Cape Town
16–24 February
2006

Abridged final report with resolutions and recommendations

Commission for Atmospheric Sciences

Fourteenth session

World Meteorological Organization

Weather • Climate • Water

WMO-No. 1002

Weather • Climate • Water

REPORTS OF RECENT WMO CONSTITUENT BODY SESSIONS

Congress and Executive Council

929 — **Executive Council**, fifty-third session, Geneva, 5–15 June 2001
932 — **Thirteenth World Meteorological Congress**, Proceedings, Geneva, 4–26 May 1999
945 — **Executive Council**, fifty-fourth session, Geneva, 11–21 June 2002
960 — **Fourteenth World Meteorological Congress**, Geneva, 5–24 May 2003
961 — **Executive Council**, fifty-fifth session, Geneva, 26–28 May 2003
972 — **Fourteenth World Meteorological Congress**, Proceedings, Geneva, 5–24 May 2003
977 — **Executive Council**, fifty-sixth session, Geneva, 8–18 June 2004
988 — **Executive Council**, fifty-seventh session, Geneva, 21 June–1 July 2005

Regional associations

934 — **Regional Association III** (South America), thirteenth session, Quito, 19–26 September 2001
944 — **Regional Association V** (South–West Pacific), thirteenth session, Manila, 21–28 May 2002
954 — **Regional Association I** (Africa), thirteenth session, Mbabane, 20–28 November 2002
981 — **Regional Association II** (Asia), thirteenth session, Hong Kong, China, 7–15 December 2004
987 — **Regional Association IV** (North America, Central America and the Caribbean), fourteenth session, San José, 5–13 April 2005
991 — **Regional Association VI** (Europe), fourteenth session, Heidelberg, 7–15 September 2005

Technical commissions

941 — **Commission for Atmospheric Sciences**, thirteenth session, Oslo, 12–20 February 2002
947 — **Commission for Instruments and Methods of Observation**, thirteenth session, Bratislava, 25 September–3 October 2002
951 — **Commission for Agricultural Meteorology**, thirteenth session, Ljubljana, 10–18 October 2002
953 — **Commission for Aeronautical Meteorology**, twelfth session, Montreal, 16–20 September 2002
955 — **Commission for Basic Systems**, extraordinary session, Cairns, 4–12 December 2002
979 — **Commission for Hydrology**, twelfth session, Geneva, 20–29 October 2004
985 — **Commission for Basic Systems**, thirteenth session, St Petersburg, 23 February–3 March 2005
995 — **Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology**, second session, Halifax, 19–27 September 2005
996 — **Commission for Climatology**, fourteenth session, Beijing, 3–10 November 2005

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Regional Association III	— English, Spanish
Regional Association IV	— English, Spanish
Regional Association V	— English, French
Regional Association VI	— Arabic, English, French, Russian
Technical commissions	— Arabic, Chinese, English, French, Russian, Spanish

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CONTENTS

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE SESSION (agenda item 1)

1.1 The fourteenth session of the Commission for Atmospheric Sciences (CAS) was held in Cape Town, South Africa, from 16 to 24 February 2006. The session venue was the Lord Charles Hotel in Somerset West. The opening ceremony took place at 10.30 a.m. on 16 February 2006.

1.2 Mr A. Eliassen, president of CAS, welcomed participants to the fourteenth session of the Commission and opened the meeting by introducing the distinguished members of the platform committee, Mr M. Jarraud, Secretary-General of the World Meteorological Organization (WMO), H.E. Mr M. van Schalkwyk, Minister of Environmental Affairs and Tourism, Ms S. Rensburg, Chairperson of the South African Weather Service Board, Mr J. Mphepya, Chief Executive of the South African Weather Service and Permanent Representative of South Africa with WMO, and Ms E. Manaenkova, Director of the Atmospheric Research and Environment Programme (AREP) of WMO.

1.3 Mr A. Eliassen expressed his thanks to the Government of the Republic of South Africa and the South African Weather Service for hosting the meeting and for the excellent arrangements that ensured the success of the Commission's meeting.

1.4 In his opening statement, Mr M. Jarraud, Secretary-General of WMO, expressed his appreciation to the Government of the Republic of South Africa, through H.E. Mr M. van Schalkwyk, Minister of Environmental Affairs and Tourism, for hosting the fourteenth session of CAS in Cape Town. He also indicated his gratitude to Mr J. Mphepya, Chief Executive of the South African Weather Service and Permanent Representative of South Africa with WMO, for the excellent arrangements made to ensure the success of the session. The Secretary-General pointed out that South Africa had a long tradition of actively supporting WMO's Programmes and activities. In particular, he noted that the South African Weather Service was a very active contributor to CAS and operated the Cape Point Global Atmosphere Watch (GAW) station.

1.5 The Secretary-General thanked Mr A. Eliassen for his leadership of the Commission over the past four years. He also thanked Mr A. Frolov, vice-president of CAS, and the chairpersons and members of the Commission's working groups and extended a warm welcome to the representatives of Members, to partner organizations and all participants.

1.6 The Secretary-General highlighted the role of the Commission in providing the framework for multi-disciplinary studies that contributed to the scientific knowledge needed to improve WMO Members' early warning capabilities aimed at mitigating the effects of natural disasters. He pointed out that the Fourteenth World Meteorological Congress had established the WMO Observing System Research and Predictability Experiment (THORPEX) programme to facilitate cooperation between research and operational communities to strengthen WMO's multi-hazard prevention strategy by increasing the accuracy and utility of longer lead-time forecasts.

1.7 The Secretary-General also noted the success of GAW, which continued to make essential atmospheric composition observations available to users, and the lead taken by WMO to develop and implement the Integrated Global Atmospheric Chemistry Observations (IGACO) strategy. He emphasized the Commission's sustained efforts to develop and demonstrate air quality forecasts for urban environments through GAW Urban Research Meteorology and Environment (GURME) projects.

1.8 The Secretary-General concluded his remarks by reiterating his gratitude to H.E. Mr M. van Schalkwyk for his presence at the opening ceremony and thanked the Government of the Republic of South Africa for hosting the session. He wished all of the delegates an enjoyable stay in Cape Town and a most successful and productive session.

1.9 In welcoming CAS to Cape Town, H.E. Mr M. van Schalkwyk pointed out that more than 95 per cent of disaster-related deaths occurred in developing countries, and that Africa stood among the most vulnerable to the effects of climate change. He pointed out that South Africa had built a proud track record of regional and international collaboration, working in CAS committees and regionally within the Southern African Development Community (SADC). He stressed South Africa's determination to work with regional neighbours, through the New Partnership for Africa's Development (NEPAD), to improve the accuracy of weather data, forecasts and analysis.

1.10 H.E. Mr M. van Schalkwyk paid tribute to the recent achievements of the South African Weather Service, under the leadership of the Chairperson of the Board, Ms S. Rensburg, and the award it had received from the United Arab Emirates for the work done in advancing the science and practice of weather modification. He pointed out that one of the most pressing environmental health challenges facing both the developed and the developing world was the issue of air quality, which each year cost South Africa more than R4 billion on respiratory health problems. In response to a new Air Quality Act, H.E. Mr M. van Schalkwyk announced that the South African Weather Service would host an Air Quality Information System to provide the Government with accurate, current, relevant and complete information for informed air quality decision-making.

1.11 H.E. Mr M. van Schalkwyk remarked that to have truly global value, meteorology must make a real difference to the everyday lives of people across the globe. He pointed out that it was not enough to only invest in monitoring and research capacity; the challenge shared by all was to integrate forecast changes into local development planning, to make wise infrastructure

investments, and to predict impacts on farming and other sectors of the economy.

1.12 In conclusion, H.E. Mr M. van Schalkwyk wished the session every success, and all participants a truly enjoyable experience of South African hospitality.

2. Organization of the session (agenda item 2)

2.1 Consideration of the report on credentials (agenda item 2.1)

2.1.1 The representative of the Secretary-General presented reports on credentials taking into account the documents received prior to and during the session. The Commission accepted the report, in accordance with General Regulation 22, and agreed not to establish a Credentials Committee.

2.1.2 The meeting was attended by 92 participants from 43 countries, and 23 representatives of other national, regional and international organizations participated in the session. The list of participants is given in Appendix A to the present report.

2.2 Adoption of the agenda (agenda item 2.2)

The Commission unanimously adopted the provisional agenda for the session.

2.3 Establishment of committees (agenda item 2.3)

2.3.1 The Commission agreed to conduct its business only in plenary meetings, with the president, Mr A. Eliassen, chairing the General Plenary for the consideration of items 1 to 4 and 10 to 16, the vice-president, Mr A. Frolov, chairing Plenary A for the consideration of items 7 and 9, and Mr M. Béland chairing Plenary B for items 5, 6 and 8.

2.3.2 In accordance with General Regulations 22 to 31, the session established the following committees.

Credentials Committee

2.3.3 No Credentials Committee was established.

Coordination Committee

2.3.4 A Coordination Committee, comprising the president, two co-chairpersons and secretaries of the plenary sessions, the representative of the Secretary-General, a representative of the host country and the conference officer, was established.

Committee on Structure

2.3.5 An open Committee on Structure was established to consider the structure of the Commission based on the proposal of the president, chaired by the Commission's vice-president.

Committee on the Terms of Reference of the Commission

2.3.6 An open committee was established to consider the terms of reference of the Commission, chaired by Mr M. Béland.

Nominations Committee

2.3.7 A Nominations Committee was established consisting of the delegates of Kazakhstan, Latvia and Norway. The principal delegate of Kazakhstan, Mr T. Kudekov, was requested to serve as convener.

2.4 Other organizational matters (agenda item 2.4)

2.4.1 The working hours of the session were agreed.

2.4.2 The Commission agreed that no minutes of the plenary meetings would be produced unless a Member specifically requested them for a particular item.

2.4.3 The Commission designated Mr Yu Rucong (China) as rapporteur on agenda item 13—Review of previous resolutions and recommendations of the Commission and of relevant Executive Council resolutions.

2.4.4 The Commission agreed to waive General Regulation 109 during the duration of the session.

3. Report of the president of the Commission (agenda item 3)

3.1 The Commission noted with appreciation the report of the president, Mr A. Eliassen (Norway), which presented an overview of the main achievements and developments of the Commission since its last session in February 2002. The president highlighted the Commission's continuous efforts to sustain the implementation of, and further develop, AREP as a comprehensive and credible programme supporting environmental prediction research capable of addressing major societal challenges, such as the reduction and mitigation of natural disasters and environmental change, and to enhance Members' predictive capabilities.

3.2 The Commission was pleased to note that CAS had considerably expanded its activities in all areas, most notably owing to the establishment of new programmes: THORPEX of the World Weather Research Programme (WWRP) and IGACO. CAS had been proactive in fostering its cooperation with the Commission for Basic Systems (CBS) and all other technical commissions and in developing multidisciplinary research, across the AREP component programmes, and with growing involvement of the World Weather Watch (WWW), the World Climate Research Programme (WCRP), the Global Climate Observing System (GCOS) and other Programmes. CAS had been responsive to and supportive of all intercommission groups and had supported all WMO cross-cutting Programmes and activities. Further details of the activities and accomplishments were provided in the reports of the chairpersons of the working groups and committees and were discussed under the relevant agenda items.

3.3 The Commission noted that, during the intersessional period, the president had been actively involved in many activities dealing with matters of

general importance to WMO, representing CAS at numerous meetings and providing input to discussions at various forums dealing with issues related to CAS and AREP.

3.4 The Commission appreciated the guidance provided by the eleventh session of the CAS Advisory Working Group (AWG) (Geneva, January/February 2005). The president emphasized the notable impact of the involvement of chairpersons of CAS working groups and committees in the work of the AWG session. The AWG had discussed the future directions of the Commission's activities within the framework of the development of the WMO Long-term Plan (LTP).

3.5 The Commission agreed with the president and the AWG that the highest priority should be the implementation of GAW, THORPEX and WWRP as a whole. It also agreed that more emphasis should be given to the connection with climate research activities. Since the last session of the Commission, comprehensive Earth system models had been developed for a broad range of forecasting applications including the chemical composition of the atmosphere; new efforts had been put into developing interactive observing systems; and ensemble methods had been employed to produce probabilistic weather forecasts. With those considerations in mind, the AWG had proposed a revision of the terms of reference of CAS.

3.6 The Commission agreed that the proposed new terms of reference, as given in Annex I to the present report, should be submitted to the fifty-eighth session of the Executive Council and Fifteenth Congress for endorsement. The Commission noted that its main contribution to the LTP was to enhance WMO's role as the United Nations authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the oceans, the climate it produces and the resulting distribution of water resources. In that way, the Commission contributed to ensuring that relevant international conventions, protocols and other legal instruments were scientifically based.

3.7 The president expressed his sincere appreciation to all CAS members who had participated in the activities of the Commission for their enthusiastic cooperation. In particular, he thanked the chairpersons of the working groups and committees for their outstanding work. On behalf of CAS, the president also thanked the Secretary-General of WMO and staff from the Secretariat, in particular the AREP Department, for their support and cooperation.

3.8 The Commission responded by expressing its appreciation to Mr A. Eliassen for his outstanding leadership of the Commission, and for his considerable contributions to CAS and AREP. The Commission also responded positively to the president's efforts to increase the effectiveness of the Commission through the proposed restructuring of its working arrangements.

4. Review of decisions of Congress and the Executive Council related to the Commission and other emerging issues (agenda item 4)

4.1 Global Earth Observation System of Systems (agenda item 4.1)

Earth Observation Summits

4.1.1 The Commission was informed that, at the invitation of the United States, on 31 July 2003 in Washington D.C., thirty-three nations, and the European Commission, joined together at the first Earth Observation Summit (EOS-I) to adopt a declaration that called for action in strengthening global cooperation on Earth observations. The purpose of the Summit was to:

> Promote the development of a comprehensive, coordinated, and sustained Earth observation system or systems among governments and the international community to understand and address global environmental and economic challenges; and begin a process to develop a conceptual framework and implementation plan for building this comprehensive, coordinated, and sustained Earth observation system or systems.

4.1.2 To that end, Summit participants had launched an ad hoc Group on Earth Observations (GEO), with the goal of furthering the creation of a comprehensive, coordinated and sustained Earth observation system or systems. The group, co-chaired by the United States, the European Commission, Japan and South Africa, and joined by more than 21 international and intergovernmental organizations, had begun its work by organizing five subgroups, as well as a secretariat to support its activities. In order to promote the development of the now named Global Earth Observation System of Systems (GEOSS), GEO had decided that a document describing the GEOSS framework and an associated 10-Year Implementation Plan would be developed.

4.1.3 The Commission noted that four sessions of the ad hoc GEO had been held, followed by the second Earth Observation Summit (EOS-II). A Communiqué stating approval of the Framework Document, pointing the way forward in the GEO effort, and encouraging broad participation in and support for the GEO effort, had been approved at EOS-II on 25 April 2004. At EOS-II a Framework Document had also been agreed consisting of: a high-level synopsis of the GEO effort for senior policymakers; a description of the GEOSS purpose and expected benefits; and a broad framework for developing the 10-Year Implementation Plan.

4.1.4 The fifth session of GEO (GEO-5), held in Ottawa (Canada), 29–30 November 2004, had negotiated the governance framework for GEO and reviewed the WMO proposal to host the GEO Secretariat. At GEO-6, followed by the third Earth Observation Summit (EOS-III), four significant events for WMO had occurred. First, the agreement through a GEO-6 Resolution to assent to a standing arrangement between WMO and GEO for hosting the GEO Secretariat in Geneva. Second,

a Communiqué relating to support for tsunami and multi-hazard alert systems which had been endorsed at EOS-III. Third, an EOS-III Resolution endorsing the 10-Year GEOSS Implementation Plan had been agreed at the ministerial level. Fourth, the establishment of the formal GEO.

THE GROUP ON EARTH OBSERVATIONS

4.1.5 GEO was governed by a plenary which met annually. A 12-member Executive Committee met regularly to ensure that plenary decisions were acted upon. The bodies were supported by a small secretariat which was supported by a trust fund. Since EOS-III, the GEO had held two meetings (May and December 2005). Since GEO-II, there were 60 members and the European Commission, as well as 43 participating organizations. GEO-II, held in December 2005, had established a number of committees that were now being populated, including on the following subjects:

(*a*) Architecture and data;
(*b*) User interface;
(*c*) Science and technology;
(*d*) Capacity-building and outreach;
(*e*) Tsunamis.

Those committees should provide input for all of the nine societal benefit areas (disasters, health, energy, climate, water, weather, ecosystems, agriculture, biodiversity) and the six transverse activities (GEO-Netcast, user engagement, architecture, data-management, capacity-building, outreach). The concept of bringing together "Communities of Practice", a term used to describe a collective of users and producers of data and information interested in a particular GEO issue, was strongly endorsed. Groups on wind energy, air quality and other areas were developing their partnerships. GEO-Netcast had received strong interest; the Plenary had conveyed it for further study and development within the context of the Architecture and Data Committee. The next GEO meeting (GEO III) was tentatively scheduled for November 2006.

DEVELOPMENT OF GEOSS

4.1.6 The GEOSS 10-Year Implementation Plan had been launched at EOS-III. GEOSS would work and build upon existing national, regional and international systems. In 2005, 80 per cent of the tasks had been completed; the remaining 20 per cent had been combined with the 2006 tasks. The workplan for 2006 was near completion. Members and participating organizations had identified their interests. The 2006 workplan consisted of nearly one hundred items covering the nine societal benefit areas and cross-cutting activities such as the GEOSS architecture, data management, user engagement and capacity-building. More details on GEOSS implementation were available at http://earthobservations.org/

4.1.7 WMO was taking a lead role in 15 tasks and contributing to another 25 tasks of the 2006 GEO Workplan. In addition to its direct involvement in GEO, WMO was participating in a collective way through its sponsored systems (GCOS, the Global Terrestrial Observing System (GTOS), the Global Ocean Observing System (GOOS) and GAW), and through WCRP. WMO, as an associate member of the Committee on Earth Observation Satellites (CEOS) and full partner in the Integrated Global Observing Strategy Partnership (IGOS-P), was able to contribute to GEO. Lastly, the executive heads of United Nations agencies, including the Secretary-General of WMO, had formed the Interagency Coordination and Planning Committee for GEO/GEOSS (ICPC). The International Council for Science (ICSU) had been involved in that process as an observer.

CAS AND GEOSS

4.1.8 The Commission noted that the fifty-seventh session of the WMO Executive Council had adopted Resolution 18 (EC-LVII) — Global Earth Observation System of Systems, which requested the Secretary-General to strengthen his support towards GEOSS implementation as well as to the GEO Secretariat in its work and to ensure that WMO Programmes were actively involved in GEOSS.

4.1.9 The Commission noted that Resolution 18 (EC-LVII) strongly encouraged all WMO Members to be actively engaged in all GEOSS processes. The Commission decided that Members should work closely with other Earth observation agencies at the national level to ensure the development of well-coordinated national plans for GEOSS implementation.

4.1.10 The Commission noted that Resolution 18 (EC-LVII) requested the Secretary-General to continue to keep WMO Members informed of GEO activities and in particular to ensure that Members received material and information on the potential socio-economic benefits expected as a result of GEOSS.

4.1.11 The Commission applauded the efforts of the Secretary-General in securing a lead role for United Nations agencies and in particular WMO, which housed the GEO Secretariat. CAS recognized its fundamental interest in the development of comprehensive, integrated and sustained Earth observations. The Commission also noted that the GEO initiative brought with it an exceptional opportunity to define, at a high political level, firm resources for operational Earth observation infrastructure.

4.1.12 The Commission noted that several of its programmes would contribute directly to the objectives of GEO and was pleased with the active engagement of its programmes and the GEO Secretariat to ensure alignment of the 2006 GEO Workplan. In particular, the Commission recognized that THORPEX addressed several of the societal benefit areas listed in the GEOSS 10-Year Implementation Plan, including health, energy, water resources and agriculture. GAW provided a major component of the observing system for atmospheric chemistry. Although each of its programmes would continue, the Commission anticipated that GEO would provide advocacy for those programmes while they would in turn address issues of relevance to the implementation of GEOSS. The Commission encouraged the

ongoing cooperation between CAS and GEO through the WMO Secretariat and through its sponsored programmes.

4.1.13 The Commission recognized that for GEO to facilitate a healthy discourse among the operators of global systems, it was essential that experts from many disciplines work with those committees to ensure that GEO was driven by science and common sense. It was also appropriate to make efforts to "map" CAS activities to the GEOSS 10-Year Implementation Plan. In that light, the Commission urged CAS representatives to be fully engaged through national or scientific bodies. More so, it would be appropriate for CAS to be represented, through WMO, on the Science and Technical Committee in particular. In that regard, it appointed a Coordinator for GEOSS as a member of the CAS Management Group to work on relevant implementation aspects of the GEOSS Implementation Plan with the terms of reference given under agenda item 12 (general summary paragraph 12.7).

4.2 Integrated Global Atmospheric Chemistry Observations (agenda item 4.2)

4.2.1 The Commission noted *that*, on 27 May 2004, the IGOS partners had approved *The Changing Atmosphere: An Integrated Global Atmospheric Chemistry Observation Theme for the IGOS Partnership: Report of the Integrated Global Atmospheric Chemistry Observation Theme Team* (GAW-159, WMO/TD-No. 1235) assessing the past, present and future state of global air composition observations, measurement requirements and priorities for the next 15 years for an IGACO system. An international expert group, co-convened by WMO and the European Space Agency (ESA), had prepared the IGACO report. Eminent scientists, including two Nobel Prize winners, had reviewed it independently. The report critically assessed the requirements on accuracy/precision and spatial/temporal resolution and the current state of modelling chemical cycles in forecast and climate models. It presented a conceptual framework for an integrated observing system for a group of 14 target variable groups (Table 4.1 of the IGACO Report). It made 12 general recommendations and seven specific recommendations to be addressed in a phased approach over the next 15 years led by the WMO GAW programme in cooperation with the WMO Space Programme and other key WMO Programmes, space agencies and the global air chemistry/meteorology/climate research community.

4.2.2 The Commission recalled that, at its fifty-seventh session, the Executive Council had agreed that "IGACO was eminently suitable to be led by WMO and endorsed the organization of WMO components in implementing IGACO with a central role taken by GAW and the WMO Space Programme and with substantial support from the WWW, WWRP, GCOS and GEOSS" (*Abridged Final Report with Resolutions of the Fifty-seventh Session of the Executive Council*, WMO-No. 988 general summary paragraph 3.3.2.9). The Commission noted that, in March 2005, the CAS Working Group on Environmental Pollution and Atmospheric Chemistry (WG-EPAC) (GAW Report No. 165) had recognized that the IGACO framework was an important step in the integration of observations including satellites and in connecting GAW to GEOSS, GCOS and the needs of the numerical weather prediction (NWP) community. Also, the Commission noted the requests made by the fifty-seventh session of the Executive Council that: (i) CAS develop by next Congress an implementation plan based on the strategic plan in the IGACO Report; a plan consistent with the evolving GCOS, GEOSS and IGOS-P; and that (ii) CAS establish an IGACO implementation team co-chaired by WMO and ESA, with CBS, the Commission for Climatology (CCl) and other technical commissions providing support as necessary. In its initial phase, implementation would be the responsibility of the Joint Scientific Steering Committee (JSSC) of the Open Programme Area Group on Environmental Pollution and Atmospheric Chemistry (OPAG-EPAC). The Commission was informed of progress made toward the development of an implementation plan. IGACO implementation would be an integral part of the new GAW Strategic Implementation Plan.

