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GENERAL SUMMARY OF THE WORK OF THE SESSION

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

1.1 The twelfth session of the Commission for Atmospheric Sciences (CAS) was held in the Hotel Continental, Skopje, from 23 February to 4 March 1998, at the kind invitation of the Government of the former Yugoslav Republic of Macedonia. The session was attended by 71 delegates representing 37 Members and by one observer from a non-Member country and two from international organizations. The list of participants appears in Appendix A to this report.

1.2 The president of the Commission, Mr D. J. Gauntlett, formally declared the session open at 10 a.m. on Monday, 23 February 1998. In his opening remarks, Mr Gauntlett expressed particular pleasure in the fact that his final session as president was being held in the historic city of Skopje. He went on to convey his personal gratitude, as well as the thanks of his vice-president for the last four years, Mr A. Eliassen, and of the CAS members present, to the host country in providing the excellent facilities and efficient arrangements to ensure the smooth running of the Commission’s activities over the coming days. The president reminded members that he had attended each session of the Commission since the eighth, which had been held in his home city of Melbourne in 1982. In that connection, he recalled the stimulus that hosting the session had given to Australian meteorologists and relevant agencies and expressed his confidence that the present session would similarly benefit the national host. Mr Gauntlett went on to observe that members of the Commission also gained much from occasions such as that, in that they obtained first hand knowledge of the technical capabilities and scientific needs of individual countries. He stressed that the concept of closing the gap was something that the World Meteorological Organization (WMO) and the Commission took very seriously in order to ensure that all Members benefited from scientific advances to the maximum extent possible. The president emphasized that the session was being held at a very important time for WMO and for the development of international meteorological science in general as nations around the world became more aware of the many critical environmental problems which they were facing. They looked to WMO and its technical commissions for scientific leadership in dealing with such matters as acid rain, ozone depletion, urban pollution and climate change. Mr Gauntlett concluded his remarks by stating that he looked forward with some anticipation to hearing the views of delegates on those key issues and by thanking the distinguished participants to the opening ceremony.

1.3 On behalf of the Government of the former Yugoslav Republic of Macedonia, Mr D. Buzlevski, Vice-Prime Minister, expressed his pleasure in having the twelfth session of CAS organized in Skopje. He emphasized in particular the fact that that was the first meeting of a United Nations Specialized Agency being organized in the country. Mr Buzlevski pointed out the many environmental questions that countries in south Eastern Europe must consider, such as droughts, acid rain, floods and others. To address those issues, it was important that all countries cooperated with WMO. Through the WMO Secretariat, the former Yugoslav Republic of Macedonia worked together with Bulgaria in the field of advancing the system for analysing and updating meteorological information. A joint project by Albania, Bulgaria and the former Yugoslav Republic of Macedonia entitled “Joint Balkan climatic estimate, including improvement of disaster reduction” was the evidence that regional cooperation in hydrometeorology could contribute to strengthening the whole mutual connections of the Members in the Region. The former Yugoslav Republic of Macedonia, since having become a WMO Member in 1993, had developed fruitful and multiple cooperation with WMO. Therefore, Mr Buzlevski expressed his confidence that the present session would strengthen those relations and would offer a further chance for deeper cooperation.

1.4 Mr V. Bogdanovski, Permanent Representative of the former Yugoslav Republic of Macedonia with WMO and Director of the Republic Hydrometeorological Institute welcomed Professor G. O. P. Obasi, Secretary-General of WMO, Mr D. J. Gauntlett and all participants in Skopje, where he hoped they would find appropriate conditions and possibilities for successful and fruitful work. He expressed his pride in having the twelfth session of CAS organized in Skopje and the wish that the meeting would further promote the progress and realization of the objectives of WMO in atmospheric sciences. Since its independence in 1993, the former Yugoslav Republic of Macedonia had developed new possibilities and great perspectives towards international cooperation in the fields of meteorology, hydrology and ecology in the framework of WMO. That had been greatly facilitated through the support received from WMO and its Member countries in the form of staff training, missions of experts in the fields of ecology, agrometeorology and telecommunications, as well as through modern equipment received through the Voluntary Cooperation Programme (VCP), assistance in the climate computing (CLICOM) and the European network for the transmission of meteorological information (RETIM) systems, etc.

1.5 The Secretary-General of WMO, Professor G. O. P. Obasi, greeted the participants and expressed his sincere thanks to the Government of the former Yugoslav
Republic of Macedonia for the invitation to hold the session of CAS in Skopje and for providing such excellent facilities. He particularly thanked Mr. V. Bogdanovski, the Permanent Representative of the host country and his staff for their efforts in ensuring the smooth organization and running of the session. Professor Obasi also acknowledged the work done by the president of the Commission, Mr. D. J. Gauntlett and the vice-president Mr. A. Eliassen in overseeing the affairs of the Commission during the inter-sessional period. The Secretary-General identified a number of issues that should be considered by the Commission:

(a) The Global Atmosphere Watch (GAW), which was the only worldwide long-term observing system for monitoring the changing chemical composition of the atmosphere, had proven to be important in underpinning policy decisions related to the atmosphere. CAS was urged to consider ways to strengthen further GAW's monitoring capabilities;

(b) A new CAS initiative being considered was the World Weather Research Programme (WWRP) which would promote the development and application in improved weather forecasting techniques with emphasis on high impact events. Professor Obasi urged the Commission to consider carefully the proposal for the establishment of WWRP which would have far-reaching implications for WMO and the national Meteorological or Hydrometeorological Services (NMSs);

(c) The Tropical Meteorological Research Programme (TMRP) had been a very active programme within CAS. It was recommended that researchers in climate change and those involved in tropical cyclones and other severe storms should coordinate their future efforts.

The Secretary-General mentioned other important issues that the delegates should consider, such as the exchange of data, the preparation of the Fifth WMO Long-term Plan (SLTP) and the role of developing countries in CAS activities. He then wished the delegates a fruitful session and an enjoyable stay in Skopje.

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2. ORGANIZATION OF THE SESSION (agenda item 2)

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

The representative of the Secretary-General reported to the Commission on the status of the credentials received. In accordance with General Regulation 22, the Commission agreed to accept the credentials of the delegates named in the list prepared by the representative of the Secretary-General. It was considered unnecessary to establish a Credentials Committee.

2.2 Adoption of the agenda (agenda item 2.2)

The Commission adopted the agenda, which is reproduced in Appendix B to this report.

2.3 Establishment of committees (agenda item 2.3)

Nominations Committee

2.3.1 In accordance with General Regulation 24, a Nominations Committee was established consisting of Messrs. E. Müller (Germany), chairman, T. Kitade (Japan) and A. R. Karev (The former Yugoslav Republic of Macedonia).

Coordination Committee

2.3.2 In accordance with General Regulation 28, a Coordination Committee was set up composed of the president, the vice-president, the chairmen and co-chairmen of the two working committees and the representative of the Secretary-General.

Working Committees

2.3.3 Two working committees were set up to examine in detail specific agenda items:

(a) Committee A to deal with agenda items 5.1, 5.2, 5.3 and 8. Messrs Yan Hong (China) served as chairman and R. D. McPherson (United States) as co-chairman;

(b) Committee B to deal with agenda items 4, 5.4, 6 and 7. Professor A. Eliassen (Norway) served as chairman and Mr. E. R. Poolman (South Africa) as co-chairman.

The Commission agreed to discuss items 3, 9, 10 and 11 as a Committee of the Whole.

Committee for Coordinating proposals for rapporteurs and membership of working groups

2.3.4 A committee for coordinating proposals for rapporteurs and membership of working groups was established consisting of the president, the vice-president, Messrs. S. I. Avdushin (Russian Federation), G. De Moor (France), R. S. Fouli (Egypt), A. K. Kamra (India), P. J. Mason (United Kingdom), and R. D. McPherson (United States).

2.4 Other organizational matters (agenda item 2.4)

Under that agenda item, the Commission decided on its working hours. The Commission agreed that the decisions arrived at for each agenda item would be recorded in the general summary of the work of the session. A full list of documents presented at the session is contained in Appendix C to this report.

3. Report by the President of the Commission (agenda item 3)

3.1 The president of CAS, Mr. D. J. Gauntlett, presented an overview of the main Commission activities which had taken place during the past inter-sessional period. The president's report drew attention to the excellent progress that was being achieved in high priority areas such as tropical meteorology research and the further development and implementation of GAW. Of particular significance was the external funding support received for GAW from agencies such as the Global Environment Facility (GEF). That, and efforts by individual Members, had resulted in significant enhancement of the global network. As a result of both those developments and of a much greater emphasis on quality assurance and assessment procedures, there was now an increasingly broad recognition of the importance and value of GAW both by Governments and the broad scientific community.

3.2 The president also highlighted a number of CAS achievements in other fields, notably weather prediction research (on various timescales) and in the Programme
on Physics and Chemistry of Clouds and Weather Modification Research. In doing so, the president drew attention to some of the scientific advances which had lead to proposals for the creation of a new WWRP to develop improved and cost-effective techniques for forecasting high impact weather and to promote their application among Members.

3.3 In commenting on the outcome of the recent ninth session of the CAS Advisory Working Group (AWG), the president indicated that while the AWG was strongly supportive of the WWRP, it was also of the view that in order for the concept to succeed a fully inclusive approach would be required involving all of the time-scales associated with the weather prediction problem. It was further noted that while some changes might be required to CAS operating structures to accommodate the possible implementation of a WWRP, the AWG recommended that CAS’s present terms of reference be retained.

3.4 The Commission responded by expressing its appreciation to the president not only for his informative report but also for his considerable contributions both to the Commission and to WMO activities in general during his term as president of CAS. The Commission also indicated its considerable satisfaction with the progress being achieved with CAS programmes and in particular, in high priority areas such as the further development and implementation of GAW. The Commission also expressed its satisfaction with initiatives taken by the president in cooperation with the chairman of the CAS Working Group on Very Short- and Short-range Weather Prediction Research in formulating proposals for the creation of the WWRP including their preliminary consideration by the Executive Council.

3.5 Looking to the future, and noting the advice of its AWG, the Commission decided that its present terms of reference were appropriate and consistent with CAS’s perceived role in support of WMO Programmes. The Commission also felt it necessary in the light of ongoing reviews of the overall WMO organizational structure to emphasize the critical role played by WMO’s technical commissions, and CAS in particular, in the design and implementation of major programme activities. While every effort must continue to be made to ensure that such activities continued to be carried out in the most cost-effective way possible, it was also important to ensure that the practical impact of the technical commissions was not diminished in future WMO organizational arrangements. The Commission requested that those views be relayed to the Executive Council by its president.

3.6 Noting the valuable work carried out by the AWG, the Commission agreed that it should be re-established albeit with some minor changes to its terms of reference. The Commission, accordingly, adopted Resolution 1 (CAS-XII).

4. GLOBAL ATMOSPHERE WATCH (GAW) (agenda item 4)

4.1 ENVIRONMENTAL POLLUTION AND ATMOSPHERIC CHEMISTRY (agenda item 4.1)

4.1.1 The Commission noted with appreciation the excellent report presented by the chairman of the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry, Mr D. Whelpdale (Canada). In response, the Commission recommended that that joint Executive Council Panel of Experts/CAS Working Group be re-established and that the Executive Council give favourable consideration to the proposed composition. The Commission, accordingly, adopted Recommendation 1 (CAS-XII).

4.1.2 The Commission appreciated the synopsis of GAW that was provided and the involvement of GAW in relation to the Global Climate Observing System (GCOS). It encouraged that development and strongly supported the efforts of GAW to become more integrated with GCOS by providing the climate-related observations that were required. In particular, the plans for the integration of atmospheric chemistry data into dynamical models and the need for sophisticated sampling strategies and techniques were noted. The Commission also encouraged the plans to develop a GAW aerosol programme in support to GCOS.

4.1.3 The Commission acknowledged the significant contribution of the GAW in activities concerning stratospheric ozone depletion. Seven major scientific ozone assessments, which each represented the judgement of several hundred experts in appropriate disciplines, had been prepared since 1981 and were based on the past 40 years of GAW ozone data. Through them, there had been highly significant advances in the understanding of the impact of human activities on the Earth’s stratospheric ozone layer and the influence of the changes in chemical composition on the radiative balance of the climate system. Those assessments had been used extensively by the Parties to the Montreal Protocol in their decisions regarding the protection of the stratospheric ozone layer. An eighth assessment was in preparation. Another major assessment, that of global acid deposition, providing a critical review of worldwide acidic atmospheric deposition, had recently been completed. The magnitude, the geographical distribution, and the temporal changes in acid deposition in all regions of the globe for which data were available were examined. Again, the Commission noted that the basis upon which that assessment was prepared was on GAW data. It was recommended that such assessment activities be continued.

4.1.4 In building on those successes, the Commission expressed satisfaction that further efforts were under way to strengthen GAW monitoring and research activities. In activities relating to Agenda 21 and the United Nations Framework Convention on Climate Change (UN/FCCC) of the United Nations Conference on Environment and Development (UNCED) and, by using funds provided by GEF, six new WMO GAW stations of global importance had been established at pristine locations in the developing world. In addition, in what was referred to as the Southern Cone Ozone Project (SCO3P), eight new surface ozone, 15 new ultraviolet-B (UV-B) and nine new total ozone monitoring stations in the southernmost regions of South America had been established. A key aspect of that expansion had been the introduction of "twinning", whereby expertise from a developed country was...
"twinned" or partnered with that in a less developed country. It commended those countries involved in those twinning efforts for their commitments to GAW and expressed appreciation for the funding which made that expansion possible. The Commission recommended that efforts to expand the network be continued especially in the southern hemisphere where there were still major climatic and ecological regions not currently represented.

4.1.5 The Commission, aware that total quality assurance was an essential part of all measurement systems, expressed satisfaction in learning of the efforts to ensure that all GAW data were being obtained through strict adherence to a comprehensive quality assurance/quality control programme that had been introduced. Scientific input to the debate on environmental issues must be derived from an adequate knowledge basis. That could only be achieved through high-quality, strategically-oriented observations, and research related to the particular issues. The GAW programme was based on quality assurance/Science Activity Centres (QA/SACs) which were responsible for interacting with individual stations, for critical review and acceptance of data, and for resolving performance differences in their regions. They also prepared and executed plans for education and capacity building within countries that were committed to maintain and operate GAW sites. The Commission expressed its gratitude to those countries who were providing the central facilities necessary to accomplish that.

