Helsinki
2–8 September
2010

Commission for Instruments and Methods of Observation

Fifteenth session

World Meteorological Organization

WMO-No. 1064

Weather • Climate • Water

Commission for Instruments and Methods of Observation

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Abridged final report with resolutions and recommendations

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GENERAL SUMMARY OF THE WORK OF THE SESSION

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

1.1 The fifteenth session of the Commission for Instruments and Methods of Observation (CIMO-XV) was held in Helsinki, Finland, from 2 to 8 September 2010. The session was opened at 10:00 a.m. on Thursday, 2 September 2010 by the president of the Commission, Dr John Nash (United Kingdom of Great Britain and Northern Ireland). He welcomed the participants, especially those who were attending the CIMO session for the first time and expressed his appreciation to the Government of Finland for hosting the session and the WMO Technical Conference on Meteorological and Environmental Instruments and Methods of Observation (TECO) preceding it, along with the WMO Exhibition of Meteorological Instruments, Related Equipment and Services (METEOREX).

1.2 On behalf of the Government of Finland, Mr H. Pursiainen, Permanent Secretary, Ministry of Transport and Communications, welcomed all participants of the session. In his address, he highlighted the importance of high quality observations for forecasts and decision-making especially for transport. He also noted the significant contributions made by the Finish Meteorological Institute (FMI) in this area.

1.3 The Secretary-General of WMO, Mr Michel Jarraud, welcomed, on behalf of the Organization, all delegates at the session and representatives of partner organizations. In his opening statement, he expressed his appreciation to the Government of Finland and Prof. Petteri Taalas, the Director General of FMI and Permanent Representative of Finland with WMO, for hosting TECO, METEOREX and the CIMO-XV session.

1.4 Mr Jarraud thanked Dr J. Nash for his leadership of the Commission and his outstanding work accomplished since CIMO-XIV. He also thanked Prof. B. Calpini, the CIMO vice-president, as well as all members of the CIMO Management Group and members of the CIMO Expert Teams for their work and contributions.

1.5 Mr Jarraud expressed his great appreciation of all contributions CIMO made to promote data accuracy, compatibility and long-term stability of WMO observing systems through authoritative calibrations and intercomparisons which are highly relevant to all WMO Members by supporting decision-making and instrument deployment. In particular, he mentioned the key events such as Field Intercomparison of Rainfall Intensity Gauges, especially relevant in the context of disaster risk reduction, Intercomparison of Thermometer Screens/Shields in Conjunction with Humidity Measuring Instruments and the Eighth Intercomparison of High-Quality Radiosonde Systems.

1.6 The Secretary-General indicated two strategic initiatives of the Organization for the next financial period, the WMO Integrated Global Observing System (WIGOS) and the Global Framework for Climate Services (GFCS). CIMO is expected to play a fundamental and crosscutting role in the development and implementation of both to ensure the high quality of observations that are critical for quality climate services and for assessing the impacts of climate variability and climate change.

1.7 Mr Jarraud emphasized the importance of the traceability of measurements to the appropriate International System of Units (SI) standards to ensure standardization and data compatibility specifications and acknowledged the role that the WMO Regional Instrument Centres (RICs) play in meeting this requirement.

1.8 The Secretary-General reiterated WMO's gratitude to Dr Nash, the outgoing president of the Commission, for his able leadership in moving forward with the agenda of the Commission during the previous four years and for his outstanding contribution and dedication to the Commission.

1.9 On behalf of FMI, Prof. Petteri Taalas, Director General and Permanent Representative of Finland with WMO welcomed all participants at the session. He underlined the role that CIMO together with the Commission for Basic Systems (CBS) have been playing in the area of observations and the global exchange of meteorological data. He also noted that standardization of meteorological observations has been a significant achievement attained through instrument intercomparisons, implementing quality assurance and quality control procedures. When dealing with climate change detection, high quality observational data associated with relevant metadata are crucial.

1.10 Prof. Taalas also noted the need for improving the global monitoring system that would meet requirements of many different observing programmes, such as greenhouse gases monitoring and monitoring of the Polar Regions. In this regard, he noted the contributions Finland had made in improving weather services and climate adaptation skills of several sister organizations in all WMO regions. He also mentioned the importance of the WMO Integrated Global Observing System for WMO Members to be implemented during the coming years.

1.11 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 representative of the Secretary–General of WMO presented a report on credentials taking into account the documents received prior and at the session. The Commission unanimously accepted the report. In accordance with General Regulation 22, the Commission decided not to establish a Credentials Committee.

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

The provisional agenda, as contained in CIMO-XV/Doc. 2.2, 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 Germany, New Zealand and Sudan. The Principal Delegate of Germany was requested to serve as Chair.

Working Committee and Working Method

2.3.3 The Commission agreed to conduct its business in plenary meetings only. No working committee was established. The General Plenary would be chaired by the president, Dr J. Nash, for consideration of items from 1 to 3 and from 8 to 15. Plenary A would be chaired by the vice-president, Prof. B. Calpini, and would consider items from 4 to 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, when 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 and vice-president of CIMO, the representative of the Secretary-General and a representative from the local organizing committee.

2.3.6 The session agreed to expand the Terms of Reference of the Coordination Committee to conduct the selection of the OPAG Chairs, Expert Team Chairs and Theme Leaders.

2.4 OTHER ORGANIZATIONAL MATTERS *(agenda item 2.4)*

2.4.1 The session agreed upon the working hours of the session. It was agreed that minutes of plenary meetings were not required, unless specifically requested for a particular item. In accordance with Regulation 3, the Commission agreed to suspend for the duration of the whole session Regulation 109.

2.4.2 Mr József Nagy (Hungary) was appointed Rapporteur on Previous Resolutions and Recommendations of the Commission.

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

3.1 The Commission noted with appreciation the report presented by Dr J. Nash (United Kingdom), the president of CIMO, on the Commission's activities since the fourteenth session of the Commission.

3.2 The Commission agreed with the president that the Commission, through its Management Group, Expert Teams and members, had made great progress since CIMO-XIV. It also agreed that new challenges pose demands on the resources and encouraged the incoming Management Group to prioritize activities and to continue to address the impacts of the current funding and expert capacity levels on the CIMO and IMOP Programme activities.

3.3 The Commission noted that Mr Rainer Dombrowsky resigned from the position of vice-president as of 2 April 2009 and that Prof. Dr Bertrand Calpini was elected, by correspondence, as the vice-president as of 9 November 2009. The Commission also noted that there had been a number of changes in the chairmanship of the Expert Teams.

3.4 The Commission expressed its appreciation for the unprecedented amount of the work done in the intersessional period and thanked the president, the vice-presidents, the co-chairs of the OPAGs, members of the expert teams and those that provided considerable expertise in undertaking instrument intercomparisons. The Commission also thanked those members that hosted meetings and other CIMO events.

3.5 The Commission welcomed the actions taken by the president that contributed to the progress of the Commission since its fourteenth session, in particular the engagement of CIMO in WMO Integrated Global Observing System (WIGOS), the Global Framework for Climate Services (GFCS), Disaster Risk Reduction (DRR) and Capacity-building, which are four of the five highest priorities of the Organization. The Commission invited its president to continue efforts regarding alignment of CIMO activities to the priorities of the Organization. It also expressed support to the president in his efforts to arrange for the Commission to further address issues of utmost importance to the Commission.

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

4.1 The Commission thanked Dr Jitze P. van der Meulen (Netherlands) and Prof. Bertrand Calpini (Switzerland) the co-chairs of the OPAG-SURFACE for steering the activities of the OPAG according to its terms of reference and CIMO Management Group (CIMO-MG) guidance.

Surface Technology and Measurement Techniques

4.2 The Commission thanked Mr Stefan Waas (Germany) and Mr Karl-Heinz Klapheck (Germany), the present and former chairs of the Expert Team on Surface Technology and Measurement Techniques (ET-ST&MT), for steering the activities of ET-ST&MT. The Commission recognized that the terms of reference of ET-ST&MT were very wide and appreciated guidance given by CIMO-MG to prioritize the expert team's activities, some of which required in depth research and the required experts were not always available.

4.3 The Commission noted the progress in the further development of metadata standards in close co-operation with the CBS Expert Team on Requirements and Implementation of AWS Platforms (ET-AWS) and requested ET-ST&MT to continue with this development in collaboration with relevant expert teams of other WMO Programmes.

4.4 The Commission noted that new automatic techniques were developed as alternatives for manual observation and agreed that this should be taken into account in the preliminary plan for surface-based instrument intercomparisons.

4.5 In the area of automation of observations, the use of standard algorithms is an essential requirement to fulfill the stated requirements for instrument and data interoperability and homogeneous datasets. The Commission recognized that standardization of algorithms should be pursued in close cooperation among CIMO, the Association for Hydro-Meteorological Equipment Industry (HMEI) and Members, and requested the relevant expert team to document and publish algorithms used by automatic observing systems. This would also enable the proper assessment and review of climate datasets.

4.6 The Commission noted that requirements for the performance of instruments used for substituting subjective observations (like present weather systems) were not yet defined. The commission requested ET-ST&MT to address this issue in the next intersessional period, by developing skill parameters to be used for defining such performance figures.

4.7 The Commission noticed that little progress had been made by the instrument industry regarding standards for the interoperability of meteorological instruments, both hardware and software. The Commission requested its management group to develop a strategy for improved instrument interoperability in collaboration with HMEI. This would be one of the CIMO contributions to the implementation of the WMO Integrated Global Observing System (WIGOS).

4.8 The Commission noted with appreciation the progress in the development of guidelines and procedures for the transition from manual to automatic weather stations and the close cooperation with CBS ET-AWS and requested to publish these guidelines as a joint CIMO/CBS Technical Report.

4.9 The Commission agreed to discontinue the Instrument Development Inquiry. It was agreed that due to the reduced instrument developments at the NMHSs and the increased number of Web portals linking to new types of instruments developed by industry and the research community, such an inquiry would not serve its purpose anymore. The Commission encouraged HMEI to put all available information on new products from its members in the HMEI catalogue.

4.10 Taking into account increased frequency and strength of severe weather events, the Commission requested that more effort be made to develop meteorological instruments that can withstand severe or extreme weather conditions. CIMO expert teams should, as far as possible,

collaborate with the research community and instrument industry to address this issue. In this regard, the cooperation with the European Cooperation in Science and Technology (COST) 727 action on "Measuring and Forecasting Atmospheric Icing on Structures" was highly appreciated. The Commission agreed with the publication of the COST-727 action final report as an Instrument and Observing Methods (IOM) Report and requested ET-ST&MT to develop an update to the CIMO Guide reflecting relevant findings.

Surface-Based Instrument Intercomparisons and Calibration Methods

4.11 The Commission thanked Mr Michel Leroy (France), the chair of the Expert Team on Surface-Based Instrument Intercomparisons and Calibration Methods (ET-SBII&CM) for steering the activities of the expert team according to its terms of reference and CIMO-MG guidance. It noted with satisfaction the progress and achievements made in this area.

4.12 The Commission expressed its thanks to the Italian Meteorological Service Centre of Meteorological Experimentation (ReSMA), Vigna di Valle, Italy, for hosting the Field Intercomparison of Rainfall Intensity Gauges and for the extensive and continuous support provided, as the results achieved can be directly attributed to it. The Commission also thanked the project team and the International Organizing Committee on Surface-Based Instrument Intercomparisons for the excellent and timely report of the WMO Field Intercomparison of Rainfall Intensity Gauges, which provides a better understanding of their characteristics and potential use and will contribute to improving rainfall intensity measurements that are of crucial importance to mitigate the impact of severe weather events, such as flash floods for example.

4.13 The Commission noted that the results of the intercomparison confirmed the feasibility to measure and compare rainfall intensities on a one minute time scale as required by users, and which would have wide implications on the operation of WIGOS and on the quality of the climate observations. The Commission requested that the relevant outcomes of this intercomparison be incorporated in appropriate form in the CIMO Guide according to the indications provided in Annex I to the present report. The Commission therefore requested that the project team and ET-ST&MT closely collaborate with the CIMO Guide Editorial Board to reflect the relevant findings of the intercomparison.

4.14 Taking into account the results of the intercomparison, the Commission recognized that improvements in the instrumentation and their operation were still needed and endorsed the requirements for improving the accuracy of rainfall intensity measurements ensued from the intercomparison as provided in Annex II to the present report, and requested the WMO Secretariat to circulate a letter to inform all Members and the manufacturers and to invite them to implement these requirements in their observing systems and their instruments developments.

4.15 The Commission encouraged Members to carry out accurate 1-minute rainfall intensity measurements in critical areas to mitigate the impact of severe/extreme weather events and to allow proper action for disaster risk reduction. Such measurements should also be used for estimating the return period of heavy rainfall events and to improve the design of structures (building, construction works) and infrastructure (drainage) to mitigate severe weather impact.

4.16 The Commission appreciated that the results of this intercomparison had led to the revision and to the development of standards related to the measurements of the rainfall intensity and encouraged their further development, possibly as WMO-ISO standards.

4.17 The Commission expressed its thanks to the national Algerian Meteorological Service (ONM) for hosting the WMO Combined Intercomparison of Thermometer Screens/Shields in conjunction with Humidity-Measuring Instruments, which was held in Ghardaïa, Algeria. The Commission also thanked Météo-France for the important support it provided to ONM to ensure the success of this intercomparison, and in particular for the analysis of the measurements. The results of this intercomparison will help improve the long-term quality and homogeneity of data that are crucial for climate change monitoring. The Commission was pleased that the draft final report

of the intercomparison had been distributed to all participating manufacturers for comments in July and requested ET-SBII&CM to finalize its publication by the end of the year.

4.18 The Commission noted with appreciation initial work done on preparations for an intercomparison on automatic measurements of solid precipitation that is needed to provide advice to those Members that wish to automate their manual observations without compromising climate requirements for the quality of solid precipitation measurements.

4.19 The Commission noted the complexity in appropriately organizing an intercomparison on solid precipitation, including snowfall and snow depth measurements, at automatic weather stations. The Commission also recognized that such an intercomparison should be carried out at a number of different sites with different climates and that manual observations would be needed at each site for verification. The Commission encouraged Members to consider hosting part of this intercomparison and to communicate their interest to the Management Group. The Commission requested the president to investigate any possibility to organize such an intercomparison, taking into account the willingness of Members to provide sufficient measurement sites and to host the intercomparison. If these investigations lead to the conclusion that such an intercomparison is not feasible, then the Commission would need to be informed whether a reduced intercomparison could be successful and relevant for the Members.

4.20 The Commission agreed that an instrument intercomparison on solid precipitation, focusing on snowfall and snow depth measurements by automatic weather stations was strongly needed. The Commission noted that Canada strongly encouraged that CIMO proceed with this initiative and welcomed Canada's commitment to take a leadership role if other Members commit to participate and share the work to ensure the results are representative and valuable for the broader community. The Commission also welcomed the support and commitment expressed by China, Finland, New Zealand, the Russian Federation, Switzerland and the United States of America to contribute to this intercomparison and to provide test sites in their respective countries. The Commission therefore decided to organize this intercomparison as a priority.

4.21 The Commission was informed that Canada would not be able to host the Intercomparison of Thermometer Screens/Shields in Conjunction with Humidity-Measuring Instruments in an Arctic environment due to capacity and priority considerations.

4.22 The Commission noted the need to address the field of ground-truth validation of satellite remote-sensing of surface variables, but recognized that more details on the specific requirements from the satellite community would be needed. The Commission agreed to collaborate with CBS and address in its future workplan the ground-truth validation of satellite remote-sensing of surface variables in coordination. This would be accomplished in line with the development of WIGOS. Further, it requested its Management Group to consider how these resulting requirements can be addressed.

4.23 The Commission noted the need to ensure that the procedures for preparing and conducting intercomparisons be very clear and specific, in particular to ensure a clear selection of the participating instruments, the early provision of information on the planed procedure for data processing preferably even prior to the selection of the participating instruments and to ensure that the final results be presented in a neutral and informative manner. The Commission requested the relevant expert teams to pay particular attention to these points in running future intercomparisons.

4.24 The Commission was informed that Algeria participates in a Fennec project organized by the scientific community of the United Kingdom, France and Germany, which would cover the north of Mali, southern Algeria and western Mauritania, to study the aerosol updraft mechanisms. This project will include surface measurements that will supplement altitude and airborne measurements.

4.25 The Commission adopted the preliminary list of surface-based instrument intercomparisons as provided in Annex III to the present report. Taking into account the limited resources to carry out these intercomparisons, the Commission encouraged Members to also

conduct similar work at the national or regional levels and to communicate their results to the CIMO community.

Meteorological Radiation and Atmospheric Composition Measurements

4.26 The Commission thanked Dr Bruce Forgan (Australia), the chair of the Expert Team on Meteorological Radiation and Atmospheric Composition Measurements (ET-MR&ACM) for steering the activities of the expert team according to its terms of reference and CIMO-MG guidance. It noted with satisfaction the progress and achievements made in this area.

4.27 The Commission was pleased about the preparations for the Eleventh International Pyrheliometer Intercomparison (IPC-XI) from 27 September to 15 October 2010, including a pre-IPC-XI survey on national network traceability, a tailored radiation training course to be conducted during IPC-XI for Regional Radiation Centre (RRC) participants, and two co-incident comparisons, one on sun photometry and the other on pyrgeometers. The Commission reiterated the need for IPCs to occur regularly, at least every 5 years, to meet the needs of WIGOS and the broader user community.

4.28 The Commission thanked the RRC Tokyo, Japan (Regional Association II) for organizing a Regional Pyrheliometer Intercomparison (RPC) in 2007. The Commission was concerned that RPCs were not regularly organized in the other Regions, which was putting at risk the dissemination of the WRR to Members and the traceability of solar radiation measurements to the WRR. The Commission requested ET-MR&ACM to assess the status of traceability of radiation measurements and to investigate which alternative mechanism could be envisaged to ensure the required traceability and quality of radiation measurements. The Commission noted with appreciation the plan of RRC Tokyo to organize another RPC for RA II (Asia) in 2012 and the interest of Algeria to organize an RRC for RA I (Africa) in Tamanrasset during the next intersessional period.

4.29 The Commission was pleased that Croatia had organized a subregional pyranometer intercomparison. Noting that users have a wide variety of requirements for pyranometers depending on their applications, the Commission encouraged Members to investigate the characteristics and performance of recent-type pyranometers using the latest characterization techniques that have been applied to high-quality instrumentation, and to publish those results to help Members in selecting the instruments best meeting their requirements.

4.30 The Commission underlined the requirements for the traceability of measurements to the International System of Units (SI) standards and expressed its appreciation for continuous co-operation with the International Bureau of Weights and Measures (BIPM) on this matter. The Commission was pleased that the comparison between the World Radiometric Reference and the SI showed very good agreement, giving independent confirmation of the procedures used to maintain the World Radiometric Reference (WRR) over the years. The Commission also appreciated the efforts of the Physikalisch-Meteorologisches Observatorium Davos/World Radiation Centre (PMOD/WRC) to develop a Cryogenic Solar Absolute Radiometer and reference standards to support the maintenance of the World Infrared Standard Group. The Commission encouraged PMOD/WRC to continue these developments and to inform the Commission on the progress.

4.31 With a view to improving the quality of radiation data, the Commission recommended that the World Radiation Data Centre (WRDC) at the Voeikov Main Geophysical Observatory, St Petersburg, Russian Federation, provide a written report to the president of CIMO on a two-year basis indicating the status of radiation data quality in the archive, and publish the QA/QC algorithms it uses so that Members can perform their own data quality check prior to submitting data to WRDC.

4.32 The Commission appreciated the review and proposal for improvements of the chapters in the CIMO Guide related to radiation, sunshine and atmospheric composition measurements. The Commission strongly encouraged further improvements in these chapters and recommended

that the Global Atmospheric Watch Programme (GAW) be invited to update the parts related to UV, ozone and atmospheric composition measurements, so that they represent up-to-date measurement practice.

4.33 The Commission noted the offer of Italy to host a future Combined Radiation Intercomparison of pyranometers and sunshine duration instruments, possibly in conjunction with UV sensors.

4.34 The Commission recognized with appreciation the close collaboration with the International Organization for Standardization (ISO). The Commission requested ET-MR&ACM to actively participate in the work of ISO Technical Committee 180/Sub-Committee 1, "Solar Energy/Climate – Measurement and Data" and to develop common ISO-WMO standards when appropriate.

Classifications for Surface Observing Stations on Land

4.35 The Commission appreciated the substantial progress made in defining an appropriate standardized classification scheme of observing stations as requested by CIMO-XIV. This scheme consists of siting and maintenance performance classifications for surface observing stations on land. It provides means for improving and assessing the quality of observations, in particular for climate purposes, as the quality of observations cannot be ensured only by the use of high-quality instrumentation, but relies at least as much on the proper siting and maintenance of the instruments. The Commission was pleased that the implementation of similar classifications by several Members had lead to an improvement of data quality from these stations.

4.36 The Commission endorsed the siting classification provided in Annex IV to the present report and requested the Secretariat to include it in the CIMO Guide with the following clarifications in order to ensure its appropriate use: 1) the use of the siting classification of observing stations depends on the purposes of the observations, 2) the proposed classification is the first official version of the siting classification, and will be reviewed and updated as needed at the next CIMO. The Commission requested that the relevant expert team develop guidance material on how to characterize the stations and advice on how to use the results obtained, indicating for which purpose stations of a specific class are appropriate. Furthermore, the Commission also requested that work on the development of the maintenance classification be finalized with a view to including it in the CIMO Guide.

4.37 The Commission agreed that the publication of the siting classification as a common WMO-ISO standard would help in assessing and improving the quality of data originating from WMO-owned, cosponsored and non-WMO observing networks. The Commission agreed to further develop this classification as a common WMO-ISO standard. The Commission was informed that ISO TC146, Air Quality, SC5, Meteorology, had agreed to undertake the work leading to the approval of the classification guidelines as ISO standards and, according to the ISO/IEC Procedures for the technical work, recommended that the WMO CIMO Secretariat submit the guidelines to ISO, for approval as an ISO standards, in conjunction with SC5.

