIMO, and to the specifications stated by the manufacturers.

4.1.12 The Commission was informed of the roles of the CIMO Instrument Development Inquiry (IDI), the World Meteorological Instrument Catalogue (WMIC) and the HMEI Product Catalogue (HMEI-PC) and agreed that the IDI should not contain information on instruments already contained within the WMIC or HMEI-PC. The Commission noted the valuable contribution of the Chinese Meteorological Administration in supporting the joint CMA-CIMO WMIC. It also noted the uniqueness of this catalogue and expressed appreciation for the CMA offer to continue the WMIC. The Commission also noted that EC-LVIII requested HMEI to work with CIMO to develop further their HMEI-PC, a product catalogue of HMEI members. This catalogue of members' products is updated regularly on the HMEI Website. The Commission appreciated the fact that both catalogues provide uniform and comparable information in line with Annex 1 (CIMO-XII).

4.1.13 The Commission noted the lists of basic metadata elements required for the operational, near-real time and non-real time purposes, prepared in collaboration with CBS, and requested the OPAG-SURFACE to facilitate its inclusion into the next edition of the CIMO Guide. The Commission agreed that basic metadata should to be available together with the observational data.

4.1.14 The Commission agreed that there is a need for a standardized classification scheme of meteorological stations, taking into account the standards for siting and exposure of meteorological instruments, and requested the OPAG-SURFACE to initiate action for the development and approval of the appropriate classification for the inclusion in the CIMO Guide.

4.1.15 The Commission noted the need to use the TDCFs for reporting from surface networks, in particular from AWS networks, in accordance with the WMO Migration Plan to table-driven code forms.

4.1.16 The Commission noted the extensive use of mercury-based instruments in the national networks and recognized the threat those instruments pose to the environment. It also recognized the difficulties in transporting the mercurial barometers to centralized laboratories for calibration, in some cases across the national boundaries. The Commission requested the OPAG-SURFACE, in collaboration with other technical commissions and the Hydro-Meteorological Equipment Industry Association (HMEI) to collect and update the guidelines for the safe handling and disposal of mercury based instruments. It also noted that information on replacement instrument options could be found in the CIMO Guide.

4.1.17 The Commission recognized the usefulness of having a recommendation on design and layout of AWS. It was advised that OPAG-SURFACE should develop general guidelines to be published in the CIMO Guide.

4.2 SURFACE-BASED INSTRUMENT INTERCOMPARISONS AND CCALIBRATION METHODS *(agenda item 4.2)*

4.2.1 The Commission thanked Mr Jitze van der Meulen (Netherlands), the co-chairperson of the OPAG-SURFACE, and Mr Michel Leroy (France), the chairperson of the Expert Team on Surface-Based Instrument Intercomparisons and Calibration Methods (ET-SBII&CM) for the report. It noted with satisfaction the progress and achievements made in this area and thanked the many experts who had served in the ET-SBII&CM.

4.2.2 The Commission also acknowledged and expressed its thanks to Mr Michel Leroy, the chairperson of the International Organizing Committee on Surface-Based Instrument Intercomparisons (IOC-SBII), and Professor Luca Lanza (Italy) for supervising the WMO Laboratory Intercomparison of Rainfall Intensity (RI) Gauges, De Bilt (Netherlands), Genova (Italy), Trappes (France), 15 September 2004–15 September 2005, and for the excellent and timely report of the intercomparison. The Commission expressed its thanks to Météo-France, the NMS of Italy (and DIAM at the University of Genova acting on its behalf) and to the Royal Netherlands Meteorological Institute for hosting the intercomparison in their laboratories and for the extensive and continuous support in this and other intercomparisons.

4.2.3 The Commission agreed that the Laboratory Intercomparison of RI Gauges provided results that would have wide implications on the operation of the GOS as regards the calibration and operational use of the RI gauges. It agreed that a standardized procedure for RI calibrations was required to obtain uniformly calibrated RI instruments able to provide compatible measurements and adopted Recommendation 2 (CIMO-XIV) — Standardized procedure for laboratory calibration of catchment type rainfall intensity gauges. The Commission also agreed that such calibrations should be used to support a correction method, either by mechanical means or in software.

4.2.4 The Commission also agreed that a well-defined and accepted reference instrument and procedures are needed for the field intercomparisons. It agreed that such a reference might be based on a set of high quality devices applying different measuring techniques. Taking into account the results of the WMO Laboratory Intercomparison, the Commission adopted Recommendation 3 (CIMO-XIV) — Procedure and reference instruments for field rainfall intensity intercomparisons, and invited other WMO Commissions, in particular CHy, to participate in this project.

4.2.5 The Commission underscored the importance of the follow up to the laboratory intercomparison and welcomed the progress to date in the organization of the WMO Field Intercomparison on RI Instruments that, at the kind invitation of Italy, would be held in the Italian Meteorological Service Centre of Meteorological Experimentation (ReSMA), Vigna di Valle, Italy, and currently planned from August 2007 to August 2008. The Commission recognized that this intercomparison would supply valuable information on high RI measurements, useful for forthcoming studies on RI in tropical regions.

4.2.6 The Commission appreciated that, at the kind invitation of Algeria, the WMO Combined Intercomparison of Thermometer Screens/Shields in conjunction with Humidity Measuring Instruments would be held in Ghardaïa, Algeria, and currently planned from January 2007 to January 2008. It agreed that the organization of the intercomparison in Ghardaïa, in desert conditions, would allow the testing of the performance of the instruments in a dry, hot and dusty environment, and noted with appreciation that Canada proposed hosting a follow-up intercomparison in the arctic environment at Iqaluit, on Baffin Island, Canada.

4.2.7 The Commission, recognizing the significance of IPY, agreed that an assessment of solid precipitation measurement methodologies at automated stations, including snowfall and snow depth, and made in consultation with CHy and other interested parties, should be undertaken, which might lead to an intercomparison of the measurement technology.

4.2.8 The Commission agreed that the above intercomparisons would be costly, and would require significant modifications of the testing grounds by the host countries, more time of the local support staff as well as the project teams, and greater planning by the ET/IOC-SBII. Therefore, the Commission requested the Secretary-General to organize meetings of the ET/IOC-SBII in Vigna di Valle (Italy) and in Ghardaïa (Algeria) in the first quarter of 2007 to guarantee smooth implementation of the WMO Intercomparisons of Rainfall Intensity Instruments and the WMO Combined Screen/Shield and Humidity Measuring Instruments, respectively. The Commission also requested the Secretary-General to call upon the services of a consultant for the management of Vigna di Valle intercomparison data and for supervising the intercomparison results.

4.2.9 The Commission noted that due to rapid technological development, many manufacturers are producing instruments that use new technology or techniques for measurements of the same variables with a negative impact on the data compatibility worldwide. It underlined the importance of intercomparisons to recognize data inhomogeneities and make instruments more compatible. The Commission requested the Secretary-General to provide support to the organization of the instrument intercomparisons and make provision for this purpose in the regular budget.

4.2.10 The Commission supported the view of EC-LVIII that intercomparisons should be held in various climatic regions, and especially in the tropics. However, the Commission noted that finding sites suitable for intercomparisons is difficult and encouraged Members to be cooperative on this matter. The Commission identified the role of the WMO Regional Instrument Centres and the need for them to be more involved in organization and hosting intercomparisons, and through such involvement strengthen their capabilities.

4.2.11 The Commission noted the importance of observations for climate change studies. Taking account of the need for more representative and typical characteristics of climate observations as well as their requirements for instruments and methods of observation, the Commission requested that further work should be done in the intercomparisons of observation instruments for climate, and for research on climate observation methods.

4.2.12 The Commission supported the proposal of Australia to undertake a Pilot Intercomparison of sea level and tsunami monitoring instruments, noting that EC-LVIII requested CIMO to examine this issue as it relates directly to the Climate and Natural Disaster Prevention and Mitigation Programme (DPM) of WMO. The Commission noted with appreciation that Australia offered to undertake this work within the work plan of the CIMO OPAG-Surface Expert Team on Surface-based Instrument Intercomparisons and Calibration Methods.

4.2.13 The Commission, noting the wish of EC-LVIII for studies of stream-flow instrumentation, and the need for a response to DPM agreed on the need for intercomparisons of hydrological gauges to cover both normal and extreme events.

4.2.14 The Commission recognized the important role of the Hydro-Meteorological Equipment Industry Association (HMEI) in the organization of the WMO instrument intercomparisons and expressed its appreciation for the support provided so far for the intercomparisons. It also recognized that benefits are shared equally between HMEI and WMO Members and requested HMEI to continue providing technical and financial assistance for future WMO intercomparisons.

4.2.15 The Commission noted the significant move towards automation of the visual and subjective observations worldwide. It also noted that new techniques had been applied in the development of Present Weather Sensor (PWS) and in characterization of Present Weather since the last intercomparison (1993–1995) and agreed on the need to organize a WMO Intercomparison of PWS, in particular in a tropical environment.

4.2.16 The Commission took note of the *Implementation Plan for the GOS for Climate in support of the UNFCCC* (WMO/TD-No. 1219) and requested the OPAG-SURFACE to provide results of surface-based intercomparisons of instruments for climate observations to International Data Centres.

4.2.17 The Commission, recognizing the needs for further instrument intercomparisons and evaluation tests, agreed on the provisional programme of future WMO surface-based intercomparisons as contained in Annex I to the present report.

4.3 METEOROLOGICAL RADIATION AND ATMOSPHERIC COMPOSITION MEASUREMENTS *(agenda item 4.3)*

4.3.1 The Commission thanked Mr Karl-Heinz Klapheck (Germany), the co-chairperson of the OPAG-SURFACE, and Mr Klaus Behrens (Germany), the chairperson of the Expert Team on Meteorological Radiation and Atmospheric Composition Measurements (ET-MR&ACM) for the report. It noted with satisfaction the progress and achievements made in this area and thanked to the experts who had served in the ET-MR&ACM.

4.3.2 The Commission also acknowledged and expressed its thanks to Mr Bruce Forgan, the chairperson of an Ad-Hoc Group of Experts in Radiometry established to oversee the procedures of the Tenth International Pyrheliometer Comparison (IPC-X), and Mr Wolfgang Finsterle, the IPC-X Project leader, for supervising the IPC-X and conjointly organized Regional Pyrheliometer Comparisons (RPCs) held in Davos, Switzerland, 26 September–14 October 2005, and for the excellent and timely report of the intercomparison. The Commission expressed its thanks to MétéoSuisse and to the Physikalisches Meteorologisches Observatorium Davos (PMOD)/World Radiation Centre (WRC) for hosting the intercomparison and for the extensive and continuous support in this and other radiometer intercomparisons.

4.3.3 The Commission noted the successful outcome of the IPC-X in terms of number of compared instruments and training provided to participants from developing countries. It welcomed that all six members of the World Standard Group reference instruments were performing well within the long-term stability of 0.2% of the measured value as required by the WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8). Following the publication of the IPC-X Final Report, it confirmed that the new World Radiation Reference (WRR) factors could be applied to participating pyrheliometers worldwide. The Commission acknowledged that the main objective of the IPC-X, the dissemination of the World Radiometric Reference (WRR) to ensure worldwide homogeneity of meteorological radiation measurements, was achieved and that the results of the IPC-X would have wide implications on the operation of the GOS.

4.3.4 The Commission recalled that the fifty-eighth session of the Executive Council had requested CIMO to review the Terms of Reference (TOR) of the Regional Radiation Centres (RRCs) and to develop a mechanism for their continuous evaluation to ensure the quality of their services and to verify the traceability of the basic meteorological variables. In view of this request and with a concern raised by the OPAG-SURFACE that the non-attendance of some RRCs in IPCs would compromise traceability of irradiance measurements performed by these centres and their associated National Radiation Centres (NRCs), the Commission agreed to modify the TOR of the World, Regional and National Radiation Centres and adopted Recommendation 4 (CIMO-XIV).

4.3.5 The Commission recognized that a successful determination of the radiation budget, which was fundamental to understanding the Earth's climatic system, climate variability and climate change, was only possible with very homogeneous solar radiation data measured all over the world. The way to guarantee a desired level of quality of radiation data is to assure the traceability of solar radiation measurements to the WRR. This is achieved through the IPCs done in 5 years cycles and RPCs that should be organized in all WMO Regions in the period from six months to 4 years following the completion of an IPC.

4.3.6 The Commission noted that out of 22 RRCs, 11 are from developing countries and need support towards the participation in the IPCs. The Commission requested the Secretary-General to assist, as far as possible, in the participation of RRCs from developing countries in IPCs as well as in the participation of the NRCs in the RPCs.

4.3.7 The Commission requested the Management Group to strengthen further the collaboration with other technical commissions (in particular CAS on GAW issues) responsible for radiation measurements. In this regard, it endorsed the proposal of the OPAG-SURFACE that a member of the ET-MR&ACM be invited as an observer to the CAS SAG UV for the purpose of establishing ties between scientific research and network observations of UV radiation.

4.3.8 The Commission noted the acceptance of a recommendation given to the fifty-eighth session of the Executive Council for the establishment of a Scientific Advisory Group for Radiation of the OPAG-EPAC (Environmental Pollution and Atmospheric Chemistry) under the Commission for Atmospheric Sciences. The Commission requested the Management Group to ensure appropriate linkages be established between the present OPAG-SURFACE ET-MR&ACM and the CAS SAG on Radiation to ensure close collaboration between the two groups while eliminating overlap.

4.3.9 Noting the need to insure global comparability of UV observations, the Commission urged Members to establish much needed calibration centres for UV. The Commission recommended that intercomparison of calibration methodologies at existing Calibration Centres be conducted and adopted Recommendation 5 (CIMO-XIV).

4.3.10 The Commission noted that UV radiation observations were often not a mandate of NMHSs. It suggested that efforts be undertaken to encourage collaboration between NMHSs and organizations mandated to observe UV radiation in Member countries.

4.3.11 The Commission recognized the need for establishing a primary reference Aerosol Optical Depth Centre to satisfy the need for traceability of Optical Depth (OD) measurements, conducting international intercomparisons guaranteeing data quality needed in climate studies. It recommended that the World Optical Depth Research and Calibration Centre (WORCC) at PMOD/WRC Davos be designated the primary WMO Reference Centre for OD measurements as part of the World Radiation Centre (WRC) activities and adopted Recommendation 6 (CIMO-XIV).

4.3.12 The Commission agreed that the increasing number of “World Calibration Centres” at PMOD, i.e. WRC, WIRC (World Infrared Radiometer Calibration Centre) and WORCC, introduced an unnecessary number of centres and acronyms and is potentially confusing to the meteorological community. The Commission was of the opinion that the specialized task areas resident at PMOD should be called sections of the WRC, with these areas being identified by the wavelength range of interest. The Commission recommended that the calibration centres designated by the Executive Council - the WRC and the World Infrared Radiation Centre (WIRC) at PMOD Davos be referred to as sections of the WRC, and be renamed and identified as the WRC Solar Radiometry Section (WRC-SRS) and the WRC Infrared Radiometry Section (WRC-IRS).

4.3.13 The Commission noted that following Recommendation 1 (CIMO-XIII) “Establishment of a World Infrared Radiometer Calibration Centre”, the PMOD/WRC had established in January 2004, within the WRC, the Infrared Radiometry Section (WRC-IRS). It recognized that the WRC-IRS was crucial to worldwide quality and compatibility of infrared data and that there remained a need to develop additional infrastructure and to establish operational procedures for the WRC-IRS. The Commission noted the results of the evaluation of the WRC-IRS and adopted Recommendation 7 (CIMO-XIV).

4.3.14 The Commission, recognizing the needs for further instrument intercomparisons of radiation instruments, agreed on the provisional programme of future WMO International and Regional Pyrheliometer Intercomparisons as contained in Annex II to the present report.

5. INSTRUMENTS AND METHODS OF OBSERVATION FOR UPPER-AIR MEASUREMENTS AND REMOTE SENSING *(agenda item 5)*

5.1 UPGRADING THE GLOBAL RADIOSONDE NETWORK *(agenda item 5.1)*

5.1.1 The Commission thanked Mr Rainer Dombrowsky (USA), the co-chairperson of the OPAG-UPPER-AIR and the chairperson of the Expert Team on Upgrading the Global Radiosonde Network (ET-UGRN) for his report.

5.1.2 The Commission appreciated the work accomplished by the team and endorsed its role, with the other OPAG-UPPER-AIR expert teams, in working with CBS and GCOS towards a stable surface-based (in situ and airborne) Global Observing System. High priority should be given to a stable and fully functional GCOS Upper-Air Network (GUAN) coupled with further development of Aircraft Meteorological Data Relay (AMDAR). The Commission asked the ET-UGRN to assist GCOS in the review of the operational status of GUAN, assist in identifying requirements and provide recommendations for further improvement.

5.1.3 The Commission recognized the need for timely information to Members on the radiosonde compatibility measurements to allow Members to rectify the problems in a timely manner without compromising the quality of the GOS. In this regard, it thanked Mr Tim Oakley (UK) for his excellent support of global radiosonde activities through his preparation of annual reports on radiosonde compatibility measurements and requested the regional data processing centres to assist him in identifying the incompatibility problems. These reports provided traceability of radiosonde and station performance critical to identifying problem areas within the global upper-air network and are made available to Members through the CIMO/IMOP Website. The Commission requested CIMO members to regularly consult the Website for results of the radiosonde compatibility measurements.