4.1.6 As a result of the developments toward implementing total quality assurance, the Commission expressed its satisfaction that there was now an increasingly broad recognition, both by Governments and within the scientific community at large, that GAW was an essential tool not only for monitoring the evolution of atmospheric composition, but also for improving the understanding of its interaction with all aspects of the environment. That conclusion was substantiated by the prominent role which GAW played in both the monitoring of global atmospheric composition and in relevant scientific assessment procedures.

4.1.7 The further success of GAW, the Commission noted, depended to a great extent on close interactions with the atmospheric scientific community both within and outside national Meteorological and Hydrological Services (NMHSs). The substantial collaboration with other WMO technical commissions and international organizations and programmes — United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), International Ozone Commission (IOC) (International Association of Meteorology and Atmospheric Sciences/International Council of Scientific Unions (IAMAS/ICSU)), the International Global Atmosphere Chemistry/International Geosphere-Biosphere Programme (IGAC/IGBP), and a large number of IAMAS activities that focused on atmospheric chemistry and climate — was therefore acknowledged. In addition, GAW closely collaborated with the World Health Organization (WHO) in pollution-related matters, with the International Atomic Energy Agency (IAEA) in matters such as isotope analysis of atmospheric trace gases and the forecasting of transport of radioactive trace gases in the atmosphere following a nuclear accident. In the long-range transport of pollutants, GAW continued to participate in, and support, international programmes such as the Co-operative Programme for the Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), the European Tracer Experiment (ETEX) and the Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) for marine pollution. Those too, the Commission asserted, needed to be maintained.

4.1.8 Another aspect of GAW that the Commission recommended to be maintained were the numerous meetings convened concerning GAW activities. Those meetings, ranging from sessions of the joint Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry, to full conferences and on to small expert meetings on specific topics, numbered more than 20 each year. They served the needs of the scientific and technical communities by providing a wealth of information on developments and were normally published in the series of GAW programme-supporting publications which were available. More than 125 GAW reports had been printed and distributed to date with numerous others in preparation.

4.1.9 Still another aspect of GAW, the Commission noted, was that dealing with academic capacity building in developing countries. Through the coordination of IGAC, the system for analysis, research and training (START), the Inter American Institute for Global Change Research (IAI) and GCOS/GAW a series of workshops, under the auspices of WMO, and a capacity building programme in developing countries for atmospheric chemistry had been prepared. The mechanism involved the establishment of a pool of voluntary lecturers recruited from the international scientific community to carry out the educational mission. It was an extremely challenging opportunity and one that was long term in nature. The first short course in instrumentation and measurement methodologies in atmospheric chemistry was conducted in Buenos Aires, Argentina in October/November 1995. The general consensus was that that course and others conducted since were very successful and accomplished most of the desired objectives. Additional training and education activities of GAW included the convening of training workshops and individual training for GAW station personnel.

4.1.10 To guide the evolution of GAW into the next millennium, the Commission was advised that a strategic plan had been proposed and accepted by Twelfth Congress. The plan had since been prepared and approved as a working document entitled *The Strategic Plan of the Global Atmosphere Watch (GAW)* (GAW Report No. 113, WMO/TD-No. 802) by the forty-ninth session of the Executive Council. The Commission accepted the strategic plan which covered the period 1997–2000, and which focused on the following core activities:
4.1.11 The Commission noted the activities planned in environmental pollution and atmospheric chemistry. Included was the development of a pilot project in East Asia to monitor regional smoke and haze pollution. This would involve all GAW stations in the Region where particulate material and possibly selected gaseous constituents would be sampled using passive samplers.

4.1.12 Also looking ahead, the Commission noted the need to pay due attention to the activities concerning the urban pollution initiative, a broad new thrust assigned to CAS by the forty-eighth session of the Executive Council; the possible inclusion of toxic chemicals (e.g. persistent organic pollutants (POPs), volatile organic compounds (VOCs) and heavy metals) in the measurement programme and modelling of their long-range atmospheric transport and deposition; the further development of the regional network (with a goal of at least one GAW global station per region); and the move toward incorporating satellite observations into GAW.

4.1.13 The Commission noted and encouraged the activities concerning the recommendation of the Executive Council Panel/CAS Working Group that GAW should play a major and increasing role in the long-term validation of satellite determinations of trace concentrations; such ongoing validation was critical for the reliable determination of trends. GAW was already fulfilling that function for total column ozone and ozone profiles.

**STATUS: network, ultraviolet, and assessments**

4.1.14 The Commission considered the status of GAW and noted that worldwide, based on a survey conducted as at 31 December 1996, the geographical distribution of stations in the network remained uneven. The widest coverage was that found in Regional Association (RA) VI (Europe) and the most sparse, in RA I (Africa) and RA III (South America). The Commission encouraged Members to address that situation with a view to improving the broad coverage. The survey also revealed that much data collected were still not submitted to the WMO World Data Centres (WDCs). The Commission urged its members to do their utmost to correct that situation. Still another revelation of the survey was that numerous GAW stations maintained measurements with hand-held sunphotometers, a practice which the forty-seventh session of the Executive Council recommended be discontinued in view of the inconsistency of the measurements. New instrumentation was being developed to correct the situation.

4.1.15 Appreciation was expressed for the funds provided through GEF which allowed several ozone stations to be established in South America as well as the six GAW stations of global importance that were established at pristine locations of the world (see paragraph 4.1.4). However, the Commission expressed some concern that the tropics and the southern hemisphere were still significantly lacking in regular observations of the vertical profile of ozone. In that regard, it was pleased to learn that Australia had recently established a four-year research programme of ozone sonde releases weekly at Macquarie Island. It expressed its hope that those could continue. The Commission also reiterated that well calibrated ozone instruments were essential for maintaining the high quality of the data available and called on all Members concerned to facilitate calibration of their instrumentation at least once every four years. Considering that point, the Secretary-General was requested to explore with interested Members the possibilities of ensuring the regular calibration of more than 44 instruments located in the former USSR.

4.1.16 In addition to the stations themselves, the Commission noted that the necessary support facilities to complement the QA/SACs (paragraph 4.1.5) such as the world calibration centres had also been established and those, along with the WDCs, completed the three GAW central facilities. They, collectively, ensured the creation of a credible and reliable global dataset from the GAW programme.

4.1.17 The Commission, being aware that the relationship between the decrease in stratospheric ozone and the increase of UV radiation reaching the surface of the Earth had become an important public and scientific concern, expressed satisfaction in learning that WMO had taken the lead in establishing, through GAW, a global UV monitoring network which would make an important contribution to understanding the global UV distribution.

4.1.18 It was also noted that the work on UV radiation in GAW had been organized in 1994 through an ad hoc Scientific Steering Committee (SSC) for UV measurements. The SSC was responsible for:

(a) Defining the requirements for the UV radiation flux measurements and data;
(b) Coordinating UV radiation flux measurement programmes;
(c) Setting up a QA/quality control (QC) programme;
(d) Organizing the data archiving system and data availability;
(e) Conducting intercomparisons;
(f) Documenting different aspects of the work of the SSC.

To be in concordance with the GAW strategic plan, the SSC was recently renamed the Scientific Advisory Group for Radiation.

4.1.19 The Commission noted that meetings on UV index were arranged in 1994 and 1997 in cooperation with WHO, the UV Monitoring and Assessment Programme, Industry Group (UMAP) and the International Commission on Non-Ionizing Radiation.
Protection (ICNIRP) to discuss the harmonization of present UV activities and to define future programme objectives of UV monitoring and index calculation. Experts from the field of measurements, modelling and calculations, quality control, UV forecasting, UV index and the user community made presentations and worked in groups to formulate new recommendations for the formation and use of UV indices.

4.1.20 The Commission strongly supported the activities to coordinate UV measurement and assessment.

4.1.21 The Commission recognized that GAW was not only a system for monitoring but also one for assessing chemical composition and related physical characteristics of the global atmosphere. Examples cited were the periodic assessments concerning stratospheric ozone depletion and the recent Global Acid Deposition Assessment. Such assessments also provided feedback on the quality and completeness of the data collected.

4.1.22 Another assessment activity, that concerning the preparation of annual bulletins on the state of the ozone layer over Antarctica during the Austral spring, was noted with appreciation by the Commission. Those bulletins were prepared by the WMO Secretariat. During the 1997 season, the bulletins were issued jointly with the WMO Ozone Mapping Centre (Greece). In addition, appreciation was also expressed for the preparation and distribution of daily ozone maps during the winter/spring period of the northern hemisphere. It requested that those activities be continued and called on all Members operating ozone stations to provide their data in a timely fashion. During a number of years, the Central Aerological Observatory of the Russian Federation Hydrometeorological Service (POSHYDROMET) had been carrying out the functions of an Operational Ozone Centre producing daily maps of total ozone for the countries of the Commonwealth of Independent States (CIS).

4.1.23 The Commission acknowledged with satisfaction the prominent role being played by WMO in collaboration with IOC of ICSU concerning the continuous work involved in the preparation of the periodic authoritative scientific ozone assessments which served as basic information for policy makers in revising the measures foreseen by the Montreal Protocol (see paragraph 4.1.3 above). It considered that that activity kept WMO and its Members in the forefront of the ozone issue and that it should be continued.

4.1.24 In still another high profile activity, the climate warming issue, the GAW programme was extensively involved. It provided systematic and reliable observations of greenhouse and related gases in the atmosphere that were archived at the World Data Centre for Greenhouse Gases (WDCCG) located in Tokyo, Japan; it sponsored the periodic international conferences held concerning carbon dioxide and had organized nine WMO carbon dioxide expert meetings since 1975. As an activity following the Third Conference of the Parties to the UN/FCCC, held in Kyoto in December 1997, the Commission encouraged Members to use the WDCCG data in order to make more reliable estimation of the sink of carbon dioxide to address the global warming issue.

4.2 TRANSPORT AND DISPERSION OF ATMOSPHERIC POLLUTANTS (agenda item 4.2)  
4.2.1 The Commission noted with interest the information provided concerning the transport and dispersion of atmospheric pollutants and involvement in EMEP as well as ETEX.

4.2.2 The Commission furthermore expressed its satisfaction and emphasized the importance of the continuation of the constructive cooperation between EMEP and the GAW programme in the future, particularly concerning:

(a) The participation in the evaluation of the three EMEP centres: the Chemical Coordinating Centre (CCC), the Meteorological Synthesizing Centre-West (MSC-W) and the Meteorological Synthesizing Centre-East (MSC-E);
(b) The complementary nature of the two programmes. Many atmospheric composition monitoring stations were both in the EMEP and in GAW programmes;
(c) The joint organization of workshops related to measurements and modelling, on data analysis, on quality assurance as well as heavy metals and POPs.

4.2.3 The Commission emphasized the importance of the coordinating role of WMO in emergency response activities and the GAW involvement in ETEX (sponsored by the European Commission, IAEA and WMO (1994–1997)). The Commission noted the successful conclusion of the experiment in 1997. ETEX significantly contributed both to the improvement of transport and dispersion models and to the reinforcement of communication and collaboration between national institutes and international organizations.

4.2.4 The Commission noted that the increasing importance of the long-range transport of pollutants paralleled the development of an increasing number of models to address those issues. In particular, there had been consistent emphasis on nuclear reactor accidents since Chernobyl by IAEA and WMO through the organization of WMO's Regional Specialized Meteorological Centers (RSMCs). There were now eight of those centers (Beijing, Bracknell, Melbourne, Montreal, Moscow, Tokyo, Toulouse and Washington) each with their own modelling capabilities. The ETEX Symposium (Vienna, 13–16 May 1997) had evaluated 47 different models. With the recent ratification of the Comprehensive Test Ban Treaty (CTBT), the development of more efficient jet aircraft engines very sensitive to volcanic ash from eruptions, the new improvements in transport and dispersion models as well as the further evaluation of their capability would be required.

4.2.5 In order to permit the modelling community to conduct sensitivity and verification studies, the Commission suggested, as a first step, to assemble a database of all known field experiments and the corresponding meteorological data in a common format by combining data from the recent re-analysis projects.
4.2.6 The Commission appreciated the offer made by the United States and Australia to assemble a small informal expert group to consider that issue and to report the results to the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry.

4.2.7 The Commission also noted that that would be a logical sequence to ETEX and that, as a second part to that effort, various statistical analysis software that was developed for ETEX could be developed and distributed as well as with the CD-ROM. In that way, each modelling group could produce results and make them available for review. Perhaps a model verification symposium could be sponsored, building upon the experience gained from the recent ETEX symposium.

4.3 Urban Environment (agenda item 4.3)

4.3.1 The Commission viewed with interest the report concerning WMO's role in urban environments. It expressed its satisfaction in learning of the involvement of CAS through its Working Group on Environmental Pollution and Atmospheric Chemistry which also served as the Executive Council Panel of Experts to increase attention to that issue, which was emerging as one of the most important within the overall context of increasing urbanization, increasing energy consumption and industrialization. It was considered that GAW had a critical role to play in the study and management of urban environments. Taking on a larger role in that area was not only responsive to the needs of many of the developing countries, but also recognized the fact that the management of urban environments required special attention and that NMHSs had an essential role to play in that context.

4.3.2 The Commission noted that urban activities, when taken collectively, had a profound impact on the environment at all scales, including global. However, if the global aspects were being well covered through programmes such as the World Climate Research Programme (WCRP), GAW and GCOS, a new emphasis was needed to address environmental problems of smaller length scale and short-time scales. GAW already had a substantial involvement in issues on the regional scale, such as transboundary pollution. The extensive GAW measurement infrastructure already in place, combined with the broad scientific expertise available in NMHSs — such as boundary layer meteorology, atmospheric numerical modelling, real-time data processing and advanced data assimilation techniques — provided the foundation upon which new urban activities could be developed.

