WORLD METEOROLOGICAL ORGANIZATION

Weather • Climate • Water

COMMISSION FOR BASIC SYSTEMS

THIRTEENTH SESSION

ST. PETERSBURG, 23 FEBRUARY–3 MARCH 2005

ABRIDGED FINAL REPORT WITH RESOLUTIONS AND RECOMMENDATIONS

WMO-No. 985

Secretariat of the World Meteorological Organization - Geneva - Switzerland

REPORTS OF RECENT WMO CONSTITUENT BODY SESSIONS

Congress and Executive Council

915 — Executive Council, fifty-second session, Geneva, 16–26 May 2000
929 — Executive Council, fifty-third session, Geneva, 5–15 June 2001
932 — Thirteenth World Meteorological Congress, Proceedings, Geneva, 4–26 May 1999
945 — Executive Council, fifty-fourth session, Geneva, 11–21 June 2002
960 — Fourteenth World Meteorological Congress, Geneva, 5–24 May 2003
961 — Executive Council, fifty-fifth session, Geneva, 26–28 May 2003
972 — Fourteenth World Meteorological Congress, Proceedings, Geneva, 5-24 May 2003
977 — Executive Council, fifty-sixth session, Geneva, 8–18 June 2004

Regional associations

927 — Regional Association IV (North and Central America), thirteenth session, Maracay, 28 March–6 April 2001
934 — Regional Association III (South America), thirteenth session, Quito, 19–26 September 2001
942 — Regional Association VI (Europe), thirteenth session, Geneva, 2–10 May 2002
944 — Regional Association V (South-West Pacific), thirteenth session, Manila, 21–28 May 2002
954 — Regional Association I (Africa), thirteenth session, Mbabane, 20–28 November 2002
981 — Regional Association II (Asia), thirteenth session, Hong Kong, China, 7–15 December 2004

Technical commissions

923 — Commission for Basic Systems, twelfth session, Geneva, 29 November–8 December 2000
931 — Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology, first session, Akureyri, 19–29 June 2001
938 — Commission for Climatology, thirteenth session, Geneva, 21–30 November 2001
941 — Commission for Atmospheric Sciences, thirteenth session, Oslo, 12–20 February 2002
947 — Commission for Instruments and Methods of Observation, thirteenth session, Bratislava, 25 September–3 October 2002
951 — Commission for Agricultural Meteorology, thirteenth session, Ljubljana, 10–18 October 2002
953 — Commission for Aeronautical Meteorology, twelfth session, Montreal, 16–20 September 2002
955 — Commission for Basic Systems, extraordinary session, Cairns, 4–12 December 2002
979 — Commission for Hydrology, twelfth session, Geneva, 20–29 October 2004

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Technical Commissions	—	Arabic, Chinese, English, French, Russian, Spanish

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NOTE

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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE SESSION (agenda item 1)

1.1 The thirteenth session of the Commission for Basic Systems (CBS) was held in St. Petersburg, from 23 February to 3 March 2005 at the invitation of the Government of the Russian Federation. The session, which took place at Pribaltiyskaya Hotel, was opened at 10 a.m. on 23 February 2005 by the acting president of the Commission, Mr A.I. Gusev.

1.2 Mr A. Prokhorenko, representing the Governor of St. Petersburg, Mrs V. I. Matvienko, conveyed her message of warm welcome to all the participants, and emphasized that it was a great pleasure for St. Petersburg, which was the home of the most significant Russian research organizations in meteorology, hydrology and physics, to host the CBS session. Mr A. Prokhorenko wished CBS a successful session and all participants an interesting and pleasant stay in the city on the Neva.

1.3 The Plenipotentiary Envoy of the President of the Russian Federation in the North-west Federal District, Mr I.I. Klebanov, welcomed all the participants of the session. He expressed his government's pleasure to host the CBS session for the first time in Russia and wished every success in the work of the Commission and a pleasant stay for all participants in St. Petersburg.

1.4 The Secretary-General of the World Meteorological Organization (WMO), Mr M. Jarraud, welcomed the participants of the session on behalf of the Organization, and expressed appreciation to the Government of the Russian Federation for hosting the session, as well as the Technical Conference on Public Weather Services held prior to the session. He also extended his thanks to the Russian Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET) for the excellent arrangements made to ensure the success of the session.

1.5 The Secretary-General noted several major events and developments of importance to CBS which had taken place since the last session. He particularly emphasized the dramatic impact of natural disasters, which led to extreme suffering, such as the Indian Ocean tsunami. He drew attention to the tremendous potential of the WMO Global Telecommunication System (GTS), already used by the Tsunami Warning System in the Pacific Ocean, for the timely and reliable exchange of warnings and messages beyond the strict domain of weather, climate and water. He said that WMO was actively joining forces with other key agencies of the United Nations system and, in particular, the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational Scientific and Cultural Organization (UNESCO), in ensuring that a tsunami warning system become a reality in the Indian Ocean and other regions at risk. In that connection, the Commission's contribution was crucial including that of the National Disaster Prevention and Mitigation (DPM) Programme for the further enhancement of Emergency Response Activities (ERA) procedures for events such as smoke, volcanic ash, chemicals, vector-borne diseases and locust swarms.

1.6 Mr Jarraud emphasized the challenges and new exciting opportunities for CBS. CBS was leading the redesign of the Global Observing System (GOS) within the overall modernization of the World Weather Watch (WWW). A new composite observing system was fundamental to meteorology to meet the demands of sustainable development in the twenty-first century, and CBS had already made substantial progress in the redesign of GOS, with special attention to the needs of developing countries. CBS was also the lead technical commission for the WMO Space Programme, a new major cross-cutting Programme. The Global Earth Observation System of Systems (GEOSS) would be an opportunity to provide additional benefits to many societal and economic areas worldwide and with its unique operational system. WMO was having a very active role in that process. In that connection, the sixth session of the Group on Earth Observations (GEO) and the Third Earth Observation Summit had decided to locate the new GEO Secretariat within the WMO building. The International Polar Year (IPY) (2007-2008), which would be organized under the auspices of WMO and the International Council for Science (ICSU), would strengthen of several World Weather Watch (WWW) components and require extensive advice and coordinating support from CBS. Another challenge was the newly established THORPEX: A World Weather Research Programme which aimed at advancing high impact numerical weather prediction by adding observations in specific areas and using new techniques. CBS would also pursue efforts in supporting further progress in the production, verification and further development of numerical weather prediction (NWP) especially ensemble prediction systems (EPS). The Commission's role was paramount in advising on the most appropriate and cost-effective application of Information and Communication Technology (ICT) for data communication and data management, and in further developing and implementing the future WMO Information System (WIS) to serve all WMO Programmes. Mr Jarraud also pointed out that part of CBS's mandate was to provide development and implementation of the Public Weather Services (PWS) Programme for providing improved services to the end-users of meteorological products and warnings, and for assisting Members to build strong partnerships with the media.

1.7 Mr Jarraud concluded by stating that he was confident that the session would address the concerns of its Members with foresight and determination in WMO's traditional spirit of cooperation. He assured of his continued commitment to support and strengthen the WWW. He expressed sincere thanks to the City of St. Petersburg for hosting the CBS session and wished participants every success in their deliberations.

1.8 Mr A.I. Bedritsky, Permanent Representative of the Russian Federation with WMO and President of WMO, on behalf of the Government of Russia, extended a warm welcome to all participants of the session. He emphasized the symbolism of the venue since St. Petersburg was the birthplace of Russian meteorology some 200 years before. He pointed out that National Meteorological and Hydrological Services (NMHSs) in the modern world were playing an ever more prominent role since the society was increasingly aware of the importance of hydrometeorology for protecting life and property and for reducing losses in weather-dependent sectors of the economy. NMHSs were already capable not only of supplying users with conventional information on current and forecast weather, hydrosphere and climate, but also of applying meteorological data to the scientific underpinning of the sustainable development and environmental protection strategy. Of great importance for long-term planning and government decision-making was the practical impact of meteorologists' work to assess preventable economic losses and to prepare recommendations for minimizing adverse environmental and/or climatic impacts on relevant economic sectors. He concluded by saying that the Russian Federation was devoted to the spirit of international cooperation in the field of hydrometeorology and to that of the free and unrestricted exchange of hydrometeorological data and products, as well as to ensuring the sustainable operation of the elements of the WWW in the Russian Federation. Mr Bedritsky wished all participants a fruitful session and a pleasant stay. He also drew their attention to the exhibition of hydrometeorological systems and technologies, that was organized in parallel to the session from 23–25 February, which would certainly be of much interest.

1.9 The acting president of CBS welcomed the participants and guests and highlighted the well-known uniqueness of the place. He emphasized the crucial role of CBS among the WMO technical commissions, as responsible for the successful functioning of the WWW, the most important operational structure of the world meteorological community, which formed the infrastructure providing the National Meteorological Services (NMSs) with their indispensable data and products. One unique feature of the WWW, which had existed for over 40 years, was its capacity for self-regulation and functioning with decentralized development and management carried out through considerable contributions from all NMSs worldwide. The WWW, as the global infrastructure of WMO, was at the same time a very important element for the technical and technological support of many other operational and research areas of WMO activities, such as climate research, natural disaster prevention and reduction, and emergency response. CBS also had a huge responsibility for fulfilling intercommission and interdisciplinary tasks, being responsible for the WMO Space Programme and taking a major role in the development and implementation of the WMO information system, the WMO DPM Programme, WMO quality management framework, the THORPEX research programme and the IPY programme. The Commission would undoubtedly also play a crucial role in GEOSS. The acting president thanked the members of the Commission, invited experts, chairpersons of working groups and expert teams and WMO Secretariat staff for their effective work during the intersessional period as well as for their assistance and collaboration.

1.10 The Secretary-General of WMO presented outstanding service awards to Messrs H. Allard (Canada) and S. Mildner (Germany) for their long-standing distinguished contributions to WMO and, particularly, to CBS and its successful new working structure. He noted that Mr Mildner had been involved with the Commission for nearly 35 years, serving as vice-president from 1992 to 1996 and as president from 1996 to 2000. He noted that Mr Allard was extensively involved with CBS for nearly 25 years, serving as chairperson of the Working Group on Data Processing from 1992 to 1998. Mr Allard expressed his sincere honour and appreciation in accepting his award. Mr G.-R. Hoffmann, the principal delegate of Germany, accepted the certificate on behalf of Mr S. Mildner.

1.11 There were 189 participants at the session, which included representations of 73 Members of WMO and 5 international organizations. The list of participants is given in Appendix A to this report.

2. ORGANIZATION OF THE SESSION (agenda item 2)

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

The Commission decided that in accordance with WMO General Regulation 22, it was not necessary to establish a Credentials Committee. The Commission approved the report of the representative of the Secretary-General.

2.2 ADOPTION OF THE AGENDA (agenda item 2.2)

The Commission approved the proposed provisional agenda.

2.3 ESTABLISHMENT OF COMMITTEES (agenda item 2.3)

2.3.1 One working committee was established to examine the various agenda items in detail. Following proposals by the acting president, the following chairpersons were appointed for consideration of the individual agenda items:

Mr Heikinheimo (Finland) for agenda items 5 (general), 5.1 and 10;

Mr R. Brook (Australia) for agenda item 5.2;

Mr F. Branski (United States) for agenda items 5.3, 5.4 and 5.5.

Agenda items 3, 4, 6, 7, 8 and 9 were considered in the Committee of the Whole, chaired by the vice-president, Mr G.-R. Hoffmann (Germany), and the remainder of the agenda items were considered in Plenary, chaired by the acting president.

2.3.2 In accordance with General Regulations 24 and 28, a Nomination Committee and a Coordination Committee were established. The Nomination Committee comprised Messrs J. Mukabana (Kenya), H. Rosa (Argentina), L. Malanche (Mexico), T. Quayle (New Zealand) and Ms E. Cordoneanu (Romania). The Coordination Committee comprised the acting president of the Commission, the vice-president of the Commission, the representative of the Secretary-General, the chairpersons of the working committee and a representative of the host country. Mr M. Sonko (Senegal) was appointed Rapporteur on Previous Recommendations and Resolutions of the Commission (agenda item 10).

2.4 OTHER ORGANIZATIONAL QUESTIONS (agenda item 2.4)

It was agreed that summarized minutes of the plenary meetings would not need to be prepared. The session agreed upon the working hours for the duration of the session.

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

3.1 The Commission noted with appreciation the report of the acting president, Mr A. Gusev (Russian Federation), which provided information on the activities of the Commission since its extraordinary session in December 2002.

3.2 The Commission recalled with satisfaction that both the expert teams and the Implementation Coordination Teams, which together included more than 160 experts, had accomplished a great deal of work. There had been more than 50 meetings, workshops and seminars during the period on matters falling under the Commission's purview or otherwise related to the WWW. Further details of the activities and accomplishments were provided in the reports of the chairpersons of the working groups and discussed under the relevant agenda items.

3.3 The Commission noted that during the intersessional period, the president was actively involved in many activities dealing with matters of general importance to WMO, representing CBS and the WWW Programme in numerous meetings and providing input to the discussions in various forums dealing with issues like collaboration with the Global Climate Observing System (GCOS) to improve surface and upper-air climatological data availability, further integration of the Aircraft Meteorological Data Relay (AMDAR) programme in the WWW, etc.

3.4 The Commission expressed its appreciation for the extensive guidance provided by the fourth session of the CBS Management Group, which had kept under review the follow-up to the decisions of CBS and activities arising from decisions of Fourteenth Congress, and for the various actions taken by the president especially as regarded the participation of the Commission in the work of other constituent bodies and for representing the Commission at sessions of the Executive Council.

3.5 The Commission appreciated the important role of the CBS Management Group in coordinating the work of the four Open Programme Area Groups (OPAGs), in making necessary adjustments in the intersessional period and in advising the president on relevant issues. In view of new developments of importance for CBS, the Commission decided that the newly established Coordinator for Natural Disaster Prevention and Mitigation (see general summary paragraph 4.34) and the Co-coordinators for GEOSS (see general summary paragraph 7.15) be members of the CBS Management Group. The Commission therefore decided to establish again the CBS Management Group by adopting Resolution 1 (CBS-XIII).

3.6 When considering its work programme and future key activities areas, the Commission agreed to put a special emphasis on the following issues and questions:

(*a*) Promotion of rehabilitation and strengthening of observational programmes, especially at Regional Basic Synoptic Network/Regional Basic Climatological Network (RBSN/RBCN) stations, and the use of new and cost-effective observing systems like surface-based automatic weather stations (AWSs), AMDAR, the Automated Shipboard Aerological Programme (ASAP) and drifting buoys;

(*b*) Fostering the implementation activities on the redesign of the GOS, including the optimization of mixes of surface- and space-based subsystems and implementation of adaptable observing programmes;

(*c*) Cooperation with WMO Programmes and projects, including THORPEX and IPY, and involvement in the GEOSS-related activities to enable full cross-benefit with the WWW Programme;

(*d*) Proactive contribution to the development of the WIS including related evolution of the WWW system, especially the GTS and pilot projects;

(*e*) Coordination and promotion of the implementation of the migration to table-driven code forms (TDCF), especially interaction with regional planning;

(*f*) Further development and implementation of EPS, with applications in severe weather forecasting;

(*g*) Development of scope and capabilities of ERA and support to natural disaster prevention and mitigation activities;

(*h*) Contribution to the development of the WMO Quality Management Framework;

(*i*) Provision of more accurate and timely warnings of severe weather events, better coordinated and integrated into national disaster preparedness activities and more effectively communicated to end-users;

(*j*) Elaboration of methodologies on the application of economics to meteorology and on the socio-economic benefits of PWS;

(*k*) Continued emphasis on capacity-building in particular in effective service delivery and development of communication skills.

3.7 The acting president expressed his sincere appreciation to all CBS members who had participated in the activities of the Commission for their enthusiastic cooperation. In particular, he thanked the chairpersons of the OPAGs and the expert teams as well as the rapporteurs for their outstanding work. On behalf of CBS, the acting president also thanked the Secretary-General of WMO and the staff of the Secretariat, in particular the WWW and Applications Programme Departments, for their support and cooperation.

Status of the WWW implementation and operation

Status of implementation and operation of the surface-based subsystem of the GOS

3.8 Based on the WWW monitoring results of October 2004 (see Annex I to this report), the Commission noted that globally, there was an increase in the number of RBSN stations, which now comprised 4 032 stations (4 004 stations in 2002). In particular, the number of stations in Region I increased from 588 (2002) to 611 stations. The number of stations in all other Regions, including the Antarctic, remained unchanged. The percentage of SYNOP reports available at main telecommunication network (MTN) centres in comparison with the number of reports required from RBSN stations was about 77 per cent during the period 2002-2004. There were still deficiencies in the availability of SYNOP reports from some areas in Region I (53 per cent), in Region III (62 per cent) and in Region V (69 per cent). The continued deficiencies in the availability of SYNOP reports from those regions affected adversely the provision of meteorological services worldwide. Efforts, taking advantage of guidance and recommendations given by Congress and the Executive Council, should be undertaken to improve the situation.

3.9 The Commission was informed that 892 (811 radiosonde and 81 radiowind) upper-air stations (as listed in *Weather Reporting* (WMO-No. 9), Volume A) were included in the RBSNs compared to 901 (820 radiosonde and 81 radiowind) stations in 2002. During 2002-2004, the number of fully operational stations (making two soundings per day) continued to decrease, following the trend from the previous two-year period. It further noted that the overall implementation of the RBSN upper-air stations making two soundings per day remained just above 70 per cent. The monitoring results showed that the global percentage of TEMP reports actually received at MTN centres in comparison with expected reports from RBSN stations was 65 per cent during the period 2002-2004. It also noted that the availability of TEMP reports during that period varied within the Regions, constituting 32 per cent for Region I, 63 per cent for Region II, 43 per cent for Region III, 87 per cent for Region IV, 64 per cent for Region V and 74 per cent for Region VI. The Commission stressed that TEMP reports were crucial for weather prediction in the tropical areas where convection processes dominated the rainfall causing systems. Every efforts should be undertaken to address the continuing high level of non-availability of TEMP reports from those regions.

3.10 The Commission noted that the number of automatic stations in the RBSN reached 651 in 2004, compared to 531 in 2000 (increase of 23 per cent). All Regions, except the Antarctic, extended the use of automatic stations with a significant increase in Regions II and VI. It further noted that at present, AWSs constituted 16 per cent of a total at 4 032 RBSN surface stations. The Commission noted that while all monitoring figures were correct based on records held in October 2004, regional rapporteurs and Members had continued to provide updated information and corrections and therefore did not represent the present situation. The Commission encouraged all Members to follow their Regional protocols and thus ensure that the RBSN and RBCN lists were as accurate as possible.

3.11 The Commission noted with interest the information provided by the Agency for Air Navigation Safety in Africa and Madagascar (ASECNA) which was responsible, among other activities, for observations, forecasting and the transmission of meteorological data in its 16 member States. ASECNA member States had around 200 synoptic stations, 130 of which were operated by the Agency. It also had 22 radiosonde stations, 17 of which were fully operational. State-operated stations were experiencing major difficulties, particularly problems relating to transmission capabilities and obsolete equipment. That accounted for the poor results shown by the nonreal-time monitoring of the WWW. The Commission noted with appreciation that ASECNA envisaged in its services and equipment plan for the period 2000-2006 substantial investments in meteorological activities at its main centres and some of the stations it operated.

Other networks, including mobile stations

3.12 The Commission noted that the daily average number of reports received from mobile stations was about 2 845 SHIP reports, 13 TEMP SHIP reports, 14 541 BUOY reports, 28 527 AMDAR reports and 3 768 AIREP reports. It also noted the increased number of reports from mobile stations in 2004, particularly, AIREP and SHIP reports. The Commission noted that the EUMETNET Composite Observing System (EUCOS) had implemented an integrated approach to optimize the collection of AMDAR reports in Region VI avoiding redundancy, which resulted in changes in the monitoring results during 2001-2004. There was also an increase in the availability of AMDAR data in the eastern part of Region II at the end of 2004 and the beginning of 2005. The Commission further noted that the monitoring of BUFR aircraft reports within the special MTN monitoring (SMM) started in 2004. The results showed that the daily average number of BUFR aircraft reports was 107 358. Except for AIREP and BUOY reports, the majority of reports from mobile stations were generated in the northern hemisphere.

Availability of CLIMAT and CLIMAT TEMP reports

3.13 The Commission noted with satisfaction that the establishment of RBCN networks in all WMO Regions and in the Antarctic did allow a more effective and consistent monitoring of the availability of climatological data in the framework of the WWW monitoring. The Commission was informed that globally, the RBCN networks comprised a total of 3 107 stations (2 600 CLIMAT reporting stations, 507 CLIMAT TEMP reporting stations). The regional breakdown was as follows:

	CLIMAT		*CLIMAT TEMP*	
	2002	*2004*	*2002*	*2004*
RA I	616	637	19	28
RA II	593	593	194	194
RA III	344	325	49	49
RA IV	242	298	72	58
RA V	188	192	74	77
RA VI	520	526	91	88
Antarctic	72	29	12	13
Global	2 575	2 600	511	507

3.14 The monitoring of the CLIMAT and CLIMAT TEMP bulletins showed deficiencies in the application of WMO standards for the presentation of CLIMAT and CLIMAT TEMP bulletins in code forms FM 72-XII CLIMAT and FM 75-XII CLIMAT TEMP. The Commission noted with appreciation that the WMO Secretariat carried out a study on those deficiencies, and informed the WMO Member countries of the results of the study, inviting them to take action in order to eliminate the deficiencies.

Status of implementation and operation of the space-based subsystem of the GOS

3.15 The Commission noted with appreciation the following:

(*a*) Research satellite operators providing data for operational utilization as follows:
   - (i) The National Aeronautics and Space Administration (NASA) MODIS Direct Readout from Terra and Aqua, Quikscat winds data, and AIRS data for NWP centres from Aqua;
   - (ii) The European Space Agency (ESA) ERS and ENVISAT data through a Joint ESA/WMO Announcement of Opportunity as well as altimetry data scatterometer winds from ERS-2;
   - (iii) The National Centre for Space Studies (CNES) Jason-1 and SPOT-5;
   - (iv) The Japan Aerospace Exploration Agency (JAXA) future GCOM series; and
   - (v) The Russian Federation Federal Space Agency's research instruments on board ROSHYD-ROMET's operational METEOR 3M N1 satellite;

(*b*) Operational satellite data available to Members from four polar satellites and six geostationary satellites from the following space agencies: The National Oceanic and Atmospheric Administration/ National Environmental Satellite, Data and Information Service (NOAA/NESDIS); the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT); ROSHYDROMET; the India Meteoro-logical Department (IMD); the China Meteorological Administration (CMA); and the Japan Meteorological Agency (JMA). (The Governments of India and the Republic of Korea made formal commitments at the fifty-sixth session of the Executive Council to participate in the space-based subsystem of the WWW GOS);

(*c*) Satellite operators having global contingency plans in place for both polar and geostationary constellations, with the geostationary backup having been in effect since mid-2003;

(*d*) In coordination with the Expert Team on Satellite System Utilization and Products, the Virtual Laboratory for Education and Training in Satellite Meteorology increased effectiveness through focussed training events through its six centres of excellence.

3.16 The Commission appreciated the contribution made by satellite operators during the past two years, by providing valuable data, products and services from the space-based subsystem of the GOS. Continuation of a EUMETSAT satellite over the data-sparse Indian Ocean had provided increased coverage and reliability as had China's polar orbiting satellite, FY-1D, the United State's NOAA-16 and NOAA-17, ROSHYDROMET's METEOR-3M-N1 in Sun-synchronous orbits and EUMETSAT's first-in-the series of Meteosat Second Generation, Meteosat-8.

3.17 The Commission noted that the present geostationary satellite constellation consisted of Meteosat-8 (formerly MSG-1) at 0° longitude and Meteosat-5 at 63°E (operated by EUMETSAT), KALPANA at 74°E and INSAT-II E at 83°E (both operated by IMD) (whereby three-hourly imaging data were available by advanced dissemination methods (ADM) with the expectation that IMD would increase the frequency of observations to meet the half-hourly WMO requirement in a phased manner with an ultimate goal to be achieved in the next three years), FY-2C at 105°E (operated by CMA), GOES-9 as a back-up to GMS-5 at 155°E (operated by NOAA/NESDIS), and GOES-10 at 135°W and GOES-12 at 75°W (operated by NOAA/NESDIS). The Commission noted with great appreciation that Japan successfully launched the Multi-functional Transport Satellite–1R (MTSAT-1R) on 26 February 2005 and information on the transition of operations from GMS-5 to the MTSAT-1R. The polar-orbiting constellation consisted of METEOR-2 and -3 series satellites operated by the Russian Federation, NOAA-16 and -17 operated by NOAA/NESDIS and FY-1C and D operated by CMA.

Ground segment of the space-based subsystem of the GOS

3.18 Improvements were noted throughout the ground segment. However, the changes in the space-based subsystem of the GOS — starting in the first decade of the new millennium — as a result of digital information services and improved capability to utilize satellite data, suggested a strategy towards implementation of ADM using commercial satellite services by WMO Members, space agencies as well as through assistance programmes. Direct broadcast services would continue to complement ADM in order to respond to extreme local timeliness requirements and to cover regions not yet well served by appropriate commercial telecommunication services.

Global contingency planning

3.19 The Commission was informed that in geostationary contingency planning, satellite operators of the Coordination Group for Meteorological Satellites (CGMS) had agreed to follow the principles of "help your neighbour." The Russian Federation cited the placement of EUMETSAT's Meteosat-5 over the Indian Ocean as one excellent example of contingency planning. EUMETSAT informed the Commission of its Council's decision to continue coverage over the Indian Ocean until the end of 2008. The service would be provided by METEOSAT-5 until the second half of 2006, and subsequently by METEOSAT-7, which would be moved to the Indian Ocean following the launch and commissioning of METEOSAT-9 in 2005. Another excellent example of contingency plans in effect was the back-up of GMS-5 by GOES-9 over the western pacific. Furthermore, nominal configurations for most satellite operators included either an "in-orbit spare" or an "on-demand launch." For the polar system, contingency planning called for a constellation of four polar-orbiting satellites with two in before noon, orbits, each capable of serving as back-up to the other, and two in after noon orbits also capable of serving as back-up to the other.

4. REVIEW OF DECISIONS OF CONGRESS AND THE EXECUTIVE COUNCIL RELATED TO THE COMMISSION
(agenda item 4)

THORPEX, a component programme of the World Weather Research Programme (WWRP)

4.1 The Commission recalled Resolution 12 (Cg-XIV) — THORPEX: A Global Atmospheric Research Programme, by which Congress established that Programme as a part of the WWRP under the auspices of the Commission for Atmospheric Sciences (CAS) (www.wmo.int/thorpex). THORPEX aimed to accelerate improvements in short-, medium- and extended-range (up to two weeks) weather predictions and to demonstrate the social value of advanced forecast products. Research topics included: global-to-regional influences on the evolution and predictability of weather systems; global observing system design and demonstration; multi-model ensemble predictions, targeting and assimilation of observations; and social and economic benefits of improved weather forecasts. The CAS International Core Steering Committee (ICSC) led THORPEX in coordination with CBS, the Joint Scientific Committee for the World Climate Research Programme (JSC/WCRP), and the Working Group on Numerical Experimentation (WGNE) and in cooperation with the European Centre for Medium-range Weather Forecasts (ECMWF), the European Meteorological Services Network (EUMETNET), and CGMS. THORPEX established open regional committees, aligned with WMO Regional Associations, a Trust Fund and the International Programme Office at the WMO Secretariat.

4.2 The Commission noted that the THORPEX International Research Implementation Plan (TIP) for 2005-2014 was approved by the ICSC in December 2004. TIP had been developed in close collaboration with WWW, WCRP, the Space Programme and other WMO Programmes and international organizations and initiatives (such as GEOSS, IPY) concerned. TIP defined principle tasks; responding science opportunities of the THORPEX International Science Plan; roles and responsibilities for the participants; required levels of international cooperation; time and resources; and expected outcomes with the specific deliverables in two, six and 10 years with subsequent transition to operations.

4.3 The Commission noted that THORPEX represented an end-to-end programme. It was important that developments such as the use of targeted observations were turned into long-term sustainable processes; also that downstream forecasting processes could benefit from new products which THORPEX would generate through early involvement of Member countries and through coordination by WMO. It noted that in the development of regional plans, ICSC emphasized and pursued further contributions to the early warning and response strategy. The Commission stressed that, inter alia, a contribution to sandstorm preparedness should also be envisaged.

4.4 The Commission noted that some components of the THORPEX project (e.g. the THORPEX Interactive Grand Global Ensemble (TIGGE)) and adaptive observing strategies had proven effective principally in mid-latitude regions and that the theoretical framework and procedures were not as well developed for tropical regions except tropical cyclones. The Commission requested that representatives of CBS, when contributing to THORPEX, should keep in mind the Ensemble's application to tropical countries in their input to the planning and design of THORPEX projects.

4.5 The Commission stressed that THORPEX required and relied on substantial support from the WWW system and, in turn, would offer a significant contribution to the improvement of WWW through demonstrated advanced capabilities and recommendations on Integrated Observing System (IOS), the Data-processing and Forecasting System (DPFS) and PWS. The Commission recalled that Congress had requested a strong link between CAS and CBS on THORPEX. It noted with satisfaction that its cooperation with CAS on THORPEX was substantially strengthened and that CBS had become a strong partner to THORPEX. The vice-president of CBS was designated as an ex officio member of the ICSC, the OPAGs on IOS, DPFS and PWS and actively participated in the development of TIP through its chairpersons (IOS chairperson led effectively the respective tasks), respective expert teams, and expert liaisons. The Commission highly appreciated those collaborative efforts and endorsed a prompt and thorough engagement of CBS in THORPEX, and vice versa (i.e., redesign of GOS, EPSs).

4.6 The Commission further recalled that the fifty-sixth session of the Executive Council had requested the presidents of CAS and CBS to pursue further collaboration and to consider further practical steps to ensure effective implementation of the programme for the benefit of all Members. It noted that the expected role and responsibilities of CBS were included in TIP in support of THORPEX development, implementation and transition of THORPEX consecutive results to operations.

4.7 The Commission supported the TIP management goals of THORPEX including the nomination of two co-chairperson for THORPEX working groups by CBS and the role of the CBS vice-president as an ex officio member of the THORPEX ICSC. It agreed that ad hoc issues related to THORPEX coordination, which concerned CBS, should be addressed by the CBS Management Group, including corresponding adjustments of the terms of reference of the CBS OPAGs concerned.

International Polar Year 2007-2008

4.8 The Commission recalled Resolution 34 (Cg-XIV) — Holding of a third International Polar Year 2007-2008. It also recalled that the fifty-sixth session of the Executive Council had recommended to the WMO technical commissions concerned to contribute to the activities of IPY within their areas of responsibility and to establish the Intercommission Task Group on IPY to coordinate WMO activities related to IPY.

4.9 The Commission noted that IPY 2007-2008 should result in an intensive burst of internationally–coordinated interdisciplinary research and observations focused on the polar regions. According to the fifty-sixth session of the Executive Council, WMO's contribution to the IPY would be provided to the areas of activities related to all WMO Programmes, particularly to the improvement and further development of the WWW GOS in the polar regions, including re-activation of existing and establishing new surface and upper-air stations, increase in the number of drifting buoys and ASAP; and extending the AMDAR programme and the use of existing satellites as well as new polar-orbiting satellite series with observational capabilities for polar regions.

4.10 The Commission recognized that successful implementation of IPY required strengthening of the technical and logistical infrastructure for operations and research during the preparation and implementation of IPY, including strengthening of observing and telecommunication facilities over the Arctic and the Antarctic, establishing a data management structure based on the WWW experience, and develop further forecasting techniques. The Commission emphasized that IPY would provide a great opportunity for NMHSs to improve their observing networks in polar regions, particularly with regard to upper-air observations and ozone soundings on the basis of international cooperation. It also stressed that observing networks established or improved during the IPY period should be kept in operational mode for as many years as possible to provide data for enhancing the understanding of climate change in the polar regions.

4.11 Comprehensive data sets and scientific results would be obtained as a result of successful implementation of the IPY. Further monitoring of the environment and development of forecasting systems would be realized, including prediction of severe weather phenomena. The IPY would also provide a valuable contribution to the assessment of climate change and its impact in polar regions, and serve as a basis for recommendations to governmental agencies and the socio-economic sector.

4.12 The Commission was informed of the current and planned activities by several Members as their contributions to the IPY. It noted with appreciation the re-instated sea-ice drifting platform NORTH-POLE-31 operated by the Russian Federation, the establishment of a new observing station by Norway and the rehabilitation of upper-air soundings by South Africa in the Antarctic. The Commission welcomed the proposal to invite experts from other countries and especially from developing countries to participate in the field operations/programmes to be carried out during the IPY.

4.13 The Commission requested its OPAG chairpersons to identify the areas where the OPAGs could contribute to IPY implementation, to establish contacts with the IPY Project Steering Committees, and to assist in promoting the IPY projects. It decided to designate the CBS vice-president as a member of the Intercommission Task Group as the CBS focal point responsible for communication with IPY mechanisms.

WMO Quality Management Framework

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

(*a*) WMO technical standards;

(*b*) Quality management system(s) including quality control; and

(*c*) Certification procedure(s).

4.15 The Commission noted the deliberations and decisions on that subject of the fifty-fifth and fifty-sixth sessions of the Executive Council and the results of a survey among NMSs to assess the quality management (QM) activities, plans and requirements for assistance through WMO.

4.16 The Commission noted that the fifty-sixth session of the Executive Council had agreed to pursue the phased approach recommended by the presidents of the technical commissions. In particular, the Council agreed that the WMO QMF should focus on technical aspects of the operation of the NMSs. The first steps should address the QM aspects of observing systems and of aeronautical meteorological services.

4.17 Study reports had been completed on QM implications on the instrument sector and on the QM approach to in situ observing systems, and a draft guide on QM procedures and practices for PWS was being prepared. CBS and the Commission for Instruments and Methods of Observation (CIMO) would consider that material in due course, as appropriate. The new edition of the *Guide to Practices of Meteorological Offices Serving Aviation* (WMO-No. 732), developed by the Commission for Aeronautical Meteorology (CAeM), now contained a new section on QM; a joint International Civil Aviation Organization (ICAO)/WMO guide was being prepared on QM related to the provision of aeronautical meteorological service oriented towards ISO 9001, with the expectation that the guide would be published by the second half of 2005. Several Members had contributed to WMO basic documents on QM systems developed in their NMSs.

4.18 With a view to progressing the development of QMF, WMO organized the Workshop on QM (Kuala Lumpur, Malaysia, 26-28 October 2004). The key conclusions and recommendations of the Workshop are given in Annex II to this report.

4.19 The Commission was pleased to note that the Secretary-General had given priority to the early publishing of guidance material in English and through electronic means (preferably as CD-ROM compilation) to meet the urgent needs of the Members who would have to address the QMF in the near future. The CD-ROM, which included the final Report of the Workshop on QMF, several conceptual documents on QM systems and the basic documentation referenced in general summary paragraph 4.17 above, had been distributed to all Members of WMO.