5.1.4 The Commission recognized the importance of annual reports on the radiosonde compatibility measurements provided by Mr Oakley, Rapporteur on Radiosonde Compatibility, who had maintained a close relationship with CIMO members and HMEI through responding to inquiries relating to instrument and station performance. The Commission requested that the annual reports continue, as they are critical in identifying and resolving deficiencies in the GOS radiosonde network. The Commission also requested the Management Group to encourage other Members in identifying experts who could support this important work.

5.1.5 The Commission requested the OPAG-UPPER-AIR to examine AMDAR system capabilities and technologies to validate whether new onboard software and alternative AMDAR technologies can satisfy the requirements for performance and are compatible with other operational upper-air instruments and systems. Once interoperability of upper-air monitoring systems has been validated, the ET should develop guidelines for Members to begin the process of integrating data sets produced by a defined set of interoperable networks.

5.1.6 The Commission noted the need to examine, in coordination with the AMDAR Panel and CBS, the possibilities of integrating the AMDAR system including mixing ratio in the WWW as a potential operational observational network. The Commission also requested the OPAG-UPPER-AIR to examine the AMDAR system capabilities and technologies in detail, and specifically, an assessment of the performance of the recently introduced humidity sensor in a wide range of climatic conditions. In addition, an assessment of aircraft type specific measurement characteristics should be undertaken. Once this comprehensive assessment has been undertaken, the ET should develop suitable guidelines for the Members. The CIMO members should be regularly informed on the availability and use of AMDAR data.

5.1.7 The Commission, in response to the concerns expressed at EC-LVIII, June 2006, requested the ET to place a high priority on the need for preparing an updated set of safety guidelines for the operation of hydrogen generators used in support of upper-air operations. The Commission encouraged Members to examine safety information for hydrogen generation and use covered in the WMO *Guide to Meteorological Instruments and Methods of Observation*, Part II,

Chapter 10, and asked the ET-UGRN to consider whether updated information need to be included in the Guide. The Commission requested the OPAG-UPPER-AIR to advise Members on use of alternative gases such as Helium and natural gas and to include hydrogen safety operation in the future training workshops in collaboration with the HMEI.

5.1.8 As regards the impact of the forced need to replace certain radiosonde systems on the upper-air network, the Commission expressed its satisfaction with the steps that were taken toward avoiding a prolonged loss of upper-air data, especially in developing countries. The Commission also expressed its appreciation to donors, especially the UK Met Office and GCOS, for the assistance provided to a number of affected stations in upgrading/replacement of their current systems. It also thanked Mr Richard Smout (UK Met Office) for the technical assistance he had provided to Members in upgrading/replacement of their obsolete systems.

5.1.9 The Commission reiterated the importance of migration to Table Driven Code Forms and requested the OPAG-UPPER-AIR to continue interaction with the CBS in this migration process. It noted that uncertainty still exists on using BUFR for representation of the full upper-air data resolution rather then simple conversion of TEMP data into BUFR. The Commission recommends that the use of TEMP code for upper-air reports be discontinued as soon as possible and replaced by a BUFR code that allows the measurements to be reported at high vertical resolution. This is a response to the requirement from CBS, reflected in the CBS "Implementation Plan for Evolution of Space- and Surface-Based Sub Systems of the GOS", that radiosonde measurements be reported at high vertical resolution in future. The Commission requested CBS to address this issue as a matter of urgency.

5.1.10 The Commission recognized the potential of combining in-situ upper-air stations with the remote sensing instruments, in particular microwave temperature profilers and wind profilers in ensuring availability of additional data between the standard upper-air soundings.

5.1.11 The Commission appreciated that a limited survey was conducted on reducing the upper-air operational cost. It requested the OPAG-UPPER-AIR to publish the results and to promote research activity aiming at reducing the upper-air operational costs.

5.2 UPPER-AIR SYSTEM INTERCOMPARISONS *(agenda item 5.2)*

5.2.1 The Commission thanked Mr John Nash (United Kingdom), the co-chairperson of the OPAG-UPPER-AIR and the chairperson of the Expert Team on Upper-Air Systems Intercomparisons (ET-UASI) for his report. It noted with satisfaction the progress and achievements made in this area and thanked the many experts who had served in the ET-UASI.

5.2.2 The Commission also acknowledged and expressed its thanks to Mr John Nash, the chairperson of the International Organizing Committee on Upper-Air Systems Intercomparison (IOC-UASI), for supervising the WMO Intercomparison of High Quality Radiosonde Systems, Vacoas, Mauritius, 2–25 February 2005 and for the excellent and timely report of the intercomparison. The Commission expressed its thanks to the Mauritius Meteorological Services for hosting the intercomparison and to the UK Met Office for the extensive and continuous support in this and other intercomparisons.

5.2.3 The Commission agreed that the Mauritius Intercomparison was vital for the worldwide and regional homogeneity of upper-air measurements and greatly facilitated the improvement of upper-air data quality and availability. The Commission noted that the geometric and geopotential height values obtained from GPS proved to be of the same accuracy as those from pressure sensor measurements, leading to a reduction of the cost of radiosondes in the future and adopted Recommendation 8 (CIMO-XIV) – Use of GPS geometric height to derive pressure and geopotential height for operational radiosondes. The Commission also noted that a combination of high quality radiosondes was developed for referencing for GCOS purposes and adopted Recommendation 9 (CIMO-XIV) – Suitable temperature measurements for high quality reference upper-air stations.

5.2.4 The Commission noted that the radiosonde intercomparisons were becoming more costly, required more time, and required greater planning which required even more staff time. The Commission requested the ET/IOC-UASI to evaluate the current planning and implementation guidelines to determine how to improve these processes with the goal of conducting future intercomparisons in a timely and cost-effective fashion.

5.2.5 The acquisition, processing, analysis and archiving of intercomparison data were performed using WRSKOMP software supplied by Mr Sergey Kurnosenko, the Data Manager. The WRSKOMP software, already used in previous intercomparisons, proved to be satisfactory, thus, the Commission confirmed that this software should be used for the next WMO radiosonde intercomparisons as a reference.

5.2.6 Intercomparisons in heavy rain or frequent cloud conditions demonstrated that temperature sensors with hydrophobic coatings have smaller errors from water evaporation after emerging from wet conditions. The Commission recommended that radiosonde manufacturers pay attention to reducing the temperature errors caused by water evaporating from wet sensors upon emerging from clouds.

5.2.7 The Commission noted the valuable work done by ET-UASI in collaboration with other OPAG Upper-Air ETs in promoting the interoperability of upper-air systems aimed at reducing the operational cost of upper-air soundings. The Commission appreciated that guidance was provided to Members on “Interoperable Upper-Air Systems” and requested the OPAG-UPPER-AIR to collaborate with the Hydro-Meteorological Equipment Industry Association (HMEI) in further development of the interoperability. The Commission adopted Recommendation 10 (CIMO-XIV) – Usefulness of interoperable upper-air systems.

5.2.8 The Commission took note of the *Implementation Plan for the GOS for Climate in Support of the UNFCCC* (WMO/TD-No. 1219) and requested the OPAG-UPPER-AIR to provide results of radiosonde intercomparisons to International Data Centres and to provide advice and guidance to GCOS in its planning for the GCOS Reference Upper-Air Network.

5.2.9 The Commission recommended that future efforts be linked to developments of new radiosonde systems in China, India and the Russian Federation to the results from Mauritius intercomparison. The Commission agreed that this be performed by regional intercomparisons to be held in these countries against more than one of the high quality radiosonde systems intercompared in Mauritius. China expressed readiness in conducting the regional intercomparison and requested the Secretary-General to provide relevant technical and other support for the intercomparison.

5.2.10 The Commission noted the valuable work done by the ET-UASI on the development of the Global Criteria for Tracing the Improvements of Radiosondes over the Past Two Decades and on the Publication Process for Radiosonde Intercomparison Tests. The Commission recommended publication of these two documents under the IOM Report series.

5.2.11 The Commission, recognizing the need for further instrument intercomparisons and evaluation tests, agreed on the provisional programme of future WMO upper-air intercomparisons as contained in Annex III to the present report.

5.2.12 The Commission requested the Secretary-General to arrange for partial funding in the regular budget of WMO for the urgently needed instrument intercomparisons.

5.3 REMOTE SENSING UPPER-AIR TECHNOLOGY AND TECHNIQUES *(agenda item 5.3)*

5.3.1 The Commission thanked Mr Alexei Ivanov (Russian Federation), the co-chairperson of the OPAG-UPPER-AIR and the chairperson of the Expert Team on Remote Sensing Upper-Air Technology and Techniques (ET-RSUT&T) for his report.

5.3.2 The Commission noted that many Members were actively using wind profilers, ground-based GPS systems, weather radars and lightning detection systems, for both research and operational practice, whilst the use of cloud radars, lidars, radiometers, microwave radiometers and other profilers were being investigated for potential operational applications either for specialized observatory networks or for more general operational application. Interest in beginning to use these systems in operations is high and greater emphasis should be placed on promoting these activities during the next intersessional period. This work may also require interaction with developments in some of the areas of surface measurement of clouds and present weather.

5.3.3 The Commission noted the increasing importance of wind profilers as part of a composite upper-air observing network. It agreed that the ET-RSUT&T should concentrate on developing operational guidelines for the operation, siting, calibration and maintenance of wind profilers. This should include information on data quality control and advice on noise sources, as well as performance characteristics. Additionally, the Commission encouraged manufacturers to further develop calibration techniques and requested the ET-RSUT&T to work with ET-UASI to design and test instrument intercomparison techniques to evaluate the profiler wind quality.

5.3.4 The Commission noted that some members of the ET-RSUT&T participated in the European cooperation in the field of science and technological research (COST), Action COST-720 “Integrated Ground-Based Remote-Sensing Stations for Atmospheric Profiling”. Its main objective was the development of integrated ground-based remote-sensing stations for atmospheric profiling and the assessment of their use for meteorological analysis and forecast as well as climate research and climate monitoring. During the project, extensive experiments were made, such as TUC (Temperature, humidity and cloud profiling experiment, Payerne, Switzerland, 2003–2004) and LAUNCH (International Lindenberg campaign for assessment of humidity and cloud profiling systems and its impact on high-resolution modeling, Germany, 2005). Their objectives were to assess the new remote-sensing techniques and/or algorithms for remote sensing of basic parameters (in particular temperature, humidity and winds), to improve their quality and resolution, to supply a dataset for NWP experimentation, and a study of remote-sensing systems integration. A comprehensive report summarizing the latest state-of-the art of ground-based remote sensing will be made available via COST (currently in press).

5.3.5 As substantial efforts had been made through various experiments to improve the quality and availability of remote-sensing data, the Commission judged that it should now be possible to consider integrating remote sensing and in situ upper-air measurements in operational networks. Thus, the Commission requested that the expert team investigate the integration of upper-air systems, both surface- and upper-air-based, and remote sensing to support future national, regional, and international network requirements. This work needs to consider operational requirements for near real-time data for national and international numerical weather prediction and the needs of the climate community for the stable data for long-term trends analysis. In preparing for the future IOS, methods of selecting the best optimal mix of sensing platforms, spatial and temporal considerations need to be developed. This can be achieved through the coordinated efforts of Members, with the required knowledge and infrastructure, through international campaigns and experiments. The Commission requested the OPAG-UPPER-AIR to investigate possibilities to facilitate the organization of such experiments in collaboration with the Hydro-Meteorological Equipment Industry Association and other international organizations, such as COST and EUMETNET. Pilot projects should be considered in tropical and subtropical regions, with the aim of implementing additional sensors to improve temporal resolution of upper-air observations in these areas and establishing the measurement quality obtained in these conditions.

5.3.6 The Commission recognized that data compatibility problems could be connected with the lack of comparable “true” values against which remote-sensing data may be compared and also the different sampling of the systems. The commission agreed that, as one possible approach, a combination of at least two high quality radiosondes tested in WMO Intercomparison of High Quality Radiosonde Systems, Mauritius, 2005, should be used as a reference in the international experiments. The Commission also requested that the ET-RSUT&T work with the ET-UASI in

promoting WMO and regional intercomparisons of remote sensing and in-situ upper-air sounding systems, as had been proposed by Germany.

5.3.7 The Commission determined that more needed to be accomplished in meeting the request of Members for training workshops and reference material and guidelines for the operation, siting, calibration, and maintenance of upper-air remote sensing instruments and systems. The Commission asked the OPAG UPPER-AIR to facilitate this activity through its expert teams and requested that a plan be submitted to the Management Group, including a list of milestones for the upcoming intersessional period. These would include guidelines on microwave radiometers, wind profilers, and GPS water vapour.

5.3.8 The Commission recognized the urgent need for a coordinated international effort in radiofrequency management to secure the range of frequencies currently in use by radio-soundings, active and passive microwave ground-based (including weather radar) and satellite-borne remote sensing (e.g. car distance radar as a threat for MW remote sensing).

5.3.9 The Commission noted the proposals from Mr Joe of Canada for the ET-RSUT&T to facilitate activities associated with improving the quality of weather radar operations, including signal processing and data processing. These included development of guidelines regarding establishment of wind turbine electrical generators in the vicinity of radars and estimating the effects of wind turbines on future radar operations.

5.3.10 The Commission requested the ET-RSUT&T to establish a web-based up-to-date and fully comprehensive database of the global use of weather radar. This would be maintained to aid the international exchange of radar data and to be used in dealing with issues like radiofrequency allocation and limitations on operational performance introduced by wind turbine operations.

5.3.11 The Commission recommended that the ET-RSUT&T collaborate with the radar community in developing a series of intercomparison workshops to evaluate the differences between current signal processing and data processing algorithms used by operational weather radars. This would include preparing common data sets to test the algorithms. The outcome should be a series of reports on the differences found between the different types of processing.

5.3.12 The Commission requested the ET to review the methods of exchanging weather radar data used by Members, and to make recommendations as to the preferred methods to be used. This could include evaluation of the BUFR format used by EUMETNET OPERA members, and recommendations for the data format to be adopted by WMO for international radar data exchange.

5.3.13 The Commission noted the proposal of Morocco to take benefit of the UK lightning detection system and to conduct an intercomparison between this system and the Moroccan lightning detection network based on IMPACT technology from Vaisala. The aim is to enlarge the operational use of existing regional lightning detection networks (UK ATD NET for example) to poorly covered areas especially in Africa and to perform intercomparison studies between different lightning detection technologies and other remote sensing systems such as weather radars and satellites.

5.3.14 The Commission recognized that the Russian Federation operates five meteor scattering radars and that these are useful for wind measurements in height range 80–100 km.

6. EDUCATION AND TRAINING, CAPACITY BUILDING *(agenda item 6)*

6.1 TRAINING ACTIVITIES AND TRAINING MATERIALS *(agenda item 6.1)*

6.1.1 The Commission thanked Mr Eliphaz Bazira (Uganda), the co-chairperson of the OPAG-CAPACITY-BUILDING (CB) and the chairperson of the Expert Team on Training Activities and Training Material (ET-TA&TM) for his report.

6.1.2 The Commission expressed its full satisfaction with the level of implementation of CIMO training and capacity building activities. This significant progress since CIMO-XIII, was achieved due to excellent collaboration of the CIMO OPAGs with experts from Member countries, especially from Regional Instrument Centres (RICs), World and Regional Radiation Centres, Regional Meteorological Training Centres (RMTCs) and in close cooperation with the Hydro-Meteorological Equipment Industry Association (HMEI) who all had contributed to these activities. The Commission expressed its sincere appreciation to those Members who hosted the training events and provided significant support towards their successful outcome. It also thanked those Members who prepared master training lecture notes for the workshops, namely France and UK.

6.1.3 The Commission noted that the CIMO Management Group (MG) had identified urgent needs for training in the operational practice of NMHSs in the area of: (a) upper-air observations (in situ and remote sensing); and (b) metrology and calibration. It recognized that more training, supported by HMEI, was needed for technicians on the maintenance and use of various individual instruments and Automated Weather Observing Systems (AWOSs). It requested the OPAG-CB to collaborate with RMTCs to strengthen their capabilities in providing regular training on instruments and methods of observation to Members.

6.1.4 The Commission noted that 17 Instruments and Observing Methods (IOM) Reports had been published since CIMO-XIII. This marked an unprecedented effort by many experts of all CIMO OPAGs. The Commission thanked all those individuals for the work done in supporting the needs of Members for technical advice concerning types, characteristics, accuracies, performance, effective and economical use of instruments and methods of observation. The Commission also recognized the increasing need for cost benefit analyses and evaluations of capabilities of automatic systems versus human observer and requested the MG to initiate such cost benefit analyses.

6.1.5 In view of further strengthening of the RICs, the Commission welcomed the involvement of the RICs in the preparation, hosting and conducting of training activities and acknowledged that the RICs benefited in terms of capacity building, through utilizing local staff in conducting the training and through the interaction with the WMO lecturing teams. The Commission appreciated the information that CMA, as host of the RIC-Beijing, planned to host an RA II training seminar on meteorological metrology in 2007, and requested that it be included in the training programme of WMO.

6.1.6 The Commission appreciated that the Web Portal on Development, Maintenance and Operation of Instruments, Observing Methods and Automatic Weather Stations had become operational on the CIMO/IMOP Website since 2004. It requested Members and the HMEI to contribute to the further development of the Portal, especially concerning the distance learning and computer assisted training modules.