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

Upgrading the Global Upper-air Networks

5.1 The Commission thanked Mr Russell Stringer (Australia), the Co-chair of the OPAG-UPPER-AIR and Mr David Helms (United States), the chair of the Expert Team on Upgrading the Global Upper-air Networks (ET-UGUN) for steering the activities of the expert team according to its terms of reference and CIMO Management Group (CIMO-MG) guidance.

5.2 The Commission appreciated the work accomplished by the team and further 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. The Commission noted that high priority should be given to foster the development of interoperable technology supporting the Implementation Strategy of the WMO Integrated Global Observing System (WIGOS) as well as the Vision for the Global Observing System in 2025. This would allow for the cost-effective evolution of the WMO observing systems in a standardized manner ensuring the compatibility of data and their traceability to international standards. It requested the CIMO-MG to closely coordinate these activities.

5.3 The Commission noted that high priority should be given to the development of a stable and fully functional GCOS Upper-Air Network (GUAN) coupled with enhanced Aircraft Meteorological Data Relay (AMDAR) with humidity measurements. The Commission asked ET-UGUN to further assist GCOS with the provision of technical guidance for the GCOS Reference Upper-air Network (GRUAN) and to assist with the preparation of the Guide on GRUAN observing practices.

5.4 The Commission requested OPAG-UPPER-AIR to work closely with the AMDAR Community to further examine the capabilities of the AMDAR system, including aircraft based water vapour sensors, in order to validate whether these AMDAR onboard software and hardware technologies can satisfy agreed performance requirements and are comparable with other operational upper-air instruments and systems. Once interoperability of upper-air monitoring systems has been validated, ET-UGUN should develop guidelines for Members to begin the process of integrating data sets produced by a defined set of interoperable networks.

5.5 The Commission noted that the current version of the Catalogue of Radiosondes and the long-term Radiosonde monitoring statistics has not been updated for a number of years. However, relevant statistics were extracted from ECMWF data in the preparation for the 8th WMO Intercomparison of Radiosonde Systems. The Commission requested its Management Group to ensure a continuity of this work through the new CIMO working structure with a support from the Secretariat.

5.6 The Commission, in response to the concerns expressed at EC-LVIII, June 2006, noted that extensive information on the use of hydrogen and safety precautions is included in the Seventh edition of the Guide to Meteorological Instruments and Methods of Observation (CIMO Guide). Furthermore, CIMO training workshops on upper-air observations were expanded to include safety operation of hydrogen systems as well as other chemical generators. It requested the respective expert team 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, including the possible replacement of generators by hydrogen cylinders; updated guidelines should then be translated in WMO languages. The Commission also requested that CIMO Guide be updated accordingly.

Upper-air System Intercomparisons

5.7 The Commission thanked Mr Heng Zhou (China), the Co-chair of the OPAG-UPPER-AIR and Mr Tim Oakley (United Kingdom), the chair of the Expert Team on Upper-air System Intercomparisons (ET-UASI) for steering the activities of the expert team according to its terms of reference and CIMO-MG guidance. It also thanked Mr John Nash, the president of CIMO, for his valuable input towards the successful outcome of the expert team's work.

5.8 The Commission was pleased to note that preparations of the 8th WMO Intercomparison of Radiosonde Systems in Yangjiang, China, from 12 to 31 July 2010, went very smoothly, thanks to all the arrangements made and the hard work carried out by the International Organizing Committee (IOC), the Project Team, instrument manufacturers involved and the host country local organizing committee. It requested ET-UASI and IOC to finalize the analysis of intercomparison data and to involve the broad international community in discussing draft conclusions and recommendations before the Final Report is published in April 2011. It also requested CIMO-MG to facilitate inclusion of the relevant conclusions and recommendations in the WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8), (CIMO

Guide) and to advise GCOS on the most suitable radiosonde system to be used by GRUAN stations. The Commission asked CIMO-MG to provide the vast amount of intercomparison data of participating radiosonde-, remote-sensing- and AMDAR-systems to the scientific community to study integration aspects among those systems and advise CIMO on testbeds and on their findings.

5.9 The Commission noted that currently used radiosondes may have negative impact on the environment and requested the respective expert team to collaborate with HMEI and Members in designing environment-friendly radiosonde, for example by avoiding the use of any potentially hazardous material and reducing their weight and size.

5.10 The Commission requested OPAG-UPPER-AIR to publish available results of other international and national radiosonde intercomparisons and tests under the Instruments and Observing Methods (IOM) Report series. It noted proposal of Algeria to provide results of their national radiosonde comparisons tests.

5.11 The Commission noted proposals for future intercomparisons, including a plan of the Danish Meteorological Institute to carry out a three year trial of automatic radiosonde launching systems in Tasiilaq/Kulusuuk situated on the eastern coast of Greenland in a harsh cold environment and a plan of India Meteorological Department to host Regional intercomparison of radiosonde systems in India. The Commission, recognizing the need for further instrument intercomparisons and tests, agreed on the provisional programme of future WMO upper-air intercomparisons as contained in Annex V to the present report.

Remote-sensing Upper-air Technology and Techniques

5.12 The Commission thanked Mr Bertrand Calpini (Switzerland), the vice-president of CIMO and Mr Seth Gutman (United States), the chair of the Expert Team on Remote-sensing Upper-air Technology and Techniques (ET-RSUAT&T) for steering the activities of the expert team according to its terms of reference and CIMO-MG guidance.

5.13 The Commission endorsed the guidance on weather radar and wind turbine siting, presented in Annex VI to the present report, developed by ET-RSUAT&T and requested CIMO-MG to arrange for its inclusion it in the CIMO Guide so as to provide advice to Members on issues related to wind turbines and their impact on weather radars. It was recognized that there is a need to raise the awareness of the environment agencies and wind industry companies on the impact that wind turbines can have on weather radar and inform them on CIMO and CBS guidance to ease negotiations between their authorities and NMHSs. It was also suggested to publish the location of weather radars to help the wind energy industry in the planning of future turbines to mitigate their impact on weather radars.

5.14 Wind profilers are affected by wind turbines and other moving objects in a manner similar to weather radars. In view of minimizing this impact, the Commission requested OPAG-UPPER-AIR to develop guidance to Members similar to that one on the effect on weather radars. It noted the need to publish guidance on the operation of wind profilers, based, for example, on the procedures applied by the Japan Meteorological Agency (JMA), as an IOM Report. The Commission expressed its appreciation to JMA for sharing the experience with other Members.

5.15 With reference to a requirement to exchange weather radar “raw” data (likely in the form of radar reflectivity and radial winds) over the GTS/WIS, the Commission requested OPAG-UPPER-AIR to work towards a clear definition of required “raw” data to ensure a consistent level of national processing before data exchange is done. Understanding that developing a common radar data format would be difficult, it might be more appropriate to look towards building a better understanding of the radar decoding software, metadata and uncertainty of radar measurements. The Commission also requested OPAG-UPPER-AIR to publish comprehensive descriptions or documentation of radar decoding software, metadata and measurement uncertainty under the IOM Report series and incorporate this report in relevant parts of the CIMO Guide.

5.16 Recognizing a potential threat posed by widely used Radio Local Area Networks (RLANs) and Dynamic Frequency Selection (DFS) devices as they can interfere with weather (especially C-Band) radars, the Commission agreed that this would require a global solution and support from all Members. It thanked ET-RSUT&T for drafting the Guidance Statement on Weather Radar/Radio Frequency Shared Spectrum for further consideration by CBS-Ext.(2010), Namibia, 17–24 November 2010. It requested OPAG-UPPER-AIR to provide radar specifications to the telecommunication industry as future considerations must be carefully addressed, particularly following deployment when remedial solutions are not available. It also requested OPAG-UPPER-AIR to facilitate cooperation between weather radar manufacturers and telecommunication industry as it could provide considerable resources to investigate possible solutions with CIMO overseeing this process.

5.17 The Commission noted that the tremendous progress in weather radar technological and processing capabilities is not equally reflected in the quality of final products and that a number of challenges remain. It therefore requested OPAG-UPPR-AIR to intercompare weather radar algorithms with a view to identifying the best quality control algorithms and to specify the quality of the radar products, such as Quantitative Precipitation Estimation (QPE). A series of steps to understand/quantify the performance of the algorithms used would be needed. Therefore, several intercomparison workshops should be organized to understand, evaluate and document the various quality control algorithms and adjustment algorithms for QPE. The first workshop should address the first two steps of the process – ground clutter removal and retrieval of the reflectivity values. An International Organizing Committee should be established to prepare and conduct this intercomparison.

5.18 The Commission noted difficulties associated with the networking of different weather radar systems and the lack of appropriate maintenance guidance and requested its Management Group to include these issues into a workplan of the respective expert team.

5.19 The Commission was pleased that a survey on weather radars had been conducted among WMO Members in August 2009 with a view to developing a comprehensive web-based weather radar database. It thanked the Turkish Meteorological Service (TMS) for the effort made with the survey and for the willingness to develop and host the web-based weather radar database on behalf of WMO. It requested OPAG-UPPER-AIR to work closely with TMS in the design and implementation of the database. It noted that this would be a significant contribution to the WIGOS effort to record metadata and to standardize observations.

5.20 The Commission noted that the atmospheric remote-sensing community has gained a better appreciation for the need to integrate various observations thus improving our ability to characterize and monitor changes in the characteristics of the upper atmosphere at high temporal and spatial resolutions. Furthermore, climate applications require upper-air observations to meet the same standards of accuracy and homogeneity that have always been required of terrestrial observations. To accomplish this, the Commission requested OPAG-UPPER-AIR to focus on identifying and then implementing tools and techniques to verify to what extent the remote-sensing observations meet certain criteria that ensure conformity and traceability of remotely-sensed data to international (SI) standards. The Commission recommended that OPAG-UPPER-AIR consider holding a workshop (in collaboration with the Satellite and GRUAN communities) to evaluate which remote-sensing tools and techniques are likely to have success in tying upper-air observations to SI standards.

5.21 The Commission welcomed that the survey on lightning detection systems was conducted with a view to evaluate the current operations of lightning detection systems that aimed at reporting the strengths and weaknesses of existing systems, including coverage, accuracy, reliability and cost effectiveness. It requested OPAG-UPPER-AIR to publish the results of this survey in the IOM Report series. It noted that this survey was undertaken as a preliminary step to the assessment of the need to carry out an intercomparison of lightning detection systems.

5.22 The Commission appreciated the work done by members of ET-RSUT&T in the development of an ISO standard on visual range LIDAR. The Commission noted that the proposed

ISO standard #28902 “Ground-based remote-sensing of visual range” is expected to reach the approval stage by May 2011 and may be ready for publication in mid 2011. The Commission requested the Secretariat to explore the possibility of a joint ISO/WMO standard on visual range LIDAR under the ISO/WMO agreement, thus recognizing the significant work done by CIMO members.

5.23 The Commission recalled that the eruption of the EyjafjallajIlökull volcano had a huge impact on air traffic in Northern Europe during April and May 2010. It expressed appreciation to members who shared specialised measurements in support of the London Volcanic Ash Advisory Centre (VAAC). Building on this experience, the Commission agreed on the importance of working with the regional associations, regional bodies, technical commissions and HMEI to develop enhanced volcanic ash observational networks and capabilities, in particular LIDAR, aerosol sounding systems and airborne systems.

5.24 The Commission noted the requirement for rapid sharing of information between Members, including announcement of national intercomparisons, new developments and improvements to systems, and allowing open discussion on performance issues and limitations that have been discovered. The Commission tasked the CIMO Management Group in conjunction with the WMO Secretariat to investigate the implementation of a WMO web-based information system so that all technical commissions can participate in an integrated way.

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

Regional Instrument Centres, Calibration and Traceability

6.1 The Commission thanked Mr Mario García (Argentina) and Mr Mohamed Nbou (Morocco), co-chairs of the OPAG-Capacity-Building and Mr Jérôme Duvernoy (France), chair of the Expert Team on Regional Instrument Centres, Quality Management Systems and Commercial Instruments Initiatives (ET-RIC), for steering the activities of the ET-RIC according to their terms of reference and guidance from the CIMO Management Group.

6.2 The Commission recalled that the traceability of measurements to the International System of Units (SI) standards was of utmost importance to ensure that observations meet the quality requirements of users as well as the standardization and data compatibility needed for the WMO Integrated Global Observing System (WIGOS). The Commission was concerned by the lack of traceability of measurements to SI in many NMHSs, revealed by the Survey on Calibration and Maintenance, and stressed the need to guarantee the traceability to SI. It recommended that steps be taken by respective CIMO expert teams to assist Members to improve this situation through various actions, such as sensitizing NMHSs to the necessity of regular calibration and by the development of training and capacity-building material. The Commission also recalled that preventive maintenance, in particular periodical instrument checks, is essential to ensure the required quality of measurements. The Commission requested the OPAG Capacity-building to develop a strategy that will ensure that the traceability of measurements to SI standards are implemented by Members, and requested that ET-RIC develop the needed outreach and guidance material.

6.3 The Commission recognized that Regional Instrument Centres (RICs) should play an important role in WIGOS in order to ensure the quality of observations, considering that worldwide compatibility of data strongly depends on assuring traceability of measurements to SI. The Commission was concerned that many NMHSs were not aware of the existence of RICs and the services they provide. The Commission recommended the OPAG on Capacity-building to facilitate better communication of RICs capabilities and services to Members through a dedicated RIC website. The Commission also requested ET-RIC to enhance collaboration with RICs to coordinate the implementation of relevant activities.

6.4 The Commission welcomed the publication of the Evaluation Scheme for Regional Instrument Centres, aimed at supporting RICs in carrying out their regular audits, as requested by

EC-LX, and improving their capabilities to meet regional needs, where necessary. The Commission recommended that the results of the evaluations be communicated to the regional associations to enable them to assess whether the existing RICs meet their requirements. The Commission also encouraged regional associations to inform CIMO on the needs for capacity-building activities to support their RICs, as identified through the review of their capabilities so that CIMO could consider developing relevant capacity-building actions, as appropriate. The Commission adopted Recommendation 1 (CIMO-XV) – Regional Instrument Centre capabilities and communication with Members.

6.5 The Commission recalled that the capabilities of metrology laboratories, such as RICs, can be demonstrated and tested through inter-laboratory intercomparisons. The Commission recommended that such intercomparisons be regularly organized by RICs and that the results be published on both the RICs and WMO Websites to provide evidence of RICs' capabilities to the users.

6.6 The meeting also recognized that an improvement in the traceability of instruments could be expected from a broader use of travelling standards (available at reasonable prices), which could be used by NMHSs that do not have a calibration laboratory to do on-site verifications, as well as for RICs to verify the standards of Members of the Region, if not possible in another manner. However, the Commission stressed that this would in no way replace the need for proper calibration of instruments and standards. In view of the importance of instrument traceability to ensure that observations meet user requirements, in particular for climate and disaster risk reduction matters, the Commission recommended that NMHSs invest in establishing calibration laboratories for, at least, pressure, temperature and humidity, to enable them to ensure the traceability of their measurements to international standards on a regular basis.

6.7 The Commission welcomed the document developed by ET-RIC on "Guidance on instrumentation for calibration laboratories, including RICs". The Commission agreed that this document provided the needed guidance for setting-up calibration laboratories and a clear and valuable description of the instrumentation useful for calibration purposes.

6.8 The Commission also recalled the need for new simple and inexpensive instruments and associated calibration facilities to replace health hazardous (mercury) instruments and obsolete instrumentation still used in numerous NMHSs in developing countries. The Commission encouraged instruments' manufacturers to develop and promote such instruments that would also help in improving traceability to SI.

6.9 The Commission noted that the National Oceanic and Atmospheric Administration (NOAA) National Data Buoy Centre (NDBC) successfully demonstrated their capabilities as a Regional Marine Instrumentation Centre (RMIC) and that the Joint World Meteorological Organization – Intergovernmental Oceanographic Commission (IOC) Technical Commission for Oceanography and Marine Meteorology (JCOMM) selected NDBC as the world's first RMIC, as part of a pilot project for the WMO Integrated Global Observing System (WIGOS). Morocco and China attended the first RMIC Workshop and indicated their preference to serve as an RMIC in their Region.

Training material and training activities

6.10 The Commission thanked Mr Ercan Büyükbas (Turkey) and Mr B.Y. Lee (Honk Kong, China), Co-Rapporteurs on Training Activities & Training Material (R-TA&TM) for their activities.

6.11 The Commission appreciated the number of trainings organized by Regional Training Centres (RTC) on a regular basis that were attracting more and more participants from different countries. The Commission also welcomed the participation of well-known and experienced lecturers from foreign countries as well as the close cooperation with the members of the Hydro-Meteorological Equipment Industry Association (HMEI) who had contributed to these activities. The Commission thanked the Members who hosted the training events and those Members who

provided lecturers and developed training lecture notes for the workshops. The Commission encouraged them to continue their efforts in providing such training.

6.12 The Commission noted that ten Instruments and Observing Methods (IOM) Reports had been published since CIMO-XIV. The Commission thanked all the authors for the work done in supporting the needs of Members for technical advice concerning measurements of upper-air parameters, radiation, rainfall intensity, solid precipitation, lightning detection and calibration laboratories including RICs. The Commission requested all the expert teams to strive at publishing important outcomes of their work in IOM reports, to reach out to all Members.

6.13 The Commission noted the need for strengthening instrument calibration procedures, particularly in estimating the uncertainties of the calibrations performed. The Commission requested ET-RIC to develop a new approach to provide support to RICs in the development of quality procedures addressing instrument calibration; and to collaborate with regional associations in organizing workshops on the subject, depending on their needs. The aim of the workshop would be to support RICs in estimating each of the uncertainty components and in computing the overall uncertainty budget for the calibrations they perform.

6.14 The Commission recognized the need of future training courses on instruments and methods of observations, including calibration and maintenance of instruments and possibly new technologies to deal with the transition to a new AWS system. The Commission encouraged regional associations to identify their specific needs and communicate them to the Theme Leader on Training Material and Training Activities in order to help the Commission with the coordination and planning of training workshops and courses. The Commission also noted that training courses should be adapted in accordance to the initial level of participants and to required level, to be more beneficial to Members.

6.15 The Commission appreciated that Japan Meteorological Agency (JMA) held the JMA/WMO Workshop on Quality Management in Surface, Climate and Upper-air Observations from 27 July to 30 July 2010. The Commission also noted the main outcomes of the workshop, namely the importance of full utilization of RICs and promotion of capacity-building, establishment of calibration laboratories within each NMHS for enhancement of data quality and availability in RA II. The Commission encouraged CIMO Expert Team chairs to take these outcomes fully into account in their future activities.

6.16 The Commission recognized the importance to support the regional activities on the availability and quality of surface, climate and upper-air observations, and encouraged the Secretariat and the OPAG on Capacity-building to make efforts to find external resources for these purposes by raising awareness among funding agencies and Members of the critical importance of the observations for high impact services including disaster mitigation and climate adaptation.

6.17 Taking into account the positive experience of the WMO Space programme using "virtual laboratories" or “e-learning” for education and staff training, the Commission agreed that there was a need to have a similar arrangement for CIMO. The Commission recommended its design and realization during the intersessional period.

6.18 The Commission noted that the CIMO Management Group had recommended that actions be taken to promote long-term partnerships to facilitate capacity-building. For instance it should be considered whether a pilot project could be set up linking WIGOS, GFCS, Disaster Risk Reduction requirements for the improvement of data availability and quality in data sparse areas.

Education and training requirements

6.19 The Commission noted the decision of EC-LXII to replace WMO Publication No. 258 "Guidelines to the Education and Training of Personnel in Meteorology and Operational Hydrology. Volume I: Meteorology” with a series of new publications. Two of this new series would be overseen by the EC Panel of Experts on Education and Training (EC Panel) whilst the remaining volumes in the series would be overseen by the technical commissions as they developed

competencies and education and training requirements for personnel undertaking tasks in their areas of interest.

6.20 In the context of WIGOS and the Quality Management Framework (QMF), the Commission agreed that this could ensure that personnel performing tasks such as making meteorological observations, calibrating or maintaining equipment would have the appropriate skills, knowledge and behaviours to do the tasks to the level outlined in the Commission's Guides. The Commission further supported the distinction between the use of qualifications for determining personnel classification and competencies for determining what tasks a person undertook. This was emphasized by Members who had personnel classified as Meteorologists performing meteorological observations who were not Meteorological Technicians. If the task of performing meteorological observations was only to be undertaken by Meteorological Technicians this would not be possible. As the personnel were trained for the meteorological observing tasks they were performing it was consistent with the approach being developed by the EC Panel. Noting the importance of subject matter experts defining the competencies and education and training material the Commission included this as a task to be undertaken during the intersessional period.

7. GUIDE TO METEOROLOGICAL INSTRUMENTS AND METHODS OF OBSERVATION *(agenda item 7)*

7.1 The Commission thanked the present and former Rapporteurs on the CIMO Guide Mr Krunoslav Premec (Croatia) and Dr Igor Zahumenský (Slovakia), respectively, for compiling and coordinating proposals for modification of the WMO *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8) (CIMO Guide).

7.2 The Commission appreciated that the production of an English electronic version of the Seventh Edition of the CIMO Guide has been available on the WMO Website: http://www.wmo.int/pages/prog/www/IMOP/IMOP-home.html to all interested users since 2008.

7.3 The Commission noted that the Draft First Supplement to the CIMO Guide had been posted on the Instruments and Methods of Observation Website for review by WMO Members. The Commission thanked all those experts who contributed to this update. The Commission approved the Final Draft of the First Supplement to the Seventh Edition of the CIMO Guide and requested the Secretary-General to make arrangements for updating the electronic version of the Guide.