4.2.3 The Commission adopted Recommendation 1 (CAS-XIV).

4.3 Global Climate Observing System (agenda item 4.3)

4.3.1 The Commission welcomed the development, under GCOS leadership, of the *Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC* (GCOS-92, WMO/TD-No. 1219). The Plan had been submitted to the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) at its tenth session in December 2004 and had been formally endorsed by the COP through decision 5/CP.10. The Commission noted that the Plan called for some 131 actions needed over the next five to 10 years to address the critical issues related to global observing systems for climate, namely improving key satellite and in situ networks for atmospheric, oceanic and terrestrial observations; generating integrated global climate analysis products; enhancing the participation of least developed countries (LDCs) and small island developing States (SIDS); improving access to high-quality global data for essential climate variables; and strengthening national and international infrastructure. In addition, the Commission noted that many of the actions explicitly involved the Commission and/or the GAW programme as 'Agents for Implementation'. The Commission supported the Plan as a major step towards the full implementation of the global observing system for climate and agreed to cooperate fully in implementing the relevant actions. It requested the GAW programme to participate fully in implementing the Plan and encouraged Members to support its implementation on an individual basis. The Commission encouraged Members to support GCOS implementation by continuing to enhance national GAW observations and to provide support for data rescue and management in developing countries by working cooperatively. The

Commission also noted the great potential of the THORPEX programme and the International Polar Year (IPY) initiative to contribute to the implementation of the Plan and encouraged close cooperation with GCOS toward that end.

4.3.2 The Commission welcomed the agreement between GAW and GCOS recognizing the WMO/GAW Global Monitoring Network for Carbon Dioxide and Methane as a major component of the GCOS comprehensive network for those gases and expressed its full support of that agreement. The 10 basic GCOS Climate Monitoring Principles should be relevant not only for carbon dioxide and methane, but also for other climatic parameters, namely ozone, ultraviolet (UV), aerosols, and so on.

4.4 Natural Disaster Prevention and Mitigation Programme (agenda item 4.4)

Issues related to the Natural Disaster Prevention and Mitigation Programme

4.4.1 The Commission recalled Resolution 29 (Cg-XIV) — Natural Disaster Prevention and Mitigation Programme, Resolution 5 (EC-LVI) — Executive Council Advisory Group on Natural Disaster Prevention and Mitigation, and Resolution 9 (EC-LVII) — Natural Disaster Prevention and Mitigation.

4.4.2 AREP, together with WWW, the Applications of Meteorology Programme (AMP), the World Climate Programme (WCP) and the Hydrology and Water Resources Programme (HWRP), contributed global capabilities for the detection, forecasting and early warning of hazards and provided effective means and procedures to minimize their adverse consequences. Through its research and development (R&D) projects and programmes, AREP had been improving tools and techniques to provide timely warnings of weather-, water- and climate-related hazards affecting populations and economies. Ongoing key activities pertinent to natural disaster prevention and mitigation (DPM) included GAW (agenda item 6.1), in partnership with WWW, WCP and other institutions, which was addressing the impact of smoke and haze from wildfires; WWRP, which was addressing wildfire prediction and detection along with other natural hazards; Physics and Chemistry of Clouds and Weather Modification Research (PCCWMR), which was addressing the conditions for severe storms, their possible impact, mitigation and augmentation of precipitation; GURME (agenda item 6.2) and its partners, which were addressing urban air quality forecasting applicable to human health; the Tropical Meteorology Research Programme (TMRP) (agenda item 7.3), in collaboration with the Tropical Cyclone Programme (TCP) of the WWW, which was addressing the track and intensity of landfalling tropical cyclones; THORPEX, which was advancing ensemble prediction techniques; and the social and economic applications subprogramme of THORPEX (agenda item 7.2), in collaboration with WWW, the Public Weather Services Programme (PWSP) of AMP and the Agricultural Meteorology Programme (AgMP) of WCP, which was implementing prototype early warning systems for health, agriculture and other societal benefit areas.

4.4.3 The Commission noted that DPM would pose new challenges for CAS and would have direct implications on its work, specifically those activities that contributed directly to the goals and expected outcomes of the DPM Programme. The Commission also considered the coordinating role of DPM and was satisfied that CAS and other technical commissions were already coordinating their projects and programmes and actively cooperating with each other to address disaster prevention and mitigation issues. The session emphasized the need for the DPM Programme to provide advocacy for R&D to improve forecasting skills of hazardous weather, which was a key component of improving early warning systems.

4.4.4 Furthermore, the Commission considered the revised DPM Implementation Plan with a view to identifying the various contributions and inputs the Commission should develop for 2006–2007. It was emphasized that much of the work already under way was directly aligned with Goal 2 of the DPM Implementation Plan and would continue to advance early warning systems, with increasing emphasis on warning systems applicable to specific societal benefit areas.

4.4.5 In view of the DPM developments of importance to CAS, the Commission decided on the appropriate coordination mechanism provided in agenda item 12.

4.5 International Polar Year 2007–2008 (agenda item 4.5)

4.5.1 The Commission noted that the Fourteenth World Meteorological Congress and the twenty-eighth General Assembly of ICSU had approved the holding of the IPY 2007–2008. The Commission also noted that the fifty-seventh session of the Executive Council had requested the WMO technical commissions to assist in the establishment of the project steering committees and in providing technical advice in the management of the IPY projects.

4.5.2 The Commission further noted that the IPY 2007–2008 should result in an intensive burst of internationally coordinated, interdisciplinary research and observations carried out in the polar regions. A contribution to the IPY would be provided, among others, to areas of activities related to AREP and focused on:

(*a*) The enhancement of ozone layer monitoring, with an increased spatial and temporal coverage, using ground-based optical remote-sensing instrumentation, ozone sondes and stratospheric aircraft campaigns to provide the measurements required to study chemical and physical properties throughout a one- to two-year period;

(*b*) The intensification of long-term integrated measurement/modelling of the transport of greenhouse gases and aerosols, particularly to the Arctic, and the carrying out of a study of atmospheric chemical

component processes to minimize the impact of ecosystem-related chemicals on polar ecology;

(*c*) The assessment of global-to-regional influences on the initiation, evolution and predictability of high-impact weather events of polar circulation within the framework of the WWRP THORPEX.

4.5.3 The Commission recognized that the successful implementation of the IPY required the strengthening of the technical and logistical infrastructure for operations and research during the preparation and implementation of the IPY, including the strengthening of observing and telecommunication facilities over the Arctic and the Antarctic, the establishment of a data management structure and the further development of forecasting techniques.

4.5.4 The Commission emphasized that the comprehensive data sets and scientific results obtained as a result of the successful implementation of the IPY would serve as a basis for the further development of environmental monitoring in polar regions. The IPY would also provide a valuable contribution to the assessment of climate change and its impact in polar regions, and its results should be used for making recommendations to governmental agencies and the socio-economic sector.

4.5.5 The Commission noted the substantial progress made in IPY planning and preparation, including the establishment by WMO and ICSU of the IPY Joint Committee (JC) (co-chaired by Messrs I. Allison and M. Béland), responsible for the scientific planning, coordination, guidance and oversight of the IPY, the establishment of the IPY International Programme Office (IPO) to provide secretariat support to JC activities, the establishment of the Open Consultative Forum to provide a platform for IPY planning and preparation and for exchanging information with the JC on IPY development, as well as the establishment of an international office on IPY projects and a regional European-Asian sub-office in St Petersburg (Russian Federation).

4.5.6 The Commission was informed that, among the projects endorsed by the JC as a result of the evaluation of more than 200 project proposals, about 40 were closely related to atmospheric sciences, in particular to the development of polar weather forecasting techniques (e.g. IPY THORPEX) and studies of atmospheric chemistry, aerosols, ozone depletion and transport of pollutants (e.g. ORACLE-O3, POLARCAT, ATMOPOL and others). Noting that CAS might substantially contribute to the successful implementation of those projects, the Commission requested its AWG to establish contact with the relevant project steering committees, and to assist in the promotion and implementation of projects.

4.5.7 The Commission noted with satisfaction that the CAS AWG and the THORPEX International Core Steering Committe (ICSC) had discussed the IPY preparation, and those bodies had provided a valuable contribution to the IPY planning process. The Commission was informed about the work of the Intercommission Task Group (ITG) on IPY established in 2004. The Commission noted with appreciation that Mr Ø. Hov (Norway) represented CAS in the Group and had provided a substantial contribution to its work and to the preparation of the ITG recommendations.

4.5.8 As regards methodological approaches to IPY studies, the Commission agreed with the ITG's view that it would be desirable to couple model-interpretation activities and process-oriented studies with observations relevant to the driving environmental issues. That would involve implementing projects on:

(*a*) The transport mechanisms of pollutants into the polar regions;

(*b*) The sensitivity of the climate system to changes in the chemical composition of the polar atmosphere and changes in surface properties, including albedo and the water cycle.

Modelling the coupled effect of physical, dynamic and chemical processes on the composition of and changes in the polar atmosphere should be carried out. In that connection, an Earth system modelling approach (atmosphere-cryosphere-ocean-terrestrial surfaces) was recommended.

4.5.9 The Commission recommended that the structure of observations and modelling related to the IPY be embedded into the IGACO framework so as to extract a maximum of information from the combined activities through data assimilation in modelling and to provide data centre/metadata centre facilities to fuse complex data streams into user-oriented products and scientific findings.

4.5.10 The Commission welcomed the decision of the THORPEX ICSC on coordinating the role of THORPEX in respect of all other proposals and projects from IPY national committees and other entities falling within THORPEX scientific objectives, including those in the Southern hemisphere. The Commission recommended that the THORPEX Subcommittee for IPY should play that role, and that the ICSC chairperson should keep in close contact with the IPY JC regarding THORPEX objectives and plans for the IPY.

4.5.11 The Commission recognized that a potential legacy of the IPY would be the expansion and maintenance in operational mode of long-term high-latitude observing systems, in particular with respect to atmospheric chemistry, the transport of pollutants and ozone measurements for as many years as possible, to provide data for the detection and projection of climate change.

4.6 WMO Information System
(agenda item 4.6)

4.6.1 With respect to the WMO Information System (WIS), the Commission recalled the proposals of CBS and the corresponding decisions of Fourteenth Congress and the subsequent fifty-fifth to fifty-seventh sessions of the Executive Council. The Commission noted that the Global Telecommunication System (GTS) would evolve as the core network of WIS, which would, based on international information and communication technology (ICT) standards, facilitate real-time, coordinated "push-pull" services for the operational, time-critical applications and information discovery, access and

retrieval services of all WMO and relevant co-sponsored international programmes, such as research, climate and environmental applications and programmes, as well as for eligible non-National Meteorological and Hydrological Services (NMHSs) users at national level.

4.6.2 It was further noted that the fifty-seventh session of the Executive Council had realized the important role that WIS played in contributing the essential data exchange and data management services to GEOSS and in facilitating the effective role of all NMHSs in disaster mitigation and prevention activities and warning systems. In the aftermath of the December 2004 tsunami catastrophe, the importance of WIS had been further demonstrated as the international community recognized that the WMO GTS of today, and consequently the WIS of tomorrow, served as the backbone network for real-time information exchange in support of multi-hazard, multi-purpose natural disaster early warning systems. The fifty-seventh session of the Executive Council had requested that the development of key components of WIS be expedited with a view to beginning implementation, at least in some countries, in 2006 instead of 2008, as originally planned.

4.6.3 The Commission emphasized that WIS would be very relevant for the future efficient implementation of its programme activities. Specifically, the research and environmental applications were expected to benefit as GAW data were being required in real time for NWP applications. WIS was expected to facilitate that data exchange and would in addition provide highly efficient information discovery, access and retrieval services. Noting the accelerated plan for the implementation of WIS, the Commission requested the GAW monitoring networks, GAW World Data Centres (WDCs) and the modelling centres using GAW data to coordinate urgently the definition of their WIS requirements, including network connectivity, data formats and metadata. The Commission also agreed that its active involvement in the design and implementation coordination of WIS should be enhanced. The Commission also agreed to participate actively in the development of WIS-related data management functions with a view to ensuring that relevant online catalogues and metadata were well defined, and that information representation formats and codes would be fully suitable to and supportive of CAS programme needs.

4.6.4 In light of the diversity of users and participating programmes, it was agreed to work towards limiting the number of standard formats so as to facilitate an efficient use of WIS. The Commission also noted the issue of the large data volumes generated, for example in connection with ensemble prediction system (EPS) projects, and agreed to liaise with CBS to ensure that the required transmission bandwidths were planned in WIS between the centres concerned. Noting the substantial overheads involved in downloading the large, complex data sets required under some of its programme activities, the Commission recommended that the network planners centralize such processes in regions or sectors and apply local knowledge and services to transfer the information to end-users. Such an approach would particulary enable remotely located sites, for example small island States or developing countries with limited ICT infrastructure, to receive relevant data sets. The Commission highlighted THORPEX, in which a similar approach was already being successfully pursued.

4.6.5 Furthermore, the Commission stressed the need for transparent and coordinated governance mechanisms to ensure that programmes understood how they could participate, introduced requirements and monitored implementation. The Commission emphasized the specific needs of the atmospheric research community as regards metadata and the importance of defining a methodology for recognizing and preserving value-adding activities in order to avoid repeated generation of the same data set.

4.6.6 The Commission agreed that it was critical for WMO to give specific attention to developing countries with respect to their WIS-related requirements and capabilities so that those countries could participate in and benefit from relevant CAS programme activities. In that context, the Commission was pleased to note that the Secretary-General had established a WIS Coordination Office that was requested, among others, to prepare and coordinate a developing country outreach programme intended primarily, but not only, for their NMHSs, to ensure that those countries fully participated in WIS.

4.6.7 With a view to ensuring optimal benefits for CAS programme activities and centres derived from the emerging WIS, the Commission decided on the following priority actions and invited the Secretary-General to facilitate the corresponding arrangements, as appropriate:

(*a*) To develop WWRP and GAW programme-specific extensions to the WMO metadata core profile and coordinate them through the Meeting of the Presidents of the Technical Commissions (which was being set up as the clearing house for that purpose);

(*b*) To identify the CAS community of experts and establish appropriate working mechanisms to address WWRP- and GAW-specific requirements with respect to data management, data discovery and retrieval;

(*c*) To ensure that relevant CAS representatives participate in critical meetings of expert teams, technical conferences, and so forth, on WIS to achieve consistent and rapid implementation progress;

(*d*) To ensure that CAS programme centres participate in a survey on identification, capabilities and requirements of WIS Data Collection or Product Centres (DCPCs);

(*e*) To organize an interdisciplinary WIS user conference in 2007.

4.6.8 While confirming the important role of the Intercommission Coordination Group on WIS (ICG-WIS) established by the Executive Council, in which CAS was represented, the Commission saw the need to set up and strengthen its direct participation in the WIS design and development work led by CBS and its

WIS-related teams. The Commission decided to establish WIS-related co-rapporteurs (agenda item 12 contains their terms of reference). In addition, the Commission requested its Management Group to stay abreast of the development and implementation of WIS; coordinate collaboration with CBS as necessary; oversee the above priority actions; initiate corrective measures as needed; and initiate other actions required to ensure the full participation of CAS programmes and centres in WIS.

4.7 WMO Quality Management Framework (agenda item 4.7)

4.7.1 The Commission recalled that Fourteenth Congress had decided (Resolution 27 (Cg-XIV) — Quality management) that WMO should work towards a Quality Management Framework (QMF) for National Meteorological or Hydrometeorological Services (NMSs) that would eventually include and develop the following distinct though related elements, which could be addressed, possibly on a phased basis:

(*a*) WMO technical standards;
(*b*) Quality management system(s) National Meteorological or Hydrometeorological Services, including quality control;
(*c*) Certification procedure(s).

4.7.2 The Commission noted the deliberations and decisions on that subject of the fifty-six and fifty-seventh sessions of the Executive Council. Surveys among NMHSs carried out in 2004 and 2005, to assess quality management (QM) activities, plans and requirements for assistance through WMO, revealed that a large number of Members required technical guidance and assistance from WMO as a matter of urgency. QM appeared to be of growing relevance for Members. At the sessions, several Council members had reported that they had been gaining positive experience with the quality management system (QMS) based on the ISO 9001 standard, which had resulted in a continuous process of improvements in the management and operation of NMSs and in the delivery of services through an enhanced focus on the customer and user community. The survey had also shown that the implementation of the QMS could be pursued for separate sectors, such as aeronautical meteorological, marine meteorological and climatological services, or for the Service as a whole.

4.7.3 The Commission further noted that Members had reported that pure certification (audit) costs were much lower than expected, while the cost for the consultant services needed in support of QMS implementation proved to be higher than anticipated. As a consequence, Members could achieve substantive savings and progress through QMF capacity-building activities and experience exchange offered by relevant Members. As far as a WMO certification scheme was concerned, the Commission noted with interest the expert conclusions that it would most likely be more expensive than the ISO 9001 certification procedure because of costs for WMO permanent staff, interpretation and travel and the requirements for neutrality and geographic balance within a WMO certification team.

4.7.4 The Commission was satisfied that guidance material in the form of the *WMO Quality Management Framework — First WMO Technical Report* (WMO/TD-No. 1268) (on CD-ROM) had already been published, which contained, among others, basic QM documentation offered by several Members and several technical reports. Translations of some of those documents were also available and could be downloaded from the newly developed website dedicated to the WMO QMF. Those sources of documentation had already proven to be highly appreciated by and helpful for Members. The Commission was informed that the joint *ICAO Manual/WMO Guide on Quality Management Systems for the Provision of Meteorological Service to International Air Navigation* (WMO-No. 1001) oriented towards ISO 9001 was expected to be published shortly.

4.7.5 The Commission recognized that capacity-building efforts were necessary in order to help, in particular NMSs from developing countries, in the implementation of the QMS, through seminars, workshops, conferences, and so on. To that end, training events, such as regional technical conferences and other suitable training events under various WMO scientific/technical programmes, should, among others, address the WMO QMF by including that topic in their programmes or curricula, and by inviting resource persons from Members that had already implemented the QMS to those events. The Commission noted with satisfaction the reports of several delegations indicating that their NMHSs, comprehensively or in sectors, had successfully implemented the QMS according to ISO 9001, including certification. They had also indicated that the corresponding efforts had not been too difficult and that the resources committed were justified by the benefits gained from that process.

4.7.6 The Commission recalled in particular the decision of the fifty-seventh session of the Executive Council, which endorsed the conclusion of the 2005 Meeting of the Presidents of Technical Commissions (Geneva, January 2005) that the technical commissions concerned should focus on a review of WMO Technical Regulations and standards relevant to observation generation, with a view to rectifying deficiencies, duplications, inconsistencies and errors. That should make the relevant WMO Technical Regulations viable reference documents for use within national QMSs and would improve the cross-programme consistency of the Technical Regulations relating to observations. In that connection, the Commission emphasized that extensive expertise in quality assurance existed already since that was an integral part of its GAW programme. In view of the very successful work of the Quality Assurance/Science Activity and Calibration Centres, the Commission agreed that that knowledge was to be shared with other technical commissions and Members to help enhance similar efforts in their observation programmmes.

4.7.7 The Commission also recalled that QMF aspects should become an integral part of the work of the technical commissions and confirmed that that was

in accordance with the CAS terms of reference and with those of some of its OPAGs. The Commission agreed to continue the development of its quality-related activities and to take special measures to ensure coordination with the other technical commissions on QMF matters of common interest through the WMO Intercommission Task Team on Quality Management Framework.

4.8 WMO Space Programme
(agenda item 4.8)

4.8.1 The Commission was informed that Fourteenth Congress had established a new major cross-cutting Programme, the WMO Space Programme, in response to the momentous expansion in the availability of satellite data, products and services and in recognition of the increase in responsibilities for WMO. Fourteenth Congress had agreed to establish a WMO Space Programme as a matter of priority and had felt that the scope, goals and objectives of the new WMO Space Programme should respond to the tremendous growth in the utilization of environmental satellite data, products and services within the expanded space-based component of the Global Observing System (GOS) which now included appropriate R&D environmental satellite missions. Fourteenth Congress had also supported the WMO Space Programme Long-term Strategy reviewed at the third session of the Consultative Meetings on High-level Policy on Satellite Matters. Fourteenth Congress had agreed that the WMO Space Programme Long-term Strategy provided an excellent balance to the Sixth WMO Long-term Plan (6LTP) and to the programme and budget for 2004–2007. Thus, Fourteenth Congress had believed it important to establish the new WMO Space Programme as a major cross-cutting Programme and adopted Resolution 5 (Cg-XIV) — WMO Space Programme.

4.8.2 The Commission noted that Fourteenth Congress had agreed that the main thrust of the WMO Space Programme Long-term Strategy should be:

> To make an increasing contribution to the development of the WWW GOS, as well as to the other WMO-supported Programmes and associated observing systems (such as AREP's GAW, GCOS, WCRP, HWRP's WHYCOS and JCOMM's implementation of GOOS) through the provision of continuously improved data, products and services, from both operational and R&D satellites, and to facilitate and promote their wider availability and meaningful utilization around the globe.

4.8.3 The Commission further noted that the main elements of the WMO Space Programme Long-term Strategy were agreed as follows:

(*a*) Increased involvement of space agencies contributing, or with the potential to contribute to, the space-based component of the GOS;
(*b*) Promotion of a wider awareness of the availability and utilization of data, products — and their importance at levels 1, 2, 3 or 4 — and services, including those from R&D satellites;
(*c*) Considerably more attention to be paid to the crucial problems connected with the assimilation of R&D and new operational data streams in nowcasting, NWP systems, reanalysis projects, monitoring climate change, chemical composition of the atmosphere, as well as the dominance of satellite data in some cases;
(*d*) Closer and more effective cooperation with relevant international bodies;
(*e*) Additional and continuing emphasis on education and training;
(*f*) Facilitation of the transition from research to operational systems;
(*g*) Improved integration of the space component of the various observing systems throughout WMO Programmes and WMO-supported programmes;
(*h*) Increased cooperation amongst WMO Members to develop common basic tools for utilization of research, development and operational remote-sensing systems.

4.8.4 The Commission also noted that Fourteenth Congress had considered the progress and results of the sessions of the Consultative Meetings on High-level Policy on Satellite Matters. Congress had recalled that it had agreed to build a new and closer partnership under the auspices of WMO between Meteorological and Hydrological Services and environmental satellite communities. It had agreed that a mechanism for such discussions should be provided through the convening of Consultative Meetings on High-level Policy on Satellite Matters. Fourteenth Congress had been convinced that the then established dialogue between WMO and the environmental satellite communities during the sessions of the Consultative Meetings had matured rapidly to the great benefit of all, and that they should be continued and institutionalized. Thus, Fourteenth Congress had considered it appropriate to institutionalize the sessions as WMO Consultative Meetings on High-level Policy on Satellite Matters in order to establish more formally the dialogue and participation of environmental satellite agencies in WMO matters. Congress had urged close cooperation with the Intergovernmental Oceanographic Commission (IOC) and other related international organizations to ensure a coordinated and integrated approach to space-based Earth observations.

4.8.5 Fourteenth Congress had been unanimous that the WMO user community should be represented at the highest level at the sessions and that the space agencies should also be represented by their Directors. Future sessions of the Consultative Meetings on High-level Policy on Satellite Matters should be chaired by the President of WMO as had been the case for the first three sessions. The Consultative Meetings would continue to provide advice and guidance on policy-related matters and would maintain a high-level overview of the WMO Space Programme. Fourteenth Congress had agreed that CBS should continue the lead role, in full consultation with the other technical commissions, for the new WMO Space Programme. Thus, Congress had adopted

Resolution 6 (Cg-XIV) — WMO Consultative Meetings on High-level Policy on Satellite Matters.

4.8.6 The Commission agreed that THORPEX was an important international programme in which satellite observations would play a major role. The programme's success would help ensure optimal utilization of satellite data across forecast scales ranging from one day to two weeks, and most likely into seasonal to inter-annual scales. Results from THORPEX would help guide the utilization of satellite data and future satellite roles as part of the WWW GOS. Information gleaned from THORPEX would help guide the future development of satellite systems. The Coordination Group for Meteorological Satellites (CGMS) joined the THORPEX ICSC in 2004. To ensure maximum realization of satellites' potential as part of the THORPEX programme, satellite agencies were invited to actively participate in the planning and implementation of THORPEX and contributed to experiments and campaigns in coordination with the WMO Space Programme. In particular, satellite agencies were invited to consider means and policy for providing access to both operational and R&D data, which would be used in THORPEX experiments, as well as contributing to the THORPEX Data Policy and Management Plan, including a solution for the real-time exchange of large volumes of data.