4.3.3 The Commission recognized that while many NMHSs were already contributing in valuable ways to that area, they could be expected to play a larger role in the future. The expanded role would take different paths in different countries, but would include the traditional activities related to meteorological and hydrological monitoring, forecasting, and modelling, as well as activities related to monitoring and modelling of air and water quality, and more comprehensive environmental prediction. An important activity would be to review and improve the meteorological infrastructure to support an urban-environment focus. One important consideration was that the roles of the NMHSs varied widely from country to country depending on the overall structure of environmental activities.

4.3.4 Within that context, the international coordination role of GAW in environmental issues would become more extensive and complex. That was not only because of the anticipated greater levels of activity, but also because of the need to encompass a broader range of scientific disciplines in the resolution of sustainable environmental development issues. The same international coordination role which GAW had used effectively in the global arena would be effectively used to provide needed leadership in urban environments.

4.3.5 The Commission believed that a focused activity on urban environments might present new opportunities for the NMHSs and GAW. Because of the linkages between urban environments and sustainable development, it was anticipated that large investments by countries and international financial institutions would be directed towards the better management of urban environments. An increased activity by GAW would be responsive to that important environmental issue, and could lead to enhanced recognition of its central role in environmental issues within UNCED, and increase WMO's opportunities to enter into joint ventures and attract external resources. A partnership between the NMHSs and urban planners to foster prevention/correction of urban environmental problems was one example of the possible synergisms arising from that initiative.

4.3.6 Considering the foregoing, the Commission strongly recommended that WMO increase its role in urban environments through coordination and focus of present activities and that is should support a twopronged strategy. The first should focus on helping NMHSs increase their capabilities in that topic. That should then lead to Members themselves addressing environmental issues such as urban and transboundary pollution, through activities directed towards enhancing infrastructure and capabilities in monitoring and modelling and environmental prediction. The second prong should be directed towards utilizing GAW's international coordination and leadership roles in environmental problems to define better the relationships and linkages between urban environments and sustainable development, and between local, regional and global environmental problems (e.g., the links between urban pollution and climate change).

4.3.7 The Commission recommended, for the next financial period, that a new Urban Environment Meteorological Research programme be established within CAS activities, strongly associated with GAW and as part of the activities of the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry. The Commission furthermore recommended that an ad hoc expert group be established to prepare a programme for submission to the next session of Congress.
4.3.8 Because of the multidisciplinary character, cooperation with other WMO Programmes and with the relevant international organizations such as WHO would be essential. Within the CAS programme, that new emphasis would lead to more joint activities and projects between GAW and WWRP. In addition, other WMO Programmes would be involved, in particular the Hydrology and Water Resources Programme (HWRP) for urban hydrology, the WCRP and World Climate Programme (WCP) for climate implications, the World Weather Watch (WWW) for the operational aspects and the Education and Training Programme (ETRP) for the necessary training component.

4.4 Contribution to the Global Climate Observing System (GCOS) (agenda item 4.4)

4.4.1 The Commission noted that GCOS had been established after the Second World Climate Conference (1991) to ensure the acquisition of the observations required to meet the needs for:
(a) Climate system monitoring, climate change detection, and response monitoring, especially in terrestrial ecosystems;
(b) Data for application to national economic development;
(c) Research towards improved understanding, modelling, and prediction of the climate system. To meet those objectives, the GCOS planning took a comprehensive view of the observational requirements for climate information and addressed the required observations from the atmosphere, ocean, land surface, and cryosphere. Those observations must include both surface-based and space-based observations, as well as a comprehensive data system.

4.4.2 It was noted that the development of overall strategies for observations of the Earth system had received considerable attention over the last two years. Most attention had been paid to space-based observations, but of comparable importance was the wide variety of in situ observations made at the surface of the Earth and in its atmosphere and oceans. The Commission noted the need to address now the question of the overall balance in the carbon dioxide cycle. In that respect, the Commission recommended the enhancement of the activities of the terrestrial component of GCOS. A joint meeting co-sponsored by the Global Climate, Ocean and Terrestrial Observing Systems (GCOS, GOOS and GTOS) was convened to examine the extent to which requirements matched the needs and key actions needed to remedy deficiencies in current systems such as land-atmosphere exchanges of carbon dioxide. The participants at the meeting identified a number of issues and made recommendations that would allow GCOS to begin to implement the required in situ observations.

4.4.3 The Commission was informed that the Atmospheric Observation Panel for Climate (AOPC), established in 1994, was working actively with GAW. The relation between GCOS and GAW was documented in the GCOS Plan. The Plan outlined the following high priority enhancements and augmentations to atmospheric composition systems: obtain quality vertical distribution of tropospheric and stratospheric water vapour from multi-spectral microwave and advanced infrared sounding instruments; increase the number of GAW sites and broaden observations of greenhouse gases, aerosols and precipitation chemistry; and add stratospheric aerosol instruments to satellite missions and provide a continuous data base.

4.4.4 The Commission noted with interest that the GCOS Joint Planning Office in cooperation with GAW organized an ad hoc GCOS Working Group on Atmospheric Constituents which identified gaps in current long-term observations of GAW and discussed a monitoring strategy. Further information regarding GCOS could be found on the GCOS homepage (http://www.wmo.ch/web/gcos/gcoshome.html).

5. Weather Prediction and Tropical Meteorology Research (agenda item 5)

5.1 Very short- and short-range weather prediction research (agenda item 5.1)

5.1.1 The Commission noted with appreciation the report of the chairman of the Working Group on Very Short- and Short-range Weather Prediction Research and highly commended the work accomplished by the group and its chairman, Mr R. Carbone (United States).

5.1.2 The Commission, in view of ongoing advances in:
(a) The understanding of atmospheric processes;
(b) Improved techniques in data assimilation;
(c) Increased capacity to observe remotely and adaptively the weather;
(d) The computing capacity to represent numerically more detailed physical processes;
(e) The availability of advanced communications;
considered it both timely and necessary to establish a formal international programme such as WWRP. The WWRP would facilitate prediction improvements at all scales up to seasonal in duration with an initial emphasis on high impact weather, much of which was amenable to nowcasting, very-short and short-range predictions (zero to three days) at the meso- to regional scales. Particular benefits were likely to include the capacity of a formal international programme to energize national resource commitments to regional research initiatives (e.g. the Mesoscale Alpine Programme (MAP) and the Fronts and Atlantic Storm Track Experiment (FASTEX)) and to research problems common to many countries (e.g. tropical cyclone landfall, detailed forecasts in urbanized areas); to broaden the base of the specialized observation support available for relevant research studies; to enhance the prospects of increased funding support from external groups; and to facilitate aspects of technology transfer. The Commission therefore expressed its broad support for initiatives to establish a WWRP to develop improved and cost-effective techniques for forecasting high-impact weather and to promote their application among Members.

5.1.3 The Commission endorsed the following description with respect to the mission, objectives and strategies of the WWRP:
(a) **Mission**

To develop improved and cost-effective forecasting techniques, with emphasis on high impact weather and to promote their application among Members;

(b) **Objectives**

(i) To improve public safety and economic productivity by accelerating research on the prediction of high impact weather;

(ii) To facilitate the integration of weather prediction research advances achieved via relevant national and international programmes;

(iii) To demonstrate improvements in the prediction of weather, with emphasis on high impact events, through the exploitation of advances in scientific understanding, new observing systems, observational network design, data assimilation and modelling techniques, and information systems;

(iv) To encourage the utilization of relevant advances in weather prediction systems to the benefit of all WMO Programmes and all Members;

(v) To improve understanding of atmospheric processes of importance to weather forecasting through the organization of focused research programmes;

(c) **Strategies**

(i) Identify the types of weather events where multinational research collaboration is likely to lead to improved prediction and associated benefits to participants;

(ii) Develop and apply methods, in conjunction with other WMO Programmes, for assessing the cost-benefits of improved forecasts of high-impact weather events;

(iii) Promote, organize and/or endorse research programmes including, where necessary, field experiments to develop understanding of weather processes and improve forecasting techniques;

(iv) Organize and lead projects in conjunction with other WMO Programmes to demonstrate and verify objectively improvements in weather forecasting accuracy;

(v) Sponsor technical workshops and conferences to further understanding of the science and technology involved in improved weather prediction;

(vi) Organize training programmes to ensure that all Members could benefit from WWRP advances.

5.1.4 The Commission noted the preparatiors being made for MAP. The MAP data access policy (see Annex I to this report) was the first implementation to meteorological research experiments of the application principles of Resolution 40 (Cg-XII) — WMO policy and practice for the exchange of meteorological and related data and products including guidelines on relationships in commercial meteorological activities, as expressed in general summary paragraphs 12.1.32 to 12.1.35 of the Abridged Final Report with Resolutions of the Forty-ninth Session of the Executive Council (WMO-No. 867). The Commission endorsed those principles for their application to other research experiments within WWRP and would follow carefully their application during MAP.

5.1.5 The Commission emphasized that real advances in forecasting capability could be expected to combine elements of improved scientific understanding, forecast technique development, the demonstration of new forecast capabilities, and the transfer of technology along with related training.

5.1.6 Research and development projects within WWRP would serve to achieve improved understanding and technique development, and were expected to arise from two main sources — those developed by the WWRP and those which were endorsed by the WWRP as being of particular merit to weather prediction research and development. The selection of both types of projects would be made on the basis of their capacity to satisfy the following criteria:

(a) The capacity of the project to produce a significant outcome (e.g. the feasibility of the project’s goals and the means of verifying the level of success would be assessed);  

(b) Overall societal importance of the project (e.g. its capacity to improve understanding and/or forecasting of a high impact weather system);  

(c) The level of general applicability of the project outcome (e.g. the broad applicability of a new forecasting technique and the transfer of techniques to developing countries);  

(d) The projected level of scientific and funding support for the project, including estimates of the likely leverage from WWRP involvement;  

(e) The level of international involvement in, and support for, the project.

5.1.7 Forecast demonstration projects (FDPs) would also form an essential part of the WWRP and would serve to exhibit and quantify formally the benefits to be derived from improved understanding and enabling technologies. FDPs would contain both a real-time component and forecast information dissemination associated with user involvement.

5.1.8 In order to ensure that the full benefits of the programme were realized, the Commission emphasized the importance of active participation of all Members, in particular from developing countries and countries in...
transition, and recognized that it would be essential for the WWRP to pay close attention to technology transfer issues and coordinate its activities with other WMO activities, including those under the WWW Programme, ETPR, the Applications of Meteorology Programme, HWRP and WCRP, in particular through the CAS/Joint Scientific Committee (JSC) Working Group on Numerical Experimentation (WGNE). In addition, close cooperation would be required with a number of existing international research and application programmes, particularly through ICSU bodies, such as IAMAS.

5.1.9 The Commission noted with satisfaction the success of a number of major scientific conferences organized within the Programme on Very Short- and Short-range Weather Prediction Research, and the preparation, publication and wide distribution of technical reports, including the annual progress reports on numerical weather prediction, proceedings of workshops or symposia and reports of expert meetings. The Commission encouraged continuation in the future under the new established WWRP.

5.1.10 The Commission noted that new observing systems and increasingly sophisticated data assimilation techniques would no doubt provide very promising and powerful tools for research work in atmospheric sciences and oceanography, as well as for operational numerical weather prediction. In that connection, the Commission welcomed the offer of the Canadian Atmospheric Environment Service to host the third WMO International Symposium on Assimilation of Observations in Meteorology and Oceanography in June 1999 in Quebec City, and encouraged active participation in that symposium of experts from Members.

5.1.11 The Commission noted with appreciation the new initiative by Spain for a cooperative project on Mediterranean cyclones and hazardous weather studies, aimed at improving the prediction of high impact weather events within the Mediterranean region.

5.1.12 The Commission expressed support for the initiative taken by the Arab League Committee on Meteorology to establish a research project on dust and sand storms in the Arab countries, and requested WWRP, through its Science Steering Committee, to advise and provide its scientific expertise to the project. It was recognized that the research advances on sand and dust storms would not only benefit the Region but also many other Members.

5.1.13 The Commission endorsed the concept of a WWRP, and recommended that a WWRP be established under CAS as a programme which encompassed the present Programmes on Very Short- and Short-range Weather Prediction Research and on Medium- and Long-range Weather Prediction Research. Furthermore, the Commission decided that a Science Steering Committee should be established as a CAS Working Group to guide the operation of the WWRP and adopted Resolution 2 (CAS-XII).

5.2 Medium- and Long-range Weather Prediction research (agenda item 5.2)

5.2.1 The Commission noted with appreciation the report of the chairman of the CAS Working Group on Medium- and Long-range Weather Prediction Research, Mr J.-F. Geleyn (France), and highly commended the work accomplished by the group and its chairman. The working group addressed at length the need to distinguish better between climate prediction and extended-range forecasts and proposed to base such a distinction on “credibility versus predictability”. Considering long-range prediction issues, the Working Group wished to stress the importance of encompassing the evolution of the cryosphere, including a request to Members for a better real-time circulation of cryospheric data, as well as of other land-surface related data.

5.2.2 The Commission was pleased with the success of the WMO International Workshops on Imbalances of Slowly Varying Components of Predictable Atmospheric Motions (Beijing, March 1995) and on Dynamical Extended-range Forecasting (Toulouse, November 1997).

5.2.3 The Commission welcomed the new publication series of Long-range Forecasting Progress Reports, which had started in 1995, and agreed that those annual reports had served as one of the efficient and effective ways of exchanging research and operational experience and of transferring technology and methodology on long-range weather prediction. The Commission encouraged more Members involved in relevant activities to contribute to the reports.

5.2.4 The Commission was pleased to learn about the ongoing updating of the WMO Statement on the Status of Long-range Weather Forecasting.

5.2.5 The Commission noted that the progressive introduction of ensembles probably represented the most important advance in dynamical extended-range forecasting and encouraged continuous efforts to be taken in that research field of all forecast ranges as a better way to address the problem of predictability.

5.2.6 The Commission noted that efforts towards coupling the atmosphere with the oceans and the cryosphere with a forecasting perspective were progressing well in several advanced centres and that correctly analysed and filtered initial conditions for such coupled models would represent a major challenge in the coming years.

5.2.7 The Commission noted the need for developing a standardized reporting system for medium- and long-range forecast verification and requested the WWRP Science Steering Committee to consider that issue in the future in collaboration with the Commission for Basic Systems (CBS) and the CAS/JSC Working Group on Numerical Experimentation.