7.4 The Commission noted that EC-LXII expressed concern that translation of the CIMO Guide into the required WMO languages was not secured. This may affect the quality of some observations, including those for climate and DRR, and that would reduce some expected benefits of WIGOS. The Commission agreed with EC-LXII that the CIMO Guide was an essential source of information for Members of developing countries for acquiring information on new technologies and methods of observations needed to improve their observing networks. The Commission agreed to request EC-LXIII and Cg-XVI to give the highest priority to funding the translation of the CIMO Guide into the official WMO languages. Priority should be given to translate the areas of the CIMO Guide relevant to basic operational observations required by WIGOS, DRR and GFCS. The Commission encouraged WMO Members to contribute to the CIMO Trust Fund and/or the WMO Publications Trust Fund to support the translation and publication of the CIMO Guide into other WMO languages. The Commission recognized that the Seventh Edition of the CIMO Guide had been significantly upgraded and that the Sixth Edition should therefore no longer be used.

7.5 The Commission recognized the need for continuous review and regular update of the CIMO Guide to reflect the rapid development of observing technology and to meet WIGOS requirements for standardization. The Commission also recognized that keeping the CIMO Guide up-to-date, reviewing the proposals for changes from a scientific perspective, as well as taking into account the uniformity in the presentation of the CIMO Guide, required a major amount of work. To ensure the quality of the information provided in the CIMO Guide and the uniformity in the

presentation of the content, the Commission agreed to establish a CIMO Guide Editorial Board with the Terms of Reference as provided under agenda item 11.

7.6 The Commission stressed that the relevant outcome of the work of the CIMO Expert Teams needed to be incorporated into the CIMO Guide. The Commission encouraged CIMO Expert Team chairs to ensure that the relevant outcome prepared by their ETs were provided in an appropriate form to be published in the CIMO Guide, and closely collaborate with the Editorial board to organize their timely publication.

7.7 The Commission noted the decision of EC-LXI that a Manual on Meteorological Instruments and Methods of Observation should be developed as an Annex to the WMO Technical Regulations. The Commission requested the CIMO Editorial Board, in close collaboration with CIMO ETs and relevant technical commissions as needed, to elaborate a strategy for the development of the CIMO Manual and to consider the possibility of upgrading non controversial parts of the CIMO Guide to the level of common ISO/WMO standards.

7.8 The Commission noted the plan to develop a WIGOS Manual and agreed with the need for CIMO to be involved in this development. Furthermore, the Commission recognized that this development had to be taken into account in the preparation of the concept for the development of the CIMO Manual to ensure appropriate coordination and avoid duplication of efforts. The Commission requested the CIMO Guide Editorial Board and the Management Group to ensure coherency between the development of the WIGOS Manual, CIMO Manual, CIMO Guide and relevant ISO standards.

7.9 The Commission recognized that WMO technical documents, guides and manuals provide a very large amount of standards, best practices and guidelines to Members, but that these documents are sometimes overlapping, insufficiently harmonized and difficult to find and access, which affects data quality and system interoperability. The Commission agreed that a web-based, user-friendly direct access tool to the CIMO Guide and other related WMO documents would greatly help Members in accessing the information they needed. The Commission supported the development of such a tool and recommended it be given significant high priority as it will provide an essential contribution to WIGOS.

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

8.1 WMO PRIORITY ISSUES *(agenda item 8.1)*

8.1.1 The Commission noted the WMO priority areas, namely: (a) the Global Framework for Climate Services (GFCS), (b) Capacity-building, (c) the WMO Integrated Global Observations and Information Systems, (d) Disaster Risk Reduction and (e) Aviation Meteorology, and agreed that CIMO future activities should be directly linked to these priorities.

8.1.2 The Commission noted that Cg-XV had requested CIMO to review its role in the context of WIGOS and that all technical commissions had been asked to review their Terms of Reference in the context of the WMO Results-based Management approach and to organize their programme structures and activities so as to pursue the top-level objectives and to achieve the Expected Results of WMO.

8.1.3 The Commission endorsed the work done, within the framework of the CIMO Pilot Project on WIGOS, on the review of its terms of reference and in consultations with other technical commissions and pilot projects so as to identify how CIMO can assist and collaborate with them in the context of WIGOS.

8.1.4 The Commission agreed that its Terms of Reference should respond to the five high priorities of the Organization and adopted Recommendation 2 (CIMO-XV) – Terms of reference of the Commission for Instruments and Methods of Observation.

8.1.5 In view of best supporting WMO priorities and recognizing that CIMO's resources were limited, the Commission requested the Management Group to prioritize CIMO activities when developing workplans of the expert teams and to concentrate on activities on which they could be most effective, while strengthening collaboration with other technical commissions.

8.2 COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION VISION *(agenda item 8.2)*

The Commission recognized the need to adapt to the changing realities in which it is carrying out its work so as to provide the guidance that is expected from it in the most appropriate and effective manner. These changing realities include the evolving requirements of WMO priority initiatives (GFCS, DRR, WIGOS&WIS, Capacity-building and Aviation Meteorology), the development of new technologies and observing techniques that impact observing systems, and also the evolving context in which experts are working. The Commission welcomed the initiative of the CIMO Management Group to develop a vision statement for CIMO that would help to inform Members of CIMO's role in supporting priority activities of WMO, such as WIGOS, GFCS and DRR, to clarify how CIMO expects to meet its goals and also to motivate and stimulate experts in participating in the activities of CIMO. The Commission decided to adopt Resolution 1 (CIMO-XV) –Vision statement of the Commission for Instruments and Methods of Observation.

8.3 COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION STRATEGIC PLANNING *(agenda item 8.3)*

8.3.1 The Commission for Instruments and Methods of Observation (CIMO) recalled the decisions of the Fifteenth World Meteorological Congress (Cg-XV) that approved a new framework for the Results-based Management (RBM) of the Organization and requested the technical commissions to adhere to the direction and priorities set forth in the Strategic Plan and to organize their programme structures and activities so as to pursue the top-level objectives and to achieve the Expected Results.

8.3.2 The Commission noted the progress in the development of the WMO Strategic Plan (SP) and Operating Plan (OP), and the involvement of the regional associations (RAs) and technical commissions (TCs) in the process. It also noted that the structure of the WMO SP and OP for the period 2012–2015 had been based on the recommendations of the 2009 Meeting of Presidents of Technical Commissions (PTCs) and the second session of the EC Working Group on Strategic and Operational Planning (EC WG/SOP) in 2009, endorsed by EC-LXI. The Commission further noted the recommendations of PTC-2010 (January 2010) and the third session of the EC WG/SOP (March 2010).

8.3.3 The Commission noted the decisions of EC-LXII on WMO Strategic and Operating Plans and Monitoring and Evaluation. It decided that in order to effectively contribute to the SP, it will have its activities included in the WMO Operating Plan and contribute to the Monitoring and Evaluation process following the guidance received from the WMO Strategic Planning Office.

9. ROLE OF THE COMMISSION IN THE WMO INTEGRATED GLOBAL OBSERVING SYSTEM, WMO INFORMATION SYSTEM, GLOBAL FRAMEWORK FOR CLIMATE SERVICES AND WMO PROGRAMMES *(agenda item 9)*

WMO Integrated Global Observing System (WIGOS)

9.1 The Commission took into account the strategy towards enhanced integration between the WMO observing systems adopted by Cg-XV and considered the status of its development and implementation with respect to CIMO current and future mandates. In this regard, the Commission emphasised that its priority should be the effective contribution to implementation of WIGOS.

9.2 It agreed that CIMO should play the fundamental and crosscutting role with regard to the standardization of measurement practices and methods of observation and integration of observing technologies and systems, especially in the first area of WIGOS standardization, which

is “Standardization of instruments and methods of observation”. The Commission also welcomed contributions from CBS in the WIGOS development and implementation and underscored the need for close collaboration and enhanced coordination among the technical commissions.

9.3 In this regard, the Commission noted with appreciation the updated version of the WIGOS Concept of Operations (CONOPS) and the WIGOS Development and Implementation Strategy (WDIS), endorsed by EC-LXII, to be presented to Cg-XVI for approval with the understanding that these documents may be further refined in view of the lessons learned from the WIGOS Test of Concept Phase.

9.4 The Commission noted the progress and the key deliverables of the CIMO Pilot Project on WIGOS. The Commission appreciated that revised Terms of Reference of CIMO within the WIGOS framework and a siting classification for land surface observing stations for use within WIGOS had been developed and considered under agenda items 4 and 8.1. The Commission also appreciated that CIMO collaborated with other WIGOS pilot projects and requested its Management Group to set-up modalities for wider collaboration under the future CIMO working structure.

9.5 When considering the status of the WIGOS development, the Commission agreed with the Executive Council Working Group on WIGOS and WIS (EC-WG/WIGOS-WIS) that the WIGOS implementation would require active coordination and support from the WIGOS Project Office with suitable project management functions. This would also allow for better interactions with the Pilot and Demonstration Project Teams, the future Inter-Commission Coordination Group on WIGOS (ICG-WIGOS) and the respective technical commission working bodies.

9.6 In accordance with WIGOS requirements and the request of EC-LXII, the Commission responded with relevant adjustment of the CIMO future working structure and by adopting new Terms of Reference (TOR) for its Open Programme Area Groups (OPAGs), Expert Teams (ETs) and Theme Leaders to best address WIGOS requirements for integration, interoperability, standardization and quality management. In this regard, the Commission requested its Management Group to coordinate with the chairs of OPAGs, ETs, relevant rapporteurs and theme leaders the inclusion of relevant tasks and activities in their workplans to contribute to the implementation of WIGOS as a high priority.

9.7 Taking into account WIGOS requirements, the Commission agreed on the following priority areas:

(a) Development of relevant WIGOS standards in collaboration with partners; including WIGOS metadata standards;

(b) Provision of the technical guidance and advice to Members and regional associations on instruments and methods of observation for use within WIGOS;

(c) Update, harmonization and development of WMO Regulatory Material, including the development of a new WIGOS Manual and/or Guide.

9.8 The Commission noted the decision of EC-LXI that a Manual on Meteorological Instruments and Methods of Observation should be developed as an Annex to the WMO Technical Regulations. The Commission requested CIMO's respective body to prepare a plan for the development of the Manual and to coordinate this development with that of the WIGOS Manual.

9.9 In a spirit of its fundamental and crosscutting role in the WIGOS integration process, the Commission agreed that the president of CIMO be directly responsible for the overall coordination of the Commission’s WIGOS activities. The Commission recommended that the CIMO president be, ex-officio, a member of ICG-WIGOS that is expected to be established immediately after Cg-XVI.

WMO Information System (WIS)

Representation of data and metadata

9.10 The Commission noted the decision of EC-LXII that special attention should be paid to data and metadata standardization to ensure data inter-operability and accessibility for WIGOS, GFCS and other WMO Programmes and initiatives; in this regard, it emphasized the importance of pursuing CIMO participation in the development of WIS-related data management functions, specifically as regards instrument-related surface and upper-air observational data representation formats and metadata.

9.11 The Commission noted the development of a WMO conceptual model of data representation as a fundamental element of a CBS policy on data representation systems, which should lead to the development of a WMO core profile of the ISO 19100 series for metadata and data, encompassing the WMO core profile of the ISO metadata standard.

9.12 The Commission stressed the need to contribute to the activities of the CBS OPAG-ISS Inter-Programme Expert Team on Metadata and data Interoperability (IPET-MDI) and to foster the awareness within CIMO of standards of ISO and of the Open Geospatial Consortium (OGC), such as Observations and Measurements (ISO 19156), and other standards developed within the framework of the OGC Sensor Web Enablement (SWE). The Commission requested its MG to nominate the representative of CIMO in IPET-MDI and the CIMO expert participating in the activities specified in the Memorandum of Understanding (MoU) signed between WMO and OGC, with the specific task to develop awareness of ISO/OGC standards within the WIGOS community and CIMO.

Global Framework for Climate Services (GFCS)

9.13 The Commission noted that EC-LXII considered the Executive Summary of the WMO Position Paper on the Global Framework for Climate Services defining the following components of the GFCS*:* (i) Observations; (ii) Climate Research, Modelling and Prediction; (iii) the Climate Services Information System (CSIS); (iv) the Climate User Interface Programme (CUIP); and (v) Capacity-building. The Commission also noted that EC-LXII had endorsed the finalization of the WMO Position Paper on the Global Framework for Climate Services. Recognizing the importance of quality-assured, quality-controlled and well-documented long-term observations to the success of GFCS, the Commission agreed that the WMO Position Paper on GFCS be used by CIMO for planning its contribution to GFCS.

9.14 In this regard, the Commission agreed with the decision of the fifteenth session of the Commission for Climatology (CCl-XV) on the need to provide guidance on the WMO Members' activities in climate observations, in close collaboration with other technical commissions and WMO Programmes, with particular emphasis on the quality and standards of all types of observations needed for climate monitoring, applications and services.

9.15 Taking into account the development of the GFCS, which is one of the priority areas of WMO, and the acknowledgment that observations are a fundamental component of the GFCS and the requirements identified by CCl-XV, the Commission agreed with the need to appoint CIMO focal points on climate observation and services with the following Terms of Reference:

(a) Liaise with other Commissions, WMO Programmes and co-sponsored programmes and the WMO Secretariat to address observational requirements for the GFCS that will be identified by the High-Level Task Force;

(b) Advise the Management Group on the Commission's role and activities needed to develop guidance material and standards on the issues of climate observations to meet the required quality and traceability of climate information and services;

(c) Identify and propose joint projects, activities and working mechanisms involving collaboration with CCl to assist Members in the development and implementation of WMO standards with focus on most critical issues such as the use of automatic weather stations (AWS) and remote-sensing observations in climate, and the difficulties encountered in solid precipitation observation.

9.16 The Commission requested its Management Group to nominate CIMO focal points on climate observation and services.

WMO Quality Management Framework (QMF)

9.17 The Commission noted that one of the key areas of standardization that CIMO should embrace in the WIGOS context is the WMO Quality Management Framework (QMF) and the development, use and maintenance of the relevant WMO regulatory material (technical regulations, manuals, guides) to ensure that:

(a) Observations, records and reports on weather, water, climate and other environmental resources, operational forecasts, warnings, related information and services are of an identified quality, and in compliance with relevant joint standards agreed upon with other international organizations;

(b) The best possible products and services are delivered to end-users. This should be based on agreed-upon quality assurance and quality control standards, with the goals of developing and implementing an integrated quality management system (QMS) that delivers reliable and timely data streams with adequate quality control and relevant metadata.

9.18 The Commission recognized the requirement for the development of standardized quality management procedures for meteorological data and services. It further agreed that implementation of standards would significantly contribute to improvements of the quality of meteorological services provided by NMHSs, as it depends to a large extent on the quality of observations.

9.19 The Commission thus agreed that an all-encompassing approach to Quality Management was required, and appreciated the initiatives taken by the WMO Marine Meteorology and Oceanography Programme (MMOP), and Climate and Water Programme (CLWP) in this regard, as well as the inclusion of Quality Management in WIS and the WIGOS concept.

9.20 The Commission was pleased to note that the WIGOS QMF implementation strategy would specify all processes of QMS for observing networks and that attention would also be paid to the guidance on how to manage observing networks and observing sub-systems to more fully meet QMF requirements. In this regard, the Commission agreed to contribute to this development by including relevant activities into workplans of its OPAGs and expert teams.

9.21 The Commission agreed that CIMO's role in QMF was principally to develop and provide standards for instruments and methods of observation that could be implemented in observing networks including standards for quality control of data at the instrument/station level, and was closely linked to CIMO's role in WIGOS. Maintaining the CIMO Guide up-to-date and expanding its scope as new observing technologies become operational represent its primary contribution to the WMO QMF.

Global Earth Observation System of Systems

9.22 The Commission noted the guidance from the sixty-second session of the WMO Executive Council reaffirming its endorsement of GEOSS and its10-Year Implementation Plan.

9.23 The Commission also noted the guidance from EC-LXII requesting CBS and other relevant technical commissions and joint steering committees to strengthen interoperability

arrangements with GEO so that WMO Members can continue to benefit from data beyond that governed by WMO Resolutions 40 (Cg-XII) and 25 (Cg-XIII), and that others can similarly benefit from WMO data for weather, water, climate and other environmental data holdings.

9.24 The Commission, therefore, again stressed the importance for GEOSS to embrace and integrate different types of data including *in situ* and remotely sensed data. In this regard, since the upcoming GEO Plenary and Ministerial Summit (Beijing, China, 3–5 November 2010) will mark the halfway point in the 10-year GEOSS Implementation Plan, the session is likely to focus on how GEO, through GEOSS, can contribute to addressing critical societal needs particularly in developing and Least Developed Countries (LDCs), including a cross-cutting emphasis on data sharing and the coordination and sustainability of *in situ* observations – an issue of interest to CIMO.

9.25 Lastly, the Commission encouraged its Members to participate in relevant GEOSS activities, and to engage fully within national GEO coordination mechanisms to reinforce the role of NMHSs in understanding national-level needs for information and services, and their responsibilities for delivering such services in the areas of weather, climate, water and disaster risk reduction.

9.26 The Commission noted that a special survey had been conducted by the Secretariat for defining the benefits of WMO participation in GEO. The Commission noted also that there were different points of view concerning both the benefits to WMO and NMHSs from participation in GEO and GEOSS. There are concerns about the expansion of the GEO mandate beyond observations into information. Contribution to GEOSS should be on the basis of mutual benefit that maximizes synergies and avoids duplication.

9.27 The Commission noted that the Executive Council at its sixty-second session had requested the Secretary-General to ensure strengthened coordination with GEO.

WMO Disaster Risk Reduction (DRR)

9.28 The Commission noted that between 1980 and 2007, on the global scale, more than 90% of the total number of disasters, 72% of the casualties and 75% of total economic losses were related to hydrometeorological hazards. In this regard, the Commission noted that disasters can have impacts on observing networks leading to interruption of the core functions of National Meteorological and Hydrological Services (NMHSs), including observations, monitoring, forecasting and warning services.

9.29 The Commission was informed that the WMO DRR country-level survey (2006) indicated that droughts, flash and river floods, strong winds, severe storms, tropical cyclones, storm surges, forest and wild land fires, heat waves, landslides and aviation hazards were the top ten hazards of concern to all Members. The Commission noted that maintenance of high quality observational records (historical and real time) is critical for DRR applications, including: (i) risk identification; (ii) risk reduction through the provision of early warnings to support emergency preparedness and response as well as climate services for medium- and long-term sectoral planning; and (iii) risk transfer through insurance and other financial tools. Thus, interruptions in monitoring caused by damages to instruments and observing networks as a result of natural hazards, hamper NMHSs capacities in delivering effective services not only during and following a disaster, but also in the long-term, if these systems are not rebuilt.

9.30 In this regard, the Commission stressed that it is critical to ensure that instrumentation and observing networks are designed per standards that would withstand the impact of extreme weather events. The Commission agreed to: (i) develop standards for instruments and their installation so that they could withstand extreme hydrometeorological events; and (ii) to assist CBS and CHy in developing guidelines for the design of observing networks capable of reliably and accurately measuring extreme hydrometeorological events especially in regions at risk. The Commission requested its MG to incorporate relevant tasks and activities in the work programme of OPAGs and ETs.

9.31 The Commission recalled that the Fifteenth WMO Congress (Cg-XV) approved the strategic goals of WMO in disaster risk reduction, derived from the Hyogo Framework for Action 2005–2015 (HFA), which was adopted by 168 countries during the World Conference on Disaster Reduction (January 2005, Kobe, Japan). The Commission further noted that Cg-XV requested that WMO strategic goals in disaster risk reduction be implemented through national and regional projects built upon five major thrusts:

(a) Modernization of National Meteorological and Hydrological Services and their observing networks;

(b) Implementation of national operational multi-hazard early warning systems;

(c) Strengthening of hazard data, analysis and hydrometeorological risk assessment tools;

(d) Strengthening National Meteorological and Hydrological Service's cooperation with civil protection and disaster risk management agencies other stakeholders;

(e) Coordinated training and public outreach programmes.

9.32 The Commission was informed that under the crosscutting framework of the DRR Programme, national/regional cooperation projects are underway in a number of WMO Regions to demonstrate the benefits of utilizing meteorological, hydrological and climate services from the NMHSs for effective disaster risk management (DRM). The Commission noted that with strong support from EC-LX, EC-LXI and EC-LXII these projects have been or are being initiated in Southeast Europe (8 countries), Central Asia and Caucuses (8 countries), South-East Asia (5 countries) and Central America and the Caribbean (3 countries) in collaboration with key strategic partners such the World Bank, UN–International Strategy for Disaster Reduction (UN-ISDR) and UNDP and many involve modernization or improvement of the observing networks. The Commission recommended that its guidelines, when available, could be utilized for the design of observing networks as part of initiatives for modernizing or improving observing networks in beneficiary countries.

WMO Polar Observations (PORS)

9.33 The Commission appreciated the extensive work done by the Executive Council Panel of Experts on Polar Observations, Research and Services (EC-PORS) in addressing tasks related to Polar observations their standardization and data quality issues.

9.34 The Commission emphasized the challenge of operating and sustaining operational and research observing systems in harsh, remote, cold environments, especially the Polar Regions. It agreed that the CIMO Guide should include a chapter related to measurements and observations in Polar Regions, including measurements from automatic weather stations (AWS). It agreed that the membership of relevant CIMO expert teams should include EC-PORS representatives to make a link between CIMO and EC-PORS.

9.35 EC-LXII (Geneva, June 2010) noted the importance of the establishment of standards related to the measurements of snowfall, snow depth and solid precipitation, which are critical for weather, climate and hydrological research and services within and beyond the Polar Regions. They are also a critical component for WMO's proposed Global Cryosphere Watch (GCW). In this regard, the Commission recognized that there were many different methods and sensors in use for in-situ snowfall, snow depth and precipitation measurements, most with unknown measurement errors and that CIMO should make the effort to assess Members' current methods of observing such measurements. The Commission agreed that, as a matter of urgency, an intercomparison to assess the impact of automation and to determine the errors in measurement of snowfall, snow depth and solid precipitation in cold climate, particularly from automatic weather stations, should be conducted in cooperation with other relevant technical commissions and EC-PORS.