6.1.7 Training continues to be an important element for ensuring proper use and maintenance of instruments and the generation of high-quality data and for ensuring traceability of measurements to International System of Units. In this regard, the Commission requested the Secretary-General to continue implementing the CIMO training workshops on upper-air observations and training workshops on metrology and calibrations in all WMO Regions, particularly in those sub-regions that had not yet benefited from such workshops.

6.1.8 The Commission noted that the use of Doppler weather radars by Members is increasing, and considering that this is a new and developing technology, capacity building activities, including training workshops on Doppler weather radar should be supported, encouraged and organized by CIMO, to ensure optimum use of these systems.

6.1.9 The Commission welcomed the proposals from Hong Kong, China to hold a training course on automatic weather stations in the 2007 to 2008 timeframe, and from the UK to organize a training workshop on GCOS matters during 2007.

6.1.10 The Commission noted that the fourth International Conference on Experience with Automatic Weather Stations, including an exhibition by suppliers of instruments and AWS, took place in Lisbon, in May 2006, organized by the Portuguese Meteorological Institute. The Commission also noted that this series of conferences, started in 1995 by the initiative of the Austrian Meteorological Service, has been attracting an increasing number of participants, including instrument specialists, network managers, climate experts and other data users. Since the co-sponsorship of WMO/WCP enabled the participation of technicians from less developed countries, the Commission recognizes the importance of strengthening cooperation with CCl, in order that more members may keep pace with developments related to AWS.

6.2 REGIONAL INSTRUMENT CENTRES, QUALITY MANAGEMENT SYSTEMS AND COMMERCIAL INSTRUMENTS INITIATIVES *(agenda item 6.2)*

6.2.1 The Commission thanked Mr Heng Zhou (China), the co-chairperson of the OPAG-CAPACITY-BUILDING (CB) and the chairperson of the Expert Team on Regional Instrument Centres (RICs), Quality Management Systems and Commercial Instruments Initiatives (ET-RICs) for his report.

6.2.2 The Commission recalled that the fifty-eighth session of the Executive Council requested CIMO to review the Terms of Reference (TOR) of the RICs and to develop a mechanism for their continuous evaluation to ensure quality of their services and to verify the traceability of the basic meteorological variables. The Council also requested strengthening the Quality Assurance processes of the RICs. In view of this request and following the evaluation of the RICs by the ET-RICs, the Commission agreed to modify the TOR of the RICs and adopted Recommendations 11 (CIMO-XIV) and 12 (CIMO-XIV).

6.2.3 The Commission welcomed sound proposals for further strengthening of the RICs developed by the ET-RICs and agreed that assistance should be provided to them in four main areas:

(a) Building laboratories and purchase of calibration equipment;

(b) Quality Assurance and Quality Control;

(c) Training;

(d) Evaluation of the RICs.

6.2.4 The Commission requested the OPAG-CB to include these areas in the work plan of the ET-RICs. It also requested the Secretary-General to facilitate support to RICs in building their infrastructure through the WMO Voluntary Cooperation Programme (VCP) and various donors. The Commission recognized that strengthened RICs would play an important future role in Natural Disaster Prevention and Mitigation as well as in support of the Global Earth Observing System of Systems and that the RICs should also look into these sources of support.

6.2.5 The Commission emphasized the need to further enhance the partnership between RICs of developing and developed countries and it encouraged Members to use the system of internship in RICs in the various WMO Regions. It was agreed that a regular meeting mechanism be established in order to strengthen the exchanges and coordination among RICs. The Commission also requested the OPAG-CB to develop all means by which cooperation among the Members of various regions could be enhanced. The Commission was pleased to be advised of the Russian Federation plans to establish an RIC within the intersessional period.

6.2.6 The Commission recognized that further improvements in quality and worldwide compatibility of data strongly depend on assuring traceability of measurements to the International System of Units (SI) standards. It agreed that this is a critical issue for most of the NMHSs and requested CIMO OPAGs to develop a strategy on how to best address the current deficiencies of traceability of measurements to SI standards.

6.3 *GUIDE TO METEOROLOGICAL INSTRUMENTS AND METHODS OF OBSERVATION* AND INFORMATION DISSEMINATION *(agenda item 6.3)*

6.3.1 The Commission thanked Mr Heng Zhou (China), the co-chairperson of the OPAG-CAPACITY-BUILDING (CB) and Mr Russell Stringer (Australia), the chairperson of the Expert Team on the CIMO Guide and Information Dissemination (ET-Guide) for the report.

6.3.2 The Commission noted with appreciation that the preliminary issue (English version) of the seventh edition of the WMO *Guide to Meteorological Instruments and Methods of Observation*, WMO-No. 8 (CIMO Guide) was published on the CIMO/IMOP Website in March 2006 and distributed to the Permanent Representatives of Member countries with WMO. The Commission recognized the amount of work done on the revision of the CIMO Guide and the preparation of its seventh edition and thanked to the many experts who took part in the process.

6.3.3 The Commission approved the seventh edition of the CIMO Guide and requested the Secretary-General, in addition to standard publication arrangements, to make arrangements for its translation in relevant WMO languages and for the production of an electronic version of the Guide that should be available at the CIMO/IMOP Website for instrument and methods of observation specialists worldwide. The Commission stressed the need to make the availability of the Guide known to all meteorologists and measurement experts in other fields. The Commission appreciated the offer of HMEI to make a direct link on its website so that instrument manufacturers would have immediate access to the Guide.

6.3.4 The Commission stressed the need for a continuous review and update of the CIMO Guide to reflect the rapid development of observing technology and observing practices and to respond to users' and Members' requirements for standardization, and called on experts in all fields to make themselves available for this important task.

6.3.5 The Commission recognized that updates and corrections to some chapters of the Guide were already needed and discussed the various options of how future updates of the CIMO Guide would be conducted. It recognized that the variety of expertise needed to review the CIMO Guide cannot be found in an expert team and agreed on the streamlining of the process by using a Rapporteur on the CIMO Guide, technical evaluators, and the services of contract experts as needed. It also acknowledged the necessity of providing a mechanism for tracking and traceability of changes in the electronic version of the Guide. The Commission noted the new procedures for further revisions/updates of the CIMO Guide developed by the CIMO MG and requested OPAG-CB to implement those procedures in collaboration with other OPAGs.

7. ADDITIONAL MATTERS RELATED TO THE INSTRUMENTS AND METHODS OF OBSERVATION PROGRAMME *(agenda item 7)*

7.1 GLOBAL EARTH OBSERVING SYSTEM OF SYSTEMS (GEOSS) *(agenda item 7.1)*

7.1.1 The Commission noted the information on activities related to the Group on Earth Observations (GEO) and its associated Global Earth Observing System of Systems (GEOSS). It also noted that WMO had maintained active participation in the initial phase of GEOSS implementation. In particular, it noted that WMO would either lead or contribute to more than 36 of the 96 GEO 2006 Work Plan tasks including the development of GEONETCast and specific tasks related to weather, water, climate, and disasters. The Commission was informed that several WMO key systems would be core GEOSS components and that GEOSS was based on the principle that existing systems contributing to GEOSS would retain their mandate and responsibilities. Thus, the GEO System (GEOS) would be owned and operated by GEO Members while existing WMO components in fulfilling their "of Systems" role would continue to be owned and operated by WMO Members. The interoperable arrangements being developed by GEO - and to be funded by GEO Members - would provide access to WMO Members' data without adversely impacting WMO systems' functionalities or operations.

7.1.2 The Commission noted that several of its activities would contribute directly to the objectives of GEO and was pleased with the active engagement of the IMOP Programme, CIMO Coordinator for GEOSS, and the WMO GEO Focal point with the GEO Secretariat to ensure alignment of the 2006 GEO work plan and inclusion of the CIMO components. The Commission recognized that CIMO addressed several of the societal benefit areas listed in the 10-year GEOSS Implementation Plan and provided a major component of the observing system as relates to the instruments and methods of observation area. The Commission encouraged the ongoing cooperation between CIMO and GEO through the WMO Secretariat.

7.1.3 The Commission decided to establish a CIMO Coordinator for the GEOSS with the relevant terms of reference under agenda item 10.

7.1.4 The Commission also agreed that linguistic support would be an issue for GEO to address as a matter of urgency. The Commission recalled that it issued all its reference documents in four languages. If GEO documents or the GEO portals would be in English only, this would be a significant and unnecessary impediment for GEOSS.

7.1.5 The Commission also stressed the importance for GEOSS to embrace and integrate all types of data including in situ and remotely sensed. Only through the full use of all data would a comprehensive, coordinated and sustained system be possible that would address the nine societal benefit areas served by GEOSS.

7.2 NATURAL DISASTER PREVENTION AND MITIGATION (DPM) PROGRAMME *(agenda item 7.2)*

Progress with the Development of WMO Disaster Prevention and Mitigation Programme

7.2.1 The Commission acknowledged the establishment of the new crosscutting WMO Natural Disaster Prevention and Mitigation (DPM) Programme with the vision to enhance contributions of National Meteorological and Hydrological Services (NMHSs), in a more cost-effective, systematic, and sustainable manner, toward improving the safety and well being of communities. The Commission noted that this Programme addressed capacity development of NMHSs in supporting disaster risk reduction (DRR), including prevention and mitigation, emergency preparedness, response, recovery, and reconstruction decisions at the national level.

7.2.2 The Commission noted that EC-LVIII approved a crosscutting coordination framework, for identifying WMO DPM Programmes strategic priorities and projects that would be measurable with respect to their benefits and outcomes. Such crosscutting projects would be prioritized and built upon activities of WMO Programmes, technical commissions, regional associations, and strategic partners, with clear definition of roles, responsibilities and deliverables. In this regard the Commission expressed its appreciation to the Chief of DPM for recognizing and encouraging the special relevance of CIMO to the crosscutting programme. The Commission noted that DPM had been particularly active in engaging CIMO experts.

7.2.3 The Commission welcomed that the cross-cutting framework of the DPM Programme, was supported by an Executive Council Advisory Group on DPM (EC AG DPM), high-level focal points in technical commissions, working groups of the regional associations, National focal points designated by Permanent Representatives, the Secretariat Steering Committee on DRR, DPM Programme Office and the focal points of WMO Departments. Furthermore, it noted the role of presidents of technical commissions to coordinate contributions, particularly related to inter-Commission activities. The Commission acknowledged the need to designate officially its DPM focal point, within the Management Team of the Commission.

7.2.4 The Commission acknowledged that as a benchmark, the Secretariat had initiated four fact-finding surveys to document DRR capabilities, activities and needs of WMO Members, WMO Regions, as well as to map related activities of WMO Programmes and technical commissions. The Commission noted that on-going consultations with DPM focal points and working groups as well as the outcomes of these surveys are essential in identifying strategic priorities and prioritizing crosscutting projects to assist NMHSs. The Commission noted that the WMO DPM Programme's

strategic document was being prepared outlining the overall WMO strategy in DRR and, within the new WMO result-based approach, providing prioritized projects as described in paragraph 7.2.2.

Opportunities arising for NMHSs through the International Movement for Disaster Risk Reduction

7.2.5 The Commission noted the international movement in DRR following the World Conference for Disaster Reduction (WCDR, Kobe, Japan, January 2005) and its outcome, the Hyogo Framework for Action. The Commission noted that this movement aimed to shift disaster risk management at the national level from post emergency response and recovery to a more balanced approach that would include prevention and mitigation strategies, as well as preparedness and contingency planning. This movement is already reflected through changes in the strategic direction of some international and regional humanitarian development and donor agencies supporting activities on national and regional levels. The Commission was informed that many of these agencies work with different ministries at the national level, and thus collaboration could result in enhanced recognition, credibility and financing, providing a basis for better NMHS services.

7.2.6 The Commission noted that within the context of the international movement in DRR, increasingly more development agencies at national, regional and international levels would work towards mainstreaming hydrometeorological hazard assessment as part of the risk assessment for development projects. Availability of hydrometeorological hazard databases as well as mapping and analysis techniques would be critical contributions of the NMHSs to this area. The Commission noted that this presented an opportunity to raise awareness as to the importance of the observing systems in support of development planning in the countries and requested its DPM Coordinator to work with DPM focal points of other Commissions and DPM Working Groups of Regional Associations to identify joint projects demonstrating the benefits of meteorological, hydrological and climatological observing systems in this regard.

7.2.7 The Commission noted that new initiatives in DRR are leading to the development of national disaster risk management plans, built upon the organizational capacities including the role of NMHS. In this regard, initiatives are underway in several countries particularly developing and least developed countries. The Commission noted the need for developing their modernization planning to include NMHS requirements for observing systems in support of national plans.

Role of CIMO in WMO DPM Programme

7.2.8 The Commission recognized its critical role in the WMO DPM Programme through the provision of:

(a) Instrument and observing system specifications to meet requirements for the accurate and traceable measurement of meteorological, related geophysical and environmental variables, taking into account both experience and new developments for hazard monitoring and detection;

(b) Support of the CIMO Coordinator for DPM in identifying how surface-based technologies can support natural hazard monitoring activities;

(c) Encouragement to the instrument manufacturers to develop more robust instruments with greater resilience to extreme weather condition and with increased measuring range;

(d) Guidance on use of instruments in harsh atmospheric conditions.

7.2.9 The Commission noted that NMHSs would require expert advice for development of their modernization plans and the Commission could support these needs. Specifically, the Commission requested its Coordinator for DPM to contact the CBS Coordinator for DPM to develop a joint plan for:

(a) Development of guidelines detailing the TOR of expert missions to the NMHSs to assist with the development of modernization plans for observing systems;

(b) Development of training modules for these experts on how to undertake these missions.

The Commission noted that if there is a clear increase in demand for these missions over time, this Commission should explore with CBS the possibility for coordinated training of experts in support of these missions.

7.2.10 The Commission encouraged the CIMO Management Group, its appropriate Expert Teams, Rapporteurs and Coordinators to liaise through the CIMO Coordinator for DPM with other DPM focal points and working groups within the WMO structure as appropriate to maximize the benefits of CIMO's activities to relevant crosscutting DPM projects as they emerge.

7.3 WMO QUALITY MANAGEMENT FRAMEWORK *(agenda item 7.3)*

7.3.1 The Commission noted with appreciation that action was taken by the CIMO Expert Team on Regional Instrument Centres, Quality Management Systems and Commercial Instrument Initiatives (ET-RICs) to review Part III "Quality Assurance and Management of Meteorological Observing Systems" and especially its Chapter 3 "Quality Management" of the WMO *Guide to Meteorological Instruments and Methods of Observation*, WMO-No. 8 (CIMO Guide). It requested the ET-RICs to follow the guidance of the Executive Council to ensure that the terminology used is in agreement with the definitions of the quality-related terms given in the ISO 9000:2005 standard.

7.3.2 The Commission also noted that the review was conducted to remove duplications and inconsistencies between the CIMO Guide and the *Manual* and *Guide on the Global Observing System* (WMO-No. 544 and WMO-No. 488). It requested the OPAG-CAPACITY-BUILDING to initiate similar reviews with technical documentation of other technical commissions. Further it requested the CIMO MG to work with other Commissions to establish procedures to ensure such duplications and inconsistencies were avoided in the future.

7.3.3 The Commission welcomed the progress made in view of strengthening collaboration with the International Organization for Standardization (ISO) and fully supported the development of a working agreement with ISO, which would enable the development of joint ISO-WMO technical standards based on WMO Technical Regulations, Manuals and Guides. The Commission felt that a balanced approach would need to be followed, so that only practices that are considered as essential requirements be proposed for joint standards.

7.3.4 The Commission decided to establish a CIMO Coordinator for WMO Quality Management Framework with the relevant terms of reference under agenda item 10.

7.4 WMO INFORMATION SYSTEM (WIS) (*agenda item 7.4)*

7.4.1 With respect to the WMO Information System (WIS), the Commission recalled the proposals of CBS and the corresponding decisions of Cg-XIV and of the subsequent fifty-fifth to fifty-seventh sessions of the Executive Council. The Commission noted that the GTS would evolve as the core network of the WIS, which would, based on international ICT standards, facilitate real-time, coordinated "push-pull" services for operational, time-critical applications, and information discovery, access and retrieval services of all WMO and relevant co-sponsored international programmes, such as research, climate and environmental applications and programmes, as well as for eligible non-NMHSs users at national level. The Commission noted that WIS will fully comply with WMO data policies (e.g. Res. 40 (Cg-XII) and Res. 25 (Cg-XIII)), and that standard procedures for managing users' access authentication and rights by NMHSs will be agreed. The Commission appreciated that an important goal for the WIS has been facilitating a cost-effective access to and reception of WMO Programmes' data and products for NMHSs of developing countries and LDCs. It was noted further that EC-LVII (2005) had realized the important role WIS played in contributing the essential data exchange and data management services to the GEOSS.

7.4.2 The Commission noted that WIS could play a useful role in its programme activities, specifically in facilitating the non-real-time information exchange of IMOP programmes. WIS was also expected to provide efficient information discovery, access and retrieval services. The Commission requested that IMOP requirements on WIS services be identified. It also emphasized the importance of pursuing CIMO participation in the development of WIS-related data management functions, specifically as regards instrument-related and surface and upper-air observational data representation formats and metadata. It noted with appreciation that an expert was representing CIMO in the CBS/Inter-Programme Expert Team on Metadata Implementation.