4.20 The Commission noted that the Meeting of the Presidents of Technical Commissions (Geneva, January 2005) had reviewed the outcome of the Workshop on QMF, and that the Meeting's conclusions would be submitted to the fifty-seventh session of the Executive Council (Geneva, June 2005). The Meeting agreed with the Workshop's recommendation that the next actions should focus on a review of the WMO Technical Regulations relevant to observation generation with a view to identifying and rectifying deficiencies, duplications, inconsistencies and errors; that should achieve that the relevant WMO Technical Regulations would become viable documents of reference for use within national QM systems. It also agreed that a document that would describe work processes typical for observation generation should be developed making reference to the relevant WMO documents; that document should serve as a model or template for use in process description within national QM systems and should introduce at the same time a quality control scheme related to the quality of observations. The Meeting agreed that those actions should be pursued by the Intercommission Task Team (ICTT) on QMF. The Commission designated Mr A. Zaitsev (Russian Federation) as CBS representative in the ICTT-QMF and as Rapporteur on QMF reporting to the president.

4.21 The Commission noted that a number of NMHSs were working on introducing certain elements of QM for meteorological information and services for certain sectors, such as aeronautical meteorology, or for the Service in general. It noted that some NMHSs had implemented their own QM systems and mechanisms for certification and review. It encouraged other NMHSs to develop a QM system, taking into account the WMO guidance material.

4.22 The Commission noted the progress in considering and deciding on QM-related matters during the fifty-fifth and fifty-sixth sessions of the Executive Council and that a large number of NMHSs required guidance from WMO in creating national QM systems. The Commission recommended that the development of WMO guidance material on QMF be continued, taking into account the experience of a number of NMHSs in implementing their own QM systems and those based on the ISO 9001 standard.

Natural Disaster Prevention and Mitigation Programme

4.23 The Commission recalled Resolutions 29 (Cg-XIV) — Natural Disaster Prevention and Mitigation Programme (DPM) and 5 (EC-LVI) — Executive Council Advisory Group on Natural Disaster Prevention and Mitigation.

4.24 The WWW Programme, together with the Applications of Meteorology Programme, the World Climate Programme (WCP), the Hydrology and Water Resources Programme (HWRP) and the Atmospheric Research and Environment Programme (AREP) contributed to global capabilities in the detection, forecasting and early warning of hazards, and provided effective means and procedures to minimize their adverse consequences. The WWW Programme had been promoting upgrades to infrastructures to generate and exchange observations, forecasts and warnings. Through its system of Regional Specialized Meteorological Centres (RSMCs), the WWW had been providing weather forecasts, early warnings and advisories on tropical cyclones and other severe events. As a part of WWW, the Tropical Cyclone Programme (TCP) had been coordinating activities with respect to tropical cyclones, associated floods and storm surges. Ongoing key activities pertinent to DPM included developments in adaptable observing networks and programmes at the regional level with reference to disaster-prone regions and seasons, in high-impact weather forecasting based on NWP output, and in communication solutions providing access to, and dissemination of, early warnings and related information.

4.25 The PWS Programme, as part of the Applications of Meteorology Programme, had been providing assistance to NMHSs through training activities and the publication of guidelines on media issues, on the use of Internet, and on the communication of adequate warning messages to both the public and the emergency management community.

4.26 The Commission further recalled Resolution 13 (Cg-XIV) — Public Weather Service Programme, which requested the Executive Council to consider an appropriate mechanism for its oversight of that Programme in close collaboration with DPM. In its terms of reference, the Executive Council Advisory Group on Natural Disaster Prevention and Mitigation was requested to "oversee the activities on natural disaster prevention and mitigation from the various relevant WMO Programmes, in particular the activities of the PWS and DPM Programmes", and to "promote and strengthen the cooperation between the WMO technical commissions, regional bodies, and Members on natural disaster prevention and mitigation issues" (see the Annex to Resolution 5 (EC-LVI) — Executive Council Advisory Group on National Disaster Prevention and Mitigation).

4.27 The Commission noted that DPM would pose new challenges for CBS and would have direct implications on its work, specifically as regarded those activities and related priorities that contributed directly to the goals and expected outcomes of the DPM Programme. The session emphasized the need for observational data and forecasts exchanged among neighbouring countries that supported effective early warnings, for example, as well as the need for education and training opportunities that would assist Members to make progress on prevention and mitigation measures. It was also realized that the technical responsibility of CBS for the PWS Programme and the working modalities of the OPAG on PWS would need to be reconsidered in light of Resolution 13 (Cg-XIV), at least as regarded those programme activities connected with, or contributing, to DPM.

4.28 Furthermore, the Commission considered the DPM Implementation Plan with a view to identifying the various contributions and inputs the Commission should develop for the period 2005-2006. It was emphasized that when considering new activities and/or working structure, coordination was needed with the Secretariat of the International Strategy for Disaster Reduction (ISDR) on ISDR activities at the global and the regional levels, to enhance collaboration and avoid duplication of effort. It concluded that the terms of reference for the OPAGs should be revised to take into consideration relevant aspects of the DPM Implementation Plan.

WMO's potential contribution to a tsunami warning system

4.29 On 26 December 2004, a tsunami demonstrated, in most tragic proportions, the need for an appropriate warning system in the Indian Ocean and other regions at risk. The Commission was informed of the plans for the development of an end-to-end tsunami warning system in the Indian Ocean and other regions at risk. It noted that WMO strongly supported the leadership of UNESCO/IOC in coordinating that critical undertaking. The Commission fully supported WMO's commitment to working together with UNESCO/IOC, the ISDR Secretariat and other key partners at the international, regional, and national levels to combine WWW relevant capabilities and build on them to ensure that tsunami warning systems be made available not only to all countries in the Indian Ocean, but also to other regions at risk. It stressed, in particular, that the tsunami warning system should be embedded into a strategy for the development of a global multi-hazard end-to-end early warning system in the framework of the WMO NDP Programme.

4.30 The Commission emphasized the importance of national multi-hazard alert and response mechanisms benefiting from NMHS's experiences and capabilities with warning systems for weather- climate- and water-related natural hazards. It also stressed the importance of an end-to-end system, including NMHS linkages and capabilities to disseminate effective multi-hazard alerts at the national level to government authorities, the risk management community, the media and the public at-large.

4.31 The Commission emphasized that the GTS, and in particular the satellite-based telecommunications subsystem and the data-collection and data-distribution components of meteorological satellites, had the potential to support the exchange of tsunami warnings and information, as well as related data collection. The Commission expressed its full support to WMO's short-term and long-term goals and activities in participating actively in the development and implementation of tsunami warning systems. In the short-term, WMO would ensure that the GTS could support the exchange of warnings and related information in the Indian Ocean within the next six months. To that effect, a technical proposal for funding, where needed, of necessary upgrades for strengthening the GTS was developed. In the longer-term, WMO proposed to expand the GTS for tsunami early warning applications to other regions at risk regions, including the Mediterranean Sea, the Atlantic Ocean and the Caribbean Sea.

4.32 The Commission noted with appreciation that a WMO Workshop and Expert Meeting on GTS Support to Early Warning Systems in the Indian Ocean, including for Tsunamis (Jakarta, Indonesia, 14-18 March 2005) was organized to develop a technical implementation plan, including operational arrangements, for the distribution of interim tsunami warnings and advisories from contributing centres in the immediate future.

4.33 The Commission emphasized that GEOSS should play a crucial role in the context of early warnings systems, including tsunami warning systems, for the provision of comprehensive observational data from in situ and space-borne remote-sensing stations. The Commission, noting WMO's commitment to participate in tsunami warning systems and that 53 of the NMHSs in the world had their governments' mandate to provide seismic and tsunami warnings, encouraged the possible development of a WMO programme on seismology, including earthquakes and tsunami.

4.34 In view of those developments of importance for CBS, the Commission decided to establish a Coordinator for Natural Disaster Prevention and Mitigation and designated Ms Susan Barrell (Australia). It also agreed that the Coordinator should be member of the Management Group.

Regional Climate Centres (RCCs)

4.35 The WMO regional associations had made varying levels of progress in their efforts to consider regional needs for, and to implement RCCs. At the Meeting on the Organization and Implementation of RCCs (Geneva, 26-28 November 2003), representatives from each Region reported on the status of their progress on RCCs, and on the capacity within their Region to deliver RCC functions. At that time, RAs I, II and III had not held formal discussions at the regional level, but in the other three Regions (RAs IV, V and VI) regional discussions were in progress. The Meeting established guidelines for all regions to use in their further consideration of implementation of RCCs. Those guidelines included a draft survey for use in evaluating the needs of the regions for climate services, and also the capacity within the regions to deliver such services for the benefit of all the countries involved.

4.36 The Commission noted that since that Meeting, the RA II Working Group on Climate Matters including CLIPS completed their survey, and then met in Tokyo (25-27 October 2004) to review the results. The key outcome of that meeting was a resolution to be presented at the RA II thirteenth session in Hong Kong, China (December 2004) to implement a network of RCCs and other contributing centres on a voluntary basis for the upcoming four-year intersessional period. At the thirteenth session of RA II, Members agreed to proceed with that plan on a pilot basis. The Association had specifically stated that RCCs in that Region would be NMHSs that could deliver a number of the RCC activities (see general summary paragraph 5.1.21 in the *Abridged Final Report with Resolutions of the Thirteenth Session of Regional Association II (Asia)*, WMO-No. 981).

4.37 RA IV had also made considerable progress since the Meeting on the Organization and Implementation of RCCs, and Members in that Region were considering a virtual RCC system with a number of nodes. In addition to those identified in the *Proceedings of the Meeting on Organization and Implementation of Regional Climate Centres* (WCASP-No. 62, WMO/TD-No. 1198), Mexico and Cuba had recently offered to serve as nodes as well. Coordination of that system had not yet been resolved, but would be discussed at the upcoming fourteenth session of RA IV in Costa Rica.

4.38 Most Regions recognized a need for regional climate services, and it was clear that within each Region there was considerable capacity in some NMHSs or other existing centres to provide climate services to support the climate-related needs of the Region. Furthermore, in some RAs (particularly RA II) there was a clear intent that their RCCs were to be, eventually, officially included in Volume I of the *Manual of the GDPFS* (WMO-No. 485). It was therefore recommended that the presidents of the technical commissions, particularly of CBS and the Commission for Climatology (CCl) (at present), plan the necessary steps needed to amend the text of Volume I of the *Manual on the GDPFS* for eventual formal designation of RCCs, and to consider an appropriate mechanism to ensure the support of the Global Production Centres (GPCs) to RCCs as they evolved (including issues of standardization of formats, etc.). It was further proposed that all developments in WIS were communicated to the WCP and CCl, as those would have to be taken into account as RCCs were developed and implemented. There was a need to accelerate the establishment of RCCs since some of the potential tasks were nearing completion, such as the administration of the climate watch/alert system, being currently developed by CCl following the recommendation of the fifty-sixth session of the Executive Council.

5. WORLD WEATHER WATCH PROGRAMME, SUPPORT FUNCTIONS AND PUBLIC WEATHER SERVICES, INCLUDING THE REPORTS BY THE CHAIRPERSONS OF THE OPEN PROGRAMME AREA GROUPS (agenda item 5)

Technical cooperation and system support activities

5.0.1 The Commission reviewed the technical cooperation and system support activities carried out through the WMO Technical Cooperation Programme and related to the WWW basic systems and PWSs. The Commission agreed on guidelines for the allocation of priorities for technical cooperation support as given below.

Integrated observing systems

5.0.2 In 2003-2004, 47 countries received support for a total of 52 projects concerning observing systems. Eighteen projects aimed at strengthening surface observing stations, 33 at strengthening upper-air observing stations and one project at establishing a radar network. There remained 99 Voluntary Cooperation Programme (VCP) projects for observing systems, which had not yet been fully supported.

5.0.3 The Commission agreed on the following guidelines for the allocation of priorities for the IOS:

(*a*) Highest priority to the projects aimed at improving and restoring the existing, and building, the new upper-air observational capabilities of the RBSNs with emphasis on the activation of silent upper-air stations and the improvement of coverage over data-sparse areas;

(*b*) High priority to the projects related to the improvement of data quality, regularity and coverage of surface observations of the RBSNs with emphasis on the activation of silent stations and the improvement of coverage over data-sparse areas;

(*c*) High priority to projects related to the introduction and/or use of new cost-effective observing equipment and systems including surface-based AWSs, AMDAR, ASAP and drifting buoys;

(*d*) High priority to the projects related to the improvement of the data quality and coverage provided by RBCNs.

Information systems and services

5.0.4 Sixty-five countries received support for 77 projects concerning information systems and services in 2003-2004. Twelve projects aimed at strengthening the message switching systems at GTS centres, 36 at providing satellite receiving systems, 10 at connecting WWW centres to the Internet, and five at strengthening the national meteorological telecommunication networks. The installation of Meteosat Second Generation (MSG) receiving stations, including the Preparation for the Use of MSG in Africa (PUMA) project in Africa, began in 2004 and should continue in 2005 in order to cover the needs of reception in Africa and Europe. Fifty-eight VCP projects had not yet been fully supported.

5.0.5 The Commission agreed on the following guidelines for the allocation of priorities for cooperation activities for the information systems and services:

(*a*) Highest priority to the implementation of the connection of each National Meteorological Centre (NMC) to the GTS for the exchange of observational data and processed information (at a minimum speed of 16 Kbits/s using TCP/IP procedures), including reception of satellite-based data-distribution systems;

(*b*) Highest priority for the exchange of data between Regional Telecommunication Hubs (RTHs) at a minimum speed of 64 Kbits/s using TCP/IP procedures;

(*c*) Highest priority for the completion of the implementation of the project for an improved MTN;

(*d*) Highest priority for the collection of data from RBSN stations at NMCs or centres with similar functions;

(*e*) Highest priority for activities at capacity-building facilities and use of the Internet and implementation of related facilities in developing countries for improving exchange of meteorological and related information;

(*f*) High priority for a backup connection of each WWW centre to the GTS;

(*g*) High priority for the implementation of the virtual private network (VPN) connections via the Internet as a backup for the exchange of data, in particular for RTHs.

5.0.6 The WMO goals for Members equipped with meteorological satellite receiving equipment were 100 per cent for polar-orbiting satellite data receivers and for geostationary satellite data receivers. The Commission agreed on the following guidelines for the allocation of priorities for satellite receivers:

(*a*) Highest priority for satellite receivers for those Members without any receiver;

(*b*) High priority for satellite receivers for those Members without a polar-orbiting receiver or a geostationary receiver;

(*c*) Medium priority for satellite high-resolution receivers for those Members with only low-resolution polar-orbiting receivers or only low-resolution geostationary receivers;

(*d*) Low priority for satellite receivers for those Members already exceeding the WWW goal.

Data-processing and forecasting system

5.0.7 Seven countries received support for seven projects concerning DPFS in 2003-2004. The African countries of the Southern African Development Community and the Intergovernmental Authority on Development also received support for computing systems, including training. Thirty-two VCP projects had not yet been fully supported.

5.0.8 With regard to technical cooperation activities for DPFS, the session agreed on the following guidelines for the allocation of priorities:

(*a*) Highest priority for cooperation activities in establishing access to NWP products for additional post-processing or use as guidance for forecasting functions and applications at NMHSs in particular for severe weather forecasting, in NWP products for long-range forecasting, and the application of those products for use by disaster management agencies;

(*b*) Highest priority for activities contributing to the improvement of the dissemination and application of weather and long-range forecast products;

(*c*) Highest priority should be given to practical workshops on EPS concepts and products, including the interpretation of probabilistic products and case studies, relevant to the trainees; and high priority should be given to cooperation for training in EPS for those at NMHSs that intended to make their own products and/or who would need more specific training about products or the forecasting methodology;

(*d*) Highest priority in training on data-processing, modelling and applications;

(*e*) High priority in setting up remote support and maintenance, and distance learning methods.

Public weather services

5.0.9 Ten countries received support for the provision/upgrading of media weather presentation systems in 2003-2004. There were nine unsupported VCP projects related to PWS.

5.0.10 WMO Members, especially those in small and developing countries, needed assistance for the acquisition, replacement and upgrading of computing and communications systems in order to satisfy the increased demand for high quality PWS, as well as to keep up with the rapid advances in technology. As regarded technical cooperation activities for the PWS, the Commission agreed on the following guidelines for the allocation of priorities:

(*a*) Highest priority for television/media presentation systems comprising high performance computing and communications hardware, peripherals and software, video equipment for television production, as well as related training of staff;

(*b*) Highest priority for computer-based meteorological workstations that enabled, through forecaster interaction, the creation of new or enhanced products for users, based on satellite imagery and processed products (inputs);

(*c*) Highest priority for enhanced Internet access for NMHSs as a communications tool to improve their data access, as well as expand the dissemination methods of their PWS, and promote the use of official consistent information;

(*d*) Highest priority for training related to national PWS plans; that included training in media skills (writing and presentation), product design, and public education and awareness;

(*e*) High priority for fixed and mobile communications systems for the dissemination of PWS, preferably modern telephone and communication services (e.g., mobile telephones, pagers/short message system and fax-on-demand);

(*f*) Medium priority for very-high-frequency radios to provide radio broadcast and warning alert systems.

5.1 INTEGRATED OBSERVING SYSTEMS (agenda item 5.1)

5.1.1 The chairperson of the OPAG on IOS summarized the performance of the surface-based and space-based subsystems of the GOS, specific activities within the OPAG on IOS including observational data requirements and redesign, satellite system utilization and products, requirements and representation of data from AWSs, and other related issues. The chairperson expressed his deep appreciation to all of those who had contributed to the success of the OPAG: experts involved in the work of expert teams, specialized rapporteurs and regional rapporteurs/coordinators, and the Secretariat.

Observational data requirements and redesign of the GOS

5.1.2 The Commission noted with appreciation the work carried out by the Expert Team on Observational Data Requirements and Redesign of the GOS (ET-ODRRGOS), which focused on:

(*a*) The update of user requirements and observing system capabilities in 10 application areas, including the rolling requirements review and the corresponding Statements of Guidance;

(*b*) The review of several Observing System Experiments that tested possible re-configurations of the GOS and the Third WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction (Alpbach, Austria, 9-12 March 2004).

5.1.3 The Commission recognized, in particular, the substantial work carried out in drafting the Implementation Plan for the Evolution of Space- and Surface-Based Subsystems of the GOS, which appears in Annex III to this report. The Plan included 47 recommendations, as follows:

(*a*) Twenty recommendations addressed the space-based subsystem of the GOS. They built upon known plans of the operational and research and development (R&D) satellite operators and called for rigorous calibration of remotely-sensed radiances as well as improved spatial, spectral, temporal and radiometric accuracies. The wind profiling and global precipitation measurement missions were singled out for their importance to the GOS. Implementation of most of those recommendations would be realized through the WMO Space Programme working with space agencies, via CGMS;

(*b*) Twenty-two recommendations addressed the surface-based subsystem of the GOS. They included more complete and timely data distribution; improved data coding; enhanced AMDAR and Tropospheric Airborne Meteorological Data Reporting (TAMDAR) especially over data-sparse areas; optimized rawindesonde distribution and launches; improved upper tropospheric and lower stratospheric moisture measurements; operational use of targeted observations; inclusion of ground-based global positioning system, radars, and wind profilers; increased oceanic coverage through expanded ASAP, drifting buoys, and the Argo float programme, and development of some new observing technologies;

(*c*) Five recommendations addressed NWP interactions with data from evolving GOS, further study of observing system design and training issues.

5.1.4 The Commission agreed that the implementation of those recommendations should comprise the following elements:

(*a*) CBS, working through regional rapporteurs, to urge all Members with the existing operational observing capabilities and networks to distribute their full information content as quickly as possible;

(*b*) The chairperson of the OPAG on IOS, in consultation with the chairperson of the regional Working Group on Planning and Implementation of the WWW, to ensure that operators and managers of regional observing systems were made aware of GOS requirements;

(*c*) CBS, via the OPAG on IOS, to collaborate with other technical commissions such as CIMO and CCl;

(*d*) CBS, via the OPAG on IOS, to maintain liaison and ensure that targeting strategies developed by, e.g. EUMETNET and THORPEX, were carried through to operational implementation;

(*e*) CBS, via the OPAG on IOS, to monitor progress of the AMDAR programme related to TAMDAR and the automated flight information reporting system;

(*f*) CBS, via the OPAG on IOS, to evolve ocean observing systems in collaboration with the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM);

(*g*) CBS, via the OPAG on IOS, to encourage regional cooperation in weather radar networking.

5.1.5 The Commission expressed its gratitude to all experts who had been involved in preparing and reviewing the Implementation Plan and requested the Secretary-General to publish it and to arrange for its circulation, as guidance material to Members, appropriate working bodies of regional associations and technical commissions. The Commission felt that on circulating guidance material to Members, it would be helpful to request Members to identify implementation impediments and difficulties as a means of assessing implementation progress and of identifying where further work might be required.

5.1.6 The Commission recognized that the ET-ODRRGOS had successfully accomplished its major activities related to the redesign of the GOS and was now entering a new phase of its work, that would be concentrated on the implementation aspects of the evolving GOS. The Commission agreed that the Expert Team should be re-named Expert Team on Evolution of the Global Observing System (ET-EGOS) and endorsed its future work programme.

Satellite system utilization and products

5.1.7 The Commission noted with appreciation the work carried out by the Expert Team on Satellite System Utilization and Products (ET-SSUP) and in particular, the following accomplishments:

(*a*) Analysis of the 2004 edition of the Biennial Questionnaire;

(*b*) Refinement of ADM in the framework of the Integrated Global Data Dissemination Service (IGDDS);

(*c*) Definition of a comparable data content for polar and geostationary satellite missions;

(*d*) Identification of most-required, but not yet available, satellite data products, in particular for precipitation rate, stability information and wind profiles;

(*e*) Furthering cooperation with the PWS Programme;

(*f*) Further advancement of the Virtual Laboratory (VL), in particular through the organization of a high-profile global training event in the framework of VL activities;

(*g*) Accomplished arrangements upon the request by the National Meteorological Service of Omani jointly with the Sultan Qaboos University to become a Centre of Excellence within the VL;

(*h*) Adaptation of the strategy to improve satellite system utilization for the period 2004-2006.

The Commission also noted that pertinent points and recommendations from the work carried out by ET-SSUP were reflected in the Implementation Plan for the Evolution of Space and Surface-Based Subsystems of the GOS.

5.1.8 The Commission reviewed and endorsed the future work programme of the Expert Team.

5.1.9 The Commission reiterated the increasing role of satellite operators in the implementation of operational and R&D satellite programmes to contribute to the evolution of the GOS. It felt that CBS contacts with satellite operators should be broadened to facilitate early assessments of capabilities of satellite technology, problem areas and planned missions. It also felt that the partnership between satellite operators and NMHSs should be strengthened. In that connection, the Commission agreed to the proposal of the ICT on IOS to establish under the OPAG on IOS the new Expert Team on Satellite Systems (ET-SAT). It noted that membership of the ET-SAT should comprise representatives from space agencies and satellite operators participating in the WMO Consultative Meetings on High-level Policy on Satellite Matters and contributing, or with the potential to contribute, to the space-based component of the GOS. Participation in the work of ET-SAT would be at no cost to WMO. Accordingly, the Commission endorsed the terms of reference of ET-SAT.

Requirements and representation of data from AWSs

5.1.10 The Commission noted with appreciation the work carried out by the Expert Team on Requirements for Data from Automatic Weather Stations (ET-AWS), which addressed a number of issues related to:

(*a*) Maintenance definition and housekeeping of AWS metadata;

(*b*) The need for reporting both nominal and instrument values from AWS sensors;

(*c*) The need for the development of standards/procedures for conducting quality control of data produced by AWS platforms;

(*d*) The role of AWS installations in the future Earth Observation System and the role of AWS in the evolution of the Global Observation System.

It was also noted that in addition to those key activities, the Expert Team also reviewed and refined a number of AWS-related definitions, updated BUFR/CREX code tables for consideration by the Expert Team on Data Representation and Codes, and carried out a preliminary work in defining a standard AWS platform.

5.1.11 The Commission, taking into account the recommendations developed by ET-AWS, agreed that:

(*a*) Variables such as irradiance and radiant exposure should be used to distinguish between physical quantities such as power and energy;

(*b*) AWS installations should report both dew-point temperature and relative humidity to satisfy all data users;

(*c*) Both instrument (Level I) and nominal (Level II) data by AWS installations should be reported and that BUFR/CREX templates should be updated accordingly;

(*d*) Proposed guidelines for AWS quality control procedures should be published in the *Guide on the Global Data-processing and Forecasting System* (WMO-No. 305);

(*e*) AWS installation quality control procedures should include a Flag Table for data quality within AWS BUFR templates;

(*f*) The location of AWS installations should be described more accurately by representing latitude and longitude degrees in decimal notation, and with the accuracy of at least 1/1 000 of a degree; also *Weather Reporting* (WMO-No. 9), Volume A should be updated accordingly;

(*g*) The Earth Geoid Model (EGM-96) should be adopted as a primary reference for horizontal positioning and GEOID99 as the primary reference for mean sea level determination.

It requested the OPAGs on IOS and on ISS to keep the implementation of the above under review.

5.1.12 The Commission invited CIMO to address the above recommendations with a view to include them in the *Guide to Meteorological Instruments and Methods of Observation* (WMO-No. 8), as appropriate.

5.1.13 The Commission reviewed and endorsed the future work programme of the Expert Team.

Scientific evaluation of Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs)

5.1.14 The Commission noted with appreciation the fact that the Rapporteurs on Scientific Evaluation of OSEs and OSSEs had worked closely with the ET-ODRRGOS with respect to the results of OSEs carried out in Australia, Canada, Japan, the Russian Federation, the United States, major European NWP centres, the EUCOS Programme, the High-resolution Limited Area Model (HIRLAM) Consortium, and others. Specifically, the Commission noted that the conclusions drawn at the Third WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction in Alpbach, Austria (March 2004), were included into the Implementation Plan for the Evolution of Space- and Ground-based Subsystems of the GOS (see general summary paragraph 5.1.3).

5.1.15 The Commission reiterated the great value of experiments in the redesign process and encouraged leading NWP centres and relevant scientific groups to continue their efforts in that area. It felt that WMO-sponsored workshops continued to be very efficient forums for summarizing results of NWP experiments for evaluating observing systems sensitivity and quality and agreed to convene such workshops on a regular basis.

GCOS matters

5.1.16 The Commission appreciated the report of the Rapporteur on GCOS Matters and noted with satisfaction the continued cooperation that existed between CBS, GCOS and regional associations in the implementation of the GCOS surface network (GSN) and the GCOS upper-air network (GUAN). CBS Lead Centres for GCOS had been established at JMA for GSN, and at NOAA's National Climatic Data Center for GSN and GUAN.

5.1.17 The Commission noted that after having shown some improvement since 2001, the data availability had been steady at 60 to 70 per cent for GSN and at 70 to 80 per cent for GUAN. The Commission recognized that a list of Focal Points for GCOS and related climate matters had been established and was being used by the GCOS Lead Centres to address problems of receipt of expected messages. The Commission was also informed of Lead Centre efforts to collect historical GSN data and updated metadata for GUAN stations. Updated metadata information for approximately 40 GUAN stations had been provided by 24 different NMHSs. The Commission recommended the active involvement of Focal Points for GCOS to foster a better understanding of the means of continuing improvements in data availability and their engagement in continued efforts to collect required metadata for GUAN stations.

5.1.18 The Commission welcomed and encouraged the continuation of the revitalization activities that were being carried out at a number of high priority GUAN stations with support being provided by a number of Members including the Australia, New Zealand, the United Kingdom and the United States.

5.1.19 The Commission appreciated the development and publication (in four languages and on CD-ROM) of the WWW technical report entitled *Handbook on CLIMAT and CLIMAT TEMP Reporting* (WMO/TD-No. 1188), which was specifically addressed to the personnel responsible for compiling and transmitting CLIMAT and CLIMAT TEMP messages at the national level. The Commission felt that all NMHSs reporting CLIMAT and CLIMAT TEMP messages should make the best use of the *Handbook* for improving the quality of climatological reports. It furthermore welcomed the development, under the GCOS and WCP leadership and with support from the United States, of specialized software for the automatic generation of CLIMAT and CLIMAT TEMP messages that had been distributed to Members for beta testing. The Commission noted with appreciation the organization of the RA II/RA VI subregional Training Seminar on CLIMAT and CLIMAT TEMP Reporting (Moscow, November 2004), which was the first in the series of such seminars for countries in WMO Regions having problems generating and exchanging climate data.

Implementation Plan for the Global Observing System for Climate in support of the United Nations Framework Convention on Climate Change (UNFCCC)

5.1.20 The Commission welcomed the development, under the GCOS leadership, of the

Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC. The Plan had been submitted to the Conference of the Parties to the UNFCCC at its tenth session in December 2004 which supported it through a formal decision. The Commission noted that the Plan called for some 131 actions needed over the next five to 10 years to address the critical issues related to global observing systems for climate, namely: improving key satellite and in situ networks for atmospheric, oceanic and terrestrial observations; generating integrated global climate analysis products; enhancing the participation of least developed countries and small island developing States; improving access to high-quality global data for essential climate variables; and strengthening national and international infrastructure. It furthermore noted that many of the actions involved the Commission and/or the WMO Space Programme explicitly as an 'Agent for Implementation'. The Commission supported the Plan as a major step in the full implementation of the global observing system for climate and agreed to participate fully in implementing the relevant actions and in facilitating access to essential climate variables by developing countries. It encouraged Members to support implementation of the Plan and associated regional plans on an individual basis. It requested the OPAG on IOS to provide advice on how the Commission could best respond to those actions. It also requested the OPAG on IOS to work with GCOS to identify the relationship between elements of the Implementation Plan for the GCOS and elements of the Implementation Plan for the Evolution of Space- and Surface-based Subsystems of the GOS.

AMDAR matters

5.1.21 The Commission reaffirmed the growing contribution of the AMDAR programme in complementing the existing upper-air observing system. New AMDAR programmes had become operational in Canada; China; Hong Kong, China; Japan; and Saudi Arabia. Of interest were also a series of newly planned programmes such as the targeted programme for ASECNA in collaboration with E-AMDAR, and the new development of AMDAR systems in Argentina, Chile, China and the United Arab Emirates. It noted that a number of countries continued to plan an AMDAR programme, including Egypt, Hungary, India Morocco, Oman, Poland and the Russian Federation. The Commission was informed that a new, standardized onboard software package had been approved, and that changes to the BUFR code to take into account the AMDAR data coding accepted by CBS-Ext.(02), had been successfully tested.

5.1.22 The Commission was pleased to note that in order to follow-up steps being undertaken to integrate more fully AMDAR into the WWW operations, the OPAG on IOS Rapporteur on AMDAR Matters had been appointed. It also noted that, in addition to the increasing availability of AMDAR data on the GTS, a number of display systems were currently operational and available using the Internet, e.g.:

(*a*) The password-protected display system of the Forecast Systems Laboratory (http://acweb.fsl.noaa.gov/java);

(*b*) The similar EUCOS Web site (http://www.eucos.net, also password protected);

(*c*) A simple, Windows-based, stand-alone display system was currently not available, but the Forecast Systems Laboratory and the UK Met Office were working on solutions based on existing technology.

The Commission was informed that the AMDAR Panel had organized technical training workshops for ASECNA, as well as in South Africa, in the United Arab Emirates, and in Hungary for central and eastern European countries and was planning for additional technical training, in Arab League States, and in Asia, Morocco, Russia and South America. The Commission recognized the need for developing a training concept for the use of AMDAR data and adopted Recommendation 1 (CBS-XIII).

GOS-related regulatory material

Manual *and* Guide on the Global Observing System *(WMO-No. 544 and WMO-No. 488)*

5.1.23 The Commission considered the proposed changes to the *Manual on the Global Observing System* (WMO-No. 544), Volume I and the *Guide on the Global Observing System* (WMO-No.488), Part II submitted by the ET-AWS, ET-SSUP and ICT on IOS and requested that the new text of the *Manual* be reviewed by the Task Team on Regulatory Material and then posted on the WMO Web site with an invitation for review and comments by WMO Members by the designated date. In that connection, the Commission adopted Recommendation 2 (CBS-XIII).

5.1.24 Considering the role of GOS-related regulatory material and taking into account changes occurred in the operational practice of NMHSs, the Commission felt that activities should be undertaken to review and update the *Guide on the Global Observing System* (WMO-No. 488).

Improvements to* Weather Reporting *(WMO-No. 9), Volume A

5.1.25 The Commission recalled that CBS-XII considered possible measures to improve the accuracy of *Weather Reporting* (WMO-No. 9), Volume A. The Commission was advised on the progress that had been made to implement the recommendations included in the report "Possible improvements of WMO Publication No. 9 – Volume A", prepared by Mr Harald Daan, the OPAG on IOS Rapporteur on the Improvement of Volume A. It noted that in order to turn that report into a procedural plan, a User Specification and a detailed

Design Specification were developed. The Design Specification had then developed into a comprehensive database application, written in Access 2000. The revised Volume A application had been trialed within the Secretariat. It was planned to seek the assistance from some WMO Members who had already developed similar applications, with the aim that a suitable application could be implemented in WMO with minimum modifications. The CBS members should be informed about the time of introduction of the revised Volume A.

Regional aspects of the GOS

5.1.26 The Commission noted the increasing coordination role between Rapporteurs/Coordinators on the Regional Aspects of the GOS and the OPAG on IOS activities. It also recognized that depending on the region, there were significant differences in the terms of reference of regional rapporteurs. Taking into account evolution aspects of the GOS, the Commission felt that some new and common tasks for regional rapporteurs should be developed for consideration by regional Working Groups on Planning and Implementation of the WWW with subsequent inclusion in revised terms of reference. The Commission requested the OPAG on IOS to collaborate more closely with regional rapporteurs in carrying out their assigned tasks and to facilitate dissemination of information on GOS developments in the regions. The Commission agreed that there should be closer interaction and coordination between regional rapporteurs and newly established/revised national focal points on observation aspects. It noted that the lists of the national Focal Points on GCOS, on Volume A, and on the RBSN were maintained by the Secretariat.

Upper-air observations — transition to the Vaisala RS92 radiosondes

5.1.27 The Commission was informed of the transition to the new family of RS92 radiosondes, as announced by Vaisala Oyj. The RS92 radiosondes provided technological advancements, such as improved (digital) telemetry, better slant range, more reliable data link, narrow band transmission and a higher level of pressure-temperature-humidity performance and continuous wind data availability.

5.1.28 Based on the Vaisala Transition Plan, the production of the RS90 had been discontinued during the autumn of 2004 and the RS80 /400 MHz series of radiosondes would be discontinued in the course of 2005, which would necessitate upgrades of currently used ground stations to be compatible with RS92 sondes, or their total replacement in case of some older systems, such as CORA (1973), MicroCORA (1981) and PC-CORA (1990), as no upgrade options would be made available.

5.1.29 Based on the WMO Radiosonde Catalogue, Vaisala RS80 radiosondes were at present used at about 447, and RS90 at about 78, upper-air stations, which represented 45 and 7.8 per cent, respectively, of the upper-air stations worldwide. All stations would need different levels of upgrades. That significant change in the use of RS80/90 was, therefore, of great concern to the WMO Members.