9.36 The Commission noted the importance of supersites/reference sites for integrated multidisciplinary monitoring to provide standardized data and information. It noted that the future

WMO Global Cryosphere Watch (GCW) aims to implement a standardized network of cryospheric observatories in cold climate regions, not just Polar Regions, where as many cryospheric elements as possible would be monitored in a standard manner for the long-term. This will require a collaborative effort to compile existing guidelines and standards for cryospheric measurements. New guidelines may be needed. The Commission agreed to contribute to the compilation of cryospheric guidelines and to be involved in the identification of supersites and their instrumentation and observations.

9.37 It was noted that EC-PORS would discuss the potential for an International Polar Decade (IPD) within WMO and with other agencies and scientific bodies. The Commission agreed that IPD would provide CIMO with a framework for potential future polar initiatives/ intercomparisons.

9.38 The Commission requested its Management Group (MG) to nominate a focal point to interface with EC-PORS on issues related to instruments and methods of observation standardization, maintenance and operation, as well as to liaise with EC-PORS on IPD issues.

9.39 The Commission recognized the activities being organized to support polar observations, solid precipitation measurement, GCW and a potential IPD in the future were not only consistent with WIGOS but they would be essential elements of WIGOS implementation. It also noted that together with CBS, the Commission would play a major part in the implementation of WIGOS. It requested its MG in coordination with EC-PORS, CBS, and other relevant bodies, as needed, to consider organizing these activities as a component of WIGOS implementation. This integrated approach would result in a significant contribution that not only supports WIGOS, GCOS and EC-PORS but also the future GFCS, as well as GEOSS.

Global Atmosphere Watch (GAW) programme

9.40 The Commission noted that WMO priority areas for the next financial period include the Global Framework for Climate Services (GFCS) and WMO Integrated Global Observing System (WIGOS). In this respect, the Commission stressed the importance of quality assurance (QA) and quality control (QC) of greenhouse gas, ozone and aerosol measurements in the Global Atmosphere Watch (GAW) programme. The Commission recognized that as regards these measurements, CIMO needs to link to the activities of the GAW programme.

9.41 The Commission appreciated the efforts by the GAW programme to enhance the quality of atmospheric composition measurements via the establishment of necessary WMO/GAW Central Facilities, intercomparison campaigns and training activities, including courses at GAWTEC. The Commission agreed that the signed agreement between BIPM and WMO provides better international recognition of the Central Facilities in the GAW programme and CAS.

9.42 Regarding the CIMO Guide, the Commission agreed that for the issues connected with atmospheric chemical composition measurements, the advice of CAS experts needs to be taken into consideration. Work on the CIMO Guide for the part on atmospheric chemical measurements should be performed in close collaboration with GAW and take into account the experience accumulated within this programme.

9.43 The Commission appreciated the organization of several intercomparison campaigns and requested for these activities to be continued. These included the first intercomparison of multiband filter radiometers (UV) in Oslo in May 2005, the first International Calibration Workshop of TECO surface ozone gas analysers at the end of 2006 (next to be organized in Buenos Aires in 2010), regular intercomparisons of Brewer and Dobson total ozone instruments organized by regional calibration centres, and the regular calibration and intercomparison campaigns organized on different aerosol properties by the Institute for Tropospheric Research in Leipzig, Germany, which serves as a WMO/GAW World Calibration Centre for Aerosol Physics. The Commission noted that “Instruments to measure solar ultraviolet radiation: Part 2: Broadband Instruments measuring Erythemally Weighted Solar Irradiance” (GAW Rep No. 164) had been published, and encouraged Members to use this document.

10. COLLABORATION WITH RELEVANT INTERNATIONAL ORGANIZATIONS *(agenda item 10)*

10.1 The Commission recognized the importance of close collaboration with relevant international organizations and scientific institutions in view of achieving common goals and making best use of available resources and expertise. The Commission requested the Management Group to ensure appropriate linkages with such organizations are maintained and strengthened according to the needs of the work priorities agreed by the session.

10.2 The Commission noted that WMO signed working arrangements with the International Organization for Standardization (ISO) that enabled increased collaboration between WMO and ISO allowing the development of common ISO/WMO technical standards and that EC-LXI adopted Resolution 8 (EC-LXI) on the procedures to be followed in proposing common WMO/ISO technical standards. The Commission recognized that it would enable them to strengthen the linkages that already exist between CIMO and ISO as a number of experts contribute to both CIMO Expert Teams and ISO Technical Committees.

10.3 The Commission agreed that developing a strong liaison with ISO to collaborate in the development and revision of standards would be very beneficial to ensure that relevant ISO and WMO standards meet the requirements of the meteorological community and to improve the quality of meteorological observations through publication of appropriate standards. The Commission felt that experience would need to be gained on the practical implementation of the working arrangements as to date no common ISO/WMO standard had yet been published. The Commission therefore requested the Management Group and ET Members to ensure experience gained in this process will be shared with other CIMO ETs.

10.4 The Commission was pleased that WMO signed the Mutual Recognition Arrangement (MRA) of the International Committee for Weights and Measures (CIPM) and had nominated three laboratories to represent it in activities organized within the CIPM MRA as it would contribute to improving measurement traceability world-wide. The Commission thanked those laboratories for their contributions and asked them to keep the Commission informed, through its Management Group, of any issue/development relevant to its work they would encounter through their participation in the CIPM/MRA.

10.5 The Commission appreciated that WMO organized, together with the International Bureau for Weights and Measures (BIPM), the “WMO-BIPM Workshop on Measurement Challenges for Global Observation Systems for Climate Change Monitoring: Traceability, Stability and Uncertainty” and that CIMO experts had actively participated in this workshop. The Commission requested the Management Group to advise on the need to organize a follow-up workshop in due time, and actively participate in its organization, if needed.

10.6 The Commission was pleased by the positive collaboration that had taken place with instrument manufacturers, in particular through the Association for Hydro-meteorological Equipment Industry (HMEI), and their participation in CIMO ET meetings, training workshops and instrument intercomparisons. The Commission recognized that the participation of instrument manufacturers in WMO instrument intercomparisons provided a unique testing of instruments that was of high interest to Members for assessing instrument capabilities and selecting network instruments according to their particular requirements.

10.7 The Commission thanked the EUMETNET OPERA programme for its willingness to share data and support the development of a weather radar database for WMO that is being kindly carried out by the Turkish State Meteorological Service. The Commission recommended that this development be conducted so as to minimize the work needed to maintain the database up-to-date, from the perspective of the database managers, as well as from the perspective of the NMHSs that need to supply their data. The Commission recognized that there are significant overlaps between many EUMETNET and CIMO activities and requested its Management Group and the chairs of the expert teams to investigate the possibility of collaboration in areas of mutual benefit.

10.8 The Commission recognized that outcomes of COST actions were highly relevant to its work and requested CIMO ETs to have active linkages with relevant COST actions contributing to them as far as possible, and ensuring that the lessons learned from those actions are used to develop guidance to CIMO Members, in particular through updates of the CIMO Guide.

11. FUTURE WORK AND WORKING STRUCTURE OF THE COMMISSION *(agenda item 11)*

11.1 The high priorities of WMO, WIGOS-WIS, GFCS, DRR, Capacity-building and Aeronautical Meteorology require increased collaboration with other technical commissions and regional associations. The Commission is also faced with large expectations to contribute to the development of these initiatives. This is particularly the case for WIGOS as the first area of standardization identified by WIGOS addresses instruments and methods of observation, while the third area addresses quality assurance, which are both very relevant to the Commission. The Commission recognized that its resources would not allow addressing everything at once and that it should therefore concentrate on activities on which it could be most effective, while strengthening collaboration with other technical commissions and prioritizing its work to best support WIGOS's development. The Commission also noted that it was a challenge for its management to respond positively to all the requests for collaboration and nomination of experts that it is receiving.

11.2 The Commission recognized the need to adapt its working structure to the new priorities of WMO, putting more emphasis on the areas for which guidance was critically needed and to have a flexible structure as WIGOS and GFCS would require adaptation from the Commission as they become better formulated. The Commission decided to build on the structure it had put in place during CIMO-XIII, including the concept of small Task Teams (TT) that could be established during the intersessional period to work on specific issues and adopted Resolution 2 (CIMO-XV) – Working structure of the Commission for Instruments and Methods of Observation.

11.3 The Commission decided to establish three Open Programme Area Groups on Standardization and Intercomparisons, on Remote-Sensing and New Technologies and on Capacity-building and adopted Resolution 3 (CIMO-XV) – Commission for Instruments and Methods of Observation Open Programme Area Groups.

11.4 The Commission agreed that CIMO Management Group members would have to assist the CIMO president and vice-president to ensure appropriate linkages and collaboration with other technical commissions and programmes by taking part in their activities. The Commission decided to re-establish the CIMO Management Group and adopted Resolution 4 (CIMO-XV) – Commission for Instruments and Methods of Observation Management Group.

11.5 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 decided to establish Expert Teams (ET) as well as theme leaders within each of the OPAGs and to allocate them tasks as given in Annex VII to the present report.

11.6 The Commission noted the positive experience that had been made by some expert teams that worked extensively via teleconferences to achieve their work programmes. The Commission agreed that new working methods and opportunities (such as teleconference, e-meetings, etc.) would need to be used by the Commission. The Commission proposed that each ET should hold a teleconference, with the responsible MG member, in the six months following CIMO-XV. Such teleconferences would be used as kick-off meetings to establish contact between the ET members, agree on workplan responsibilities and start the work. Furthermore, ETs should attempt to have ad-hoc meetings of opportunities, for example during next TECO, and recommended that the Management Group takes this into account in the preparation of TECO's schedule.

11.7 The Commission recognized that ET chairs play a crucial role in achieving the goals of the Commission by coordinating the work to be carried out. In view of ensuring the effective work

of the Commission, it is therefore highly desirable to avoid changes in ET-Chairmanship during an intersessional period. The Commission encouraged ET-Chairs to do their utmost in coordinating the work of their teams until the next session of the Commission. The Chairs and Vice-chairs of the ETs and Theme Leaders who were designated by the Commission are given in Annex VIII to the present report.

11.8 The Commission requested the MG to establish the membership of the ETs. It invited the chairs of the respective ETs and OPAGs, in agreement with the Management Group and in cooperation with the Secretariat, to develop a workplan according to the priorities set by CIMO-XV with realistic and focused target activities and deliverables to ensure that all experts could actively participate and contribute to the work programme. The Commission requested the Management Group to reassign the tasks that had been assigned to Expert Teams of the former structure of the Commission to the expert teams of the newer structure, and to make any adjustments in its structure as would be needed.

11.9 The Commission noted that a CIMO Trust Fund had been established to strengthen CIMO resource mobilization and allow external resources to support critical CIMO activities, like instrument intercomparisons, the development of updates to the CIMO Guide and its translation that could not be fully supported under the WMO regular budget. The Commission encouraged Members to provide support to specific CIMO activities through donations to this Trust Fund.

11.10 The Commission noted that the first meeting of the EC Advisory Panel on Gender Mainstreaming had been held in Geneva, on 25 and 26 February 2010, and also noted the agreement of EC-LXII to assign high priority to the issue of gender mainstreaming and its inclusion in relevant parts of the WMO Strategic Plan. The Commission agreed with the recommendation of the Panel to appoint a focal point on gender issues that should liaise with the EC Panel and requested the CIMO Management Group to nominate a CIMO Focal Point on Gender Issues. The Terms of Reference for the CIMO Focal Point on Gender Issues are contained in Annex IX to the present report.

11.11 Following-up on its request to the Management Group to nominate a focal point for the Executive Council Panel of Experts on Polar Obsrvations, Research and Services (EC-PORS) matter, the Commission agreed with the draft terms of reference for the CIMO Focal Point for EC-PORS as contained in Annex X to the present report.

11.12 The Commission recalled the JCOMM Pilot Project named Regional Marine Instrumentation Centre (RMIC) for the WIGOS. It noted that one RMIC was already designated with several more soon to follow. The Commission also noted the positive experience of the first successful demonstration of the RMIC at the United States NOAA National Data Buoy Center (NDBC) in April 2010. The Commission agreed that it needed to support marine instrumentation and methods of observation, as coordinated through JCOMM, in its future work and working structure.

11.13 Noting that the International Pyrheliometer Comparison (IPC) XI will commence on 27 September 2010, the Commission requested that at the earliest opportunity the CIMO MG establish a Task Team to ensure effective outcomes of IPC XI and recommend actions based on those outcomes, using the terms of reference of the ad hoc teams formed at previous IPCs as a draft basis for action. The Commission also asked the CIMO MG to ensure that the governance structure and TORs of the IPC Task Team will provide the mechanisms to sustain the World Radiometric Reference (WRR) as the WMO primary solar radiation reference and enable traceability of Regional Radiation Centres and National Radiation Centres to the WRR.

11.14 The Commission recommended that the Secretariat investigate possibilities to develop a Web-based information tool to share information on instruments and methods of observation best practices, in particular announcement and results of national intercomparisons, new developments and improvements to observing systems, development of standards, and information on performance issues.

11.15 The Commission requested the Management Group to prioritize the activities of the Commission based on the available resources.

CIMO Testbeds and Lead Centres

11.16 The Commission agreed with the proposal to establish CIMO Testbeds and Lead Centres to promote collaboration between CIMO and relevant NMHSs in testing, development and standardization of meteorological instruments and systems performance for the benefit of all WMO Members. It would utilize and build on both existing state-of-the-art facilities and specific expertise available at NMHSs for the provision of guidance to all WMO Members, while providing recognition by CIMO of state-of-the-art facilities and expertise available in the designated Testbeds and Lead Centres, as well as of their significant contribution towards developing guidance for WMO Members, and their impact on the WMO observing systems.

11.17 The Commission reviewed the generic terms of reference proposed for CIMO Testbeds and Lead Centres and adopted Resolution 5 (CIMO-XV) – Generic terms of reference of CIMO testbeds and lead centres.

11.18 The Commission welcomed the proposals for the establishment of CIMO Testbeds and Lead Centres received before CIMO-XV. The Commission established an Ad Hoc Group of experts, composed of Bruce Forgan (Chair, Australia), Heng Zhou (China), Michel Leroy (France) and Bruce Hartley (New Zealand) to evaluate these proposals during the CIMO-XV session, based on the following evaluation criteria:

- Formal written proposal from the Permanent Representatives of Members with WMO;
- Ensure that the title of the Testbed/Lead Centre reflects the focus area;
- Facilities – technical and infrastructure;
- Intersessional plan with focus areas of activities;
- Staffing available to support activities;
- Long-term commitment, for example, two intersessional periods;
- Compatibility with CIMO ToRs;
- Adequate resources – capability and capacity to run testbeds and lead centres;
- Statement on quality management system;
- Potential for capacity-building.

11.19 The Commission noted the report of the Ad Hoc Group provided in Annex XI to the present report. The Commission appreciated the high quality of all proposals, but recognized that some additional information would be needed to finalize the evaluation of some of these proposals before the end of 2010. The Commission requested the Ad Hoc Group to finalize these evaluations and to make a proposal to the president of CIMO for consideration. Based on the recommendation of the Ad Hoc Group, the Commission decided to designate the following CIMO Testbeds and CIMO Lead Centres:

- WMO-CIMO Testbed, Lindenberg Meteorological Observatory – Richard Assmann Observatory, Germany
- WMO-CIMO Lead Centre on Precipitation Intensity, Italy

The Commission also encouraged those Members who had submitted proposals to provide the needed information to enable the finalization of their evaluation by the Ad Hoc Group.

11.20 The Commission also agreed on the designation process for the establishment of future CIMO Testbeds and Lead Centres as provided in Annex XII to the present report. The Commission further encouraged Members to make similar proposals as soon as possible.

11.21 The Commission recognized that the designated Testbeds and Lead Centres would be reviewed at least once before each CIMO session.

TECO 2010 outcome

11.22 The WMO Technical Conference on Meteorological and Environmental Instruments and Methods of Observation (TECO-2010) was held in Helsinki, Finland, from 30 August to 1 September 2010. The Conference Theme was "Observing technologies and systems in support of evolving demands on weather, climate and water services". The Commission was informed about the major outcomes of the round table provided in Annex XIII to the present report and requested the Management Group to consider incorporating these proposals in the Expert Teams' workplans.

12. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND OF RELEVANT RESOLUTIONS OF THE EXECUTIVE COUNCIL *(agenda item 12)*

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 6 (CIMO-XV) – Review of previous resolutions and recommendations of the Commission for Instruments and Methods of Observation and Recommendation 3 (CIMO-XV) – Review of the resolutions of the Executive Council related to the Commission for Instruments and Methods of Observation.

13. ELECTION OF OFFICERS *(agenda item 13)*

13.1 The Commission unanimously elected Prof. Bertrand Calpini (Switzerland) as president of the WMO Commission for Instruments and Methods of Observation.

13.2 The Commission elected Dr Clifford Bruce Baker (United States of America) as vice-president of the WMO Commission for Instruments and Methods of Observation.

14. DATE AND PLACE OF THE SIXTEENTH SESSION *(agenda item 14)*

The Commission received the offer from the Russian Federation to host the sixteenth session of CIMO.

15. CLOSURE OF THE SESSION *(agenda item 15)*

The fifteenth session of CIMO closed at 11.10 a.m. on 8 September 2010.

RESOLUTIONS ADOPTED BY THE SESSION

Resolution 1 (CIMO-XV)

VISION STATEMENT OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

(1) The *Abridged Final Report with Resolutions of the Fifteenth World Meteorological Congress* (WMO-No. 1026), Resolution 13 (Cg-XV) – World Climate Applications and Services Programme, including the CLIPS project,

(2) The *Abridged Final Report with Resolutions of the Sixty-second Session of the Executive Council* (WMO-No. 1059),

(3) The *WMO Strategic Plan* (WMO-No. 1028),

Considering the increasing need for standardization of meteorological observations to ensure the quality of data to meet user requirements, such as those related to climate variability and change,

Recognizing:

(1) The role of the Commission in providing guidance for observing network managers and technicians to keep the national observing networks standardized to guarantee the required quality of products and services of National Meteorological and Hydrological Services to users,

(2) The need to motivate and stimulate experts in participating in the activities of the Commission,

(3) The importance of informing Members of the role of the Commission in supporting priority activities of WMO, such as the WMO Integrated Global Observing System, the Global Framework for Climate Services and disaster risk reduction,

Decides to adopt the CIMO Vision statement provided in the annex to this resolution.

Annex to Resolution 1 (CIMO-XV)

VISION OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

To ensure achievable standards and sustainable improvement of observing technologies for Members, the Commission for Instruments and Methods of Observation will:

(a) Promote the effective and economic development, implementation and use of instruments for meteorological, climatological, hydrological, oceanic and related geophysical and environmental observations under varying environmental conditions and in differing technical infrastructures as required;

(b) Develop, publish and provide effective access to standards, guidance material, for example, the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8), on instrumentation, reliable methods of observation, quality assurance, including instrument calibration and measurement traceability, performance specifications and issues associated with compatibility of instruments, interoperability between in situ and remotely sensed observations needed to operate observing networks for meteorology, climatology, hydrology, and other relevant environmental observations;

(c) Coordinate the introduction of new technologies together with the scientific community, instrument manufacturers and National Meteorological and Hydrological Services, evaluate them by appropriate methods, for example, instrument intercomparisons or testbed operations, and provide advice to facilitate introduction into operational use;

(d) Expand the scope of its work to take into account the increasing requirements of the WMO Integrated Global Observing System, Global Framework for Climate Services and disaster risk reduction, and coordinate with other relevant technical commissions as well as regional associations in the development of instruments suitable to difficult climate and social environments, and in training and other capacity-building activities.

Resolution 2 (CIMO-XV)

WORKING STRUCTURE OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

(1) The progress made in the development of the WMO Integrated Global Observing System (WIGOS) and the Global Framework for Climate Services,

(2) That the working structure adopted by the Commission at its thirteenth session proved effective,

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

Considering the need:

(1) To provide a greater opportunity for experts to work in highly focused teams on important specific technical problems,

(2) To strengthen the development of standards for instruments and methods of observation, including relevant quality control procedures, to meet the requirements of the WMO Integrated Global Observing System,

(3) To strengthen development of guidance material to Members on remote-sensing and new technologies that can be used operationally in observing networks, in particular for the attention of developing countries,

(4) To enhance participation of experts from developing countries in the work of the Commission, and collaboration with Regional Instrument Centres,

(5) To have a working structure that is adapted and flexible to meet the expectations of WMO priority activities, as they will be further developed,

(6) To build and maintain effective links with other technical commissions, regional associations, and relevant instrument manufacturers, in particular to address WIGOS-related matters,

(7) To ensure appropriate flow of technical information concerning the activities of the Commission to all Members,

Decides to modify its working structure consisting of Open Programme Area Groups as given in the annex to this resolution;

Authorizes the president to establish and activate expert teams and task teams in accordance with priorities agreed by the Commission and its Management Group;

Authorizes further the president, with assistance from the Management Group, to establish during the intersessional period expert teams and task teams for areas additional to those agreed by the Commission, if a demand arises;

Requests the president, with assistance from the Management Group, to keep the impact and effectiveness of the new working structure under review and to make adaptations in case of need;

Invites the Secretary-General to arrange, within available resources, for the support of the new structure that will facilitate the participation of the members of the Open Programme Areas Groups and the expert teams in the work of the Commission.

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Note: This resolution replaces Resolution 1 (CIMO-XIII), which is no longer in force.

Annex to Resolution 2 (CIMO-XV)

WORKING STRUCTURE OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

1. The working structure of the Commission will comprise a system of small, task-focused expert teams complemented by suitable ways to involve and inform all Commission members in the process. The activities of the Commission are grouped under three main open programme areas:

(a) Standardization and Intercomparisons;

(b) Remote-sensing and New Technologies;

(c) Capacity-building.

2. The activities under each of these open programme areas are handled by Open Programme Area Groups (OPAGs):

(a) OPAG on Standardization and Intercomparisons;

(b) OPAG on Remote-sensing and New Technologies;

(c) OPAG on Capacity-building;

3. The members of the OPAGs are regularly consulted and informed through suitable means of distribution, such as circular letters from the president of the Commission or co-chairs and the WMO/CIMO Website.