5.2.8 In view of the importance of technology transfer and of closing the gap between the forecasting capacities of developed and developing countries, the Commission supported the recommendation of that Working Group for WMO to organize a training workshop on long-range weather forecasting in 1999.

5.2.9 The Commission agreed with the Working Group that most of the scientific and socio-economic issues were common to all the forecast ranges and, therefore, agreed that the activities of medium- and long-range weather prediction research should be continued in the future within the WWRP.
MIDDLE-ATMOSPHERE STUDIES

5.2.10 The Commission expressed appreciation for the informative report provided by its Rapporteur on Middle-Atmosphere Studies, Mr H. Ritchie (Canada). In view of that information, the Commission considered the recommendations made and concurred that the performance of forecast models in the stratosphere should be compared, since the sensitivity to different choices of model top and resolution might become evident. It was also proposed that experimentation with alternative distributions and numbers of levels in the model stratosphere should continue, for both medium-range forecasts and longer-range simulations. Testing of promising model versions in data assimilation should be an important component of that work. Potential improvements in medium- and long-range forecasts resulting from carrying stratospheric ozone as a predictive variable, leading to improved radiative forcing in forecast models, should be examined. The Commission requested the CAS/JSC Working Group on Numerical Experimentation to address those recommendations.

5.2.11 The Commission noted a number of important scientific considerations:

(a) The ability of current operational global numerical models to maintain the integrity of conservative properties had been called into question, especially with respect to the prediction of trace constituent transport in the stratosphere;

(b) Increasing evidence that isentropic numerical simulations of the stratosphere provided for a more accurate simulation of transport of ozone and other trace constituents as well as better conservation properties for potential vorticity;

(c) Proper representation of water vapour and wave-breaking in numerical models of the stratosphere which were major issues for long-range and climate studies;

(d) Progress in our understanding of the dynamic of the stratospheric circulation;

(e) The strong sensitivity of tropopause height to the temperature of the Earth's surface — recently, temperatures throughout the stratosphere had continued to be below the long-term average; in the lower and middle stratosphere, temperatures were near the lowest recorded in their 17-year record of global stratospheric analysis;

(f) The Northern Hemisphere Winter Summary 1996 showed that the total ozone values continued to be very low over high latitude regions of the northern hemisphere during the winter 1995–1996;

(g) Lower stratospheric temperatures over the northern polar region also reached record low value. As already hinted at, several key areas of research into stratospheric ozone depletion had come to depend heavily on computation of Lagrangian parcel trajectories on contour advection (which isolated the purely advective effects in unprecedented detail). Those were important in calculating chemical budgets along parcel trajectories, and for mass exchange rates across the edge of the polar vortex and across the subpolar region.

5.2.12 The Commission expressed great concern regarding the decreasing number of radiosondes to reach the stratosphere as many countries seeked economies in observing system costs. The number of sondes reaching 10 hPa was very poor, which had adverse consequences both directly through the loss of those observations, and indirectly through problems in the calibration/validation of satellite sonders. It had also been found that bias corrections for radiosonde and tellurometer data was very poor, which had adverse consequences both directly through the loss of those observations, and indirectly through problems in the calibration/validation of satellite sonders. The Commission further supported the recommendation of the Stratospheric Processes and the Role in Climate (SPARC) Scientific Steering Committee that NMSs archived operational radiosonde data at the highest available resolution since they provided a potential source for research into gravity waves up to 30 km. The president of CAS was requested to liaise with the president of CBS on that matter.

5.2.13 The Commission further supported the recommendation of the Stratospheric Processes and the Role in Climate (SPARC) Scientific Steering Committee that NMSs archived operational radiosonde data at the highest available resolution since they provided a potential source for research into gravity waves up to 30 km. The president of CAS was requested to liaise with the president of CBS on that matter.

5.2.14 The Commission particularly noted the importance of the GAW WMO ozone soundings as the best description of the vertical structure of the ozone profile and as an invaluable source of information. The Commission further noted the need for using ozone data in the real-time assimilation systems in large NWP centres in order to provide better initial representation of the stratosphere, in particular the wind field. The Commission urged WMO to set up progressively a real-time exchange of ozone data and other data assimilation relevant to middle atmospheric parameters to satisfy the important numerical weather prediction (NWP) requirement. Ozone information was also available from limb sounders and nadir sounders. Water vapour measurements in the middle-atmosphere should benefit from the arrival of more advanced technologies. The real-time treatment of such data should also be considered.

5.2.15 The WMO stratospheric warming alert message (STRATALERT) and geophysical alert (GEOALERT)/stratospheric warming (STRATWARM) arrangements continued to be prepared and disseminated as messages via the Global Telecommunications System (GTS). Those were important to meet the needs of researchers engaged in various studies connected with stratospheric circulation modelling and analysis, tropospheric/stratospheric interactions, stratospheric ozone, MAP and climate studies. Daily messages contained the 10 hPa circulation description and incorporated all information for the northern hemisphere.

5.2.16 Considering the scientific advances reported and the scientific opportunities provided by advances in middle atmospheric numerical modelling and satellite observing systems, the Commission decided that it would be important to maintain a Rapporteur for Middle-Atmosphere Studies. It therefore approved Resolution 3 (CAS-XII) re-appointing a Rapporteur on Middle-Atmosphere Studies. The Commission further recommended that the Rapporteur be strongly linked with the CAS/JSC Working Group on Numerical Experiments.
Experimentation with a view to exploring the new scientific opportunities referred to above.

5.3 TROPICAL METEOROLOGY RESEARCH (AGENDA ITEM 5.3)

5.3.1 The Commission noted with appreciation the report of the chairman of the CAS Working Group on Tropical Meteorology Research (WGTMR), Mr. G. Holland (Australia) and highly commended the work accomplished by the Working Group since its re-establishment by the eleventh session of CAS to implement TMRP.

5.3.2 The Commission reviewed the activities of CAS Project TC1 (Tropical cyclone motion and intensity) and noted that, in response to Twelfth Congress, the WGTMR had continued to play an important role in research activities relating to tropical cyclones in collaboration with ICSU. Those activities had made a substantial contribution to IDNDR under the demonstration project "Tropical Cyclone Disasters". In that regard, the Commission was particularly pleased with the progress of the programme on the autonomous aerosonde, which was now nearing the stage where the unmanned aerosondes would soon be available to Members for operational use as another major contribution to the demonstration project. The Commission also noted that arrangements were well advanced for the holding, in China in April 1998, of the Fourth International Workshop on Tropical Cyclones (IWTC-IV). The Commission was also pleased that IWTC-IV would incorporate a human dimensions session on social and economic impacts of tropical cyclones. The Commission encouraged the further continuation of the IWTC series as quadrennial gatherings to provide forums for researchers and forecasters of tropical cyclones.

5.3.3 The Commission noted with appreciation the report of the Steering Committee for CAS Project TC2 (Scientific assessment of climate change effects on tropical cyclones). The comprehensive report concluded inter alia, that:

(a) Substantial multi-decadal variability was found in cyclone frequency, but there was no clear evidence of long-term trends;

(b) Recent studies indicated that the maximum potential intensity of tropical cyclones would remain the same or undergo a modest increase of up to 10-20 per cent. Those predicted changes were small compared with the observed natural variations and would fall within the uncertainty range in current studies;

(c) Current knowledge and available techniques were too rudimentary for quantitative indications of potential changes in tropical cyclone frequency or structure;

(d) The broad geographic regions of cyclogenesis, and therefore also of the regions affected by tropical cyclones, were not expected to change significantly.

The Commission also noted that the conclusions provided in that report had been published in a separate article in the January 1998 issue of the Bulletin of the American Meteorological Society. Members were urged to consider the full report in the context of their own operations. Further work was encouraged on climate change aspects of tropical cyclone and other severe weather systems.

5.3.4 The Commission noted the existing and future prospects for fruitful research in tropical cyclone landfall, in collaboration with the WWRP, and encouraged the intensification of such research activity, which would reduce the impact of tropical cyclones on coastal communities.

5.3.5 Concerning the monsoon component, the Commission was pleased with the excellent role of the Monsoon Activity Centres in support of CAS Project M2 (Long-term Asian/African monsoon studies). The Commission recommended that the role of the Centres should be broadened beyond the collection of delayed mode data and the issuance of annual reports. For example, the involvement of the Activity Centres in PROVOST (the European Programme on Prediction of Climate Variation on Seasonal and Interannual Time Scales), which involved the European Centre for Medium-range Weather Forecasts (ECMWF) and a number of other countries) and in Monsoon Modelling Intercomparison Projects could be looked into. The Commission reviewed the outcome of the WMO/Indian Meteorological Department (IMD) Fifth Regional Workshop on Asian/African Monsoon Emphasizing Training Aspects (New Delhi, 30 January–3 February 1995) and recommended the continuation of the series in view of the important role of training aspects. In that regard, the Commission noted plans for the sixth workshop in the series to be held in Nairobi, Kenya, early in 1999. The Commission noted that, in response to the recommendation of its eleventh session, the first in the series of quadrennial International Workshops on Monsoon Studies had been successfully held in Denpasar, Indonesia, from 24 to 28 February 1997 and that it had provided an excellent forum for interaction between researchers and forecasters.

5.3.6 With regard to the Project on Tropical Limited-Area Modelling (TLAM), the Commission noted with satisfaction the continuing progress being made in the transfer of expertise in limited-area modelling (LAM) to developing tropical countries mainly through the LAM workshop series being conducted in collaboration with the International Centre for Theoretical Physics (ICTP) in Trieste, Italy. The Commission endorsed the proposal of the WGTMR to establish a demonstration project in collaboration with the WWRP that would assist Members to transfer LAM to their countries for operational use, with special attention being given to training on model application and maintenance. Emphasis should be given to the continued participation of the receiving parties in the development work led by the donor countries.

5.3.7 The Commission noted that during the Workshop on Interaction between Tropical and Mid-latitude Weather Systems held in Tallahassee, Florida in December 1995, great interest was expressed in country reports to CAS on weather effects associated with the intrusion of fronts in the tropics as well as in the
movement of tropical cyclones into mid-latitudes. The Commission encouraged the continuation of the organization of the workshops in collaboration with the newly established WWRP.

5.3.8 The Commission noted that little progress had been achieved with respect to its Project AZ1 (Scientific support for the African Centre of Meteorological Applications for Development (ACMAD) and the Drought Monitoring Centres (DMCs)) mainly because of a lack of an organized group within the WGTMR. On the other hand, the Commission noted with satisfaction that WMO had co-sponsored with ICTP the International Symposium on African Drought (Trieste, July/August 1995) under its project AZ2 (Tropical rain-producing systems other than tropical cyclones and the intertropical convergence zone (ITCZ)). The Commission endorsed further collaboration with ICTP and other international institutions in advancing research on tropical and subtropical droughts and related rain-producing weather systems. The Commission also endorsed the proposal by the WGTMR to rationalize its projects AZ1, AZ2, and M3 into a new Project AZ1 (Tropical and subtropical droughts and related rain-producing systems, including the ITCZ). The Commission was pleased to note the publication *National Research Work in Tropical Meteorology: Twenty-fourth Report 1991–1994* (Tropical Meteorology Research Programme Report No. 56, WMO/TD-No. 753) which focussed on tropical droughts and monsoons and encouraged the continuation of such a publication, which helped to disseminate research findings to other Members.

5.3.9 The Commission noted that although drought and rainfall variation were very significant to the people and economies of South-West Asia, there was little available information on related processes. Therefore, the Commission encouraged research on drought and annual rainfall variation by WGTMR in coordination with Members in the Region.

5.3.10 Concerning the recent and envisaged future developments in tropical meteorology as advanced by the WGTMR, the Commission decided to redefine its project under the TMRP as follows (see Annex II to this report):

(a) Project TC1: Tropical cyclone forming, motion and intensity;
(b) Project TC2: Tropical cyclone climate change assessment;
(c) Project TC3: Land falling tropical cyclones;
(d) Project M1: Research initiative on the East-Asian monsoon;
(e) Project M2: Long-term Asian/African monsoon studies;
(f) Project M3: American monsoon studies;
(g) Project AZ1: Tropical and subtropical droughts and related rain-producing systems, including the ITCZ;
(h) Project LAM1: Application of limited-area modelling to tropical countries.

5.3.11 Having recognized the continuing need for a source of expert advice on relevant areas of the TMRP during the next four years, the Commission decided to re-establish the Working Group on Tropical Meteorology Research and adopted Resolution 4 (CAS-XII).

5.4 Other activities related to weather prediction (agenda item 5.4)

Activities of the CAS/JSC Working Group on Numerical Experimentation

5.4.1 The Commission thanked the chairman of WGNE, Mr D. Williamson (United States), for his informative report describing the activities of the Group, especially those relevant to weather prediction research. Many of the studies undertaken would contribute to WCRP. The Commission urged that there should be close liaison between WGNE and CAS groups including the WWRP Science Steering Committee and the WGTMR.

Model intercomparison activities

5.4.2 A key element in WGNE efforts to identify errors in atmospheric models and their causes were organized model intercomparisons. The most important activity in that respect was the Atmospheric Model Intercomparison Project (AMIP) conducted on behalf of WGNE through the Programme for Climate Model Diagnosis and Intercomparison at the Lawrence Livermore National Laboratory (United States), with the support of the United States Department of Energy. The 10-year period 1979–1988 had been simulated by virtually every atmospheric model in the world under specified conditions (observed sea-surface temperature, sea-ice distributions, etc.). That collection of simulations had provided an unequalled opportunity to evaluate the performance of models and assess model capability to represent seasonal mean states and large-scale interannual variability. As the AMIP infrastructure had matured, the benefits of the project had continued to unfold and there had been a substantial increase in cooperation and collaboration among atmospheric modelling and diagnostic groups. Many revealing investigations had been undertaken, leading to increasingly comprehensive evaluation of models.

5.4.3 Noting the success of the first phase of AMIP, the Commission welcomed the planning of an AMIP-II. The focus of AMIP-II would remain a community standard control experiment in conjunction with careful, specific analyses of various aspects of the simulations. There would also be a special effort to study the intrinsic variability in climate simulations and consideration would be given to coordinated systematic sensitivity experiments and multiple simulations. A 17-year simulation period (1 January 1979–1 March 1996) was planned using specific AMIP-II monthly mean sea-surface temperatures and sea-ice limits.