7.4.3 The Commission confirmed the important role of the Meetings of the Presidents of Technical Commissions, in which CIMO was represented, for the inter-programme coordination of WIS. It also noted that CIMO was not yet represented in the Intercommission Coordination Group on WIS (ICG-WIS), which had been established by Resolution 2 (EC-LVI) for coordinating and guiding WIS development. The Commission was informed that CBS, at its extraordinary session (2006), agreed upon recommended governance procedures in principle for the designation of the Global Information System Centres (GISC) and the Data Collection or Production Centres (DCPC). According to these procedures, the relevant technical commissions are expected to consider the services offered by potential DCPCs under their respective WMO Programmes, and to endorse their programmes' candidate DCPCs for submission to ICG-WIS, CBS and then the Executive Council.

7.4.4 With a view to ensuring optimal benefit and coordination for IMOP activities, derived from the WIS, the Commission decided on the following actions:

(a) Pursue the involvement of CIMO in the development of the WMO Metadata Core Profile in coordination with the CBS/Inter-Programme Expert Team on Metadata Implementation;

(b) Identify the specific CIMO requirements with respect to data management, data discovery and retrieval and non-real-time information exchange, and coordinate them through the Intercommission Coordination Group on WIS (ICG-WIS) and the Meeting of the Presidents of the Technical Commissions;

(c) Requested its Management Group to designate a CIMO representative to serve as member of the Intercommission Coordination Group on WIS (ICG-WIS);

(d) Requested its Management Group to establish a process for identifying potential DCPCs under the IMOP Programme, and for endorsing relevant candidate DCPCs for submission to ICG-WIS, CBS and then the Executive Council.

7.5 INTERNATIONAL POLAR YEAR 2007–2008 (IPY) *(agenda item 7.5)*

7.5.1 The Commission recalled Resolution 34 (Cg-XIV) that had approved the holding of the International Polar Year (IPY) in 2007–2008. It noted that the IPY 2007–2008 should result in an intensive burst of internationally coordinated, interdisciplinary research and observations focused on the Polar Regions. The Commission stressed that observing systems established or improved during the IPY should be reliable and be kept in operational mode for as many years as possible to provide data for detection and projection of climate change.

7.5.2 The Commission noted that WMO and ICSU as lead agencies for the IPY preparation and implementation had established the IPY Joint Committee (JC) and that the JC, on the basis of evaluation of 452 proposals, had endorsed 172 IPY scientific projects as well as 56 education and outreach projects. It noted with satisfaction that in order to coordinate IPY activities within WMO, in particular among technical commissions and NMHS, EC-LVI established an Intercommission Task Group (ITG) on the IPY, which includes Mr Y. Viisanen (Finland) as the representative of CIMO. The Commission was pleased to learn that the ITG had developed a number of recommendations to technical commissions that were very helpful in the preparation of the IPY project proposals.

7.5.3 The Commission recognized that successful implementation of IPY had required strengthening of the technical and logistical infrastructure for operations and research during the preparation and implementation of the IPY, including calibration and standardization of observing instruments and equipment over the Arctic and the Antarctic.

7.5.4 In this connection, the Commission encouraged Members participating in the IPY to provide their IPY National Committees and the International Programme Office for IPY with information on the enhancement of their observing systems deployed in Polar Regions in the period of IPY. With respect to standardization of observing instruments and equipment used in harsh conditions, the Commission stressed the necessity to organize an intercomparison of automated solid precipitation measurements through a multi-agency approach, as well as an intercomparison of measurements of river discharges at the main rivers providing discharge into the Arctic Basin. In view of the importance of satellite and aircraft data coverage over Polar Regions during the IPY, the Commission emphasized the need to strengthen a verification of satellite and aircraft observations by use of in-situ ground-truth stations which would allow for the use of an integrated observing systems approach during the IPY. The Commission felt that operational exchange of upper-air observational data including wind profilers data would be beneficial for IPY projects implementation. The Commission therefore urged Members to provide upper-air data in real-time mode.

7.5.5 Taking into account that comprehensive data sets obtained as a result of successful implementation of the IPY would serve as a basis for further development of the environmental monitoring in Polar Regions, the Commission emphasized the necessity to ensure the instrument traceability providing quality data sets derived from standard and hardened instruments developed to operate in harsh climates. As regards radiation measurements, the Commission recommended that all radiation data should be collected in appropriate radiation data centres. It was also recommended that in some cases it would be necessary to organize proper training for projects participants on operational observations in polar conditions. The Commission encouraged the CIMO Management Group and appropriate expert teams to provide CIMO expertise to the relevant IPY projects.

8. WMO STRATEGIC PLANNING RELEVANT TO THE COMMISSION *(agenda item 8)*

8.1 The Commission noted the decision of the fifty-eighth session of the Executive Council related to the preparation of the WMO Strategic Plan 2008–2011, which would be a statement of strategic intent for the Organization for the period 2008–2011, corresponding with the fifteenth financial period. It also noted that a mechanism would be developed for ensuring that this framework is put into operation consistently across Regions, Technical Commissions and Programmes.

8.2 The Commission requested the CIMO Management Group to develop CIMO's own strategic plan in which it would identify CIMO's own Key Performance Targets (KPTs) in support of the overall WMO KPTs identified for each expected result. The Commission requested that the KPT should be specific, measurable, achievable, relevant and timebound.

8.3 It also requested it's president to provide the necessary input in the assessment of the implementation of the relevant parts of the Sixth WMO Long-term Plan and Seventh Strategic Plan, 2008–2011, assisted by the CIMO Management Group.

9. COLLABORATION WITH RELEVANT INTERNATIONAL ORGANIZATIONS *(agenda item 9)*

9.1 The Commission recognized that many of the recent CIMO achievements would not be possible without close collaboration with relevant international organizations, universities and scientific institutions. It also appreciated the work of its president and vice-president aimed at strengthening the relation with those organizations.

9.2 It noted that progress in the area of standardization and compatibility of instruments and methods of observation was also made through increased collaboration with the International Organization for Standardization (ISO), International Committee for Weights and Measures (CIPM), represented by the International Bureau of Weights and Measures (BIPM), the Association of Hydro-Meteorological Equipment Industry (HMEI), the Network of European Meteorological Services (EUMETNET), and the European Union Cooperation on Science and Technology (COST).

9.3 The Commission requested the CIMO Management Group (CIMO MG) to involve, as far as possible, the experts of the above international organizations in the work of the CIMO expert teams and requested Members to actively participate in the work of those organizations on behalf of WMO. The Commission also requested the Secretary-General to maintain the high level of contact with the above organizations by participating, as an observer, in their constituent bodies meetings, as appropriate.

9.4 The Commission took note of the decision of the fifty-eighth session of the Executive Council to develop a formal working agreement with the ISO, with the objective to develop joint ISO-WMO technical standards based on WMO Technical Regulations, Manuals and Guides and requested the CIMO OPAGs to identify those CIMO technical standards that could benefit from promoting them as joint ISO-WMO technical standards.

9.5 The Commission recognized, in particular, the need to coordinate efforts of Expert Teams with ISO Sub-committee 5, Meteorology, of the ISO Technical Committee TC-146 “Air Quality”, on the development of standards and guides related to instruments and methods of observation (including methods of assessing instruments and systems. The Commission further noted that ISO was establishing a Technical Committee, TC-180, with a Sub-committee SC-1 on “Climate” which would be chaired by a CIMO expert in this area.

9.6 The Commission took note of the offer from the CIPM for the WMO to become a signatory to the CIPM Mutual Recognition Agreement and requested the Secretary-General to consider this proposal as this would be of a benefit to Members. It noted the proposal of the BIPM to organize joint workshops to highlight the importance of traceable measurements in studies related to climate change and requested the CIMO MG to collaborate with the BIPM on traceability of measurements to the International System of Units standards.

9.7 The Commission welcomed the statement by the representative of the International Union of Geodesy and Geophysics (IUGG). It noted the importance of good quality, long-term field data to the work of the IUGG and welcomed the words of endorsement and support for the work of CIMO and the invitation for collaboration in areas of mutual interest.

9.8 The Commission recognized major inputs of the HMEI members towards the organization of the WMO instrument intercomparisons and recalled that the fifty-seventh session of the Executive Council agreed that a solution should be found to provide partial support for the future intercomparisons from the regular budget thus avoiding undue dependence on extrabudgetary resources from instrument manufacturers.

9.9 The Commission further recognized the significant contributions of HMEI members, particularly the smaller members, in supporting the radiosonde intercomparisons in Mauritius. The willingness of HMEI members to support CIMO intercomparison activities is vital to the significant improvements in upper-air measurements.

9.10 The Commission thanked those HMEI manufacturers who donated equipment to WMO Members under the Voluntary Cooperation Programme, and encouraged them to continue to do so in the future.

9.11 The Commission noted that HMEI had cooperated with ET-UASI in preparing an information document on interoperability. It also noted the different opinions of manufacturers that had been incorporated in the final document. Questions with respect to standardization of

transmissions from the radiosonde to the ground-station would need further study in the next intersessional period.

9.12 The Commission noted the concern of some Members relating to obtaining timely responses regarding equipment inquiries to HMEI instrument manufacturers at the local representative level. The Commission therefore requested HMEI to consider all reasonable options for facilitating timely responses, for example the HMEI e-mail contact point and access to FAQ information through the HMEI Website.

9.13 The Commission noted the concern of Members related to level of detail of technical documentation provided for some equipment. It further noted the importance to Members, in relation to climate and other studies, of having a detailed and complete understanding of the methods by which observations are generated. The Commission therefore requested HMEI members to fully document and inform equipment users of the required details, including algorithms, while finding other means of addressing intellectual property issues.

9.14 The Commission recommended collaboration between RICs and HMEI Members, especially in the area of research and development in order to enhance capacity building and manufacture of instruments that meet harsh environmental conditions. The Commission further noted that such collaboration would facilitate technology transfer and may lower the cost of production.

9.15 The Commission noted the continued strengthening of its relationship with EUMETNET. In particular, the WinProf and OPERA Programme work in developing and implementing standards for wind profiler and weather radar data compatibility and exchange were seen as highly relevant. In addition, the Commission welcomed the support EUMETNET offered via the EUCOS programme to the prospective AMDAR intercomparison studies for the forthcoming intersessional period.

9.16 The Commission noted the many relevant meteorological activities of the COST community in different actions, and that continued WMO representation in those actions would continue to facilitate the rapid transfer of results and knowledge to all interested parties. For example, WMO has already gained benefits from COST Action 727 in relation to Icing on Structures. The Commission further noted that COST had provided financial and scientific support to the WMO High Quality Radiosonde Comparison in Mauritius. A new COST project has been proposed addressing the design and evaluation of upper-air networks where ground-based remote sensing systems are integrated with in-situ measurements providing a network suitable for both weather forecasting and climate studies. The Commission encouraged Members to further support the United Kingdom in preparation and promotion of this proposal.

10. FUTURE WORK AND WORKING STRUCTURE OF THE COMMISSION *(agenda item 10)*

10.1 The Commission recalled the decision of CIMO-XIII to establish a working structure that would enable it to meet the needs of Members effectively during the intersessional periods. The progress has been evaluated periodically by the CIMO Management Group (MG) during the past four years. The initial review was conducted at CIMO-MG-2, Bucharest, Romania, 2–3 May 2005, and the final review at CIMO-MG-3, Geneva, Switzerland, 3–7 July 2006. During these meetings the MG took into account CIMO performance and experience gained under the new working structure, recommendations of its Open Programme Area Groups (OPAGs) and Expert Teams (ETs), and conclusions of other WMO constituent bodies, as well as other relevant intergovernmental and non-governmental organizations on issues related to CIMO.

10.2 The conclusions derived at MG-3 were that the new structure was responsive to the needs of Members and the user community. In this regard, the Commission recognized that work programme activities and deliverables of the Commission had increased significantly due to the effective and flexible working structure based on the OPAGs and their ETs.

10.3 The Commission thanked all the chairpersons and members of the expert teams for their contribution to the CIMO OPAGs. The Commission expressed its sincere gratitude to those who were no longer able to continue serving in those positions for their important contribution to the work of the Commission over many years.

10.4 The Commission agreed on its work programme, based on the relevant sections of the Sixth WMO Long-term Plan and the Draft WMO Strategic Plan 2008–2011, relevant decisions of the Executive Council, and taking into account detailed discussions under the various agenda items. The Commission decided to re-establish the three Open Programme Area Groups on Surface Observation Technology (OPAG-Surface), on Upper-air Observation Technology (OPAG-Upper-Air) and on Capacity Building (OPAG-CB) and adopted Resolution 1 (CIMO-XIV).

10.5 The Commission decided to re-establish the CIMO Management Group and adopted Resolution 2 (CIMO-XIV). It further decided to appoint within the CIMO-MG a CIMO Coordinator for GEOSS to coordinate Commission activities across its relevant Open Programme Area Groups and related to the GEOSS 10-Year Implementation Plan (see agenda item 7.1), a CIMO Coordinator for Natural Disaster Prevention and Mitigation (DPM) (see agenda item 7.2) and a CIMO Coordinator for WMO Quality Management Framework (QMF) (see agenda item 7.3).

10.6 With a view to making the necessary arrangements for efficiently carrying out the various tasks under the agreed work programme and the corresponding activities, the Commission agreed to establish teams as well as rapporteurs within each of the OPAGs and to allocate them tasks as given in Annex IV to the present report.

10.7 The Chairs of the ETs and Rapporteurs who were designated by the Commission are given in Annex V to the present report.

10.8 The Commission requested the MG to establish the membership of the ETs. It invited the chairpersons of the respective OPAG and ETs, in cooperation with the Secretariat, to develop target activities and deliverables as well as an adequate working mechanism to ensure that all experts could actively participate and contribute to the work programme.

Participation of women in the work of the Commission

10.9 The Commission noted the recommendations of the Second WMO Conference on Women in Meteorology and Hydrology (Geneva, March 2003) and Resolution 33 (Cg-XIV) of Fourteenth World Meteorological Congress which calls for equal opportunities for the participation of women in meteorology and hydrology and noted the past efforts of the Commission to strengthen the participation of women in the work of the Commission. Recognizing that these efforts need to be revised and strengthened with new initiatives on a continuous basis, the Commission adopted Resolution 3 (CIMO-XIV) and designated Mr R. Canterford as the CIMO focal point for gender issues. The Terms of Reference of the CIMO focal point for gender issues are contained in Annex VI to the present report.

11. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND OF RELEVANT RESOLUTIONS OF THE EXECUTIVE COUNCIL *(agenda item 11)*

In accordance with established practice, the Commission examined those resolutions and recommendations adopted prior to the present session which were still in force and adopted Resolution 4 (CIMO-XIV) and Recommendation 13 (CIMO-XIV).

12. ELECTION OF OFFICERS *(agenda item 12)*

The Commission unanimously elected Mr J. Nash (UK) as president and Mr R. Dombrowsky (USA) as vice-president of the WMO Commission for Instruments and Methods of Observation.

13. DATE AND PLACE OF THE FIFTEENTH SESSION *(agenda item 13)*

13.1 The Commission was informed that the fifteenth session was scheduled to be held in 2010.

13.2 The actual date and place would be announced at a later date.

14. CLOSURE OF THE SESSION *(agenda item 14)*

The fourteenth session of the Commission for Instruments and Methods of Observation closed at 12.00 p.m. on 14 December 2006.