CIMO Management Group

4. The CIMO Management Group shall consist of the president and vice-president, the co-chairs of the three OPAGs, along with the minimum additional experts needed to ensure regional representation. It should not normally exceed eight members in total. The Group has a strong, active and pivotal role in guiding and managing the activities of the Commission between sessions. It is responsible for ensuring the integration of the programme areas, for strategic planning issues, for the evaluation of the progress achieved in the agreed work programme and for related necessary adjustments to the working structure in the intersessional period. The Group should meet at least once, preferably twice, in the intersessional period. The Commission, by means of a resolution, decides the terms of reference for the CIMO Management Group. The reports of CIMO Management Group meetings will be accessible through the WMO/CIMO Website.

5. The CIMO Management Group must be fully committed to its management responsibilities. It should:

(a) Focus on user requirements;

(b) Monitor and make adjustments to the terms of references of the OPAGs;

(c) Coordinate the specific tasks and schedules resulting from the work of the specific programme activities (expert teams);

(d) Set standards for the documentation/reporting of the Commission;

(e) Conduct a regular management review;

(f) Ensure appropriate coordination with other technical commissions, regional associations and relevant WMO Programmes.

Open Programme Area Groups

6. The terms of reference of the Open Programme Area Groups and the designation of co-chairs are decided by the Commission at a session. The terms of reference of a general nature are defined for each OPAG, together with specific tasks, and are approved by the Commission. The co-chairs of each OPAG coordinate and manage the work of the expert teams. The expert teams, established by the Commission or its president with the assistance of the CIMO Management Group, carry out specific tasks assigned to them. The co-chairs will determine the appropriate allocation of responsibilities for the leadership of the expert teams, including coordination of their work and reports. The co-chairs are responsible for the management and technical guidance of the work of the OPAG area.

Expert Teams

7. An expert team is mainly based on expertise to develop proposed solutions to scientific/technical problems and for studying issues for which specific expert knowledge is needed. In some cases it may be more effective to establish a theme leader (single expert to be considered as a “one-member” expert team) providing expert guidance, reporting on implementation and liaising with other expert teams and groups on specific matters and themes. The terms of reference of the expert teams are established by the Commission at a session, the president, or the Management Group.

8. The chairs of the expert teams are normally designated by the Commission at a session. If this is not possible, the team leaders will be designated by the president upon a recommendation from the co-chairs of the OPAG.

9. Members of the expert teams will be designated by the Management Group upon recommendation from the OPAG and expert team chairs. If this is not possible, an alternative mechanism agreed to by the president will be invoked. Establishment and activation of the expert teams is normally done by the Commission at a session or its president under guidance from the Management Group. The OPAG co-chairs will invite suitable experts from other interested bodies to participate in CIMO expert teams.

10. The expert teams are expected to deliver their working results within a specific time period to their parent body. Work by correspondence or meetings, as necessary, should achieve this. The need for the meetings of the expert teams will be considered by the Management Group in consultation with the Secretariat taking due note of the nature and urgency of the task(s) entrusted to the teams. The reports of the expert teams will generally be accessible through the WMO/CIMO Website or distributed by regular mail, as necessary.

11. Expert team chairs may, with the approval of the Management Group, draw upon CIMO experts as required to accomplish their tasks. Expert team chairs should plan their tasks and milestones and report regularly on the progress achieved in carrying out tasks assigned to their teams.

Task Teams

12. Task teams are small groups of experts that can be established to address a specific issue. They are established either directly by the Management Group (reporting directly to the Management Group), or by the Management Group upon recommendation of an expert team chair. They work independently of the rest of the expert team and can include members that are not core members of the expert team. They are normally short-lived and report to the Management Group via the expert team chair if established under the supervision of an expert team. They normally work by correspondence and a meeting may be considered at the time of finalization of their mandate.

Resolution 3 (CIMO-XV)

COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION OPEN PROGRAMME AREA GROUPS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Considering:

(1) The need for continued development and coordination of activities with WMO relating to:

   (a) Ensuring that the quality of observational networks is continuously improved and quantified,

   (b) Introducing new technology into operations, whether from research institutes or commercial manufacturers,

   (c) Improving the availability of observations to support the requirements for disaster risk reduction, the WMO Integrated Global Observing System and the Global Framework for Climate Services,

(2) The need to provide advice to Members on the use of instruments and their maintenance and calibration,

(3) The need to align the activities of the Commission with the requirements of the WMO priority activities and the WMO Strategic Plan,

Recalling:

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

(2) Resolution 1 (CIMO-XIV) – CIMO Open Programme Area Groups (OPAGs),

Decides:

(1) To establish:

(a) The OPAG on Standardization and Intercomparisons;

(b) The OPAG on Remote-sensing and New Technologies;

(c) The OPAG on Capacity-building;

(2) To adopt the terms of reference for each Open Programme Area Group as given in the annex to this resolution;

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

(a) OPAG on Standardization and Intercomparisons:
- Co-chair: Bruce Forgan (Australia);
- Co-chair: Jitze P. van der Meulen (Netherlands);

(b) OPAG on Remote-sensing and New Technologies:
- Co-chair: Heng Zhou (China);
- Co-chair: Alexander Gusev (Russian Federation);

(c) OPAG on Capacity-building:
- Co-chair: Mario García (Argentina);
- Co-chair: Samir Issara (Morocco);

Requests the co-chairs of the Open Programme Area Groups:

(1) To act upon matters referred to the OPAG by the Commission and its president;

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

(3) To submit a report to the Commission on the outcome of their activities, recommendations for adoption by the Commission at its session, as well as requirements and proposals for future activities in their field, not later than four months prior to its session.

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Note: This resolution replaces Resolution 1 (CIMO-XIV), which is no longer in force.

Annex to Resolution 3 (CIMO-XV)

TERMS OF REFERENCE OF COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION OPEN PROGRAMME AREA GROUPS

A. OPAG ON STANDARDIZATION AND INTERCOMPARISONS

1. To promote developments in surface, in situ upper-air and radiation instruments and methods of observations suitable for all Members, including least developed countries, in liaison with the Association of Hydro-Meteorological Equipment Industry, National Meteorological and Hydrological Services and relevant scientific institutions;

2. To establish standards for instruments and methods of observation, including metadata, as required by the WMO Integrated Global Observing System (WIGOS) and WMO Programmes, and in cooperation with other international standardization organizations;

3. To develop guidance material for Members on the use and operations of instruments;

4. To organize instrument testing and intercomparisons;

5. To provide advice to the WMO Programmes and Members, as required;

6. To effectively liaise with the OPAG on Capacity-building for the publication of standards (CIMO Guide, CIMO and WIGOS Manuals, etc.) and for supporting relevant training activities;

7. To regularly inform Members on the achievements of the OPAG.

B. OPAG ON REMOTE-SENSING AND NEW TECHNOLOGIES

1. To promote developments associated with the operation, development, testing and documentation of ground-based remote-sensing systems and new observing technologies, including coordination with other technical commissions;

2. To maintain an overview of all activities related to the operation, development, testing and documentation of ground-based remote-sensing systems and new observing technologies, including the progress of testbed operations;

3. To develop guidance material and standards on remote-sensing and new technologies that can be used operationally;

4. To provide advice to the WMO Programmes and Members, as required;

5. To effectively liaise with the OPAG on Capacity-building for the publication of standards (CIMO Guide, CIMO and WIGOS Manuals, etc.) and for supporting relevant training activities;

6. To regularly inform Members on the achievements of the OPAG.

C. OPAG ON CAPACITY-BUILDING

1. To strengthen and develop capacity-building activities related to instruments and methods of observations, including the development of guidance material on instrument calibration and maintenance, and measurement traceability;

2. To collaborate in organizing capacity-building activities with regional associations and other relevant WMO capacity-building activities;

3. To undertake all needed coordination activities and ensure the review and publication of standards (CIMO Guide, CIMO and WIGOS Manuals, common International Organization for Standardization/WMO standards, etc.);

4. To effectively liaise with the OPAG on Standardization and Intercomparisons and the OPAG on Remote-sensing and New Technologies for the publication of standards and for supporting relevant training activities and to ensure that the work of the theme leaders is coordinated with the expert teams of the other OPAGs;

5. To regularly inform Members on the achievements of the OPAG.

Resolution 4 (CIMO-XV)

COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION 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-XIV) – CIMO 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, to prioritize activities and decide on necessary adjustments to the working structure of the Commission during the intersessional period, and to liaise with other technical commissions and regional associations,

Decides:

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

   (a) To advise and help 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, expert teams and task teams, including evaluating the progress achieved in the work programmes and advising on the new priority activities;

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

(e) 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;

(f) To coordinate the activities of the Commission with respect to other technical commissions, regional associations and WMO cross-cutting programmes;

(g) To mobilize experts 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 its working structure during the intersessional period, for efficiency reasons and/or to meet emerging requirements of the Organization;

(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 designations of experts to carry out specific tasks as necessary between sessions of the Commission;

(k) Open Programme Area Group chairs will participate in the meetings of the expert teams under their responsibility;

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

(a) The president of the Commission (chair);

(b) The vice-president of the Commission;

(c) The co-chairs of the Open Programme Area Groups;

(d) Chair of the CIMO Guide Editorial Board;

Allows the president to modify the composition and size of the CIMO Management Group for efficiency reasons and/or to meet emerging requirements of the Organization.

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Note: This resolution replaces Resolution 2 (CIMO-XIV), which is no longer in force.

Resolution 5 (CIMO-XV)

GENERIC TERMS OF REFERENCE OF CIMO TESTBEDS AND LEAD CENTRES

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

(1) The request of the Executive Council at its fifty-ninth session for the Commission to identify one or more centres of excellence that would serve as a CIMO Lead Centre for Instrument Development and Testing and to develop terms of reference for such a centre,

(2) The request of the Executive Council at its sixtieth session for the Commission to build the foundations for the future CIMO testbed instrument facility while addressing integration of

ground-based remote-sensing and in situ observations as appropriate for future observing networks,

Considering:

(1) The ongoing need for testing and for development of guidance to Members on instrument performances,

(2) The need to establish the principles for the optimal mix of sensing systems to improve both temporal and spatial capabilities for future operational upper-air networks,

(3) The significant contribution of National Meteorological and Hydrological Services with special facilities and expertise towards developing guidance for WMO Members, and their impact on the WMO observing systems,

Recognizing:

(1) That testbeds are centres with experimental facilities to assess the capabilities of various remote-sensing technologies and to provide guidance on remote-sensing instrumentation from a variety of observing systems, such as guidance concerning the optimal distribution of the deployment of new observing systems and the best mix of instruments, or centres for long-term testing of surface in situ observations;

(2) That lead centres are centres of excellence for instrument development and testing that could be focused on a specific parameter;

Decides to adopt the generic terms of references for CIMO testbeds and lead centres as provided in Annexes 1 and 2 to this resolution;

Invites Members to submit further proposals for such testbeds and lead centres including a description of the infrastructure and instrumentation available as well as the proposed main activities of the testbed/lead centre.

Annex 1 to Resolution 5 (CIMO-XV)

GENERAL TERMS OF REFERENCE OF CIMO TESTBEDS FOR GROUND-BASED REMOTE-SENSING AND IN SITU OBSERVATIONS

1. The purpose of a CIMO testbed for ground-based remote-sensing and in situ observations is to capture the results and information that are available at specific National Meteorological and Hydrological Services in testing of ground-based remote-sensing and in situ instruments and providing an international platform for integration of observations within the WMO Integrated Global Observing System.

2. CIMO testbeds will be established by the Commission based on proposals from Members, on the basis that it is confident that through the proposal and any supplementary information the proposed testbed has the necessary capability, capacity and expertise and has made a long-term commitment.

3. CIMO testbeds will be responsible for providing guidance in integration of ground-based remote-sensing and in situ observations, as well as in the development of standard procedures and advice related to instrument use and operation. CIMO testbeds will be expected to collaborate with relevant CIMO expert teams in developing guidance material.

4. CIMO testbeds should include “centres of excellence” where latest technologies are explored and also “centres of excellence” where new technologies are applied that result in cost-effective instrument technology and systems. CIMO testbeds should collaborate with other scientific and development institutions and agencies, including instrument manufacturers.

5. CIMO testbeds should be instrumental in the CIMO effort to bridge gaps between countries by assisting the Commission in conducting training and capacity-building activities. This would not be restricted to participating in CIMO training events, but could also be by developing a special relationship with a companion station/site from a developing country.

6. CIMO testbeds will provide at least one report every two years to the CIMO Management Group, publish Instruments and Observing Methods reports and where relevant provide contributions to Technical Conferences on Meteorological and Environmental Instruments and Methods of Observation. CIMO testbed activity will be evaluated by the CIMO Management Group prior to each session of the Commission to ensure they are delivering the expected outcomes.

7. The CIMO testbeds will liaise with the Commission via a CIMO expert team specified by the CIMO Management Group. CIMO testbeds must provide a contact person responsible for communication between CIMO testbeds and the Commission.

8. CIMO testbeds are requested to inform WMO if they no longer have the capabilities to provide the expected service, for example, for human resource reasons.

Annex 2 to Resolution 5 (CIMO-XV)

GENERAL TERMS OF REFERENCE OF CIMO LEAD CENTRES

1. The purpose of CIMO lead centres is to provide high-level expertise in testing of instruments’ performance including in laboratory facilities, and instrument intercomparisons, resulting in standardization of instruments’ performance, instrument interoperability and compatibility within the WMO Integrated Global Observing System (WIGOS).

2. CIMO lead centres will provide reports on all significant tests to the CIMO community, and in support of services of WIGOS and the Global Framework for Climate Services, through publication of Instruments and Observing Methods reports and publications in scientific journals, as appropriate.

3. CIMO Lead centres will be established by the Commission based on proposals from Members, on the basis that the Commission is confident that through the proposal and any supplementary information the proposed lead centre has the necessary capability, capacity and expertise and has made a long-term commitment.

4. CIMO lead centres will contribute to the development of standard procedures for all aspects of instrument use and operation with a view to promote worldwide instrument compatibility and interoperability. They should provide advice related to instrument use, operation and calibration. CIMO Lead centres will be expected to collaborate with relevant CIMO expert teams in developing guidance material and with Regional Instrument Centres and Regional Radiation Centres, as relevant.

5. CIMO lead centres should be instrumental in CIMO efforts to bridge gaps between countries by assisting the Commission in conducting training and capacity-building activities.

6. CIMO lead centres will provide at least one report every two years to the CIMO Management Group, publish IOM reports and where relevant provide contributions to Technical

Conferences on Meteorological and Environmental Instruments and Methods of Observation. CIMO lead centre activity will be evaluated by the CIMO Management Group prior to each session of the Commission to ensure centres are delivering the expected outcomes.

7. CIMO lead centres will liaise with the Commission via a CIMO expert team specified by the CIMO Management Group. CIMO lead centres must provide a contact person responsible for communication between the lead centre and the Commission.

8. CIMO lead centres are requested to inform WMO if they no longer have the capabilities to provide the expected service, for example, for human resource reasons.

Resolution 6 (CIMO-XV)

REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

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

Decides:

(1) To keep in force Resolution 3 (CIMO-XIV);

(2) To keep in force Recommendations 1 (CIMO-XIV), 5 (CIMO-XIV), 7 (CIMO-XIV), 9 (CIMO-XIV), 10 (CIMO-XIV), 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 fifteenth session.

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Note: This resolution replaces Resolution 4 (CIMO-XIV), which is no longer in force.

RECOMMENDATIONS ADOPTED BY THE SESSION

Recommendation 1 (CIMO-XV)

REGIONAL INSTRUMENT CENTRE CAPABILITIES AND COMMUNICATION WITH MEMBERS

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

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

(2) The terms of reference of Regional Instrument Centres (RICs), as published in the *Guide to Meteorological Instruments and Methods of Observations* (WMO-No. 8),

(3) The RICs that were established by regional associations,

(4) The Evaluation Scheme for Regional Instrument Centres,

Recognizing:

(1) The need to improve measurement traceability to the International System of Units (SI) standards in many National Meteorological and Hydrological Services,

(2) That many National Meteorological and Hydrological Services are not aware of the existence of RICs and of the services they can provide,

Considering:

(1) The important role that RICs play in the WMO Integrated Global Observing System to ensure the quality of observed data by providing traceability of measurements to SI standards,

(2) The need for the regular assessment of RICs by a recognized authority to verify their capabilities and performances as requested by the Executive Council at its sixtieth session,

(3) The availability of an Evaluation Scheme for the auditing of Regional Instrument Centres based on the terms of reference of the RICs and on the International Organization for Standardization standard ISO 17025 – General requirements for the competence of testing and calibration laboratories,

Recommends:

(1) That RICs develop websites to improve communication with the Members of their Region, providing information on their capabilities and the services they provide including relevant contact information, and maintain a database of the standards used by the Members of the Region and already calibrated by the RIC;

(2) That RICs, in collaboration with the Commission, develop necessary training and capacity-building material and organize training events to improve understanding of traceability of measurements to international standards and implementation of the concept in Regions;

(3) That RICs make regular use of the Evaluation Scheme for Regional Instrument Centres, developed by the Commission, communicate the results to Members of the Region and to the president of the respective regional association to enable the regional association to assess whether the existing RICs meet their stated requirements; and that regional associations inform the Commission whether any capacity-building actions are needed;

(4) That RICs organize regular inter-laboratory comparison between RICs, preferably within their Region, and publish their results on their dedicated websites and on the WMO Website;

Further recommends that regional associations be invited to review the results of the evaluation of their RICs at each session of the regional association.

Recommendation 2 (CIMO-XV)

TERMS OF REFERENCE OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION,

Noting:

(1) The *Abridged Final Report with Resolutions of the Fifteenth World Meteorological Congress* (WMO-No. 1026),

(2) The final reports of the 2009 Meeting of Presidents of Technical Commissions (Geneva, February 2009) and 2010 Meeting of Presidents of Technical Commissions (Geneva, January 2010),

(3) The *Abridged Final Report with Resolutions of the Sixty-second Session of the Executive Council* (WMO-No. 1059),

(4) The WMO *Strategic Plan* (WMO-No. 1028),

Considering the positive outcome of consultations with other technical commissions and the collaboration with pilot projects on the WMO Integrated Global Observing System,

Considering further the new preamble proposed by the Executive Council to be incorporated in the general terms of reference of technical commissions in the WMO General Regulations,

Recognizing that the terms of reference of technical commissions should be aligned with the long-term priorities of the Organization, the WMO results-based management approach and overall Organization objectives and strategic thrusts,

Recommends that the terms of reference of the Commission should be amended as provided in the annex to this recommendation;

Requests the Secretary-General to bring this proposal to the attention of Sixteenth Congress for its consideration and inclusion in the WMO General Regulations.

Annex to Recommendation 2 (CIMO-XV)

TERMS OF REFERENCE OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

The Commission shall be responsible for matters relating to international standardization, compatibility and sustainability of instruments and methods of observation of meteorological, climatological, hydrological, marine, and related geophysical and environmental variables.

This responsibility underpins all observations within the WMO Integrated Global Observing System, and will be carried out in close consultation with relevant WMO partner organizations that co-sponsor, own and/or operate some of the observing systems. This responsibility also extends to supporting the requirements of WMO cross-cutting activities such as the Global Framework for Climate Services, disaster risk reduction and capacity-building.

This shall include, in particular, the following:

(a) Respond to the requirements for standardized and compatible observations, including data content, quality, metadata and observational product generation;

(b) Provide advice and recommendations, and promote studies concerning effective and sustainable use of instruments and methods of observation, including quality management procedures such as methods for testing, preventive maintenance, calibration and quality assurance;

(c) Conduct and/or coordinate global and regional instrument intercomparisons and performance testing of instruments and methods of observation;

(d) In collaboration with the other international organizations, such as the International Bureau of Weights and Measures and the International Organization for Standardization, promote the development of measurement traceability to recognized international standards (SI), including reference instruments and effective hierarchy of world, regional, national and lead centres for instrument calibration, development and testing;

(e) Promote compatibility, intercomparison, integration and interoperability with respect to both, and between, space-based and surface-based (in situ and remote-sensing) observations, including conducting testbed observing experiments;

(f) Encourage research and development of new approaches in the field of instruments and methods of observation of meteorological, climatological, hydrological, marine, and related geophysical and environmental variables;

(g) Promote the appropriate and economical production of instruments and methods of observation with particular attention to the needs of developing countries;

(h) Support training and capacity-building activities in the area of instruments and methods of observation;

(i) Liaise with the scientific research community and instrument manufacturers in introducing new observing systems into operations.

Recommendation 3 (CIMO-XV)

REVIEW OF THE RESOLUTIONS OF THE EXECUTIVE COUNCIL RELATED TO THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

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-LIX) – Report of the fourteenth 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 kept in force.

ANNEXES

ANNEX I
Annex to paragraph 4.13 of the general summary

UPDATING THE *GUIDE TO METEOROLOGICAL INSTRUMENTS AND METHODS OF OBSERVATION* (WMO-NO. 8) ON RAINFALL INTENSITY MEASUREMENT AND INSTRUMENT INTERCOMPARISON BEST PRACTICES

The CIMO Guide should be updated according to the specific indications below:

– To explicitly address Rainfall Intensity (RI) measurements and to include specific relevant information where appropriate.

– 1-min RI should only be measured in a station and used for further analysis if all 1-min data are transmitted and used (1-min RI intensity should not be used in a temporal sampling scheme, i.e. one synoptic measurement every hour or 3 hours as a single 1-min RI values is not representative of a longer period of time) and a very good time synchronization, better than 10s, is achieved, both between the reference time and the different instruments of the observing station.

– Row 6.4 (precipitation intensity)) of the Table included in Chapter 1, Annex 1.B should be split to account for both liquid and solid precipitation intensity. The comments should be appropriately attributed to the relevant type of precipitation intensity.