4.8.7 The fifth session of the Consultative Meetings on High-level Policy on Satellite Matters had noted that *The Changing Atmosphere: An Integrated Global Atmospheric Chemistry Observation Theme for the IGOS Partnership: Report of the Integrated Global Atmospheric Chemistry Observation Theme Team* (GAW-159, WMO/TD-No. 1235), prepared by an expert international group convened by WMO and ESA, had been reviewed independently by eminent scientists, including two Nobel Prize winners. IGACO was a highly focused strategy for bringing together ground-based, aircraft and satellite observations for 13 chemical species in the atmosphere using atmospheric forecast models that assimilated not only meteorological observations, but also chemical constituents. Socio-economic issues related to climate change, ozone depletion/UV increase and air quality would benefit by having such a system in place.

4.8.8 The IGACO Report critically assessed the requirements on accuracy/precision and spatial/temporal resolution and the current state of modelling chemical cycles in forecast and climate models. It had recommended specific steps to be taken in a phased approach over the next 15 years led by the WMO GAW programme in cooperation with the WMO Space Programme and other key WMO Programmes, space agencies and the global air chemistry/meteorology/climate research community.

4.8.9 The Commission noted that a number of space missions were currently under consideration (i.e. being studied but not yet approved for full development) by several space agencies (the National Aeronautics and Space Administration (NASA), ESA, the Japan Aerospace Exploration Agency (JAXA), the National Centre for Space Studies (CNES), the Indian Space Research Organisation (ISRO), and so on) for launch in the 2006–2010 time frame. Those missions would contribute to a better understanding of key chemical climate and weather variables such as:

(*a*) The water cycle through the Global Precipitation Measurement (GPM) mission, a multiple satellite constellation concept, implemented between NASA and JAXA, using a dual-frequency precipitation radar and passive microwave imaging radiometers;

(*b*) The intertropical zone and convective processes through the CNES/ISRO cooperative mission MEGHA-TROPIQUES, scheduled for 2006, using a microwave radiometer (MADRAS) and a microwave sounder (SAPHIR), plus a ScaRaB for Earth radiation budget measurement;

(*c*) The cloud radiative and aerosol processes through the Earth Clouds, Aerosols and Radiation Explorer (EarthCARE), an ESA/JAXA mission, using a backscatter lidar, a cloud profiler radar and a Fourier transform spectrometer (FTS) for measuring cloud and aerosol properties, temperature and water vapour and radiation budget at the top of the atmosphere;

(*d*) The distribution of atmospheric water vapour in the troposphere and lower stratosphere through the Water Vapour and Lidar Experiment in Space (WALES), an ESA mission using a differential absorption lidar (DIAL), and the Atmosphere and Climate Explorer (ACE+), also an ESA mission to measure variations and changes in global atmosphere temperature and water vapour with a four-satellite constellation and using Global Positioning System (GPS) signal occultation techniques providing good accuracy and high vertical resolution for temperature and humidity across the tropopause;

(*e*) The ozone and greenhouse gases circulation through the Greenhouse Gases Observing Satellite (GOSAT), a JAXA and ESA cooperative mission, with an ozone and pollution measuring UV spectrometer (OPUS), a solar occultation FTS for inclined-orbit satellite (SOFIS) and a stratospheric wind interferometer for transport studies (SWIFT);

(*f*) The determination of ocean surface salinity through the ESA/CNES SMOS (Soil Moisture and Ocean Salinity) and NASA/Aquarius demonstration missions which would both attempt to measure that important oceanic parameter which was in great demand for climate research. The combination of salinity and precipitation observations would provide new and important information on evaporation and precipitation estimates over the oceans;

(*g*) The measurement of soil moisture in the upper layer with the ESA/CNES SMOS mission, based on a passive L-band 2-D interferometer technique;

(*h*) The study of land surface processes and the role of vegetation in the global carbon cycle through the ESA SPECTRA (Surface Processes and Ecosystem Changes through Response Analysis) Earth Explorer

mission, using an advanced hyper-spectral sensor (PRISM).

4.8.10 The Commission agreed that, through its Space Programme, WMO had acted as a catalyst to greatly improve the utilization of satellite data and products. The Virtual Laboratory for Education and Training in Satellite Meteorology had already made a considerable impact through its "Centres of Excellence". The Commission was pleased to see the integration of the new R&D constellation into education and training activities. It also noted that the WMO Space Programme Long-term Strategy and associated Implementation Plan provided for increased utilization of the Virtual Laboratory to the benefit of WMO Members, especially for fuller exploitation of R&D data, products and services, as well as those from new and existing operational meteorological satellite systems.

4.8.11 The Commission noted that in the development of the WWW GOS there were 47 recommendations, 20 of which were relevant to the space-based subsystem of the GOS. Furthermore, it was expected that the WMO Space Programme Implementation Plan would act as a catalyst for those recommendations through interaction with space agencies, via CGMS, CEOS and the WMO Consultative Meetings on High-level Policy on Satellite Matters. Additionally, the Commission noted that the WMO Space Programme Office was reviewing the GEOSS 10-Year Implementation Plan to ensure effective coordination with the work of the Commission in the development of the GOS.

4.8.12 The Commission further noted that considerable progress had been made in the first two years of the WMO Space Programme. The WMO Space Programme Implementation Plan provided a solid framework to meet the goals and objectives established by Fourteenth Congress. There were already noteworthy achievements, and more were anticipated. Thus, the Commission strongly encouraged WMO Members to support the WMO Space Programme, including contributions to the Space Programme Trust Fund and secondments to the Space Programme Office. The Commission also expressed its deep gratitude to all space agencies for their efforts to make satellite data, products and services available to all WMO Members. The space-based subsystem of the GOS had become vital in allowing WMO Members to carry out their mandates and would continue to do so in the future.

4.9 OTHER EMERGING ISSUES (agenda item 4.9)

ISSUES RELATED TO MARINE OBSERVING SYSTEMS

4.9.1 The Commission recalled that the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) had the responsibility, among others, for the implementation and maintenance of an operational marine meteorological and oceanographic in situ observing system, as the ocean component of the WWW GOS and GCOS, and in support of operational weather forecasting, global climate studies, and the provision of a range of marine meteorological and oceanographic services. In that context, the Commission noted with interest that the second session of JCOMM (Halifax, Canada, 19–27 September 2005) had agreed that the workplan for the JCOMM Observations Programme Area should be based on implementing the ocean and associated atmospheric actions specified in the GCOS *Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC* (GCOS-92, WMO/TD-No. 1219). Although the backbone system specified in the Plan was designed to meet climate requirements, that system would also support and largely satisfy requirements for marine observational data for marine services, global weather prediction, marine hazard warning, marine environmental monitoring, and a range of other non-climate applications.

4.9.2 The Commission recognized that fully coupled ocean-atmosphere models were being increasingly developed and used for operational weather forecasting, and that the ocean component of those models involved not just the ocean surface, but more often than not at least the ocean mixed layer, and included variables such as upper ocean heat content, dynamic height and surface roughness. In addition, the models involved the real-time assimilation of observational ocean data, including ocean temperature profiles, surface topography and sea state. Thus, there was an increasing requirement for real-time ocean observational data to support NWP, global weather forecasting and associated atmospheric research programmes.

4.9.3 In that context, the Commission noted with interest that, in general terms and in relation to the GCOS Implementation Plan requirements, ocean observing system implementation had increased from some 34 per cent in 2001 to around 55 per cent in late 2005, including full implementation of the surface drifter network. At the same time, however, the Commission expressed concern that:

(*a*) Some components of the integrated system were not expanding, and in some cases even decreasing. Those included the Voluntary Observing Ships (VOS) network for surface meteorological observations; and the Automated Shipboard Aerological Programme (ASAP) network for upper-air soundings over the ocean, where the project to provide ASAP soundings in the Southern hemisphere had ceased in the past year through lack of sufficient support;

(*b*) Some key components of the system were supported wholly or partly through research funding, with attendant uncertainties over their long-term maintenance. That was particularly the case for the Argo network of subsurface profiling floats;

(*c*) In any case, funding to fully implement and operationally maintain all system components was uncertain, and global coverage of the ocean observing system could not be achieved with the resources that were presently being applied;

(*d*) There was also considerable uncertainty over the long-term future of key ocean satellite missions,

including the JASON altimeter satellite series after JASON-2.

4.9.4 The Commission recognized that the maintenance of ocean observing systems was both expensive and complicated, in view of the lack of clearly defined national responsibilities for specific ocean areas and/or system components, and offered its appreciation and support to JCOMM in its efforts to coordinate system enhancements and long-term maintenance. The Commission stressed that key elements of the ocean observing system were of considerable importance to operational weather forecasting as well as to atmospheric research, and therefore urged Members to make every effort to increase their involvement in, and commitment to, marine meteorological and oceanographic observations. At the same time, the Commission recognized that, for some applications within its own areas of interest, a more tactical approach to such observations, rather than uniform, broadscale coverage, might represent a more cost-effective use of available resources, and that it could provide JCOMM with appropriate advice on that issue. In that context, the Commission agreed that a closer liaison between CAS and JCOMM would be mutually advantageous, and therefore requested the president of CAS to consult with the co-presidents of JCOMM regarding the establishment of an appropriate liaison mechanism between CAS and JCOMM. Furthermore, the Commission noted that operational ocean prediction and related areas in the modelling of data assimilation were of increasing mutual scientific interest and requested the Management Group to consider those issues.

Participation of women in the work of the Commission

4.9.5 The Commission noted the recommendations of the second WMO Conference on Women in Meteorology and Hydrology (Geneva, March 2003) and Resolution 33 (Cg-XIV) — Equal opportunities for the participation of women in meteorology and hydrology, which noted the past efforts of the Commission to strengthen the participation of women in its work. Recognizing that those efforts needed to be renewed with new initiatives, the Commission adopted Resolution 1 (CAS-XIV) and agreed to designate a CAS focal point for gender issues.

Other emerging issues and challenges for the Commission

4.9.6 The Commission welcomed the initiative to have a special session that provided an opportunity to freely discuss emerging issues of relevance to the Commission. There was an extensive exchange of views on the following topics:

(*a*) How to ensure that meteorological service providers supplied the information needed by users in order to make informed decisions;

(*b*) How to ensure that all relevant research was effectively utilized by operational services;

(*c*) How to sustain the research infrastructure.

[The views expressed in the paragraphs that follow represent an aggregation of ideas and do not constitute agreements or decisions of the Commission.]

4.9.7 The initial discussion drew the Commission's attention to the area of socio-economic research and specifically to the need to better understand the relationship between the products associated with the Commission's work (atmospheric sciences and related systems and products) and the resulting benefits enjoyed by various socio-economic sectors and users. Members noted the need to be able to measure utility, perhaps through sector- or user-specific metrics that captured the impact of a product line in that area. Such measures would be both quantitative and qualitative and would make use of intercomparisons, among other things. A sound knowledge of the performance of forecasts for high-impact weather events was an important element of developing measures of utility, and the Commission was encouraged to give that issue specific attention. Emerging socio-economic research was in essence generating knowledge of the value-adding and decision-making chain and contributed directly and indirectly to the identification of measures of impact/utility.

4.9.8 Another theme from the discussion concerned the need to better understand the various external drivers of multidisciplinary products. The heart of the Commission's work lay in the atmospheric sciences, but, increasingly, NMHSs were developing multidisciplinary capacity and products, driven by the fact that many users and decision makers needed broader environmental data. For the Commission, that was exemplified by the work now under the OPAG-EPAC, for example in urban pollution. Expert advice provided on weather modification was another example. The Commission faced a challenge to which it could respond either through some broadening of its mandate (agenda item 3) or through strengthened partnerships in those areas where the Commission itself lacked expertise and competence. Scientifically, that broadened the scope of predictability of the atmospheric system to include predictability of multidisciplinary fields such as agricultural production and energy. The challenge was to ensure that the Commission's products were fit for the intended purpose, within the constraints of technology and science.

4.9.9 Partnering was referred to by several Members. It was noted that the Commission had not in the past given specific attention to forming partnerships beyond its own areas of expertise. That was probably reflected broadly in the activities of WMO. Recent natural disasters had brought such partnerships to the foreground, for example in work with the International Strategy for Disaster Reduction (ISDR) and the response to the December 2004 tsunami. Within the context of CAS, the discussion led to the suggestion that there was a need to broaden the demonstration project concept to encompass decision-making, technology transfer, awareness-building and education and sector-specific applications (e.g. health, agriculture). Many Members

referred to the need for the transfer of scientific knowledge and technology capacity, for example, enhanced ability to use modern products. Moreover, it was suggested that regional partnerships (not necessarily corresponding to regional associations) and bilateral exchanges would be an effective route for such transfers.

4.9.10 Disaster mitigation was a prominent theme throughout the work programme of the Commission. However, several Members noted the lack of quantitative information on disasters relative to the competencies of NMHSs. Although there were several governmental and non-governmental agencies that specialized in the collation of such information, it was often difficult for the Commission to articulate the implications or messages. Post-disaster surveys by members of the Commission provided one avenue for improving such information (sharing such information in a standardized and regular way). That information was often available for major hurricanes/typhoons and tropical cyclones. Major flood events were another area in which the Commission would collectively benefit from better documentation of those aspects of the disaster relevant to the Commission's competencies, namely by obtaining quantitative information that might lead to improvement of the forecasting and early warning systems and mitigate the impact of the disaster.

4.9.11 Improved communication was a recurring theme throughout the discussions. At the basic level, it was clear that the language of atmospheric science posed a barrier for many Services and cultures. There was a need for a glossary of terms used to characterize the external face of the Commission's products, compared with the scientific language used to describe the internal systems (skill, resolution, predictability, and so on). That glossary needed to be adapted to different languages and/or cultures and could include indigenous knowledge. It was possible that a partnership with the United Nations Educational, Scientific and Cultural Organization (UNESCO) might be profitable in that respect. Language was just one of the barriers to optimal dissemination of knowledge, and Members reiterated the need to improve communication lines for science and products and, perhaps, to develop novel structures for disseminating useful data, products and knowledge at the regional level and among specific sectors.

4.9.12 Two specific areas for action emerged from the discussion. First, it was argued that the work of the Commission would benefit from improved mechanisms for dialogue with, and feedback from, the user community. Such a mechanism should facilitate the collation of shared experiences and form part of the qualitative evaluation of the "fitness for purpose" of Commission products. It was noted that the identification of intermediaries or value-adders was often a very efficient way to communicate with users since they provided a ready-made mechanism for understanding the market for (the utilization and take up of) knowledge and products. Some of those intermediaries were directly represented by the members of sister technical commissions within WMO or by agencies outside WMO. An "evaluation board" or "user forum" at which both the providers (that is, the members of the Commission) and users were represented was suggested as an effective mechanism for such an exchange. Those could be associated with the socio-economic research of the Commission or be organized regularly by Members on behalf of the Commission. Such forums would also provide further opportunity for feedback from the developing world.

4.9.13 A second action was implied by the overall discussion which suggested that the Commission was facing a new paradigm for its operations, one that drew attention to the multifaceted capabilities of modern NMHSs and the increasing demand for multidisciplinary products of direct relevance to users. There was a need to restate the "raison d'être" of the Commission in terms of its lines of activity, in the form of a new description and articulation of the required characteristics of products for different applications (accuracy, timeliness, certainty, lead time, reliability, and so on). That knowledge probably lay in some Services, but it had not been collated for the overall benefit of the Commission. A forum should be developed, probably in the shape of a workshop, where sectors and user groups were represented and asked to articulate what constituted "fitness for purpose" for their area. The forum would place particular focus on developing nations and regional characterization. Areas that were particularly important at that time were risk management and hazard characterization, extreme weather events, agriculture and the energy industry. Members of the Commission would mostly participate as listeners, but the workshop could provide an opportunity for dialogue and some matching of capabilities to needs.

4.9.14 The discussion on a more effective transfer and uptake of research further elaborated on some of those ideas. The Commission recognized that its work would benefit from a greater participation of the academic community, including through more opportunities to work on, and with, operational systems since ultimately they were the most important users (beneficies) of such research. Members noted that there were several examples of such collaboration, including participation of developing nations, for example in the ALADIN Project. In some cases, explicit measures of participation in the development of operational systems had been developed. The broadening of the Commission's interests (agenda item 3) also created opportunities for the involvement of a wider research community. Several Members noted the importance of providing opportunities for students and young scientists in that work, through visits to research groups in NMHSs and experimental projects.

4.9.15 The availability of data and products and ease of access was an important aspect of any enhanced participation of the research community in the research of the Commission. The Commission must endeavour, through WIS and other projects, to enhance the real-time exchange of data and products. As such, the Commission recognized the important roles that operational data, data assimilation and model centres could play in supporting research endeavours and thus in accelerating the operations transition process.

4.9.16 Several Members noted the challenge of facilitating external involvement in the development of NMHS systems, and that NMHSs had a responsibility to promote scientific opportunities and advocate increased support for such involvement.

4.9.17 The Commission recognized the challenge of articulating the needs of Members in such a way as to guide and drive research. Many needs were nation- or region-specific, but there were also needs that were shared broadly among nations. The forum suggested above (general summary paragraph 4.9.12) perhaps provided a mechanism to better acquaint the Commission with common needs, alert users of potential opportunities and recent progress and facilitate a more effective transfer of technology. It might also provide a mechanism for identifying opportunities for regional cooperation.

4.9.18 There was also support for developing a description of the modalities and stages for transferring research to operations and user communities. The forecast demonstration project (FDP) and research and development project (RDP) structure developed by WWRP provided the basis for such an initiative. The discussion referred to at least five different modes:

(*a*) Inquiry-driven research, which was of potential relevance to the Commission (see also the discussion in general summary paragraph 4.9.14). That mode allowed for the exploration of ideas and techniques of relevance to CAS, but which were not constrained by a commitment to a particular system or adoption by an NMHS. Academic research often fell into that category. The ability to provide CAS test beds to facilitate such research was an important issue, as was the Commission's ability to advocate support for such work, independently of the Commission's own direct interest and investment.

(*b*) Research dedicated to proving the potential of a technique. RDPs fell into that category, since the initiatives were derived from the interests of the Commission and had the Commission's objectives in mind as part of testing and validation. It provided a demonstration of potential "fitness for purpose" relative to the goals of the Commission.

(*c*) FDPs, which had the role of developing and demonstrating components and systems and proving "fitness for purpose".

(*d*) Operational adoption.

(*e*) Application, which constituted a move out of operational systems into the applied community and demonstrated the value of data and products for a wide range of purposes. Such projects might often be accompanied by socio-economic research to demonstrate more precisely the benefits of the methodology.

The Commission concluded that it would be useful to explore such ideas as part of the development of strategic plans for the Commission.

4.9.19 A common issue was the scale-up (export) of national/regional demonstration projects to the global community of CAS. That should be included in the staged strategy mentioned above, so that all Members could receive the benefits.

4.9.20 The final exchange concerned support of research infrastructure. The initial discussion focused on the opportunity to develop atmospheric sciences as a "big enterprise" science, at a scale that would attract large investment and wide public buy-in. Without such recognition, it became difficult to respond to the urgent issues that Members were currently facing.

4.9.21 Several Members noted the difficulty of developing operational services in big centres since there was potential for confusion concerning authority and responsibility. For example, the tsunami warning systems were being developed as distributed centres for that reason.

4.9.22 There were two aspects of research infrastructure that drew specific suggestions for action. First, Members noted the need to develop and enhance support for research in the form of computing, data systems, communication systems, and so forth, and to explore the opportunities for the adoption of "grid" technologies that allowed for distributed research collaboration. A picture emerged of distributed systems that (*a*) facilitated the development of regional subsystems within global systems; (*b*) permitted offline involvement in the development, testing and validation of new components; (*c*) provided opportunities for the development of local and/or sector-specific modules and applications, with regional or global systems; and (*d*) provided effective methods for measuring the strength of distributed infrastructure and providing feedback. Such architecture would in part be enabled by WIS. Several European initiatives and the Earth Simulator provided prototypes of such systems.

4.9.23 The second element focused on the human aspect and the optimization of research scientist involvement (networking, communication, and so on). It was noted that summer schools often provided an effective route for improving the understanding and adoption of systems/methods and for familiarizing young scientists and/or developing nation scientists with the research, demonstration and applied aspects of the Commission's work. The discussion led to the conclusion that the Management Group should give specific attention to that form of infrastructure.

4.9.24 The Commission requested the newly formed Management Group to consider the matters introduced above and, as appropriate, to develop a strategy and plans to take advantage of those ideas. The Commission further requested the Secretariat to make the detailed notes from those discussions available to the Management Group.

5. Support to ozone and other environment-oriented conventions (agenda item 5)

5.1 The Commission noted that GAW continued to provide observational products and coordination of research activities in support of the Vienna Convention for the Protection of the Ozone Layer, its Montreal Protocol and subsequent adjustments and amendments;

the UNFCCC and its Kyoto Protocol; and the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (LRTAP).

5.2 With respect to support of the Vienna Convention and its Montreal Protocol, the Commission acknowledged that GAW continued to play an essential role in coordinating global ozone observations and informing the media, the public and the scientific community on the ozone and UV issue. That was done by coordinating the Scientific Assessment of Ozone Depletion and regular Ozone Bulletins. The Commission emphasized the critical need for Members to support their ongoing national research and monitoring of ozone and ozone-depleting substances over at least the next 20 years to ensure the future recovery of the ozone layer. The Commission recognized the need to continue the lead role of Environment Canada in supporting the global ground-based Brewer network, maintaining the World Ozone and Ultraviolet Radiation Data Centre and the World Reference Standard for Brewer instruments and providing the WMO trust fund for Brewer calibration and maintenance of instruments in developing countries. The Commission also noted the establishment of the Trust Fund for the Vienna Convention for the Protection of the Ozone Layer for research and systematic observations and encouraged Members to support the strengthening of ozone monitoring and research capacites in developing countries and countries with economies in transition through the Trust Fund and other mechanisms.

5.3 The Commission noted that the next quadrennial Scientific Assessment of Ozone Depletion was due in the autumn of 2006. The Commission encouraged the submission of the final version of assessment data set to the World Ozone and Ultraviolet Radiation Data Centre. WMO would play its usual role in the development and review of the assessment, the publication/distribution of the report, and the communication of the results to the public. WMO would host the Scientific Assessment of Ozone Depletion: 2006 in Les Diablerets (Switzerland) from 19 to 23 June 2006. The Commission appreciated the new format of the bi-weekly WMO Antarctic Ozone Bulletins and welcomed their expansion, since 2006, to include Arctic Ozone Bulletins.

5.4 With respect to the UNFCCC, the Commission supported GAW in taking the lead in: (*a*) coordinating atmospheric chemistry contributions to the GCOS *Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC* (GCOS-82, WMO/TD-No. 1143) and its Implementation Plan (agenda item 4.3); (*b*) maintaining and strengthening the GAW global networks for the essential climate variables (greenhouse gases, ozone and aerosols); and (*c*) supporting research contributing to increased knowledge of climate change which was summarized every four years by the scientific assessment conducted by the Intergovernmental Panel on Climate Change (IPCC).

5.5 The Commission noted that by accepting the GCOS Report mentioned above, the Parties to the UNFCCC had for the first time included greenhouse gases, ozone and aerosols in its list of essential climate variables. That acknowledged the critical role of those atmospheric constituents in direct radiative forcing and climate processes, and the need for systematic global observations. The Commission appreciated the GCOS-GAW agreement establishing the WMO/GAW Global Monitoring Network for Carbon Dioxide and Methane as a comprehensive network of GCOS and thanked the Scientific Advisory Group (SAG) on Greenhouse Gases for having taken the lead, with the GAW and GCOS secretariats, in implementing GCOS actions for carbon dioxide and methane observations. The Commission requested GAW to continue the implementation to address similar GCOS actions for ozone and aerosols.

5.6 The Commission, recognizing the support of the fifty-seventh session of the Executive Council (*Abridged Final Report with Resolutions of the Fifty-seventh Session of the Executive Council*, WMO-No. 988, general summary paragraph 3.3.2.1), reviewed progress and welcomed the initiative of the Secretariat, the WDC on Greenhouse Gases in Japan, the GAW SAG on Greenhouse Gases and the United States National Oceanic and Atmospheric Administration (NOAA) programme on greenhouse gases in developing an annual WMO bulletin on atmospheric on greenhouse gases to be released for the annual meetings of the COP to the UNFCCC.