5.1.30 As the action of a leading radiosonde manufacturer would require money over and above the already costly operation of the network of upper-air stations, the Commission expressed its serious concern over the possible weakening of the worldwide network, because numerous stations would most likely not be timely upgraded or replaced due to lack of funds. The Commission noted in particular the statements made by Egypt, Mauritius, Namibia, Nigeria and Senegal expressing the short notice and absence of funds to carry out changes to new radiosondes. The Commission requested the Secretary-General, as a matter of urgency, to investigate the impact of that development on the upper-air network and to initiate action towards alleviating the risk of a prolonged loss of upper-air data, especially in developing countries and to increase interoperability between equipment from different suppliers. The Commission appreciated the United Kingdom's support, through VCP and with the assistance of New Zealand and South Africa, to upgrade several GUAN stations in the southern hemisphere. The Commission asked the Secretary-General to request from Vaisala, details of their long-term strategy of radiosonde production. It also suggested to appoint within the OPAG on IOS co-rapporteurs on the development and introduction of new instrumentation to collaborate with CIMO and the Association of Hydrometeorological Equipment Industry (HMEI).

5.2 INFORMATION SYSTEMS AND SERVICES, INCLUDING DEVELOPMENT OF THE FUTURE WMO INFORMATION SYSTEM (agenda item 5.2)

5.2.1 The Commission thanked Mr Peiliang Shi, acting chairperson of the OPAG on ISS, for his report. It noted with satisfaction the progress and achievements made, covering a wide range of tasks. It noted that the proposals and recommendations developed by the Expert Teams had been reviewed and consolidated by the ICT on ISS. The Commission expressed its thanks to the many experts who had served on the various expert and Implementation Coordination Teams.

Status of implementation and operation of the GTS

5.2.2 All the 24 MTN circuits were in operation and all MTN centres were automated. Sixteen MTN circuits were implemented through data-communication network services in the framework of the improved MTN, five circuits were operating at 64 kbit/s and two at 9.6 kbit/s. All MTN circuits (but one) were operating with TCP/IP or had a firm plan for the migration to TCP/IP. However, the Commission noted with concern that one circuit (New Delhi-Cairo) remained using very low speed characteristics and was not capable of meeting the MTN requirements. The Commission noted that the implementation of computer-based systems for GTS and/or GDPS functions in WWW centres were making progress, in particular through the introduction of cost-effective PC-based systems in several developing countries. The Commission was pleased with the significant progress made in the implementation of RMTNs, but it also noted that serious shortcomings still existed in some regions at the regional and national levels.

5.2.3 In Region I, despite serious economic difficulties, continuous efforts had enabled some improvement of GTS circuits via leased lines, satellite-based telecommunications or public data networks, including the Internet. Satellite-based data-distribution systems (MDD, RETIM and UKSF) and data-collection systems (METEOSAT/DCS) would continue to play a crucial role, taking into account the upgrades (EUMETCast and RETIM-Africa). There were still serious shortcomings, in particular at the national level, and a strategy for enhancing WWW basic systems was developed to foster sustainable development, in particular of meteorological data-communications. In that regard, the PUMA project (funded by the European Commission) that was being implemented and the RETIM Africa system were essential contributions to the strategy. The Commission noted with concern that the actual implementation of most of the strategy was lacking the necessary resources.

5.2.4 Most of Region II GTS circuits were operating at medium or high speed, but there were still a number of low-speed connections. The Regional Meteorological Telecommunication Network (RMTN) in Region II, particularly in its eastern and southern parts, was being improved by the continued implementation of improved data communication services, including frame relay services, complemented by satellite-based distribution systems and the use of the Internet. The plan for an improved RMTN was nearly implemented.

5.2.5 In South America, the RA III Regional Meteorological Data Communication Network (RMDCN) project was entering its implementation phase, since the provider's Framework Contract for the new RMDCN was concluded by the Secretary-General. Those upgrades would enable NMHSs to enhance considerably their reception and use of highly valuable data and products. All 13 NMCs were also equipped with World Area Forecast System/operational meteorological information (WAFS/OPMET) receiving systems via the international satellite communication system (ISCS) operated by the United States.

5.2.6 In Region IV, the ISCS operated by the United States that was providing for the RMTN as well as data distribution over Regions III and V, was upgraded to TCP/IP procedures with an increased capacity. The Commission noted that the ISCS upgrade also led to the replacement of all NMCs' workstations.

5.2.7 Significant progress was made in the Region V RMTN with the implementation of frame relay services and the expansion and upgrades of ISCS. Technical changes to the satellite-based emergency managers weather information network, which was a crucial source of data, warnings and forecasts for the Pacific and some parts of the Caribbean, in particular for small island countries, were planned for 2007. There was also an increasing use of the Internet, in particular for the collection of observational reports and for linking small nations in the Pacific.

5.2.8 The RA VI RMDCN, based on a shared network service managed by ECMWF, was interconnecting 33 RTHs and NMCs. Those data-communication network services had continued to be an excellent cost-effective implementation of the GTS, with a very high reliability and full security, a guaranteed quality of service and an easy scalability of capacity. The RMDCN services were extended to include interregional and MTN GTS circuits. The other RA VI Members were operating leased point-to-point GTS circuits and Internet connections and were expected to join the RMDCN as soon as possible. Satellite-based distribution systems (DWDSAT, RETIM, TV-Inform and MDD) were also playing an important role, taking account of the upgrades.

5.2.9 The Commission expressed its appreciation for the extensive implementation and significant technological upgrades of satellite-based multipoint telecommunications systems that were operating as integrated components of the GTS for the distribution of large volume of information, in complement to the dedicated connections. Each WMO Region was completely covered by at least one satellite-based data-distribution system, and several systems were implemented at the national or subregional level. Satellite-based systems using digital video broadcasting techniques were implemented in Region VI and extended to cover Regions I and II, including RETIM operated by France and EUMETCast operated by EUMETSAT and also supporting DWDSAT of Germany. They were also planned in other regions. Satellite-based systems using digital audio broadcasting techniques for "data casting" were also used by the World Space Radio and Internet (RANET) Experiment over Africa and the Pacific, and by the India Meteorological Department for replacing and upgrading the radiobroadcast from RTH New Delhi.

Review of the organization of the GTS

5.2.10 The Commission noted that a direct link between the World Meteorological Centre (WMC)/RTHs Melbourne and Washington had been in operation for several years in the framework of the implementation of the improved MTN (see also general summary paragraphs 5.2.26 and 5.2.31), and that the ICT on ISS recommended its inclusion in the MTN. The Commission agreed that the Melbourne-Washington circuit was efficiently contributing to the global data exchange and should be included in the MTN. Noting the impact and benefits of data-communication network services on data exchange capabilities and interconnectivity, the Commission requested the OPAG on ISS to review and propose updates to the organization and design principles for the GTS, especially the MTN, to take the best benefits from ICT development, including its smooth evolution towards the core communication component of the Future WMO Information System (FWIS).

Data-communication systems and techniques

TCP/IP and related protocols on the GTS

5.2.11 The Commission noted that, in compliance with the procedures and implementation guidance for the use of TCP/IP on the GTS (*Manual on the Global Telecommunication System* (WMO-No. 386), Attachment II-15), the WMO Secretariat was coordinating the assignments of IP addresses for GTS connections upon request from GTS centres. The Commission, however, was informed that the set of IP addresses that were originally provided by *Météo-France* for allocation to GTS links were no longer officially available, as a consequence of the strict application of Internet standards (RFCs) by Internet service providers in view of the general shortage of IP addresses. The Commission noted that the Expert Team on Enhanced Utilization of Data Communication Systems (ET-EUDCS), in close association with the centres that were the main users of those IP addresses, was developing an IP address migration plan to resolve that issue as a matter of urgency. Until the migration to a new IP address scheme was completed, the centres using the current IP addresses were urged to take great care not to leak those addresses to the Internet to avoid Internet problems. The Commission noted that the ET-EUDCS had developed a short guide to help NMHSs that so desired to establish a system architecture to connect to the Internet with a minimum set of IP addresses.

5.2.12 The Commission noted the status of IPv6 development. The development in Asia was ahead, but IPv6 deployment still did not seem to be an urgent issue for American and European countries. It concluded that it was still premature to expend much efforts in IPv6 testing, but requested the OPAG on ISS to keep abreast of developments, in particular in Asia, with a view to taking action as appropriate, and to investigate the possibility of registering IPv6 addresses for WMO purposes as soon as possible.

5.2.13 The Commission recalled that through Recommendation 3 (CBS-Ext.(02) — Amendments to the *Manual on the Global Telecommunication System* (WMO-No. 386), Volume I, Part I and II) that was endorsed by the Executive Council, it had approved a general file naming convention that should be implemented with a transition period not exceeding 2007. File names for new message types should follow the following format:

pflag_productidentifier_oflag_originator_yyyy
MMddhhmmss[_freeformat].type[.compression]

It noted that the OPAG on ISS agreed upon the principles for allocating the corresponding new mandatory field "productidentifier", based on a hierarchy of sections with a cascade of identified "authorities" that would ensure its uniqueness and facilitate its management (see also general summary paragraph 5.2.48).

Guidance for using the Internet between GTS centres

5.2.14 The Commission recognized that, for several small NMHSs, the Internet was the only affordable telecommunication means for transmitting meteorological information, despite its possible shortcomings (availability, reliability, delays, security). The OPAG on ISS revised the existing guidance for observational data collection using e-mail over the Internet in the light of operational experience. The revised recommended procedure was meant to provide a simple, clear tool for small NMHSs for which email remained almost the only option for providing observational reports, in some cases through low-capacity Internet access (e.g. very slow dial-up lines). Recommended practices were also developed on the Web interface for meteorological data ingest, noting that several NMSs had shown a preference for that option and that both systems were required as complementary solutions. The Commission noted with much appreciation that the source code for the Web data-ingest implementation at RTH Washington could be made available through request to WMO. The Commission agreed that the recommended practices should be included in the *Manual on the Global Telecommunication System*, Volume I, Part II.

5.2.15 The Commission noted that the OPAG on ISS reviewed the guidance for the establishment of cost-effective Internet-based connections between RTHs and NMCs, including the current *Guide on Virtual Private Networks (VPNs) via the Internet between GTS Centres*. It also noted with appreciation the Technical Note *IPSec Feasibility Study* (*in cooperation with DWD, Météo-France (HNMS and KNMI): Summary and Recommendations* that was developed by ECMWF and made available to WMO. The Technical Note was translated into French, Spanish and Russian and posted on the WMO Web site. It was noted that VPNs over the Internet were efficient, but that there were still certification issues, in particular with the choice of a proper Certificate Authority, which were also of concern to the FWIS and Virtual Global Information System Centre project. The Commission also noted with appreciation the FWIS VPN pilot project in Regions II and V, which was primarily concerned with the connectivity of FWIS National Centres to their Global Information System Centre. The Commission requested the OPAG on ISS to continue to keep abreast of VPN developments and to update and refine accordingly the guidance documentation. The Commission confirmed that, as the guidance documentation on VPNs was strongly influenced by rapidly changing technology, it should be published in an electronic form on the WMO Web server.

5.2.16 The Commission noted with appreciation that the *Guide on Internet Practices* had been revised to take account of technological developments, and that it was now available on the WMO Web server in English, French, Russian and Spanish. It noted that the OPAG on ISS was planning to review the *Guide* as regarded the information technology security component explanations after the new *Guide on Information Technology Security (ITS)* was developed (see general summary paragraph 5.2.18).

5.2.17 The Commission recognized that many NMHSs, if not all, had requirements for FTP servers, but several did not have the system administration experience to configure them adequately. It noted with appreciation that the OPAG on ISS was developing a guide on use of FTP and FTP servers at WWW centres, based on a document that was developed by JMA; the current draft was accessible via the WMO Web server. The current available experience was on a Unix platform, but it was agreed that such documentation should not focus on a particular operating system. The Commission asked the OPAG on ISS to pursue the development of that guide and agreed that it should be published on the WMO Web server.

Guidance on information technology facilities at WWW centres

5.2.18 The Commission emphasized the increasing security threats to networked systems that NMHSs had to face and the potential impacts to specific sites as well as other interconnected sites, in particular for WWW systems. It noted with satisfaction that, in view of the lack of expertise especially in smaller countries, the ET-EUDCS had decided to develop a guide on information technology security (ITS) at WWW centres. The document should cover the purpose, industry approved security processes, security procedures and best practices. The guide should be readable by managers and be a precise source of information for technical personnel, although it was not meant to cover all technical aspects in great detail. The draft guide, which was undergoing further development, was available on the WMO Web server. The Commission asked the OPAG on ISS to pursue its development and invited WWW centres with security experience to provide comments and contributions.

5.2.19 The Commission also recalled that online information resources on data communication systems and techniques were available on the WMO Web server. That provided all Members with practical information and guidance on the actual implementation of data communication systems and techniques. It invited all WWW centres to continue contributing to, and making use of, those information resources.

GTS operation and information exchange

5.2.20 The Commission recalled that through Recommendation 3 (CBS-Ext.(02)) that was endorsed by the Executive Council, it had approved that the maximum length of meteorological messages be extended to 500 000 octets for messages containing data in binary presentation forms (T_1=H, I, J, O, P, Q and Y). The Commission recognized that a transition period was needed to implement the recommendation and agreed upon a maximum period of five years. It invited the OPAG on ISS to assess a realistic implementation date.

5.2.21 The OPAG on ISS reviewed the outcome of a technical consultation of RTH experts (in particular RTH focal points) to assess the status of some GTS operational procedures at RTHs and at their respective associated NMCs. The Commission noted that the majority of RTHs were currently, or in the near future, able to receive, handle and relay meteorological messages containing data in binary presentation forms up to the maximum length of 500 000 octets. Some RTHs, however, needed to replace or upgrade their message switching system that was planned by the year 2007. Several NMCs were also not yet able to receive and use 500 000 octets meteorological messages containing data in binary presentation forms. The Commission therefore concluded that the target implementation date of November 2007 should be retained. It also asked the OPAG on ISS to carry out a further assessment in the future (e.g., at the end of 2005).

5.2.22 The Commission also endorsed the recommendation for an improved text on the relevant procedure included in the *Manual on the Global Telecommunication System*, Volume I, Part II, (paragraph 2.7.1) for clarifying the procedures before and after the extension of the maximum length of 500 000 octets for meteorological messages containing data in binary presentation forms.

5.2.23 The Commission noted that the technical consultation of RTHs also addressed the requirements for maintaining some of the current specifications of procedures that originated from teleprinter operation, such as the International Telegraph Alphabet No. 2 (five bits), the limited set of characters from the International Alphabet No. 5 (eight bits) used in meteorological messages, the "end of line" marker (CR-CR-LF) and the limit of 69 characters per line. It concluded that the impact of changing those procedures would be significant, while very little benefit was expected to be gained from the change; it however agreed that a more flexible use of the International Alphabet No. 5 (eight bits) should be allowed for meteorological messages containing plain text, and that the recommended practices should be reviewed in that respect.

5.2.24 The Commission recalled that, at its extraordinary session (2002), it had agreed upon a scheme of allocations of abbreviated headings, which provided for the reservations required to facilitate the migration to table-driven code forms. Adequate abbreviated headings were required to distribute "migrated" data encoded into BUFR and CREX, including a parallel heading scheme for BUFR and CREX versions. It had further agreed that the relevant Tables (B3, C6 and C7) of Attachment II-5 of the *Manual on the Global Telecommunication System* should be reviewed and revised accordingly, as soon as the actual need for exchanging "migrated data" arose. The Commission was informed that some centres were starting the exchange of "migrated data"; it therefore requested the OPAG on ISS to follow-up that matter and invited centres concerned to inform of their requirements.

Amendments to the *Manual on the Global Telecommunication System*, Volume I

5.2.25 Subsequent to the conclusions above, the Commission adopted Recommendation 3 (CBS-XIII) concerning amendments to the *Manual on the Global Telecommunication System*, Volume I, Parts I and II.

Improved MTN (IMTN) project

5.2.26 Fourteenth Congress noted that managed data-communication network services had proven to be a cost-effective implementation of the GTS, with a very high reliability and full security, a guaranteed quality of service and an easy connectivity and scalability of capacity. It noted that new and imaginative administration and financial arrangements were required to share and take full benefit from those new data-communication network services, and it invited NMHSs to be as flexible as possible in that regard, taking account of respective national policies. Congress fully supported the conclusions of CBS on the improved MTN (IMTN) project, which facilitated a progressive but rapid implementation of data-communication network services for the core GTS services. Congress noted with much satisfaction that the IMTN implementation and operation had started at the end of 2002. Congress also emphasized that the FWIS would build upon the GTS with respect to the requirements for highly reliable delivery of time-critical data and products, and the improved MTN would be the basis for the core communication network.

5.2.27 The IMTN implementation plan consisted of:

(*a*) The implementation of a "cloud I" providing the interconnectivity between the RTH/WMCs Washington and Melbourne and the RTHs Tokyo, Exeter, Brasilia and Buenos Aires, including RTH/WMC Moscow in a further step;

(*b*) The implementation of a "cloud II" as an extension of the RA VI-RMDCN, providing the interconnectivity between the RTHs Exeter, Toulouse, Offenbach, RTH/WMC Moscow and other adjacent RTHs, i.e. RTHs Nairobi, Dakar, Algiers, Cairo, Jeddah, New Delhi and Beijing. The inclusion of the Tokyo-Beijing and Tokyo-New Delhi circuits would also provide an effective interconnectivity between both "clouds".

5.2.28 With respect to "cloud I", the portion Washington, Melbourne, Tokyo and Exeter was implemented. Asymmetric committed information rate (CIR) was cost-effective for matching the unbalanced traffic. It was noted that the provider's contract was renewed by the end of 2004. The inclusion of RTHs Brasilia and Buenos Aires that were currently connected to RTH/WMC Washington via effective 64 kbit/s digital leased circuits would be considered at the respective opportunity of the end of the current contracts. The connection of RTH/WMC Moscow was planned as a further step in 2005.

5.2.29 The implementation of "cloud II" made significant progress through the extension of the RA VI-RMDCN managed data-communication services provided by Equant Network Services Limited "Equant". The ECMWF, in the framework of the WMO/ECMWF agreement, was managing the RMDCN and monitoring, on behalf of all participating centres, the quality of service and the contractor's adherence to the Service Level Agreements. The Beijing-Offenbach, Tokyo-Beijing and New Delhi-Tokyo, New Delhi-Moscow and Jeddah-Offenbach MTN links had been implemented. RTHs Exeter and Tokyo were providing the actual interconnection between "cloud I" and "cloud II". The Equant master RMDCN contract was also renegotiated and revised, which led to significant tariff reductions for the benefit of the IMTN "cloud II". The Commission also noted the project for migrating "cloud II" to advanced data-communication network services (see general summary paragraph 5.2.33).

5.2.30 The Commission was informed that RTH Dakar had decided not to join the RMDCN, since the option of upgrading the Dakar-Toulouse MTN circuit via an extension of their very small aperture terminal (VSAT) SATCOM network, which was implemented, was more cost-effective at that time. The current Algiers-Toulouse MTN leased circuit (64 kbit/s digital) was also significantly more cost-effective at that time benefiting from special tariff agreements between France and Algeria. RTH Nairobi was considering the option of upgrading the Nairobi-Offenbach MTN circuit via an extension of their national VSAT network. The Commission was also informed that plans for the upgrade of the MTN links Moscow-Cairo, Cairo-Nairobi and New Delhi-Cairo were under consideration.

5.2.31 The Commission noted with satisfaction the progress made in the implementation of the IMTN project and expressed its great appreciation for the collaborative and fruitful efforts made by the NMHSs concerned that contributed to the upgrade of the overall GTS as well as to an effective building block for FWIS. The current IMTN status is included in Annex IV to this report.

Telecommunication techniques and services

5.2.32 The OPAG on ISS had reviewed the development of telecommunication techniques and services for an improved GTS. The Commission particularly noted that digital audio broadcasting and digital video broadcasting techniques via satellite were implemented and planned by several NMHSs for national and international data-distribution systems, confirming their suitability and cost-effectiveness for an improved GTS, as well as for the FWIS. In that regard, the Commission agreed that the integration into the GTS/WIS of digital video broadcasting satellite-based systems operated by NMSs or relevant organizations should be pursued.

5.2.33 The Commission noted the characteristics of new emerging advanced data-communication network services, especially multi-protocol label switching (MPLS) that was expected to supersede frame relay networks in some areas of the world. It was informed that ECMWF was currently pursuing with Equant the migration of the underlying network structure of the RMDCN/IMTN (Cloud II) to one based on MPLS. Pilot testing of the use of MPLS should take place during 2005. The Commission noted that MPLS would give the potential capacity of any-to-any connectivity, and was likely to lead to new opportunities and challenges with respect to traffic management between GTS centres. The Commission asked the OPAG on ISS to consider the full implications, and agreed that the exchange and routeing mechanisms for messages and files on the GTS should be reviewed in the light of those new capabilities, and with a view to FWIS.

Radio frequencies for meteorological activities

5.2.34 The Commission emphasized that the threat on the full range of radio-frequency bands allocated to meteorological systems and environmental satellites would continue with the increasing development and expansion of new commercial radiocommunication systems, especially ultrawide band devices, i.e. radiocommunication systems operating at high frequencies with very large bandwidth.

5.2.35 The Commission noted with appreciation that the World Radiocommunication Conference 2003 (WRC-03) had a favourable outcome and closed serious issues that had been debated since 1992, including the bands 401-406 MHz, 1 675-1 710 MHz (radiosondes and meteorological satellites) and 2 700-2 900 MHz (meteorological radar) which were therefore consolidated as important allocations for meteorological operations. The next WRC was planned for 2007. The most important issues were related to the protection of space-borne passive sensing, as emphasized by Congress (Resolution 3 (Cg-XIV) — Radio frequencies for meteorological and related environmental activities). Noting with serious concern the threat that was developing in some regions to the exclusive 23.6 - 24 GHz passive band (water vapour absorption line), the fifty-sixth session of the Executive Council urged all NMHSs and meteorological and environmental satellite operators to do their utmost to safeguard that frequency band as it was crucial for WMO. It noted with appreciation that WMO, meteorological and R&D satellite agencies and several NMSs were actively participating in the International Telecommunication Union Radio-communication (ITU-R) activities. Referring to Resolution 3 (Cg XIV), the fifty-sixth session of the Executive Council urged Members to participate actively in national, regional and global (i.e. ITU-R) activities regarding radio frequencies to ensure that meteorological and related environmental interests were protected. It also requested CBS, with the support of the Secretariat, to pursue its review and guidance on those issues.

5.2.36 The Commission confirmed the importance of keeping NMHSs aware of the criticality of issues related to the various radio-frequency bands used by meteorological systems. It urged Members to ensure that their respective national Radiocommunication Authorities were fully aware of the impact of relevant issues for meteorological operations and to seek their support. The Commission asked the Steering Group on Radio-Frequency Coordination to pursue actively its activities, in close collaboration with CIMO as well as with the OPAG on IOS on relevant matters. It noted with appreciation that a workshop on radio frequencies for meteorology, including sharing aspects between Met Aids and Met Sat in common bands, was planned to be held in the third quarter of 2005.

5.2.37 The Commission also noted that the Steering Group was updating the joint ITU/WMO publication *Handbook: Use of Radio Spectrum for Meteorology* in coordination with the ITU, and that the updated information would be posted on the WMO and ITU Web sites.

Metadata standards

5.2.38 The Commission emphasized that Metadata was the key to the effective data exchange and the success of the WMO Programmes. It noted with satisfaction that its OPAG on ISS had pursued the development of the WMO core metadata standard with the involvement of experts from other WMO Programmes. The Commission endorsed the draft WMO Core Profile within the context of the ISO 19115 geographic information standard as the "formal draft version 1.0" against which WMO

Programmes would perform formal testing. The draft WMO Core Profile should be posted on the WMO Web server.

5.2.39 The WMO metadata standard should consist of the WMO Core Profile of the ISO Metadata Standard and its extensions specific to each WMO Programme. Each WMO Programme was expected to propose amendments to the WMO Core Profile, especially if they had requirements that were common to several Programmes, and to develop and maintain its own "community extension" for specific items. The WMO Core Profile of the ISO Metadata Standard should be registered by the WMO Secretariat and be posted on the WMO server as a "community profile" with ISO once it was consolidated after testing. In preparing the extension, Programmes should comply with the ISO standard and were encouraged to register their extensions through the OPAG on ISS.

5.2.40 The Commission emphasized that one of the major issues was the further development and coordinated implementation of a detailed WMO Core Metadata Profile for all Programmes. It noted that technical commissions had been invited to designate focal points on WMO metadata issues relevant to their WMO Programmes. The focal points were expected to:

(*a*) Compile and share information on the experiences gained in the use of the draft WMO Core Profile within their Programmes;

(*b*) Coordinate proposals for the amendments to the WMO standard, i.e. amendments to the core WMO metadata standard and development/amendments to the relevant extensions;

(*c*) Consolidate proposals for the extension of the WMO Core Profile;

(*d*) Pass their extension to the Interprogramme Expert Team on Metadate Implementation (IPET-MI) for consolidation and registration.

5.2.41 Noting that other environmental communities were developing their own core profile of the ISO Metadata Standard, the Commission emphasized that the WMO Core Profile should be developed in consultation with the appropriate working groups of those communities. There were initiatives related to the interoperability of systems in the geophysical and environmental sciences, such as GEOSS, the Global Monitoring for Environment and Security, including the Integrated Spatial Potential Initiative for Renewable Energy in Europe in the European Union, and Data Management and Communications in the United States. The WMO Core Profile of the ISO Metadata Standard should be made known and WMO should closely follow those initiatives.

5.2.42 The Commission noted that a catalogue of features and keywords was an important aspect of the metadata, and it agreed that the keywords list should be further developed in classes:

(*a*) A core list shared by all WMO Programmes;

(*b*) Supplementary lists, prepared and maintained by the respective WMO Programmes, which would consist of Programme-specific keywords.

5.2.43 With a view to facilitating the coordinated development of the comprehensive WMO Metadata Standard that was critical for the development of FWIS, the Commission agreed to establish within the OPAG on ISS the IPET-MI to maintain and update the WMO Core Profile, including the catalogue of features and the list of keywords for describing WMO datasets. The IPET-MI should develop WMO Metadata Standard extensions specific to the WWW Programmes, and also promote development of extensions specific to other WMO Programmes in liaison with respective technical commissions.

5.2.44 The Commission noted that WMO was granted the class A liaison status for participating in ISO Technical Committee 211 responsible for the 19100 series of ISO standards. It agreed that the IPET-MI should contribute to the work of ISO Technical Committee 211, in particular by submitting WMO contributions to the development of the standards and by publicizing the WMO activities in the development and implementation of the WMO Core Profile and its extensions.

5.2.45 The Commission stressed the need to assist NMHSs' centres in the implementation of the WMO Core Profile of the ISO Metadata Standard. It asked the OPAG on ISS, and namely (IPET-MI), to coordinate the development of:

(*a*) A reference implementation of the Profile so that it could be used as a guide by implementers;

(*b*) Tools to facilitate the manual creation of metadata;

(*c*) Applications to maintain metadata in the standard profile;

(*d*) Mechanisms for users to search globally among metadata catalogues;

(*e*) A Core Feature Catalogue compliant with ISO 19110.

5.2.46 In view of the importance of the above-mentioned development and the cross-cutting nature of metadata, the Commission fully concurred that convening workshop on metadata in 2005, with the involvement of relevant partner programmes, would facilitate reaching a consensus on metadata implementation.

Other WWW data management matters

5.2.47 The Commission noted that revised content of the *Guide on World Weather Watch Data Management* (WMO-No. 788) was developed by the OPAG on ISS. The *Guide* should be designed for electronic publication and only those aspects of the *Guide* that described best practices should be maintained. Guidance on other aspects of data management should be included indirectly through references to other sources of information available on the Web. The Commission agreed that the responsibility for editing each part of the G*uide* should lie with the CBS OPAGs and expert teams with key knowledge on each topic, under the coordination of the OPAG on ISS assisted by the Secretariat. It asked the OPAGs to contribute to update the *Guide* accordingly.

5.2.48 The Commission recognized the need of WMO for unique identifiers in a wide range of activities, including documents, file names and stations identifiers, and agreed that a common approach was appropriate. The Commission concurred with the method of defining unique identifiers that should place responsibility for ensuring uniqueness as close to the point of creation of the item as possible. It asked the OPAG on ISS to consolidate, as a matter of urgency, a mechanism for assigning unique identifiers based on a sequence of delegating authority to generate identifiers, in particular for generating unique file names.

Integrated WWW monitoring

5.2.49 The project on integrated WWW monitoring (IWM), as agreed by the Commission at its twelfth session, comprised two parts: an operational trial of the proposed integrated monitoring and an extension of the special MTN monitoring. The Commission noted the Workshop on WWW Integrated Quantitative Monitoring (Toulouse, 2–4 June 2003) that was held related to the implementation of the IWM. The IWM project was based on sharing the monitoring responsibilities between the WWW centres and the Secretariat. The RTHs would play a key role by collecting monitoring reports from their associated NMCs and sending the consolidated IWM reports to the Secretariat and their associated MTN centres. The RTHs could use the annual global monitoring reports of their associated NMCs to prepare their IWM reports.

5.2.50 The Commission emphasized that the use of a PC-based common monitoring application would greatly facilitate the consistent and effective implementation of the IWM at WWW centres. The Commission was very pleased that the *Deutscher Wetterdienst* (*DWD*) had developed a monitoring application on PC; it expressed its appreciation and thanks that the *DWD* was making the arrangements for distributing through WMO the monitoring software for use by the NMHSs. The Commission supported that an operational trial of the IWM be carried out at an RTH in Region I, such as RTH Dakar, using the PC-based monitoring application.

5.2.51 In view of the development of the use of the BUFR code, in particular through the migration to TDCF, the Commission stressed the importance of monitoring data presented in the BUFR code. It noted with appreciation that RTHs on the MTN, in particular RTHs Melbourne, Offenbach, Tokyo and Toulouse, were participating in a pilot study and in preliminary tests for the monitoring of BUFR bulletins. The present and planned responsibilities taken by the centres were as follows:

(*a*) Offenbach agreed to prepare pre-analysis files for aircraft BUFR data provided by Melbourne, Offenbach and Toulouse. Offenbach was currently providing such pre-analysis files;

(*b*) Tokyo developed a pre-analysis application for wind profiler BUFR data and implemented it on a trial basis in October 2004;

(*c*) Melbourne was considering making the pre-analysis for other types of data, thus preparing the monitoring of the migration to TDCF.

5.2.52 The Commission asked the OPAG on ISS to promote further the development and implementation of the IWM, and invited RTHs on the MTN to join actively that effort. It also invited centres to carry out ad hoc monitoring exercises on the exchange of products, in particular at the regional level. With a view to the transition towards FWIS, the Commission emphasized the need to define the monitoring scheme for the FWIS, in particular the monitoring tasks of the Global Information System Centres (GTSCs), the Data Collection or Product Centres and National Centres.

Future activities

5.2.53 The Commission reviewed the key tasks of the OPAG on ISS for the forthcoming CBS intersessional period (2005-2006). It agreed on a proposed structure and list of tasks for the Implementation Coordination Team and Expert Teams of the OPAG on ISS (see agenda item 9).

Future WMO Information System

5.2.54 The Commission recalled that Fourteenth Congress endorsed the concept of FWIS, as an overarching approach to meet information exchange requirements of all WMO Programmes. Congress requested CBS to pursue the further development of the FWIS, while emphasizing that all WMO Programmes and technical commissions should participate actively and contribute their own expertise and resources in all phases of the development of the FWIS.

5.2.55 The Commission was pleased that the Interprogramme Task Team on FWIS (ITT-FWIS) had further refined the FWIS concept with the participation of representatives of technical commissions. The ITT-FWIS considered data management and communication structures and plans of other WMO Programmes and reviewed pilot projects that had a strong relationship to the development of the FWIS, including the WMO Core Metadata Standard, the Virtual (distributed) Global Information System Centre in Region VI, including the European Project on Grid Technology for Product Development and Production Process Design, the VPN Project in Regions II and V, the EUMETNET Uniform Data Request Interface Project, the JCOMM End-to-End Data Management Project, the Roshydromet CliWare Project, the Earth System GRID and the Community Data Portal. It also noted that the ITT-FWIS had started the assessment of data exchange requirements of WMO Programmes at present and for the foreseeable future, including issues related to metadata and data catalogues.

5.2.56 The Commission re-emphasized that the success of FWIS depended upon volunteering Members actively to support and contribute to the pilot projects related to various WMO Programmes. The experience gained through pilot projects would be shared with all Members to promote and facilitate the early introduction of FWIS elements. The Commission was very satisfied with the further development made on the Virtual GISC Project with the participation of *DWD*, the United Kingdom, the Met Office, *Météo-France*, ECMWF, EUMETSAT and the National Center for Atmospheric Research. It noted with particular appreciation the actual presentation of the GISC prototype, which was made on the occasion of the present session, and which demonstrated which Internet technology (e.g. portals, portlets, J2EE, application server, Web services, XML, FTP, e-mail) could be used for the provision of the services from a GISC. The Commission was also very pleased to note the success of the first phase of the VPN project in Regions II and V, and the fact that the pilot project would be significantly expanded with additional components, including prototype applications and more participating NMHSs in the years 2005-2006. It also noted that new pilot projects were emerging, including a project in the framework of the World Agrometeorological Information Service (Commission for Agricultural Meteorology (CAgM)) supported by the Korea Meteorological Administration.

5.2.57 The Commission noted that the fifty-sixth session of the Executive Council agreed that a strong, high-level coordination and collaboration mechanism spanning across the technical commissions was needed for achieving the challenging task of the development of FWIS. By Resolution 2 (EC-LVI) the Executive Council established the Intercommission Coordination Group on FWIS (ICG-FWIS), chaired by Mr G.-R. Hoffmann (Germany) with the following terms of reference:

(*a*) To coordinate the refinement and consolidation of the FWIS based on the approved concept and then the implementation planning phases;

(*b*) To assess in detail the data exchange and data management requirements of WMO Programmes at present and for the foreseeable future, which should be met by the FWIS;

(*c*) To advise the technical commissions on the development of data-communications and management functions to be required in the FWIS as regarded their respective programmes;

(*d*) To guide the orderly evolution of existing WMO information systems towards FWIS;

(*e*) To address the major issues that had been identified.

The Commission also noted that the president of CBS was requested to report on the work of ICG-FWIS to each session of the Executive Council, taking into account the relevant outcome of the Meetings of the Presidents of Technical Commissions.

5.2.58 The Commission was informed that the ICG-FWIS held its first session on 12-14 January 2005, at the WMO Headquarters in Geneva. The ICG-FWIS stressed that significant further work was required from the individual WMO Programmes, as well as through a common effort, to consolidate a comprehensive and consistent status of data exchange and data management requirements. The ICG-FWIS supported strongly the establishment and activities of expert teams of technical commissions that were relevant to FWIS (data-management, metadata, XML, data exchange) for fostering the FWIS development. It noted that CBS would pursue its proactive role in, and contribution to, the further development of the FWIS through activities relevant to its OPAGs, in particular the OPAG on ISS. The ICG-FWIS emphasized that the cooperation and coordination between corresponding technical commission expert teams was of prime importance. Noting that metadata aspects were crucial for the FWIS development, the ICG-FWIS noted with appreciation the work of IPET-MI and recommended that the technical commission focal points on metadata be members of the Team.