– Row 6.4-Column 8 (Achievable measurement uncertainty) of the Table included in Chapter 1, Annex 1.B should be split to account for both laboratory and field conditions. For precipitation intensity (liquid) the following figures should be added:

Under constant flow conditions in laboratory	5% above 2 mm/h 2% above 10 mm/h
In field conditions	5 mm/h, and 5% above 100 mm/h

– The procedure for laboratory calibration of catchment type RI gauges already included in the CIMO Guide should be updated with the procedure adopted in the WMO Field Intercomparison (at a 1-min resolution in time), for both the laboratory and field calibration methods specifically documented in sections 4.1.2 and 4.2 of IOM 99-WMO/TD1504 (2009).

– In Part III, Chapter 4.4 and related Annexes, it should be recommended that the International Organizing Committee of future intercomparisons considers having regular teleconferences to monitor the progress of the intercomparison, to provide advice to the local host and to develop the final report. It should be also recommended that a test period should be held before the official start of the intercomparison: after this test period a meeting with all participants should be organized to confirm and verify the setting of the instruments and data acquisition.

ANNEX II
Annex to paragraph 4.14 of the general summary

REQUIREMENTS FOR IMPROVING THE ACCURACY OF RAINFALL INTENSITY MEASUREMENTS

The results obtained during the Field Intercomparison of Rainfall Intensity Gauges held in Vigna di Valle, Italy allowed in particular to identify the following requirements for the development of rainfall intensity measurements:

(1) The minimum list of technical parameters provided below should be included in the user manual of each instrument and sufficient advice on the best choice of output values should be provided to use for different applications:
- Measurement range, resolution, threshold and linearity;
- Measurement uncertainty (for the whole measurement range);
- Dead time, delay time and time constant;
- Internal calculation or update cycle and possible output cycles.

(2) Tipping bucket rain gauges should be corrected to compensate for underestimation of high RI. Software correction methods that take into account the timestamp of each tip provide the best results.

(3) The calculation of rainfall intensity and accumulation should be separated and both values be reported.

(4) The use of algorithms that increase the time constant should be avoided.

(5) Quality information should be provided in the output data telegram.

(6) The design of instruments should be improved to reduce the uncertainty of 1-min rain intensity measurements at low rainfall intensities (especially below 20 mm/h).

ANNEX III
Annex to paragraph 4.25 of the general summary

PROVISIONAL PROGRAMME OF CIMO SURFACE-BASED INSTRUMENT INTERCOMPARISONS (2011–2014)

1. WMO Intercomparison on Solid Precipitation including Snowfall and Snow Depth Measurements in various regions of the world (multi-site experiment) at Automatic Stations;

2. WMO Regional Pyrheliometer Comparisons

3. WMO Combined Intercomparison of Thermometer Screens/Shields in conjunction with Humidity-Measuring Instruments in the 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 of Ceilometers in support of the ET on Upper-Air Systems Intercomparisons;

8. WMO Combined Intercomparison of pyranometers, sunshine duration instruments, possibly in conjunction with UV sensors.

ANNEX IV
Annex to paragraph paragraph 4.36 of the general summary

SITING CLASSIFICATIONS FOR SURFACE OBSERVING STATIONS ON LAND

Environmental conditions of a site[1] may generate measurement errors exceeding the tolerances envisaged for instruments. More attention is usually given to the characteristics of the instrument than to the environmental conditions in which the measurement is made and it is often environmental conditions that distort results, influencing their representativeness, particularly when a site is supposed to be representative of a large area (i.e. 100 to 1 000 km^2).

WMO-No. 8 indicates exposure rules for various sensors. But what should be done when these conditions are not fulfilled?

There are sites that do not respect the recommended exposure rules. Consequently, a classification has been established to help determine the given site's representativeness on a small scale (impact of the surrounding environment). Hence, a class 1 site can be considered as a reference site. A class 5 site is a site where nearby obstacles create an inappropriate environment for a meteorological measurement that is intended to be representative of a wide area (at least tenths of km^2) and where meteorological measurements should be avoided. The smaller the siting class, the higher the representativeness of the measurement for a wide area. A site with a poor class number (large number) can still be valuable for a specific application needing a measurement in this particular site, including its local obstacles.

Each type of measurements on a site is subject to a separate classification.

By linking measurements to their associated uncertainty levels, this classification may be used to define the maximum class number of a station in order to be included in a given network, or to be used for a given application. In a perfect world, all sites would be in class 1, but the real world is not perfect and some compromises are necessary. It is more valuable to accept this situation and to document it by means of this siting classification.

Judging from the experience of Météo-France, the classification process helps the actors and managers of a network to better take in to consideration the exposure rules, and thus it often improves the siting. At least, the siting environment is known and documented in the metadata. It is obviously possible and recommended to fully document the site, but the risk is that a fully documented site may increase the complexity of the metadata, which would often restrict their operational use. That is why this siting classification is defined to condense the information and facilitate the operational use of this metadata information.

[1] A "site" is defined as the place where the instrument is installed.

A site as a whole has no single classification number. Each parameter being measured at a site has its own class, and is sometimes different from the others. If a global classification of a site is required, the maximum value of the parameters' classes can be used.

The rating of each site should be reviewed periodically as environmental circumstances can change over a period of time. A systematic yearly visual check is recommended: if some aspects of the environment have changed, a new classification process is necessary.

A complete update of the site classes should be done at least every 5 years.

In the following text, the classification is (occasionally) completed with an estimated uncertainty due to siting, which has to be added in to the uncertainty budget of the measurement. This estimation is coming from bibliographic studies and/or some comparative tests.

The primary objective of this classification is to document the presence of obstacles close to the measurement site. Therefore, natural relief of the landscape may not be taken into account, if far away (i.e., >1 km). A method to judge if the relief is representative of the surrounding area is the following: does a move of the station by 500 m change the class obtained? If the answer is no, the relief is a natural characteristic of the area and is not taken into account.

Complex terrain or urban areas generally lead to high class numbers. In such cases, an additional flag "S" can be added to class numbers 4 or 5 to indicate specific environment or application (i.e., 4S).

AIR TEMPERATURE AND HUMIDITY

Sensors situated inside a screen should be mounted at a height determined by the meteorological service (within 1.25 m to 2 m as indicated in the CIMO Guide). The height should never be less than 1.25 m. The respect of the higher limit is less stringent, as the temperature gradient vs. height is decreasing with height. For example, the difference in temperature for sensors located between 1.5 and 2 m is less than 0.2°C.

The main discrepancies are caused by unnatural surfaces and shading.

- Obstacles around the screen influence the irradiative balance of the screen. A screen close to a vertical obstacle may be shaded from the solar radiation or "protected" against the night radiative cooling of the air, by receiving the warmer infrared (IR) radiation from this obstacle or influenced by reflected radiation;
- Neighbouring artificial surfaces may heat the air and should be avoided. The extent of their influence depends on the wind conditions, as wind affects the extent of air exchange. Unnatural or artificial surfaces to take into account are heat sources, reflective surfaces (e.g., buildings, concrete surfaces, car parks) and water sources (e.g., ponds, lakes, irrigated areas).

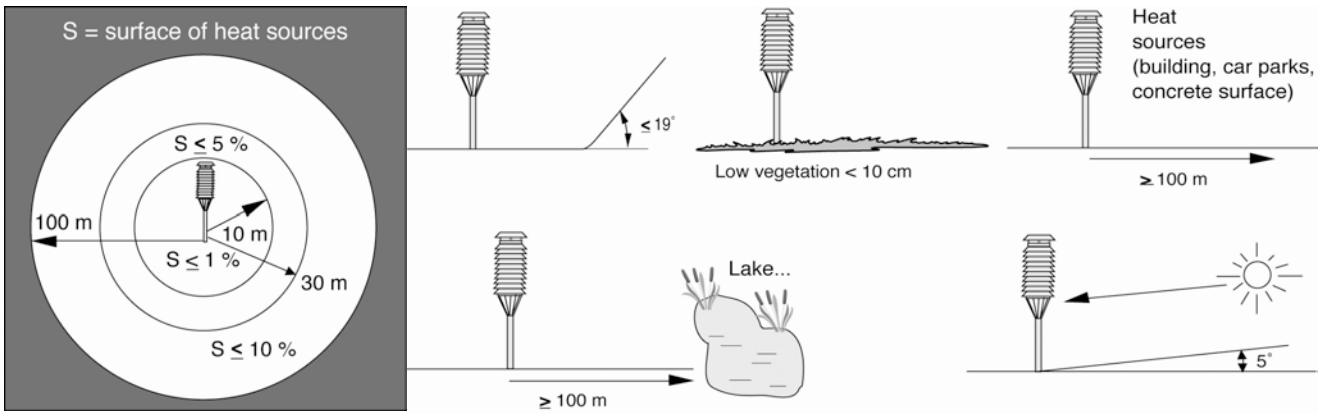
Shading by nearby obstacles should be avoided. Shading due to natural relief is not taken into account for the classification (see above).

The indicated vegetation growth height represents the height of the vegetation maintained in a 'routine' manner. A distinction is made between structural vegetation height (per type of vegetation present on the site) and height resulting from poor maintenance. Classification of the given site is therefore made on the assumption of regular maintenance (unless such maintenance is not practicable).

Class 1

- Flat, horizontal land, surrounded by an open space, slope less than 1/3 (19°);
- Ground covered with natural and low vegetation (< 10 cm) representative of the region;
- Measurement point situated:
  - at more than 100 m from heat sources or reflective surfaces (buildings, concrete surfaces, car parks, etc.)
  - at more than 100 m from an expanse of water (unless significant of the region)
  - away from all projected shade when the Sun is higher than 5°.

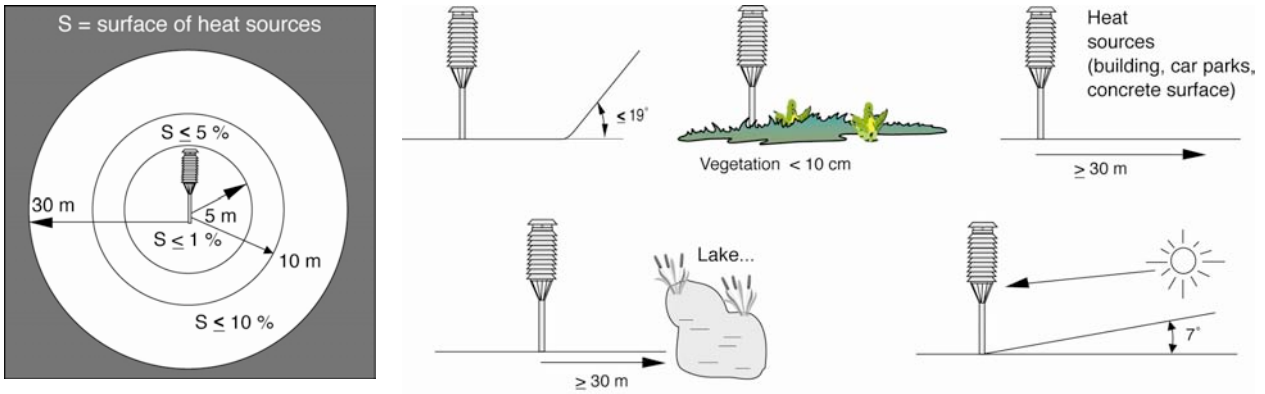
A source of heat (or expanse of water) is considered to have an impact if it occupies more than 10% of the surface within a circular area of 100 m surrounding the screen, makes up 5% of an annulus of 10m–30m, or covers 1% of a 10 m circle.



Class 2

- Flat, horizontal land, surrounded by an open space, slope inclination less than 1/3 (19°);
- Ground covered with natural and low vegetation (<10 cm) representative of the region;
- Measurement point situated:
  - At more than 30 m from artificial heat sources or reflective surfaces (buildings, concrete surfaces, car parks, etc.)
  - At more than 30 m from an expanse of water (unless significant of the region)
  - Away from all projected shade when the Sun is higher than 7°.

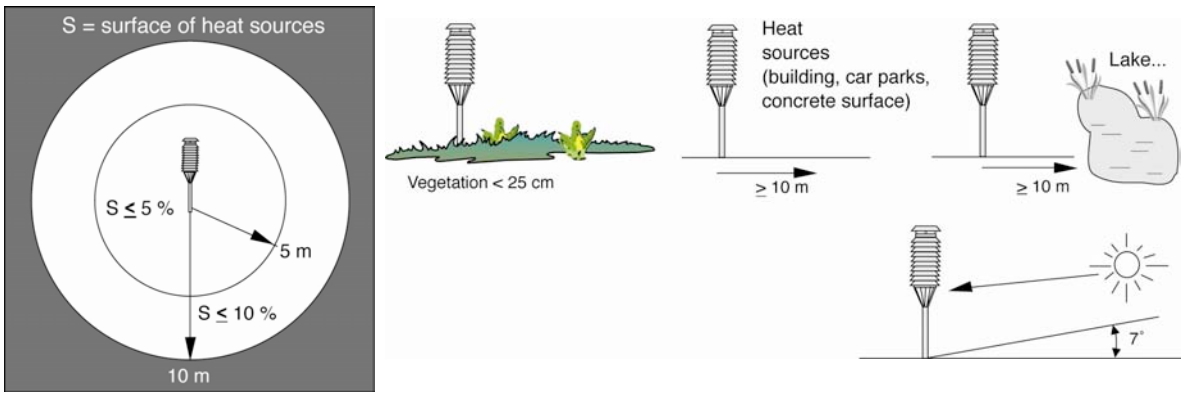
A source of heat (or expanse of water) is considered to have an impact if it occupies more than 10% of the surface within a circular area of 30 m surrounding the screen, makes up 5% of an annulus of 5m–10m, or covers 1% of a 5 m circle.



Class 3 (additional estimated uncertainty added by siting up to 1°C)

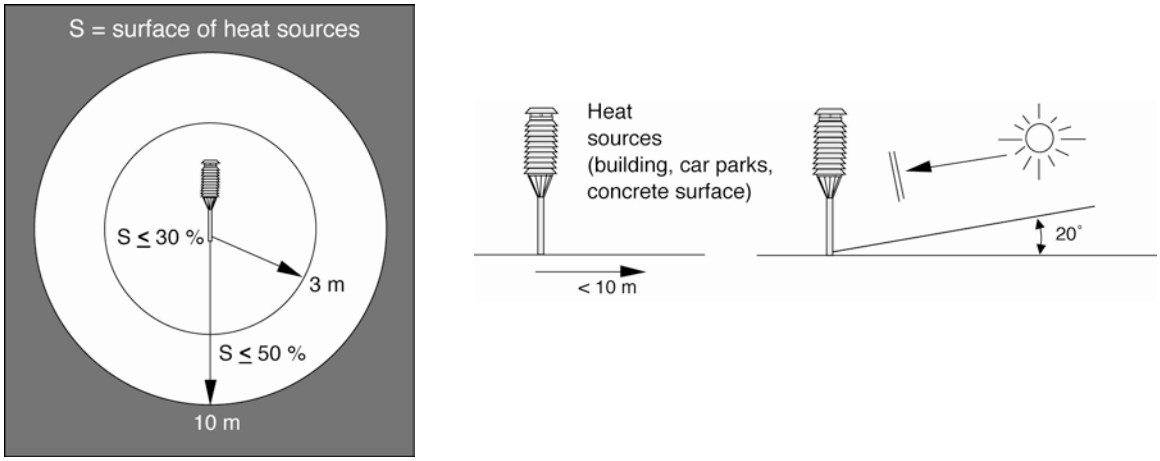
- Ground covered with natural and low vegetation (<25 cm) representative of the region;
- Measurement point situated:
  - at more than 10 m from artificial heat sources and reflective surfaces (buildings, concrete surfaces, car parks, etc.)
  - at more than 10 m from an expanse of water (unless significant of the region)
  - away from all projected shade when the Sun is higher than 7°.

A source of heat (or expanse of water) is considered to have an impact if it occupies more than 10% of the surface within a circular area of 10 m surrounding the screen or makes up 5% of an annulus of 5 m.



Class 4 (additional estimated uncertainty added by siting up to 2°C)

- Close, artificial heat sources and reflective surfaces (buildings, concrete surfaces, car parks, etc.) or expanse of water (unless significant of the region, occupying:
  - Less than 50% of the surface within a circular area of 10 m around the screen
  - Less than 30% of the surface within a circular area of 3 m around the screen
- Away from all projected shade when the Sun is higher than 20°.



Class 5 (additional estimated uncertainty added by siting up to 5°C)

Site not meeting the requirements of class 4.

PRECIPITATION

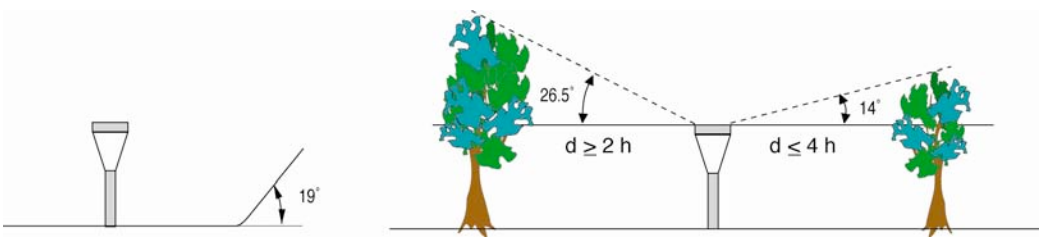
Wind is the greatest source of disturbance in precipitation measurements, due to the effect of the instrument on the airflow. Unless raingauges are artificially protected against wind, for instance by a wind shield, the best sites are often found in clearings within forests or orchards, among trees, in scrub or shrub forests, or where other objects act as an effective windbreak for winds from all directions. Ideal conditions for the installation are those where equipment is set up in an area surrounded uniformly by obstacles of uniform height. An obstacle represents an object with an angular width of 10° or more.

The choice of such a site is not compatible with constraints in respect of the height of other measuring equipment. Such conditions are practically unrealistic. If obstacles are not uniform, they are prone to generate turbulence, which distorts measurements; this effect is more pronounced for solid precipitation. This is the reason why more realistic rules of elevation impose a certain distance from any obstacles. The orientation of such obstacles with respect to prevailing wind direction is deliberately not taken into account. Indeed, heavy precipitation is often associated with convective factors, whereby the wind direction is not necessarily that of the prevailing wind. Obstacles are considered of uniform height if the ratio between the highest and lowest height is lower than 2.

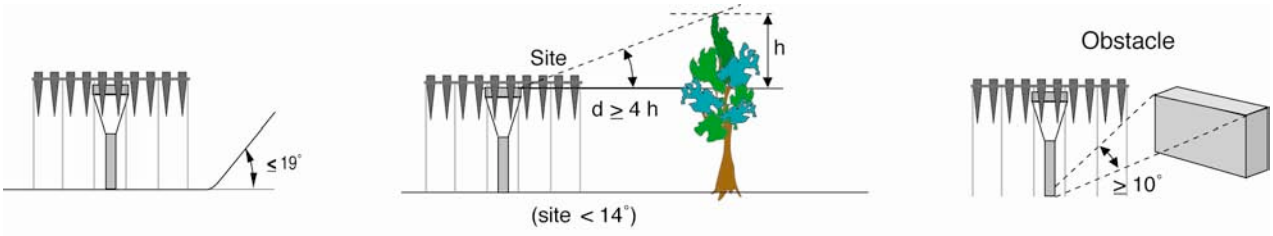
Reference for the heights of obstacles is the catchment's height of the rain gauge.

Class 1

- Flat, horizontal land, surrounded by an open area, slope less than 1/3 (19°). Raingauge surrounded by obstacles of uniform height, seen under an elevation angle between 14° to 26° (obstacles at a distance between 2 to 4 times their height);



or

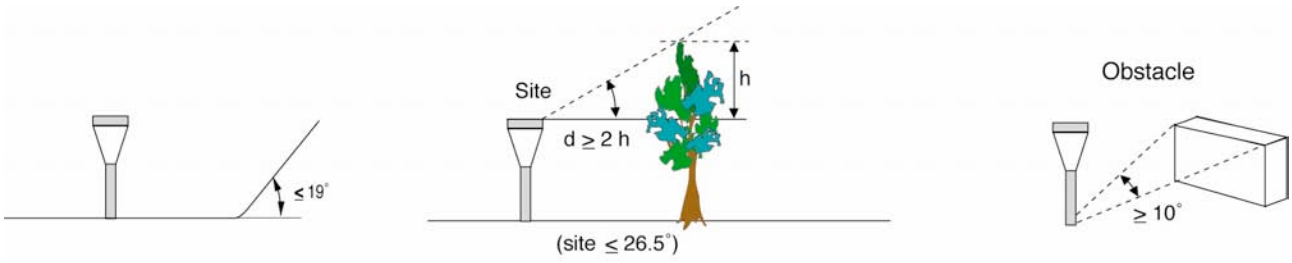


- Flat, horizontal land, surrounded by an open area, slope less than 1/3 (19°). For a raingauge artificially protected against wind, the instrument does not necessarily need to be protected by obstacles of uniform height. In this case, any other obstacles must be situated at a distance of at least 4 times their height.

Class 2 (additional estimated uncertainty added by siting up to 5%)

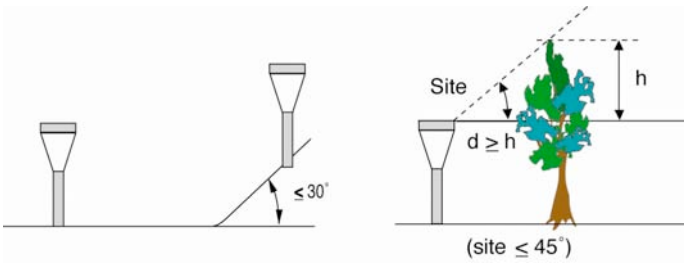
- Flat, horizontal land, surrounded by an open area, slope less than 1/3 (19°);

- Possible obstacles must be situated at a distance at least twice the height of the obstacle (with respect to the catchment's height of the raingauge).