5.7 The Commission acknowledged the role that WMO had played, and continued to play, in the monitoring, modelling and assessment activities of the UNECE LRTAP and welcomed the involvement of WMO in the two priority activities of the Convention: (*a*) the UNECE Task Force on Hemispheric Transport of Air Pollution; and (*b*) particulate matter and human health activities. The Commission supported the continued co-chairmanship by WMO of the Task Force on Measurements and Modelling of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) under LRTAP. The Commission thanked EMEP and its European supporters for establishing with WMO a cooperative agreement on data flow and exchange between the EMEP Data Centre and the WMO WDC for Aerosols at the Joint Research Centre (JRC) of the European Commission in Ispra (Italy).

6. Environmental pollution and atmospheric chemistry (agenda item 6)

6.1 Global Atmosphere Watch programme, including the report of the chairperson of the Working Group on Environmental Pollution and Atmospheric Chemistry (agenda item 6.1)

6.1.1 The Commission noted the report of Mr Ø. Hov (Norway), chairperson of the CAS WG-EPAC. Atmospheric chemistry was a key element of weather, climate, precipitation formation and air pollution that affected human health and sustainable development. The Commission welcomed the two reports (GAW-151,

WMO/TD-No. 1181 and GAW-165, WMO/TD-No. 1302) of the biennial meetings of the WG-EPAC to review progress made by GAW as outlined in the *Strategy for the Implementation of the Global Atmosphere Watch Programme (2001–2007): A contribution to the WMO Long-term Plan* (GAW-142, WMO/TD-No. 1077) and its addendum (GAW-156, WMO/TD-No. 1209). The Commission commended the WG-EPAC and Members contributing to GAW on the considerable progress made by the GAW programme since 2002.

6.1.2 The Commission supported the abovementioned strategy and its addendum which had been prepared by the Secretariat with the help of a number of atmospheric chemistry experts and thoroughly reviewed and endorsed by the WG-EPAC. The Commission noted the recommendations adopted by the fifty-sixth and fifty-seventh sessions of the Executive Council and supported the GAW strategic goals and implementation strategies, with continued focus on the following core activities:

(*a*) The stabilization of operations at current stations;
(*b*) The extension of measurements in regions with insufficient coverage, especially in the tropics, the Southern hemisphere and Asia;
(*c*) The continuation of capacity-building efforts;
(*d*) The development of GAW into a three-dimensional global observation network through the integration of surface-based, aircraft, satellite and other remote-sensing observations within the framework of IGACO;
(*e*) The completion of the quality assurance/quality control system for all measurement parameters;
(*f*) The expansion of the GAW database system by providing easy user access to the data;
(*g*) The promotion of GAW data use in applications such as chemical weather forecasting, climate studies and scientific assessments;
(*h*) The strengthening of analysis capabilities at GAW in cooperation with the scientific research community.

6.1.3 The Commission welcomed the decision made by the WG-EPAC to revise the GAW Strategic Plan to cover the period 2008–2015 (GSP: 2008–2015) and endorsed the proposed revision process managed by Mr G. Müller (Switzerland) and supported by the Secretariat as well as the chairpersons of the GAW SAGs. The Commission agreed that the IGACO strategy provided the science rationale and conceptual framework for GSP: 2008–2015. In addition, links to other elements of the WMO Integrated Global Observing System (WIGOS) as well as to GEOSS would be defined clearly. The Commission requested that the final GSP: 2008–2015 be completed by the WG-EPAC by 2007 and requested its president to present the plan to Fifteenth Congress.

6.1.4 The Commission stressed that long-term financial and technical commitments to atmospheric chemistry observations were critical to the development of WMO climate, weather and air quality products that would reduce environmental risks. The Commission encouraged Members to renew commitments to the GAW programme and to offer new support. The Commission also agreed with the WG-EPAC that, through GAW, WMO should promote linkages between regional components of the global atmospheric chemistry network.

6.1.5 The Commission noted that many meteorological centres were extending their NWP activities to include global and regional chemical composition of the atmosphere. That was motivated by an acute need for forecasting products for use in minimizing susceptibility to short-term and long-term hazards. Offline operational air quality predictions were currently being carried out at a number of centres. Before the end of the decade, many more centres would have upgraded to the online use of chemical observations, particularly of smoke and dust aerosols, to obtain feedback for atmospheric dynamics and rainfall. That was both an opportunity and a practical challenge for GAW. While those centres would rely mainly on satellite remote sensing for initial data, GAW surface-based and aircraft observations would be crucial for the verification of both analyses and forecasts. The Commission therefore requested that actions be initiated by the WG-EPAC and the Secretariat to enable data to be exchanged in real time and in delayed mode in cooperation with CBS. The Commission encouraged the timely submission of data to GAW WDCs and WIS. The Commission noted with appreciation the joint GAW/WWRP Sand and Dust Storm (SDS) RDP and encouraged new research projects to develop improved predictive capabilities of various high-impact phenomena through the utilization of atmospheric chemistry data.

6.1.6 Since current environmental challenges were interlinked and an integral part of the solution to weather, climate, air pollution and water supply problems, the Commission noted that GAW needed to serve as a multipurpose integrated system for atmospheric chemistry. The system should include all types of observations (surface-based, aircraft, satellite) and atmospheric models. In addition, quality assurance in the sensor-user chain, the production of user-driven information and extraction of knowledge (i.e. fusion of diverse data streams specified by a user) were essential components of the system. The Commission recognized that IGACO provided GAW with a framework to do that and recommended that Members support the implementation of IGACO recommendations.

6.1.7 The Commission noted that correlation between atmospheric chemical composition conditions and different societal impacts (health, environment, economy, and so forth) attracted more public interest. The Commission recognized GAW as a lead and most natural programme in the atmospheric chemistry component of the Earth observation system (GEO/GEOSS). The Commission encouraged the use of GAW for research and development relating to user-oriented products such as the analysis and forecasting of both short-term and long-term hazards related to severe air pollution episodes; chemical loading of ecosystems from the atmosphere; UV radiation exposure; restricted

visibility and air quality due to smog, smoke and dust; and extreme changes and variations in climate, weather and water supply. WMO had a proven model to fuse complex data according to the user needs as expressed by NMHSs. That model needed to be expanded to include atmospheric chemistry variables.

6.1.8 The Commission discussed the future programme of work and decided to implement its structures as defined under agenda item 12.

STATUS OF IMPLEMENTATION AND DEVELOPMENT

6.1.9 The Commission recalled that the GAW programme focused on the role of atmospheric chemistry in global change. Involving approximately 80 WMO Members and many organizations, it provided observations, analysis and information for the development of national and international policies. The GAW mission was threefold: (*a*) the systematic monitoring of atmospheric chemical composition and related physical parameters on a global to regional scale; (*b*) analysis and assessment in support of environmental conventions and future policy development; and (*c*) the development of a predictive capability for future atmospheric states.

6.1.10 The Commission acknowledged the role of the SAGs of the WG-EPAC in setting measurement guidelines, data quality objectives and standard operating procedures for each of the six global monitoring groups of GAW, namely ozone, UV radiation, greenhouse gases, aerosols (i.e. suspended particulate matter), selected reactive gases and precipitation chemistry. The Commission expressed its satisfaction with the 21 technical reports published by GAW since the last session of CAS in 2002.

6.1.11 The Commission noted the emphasis that GAW placed on calibration and quality assurance as a product and service. Members' countries were thanked for their support of Central Calibration Laboratories hosting the GAW world reference standards for greenhouse gases (United States/NOAA), ozone (Canada, United States/NOAA and the National Institute of Standards and Technology (NIST), Germany and the Russian Federation) and optical depth/radiation (Switzerland). The Commission commended the experimental research activities that had been undertaken in support of those Central Calibration Laboratories. A noteworthy example was the Balloon Experiment on Standards for Ozone Sondes in Wyoming conducted on 13 April 2004, sponsored primarily by NOAA/National Weather Service (NWS), in which an ozone reference instrument and 18 ozone sondes were flown on a single large balloon to an altitude of 30 km. The experiment had proven that the environmental simulator chamber at the GAW World Calibration Centre for Ozone Sondes supported by the Juelich Research Centre in Germany was applicable to real atmospheric conditions. Participating organizations included the University of Wyoming; the Juelich Research Centre in Germany; NOAA; NASA; and the ozone research groups of the Meteorological Services of Canada, Switzerland, Finland and Japan. Recognizing the importance of global aerosol observations to climate, weather and water resource issues, the Commission urged Members to support the GAW programme and its World Optical Depth Research and Calibration Centre in Davos (Switzerland) in developing a central calibration facility/programme for a global aerosol optical depth network to complement those already existing for ozone and greenhouse gases. The Commission also commended China for its creation of a Quality Assurance/Science Activity Centre (QA/SAC) in 2004, which would provide calibration centres for GAW measurements in China.

6.1.12 The Commission expressed appreciation to the Members operating the World and Regional Calibration Centres as well as on-site instrumental calibration programmes, which were part of the GAW quality assurance system linking the calibration of observations in the field to the world reference standards. Six GAW Regional Dobson Calibration Centres, at the Meteorological Services of Argentina, Australia, Japan, Germany/Czech Republic, South Africa/Egypt and the Russian Federation, regularly hosted instrument calibration and training workshops. The Commission thanked the United States GCOS programme for its support of the Argentine Centre. The Commission highly appreciated Spain's establishment of the first Regional Brewer Calibration Centre at Izana (Tenerife, Spain) and Canada's annual support since 2003 of a WMO trust fund for brewer calibration maintenance and training in developing countries. The Commission also thanked Switzerland for the regular audits, instrument maintenance and calibrations that it performed through support to the World Calibration Centre for Surface Ozone, Carbon Monoxide and Methane. WMO co-sponsored biennial meetings of the WMO/International Atomic Energy Agency (IAEA) Meeting of Experts on Carbon Dioxide Concentration and Related Tracer Measurment Techniques. The twelfth (2003) and thirteenth (2005) meetings were hosted by research departments of the Meteorological Service of Canada and the United States NOAA, respectively. The Finnish Meteorological Institute had agreed to host the next meeting. WMO provided support to developing country scientists to attend those meetings and published the meeting reports with recommendations. In addition, every four years the International Carbon Dioxide Conference, co-sponsored by WMO, was held in conjunction with the Meeting of Experts. The United States was thanked for having hosted the seventh conference in 2005. The Central Calibration Laboratory at the United States NOAA organized regular intercomparisons of greenhouse gas analytical laboratories. The China Meteorological Administration (CMA) provided an expert as a referee to analyse and report the results.

6.1.13 The Commission further agreed that the establishment of quality assurance facilities and the development of a globally coordinated aerosol network following the *WMO/GAW Aerosol Measurement Procedures, Guidelines and Recommendations* (GAW-153, WMO/TD-No. 1178) was a priority for the GAW programme. Support by the German Federal

Environmental Agency for the GAW World Calibration Centre for Aerosol Physical Properties was greatly appreciated. The Commission supported the recommendation made by the WG-EPAC that the GAW SAG on Aerosols work with the WMO Secretariat to establish a World Calibration Centre for Aerosol Chemistry (GAW-165, WMO/TD-No. 1302). The SAG on Aerosols had organized, and Switzerland had hosted, the WMO/GAW Experts Workshop on a Global Surface-based Network for Long-term Observations of Column Aerosol Optical Properties in March 2004 (GAW-162, WMO/TD-No. 1287). The report was a big step towards a global aerosol network coordinated by WMO. The Commission endorsed the implementation of the experts' recommendations. Such a programme would begin to meet the emerging needs of Members for real-time aerosol data and the calibration/validation of aerosol satellite products. GAW and WWRP programmes were exploring the interest of WMO Members in the use of routine sand and dust storm forecasts. The Commission supported plans to organize an expert meeting to review current dust forecasting research and to link it to user needs.

6.1.14 The Commission was pleased to note that great progress in network description and mapping had been made through the Swiss-supported GAW Station Information System (GAWSIS). In June 2004, it had been upgraded to include a mapping capability and new links to data information in GAW WDCs. In parallel, the Secretariat had initiated an ongoing review of the information contained in GAWSIS. GAWSIS and the WDCs were striving to improve metadata updates and achieve more standardized data management. The Commission requested that those responsible for GAW global, regional and contributing stations keep the station information in GAWSIS accurate and up to date.

6.1.15 The Commission noted that approximately 24 global stations, 200 regional stations and 90 contributing partner stations were currently delivering data to GAW WDCs. Global and regional GAW stations were operated by WMO Members, while contributing stations were operated by partner networks that contributed data of known quality to a GAW WDC. The Commission thanked Switzerland and Malaysia for adding the twenty-third and twenty-fourth global stations. Large gaps existed in global observations in Latin America, Africa and Asia. Five of the six GAW global stations established in developing countries through the WMO/Global Environment Facility (GEF) projects in the mid-1990s were struggling not only because of a lack of facility support from the NMHS, but also because of a lack of local expertise in data analysis and product generation. The Commission recognized that, to assure successful long-term operations at those stations, the established GAW community needed to continue to cooperate and provide assistance to those stations. Twinning partnerships such as that between *MétéoSuisse*/the Swiss Federal Laboratories for Materials Testing and Research (EMPA) and the Kenya Meteorological Department were one commendable mechanism. In addition, the Commission suggested that NMHSs consider developing partnerships with other national groups, agencies and organizations involved in air quality measurements. The long-term support of observatory facilities and meteorological observations offered by an NMHS was often attractive to air chemistry research and monitoring experts operating in a university or project research environment. As an example to developing countries, the Commission cited the Swiss GAW programme in which researchers in *MétéoSuisse*, universities and federal institutes were joined by those operating observatories throughout the country in a successful multi-agency approach.

6.1.16 The Commission was informed of the GAW 2005 Workshop organized by the Secretariat from 14 to 16 March 2005 at the WMO Headquarters in Geneva. Eighty-three representatives from 23 countries met to present their activities, exchange experience, learn how participation in GAW could assist them, hear about and meet representatives of 13 GAW partners and suggest ways to develop and improve GAW. Representatives of GAW Central Calibration Laboratories, QA/SACs, World Calibration Centres, Regional Calibration Centres and WDCs met with those involved in established and evolving observatory programmes. The meeting was followed by the biennial meeting of the CAS WG-EPAC (17–18 March 2005) (GAW-165, WMO/TD-No. 1302). The Commission agreed that such a quadrennial workshop was of benefit to GAW and should continue.

6.1.17 The Commission endorsed the *Manual for the GAW Precipitation Chemistry Programme: Guidelines, Data Quality Objectives and Standard Operating Procedures* (GAW-160, WMO/TD-No. 1251), which had been prepared by the GAW SAG on Precipitation Chemistry. The Commission supported the plan to initiate development of the next global precipitation chemistry assessment by organizing an expert workshop and establishing GAW partnerships with regional precipitation chemistry networks, in particular the Acid Deposition Monitoring Network in East Asia (EANET), and the Deposition of Biogeochemically Important Trace Species (DEBITS II) operating in Africa and South America. Appreciation was extended to NOAA and the United States GCOS for conducting a very successful precipitation chemistry quality assurance programme generating information that enabled the merging of regional data sets into a global one.

6.1.18 The Commission acknowledged the role of GAW in standardizing global UV radiation observations. The following UV radiation intercomparisons had been successfully carried out: South American UV broadband instrument intercomparison, Buenos Aires (Argentina); comparison of the irradiance standards at the European Reference Centre for Ultraviolet Radiation Measurements, JRC of the European Commission and at the Central UV Calibration Facility, NOAA, Boulder, Colorado (United States); standardization of spectral measurements of direct solar irradiance, Izana (Tenerife, Spain); and the first international intercomparison of multiband filter radiometers for UV radiation measurements, Oslo (Norway). It was noted that there was a

need for regional UV calibration centres. For instance, in Europe it would be desirable for that activity to be taken up by another institution once the unit in JRC stopped functioning. Reports on quality assurance (GAW-146, WMO/TD-No. 1180) and broadband instruments (GAW-164, WMO/TD-No. 1289) had been published. UV forecasts and analysis were moving increasingly into the public domain. For that reason, a good observation basis was needed. To that end, a survey of UV measurements had been carried out by the Secretariat.

6.1.19 The Commission noted with satisfaction two major developments in the GAW reactive gas activities related to carbon monoxide and Volatile Organic Compounds (VOCs). GAW had co-sponsored an international experts workshop entitled the Workshop on the Global Tropospheric Carbon Monoxide Observations System, Quality Assurance and Applications (24–26 October 2005), hosted by Switzerland, and had organized the WMO/GAW Experts Workshop on Volatile Organic Compounds in Geneva (30 January to 1 February 2006). Results of the meetings provided critical input for the next GAW Strategic Plan (2008–2015), the development of which the Commission strongly endorsed.

6.1.20 The Commission recalled that there were at that time five GAW WDCs; one each for greenhouse and other gases (Japan), total ozone and UV (Canada), aerosols (European Commission, Italy), precipitation chemistry (United States) and solar radiation (Russian Federation). That was being done in coordination with WIS (agenda item 4.6). Since the thirteenth session of CAS, managers of WDCs had met twice to coordinate and harmonize their work, including common formats for input and output data, data storage software and hardware, data duplication between the data centres, quality assurance/flagging methods, data distribution and access for users. Since 2005, the manager of GAWSIS had been the chairperson of the WDC managers meetings. The Commission commended those countries and organizations that hosted the WDCs and assumed the costs of their operations. The Commission noted that the centres in Japan and Canada were conducting their operations in a satisfactory manner, and that the World Data Centre for Aerosols (WDCA) had made great progress in the last four years. The Commission expressed its concern that the other centres remained less than fully operational. The Commission agreed with the fifty-seventh session of the Executive Council (*Abridged Final Report with Resolutions of the Fifty-seventh Session of the Executive Council*, WMO-No. 988, general summary paragraph 3.3.2.6) that there was a lack of appropriate infrastructure in WMO for global radiation observations supported by the GAW World Radiation Data Centre (WRDC) hosted by the Russian Federation, and that a programmatic gap existed between the global monitoring and user community relevant to WWW and WCRP. The Commission supported the Executive Council request that CAS and CBS find a solution. The Commission was pleased with the efforts of the Russian Federation directed at modernizing the computing resources of the WRDC and with the rise of efficiency in services for users of the Centre that year.

6.1.21 Recognizing the growing need in the operational use of chemical observations for NWP and other applications, the Commission fully agreed with the recommendation of the fifty-seventh session of the Executive Council to enable, when possible, GAW data exchange in real time and welcomed the work started between CAS and CBS, in particular through WIS. The Commission urged its WG-EPAG to pursue, in collaboration with CBS, the development of transition mechanisms as a matter of priority.

6.1.22 The Commission emphasized that training and education needs in developing countries should continue to be a high priority for the GAW programme. In that connection, many GAW centres and collaborating national organizations were commended for their substantial efforts in providing training to GAW station personnel from developing countries. Particular appreciation was expressed to the Government of Germany for establishing — and various Members for offering training at — the GAW Training and Education Centre (GAWTEC). Eight two-week courses had been held on surface ozone, aerosols, carbon monoxide, VOCs, greenhouse gases, precipitation chemistry and UV radiation. In total, 109 participants from 39 countries had benefited from that training. Member training sessions had been organized at GAW collaborating centres such as the NOAA/Global Monitoring Division (GMD) (United States), the Solar and Ozone Observatory (Czech Republic), the Meteorological Service of Canada, the Japan Meteorological Agency (JMA), EMPA, and elsewhere. Training was a key element of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)/WMO regional haze project entitled Support to the Implementation of the Regional Haze Action Plan of ASEAN Member Countries. Within that project, instruments for aerosol measurements had been obtained with the funding kindly provided by Australia. The instruments had been placed in Malaysia and Indonesia close to the sources and at locations suitable for the study of smoke plume evolution. An aerosol training workshop had been held in Kuala Lumpur (Malaysia) in December 2003, and training had also been provided in Australia and through GAWTEC. The project included a study on the modelling of aerosol transport within the region affected by the 1997–1998 South-East Asian haze event and its aftermath. The project also served to strengthen the capacities of the Association of South-East Asian Nations (ASEAN) Specialized Meteorological Centre (ASMC) with regard to modelling activities in the region.

6.2 URBAN AND REGIONAL AIR POLLUTION ISSUES, INCLUDING GURME (agenda item 6.2)

6.2.1 The Commission recalled that the GURME project enhanced the capabilities of NMHSs to manage different aspects of urban air quality, as noted by the thirteenth session of CAS, and provided an international platform for cross-cutting urban air pollution activities.

6.2.2 The Commission noted that recent developments in atmospheric chemical transport modelling was leading to a more effective linkage of air pollution issues on different scales ranging from urban to global. Thus, in urban air pollution studies, it was important to also consider the regional picture and, in regional air pollution, the effects of mega-cities and hemispheric transport. There was close collaboration in GAW in Europe with EMEP, and in Asia with the Atmospheric Brown Cloud (ABC). For instance, within ABC an observational network was being established that built upon and collaborated with GAW. The network included existing GAW sites (e.g. Linan, China, and Anmyon, the Republic of Korea) and expanded the measurement sets to include more radiation and aerosol parameters, using GAW guidelines and procedures. Passive samplers were also being deployed for select gaseous species. In addition, models were being used to link emissions to ambient distributions of trace gases and aerosols, and to use those along with satellite observations in calculations of aerosol radiative effects. The Commission encouraged GAW participation in the new Task Force on Hemispheric Transport of Air Pollution under the UNECE LRTAP, which would provide additional possibilities for interaction related to modelling and measurements on different scales.

6.2.3 The Commission expressed its satisfaction with the progress of GURME pilot projects. Further pilot projects were encouraged.

6.2.3.1 The Hydrometeorological Bureau for Moscow and the Moscow region continued to implement the Moscow GURME Pilot Project. The work related to climate features research was being continued. In particular, the thermal structure of the planetary boundary layer (PBL) and its relation to air pollution from automobile emissions had been studied. Also, a system had been created for the preparation of short-range air pollution forecasts on the basis of weather forecasts in cooperation with the Moscow Government Ecological Service. Within the Moscow megalopolis, a network for simultaneous monitoring of air pollution and meteorological conditions at 25 stations had been established, with more stations planned. That ongoing work was implemented with the Moscow Government Department for the Environment. Development and implementation of the public Internet information system presenting weather data and forecasts of meteorological conditions influencing urban air pollution and current environmental data and short-range forecasts was being continued. That information was prepared daily by the Moscow Government Ecological Service jointly with the Hydrometeorological Bureau for Moscow and the Moscow region. The Moscow GURME Pilot Project had been extended to the Verhne-Volgskoe territorial branch of the Russian Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET) and the Nizhniy Novgorod area.

6.2.3.2 The Beijing Pilot Project had come to the end of its first stage. Several different agencies, with a total of about 75 people, had participated in that project. The research themes included urban PBL structure of Beijing and the formation mechanism of its air dome; chemical features of air pollution in Beijing and its temporal and spatial variation; modelling of air pollution in the Beijing area; the Beijing air pollution warning system; and regulating-controlling principles and synthetic control and improvement scheme for air pollution in Beijing. Those included chemical and meteorological observations, the contributions of distant sources, including the effect of dust storms, and heat island studies. The City Air Pollution Prediction System (CAPPS) had been developed and used to provide air quality forecasts in 47 cities in 2005. The study had also included research into the effects of urbanization on regional climate change. The next phase of that project would focus on New Beijing and the forthcoming 2008 Olympic Games.

6.2.4 The GURME Expert Workshop on Air Quality Forecasting, held in Mexico in October 2002, bringing together scientists and those working with operational questions had led to the GURME pilot project "Improvement of Air Quality Forecasting in Latin American Cities". Mexico City, Santiago de Chile and São Paulo were large cities that shared common air quality problems. As a first step, the first GURME Air Quality Forecasting Workshop for the Latin American Project had been held in Santiago in October 2003. That meeting had brought together academia, government institutes and industry. That activity also included training on the use of remote sensing for evaluating air quality. The project would be the basis of an emerging International Geosphere-Biosphere Programme (IGBP)/International Global Atmospheric Chemistry Programme (IGAC) mega-cities project in Latin America.