5.4.4 The Commission noted with interest the preliminary results from the comparisons of stratospheric activity being organized by the Australian Bureau of Meteorology Research Centre and the Japan Meteorological Agency under WGNE auspices. Pilot experimentation had included the preparation of forecasts up to 10–12 days ahead from 10, 11, 12 October 1994. A common fault was the excessive zonality in the
predicted fields. That seemed partly to be alleviated by increased vertical resolution in the stratosphere although phase errors in planetary waves were not reduced.

Comparison of Dynamical Cases of Atmospheric General Circulation Models

5.4.5 The Commission observed that the dependence of errors in atmospheric models on their basic dynamical cores and the sensitivity to the numerical schemes employed, coordinate systems and spatial resolution were still unresolved questions. Various test cases had been devised and had given useful hints but few definitive answers had yet emerged. Appropriate three-dimensional tests for global atmospheric models were badly needed: it would appear that those should be something between a complete model run to equilibrium and an idealized test, but which retained most of the characteristics of the parameterized forcing of complete models. Under WGN(E auspices, an informal working group including 20 members from 14 organizations in five countries had been set up to consider the formulation of suitable tests and/or experimentation. The Commission suggested that studies should include an assessment of the advantages/disadvantages of particular coordinate systems (e.g., use of isentropes as a vertical coordinate).

Atmospheric Model Parameterizations

5.4.6 In the area of refining atmospheric model parameterizations, WGNE worked in close association with the WCRP Global Energy and Water Cycle Experiment (GEWEX). Of particular note was the GEWEX Cloud System Study (GCSS) aimed at the development of the improved parameterizations of cloud systems in atmospheric models used in NWP or climate simulations. The coupled physical processes at play within different types of cloud systems were being investigated but the emphasis was on determining the effect of clouds acting as systems, not as individual elements. A joint WGNE/GCSS workshop on cloud processes in large-scale models was being planned for October 1998, focussing on the capabilities of current model cloud parameterizations and what gaps needed attention. The workshop would bring together general circulation modellers, the mesoscale/microscale cloud modelling community as well as experts in radiative transfer, relevant satellite and aircraft observational data with the intention of also reviewing the current uncertainties in cloud forcing and feedback in climate models.

5.4.7 The Project for Intercomparison of Land-surface Parameterization Schemes (PILPS), conducted by WGNE and GEWEX, had the goal of assessing parameterizations of the interaction between the atmosphere and the land surface in models. Off-line integrations with such parameterization schemes with observed forcing had been conducted and the results compared with observed fluxes. Substantial differences had been seen between various schemes mainly in the surface moisture budget with considerable variations from model to model in the partition of precipitation between evaporation and run-off or drainage. It was planned to investigate the performance of selected land-surface schemes in a common host atmospheric model.

Data Assimilation/Analysis

5.4.8 WGNE kept under close review progress in data assimilation and analysis. The Commission noted particularly the rapid progress in recent years in the development and operational implementation of variational assimilation schemes which permitted more effective exploitation of all types of observational data including satellite radiance measurements and scatterometer winds. That, in parallel with other improved methods of processing and using satellite data (in particular the television infrared observation satellite (TIROS) operational vertical sounder (TOVS)), had led to significant gains in forecast skill.

5.4.9 The Commission strongly encouraged the WGNE initiative to build a library of results from the main operational NWP centres on details of observation usage and the impact of different types of data seen in various centres. That would establish a foundation for forming a more general judgement on the impact of various types of observations.

5.4.10 The Commission appreciated the value and importance of carrying out re-analyses of available meteorological data with a fixed state-of-the-art data assimilation/analysis system and urged all centres that had produced re-analyses to provide those multi-year homogeneous datasets to carry out a range of comparative investigations of many aspects of climate, particularly interannual variability, and for model validation and predictability studies. The Commission congratulated the three centres who had completed major efforts in that respect: ECMWF, re-analysis for the period 1979–1993; National Centres for Environmental Prediction (NCEP)/National Centre for Atmospheric Research (NCAR), re-analysis for the period, 1957–1996; National Aeronautics and Space Administration (NASA)/Goddard Space Flight Center, re-analysis for the period, 1985–1993. WGNE played the principal role in the organization of the first WCRP International Conference on Re-analyses, held in Silver Spring, Maryland, from 27 to 3 October 1997. The Conference reviewed the results of the re-analyses, their strengths and deficiencies, and the lessons learned. The Conference agreed that the re-analyses, despite certain shortcomings, formed a uniquely valuable resource for many activities and urged that re-analyses be undertaken on a systematic basis. The value of having two or three parallel re-analyses as a basis for cross-comparison was stressed.

Performance of Operational Models

5.4.11 WGNE also kept under review various aspects of performance of the main operational models. The Commission observed that there continued to be a gradual increase of skill in short- and medium-range forecasts, and a tendency for convergence in the performance of most models in the northern hemisphere. However, last year appeared to have been more difficult for many models, possibly reflecting either a variation in the natural intrinsic atmospheric predictability for that period or a reduction in worldwide data availability or quality for NWP purposes. The Commission also noted the results of
an analysis of typhoon track forecasts carried out by the Japan Meteorological Agency on behalf of WGNE. The distance error in the typhoon track forecast compared to "best-track" data showed a marked improvement in recent years.

**Comparison of Mesoscale Prediction and Research Experiment (COMPARE)**

5.4.12 The Commission was advised of the latest results from the COMPARE project overseen by WGNE. In COMPARE, comparative experiments with regional mesoscale models were carried out in a collaborative manner in order to further understanding and predictive capability at that scale. Findings from the second case study, an example of mountain forcing using data from the Franco-Spanish Pyrenées Experiment (PYREX) indicated that the representation of sub-grid scale orographic effects was still open to question. The partition of the modelled flow between the blocked and cross-range components showed great sensitivity to the parameterization employed. Further light on the questions raised could be shed by MAP. A further experiment, led by the Japan Meteorological Agency, was now under way, based on data from the Tropical Cyclone Motion Experiment (TCM 90), SPECTRUM and TYPHOON-90, and should provide a basis for assessing the ability of the current generation of mesoscale models to simulate explosive tropical cyclogenesis, particularly storm intensity.

**Modelling Large-Scale Atmospheric Transport**

5.4.13 From the perspective of its interest in environmental pollution issues, WGNE investigations of the ability of atmospheric models to simulate the global distribution of inert or chemically-interacting gases attracted the Commission's attention. That ability depended on the adequacy of the numerical simulation of advection and the parameterization of many sub-grid scale processes such as deep convection, boundary layer effects, gravity wave drag, horizontal diffusion and scavenging by clouds. Three workshops had now taken place. The first (Bermuda, December 1991) focussed on global scale transport by resolved processes in models, the second (Virginia Beach, United States, November 1993) was concerned with the parameterization of vertical sub-grid scale tracer transport, and the third (Cambridge, United Kingdom, August 1995) assessed the parameterization of the scavenging of trace constituents by clouds. A fourth workshop, jointly sponsored by WGNE and IGAC, was being arranged (Halifax, Canada, September 1998) to examine the simulations of distributions of atmospheric aerosols.

**Contacts with Numerical Modelling Groups**

5.4.14 The Commission expressed satisfaction with the WGNE efforts to maintain contact with research and numerical modelling groups, as well as individual scientists active in many countries in numerical experimentation related to weather prediction and climate simulation. The Commission considered that the wide distribution of the working group's "blue-cover" numerical experimentation series, including the periodic progress reports Research Activities in Atmospheric and Oceanic Modelling and other reports summarizing the results of particular investigations or conclusions of seminars or conference on numerical experimentation, was a valuable mechanism for the exchange of such information. The Commission acknowledged with gratitude the contribution of the Atmospheric Environment Service of Canada in compiling, editing and producing those reports.

6. **Physics and Chemistry of Clouds and Weather Modification Research** (agenda item 6)

6.1 The Commission noted that two additional experts were named to the Executive Council Panel of Experts/CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research by the forty-seventh session of the Executive Council.

6.2 The Commission noted with appreciation the excellent report presented by the chairman of the Executive Council Panel of Experts/CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research, Professor H. Orville (United States). In response, the Commission recommended that that joint Working Group be re-established and that the Executive Council give favourable consideration to the proposed composition. Accordingly, the Commission adopted Recommendation 2 (CAS-XII).

6.3 The eighteenth session of the Executive Council Panel/CAS Working Group was held from 30 January to 3 February 1995 in Geneva, Switzerland to review the current activities in the physics and chemistry of clouds of interest to Member and to review the status of weather modification. In addition, plans were made for the next few years. Rapporteurs and Members gave reports on cloud chemistry; warm cloud modification; weather modification activities in CIS and cloud modelling. Some time was devoted to the discussion of cloud physics impact on aviation, atmospheric electricity, the next cloud modelling workshop, and activities in aerosol and stable isotope studies. Finally, the guidelines for Member were revised for advice and assistance related to the planning of weather modification activities, as requested by the eleventh session of CAS. Those guidelines were approved by the forty-seventh session of the Executive Council.

6.4 The nineteenth session of the Panel was held from 5 to 9 May 1997 in Geneva, Switzerland. In addition to the reports of the rapporteurs concerning various forms of weather modification and cloud physics and chemistry topics, it considered various operational weather modification initiatives, the most prominent being one for the increase of precipitation in the Mediterranean region and countries east of the Mediterranean. A review of the last three Registers of National Weather Modification Projects, one for the year 1992, one for the combined years of 1993 and 1994 and one for the year 1995 showed continued interest in weather modification with activities in about 26 countries and nearly 90 ongoing projects. Those were the...
statistics collected from the report contributions by WMO Member countries. Several known projects were not included however. Hygroscopic seeding received more attention by the Panel, as a new flare technique had produced encouraging results for increasing rain in South Africa. Several meetings concerning cloud physics topics were co-sponsored by WMO and several more were planned in the next few years. Connections of the Panel with the new WWRP were discussed and were strong because one of their objectives was to improve the forecasts of high impact weather. Planning for the Seventh WMO Scientific Conference on Weather Modification had focussed on early 1999 in time of the conference. The Panel issued a Declaration of Concern regarding the review of the activities in hail suppression in several regions and made recommendations concerning future developments indicated there, a review of the status of climate-based technologies to benefit water resource management was held in Pretoria, South Africa in April 1997. The Governments of South Africa and the United States, in collaboration with WMO and the American Meteorological Society, convened the workshop, which could be of substantial benefit to water resources worldwide. Encouraging new research results were presented and note was made of the need for further trial and research.

6.5 The sixth in the series of WMO Scientific Conferences on Weather Modification was held in Paestum, Italy from 30 May to 4 June 1994. WMO received over 200 contributions on weather-modification projects from scientists in 37 countries from all WMO RAs, and 178 scientists from 30 countries participated. Two volumes of preprints had been published and were available from WMO. A special issue of the Journal of Applied Meteorology, published in September 1996 by the American Meteorological Society, was devoted to expanded papers from the Conference. Other papers, too late for the special issue, were still under review and would be published in the future.

6.6 WMO sponsored a meeting in South Africa to review the status of hail suppression and was attended by 13 scientists from around the world. The participants reviewed the activities in hail suppression in several regions and made recommendations concerning future activities. All agreed that the technology existed to conduct a more comprehensive and revealing field experiment in hail suppression than had been done in the past. Physical studies of the seeding process, the development of hail and the air motions in severe storms could be pursued with Doppler radars, instrumented aircraft, ground-based hail sensors and precipitation measurements. Fast computers aided in data collection and analysis and in the development of hypotheses using realistic hailstorm models. The Panel urged the development of plans for a modern day experiment and cooperation with an appropriate existing cloud physics experiment. A report concerning the meeting had been published by WMO.

6.7 WMO co-sponsored the Fourth International Cloud Modelling Workshop, held in August 1996 in Clermont Ferrand, France. That was the first of the workshops to consider cloud chemistry for one of the test cases, which reflected the expanded responsibilities of the Panel. Numerical simulations of the precipitation processes were also concentrated on. The workshop was attended by 78 scientists from 15 countries.

6.8 The WMO Workshop on the Measurement of Cloud Properties for Weather, Air Quality and Climate Forecasts was conducted in Mexico City from 16 to 20 June 1997. The workshop was attended by about 60 scientists from 42 countries and was very productive. The objective was to organize a meeting between the cloud physics community and the communities specialized in the domains of weather, air quality or climate forecasts, in order to define better their needs in cloud measurements and to prepare plans to answer them. A report concerning that workshop had been published by WMO.

6.9 WMO co-sponsored, with the European Union and the Associazione per la diffusione della tecnica e della professionalità nell’agricoltura italiana (TECNAGRO) of Italy, a workshop on the Theoretical and Practical Aspects of a Regional Precipitation Enhancement Programme for the Middle East and the Mediterranean. The workshop was held from 11 to 15 November 1996 in Bari, Italy. It recommended that a similar workshop be organized to identify the problems encountered in South-West Asia.

6.10 An International Workshop on Weather and Climate-based Technologies to Benefit Water Resource Management was held in Pretoria, South Africa in April 1997. The Governments of South Africa and the United States, in collaboration with WMO and the American Meteorological Society, convened the workshop, which could be of substantial benefit to water resources worldwide. Encouraging new research results were presented and note was made of the need for further trial and research.

6.11 The First International Conference on Fog and Fog Collection was planned for 19–24 July 1998 in Vancouver, Canada. The meeting was being co-sponsored by WMO under the auspices of the Panel.

6.12 A review of the Panels’ previous plans, as well as for the next four years, showed that most items discussed at the eighteenth and nineteenth sessions had been acted upon. The Seventh WMO Scientific Conference on Weather Modification was being planned, as indicated above, for early 1999. Shortly after that, and based on the developments indicated there, a review of the status of weather modification would be conducted.

6.13 The Commission noted the interaction of clouds and fog with vegetation, especially at high altitudes. That process was contributing to the hydrological cycle as well as to the deposition of pollutants to ecosystems which, in turn, could contribute to forest decline in sensitive areas. By application of the various water harvesting techniques, a gain of water was possible in areas with low precipitation.