5.2.59 The Commission emphasized the critical importance of the FWIS for the WWW, noting that the implementation of FWIS would build upon the most successful components of existing WMO information systems, in particular the WWW GTS and Data Management, and that a smooth and coordinated transition was crucial. It also emphasized that the WMO Space Programme IGDDS should be fully integrated as a communication component of FWIS. The Commission therefore agreed that CBS should pursue its proactive role in the further development of the FWIS through activities relevant to its OPAGs, in particular the OPAG on ISS, and in the framework of the new ICG-FWIS. To that effect, the Commission agreed to establish within the OPAG on ISS an Expert Team on FWIS/GTS Communication Techniques and Structure and an Expert Team on FWIS GISCs and DCPCs (see agenda item 9). It also recalled the critical activities of the IPET-MI for the development of FWIS. The Commission also recommended that the possibility of holding a technical conference on FWIS jointly with CBS-Ext. 2006 be considered.

5.2.60 With respect to the Earth Observation Summit (EOS) initiative, the Commission emphasized that the FWIS, in particular the WWW GTS, should be an initial component as well as an important backbone building block within the GEOSS for achieving greater interoperability and connectivity among individual component observing systems. It agreed that the participation of FWIS as a critical component of the GEOSS was a unique opportunity as well as a challenge.

5.2.61 The Commission agreed that the qualifier "Future" in the name Future WMO Information System (FWIS), which was relevant when the concept had been launched, was not adequate any longer when entering the implementation phase. It noted that the ITT-FWIS recommended that the name be changed and, noting the recommendation of the ICG-FWIS in that regard, it supported the new proposed name "WMO Information System (WIS)" that would well reflect the structure and purpose of the system and appear as a logical phase after the initial Future WMO Information System project.

Data representation and codes

5.2.62 The Commission noted with appreciation the work of the Expert Team on Data Representation and Codes (ET-DR&C) and thanked Mr Jean Clochard (France), who chaired the team.

Modifications to the Manual on Codes (*WMO–No. 306)*

5.2.63 The Commission recalled the scheme agreed upon during its previous session, which defined a three-steps mechanism for modifications to BUFR, CREX and GRIB 2 tables (see general summary paragraph 6.2.66 *of the Abridged Final Report with Resolutions and Recommendations of the 2002 Extraordinary Session of the Commission for Basic Systems* (WMO-No. 955)). The Commission noted the working results and recommendations of the ET-DR&C and the ICT on ISS concerning additions to data representation tables, including the additions approved during the intersessional period for pre-operational use, as summarized in the following paragraphs.

FM 92 GRIB edition 2

5.2.64 Based on the results of tests and experimental exchanges, additional templates for two new compression schemes based on JPEG 2000 and PNG, as well as new parameters for image-type products and Earth surface information, were recommended for operational use. However, more testing and validation were requested for the Weather-Huffman compression (see Annex 1 to Recommendation 4 (CBS-XIII)). Regarding the available GRIB 2 encoder/decoder software, the Commission took note with appreciation of the work done by ECMWF, EUMETSAT, *DWD*, JMA, the National Centres for Environmental Prediction (NCEP) and the United Kingdom Met Office, and thanked those making their software freely available, especially the decoder, which would facilitate a wide use of GRIB 2 products.

FM 94 BUFR and FM 95 CREX tables

5.2.65 In the light of various requirements, and after validation and pre-operational use, corrections and additions to BUFR or CREX regulations and tables were recommended for operational use (see Annex 2 to Recommendation 4 (CBS-XIII)). A regulation was amended to define clearly displacement and increment descriptors. New descriptors and new common sequences were added for translation in BUFR of PILOT and TEMP observations and AMDAR profiles. Encoding of Meteosat 8 data and satellite radio occultation data was facilitated through appropriate table entries. Tables were adopted for operational use for the following data: AIRS satellite data, ENVISAT data, wave–spectra, oceanographic data, ozone concentrations and radiosondes data. New descriptors and new common sequences for translation in BUFR of SYNOP and SHIP observations, and encoding of nominal and instrument values for surface observation data, instantaneous radiation data and SIGWX messages were being validated. Additions of new entries defining new satellite instruments and identifiers, and new entries defining NMCs of all countries as originating centres in Tables C-1 and C-11, and new radiosondes entries in Common Code Table C-2 had been approved by the president of CBS during the intersessional period. As Table C-2 was nearly saturated, it was recommended to use BUFR for exchanging radiosonde data, as soon as possible.

New editions of FM 94 BUFR and FM 95 CREX

5.2.66 The Commission recommended additions for a new BUFR edition, which had been validated for representation of probabilities, forecast values and new operators. The other additions included in the new edition were the definition of international subcategories, which would help the migration process (for sorting out bulletins) (see Annex 3 to Recommendation 4 (CBS-XIII)). To increase the compatibility with BUFR, additions for a new edition of CREX were also recommended. The Commission recommended the new editions for operational implementation on 2 November 2005, with the understanding that both editions, BUFR editions 3 and 4, and CREX editions 1 and 2, could be used in parallel up to 2012, when the migration process would be fully completed for most of the data types; then BUFR edition 4 and CREX edition 2 would be the only ones in use after that date. The Commission consequently urged BUFR and CREX decoder software providers to adjust their software as soon as possible to decode BUFR edition 4 and CREX edition 2 as from 2 November 2005. Producers were also invited to encode data in the new edition formats as soon as possible.

5.2.67 In that connection, the Commission adopted Recommendation 4 (CBS-XIII) and recommended operational implementation of the amendments on 2 November 2005.

Modifications to FM 15 METAR, FM 16 SPECI, FM 50 WINTEM and FM 51 TAF

5.2.68 In response to the requirements expressed by ICAO related to amendment 73 to Annex 3/ Technical Regulations [C.3.1], the Commission recommended modifications to METAR/SPECI and TAF codes, for implementation on 2 November 2005 and adopted Recommendation 5 (CBS-XIII). The Commission also recommended that WMO request ICAO to consider seriously for the future, to bring into phase the implementation date of WMO code changes and the corresponding Annex 3 amendments. The ICAO observer indicated that it was the firm intention by ICAO to ensure, in coordination with WMO, that the applicability dates of future amendments to ICAO Annex 3/Technical Regulations [C.3.1] related to aeronautical meteorological codes and of the corresponding changes to the WMO codes would coincide. The Commission also recognized the importance of streamlining the approval of code changes, for example by striving to adapt the calendar of the meetings on code matters with a view to meeting the target dates for code changes.

Migration to table-driven code forms

5.2.69 The Commission noted also with appreciation the work of the Expert Team on Migration to Table-driven Code Forms (ET-MTDCF) and thanked Mr Fred Branski (United States), who chaired the team.

5.2.70 The Commission recalled that Fourteenth Congress had endorsed the migration plan developed by CBS and urged Member countries to develop as soon as possible a national migration plan, derived from the international plan, with analysis of impacts, costs, solutions, sources of funding (as necessary), national training, technical planning and schedule. Congress had requested CBS to put in place an effective implementation/ coordination mechanism for guiding, assisting and monitoring the migration to TDCF. For that purpose, CBS agreed to establish a Coordination Team on MTDCF (see general summary paragraph 9.5).

5.2.71 The Commission noted that the era of implementation and coordination of the migration to TDCF had now started. The migration plan called for the start of operational exchange by 2 November 2005 for TDCF from category 1, Common codes, but still with dissemination duplicated in traditional alphanumeric codes as long as users could not receive and process the TDCF. That category included SYNOP, TEMP, PILOT and CLIMAT types (see the table given in Annex V to this report). It agreed to consider, among other things, RADREP, CODAR, ARFOR and WINTEM as almost obsolete code forms (category 6).

5.2.72 The Commission reviewed the status of the migration to TDCF and noted that several centres had already produced a variety of observations in BUFR. The United States would exchange soon on the GTS radiosonde data in BUFR. It also noted that several activities were carried out to promote the use of TDCF, in particular BUFR, at a number of international meetings and conferences.

5.2.73 Regarding the implications of the MTDCF for the *Manual on Codes* (WMO-No. 306), CBS re-asserted the need to adapt and update current reporting practices in the alphanumeric code regulations for adaptation to TDCF. Additional work would need to consider what would be the best order for BUFR template parameters both from a migration and a coding standpoint. The Commission noted that national coding practices that were not recorded in the *Manual on Codes* would make MTDCF more difficult. The Commission agreed to include regional/national practices in the BUFR templates and to develop a BUFR template for the transmission of TAF messages.

5.2.74 The Commission took note of the results of the Questionnaire on WMO Codes Processing related to the MTDCF and concluded that progress was taking place in the use of BUFR, however mainly in Region VI. The encoding software was mostly run on UNIX and LINUX operating systems, and FORTRAN and C were the languages used most. Some countries used or planned to use CREX for SYNOP, AWS, BATHY, BUOY, TESAC and WAVEOB encoding.

5.2.75 ECMWF had made available BUFR, CREX and GRIB edition 1 encoder/decoder software (under UNIX/LINUX) for free downloading from its Web site. In the first 10 months, it had recorded 1 205 downloadings of the BUFR software, 123 of the CREX software and about 2 500 of the GRIB software. The Commission thanked ECMWF for those remarkable service. The Commission was also informed that *DWD* had contracted the development of a BUFR encoder/decoder under Windows, which could be purchased under specific conditions.

5.2.76 TDCF training seminars had been organized for countries in RA I (training in English in Arusha, Tanzania), in RAs III/IV (in San José, Costa Rica) in 2003 and in RA I (training in French in ASECNA (Niamey, Niger)) and east RA II/west RA V (in Kuala Lumpur, Malaysia) in 2004. The Commission recommended that training should be continued and organized for the remaining countries in west RA II, east RA VI, as well as east RA V. Training for RA I might also need to be repeated in 2006.

5.2.77 The Commission recommended that the Secretariat should publish more information material on TDCF matters and the migration. Considering that the efforts for migration to TDCF should be increased, it urged Members to create national mechanisms, such as a project steering group to develop, as soon as possible, a national migration plan. The WWW *Operational Newsletter* should be used to report regularly on progress in, and activities related to, MTDCF, including the availability of bulletins in TDCF.

5.2.78 The Commission felt that the BUFR or CREX code forms, not being standard outside the WMO community, were not the most appropriate forms of presentation of WWW data and products for users outside the WMO community. The Commission agreed to consider the use of XML, more and more used within the Internet community, for the presentation of WWW data and products to users outside the WMO community.

5.3 DATA-PROCESSING AND FORECASTING SYSTEM, INCLUDING EMERGENCY RESPONSE ACTIVITIES (agenda item 5.3)

5.3.1 The Commission thanked Ms Angèle Simard (Canada), chairperson of the OPAG on DPFS who also served as chairperson of the ICT on DPFS, for her report. In addition the president of the Commission expressed special recognition and appreciation to Ms Simard for her long-standing dedication, scientific understanding and management skills with which she effected significant progress in the work of CBS. It noted with satisfaction the significant progress made and the important achievements attained by the OPAG team and rapporteurs in addressing requirements of the WWW and other programmes and in accomplishing their tasks in collaboration with experts of other Commissions working under the auspices of OPAG. The Commission thanks all experts who served on the Expert Team on Ensemble Prediction Systems, the Emergency Response Activities Coordination Group, the Expert Teams on Infrastructure for Long-range Forecasting, the Expert Team to Develop a Verification System on Long-range Forecasts, and the Rapporteurs on the Application of NWP to Severe Weather Forecasting and on the Impact of Changes to GOS on NWP.

Forecasting standards

5.3.2 The Commission noted that Fourteenth Congress was of the view that the establishment of a WMO standard and/or recommended practices for weather forecasting techniques would assist in producing more reliable forecasts using optimally the current levels of meteorological science and technology. It also noted that the fifty-sixth session of the Executive Council asked to give consideration to the development of guidance and support systems for forecasting, noting with satisfaction that work had started on the development of WMO standards or recommended practices for weather forecasting as requested by Congress.

5.3.3 There were many factors which determined the actual forecasting processes and procedures, including forecast range, geographical and climatological context, organization of the forecast office, users, technical environment (capabilities and equipment) of the forecasting system. There existed several references (e.g. *Guides*, Web sites), which described forecasting practices. The Commission recommended that the Recommended Practices for Short-range Weather Forecasting given in Annex 1 to Recommendation 6 (CBS-XIII) be added to paragraph 3 (Analysis and forecasting practices) of the *Manual on the GDPFS* (WMO-No. 485). The session added that further work was required to develop, refine or provide guidance on those standards and practices, and to maintain an up-to-date guide for the full range of forecasting functions and processes. In particular, there was a need to distinguish practices at the global, regional, national and local centres to ensure there were no overlaps.

5.3.4 The Commission noted that the ultimate goal of a QMF for weather forecasting was to establish the functional basis to ensure ongoing improvements of the forecasts' reliability and accuracy, and to build and maintain the confidence of customers and users. It agreed on recommended practices for the short-range forecasting as found in Annex VI to this report. The NMHSs were encouraged to use those recommended practices, evaluate their applicability, and make necessary adjustments and then refine and apply them according to their respective needs and capabilities.

5.3.5 The Commission noted that a condensed and revised version of the report of the WMO consultant on forecasting standards had been prepared (November 2004) entitled: "A summary of recommended practices for weather forecasting", and recommended that the document be made widely available.

5.3.6 The Commission agreed that some guidance material should be developed to help NMHSs develop their own performance measurement systems for forecasting.

5.3.7 The Commission was informed that Oman was making available its verification software package to any requesting WMO Member running NWP. That package verified deterministic model outputs against observations and model output statistics. This package allowed a user to select input and output parameters according to the circumstances and needs.

5.3.8 The Commission noted that the *Guide on the GDPFS* (WMO-No. 305) had not been revised for quite some time and invited the OPAG on DPFS to establish a mechanism to undertake that task.

Ensemble forecasting systems: products and applications

5.3.9 Most advanced centres were now operating or developing EPSs for use in the short, medium and/or long range. Most operational EPS used global models for medium-range predictions. A small number of regional ensembles focusing on short-range forecasts were in quasi-operational mode and many more were under development.

5.3.10 Research in the Poor-Person's Ensemble System (PEPS) at the United Kingdom Met Office had demonstrated that that approach could provide reliable probability forecasts at relatively low cost. A regional PEPS for Europe was under development at *DWD*.

5.3.11 The Commission noted that a six-day workshop programme on the subject of EPS was developed, with the view that workshops would be organized to train trainers on the concepts and practical use of EPS. Two workshops were being organized by WMO in 2005: for RAs III/IV in Brasilia (January) and for RAs II/V, tentatively in China (April). Such training was also needed for RA I and for some Members of RA VI. It recognized the existence and high value of the United States COMET computer-assisted learning system and considered that it could be the basis for the development of training material. However, examples in the COMET modules were all United States region based. In order to make the modules more appropriate for use by more NMHSs, the COMET developers had offered to generate some case studies for regions outside the United States, in particular in regions appropriate to the forthcoming training workshops.

5.3.12 COMET modules for training on EPS were at present only available in English. The Commission invited Members to consider providing translations so that the training modules became more widely accessible and beneficial to more NMHSs.

5.3.13 The Commission noted that guidance was needed on how to use EPS products in relation to those from deterministic models, that were also available at NMCs, in the preparation of final forecasts and warnings.

5.3.14 Training workshops placed a high demand on experts who provided the lectures. The development resources needed to prepare the workshops were considerable, especially for suitable materials for specific regions. The Commission invited Members to allow their subject experts to have adequate time to develop necessary materials. It also requested the Secretary-General to consider providing appropriate assistance to invited lecturers.

5.3.15 The Commission noted with satisfaction that a WMO framework for standardized verification of EPS was being developed and implemented. The experimental exchange of verification data had been established by JMA who provided a data server and Web site. The Commission expressed its gratitude to JMA for offering to operate as lead centre for EPS verification and encouraged EPS-producing centres to provide verification results as per the agreed content and format.

5.3.16 The Commission recommended defining the responsibility of a lead centre for EPS verification. The president of CBS was requested to designate RSMC Tokyo as the lead centre for verification of EPS. The proposed amendments to Attachment II.7 of the *Manual on the Global Data-processing and Forecasting System* (WMO-No. 485) were given in Annex 2 to Recommendation 6 (CBS-XIII).

5.3.17 The Commission recommended that all RSMCs with activity specializations in tropical cyclones should transmit their tropical cyclone observations in BUFR format for acquisition by NWP centres, and especially global EPS producers, to improve their data assimilation and initialization. It noted that the performance of EPS for tropical cyclones needed further research attention.

5.3.18 The Commission encouraged all NMHSs to access EPS products that were available on several major GDPFS centres' Web sites. Links to those Web sites were available on the WMO Web site under the GDPFS Programme (http://www.wmo.int/web/www/DPS/EPS-HOME/eps-home.htm). The GDPFS centres were invited to notify the WMO WWW Department whenever those URL links were changed.

Severe weather events forecasting

5.3.19 The Commission noted that the CBS Management Group had suggested a demonstration project on forecasting of severe weather, involving EPS, NWP models, nowcasting, interpolation techniques, as well as involving, through voluntary participation, global NWP model producer(s), RSMC(s), developing NMHS(s) and disaster management and civil protection authorities. The scope of the project was to test the usefulness of the products currently available from NWP centres, or products that could be made available from current systems, with the goal of improving severe weather forecasting services in countries where sophisticated model outputs were not currently used. Such a demonstration project would use a cascading (forecasting) approach to provide greater lead-time for severe weather and would, at the same time, contribute to capacity-building and improve links with disaster management authorities.

5.3.20 The Commission noted and agreed on a general definition for severe weather, which was based on impacts as follows:

> Severe weather event: A meteorological or hydrometeorological event that presents a risk of adverse impact to life, property or national infrastructure, on any geophysical scale and timescale of a few weeks or less, and that requires action to both communicate to the public and to the responsible authorities, and to reduce the impact.

The key points were that severe weather was expressed as a risk of an event, as a risk that must be managed, that it was an event and not a climatological state, and that it could be small (e.g. flash flood), or large events (e.g. storm surge, periods of heavy rain over several weeks).

5.3.21 The Commission further noted that a cascading approach was well suited for severe weather forecasting. For example, EPS-based guidance could be used to identify several days in advance potential areas for severe weather. Then higher resolution models would be used to refine the forecasts in the shorter range. Finally, in the very-short-term (few hours), nowcasting techniques or extrapolation techniques could be used to provide more up-to-date information. In case of severe weather, it was necessary to provide the users, e.g., Disaster Management and Civil Protection Authorities (DMCPA), with meteorological information which was easy to understand and met their needs.

5.3.22 The Commission agreed with the goals of the demonstration project(s) as follows:

(*a*) To improve the ability of NMCs to forecast severe weather events;

(*b*) To improve the lead time of alerting of those events;

(*c*) To improve interaction of NMCs with DMCPA before and during events;

(*d*) To identify gaps and areas for improvements;

(*e*) To improve the skill of products from GDPFS centres through feedback from NMCs.

5.3.23 The Commission noted that the Workshop on Severe and Extreme Events Forecasting (Toulouse, 26-29 October 2004) developed the general terms for the demonstration project including goals, the roles of the participating centres, and the criteria for participation, all of which are given in Annex VII to this report.

5.3.24 The Commission agreed that the DPFS programme should coordinate the implementation of the two types of projects; one that was aimed at improving forecasting severe weather associated with tropical cyclones, and another that was focused on improving heavy precipitation/strong wind forecasts (not associated with tropical cyclones).

5.3.25 The Commission further agreed that the demonstration project(s) could be used as an opportunity:

(*a*) To evaluate further the recommended practices for forecasting standards and the yet-to-be developed recommended practices for performance measurement;

(*b*) To provide capacity-building in the use of post-processed products;

(*c*) To define most useful products for severe weather forecasting in developing countries;

(*d*) To help clarify and specify the appropriate NWP/EPS products which were needed in the NMHSs from GDPFS centres;

(*e*) To strengthen the links between NMHSs and DMCPAs.

5.3.26 The Commission noted that the demonstration project(s) could only succeed if there were clear commitments from all participants to fulfil their respective roles as well as to participate in the evaluation of the project. The project would build on existing capabilities and would be developed with a view to ensuring sustainability. Performance measures would be established prior to the start of the project, as well as the necessary documentation criteria. At the end of the project, there would be an in-depth analysis, including feedback from all parties and DMCPAs involved. It was agreed that the project duration should be of one year to ensure that sufficient severe weather events were analysed.

5.3.27 The Commission agreed with the following conclusions of the value and pertinence of the proposed demonstration project(s). It would:

(*a*) Be an excellent way to apply the cascading approach in three levels:

(i) Global NWP centres to provide available NWP products, including in the form of probabilities;

(ii) Regional centres to interpret information received from global NWP centres, run mesoscale models to refine products, liaise with the participating NMCs;

(iii) NMCs to issue alert, advisory, severe weather warning; to liaise with disaster management authorities; and contribute to the evaluation of the project;

(*b*) Provide means to evaluate the value of current EPS, diagnostic products, nowcasting techniques and direction for improvement, for example in the assessment of the value of probabilistic forecasts and the skill of EPS products in severe weather forecasting;

(*c*) Encourage NMCs to request, from the global producing centres, products related to severe weather (e.g., stability indices);

(*d*) Encourage the availability of more NWP outputs on the GTS and/or the Internet, so that comparison between model outputs and conceptual models could be done;

(*e*) Contribute to enhancing the capacity of NMHSs.

5.3.28 The Commission invited the Secretary-General to circulate the proposal to the NMHSs to seek voluntary participation in the demonstration project(s). The Commission noted the interest of several NMHSs as well as the willingness of some global NWP centres to participate in the proposed demonstration projects. It requested the chairperson of the OPAG on DPFS, in consultation with the Rapporteur on the Application of NWP to Severe Weather Forecasting, to select participating centres. Once the participating centres were determined, implementation details of the demonstration project(s) would be developed with involvement of the participating centres.

5.3.29 The Commission recognized the need to come up with a minimum list of products to be provided to NMHSs that had low telecommunications bandwidth, and recommended that the regional rapporteurs on the GDPFS review the minimum list of NWP products on the GTS within their own regional association, in coordination with the Rapporteur on the Application of NWP to Severe Weather Forecasting. At the same time, global NWP centres were encouraged to make their high resolution products available.

5.3.30 The Rapporteur on the Application of NWP to Severe Weather Forecasting, Ms Corinne Mithieux (France), prepared a report to try to classify severe weather events. The report also addressed current and future possibilities of the NWP models to support issuing of advisories and warnings as early as possible to the responsible authorities and to the public. It highlighted that significant evolution in NWP systems was planned to be achieved for the end of the decade including a new generation of atmospheric models, which would be non-hydrostatic with local-scale models of horizontal resolution of 1-3 km, some forseen to become operational by 2008.

5.3.31 The Commission supported the continuing need for the Rapporteur on the Application of NWP to Severe Weather Forecasting with revised terms of reference. Once the demonstration project(s) was completed, an expert team should be established to analyse the results and make recommendations on a broader implementation of the proposed approach. Such a team would most likely not be established before two years from now.

Long-range forecasting (infrastructure and verification)

5.3.32 The Commission noted that significant progress had been made over the last few years. Several centres were offering global forecasts products and services on a regular schedule and had begun producing verifications according to the stardardized verification system for long-range forecasts (SVSLRF). GPCs were encouraged to make their high resolution products available.

5.3.33 The Commission recommended that GPCs for long-range forecasts (LRF) should be officially designated. That would allow institutions outside the WWW system that had demonstrated capabilities in LRF production and services on an operational scale to be officially recognized as such. It would facilitate international cooperation and exchange of products within WMO and those institutions. It would also contribute to a more credible programme in LRF, under the auspices of WMO. For that purpose, a formal minimum list of LRF products to be made available by GPCs was endorsed by CBS-Ext.(02). The Commission recommended that the minimum list of LRF products be included in Appendix II-6 in the *Manual on the GDPFS* as given in Annex 3 to Recommendation to 6 (CBS-XIII) and agreed to review it on a regular basis.

5.3.34 The Commission agreed that the procedure for broadening the functions of existing RSMCs and for designating new RSMCs should be applied to GPCs for LRF. In order to be recognized officially as a GPC, the candidate centre must, as a minimum, adhere to the following criteria:

(*a*) Fixed production cycles and time of issuance;

(*b*) Provide a limited set of products as determined by the revised Appendix II-6 of the *Manual on the GDPFS*;

(*c*) Provide verifications as per the WMO SVSLRF;

(*d*) Provide up-to-date information on methodology used by the GPC;

(*e*) Make products accessible through the GPC Web site and/or disseminated through the GTS and/or Internet.

5.3.35 The Commission encouraged GPCs to commit further to participating in development and research activities, and to training of users (RCCs and/or NMHSs) on LRF products.

5.3.36 The Commission was informed of the DPFS' updates to the Statement of Guidance for Seasonal-to-Interannual Forecasts (November 2003). Those were intended for inclusion by the CBS/OPAG on IOS into the rolling requirements review process.

5.3.37 The Commission noted the scientific benefits of the development of multimodel ensembles for LRF and the significant progress made in the Asia Pacific Environment Council (APEC) Climate Network (APCN) and in the European and International Research Institute for Climate Prediction (IRI) systems.

5.3.38 The Commission noted issues identified by the ICT on DPFS which needed to be addressed regarding LRF. It invited:

(*a*) The GPCs to conduct studies to assess the optimum ensemble size;

(*b*) CCl to provide guidance on the use of climatological normals as a basis for forecasting LRF anomalies, in consideration of both climatological shifts as well as availability of hindcast data sets;

(*c*) The WCRP Working Group on Seasonal to Interannual Predictions and the CAS Working Group on Numerical Experimentation to consider conducting intercomparison studies on the relative performance of Tier-1 and Tier-2 LRF models and make available the results to GPCs.

5.3.39 The Commission noted with appreciation that the SVSLRF was being implemented in APCN, IRI, CMA, the Canadian Meteorological Centre, JMA, ECMWF and the United Kingdom Met Office, and that JMA had implemented the most comprehensive system. The session also noted significant progress carried out by the co-lead centres, the Bureau of Meteorology (Australia) and the Canadian Meteorological Centre, referred to as "Lead Centre for SVSLRF". The dedicated Web site was planned to be operational in the first half of 2005.

5.3.40 The Commission was pleased that the DPFS Expert Team on LRF Verification revised a new draft Attachment II.8 of the *Manual on the GDPFS* (WMO-No. 485), Volume I, entitled "Standardized verification system (SVS) for long-range forecasts (LRF)". The Commission noted that the Expert Team had proposed the revision after a considered review of the current documentation in light of experience gained by GPCs in applying the verification scheme. The Commission noted that no changes to the verification scheme itself were proposed. The proposed revisions improved the readability and utility of the documentation by merging two separate attachments to the *Manual on the GDPFS*, removing some ambiguities, more clearly specifying the core components of the verification scheme, and adding a section on the role of the Lead Centre for SVSLRF. The Commission agreed that the new draft Attachment II.8 should be submitted to the president of CBS for recommendation to the Executive Council for approval.

5.3.41 The Commission invited the Secretary-General to approach the GPCs concerning the submission of their verification results to the SVSLRF Web site once the latter was ready. Verification software required for the implementation of the SVSLRF would be made available and maintained through the Lead Centre Web site. Information on the role of the Lead Centre also should be sent to RCCs and NMHSs.

5.3.42 The Commission also invited the Secretary-General to request feedback from RCCs and NMHSs for one year after the launch of the SVSLRF Web site and noted that the Lead Centre offered to develop a questionnaire for that purpose.

5.3.43 The Commission recommended that verification of LRF be discussed and that the Lead Centre activity be publicized at the Workshop of Global Producers of Seasonal to Interannual Forecasts planned for 2005.

5.3.44 The Commission emphasized the need to ensure that links to the research and climate product user community (through CAS, the Climate Prediction and Variability (CLIVAR)/Working Group on Seasonal to Interannual Prediction and the CCl Climate Information and Prediction Services — CLIPS)) be maintained.

Emergency response activities

5.3.45 The Commission noted that while faxing remained the official product distribution method, all RMSCs had implemented Web-based technologies to exchange information and products. Some had implemented identical (mirror) but independent password-protected Web pages. The session encouraged all RSMCs in ERA to adopt that approach which assured the availability of the RSMCs' products in a fail-safe manner.

5.3.46 The Commission noted that regularly-performed operational notification tests between the Emergency Response Centre of the International Atomic Energy Agency (IAEA) and the RTH Offenbach had been implemented and were extended to include the RSMCs once every quarter. A test of the full arrangements, including the transmission of messages on the GTS, participation of NMHSs and IAEA Contact Points was to be done every other year.

5.3.47 The Commission noted that the "ensembles" approach for predicting the atmospheric transport and dispersion models was being explored for ERA applications, with promising developments, some of which had been incorporated in the HYSPLIT dispersion code used at RSMC Washington. New products could be adopted as supplemental products to be issued by the RSMCs, depending upon customer requirements. The Commission agreed that the technical questions related to such products should be examined, in conjunction with the users' (e.g. IAEA) requirements.

5.3.48 The Commission noted that the future Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)/WMO operational response system was being further developed through experimentation (e.g. first one in 2003) and coordination, and that a second CTBTO/WMO experiment was planned for early 2005, in advance of a System-Wide Performance Test in 2005 as required by CTBTO.

5.3.49 The Commission noted that in the context of international air navigation, the nine Volcanic Ash Advisory Centres designated by the ICAO regional air navigation agreement depended on specialized atmospheric transport modeling products that predicted the movement of airborne volcanic ash to support the operation of ICAO's International Airways Volcano Watch Programme. A report was being prepared by an expert at CTBTO, to assess the potential usefulness of the Treaty's verification monitoring information for the early detection of explosive volcanoes, which could serve as an early indication of the possible presence of airborne ash.

5.3.50 In the domain of international chemicals management, WMO participated at the Preparatory Committee for the Development of a Strategic Approach to International Chemical Management, led by the United Nations Environment Programme (UNEP), at its first session in November 2003, and its second session in October 2004. Until such time as when UNEP would establish an operational emergency coordination unit, WMO Members would continue to develop the appropriate environmental prediction tools and make them and/or the products available to NMHSs to prepare and strengthen their operational capability to advise national authorities when the need arose. The Commission agreed that those tools should be developed under the WWW/ERA programme in collaboration with other programme areas.

5.3.51 The Commission noted the decisions of Congress, as well as relevant aspects of the Sixth

WMO Long-term Plan (6LTP), regarding the activities related to non-nuclear environmental emergencies and the corresponding conclusions of the fifty-sixth session of the Executive Council (see general summary paragraph 3.1.38 of the *Abridged Final Report with Resolutions of the Fifty-sixth Session of the Executive Council* (WMO-No. 977).

5.3.52 Many NMHSs already had a national responsibility to provide information in support of chemical accident emergency response and/or marine environmental emergencies. Also, the RSMCs designated for nuclear emergencies were already involved in the provision of some support services for non-nuclear environmental emergencies. Because many of the problems were regional in nature and because some of the required products and expertise might not be available at NMHSs, there was a potential role for regional/specialized centres to provide meteorological support and services in relation to regional NWP, specialized dispersion forecasts, remote-sensing data and possibly other needs. As well, some national governments were investing and cooperating in science and technology and reviewing operational arrangements to enhance the level of security measures, including in the areas of environmental monitoring and numerical modeling and simulations for detection, assessment and prediction of atmospheric transport of hazardous materials. Skill development was needed for forecasters to enable them to provide the kind of specialized information to support emergency response.

5.3.53 The Workshop on Development of Scope and Capabilities of Emergency Response Activities (Geneva, December 2004), attended by 17 participants — including subject experts, representatives of RSMCs, NMHSs and relevant international organizations — developed recommendations on how to advance the programme of the ERA for non-nuclear environmental emergencies. It highlighted aspects and issues related to scope, capabilities, organizational questions, as well as some guiding principles.

5.3.54 The Commission emphasized that the ERA programme shared common goals with, and directly contributed to the WMO disaster prevention and mitigation activities. In addition to environmental emergencies caused by natural disasters, those could also trigger environmental emergencies of an industrial or technological nature, where specialized atmospheric and hydrologic modelling products would be needed to support emergency response operations.

5.3.55 A survey among NMHSs carried out in 2004 helped in developing an understanding of both their requirements and their existing capabilities in the Emergency Response Activities programme in order to deal with the whole spectrum of environmental emergencies. A total of 76 replies were received (30 from Region VI, 14 from each of Regions I and II, seven or less from each of Regions III, IV, V). The results led to the following workshop recommendations:

(*a*) The existing RSMCs with activity specialization in atmospheric transport modeling were prepared to assist in capacity-building and training, although were limited in capacity themselves. However, those could not cover neither the number nor the whole spectrum of possible environmental emergencies. Therefore, a concept of a network of centres could be developed and participation could include the capabilities and capacities of the RSMCs and other NMHSs;

(*b*) The first priority should be given to expanding the ERA programme to atmospheric transport and dispersion modeling to support response to chemical accidents;

(*c*) The second priority could be smoke from large wildland fires. Experience (e.g. with the forest fires in Indonesia 1997–1998) had shown that models developed for nuclear emergencies could well be applied for dispersion of smoke from forest fires.

It was also noted that research, development and applications in the field of biological emergencies was today mainly limited to the foot-and-mouth disease virus, and that there were only very few activities of NMHSs in the field of freshwater pollution.

5.3.56 The Commission considered the recommendations developed at the workshop and agreed that the following tasks for non-nuclear emergencies needed to be addressed:

(*a*) Implementation of a Web-based reference (inventory), at the regional level, of what modelling tools and services were available from NMCs (provider) to support other NMHSs (users), in different categories of hazards;

(*b*) Development of a basic framework for ERA programme coordination and for operational services. The framework might work best as a regionally-organized programme and could be started as a demonstration of a concept of emergency response operations;

(*c*) Identification of the potential role of international organizations, for example, to assist in establishing links with suitable national contact points.

5.3.57 The Commission agreed to form an expert team to examine the issues related to the development of scope and capabilities of the ERA in non-nuclear areas based on the conclusions of the workshop relating to “development of scope”, “development of capabilities”, “organizational issues” and “guiding principles”, as given in Annex VIII to this report.

5.3.58 As an interim process, the Commission recommended that with respect to the provision of meteorological support for chemical incidents the NMHSs that had expressed the willingness to support capacity-building, should be invited to provide an interim contact point to the WMO Secretariat that could be forwarded to those NMHSs that had expressed an immediate need for such support. The Commission also encouraged the use of bilateral arrangements.

Impact of changes of GOS on GDPFS

5.3.59 The Commission noted that data denial experiments were conducted at NCEP in late 2003 and early 2004 to assess the relative contribution of various satellite observational data sources to the performance of the NCEP Global Forecast System model which yielded the following conclusions. The overall contribution to hurricane track forecast performance by satellite observational data sources was 10-15 per cent. The relative contribution to Global Forecast System model performance in the northern hemisphere generated by advanced microwave sounding unit (AMSU) data was as significant as all conventional observational data. AMSU data yielded a one-half to three-quarters of a day improvement in model performance for temperature relative to high resolution infrared sounder data. Those findings were consistent with sensitivity studies conducted by other centres. The Commission supported the need for the Rapporteur on the Impact of Changes to GOS on NWP.