6.2.5 Passive air chemistry measurements were a potentially powerful cost-effective observational tool for mega-city air pollution studies in developing countries and a way to link GAW monitoring networks with regionally representative sites on the edge of cities. A passive sampler pilot project had been conducted globally with urban sites supported by GURME. Measurements of gaseous sulphur dioxide, ammonia, ozone and non-methane hydrocarbon had been obtained at 50 stations in Asia, Africa, South America and Europe from September 1999 to May 2001. The results of that study had been published in *Atmospheric Environment*. The Commission agreed that GAW should conduct an expert workshop on precision passive sampling to document what was currently available and to link users in developing countries to the experts.

6.2.6 The Commission welcomed the fact that a GURME Training Team (GTT) had been established which included the chairperson of the WCP Expert Team on Urban Climatology Including Training and a representative of the World Bank as members. That group was compiling and creating training material for a basic air quality forecasting course. The material would be first used in a training workshop in Lima in 2006, after which it would be available on the Web. The Commission recommended that the material be used in

training workshops in other regions. The Commission welcomed the GURME initiative to build a Web-based database through a Member questionnaire documenting urban air quality models with information on model type, time and space resolution, availability and existing possibilities to model and/or forecast air quality. When completed in 2006, any user would be able to access the database to gain information on which type of model would serve their requirements.

6.2.7 The Commission noted the cross-cutting collaboration of GURME within the WMO Programmes. The *Guidelines on Biometeorology and Air Quality Forecasts* (PWS-10, WMO/TD-No. 1184), prepared by the Public Weather Services, included input from GURME. The Instruments and Observing Methods Report No. 81, *Initial Guidance to Obtain Representative Meteorological Observations at Urban Sites* (WMO/TD-No. 1250), by Mr T. Oke, was useful for GURME. Strong links had been established with the European Cooperation in the Field of Scientific and Technical Research (COST) Actions 728: Enhancing mesoscale meteorological modelling capabilities for air pollution and dispersion applications, and 732: Quality assurance and improvement of microscale meteorological models. Within those Actions collaboration existed especially in training, model validation and model information retrieval (questionnaires) activities. GURME had gained acknowledgement as a cross-cutting urban air quality programme through keynote addresses and other presentations given at several major conferences and specialized workshops, and support had been given to scientists from developing countries to participate in those events.

6.2.8 GURME had contributed to several emerging initiatives in chemical weather forecasting, an important user of the integrated global atmospheric chemistry observational products being provided by GAW. GURME had collaborated in a NOAA-sponsored Workshop on Chemical Data Assimilation and Data Needs for Air Quality Forecasting that was held in June 2005. The Workshop had brought together 36 representatives of the research and operational modelling communities to discuss the current state of knowledge of assimilating trace gas and particle data into air quality simulation forecast models, to provide better chemical initialization and overall accuracy of the forecasts. Data needs and the availability of real-time monitoring data from surface-based, sounding and satellite platforms were also discussed. The goals of the Workshop had been to identify promising techniques that might be capable of being transitioned to an operational forecasting system, and to identify the research needed to improve the state of knowledge in that emerging field. The Commission welcomed such activities as an important step towards matching the observational capabilities of the GAW community with chemical weather forecast needs.

6.2.9 Recognizing the large number of different urban air quality modelling systems currently in use by Members, the Commission urged that the establishment of a model intercomparison study be considered to identify the primary sources of uncertainty in high-resolution urban air quality models and to identify the most suitable models, especially regarding the respective interest of online and offline approaches.

6.2.10 The Commission noted the increasing importance of air quality monitoring in large cities owing to the growing interest of urban populations in air quality and related well-being, including for some "weather sensitive" diseases such as asthma. That constituted a good opportunity for NMHSs to play an important role in improving urban air quality and in decision-making for all related socio-economic sectors, including that of human health. The Commission recognized the need to establish a guide of best practices focusing on experimental design aspects that included: (*a*) meteorological and air quality observations; (*b*) online NWP and offline air quality modelling; (*c*) effective ways to serve user needs and to communicate to policymakers; (*d*) partnerships with key sectors, including health, through the establishment of routine procedures for information-evaluation-feedback and reorientation; and (*e*) ways for NMHSs and key sectors to strengthen their capacities.

6.2.11 Given the wide range of accomplishments reported by GURME and supported by many statements made by Members, the Commission recognized the need to map the future of GURME within the GAW Strategic Implementation Plan: 2008–2015 being developed by the OPAG-EPAC. The GAW Strategic Implementation Plan should describe the end-to-end aspects of GURME that linked observation issues to data assimilation techniques; numerical models; the diverse array of dissemination methods; and the capacity-building required for developing countries to reap the full benefits of GURME.

7. WEATHER PREDICTION AND TROPICAL METEOROLOGY RESEARCH (agenda item 7)

7.1 WORLD WEATHER RESEARCH PROGRAMME, INCLUDING THE REPORT OF THE CHAIRPERSON OF THE SCIENCE STEERING COMMITTEE (agenda item 7.1)

7.1.1 The Commission noted with appreciation the report of the chairperson of the CAS Science Steering Committee (SSC) for WWRP, Mr P. Courtier (France), highlighting the developments of WWRP. The Commission commended the work accomplished by the SSC since its re-establishment by the thirteenth session of CAS to implement WWRP. WWRP had successfully provided a focus for the Commission's activities and had added a positive international dimension to some national projects.

7.1.2 The Commission was pleased with the success of the Mesoscale Alpine Programme (MAP), which aimed to improve understanding and forecasting of high-impact weather in the vicinity of large mountains, such as the Alps, and had allowed considerable breakthroughs in the understanding of the interactions of moist flows with mountains leading to heavy precipitation.

7.1.3 The Commission noted with satisfaction the success in the implementation of the WWRP Sydney 2000 Forecast Demonstration Project and the follow-on

Thunderstorm Interactive Forecast System, which was an example of an effective transition from research to operations.

7.1.4 The Commission was pleased to note the significant progress of the WWRP Aircraft In-flight Icing Project (AIFI) over the past several years and the completion of its activities under the current plan. In recognition of the requirements and priorities of the aviation industry for weather information, the Commission expressed its desire to see a proposal for a new project on aviation forecasting/nowcasting and related weather hazards. Such a project would need to be closely coordinated with the Commission for Aeronautical Meteorology (CAeM).

7.1.5 The Commission noted the completion of the First Phase of MEDEX (Mediterranean Experiment on Cyclones that Produce High Impact Weather in the Mediterranean), which included the development of dynamic climatology, a better understanding of the genesis and evolution of cyclones, the identification of the most sensitive areas, and the evaluation of the societal impacts. The Commission also noted that the tasks not fully achieved in the First Phase had been included in the Second Phase of MEDEX, and welcomed that MEDEX would be one component of the European contribution to THORPEX.

7.1.6 The Commission noted the efforts made by CMA and the WWRP SSC to prepare a WWRP FDP focused on nowcasting and very short-range forecasting (0–6 hours) of convective storm tracks, precipitation and severe weather events, and a WWRP RDP dedicated to mesoscale data assimilation and 6–36-hour mesoscale ensemble prediction, in association with the 2008 Olympic Games in Beijing. The Commission considered that the successful implementation of those projects would demonstrate how state-of-the-art nowcasting and mesoscale ensemble systems could provide an improved weather service.

7.1.7 The Commission welcomed the endorsement by the SSC of the MAP D-PHASE FDP in order to demonstrate the benefits of forecasting heavy precipitation and related flood events, as gained from improved understanding, refined atmospheric and hydrologic modelling, and advances in technological abilities acquired through research work within the MAP. An end-to-end flood forecasting system was planned that relied on both high-resolution and deterministic modelling and was supported by all Alpine countries. The Commission welcomed strong links between the MAP D-PHASE and the Convective and Orographically-induced Precipitation Study (COPS) and encouraged close connections with the Beijing 2008 RDP on mesoscale ensemble prediction.

7.1.8 The Commission noted with satisfaction the significant progress in planning and conducting a 10-year WWRP/GAW SDS project, which was aimed at addressing the global SDS issue and had started with a pilot project focusing on East Asia for five years, while maintaining strong links with projects elsewhere dealing with arid and semi-arid regions (e.g. the European Global and Regional Earth-system Monitoring using Satellite and In-situ Data (GEMS) and the African Monsoon Multidisciplinary Analysis (AMMA) projects). Advances made in that project would result in an improved operational forecast and early warning system of SDS.

7.1.9 The Commission was impressed with the new WWRP RDP entitled COPS, which was focusing on the improvement of quantitative precipitation forecasts in low-mountain regions. Advances made in COPS would improve the applications of quantitative precipitation forecasts in hydrology, particularly for flash flood forecasting.

7.1.10 The Commission welcomed the proposals to develop a new WWRP RDP and FDP associated with the Vancouver 2010 Winter Olympics and the Shanghai World EXPO 2010, respectively, an FDP on a global early warning system for wildland fires, and an RDP on coordinated warm season precipitation research. Those proposals offered the potential to achieve major advances in forecast skill for dealing with problems related to widespread global application.

7.1.11 The Commission recognized the significant effect of high-impact weather events on the livelihood and economies of developing countries, and the need to enhance the scientific and forecasting capabilities of developing countries. In that regard, the Commission supported the decision of the SSC to initiate a new category of research projects called developing country forecast demonstration projects (DC-FDPs) that would involve scientists from relevant developing countries, a responsible regional meteorological centre and interested developed countries. The Commission strongly encouraged developing countries, in particular LDCs, to participate more actively in WWRP activities. Linked with the THORPEX demonstration projects, which emphasized forecast applications, those projects had the potential to substantially increase the capacity and capabilities of LDCs and developing countries to deliver useful forecast products.

7.1.12 The Commission was pleased to note the full success of the fourth WMO International Symposium on Assimilation of Observations in Meteorology and Oceanography (Prague, Czech Republic, April 2005) and welcomed the proposal of Australia to host the next symposium on that subject in 2009.

7.1.13 The Commission noted with satisfaction that a WWRP Invited Experts Workshop on a Proposed International Hydrometeorological Test Bed (IHMT) had been held at the United States National Center for Environmental Prediction in May 2005 to advise the SSC on the vision, goals and various components of the IHMT; the planning of the IHMT was well under way. The Commission considered that the IHMT goal of accelerating the transition from research to operations would bridge the currently defined activities of FDPs and RDPs under WWRP. The IHMT intended to involve participants from developing countries and LDCs so that those Members would directly benefit in order to deal with a problem of extreme importance.

7.1.14 The Commission was pleased with the important role of the WWRP Nowcasting Working Group (NWG), which had been created by the SSC in 2003 in order to promote and provide advice on the long-term development of nowcasting science, including science advancement through RDPs, the transfer of technology and science into operations through FDPs and the use of test beds. The Commission noted with satisfaction the successful organization of the WWRP Nowcasting Training Workshop 2003 and 2005 held in Brasilia (Brazil) and Pretoria (South Africa), respectively, and the excellent cooperation with CAeM in the organization of the WWRP Symposium on Nowcasting and Very Short Range Forecasting (Toulouse, France, September 2005) and a follow-up CAeM workshop on nowcasting and value added services.

7.1.15 The Commission welcomed the establishment of the Joint Working Group on Numerical Experimentation (WGNE)/WWRP Working Group on Verification (JWGV), aimed at planning and implementing the verification component of future WWRP projects, to serve as a focal point for the development and dissemination of new verification methods and to facilitate and encourage training and dissemination of information on verification methodologies. The Commission noted with satisfaction the successful organization of the International Verification Methods Workshop in Montreal (Canada) in September 2004, the development of an informative website on verification methods, and the preparation of standards for the verification of precipitation forecasts. In that regard, the Commission urged the JWGV to maintain close contact with groups focusing on verification under other WMO commissions, such as the Expert Team on Performance Measurement of the Working Group on Training, the Environment and New Developments in Aeronautical Meteorology (TREND) OPAG under CAeM.

7.1.16 The Commission supported the idea of the SSC to establish an advisory group on societal impact in the form of a THORPEX working group on social and economic applications, which would serve as a resource for all WWRP projects and working groups and provide support to — and participate as partners in — WWRP RDPs and FDPs. The advisory group should also coordinate its work with relevant WMO activities and initiatives (e.g. on natural disaster prevention and mitigation).

7.1.17 The Commission recognized that weather research and prediction was evolving, with broad consideration of the understanding and prediction of environment variability, and increasing collaboration and integration of ocean aspects in prediction systems and forecast applications. The Commission also noted the increasing complexity of the work of WWRP and believed that it was important that a road map (strategic plan) be developed to guide that future work. Consideration should be given to developing a substructure within the Programme to assist its effective implementation and to promote the deployment and integration of capacities developed within demonstration projects more broadly within the Programme. That would be followed by the development of an implementation plan.

7.1.18 Recognizing the continuing need for a source of expert advice on relevant areas of WWRP during the next four years, the Commission agreed to establish a WWRP Joint Scientific Committee (JSC) as given under agenda item 12 (see Annex II to the present report). The Commission also welcomed the clarification of the structure as detailed under agenda item 12.

7.2 THORPEX: A World Weather Research Programme, including the report of the chairperson of the International Core Steering Committee (agenda item 7.2)

7.2.1 The Commission noted with appreciation the reports of the chairperson of the THORPEX ICSC, Mr M. Béland, and the Director of the THORPEX IPO, Mr D. Burridge, highlighting the development of THORPEX since its inception at the last session of the Commission. The Commission commended the work accomplished by the ICSC and the International Science Steering Committee (ISSC), which had been established through Resolution 12 (Cg-XIV) — THORPEX: A Global Atmospheric Research Programme. The Commission also thanked the many scientists who had contributed, and continued to contribute, their expertise to the ongoing success of the programme, and drew particular attention to Canada, China, Japan, France, Norway, the United States and the United Kingdom for their continuing financial support, and to China for its seconded expert at the IPO. The Commission further noted the prominent attention and guidance given to THORPEX by the fifty-sixth and fifty-seventh sessions of the Executive Council and the endorsement by the fifty-seventh session of the Executive Council of the THORPEX International Research Implementation Plan for 2005–2014, the established management mechanism and the organizational structure instituted by ICSC for the implementation phase with an initial budget of US$ 1.2 million.

7.2.2 The Commission noted the pressing budgetary issues and urged more Members to commit support to the trust fund. It also encouraged THORPEX to reconsider its overall work programme and plan according to reasonable expectations of future financial contributions. In particular, it requested the Director of the IPO to investigate ways of simplifying the structure to reduce its costs without harming programme outputs.

7.2.3 The Commission also noted the comments of the fifty-seventh session of the Executive Council, which had drawn attention to the explicit roles of the majority of WMO Programmes in THORPEX, namely cross-cutting activities and developing cooperation, and noted that the recommendations of the fifty-sixth session of the Executive Council had been promptly followed by the ICSC, e.g. CBS provided full support of all OPAGs coordinated through its vice-president and the Management Group and designated experts to THORPEX, and vice versa; the THORPEX plan was consistent with research required in the framework of

multi-hazard early warning systems and GEOSS; THORPEX and WCRP had progressed considerably in partnering the weather and climate forecast community, aiming at the development of a unified global weather/climate prediction system in 10 years, addressed through the Coordinated Observation and Prediction of the Earth System (COPES) and the THORPEX Implementation Plan, respectively, and were considering working arrangements between JSC and THORPEX working bodies on priority foci for that collaboration; other steps forward were also being undertaken by JCOMM and CCl.

7.2.4 The Commission was particularly pleased with the progress made towards the development of the THORPEX Interactive Grand Global Ensemble (TIGGE), which was a prototype for a multi-model ensemble forecast system that would guide the development of a possible Global Interactive Forecasting System (GIFS). In its first phase, TIGGE would provide near-real-time access to ensemble forecast products to all WMO Members for research purposes. The Commission thanked the European Centre for Medium-range Weather Frecasts (ECMWF), CMA and the National Center for Atmospheric Research (NCAR) for their commitments to host the initial TIGGE Data Archive Centres and also thanked the major operational centres for their commitments to provide near-real-time ensemble forecast products for the TIGGE Phase 1 archives.

7.2.5 The Commission noted the regional organization of THORPEX in Regional Association (RA) II, RA IV and RA VI, including WWRP/THORPEX Rapporteurs nominated by the respective regional associations, and the efforts to initiate health- and agriculture-related demonstration projects within RA I. The Commission was pleased to note the rapid development of the THORPEX partnership in the Southern hemisphere led by Australia and South Africa, with the active participation of New Zealand, Chile, Brazil and Cook Islands, which should involve countries from RA I, RA III and RA V. The Commission noted the importance of the emphasis THORPEX placed on social and economic benefits for WMO Members and the ongoing activities designed to show the utility of improved forecasts to users.

7.2.6 The Commission was pleased with the development of THORPEX IPY activities, the planned cooperation between THORPEX and AMMA, and the participation of THORPEX in the GEO Workplan. Those various activities demonstrated the importance of the core scientific objectives of THORPEX to many other communities.

7.2.7 The Commission welcomed the clarification of the role of THORPEX brought about by the restructure proposal and encouraged further consideration of opportunities for rationalization, as had been proposed for research on societal and economic applications (SEA). There were additional opportunities for rationalization and cooperation within the weather research components of the Commission, in particular for tropical meteorological research — THORPEX provided an excellent vehicle for the effective implementation and execution of projects, for example.

7.3 Tropical Meteorology Research Programme, including the report of the chairperson of the Working Group (agenda item 7.3)

7.3.1 The Commission noted with appreciation the report of the chairperson of the CAS Working Group on Tropical Meteorology Research (WGTMR), Mr Lianshou Chen (China), and highly commended the work accomplished by the WGTMR since its re-establishment by the thirteenth session of CAS to implement TMRP.

7.3.2 The Commission also noted the endorsement of the TCP Expert Meeting on Effective Early Warnings of Tropical Cyclones (Kobe, Japan, January 2005) by the fifty-seventh session of the Executive Council, and particularly the request that all Regional Specialized Meteorological Centres (RSMCs) on Tropical Cyclones and Tropical Cyclone Warning Centres (TCWCs) should strive to increase the accuracy of track and intensity forecasts of tropical cyclones by 10 per cent by 2015, and that those bodies should issue probabilistic forecasts of tropical cyclones up to five days ahead by the same date. The Commission concurred with the opinion of the fifty-seventh session of the Executive Council that attaining the intensity goal was a difficult challenge for research.

7.3.3 The Commission was satisfied that TMRP was addressing those issues. The Commission was pleased to note that the fifth International Workshop on Tropical Cyclones (IWTC-V) held in Cairns (Australia) in December 2002 had achieved its objective of facilitating the exchange of information between researchers and forecasters and thus contributed to improving early warnings of tropical cyclones, and that the final report of IWTC-V, which had been distributed to Members, contained very important and useful recommendations separately addressed to WMO, the research community and tropical cyclone operational forecasters. The Commission urged its members and all concerned to endeavour to implement the recommendations relevant to their activities. In particular, the Commission encouraged the distribution in real time of tropical cyclone tracks (i.e. position, intensity) and other environmental information by all NWP centres on the GTS or Internet, which would be invaluable for developing countries as well as creating an effective tool for exploiting those products through ensemble averaging or consensus forecasting.

7.3.4 The Commission noted that the four priority research areas agreed by the first International Workshop on Tropical Cyclone Landfall Processes (IWTCLP-I) held in Macao (China) in March 2005, which had put emphasis on tropical cyclone track forecasting, quantitative precipitation forecasting, structure/intensity changes, and storm surges, were directed at the problems identified by the TCP. The Commission encouraged further development of scientific and implementation plans of the research projects

that would address those problems as a matter of urgency. The Commission also requested TMRP to continue the development of probabilistic forecasting techniques for tropical cyclones and to cooperate with TCP to quantify the socio-economic impacts of tropical cyclones and tropical cyclone forecasts.

7.3.5 The Commission was pleased to note the well-advanced planning and preparation of the sixth WMO International Workshop on Tropical Cyclones (IWTC-VI), which would be held in San José (Costa Rica) from 21 to 30 November 2006 with the theme "Quantitative Forecast Guidance for Tropical Cyclone Landfall in Relation to an Effective Warning System", which the Commission considered to be a timely topic given the devastation caused by tropical cyclones in both the Atlantic and the Pacific in 2005. In that connection, the Commission noted with satisfaction the establishment of a new International Committee for the Workshop led by the co-chairpersons, Mr C.Y. Lam and Mr J.C. L. Chan (Hong Kong, China), which would be responsible for the organization of IWTC-VI.

7.3.6 The Commission received with appreciation the draft Statement on Tropical Cyclones and Climate Change prepared by TMRP Project TC-2 (Scientific Assessment of Climate Change Effects on Tropical Cyclones) and submitted by Australia. The Commission noted that some conclusions of the earlier study published in the *Bulletin of the American Meteorological Society* by Henderson-Sellers and others (1998) remained current, but that the new draft Statement provided some further useful development. The Commission also noted the intent of the authors to finalize the document at the IWTC-VI and invited Members to provide comments on the draft Statement via the Secretariat. Although the Commission recognized the importance of the issue, it postponed the recommendation of WGTMR that a CAS panel on climate change impacts on tropical weather systems be established within WGTMR until the draft Statement had been discussed and ratified at IWTC-VI.

7.3.7 The Commission was pleased to note the success and achievements of several field experiments focused on landfalling tropical cyclones, including those conducted under the Australian Tropical Cyclone Coastal Impacts Program (TCCIP); the Canadian field experiments on transitioning tropical cyclones; the China Landfalling Typhoon Experiment (CLATEX); and the United States Coupled Boundary Layer/Air-Sea Transfer (CBLAST) Project. Those had provided a better understanding of the key physical processes for structure/intensity change as well as the motion, duration, dissipation and precipitation of tropical cyclones during landfall, which had led to improved predictions.

7.3.8 The Commission noted the activities under the monsoon prediction component and noted with appreciation the success of the third International Workshop on Monsoons (IWM-III) held in Hangzhou (China) in November 2004. The Commission also expressed appreciation to the International Panel on East Asian Monsoon (IPEAM), chaired by Mr C.P. Chang (Naval Postgraduate School, United States), for having edited and published a series of books on the meteorology of East Asia, and for the WMO Technical Document, *The Global Monsoon System: Research and Forecast* (WMO/TD-No. 1266), which served as a basis to advance the application of monsoon research through the exchange of new ideas and results among research scientists, forecasters and users of monsoon predictions.

7.3.9 The Commission noted with appreciation that China was planning a post-South China Sea Monsoon Experiment (SCSMEX) programme, the East Asian Monsoon Experiment (EAME), under the auspices of Project M1 (Research initiatives on the East-Asian monsoon). The Commission endorsed China's proposal to establish an East Asian Monsoon Activity Centre in Beijing for Project M1. The main functions of the Centre would be: (*a*) to improve operational capabilities on East Asian monsoon monitoring, prediction and service; (*b*) to provide training related to the Asian monsoon; and (*c*) to organize and coordinate activities on East Asian monsoon research.

7.3.10 The Commission highlighted the importance of the international research programme AMMA, which was under way and comprised field experiments of unprecedented scope in West Africa covering atmospheric, oceanic and hydrological aspects of the monsoon system. The resultant data would increase knowledge of the processes causing the space-time variability of monsoon precipitation and improve numerical forecasting skill as well as climate simulations. The programme included a component on applications in the fields of water resources, food security and health. Moreover, the programme had planned important linkages to THORPEX in considering, for example, the development of easterly waves into tropical cyclones. Considering the stakes involved, the Commission encouraged NMSs and the international scientific community to support the successful implementation of the AMMA programme.

7.3.11 The Commission was pleased with the important role of the Monsoon Activity Centres in New Delhi (India), Kuala Lumpur (Malaysia) and Nairobi (Kenya) in support of Project M2 (Long-term Asian/African monsoon studies) to improve the understanding and prediction (short- and long-term) of the summer/winter monsoon onset, intensity and variability. Those centres should enhance their activities to serve as dissemination and coordination centres for NWP products relevant to monsoon forecasting, as well as data centres for *El Niño*/Southern Oscillation (ENSO) and inter-annual variability studies in the regions.