7. CLIMATE RESEARCH (agenda item 7)

7.1 STRATEGY AND ACTIVITIES OF THE WORLD CLIMATE RESEARCH PROGRAMME (WCRP) (agenda item 7.1)

7.1.1 The Commission noted with interest the report provided on the activities of the WCRP, jointly undertaken by WMO, the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) and ICSU. The principal aim of the WCRP was to develop the fundamental scientific understanding of the physical climate system needed to predict global and regional climate variations on all time-scales, including those
The Commission provided input to the planning and development of the WCRP through the participation of a nominated representative in the annual sessions of the WMO/ICSU/IOC/JSC which formulated the overall scientific goals for WCRP. That representative briefed JSC on relevant activities being conducted under the auspices of the Commission.

7.1.2 The Commission was informed of the major Conference on the WCRP in August 1997, jointly organized by the three sponsoring bodies, to review the accomplishments of the programme and the challenges to be faced. The Conference re-affirmed the research priorities in the WCRP and agreed that the WCRP project structure laid out by the JSC provided an efficient and flexible framework to tackle the outstanding scientific issues, and to respond to questions identified in the Scientific Assessments of the Intergovernmental Panel on Climate Change (IPCC).

7.1.3 Within individual WCRP projects, particular items of interest for the Commission included the conclusion of the observational phase of the World Ocean Circulation Experiment (WOCE) in 1997, with 90 per cent of the global hydrographic survey planned at the inception of the programme having been carried out. The operation of satellites for WOCE purposes had also been highly successful, in particular the quality and precision of altimetric measurements which had provided the basis for improved tidal predictions. GEWEX had continued to build up a range of basic global climatological datasets, combining conventional in situ measurements, satellite observations and operational meteorological analyses. Among those, were the International Satellite Cloud Climatology Project (ISSCP), the Global Precipitation Climatology Project (GPCP) and the GEWEX Water Vapour Project (GVaP), all of which could be of importance for activities in WWRP. GEWEX had also promoted a range of regional experiments aimed at studying energy and water budgets under a variety of geographical and climatic conditions, namely the GEWEX Continental-scale International Project (GCIP) embracing the Mississippi river basin, the Baltic Sea Experiment (BALTEx) centred around the Baltic Sea, the GEWEX Asian Monsoon Experiment (GAME), the Mackenzie River GEWEX Study (MAGS), and the Large-scale Biosphere-Atmosphere (LBA) experiment in the Amazon. In the Arctic Climate System Study (ACSYS), the field programme was advancing with a range of Arctic Ocean hydrographic and shelf surveys having been undertaken. An extensive historical Arctic Ocean climate database had also been compiled including previously classified Arctic Ocean Russian and United States observations for the period 1948 to 1993. The Climate Variability and Predictability (CLIVAR) study aimed at understanding and predicting the coupled behaviour of the rapidly changing atmosphere and slowly varying land-surface, oceans and ice masses as they responded to natural processes and human influences. The first steps had been taken to put in place the appropriate mix of observing systems to provide the range of oceanographic and other data needed. As part of the CLIVAR monsoon focus, process studies and observations of key ocean, atmosphere and land surface variables in monsoon regions were also being planned in consultation with the CAS Working Group on Tropical Meteorology Research.

7.1.4 The Commission welcomed the synergy between the WCRP study on SPARC and GAW activities which provided the range of measurements of environmental parameters and atmospheric composition that underpinned SPARC investigations. In close collaboration with GAW and IGAC, SPARC was undertaking work on understanding upper tropospheric/lower stratospheric chemistry and stratosphere-troposphere exchange, which was essential in understanding anthropogenic effects on stratospheric circulation and composition, the feedback to the troposphere, and the impacts of aircraft emissions on the ozone layer. Also, as a complement to the GAW implementation of a surface global UV monitoring network, SPARC was assessing the possibility of determining UV flux in the troposphere and lower stratosphere as a function of altitude. That would require taking advantage of in situ measurements from aircraft and (long-duration) balloon-flights using nadir- and limb-viewing instruments, as well as satellite observations, in combination with a programme for the development and validation of the appropriate radiative transfer models.

7.1.5 The unifying theme running through the WCRP was the development of comprehensive global models of the full climate system, building on scientific and technical advances in the other main WCRP projects. Those models were the fundamental tool for understanding and predicting natural climate variations and for providing reliable estimates of anthropogenic climate change. In order to ensure a more integrated approach to that key component of the WCRP, activities had been polarized round two main groups: the joint CAS/JSC WGNE and the WCRP Working Group on Coupled Modelling (WGCM). The activities of the WGNE, concerned with the development of the atmospheric component of climate models and the closely related atmospheric models used for numerical weather prediction in support of both WCRP and CAS weather prediction research, were reviewed by the Commission under agenda item 5.4. It was intended that WGNE would provide the feedback from WCRP results into improvements in operational predictions and would be the interface between WCRP and the WWRP. WGCM had the task of overseeing the development of fully coupled atmosphere/ocean/land/cryosphere models to study climate variations on time-scales from several years to a century and to provide projections of anthropogenic climate change.

7.2 Climate activity interactions (agenda item 7.2)

7.2.1 The Commission was informed on the creation of a Commission for Climatology (CCI)/CLIVAR Working Group on Climate Change Detection and noted its role to serve as an advisory group on data and activities related to the detection and assessment of climate change. In particular, the Commission noted the
initiative to develop climate change detection indices whose immediate goal was to stimulate related research which could potentially be considered for the IPCC Third Assessment. The Commission encouraged its Members to consider ways of collaborating on that research initiative. The Commission also noted the requirement to provide the Conference of the Parties to the UN/FCCC, at its fourth session, an assessment of the long-term sustainability of observational systems needed for climate analysis and research. It welcomed the working group's intention to contribute and encouraged consideration of the GAW network in preparing the report.

7.2.2 The Commission was informed on the progress being made by WMO in preparing a popular book on the climate of the twentieth century. Noting that it was proposed to include articles detailing the progress made in understanding the climate system during the twentieth century, the Commission encouraged its Members to look for opportunities to be involved in the project, including the planned peer review process. The Commission also looked to WMO to provide due prioritization to enable prompt publication.

8. OTHER RESEARCH ACTIVITIES (agenda item 8) DEFINITION OF FORECASTING RANGES

8.1 The Commission reviewed the definition of forecasting ranges adopted by the eleventh session of CBS. Several comments were made by the delegates concerning the difficulty of such classifications: different criteria could be considered depending on the atmospheric processes involved and the type of operational techniques used to provide the forecast, for instance ensemble forecasting or deterministic high resolution mesoscale limited-area model, etc. In addition, remarks were made that with our understanding of atmospheric processes and numerical forecasting techniques improving with time, classifications were also evolving. Therefore, the Commission decided not to try to produce its own version of the classification but rather simply to provide some comments on the proposed new definition to CBS.

8.2 The following comments were made:

(a) To better reflect the current forecasting practice, the three categories of forecasting ranges could be redefined and simplified as: weather forecasting (0 to 14 days), long-range outlooks (week to multi-season) and climate simulations (multi-year);

(b) Under the “weather forecasting” category, nowcasting, very short-range weather forecasting and short-range forecasting could have definitions similar to those adopted by the eleventh session of CBS, but medium-range weather forecasting could be better defined as “from three to 14 days”;

(c) Another proposal was to change time-scale to distinguish “long-range weather forecasting” and “climate forecasting” from two years to one year.

8.3 The Commission therefore requested its president to consult further with CBS and CCI, with a view to achieving standard definitions as requested by the forty-ninth session of the Executive Council.
data banks and metadata might need to be explored;

(e) The Commission requested the Executive Council to consider adding a timeliness component to paragraph 7 by inserting the words “and up-to-date”, in order to read “... accessible and comprehensive and up-to-date information ...”.

**PARTICIPATION OF WOMEN IN THE WORK OF THE COMMISSION**

8.7 The Commission noted the contribution of women to the field of meteorology and adopted Resolution 5 (CAS-XII) to further support the achievement of equal opportunity for participation in CAS programmes and activities.

9. **SCIENTIFIC LECTURES** (agenda item 9)

The following three lectures were presented during the session:

(a) FASTEX: An international research project to improve cyclogenesis forecasting, by Dr A. Joly, Météo-France, France;

(b) Interannual variations of Asia-Pacific climate, by Dr B. Wang, University of Hawaii, United States;

(c) Atmospheric chemistry — from the local scale to the regional scale to the global scale and back, by Professor G. Carmichael, University of Iowa, United States.

Those lectures were of very high quality and greatly facilitated the discussions of agenda items 5.1, 5.2, 5.3 and 5.4.

10. **WMO LONG-TERM PLANNING** (agenda item 10)

10.1 The Commission noted that activities relating to the monitoring and evaluation of the long-term plans as well as the preparation of the SLTP were progressing well. The Commission further noted the draft SLTP and recognized that the orientations recommended by its present session were reflected in the document. The Commission requested its president, with the support of the WMO Secretariat, to continue its follow-up of the finalization of the Plan to be submitted for the approval of Thirteenth Congress.

10.2 The Commission made some specific comments on issues that should be considered in the preparation of the SLTP. They included:

(a) The Plan should better reflect the adverse effect of reductions in the global observing system, in particular for research programmes;

(b) The three-dimensional description of the atmosphere was highly dependent on satellite observations and in that respect, more effort should be devoted to the extraction of data from satellite platforms, in coordination with CBS;

(c) Proposed activities involving the study of the Asian and Australian monsoons should be extended to also include relevant South American considerations;

(d) Many aspects of CAS activities had a strong societal implication such as the WWRP and GAW. In cooperation with CBS, such strong societal issues should be coordinated and kept at the forefront of CAS programme objectives;

(e) In the future activities of the Programme on the Physics and Chemistry of Clouds and Weather Modification Research the profile of cloud chemistry required greater prominence;

(f) Seasonal forecasting and its promotion toward operation should receive appropriate emphasis in the future activities of the WWRP;

(g) More consideration should be given to multidisciplinary research involving hydrology and meteorology to address the critical question of water availability;

(h) In view of its importance, a specific project on the urban environment meteorological research should be established;

(i) The WWRP should ensure coordination between its activities in medium- and extended-range forecasting activities of the global ocean atmosphere, land system component for CLIVAR (CLIVAR-GOALS);

(j) In view of the recommendation of the Executive Council Working Group on Long Term Planning at its second session (November 1997) to consider the merge of CBS and the Commission for Instruments and Methods of Observation (CIMO), the president of CAS should ensure that the Executive Council gave consideration to the appropriateness of CAS assuming existing CIMO responsibilities in such areas as research into instruments and methods of observation, and the development of reference standards and methods of calibration.

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

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 6 (CAS-XII) and in Recommendation 3 (CAS-XII).

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

The Commission unanimously elected Messrs A. Eliassen (Norway) and Yan Hong (China) as president and vice-president, respectively of the Commission. The newly elected officers accepted with pleasure to serve the Commission until the end of its thirteenth session.

13. **NOMINATION OF MEMBERS OF WORKING GROUPS** (agenda item 13)

13.1 The Commission established working groups (two of which were expected to be asked to fulfill the joint functions of Executive Council Panel of Experts/CAS Working Groups) and appointed rapporteurs to carry out its work between the twelfth and thirteenth sessions:

(a) Advisory Working Group of CAS;

(b) Executive Council Panel of Experts/Working Group on Environmental Pollution and Atmospheric Chemistry;

(c) Science Steering Committee for the WWRP;

(d) Working Group on Tropical Meteorology Research;
(e) Executive Council Panel of Experts/Working Group on Physics and Chemistry of Clouds and Weather Modification Research;
(f) Rapporteur on Middle-Atmosphere Studies.

13.2 The Commission established the membership of the working groups, recommended membership for the joint Executive Council Panels of Experts/CAS Working Groups and appointed rapporteurs as indicated in the relevant resolutions of the session.

13.3 Between sessions of the Commission, and notwithstanding General Regulation 33, the president was authorized to make any necessary changes in the composition of the working groups, including the appointment of new chairmen and the designation of suitable experts to participate in the work of the relevant working groups.

13.4 The Commission expressed its appreciation to the committee for coordinating proposals for rapporteurs and membership of working groups for the excellent manner in which it had completed its difficult task.

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

The Commission welcomed the invitation from Turkey to host its next session. It was agreed that the exact date and place of the session should be negotiated between the president of the Commission, the Secretary-General, and the potential host country.

15. CLOSURE OF THE SESSION (agenda item 15)

The president declared the twelfth session of the Commission for Atmospheric Sciences closed at 12.45 p.m. on 3 March 1998.
RESOLUTIONS ADOPTED BY THE SESSION

RESOLUTION 1 (CAS-XII)

ADVISORY WORKING GROUP OF THE COMMISSION FOR ATMOSPHERIC SCIENCES

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 presidents of technical commissions,
(2) The future policies, strategy, objectives and outline plans of CAS adopted by the Twelfth World Meteorological Congress,

CONSIDERING:
(1) The importance attached to the role of CAS in directing attention to outstanding research problems and in facilitating the distribution of scientific knowledge,
(2) The revision of the above policies and strategy to include the period of the Fifth WMO Long-term Plan,
(3) That the Executive Council has requested CAS to exercise a coordinating role for WMO research programmes,

DECIDES:
(1) To re-establish the Advisory Working Group of CAS with the following terms of reference:
   (a) To assist the president of CAS in providing advice on urgent matters which cannot be dealt with by regular working groups or by correspondence among members of the Commission;
   (b) To advise on, and to assist the president in, reviewing the progress of the work, in particular of working groups and rapporteurs, in organizing conferences, symposia and meetings of experts and in planning the future programme of the Commission;
   (c) To respond quickly and effectively concerning any relevant project which the Commission might be invited to undertake;
   (d) To assist the president in maintaining a review of the research activities within WMO and of interest to the Organization and in formulating the relevant parts of the WMO Long-term Plan;
   (e) To maintain overall responsibility for ensuring the transfer of research results, techniques and information between Members in the fields of atmospheric and related sciences, including environmental aspects;
(2) That the composition of the Advisory Working Group should be as follows:
   A. Eliassen (Norway), president of CAS;
   Yan Hong (China), vice-president of CAS;
   D. J. Gauntlett (Australia), past president of CAS;
   D. M. Lesolle (Botswana);
   L. W. Uccellini (United States);
   D. Whelpdale (Canada);
(3) To authorize the president to call on other experts, keeping in mind General Regulation 34, to participate in any particular task when he feels that such additional assistance is necessary;

REQUESTS the president to report to the Commission on the activities of the Advisory Working Group not later than six months before the thirteenth session of the Commission.