RESOLUTIONS ADOPTED BY THE SESSION

Resolution 1 (CIMO-XIV)

CIMO OPEN PROGRAMME AREA GROUPS (OPAGs)

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Recalling Resolution 1 (CIMO-XIII) – Working Structure of the Commission for Instruments and Methods of Observation,

Noting Resolution 9 (EC-LVI) – Global Earth Observing System of Systems,

Decides:

(1) To re-establish:

(a) The OPAG on Surface Observation Technology (OPAG-Surface);

(b) The OPAG on Upper-air Observation Technology (OPAG-Upper-Air);

(c) The OPAG on Capacity Building (OPAG-CB);

(2) To update the terms of reference for each OPAG as given in the Annex to this resolution;

(3) To select, in accordance with General Regulation 32, the co-chairpersons for each of the Open Programme Area Group as follows:

(a) OPAG on Surface Observation Technology:

- Co-chairperson: Mr J. van der Meulen (Netherlands);
- Co-chairperson: Mr B. Calpini (Switzerland);

(b) OPAG on Upper-air Observation Technology:

- Co-chairperson: Mr H. Zhou (China);
- Co-chairperson: Mr R. Stringer (Australia);

(c) OPAG on Capacity Building:

- Co-chairperson: Mr M. Nbou (Morocco);
- Co-chairperson: Mr M. Garcia (Argentina);

Decides further:

(1) To establish a CIMO Coordinator for the Global Earth Observing System of Systems (GEOSS) with the following Terms of Reference:

(a) To coordinate Commission activities, across its relevant Open Programme Area Groups, related to implementation aspects of the GEOSS 10-Year Implementation Plan and advise Commission members on activities contributing to the development and implementation of GEOSS;

(b) To coordinate with other regional and technical commission GEOSS rapporteurs and liaise with the WMO Secretariat on relevant GEOSS activities;

(c) To coordinate with GEO through its GEO Secretariat located with the WMO Secretariat on matters relevant to the Commission and GEO;

(d) To provide the CIMO Management Group with appropriate periodic status reports on CIMO related activities and recommendations on newly identified requests to the Commission on GEOSS related activities;

(2) To select Mr A. Gusev (Russian Federation) to serve as the Coordinator for the GEOSS;

(3) To establish a CIMO Coordinator for Natural Disaster Prevention and Mitigation (DPM) with the following Terms of Reference:

(a) To coordinate Commission activities, across its relevant Open Programme Area Groups, related to Natural Disaster Prevention and Mitigation (DPM) and advise Commission members on activities that will contribute fully to the DPM Programme including relevant enhanced operation of the World Weather Watch;

(b) To provide the CIMO Management Group with appropriate information and recommendations on the Commission's DPM related activities;

(4) To select Mr R.P. Canterford (Australia) to serve as the CIMO Coordinator for DPM;

(5) To establish a CIMO Coordinator for WMO Quality Management Framework (QMF) with the following Terms of Reference:

(a) To coordinate Commission activities, across its relevant Open Programme Area Groups related to Quality Management Framework (QMF) practices and advise Commission members on activities contributing fully to the QMF Programme and to ensure that CIMO technical activities cover all aspects of product delivery and data services specified under the WMO policy on quality;

(b) To provide the CIMO Management Group with appropriate information and recommendations on the Commission's QM and QA related activities;

(c) To provide the president with an annual report for Congress and EC as to CIMO's progress and achievements related to QM activities;

(d) Monitor progress of the development of the WMO QMF across the technical commissions and represent CIMO in the Intercommission Task Team (ICTT) on QMF;

(e) Review and assess the experience of NMHSs with QM and QA;

(f) Coordinate the consolidation and updating of CIMO technical standards and recommended practices;

(g) Collaborate with ISO and BIPM in the standardization activities of the Commission;

(h) Provide support for the harmonization of terminology in technical guidance documents (technical regulations, manuals, guides, guidelines, technical documents) of WMO and of possible joint ISO-WMO technical standards relating to instruments and methods of observation;

(6) To select Mr U. Busch (Germany) to serve as the CIMO Coordinator for WMO QMF;

(7) To establish a CIMO Coordinator for Cross Programme and Intercommission work relevant to IMOP, with the following Terms of Reference:

(a) To coordinate Commission activities, across the relevant WMO Programmes, related to the implementation aspects of the IMOP;

(b) To coordinate with regional associations, technical commissions and with the WMO Secretariat on relevant WMO developments to ensure CIMO input, e.g., WMO Strategic Plan 2008–2011;

(c) To provide the CIMO Management Group with appropriate periodic status reports on CIMO related activities and recommendations on cross programme areas relevant to the Commission;

(d) To ensure the work of CIMO Expert Teams is input to other WMO Programmes and Commissions (e.g., CHy and JCOMM);

(e) To provide input to the evolving role and enhancement of WMO with respect to IMOP;

(8) To select Mr E. Bazira (Uganda) to serve as the Coordinator for the Cross Programme and Intercommission work relevant to IMOP;

Requests:

(1) The co-chairpersons of the OPAGs to act upon matters referred to the OPAG by the president of CIMO;

(2) The co-chairpersons of the OPAGs and the CIMO Coordinators:

(a) To prepare an activity report at the end of every calendar year for distribution to CIMO members;

(b) To submit a report to the Commission not later than four months prior to its session.

Annex to Resolution 1 (CIMO-XIV)

TERMS OF REFERENCE OF OPAGs

A. GENERAL TERMS OF REFERENCE OF THE SURFACE AND UPPER-AIR TECHNOLOGY OPAGs

1. Carry out the activities of the OPAG and ensure contributions are relevant and timely.

2. Review and publish performance results and recommendations relating to the state-of-the-art of operational instruments, their calibration and methods of observation as well as their use in different application areas.

3. Work closely with other technical commissions and regional associations through representatives and regional rapporteurs, in order to coordinate the ongoing standardization of observation technologies.

4. Respond to user requirements and recommend appropriate action of the Commission, including provision of guidance material.

5. Support WMO Programmes and bodies through the provision of specifications for instruments and observing systems in order to meet requirements for the measurement of meteorological, related geophysical and environmental variables, taking into account both experience and new developments.

6. Prepare technical specification for selection of instruments and observing systems for use in WMO and national procurements.

7. In coordination with relevant ETs, strengthen further the Regional Radiation Centres (RRCs), regularly evaluate their functions and capabilities and suggest corrective measures.

8. Facilitate collaboration on crosscutting issues, such as WMO Integrated Global Observing System (WIGOS), WMO Quality Management Framework (QMF), Natural Disaster Prevention and Mitigation Programme (DPM) and the Global Earth Observing System of Systems (GEOSS). Cooperate with CIMO Coordinators for WMO QMF, DPM and GEOSS.

9. Propose, coordinate implementation, review and evaluate global and regional intercomparisons of instruments and methods of observation in collaboration with relevant manufacturers and the Hydro-Meteorological Equipment Industry Association (HMEI).

10. Review, develop and update guidance material related to instruments and methods of observation.

11. Provide guidance concerning instrument types, characteristics, accuracies, performance, as well as, effective and economical use of instruments and methods of observation.

12. Promote studies on methods of observation, including test and calibration methods.

13. Encourage research and development of new approaches in the field of instruments and methods of meteorological observation and related geophysical, and environmental variables.

14. Promote the economical production and use of instruments and methods of observation with particular attention to the needs of developing countries.

15. Facilitate actions towards worldwide traceability of measurements to the International System of Units (SI).

16. Develop further basic procedures for quality management of observations, instrument maintenance, calibration and operation (based on the seventh edition of the WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8) (CIMO Guide).

17. Monitor and cooperate with the relevant work of international and regional bodies, such as the International Organization for Standardization (ISO) and the International Committee for Weights and Measures (CIPM/BIPM), European Cooperation in the field of Scientific and Technical Research (COST), the Network of European Meteorological Services (EUMETNET), and appropriate other international organizations, report on such work and advise on action as necessary. Advise the CIMO Coordinator on WMO QMF on these matters.

B. GENERAL TERMS OF REFERENCE OF THE OPAG ON CAPACITY BUILDING

1. Work closely with other technical commissions and regional associations on issues related to capacity building, such as their involvement in instrument comparison, workshops, seminars and activities of the Regional Instrument Centres (RICs).

2. Maintain close liaison with the regional Rapporteurs on Instrument Development, Related Training and Capacity Building, review their reports and recommend action to deal with indicated deficiencies.

3. Develop proposals on resource mobilization including how to engage manufacturers in building capacity.

4. Review the needs for building national capacities related to IMOP with the view to making developing countries more self-reliant.

5. Review, develop and update guidance and training material related to instruments and methods of observation and liaise with the RICs, RRCs and RMTCs on these matters.

6. Prepare plans for urgently needed training workshops and, in collaboration with the OPAGs on SURFACE and UPPER-AIR prepare training material and assist the Secretariat in their organization.

7. Ensure guidance information on modern technology is available to Members.

8. Promote the use of calibration standards by RICs and Members and facilitate associated technology transfer activities.

9. Develop further basic procedures for quality management of observations, instrument maintenance, calibration and operation (based on the seventh edition of the WMO Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8) (CIMO Guide).

10. Provide guidance to Members on strategies for the procurement process of instrumentation and related management.

11. In coordination with relevant ETs, strengthen further the Regional Instrument Centres (RICs), regularly evaluate their functions and capabilities and suggest corrective measures.

12. Promote, through the RICs and RRCs, worldwide traceability of measurements to the International System **of Units (SI).**

Resolution 2 (CIMO-XIV)

CIMO MANAGEMENT GROUP

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Recalling:

(1) Resolution 1 (CIMO-XIII) – Working Structure of the Commission for Instruments and Methods of Observation,

(2) Resolution 2 (CIMO-XIII) – Commission for Instruments and Methods of Observation Management Group,

Recognizing:

(1) That the effectiveness of the Commission depends to a large extent on the effective management of its activities and effective communication between sessions,

(2) That a management group will be required to ensure the integration of programme areas, to evaluate the working progress achieved, to coordinate strategic planning, and decide on necessary adjustments to the working structure of the Commission during the intersessional period,

Decides:

(1) To re-establish a CIMO Management Group (CIMO-MG) with the following terms of reference:

(a) To advise the president on all matters related to the work of the Commission;

(b) To assist the president in planning and coordinating the work of the Commission its Open Programme Area Groups and Expert Teams;

(c) To plan, coordinate and actively manage the work of the Commission, its Open Programme Area Groups and Expert Teams, including evaluating the progress achieved in the work programmes and advising on the new priority activities;

(d) To monitor the implementation of the IMOP Programme in relation to the WMO Strategic Plans and advise the president on appropriate actions;

(e) To ensure the overall integration of the programme areas and coordinate IMOP strategic planning issues;

(f) To advise the president on matters related to cooperation with other technical commissions, regional associations and other relevant international organizations and governmental or non-governmental bodies;

(g) To mobilize resources to enable the work of the Commission to be achieved;

(h) To keep under review the internal structure and working methods of the Commission and make necessary adjustments to the working structure during the intersessional period;

(i) To keep under review the terms of reference of the Open Programme Area Groups and Expert Teams and make necessary adjustments;

(j) To advise the president on all team leader designations necessary between sessions of the Commission;

(k) To coordinate the activities of the Commission with respect to GEOSS;

(l) To coordinate the activities of the Commission with respect to DPM;

(m) To coordinate the activities of the Commission with respect to WMO QMF;

(n) To provide CIMO input to the evolving role and enhancement of WMO with respect to CIMO;

(o) OPAG chairs will refrain from acting as ET chairs;

(2) That the composition of the CIMO Management Group shall be as follows:

(a) The president of CIMO (chairperson);

(b) The vice-president of CIMO;

(c) The co-chairpersons of the OPAGs;

(d) The CIMO Coordinator for Natural Disaster Prevention and Mitigation (DPM);

(e) The CIMO Coordinator for Global Earth Observing System of Systems (GEOSS);

(f) The CIMO Coordinator for WMO Quality Management Framework (QMF);

(g) The CIMO Coordinator for Cross Programme and Intercommission work relevant to IMOP.

Resolution 3 (CIMO-XIV)

PARTICIPATION OF WOMEN IN THE WORK OF THE COMMISSION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

(1) The United Nations Conference on Women (Beijing 1995) and its recognition of the importance of women and their contribution to science,

(2) The appeals made in *Agenda 21: Programme for Action for Sustainable Development* (Rio de Janeiro, June 1992), Chapter 24: Global action for women towards sustainable and equitable development,

(3) The Report of the Second WMO Conference on Women in Meteorology and Hydrology, Geneva, March 2003,

(4) Resolution 33 (Cg-XIV) of Fourteenth World Meteorological Congress, which calls for equal opportunities for the participation of women in meteorology and hydrology,

Considering:

(1) The need for trained, qualified professionals regardless of gender, in the work of the Commission,

(2) The need to encourage national education programmes in science and technology that actively target girls and women predisposing and training them to enter the fields of meteorology and related sciences,

(3) The need to increase opportunities and inducements for the recruitment of women within NMHSs, and provide equal opportunities for career advancement to the highest levels,

Welcoming and supporting the active participation of women delegates in this Commission,

Urges increased participation and involvement of women in the work of this Commission;

Recommends that Members:

(1) Continue to encourage, promote and facilitate equal opportunities for women in science and technology in order to prepare them for careers in scientific professions such as meteorology and related sciences;

(2) Facilitate the participation of women in the activities of the Commission;

(3) Provide active encouragement and support for equal opportunity for the participation of women in all fields of meteorology and related sciences at decision-making levels, particularly, in CIMO and its working programmes;

Further recommends that Members encourage the promotion of science studies in schools, as a means of ensuring the participation of women and men on an equal basis in this field of work;

Requests the president of the Commission to report to the next session of the Commission on progress made on the main aspects of the implementation of this resolution during the intersessional period;

Decides to appoint and support a gender focal point from among the members with appropriate expertise, who will report to the president of the Commission.

Resolution 4 (CIMO-XIV)

REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting the actions taken on the resolutions and recommendations adopted by the Commission prior to its fourteenth session,

Decides:

(1) To keep in force Resolution 1 (CIMO-XIII);

(2) To keep in force Recommendations 1 (CIMO-XII), 3 (CIMO-XII), 4 (CIMO-XI), 6 (CIMO-XI), 8 (CIMO-XI), 12 (CIMO-XI) and 13 (CIMO-XI);

(3) Not to keep in force other resolutions and recommendations adopted before its fourteenth session.

RECOMMENDATIONS ADOPTED BY THE SESSION

Recommendation 1 (CIMO-XIV)

MEASUREMENTS IN SEVERE ICING CONDITIONS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting that:

(1) Meteorological icing is different from instrumental icing, the latter being the consequence of the former. This should be taken into account in the design of instruments. Instrumental icing may be of different duration to meteorological icing due to longer recovery times, especially in northern countries with low solar irradiance in winter,

(2) The comparison of both types of icing has not yet been achieved due to the small selection of available instruments for measurement and characterization of ice accretion,

(3) Both, instrument heating power and instrument design influence the instrument performance,

Considering that:

(1) There is an increasing demand for accurate and reliable meteorological measurements in icing conditions,

(2) The WMO *Guide to Meteorological Instruments and Methods of Observation (*WMO-No. 8) (CIMO Guide) defines meteorological requirements and characteristics for sensors, but does not independently consider severe weather conditions like icing, even if low temperature operation is specified in the requirement for instrument performance. Therefore, manufacturers specify the instrument performance in severe weather conditions in terms of low temperatures (operating temperature range) rather than in terms of icing,

(3) There is a demand for accurate measurement of ice accretion in cold climates and mountainous regions to produce reliable data for ice accretion forecasting and design of structures for harsh climates,

Recommends that:

The CIMO Guide be expanded to include:

(1) A definition of the siting characteristics of Automatic Weather Stations in terms of local icing conditions;

(2) The requirements for measurements in severe icing conditions.

Recommendation 2 (CIMO-XIV)

STANDARDIZED PROCEDURE FOR LABORATORY CALIBRATION OF CATCHMENT TYPE RAINFALL INTENSITY GAUGES

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting that:

(1) Gauges designed to measure rain intensity should be calibrated and have the ability to apply corrections to quantify measured rain intensity rates,

(2) The output of many rain gauges, suitable for the measurement of rain intensity (RI) are not linear with respect to RI and cannot meet stated uncertainty requirements unless appropriate rain intensity dependent adjustments are applied,

(3) Not only the measuring sensor, but also wetting of the instrument, evaporation of rain catch and other losses may introduce non-linear deficiencies,

Considering that:

(1) The WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8) (CIMO Guide) defines meteorological requirements and characteristics for sensors and specifies requirements for the RI measurement uncertainties as a function of RI itself,

(2) There is an increasing demand for accurate meteorological measurements of rain intensities, in particular for higher rain rates (up to 2000 $mm \cdot h^{-1}$),

Recommends that:

(1) The standardized procedure as stated in the Annex to this recommendation be used for laboratory calibration of catchment type RI gauges in operational practice of the NMHSs;

(2) The standardized procedure for laboratory calibration of catchment type RI gauges be included in the CIMO Guide.

Annex to Recommendation 2 (CIMO-XIV)

STANDARDIZED PROCEDURE FOR LABORATORY CALIBRATION OF CATCHMENT TYPE RAINFALL INTENSITY (RI) GAUGES

1) Principles

The calibration laboratory should be well prepared to perform calibrations of instruments to be used for operational practices (see the WMO *Guide to Meteorological Instruments and Methods of Observations* (WMO-No. 8 for details). Apart from a well-designed reference system, the calibration procedures should be documented in full detail and set-up and staff should be well prepared before starting any calibration activity (see ISO 17025 for details). The result of any calibration will be a calibration certificate presenting the results of the calibration (including corrections to be applied), allowing a compliance check with the relevant WMO recommendations. This certificate should also contain the measurement uncertainty for RI. It should document the traceability of the RI reference, the environmental conditions (such as temperature) and the applied time averaging method.

Rainfall intensity (RI) gauges should be calibrated using a calibration system that:

(a) Has the capability of generating a constant water flow at various flow rates corresponding to the entire operational range of measurement (recommended range: from 0.2 $mm \cdot h^{-1}$ up to 2000 $mm \cdot h^{-1}$);

(b) Is able to measure the flow by weighing the amount of water over a given period of time; and

(c) Is able to measure the output of the calibrated instrument at regular intervals or when a pulse occurs, which is typical for the majority of tipping-bucket rain gauges.

2) Requirements

(a) The calibration system should be designed to obtain uncertainties less than 1% for the generated RI, and such performances should be reported and detailed;

(b) In case of tipping bucket rain gauges (TBRG), correct and suitable balancing of the buckets should be verified in order to guarantee a minimal variance of the tipping duration during the measurement process;

(c) At least five reference intensities suitably spaced to cover the whole operating range of the instrument should be used;

(d) The number of RI reference setting points should be large enough to be able to determine a fitting curve by interpolation. The reference setting should be selected and well spaced so that the calibration curve can be established by interpolation in such a way that the uncertainty of the fitting curve is less than the required measurement uncertainty for the full range;

(e) The calculation of flow rate is based on the measurements of mass and time;

(f) The measurement of mass is better than 0.1%;

(g) The duration of any test should be long enough to guarantee an uncertainty less than 1% on the generated intensity;

(h) The maximum time resolution for the measurement of rainfall intensities should be 1 second;

(i) The following issues must be considered for any related laboratory activity in addressing possible error sources:

- The water quality/purity used for calibration should be well defined;
- The reproducibility of the calibration conditions should be a priority;
- Suitable control and recording equipment should be used (such as PC-controlled);
- All acquisition systems must comply with electromagnetic compatibility to avoid parasitic pulses;

(j) The quantity, for which measurements of precipitation are generally reported, is height expressed in millimeters although weighing gauges measure mass. Since the density of rain depends on ambient temperature the relationship between mass and the equivalent height of rainfall introduces an inaccuracy that must be taken into account during calibration and uncertainty calculation;

(k) The environmental conditions during each calibration shall be noted and recorded:

- Date and hour (start/end);
- Air temperature [°C];
- Water temperature [°C];

- Atmospheric pressure [hPa];
- Ambient relative humidity [%];
- Any special condition that may be relevant to calibration (e.g. vibrations);
- Evaporation losses must be estimated [mm];

(l) The number of tests performed for each instrument, their description in terms of time units and/or number of tips shall be documented.