7.3.12 The Commission noted that the WMO/TMRP International Workshop on Tropical and Extra-tropical Interactions, which had been held in Perth (Australia) in December 2005, aimed to improve understanding of the interaction processes between the tropics and extra-tropics, and to develop plans for a THORPEX and IPY project related to the extra-tropical transition of tropical cyclones.

7.3.13 The Commission emphasized the importance of technology transfers to developing countries,

particularly to LDCs. In that connection, the Commission was pleased with the successful organization of the seventh WMO Regional Workshop on Asian/African Monsoon Emphasizing Training Aspects (Nanjing, China, October 2004) and encouraged continuation of training activities under the programme.

7.3.14 The Commission endorsed the recommendation of WGTMR that Project M3 (American monsoon studies) should establish close collaboration with the Climate Variability and Predictability (CLIVAR)/Variability of the American Monsoon Systems (VAMOS) under WCRP in order to encourage collaborative research activities in the Americas and promote the dissemination of knowledge and methodologies regarding research and prediction.

7.3.15 Concerning Project AZ1 (Tropical and subtropical droughts and related rain-producing systems, including the intertropical convergence zone (ITCZ)), the Commission approved the decision made by WGTMR to establish a new steering committee to develop research activities in that area.

7.3.16 Having recognized the continuing need for a source of expert advice on relevant areas of TMRP during the next four years, the Commission considered the future organization of work in the area of tropical meteorology research and decided to re-establish the Working Group on Tropical Meteorology (WGTM) (see Annex II to the present report).

7.3.17 The Commission requested WGTM to give immediate attention to the development of a strategic plan for its work, over the frame of the LTP. That work should be done in concert with the development of a strategic plan by the WWRP JSC.

7.3.18 The Commission further requested WGTM to develop an implementation plan encompassing the broad work of TMRP, that allowed the Commission and its Management Group to be better acquainted with the priorities and research outcomes over the intersessional period. The Commission requested that the plan be presented to the WWRP JSC for review at its 2007 session.

7.4 Numerical experimentation, including the report of the chairperson of the Working Group (agenda item 7.4)

7.4.1 The Commission noted with approval the extensive activities of WGNE in fostering the development of atmospheric models for use in weather prediction and climate studies. In particular, WGNE had strengthened its role in support of CAS through increasing collaboration with WWRP, notably through its involvement in the planning and implementation of THORPEX. Also, by maintaining a close relationship with operational centres, WGNE ensured synergy between NWP research and operations and supported the CAS objective of transitioning research to operations.

7.4.2 The Commission appreciated the fact that WGNE highlighted the importance of the link between weather and climate outlined in the THORPEX Science Plan and noted its willingness to consult with the CLIVAR Working Group on Seasonal-to-Interannual Prediction (WGSIP) to consider the possibility of using seasonal forecast systems to study that issue.

7.4.3 The Commission also noted the importance of WGNE's involvement in reviewing reanalysis and data assimilation projects and informing the Commission of the ongoing progress in those activities, which provided the data for numerous retrospective studies and analyses of the Earth system.

7.4.4 The Commission was pleased with the emphasis that WGNE placed on model verification and in particular with the formation of the JWGV. The JWGV had been active in organizing an international workshop on verification methods and had prepared a set of recommendations for the verification and intercomparison of quantitative precipitation forecasts from operational NWP models, which were being conducted at various operational centres.

7.4.5 The Commission also appreciated the emphasis that WGNE had placed on documenting research activities in atmospheric and oceanic modelling and noted the valuable contribution its annual report made to the modelling community.

8. Physics and chemistry of clouds and weather modification research (agenda item 8)

8.1 Physics and Chemistry of Clouds and Weather Modification Research Programme, including the report of the chairperson of the Working Group (agenda item 8.1)

8.1.1 The Commission noted that more than 70 countries had expressed an explicit interest in information and guidance on weather modification activities. At present there were several hundred weather modification activities in progress around the world. There was a need to approach the broad subject of weather modification in a manner that would benefit its scientific basis as well as its application to deal with growing water-related needs and the increased weather-related risks faced by a growing global population.

8.1.2 The Commission noted with appreciation the report of the chairperson of the CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research, Mr J.-P. Chalon (France). The Commission was informed that the Working Group had reviewed and proposed updates to the WMO Statement on Weather Modification and the WMO Guidelines for the Planning of Weather Modification Activities, and had written an Executive Summary of the WMO Statement on Weather Modification, which summarized the status of different technologies used in weather modification projects and indicated the levels of confidence that could be given to those technologies. However, the Commission expressed concern that those documents might not have been subjected to adequate scientific peer review, and that the Executive Summary did not properly reflect the content of the Statement. Therefore, the Commission agreed to forward those

documents to the CAS Management Group, which would establish a process for reviewing the Working Group documents. Furthermore, the Commission suggested that:

(*a*) The members of the previous Working Group be asked to serve as a drafting group, together with the newly constituted Expert Team on Weather Modification, as appropriate, to respond to reviews received and provide the Management Group with a revised version of the documents;

(*b*) The Management Group determine the further disposition of the documents, including the need for additional review, if required.

The Commission expressed its wish that the revised documents be adopted before the fifteenth session of CAS.

8.1.3 The Commission noted that, in response to the recommendation made by Fourteenth Congress, the International Aerosol-Precipitation Science Assessment Group (IAPSAG) had been created to review the current scientific understanding of the effects of natural and anthropogenic aerosols on precipitation. That review was currently under way and a progress report had been presented to the Commission (agenda item 8.2). The newly constituted Expert Team on Weather Modification should take cognizance of the contents of that review when it became available.

8.1.4 The Commission further noted the summary and recommendations of the twenty-first session of the Working Group, which had drawn attention to scientific developments in nine areas: cloud precipitation enhancement; fog dissipation; hail suppression; anthropogenic modification of clouds; fundamental cloud physics and chemistry; the application of cloud physics; cloud modelling; cloud electricity; and radars and other instrumentation. Significant progress had been achieved in cloud microphysics, numerical modelling, and statistical and observation technologies.

8.1.5 The Commission debated the recommendations of the Working Group and agreed that:

(*a*) Cloud behaviour and its reaction to various types of seeding should be addressed, including the effects of seeding on the environment;

(*b*) Further detailed microphysics studies were required to support the parametrization algorithms in large-scale numerical models;

(*c*) Greater use of modern radar technologies needed to be made to improve the understanding of cloud processes relative to weather modification;

(*d*) Further studies into the clearing of warm fog were needed, and more fog dissipation activities should be linked with activities aimed at reducing icing on crops and vegetation;

(*e*) Research programmes to better understand hailstorm physics and seeding efficiency were needed;

(*f*) Further studies were needed on the sources, sinks and transport of both natural and anthropogenic aerosols and how those aerosol interacted with clouds and precipitation processes as well as how those processes were represented in numerical models;

(*g*) More data on the vertical distribution of nitric oxide and nitrogen doixide to validate models that included cloud electricity were required;

(*h*) Further efforts should be made to establish constructive cooperation and scientific interaction between the weather modification community and other atmospheric science communities;

(*i*) WMO workshops and training programmes to help countries to develop activities in physics and chemistry of clouds and weather modification research were needed;

(*j*) The training of young scientists in disciplines relevant to weather modification should be encouraged;

(*k*) The ninth WMO Scientific Conference on Weather Modification should be held in 2007, preceded by a training workshop on weather modification, in Turkey.

8.1.6 The Commission noted with appreciation the proposal made by the Russian Federation to host a WMO expert workshop on cloud physics and weather modification in Obninsk during 2007. That workshop would focus on the simulation of cloud properties in aerosol chambers.

8.1.7 In response to Fourteenth Congress (*Abridged Final Report with Resolutions of the Fourteenth World Meteorological Congress*, WMO-No. 960, general summary paragraph 3.3.5.3), the Commission requested the newly constituted Expert Team on Weather Modification to arrange for a review of the criteria for assessing the success of weather modification experiments and to redefine the criteria by taking into account recent advances in cloud microphysical measurements, the application of statistics and scientific discussions, and to then prepare a progress report for broad consideration.

8.1.8 The Commission noted the efforts of the WMO Secretariat to finalize the updated version of the WMO Precipitation Enhancement Project (PEP) Report No. 3. The Commission requested that the updated version of that document reflect the latest relevant findings. The Commission agreed that other applicable documents of that nature should also be consulted in preparation of the updated version of the WMO PEP Report and requested that it be prepared by the newly constituted Expert Team on Weather Modification.

8.1.9 The Commission noted with appreciation the release of a CD-ROM by the WMO Secretariat which contained the series of previous WMO PEP Reports. Considering the value of the information contained in the six WMO reports on hail suppression research, the Commission requested the WMO Secretariat to also release those documents on CD-ROM.

8.1.10 The Commission was informed by the Russian Federation of significant technological advances made during the last decade which had opened new avenues to document and better understand the evolution of severe thunderstorms and hail-producing storms, which would give more confidence to the possibility of hail suppression, at least for non-severe hailstorms. The experience acquired in well-known scientific centres around the world could be consulted by interested bodies for the

planning, organization and execution of weather modification projects.

8.1.11 The Commission was informed of the conclusions and recommendations of the WMO Regional Seminar on Cloud Physics and Weather Modification for Interested Members of the League of Arab States, held in Damascus (Syrian Arab Republic) in October 2003, in which delegates from 24 countries participated. The Commission noted the emphasis put on the need for a thorough study of cloud and precipitation climatology, knowledge of cloud microphysics and the preparation of a proper project design before engaging in weather modification activities. The Commission also noted the need to establish a "databank" containing information on precipitation enhancement for the benefit of interested African, Mediterranean and Middle Eastern countries. The Commission recognized the acute need for training in cloud physics and applications in weather modification in that and other regions.

8.1.12 The Commission noted that Fourteenth Congress (*Abridged Final Report with Resolutions of the Fourteenth World Meteorological Congress*, WMO-No. 960, general summary paragraph 3.3.5.7) had urged its Members and the WMO Secretariat to continue to promote the Mediterranean, South-East Europe and Middle East Precipitation Enhancement Project (MEDSEEME-PEP). The Commission also noted its early recognition of the potential importance of such a project (*Abridged Final Report with Resolutions and Recommendations of the Thirteenth Session of the Commission for Atmospheric Sciences*, WMO-No. 941, general summary paragraph 6.10) and requested its newly constituted Expert Team on Weather Modification to keep abreast of developments and assist in giving advice to the more than 20 members involved.

8.1.13 The Commission noted with appreciation the proposal made by Serbia and Montenegro to establish an international precipitation enhancement research programme within the framework of WMO and which could take advantage of the considerable infrastructure available in Serbia and Montenegro. The Commission referred the issue to the newly constituted Expert Team on Weather Modification for further consideration.

8.1.14 The Commission recognized the continuing interest of members in the science and application of weather modification and established the Expert Team on Weather Modification (see Annex II to the present report).

8.2 WMO/IUGG Science Assessment of Aerosol Effects on Precipitation on local, regional and global scales. The report of the chairperson of the International Aerosol-Precipitation Science Assessment Group (agenda item 8.2)

8.2.1 The Commission noted the request made of CAS by Fourteenth Congress (*Abridged Final Report with Resolutions of the Fourteenth World Meteorological Congress*, WMO-No. 960, general summary paragraph 3.3.5.4) in 2003, which had been supported subsequently by a resolution of the Congress of the International Union of Geodesy and Geophysics (IUGG) in July 2003, for an assessment of the effects of aerosol pollution on precipitation. The Commission welcomed the joint action by WMO (represented by the president of CAS) and IUGG (represented by the International Association of Meteorology and Atmospheric Sciences (IAMAS)) in May 2004 with the establishment of IAPSAG to lead the research community in the Science Assessment of Aerosol Effects on Precipitation, led by the late Mr P. Hobbs of the University of Washington, and also the creation of an independent review group chaired by Mr G. Isaac of Environment Canada. It was further noted that the fifty-sixth session of the Execcutive Council had endorsed the recommendation of the president of CAS for the preparation of the Assessment.

8.2.2 The Commission noted that the first IAPSAG meeting had been held at the WMO co-sponsored fourteenth International Conference on Clouds and Precipitation (Bologna, Italy, July 2004) to review the outline of the assessment, assign chapter leaders, establish procedures and initiate work. The Commission expressed its deep appreciation for the leadership of Mr P. Hobbs until July 2005, which brought the assessment to its first stage, and for his successor, Mr Z. Levin of Tel Aviv University. The Commission thanked Environment Canada for its support of the first assessment workshop supported by WMO, to be hosted by Environment Canada in Toronto from 29 November to 2 December 2006, and the review process. The Commission urged Members to support that important science assessment, recognizing that it was highly relevant to climate change, water supply and risks related to severe meteorological events. The Commission recommended that WMO support a final workshop in 2006 and completion of a reviewed assessment in time for the next WMO and IUGG Congresses in 2007.

8.3 The United Arab Emirates Prize for Excellence in Advancing the Science and Practice of Weather Modification (agenda item 8.3)

8.3.1 The Commission noted that Fourteenth Congress had conveyed its appreciation to the Department of Water Resources Studies, of the Ministry of Presidential Affairs of the United Arab Emirates, which had provided the funds to establish the United Arab Emirates Prize for Excellence in Advancing the Science and a Practice of Weather Modification, in collaboration with WMO. On the recommendation of an evaluation committee comprising world-known prominent scientists from Canada, China, the Russian Federation, Serbia and Montenegro and the United States, the United Arab Emirates Prize for Excellence in Advancing the Science and Practice of Weather Modification had been conferred on the following winners:

(*a*) The South African National Precipitation Research and Rainfall Enhancement Programme (Messrs G. Mather, D. Terblanche, F. Steffens, A. Gorgens and Ms L. Fletcher);

(*b*) Mr T.J. Henderson (Atmospherics Incorporated, Fresno, California, United States);
(*c*) Mr B. Silverman (Englewood, Colorado, United States);
(*d*) Mr M.T. Abshaev (High Mountain Geophysical Institute of ROSHYDROMET Nalchik, Russian Federation) with Mr G. Sulakvelidze, Mr I. Burtzev, Ms L. Fedchenko, Mr M. Jekamuhov, Mr A. Abshaev, Mr B. Kuznetsov, Ms A. Malkarova, Mr A. Terbuev, Mr P. Nesmejanov, Mr I. Shakirov and Mr G. Shevela;
(*e*) The Chinese Institute of Weather Modification (Chinese Academy of Meteorological Sciences, CMA);
(*f*) Mr P. Simeonov with Messrs P. Konstantinov, P. Boev and R. Petrov (Cloud Physics and Weather Modification Team of the National Institute of Meteorology and Hydrology of the Bulgarian Academy of Sciences);
(*g*) Mr W.L. Woodley with Mr D. Rosenfeld (Woodley Weather Consultants, Littleton, Colorado, United States);
(*h*) Mr P. Hobbs with Mr A. Rangno (University of Washington, Seattle, United States).

8.3.2 The Commission congratulated the winners and expressed its deep appreciation to the Department of Atmospheric Sciences, successor of the Department of Water Resources Studies, of the Ministry of Presidential Affairs of the United Arab Emirates, which had generously offered the Prize, which would stimulate international efforts for advancing knowledge in that field which was important for satisfying the need for water under the increased shortage of freshwater in many regions of the world.

9. Climate research (agenda item 9)

9.1 The World Climate Research Programme and the Coordinated Observation and Prediction of the Earth System (agenda item 9.1)

9.1.1 The Commission noted with approval the progress being made in the implementation of WCRP. In particular, the Commission fully endorsed the introduction of the new WCRP strategic framework for 2005–2015, COPES, with the stated aim to facilitate analysis and prediction of Earth system variability and change for use in an increasing range of practical applications of direct relevance, benefit and value to society.

9.1.2 The Commission also noted the close collaboration that COPES sought with IGBP, THORPEX and the System for Analysis, Research and Training (START) to address the key research challenges, namely seamless predictions from weeks to centuries; prediction of the broader climate/Earth system; and demonstrating the use of WCRP-enabled predictions to society.

9.1.3 The Commission drew attention to the revised terms of reference for the Commission (agenda item 3) and the new structure (agenda item 12). There was a tendency towards more extensive monitoring and prediction systems, which embraced environmental prediction in a more comprehensive way than had been done in the past. Additional elements that might be associated with Earth systems science were being introduced. The new structure provided an improved channel for communication between WCRP and WWRP, including all elements of weather research. While the existence of WGNE and cooperation through THORPEX had proven to be effective links, it would be important to improve coordination on tropical research (including monsoons) and in applications such as bush-fire and permafrost research and socio-economic research. The Commission agreed to task JSC/WWRP with that responsibility.

9.2 Climate activity interactions (agenda item 9.2)

The Commission welcomed collaboration between WWRP/THORPEX and WCRP to initiate research leading to global weather and climate prediction that advanced forecast skill for all timescales, from one-day to seasonal. That collaboration would include research to advance the development of ultra-high-resolution, global prediction systems for weather and climate that resolved high-impact weather events for daily to decadal timescales. Such systems would contribute to improving predictions of short-term weather hazards, climate variability and change, including the climatology of extreme events and their inherent uncertainties, and would assist policymakers and stakeholders in their decisions regarding mitigation and sustainable development.

10. WMO long-term planning relevant to the Commission (agenda item 10)

10.1 The Commission recalled the adoption by Fourteenth Congress of the 6LTP (2004–2011) as well as the guidelines and directives developed by the fifty-sixth session of the Executive Council for its monitoring and evaluation, and the plans outlined for the 7LTP (2008–2015) by the fifty-seventh session of the Executive Council. The Commission noted that the activities carried out within AREP primarily implemented Strategies 3, 5 and 6 and made important contributions to addressing Strategies 1, 2 and 8, which related to service delivery, enhancing basic infrastructure and predictions, and the partnerships needed to achieve the goals associated with Strategies 1 to 4.

10.2 The Commission discussed the adequacy of current performance indicators for R&D, and the extent to which programmes and projects were properly aligned with the 6LTP. The Commission concluded that it needed to develop more effective performance targets and metrics, to develop a more transparent strategy for R&D that would contribute directly to the 7LTP, and to help evaluate progress towards meeting the goals of the 6LTP.

10.3 The Commission discussed the importance of striking a proper balance between the need to deliver services today and the need to equip Members with the tools to deliver the services that would be required of them in the near future. The Commission noted that

any future programme structure, and the 7LTP, should reinforce the importance of a close relationship between the R&D programmes and the operational programmes, and identify ways to improve the connection between research and operations to achieve the overall WMO strategy by including a requirements process that identified the critical research areas to address operational needs in the short, medium and long term.

10.4 The Commission discussed the role of R&D in the 7LTP. The combined R&D activities of all the relevant technical commissions were already closely connected, and effectively underpinned all of the service programmes. That cross-cutting function could be more effectively reflected in the 7LTP by defining explicitly the expected contributions from each of the major enterprises (observing systems, operational forecasting services, research, and so forth) to each of the Strategies that would deliver the desired outcomes. The Commission considered the importance of the transition of research to operations as a metric of a successful R&D programme. In order to accomplish that, close cooperation between those responsible for services and the research community was required. The Commission considered that it had made significant progress in several of its programmes to achieve that cooperation, including WWRP, THORPEX, TMRP and GAW.

10.5 The Commission noted the need to maintain a balanced investment between user-driven research (meeting the needs of operations and services) and atmospheric science motivated by the need to understand the atmosphere. There was also an important element that fostered the integrity and strength of the dependent systems, continually evaluating and testing effectiveness and assessing the scientific basis.

10.6 The Commission considered the overall long-term planning process, its usefulness and the ways in which it could be improved. Effective planning required all components of an organization to be part of the planning process. Therefore, the Commission welcomed efforts to ensure that its views would be considered in the development of the 7LTP. The Commission noted the importance of working within and with the LTP process to ensure that a strategy for delivering the relevant outcomes and objectives was in place, and observed that that delivery could be both more efficient and effective if quantitative, or at least qualitative metrics, were used to measure progress towards achieving the Plan's objectives. With that in mind, the Commission stressed the importance of developing key performance targets that, if met, would be quantitative measures of success in achieving the desired outcomes of the LTP. Such targets should capture the outcomes and outputs achieved collectively through the value added delivered by the existence of WMO programmes. Consideration would be given to designing regular surveys to gauge how Members had performed against the key performance targets.

10.7 The Commission requested its Management Group to prepare the Commission's contributions to the 7LTP, which would be requested by the Executive Council Working Group on Long-term Planning and the Executive Council.

11. SCIENTIFIC LECTURES (agenda item 11)

The following lecture was presented during the session:

Risks estimates from hydrometeorological phenomena probability distribution functions for atmospheric vortices, by Mr G.S. Golitsyn (Russian Federation).

The lecture was of a very high quality and was very well received.

12. FUTURE WORK OF THE COMMISSION, INCLUDING THE NOMINATION OF MEMBERS OF WORKING GROUPS, COMMITTEES AND RAPPORTEURS (agenda item 12)

12.1 The Commission thanked all the chairpersons, members of the groups and committees for their important contribution to the work of the Commission and particularly thanked those who would no longer serve in CAS, wishing them every success in their future work.

12.2 The Commission agreed on its work programme, based on the relevant sections of the 6LTP and relevant decisions of the Executive Council, and taking into account the detailed discussions under the various agenda items.

12.3 The Commission discussed the president's proposal concerning the most efficient way to organize the working structure, without increasing costs, in view of the need for much closer and enhanced coordination between its discipline areas, the increasing need to fulfil the Commission's growing responsibilities and respond to emerging tasks, and the need for resources in terms of expertise and currently available funds. The Commission further noted the experience and positive impact of new structures as implemented by other technical commissions, which provided more flexible and adaptive organization through OPAGs. The Commission decided to group its activities under two OPAGs: (*a*) WWRP; and (*b*) EPAC. The Commission identified the main elements of the work programme within each OPAG and consequently established major activities, working groups and expert teams as given in Annex II to the present report. The OPAG-WWRP JSC and the OPAG-EPAC JSSC, which were chaired by the chairpersons of the respective OPAGs, should lead and coordinate activities within the respective programme areas, ensure the regular exchange of information between the OPAGs and propose adequate adjustments to the OPAGs' compositions as new tasks emerged. The OPAGs' working bodies were expected to adopt flexible working mechanisms, including electronic correspondence and involving a broader community through the necessary forums. The Commission invited the Secretariat to adapt its working methods, facilitate the circulation of information within and between OPAGs and CAS members, and support meetings and other working mechanisms of the various bodies according to the available financial resources.

12.4 The Commission decided to implement the new working structure and establish OPAGs by adopting

Resolution 2 (CAS-XIV). The Commission agreed to assess the impact and effectiveness of that structure at its next session. The Commission decided to appoint a Coordinator for the Global Earth Observation System of Systems (agenda item 4.1) and a Coordinator for Natural Disaster Prevention and Mitigation (agenda item 4.4), with the terms of reference given below (general summary paragraphs 12.6 and 12.7).

12.5 The Commission stressed that the success of the new structure would depend to a great extent on having an effective process to manage, assess, guide and coordinate the work of the two OPAGs so as to make necessary adjustments in the intersessional period and advise the president on relevant issues. The Commission therefore decided to establish the CAS Management Group by adopting Resolution 3 (CAS-XIV). The Commission further requested the Management Group to examine the missions and harmonize the tasks of the respective groups supporting OPAG-WWRP dealing with mesoscale weather forecasting (THORPEX, the Working Group on Mesoscale Weather Forecasting (WG-MWF), the Working Group on Nowcasting (WGN) and WGNE) so that their activities either complemented each other's without undue duplication, or so that a progressive merging of some of those same activities be implemented by appropriate changes in the structure. The Commission also requested the Management Group to consider scientific issues concerning the physics and chemistry of clouds since there was no longer a group tasked with that role.