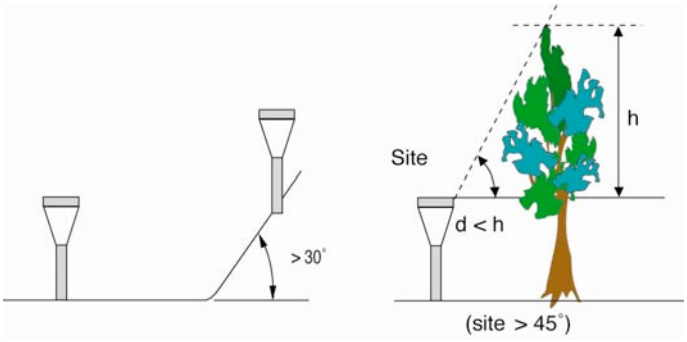
Class 3 (additional estimated uncertainty added by siting up to 15%)

- Land is surrounded by an open area, slope less than 1/2 (≤ 30°);
- Possible obstacles must be situated at a distance greater than the height of the obstacle.



Class 4 (additional estimated uncertainty added by siting up to 25%)

- Steeply sloping land (>30°);
- Possible obstacles must be situated at a distance greater than one half (1/2) the height of the obstacle.



Class 5 (additional estimated uncertainty added by siting up to 100%)

- Obstacles situated closer than one half (1/2) their height (tree, roof, wall, etc.).

SURFACE WIND

Conventional elevation rules stipulate that sensors should be placed 10 m above ground surface level and on open ground. Open ground here represents a surface where obstacles are situated at a minimum distance equal to at least ten times their height.

ROUGHNESS

Wind measurements are disturbed not only by surrounding obstacles; terrain roughness also plays a role. WMO defines wind blowing at a geometrical height of 10 m and with a roughness length of 0.03 m as the surface wind for land stations.

This is regarded as a reference wind for which exact conditions are known (10 m height and roughness length of 0.03 m).

Therefore, roughness around the measuring site has to be documented. Roughness should be used to convert the measuring wind to the reference wind, but this procedure can be applied only when the obstacles are not too close. Roughness-related matters and correction procedure are described in Chapter 5 of the CIMO Guide.

The roughness classification, reproduced from the CIMO Guide, is recalled here:

Terrain classification by Davenport (1960), adapted by Wieringa (1980) in terms of aerodynamic roughness length z_0		
Class index	*Short terrain description*	z_0 *(m)*
2	Mud flats, snow; no vegetation, no obstacles	0.005
3	Open flat terrain; grass, few isolated obstacles	0.03
4	Low crops; occasional, large obstacles: $x/H > 20$	0.10
5	High crops; scattered obstacles: $15 < x/H < 20$	0.25
6	Parkland, bushes; numerous obstacles: $x/H \sim 10$	0.5
7	Regular large obstacle coverage (suburb, forest)	1.0
8	City centre with high- and low-rise buildings	≥2

Here x is a typical upwind obstacle distance and H is the height of the corresponding major obstacles. For more detailed and updated terrain class index descriptions see Davenport, et al. (2000).

ENVIRONMENT CLASSIFICATION

The presence of obstacles (almost invariably) means a reduction in average wind readings, but less significantly affects wind gusts.

The following classification assumes measurement at 10 m, which is the standard elevation for meteorological measurement.

When measurements are carried out at lower height (such as measurements carried out at 2 m, as is sometimes the case for agro-climatological purposes), a class 4 or 5 (see below) is to be used, with flag S (Specific situation).

Where numerous obstacles higher than 2 m are present, it is recommended that sensors be placed 10 meters above the average height of the obstacles. This method allows the influence of the adjacent obstacles to be minimized. This method represents a permanent solution for partly eliminating the influence of certain obstacles. It inconveniently imposes the necessity for higher

masts that are not standard and consequently are more expensive. It must be considered for certain sites and where used, the height of obstacles to be taken into account is that above the level situated 10 m below the sensors (e.g., for an anemometer installed at a 13 m height, the reference "ground" level of the obstacles is at a 3 m height; an obstacle of 7 m is considered to have an effective height of 4 m).

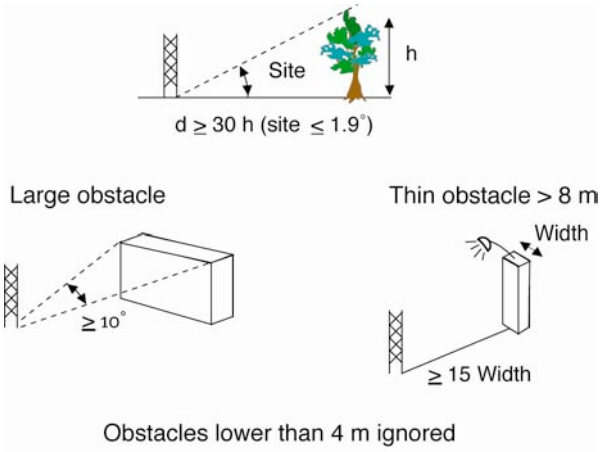
In the following, an object is considered to be an obstacle if its angular width is over 10°, except for tall thin obstacles, as mentioned below.

Changes of altitude (positive or negative) in the landscape which are not representative of the landscape are considered as obstacles.

Class 1

- The mast should be located at a distance equal to a least 30 times the height of surrounding obstacles;
- Sensors should be situated at a minimum distance of 15 times the width of narrow obstacles (mast, thin tree) higher than 8 m;

Single obstacles lower than 4 m can be ignored.

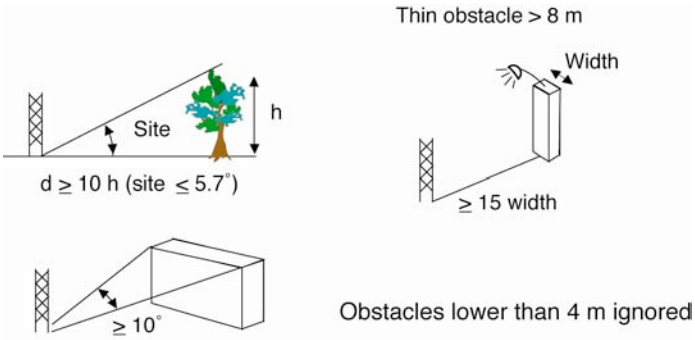


- Roughness class index is between 2 to 4 (roughness length ≤ 0.1 m).

Class 2 (additional estimated uncertainty added by siting up to 30%, possibility to apply correction)

- The mast should be located at a distance of at least 10 times the height of the surrounding obstacles;
- Sensors should be situated at a minimum distance of 15 times the width of narrow obstacles (mast, thin tree) over 8 m high;

Single obstacles lower than 4 m can be ignored.



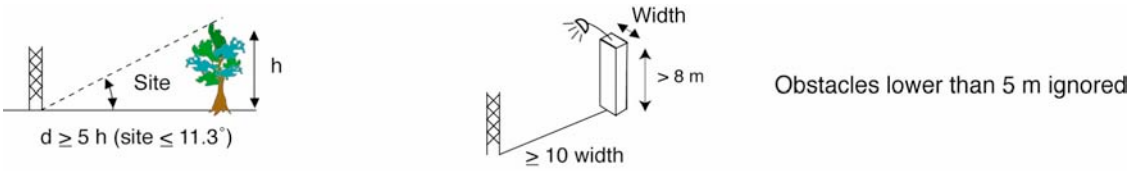
- Roughness class index is between 2 to 5 (roughness length ≤ 0.25 m).

Note: When the mast is located at a distance of at least 20 times the height of the surrounding obstacles, a correction (see CIMO Guide, wind chapter) can be applied. In case of nearer obstacles, a correction may be applied is some situations.

Class 3 (additional estimated uncertainty added by siting up to 50%, correction cannot be applied)

- The mast should be located at a distance of at least 5 times the height of surrounding obstacles;
- Sensors should be situated at a minimum distance of 10 times the width of narrow obstacles (mast, thin tree) higher than 8 m.

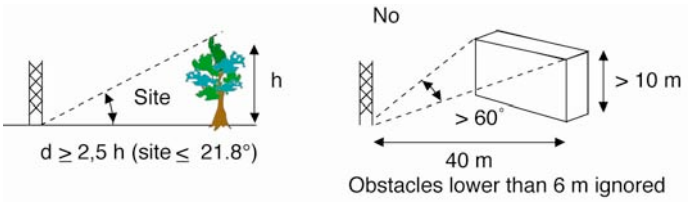
Single obstacles lower than 5 m can be ignored.



Class 4 (additional estimated uncertainty added by siting greater than 50%)

- The mast should be located at a distance of at least 2.5 times the height of surrounding obstacles;
- No obstacle with an angular width larger than 60° and a height greater than 10 m, within a 40 m distance.

Single obstacles lower than 6 m can be ignored, only for measurements at 10 m or above.



Class 5 (additional estimated uncertainty cannot be defined)

Site not meeting the requirements of class 4.

GLOBAL AND DIFFUSE RADIATION

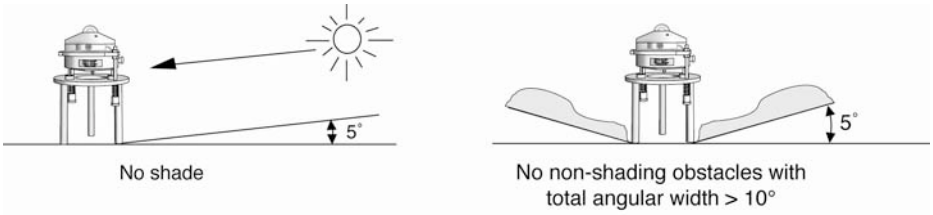
Close obstacles have to be avoided. Shading due to the natural relief is not taken into account for the classification. Non-reflecting obstacles below the visible horizon can be neglected.

An obstacle is considered as reflecting if its albedo is greater than 0.5.

The reference position for elevation angles is the sensitive element of the instrument.

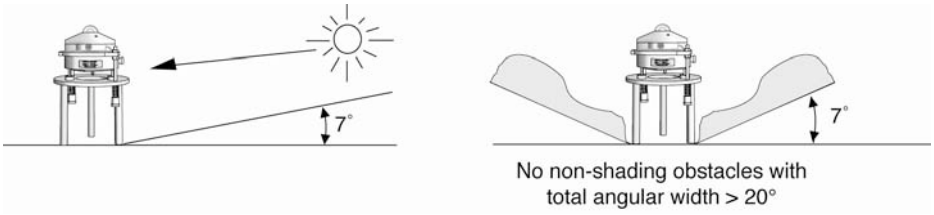
Class 1

- No shade projected onto the sensor when the Sun is at an angular height of over 5°. For regions with latitude ≥ 60°, this limit is decreased to 3°;
- No non-shading reflecting obstacles with an angular height above 5° and a total angular width above 10°.



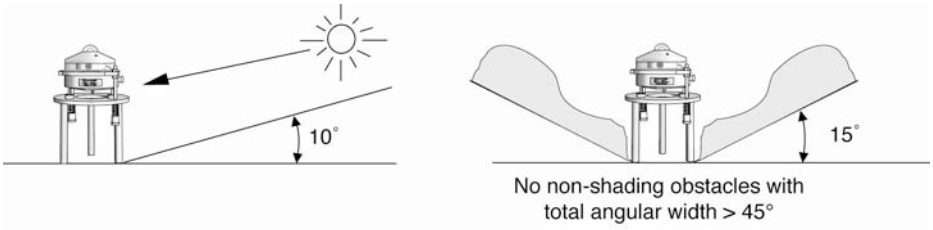
Class 2

- No shade projected onto the sensor when the Sun is at an angular height of over 7°. For regions with latitude ≥ 60°, this limit is decreased to 5°;
- No non-shading reflecting obstacles with an angular height above 7° and a total angular width above 20°.



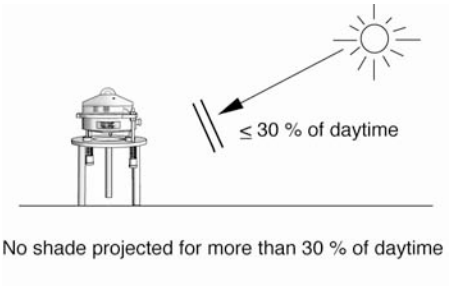
Class 3

- No shade projected onto the sensor when the Sun is at an angular height of over 10°. For regions with latitude ≥ 60°, this limit is decreased to 7°;
- No non-shading reflecting obstacles with an angular height above 15° and a total angular width above 45°.



Class 4

- No shade projected during more than 30% of the daytime, for any day of the year.



Class 5

- Shade projected during more than 30% of the daytime, for at least one day of the year.

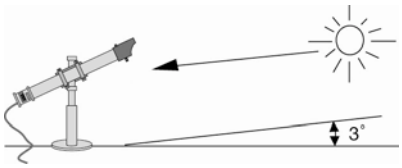
DIRECT RADIATION AND SUNSHINE DURATION

Close obstacles have to be avoided. Shading due to the natural relief is not taken into account for the classification. Obstacles below the visible horizon can be neglected.

The reference position for angles is the sensitive element of the instrument.

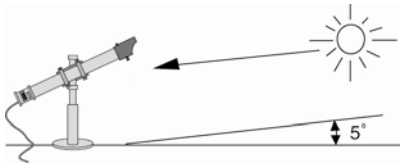
Class 1

- No shade projected onto the sensor when the Sun is at an angular height of over 3°.



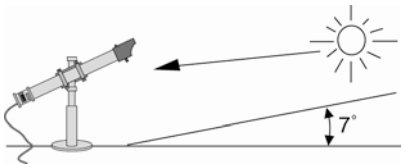
Class 2

- No shade projected onto the sensor when the Sun is at an angular height of over 5°.



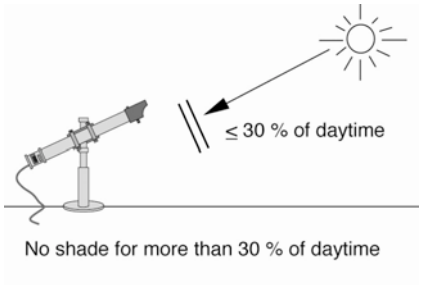
Class 3

- No shade projected onto the sensor when the Sun is at an angular height of over 7°.



Class 4

- No shade projected during more than 30% of the daytime, for any day of the year.



Class 5

- Shade projected during more than 30% of the daytime, for at least one day of the year.

ANNEX V
Annex to paragraph 5.11 of the general summary

PROVISIONAL PROGRAMME OF WMO UPPER-AIR AND REMOTE-SENSING INSTRUMENT INTERCOMPARISONS (2011–2014)

1. WMO High Quality Radiosonde Regional Intercomparison, Region II, China (completion of the analysis).
2. Weather Radar Workshops to Examine Differences on Signal and Data Processing Using Common Signal Data Set.
3. WMO International Evaluation of AMDAR Water Vapour Sensor.
4. WMO Evaluation of Wind Profiler Wind Measurement Quality and Quality Control Procedures.
5. International Test-bed Experiments and Pilot Studies for Integrated In-situ and Remote-Sensing Upper-air Networks (including tropical and subtropical tests).
6. Intercomparison of automatic radiosonde launching systems to be hosted and organized by Denmark in Greenland.
7. Regional radiosonde intercomparison to be hosted and organized by India.

ANNEX VI
Annex to paragraph 5.13 of the general summary

WMO GUIDANCE STATEMENT ON WEATHER RADAR/WIND TURBINE SITING

The WMO expresses concern over increasing impacts of wind turbine farms on weather radar and stresses the need for adequate consultation, protection and mitigation efforts. The WMO addresses its concern to policy makers, to national radio administration agencies, to national hydrological and meteorological societies, to wind turbine farm developers, to commercial vendors of wind turbine equipment and to the meteorological community.

Protection of weather radar data is critical to the continued function and improvement of weather sensing, monitoring, forecasting, and warning, and is therefore in the best interests of public safety and security. Weather prediction models and localized operational forecasts increasingly depend on national networks of ground-based Doppler weather radars and wind profilers for severe weather warnings such as tornadoes, flash flooding and land-falling hurricanes, precipitation (rain, snow, hail) forecasts, aircraft icing and air traffic/weather avoidance. Worldwide, Doppler radar and wind profile networks are now contending with increasing pressures by wind farms.

Wind farms have already had an impact on operational weather radar networks, creating confounding ground echoes that create a significant loss of data or create false precipitation for hydrological applications. The rotating blades can create velocities which could potentially be mistaken to be severe weather such as a tornado. While, weather radars have been moved by the wind farm developers; generally, the meteorological community has no jurisdiction on the location of the wind farms and relies on cooperative “good neighbour” polices for mitigation.

Development of new radar and wind profiler networks and wind farms will require strategic planning for mitigation by the meteorological and wind farm communities. The WMO and the meteorological community rely on and support mandated international and national radio agencies

and will pro-actively encourage and support these agencies' efforts to promote and to protect the meteorological use of unobstructed space. The WMO encourages national radio agencies to develop acceptable obstruction criteria and to provide tools to help the wind farm developer on site selection.

The range between wind turbines and the weather radar can be used to generally describe the impact on radar quality data and also used to provide a mitigation strategy for cooperative siting of weather radars and wind turbines. Below are the general guidelines for typical radars, flat terrain situation and that may require modifications for specific situations and for particular radars. Higher powered radars such as S Band (10 cm wavelength) radars with less attenuation may necessitate increasing the range limits in the table.

Range	Potential Impact	Guideline
0–5 km	The wind turbine may completely or partially block the radar and can result in significant loss of data that cannot be recovered.	Definite Impact Zone: Wind turbines should not be installed in this zone.
5–20 km	Multiple reflection and multi-path scattering can create false echoes and multiple elevations. Doppler velocity measurements may be compromised by rotating blades.	Moderate Impact Zone: Terrain effects will be a factor. Analysis and consultation is recommended. Re-orientation or re-siting of individual turbines may reduce or mitigate the impact.
20–45 km	Generally visible on the lowest elevation scan; ground-like echoes will be observed in reflectivity; Doppler velocities may be compromised by rotating blades.	Low Impact Zone: Notification is recommended.
> 45 km	Generally not observed in the data but can be visible due to propagation conditions.	Intermittent Impact Zone Notification is recommended.

The WMO encourages funding and implementation of studies to develop technologies to mitigate the impact. Weather radar signal processing techniques or use of other materials to construct wind turbines may be able to mitigate clutter at long ranges. Further, the WMO recommends the results of these studies be made available to weather radar and wind turbine manufacturers.

It is in all nations' best interests to protect unobstructed space for weather radars and wind profilers that are essential and critical to the accurate forecasting of adverse weather. Local, national and technological solutions are sought. The WMO will support and provide guidance material and tools to protect unobstructed space for weather radars and wind profilers.

ANNEX VII
Annex to paragraph 11.5 of the general summary

TERMS OF REFERENCE OF EXPERT TEAMS AND THEME LEADERS

A. OPAG ON STANDARDIZATION AND INTERCOMPARISONS

A.1 Expert Team on Standardization

1. Provide specifications for instruments and observing systems in order to meet requirements from Members for the measurement of meteorological, climatological, marine, related geophysical and environmental variables.

2. Review, develop and update guidance material and standards related to instruments and methods of observation, including identification of standards for inclusion in the CIMO Guide. The development and identification of standards will be done in co-operation with other international standardization organizations, like ISO and BIPM.

3. Review outcomes of Lead Centres and coordinate inclusion of guidance material in IOM reports and the CIMO Guide on: standard procedures for all aspects of instrument use and operation; advice related to instrument use, operation, testing, verification and calibration; and the calculation of uncertainty for operational measurements.

4. Formulate proposals for improving the interoperability of instruments in support of cost-effective operations in WIGOS.

5. Develop proposals for metadata standards to be disseminated through WIS as required by WIGOS.

6. Develop further basic procedures for quality assurance and management of observations, instrument maintenance, calibration and operation within WIGOS.

7. Coordinate with other technical commissions and WMO Programmes such as GFCS and DRR in reviewing siting, performance, classifications and metadata standards for systems and individual sensors.

8. Develop guidance material relevant to the ET ToRs, including proposals for updates of/new chapters for the CIMO Guide.

9. Establish Task Teams to address specific tasks, as appropriate, monitor Task Team work progress and report to CIMO-MG.

A.2 Expert Team on New In-situ Technologies

1. Review and publish performance results and recommendations relating to the state-of-the-art of operational instruments, their calibration and methods of observation and their observing system supporting infrastructure.

2. Monitor and report on progress in development and performance of new surface and upper-air observation technologies and measurement techniques.

3. In view of the increased impact of extreme weather events, review and make proposals on:

- Need for development of more robust instruments with greater resilience to extreme weather conditions and combinations of weather conditions;
- Need for development of instruments with increased measuring range;
- Investigation of performance of instruments in extreme climate.

4. Monitor progress and give guidance on observing technology associated with sustaining AWS network operations, including in extreme climate conditions.

5. Review development of new radiation reference instruments and update relevant guidance material.

6. Develop guidance material relevant to the ET ToRs, including proposals for updates of/new chapters for the CIMO Guide.

7. Establish Task Teams to address specific tasks, as appropriate, monitor Task Team work progress and report to CIMO-MG.

A.3 Expert Team on Instrument Intercomparisons

1. Prepare and prioritize proposals for instrument intercomparisons (in-situ surface, upper-air and marine) according to the CIMO Provisional Programme (2010–2014) and available funds, in particular taking into account the requirements of WIGOS.

2. Propose the membership of International Organizing Committees. These will appoint a Project Leader responsible for conducting a specific instrument intercomparison.

3. Plan, 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).

4. Develop guidance material relevant to the ET ToRs, including proposals for updates of/new chapters for the CIMO Guide.

5. Monitor progress of TT and report to CIMO-MG.

A.4 Theme Leader on Aircraft Measurements

1. Provide technical review of approved aircraft based humidity capabilities.

2. Liaise closely with ET-A3 for testing and validation of the AMDAR system and aircraft based humidity sensor.

3. Provide input to future updates to the CIMO Guide relevant to aircraft based observations, including identification of standards for inclusion in the CIMO Guide.

4. Work closely with ET-A1 for the development and provision of specifications and standards for aircraft based observation systems in order to meet user requirements.