5.3.60 In view of the numerous operational implications indicated above which resulted from the work of the OPAG on DPFS, the Commission adopted Recommendation 6 (CBS-XIII).

Regional perspectives

5.3.61 The Commission noted a number of issues raised through the Regional Rapporteurs on DPFS, that had been addressed through the work programme and discussions of the OPAG on DPFS, for example at the meeting of the ICT on DPFS. Those included the need to:

(*a*) Review the NWP products on the GTS and facilitate more gridded-type data from GDPFS centres to be provided through the GTS or the Internet to those NMHSs that had made such requests;

(*b*) Support training and capacity-building on application of EPS products to severe weather forecasting particularly to improve on lead times, as well as aspects related to tropical cyclones, while encouraging feedback from users to be provided to the producing centres;

(*c*) Exchange verification results for both EPS and deterministic models;

(*d*) Improve the skill of forecasting severe weather in the tropics by NWP and EPS;

(*e*) Identify a list of useful NWP products focusing on severe weather forecasting considering the limited bandwidth and local characteristics;

(*f*) Facilitate dissemination of trajectory information related to airborne pollutants to NMHSs;

(*g*) Promote bilateral or regional collaboration for the technical transfer of NWP systems, e.g. on PC clusters;

(*h*) Promote collaboration among various disciplines in NMHSs to enhance the capacity-building toward mitigation of natural disasters associated with severe weather, including meteorology, hydrology, coastal engineering, disaster management, and other applied fields at downstream end of the cascading process from the medium-range EPS to the nowcasting.

5.3.62 The Commission noted that some silent upper-air stations in Region III could rapidly be re-activated (in particular in middle and high latitude) provided that the necessary consumables were obtained by means of some sort of bilateral or multilateral cooperation since infrastructure and staff were still available. It invited Members who were able to do so to consider favourably to provide the support.

Training needs related to the Data-processing and Forecasting System

5.3.63 The Commission agreed that implementation of coherent education and training was important for realizing the benefits of NWP modelling and interpretation of products by developing countries, in particular for EPS in its numerous potential applications. It noted that regional workshops devoted to EPS were planned. The “train-the-trainers” approach, promoted for the current EPS training workshops could also involve participants from RMTCs. Training in forecast verification was also needed.

5.3.64 The Commission recognized the potential benefits to be realized from the demonstration project on severe weather forecasting, in training and capacity-building. The demonstration project intends to increase the benefits to developing countries by making available NWP and EPS products from a global centre(s), and regional models or post-processed products from regional centre(s), and develop or introduce nowcasting techniques, with the focus on severe weather forecasting.

5.3.65 The Commission noted that several Members in all regions were interested in the development of an NWP system on workstations or PCs and agreed on the need for more training on NWP modelling as a means to promote technical transfer from advanced centres to developing NMCs. Assistance through technical and bilateral cooperation was required. The Commission encouraged Members to make specific requests to NMCs, who, for example, were already planning or carrying out seasonal refresher training (e.g. severe weather) or other specialized topics. It noted the need for training in the use of atmospheric transport products, in part to be addressed in the context of the expanding of the scope of the ERA programme.

5.3.66 The Commission noted that the Workshop of Global Producers of Seasonal to Interannual Forecass (Geneva, 10-13 February 2003) recommended that global producers should organize training directed to RCCs, NMHSs and users so that they could make best use of GPC data.

5.3.67 The Commission noted additional training aspects were identified by the Expert Team on EPS (October 2003):

(*a*) Education on EPS needs to be focused in part on the interpretation of probabilistic forecasts for applications in high impact weather, and the products available in an operational environment;

(*b*) Following the training of weather forecasters, a joint training seminar on EPS for the NMHSs and disaster prevention and preparedness agencies would be useful for maximizing benefit of EPS products to the end-users faced with measures of uncertainty for decision-making.

5.3.68 The Commission noted that training workshops on EPS were being organized for Regions III/IV and Regions II/V, and that regional training plans should include the needs of Regions I and VI on that subject.

Future activities

5.3.69 The Commission reviewed the key tasks of the OPAG on DPFS, including ERA for the forthcoming CBS intersessional period. It agreed on a proposed structure and list of tasks for the Implementation Coordination Team and Expert Teams of the OPAG on DPFS, as well as the ERA Coordination Group (see agenda item 9).

5.3.70 The Commission agreed that a representative of THORPEX attended the meeting of the ICT for DPFS; likewise, that a representative of the ICT on DPFS, its chairperson or its delegate, participated in the most appropriate working group of THORPEX, in order to improve the linkage and communication between DPFS and the developments in THORPEX research programme.

5.3.71 The Commission noted the proposal for the demonstration project(s) developed at the Workshop on Severe and Extreme Events Forecasting (Toulouse, 26-29 October 2004), and agreed that WMO should circulate the proposal to the NMHSs to seek voluntary participation noting that criteria had been established to help in the selection of participants. It also agreed that the chairperson of the OPAG on DPFS, in consultation with the Rapporteur on the Application of NWP to Severe Weather Forecasting, should select participating centres based on those criteria. Two demonstration projects were envisaged, one that was aimed at improving severe weather forecasting associated with tropical cyclones, and another demonstration project focusing on improving heavy precipitation/strong wind forecasts (not associated with tropical cyclones). Once the participating centres had been determined, it was proposed that a WMO consultant develop further details of the demonstration project in collaboration with participating centres.

5.3.72 The Commission agreed to review existing materials with respect to performance measures with a view to developing further recommended practices to be added in the *Guide on the Global Data-processing and Forecasting System* (WMO-No. 305) to help NMHSs to develop their own performance measurement systems.

Future developments in global NWP forecasting

5.3.73 The Commission considered a number of new developments in NWP which were currently under research, but might lead to operational systems within the next decade, including, in particular, the concepts of a global multimodel ensemble and an adaptive observing network as proposed under the THORPEX research programme.

5.3.74 In order to respond to those potential developments, the Commission noted the significant changes needed to ensure that the GDPFS was adapted to deliver benefits to all NMHSs. The Commission also noted the proposed coordination between the OPAG on DPFS and the THORPEX research programme and was confident that that coordination would ensure that appropriate development of the GDPFS would be included in the 6LTP.

5.3.75 The Commission invited JCOMM to participate in, and contribute to, the development of appropriate adaptive observing strategies, in particular with respect to marine components of the GOS.

5.4 PUBLIC WEATHER SERVICES (agenda item 5.4)

5.4.1 The Commission noted with appreciation the report of the chairperson of the OPAG on PWS, Mr Kevin O'Loughlin (Australia), and recalled that three expert teams and an Implementation and Coordination Team coordinated the work of that OPAG. In expressing satisfaction with the interim progress and development of the PWS Programme, the Commission commended the dedication of the respective teams for delivering on their mandate according to the decisions of Congress. The Commission expressed its appreciation to the outgoing chairperson, Mr O'Loughlin, for his able leadership of OPAG on PWS.

5.4.2 The Commission recalled Resolution 13 (Cg-XIV) — Public Weather Services, which considered the provision of PWS as one of the most fundamental functions of NMHSs and an important channel through which national communities could benefit from the work of the NMHS. Global demand continued to increase for more accurate weather forecasts, warnings and information to facilitate planning and everyday living, and to ensure the safety of life and protection of property and sustainable development. To cope with that demand, WMO Members, especially developing countries, would continue to require urgent assistance to enhance their capabilities to deliver PWS. Many Members faced difficulty in overcoming challenges brought on by business and policy changes at the global and national levels and by issues related to natural and environmental disasters, funding support and visibility of the NMHS. Noting its own role in providing guidance to the PWS Programme, and being alert to the problems and needs of Members globally, the Commission stressed the need for intensified efforts within the PWS Programme to provide assistance and guidance to Members' NMHSs so that they could serve more effectively their communities.

The work of the expert teams

5.4.3 The Commission noted that the teams' Terms of reference had been modified to reflect work still outstanding or needing additional emphasis, and covered all the broad issues of concern to the PWS Programme. Also, membership of the teams had been adjusted to cover the areas of expertise accordingly required to complete the work of the PWS Programme.

Expert Team on Media Issues (ET–MI)

5.4.4 The Commission recalled the past achievements of the ET–MI in establishing rapprochement with international broadcasters, in promoting NMHSs as the authority for forecasts and warnings and in providing Web sites to permit media access to forecasts and warnings. A meeting of ET–MI was held in Moscow, Russian Federation from 20 to 24 October 2003.

5.4.5 The Commission endorsed strategies promoting awareness and use of the Severe Weather Information Centre (SWIC) and the World Weather Information Service (WWIS) Web sites as official sources of NMHS information and noted their expected increased popularity and use (see paragraphs 5.4.29 to 5.4.34). The Commission believed that in addition to the efforts of WMO and Hong Kong, China, NMHSs should be encouraged to promote the Web sites on their respective home pages, through media publications, during World Meteorological Day activities, press conferences and public awareness exercises.

5.4.6 The Commission emphasized the need for an NMHS strategy to handle the prevailing high level of media interest for speedy access to information on weather-related disasters. That was especially important for developing and least developed countries. It strongly supported team recommendations for meeting media demand during each of the five distinct stages of a severe weather event: the quiet period, the developing situation, the ''height of the storm'', the aftermath and the post-event review. The Commission stressed that the final stage allowed the NMHS to explain its successes or, if any, shortcomings in the event, and that that should be managed by a senior authoritative spokesperson from the NMHS.

5.4.7 The Commission asserted that the basic nature and mission of PWS relied equally on good communication skills and the weather information itself. Strong partnerships with the media, complemented by media-skilled staff, would effectively communicate the NMHS message to the public and the media, thereby promoting a strong brand image and enhancing the NMHS public profile and credibility. Accordingly, it requested the PWS Programme to pay special attention to assisting Members to enhance staff communication skills.

5.4.8 The Commission noted that mobile communications technology would become more and more important in PWS delivery, as would the Internet, in spite of certain limitations. It urged NMHSs to explore the possibility of disseminating warnings and very short-range forecasts via cellular networks/phones. Radio represented a powerful weather broadcast medium, with the capability of reaching remote communities, especially in the developing world. The Commission appreciated the preparation of guidelines relating to radio broadcasting of weather information.

Expert Team on Product Development and Service Assessment (ET–PDSA)

5.4.9 The Commission was informed that the ET–PDSA had met in Kuala Lumpur, Malaysia from 22 to 26 September 2003. The meeting considered the needs and opportunities for new and improved products and services, the needs for standardized formats for the dissemination of PWS products, and incorporating air quality and biometeorology information in PWS delivery. It also developed core assessment criteria and questions to be used by NMHSs in assessment and guidance on quality management practices.

5.4.10 The Commission urged ongoing scrutiny of the latest developments and achievements in meteorological science and related technologies with potential for PWS application. Recent prospects included automated forecasting techniques, increasing availability of EPS products with possibilities for probabilistic forecasting, improved operational NWP models with impacts on longer-range forecasts, use of the Internet and other wireless delivery channels for real-time dissemination of operational nowcasting products, and the application of XML. The Commission noted that all existing PWS guidance material on new technologies and research were available on Internet. The Commission requested that additional training be organized for the staff of NMHSs on communication to the users of forecasts resulting from ensemble prediction techniques.

5.4.11 The Commission urged NMHSs to evaluate the new computer and communication technologies and information systems and identify any opportunities to integrate PWS dissemination and service delivery, particularly with respect to the Internet and wireless technologies. The Internet facilitated and enhanced the provision to the public of weather forecasts, warnings, and climate information in graphical and digital formats and permited expansion of service delivery. In addition, several NMHSs were exploring automated forecasting techniques to make text-based forecasts derived from NWP models available on the Internet.

5.4.12 In light of new emerging technologies, globalization and the ravages of severe weather, the Commission welcomed the proposal for standardized formats for the exchange of warnings and forecasts. Based on work done in developing the WWIS Web site, the proposal should help, for instance, to solve problems of terminology, language and icon usage associated with cross-border warnings exchange. It included information commonly used in forecasts and warnings to be read by graphical interfaces in order to generate public products and was readily adaptable to new technologies like XML, suggested thresholds, icon standardization and warning levels.

5.4.13 The Commission welcomed efforts to broaden the content of public weather forecasts by including information such as air quality forecasts and/or forecasts of atmospheric conditions that impact on air quality, and appreciated the preparation of guidelines to assist NMHSs wishing to add air quality and biometeorological information to their forecast suite. Accessing the information in some countries where other agencies handled environmental issues could be problematic, and the Commission recommended that NMHSs should take an active role in addressing the issue, with WMO facilitating coordination as necessary.

5.4.14 The Commission endorsed efforts at formalizing collaboration between the PWS Programme and other WMO technical commissions particularly on information sharing with appropriate WWW experts on the needs of PWS in product exchange and service delivery, especially in areas such as development of GTS and FWIS, Internet use, satellite data utilization, observational data requirements and climate services. In order to achieve progress in such collaborations, the Commission welcomed the appointment of OPAG on PWS focal points to liaise with counterparts in other OPAGs.

5.4.15 The Commission had regarded the PWS guidance material on verification and service assessment as a valid step towards quality management in PWS. However, it noted that a more rigorous approach needed to be developed to ensure the best possible practices in PWS production and delivery. As a result, the Expert Team developed additional guidance on quality management procedures and practices that would assist NMHSs in management and continuous improvement of their national programmes. The Commission welcomed the preparation of those guidelines and noted that they included information regarding: an overview of the objectives and principles of quality management in an NMHS context, treatment of the advantages and challenges of a quality management for an NMHS, core assessment criteria and questions, a discussion of the analysis, definition and documentation process requirements within an NMHS, the required monitoring, assessment, management and control of processes within an NMHS, and within an ISO 9001 context, the approaches and strategies for a quality system certification. The Commission recalled the advice of Fourteenth Congress that a balanced and careful approach would be required to assist NMHSs, especially in developing countries, to strengthen their quality management systems for end-user products and services delivery without incurring the overhead burden that might be associated with generic quality management standards developed for application beyond meteorology. In particular, special efforts must be made to address the specific concerns of developing countries with small NMHSs, by avoiding complex quality management systems with heavy financial implications.

Expert Team on Warnings and Forecast Exchange, Understanding and Use (ET–WFEU)

5.4.16 The Commission reviewed the work of the ET–WFEU that included improving the SWIC and WWIS Web sites, providing guidance to Members on PWS exchange on the Internet, implementing cross-border exchange of forecasts and warnings, and the application of risk management principles in the provision of severe weather warnings. The ET-WFEU met in Paris from 31 May to 4 June 2004.

5.4.17 The Commission noted the several promotional efforts to increase the public and media awareness of the SWIC and WWIS Web sites as authoritative weather information sources and urged that promotional activities continue. In a related matter, the Commission expressed appreciation of the Training Course on Provision of Weather Services via the Internet that was organized for WMO by Hong Kong, China and conducted twice, in December 2003 and March 2004.

5.4.18 The Commission reasserted that severe weather warning systems were the highest priority function of NMHSs since they constituted an essential and highly cost-effective component of local, regional and national strategies for natural disaster reduction. In that connection, the Commission was pleased to learn of the RA VI project on cross-border exchange of warnings. NMHSs must incorporate risk management principles in providing warning products to match their wider disaster management roles. In that regard, the Commission appreciated the preparation of guidelines on the application of risk management principles in providing severe weather warnings.

Implementation Coordination Team on PWS

5.4.19 The Commission appreciated the work of the ICT that included review and supervision of the activities of the OPAG on PWS expert teams as well as delivering on its own terms of reference. The ICT met in Hong Kong, China from 24 to 28 November 2003 and considered emerging issues pertinent to PWS and its future directions, as discussed and approved by Fourteenth Congress.

5.4.20 The Commission noted the ICT's deliberations on the effectiveness of PWS training activities following participant feedback data. It stressed that the PWS Programme's training component was undoubtedly one of the most fundamental pillars of WMO assistance to developing NMHSs and instructed that in spite of budgetary constraints, every effort must be made to maintain the level of training activities. Several Members expressed their appreciation to the United Kingdom Met Office for their assistance in capacity-building efforts.

5.4.21 The Commission welcomed the concept of a Web-based reference system to complement the existing PWS guidance material. The favoured approach was a catalogue of existing guidance material produced by the OPAG on PWS through the WMO Secretariat as well as those existing at the national level. The Commission believed that continued enhancement of the WWIS Web site and ameliorating the WMO, PWS and NMHS Web sites would help to improve visibility and accessibility of the reference information.

5.4.22 The Commission advised that the economic and political environment in which NMHSs operated meant that the provision of PWS was intrinsically linked to its social and economic values. Many NMHSs could benefit from advice and guidance in demonstrating the social and economic values of their services, particularly to their funding agencies. The Commission advised that regional rapporteurs on PWS should include questions on that issue in any future questionnaires and supported the appointment of an expert rapporteur on the topic. Furthermore, the Commission requested that guidance material on social and economic aspects of weather information be prepared by relevant PWS experts and suggested that the Executive Council consider the possibility of organizing an international conference on meteorological economics.

5.4.23 Noting that there was an obligation and necessity on the part of host countries to provide weather and climate support for the Olympic Games, the Commission welcomed the development of generic guidelines based upon the experiences and information obtained on the weather support at the Sydney 2000 Olympics and the Winter Olympics in Salt Lake City, and which would form the basis for discussions between WMO and the International Olympic Committee. Apart from the specific application to the Olympics, it was noted that that information could have wider application for other major sporting events.

Expert Meeting on Presentation Skills and Dissemination Technology

5.4.24 The Commission noted that in addition to the work of the ET–MI, an Expert Meeting on Presentation Skills and Dissemination Technology was held in Sigtuna, Sweden on 6-10 September 2004. The meeting was tasked to develop guidelines for Members on the presentation of weather information and on graphics technology and emerging new communication technologies; and to identify topics for inclusion in future WMO training courses in weather presentation and to discuss the advisability of establishing an accreditation scheme under the auspices of WMO.

5.4.25 The Commission emphasized the importance of improving presentation skills among weather broadcasters and the resulting positive impact on the image of NMHSs, but acknowledged that personal presentation skills were not traditionally promoted among NMHSs. As a result, in attempting to develop and enhance staff presentation skills, it must be kept in mind that some of the concepts that the Team discussed would seem unfamiliar to those meteorologists coming from a purely technical background. The Team had drafted guidelines aimed at providing a resource for capacity-building and training of staff in that area.

5.4.26 The Commission welcomed the Team's survey of the range of graphics technologies commonly used in weather broadcasting and recognized that different technologies were appropriate in different situations. NMHSs needed to be structured and resourced in a manner that enabled them to adjust to, and take advantage of, developments in communications technology as they arose. The expert Team drafted guidelines that offered detailed recommendations as to how NMHSs might best incorporate broadcast and communications technology for improved service delivery. The Commission also noted that NMHSs needed assistance on gaining access to low cost television graphics software and systems.

5.4.27 The Commission agreed that training in presentation skills and communication was an essential element in capacity-building and welcomed the Team's proposal for a set of competencies that should be developed and improved upon in the continuing process of PWS presentation and dissemination. The Commission appreciated the Team's proposal of a structure for WMO training courses that would allow courses to be tailored to a range of different skill levels; the scheme envisaged that those with advanced level of presentation capability would eventually be able to pass on their in-house training to other staff.

5.4.28 The Commission noted that the establishment of a WMO-backed scheme of accreditation for weather broadcasters had been discussed at the Expert Meeting. The Commission was of the opinion that such a scheme offered many benefits but recognized that there were many issues that needed to be addressed before such a scheme might gain wide acceptance and be practically feasible.

Pilot projects on international exchange of public forecasts and warnings via the Internet

World Weather Information Service Web site

.29 The Commission noted with satisfaction the success and popularity of the WWIS Web site among the public and WMO Members since its launching in December 2002. By mid-February 2005, WWIS carried forecasts for 1 016 cities from 101 Members and climatological information for 1 075 cities from 154 Members. The average hit rate in 2004 reached 230 000 page visits per day, confirming the Web site's potential in promoting Members' visibility internationally. The Commission appreciated the efforts made to facilitate participation by developing countries through diverse input methods: GTS, FTP, e-mail and a Web-based form.

5.4.30 The Commission thanked Hong Kong, China for designing and operating the WWIS Web site in English and for coordinating the pilot project in consultation with participating Members. It also noted with gratitude the launching of multi-language versions of the WWIS Web site (namely, in Arabic, by Oman, May 2003; in Chinese, by China, February 2004; and in Portuguese, by Macao, China in cooperation with Portugal, March 2004). It noted with interest that France was considering a French version of the Web site in the near future. It also noted that a Web form in Spanish had been developed to facilitate Spanish-speaking Members to prepare and submit city forecasts. A Web form in Arabic was also under development.

5.4.31 Noting the success of the pilot project, the Commission agreed that the WWIS Web site should henceforth become an operational component of the PWS Programme, and be maintained by the current WWIS host Members, namely, China; Hong Kong, China; Macao, China; and Oman. It thanked the current WWIS host Members, for agreeing to continue hosting the Web site in different languages. The Commission invited other Members to consider hosting WWIS Web sites in other languages and encouraged all Members to participate actively in the WWIS Web site and to link to it from their own Web sites. The Commission noted that it would now be timely to brief the international and national media properly on those developments. The Commission designated Hong Kong, China to serve as the coordinator of WWIS operation in collaboration with other Members hosting the WWIS in multiple languages as well as with all participating Members.

Severe Weather Information Centre Web site

5.4.32 The Commission commended highly the progress of the WMO-sponsored SWIC Web site that was developed by Hong Kong, China to provide basic warning information to the public and the media. The Web site, which featured dynamically-updated pages covering all tropical basins, was implemented in phases in close cooperation with the Tropical Cyclone Programme, six RSMCs on tropical cyclones, five Tropical Cyclone Warning Centres and 20 WMO Members. It was thoroughly tested during the 2002 and 2003 tropical cyclone seasons, recording a highest monthly hit rate of more than 1.3 million page views during September 2003, around when the Web site was revamped to yield a more professional look and to improve navigation. The Commission congratulated the developers of the SWIC and WWIS Web sites on winning the Certificate of Merit "Best of E-Government and Services" in the Asia Pacific Information and Communication Technology Awards 2003.

5.4.33 The Commission supported expansion of the SWIC Web site to include other severe weather types and welcomed the addition of a new Web page for displaying heavy rain or snow. The product was generated automatically by reading the six-hourly or 24-hourly precipitation amounts from more than 10 000 SYNOP reports received via the GTS, and automatically selecting and displaying on a world map, stations with precipitation amounts of above 50 mm in the past 24 hours.

5.4.34 Noting the success of the pilot project, the Commission agreed that the SWIC Web site should henceforth become an operational component of the PWS Programme and be maintained by Hong Kong, China. It thanked the current SWIC host, namely Hong Kong, China, for agreeing to continue hosting the Web site. The Commission noted that China would host a Chinese version of the SWIC Web site. The Commission encouraged all Members to participate actively in the SWIC Web site and to link to it from their own Web sites. The Commission designated Hong Kong, China to serve as the coordinator of the SWIC operation in collaboration with all participants.

Support for capacity-building and training

5.4.35 The Commission emphasized that capacity-building activities constituted a principal component and cornerstone of the PWS Programme as part of its efforts in reducing the impact of natural disasters. Those activities represented a key area of assistance to Members to strengthen their capacity to deliver high quality PWS to the national community. The Commission therefore welcomed the following training events since CBS-Ext.(02): PWS workshops in conjunction with the RA III/IV Workshop on Hurricane Forecasting and Warning in Miami, Florida, USA in April 2003 and April 2004; a PWS workshop organized for Members of Region I, in conjunction with the Third RA I Training Course on Tropical Cyclones, in St. Denis, La Réunion in November 2003; an RA II/RAV Regional Training Seminar on the improvement of PWS in Brunei Darussalam in December 2003; an RA I Media Training Workshop in Dakar, Senegal in

September 2004; and the First RA VI Workshop on PWS in Langen, Germany in October 2004. The Commission expressed appreciation to the Governments of Brunei Darussalam, France, Germany, Senegal and the United States for hosting the respective training events.

5.4.36 The Commission welcomed information concerning the Expert Meeting on Capacity-building Strategies in Public Weather Services that was held in San José, Costa Rica during 30 November to 4 December 2004. The meeting developed guidance material on strategies for capacity-building for PWS delivery for use by NMHSs, especially those in developing countries. The Commission stressed the importance of continued training in the delivery of PWS and the use of weather information by the public. On a related topic, the Commission stressed the need to continue monitoring and reporting on the effectiveness of training activities and on national PWS improvements resulting from Programme initiatives. The Commission expected increased future demands from Members, especially developing countries, for support for capacity-building and training and requested the PWS Programme to continue efforts to assist in that regard, in spite of funding limitations. It was noted that in some cases that would require improvements to the basic WWW infrastructure.

Disaster reduction activities

5.4.37 The Commission reiterated that the fundamental purpose of the PWS Programme was to assist WMO Members to provide comprehensive weather services to the community with particular emphasis on public safety and welfare, and give guidance to the public on how to use those services. It highlighted the important role the Programme should play in assisting Members with application of appropriate technology, meteorological science and research in delivering quality products and services to ensure the protection of life and property and to reduce losses due to natural disasters, especially in those countries that were geographically located and exposed to natural disasters more than others. The Commission recalled Resolution 13 (Cg-XIV) — Public Weather Services Programme, which requested the Executive Council to consider an appropriate mechanism for its oversight of the PWS in close collaboration with the related new Natural Disaster Prevention and Mitigation Programme and awaited information on any decision in that regard.

5.4.38 The Commission acknowledged that natural disaster mitigation was a major concern to WMO and its Members since the majority of natural disasters were related to weather and climate. Natural disaster prevention and mitigation efforts were slowly becoming more successful through technology and the application of improvements in atmospheric and related sciences to reduce losses caused by natural disasters. Among those means were risk assessment and risk management support studies and databases, improved disaster management infrastructure and strategies, increased availability of more accurate weather data, multi-channel satellite imagery, progressively improved NWP products, increasing capabilities of technology for communications, dissemination and presentation of meteorological products, enhanced accuracy of severe weather forecasts and warnings, better trained meteorologists, more informed emergency managers, and a more alert and informed public. The Commission strongly supported the PWS Programme's strategy of encouraging NMHSs to collaborate closely with relevant national organizations to educate them on the impact; of severe weather events and on the value of weather products and services in reducing those impacts; to get the message out to the public; training activities; transfer of knowledge and technology; and publication of guidelines on topics related to the NMHS role in disaster prevention and mitigation to achieve its public safety objective. In that regard, the Commission emphasized the importance of a single official voice for all warnings. It was also noted that regional collaborative projects such as the European Multi-services Meteorological Awareness could assist in more uniform approaches to the communication of warnings.

Improving communications and understanding of PWS by the community

5.4.39 The Commission was reminded of the effect of high impact weather, defined by its impact on society, the economy and the environment, including both severe weather and day-to-day weather, which might have adverse effects on vulnerable societies of the WMO Members, and the importance of good quality public weather services in achieving the desired outcomes of WMO as identified in the 6LTP. In order to achieve those outcomes, and a target for WMO to reduce the loss of life from meteorological, hydrological and climatic natural disasters by 50 per cent over the next 10 years, it was recognized that NMHSs needed to present information on high impact weather in a way which was readily understandable by the decision makers, the public and the media, and work with the user community to ensure that appropriate action was taken when high impact weather warnings were in force. It noted that user groups such as farm extension workers could play a valuable role in disseminating information to the community.

5.4.40 The Commission was also reminded of the need for NMHSs to work with the user community, governments and the media to understand fully the requirement for PWS, especially warnings of high impact weather and the actions required to mitigate the impacts.

Links between PWS and WMO's WWRP

5.4.41 The Commission noted the valuable linkages established between PWS and the WWRP carried out by CAS. The WWRP required its projects on research into high impact weather to include an end-user perspective and ways of measuring societal and economic values. That was a feature of the Sydney 2000 Olympics Forecasts Demonstration Project and would be part of a similar project for the Beijing 2008 Olympics. The presence of the chairperson of the OPAG on PWS on the WWRP Scientific Steering Committee had proved beneficial in linking research to operational needs for public weather services. Noting that CAS/CBS coordination was expanding due to the development of THORPEX, the Commission felt that it was important to continue some links with the specific applied research projects of WWRP that aimed to improve forecasts and warnings of high impact weather.

Technical Conference on Public Weather Services

5.4.42 The Commission expressed its appreciation for convening the Technical Conference on PWS in St. Petersburg, Russian Federation, which was held from 21-22 February 2005, immediately preceding the session of the Commission. Topics focused on innovation and new technology for improved services, disaster mitigation and prevention, social and economic benefits of PWS, and communication with the public via the media. It also provided a forum for PWS training and capacity-building. It was attended by 128 participants from 73 countries and eight international organizations. The Commission specifically thanked the Conference Director, Mr Kevin O'Loughlin, the Organizing Committee and the Secretariat for their excellent preparatory work. It also expressed special thanks to the session chairpersons, and to the authors and presenters of papers for the very high quality of their papers and presentations. The Commission reviewed and endorsed the statement and recommendations of the Technical Conference as given in Annex IX to this report.

Trends, changes and challenges

5.4.43 The Commission acknowledged the continuing impact on NMHSs from a wide range of political, social, economic and environmental issues, and significant developments in science and technology. Effective carriage of their national mandate would depend on the ability of NMHSs to identify trends, evaluate and meet challenges and capitalize on future opportunities. The Commission identified developments that could affect NMHS operations: rapid technological changes, including advances in computer systems, NWP and improvements in satellite-based and automated observations; globalization, including globalization of meteorological and related services through the growth of information technology; commercialization, including commercialization within NMHSs, as a result of emphasis on international trade agreements and the increasing role of the private sector, the media and academia; and impressive results from scientific research that enabled the advancement of knowledge of atmospheric science and related disciplines. A major challenge and opportunity for Members was that those advances should empower NMHSs to focus more on actual requirements of decision makers, both in the government organizations and the private sector. The products and services should then be tailored to assist in making sound decisions, with applications ranging from combating natural disasters to social benefits and economic gains. At the same time, the Commission noted the challenge of managing high expectations of decision makers and the community for forecasts and warnings that were 100 per cent accurate.

5.4.44 The Commission stressed that many NMHSs would need to develop a strategy in coordination with WMO to counteract the negative impacts of reduced government support, private sector competition and inability to modernize, all of which were factors that could reduce the capability to provide PWS effectively. The NMHS strategy must include efforts to demonstrate to governments and the public how weather, climate and environmental issues impacted on the daily lives of people and consequently on sustainable national development. As a result, a modern NMHS was indispensable to personal, community and national needs.

5.4.45 The Commission agreed that many opportunities existed to allow NMHSs to highlight their role as providers of the most needed services, such as forecasts, severe weather warnings and information and advice for social and economic benefits. Those included the increased availability of data, technological advances and research in areas such as NWP, the availability of more powerful PC-based computer systems and advancements in information technology.

Evolving needs of Members

5.4.46 The Commission advised that any strategy to assist Members to develop their national PWS efforts should consider their challenging circumstances and changing needs for:

(*a*) A broader range of improved public weather products and services to assist decision-making processes;

(*b*) More accurate and timely warnings of severe weather events, communicated via rapid and reliable systems;

(*c*) Better warnings coordination and integration of national disaster preparedness activities;

(*d*) Increasing involvement, in collaboration with governmental authorities, in environmental matters, including air and water quality, marine pollution and public health-related issues;

(*e*) Greater efforts to increase effectiveness, efficiency, productivity and competitiveness due to the dynamic global economy;

(*f*) Coping with rapid technological developments and modernization of facilities;

(*g*) Capacity-building to maintain an effective Service, keep up with changes and utilize emerging opportunities;

(*h*) Ensuring attainment and maintenance of high standards in all operational aspects of meteorology and hydrology;

(*i*) Improving national image and visibility of the NMHSs by highlighting and promoting their core functions and vital services, as necessary, for everyday living, the safety of life and property and national sustainable development.

Future directions

5.4.47 Upon reviewing the progress of the PWS Programme and considering Members' needs and aspirations vis-à-vis their current and likely future operating environment, the Commission requested future focus on the following implementation components:

(*a*) Assisting Members to improve their national public weather services, including:
  - (i) Organizing training events emphasizing public safety, coordination with the media and emergency managers, effective service delivery, development of communication skills;
  - (ii) Providing guidance on formulation and application of standardized formats to publicly disseminated forecasts, warnings and information;
  - (iii) Providing guidance on effective techniques and methods for dissemination, communication and presentation of PWS to the media;

(*b*) Continuing to provide guidance on quality management issues, methodologies for user-based service assessment, and quality control of defined services and products including verification of warning and forecast products;

(*c*) Assisting Members with the application of new technology and scientific research in data acquisition, communication, new product design and development and service delivery;

(*d*) Providing guidance on the economic valuation of meteorological services, including PWS;

(*e*) Providing advice on the regional and global exchange of weather information and warnings and establishing exchange mechanisms.

5.4.48 In order to address those issues, the Commission agreed to the future work plan of the PWS Programme as given under agenda item 9.

5.5 OPERATIONAL INFORMATION SERVICE (agenda item 5.5)

5.5.1 The Commission recalled that the objective of the Operational Information System (OIS) was to collect from, and distribute to, WMO Members and WWW centres detailed and up-to-date information on facilities, services and products made available in the day-to-day operation of the WWW. An important goal was to make available the updated information on the WMO server and to provide interactive on-line access services.

5.5.2 The Commission noted with appreciation that the WMO Secretariat posted the updated versions of *Weather Reporting* (WMO-No. 9), Volumes A, C1, C2 and D, as well as the *International List of Selected, Supplementary and Auxiliary Ships* (WMO-No. 47) on the WMO server at http://www.wmo.ch/web/www/ois/ois-home.htm. That OIS home page also included links to other operational information such as the Catalogue of Radiosondes, the lists of RBSN and RBCN stations, the routeing catalogues of bulletins, monitoring reports, and information on additional data and products as defined in 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.

5.5.3 The Secretariat dispatched the WMO-No. 9 on CD-ROM once a year. The WWW *Operational Newsletter* and Marine Meteorological Services were distributed only via electronic mail every month.

5.5.4 CBS-Ext.(02) had agreed on revisions to Volume A – Observing stations. As requested by CBS-Ext.(02), the Secretariat initiated the implementation of the proposed changes (see also general summary paragraph 5.1.25).

5.5.5 Information on the Data-Processing and Forecasting System was available on the WMO server on a yearly basis in the WWW Technical Progress Report on the GDPS. Further information on the processed information exchanged on the GTS was available in Volume C1 — Catalogue of meteorological bulletins. The Commission noted that Fourteenth Congress agreed to delete Volume B from the list of WMO mandatory publications.

5.5.6 With respect to Volume C1 – Catalogue of meteorological bulletins, 13 MTN centres (Algiers, Beijing, Brasilia, Buenos Aires, Cairo, Exeter, Melbourne, Moscow, Offenbach, Prague, Sofia, Tokyo and Toulouse) were using the database procedures for maintaining their own parts of Volume C1. The Commission urged all MTN centres to implement those procedures with a view to achieving a complete catalogue.