12.6 Noting Resolution 9 (EC-LVII) — Natural Disaster Prevention and Mitigation, the Commission further decided to appoint a Coordinator for Natural Disaster Prevention and Mitigation, with the following terms of reference:

(*a*) To coordinate Commission activities related to DPM and to provide the CAS Management Group and OPAGs with appropriate information and recommendations on activities that would contribute fully to the DPM Programme;

(*b*) To liaise with other WMO rapporteurs on/coordinators of DPM and with the WMO Secretariat on relevant DPM activities.

The coordinator was invited to submit an annual progress report to the president.

12.7 Noting Resolutions 9 (EC-LVI) and 18 (EC-LVII) — Global Earth Observation System of Systems, the Commission further decided to appoint a Coordinator for the Global Earth Observation System of Systems, with the following terms of reference:

(*a*) To keep under review the Commission's activities related to GEOSS implementation and to provide the CAS Management Group and OPAGs with appropriate information and recommendations on relevant actions;

(*b*) To liaise with other WMO rapporteurs on/coordinators of GEOSS and with the WMO Secretariat on relevant GEOSS activities.

The coordinator was invited to submit an annual progress report to the president.

12.8 Confirming the important role of ICG-WIS (agenda item 4.6), in which CAS was represented, the Commission saw the need to set up and strengthen its direct participation in the WIS design and development work led by CBS and its WIS-related teams. The Commission decided to establish WIS-related co-rapporteurs as follows:

(*a*) A Co-rapporteur on the WIS-related Requirements of the Research Community and WWRP, who should contribute to defining and coordinating the implementation of information discovery, access and retrieval services so that they could meet their requirements;

(*b*) A Co-rapporteur on the WIS-related Requirements of GAW, who should contribute to defining and coordinating services for operational, time-critical applications so that GAW and other environmental observational data be made available to users online and in near real time.

Both co-rapporteurs were invited to participate in the work of the relevant WIS planning and coordination teams and to submit an annual progress report to the president.

12.9 The Commission agreed to designate a representative to the Intercommission Task Team on Quality Management Framework and to continue its representation in the ITG on the International Polar Year 2007–2008.

12.10 The Commission considered it important to ensure that its work was consistent with regional research priorities and activities. The Commission agreed that greater programme integration and efficiency would be achieved by designating members of the WWRP JSC as regional rapporteurs, as required. The Commission also acknowledged the work of a number of regional rapporteurs on GAW designated by regional associations and invited all regional associations to consider designating one rapporteur to OPAG-EPAC.

12.11 The Commission requested the CAS Management Group to establish the membership of the groups and committees of each OPAG upon the recommendation of the OPAG chairperson, in accordance with applicable regulations. The Commission invited the chairpersons, in cooperation with the Secretariat, to develop targets for deliverables and adequate working mechanisms to ensure that all experts could actively participate and contribute to the work of the Commission.

12.12 The organization chart of the CAS working structure is contained in Annex III to the present report.

13. Review of previous resolutions and recommendations of the Commission and of relevant Executive Council resolutions (agenda item 13)

The Commission reviewed the resolutions and recommendations adopted at its previous session which were still in force, as well as those of the Executive Council relating to CAS activities. Accordingly, the decisions of the present session were recorded in

Resolution 4 (CAS-XIV) and Recommendation 2 (CAS-XIV).

14. ELECTION OF OFFICERS (agenda item 14)

The Commission unanimously elected Mr M. Béland (Canada) as president of the Commission and re-elected Mr A. Frolov (Russian Federation) as vice-president. The newly elected officers agreed with pleasure to serve the Commission until its fifteenth session.

15. DATE AND PLACE OF THE FIFTEENTH SESSION (agenda item 15)

The Commission noted with appreciation that the delegates from Turkey had, on behalf of their Government, extended an invitation to WMO to host the fifteenth session of CAS, to be held in 2010. The Commission also noted that the date and place of its fifteenth session would be determined in accordance with General Regulation 186.

16. CLOSURE OF THE SESSION (agenda item 16)

16.1 In his closing address, the president of the Commission thanked all those who had contributed to the successful completion of the work of the session, in particular the delegates, the Government of South Africa and the South African Weather Service and its Head, Mr J. Mphepya, for the excellent arrangements and facilities made available to the session. He also thanked the staff of both the WMO and local secretariats, including the interpreters, translators and those producing the documents behind the scenes. He congratulated Mr M. Béland and Mr A. Frolov on their election as president and vice-president, respectively, of the Commission for the next intersessional period. He also congratulated the new chairpersons of OPAGs and experts and wished them the very best.

16.2 The fourteenth session of the Commission for Atmospheric Sciences closed at 10.20 a.m. on 24 February 2006.

RESOLUTIONS ADOPTED BY THE SESSION

RESOLUTION 1 (CAS-XIV)

PARTICIPATION OF WOMEN IN THE WORK OF THE COMMISSION

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING:

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

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

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

(4) Resolution 33 (Cg-XIV) — Equal opportunities for the participation of women in meteorology and hydrology,

CONSIDERING:

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

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

(3) The need to increase opportunities and inducements to recruit women in research within National Meteorological and Hydrological Services (NMHSs) and partner institutions, and to provide equal opportunities for career advancement to the highest levels,

WELCOMING and supporting the active participation of women delegates in the Commission,

ENCOURAGES the increased participation and involvement of women in the work of the Commission;

URGES Members to implement the recommendations made by the second WMO Technical Conference on the Participation of Women in Meteorology and Hydrology (Geneva, March 2003) in order to speed up the process of equal opportunities for the increased participation of women in these professions;

RECOMMENDS that Members:

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

(2) Facilitate the participation of women in the research, education and training activities of the Commission;

(3) Provide active encouragement and support for equal opportunities for the participation of women in all fields of meteorology and related sciences at decision-making levels, and in national, regional and international research programmes;

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

REQUESTS the Secretary-General to report to the fifteenth session of the Commission on progress made on the main aspects of the implementation of this resolution during the intersessional period;

DECIDES to appoint and support a gender focal point from among the women with appropriate expertise, and to designate this person as a member of the CAS Management Group.

NOTE: This resolution replaces Resolution 5 (CAS-XII), which is no longer in force.

RESOLUTION 2 (CAS-XIV)

WORKING STRUCTURE OF THE COMMISSION FOR ATMOSPHERIC SCIENCES

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

CONSIDERING that there is a continuing need to:

(1) Determine the requirements of WMO Members and transfer knowledge, technologies and advice to them concerning atmospheric science issues,

(2) Conduct research in atmospheric and related sciences to advance understanding and predictability of the Earth system relevant to WMO Members,

(3) Meet the requirements of environmental security and environmental conventions,

(4) Coordinate the international aspects of the Commission's activities with relevant scientific bodies,

(5) Standardize functions, constants, terminology and bibliographic practices applicable to the atmospheric sciences,

(6) Support research on the policy and socio-economic impacts of advances in the understanding of atmospheric sciences,

DECIDES:

(1) To establish:

(*a*) The Open Programme Area Group on the World Weather Research Programme (OPAG-WWRP), which has the responsibility for the implementation of all Commission activities related to weather research and development;

(*b*) The Open Programme Area Group on Environmental Pollution and Atmospheric Chemistry (OPAG-EPAC), which has the responsibility for the implementation of all Commission activities related to atmospheric chemistry, including the Global Atmosphere Watch (GAW) programme;

(2) To request:

(*a*) Each OPAG to develop contributions to the WMO Natural Disaster Prevention and Mitigation (DPM) Programme;

(*b*) Each OPAG to contribute to the development and implementation of the WMO Integrated Global Observing System (WIGOS) and to coordinate their activities with the WMO Space Programme, other WMO and jointly sponsored programmes, and with the Group on Earth Observations (GEO) developing the Global Earth Observation System of Systems (GEOSS), in accordance with the agreed work programme of the Commission;

(*c*) Each OPAG to contribute to the development and implementation of the WMO Information System (WIS) and to coordinate with the Intercommission Coordination Group on WIS;

(*d*) Each OPAG to contribute to the development and implementation of societal and economic applications (SEA) research related to weather, climate, environmental pollution and atmospheric chemistry;

(*e*) Each OPAG to take into consideration Resolution 1 (CAS-XIV) — Participation of women in the work of the Commission, which encourages the involvement of women in the Commission's work;

(3) To select, in accordance with General Regulation 32:

(*a*) Mr P. Courtier as chairperson of the OPAG on the World Weather Research Programme (OPAG-WWRP) and chairperson of the Joint Scientific Committee (JSC) of OPAG-WWRP;

(*b*) Mr Ø. Hov as chairperson of the OPAG on Environmental Pollution and Atmospheric Chemistry (OPAG-EPAC) and chairperson of the Joint Scientific Steering Committee (JSSC) of OPAG-EPAC;

REQUESTS:

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

(2) The chairpersons of the OPAGs to prepare and submit a report to the CAS Management Group and the Commission no later than three months prior to their sessions.

RESOLUTION 3 (CAS-XIV)

CAS MANAGEMENT GROUP

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING:

(1) The views of the Sixth World Meteorological Congress on retaining the system of advisory bodies to provide advice to the presidents of technical commissions,

(2) The future policies, strategy, objectives and outline plans of the Commission for Atmospheric Sciences (CAS) adopted by the Fourteenth World Meteorological Congress,

(3) Resolution 2 (CAS-XIV) — Working Structure of the Commission for Atmospheric Sciences,

RECOGNIZING:

(1) That the effectiveness of the Commission depends to a large extent on the effective management of its activities and coordination of cross-cutting aspects of the programme areas between the sessions,

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

DECIDES:

(1) To establish the CAS Management Group to provide the president with appropriate and timely advice to ensure that the Commission can respond effectively following the terms of reference given below:

   (*a*) To provide management oversight of the work of the Commission, as undertaken through the Open Programme Area Groups (OPAGs) and associated primary scientific and expert groups and rapporteurs;

   (*b*) To review the short- and long-term strategic planning and work programmes of the Commission and manage and coordinate their adoption and implementation;

   (*c*) To maintain overall responsibility for ensuring the excellence, relevance and impact of the work of the Commission and the transfer of research results, techniques and information between Members in the fields of atmospheric and related sciences, including environmental aspects;

   (*d*) To review the internal structure and working methods of the Commission, including its relationship with other bodies, both inside and outside WMO, and to develop proposals for more effective modes and substructures, where appropriate;

   (*e*) To be the focal point for formulating the relevant parts of the WMO Long-term Plans and for communication on scientific matters of relevance to the Commission;

   (*f*) To establish the membership of the working bodies of each OPAG upon the recommendation of the OPAG chairperson;

(2) That the composition of the CAS Management Group should be as follows:

   (*a*) President of CAS (chairperson);

   (*b*) Vice-president of CAS;

   (*c*) Immediate former president of CAS;

   (*d*) Chairperson of the OPAG on Environmental Pollution and Atmospheric Chemistry (OPAG-EPAC);

   (*e*) Chairperson of the OPAG on the World Weather Research Programme (OPAG-WWRP);

   (*f*) Chairperson of the Working Group on Numerical Experimentation (WGNE);

   (*g*) Up to six members at large appointed by CAS broadly representing the scientific diversity of the membership of the Commission and providing coordination for the Global Earth Observation System of Systems (GEOSS), Natural Disaster Prevention and Mitigation (DPM), appointing a focal point for gender issues, capacity-building, education and emerging issues;

(3) To authorize the president to call on regional rapporteurs and other experts, keeping in mind General Regulation 34, to participate in any particular task when he considers that such additional assistance is necessary.

RESOLUTION 4 (CAS-XIV)

REVIEW OF THE RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION FOR ATMOSPHERIC SCIENCES

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING:

(1) General Regulation 190 concerning the review of previous resolutions and recommendations of the Commission,

(2) The action taken by the competent bodies on the resolutions and recommendations of its previous sessions,

DECIDES not to keep in force any resolutions adopted before its fourteenth session.

NOTE: This resolution replaces Resolution 4 (CAS-XIII), which is no longer in force.

RECOMMENDATIONS ADOPTED BY THE SESSION

RECOMMENDATION 1 (CAS-XIV)

IGACO IMPLEMENTATION

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING:

(1) The commitment of WMO to lead the implementation of the strategy outlined in *The Changing Atmosphere: An Integrated Global Atmospheric Chemistry Observation Theme for the IGOS Partnership: Report of the Integrated Global Atmospheric Theme Team* (GAW-159, WMO/TD-No. 1235),

(2) The request of the fifty-seventh session of the Executive Council (*Abridged Final Report with Resolutions of the Fifty-seventh Session of the Executive Council*, WMO-No. 988, general summary paragraph 3.3.2.9) that the Commission for Atmospheric Sciences (CAS):

(*a*) Develop by next Congress an implementation plan based on the strategic plan in the IGACO Report; a plan consistent with the evolving the Global Climate Observing System (GCOS), the Global Earth Observation System of Systems (GEOSS) and the Integrated Global Observing Strategy Partnership (IGOS-P),

(*b*) Establish an IGACO implementation team co-chaired by WMO and the European Space Agency (ESA),

(3) That the three objectives of IGACO are:

(*a*) To ensure long-term continuity and spatial comprehensiveness of high-quality atmospheric composition observations,

(*b*) To optimally integrate surface-based (in situ, balloon and remote-sensing), aircraft and space-borne measurements using models and data assimilation techniques,

(*c*) To make the integrated data easily accessible to a wide range of users, including those responsible for designing and implementing data assimilation systems required for real-time access and use of these data in numerical weather prediction,

CONSIDERING:

(1) The lead role expected of CAS in developing this plan,

(2) That the Executive Council has requested CAS to take a lead, with the support of the Commission for Basic Systems (CBS), the Commission for Climatology (CCl) and other commissions,

RECOMMENDS that the IGACO Implementation Plan be prepared as an integral part of the new GAW Strategic Implementation Plan 2008–2015.

RECOMMENDATION 2 (CAS-XIV)

REVIEW OF THE RESOLUTIONS OF THE EXECUTIVE COUNCIL RELEVANT TO THE FIELDS OF RESPONSIBILITY OF THE COMMISSION FOR ATMOSPHERIC SCIENCES

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING the action taken on its previous recommendations by the Executive Council,

CONSIDERING:

(1) That some of these recommendations have become redundant in the meantime,

(2) That the substance of some of its previous recommendations has been included in recommendations of the fourteenth session,

RECOMMENDS:

(1) That the following Executive Council resolution be no longer considered necessary:
Resolution 3 (EC-LIV);

(2) That the following Executive Council resolutions be maintained in force:
Resolutions 6 (EC-XXXVI), 7 (EC-XLV), 3 (EC-LVI), 7 (EC-XXXIX), 11 (EC-LVI) and 12 (EC-LVI).

NOTE: This recommendation replaces Recommendation 3 (CAS-XIII), which is no longer in force.

ANNEXES

ANNEX I
Annex to paragraph 3.6 of the general summary

DRAFT TERMS OF REFERENCE OF THE COMMISSION FOR ATMOSPHERIC SCIENCES

The Commission for Atmospheric Sciences is responsible for promoting, coordinating and facilitating activities relating to atmospheric sciences, including weather research, environmental pollution and atmospheric chemistry research, and associated training and capacity-building.

Within the context of this broad role, the specific objectives of the Commission are:

(*a*) To determine the requirements of WMO Members, including in support of environmental and climate conventions, and facilitate the transfer of knowledge, technologies and advice concerning atmospheric science issues;

(*b*) To conduct research in atmospheric and related sciences to advance the understanding and predictability of atmospheric processes within the broader Earth system, with emphasis on the following:

- (i) Weather prediction for timescales ranging from very-short to long range, embracing new developments in environmental prediction, with emphasis on forecasting high-impact events associated with serious consequences for populations and economies;
- (ii) Atmospheric composition and air pollution, including their interaction with weather, studies of the transport, transformation and deposition of air pollutants and related monitoring;
- (iii) Physics and chemistry of clouds, particularly in support of weather prediction, atmospheric chemistry and the prediction of the chemical composition of the atmosphere;
- (iv) Weather modification, with emphasis on the underlying physical and chemical processes and the development of rigorous evaluation procedures;
- (v) Tropical meteorology, including studies of processes and phenomena of particular relevance to low latitudes and their influence beyond;
- (vi) Climate, noting the central role of the World Climate Research Programme (WCRP) for improved understanding of climate; the Commission will provide supporting science and contribute expertise, especially in atmospheric, environmental and Earth system modelling, which links the weather interests of the Commission to climate scales;

(*c*) To maintain and develop the Global Atmosphere Watch (GAW) programme using an integrated approach to global atmospheric chemistry observations and air quality, contributing to scientific assessments in support of international environmental and climate conventions and policies;

(*d*) To coordinate the Commission's activities with relevant WMO bodies, the WMO Long-term Plan and other scientific groups;

(*e*) To standardize functions, constants, terminology and bibliographic practices applicable to atmospheric sciences;

(*f*) To support research on the policy and socio-economic impacts of advances in the understanding of atmospheric sciences;

(*g*) To formulate requirements for observations and for the storage, retrieval and exchange of raw and/or processed data;

(*h*) To conduct scientific assessments of technical meteorological procedures, including verification techniques.

ANNEX II

Annex to paragraph 12.3 of the general summary

PROPOSED TERMS OF REFERENCE OF THE OPAG ON THE WORLD WEATHER RESEARCH PROGRAMME AND THE OPAG ON ENVIRONMENTAL POLLUTON AND ATMOSPHERIC CHEMISTRY

OPAG ON THE WORLD WEATHER RESEARCH PROGRAMME (OPAG-WWRP)

(1) Joint Scientific Committee

The Joint Scientific Committee (JSC) has the following terms of reference:

(*a*) To provide the overall scientific guidance for the World Weather Research Programme (WWRP);

(*b*) To develop a strategic science and implementation plan for WWRP and a work programme aligned with the WMO Long-term Plan;

(*c*) To review and assess, in close coordination with the OPAG on Environmental Pollution and Atmospheric Chemistry (OPAG-EPAC), the societal and economic component of WWRP and contribute to other WMO societal and economic application (SEA)-related activities;

(*d*) To review and assess the development of all elements of WWRP, including demonstration forecast evaluation methods, formulate recommendations to guide further actions and report on the progress of the programme to the president of the Commission for Atmospheric Sciences (CAS);

(*e*) To facilitate, coordinate, prioritize and focus on weather research and development activities, which are planned and implemented through the project committees and working groups, to meet the objectives of CAS;

(*f*) To facilitate the exchange of information among scientists participating in the programme and relevant scientific institutions and agencies, at the national and international levels;

(*g*) To collaborate, as appropriate, with OPAG-EPAC, the Commission for Basic Systems (CBS) and other technical commissions, relevant groups of the JSC/ World Climate Research Programme (WCRP) and the WCRP projects committees, academia, users of forecast products and other partners;

(*h*) To delegate to each working group and expert team, as required, the responsibility to promote the timely exchange of information, data and new knowledge through publications, workshops and meetings.

The members of the JSC should be drawn from the chairpersons of the working groups and expert teams of WWRP and other selected experts to fill gaps in geographical and thematic representation. The members are appointed by the Management Group upon recommendation by the JSC chairperson.

(2) Joint CAS-JSC/WCRP Working Group on Numerical Experimentation

The Joint CAS-JSC/WCRP Working Group on Numerical Experimentation (WGNE) has the following terms of reference:

(*a*) To advise the JSC for WCRP and CAS on progress in atmospheric modelling;

(*b*) To review the development of atmospheric models for use in weather prediction and climate studies on all scales, including the diagnosis of shortcomings;

(*c*) To propose numerical experiments aimed at refining numerical techniques and the formulation of atmospheric physics processes, boundary layer processes and land surface processes in models;

(*d*) To design and promote coordinated experiments to:

(i) Validate model results against observed atmospheric properties and variations;

(ii) Explore the intrinsic and forced variability and predictability of the general circulation of the atmosphere on short to extended ranges;

(iii) Assess the intrinsic and forced variability of the atmosphere on climate timescales;

(*e*) To promote the development of data assimilation methods for application to numerical weather and climate predictions, and for the estimation of derived climatological quantities;

(*f*) To promote the development of new methods for numerical weather prediction (NWP) and climate simulation;

(*g*) To maintain scientific liaison with other WCRP and CAS groups, as appropriate;

(*h*) To promote the timely exchange of information, data and new knowledge on atmospheric modelling through publications, workshops and meetings.

(3) THORPEX

THORPEX is a major activity of WWRP and a designated programme within the Atmopsheric Research and Environment Programme (AREP) of WMO to accelerate improvements in the accuracy and utility of one-day to two-week high-impact weather forecasts.

The THORPEX terms of reference are contained in its science and implementation plans. THORPEX is led by an International Core Steering Committee (ICSC) and managed through an Executive Board (THORPEX EB).

(4) Working Group on Mesoscale Weather Forecasting

The Working Group on Mesoscale Weather Forecasting (WG-MWF) has the following terms of reference:

(*a*) To promote, organize and/or endorse end-to-end weather research and development projects (RDPs) including understanding of weather processes, improving forecasting techniques and improving the utility of forecast information with an emphasis on high-impact weather;

(*b*) To establish project committees and expert teams, as required, for the implementation of projects to meet the objectives of the Working Group;
(*c*) To actively promote the application of improvements in weather forecasting capability through forecast demonstration projects (FDPs) and the establishment of test beds;
(*d*) To supervise the process of individual evaluation and quality assessment of each "pre-operational"-type project (in particular of each demonstration project) and to validate its conclusions, in light of the state of the art.

(5) Working Group on Tropical Meteorology

The Working Group on Tropical Meteorology (WGTM) has the following terms of reference:
(*a*) To monitor the implementation of existing priority projects within the Working Group and to further develop other appropriate research projects as the need arises, under the following main programme components:
  (i) Tropical cyclones;
  (ii) Monsoon studies (on regional and global scales);
  (iii) Tropical drought and rain-producing systems;
  (iv) Limited-area modelling in the tropics;
  (v) Interaction between tropical and mid-latitude weather systems;
  (vi) Tropical meteorology and climate;
(*b*) To identify and support the research initiatives of National Meteorological and Hydrological Services (NMHSs) in tropical countries, generally including collaboration with groups in universities or research institutes, which are likely to lead to economic benefits, particularly in agriculture and water resources management;
(*c*) To keep developments in research aspects of the WMO Tropical Cyclone Programme (TCP) under continuous review by maintaining close liaison with TCP regional bodies and to facilitate the coordination of research at regional levels.

(6) Joint Working Group on Verification

The Joint Working Group on Verification (JWGV) has the following terms of reference:
(*a*) To plan and implement the verification component of WWRP;
(*b*) To serve as a focal point for the development and dissemination of new verification methods for WWRP and EPAC, as required;
(*c*) To facilitate and encourage training and dissemination of information on verification methodologies;
(*d*) To take into account the needs of users so as to ensure the relevance of the practice of forecast verification;
(*e*) To facilitate the development and application of improved diagnostic verification methods to assess and enable improvement of the quality of weather forecasts, including forecasts from numerical weather and climate models;
(*f*) To encourage the sharing of observational data for verification purposes;
(*g*) To encourage greater awareness in the research community of the importance of verification as a vital part of numerical and field experiments, rather than an "afterthought";
(*h*) To promote collaboration among scientists conducting research on various aspects of forecast verification, as well as with model developers and forecast providers;
(*i*) To collaborate on forecast verification with the Working Group on Numerical Experimentation (WGNE) and WCRP and in coordination with CBS.

(7) Working Group on Nowcasting

The Working Group on Nowcasting (WGN) has the following terms of reference:
(*a*) To advance the science of nowcasting, including meteorological processes and predictability;
(*b*) To promote and aid the implementation of nowcasting in the WWRP framework and within National Meteorological Services (NMSs) and among their end-users, including the potential use of numerical modelling and assimilation of very high resolution data;
(*c*) To develop and implement RDPs and FDPs to advance the underlying science as well as to develop, compare, validate and exchange various nowcasting techniques, and to involve the operational evaluation outcomes.