3) Procedure for data interpretation

(a) The results should be presented in the form of a graph where the relative error is plotted against the reference intensity. The relative error is evaluated for each reference flow rate as:

$$e = \frac{I_m - I_r}{I_r} \cdot 100\% ,$$

where I_m is the intensity measured by the instrument and I_r the actual reference intensity provided to the instrument;

(b) Ideally five tests, but a minimum of three, should be performed for each set of reference intensities, so that five error figures are associated with each instrument. The average error and the average values of I_r and I_m are obtained by discarding the minimum and the maximum value of e obtained for each reference flow rate, then evaluating the arithmetic mean of the three remaining errors and reference intensity values. For each reference intensity, an error bar encompassing all the five error values used to obtain the average figures should be reported;

(c) In addition, I_r versus I_m can be plotted, where I_m and I_r are average values, calculated as indicated above; all data are fitted with an interpolating curve, obtained as the best fit (linear, power law or second order polynomial are acceptable);

(d) In the graphs presenting the results, the ± 5% limits shall be drawn to allow an easy comparison of the results with the WMO recommendations;

(e) In case water storage should occur for an intensity below the maximum declared intensity, the intensity at which water storage begins should be documented in the calibration certificate and intensities above this limit should not be considered;

(f) In addition to measurements based on constant flow rates, the step response of each non-TBRG instrument should be determined. The step response should be measured by switching between two different constant flows, namely from 0 $mm \cdot h^{-1}$ to the reference intensity and back to 0 $mm \cdot h^{-1}$. The constant flow should be applied until the output signal of the instrument is stabilized, *i.e.* when the further changes or fluctuation in the established RI can be neglected with respect to the stated measurement uncertainty of the reference system. The sampling rate must be at least one per minute for those instruments that allow it. The time before stabilization is assumed as a measure of the delay of the instrument in measuring the reference RI. Less than one minute delay is required for accurate RI measurements. The response time should always be documented in the calibration certificate.

4) Uncertainty calculation

The following sources of the measurement uncertainty should be considered and quantified:

(a) Flow generator: Uncertainty on the flow steadiness deriving from possible variations in the constant flow generation mechanism, including pressure difference inside water content and in distribution pipes;

(b) Flow measuring devices (both reference and device under calibration): Uncertainties due to the weighing apparatus, to time measurement and delays in acquisition and data processing and to the variation of experimental and ambient conditions such as Temperature and Relative Humidity.

These two sources of uncertainty are independent from each other; therefore a separate analysis can be performed, and results can be then combined into the uncertainty budget.

Recommendation 3 (CIMO-XIV)

PROCEDURE AND REFERENCE INSTRUMENTS FOR FIELD RAINFALL INTENSITY INTERCOMPARISONS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting that:

(1) For the intercomparison of instruments a well-defined reference is required,

(2) The WMO *Guide to Meteorological Instruments and Methods of Observation (*WMO-No. 8) (CIMO Guide) recommends neither procedure nor a reference instrument for the rainfall intensity (RI) field intercomparisons,

Considering that:

(1) The CIMO Guide requires that agreement on analyses methodology should be done before any intercomparison,

(2) A reference can be defined as a virtual device based on the set of measuring instruments,

Recommends that:

The following procedure and reference instrument be used for the field intercomparison of RI measuring instruments:

(1) The use of one single reference instrument in the intercomparison should be avoided. Instead, a set of gauges acting as a working reference is recommended. The combined analysis of a set of reference gauges allows the best possible estimation of rainfall intensity in the field, given their demonstrated performance during the Laboratory Intercomparison of RI measuring instruments;

(2) The working reference rain gauges should be inserted in a pit according to the EN-13798 Reference Rain Gauge Pit, as adopted by ISO, to minimize the effect of weather related errors on measured rain intensities;

(3) According to the results of the WMO Laboratory Intercomparison of RI Gauges (De Bilt, Genoa, Trappes, September 2004–September 2005), dynamically corrected tipping bucket rain gauges (TBRG) and weighing gauges (WGs) with the shortest step response and the lowest uncertainty are used as working reference instruments. These are: TBRG ETG R102 (Italy), TBRG CAE PMB2 (Italy), WG Meteoservis MRW500 (Czech Republic) and WG Geonor T200B (Norway).

Recommendation 4 (CIMO-XIV)

TERMS OF REFERENCE OF THE WORLD, REGIONAL AND NATIONAL RADIATION CENTRES FOR SOLAR RADIATION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting that the non-attendance of some Regional Radiation Centres (RRCs) at the International Pyrheliometer Comparisons compromises traceability of irradiance measurements performed by these RRCs, their associated National Radiation Centres (NRC), and RRCs' role to guarantee the regional data compatibility and homogeneity,
Considering that:

(1) There have been significant improvements in understanding uncertainties of pyrheliometer measurements,

(2) Some RRCs no longer have traceability to the World Radiation Reference,

Recommends that:

(1) The new Terms of Reference (TOR) be used for the World Radiation Centres, RRCs and NRCs as stated in the Annex to this recommendation;

(2) New TOR be included in the WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8).

Annex to Recommendation 4 (CIMO-XIV)

TERMS OF REFERENCE OF THE WORLD, REGIONAL, AND NATIONAL RADIATION CENTRES FOR SOLAR RADIATION

World Radiation Centres

World Radiation Centres were designated by the thirteenth session of the Executive Council in 1978 through its Resolution 11 (EC-XXX) to serve as centres for international calibration of meteorological radiation standards within the global network and to maintain the standard instruments for this purpose.

A World Radiation Centre shall fulfill the following requirements. It shall either:

(1) (*a*) Possess and maintain a group of at least three stable absolute pyrheliometers, with a traceable 95% uncertainty of less than 1 Wm^{-2} to the World Radiometric Reference, and in stable clear sun conditions with direct irradiances above 700 Wm^{-2}, 95% of any single measurements of direct solar irradiance will be expected to be within 4 Wm^{-2} of the irradiance. The World Radiation Centre Davos is requested to maintain the World Standard Group for the realization of the World Radiometric Reference;

(*b*) It shall undertake training of specialists in radiation;

(*c*) The staff of the centre should provide for continuity and should include qualified scientists with wide experience in radiation;

(*d*) It shall take all steps necessary to ensure at all times the highest possible quality of its standards and testing equipment;

(e) It shall serve as a centre for the transfer of the World Radiometric Reference to the regional centres;

(f) It shall have the necessary laboratory and outdoor facilities for the simultaneous comparison of large numbers of instruments and for the reduction of the data;

(g) It shall follow closely or initiate developments leading to improved standards and/or methods in meteorological radiometry;

(h) It shall be assessed by an International agency or CIMO experts, at least every 5 years to verify traceability of the direct solar radiation measurements.

or

(2) (*a*) Provide and maintain an archive for solar radiation data from all the Member States of WMO;

(b) The staff of the centre should provide for continuity and should include qualified scientists with wide experience in radiation;

(c) It shall take all steps necessary to ensure at all times the highest possible quality of and access to its database;

(d) It shall be assessed by an International agency or CIMO experts, at least every 5 years.

Regional Radiation Centres

A Regional Radiation Centre is a centre designated by a Regional Association to serve as a centre for intraregional comparisons of radiation instruments within the Region and to maintain the standard instruments necessary for this purpose.

A Regional Radiation Centre shall satisfy the following conditions before it is designated as such and shall continue to fulfill them after being designated:

(*a*) It shall possess and maintain a standard group of at least three stable pyrheliometers, with a traceable 95% uncertainty of less than 1 Wm^{-2} to the World Standard Group, and in stable clear sun conditions with direct irradiances above 700 Wm^{-2}, 95% of any single measurements of direct solar irradiance will be expected to be within 6 Wm^{-2} of the irradiance;

(*b*) One of the radiometers shall be compared through a WMO/CIMO sanctioned comparison, or calibrated, at least once every five years against the World Standard Group;

(*c*) The standard radiometers shall be intercompared at least once a year to check the stability of the individual instruments. If the mean ratio, based on at least 100 measurements, and having an 95% uncertainty less than 0.1%, has changed by more than 0.2% and if the erroneous instrument cannot be identified, then a recalibration at one of the World Radiation Centres must be performed prior to further use as standard;

(*d*) It shall have, or have access to, the necessary facilities and laboratory equipment for checking and maintaining the accuracy of the auxiliary measuring equipment;

(*e*) It shall provide the necessary outdoor facilities for simultaneous comparison of national standard radiometers from the Region;

(*f*) The staff of the centre should provide for continuity and should include a qualified scientist with wide experience in radiation;

(*g*) It shall be assessed by a National or International agency or CIMO experts, at least every 5 years to verify traceability of the direct solar radiation measurements.

National Radiation Centres

A National Radiation Centre is a centre designated at the national level to serve as a centre for the calibration, standardization, and checking of the instruments used in the national network of radiation stations and for maintaining the national standard instrument necessary for this purpose.

A National Radiation Centre shall satisfy the following requirements:

(*a*) It shall possess and maintain at least two pyrheliometers for use as a national reference for the calibration or radiation instruments in the national network of radiation stations with a traceable 95% uncertainty of less than 4 Wm^{-2} to the regional representation of the World Radiometric Reference, and in stable clear sun conditions with direct irradiances above 700 Wm^{-2}, 95% of any single measurements of direct solar irradiance will be expected to be within 20 Wm^{-2} of the irradiance;

(b) One of the national standard radiometers shall be compared with a regional standard at least once every five years;

(c) The national standard radiometers shall be intercompared at least once a year to check the stability of the individual instruments. If the mean ratio, based on at least 100 measurements, and having an 95% uncertainty less than 0.2%, has changed by more than 0.6% and if the erroneous instrument cannot be identified then a recalibration at one of the Regional Radiation Centres must be performed prior to further use as standard;

(d) It shall have, or have access to, the necessary facilities and equipment for checking the performance of the instruments used in the national network;

(e) The staff of the centre should provide for continuity and should include a qualified scientist with experience in radiation.

National Radiation Centres shall be responsible for preparing and keeping up to date all necessary technical information for the operation and maintenance of the national network of radiation stations.

Arrangements should be made for the collection of the results of all radiation measurements made in the national network of radiation stations and for the regular scrutiny of these results with a view to ensuring their accuracy and reliability. If this work is done by some other body, the National Radiation Centre shall maintain close liaison with that body.

List of World and Regional Radiation Centres

WORLD RADIATION CENTRES

Davos	(Switzerland)
St. Petersburg[1]	(Russian Federation)

REGIONAL RADIATION CENTRES

Region I (Africa):

Cairo	(Egypt)
Khartoum	(Sudan)
Kinshasa	(Democratic Republic of the Congo)
Lagos	(Nigeria)
Tamanrasset	(Algeria)
Tunis	(Tunisia)

[1] Mainly operated as a World Radiation Data Centre (WRDC) under the GAW Strategic Plan.

Region II (Asia):

Pune	(India)
Tokyo	(Japan)

Region III (South America):

Buenos Aires	(Argentina)
Santiago	(Chile)
Huayao	(Peru)

Region IV (North and Central America):

Toronto	(Canada)
Boulder	(United States of America)
Mexico City/Colima	(Mexico)

Region V (South-West Pacific):

Melbourne	(Australia)

Region VI (Europe):

Budapest	(Hungary)
Davos	(Switzerland)
St. Petersburg	(Russian Federation)
Norrköping	(Sweden)
Trappes/Carpentras	(France)
Uccle	(Belgium)
Lindenberg	(Germany)

Recommendation 5 (CIMO-XIV)

DEVELOPMENT OF UV CALIBRATION CENTRES

THE COMMISSISON FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting the need to guarantee the quality and traceability of UV measurements,

Considering that there is a need for establishing UV calibration centres, the development of new reference methods, and the need to insure global comparability of UV observations,

Recommends that:

(1) Members seriously consider establishing UV calibration centres;

(2) A comparison of calibration methodologies at calibration centres be undertaken once established;

(3) Such a comparison needs to be coordinated through other relevant WMO Technical Commissions and Programmes and relevant multi-national coordinating bodies.

Recommendation 6 (CIMO-XIV)

ESTABLISHMENT OF THE PRIMARY WMO REFERENCE CENTRE FOR AEROSOL OPTICAL DEPTH MEASUREMENTS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting the need to establish a primary reference centre to provide traceability for optical depth measurements, allowing international intercomparisons with the goal of producing the highest quality data possible,

Considering that:

(1) There is a need to establish a primary reference centre for optical depth measurements,

(2) The World Optical Depth Research and Calibration Centre (WORCC) has significantly contributed to improving the understanding of optical depth measurements,

Recommends that the WORCC at PMOD/WRC Davos be recognized as the primary WMO reference centre for aerosol optical depth measurements as part of WRC activities.

Recommendation 7 (CIMO-XIV)

WRC INFRARED RADIOMETRY SECTION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting the crucial need for measuring infrared radiation at the highest level of quality possible,

Considering that:

(1) Following Recommendation 1 (CIMO-XIII) — Establishment of a World Infrared Radiometer Calibration Centre, the PMOD/WRC had established within the World Radiation Centre the Infrared Radiometry Section (WRC-IRS), in January 2004, to fulfil Recommendation 1 (CIMO-XIII),

(2) WRC-IRS is crucial to worldwide quality and compatibility of infrared data,

(3) There remains a need to develop additional infrastructure and to establish operational procedures for the WRC-IRS,

Recommends that:

(1) The WRC-IRS establishes an Interim WMO Pyrgeometer Infrared Reference using the procedures and instrumentation that make up the World Infrared Standard Group;

(2) The members of CIMO and instrument manufacturers be encouraged to collaborate in the development of instruments and methods for improving traceability of infrared (3 – 50μm) irradiance measurements to SI units;

(3) Every three years Regional Radiation Centres supporting networks measuring Infrared (3 – 50μm) irradiance shall submit their pyrgeometers to the WRC-IRS for comparison, to ensure that networks run by NMHSs are compatible.

Recommendation 8 (CIMO-XIV)

USE OF GPS GEOMETRIC HEIGHT TO DERIVE PRESSURE AND GEOPOTENTIAL HEIGHT FOR OPERATIONAL RADIOSONDES

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

(1) The excellent reproducibility of geopotential heights derived from GPS geometric heights found during the WMO Intercomparison of High Quality Radiosonde Systems in Mauritius,

(2) The small systematic differences found in the lower troposphere between geopotential heights derived from high quality radiosonde pressure sensors and geopotential heights derived from GPS geometric height measurements,

(3) The small systematic differences found in Mauritius between pressure values derived from high quality radiosonde pressure sensors and pressure values derived from GPS geometric height measurements,

(4) The much better reproducibility of GPS geopotential heights at pressure lower than 20 hPa compared to geopotential heights from pressure sensors,

Considering:

(1) There would be a major benefit to upper-air observing networks (operational and climate), if the cost of GPS radiosondes could be reduced,

(2) Radiosonde systems in China and the Russian Federation already use geometric height measurements to produce geopotential height,

Recommends that GPS radiosondes which derive geopotential heights from GPS geometric height measurements are suitable for use in the GOS for operational purposes and may be suitable for climate research purposes, particularly in the stratosphere. Members should explore with the manufacturers how the benefits from this technological advance can be exploited to reduce the cost of consumables for upper-air operations.

Recommendation 9 (CIMO-XIV)

SUITABLE TEMPERATURE MEASUREMENTS FOR HIGH QUALITY REFERENCE UPPER-AIR STATIONS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

(1) The good agreement obtained between the temperature measurements of most new operational radiosondes participating in the WMO Intercomparison of High Quality Radiosonde Systems in Mauritius,

(2) The requirements of GCOS to establish GCOS Reference Upper-Air Network (GRUAN),

(3) The practical difficulties of building specialized reference radiosondes on a scale that allows the systems to be adequately tested with the operational problems debugged,

(4) The traceability of the operational radiosonde temperature sensor calibrations to the relevant national temperature standard,

Considering:

(1) The main problem in maintaining the highest standards in radiosonde measurements are the changes introduced by production engineering, when components may need to be replaced to allow economic production to continue,

(2) The production problems rarely occur simultaneously in two independent radiosonde designs,

Recommends that a suitable working temperature reference for the GRUAN and similar installations would be measurements from two of the best operational radiosondes, or a combination of one operational radiosonde with a higher quality multi-thermistor temperature sensing system. The two radiosonde types could either be flown together to establish the origin of temperature differences between the systems, or launched from the same site with a relatively short time between the two launches, providing a better representation of a larger volume of the atmosphere near the site. The radiosondes should use GPS height measurements to minimize errors in the heights assigned to the temperature measurements.