5.5.7 Volume C2 contained the transmissions schedules of the distribution systems of the GTS (satellite distribution systems, radio teletype and radio-facsimile broadcasts). In order to avoid unnecessary duplication of information, in particular with Volume D and routeing catalogues of RTHs, CBS-Ext.(02) agreed that Volume C2 should contain the identification and the technical specifications of each data distribution system and a summary of the transmission programmes. The Secretariat invited

Members to provide the information to be included in Volume C2 in the new format, as many entries in Volume C2 appeared obsolete or incomplete. Information on satellite distribution systems was particularly insufficient. The Commission requested the Secretariat to remind the relevant WWW centres to review the content of Volume C2 and to send to the Secretariat the required updates in the new format.

5.5.8 Each RTH should prepare a routeing catalogue and make it accessible by the other GTS centres, in particular by its associated NMCs. The MTN centres, except for Buenos Aires and Dakar, made their routeing catalogues available on the Internet. The Commission urged all MTN centres to update their routing catalogues, at least every three months.

5.5.9 Fourteenth Congress noted with satisfaction that the Secretariat had established a data quality monitoring Index Page on the WMO server (http://www.wmo.int/web/www/DPS/Monitoring-home /mon-index.htm) with links to Web sites containing the quality monitoring information. Congress invited all the quality monitoring centres to provide the Secretariat with the relevant URL addresses of their Web sites and their subsequent updates. The Commission urged all WWW centres having responsibilities in quality monitoring to do so.

5.5.10 Fourteenth Congress agreed that an important goal was to facilitate the access to the information through interactive online access services. A project for the interactive online access to Volume C1 was being developed by the Secretariat. A demonstration of the application was available from http://alto-stratus.wmo.ch/WWWOIS/. The Commission was pleased to note the project and recommended the further development of interactive online services to access the operational information.

5.5.11 The Commission noted with satisfaction the progress made in updating and in presenting the operational information, and encouraged the further development of the access to the information through interactive online access services. The Commission also encouraged the Secretariat and OPAGs to consider ways of simplifying the procedures for updating the contents of the OIS. In particular, they should consider how information already held by Members in their automated centres could be included more simply. In addition, the usefulness of the OIS would be greatly increased by making the information available in a more universal form, such as XML, for direct use by automated centres.

5.5.12 The documents prepared for the meetings of the OPAG teams were considered useful information for WWW centres. The Commission requested the Secretariat to keep the complete set of documents available on the WMO server, at least up to the availability of the final reports of the meetings on the WMO server.

6. WMO SPACE PROGRAMME
(agenda item 6)

6.1 The Commission was informed that by Resolution 5 (Cg-XIV), Fourteenth Congress had established a new major cross-cutting Programme, the WMO Space Programme, in response to the momentous expansion in the availability of satellite data, products and services and in recognition of the increase in responsibilities for WMO. The fifty-fourth session of the Executive Council had felt that the scope, goals and objectives of the new WMO Space Programme should respond to the tremendous growth in the utilization of environmental satellite data, products and services within the expanded space-based component of the GOS that now included appropriate R&D environmental satellite missions. Fourteenth Congress also supported the WMO Space Programme Long-term Strategy reviewed at the third session of the Consultative Meetings on High-level Policy on Satellite Matters.

6.2 Fourteenth Congress had agreed that the main thrust of the WMO Space Programme Long-term Strategy should be to make an increasing contribution to the development of the WWW GOS, as well as to the other WMO-supported Programmes and associated observing systems (such as AREP's GAW, GCOS, WCRP, HWR's WHYCOS and JCOMM's implementation of GOOS) through the provision of continuously improved data, products and services, from both operational and R&D satellites, and to facilitate and promote their wider availability and meaningful utilization around the globe.

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

(*a*) Increased involvement of space agencies contributing, or with the potential to contribute to, the space-based component of the GOS;

(*b*) Promotion of a wider awareness of the availability and utilization of data, products — and their importance at levels 1, 2, 3 or 4 — and services, including those from R&D satellites;

(*c*) Considerably more attention to be paid to the crucial problems connected with the assimilation of R&D and new operational data streams in nowcasting, numerical weather prediction systems, re-analysis projects, monitoring climate change, chemical composition of the atmosphere, as well as the dominance of satellite data in some cases;

(*d*) Closer and more effective cooperation with relevant international bodies;

(*e*) Additional and continuing emphasis on education and training;

(*f*) Facilitation of the transition from research to operational systems;

(*g*) Improved integration of the space component of the various observing systems throughout WMO Programmes and WMO-supported Programmes;

(*h*) Increased cooperation among WMO Members to develop common basic tools for utilization of research, development and operational remote-sensing systems.

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

6.5 Congress had stressed that the WMO user community and space agencies should be represented at the highest level at the sessions. Future sessions of the WMO Consultative Meetings on High-level Policy on Satellite Matters should be chaired by the President of WMO as had been the case for the first three sessions. The Consultative Meetings would continue to provide advice and guidance on policy-related matters and would maintain a high level overview of the WMO Space Programme. Congress had agreed that CBS should continue the lead role in full consultation with the other technical commissions for the new WMO Space Programme. Thus, Congress had adopted Resolution 6 (Cg-XIV) establishing the WMO Consultative Meetings on High-level Policy on Satellite Matters.

WMO Space Programme implementation

6.6 The Commission noted that the WMO Space Programme Implementation Plan for 2004-2007, as contained in Section 4 and Annex III to the report of the fourth session of the WMO Consultative Meetings on High-level Policy on Satellite Matters (CM-4) (the CM-4 report was available at: http://www.wmo.int/hinsman/publications/CM-4_Final_Report.doc, had been approved by the fifty-sixth session of the Executive Council and that the Implementation Plan provided further details to the WMO Space Programme Long-term Strategy as contained in the WMO 6LTP and approved by Fourteenth Congress.

6.7 The Commission was pleased to be informed of the formal commitments made by the Governments of India and the Republic of Korea to participate in the space-based component of the WWW GOS. IMD recalled that it had a long history of satellites in both geostationary and polar orbits. As a result of new technologies, including ADM, it was now possible to make satellite data and products, including GTS data and NWP products, freely available to WMO Members. IMD announced its plans to meet the WMO requirements for half-hourly imagery in a phased manner with an ultimate goal to be achieved in the next three-four years. The Commission was also informed that the Republic of Korea intended to participate in the space-based GOS with its new geostationary Communications, Oceanographic and Meteorological Satellites (COMS) due to be launched in 2008. The KMA planned to make meteorological observation available for research, operations and applications without restrictions. Data would be distributed directly from COMS or by alternative approaches such as the Internet. The Korea Meteorological Administration also intended to join CGMS as a full member at its next session in 2005. The Russian Federation informed the Commission of its plans for the period 2006-2015 for new satellite missions including two geostationary meteorological satellites with the first one to be launched in 2007, and three polar orbiting satellites with the first one to be launched in 2006 where one of the three would have oceanography as its primary mission. The Commission expressed its gratitude to EUMETSAT for the data, products and services available from Meteosat-5 over the Indian Ocean and areas within the field of view of the satellite.

6.8 The Commission agreed that WMO, through its Space Programme, had acted as a catalyst to improve greatly the utilization of satellite data and products. The VL for Education and Training in Satellite Meteorology had already made a considerable impact throughout the Region through its Centre of Excellence co-sponsored by the People’s Republic of China at the Regional Meteorological Training Centre (RMTC) in Nanjing, China. The Commission was pleased to see the integration of the new R&D constellation into education and training activities. It also noted that the WMO Space Programme Long-term Strategy and associated Implementation Plan provided for increased utilization of the VL to the benefit of WMO Members especially for fuller exploitation of R&D data, products and services, as well as those from new and existing operational meteorological satellite systems.

6.9 With regard to the Centres of Excellence, the Commission strongly supported the offer by Oman to host such a centre in noting that there was a preliminary offer to co-sponsor it by EUMETSAT. EUMETSAT informed the Commission of its efforts to provide a final commitment to co-sponsor a Centre of Excellence in Oman with the expectation that confirmation would be made by the EUMETSAT Council to be held in July 2005. The Commission recalled the basic principle that education and training should occur in the working language of the local meteorological staff. The present configuration of the six Centres of Excellence provided for education and training in Chinese, English, French and Spanish. However, a gap existed for Arabic-speaking countries. Oman informed the Commission of its strong willingness to support a Centre of Excellence in which the Omani National Meteorological Service would work jointly with the Sultan Qaboos University and make available their considerable expertise. Oman also indicated that it would provide necessary financial and staff resources to meet its responsibilities within the VL framework. Furthermore, the Commission noted the recent efforts by EUMETSAT to hold a training event in Oman that confirmed the existence of the facilities described in the proposal. It also expressed its appreciation to EUMETSAT for the series of User Forums held in RA I and encouraged their continuation.

6.10 The Commission also noted the activities by the Russian Federation, supported by WMO and EUMETSAT, to hold regional training events in Moscow in satellite meteorology for members of the Commonwealth of Independent States and the Baltic States. The Commission agreed that such activities were vital to improve the utilization of satellite data and products and suggested that the Russian Federation consider further development of its activities with the possibility to join eventually the VL and thus fill a gap for a “Centre of Excellence” where Russian would be the basis for training events. The Commission was also informed of related training activities in Region VI at the RMTC in Turkey. Finally, the Commission stressed the need for continued efforts within the VL to increase training materials contained in its Virtual Resource Library and thus contribute to capacity-building at the national level.

6.11 The Commission noted that the WMO Space Programme had assisted with the development of a multi-spectral data analysis tool kit using freeware called Hydra. Hydra enabled interrogation of multispectral fields of data so that: (*a*) pixel location and measurement value (radiance or brightness temperature) could be easily determined; (*b*) spectral channels could be combined in linear functions and the resulting images displayed; (*c*) false colour images could be constructed from multiple channel combinations; (*d*) scatter plots of spectral channel combinations could be viewed; (*e*) pixels in images could be found in scatter plots and vice versa; and (*f*) transects of measurements could be displayed. It was anticipated that Hydra would become a part of the WMO VL and hence be available to all WMO Members. Additionally, an interactive training tool called VISITview had been developed by the Virtual Institute for Satellite Integration Training (VISIT) at the Cooperative Institute for Meteorological Satellite Studies (CIMSS) and the Cooperative Institute for Research in the Atmosphere (CIRA). VISITview was a platform-independent distance learning and collaboration software program that allowed multiple users to view the same series of images containing graphics and text with a large number of user features. Hydra could contribute to the tele-training software that was not proprietary and freely available. VISITview was designed to provide instructors and students with a set of easy to use tools for creating and conducting tele-training sessions. The WMO Space Programme implementation activities included organizing a demonstration of those training materials in China in 2005.

6.12 The Commission noted that in the evolution of the GOS, as described in the report by the chairperson of the OPAG on IOS, there were 47 recommendations of which 20 were relevant to the space-based subsystem of the GOS. Furthermore, it was expected that the WMO Space Programme implementation activities would act as a catalyst for those recommendations through interactions with space agencies, via CGMS, the Committee on Earth Observation Satellites (CEOS) and the WMO Consultative Meetings on High-level Policy on Satellite Matters. Additionally, the Commission noted that the WMO Space Programme Office was reviewing the GEOSS 10-year Implementation Plan to ensure effective coordination with the work of the Commission in the evolution of GOS.

6.13 The Commission was informed that CGMS XXXII supported the concept of an International Geostationary Laboratory (IGeoLab). The IGeoLab concept was focused on sharing the benefit of a geostationary demonstration mission across several space development agencies, operators of operational meteorological satellites and users. CGMS XXII had requested that the WMO Space Programme work with CGMS members to draft several “test” proposals in order to demonstrate the benefits and viability of the concept; a demonstration of the GIFTS instrument at several geographical locations and the exploitation of a microwave sounding instrument in geostationary orbit were considered two excellent “test” proposals. A white paper describing the IGeoLab concept and two test proposals had been written. The Commission noted the continuing IGeoLaB activities including a Task Force Meeting in December 2004 and the subsequent discussion at CM-5 where the concept was strongly endorsed. It was pleased to note the further interest by several space agencies towards a demonstration of the GIFTS instrument in geostationary orbit. A preliminary meeting between relevant staff from the Russian Federation and the United States had discussed technical matters for the possible integration of GIFTS on an Electra satellite bus and future meetings were planned.

6.14 The Commission noted that the EUMETSAT Advanced TIROS Operational Vertical Sounder (ATOVS) Retransmission Service (EARS) had increased real time access (within 30 minutes) to ATOVS data three- to four-fold in much of the northern hemisphere. Near real-time access to ATOVS data was important for WMO Members with NWP capability. Access to near-real time ATOVS data was also important for WMO activities such as implementation planning for the redesign (evolution) of GOS and THORPEX. The Commission noted that EARS was an extremely effective example of ADM. The Commission was pleased to be informed by the Russian Federation that it was prepared to extend the coverage in the northern hemisphere with several key high resolution picture transmission (HRPT) stations. It was pleased to be informed that the WMO Space Programme implementation activities included an initiative to extend the coverage into the southern hemisphere. To that end, the WMO Space Programme Office had contacted CGMS and WMO Members with a view to form local consortiums to develop regional ATOVS retransmission services in a fashion similar to EARS. Many Commission Members had responded and an initial workshop had been hosted by EUMETSAT in December 2004. The Commission looked forward to the establishment of Regional ATOVS Retransmission Services (RARS). The Commission noted that WMO Members within RA VI had recently agreed to a two-year evaluation period whereby basic GTS meteorological data would also be disseminated through the EUMETCast system, an ADM system already operational in Regions I and VI, and suggested that WMO further evaluate use of that new technology as a complement to the GTS and in accordance with the WMO information system concept.

6.15 The Commission recalled that the fifty-sixth session of the Executive Council strongly supported the development of the space component of an integrated WMO GOS and requested CBS, as a matter of urgency especially in light of the emerging new activity for a GEOSS, to further its development through its role as lead technical commission for the WMO Space Programme in consultation with all other relevant WMO and co-sponsored bodies. The Commission agreed that such activities should be included in the work programme of the Expert Team on Satellite Systems of the OPAG on IOS.

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

7. EARTH OBSERVATION SUMMITS (agenda item 7)

EOS-I

7.1 The Commission was informed that at the invitation of the United States, on 31 July 2003 in Washington DC, 33 countries, and the European Commission, joined together for the first Earth Observation Summit (EOS-I) to adopt a Declaration that called for action in strengthening global cooperation on Earth observations. The purpose of the Summit was to promote the development of a comprehensive, coordinated, and sustained Earth observation system or systems among governments and the international community to understand and address global environmental and economic challenges; and begin a process to develop a conceptual framework and implementation plan for building that comprehensive, coordinated, and sustained Earth observation system or systems.

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

EOS-II

7.3 The Commission noted that by the end of April 2004, four sessions of GEO and two Earth Observation Summits had been held. A Communiqué stating approval of the Framework Document, pointing the way forward in the GEO effort, and encouraging broad participation in, and support, for the GEO effort, was approved at EOS-II on 25 April 2004.

Further development of GEOSS

7.4 The Commission noted that the fifty-sixth session of the Executive Council had adopted Resolution 9 (EC-LVI) — Global Earth Observation

System of Systems, in affirming its full support for the GEO process and resulting GEOSS.

7.5 The Commission noted that in that GEOSS resolution, WMO Members should work closely with other Earth observation agencies at the national level to ensure the development of well-coordinated national plans for GEOSS implementation.

7.6 The Commission also noted that Resolution 9 (EC-LVI) requested the Secretary-General to keep GEO Members fully informed of WMO's long-term experience in operational observing and telecommunication systems and service provision and of its capacity to provide effective leadership in the implementation and operation of several key components of GEOSS. It also authorized the Secretary-General to indicate WMO's readiness to host the GEOSS Secretariat.

7.7 A GEO Special Session on Governance was held in Brussels (27-28 September 2004), hosted by the European Commission. During the Special Session and at the request of the European Commission, the Secretary-General was invited to provide details on the potential hosting of the GEOSS Secretariat in the WMO Headquarters building and he expressed WMO's willingness to do so. The reaction of GEO Members and participating organizations at the Special Session was most supportive.

GEO-5, GEO-6 and EOS III

7.8 The Commission was informed that the fifth session of GEO (GEO-5) was hosted in Ottawa, Canada (29-30 November 2004) at which a draft GEOSS Implementation Plan and enabling Resolution were negotiated. Additionally, GEO-5 reviewed a proposal by WMO to host the GEOSS Secretariat and reached consensus in principle to consider an agreement describing the WMO offer at GEO-6 to be held in Brussels on 14-15 February 2005. The Implementation Plan and resolution were submitted to the sixth session of GEO (GEO-6), hosted by the European Commission in Brussels on 14-15 February 2005 followed by EOS III on 16 February 2005.

7.9 At GEO-6 and EOS III, there were three significant events for WMO. First was the agreement by a GEO-6 resolution to assent to a Standing Arrangement between WMO and GEO for hosting the GEO Secretariat in Geneva. Second was a Communiqué relating to support for tsunami and multi-hazard alert systems which was endorsed at EOS III. Third was an EOS III resolution endorsing the 10-Year GEO Implementation Plan.

7.10 The Commission noted that plans to start moving a portion of the GEO Secretariat Office from Washington DC to Geneva, potentially starting in March 2005. The Commission was informed that 2005 would be a transition year for the GEO Secretariat. There would be a core of up to eight persons serving in the transitional GEO Secretariat in Geneva by April 2005. The transitional GEO Secretariat would serve until the permanent GEO Secretariat was established by the end of 2005. The first meeting of the new intergovernmental GEO, GEO I, was scheduled to be held at WMO Headquarters on 3-4 May 2005. The core transitional GEO Secretariat would make all the necessary preparations for GEO I. Included in the core would be a three to four person Task Force to develop the 2006 Work Plan to be reviewed and approved at GEO II, to be held in December 2005, possibly in Geneva. All GEO Secretariat members would become WMO staff members.

7.11 The Commission noted that GEO I already had a full agenda including: a pledging session to identify US$ 1 million for 2005 and US$ 3.5 million for 2006 GEO activities; formal acceptance of the structure and voting on members for a new Executive Committee with 12-15 members; agreement on a science and technical advisory mechanism; and a user interface mechanism.

7.12 The enabling resolution endorsed at EOS III on 16 February 2005 contained points relevant to the work of the Commission including: acknowledgement of United Nations Specialized Agencies; the need to build upon and work with existing planning and coordination mechanisms; invited WMO to endorse the implementation plan; request GEO to consult with component systems of GEOSS on progress and on issues involved in implementation; and affirm the intention to provide resources to implement the Plan.

The Commission's perspective

7.13 The Commission viewed GEO and its associated GEOSS as one of the most important and key initiatives which would enable WMO to address the challenge of the coming decades. Given that GEOSS was of such importance and yet still in a formative stage, several vital factors were identified as areas where WMO should continue to play an active role within GEO to ensure they remained aligned with the mandates of NMHSs, the objectives of WMO as an organization, and the continued improvement of WMO components that would serve as the core for GEOSS, including the WMO Space Programme as a core for the GEOSS space component. The Commission agreed that the vital factors were not mutually exclusive nor represented a dichotomy but rather served as a guideline for discussions to assist WMO in setting its path forward. Three key factors were discussed:

(*a*) The role and increased participation by developing countries in GEO towards achieving universal ownership;

(*b*) The preservation of national mandates for NMHSs including potential expansions as well as the continuance and enhancement of the visibility of NMHSs at the national level; and

(*c*) A strengthened WMO role within GEO as a major and recognized contributing partner.

7.14 The Commission recalled that the fifty-sixth session of the Executive Council considered it important that the successor arrangements to GEO achieve a strong sense of universal ownership among all WMO Members and expressed the hope that GEOSS would eventually become fully integrated into the United Nations system in a way that added value to the various observing systems that were sponsored or co-sponsored by WMO, UNESCO, IOC, the Food and Agriculture Organization at the United Nations (FAO), UNEP and other international agencies and programmes. The Commission reaffirmed the desire for such an eventual integration into the United Nations system.

7.15 In all cases, the Commission noted that GEO had proceeded at an extremely rapid pace in the previous 18 months and that WMO must be structured to work at a comparable pace if it wished to remain vibrant and relevant as GEO developed. The Commission agreed that WMO should remain as a primary catalyst to enhance GEO while maintaining WMO mandates. Thus, the Commission supported the establishment of two Co-coordinators for GEOSS, as described in general summary paragraph 9.3, to coordinate Commission activities across its relevant OPAGs and related to implementation aspects of the GEOSS 10-Year Implementation Plan including WIS as an initial system to accommodate GEOSS-related data and products. The Commission designated Mr P. Dubreuil (Canada) and one expert from RA III.

7.16 The Commission agreed that there were some very positive developments in the present GEO that provided a basis for a continued strong WMO role and should also prove beneficial to both GEO and WMO. Firstly, the co-location of the GEO Secretariat within the WMO building working administratively as WMO staff members while receiving technical direction and full financial support from GEO would ensure an optimum arrangement for mutual benefit. Secondly, the present, endorsed 10-Year GEO Implementation Plan clearly identified its role for improved observations and better products without encroaching on national mandates for service delivery. Thus, NMHSs had the potential for improved observational data and products to allow them to serve better their constituencies. Thirdly, the enabling resolution for the 10-Year GEO Implementation Plan clearly described GEO's commitment:

(*a*) To take into account the particular needs of developing countries;

(*b*) To acknowledge the achievements of the established national, regional and international observing systems, including those sponsored and co-sponsored by a number of United Nations Specialized Agencies and Programmes;

(*c*) To build upon, strengthen and expand, where appropriate, the established observing systems by working with, and through, existing planning and coordination mechanisms;

(*d*) To encourage the governments of all United Nations Member States to participate in GEO and invite the governing bodies of the United Nations Specialized Agencies and Programmes and other relevant international and regional organizations, which sponsored and co-sponsored established global, regional and national observing systems, to endorse the implementation of GEOSS and to encourage and assist GEO in its work;

(*e*) To request GEO to consult the intergovernmental and other sponsors of the component systems of GEOSS on progress and on issues involved in the implementation of the Plan; and

(*f*) To affirm GEO's intention to provide the necessary support to execute the GEOSS 10-Year Implementation Plan.

7.17 The Commission noted that the 10-Year GEO Implementation Plan would continue to evolve as GEOSS further developed. In particular, the Commission recalled that the enabling EOS III resolution had:

(*a*) Endorsed the 10-Year Implementation Plan as the basis for its further development and for establishing a GEOSS to fulfil user requirements among various socio-economic benefit areas; and

(*b*) Noted with appreciation the extensive supporting information compiled in the GEOSS 10-Year Implementation Plan Reference Document prepared by the ad hoc GEO.

8. LONG-TERM PLANNING RELEVANT TO THE COMMISSION (agenda item 8)

Sixth WMO Long-term Plan

8.1 The Commission recalled the adoption by Fourteenth Congress of the 6LTP as well as the guidelines and directives developed by the fifty-sixth session of the Executive Council for its monitoring and evaluation. It was noted with satisfaction that the activities carried out within the OPAG since the beginning of 2004 had produced results that contributed directly to the outcomes and strategies specified in the 6LTP with respect to the WWW and the PWS Programmes. The Commission requested the chairpersons of the OPAGs to keep the implementation of the 6LTP constantly under review. The CBS Management Group was requested to advise on the reports on the evaluation of the impacts of activities performed under the Plan, to be submitted by the president of the Commission to the future sessions of the Executive Council.

Seventh WMO Long-term Plan

8.2 The Commission noted the decisions of Fourteenth Congress and the guidance provided by the fifty-sixth session of the Executive Council for the preparation of the Seventh Long-term Plan (7LTP).

The Commission requested its Management Group to prepare the contributions of the Commission, which would be requested by the Executive Council Working Group on Long-term Planning and by the Executive Council, in coordination with the chairpersons of the OPAGs. Those contributions would be reviewed by the Commission at its next (extraordinary) session.

9. FUTURE WORK PROGRAMME (agenda item 9)

9.1 The Commission thanked all the chairpersons, members of the expert teams and the rapporteurs for their contribution to the CBS OPAGs and in particular those who would no longer serve within the CBS OPAGs. The Commission expressed its sincere gratitude to those chairpersons and co-chairpersons of the OPAGs who were no longer able to continue serving in those positions for their important contribution to the work of the Commission over many years. The Commission recognized Ms A. Simard (Canada) and Messrs K. O'Loughlin (Australia), V. Dall'Antonia (Brazil) and M. Saloum (Niger) and wished them success in their future work.

9.2 The Commission noted that an informal meeting held among the chairpersons of the Regional Working Groups on Planning and Implementation of the WWW, all of whom were present at the session of the Commission, contributed very much to the effective conduct of their activities. It recommended therefore, that such informal coordination meetings should be held again during future sessions of the Commission.

9.3 The Commission agreed on its work programme, based on the relevant sections of the 6LTP and relevant decisions of the Executive Council, and took into account the detailed discussions under the various agenda items. The Commission decided to re-establish the four OPAGs — on IOS, on ISS, on DPFS, and on PWS — and adopted Resolution 2 (CBS-XIII). It further decided to appoint two Co-coordinators for GEOSS to coordinate Commission activities across its relevant OPAGs and related to the GEOSS 10-Year Implementation Plan (see agenda item 7) and a Coordinator for Natural Disaster Prevention and Mitigation (see agenda item 4).

9.4 The Commission felt it important to ensure that the structure of the CBS OPAGs be consistent with the Regional Working Groups on Planning and Implementation of the WWW. It therefore invited regional associations to consider designating one rapporteur, or coordinator, corresponding to each of the CBS OPAG.

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

9.6 The chairpersons, co-chairpersons, Rapporteurs of the ICTs and Expert Teams, as well as the Coordinator for Natural Disaster Prevention and Mitigation, the coordinators for GEOSS, the Rapporteur on Quality Management and CBS representative in the ICTT on Quality Management Framework, the co-chairperson of the THORPEX ICSC Technical Advisory Board, the co-chairperson of the THORPEX ICSC Data Policy and Management Working Group, and the CBS focal point responsible for communication with IPY mechanisms and CBS representative in the Intercommission Task Group on IPY, who were designated by the Commission, are given in Annex XI to this report.

9.7 The Commission requested the CBS Management Group to establish the membership of the ICTs and the Expert Teams of each OPAG. It invited the chairpersons of the OPAGs and respective teams, in cooperation with the Secretariat, to develop targets for deliverables, and adequate working mechanisms to ensure that all experts could actively participate and contribute to the work programme and assist the respective teams.

10. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND RELEVANT RESOLUTIONS OF THE EXECUTIVE COUNCIL (agenda item 10)

In accordance with established practice, the Commission examined those resolutions and recommendations adopted prior to the present session which were still in force. It adopted Resolution 3 (CBS-XIII) and Recommendation 7 (CBS-XIII).

11 ELECTION OF OFFICERS (agenda item 11)

The Commission elected Messrs A.I. Gusev (Russian Federation) and G.-R. Hoffmann (Germany) as president and vice-president, respectively, of the WMO Commission for Basic Systems.

12. DATE AND PLACE OF THE EXTRAORDINARY SESSION 2006 (agenda item 12)

The Commission received with appreciation the declaration of intent by the delegation of the Republic of Korea to host the extraordinary session of CBS in the fourth quarter of the 2006. It was noted that the date of that session should be determined by the president of the Commission after consultation with the Secretary-General, according to General Regulation 187.

13. CLOSURE OF THE SESSION (agenda item 13)

13.1 In his closing remarks the acting president and president-elect, Mr A. Gusev, reviewed the main accomplishments, decisions and recommendations of the thirteenth session of the Commission. He expressed confidence that the Commission had once again shown its ability to respond promptly and effectively to the newly emerged challenges, notably as regarded the cross-cutting programmes established by Fourteenth Congress, namely, the Disaster Prevention and Mitigation Programme and the WMO Space Programme. He also remarked on the good progress being made in the development of the Future WMO Information System and emphasized the expectation that the Executive Council would follow the Commission's recommendation to change the project title to WMO Information System. Furthermore, he recalled the new demands that were to be addressed in connection with the WMO Quality Management Framework, and finally urged to work towards the integration of AMDAR into the WWW. He also suggested that active dissemination of CBS decisions, achievements, plans, corresponding information and guidance material was now necessary, also within the NMHSs, in order to facilitate the proper follow-up to the work of the Commission.

13.2 The acting president thanked again the members of the Expert Teams and of the Management Group for their valuable work and reminded the Management Group that it was now urgent to meet in order to coordinate the memberships of the newly established Expert Teams. He also thanked the Secretariat for the effective support provided to the Commission both during the intersessional period and during the session.

13.3 Several delegations recognized the efficient and constructive work of the Commission and thanked the acting president and the vice-president for the leadership and hard work. They also thanked all experts working within the working structure of the Commission for their important contribution during the past two years, which resulted in significant progress in all component programmes of the WWW and other activities coordinated under the auspices of the CBS.

13.4 The thirteenth session of the Commission for Basic System was closed at 12:30 p.m. on 3 March 2005.

RESOLUTIONS ADOPTED BY THE SESSION

RESOLUTION 1 (CBS-XIII)

CBS MANAGEMENT GROUP

THE COMMISSION FOR BASIC SYSTEMS,

RECALLING:

(1) General summary paragraph 7.13.5 of the *Abridged Report with Resolutions of* the *Fifth World Meteorological Congress* (WMO-No. 213.RC.28),

(2) Resolution 2 (CBS-Ext.(98)) – Working structure of the Commission for Basic Systems,

(3) Resolution 1 (CBS-XII) – Working Structure of the Commission,

(4) Resolution 2 (CBS-XII) – CBS Management Group,

RECOGNIZING:

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

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

DECIDES:

(1) To establish the Management Group of CBS with the following terms of reference:

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

(*b*) To assist the president in planning and coordinating the work of the Commission and its working groups;

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

(*d*) To assess and evaluate the progress achieved in the agreed work programme of the Commission and give guidance and advice on the activities of the working groups and the corresponding teams established under their responsibility;

(*e*) To monitor the implementation of the WWW and the PWS Programmes in relation to the WMO Long-term Plans and advise the president on appropriate actions;

(*f*) To ensure the overall integration of the programme areas and to coordinate strategic planning issues;

(*g*) To advise the president on matters related to cooperation with other technical commissions and support to other WMO and related programmes;

(*h*) Coordinate the activities of the Commission with respect to GEOSS;

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

(*j*) To review and contribute to the evolving role and enhancement of WMO with respect to CBS;

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

(*a*) The president of CBS (chairperson);

(*b*) The vice-president of CBS;

(*c*) The chairpersons and co-chairpersons of the four OPAGs;

(*d*) Two CBS Co-coordinators for the GEOSS;

(*e*) The CBS Coordinator for Natural Disaster Prevention and Mitigation.

RESOLUTION 2 (CBS-XIII)

OPEN PROGRAMME AREA GROUPS

THE COMMISSION FOR BASIC SYSTEMS,

CONSIDERING that there is a need for the continued development and coordination of:

(1) The surface- and space-based components of the global observing systems,

(2) The information systems and services,

(3) The data-processing and forecasting system,

(4) The public weather services,

RECALLING that the working structure implemented by CBS-Ext.(98) has been maintained according to Resolution 2 (CBS-Ext.(98)) — Working structure of the Commission for Basic Systems, and Resolution 1 (CBS-XII) — Working structure of the Commission,

NOTING Resolution 9 (EC-LVI) — Global Earth Observation System of Systems,

DECIDES:

(1) To re-establish:
- (*a*) The OPAG on Integrated Observing Systems;
- (*b*) The OPAG on Information Systems and Services;
- (*c*) The OPAG on Data-processing and Forecasting System;
- (*d*) The OPAG on Public Weather Services;

(2) To maintain the terms of reference for each OPAG as given in Resolution 4 (CBS-Ext.(98)) and, in addition, to request:
- (*a*) Each OPAG to develop contributions to, and coordinate their activities with, GEOSS, in accordance with, the agreed work programme of the Commission;
- (*b*) The OPAG on ISS to contribute to the development and implementation planning of the WMO Information System and coordinate with the Intercommission Coordination Group on FWIS;
- (*c*) Each OPAG to develop contributions to the activities of the Disaster Prevention and Mitigation Programme;

(3) To select, in accordance with General Regulation 32:
- (*a*) Mr J. Purdom (United States) as chairperson and Ms S. Barrell (Canada) as co-chairperson of the OPAG on Integrated Observing Systems;
- (*b*) Mr Peiliang Shi (China) as chairperson and Mr S. Foreman (United Kingdom) as co-chairperson of the OPAG on Information Systems and Services;
- (*c*) Mr B. Strauss (France) as chairperson and Mr N. Sato (Japan) as co-chairperson of the OPAG on Data-processing and Forecasting System;
- (*d*) Mr G. Fleming (Ireland) as chairperson and Mr M. Ndabambi (South Africa) as co-chairperson of the OPAG on Public Weather Services;

DECIDES FURTHER:

(1) To establish two Co-coordinators for the Global Earth Observation System of Systems (GEOSS) with the following terms of reference:
- (*a*) To coordinate Commission activities, across its relevant Open Programme Area Groups, related to implementation aspects of the GEOSS 10-Year Implementation Plan and advise Commission members on activities that will contribute fully to the development and implementation of GEOSS including enhanced operation of WWW relevant to GEOSS;
- (*b*) To coordinate with other regional and technical commission GEOSS rapporteurs and liaise with the WMO Secretariat on relevant GEOSS activities;
- (*c*) To coordinate with GEO through its GEO Secretariat located in the WMO Secretariat on matters relevant to the Commission and GEO;
- (*d*) To provide the CBS Management Group with appropriate information and recommendations on the Commission's GEOSS-related activities;

(2) To select Mr Pierre Dubreuil (Canada) and an expert from Region III (to be designated by the Management Group) to serve as the Co-coordinators for the GEOSS;

(3) To establish a Coordinator for Natural Disaster Prevention and Mitigation with the following terms of reference:
- (*a*) To coordinate Commission activities, across its relevant OPAGs, related to Natural Disaster Prevention and Mitigation (DPM) and advise Commission members on activities that will contribute fully to the DPM Programme including relevant enhanced operation of the WWW;
- (*b*) To provide the CBS Management Group with appropriate information and recommendations on the Commission's DPM-related activities;

(4) To select Ms S. Barrell (Canada) to serve as the Coordinator for Natural Disaster Prevention and Mitigation;

REQUESTS:

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

(2) The chairpersons of the OPAGs, the Co-coordinators for the GEOSS and the Coordinator for Natural Disaster Prevention and Mitigation:
- (*a*) To prepare an activity report at the end of 2005 for distribution to CBS members;
- (*b*) To submit a report to the Commission not later than three months prior to its session.

RESOLUTION 3 (CBS-XIII)

REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION FOR BASIC SYSTEMS

THE COMMISSION FOR BASIC SYSTEMS,

NOTING the action taken on the resolutions and recommendations adopted by the Commission prior to its thirteenth session,

DECIDES:

(1) To keep in force Resolutions 1 and 2 (CBS-Ext.(98)) and Resolution 1 (CBS-XII);

(2) Not to keep in force recommendations adopted prior to its thirteenth session.