RESOLUTION 2 (CAS-XII)

SCIENCE STEERING COMMITTEE FOR THE WORLD WEATHER RESEARCH PROGRAMME

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING:
(1) The report by the Chairman of the Working Group on Very Short- and Short-range Weather Prediction Research,
(2) General summary paragraphs 3.3.0.8 and 3.3.0.9 as well as 3.3.2.1 to 3.3.2.6 of the Abridged Final Report with Resolutions of the Twelfth World Meteorological Congress (WMO-No. 827),
(3) General summary paragraphs 5.1.5 and 5.3.1 of the Abridged Final Report with Resolutions of the forty-ninth session of the Executive Council (WMO-No. 867),
(4) The report of the ninth session of the CAS Advisory Working Group,

CONSIDERING:
(1) The demand for a formal international programme to promote a concerted new effort on the weather
prediction problem, with emphasis on high impact weather, to the benefit of all Members,
(2) The demand for a formal international programme to energize national resource commitments to regional research initiatives and to research problems common to many countries,
(3) The need to broaden the basis of the specialized observation support available for relevant research studies,
(4) The need to enhance the prospects of increased funding support from external groups,
(5) The need to facilitate aspects of technology transfer,
DECIDES:
(1) To pursue the implementation of the WWRP;
(2) To establish a Science Steering Committee for WWRP as a CAS Working Group, with the following terms of reference:
   (a) To promote, organize and/or endorse research projects including, where necessary, field experiments to develop understanding of weather processes and improve forecasting techniques;
   (b) To review and assess the development of all elements of the WWRP, including demonstration forecast evaluation methods, formulate recommendations to guide further actions and report periodically on the progress of the programme to the president of CAS;
   (c) To facilitate the exchange of information among scientists participating in the programme and relevant scientific institutions and agencies, at the national and international levels;
   (d) To promote actively the applications of improvements in weather forecasting capability through forecast demonstration projects and the sponsoring of technical workshops and conferences;
   (e) 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;
   (f) To collaborate with CBS, the CAS Working Group on Tropical Meteorology Research and the Executive Council Panel of Experts/CAS Working Groups on Physics and Chemistry of Clouds and Weather Modification Research, and on Environmental Pollution and Atmospheric Chemistry, in considering scientific opportunities provided by advances in middle atmospheric modelling and satellite observing systems,
   (g) To collaborate with the CAS/JSC Working Group on Numerical Experimentation in considering developments in atmospheric models;
   (h) To prepare for the next session of CAS a report on the progress in weather prediction research;
(3) To invite the following individuals to serve on the Committee:
   (a) R. Carbone (United States), chairman;
   (b) G. Isaac (Canada), Rapporteur on Physical Processes;
   (c) L. Bubnova (Czech Republic), Rapporteur on Forecast Verification Techniques and Validation;
   (d) P. Bougeault (France) and A. V. Prolov (Russian Federation), Rapporteurs on Data Assimilation and Modelling;
   (e) K. Browning (United Kingdom), Rapporteur on Nowcasting and Integrated Forecast Systems;
   (f) G. Holland (Australia), Rapporteur on Tropical Meteorology;
   (g) T. Tsuyuki (Japan), Rapporteur on Long-range Weather Prediction;
   (h) R. Pielke (United States) and G. Berz (Germany), Rapporteurs on Social and Economic Effects;
   (i) Y. Xiao (China), Rapporteur on Forecast Technology Transfer — Application to Members;
(4) To invite CBS to nominate a representative to liaise with, and to participate in, the work of the committee, serving as a Rapporteur on Observation Systems (including remote sensing from Earth, air and space);
(5) To invite IAMAS to nominate a representative to liaise with, and to participate in, the work of the committee;
(6) To invite the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry, in the context of its Initiative on Urban Environment, to liaise with, and to participate in, the work of the committee concerning the conduct of research and development projects and forecast demonstration projects in urban areas;
(7) To request the chairman of the committee to submit the final report to the president of CAS not later than six months before the thirteenth session of the Commission.

RESOLUTION 3 (CAS-XII)
RAPPOREUR ON MIDDLE-ATMOSPHERE STUDIES

THE COMMISSION FOR ATMOSPHERIC SCIENCES,
NOTING the report of the Rapporteur on Middle-Atmosphere Studies,
CONSIDERING the need for CAS to be informed of research activities concerning the middle atmosphere and the
questions in weather prediction that span all time-scales;
DECIDES:
(1) To appoint a Rapporteur with the following terms of reference:
(a) To maintain a continuing review of international activities and scientific research in the field of numerical modelling of the middle atmosphere, including data assimilation, in the context of long-range weather prediction and climate studies, in close liaison with WGNE;

(b) To report on the quantity and quality of middle-atmosphere data, including analysis, available for operational and research purposes;

(c) To maintain liaison with other international bodies which have research activities related to the middle-atmosphere, such as the Committee on Space Research (COSPAR) and IAMAS;

(d) To recommend, relative to the above fields, appropriate research studies;

(2) To invite H. Ritchie (Canada) to serve as Rapporteur;

(3) To request the rapporteur to submit a report to the president of CAS not later than six months before the thirteenth session of the Commission.

RESOLUTION 4 (CAS-XII)

WORKING GROUP ON TROPICAL METEOROLOGY RESEARCH

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING:
(1) The report of the ninth session of the CAS Advisory Working Group,
(2) The report of the Working Group on Tropical Meteorology Research,
(3) The Abridged Final Report with Resolutions of the Twelfth World Meteorological Congress (WMO-No. 827),

CONSIDERING:
(1) The potential for disaster reduction and economic benefit to be derived from increasing research of tropical atmospheric processes directed towards improved weather prediction capabilities,
(2) The need to assist coordination of research efforts in tropical and subtropical meteorology of all countries involved,
(3) The likelihood of significant developments in the scientific aspects of tropical meteorology, particularly those resulting from data obtained by advanced observing methods and prediction models over the next few years,

DECIDES:
(1) To re-establish the Working Group on Tropical Meteorology Research with members serving as rapporteurs for specifically-defined areas with the following overall terms of reference:
(a) To monitor and coordinate the implementation of existing priority projects within the TMRP and to develop further 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 provide scientific advice to the Secretary-General and the president of CAS, as necessary, on the implementation and development of the main TMRP components;
(c) To identify those research initiatives which, if taken by Meteorological Services in tropical countries, generally including collaboration with other groups in universities or research institutes, are likely to lead to economic benefits, particularly in agriculture and water resources management;
(d) To keep under continuous review developments in research aspects of the WMO Tropical Cyclone Programme (TCP) by maintaining close liaison with TCP regional bodies and to facilitate coordination of research at the regional level;
(e) To prepare for the next session of CAS a report on the progress in tropical meteorology;
(f) To coordinate its activity with CLIVAR and CLIVAR-GOALS components of the WMO/ICSU WCRP on monsoons, as well as of GAME and the South China Sea Monsoon Experiment (SCSMEX);
(g) To keep in contact, through the Secretariat, with various WMO regional and other groups dealing with tropical meteorology research (particularly the WWRP);

(2) To invite the following individuals to serve as rapporteurs:
(a) G. Holland (Australia), chairman and Rapporteur on Interaction between Tropical and Mid-latitude Weather Systems;
(b) J. H. Oh (Republic of Korea) and A. Grimm (Brazil), Rapporteurs on Monsoon Prediction Research;
(c) R. Okoola (Kenya), Rapporteur on Tropical Droughts and Rain-producing Systems;
(d) K. Kuma (Japan) and A. Youssef (Egypt), Rapporteurs on Tropical Limited-area Weather
Prediction Modelling and Operational Use of NWP Products;
(e) G. B. Pant (India), Rapporteur on Climate Change Aspects of Tropical Weather Systems;
(f) R. Elsberry (United States), Rapporteur on Tropical Cyclone Prediction Research;

(3) To request the chairman of the working group to submit periodical reports as necessary and a formal report to the president of CAS not later than six months before the thirteenth session of the Commission.

RESOLUTION 5 (CAS-XII)
PARTICIPATION OF WOMEN IN THE WORK OF THE COMMISSION

THE COMMISSION FOR ATMOSPHERIC SCIENCES,
NOTING:
(1) The United Nations Conference on Women (Beijing, 1995) and its recognition of the importance of women and their contribution to science,
(2) The appeals made in Agenda 21: Programme of Action for Sustainable Development (Rio de Janeiro, June 1992), Chapter 24: Global action for women towards sustainable and equitable development,
(3) That the forty-eighth session of the Executive Council, in general summary paragraph 13.1.2 of the Abridged Final Report with Resolutions of the Forty-eighth session of the Executive Council (WMO-No. 846), requested Members to encourage the advancement of women in meteorology and operational hydrology,
(4) That the tenth session of the Commission for Hydrology (CHy) passed a recommendation encouraging increased participation by women in the work of the Commission,
(5) The recommendations of the International Experts Meeting on the Participation of Women in Meteorology and Hydrology (Bangkok, 1997),

CONSIDERING the need for trained meteorologists in the work of the Commission,

WELOUR the very active participation of women delegates at this session,
URGES Members to identify focal points in their NMHSs for this activity;
FURTHER URGES Members to review the report of, and implement appropriate recommendations made by, the International Experts Meeting on the Participation of Women in Meteorology and Hydrology, held in Bangkok, Thailand in 1997;
RECOMMENDS that Members provide active encouragement and support for equal opportunity for participation:
(1) In all fields of meteorology, including at decision-making levels;
(2) In CAS and in other national, regional and international meteorological research programmes;

FURTHER RECOMMENDS that Members encourage the promotion of atmospheric 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 thirteenth session of the Commission on progress made on main aspects of the implementation of this resolution during the inter-sessional period.

RESOLUTION 6 (CAS-XII)
REVIEW OF THE RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION FOR ATMOSPHERIC SCIENCES

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

CONSIDERING:
(1) That all its previous resolutions are now obsolete,
(2) That the substance of some of its previous recommendations has been included in the recommendations of its twelfth session,

NOTING the action taken by the competent bodies on the resolutions and recommendations of its previous sessions,
DECIDES not to keep in force any of its resolutions adopted prior to its twelfth session.

NOTE: This resolution replaces Resolution 6 (CAS-XI), which is no longer in force.
RECOMMENDATIONS ADOPTED BY THE SESSION

RECOMMENDATION 1 (CAS-XII)

TERMS OF REFERENCE AND THE COMMISSION REPRESENTATION IN THE PROPOSED RE-ESTABLISHMENT OF THE EXECUTIVE COUNCIL PANEL OF EXPERTS/CAS WORKING GROUP ON ENVIRONMENTAL POLLUTION AND ATMOSPHERIC CHEMISTRY

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING:

(1) Resolution 7 (EC-XLVI) — Re-establishment of the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry,

(2) General Regulation 179, Annex III: Structure and terms of reference of technical commissions,

(3) General summary paragraphs 3.3.1.1 to 3.3.1.7 of the Abridged Final Report with Resolutions of the Twelfth World Meteorological Congress (WMO-No. 827),

(4) Resolution 13 (Cg-XI) — Atmospheric Research and Environment Programme,

(5) The Fourth WMO Long-term Plan 1996-2005, Part I (WMO-No. 830), paragraphs 167 to 170 and Part II, Volume 3 (WMO/TD-No. 702), paragraphs 16 to 60 and relevant sections of the Fifth WMO Long-term Plan,

CONSIDERING:

(1) The need, as re-affirmed by the Eleventh World Meteorological Congress, for WMO to be the lead United Nations agency dealing with those environmental matters and processes in which the atmosphere plays a major part,

(2) That WMO is highly suited to undertake the tasks of long-term monitoring of global atmospheric composition and related physical characteristics including the preparation of related scientific assessments, and that through the implementation of GAW the involvement of WMO in such activities has increased substantially,

(3) That WMO had a profound responsibility, as stated by the Twelfth World Meteorological Congress, concerning environmental issues,

(4) That a focal point to coordinate all WMO activities in the fields of environmental pollution and atmospheric chemistry is needed,

RECOGNIZING the responsibility of CAS as the lead Commission in this field,

RECOMMENDS to re-establish the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry with the following terms of reference:

(1) To serve as the advisory body to the Executive Council and the president of CAS for all WMO activities in the fields of atmospheric chemistry and environmental pollution;

(2) To act as the focal point for GAW and to provide scientific guidance on the design and implementation of improvements required to enhance GAW data quality, availability and global coverage, as a top priority;

(3) To serve as an advisory panel for GAW QA/SACs;

(4) 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 perturbations to the natural cycles of chemical species in the atmosphere/ocean/biosphere system;

(5) To recommend to the Executive Council, in consultation with the president of CAS, actions that WMO should take to promote, initiate, facilitate or set priorities for research and monitoring activities in the above areas with special attention to:

(a) Long-term observations of background atmospheric composition and air pollution, including greenhouse gases, ozone, other reactive gases, radiation and optical depth, aerosol particle characteristics, precipitation composition and related parameters;

(b) The high quality, accessibility and timeliness of data from the monitoring network and development of a functional system for real-time or quasi-real-time measurements;

(c) The transport, transformation and deposition of air pollutants on all space and time-scales;

(d) The air/sea and air/land/sea exchanges of atmospheric constituents;

(e) Integrated monitoring of background environmental pollution;

(f) Siting of stations;

(6) To keep informed of scientific developments in the field of urban atmospheric environment and to provide advice to Members' Meteorological and Hydrometeorological Services;

(7) To promote the use of data and other results obtained from the GAW system, in particular to
arrange for, or prepare, competent scientific assessments on emerging environmental issues;

(8) To collaborate, as appropriate, in the work of relevant working groups and rapporteurs;

(9) To design and implement training and educational activities within the GAW framework in the fields of environmental pollution and atmospheric chemistry;

(10) To keep informed of the work of other relevant international organizations and to advise the Executive Council and the president of CAS of their activities on their policy implications for WMO and on appropriate coordinations measures;

RECOMMENDS further:

(1) That the membership of the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry be as follows:

(a) W. Kimani (Kenya), Rapporteur on Changes in Atmospheric Composition on a Long-term Basis;
(b) D. Ehhalt (Germany) and Ding Guoan (China), Rapporteurs on the Urban Atmosphere Environment;
(c) R. M. Hoff (Canada), Rapporteur on Long-range Transport Including Acid Rain;

(d) H. Yoshikawa (Japan), Rapporteur on Greenhouse Gases Including Carbon Dioxide;
(e) C. Zerefos (Greece), Rapporteur on Atmospheric Ozone and Ultraviolet-B;
(f) J. Gras (Australia), Rapporteur on Radiation and Aerosol Optical Depth;
(g) A. G. Riaboshapko (Russian Federation), Rapporteur on Precipitation Chemistry;
(h) B. Hicks (United States), Rapporteur on Exchange of Pollutants between Various Media (including integrated monitoring);
(i) S. Penkett (United Kingdom), Rapporteur on Atmospheric Chemical System Modelling;
(j) J. Gille (United States), Rapporteur on Satellite Measurements of Atmospheric Constituents;

and to appoint O. Hov (Norway) as chairman and coordinator of the work of the individual rapporteurs;

(2) To request the chairman of the Executive Council Panel of Experts/CAS Working Group to keep the president of CAS informed of significant developments in atmospheric environment-related activities and to submit reports on atmospheric environment research to the president of CAS at his request, and a final report not later than six months before the thirteenth session of the Commission.