Recommendation 10 (CIMO-XIV)

USEFULNESS OF INTEROPERABLE UPPER-AIR SYSTEMS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

(1) The two differing views on the usefulness of Interoperable Upper-Air Systems provided by HMEI to the ET-UASI in 2006,

(2) The requirement to reduce the operational cost of upper-air observations worldwide, while not losing traceable measurement quality,

(3) That the interoperability is most easily achieved on systems that use relatively complex ground systems such as radio-theodolites or secondary radars, operating at frequencies near 1680 MHz, that may not be suitable for all locations worldwide,

(4) GPS radiosonde systems operating at around 403 MHz ought to have relatively cheap PC-based ground systems with no moving parts,

(5) The encouraging results of the demonstration test of IMS 1600 interoperable system in Dar Es Salaam, United Republic of Tanzania, in October 2004, and the experience with using of similar systems in Africa,

Considering:

(1) The cost of running different types of ground systems varies significantly between countries, depending on technical resources available to support systems and to sustain the operation after initial delivery of the equipment,

(2) Most radiosonde designs and ground system software are evolving rapidly with time, so that regular software updates are necessary to cope with modifications to the radiosonde designs,

(3) Some manufacturers are unwilling to cooperate to facilitate the operation of interoperable systems, partly because of lack of responsibility of the manufacturer for the output quality from the interoperable system,

Recommends that Members consider whether the use of an interoperable system will be a suitable method of reducing the costs of their upper-air observations. This will necessitate negotiating with the manufacturers and exploring available options. It would need to be established whether the climatology of upper winds at the location were suitable for use with a radiotheodolite. It will be essential to establish the costs of long term sustainability, including hardware and software upgrades, and identifying the method of technical support to the upper-air system.

Recommendation 11 (CIMO-XIV)

REGIONAL INSTRUMENT CENTRE WITH FULL CAPABILITIES AND FUNCTIONS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting Recommendation 19 (CIMO-IX) – Establishment of Regional Instrument Centres (RICs),

Considering:

(1) The results of the evaluation of the RICs and the need for the sustainability of their services to Members,

(2) The need for regular calibration and maintenance of meteorological and related environmental instruments to meet increasing needs for high quality meteorological and hydrological data,

(3) The need for building the hierarchy of traceability of measurements to International System of Units (SI) standards,

(4) The requirements of Members in the Region for standardization of meteorological and related environmental measurements,

(5) The need for international instrument comparisons and evaluations in support of worldwide data compatibility and homogeneity,

(6) The role RICs may play in the Global Earth Observing System of Systems, Natural Disaster Prevention and Mitigation, QMF and other WMO crosscutting programmes,

Recommends that:

(1) Regional Instrument Centres with full capability should have the following capabilities to carry out their corresponding functions:

Capabilities:

(a) A RIC must have, or have access to, the necessary facilities and laboratory equipment to perform the functions necessary for the calibration of meteorological and related environmental instruments;

(b) A RIC must maintain a set of meteorological standard instruments and establish traceability of its own measurement standards and measuring instruments to the SI;

(c) A RIC must have qualified managerial and technical staff with necessary experience in fulfilling its functions;

(d) A RIC must develop its individual technical procedures for calibration of meteorological and related environmental instruments using calibration equipment employed by the RIC;

(e) A RIC must develop its individual quality assurance procedures;

(f) A RIC must participate in, or organize inter-laboratory comparisons of standard calibration instruments and methods;

(g) A RIC must, as appropriate, utilize the resources and capabilities of the Region to the best interest of the Region;

(h) A RIC must, as far as possible, apply international standards applicable for calibration laboratories, such as ISO 17025;

(i) A recognized authority must assess a RIC, at least every five years, to verify its capabilities and performance;

Corresponding Functions:

(j) A RIC must assist Members of the Region in calibrating their national meteorological standards and related environmental monitoring instruments;

(k) A RIC must participate in or organize, WMO and/or regional instrument intercomparisons, following relevant CIMO recommendations;

(l) According to relevant recommendations on the WMO Quality Management Framework a RIC must contribute positively to Members regarding quality of measurements;

(m) A RIC must advise Members on inquiries regarding instrument performance, maintenance and the availability of relevant guidance materials;

(n) A RIC must actively participate in, or assist in the organization of regional workshops on meteorological and related environmental instruments;

(o) The RIC must cooperate with other RICs in standardization of meteorological and related environmental measurements;

(p) A RIC must regularly inform Members and report,[1] on an annual basis, to the president of the Regional Association and to the WMO Secretariat on services offered to Members and activities done;

(2) The WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8) Annex 1.A should be updated accordingly.

[1] Web based approach is recommended.

Recommendation 12 (CIMO-XIV)

REGIONAL INSTRUMENT CENTRE WITH BASIC CAPABILITIES AND FUNCTIONS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting Recommendation 19 (CIMO-IX) – Establishment of Regional Instrument Centres (RICs),

Considering:

(1) The results of the evaluation of the RICs and the need for the sustainability of their services to Members,

(2) The need for regular calibration and maintenance of meteorological and related environmental instruments to meet increasing needs for high quality meteorological and hydrological data,

(3) The need for building the hierarchy of the traceability of measurements to International System of Units (SI) standards,

(4) The requirements of Members in the Region for standardization of meteorological and related environmental measurements,

(5) The need for international instrument comparisons and evaluations in support of worldwide data compatibility and homogeneity,

(6) The role RICs play in the Global Earth Observing System of Systems, Natural Disaster Prevention and Mitigation, QMF and other WMO crosscutting programmes,

Recommends that:

(1) Regional Instrument Centres with basic capabilities and functions should have the following capabilities to carry out their corresponding functions:

Capabilities:

(a) A RIC must have, or have access to, the necessary facilities and laboratory equipment to perform the functions necessary for the calibration of meteorological and related environmental instruments,

(b) A RIC must maintain a set of meteorological standard instruments[1] and establish traceability of its own measurement standards and measuring instruments to the SI,

(c) A RIC must have qualified managerial and technical staff with necessary experience in fulfilling its functions,

(d) A RIC must develop their individual technical procedures for calibration of meteorological and related environmental instruments using calibration equipment employed by the RIC,

(e) A RIC must develop their individual quality assurance procedures,

(f) A RIC must participate in, or organize inter-laboratory comparisons of standard calibration instruments and methods,

[1] For calibrating one or more of the following variables: temperature, humidity, pressure and others specified by the Region.

(g) A RIC must, when appropriate, utilize the resources and capabilities of the Region to the best interest of the Region,

(h) A RIC must, as far as possible, apply international standards applicable for calibration laboratories, such as ISO 17025,

(i) A recognized authority must assess a RIC, at least every five years, to verify their capabilities and performance,

Corresponding functions:

(j) A RIC must assist Members of the Region in calibrating their national meteorological standards and related environmental monitoring instruments according to Capabilities (b),

(k) According to relevant recommendations on WMO Quality Management Framework a RIC must contribute positively to Members regarding quality of measurements,

(l) A RIC must advise Members on inquiries regarding instrument performance, maintenance and the availability of relevant guidance materials,

(m) The RIC must cooperate with other RICs in standardization of meteorological and related environmental measurements,

(n) A RIC must regularly inform Members and report,[1] on an annual basis, to the president of the Regional Association and to the WMO Secretariat on services offered to Members and activities done,

(2) The WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8) Annex 1.A should be updated accordingly.

[1] Web based approach is recommended.

Recommendation 13 (CIMO-XIV)

REVIEW OF THE RESOLUTIONS OF THE EXECUTIVE COUNCIL RELATED TO THE COMMISSION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting with satisfaction action taken by the Executive Council on the previous recommendations of the Commission,

Recommends:

(1) That Resolution 7 (EC-LV) — Report of the thirteenth session of the Commission for Instruments and Methods of Observation no longer be considered necessary;

(2) That Resolution 13 (EC-XXXIV) — Development and comparison of radiometers, be still kept in force.

ANNEXES

ANNEX I
Annex to paragraph 4.2.17 of the general summary

PROVISIONAL PROGRAMME OF WMO SURFACE-BASED INSTRUMENT INTERCOMPARISONS (2006–2010)

1. WMO Field Intercomparison on RI, Vigna di Valle, Italy, August 2007–August 2008;

2. WMO Combined Intercomparison of Thermometer Screens/Shields in conjunction with Humidity Measuring Instruments, Ghardaïa, Algeria, January 2007 to January 2008;

3. WMO Combined Intercomparison of Thermometer Screens/Shields in conjunction with Humidity Measuring Instruments in Arctic Region;

4. WMO Intercomparison of Present Weather Sensors in tropical conditions;

5. WMO Pilot Intercomparison of Sea-level and Tsunami monitoring instruments;

6. WMO Intercomparison of Hydrological Gauges to cover both normal conditions and extreme events;

7. WMO Intercomparison on Solid Precipitation including Snowfall and Snow Depth measurements at automatic stations;

8. WMO Intercomparison of Ceilometers in support of the ET on Upper-Air Systems Intercomparisons.

ANNEX II
Annex to paragraph 4.3.14 of the general summary

PROVISIONAL PROGRAMME OF WMO PYRHELIOMETER INTERCOMPARISONS (2006–2010)

1. WMO Eleventh International Pyrheliometer Comparison (IPC-XI), Davos, Switzerland, September/October 2010;

2. WMO Regional Pyrheliometer Comparisons, 2006–2010.

ANNEX III
Annex to paragraph 5.2.11 of the general summary

PROVISIONAL PROGRAMME OF WMO UPPER-AIR INSTRUMENT INTERCOMPARISONS (2006–2010)

1. WMO High Quality Radiosonde Regional Intercomparison, Region II, China;

2. WMO International Evaluation of AMDAR Water Vapour Sensor;

3. WMO Evaluation of Wind Profiler Wind Measurement Quality and Quality Control Procedures

4. International Test-bed Experiments and Pilot Studies for Integrated In-situ and Remote Sensing Upper-Air Networks (including tropical and subtropical tests);

5 Weather Radar Workshops to Examine Differences on Signal and Data Processing Using Common Signal Data Set.

ANNEX IV
Annex to paragraph 10.6 of the general summary

TERMS OF REFERENCE OF OPAG TEAMS AND RAPPORTEURS

A. OPAG-SURFACE

A.1 Expert Team on Surface Technology and Measurement Techniques (ET-ST&MT)

1. Monitor and report on progress in development and performance of new surface observation technologies and measurement techniques, for example ultrasonic wind sensors and optical precipitation gauges;

2. In collaboration with the other technical commissions identify siting, performance, classifications and metadata standards for systems and individual sensors used for Synoptic and mesoscale meteorology, Climate, Marine, Agrometeorology, Hydrology, Urban and Roadway purposes. Identify standards for inclusion in the CIMO Guide;

3. Recommend standard observing methods for the automatic measurement of present weather, clouds, the state of the ground and weather phenomena. Advise on optimizing manual and automated methods for reporting present weather, clouds, the state of the ground and weather phenomena. Consult with the HMEI as appropriate;

4. Develop standards for the interoperability of instruments hardware and software to allow easy exchange by users. Consult with the HMEI as appropriate;

5. Evaluate the performance of AWOSs in tropical, arctic, mountainous and desert regions and consult manufacturers on relevant findings to propose improved designs. Advise Members on use of AWOS in extreme climatological conditions;

6. Monitor and review the available algorithms used in AWSs and advise on their possible standardization;

7. Support to DPM in identifying how surface-based technologies can support monitoring of natural hazards, such as high wind speeds and extreme precipitation rates;

8. In view of the increased impact of extreme weather events, encourage the instrument manufacturers and others to: Develop more robust instruments with greater resilience to extreme weather conditions and combinations of weather conditions; Develop instruments with increased measuring range;

9. Taking into account the environmental concerns of Members using mercury-based instruments investigate alternative solutions and advise Members;

10. Develop guidelines and procedures for the transition from manual to automatic weather stations, including assessment of data homogeneity, and recommend them for inclusion in the CIMO Guide;

11. In cooperation with the HMEI, encourage manufacturers to develop lower power instruments so power sources such as solar and wind can be used more frequently;

12. Respond to requests from relevant CBS ETs to review and report on evaluation calibration requirements for satellite remote sensing of surface variables in line with the development in the WMO Integrated GOS;

13. Update the relevant parts of the CIMO Guide in collaboration with the Rapporteur on the CIMO Guide.

A.2 Expert Team on Surface-Based Instrument Intercomparisons and Calibration Methods (ET-SBII&CM)

1. Act as the International Organizing Committee for Surface-based Instrument Intercomparison (IOC-SBII);

2. Prepare and prioritize proposals for instrument intercomparisons according to the CIMO Provisional Programme of WMO Surface-based Instrument Intercomparisons (2006–2010) and available funds, in particular taking into account ET suggestions and requests from Technical Commissions, GCOS, etc;

3. Prepare an implementation plan for each approved intercomparison proposal, taking into account suggestions from HMEI if required;

4. Coordinate activities related to the organization and conduct of WMO Surface-Based Instrument Intercomparisons according to the CIMO Provisional Programme of WMO Surface-based Instrument Intercomparisons (2006–2010). The emphasis should be placed on the ongoing intercomparisons, namely: the WMO Field Intercomparison of Rainfall Intensity Gauges (Vigna di Valle, Italy, 2007–2008) and the WMO Combined Intercomparison of Thermometer Screens/Shields in Conjunction with Humidity Measurements (Ghardaïa, Algeria, 2007–2008), the latter followed by a similar intercomparison in an arctic environment at Iqaluit, Baffin Island, Canada;

5. Take responsibility for overseeing the evaluation of the intercomparison results;

6. To organize and participate in peer reviews of the intercomparison results before publication;

7. According to intercomparison results, update the recommended standard calibration procedures, including traceability, especially for new measured variables;

8. Take responsibility for producing targeted documents and recommendations for the user communities;

9. Provide technical and scientific advice on surface-based measurements to Members, as requested through the WMO Secretariat;

10. Prioritize and prepare proposals as required from Members suggestions:

    a) Updated Present Weather instrument intercomparison demonstrating use in tropical environment;

    b) Deployments of laser ceilometers for integration and use for pilot projects and test-bed studies for future operational upper-air networks (in collaboration with the ET-RSUT&T);

c) Develop methodologies for assessment of the dynamic and static uncertainty characteristics of sea-level sensors. A small sample of sensors will be used to develop the techniques and form preliminary intercomparison results. These will be used to plan and guide a larger scale intercomparison of a wide variety of sensing technologies. The needs of other sea-level users, including tidal, climate and oceanography, will be included;

d) In consultation with CCl, Antarctic WG, WCRP-CLiC, WCP, CHy, CAgM, CBS and GCOS, assess the methods of measurement and observation of solid precipitation, snowfall and snow depth at automatic unattended stations used in cold climates (polar and alpine). This includes:

- Documenting the needs of WMO Technical Commissions and Programmes;
- Compiling, updating and if required, ensuring compatibility of measurement standards and requirements of WMO Technical Commissions for cold climate precipitation measurement;
- Updating and making accessible all metadata related to precipitation measurement instrumentation at all NMHS AWS operated in cold climate regions, and especially for those countries participating in IPY. (A recent WCRP/CLiC survey of their in-situ measurements would provide a guide for information required.);
- Preparing national summaries of the methods, issues and challenges of automated solid precipitation measurement in cold climate countries;
- Assessing the need for an intercomparison of methods and equipment for automated snowfall/snow depth/precipitation measurements in cold climate regions, on both global and regional basis, and develop an intercomparison plan) during the IPY period;

e) Intercomparisons of hydrological gauges to cover both normal conditions and extreme events;

11. Update the relevant parts of the CIMO Guide in collaboration with the Rapporteur on the CIMO Guide.

A.3 Expert Team on Meteorological Radiation and Atmospheric Composition Measurements (ET-MR&ACM)

1. Initiate and coordinate pre-, and post-comparison activities of IPC-XI, 2010, WRC, Switzerland;

2. Initiate and coordinate pre-, and post-comparison activities of RPCs, 2006–2010, either in conjunction with IPC-XI or at RPCs concerned;

3. Coordinate the dissemination of World Radiometric Reference (WRR) factors to regional and national radiation standards;

4. Liaise with the World Climate Research Programme on matters related to Baseline Surface Radiation Network and inform Members of developments;

5. Liaise with the three CAS SAGs for Ozone, UV and Aerosol and report, as necessary, on the operational practice for measurements of Ozone, UV, Aerosol Optical Depths, and other issues as agreed;

6. Update the relevant parts of the CIMO Guide in collaboration with the Rapporteur on the CIMO Guide;

7. Provide technical and scientific guidance to the WRC Davos for the further development of the World Infrared Standard Group (WISG) of radiometers to ensure the ongoing traceability of atmospheric radiation measurements and coordinate the dissemination of pyrgeometer calibration coefficients;

8. Evaluate the process of the WISG transfer to network measurement of infrared irradiance and if necessary, refine the recommendations on infrared calibration procedures;

9. Respond to instrument and measurement problems reported by WRDC St. Petersburg, Russian Federation;

10. Initiate activities so that radiation measurements in all national radiation networks are of a high quality;

11. Liaise with BIPM and report on the status of the traceability of radiation measurements to SI;

12. Provide technical and scientific advice on surface-based measurements to Members, as requested through the WMO Secretariat by the production of supplementary targeted documents and recommendations for the user community who have requested intercomparisons;

13. Respond to requests from relevant CBS ETs to review and report on evaluation calibration requirements for satellite remote sensing of surface radiation and atmospheric composition variables in line with the development in the WMO Integrated GOS.