RECOMMENDATIONS ADOPTED BY THE SESSION

RECOMMENDATION 1 (CBS-XIII)

REQUIRED TRAINING RELEVANT TO AMDAR

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) That the fifty-sixth session of the Executive Council requested CBS and CAeM to initiate studies on required training activities relevant to AMDAR,

(2) That the CBS Management Group at its fourth session requested the OPAG on IOS to study the required training activities relevant to AMDAR data and develop proposals for training events,

CONSIDERING that the current status of data usage is that:

(1) Much of the AMDAR data is available on the GTS, either in FM42-XI Ext. AMDAR character code or FM94-X Ext. BUFR code,

(2) BUFR encoder/decoder can be made available on request through WMO,

(3) A number of display systems are currently operational and available using the Internet,

RECOGNIZING that the required training relevant to AMDAR implies:

(1) Data formats and codes,

(2) Telecommunication and data distribution,

(3) Data management,

(4) Data presentation tools and utilization,

RECOMMENDS:

(1) That for the maximum benefit to Members, a training concept for the usage of AMDAR data should be developed including an implementation plan. Training activities should comprise a number of approaches, including:

(*a*) Regional or subregional training workshops and training seminars;

(*b*) Use of computer-aided learning programmes including CD-based self-educational programmes;

(*c*) Integration into the training for basic upper-air data use;

(2) That a CAeM/CBS task team should be established to evaluate current activities such as the CGMS/WMO Virtual Laboratory for Satellite Data Utilization, systems such as VISITView, and prepare appropriate guidance;

(3) That the concept should be addressed through the “train the trainer“ approach;

(4) That consideration should be given in each region to the development of a specialized Centre of Excellence dealing with AMDAR matters within its RMTC structure;

(5) That the Regional Rapporteurs/ Coordinators on Regional Aspects of the GOS, in consultation with the Rapporteur on AMDAR of the OPAG on IOS and other appropriate focal points in their regions, should develop a questionnaire on the AMDAR training requirements and send it to Members;

(6) That WMO Members should formulate AMDAR training requirements for Centres of Excellence in their region.

RECOMMENDATION 2 (CBS-XIII)

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* (WMO-No. 544), VOLUME I, AND THE *GUIDE ON THE GLOBAL OBSERVING SYSTEM* (WMO-No. 488), PART II

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The reports of the Meetings of the Expert Team on Requirements for Data from Automatic Weather Stations and of the Expert Team on Satellite System Utilization and Products (28 June-2 July 2004),

(2) The report of the Meeting of the Implementation Coordination Team on Information Systems and Services (6-10 September 2004),

CONSIDERING the requirement that for maintaining the accuracy of these documents, the need for periodic review is necessary to accommodate timely updates,

RECOMMENDS that the following amendments to the *Manual on the Global Observing System* (WMO-No. 544) be adopted for use:

(1) Volume I should include a standard set of metadata elements for AWS installations as submitted in the ET AWS-3 Final Report, Annex 3;

(2) Volume I, Part III, section 2.9 and 2.10, in the opening phrase after the comma replace the text by the following: “Members should adhere as appropriate to the GCOS Climate

Monitoring Principles adopted by Resolution 9 (Cg-XIV)). In particular, they should comply with the following best practices:";

(3) Volume I, Part III, section 2.10(*b*), replace the text by the following: " Soundings should preferably be made at least twice per day and should reach as high as possible, noting the GCOS requirement for ascents up to a minimum height of 30 hPa. Since climate data are needed in the stratosphere to monitor changes in the atmospheric circulation and to study the interaction between stratospheric circulation, composition and chemistry, every effort should be made to maintain soundings regularly up to a level as high as 5 hPa where feasible, noting the above GCOS requirements";

(4) Volume I, Part IV, section 2.1.2.1(*b*), replace the word "alternative" with the word "advanced". The sentence will read: "Direct broadcast, data-dissemination missions and advanced dissemination methods (ADM)";

(5) Volume I, Part IV, section 2.1.2.1(*b*) (iv), replace the word "alternative" with the word "advanced". The sentence should start with the word "Advanced";

(6) Appendix, Definitions, Section A, replace the definition of Alternative Dissemination Method with the following text: "*Advanced Dissemination Method* (ADM): Dissemination services other than through direct broadcast for satellite sensor, data and products. These advanced methods include: the use of data relay between satellite systems, the use of commercially provided higher data rate services, and the use of services such as the Internet. ADM should complement or supplement direct broadcast services.";

(7) Appendix, Definitions, Section A should contain the unequivocal definition of Automatic Weather Station (AWS) as found in the *International Meteorological Vocabulary* (WMO-No. 182);

RECOMMENDS FURTHER that the updated Functional Specifications for Automatic Weather Stations as presented in Annex 8 of the Final Report of the Third Session of the Expert Team on Requirements for Data from Automatic Weather Stations, be adopted and included in the *Guide on the Global Observing System*.

RECOMMENDATION 3 (CBS-XIII)

AMENDMENTS TO THE *MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM* (WMO-No. 386), VOLUME I, PARTS I AND II

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 2 (Cg-XIV) - World Weather Watch Programme for 2004-2007,

(2) The *Manual on the Global Telecommunication System* (WMO-No. 386), Volume I, Parts I and II,

RECOMMENDS that the *Manual on the Global Telecommunication System*, Volume I, Parts I and II, be amended as given in the annex to this recommendation, with effect from 9 November 2005;

REQUESTS the Secretary-General to make the amendments, as given in the annex to this recommendation, to the *Manual on the Global Telecommunication System*, Volume I, Parts I and II;

AUTHORIZES the Secretary-General to make any consequent purely editorial amendments of the *Manual on the Global Telecommunication System*, Volume I, Parts I and II.

ANNEX TO RECOMMENDATION 3 (CBS-XIII)

AMENDMENTS TO THE *MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM* (WMO-No. 386), VOLUME I

PART I

Amend Attachment I-2 — Configuration of the MTN, to include the circuit Melbourne – Washington.

PART II

Replace the text of paragraph 2.7.1 to read:

2.7.1 The length of meteorological bulletins shall be determined according to the following:

2.7.1.1 Prior to 7 November 2007:

(*a*) Any meteorological bulletin not segmented for transmission on the GTS should not exceed 15 000 octets;

(*b*) Any meteorological bulletin segmented into a series of meteorological bulletins for transmission on the GTS should not exceed 250 000 octets in its original form or when reassembled.

2.7.1.2 On or after 7 November 2007:

(*a*) Meteorological bulletins for alphanumeric data representation transmitted on the GTS should not exceed 15 000 octets;

(*b*) The limit for meteorological bulletins for binary data representation or pictorial form shall be increased from 15 000 to 500 000 octets;

(*c*) Meteorological bulletins shall no longer be segmented for transmission on the GTS.

NOTE: Meteorological information may be exchanged using the file transfer technique described in Attachment II-15, particularly when the information exceeds 250 000 octets.

Insert new paragraph 2.13 and renumber paragraph 2.13 as 2.14:

2.13 Transmission and collection of meteorological bulletins on the Internet

The Internet may be used for transmitting and collecting meteorological bulletins on the Internet. The purpose is to serve as a complementary communication system to be used in test and special cases, or when a dedicated GTS link is unavailable. The practices for electronic mail (e-mail) and/or Web data ingest, as given in Attachment II-16, should be used with a view to minimizing inherent security risks.

Insert new Attachment II-16 as follows:

ATTACHMENT II-16
Procedures for transmitting and collecting meteorological bulletins on the Internet

A – Use of electronic mail (e-mail)

Background

Electronic mail (e-mail) can be a very simple and cost effective way to exchange meteorological bulletins, in particular for collecting meteorological data bulletins. It should be noted however that e-mail is not an end-to-end service and there is no guarantee of the timely delivery of messages. E-mail is also inherently insecure.

The following guidelines describe practices for sending both data collection bulletins and binary meteorological bulletins via e-mail while minimizing security issues.

Centres implementing this procedure should ensure that meteorological bulletins to be ingested in the GTS follow the standard GTS procedures and formats.

Format of messages for sending meteorological bulletins via electronic mail on the Internet:

1. E-mail messages should use only International Alphabet No. 5. It is recommended that the meteorological bulletin should be contained in the main body of the e-mail message; as an option it may be contained in an attachment.

   NOTE: ‘Attachments' are a part of an e-mail message that are separate from the main body of the mail message, and that their display/storage is normally contingent upon some further action of the user.

2. It is recommended that only a single bulletin should be sent in each e-mail message. However, receiving centres may agree to accept multiple meteorological bulletins per e-mail message to a maximum of five.

3. The meteorological bulletin(s) can be sent either as text in the main body of the e-mail message, or in the attachment(s) of the e-mail message, but not in both. Binary data can only be sent in the attachment(s).

4. The main body of an e-mail message should follow the following format:

<Meteorological Bulletin>

NNNN

where,

<Meteorological Bulletin> is a standard meteorological bulletin starting with the abbreviated header line, such as

TTAAii CCCC YYGGgg [BBB]

message text

A termination string NNNN is required after every meteorological bulletin.

No other information should be included in the main body of the e-mail message unless agreed by the receiving centre. For example, automatic forward and reply informational text should not be allowed in the body of the message.

NOTE: The receiving centre shall validate the AHL before processing the meteorological bulletin.

5. The total size of all attachments should not exceed 2 MBytes or as specified in a bilateral agreement. Attachments should be coded in Base64 (MIME standard).

6. The e-mail header "Subject:" field either:

   (a) May contain the AHL if the e-mail message contains a single meteorological bulletin;

   (b) Or a pre-defined <security string>.

Security considerations:

1. E-mail is inherently insecure. To minimize security issues, all e-mail input should be pre-authorized by means of a list of valid source email addresses at the receiving site. The receiving centre should only process GTS-related e-mails from the pre-defined list of e-mail addresses. That is, the receiving centre should validate the e-mail message header "From:" field. To avoid problems with e-mail messages containing manipulated "From"-fields, centres may optionally agree to implement <security strings> in the message. If <security strings> are agreed on, and GTS message(s) are included in attachment(s), then the main body of the e-mail message can only contain the <security string>. The receiving centre should validate the "Subject"-field for the AHL or the pre-agreed string.
2. No automatic acknowledgements or replies should be sent from the receiving centres.
3. It is recommended to use specific mail accounts for GTS data transfer with bilaterally agreed names and not to receive GTS data in personal mailboxes.
4. A problem with some mail exchanger applications is that by default they operate as an "open-relay". An open-relay occurs, for example, if site A.COM accepts mail from B.NET destined for C.ORG. This means that spammers can use A.COM's mail system to distribute their emails. Centres should ensure that they do not operate as an open-relay.

Example

From: NMCAAAAA <NMCAAAAA@meteo.fr>

To: RTHcollector <RTHcollector@meteo.zz>

Subject: SMFW01 NWBB 270000

Information which is part of the e-mail header

```
SMFW01 NWBB 270000
AAXX 27004
91753 32481 51008 10331 20259 40078 58017 83202
  333 20263 59018 83816 84078=
91754 01581 51812 10287 20245 40092 58017 60034 70182 85200
  333 20256 59016 60017 85820=
NNNN
```

Text in the main body of the e-mail message or in the attachment

B – Use of Web data ingest

Background:

This procedure is intended for use as a simple data collection mechanism by an NMC. It may also be used by an RTH or NMC to ingest meteorological bulletins in the event of failure of a primary access method. This method is expected to have better security, timeliness and reliability than e-mail ingest.

Preliminary requirements:

The data provider that intends to send data to an RTH or NMC that offers the Web-based ingest service shall first establish an account with that centre. An authentication mechanism (such as a USERID and PASSWORD combination) shall be established for security purposes. Validating the sending IP address is impractical in most cases due to the routine translating of addresses and the nature of the possible backup scenarios.

Input:

The user shall input all mandatory fields in the abbreviated header and input the body of the message. For mandatory fields, drop-down-lists may be provided to reduce the possibility of errors. The body of the message shall conform to WMO standards.

Validation:

The Web Bulletin Input Interface should provide a fill-in-the-blank area for a single GTS abbreviated heading line. It should confirm that:

(*a*) All mandatory fields have been filled with valid information;
(*b*) All optional fields either have valid information or are left blank;
(*c*) The CCCC field is valid for the authenticated user of the sending centre;
(*d*) There will be only one bulletin created per Web page entry;
(*e*) The resulting abbreviated heading line follows all appropriate WMO standards, such as proper alphabet code and proper termination sequences.

Content verification:

Before the completed message is ingested, the Web bulletin input interface should display the entire message to the user and ask for confirmation that message is correct. The creator of the message should be given an opportunity to change the message before submission.

Security:

For additional security, the use of HTTPS is recommended.

Examples of implemented Web Bulletin Input Pages:

RTH Washington with URL: http://www.nws.noaa.gov/tg/bullguid.html

RECOMMENDATION 4 (CBS-XIII)

AMENDMENTS TO THE *MANUAL ON CODES* (WMO-No. 306), VOLUME I.2

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The report of the Meeting of the Expert Team on Data Representation and Codes (Arusha, Tanzania, 17-21 February 2003),

(2) The report of the Meeting of the Expert Team on Data Representation and Codes (Kuala Lumpur, 21-26 June 2004),

(3) The report of the Meeting of the Implementation Coordination Team on ISS (Geneva, 27 September-1 October 2004),

CONSIDERING the requirements:

(1) For two new compression schemes based on JPEG 2000 and PNG and additions of new parameters in particular for image-like products and Earth surface information in FM 92 GRIB 2,

(2) For amending Regulations 94.5.3.8 and 95.3.5.5 to define clearly displacement descriptors and increment descriptors,

(3) For new descriptors for transmission in BUFR of TEMP and SYNOP data, for reporting Meteosat 8 data, for representation of satellite radio occultation data, for ozone concentrations, for new common sequences for translation in BUFR of PILOT and TEMP observations and AMDAR profiles, for ENVISAT data, wave–spectra, oceanographic data, ozone concentrations and radiosondes data,

(4) For a new BUFR and CREX edition, for representation of probabilities, other forecast values and new operators, for the definition of full date format, international subcategories, local subcategories and for additions in CREX to increase the compatibility with BUFR,

RECOMMENDS that the following amendments be adopted for operational use as from 2 November 2005:

(1) Additions to FM 92-XII Ext. GRIB defined in Annex 1 to this recommendation;

(2) Additions to FM 94-XII Ext. BUFR and FM 95-XII Ext. CREX defined in Annex 2 to this recommendation;

(3) Additions for a new edition of FM 94-XII Ext. BUFR and FM 95-XII Ext. CREX defined in Annex 3 to this recommendation, with the understanding that both editions, i.e., BUFR editions 3 and 4, and CREX editions 1 and 2, may be used in parallel up to the first Tuesday of November 2012; after that date only BUFR edition 4 and CREX edition 2 shall be used;

REQUESTS the Secretary-General to arrange for the inclusion of these amendments in Volume I.2 of the *Manual on Codes.*

ANNEX 1 TO RECOMMENDATION 4 (CBS-XIII)

ADDITIONS TO FM 92-XII EXT. GRIB

Additional note at end of the Product definition table 4.7:

NOTE:

"This template should not be used. Product Definition Template 4.0 should be used instead."

For JPEG 2000:

The following Templates and Code tables are proposed for use with the JPEG 2000 image encoding:

Data representation template 5.40: Grid point data - JPEG 2000 code stream format	
Octet number(s)	Contents
12-15	Reference value (R) (IEEE 32-bit floating-point value)
16-17	Binary scale factor (E)
18-19	Decimal scale factor (D)
20	Number of bits required to hold the resulting scaled and referenced data values (i.e. the depth of the grayscale image) (see Note 2)

21	Type of original field values (see Code table 5.1)
22	Type of compression used (see Code table 5.40)
23	Target compression ratio, M:1 (with respect to the bit-depth specified in octet 20), when octet 22 indicates lossy compression. Otherwise, set to missing (see Note 3)

NOTES:

(1) The intent of this template is to scale the grid point data to obtain desired precision, if appropriate, and then subtract out reference value from the scaled field as is done using Data representation template 5.0. After this, the resulting grid point field can be treated as a grayscale image and is then encoded into the JPEG 2000 code stream format. To unpack the data field, the JPEG 2000 code stream is decoded back into an image, and the original field is obtained from the image data as described in Regulation 92.9.4, Note (4).

(2) The JPEG 2000 standard specifies that the bit-depth must be in the range of 1 to 38 bits.

(3) The compression ratio M:1 (e.g. 20:1) specifies that the encoded stream should be less than ((1/M) x depth x number of data points) bits, where depth is specified in octet 20 and number of data points is specified in octets 6-9 of the Data representation section.

(4) The order of the data points should remain as specified in the scanning mode flags (Flag table 3.4) set in the appropriate Grid definition template, even though the JPEG 2000 standard specifies that an image is stored starting at the top left corner. Assuming that the encoding software is expecting the image data in raster order (left to right across rows for each row), users should set the image width to Ni (or Nx) and the height to Nj (or Ny) if bit 3 of the scanning mode flag equals 0 (adjacent points in i (x) order), when encoding the "image". If bit 3 of the scanning mode flags equals 1 (adjacent points in j (y) order), it may be advantageous to set the image width to Nj (or Ny) and the height to Ni (or Nx).

(5) When the data points are not available on a rectangular grid, such as would occur if some data points are bit-mapped out or if section 3 describes a quasi-regular grid, the data field can be treated as a one-dimensional image where the height is set to 1 and the width is set to the total number of data points specified in octets 6-9.

Data template 7.40: Grid point data - JPEG 2000 code stream format

Octet number(s)	Contents
6-nn	JPEG 2000 code stream as described in Part 1 of the JPEG 2000 standard (ISO/IEC 15444-1:2000)

NOTE:

For simplicity, image data should be packed specifying a single component (i.e. grayscale image) instead of a multi-component colour image.

Code table 5.40: Type of compression

Code figure	Meaning
0	Lossless
1	Lossy
2-254	Reserved
255	Missing

For portable network graphics (PNG)

The following templates are proposed for use with PNG image encoding:

Data representation template 5.41: Grid point data - portable network graphics (PNG) format

Octet Number(s)	Contents
12-15	Reference value (R) (IEEE 32-bit floating-point value)
16-17	Binary scale factor (E)
18-19	Decimal scale factor (D)
20	Number of bits required to hold the resulting scaled and referenced data values (i.e. the depth of the image) (see Note 2)
21	Type of original field values (see Code table 5.1)

NOTES:

(1) The intent of this template is to scale the grid point data to obtain desired precision, if appropriate, and then subtract out the reference value from the scaled field as is done using Data representation template 5.0. After this, the resulting grid point field can be treated as an image and is then encoded into PNG format. To unpack the data field, the PNG stream is decoded back into an image, and the original field is obtained from the image data as described in Regulation 92.9.4, Note (4).

(2) PNG does not support all bit-depths in an image, so it is necessary to define which depths can be used and how they are to be treated. For grayscale images, PNG supports depths of 1, 2, 4, 8 or 16 bits. Red-green-blue (RGB) colour images can have depths of 8 or 16 bits with an optional alpha sample. Valid values for octet 20 can be:

1, 2, 4, 8, or 16 - treat as grayscale image

24 - treat as RGB colour image (each component having 8 bit depth)
32 - treat as RGB w/ alpha sample colour image (each component having 8 bit depth).

(3) The order of the data points should remain as specified in the scanning mode flags (Flag table 3.4) set in the appropriate Grid definition template, even though the PNG standard specifies that an image is stored starting at the top left corner and scans across each row from left to right starting with the top row. Users should set the image width to Ni (or Nx) and the height to Nj (or Ny) if bit 3 of the scanning mode flag equals 0 (adjacent points in i (x) order), when encoding the "image". If bit 3 of the scanning mode flags equals 1 (adjacent points in j (y) order), it may be advantageous to set the image width to Nj (or Ny) and the height to Ni (or Nx).

(4) When the data points are not available on a rectangular grid, such as a would occur if some data points are bit-mapped out or if section 3 describes a quasi-regular grid, the data field can be treated as a one-dimensional image where the height is set to 1 and the width is set to the total number of data points specified in octets 6-9.

Data template 7.41: Grid point data - portable network graphics (PNG) format	
Octet number(s)	Contents
6-nn	PNG encoded image

NOTE:

If octet 20 of Data representation template 5.41 specifies that the data is packed into either 1, 2, 4, 8, or 16 bits, then encode the "image" as a grayscale image. If octet 20 specifies 24 bits, the encode the "image" as a red-green-blue (RGB) colour image with 8 bit depth for each colour component, and finally if octet 20 is 32, then encode the "image" as a RGB colour image with an alpha sample using an 8 bit depth for each of the four components.

Cloud analysis image of METEOSAT 8:

Addition to Code table 4.2:

Code table 4.2, Product discipline 3 – Space products, parameter category 0: image format products
Add: Number 8, Parameter = Pixel scene type, Units = Code table (4.218)
Change: Number 8 – 191, Parameter = Reserved
to
Number 9 – 191, Parameter = Reserved

Add a new Code table 4.218:

Code Table 4.218 - Pixel scene type

0 = Nominal cloud top height quality
1 = Green needle leafed forest
2 = Green broad leafed forest
3 = Deciduous needle leafed forest
4 = Deciduous broad leafed forest
5 = Deciduous mixed forest
6 = Closed shrub-land

7 = Open shrub-land
8 = Woody savannah
9 = Savannah
10 = Grassland
11 = Permanent wetland
12 = Cropland
13 = Urban
14 = Vegetation/crops
15 = Permanent snow/ice
16 = Barren desert
17 = Water bodies
18 = Tundra
19-96 = Reserved
97 = Snow/ice on land
98 = Snow/ice on water
99 = Sun-glint
100= General cloud
101 = Low cloud/fog/Stratus
102 = Low cloud/Stratocumulus
103 = Low cloud/unknown type
104 = Medium cloud/Nimbostratus
105 = Medium cloud/Altostratus
106 = Medium cloud/unknown type
107 = High cloud/Cumulus
108 = High cloud/Cirrus
109 = High cloud/unknown
110 = Unknown cloud type
111-191 = Reserved
192-254 = Reserved for local use
255 = Missing

Multi-sensor precipitation estimate (EUMETSAT product):

Addition to Code table 4.2:

Code Table 4.2, Product discipline 3 – Space products, parameter category 1: quantitative products

Add:	Number 1, Parameter = Instantaneous rain rate, Units = kg m^{-2} s^{-1}
Change:	Number 1 – 191, Parameter = Reserved
to:	Number 2 – 191, Parameter = Reserved

METEOSAT 8 cloud top height:

Additions to Code table 4.2:

Code Table 4.2, Product discipline 3 – Space products, parameter category 1: quantitative products

Add:	Number 2, Parameter = Cloud top height, Units = m
Add:	Number 3, Parameter = Cloud top height quality indicator, Units = Code table (4.219)
Change:	Number 1 – 191, Parameter = Reserved
to:	Number 4 – 191, Parameter = Reserved

Add a new Code table, 4.219:

Code Table 4.219 - Cloud top height quality indicator

0 = No scene identified
1 = Fog in segment
2 = Poor quality height estimation
3 = Fog in segment and poor quality height estimation
4-191 = Reserved
192-254 = Reserved for local use
255 = Missing

Add the following note at end of Data representation templates 5.0 and 5.50:

NOTE: Negative values of E or D shall be represented according to Regulation 92.1.5.

Clarification of the unit for Earth radius:

Add the following as the last note to the relevant Guide definition templates 3.0, 3.10, 3.20, 3.30, 3.31, 3.40, 3.90, 3.110, 3.1000 and 3.1100:

NOTE:
A scaled value of radius of spherical Earth, or major or minor axis of oblate spheroid Earth is derived from applying the appropriate scale factor to the value expressed in metres.

Modify ***Code table 3.2 – Shape of the Earth:***

0	*(unchanged)*
1	Earth assumed spherical with radius (in m) specified by data producer
2	*(unchanged)*
3	Earth assumed oblate spheroid with major and minor axes specified (in km) by data producer
4	*(unchanged)*
5	*(unchanged)*
6	*(unchanged)*
7	Earth assumed oblate spheroid with major and minor axes specified (in m) by data producer
8-191	Reserved
192-254	Reserved for local use
255	Missing

Add new parameters as follows:

Product discipline	Parameter category	Parameter number	Parameter name	Units
0	0	16	Snow phase change heat flux	$W\ m^{-2}$
0	1	33	Categorical rain	(Code table 4.222)
0	1	34	Categorical freezing rain	(Code table 4.222)
0	1	35	Categorical ice pellets	(Code table 4.222)
0	1	36	Categorical snow	(Code table 4.222)
0	1	37	Convective precipitation rate	$kg\ m^{-2}\ s^{-1}$
0	1	38	Horizontal moisture divergence	$kg\ kg^{-1}\ s^{-1}$
0	1	39	Percent frozen precipitation	%
0	1	40	Potential evaporation	$kg\ m^{-2}$
0	1	41	Potential evaporation rate	$W\ m^{-2}$
0	1	42	Snow cover	%
0	1	43	Rain fraction of total cloud water	Proportion
0	1	44	Rime factor	Numeric
0	1	45	Total column integrated rain	$kg\ m^{-2}$
0	1	46	Total column integrated snow	$kg\ m^{-2}$
0	2	25	Vertical speed shear	s^{-1}
0	2	26	Horizontal momentum flux	$N\ m^{-2}$
0	2	27	U-component storm motion	$m\ s^{-1}$
0	2	28	V-component storm motion	$m\ s^{-1}$
0	2	29	Drag coefficient	Numeric
0	2	30	Frictional velocity	$m\ s^{-1}$
0	3	15	5-wave geopotential height	gpm
0	3	16	Zonal flux of gravity wave stress	$N\ m^{-2}$
0	3	17	Meridional flux of gravity wave stress	$N\ m^{-2}$
0	3	18	Planetary boundary layer height	m
0	3	19	5-wave geopotential height anomaly	gpm

0	4	7	Downward short-wave radiation flux	W m^{-2}
0	4	8	Upward short-wave radiation flux	W m^{-2}
0	5	3	Downward long-wave radiation flux	W m^{-2}
0	5	4	Upward long-wave radiation flux	W m^{-2}
0	6	14	Non-convective cloud cover	%
0	6	15	Cloud work function	J kg^{-1}
0	6	16	Convective cloud efficiency	Proportion
0	6	17	Total condensate	kg kg^{-1}
0	6	18	Total column-integrated cloud water	kg m^{-2}
0	6	19	Total column-integrated cloud ice	kg m^{-2}
0	6	20	Total column-integrated condensate	kg m^{-2}
0	6	21	Ice fraction of total condensate	Proportion
0	7	10	Surface lifted index	K
0	7	11	Best (4-layer) lifted index	K
0	7	12	Richardson number	Numeric
0	14	1	Ozone mixing ratio	kg kg^{-1}
0	19	17	Maximum snow albedo	%
0	19	18	Snow-free albedo	%
0	191	0	Seconds prior to initial reference time (defined in Section 1)	s
1	0	5	Baseflow-groundwater runoff	kg m^{-2}
1	0	6	Storm surface runoff	kg m^{-2}
2	0	9	Volumetric soil moisture content	Proportion
2	0	10	Ground heat flux	W m^{-2}
2	0	11	Moisture availability	%
2	0	12	Exchange coefficient	kg m^{-2} s^{-1}
2	0	13	Plant canopy surface water	kg m^{-2}
2	0	14	Blackadar’s mixing length scale	m
2	0	15	Canopy conductance	m s^{-1}
2	0	16	Minimal stomatal resistance	s m^{-1}
2	0	17	Wilting point	Proportion
2	0	18	Solar parameter in canopy conductance	Proportion
2	0	19	Temperature parameter in canopy conductance	Proportion
2	0	20	Humidity parameter in canopy conductance	Proportion
2	0	21	Soil moisture parameter in canopy conductance	Proportion
2	3	5	Liquid volumetric soil moisture (non-frozen)	Proportion
2	3	6	Number of soil layers in root zone	Numeric
2	3	7	Transpiration stress-onset (soil moisture)	Proportion
2	3	8	Direct evaporation cease (soil moisture)	Proportion
2	3	19	Soil porosity	Proportion
3	1	4	Estimated U wind	m s^{-1}
3	1	5	Estimated V wind	m s^{-1}

Add new Code table:

Code table 4.222 – Categorical result

Code figure	Meaning
0	No
1	Yes
2-191	Reserved
192-254	Reserved for local use
255	Missing

Add a note at beginning of Code table 4.1:

NOTE:

In the context of adding a new parameter entry for Code table 4.1, when more than one discipline applies, the choice of discipline should be made based on the intended use of the product.

ANNEX 2 TO RECOMMENDATION 4 (CBS-XIII)

ADDITIONS TO FM 94-XII EXT. BUFR AND FM 95-XII EXT. CREX

Amend existing FM 94 BUFR Regulation 94.5.3.8 and CREX Regulation 95.3.5.5 as follows:

94.5.3.8 Increments:
95.3.5.5

Any occurrence of an element descriptor from classes 04 to 07, which defines an increment, shall indicate that the location corresponding to that class be incremented by the corresponding data value. In the case of successive increments from the same class, this means that each increment applies in a cumulative manner, with all preceding increments remaining in effect.

Displacements:

In contrast, any displacement descriptor from classes 04 to 07 does not redefine the location corresponding to that class. In the case of successive displacements from the same class, this means that each displacement applies independently and in a non-cumulative manner to the location corresponding to that class.

DESCRIPTORS FOR AIRS SATELLITE DATA

In BUFR Table B:

Log-10 of principal components normalized fit to data

0-25-052	Numeric	4	0	15

In BUFR Table D:

3-10-050 Satellite collocated 1C reports with 3 instruments

3-10-051	Satellite position and instrument temperatures
3-10-052	Satellite instrument type and position (AIRS)
1-01-000	Delayed replication of 1 descriptor
0-31-002	Extended delayed descriptor replication factor
3-10-053	Satellite channels and brightness temperatures with expanded channel set (AIRS)
1-01-004	Replicate 1 descriptor 4 times
3-10-054	Satellite visible channels and albedos with expanded channel set
0-20-010	Cloud cover (total)
3-10-052	Satellite instrument type and position (AMSU-A)
1-01-015	Replicate 1 descriptor 15 times
3-10-053	Satellite channels and brightness temperatures with expanded channel set (AMSU-A)
3-10-052	Satellite instrument type and position (HSB)
1-01-005	Replicate 1 descriptor 5 times
3-10-053	Satellite channels and brightness temperatures with expanded channel set (HSB)

3-10-051 Satellite position and instrument temperatures

0-01-007	Satellite identifier
0-05-040	Orbit number
2-01-133	Change data width
0-05-041	Scan line number
2-01-000	Cancel change data width
2-01-132	Change data width
0-25-070	Major frame count
2-01-000	Cancel change data width
2-02-126	Change scale
0-07-001	Height of station
2-02-000	Cancel change scale
0-07-025	Solar zenith angle
0-05-022	Solar azimuth
1-02-009	Replicate 2 descriptors 9 times

0-02-151 Radiometer identifier
0-12-064 Instrument temperature

3-10-052 Satellite instrument type and position

0-02-019 Satellite instruments
3-01-011 Year, month, day
3-01-012 Hour, minute
2-02-131 Change scale
2-01-138 Change data width
0-04-006 Second
2-01-000 Cancel change data width
2-02-000 Cancel change scale
3-01-021 Latitude and longitude (high accuracy)
0-07-024 Satellite zenith angle
0-05-021 Bearing or azimuth
0-05-043 Field of view number

3-10-053 Satellite channels and brightness temperatures with expanded channel set

2-01-134 Change data width
0-05-042 Channel number
2-01-000 Cancel change data width
0-25-076 Log-10 of temperature-radiance central wave number for ATOVS
0-33-032 Channel quality flags for ATOVS
0-12-163 Brightness temperature (scale 2)

3-10-054 Satellite visible channels and albedos with expanded channel set

2-01-134 Change data width
0-05-042 Channel number
2-01-000 Cancel change data width
0-25-076 Log-10 of temperature-radiance central wave number for ATOVS
0-33-032 Channel quality flags for ATOVS
2-01-131 Change data width
2-02-129 Change scale
1-02-002 Replicate 2 descriptors 2 times
0-08-023 First-order statistics
0-14-027 Albedo
0-08-023 First-order statistics
2-02-000 Cancel change scale
2-01-000 Cancel change data width

3-10-055 Satellite radiance/channel principle components

3-10-051 Satellite position and instrument temperatures
3-10-052 Satellite instrument type and position (AIRS)
1-02-020 Replicate 2 descriptors 20 times
0-25-076 Log-10 of temperature-radiance central wave number for ATOVS
0-25-052 Log-10 of principal components normalized fit to data
1-01-000 Delayed replication of 1 descriptor
0-31-002 Extended delayed descriptor replication factor
0-25-050 Principal components of satellite radiance

Additions for METEOSAT 8 data

Name	Units	Range	Precision	Proposed descriptor	Reference value	Scale	Width (bits)
Number of observations	Numeric	0 – 99	± 1	0-08-049	0	0	8
Cloud index	Code table	0 – 99	± 1	0-20-050	0	0	8
Cloud phase	Code table	0 - 3	± 1	0-20-056	0	0	3

Code table (0-20-050) cloud index

0 = Reserved
1 = First low cloud
2 = Second low cloud
3 = Third low cloud
4 = First medium cloud
5 = Second medium cloud
6 = Third medium cloud
7 = First high cloud
8 = Second high cloud
9 – 254 = Reserved
255 = Missing

Code table (0-20-056) cloud phase

0 = Unknown
1 = Water
2 = Ice
3 = Mixed
4 – 6 = Reserved
7 = Missing

Climate data set products from METEOSAT

Climate data set products from the earlier METEOSAT satellites have been and continue to be produced, and are archived at EUMETSAT, both in an internal format and in BUFR. In order to encode all of the required parameters, the following addition descriptors are proposed:

Name	Units	Range	Precision	Proposed descriptor	Reference value	Scale	Width (bits)
Amount of segment covered by scene	%	0 – 100	± 1	0-20-083	0	0	7
Sun-glint indicator	Code table	0 – 1	± 1	0-08-065	0	0	2
Semi-transparency indicator	Code table	0 - 1	± 1	0-08-066	0	0	2
Sun to satellite azimuth difference	Degrees	-180 – 180	± 0.1	0-05-023	-1800	1	12

Code table (0-08-065) sun-glint indicator

0 = No sun-glint
1 = Sun-glint
2 = Reserved
3 = Missing

Code table (0-08-066) semi-transparency indicator

0 = Opaque
1 = Semi-transparent
2 = Reserved
3 = Missing

Global instability index

Name	Units	Range	Precision	Proposed descriptor	Reference value	Scale	Width (bits)
K index	Kelvin	-20 – 50	± 1	0-13-044	-30	0	8
KO index	Kelvin	-20 – 20	± 1	0-13-045	-30	0	8
Maximum buoyancy	Kelvin	-20 – 40	± 1	0-13-046	-30	0	8

Clear sky radiance

The additional features of the classification scheme used for METEOSAT 8 mean that it is possible to derive a new type of confidence measure for the clear sky radiance data. Additionally, a quality control mechanism based on the "Gaussian-ness" of the distribution of the clear sky radiance values is also being finalized. In order to encode confidence values from both of these schemes, two additional code table entries, 3 and 4, are proposed in Code table 0 08 033.