5. Communicate to the Commission the latest development in AMDAR and other aircraft based observational platforms.

B. OPAG ON REMOTE-SENSING AND NEW TECHNOLOGIES

B.1 Expert Team on Operational Remote-sensing

ET will work on operational weather radars, wind profilers and lightning detection systems:

1. Review operation of current instrumentation identifying best practices, including instrument specifications, and siting (including network support infrastructure and preventive maintenance).

2. Review quality control procedures including standardization, calibration, signal processing, algorithms and products generation with close collaboration with users.

3. Review the development of new technologies.

4. Facilitate activities associated with improving the operations by initiating workshops on performance evaluation and product interpretation.

5. Review data exchange technologies and recommend mechanisms noting advantages and disadvantages of WIS.

6. Develop guidance material relevant to the ET ToRs, including proposals for updates of/new chapters for the CIMO Guide.

7. Review and update training material and support OPAG capacity-building.

8. Establish Task Teams to address specific tasks, as appropriate, monitor Task Team work progress and report to CIMO-MG.

B.2 Expert Team on New Technologies and Testbeds

1. Monitor, evaluate and report on development and implementation of:

- Microwave Radiometers, especially the quality of temperature measurements in the planetary boundary layer;
- GPS Water Vapour Networks and quality of data in suitable intercomparison with other systems including radiosonde and microwave radiometer;
- Raman water vapour lidar and specifically quality of absolute humidity measurements in the troposphere;
- Wind-finding systems;
- Meteorological lidar systems;
- Cloud radars;
- Instruments for the operational aerosol and volcanic ash measurements;
- Other new technologies, such as eddy-covariance measurements for energy flux measurements and meteor scattering radars.

2. Review outcomes of testbeds and coordinate inclusion of guidance material in IOM reports and the CIMO Guide on:

- The performance of new surface based remote-sensing technology, including strengths and weaknesses, accuracy, reliability and cost effectiveness;
- The principles for the optimal mix of surface based in situ and remote-sensing systems (interoperability) to improve both temporal and spatial capabilities for future operational upper air networks.

3. Review and update existing training material and support OPAG-capacity-building in the production of suitable training workshops, reference material and guidelines for all operational aspects of remote-sensing systems.

4. Establish Task Teams to address specific tasks, as appropriate, monitor Task Team work progress and report to CIMO-MG, if appropriate.

B.3 Theme Leader on Radio-frequency Protection

1. Consider within CIMO issues related to radio-frequency protection activities for all operational upper-air and remote-sensing observing systems (radisondes, weather radars, wind profilers, microwave radiometers, etc.).

2. Liaise with all CIMO Expert Teams in a view to collect and coordinate their requirements and consider WMO positions developed by CBS Steering Group on Radio-frequency Coordination (SG-RFC).

3. Liaise with CBS SG-RFC providing CIMO input on its requirements and expertise and supporting SG-RFC to maintain a WMO strategy for ensuring availability of radio-frequencies for meteorological applications.

B.4 Theme Leader on Satellite Observations

1. Liaise with CBS ET-SAT and ET-SUP to review and report on requirements for calibration of satellite instruments and requirements for ground truth observations. Propose priorities for the meteorological variables needed by WIGOS.

2. Contribute to the review of the GSICS WIGOS Pilot Project on existing satellite calibration and validation programme.

3. Work with CBS ET-SAT and ET-SUP in updating the CIMO Guide chapter on Satellite Observations, especially with respect to the requirements for calibration and ground truth observations, as required to improve standardization of satellite observations for WIGOS.

4. Collaborate with relevant CIMO Expert Teams in preparing recommendations for providing measurements of the quality required for ground truth.

C. OPAG ON CAPACITY-BUILDING

C.1 Expert Team on Regional Instrument Centres, Calibration and Traceability

1. Develop a strategy and provide guidance towards ensuring worldwide traceability of measurements to the International System of Units (SI), including outreach material to sensitize on the need for and importance of instrument calibration and measurements traceability.

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

3. Strengthen the Quality Assurance of the RICs/RRCs as a crosscutting issue involving the regional and technical cooperation activities by:

- Collaborating with RICs to define RIC functional capabilities;
- Encouraging RICs to organize and/or participate in inter-laboratory comparisons;
- Providing support in RIC evaluations;
- Monitoring the RIC capabilities based on their yearly reports and 5-year evaluation and inform presidents of RAs;
- Provide advice for certification and accreditation of RICs;
- Monitoring RRC capabilities, provide support to RRC evaluations;
- Developing guidance to improve RRC capabilities and the quality of radiation measurements in national radiation networks;
- Collaborating with Regional Marine Instrumentation Centres (RMICs) and developing guidance material relevant to the terms of reference of the Expert Team, including updating the CIMO Guide to recognize the capabilities of RMICs.

4. With respect to capacity-building:

- Review and provide guidance to develop the IMOP capacities of developing countries, in particular the development and fabrication of instruments;
- Collaborate with testbed centres and lead centres and ensure that standards and specifications for new instruments and technologies are provided to RICs in order to promote effective access to such guidance materials and adaptation of the new technologies.

5. Develop guidance material relevant to the ET ToRs, including proposals for updates of /new chapters for the CIMO Guide.

C.2 CIMO Guide Editorial Board

1. Coordinate activities for the periodic updating of the CIMO Guide, in collaboration with CIMO OPAGs, ETs, HMEI and the Secretariat, namely:

- Develop guidelines for the updating of the CIMO Guide to ensure the uniformity of its presentation;
- Collect proposals from user community for updates and revisions;
- Identify areas to be updated, revised or completely rewritten and advise the CIMO-MG;
- Identify experts for updating/revision of the relevant parts of the Guide and advise the CIMO-MG;
- Coordinate the work of experts on revisions to the Guide;
- Arrange for approval of the updated/revised parts of the Guide according to a procedure approved by the CIMO-MG;
- 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;
- Provide regular reports to the CIMO-MG and Secretariat;

2. Develop a strategy for the development of the CIMO manual.

3. Review proposals for and advise ETs on the development of common ISO/WMO standards.

4. Contribute to the development of the WIGOS Guide and Manual, as appropriate.

C.3 Theme Leader on Training Material and Training Activities

1. Collaborate with RAs, Regional Training Centres and the WMO Education and Training Office (ETR), in identifying the needs for training and arranging training workshop courses on the use and the maintenance of instruments and new technologies based on the need of the Members.

2. Report on planned training events.

3. Provide effective access to training materials for calibration of meteorological and related environmental instruments.

4. Provide effective access to procedures for quality management of observations, instrument maintenance, calibration and operational practices.

5. In collaboration with other ETs, develop computer-aided learning strategy and explore a possibility to establish Virtual Training and Education Laboratories in collaboration with RICs and RRCs and recording of training events.

C.4 Theme Leader on Radiosonde Performance Monitoring

1. Arrange for the productions of monitoring reports on the systematic performances of radiosonde networks in GOS (Radiosonde catalogue and statistics).

2. Liaise with Members and HMEI on performance issues identified above.

C.5 Theme Leader on Surface-based Instrument Performance Monitoring

1. Develop automated methods, standards and essential criteria for real-time integrated monitoring of surface-based operational instruments performances;

2. Establish links with other WMO programmes, including WIGOS and WIS, and provide them with systematic performance results by series of reports.

ANNEX VIII
Annex to paragraph 11.7 of the general summary

DESIGNATION OF CHAIRS OF EXPERT TEAMS AND THEME LEADERS

A. OPAG ON STANDARDIZATION AND INTERCOMPARISONS

A.1 Expert Team on Standardization
Chair: Brian Howe (Canada)
Vice-chair: Mike Molyneux (United Kingdom)

A.2 Expert Team on New In-situ Technologies
Chair: Steven Oncle (United States)
Vice-chair: Wiel Wauben (Netherlands)

A.3 Expert Team on Instrument Intercomparisons
Chair: Emanuele Vuerich (Italy)
Vice-chair: Eckhard Lanzinger (Germany)

A.4 Theme Leader on Aircraft Measurements
Jitze P. van der Meulen (Netherlands)

B. OPAG ON REMOTE-SENSING AND NEW TECHNOLOGIES

B.1 Expert Team on Operational Remote-sensing
Chair: LI Bai (China)
Vice-chair: Richard Ice (United States)

B.2 Expert Team on New Technologies and Testbeds
Chair: Arkadiy Koldaev (Russian Federation)
Vice-chair: Arnoud Apituley (Netherlands)

B.3 Theme Leader on Radio-frequency Protection
Aline Kraai (Netherlands)

B.4 Theme Leaders on Satellite Observations
Kevin Schrab (United States)
SUN Anlai (China)

C. OPAG ON CAPACITY-BUILDING

C.1 Expert Team on Regional Instrument Centres, Calibration and Traceability
Chair: Jérôme Duvernoy (France)
Vice-chair: Drago Groselj (Slovenia)

C.2 CIMO Guide Editorial Board
Chair: Volker Kurz (Germany)
Vice-chair: Krunoslav Premec (Croatia)

C.3 Theme Leaders on Training Material and Training Activities
Ercan Buyukbas (Turkey)
CAO Xiaozhong (China)

C.4 Theme Leader on Radiosonde Performance Monitoring
To be designated

C.5 Theme Leader on Surface-based Instrument Performance Monitoring
PEI Chong (China)

ANNEX IX
Annex to paragraph 11.10 of the general summary

TERMS OF REFERENCE OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION FOCAL POINT ON GENDER ISSUES

The CIMO Focal Point on Gender Issues shall be responsible for the following:

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 Focal Point on Gender Issues 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 focal points on gender issues 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;
5. To submit reports in accordance with the requirements of the CIMO Management Group.

ANNEX X
Annex to paragraph 11.11 of the general summary

TERMS OF REFERENCE OF THE COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION FOCAL POINT FOR THE EXECUTIVE COUNCIL PANEL OF EXPERTS ON POLAR OBSERVATIONS, RESEARCH AND SERVICES

The CIMO Focal Point for the Executive Council Panel of Experts on Polar Observations, Research and Services shall be responsible for the following:

1. To liaise with EC-PORS on issues related to instruments and methods of observation standardization, maintenance and operation, as well as to liaise with EC-PORS on IPD issues;
2. To provide guidance to the Commission on issues related to polar observations;
3. To identify experts that would have the appropriate background to contribute to relevant EC-PORS activities;
4. To submit reports in accordance with the requirements of the CIMO Management Group.

ANNEX XI
Annex to paragraph 11.19 of the general summary

REPORT OF THE AD HOC GROUP OF EXPERTS FOR THE EVALUATION OF PROPOSALS FOR THE ESTABLISHMENT OF CIMO TESTBEDS AND LEAD CENTRES

The Ad Hoc Group for the Evaluation of Proposals for the Establishment of CIMO Testbeds and Lead Centres was composed of the following principal delegates: Mr Bruce Forgan (Chair, Australia), Mr Heng Zhou (China), Mr Michel Leroy (France) and Mr Bruce Hartley (New Zealand).

The Ad Hoc Group, having noted paragraph 11.18 of the general summary to the present report, providing the evaluation criteria for Testbeds and Lead Centres and Resolution 5 (CIMO-XV) – Generic terms of reference of CIMO Testbeds and Lead Centres, evaluated the proposals for the establishment of CIMO Testbeds and Lead Centres from the following:

Lead Centres:

- WMO-CIMO Lead Centre on Precipitation Intensity, Italy;
- WMO-CIMO Lead Centre, Chupungnyeong, Republic of Korea;
- WMO-CIMO Lead Centre for in situ Sounding, Lindenberg Meteorological Observatory – Richard Assmann Observatory, Germany;
- WMO-CIMO Lead Centre for Radiation Measurements, Lindenberg Meteorological Observatory – Richard Assmann Observatory, Germany;
- WMO-CIMO Lead Centre for Wind Profiling, Lindenberg Meteorological Observatory – Richard Assmann Observatory, Germany;
- WMO-CIMO Lead Centre for ABL Measurements, Lindenberg Meteorological Observatory – Richard Assmann Observatory, Germany;
- WMO-CIMO Lead Centre for Evaluation of Precipitation Sensors, Colorado, United States;
- WMO-CIMO Lead Centre on Atmospheric Pressure, Humidity and Wind Measurements, De Bilt, Netherlands.

Testbeds:

- WMO-CIMO Testbed for Ground-Based Remote-Sensing and In Situ Observations, Meteoswiss Aerological Station Payerne, Switzerland;
- WMO-CIMO Testbed for In Situ Remote-Sensing Instruments, Sodankylä, Finland;
- WMO-CIMO Testbed, Boseong, Republic of Korea;
- WMO-CIMO Testbed, Lindenberg Meteorological Observatory – Richard Assmann Observatory, Germany;
- WMO-CIMO Testbed for In Situ Remote-Sensing Instruments, Obninsk, Russian Federation;
- WMO-CIMO Lead Centre for Precipitation (measurements), Valday, Russian Federation;
- WMO-CIMO Testbed at Gorodets, Russian Federation;
- WMO-CIMO Testbed for Ground-Based Remote-Sensing and In Situ Observations, Cabauw, Netherlands.

The Ad Hoc Group decided that two proposals met the evaluation criteria and recommended to the president that the following be accepted:

- WMO-CIMO Lead Centre on Precipitation Intensity, Italy;
- WMO-CIMO Testbed, Lindenberg Meteorological Observatory – Richard Assmann Observatory, Germany;

Concerning the proposals that were not accepted at this time, the Ad Hoc Group noted that:

(a) The majority of those proposals met most, but not all of the criteria for operation as Testbeds or Lead Centres;

(b) Some proposals required that the proposal title be improved to specifically indicate the purpose of the proposed Testbed or Lead Centre;

(c) In the majority of those proposals, the following areas required further clarification or additional information: the plan for the intersessional period; the staff resources available to support the Testbed or Lead Centre activities; and the quality management system used at the facility.

The Ad Hoc Group recommended that the proposals not accepted could be revised using the evaluation criteria and then resubmitted.

ANNEX XII
Annex to paragraph 11.20 of the general summary

DESIGNATION PROCESS FOR ESTABLISHMENT OF CIMO TESTBEDS AND LEAD CENTRES

1. The CIMO president will establish a Task Team composed of at least three senior experts to evaluate new proposals of CIMO Testbeds and Lead Centres.

2. The Task Team will:

   (a) Apply the criteria already approved by the Commission at its fifteenth session (see paragraph 11.18) to the new proposals for the selection of CIMO Testbeds and Lead Centres;

   (b) Submit results of the evaluation to the CIMO Management Group for consideration.

3. The Management Group will make recommendations to the president of CIMO on the Testbeds and Lead Centres.

4. The president of CIMO will designate CIMO Testbeds and Lead Centres on behalf of the Commission based on the recommendation of the Management Group.

ANNEX XIII
Annex to paragraph 11.22 of the general summary

MAJOR OUTCOMES OF THE TECO-2010 ROUND TABLE

The TECO-2010 round table identified the following topics that would require further attention (in no specific order):

- Need to develop guidance material, and to publish it in the CIMO Guide, on new upper-air technologies that can now be used operationally by NMHSs,
- Need for regular updates of the CIMO guide. In that context the round table welcomed the proposal and stressed the importance of establishing a CIMO Guide Editorial Board,
- CIMO must ensure a very careful review before publishing documents relevant to manufacturers and instrument performance analysis, such as the CIMO Guide and CIMO intercomparison reports,

- With respect to the transition from manual to automatic weather stations, guidance from CIMO on how to trace the changes in the observations during this transition would be welcomed,
- Guidance material on re-designing a network, as well as on the regular monitoring instrument or network performances should be developed, in collaboration with CBS,
- CIMO should be ready to respond rapidly to new emerging customer requirements, such as in the case of the ash cloud event over Europe in April 2010,
- CIMO capacity-building activities such as technical conferences (e.g. TECO and METEOREX) are extremely important and should be continued. The support from Testbeds, Lead Centres, RICs and RMICs for enhanced training and capacity-building should also be encouraged,
- Support was given to the proposal to establish small, task-focused expert teams (task teams) to provide an effective mechanism to address high-priority activities,
- Highest priority should be given to CIMO's intercomparisons and particular attention should be given to establishing appropriate references,
- Support was given to the proposal to establish CIMO Testbeds and Lead Centres,
- Concern was expressed on the general reduction of financial resources at NMHSs level for instrument maintenance and calibration, which puts at risk data quality (in particular for the developing countries),
- With respect to the reports of CIMO intercomparisons, it was recommended that those reports should also include guidance and information on the basic principles to be followed to develop system specifications and evaluation criteria for tenders for the systems investigated. It should also include advice on what specifications are reasonable to expect and what should be considered as minimal requirements,
- Members would welcome a video-recording of future TECOs, which would be posted on the CIMO website to provide additional support in terms of capacity-building.

APPENDIX

LIST OF PARTICIPANTS

1. Officers of the session

President	John Nash (United Kingdom)
Vice-president	Bertrand Calpini (Switzerland)

2. Representatives of WMO Members

Algeria	
Djazia Bensemane EPS Bousri	Principal Delegate
Argentina	
Mario Jorge García	Principal Delegate
Australia	
Bruce Ward Forgan	Principal Delegate
Austria	
Wolfgang Lipa	Principal Delegate
Belarus	
Anatoli Palishuk	Principal Delegate
Brazil	
Edmundo Wallace Lucas	Principal Delegate
British Caribbean Territories	
Marvin Forde	Principal Delegate
Canada	
David Wartman	Principal Delegate
Rodica Nitu (Ms)	Alternate
Brian Day	Delegate
Peter Lejbjuk	Observer
China	
Zhou Heng	Principal Delegate
Li Changxing	Delegate
Li Bai	Delegate
Pei Chong (Ms)	Delegate
Zhang Qiang	Delegate
Croatia	
Krunoslav Premec	Principal Delegate
Egypt	
Essa Nessem Khalil	Principal Delegate
Mohamed Mahmoud El Sayed	Alternate
Finland	
Keijo Leminen	Principal Delegate
Juho-Pekka Kaukoranta	Delegate
France	
Michel Leroy	Principal Delegate

Germany	
Volker Kurz	Principal Delegate
Tilman Holfelder	Delegate
Bernd Mergardt	Delegate
Franz Berger	Delegate
Hong Kong, China	
TSUI Kit-chi	Principal Delegate
Hungary	
József Nagy	Principal Delegate
India	
K.C. Sai Krishnan	Delegate
Indonesia	
Sunarjo Sunarjo	Delegate
Israel	
Rova Rosenberg	Delegate
Italy	
Casimiro Ciotti	Principal Delegate
Emanuele Vuerich	Delegate
Luca Lanza	Delegate
Luigi Stagi	Delegate
Japan	
Kenji Akaeda	Principal Delegate
Koichi Nakashima	Alternate
Libyan Arab Jamahiriya	
Hisham S. Ganedi	Principal Delegate
Ali M. Mohamed	Delegate
Malaysia	
Wan Mohd Nazri Wan Daud	Principal Delegate
Mexico	
Pablo Gutierrez	Delegate
Morocco	
Mina Tounsi (Ms)	Principal Delegate
Samir Issara	Delegate
Namibia	
Willem Jacobus Gaoëb	Principal Delegate
Nepal	
Ramchandra Karki	Delegate
Netherlands	
Gijs Bertus van den Oord	Principal Delegate
Jitze P. van der Meulen	Delegate
New Zealand	
Bruce Hartley	Principal Delegate
Nigeria	
Anthony Anuforom	Principal Delegate
Norway	
Cecilie Stenersen (Ms)	Principal Delegate

Peru
Augusto Vargas Valencia — Principal Delegate

Poland
Lucas Mrozinski — Delegate

Republic of Korea
Cho Chun-Ho — Delegate
Won Jae-Gwang — Delegate

Russian Federation
Sergey Sarychev — Principal Delegate
Alexander Gusev — Delegate
Vladimir Ivanov — Alternate
Yuri Borisov — Delegate
Arkady Koldaev — Delegate

Slovakia
Branislav Chvíla — Principal Delegate

Slovenia
Jože Knez — Principal Delegate

South Africa
Nishendra Devanunthan — Principal Delegate

Spain
Manuel Lambas Señas — Principal Delegate
Marcelino Manso Rejón — Alternate

Sudan
Yaseen Salih Odan — Principal Delegate

Sweden
Ulf Christensen — Principal Delegate
Markus Andersén — Alternate

Switzerland
Bertrand Calpini — Principal Delegate
Yves-Alain Roulet — Delegate
Gerhard Mueller — Delegate

Trinidad and Tobago
Ronald Cassie — Principal Delegate

Turkey
Numan Cam — Principal Delegate
Oguzhan Sireci — Delegate

United Kingdom of Great Britain and Northern Ireland
Mike Molyneux — Principal Delegate
John Nash — Alternate

United States of America
Clifford Bruce Baker — Principal Delegate
Russell Cook — Alternate
William Burnett — Delegate
Renee Tatusko (Ms) — Delegate

Uzbekistan
Aleksandr Merkushkin — Delegate

3. Representatives of international organizations

Agency for Air Navigation Safety in Africa and Madagascar (ASECNA)
N'Cho Patrice Yapo
N'gabakouasse Moïse Besse
Jean Ngamini
Simeon Zoumara
Cumbi Hugues Ayina Akilotan

Association of Hydro-Meteorological Equipment Industry (HMEI)
Ben Dieterink
Bruce Sumner
Christine Charstone (Ms)

Network of European Meteorological Services (EUMETNET)
Volker Kurz

4. Other observers

Fred Branski	President of CBS

5. Other participants

Manuel Carvajal	Ecuador
Saúl Canjura	El Salvador
Jaber Alazemi	Kuwait
Omran Ali	Kuwait
Francis John Chithila	Malawi
Ebrahim Abdul-Kareem	Qatar
Sultan Al-Hayki	Qatar
Sifael Silas Mariki	United Republic of Tanzania
Pomokai Mazhara	Zimbabwe

6. WMO Secretariat

Michel Jarraud	Secretary-General
Wenjian Zhang	D/OBS
Miroslav Ondras	C/OSD
Isabelle Rüedi (Ms)	H/IMO
Igor Zahumenský	PO/WIGOS
Jérôme Duvernoy	Consultant/IMOP
Maja Draženović-Carrieri (Ms)	D/LSP (AC/Conference Officer)

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