RECOMMENDATION 2 (CAS-XII)

TERMS OF REFERENCE AND RE-ESTABLISHMENT OF THE EXECUTIVE COUNCIL PANEL OF EXPERTS/CAS WORKING GROUP ON PHYSICS AND CHEMISTRY OF CLOUDS AND WEATHER MODIFICATION RESEARCH

THE COMMISSION FOR ATMOSPHERIC SCIENCES,

NOTING:

(1) Resolution 13 (Cg-XI) — Atmospheric Research and Environment Programme,

(2) Resolution 8 (EC-XLVI) — Re-establishment of the Executive Council Panel of Experts/CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research,

(3) The Fourth WMO Long-term Plan 1996-2005, Part II, Volume 3 (WMO/TD-No. 702), paragraphs 163 to 192 as well as the Fifth WMO Long-term Plan,

CONSIDERING:

(1) The importance of cloud physics and chemistry with regard to weather forecasting, from the very short range to the long range,

(2) The importance of cloud physics and chemistry with regard to climate change issues, particularly in parameterizations in climate modelling,

(3) The importance of cloud physics and chemistry with regard to the transport, deposition and transformation of atmospheric pollutants,

(4) The importance, reaffirmed by WMO Congress, of providing mankind with a clear answer as to the possibility and limitations regarding intentional weather modification, still largely at the research stage,

(5) The need to assess the benefits of scientifically-based cloud seeding to the planning and management of water resources and agriculture and related activities as well as to ensure authoritative advice on weather modification, with particular regard to precipitation enhancement and hail suppression,

RECOGNIZING the responsibility of CAS in this field,

RECOMMENDS that the Executive Council re-establishes a joint group with the title Executive Council Panel of Experts/CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research with the following terms of reference:

(1) To keep under review relevant research and advise the Executive Council, CAS, and, as appropriate, other WMO bodies on urgent problems requiring attention relating to physics and chemistry of clouds and weather modification research;

(2) To keep under review the role of clouds in the transport, transformation and deposition of various pollutants, including especially nuclear pollution, in the process of their dispersion and long-range transport;
RECOMMENDATION 3

(3) To keep under review the role of cloud and fog processes in both weather and climate prediction/simulation research, in interaction with vegetation, especially at high altitudes, and in the collection of water for human use;

(4) To arrange the preparation of reviews and summaries of field experiments related to cloud physics and chemistry, of cloud-seeding experiments as well as the dispersion of fog for wide distribution to Members;

(5) To provide advice and assistance, in particular the manner and means of transferring competence for planning scientific experiments and scientific meetings organized, coordinated or sponsored by WMO in the above-mentioned fields;

(6) To draft and review WMO documents on the status of weather modification and guidelines for advice to Members and propose revisions to these documents where necessary;

RECOMMENDS FURTHER that:

(1) The membership of the Executive Council Panel of Experts/CAS Working Group on Physics and Chemistry of Clouds and Weather Modification Research be as follows:
   (a) D. Terblanche (South Africa), Rapporteur on Cold Cloud Precipitation Enhancement;
   (b) P. Jonas (United Kingdom) and Saad Al Mahlafi (Saudi Arabia), Rapporteurs on Warm Cloud Precipitation Enhancement;
   (c) A. R. Karev (the former Yugoslav Republic of Macedonia), Rapporteur on Fog Dissipation;
   (d) V. Stasenko (Russian Federation), Rapporteur on Other Aspects of Weather Modification including Hail Suppression and Anthropogenic Modification of Clouds and its Repercussions;
   (e) B. Ryan (Australia), Rapporteur on Fundamental Cloud Physics and Cloud Electricity;
   (f) J.-P. Chalon (France), Rapporteur on Cloud Physics Application (Radiative Properties of Clouds, Climatology);
   (g) D. Moeller (Germany), Rapporteur on Chemical Transformations in Clouds (in liaison with the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry);
   (h) Z. Levin (Israel), Rapporteur on Cloud Modelling;
   (i) B. Foote (United States), Rapporteur on Radar and Other Instrumentation of whom the Executive Council may wish to consider J.-P. Chalon (France) as chairman and coordinator of the work of the individual rapporteurs;

(2) IAMAS be invited to designate a representative to liaise and participate in the work of the Working Group;

(3) The chairman keep in close contact with the chairman of the Executive Council Panel of Experts/CAS Working Group on Environmental Pollution and Atmospheric Chemistry to discuss issues of common interest;

(4) The group of experts collaborate with the CAS Science Steering Committee of the WWRP;

(5) The chairman be requested to submit progress reports to the Executive Council and to the president of CAS, as needed, and to submit a final report not later than six months before the thirteenth session of the Commission.

RECOMMENDATION 3 (CAS-XII)

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 with satisfaction the action taken on its previous recommendations by the Executive Council,

CONSIDERING:

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

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

RECOMMENDS:

(1) That the following Executive Council resolutions no longer be considered necessary:
   6 (EC-XLI), 7 (EC-XLVI), and 8 (EC-XLVI);

(2) That the following Executive Council resolutions be maintained in force:
   11 (EC-XXIX), 18 (EC-XXXIV), 5 (EC-XXXIX), and 7 (EC-XXXIX).

NOTE: This recommendation replaces Recommendation 3 (CAS-XI), which is no longer in force.
The International Governing Panel (IGP) of the Mesoscale Alpine Programme (MAP),

**NOTING:**

(1) *Adopts* (3) of WMO Resolution 40 (Cg-XII) — WMO policy and practice for the exchange of meteorological data and products including guidelines on relationships in commercial meteorological activities,

(2) Report of the forty-ninth session of the Executive Council on the exchange of meteorological and related data and products,

(3) The outstanding density of observing networks routinely operated by a variety of institutions in the Alpine region,

(4) The fact that many of the recorded datasets are not exchanged under the auspices of WMO,

**RECALLING:**

(1) The crucial contribution to MAP of a number of NMSs — among which those Directors participating in the Informal Conference of the Directors of the Western European Services (ICWED) — by financing the MAP Data Centre and by providing key datasets to the MAP database,

(2) The crucial contributions of various national organizations and scientists by making special observations to be included in the MAP database,

**STRESSING:**

(1) The need to make available as many datasets as possible to the research community for MAP,

(2) The data made available through the MAP Data Centre is only for scientific research and educational, non-commercial activities,

**Adopts** the following data access policy for MAP:

The MAP data access policy differentiates between those data and/or products governed by WMO Resolution 40 (Cg-XII) and those supplemental data and/or products of value to the MAP researchers, but not normally under the ambit of Resolution 40 (Cg-XII). Both categories of data and/or products are included in the MAP database.

**REQUIRED DATA (Category R):**

Those data and/or products required for meteorological research experiments, such as MAP, are governed by Resolution 40 (Cg-XII) as it applies to research and educational activities. The required data category (R) includes:

(a) Those meteorological data and/or products which are "essential" and/or "additional" under Resolution 40 (Cg-XII); and

(b) All meteorological and related data resulting from the special observing periods (15 August to 15 November 1999).

For all "additional" data relevant to the experiment, taken during the special observing periods, Resolution 40 (Cg-XII) applies for periods up to one month from the time of observation. After one month, those data, as with the remainder of the required data, will be provided by the MAP Data Centre on the basis of free and unrestricted access for non-commercial research and educational activities.

**SUPPLEMENTAL DATA (Category S):**

Those data and/or products not included in category R, but of significant value to MAP scientists. Category S data will be part of the MAP database, but may have conditions placed upon their access by the data originators. Researchers may have to agree to access conditions prior to receiving certain subsets of category S data.

Supplemental data (S) may have conditions placed upon their access by the data providers. These conditions must be made known by the provider in advance of the submission of the data to the MAP Data Centre. The International Governing Panel (IGP) of MAP will ensure that conditions are appropriate.
ANNEX II
Annex to paragraph 5.3.10 of the general summary

REDEFINITION OF THE PROJECTS OF THE TROPICAL METEOROLOGY RESEARCH PROGRAMME (TMRP)

Project TC1* — Tropical cyclone forming, motion and intensity

An ongoing project in coordination with ICSU to maintain the initiative that has developed on tropical cyclone forming, motion and intensity and to promote the transfer of the findings to operational use.

Project TC2* — Tropical cyclone climate change assessment

A continuing project to keep abreast with the current state of scientific knowledge on tropical cyclone impact from climate change and advise the president of CAS on the issue of a revised objective statement that represents the current status of the science.

Project TC3* — Land falling tropical cyclones

A new project, in collaboration with the WWRP, to provide support for research efforts to improve land falling tropical cyclone forecasts and to reduce the impact of tropical cyclones on coastal communities.

Project M1 — Research initiatives on the East-Asian monsoon

A continuing project in support of field programmes, research and numerical experimentations in the East-Asian monsoon region, including a regional differentiation of monsoon phenomena.

Project M2 — Long-term Asian/African monsoon studies

A continuing project to improve further the understanding and prediction (in short- and/or long-term) of monsoon onset, intensity and variability, including training aspects.

Project M3 — American monsoon studies

A new project to enable CAS support of activities developing in the Americas on monsoon studies, including the Panamerican Climate Study.

Project AZ1 — Tropical and subtropical droughts and related rain-producing systems, including the ITCZ

A modified project in collaboration with ICSU to coordinate research activities in tropical and subtropical drought (particularly in the African and Middle East regions) and related rain producing systems under strong links with projects M2 and LAM1.

Project LAM1 — Application of limited-area modelling to tropical countries

A continuing project to provide support for the implementation of LAM to tropical countries, especially with regards to the development of local expertise.

* Indicates a project in support of the CAS priority mission on tropical cyclones under the IDNDR demonstration project “Tropical Cyclone Disasters”.
**APPENDIX A**

**LIST OF PERSONS ATTENDING THE SESSION**

**A. OFFICERS OF THE SESSION**

- **President**: D. J. Gauntlett
- **Vice-president**: A. Eliassen

**B. REPRESENTATIVES OF WMO MEMBER**

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<thead>
<tr>
<th>Member</th>
<th>Name</th>
<th>Capacity</th>
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<tr>
<td>Australia</td>
<td>D. J. Gauntlett</td>
<td>Principal delegate</td>
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<td>P. Price</td>
<td>Alternate delegate</td>
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<td></td>
<td>G. Holland</td>
<td>Delegate</td>
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<td>Austria</td>
<td>C. Kress</td>
<td>Principal delegate</td>
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<td>Belgium</td>
<td>A. Quinet</td>
<td>Principal delegate</td>
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<td>Brazil</td>
<td>A. M. Grimm (Ms)</td>
<td>Principal delegate</td>
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<td>Canada</td>
<td>D. Whelpdale</td>
<td>Principal delegate</td>
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<td>P. Dubreuil</td>
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<td>China</td>
<td>Yan Hong</td>
<td>Principal delegate</td>
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<td>Xiao Yongsheng</td>
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<td>Croatia</td>
<td>A. Bacic (Ms)</td>
<td>Principal delegate</td>
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<td>S. Vidic (Ms)</td>
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<td>Czech Republic</td>
<td>M. Janousek</td>
<td>Principal delegate</td>
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<td>Denmark</td>
<td>L. Laursen</td>
<td>Principal delegate</td>
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<tr>
<td>Egypt</td>
<td>R. S. Fouli</td>
<td>Principal delegate</td>
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<td>Finland</td>
<td>J. T. Kaurola</td>
<td>Principal delegate</td>
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<td>France</td>
<td>G. De Moor</td>
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**D. LECTURERS**

- G. Carmichael
- A. Joly
- B. Wang

**E. REPRESENTATIVES OF INTERNATIONAL ORGANIZATIONS**

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# APPENDIX C

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II. “PINK” series

1. Organization of the session
2. Report by the president of the Commission
3. Medium- and long-range weather prediction research
4. Opening of the session
5. Strategy and activities of the World Climate Research Programme (WCRP)
6. Other activities related to weather prediction
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10. Transport and dispersion of atmospheric pollutants
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11. Contribution to the Global Climate Observing System (GCOS)
12. Environmental pollution and atmospheric chemistry
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13. WMO long-term planning
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15. Nomination of members of working groups
16. Scientific lectures

Submitted by:
- President of the Commission
- Chairman, Committee of the Whole
- Chairman, Committee A
- President of the Commission
- Co-chairman, Committee B
- Chairman, Nominations Committee
- Co-chairman, Committee B
- Chairman, Committee B
- Chairman, Committee B
- Chairman, Committee B
- Chairman, Committee of the Whole
- Co-chairman, Committee B
- President of the Commission
- Chairman, Committee of the Whole
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