B. OPAG-UPPER AIR

B.1 Expert Team on Upgrading Global Upper-Air Networks (ET-UGUN)

1. Monitor systematic performance of radiosonde networks in GOS and liaise with Members and HMEI on performance issues. Reports will be posted annually to the CIMO Website for use by network managers and all users;

2. Investigate options for reducing cost of operational upper-air observations including: cost of radiosonde consumables; the use of interoperable radiosonde systems to improve competitive procurement; reduced use of radiosondes by introduction of other types of upper-air observing systems or adaptive strategies. Promote further the studies on the practical issues of interoperable upper-air systems, evaluate performance of the existing systems and advise Members on appropriate solutions for their requirements;

3. Complete a review of best practices used in the quality management of upper-air networks from which a methodology for affecting better performance can be derived, update relevant CIMO Guide chapters, in collaboration with the Rapporteur, and ensure experiences are shared amongst Members;

4. Address the issue related to the operational safety of hydrogen generators used at the upper-air stations and assist R-TA&TM in developing hydrogen safe practice in the future upper-air training workshops. Review alternative sources of lifting gas including natural gas and helium and make recommendations to Members;

5. Review current approved BUFR templates for detailed radiosonde profile reporting and recommend additions to enable a wider range of user requirements to be met, including high resolution 4D reporting, additional metadata and measured parameters only;

6. Undertake all radiofrequency protection activities for all operational upper-air observing systems, including radiosondes, weather radars, wind profilers, microwave radiometers, etc.

Liaise with the CBS Steering Group on Radiofrequency Allocation by developing and maintaining a strategy for protecting currently allocated frequencies, in collaboration with members of ET-RSUT&T;

7. Improve the global operational Upper-Air Network, in working with the CBS OPAG-IOS, GCOS and RAs, to identify key areas, such as the tropics, for action;

8. Provide required technical guidance to GCOS, CCl and CBS to enable them to establish the GCOS Reference Upper-Air Network (GRUAN);

9. Provide technical review of evolving AMDAR humidity capabilities as requested by CBS OPAG IOS ET EGOS. Liaise with ET-UASI in developing suitable guidelines for Members following intercomparisons;

10. Liaise with HMEI in recommending solutions for outstanding systematic technical problems with upper air instrumentation.

B.2 Expert Team on Upper-air System Intercomparisons (ET-UASI)

1. Act as the International Organizing Committee for Upper-air Systems Intercomparison (IOC-UASI) according to the CIMO Guide;

2. Prepare and prioritize proposals for instrument intercomparisons according to the CIMO Provisional Programme of WMO Upper-Air Instrument Intercomparisons (2006–2010) and available funds, in particular taking into account ET suggestions and requests from Technical Commissions, GCOS, etc;

3. Prepare an implementation plan for each approved intercomparison proposal;

4. Coordinate activities related to the organization and conduct of WMO intercomparisons of in-situ and remote sensing upper-air systems according to the CIMO Plan. This will involve liaison with HMEI. It will also recommend the number of experts supported by WMO necessary to implement the test;

5. Take responsibility for overseeing the evaluation of the intercomparison test results;

6. To organize and participate in peer reviews of the intercomparison results before publication;

7. Take responsibility for producing targeted documents and recommendations for the user communities who have requested the intercomparison, including representatives of HMEI, operational network managers, GCOS and GEOSS managers;

8. Provide technical and scientific advice on upper-air measurements to Members, as requested through the WMO Secretariat;

9. Submit meta data records and intercomparisons for radiosonde observations to International Data Centers;

10. Liaise with HMEI in improving consistency of the humidity measurements between day and night.

11. Update the relevant parts of the CIMO Guide in collaboration with the Rapporteur on the CIMO Guide.

B.3 Expert Team on Remote Sensing Upper-air Technology and Techniques (ET-RSUT&T)

1. Review latest developments in the field of remote sensing technology and report to Members;

2. Review current Wind Profiler Network operational activities, identifying strengths, weaknesses and operational costs. Identify best practices including siting and calibration and quality control, noting the need for close collaboration with users, such as the data assimilation community. Provide improved guidance material for the Members;

3. Work with ET-UASI to design and conduct an intercomparison to evaluate Profiler wind quality;

4. Monitor implementation of Microwave Radiometers as operational systems and report on progress, specifically quality of temperature measurements in the planetary boundary layer;

5. Monitor implementation of GPS Water Vapour Networks as operational systems and report on progress. Evaluate quality of data in suitable intercomparison including radiosonde and microwave radiometer. Develop operational guidelines and recommend suitable operational data exchange protocols;

6. Evaluate and report on the potential of the Raman water vapour lidar as an operational upper-air observing system for the troposphere;

7. Facilitate activities associated with improving the quality of weather radar operations, including signal and data processing, by initiating a series of intercomparison workshops exercising radar algorithms on common data sets;

8. Establish a Web based up-to-date fully comprehensive database of the global use of weather radar;

9. Provide guidance on weather radar siting and operation with respect to wind turbines and sources of radiofrequency interference;

10. Review current weather radar network data exchange methods and make recommendations on the preferred method to be adopted by WMO for international exchange, noting OPERA's BUFR implementation and its limitations;

11. Respond to requests from relevant CBS ETs to review and report on evaluation calibration requirements for satellite remote sensing methods in line with the development in the WMO Integrated GOS;

12. Review current operational lightning detection networks, and report on strengths and weaknesses, including coverage, accuracy, reliability and cost effectiveness. Undertake Moroccan intercomparison of existing systems and make recommendations for enlargement of the networks to poorly covered areas, such as Africa;

13. Working with ET-UASI initiate a series of pilot projects and testbed studies to establish the principles for the optimal mix of sensing systems to improve both temporal and spatial capabilities for future operational upper air networks, noting the need for close collaboration with users, especially the data assimilation and NWP communities;

14. Review and update existing training material and support OPAG-CB in the production of suitable training workshops, reference material and guidelines for all operational aspects of remote sensing systems, for example practitioner guide to weather radar;

15. Update the relevant parts of the CIMO Guide in collaboration with the Rapporteur on the CIMO Guide.

C. OPAG-CAPACITY BUILDING

C.1 Expert Team on RICs (ET-RICs)

1. Determine the status of the traceability of surface-based measurements to SI and develop a strategy towards ensuring worldwide traceability of measurements to SI;

2. Develop criteria for regular evaluation and establish metrics for assessing RIC performance;

3. Recommend instruments for use by RICs for calibration of meteorological and related environmental instruments;

4. Engage manufacturers in developing RIC technical procedures for instrument calibration and instrument maintenance;

5. Collaborate with the RICs in defining RIC functional capabilities;

6. Strengthen the Quality Assurance of the RICs/RRCs as a crosscutting issue involving the regional and technical cooperation activities as well as GCOS;

7. Identify the need for regional workshops on metrology;

8. Develop a methodology for conducting intercomparisons between legacy and next generation calibration instruments as well as between different calibration tools;

9. Encourage RICs to organize and/or participate in the inter-laboratory comparisons at appropriate time intervals;

10. In collaboration with RAs, establish RIC selection criteria, qualification and evaluation procedures, including procedures for rectification of problems when necessary;

11. Improve procedures for quality management of observations, instrument maintenance, calibration and operational practices;

12. Monitor the capabilities and functions of the RICs through yearly reports and 5-year evaluation of the RICs and inform relevant Members and presidents of RAs;

13. Promote further the partnership between RICs of developing and developed countries and to encourage Members to use the system of internship in RICs in the various WMO Regions;

14. Recommend the optimum network of suitable RICs for calibration in Regions, taking account of current and future capabilities;

15. Review and provide guidance to develop the IMOP capacities of developing countries, in particular the development and fabrication of instruments;

16. Coordinate with the CMA preparation of future versions of the World Meteorological Instrument Catalogue. Investigate the possibility for collaboration with the Hydro-Meteorological Equipment Industry Association.

17. Update the relevant parts of the CIMO Guide in collaboration with the Rapporteur on the CIMO Guide.

C.2 Rapporteur on Training Activities and Training Materials (R-TA&TM)

1. In collaboration with the CIMO OPAGs, RICs, RRCs and the HMEI, coordinate, update and develop training materials, conduct CIMO training and capacity building activities and provide training materials on CD ROMs to Members;

2. Assist in implementation of CIMO training and capacity building events, such as training workshops on upper-air measurements (depending on the available resources and concentrating on Regions where training has not yet been held), technical conferences such as TECO and METEOREX;

3. Cooperate in the organization of instrument related workshops and seminars co-sponsored by WMO, such as the International Conference on Experiences with AWS (ICEAWS);

4. Cooperate with the RMTCs/RICs/RRCs in promoting training courses related to instruments and methods of observation, with a special emphasis on automated observing systems, radar systems, instrument maintenance and calibration;

5. Arrange for the publication of training material, used in the above training, under IOM Report series;

6. In collaboration with other ETs, develop computer-aided learning strategy and explore a possibility to establish a Virtual Training Laboratory in one of the RICs and RRCs;

7. Develop further the training components within the CIMO/IMOP Web Portal, with inputs from HMEI as appropriate;

8. Cooperate with manufacturers, RICs and RRCs in promoting attachments / on-the-job training of instrument specialist from developing countries;

9. Develop training material for technicians on the maintenance and use of various individual instruments, for instance, Automated Weather Observing Systems (AWOSs), meteorological radars and algorithms for use by AWOS. Request input from instrument manufacturers as appropriate;

C.3 Rapporteur on CIMO Guide (R-CIMO-Guide)

1. In collaboration with CIMO OPAGs, ETs, HMEI and the Secretariat, coordinate activities aimed at periodic updating of the CIMO Guide, namely:

    a. Collect proposals from user community for updates and revisions;
    b. Identify areas to be updated, revised or completely rewritten and advise the CIMO-MG;
    c. Identify experts for updating/revision of the relevant parts of the Guide and advise the CIMO-MG;
    d. Coordinate the work of experts on revisions to the Guide;
    e. Arrange for approval of the updated/revised parts of the Guide according to a procedure approved by the CIMO-MG;
    f. Provide updates/revisions in a form of track changes for consideration by the CIMO-MG and approval by the president of CIMO or a CIMO session;
    g. Provide regular reports to the CIMO-MG and Secretariat;

2. In collaboration with CIMO OPAGs, ETs and HMEI develop further the CIMO/IMOP Web Portal on Development, Maintenance and Operation of Instruments, Observing Methods and Automatic Weather Stations. Provide regular information to Members.

C.4 Rapporteur on Regional Implementation Activities (R-RIA)

1. Liaise with the Regions (regional rapporteurs, regional centers) in assisting CIMO expert teams in implementing of instrument and methods of observations in the Regions.

C.5 Rapporteur on Climate Observation (R-CO)

1. Collaborate with CCl in monitoring emerging requirements for climatological observation;

2. In collaboration with relevant CIMO and CCl OPAGs, encourage conducting of studies and draft relevant proposals for observing practices for climate monitoring;

3. In coordination with the Rapporteur on CIMO Guide include updated/new practices in the revised versions of the Guide;

4. Provide guidance on the selection and use of instruments in harsh climatological conditions and remote locations.

ANNEX V
Annex to paragraph 10.7 of the general summary

DESIGNATION OF CHAIRPERSONS AND RAPPORTEURS OF THE OPAG TEAMS

A. OPAG-SURFACE

A.1 Expert Team on Surface Technology and Measurement Techniques (ET-ST&MT)
Mr K.-H. Klapheck (Germany)

A.2 Expert Team on Surface-Based Instrument Intercomparisons and Calibration Methods (ET-SBII&CM)
Mr M. Leroy (France)

A.3 Expert Team on Meteorological Radiation and Atmospheric Composition Measurements (ET-MR&ACM)
Mr B. Forgan (Australia)

B. OPAG-UPPER AIR

B.1 Expert Team on Upgrading Global Upper-Air Networks (ET-UGUN)
Mr D. Helms (USA)

B.2 Expert Team on Upper-air System Intercomparisons (ET-UASI)
Mr T. Oakley (United Kingdom)

B.3 Expert Team on Remote Sensing Upper-air Technology and Techniques (ET-RSUT&T)
Mr D. Engelbart (Germany)

C. OPAG-CAPACITY BUILDING

C.1 Expert Team on RICs, Quality Management Systems and Commercial Instruments Initiatives (ET-RICs)

Mr J. Gorman (Australia)

C.2 Co-Rapporteurs on Training Activities and Training Materials (R-TA&TM)

Mr E. Büyükbas (Turkey)

Mr B.Y. Lee (Hong Kong, China)

C.3 Rapporteur on CIMO Guide (R-CIMO-Guide)

Mr I. Zahumenský (Slovakia)

C.4 Rapporteur on Regional Implementation Activities (R-RIA)

Mr G. Srinivasan (India)

C.5 Rapporteur on Climate Observation (R-CO)

Mr B. Baker (USA)

ANNEX VI
Annex to paragraph 10.9 of the general summary

TERMS OF REFERENCE OF THE CIMO GENDER FOCAL POINT

1. To gather and analyse details as required, of the role of women and men in the work of the Commission;

2. To liaise with the WMO Gender Focal Point and to jointly collect and disseminate information including studies and policies on the role of women in areas relevant to the Commission;

3. To collaborate with gender focal points in other technical commissions;

4. To explore, document and make recommendations for addressing the need for capacity building in gender mainstreaming in each region, pertinent to the Commission; and

5. To submit reports in accordance with the requirements of the CIMO Management Group.

APPENDIX

LIST OF PARTICIPANTS

1. Officers of the session

Acting president	R.P. Canterford (Australia)
Vice-president	J. Nash (United Kingdom)

2. Representatives of WMO Members

Algeria

R. Naili	Principal Delegate

Argentina

M.J. García	Principal Delegate

Australia

R.P. Canterford	Principal Delegate
R.K. Stringer	Delegate

Austria

E. Rudel	Principal Delegate

Belgium

D. De Muer	Principal Delegate

Canada

T. Nichols	Principal Delegate
T. Allsopp	Alternate
R. Nitu (Ms)	Delegate

Chad

B. Beinde	Principal Delegate

China

ZHANG Wenjian	Principal Delegate
YU Jixin	Delegate
LI Feng	Delegate
HAN Tongwu	Delegate
WEN Kegang	Delegate
ZHOU Heng	Delegate
LI Dongyan (Ms)	Delegate
SHA Yizhou	Delegate
WEI Li	Delegate

Croatia

K. Premec	Principal Delegate

Egypt

M.M. El-Sayed	Principal Delegate

Finland

J. Poutiainen	Principal Delegate

France
P. Boiret — Principal Delegate
M. Leroy — Delegate

Germany
U. Busch — Principal Delegate
K-H. Klapheck — Delegate

Guinea
F. Traore (Ms) — Principal Delegate

Hong Kong, China
B-Y. Lee — Principal Delegate

Hungary
J. Nagy — Principal Delegate

Iceland
H. Hjartarson — Principal Delegate

Indonesia
B. Nurdin — Delegate
Sugijatno — Delegate

Iran, Islamic Republic of
N. Chiniforoush — Principal Delegate

Israel
J. Mishaeli — Principal Delegate

Italy
C. Ciotti — Principal Delegate
L.G. Lanza — Delegate
L. Stagi — Delegate
E. Vuerich — Delegate

Japan
M. Ishihara — Principal Delegate

Libyan Arab Jamahiriya
B.A. Alsiebaie — Principal Delegate
A.E. Ben Ali — Delegate

Malaysia
Zahari A. — Principal Delegate

Morocco
M. Geanah — Principal Delegate
M.L. Dahoui — Delegate
R. Merrouchi — Delegate
M. Nbou — Delegate

Namibia
W.J. Gaoeb — Principal Delegate

Netherlands
J. van der Meulen — Principal Delegate
W. Nieuwenhuizen — Delegate

New Zealand

B. Hartley	Principal Delegate

Nigeria

E.O. Adeniji	Principal Delegate
S.A. Aderinto	Delegate
C.E. Ummunakwe	Delegate
F.I. Agundo	Delegate

Norway

K. Hegg	Principal Delegate

Poland

J. Zieliński	Principal Delegate
I. Marczyk	Delegate

Portugal

L. Nunes	Principal Delegate

Republic of Korea

LEE Sung-jae	Principal Delegate
KIM Kyung-eak	Delegate
KIM Seong-heon	Delegate
SHIN Dong-chul	Delegate
SHIN Seoug-sook	Delegate

Russian Federation

A. Gusev	Principal Delegate
S. Chicherin	Delegate
A. Ivanov	Delegate
V. Ivanov	Delegate
Z. Kopaliani	Delegate
Y. Sirenko	Delegate

Slovakia

I. Zahumenský	Principal Delegate

Slovenia

J. Knez	Principal Delegate
K. Bergant	Delegate
M. Lodrant (Ms)	Delegate

South Africa

N. Devanunthan	Principal Delegate

Sudan

Y. Adan	Principal Delegate

Sweden

E. Boholm (Ms)	Principal Delegate

Switzerland

B. Calpini	Principal Delegate
A. Schmutz	Alternate
A. Heimo	Delegate

Togo

A.A. Egbare	Principal Delegate

Turkey
E. Büyükbas — Principal Delegate

Uganda
E. Bazira — Principal Delegate
L. Aribo — Delegate

United Arab Emirates
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B.A. Alhamadi — Delegate
A. Almandoos — Delegate
F.H.S. Al Meheri — Delegate
I.A. Karmastaji — Delegate

United Kingdom of Great Britain and Northern Ireland
J. Nash — Principal Delegate
S. Goodchild (Ms) — Alternate
M. Molyneux — Delegate
G. Ryall (Ms) — Delegate

United Republic of Tanzania
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United States of America
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3. Other Participants

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J. Simmons

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