(8) Working Group on Societal and Economic Applications

The Working Group on Societal and Economic Applications (WG-SEA) shall be the THORPEX Working Group on Societal and Economic Applications, to avoid any unnecessary duplication of effort in this important area. WG-SEA has the following terms of reference:
(*a*) To advance the science of the social and economic application of weather-related information and services;
(*b*) To promote and aid the implementation of social science research within OPAG-WWRP, OPAG-EPAC and throughout WMO, as may be required;
(*c*) To review and assist in the development and promotion of societal and economic-related demonstration projects.

(9) Expert Team on Weather Modification

The Expert Team on Weather Modification (ET-WM) has the following terms of reference:
(*a*) To keep under review, on behalf of OPAG-WWRP and OPAG-EPAC, relevant research, advise CAS on issues requiring attention related to weather modification and suggest mechanisms for addressing such issues;
(*b*) To review the criteria for conducting weather modification research to ensure the quality of the science, from the initial design to the final evaluation of field experiments, taking into account

advances in supporting fields, including cloud physics, atmospheric chemistry, numerical modelling and SEAs;

(*c*) To serve as a focal point and provide advice and assistance to Members on the manner and means of transferring competence for planning scientific experiments;

(*d*) To assist in the drafting of WMO documents on the status of weather modification and guidelines for providing advice to Members and to propose revisions to these documents where necessary.

(10) Regional rapporteurs on WWRP

Regional rapporteurs are designated, as required, from the members of the JSC/WWRP. Their terms of reference are:

(*a*) To promote and facilitate the participation of NMSs, academia and related organizations and agencies of the Region in weather research and development projects and activities, in particular through the CAS working structure;

(*b*) To keep the regional associations and CAS informed on relevant plans and activities in the area, specifically those requiring the support and engagement of the Region;

(*c*) To assist the Secretariat and WWRP in the exchange of information and support of cooperative research and monitoring projects in the field of weather prediction research in the Region.

OPAG ON ENVIRONMENTAL POLLUTION AND ATMOSPHERIC CHEMISTRY (OPAG-EPAC)

(1) OPAG-EPAC Joint Scientific Steering Committee

The OPAG-EPAC Joint Scientific Steering Committee (JSSC) has the following terms of reference:

(*a*) To keep informed of, and review scientific developments in, the fields of environmental pollution and atmospheric chemistry, including the interrelationships between changes in atmospheric composition, global and regional climate and other aspects of the Earth system, and disturbances to the natural cycles of chemical species in the atmosphere/ocean/biosphere system;

(*b*) To advise CAS and recommend actions that WMO should take to promote, initiate, facilitate or set priorities for:

(i) Long-term globally integrated observations of atmospheric composition and air pollution, including greenhouse gases, ozone, ultraviolet (UV) radiation, reactive gases, aerosols and precipitation chemistry;

(ii) The high quality, timeliness and continuity of data from the monitoring network including aircraft and satellite and the development of a functional system for real-time or quasi-real-time measurements;

(iii) The transport, transformation and deposition of air pollutants on all space scales and timescales;

(iv) User-friendly access to the data and the application of data for analysis, assimilation and assessments pertaining to the existing and emerging environmental issues both of global and regional importance;

(v) The development of air pollution, weather and climate predictive capability, including inverse modelling for source estimation;

(vi) The management of urban air quality;

(*c*) To maintain a strategic implementation plan for the GAW programme, taking into account the Integrated Global Atmospheric Chemistry Observations (IGACO) strategy;

(*d*) To oversee the operation of the GAW programme;

(*e*) To cooperate with other relevant programmes and organizations inside and outside WMO, namely:

(i) To liaise and communicate with the Global Earth Observation System of Systems (GEOSS), the Committee on Earth Observation Satellites (CEOS) and the Integrated Global Observing Strategy (IGOS);

(ii) To collaborate with the CAS OPAG-WWRP, particularly with ET-WM, CBS working groups and other WMO technical commissions;

(iii) To review and assess the SEA component of OPAG-EPAC and contribute to other WMO SEA-related activities;

(*f*) To support international conventions.

The members of the OPAG-EPAC JSSC are the chairperson of the Scientific Advisory Groups (SAGs) and other experts selected to fill gaps in geographical and thematic representation. The members are appointed by the Management Group upon recommendation by the OPAG-EPAC chairperson.

(2) GAW Scientific Advisory Groups

The SAGs of the GAW programme cover:

(*a*) Ozone (SAG-Ozone);

(*b*) UV Radiation (SAG-UV);

(*c*) Greenhouse Gases (SAG-GHG);

(*d*) Aerosols (SAG-Aerosols);

(*e*) Precipitation Chemistry (SAG-PC);

(*f*) Reactive Gases (SAG-RG);

(*g*) Urban Research Meteorology and Environment Project (SAG-GURME).

The GAW SAGs have the following terms of reference:

(*a*) To provide guidance and advice on assessments relevant to OPAG-EPAC;

(*b*) To develop scientific priorities based on user requirements;

(*c*) To contribute to the GAW Strategic Implementation Plan, taking into account the IGACO strategy and regional needs;

(*d*) To implement recommendations, tasks and projects as defined in the GAW Strategic Implementation Plan;

(*e*) To monitor operations at sites and recommend the development of networks, observation methodologies and techniques;

(*f*) To develop measurement procedures and guidelines, data quality objectives and, when applicable, standard operating procedures;

(*g*) To report to the OPAG-EPAC JSSC on progress and critical problems;
(*h*) To interact with OPAG-WWRP.

(3) Expert Team on GAW World Data Centres

The Expert Team on GAW World Data Centres (ET-GAW WDCs) has the following terms of reference:
(*a*) To coordinate the activities of GAW WDCs and the GAW Station Information System (GAWSIS);
(*b*) To formulate GAW requirements for the WMO Information System (WIS) and contribute to defining and coordinating services for operational, time-critical applications so that GAW and other environmental observational data are available to users online and, when possible, in near real time.

(4) Expert Team on WMO/IUGG International Aerosol-Precipitation Science Assessment Group

The Expert Team on WMO/IUGG International Aerosol-Precipitation Science Assessment Group (ET-IAPSAG) was established to lead the research community in the Science Assessment of Aerosol Effects on Precipitation and to prepare an assessment report in 2006, which will be reviewed by an independent review group and completed in time for the next WMO and International Union of Geodesy and Geophysics (IUGG) Congresses in 2007.

(5) Regional rapporteurs on OPAG-EPAC

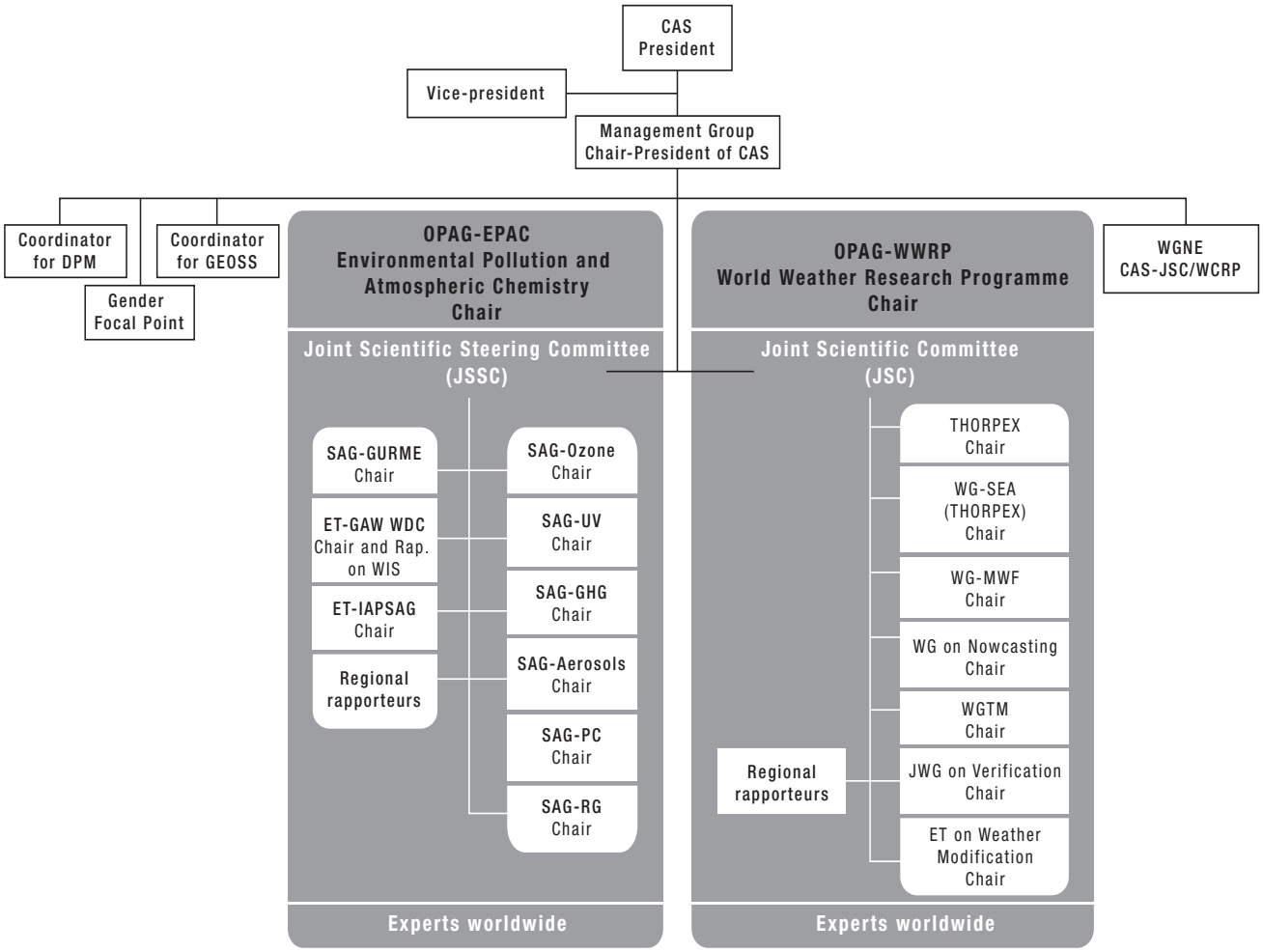
The regional rapporteurs on OPAG-EPAC have the following terms of reference:
(*a*) To survey, report and promote Members' efforts in the GAW programme in the WMO Regions;
(*b*) To report to the OPAG and the respective regional associations of WMO;
(*c*) To assist the WMO Secretariat in the exchange of information and support of cooperative research and monitoring projects in the field of atmospheric chemistry and pollution in the Region.

Each regional association may appoint one rapporteur to the OPAG-EPAC JSSC.

ANNEX III

Annex to paragraph 12.12 of the general summary

ORGANIZATION CHART OF THE CAS WORKING STRUCTURE



APPENDIX A

LIST OF PERSONS ATTENDING THE SESSION

A. Officers of the session

A. Eliassen	President
A.V. Frolov	Vice-president

B. Representatives of WMO Members

Member	*Name*	*Capacity*
Algeria	Mokhtar Achachia	Principal delegate
Australia	N.R. Smith	Principal delegate
	Kamal Puri	Delegate
Austria	Yong Wang	Principal delegate
Brazil	Manoel Alonso Gan	Principal delegate
Bulgaria	P. Simeonov	Principal delegate
	R. Bojkov	Alternate
Cameroon	J.C. Eloundou Mani (Ms)	Delegate
Canada	M. Béland	Principal delegate
	G. Brunet	Alternate
	B. Angle	Delegate
	M. Shepherd (Ms)	Delegate
China	Yu Rucong	Principal delegate
	Zhang Renhe	Delegate
	Guo Yaxi (Ms)	Delegate
	Yu Jixin	Delegate
	Duan Yihong	Delegate
Croatia	I. Čačić	Principal delegate
	B. Ivančan-Picek	Delegate
Egypt	A. El-Sayed Yousef	Principal delegate
	D. Mohamed Ahmed	Alternate
France	E. Brun	Principal delegate
	J.-P. Chalon	Delegate
	J. Pailleux	Delegate
Germany	G. Adrian	Principal delegate
Ghana	V. Antwi	Principal delegate
Hong Kong, China	Kai-hing Yeung	Principal delegate
Hungary	L. Bozó	Principal delegate
India	A.K. Kamra	Principal delegate
Indonesia	Mezak A. Ratag	Principal delegate
	Aris Garinto	Delegate
Italy	G. Daddario	Principal delegate
Japan	Hideyuki Sasaki	Principal delegate
	Yoshiaki Takeuchi	Delegate
Kazakhstan	T. Kudekov	Principal delegate
Kenya	P. M. Nthusi	Principal delegate
Latvia	A. Leitass	Principal delegate
Liberia	A. Kpadeh	Principal delegate
Malaysia	Chow Peng Leong (Ms)	Principal delegate
Morocco	Abdalah Mokssit	Principal delegate
	El Hassan Lasri	Delegate
Netherlands	H. Kelder	Principal delegate
New Zealand	N. Gordon	Principal delegate
Nigeria	L.E. Akeh	Principal delegate
	N.O. Nnoli	Alternate
	I.D. Nnodu	Delegate
	S.E. Osaghaede	Delegate
Norway	A. Eliassen	Principal delegate
	Ø. Hov	Alternate
Poland	R. Klejnowski	Alternate
Portugal	D. de Saldanha E Alvim	Principal delegate
	P. Barbosa	Delegate
Russian Federation	A. Frolov	Principal delegate
	Y. Tsaturov	Alternate
	A. Konoplev	Delegate
	V. Stasenko	Delegate
Serbia and Montenegro	M. Curic	Principal delegate
South Africa	J. Mphepya	Principal delegate
	E. Poolman	Delegate
	E. Brunke	Alternate
	H. Rautenbach	Alternate
	G. Schulze	Delegate
	D. Terblanche	Delegate
	W. Tennant	Delegate
	G. Coetzee	Delegate
	B. Parker	Delegate
	C. Labuschagne	Delegate
	M. Majodina	Delegate
	J. Collins (Ms)	Alternate
	A. Phahlane (Ms)	Delegate
	L. Ntsangwane	Delegate
	R. Benefeldt	Observer
Spain	J.R. de Grado Sanz	Principal delegate
	B. Orfila-Estrada	Delegate

Member	*Name*	*Capacity*
Sweden	S. Nilsson	Principal delegate
Switzerland	G. Müller	Principal delegate
	M. Rotach	Delegate
Turkey	M. Kayhan	Principal delegate
	K. Dokuyucu	Delegate
United Arab Emirates	F.H. Salman Al-Mehairi	Principal delegate
	Adel Gabr	Delegate
United Kingdom of Great Britain and Northern Ireland	A. Dickinson	Principal delegate
	B. Garnier-Schofield (Ms)	Alternate
	A. Brown	Alternate
United Republic of Tanzania	N.D. Pyuzza	Principal delegate
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	L.W. Uccellini	Alternate
	J.L. Moyers	Delegate
	J. Parsons (Ms)	Delegate
	M. Shapiro	Observer
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C. Invited experts

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P. Courtier (France)

M. Abshaev (Russian Federation)

A. Chernikov (Russian Federation)

G. Golitsyn (Russian Federation)

A. Al-Mandoos (United Arab Emirates)

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P. Mason (United Kingdom of Great Britain and Northern Ireland)

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A. Rangno (United States of America)

B. Silverman (United States of America)

G. Vali (United States of America)

D. Representatives of international organizations

Organization	*Name*
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European Centre for Medium-range Weather Forecasts (ECMWF)	M. Miller
European Meteorological Services Network (EUMETNET)	J.-P. Chalon
International Commission on Irrigation and Drainage (ICID)	S. Walker (Ms)
International Union of Geodesy and Geophysics (IUGG)	D.E. Terblanche
International Federation of Red Cross Red Crescent Societies (IFRC)	H. Letz
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E. Other participants

Djibrilla Maiga (Mali)
Bahij Shhada (Syrian Arab Republic)
Moncef Rajhi (Tunisia)

F. WMO Secretariat

M. Jarraud	Secretary-General
E. Manaenkova (Ms)	Director, Atmospheric Research and Environment Programme (AREP)
D. Schiessl	Director, Crosscutting Coordination
L. Barrie	Senior Scientific Officer, AREP
D. Burridge	Director, IPO THORPEX
Z. Lei	Senior Scientific Officer, AREP
D. Rogers	WMO consultant, AREP
M. Peeters	Conference officer
X. Feng (Ms)	IPO THORPEX

APPENDIX B
LIST OF ABBREVIATIONS

ABC	Atmospheric Brown Cloud
ACE+	Atmosphere and Climate Explorer
AgMP	Agricultural Meteorology Programme
AIFI	Aircraft In-Flight Icing Project
AMMA	African Monsoon Multidisciplinary Analysis
AMP	Applications of Meteorology Programme
APP	Applications Programme
AREP	Atmospheric Research and Environment Programme
ASAP	Automated Shipboard Aerological Programme
ASEAN	Association of South-East Asian Nations
ASMC	ASEAN Specialized Meteorological Centre
AWG	Advisory Working Group
CAeM	Commission for Aeronautical Meteorology
CAPPS	City Air Pollution Prediction System
CAS	Commission for Atmospheric Sciences
CBLAST	Coupled Boundary Layer/Air-Sea Transfer
CBS	Commission for Basic Systems
CCl	Commission for Climatology
CEOS	Committee on Earth Observation Satellites
CGMS	Coordination Group for Meteorological Satellites
CLATEX	China Landfalling Typhoon Experiment
CLIVAR	Climate Variability and Predictability
CMA	China Meteorological Administration
CNES	National Centre for Space Studies
COP	Conference of the Parties
COPES	Coordinated Observation and Prediction of the Earth System
COPS	Convective and Orographically-induced Precipitation Study
COST	European Cooperation in the Field of Scientific and Technical Research
DC-FDP	Developing Country FDP
DCPC	Data Collection or Product Centre
DEBITS II	Deposition of Biogeochemically Important Trace Species
DIAL	Differential Absorption Lidar
DPM	Natural Disaster Prevention and Mitigation
EAME	East Asian Monsoon Experiment
EANET	Acid Deposition Monitoring Network in East Asia
EarthCARE	Earth Clouds, Aerosols and Radiation Explorer
ECMWF	European Centre for Medium-range Weather Forecasts
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
EMPA	Swiss Federal Laboratories for Materials Testing and Research
ENSO	*El Niño*/Southern Oscillation
EOS	Earth Observation Summit
EPS	Ensemble Prediction System
ESA	European Space Agency
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ET-WM	Expert Team on Weather Modification
FDP	Forecast Demonstration Project
FTS	Fourier Transform Spectrometer

GAW	Global Atmosphere Watch
GAWSIS	GAW Station Information System
GAWTEC	GAW Training and Education Centre
GCOS	Global Climate Observing System
GEF	Global Environment Facility
GEMS	Global and Regional Earth-system Monitoring using Satellite and In-situ Data
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GIFS	Global Interactive Forecasting System
GMD	Global Monitoring Division
GOOS	Global Ocean Observing System
GOS	Global Observing System
GOSAT	Greenhouse Gases Observing Satellite
GPM	Global Precipitation Measurement
GPS	Global Positioning System
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunication System
GTT	GURME Training Team
GURME	GAW Urban Research Meteorology and Environment
HWRP	Hydrology and Water Resources Programme
IAEA	International Atomic Energy Agency
IAMAS	International Association of Meteorology and Atmospheric Sciences
IAPSAG	International Aerosol-Precipitation Science Assessment Group
ICG-WIS	Intercommission Coordination Group on WIS
ICPC	Interagency Coordination and Planning Committee for GEO/GEOSS
ICSC	International Core Steering Committee
ICSU	International Council for Science
ICT	Information and Communication Technology
IGAC	International Global Atmospheric Chemistry Programme
IGACO	Integrated Global Atmospheric Chemistry Observations
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
IGOS-P	IGOS Partnership
IHMT	International Hydrometeorological Test Bed
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climate Change
IPEAM	International Panel on East Asian Monsoon
IPO	International Programme Office (IPY)
IPY	International Polar Year
ISDR	International Strategy for Disaster Reduction
ISRO	Indian Space Research Organisation
ISSC	International Science Steering Committee (THORPEX)
ITCZ	Intertropical Convergence Zone
ITG	Intercommission Task Group
IUGG	International Union of Geodesy and Geophysics
IWM	International Workshop on Monsoons
IWTC	International Workshop on Tropical Cyclones
IWTCLP	International Workshop on Tropical Cyclone Lanfall Processes
JAXA	Japan Aerospace Exploration Agency
JC	Joint Committee
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JMA	Japan Meteorological Agency
JRC	Joint Research Centre
JSC	Joint Scientific Committee
JSSC	Joint Scientific Steering Committee
JWGV	Joint Working Group on Verification

LDCs	Least Developed Countries
LRTAP	Convention on Long-range Transboundary Air Pollution
LTP	WMO Long-term Plan
MAP	Mesoscale Alpine Programme
MEDEX	Mediterranean Experiment on Cyclones that Produce High Impact Weather in the Mediterranean
MEDSEEME-PEP	Mediterranean, South-East Europe and Middle East Precipitation Enhancement Project
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NEPAD	New Partnership for Africa's Development
NIST	National Institute of Standards and Technology
NMHS	National Meteorological and Hydrological Service
NMS	National Meteorological or Hydrometeorological Service
NOAA	National Oceanic and Atmospheric Administration
NWG	Nowcasting Working Group
NWP	Numerical Weather Prediction
NWS	National Weather Service
OPAG	Open Programme Area Group
OPAG-EPAC	OPAG on Environmental Pollution and Atmospheric Chemistry
OPUS	Ozone and Pollution Measuring Ultraviolet Spectrometer
PBL	Planetary Boundary Layer
PCCWMR	Physics and Chemistry of Clouds and Weather Modification Research
PEP	Precipitation Enhancement Project
PWSP	Public Weather Services Programme
QA/SAC	Quality Assurance/Science Activity Centre
QM	Quality Management
QMF	Quality Management Framework
QMS	Quality Management System
R&D	Research and Development
RA	Regional Association
RDP	Research and Development Project
ROSHYDROMET	Russian Federal Service for Hydrometeorology and Environmental Monitoring
RSMC	Regional Specialized Meteorological Centre
7LTP	Seventh WMO Long-term Plan
6LTP	Sixth WMO Long-term Plan
SADC	Southern African Development Community
SAG	Scientific Advisory Group
ScaRaB	Scanner for Radiation Budget
SCSMEX	South China Sea Monsoon Experiment
SDS	Sand and Dust Storm
SEA	Societal and Economic Applications
SIDS	Small Island Developing States
SMOS	Soil Moisture and Ocean Salinity
SOFIS	Solar Occultation FTS for Inclined-orbit Satellite
SPECTRA	Surface Processes and Ecosystem Changes through Research Analysis
SSC	Science Steering Committee
START	System for Analysis, Research and Training
SWIFT	Stratospheric Wind Interferometer for Transport Studies
TCCIP	Tropical Cyclone Coastal Impacts Program
TCP	Tropical Cyclone Programme
TCWC	Tropical Cyclone Warning Centre
THORPEX	Observing System Research and Predictability Experiment
TIGGE	THORPEX Interactive Grand Global Ensemble

TMRP	Tropical Meteorology Research Programme
TREND	Working Group on Training, the Environment and New Developments in Aeronautical Meteorology
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UV	Ultraviolet
VAMOS	Variability of the American Monsoon Systems
VOCs	Volatile Organic Compounds
VOS	Voluntary Observing Ships
WALES	Water Vapour and Lidar Experiment
WCP	World Climate Programme
WCRP	World Climate Research Programme
WDC	World Data Centre
WDCA	WDC for Aerosols
WG-EPAC	Working Group on Environmental Pollution and Atmospheric Chemistry
WG-MWF	Working Group on Mesoscale Weather Forecasting
WGN	Working Group on Nowcasting
WGNE	Working Group on Numerical Experimentation
WGSIP	Working Group on Seasonal-to-Interannual Prediction
WGTM	Working Group on Tropical Meteorology
WHYCOS	World Hydrological Cycle Observing System
WIGOS	WMO Integrated Global Observing System
WIS	WMO Information System
WMO	World Meteorological Organization
WRDC	World Radiation Data Centre
WWRP	World Weather Research Programme
WWW	World Weather Watch