The "method of derivation of percentage confidence" code table (0-08-033) would be as follows:

0 = Reserved
1 = Percentage confidence calculated using cloud fraction
2 = Percentage confidence calculated using standard deviation of temperature
3 = Percentage confidence calculated using probability of cloud contamination
4 = Percentage confidence calculated using normality of distribution
5 – 126 = Reserved
127 = Missing

Add one entry in Code table (0-02-163) - height assignment method

14 = Composite height assignment

ADDITIONS NEEDED FOR TRANSMISSION OF SYNOP, TEMP AND OZONE SOUNDING DATA IN BUFR/CREX

Modify in Code table 0 08 001- Vertical sounding significance*:*

(1) *Modify bit number 5 of flag table 008001 to read:*

5 Significant level, temperature and/or relative humidity

(2) *Add new descriptors*:

F X Y	Element name	BUFR				CREX		
0 08 042	Extended vertical sounding significance	Flag table	0	0	18	Flag table	0	6

Code table 0 08 042 Extended vertical sounding significance

Bit No.
1 Surface
2 Standard level
3 Tropopause level
4 Maximum wind level
5 Significant temperature level
6 Significant humidity level
7 Significant wind level
8 Beginning of missing temperature data

9 End of missing temperature data
10 Beginning of missing humidity data
11 End of missing humidity data
12 Beginning of missing wind data
13 End of missing wind data
14-17 Reserved
All 18 Missing value

F X Y	Element name	BUFR				CREX		
0 04 086	Long time period or displacement	Second	0	-8192	15	Second	0	5
0 05 015	Latitude displacement (high accuracy)	Degree	5	-9000000	25	Degree	5	7
0 05 016	Latitude displacement (coarse accuracy)	Degree	2	-9000	15	Degree	2	4
0 06 015	Longitude displacement (high accuracy)	Degree	5	-18000000	26	Degree	5	8
0 06 016	Longitude displacement (coarse accuracy)	Degree	2	-18000	16	Degree	2	5

(3) To be able to oblige the current practice of reporting the time offset from the launch time in the ozone sounding messages, a new sequence descriptor 3 09 031 (and D 09 031) is needed:

		(Ozone sonde flight data)
3 09 031	0 15 004	Ozone sounding correction factor
	0 15 005	Ozone p
	1 04 000	Delayed replication of 4 descriptors
	0 31 001	Replication factor
	0 04 025	**Time displacement (since launch time) in minutes**
	0 08 006	Ozone vertical sounding significance
	0 07 004	Pressure
	0 15 003	Measured ozone partial pressure

And add footnote (1) to sequence descriptor 3 09 030 (D 09 030) in BUFR (CREX) Table D:

“This sequence is deprecated because of incorrect usage of descriptor 0 04 015 (B 04 015); sequence 3 09 031 (D 09 031) should be used instead”

(4) New CREX sequence descriptors

To report the time offset from the launch time in the ozone vertical sounding messages, a new set of descriptors **D 09 045, D 09 046, D 09 047, D 09 048 and D 09 049** is proposed in which D 09 031 would be included instead of D 09 030; otherwise these descriptors would be identical with D 09 040, D 09 041, D 09 042, D 09 043 and D 09 044, respectively, and footnotes should be added to Class 9 of CREX Table D for each of the sequences D 09 040,41,42,43,44 stating:

“This sequence is deprecated because it includes deprecated sequence D 09 030; sequence D 09 045(46,47,48,49) should be used instead.

B 04 075 (short-time period or displacement) is currently used in sequence descriptors D 06 020 and D 06 024 to redefine the initial time of observation, which is inconsistent with the recent interpretation of the BUFR/CREX regulations. B 04 065 (short-time increment) should be used for this purpose. As corresponding modification is not acceptable, it is proposed to **deprecate D 06 020 and D 06 024** and to introduce two new sequence descriptors (e.g. **D 06 019 and D 06 025**) which would be identical with D 06 020 and D 06 024**,** only B 04 075 would be replaced by B 04 065. In addition, a footnote would be added to each of the sequences D 06 020 and D 06 24 as follows:

“This sequence is deprecated because of incorrect usage of descriptor B 04 075; sequence D06 019 (25) should be used instead.”

ADDITIONS FOR ENVISAT DATA

(a) AATSR *(Advanced Along Track Scanning Radiometer). This is the advanced version of the ATSR system operated on ERS1 and ERS2. The main objective of the AATSR is precise measurement of sea-surface temperature (SST).*

Proposal for standard WMO BUFR Table B entries:

0 01 096	Station acquisition	CCITTIA5	0	0	160
0 02 174	Mean across track pixel number	Numeric	0	0	9
0 12 180	Averaged 12 micron bt for all clear pixels at nadir	K	2	0	16
0 12 181	Averaged 11 micron bt for all clear pixels at nadir	K	2	0	16
0 12 182	Averaged 3.7 micron bt for all clear pixels at nadir	K	2	0	16
0 12 183	Averaged 12 micron bt for all clear pixels, forward view	K	2	0	16
0 12 184	Averaged 11 micron bt for all clear pixels, forward view	K	2	0	16
0 12 185	Averaged 3.7 micron bt for all clear pixels, forward view	K	2	0	16
0 12 186	Mean nadir sea surface temperature	K	2	0	16
0 12 187	Mean dual view sea surface temperature	K	2	0	16
0 21 086	Number of pixels in nadir only, average	Numeric	0	0	9
0 21 087	Number of pixels in dual view, average	Numeric	0	0	9
0 33 043	Ast confidence	Flag table	0	0	8

0 33 043 Flag table ast confidence

Bit No.	Meaning
1	Sea mds. nadir only sst retrieval used 3.7 Micron channel. land mds reserved
2	Sea mds. dual view sst retrieval used 3.7 micron Channel. land mds reserved
3	Nadir view contains day time data
4	Forward view contains day time data
5-7	Reserved
All	Missing value

Proposal for standard WMO BUFR Table D entries:

3 12 045 AATSR sea-surface temperatures

3 12 045 0 01 007 Satellite identifier
0 02 019 Satellite instruments
0 01 096 Station acquisition
0 25 061 Software identification and version number
0 05 040 Orbit number
3 01 011 Date
3 01 013 Time
3 01 021 Lat/long

0 07 002 Height or altitude
0 12 180 Average 12 micron BT for all clear pixels at nadir
0 12 181 Average 11 micron BT for all clear pixels at nadir
0 12 182 Average 3.7 micron BT for all clear pixels at nadir
0 12 183 Average 12 micron BT for all clear pixels, forward view
0 12 184 Average 11 micron BT for all clear pixels, forward view
0 12 185 Average 3.7 micron BT for all clear pixels, forward view
0 02 174 Mean across track pixel number
0 21 086 Number of pixels in nadir only, average
0 12 186 Mean nadir sea-surface temperature
0 21 087 Number of pixels in dual view, average
0 12 187 Mean dual view sea-surface temperature
0 33 043 ATS confidence

(b) SCIAMACHY *(Scanning Imaging Absorbtion Spectrometer for Atmospheric Cartography). The instrument provides spectra measured from light transmitted, back scattered or reflected by trace gases in the atmosphere and needs existing standard entry 310020.*

(c) MIPAS *(Michelson Interferometer for Passive Atmospheric Sounding). The instrument measures atmospheric radiation emitted by trace gases in the infrared spectral range 4.14 to 14.6 micrometres.*

BUFR Table B reserved entry:

0 13 098	Integrated water vapour density	kg m^{-2}	8	0	30

BUFR Table D reserved entry:

3 10 030	3 10 022 Satellite id, product type
	3 01 011 Date
	3 01 013 Time
	3 01 021 Lat/long
	3 04 034 Lat/long, solar elevation, number of layers
	3 100 29 Layer, ozone, height, temperature and water vapour

3 10 029	1 10 000
	0 31 001 Delayed replication
	2 01 138 Change data width
	2 02 130 Change scale
	0 07 004 Pressure
	0 07 004 Pressure
	2 02 000 Cancel operator
	2 01 000 Cancel operator
	0 15 020 Integrated ozone density
	0 10 002 Height
	0 12 101 Temperature
	0 13 098 Integrated water vapour density

(d) GOMOS *(Global Ozone Monitoring by Occulation of Stars Gomos). This measures tangential atmospheric ultraviolet, visual and infrared light.*

*The BUFR template is the same as for **MIPAS** data.*

(e) MERIS *(Medium-resolution Imaging Spectrometer). The instrument produces multi-spectral images obtained in a downward viewing push broom imaging manner. The 15 bands acquire radiance in the visible and near infrared bands.*

BUFR table B reserved entries:

0 10 080	Viewing zenith angle	Degree	2	-9000	15
0 27 080	Viewing azimuth angle	Degree True	2	0	16
0 13 093	Cloud optical thickness	Numeric	0	0	8
0 13 095	Total column water vapour	Kg m^{-2}	4	0	19

BUFR table D reserved entries:

3 12 050 0 01 007 Satellite identifier
0 02 019 Instrument type
0 01 096 Station acquisition
0 25 061 Software identification
0 05 040 Orbit number
3 01 011 Date
3 01 013 Time
3 01 021 Lat/long
0 07 025 Solar zenith angle
0 05 022 Solar azimuth
0 10 080 Viewing zenith angle
0 27 080 Viewing azimuth angle
0 08 003 Vertical significance
0 07 004 Pressure
0 13 093 Cloud optical thickness
0 08 003 Vertical significance
2 01 131 Change data width
2 02 129 Change scale
0 07 004 Pressure
0 07 004 Pressure
2 02 000 Cancel operator
2 01 000 Cancel operator
0 13 095 Total column water vapour

(f) ASAR *(Advanced Synthetic Aperture Radar). This is a high resolution imaging radar.*

Ocean cross spectra - (WVS)

3 12 051 0 01 007 Satellite identifier
0 02 019 Satellite instrument type
0 01 096 Station acquisition
0 25 061 Software identification
0 05 040 Orbit number
0 08 075 Ascending/descending orbit qualifier
3 01 011 Date
3 01 013 Time
3 01 021 Lat/long
0 01 012 Direction of motion of moving observing platform
2 01 131 Change data width
0 01 013 Speed of motion of moving observing platform
2 01 000 Cancel operator
0 10 032 Satellite distance to Earth centre
0 10 033 Altitude (platform to ellipsoid)
0 10 034 Earth radius
0 07 002 Height
0 08 012 Land/sea qualifier
0 25 110 Image processing summary
0 25 111 Number of input data gaps
0 25 102 Number of missing lines excluding data gaps
0 02 104 Antenna polarization
0 25 103 Number of directional bins
0 25 104 Number of wave-length bins

0 25 105 First directional bin
0 25 106 Directional bin step
0 25 107 First wave-length bin
0 25 108 Last wave-length bin
0 02 111 Radar incidence angle
0 02 121 Mean frequency
0 02 026 Cross track resolution
0 02 027 Along track resolution
0 21 130 Spectrum total energy
0 21 131 Spectrum maximum energy
0 21 132 Direction of spectrum max on higher resolution grid
0 21 133 Wavelength of spectrum max on higher resolution grid
0 21 064 Clutter noise estimate
0 25 014 Azimuth clutter cut-off
0 21 134 Range resolution of cross covariance spectrum
1 07 018 Replicate next 7 descriptors 18 times
0 05 030 Direction (spectral)
1 05 024 Replicate 5 descriptors 24 time
2 01 130 Change data width
0 06 030 Wave number (spectral)
2 01 000 Cancel operator
0 21 135 Real part of cross spectra
0 21 136 Imaginary part of cross spectra
0 33 044 ASAR quality

New Table B descriptors

0 10 032 Satellite distance to Earth centre	m	1	0	27
0 10 033 Altitude (platform to ellipsoid)	m	1	0	27
0 10 034 Earth radius	m	1	0	27
0 25 110 Image processing summary	Flag table	0	0	10
0 25 111 Number of input data gaps	Numeric	0	0	8
0 25 102 Number of missing lines excluding data gaps	Numeric	0	0	8
0 25 103 Number of directional bins	Numeric	0	0	8
0 25 104 Number of wave-lenght bins	Numeric	0	0	8
0 25 105 First directional bin	Degrees	3	0	19
0 25 106 Directional bin step	Degrees	3	0	19
0 25 107 First wave-lenght bin	m	3	0	29
0 25 108 Last wave-lenght bin	m	3	0	29
0 21 130 Spectrum total energy	Nnumeric	6	0	28
0 21 131 Spectrum maximum energy	Numeric	6	0	28
0 21 132 Direction of spectrum maximum on higher resolution grid	Degrees	3	0	19
0 21 133 Wave-lenght of spectrum maximum on higher resolution grid	m	3	0	29
0 21 134 Range resolution of cross covariance spectrum	Rad/m	3	0	19
0 21 135 Real part of cross spectra polar grid number of bins	Numeric	3	-524288	20
0 21 136 Imaginary part of cross spectra polar grid number of bins	Numeric	3	-524288	20
0 33 044 Asar quality information	Flag table	0	0	15

Flag table 0 25 110 Image processing summary

Bit number	Meaning
1	Raw data analysis used for raw data correction. Correction done using default parameters

2	Raw data analysis used for raw data correction Correction done using raw data analysis results
3	Antenna elevation pattern correction applied
4	Nominal chirp replica used
5	Reconstructed chirp used
6	Slant range to ground range conversion applied
7-9	Reserved
All 10	Missing value

Flag table 0 33 044 ASAR quality information

Bit number	Meaning
1	Input data mean outside nominal range flag
2	Input data standard deviation outside nominal range flag
3	Number of input data gaps is greater than threshold value
4	Percentage of missing lines is greater than threshold value
5	Doppler centroid uncertain. Confidence measure is less than specific value
6	Doppler ambiguity estimate uncertain. Confidence measure is less than specific value
7	Output data mean outside nominal range flag
8	Output data standard deviation outside nominal range flag
9	Chirp reconstruction failed or is of low quality flag
10	Data set missing
11	Invalid downlink parameters
12	Azimuth cut-off iteration count. The azimuth cut-off fit did not converge within minimum number of iterations
13	Azimuth cut-off fit did not converge within a minimum number of iterations
14	Phase information confidence measure. The imaginary spectral peak is less than a minimum threshold, or the zero lag shift is greater than a minimum threshold
All 15	Missing value

Ocean wave spectra

Table D sequence

3 12 053	0 01 007 Satellite identifier
	0 02 019 Satellite instrument type
	0 01 096 Station acquisition
	0 25 061 Software identification and version number
	0 05 040 Orbit number
	0 08 075 Ascending/descending orbit qualifier
	3 01 011 Date
	3 01 013 Time
	3 01 021 Lat/long
	0 01 012 Direction of motion of moving observing platform
	2 01 131 Change data width
	0 01 013 Speed of motion of moving observing platform
	2 01 000 Cancel operator
	0 10 032 Satellite distance to Earth centre
	0 10 033 Altitude (platform to ellipsoid)
	0 10 034 Earth radius
	0 07 002 Height or altitude
	0 08 012 Land/sea qualifier
	0 25 110 Image processing summary
	0 25 111 Number of input data gaps
	0 25 102 Number of missing lines excluding data gaps
	0 02 104 Antenna polarisation
	0 25 103 Number of directional bins
	0 25 104 Number of wave-length bins
	0 25 105 First directional bin
	0 25 106 Directional bin step
	0 25 107 First wave-length bin

0 25 108 Last wave-length bin
0 11 001 Wind direction
0 11 002 Wind speed
0 22 160 Normalized inverse wave age
0 25 138 Average signal to noise ratio
2 01 130 Change data width
2 02 129 Change scale
0 22 021 Height of waves
2 02 000 Cancel operator
2 01 000 Cancel operator
0 33 048 Confidence measure for SAR inversion
0 33 049 Confidence measure for wind retrieval
0 02 026 Cross track resolution
0 02 027 Along track resolution
0 21 130 Spectrum total energy
0 21 131 Spectrum max energy
0 21 132 Direction of spectrum max
0 21 133 Wave-length of spectrum max
0 25 014 Azimuth clutter cut-off
1 06 036 Replicate 6 descriptors 36 times
0 05 030 Direction (spectral)
1 04 024 Replicate 4 descriptors 24 time
2 01 130 Change data width
0 06 030 Wave number (spectral)
2 01 000 Cancel operator
0 22 161 Wave spectra
0 33 044 ASAR quality

Table B descriptors

0 22 160 Normalized inverse wave age	Numeric	6	0	21
0 25 138 Average signal to noise ratio	Numeric	0	-2048	12
0 33 048 Confidence measure of sar inversion	Code table	0	0	2
0 33 049 Confidence measure of wind retrieval	Code table	0	0	2
0 221 61 Wave spectra	m^{-4}	4	0	27

Code table 0 33 048 Confidence measure of SAR inversion

Code figure	Meaning
0	Inversion successful
1	Inversion not successful
2	Reserved
3	Missing

Code table 0 33 049 Confidence measure of wind retrieval

Code figure	Meaning
0	External wind direction used during inversion
1	External wind direction not used during inversion
2	Reserved
3	Missing

(g) RA2 (Radar altimeter-2)

3 12 052 0 01 007 Satellite identifier
0 02 019 Satellite instrument type
0 01 096 Station acquisition

0 25 061 Software identification
0 05 040 Orbit number
0 25 120 Ra2 L2 processing flag
0 25 121 Ra2 L2 processing quality
0 25 124 MWR L2 processing flag
0 25 125 MWR L2 processing quality
0 25 122 Hardware configuration for RF
0 25 123 Hardware configuration for HPA
3 01 011 Date
3 01 013 Time
3 01 021 Lat/long
0 07 002 Height or altitude
0 02 119 Instrument operations
0 33 047 Measurement confidence data
0 10 081 Altitude of COG above reference ellipsoid
0 10 082 Instantaneous altitude rate
0 10 083 Off nadir angle of the satellite from platform data
0 10 084 Off nadir angle of the satellite from waveform data
0 02 116 Percentage of 320 MHz band processed
0 02 117 Percentage of 80 MHz band processed
0 02 118 Percentage of 20 MHz band processed
0 02 156 Percentage of valid Ku ocean retracker measurements
0 02 157 Percentage of valid S ocean retracker measurements
0 14 055 Solar activity index
0 22 150 Number of 18 Hz valid points for Ku band
0 22 151 Ku band ocean range
0 22 152 STD of 18Hz Ku band ocean range
0 22 153 Number of 18 Hz valid points for S band
0 22 154 S band ocean range
0 22 155 STD of 18 Hz S band ocean range
0 22 156 Ku band significant wave height
0 22 157 STD of 18 Hz Ku band significant wave height
0 22 158 S band significant wave height
0 22 159 STD 18 Hz S band significant wave height
0 21 137 Ku band corrected ocean backscatter coefficient
0 21 138 STD Ku band corrected ocean backscatter coefficient
0 21 139 Ku band net instrumental correction for AGC
0 21 140 S band corrected ocean backscatter coefficient
0 21 141 STD S band corrected ocean backscatter coefficient
0 21 142 S band net instrumental correction for AGC
0 10 085 Mean sea-surface height
0 10 086 Geoid height
0 10 087 Ocean depth/land elevation
0 10 088 Total geocentric ocean tide height solution 1
0 10 089 Total geocentric ocean tide height solution 2
0 10 090 Long period tide height
0 10 091 Tidal loading height
0 10 092 Solid earth tide height
0 10 093 Geocentric pole tide height
0 11 002 Wind speed
0 25 126 Model dry tropospheric correction
0 25 127 Inverted barometer correction
0 25 128 Model wet tropospheric correction
0 25 129 MWR derived wet tropospheric correction
0 25 130 Ra2 ionospheric correction on Ku band
0 25 131 Ionospheric correction from Doris on Ku band
0 25 132 Ionospheric correction from model on Ku band
0 25 133 Sea state bias correction on Ku band
0 25 134 Ra2 ionospheric correction on S band
0 25 135 Ionospheric correction from Doris on S band
0 25 136 Ionospheric correction from model on S band
0 25 137 Sea state bias correction on S band

0 13 096 MWR water vapour content
0 13 097 MWR liquid water content
0 11 095 u component of model wind vector
0 11 096 v component of model wind vector
0 12 188 Interpolated 23.8 GHz brightness temp from MWR
0 12 189 Interpolated 36.5 GHz brightness temp from MWR
0 02 158 RA- 2 instrument
0 02 159 MWR instrument
0 33 052 S band ocean retracking quality
0 33 053 Ku band ocean retracking quality
0 21 143 Ku band rain attenuation
0 21 144 Altimeter rain flag

Table B descriptors

0 02 119 Ra - 2 Instrument operations	Code table	0	0	3
0 02 116 Percentage of 320 Mhz band processed	%	0	0	7
0 02 117 Percentage of 80 Mhz band processed	%	0	0	7
0 02 118 Percentage of 20 Mhz band processed	%	0	0	7
0 02 156 Percentage of valid Ku ocean retracker measurements	%	0	0	7
0 02 157 Percentage of valid S ocean retracker measurements	%	0	0	7
0 02 158 Ra - 2 Instrument	Flag table	0	0	9
0 02 159 MWR Instrument	Flag table	0	0	8
0 10 081 Altitude of cog above reference ellipsoid	m	3	0	31
0 10 082 Instantaneous altitude rate	m s^{-1}	3	-65536	17
0 10 083 Off nadir angle of the satellite from platform data	Degree	2	-36000	17
0 10 084 Off nadir angle of the satellite from waveform data	Degree	2	-36000	17
0 10 085 Mean sea surface height	m	3	-131072	18
0 10 086 Geoid height	m	3	-131072	18
0 10 087 Ocean depth/land elevation	m	1	-131072	18
0 10 088 Total geocentric ocean tide height solution 1	m	3	-32768	16
0 10 089 Total geocentric ocean tide height solution 2	m	3	-32768	16
0 10 090 Long period tide height	m	3	-32768	16
0 10 091 Tidal loading height	m	3	-32768	16
0 10 092 Solid earth tide height	m	3	-32768	16
0 10 093 Geocentric pole tide height	m	3	-32768	16
0 11 095 U component of the model wind vector	m s^{-1}	1	-4096	13
0 11 096 V component of the model wind vector	m s^{-1}	1	-4096	13
0 12 188 Interpolated 23.8 Ghz brightness T from MWR	K	2	0	16
0 12 189 Interpolated 36.5 Ghz brightness T from MWR	K	2	0	16
0 13 096 MWR water vapour content	Kg m^{-2}	2	0	14
0 13 097 MWR liquid water content	Kg m^{-2}	2	0	14
0 14 055 Solar activity index	Numeric	0	-32768	16
0 21 137 Ku band corrected ocean backscatter coefficient	Db	2	-32768	16
0 21 138 Std Ku band corrected ocean backscatter coefficient	Db	2	-32768	16
0 21 139 Ku band net instrumental correction for acg	Db	2	-2048	12

0 21 140 S band corrected ocean backscatter coefficient	Db	2	-32768	16
0 21 141 Std S band corrected ocean backscatter coefficient	Db	2	-32768	16
0 21 142 S band net instrumental correction for acg	Db	2	-1024	11
0 21 143 Ku band rain attenuation	Db	2	-1073741824	31
0 21 144 Altimeter rain flag	Flag table	0	0	2
0 22 150 Number of 18 Hz valid points for Ku band	Numeric	0	0	10
0 22 151 Ku band ocean range	m	3	0	31
0 22 152 Std of 18 Hz Ku band ocean range	m	3	0	16
0 22 153 Number of 18 Hz valid points for S band	Numeric	0	0	10
0 22 154 S band ocean range	m	3	0	31
0 22 155 Std of 18 Hz S band ocean range	m	3	0	16
0 22 156 Ku band significant wave height	m	3	0	16
0 22 157 Std 18 hz Ku band significant wave height	m	3	0	16
0 22 158 S band significant wave height	m	3	0	16
0 22 159 Std 18 Hz S band significant wave height	m	3	0	16
0 25 120 RA2 L2 processing flag	Code table	0	0	2
0 25 121 RA2 L2 processing quality	%	0	0	7
0 25 122 Hardware configuration for Rf	Code table	0	0	2
0 25 123 Hardware configuration for Hpa	Code table	0	0	2
0 25 124 MWR L2 processing flag	Code table	0	0	2
0 25 125 MWR L2 processing quality	%	0	0	7
0 25 126 Model dry tropospheric correction	m	3	-32768	16
0 25 127 Inverted barometer correction	m	3	-32768	16
0 25 128 Model wet tropospheric correction	m	3	-32768	16
0 25 129 MWR derived wet tropospheric correction	m	3	-32768	16
0 25 130 RA2 ionospheric correction on Ku band	m	3	-32768	16
0 25 131 Ionospheric correction from doris on Ku band	m	3	-32768	16
0 25 132 Ionospheric correction from model on Ku band	m	3	-32768	16
0 25 133 Sea state bias correction on Ku band	m	3	-32768	16
0 25 134 Ra2 ionospheric correction on S band	m	3	-32768	16
0 25 135 Ionospheric correction from doris on S band	m	3	-32768	16
0 25 136 Ionospheric correction from model on S band	m	3	-32768	16
0 25 137 Sea state bias correction on S band	m	3	-32768	16
0 33 052 S Band ocean retracking quality	Flag table	0	0	21
0 33 053 Ku Band ocean retracking quality	Flag table	0	0	21
0 33 047 Measurement confidence data	Flag table	0	0	31

Code table 0 02 180 Instrument operations

Code figure	Meaning
0	Intermediate Frequency calibration mode (if Cal)
1	Built-in test equipment digital (bite Dgt)
2	Built-in test equipment radio frequency (bite Rf)
3	Preset tracking (Pset Trk)

4	Preset loop out
5	Acquisition
6	Tracking
7	Missing value

Flag table 0 02 158 RA-2 Instrument

Bit number	Meaning
1	Mismatch in red vec hpa
2	Mismatch in red vec rfss
3	Ptr calibration band 320 Mhz (Ku)
4	Ptr calibration band 80 Mhz (Ku)
5	Ptr calibration band 20 Mhz (Ku)
6	Ptr calibration band 160 Mhz (S)
7	Ku flight calibration parameters available
8	S Flight calibration parameters available
All	Missing value

Note: PTR - Pulse target response
HPA - High power amplifier
RFSS – Radio-frequency subsystem
RED - Redundancy

Flag table 0 02 159 MWR instrument

Bit number	Meaning
1	Temperature inconsistency
2	Data is missing
3	Redundancy channel
4	Power bus protection
5	Overvoltage/Overload protection
6	Reserved
7	Reserved
All	Missing

Note: MWR - Microwave radiometer

Flag table 0 21 144 Altimeter rain flag

Bit number	Meaning
1	Rain
all	Missing value

Code table 025120 RA2 L2 processing flag

Code figure	Meaning
0	Percentage of DSRs free of processing errors during Level 2 processing is greater than the acceptable threshold
1	Percentage of DSRs free of processing errors during Level 2 processing is less than the acceptable threshold
2	Reserved
3	Missing value

Note: DSR - Data set record

Code table 0 25 122 Hardware configuration for RF

Code figure	Meaning
0	Hardware configuration for RF is A
1	Hardware configuration for RF is B
2	Reserved
3	Missing

Note: RF - Radio frequency

Code table 0 25 123 Hardware configuration for HPA

Code figure	Meaning
0	Hardware configuration for HPA is A
1	Hardware configuration for HPA is B
2	Reserved
3	Missing

Code table 0 25 124 MWR l2 processing flag

Code figure	Meaning
0	Percentage of DSRs free of processing errors during Level 2 processing is greater than the acceptable threshold
1	Percentage of DSRs free of processing errors during Level 2 processing is less than the acceptable threshold
2	Reserved
3	Missing

Note: DSR - Data set record
MWR - Microwave radiometer

Flag table 0 33 053 Ku band ocean retracking quality

Bit number	Meaning
1-20	First 20 least significant bits correspond to the 20 values (one per data block containing 0=valid measurement, 1=invalid) Bit 1 applies to the 20th data block
All	Missing

Flag table 0 33 052 S band ocean retracking quality

Bit number	Meaning
1-20	First 20 least significant bits correspond to the 20 values (one per data block containing 0=valid measurement, 1=invalid) Bit 1 applies to the 20th data block
All	Missing

Flag table 0 33 047 Measurement confidence data

Bit number	Meaning
1	Error detected and attempts to recover made
2	Anomaly in on-board data handling (OBDH) value detected
3	Anomaly in ultra stable oscillator processing (USOP) value detected
4	Errors detected by on-board computer
5	Automatic gain control (AGC) out of range

6	Rx delay fault. Rx distance out of range
7	Wave form samples fault identifier error
8	Reserved
9	Reserved
10	Reserved
11	Reserved
12	Brightness temperature (channel 1) out of range
13	Brightness temperature (channel 2) out of range
14	Reserved
15	Ku ocean retracking error
16	S ocean retracking error
17	Ku ice 1 retracking error
18	S ice 1 retracking error
19	Ku ice 2 retracking error
20	S ice 2 retracking error
21	Ku Sea Ice retracking error
22	Arithmetic fault error
23	Meteo data state. No map
24	Meteo data state. 1 map
25	Meteo data state 2 maps degraded
26	Meteo data state 2 maps nominal
27	Orbit propagator status for propagation mode, several errors
28	Orbit propagator status for propagation mode, warning detected
29	Orbit propagator status for initialization mode, several errors
	Orbit propagator status for initialization mode, warning detected
All 31	Missing

ADD NEW DESCRIPTOR FOR:

Satellite zenith angle

0-07-026	Degrees	4	-900000	21
B-07-026	Degrees	4		7

ADDITIONS FOR MEASURING POLLUTANTS (REQUEST OF ENVIRONMENTAL PROTECTION AGENCY – USA)

TABLE REFERENCE			TABLE ELEMENT NAME	BUFR				CREX		
F	X	Y		UNIT	SCALE	REF. VALUE	DATA WIDTH (Bits)	UNIT	SCALE	DATA WIDTH (Characters)
0	15	025	Type of pollutant	Code table	0	0	4	Code table	0	2
0	15	026	Concentration of pollutant	mol mol^{-1}	9	0	9	mol mol^{-1}	9	3

Code table 0 15 025 - Type of pollutant

Code figure	Meaning
0	Ozone
1-14	Reserved
15	Missing value

Add entry in Code table 0 33 020 – Quality control indication of following value:

6 Estimated

ADDITIONS FOR OCEANOGRAPHIC DATA

Proposed new BUFR descriptors for buoy data:

Tab		BUFR				CREX		
Ref	Name	Unit	Scale	Ref	Width	Unit	Scale	Width
0 08 082	Artificial correction of sensor height to another value	Code	0	0	3	Code	0	1
0 22 060	Lagrangian drifter drogue status	Code	0	0	3	Code	0	1
0 08 081	Type of equipment	Code	0	0	6	Code	0	2
0 25 026	Battery voltage (large range)	V	1	0	12	V	1	4
0 250 28	Operator or manufacturer defined parameter	Numeric	1	-16384	15	Numeri c	1	5

Change name and note of descriptor 0 07 064:

F X Y	Element name	BUFR				CREX		
0 07 064	Representative height of sensor above station	m	0	0	4	m	0	2

NOTE (7):
Representative height of sensor above station is the standard height of a sensor required by WMO documentation. Value of the following meteorological element should be adjusted using a formula. For example, standard height recommended in WMO documentation for surface wind sensors is 10 metres. If the sensor is placed at different height, the wind speed may be adjusted using a formula.

Add Code tables:

0 08 081
Type of equipment

Code figure	Meaning
0	Sensor
1	Transmitter
2	Receiver
3	Observing platform
4-62	Reserved
63	Missing value

0 08 082

Modification of sensor height to another value

Code figure	Meaning
0	Sensor height is not modified
1	Sensor height is modified to standard level
2-6	Reserved
7	Missing value

NOTE: If 0 08 082 = 1, then standard level is indicated by the descriptor of class 7, which immediately follows. It is possible to indicate the real height of the sensor by preceding the descriptor by relevant class 7 descriptor.

0 22 060
Lagrangian drifter drogue status

Code figure	Meaning
0	Drogue is detached
1	Drogue is attached
2	Drogue status unknown
3-6	Reserved
7	Missing value

ADDITION FOR REPRESENTING WAVE SPECTRA

0 02 120	Ocean wave frequency	Hz	3	0	10 bits
0 22 069	Spectral wave density	M^2Hz^{-1}	3	0	22 bits

ADDITIONS OF COMMON SEQUENCES TO REPRESENT RADIOSONDES DATA

TABLE REFERENCE F X Y	TABLE REFERENCES	ELEMENT NAME
		(Radiosonde abbreviated header and launch information)
3 01 120	3 01 001	WMO block and station number
	0 01 094	WBAN number
	0 02 011	Radiosonde type
	3 01 121	Radiosonde launch point location
		(Radiosonde launch point location)
3 01 121	0 08 041	Data significance (3 = “balloon launch point”)
	3 01 122	Date/time (to hundredths of second)
	3 01 021	Latitude and longitude (high accuracy)
	0 07 031	Height of barometer above MSL
	0 07 007	Height (of radiosonde release above MSL)
		(Date/time (to hundredths of second))
3 01 122	3 01 011	Date
	3 01 012	Time
	2 01 135	Change data width
	2 02 130	Change scale
	0 04 006	Second
	2 02 000	Cancel change scale
	2 01 000	Cancel change data width
		(Radiosonde full header information)
3 01 123	1 02 002	Replicate 2 descriptors 2 times
	0 08 041	Data significance (0 = “parent site”, 1 = “observation site”)
	0 01 062	Short ICAO location identifier
	3 01 001	WMO block and station number
	0 01 094	WBAN number
	0 02 011	Radiosonde type
	0 01 018	Short station or site name
	0 01 095	Observer identification
	0 25 061	Software identification
	0 25 068	Number of archive recomputes
	0 01 082	Radiosonde ascension number
	0 01 083	Radiosonde release number

	0 01 081	Radiosonde serial number
	0 02 067	Radiosonde operating frequency
	0 02 066	Radiosonde ground receiving system
	0 02 014	Tracking technique/status of system used
	0 25 067	Release point pressure correction
	0 25 065	Orientation correction (azimuth)
	0 25 066	Orientation correction (elevation)
	0 02 095	Type of pressure sensor
	0 02 096	Type of temperature sensor
	0 02 097	Type of humidity sensor
	0 02 016	Radiosonde configuration
	0 02 083	Type of balloon shelter
	0 02 080	Balloon manufacturer
	0 02 081	Type of balloon
	0 01 093	Balloon lot number
	0 02 084	Type of gas used in balloon
	0 02 085	Amount of gas used in balloon
	0 02 086	Balloon flight train length
	0 02 082	Weight of balloon
	0 08 041	Data significance (2 = “balloon manufacture date”)
	3 01 011	Date
		(Radiosonde surface observation)
3 02 050	0 08 041	Data significance (5 = “sfc ob displacement from launch pt)
	0 05 021	Bearing or azimuth
	0 07 005	Height increment
	2 02 130	Change scale
	0 06 021	Distance
	2 02 000	Cancel change scale
	0 08 041	Data significance (4 = “surface observation”)
	2 01 131	Change data width
	2 02 129	Change scale
	0 02 115	Type of surface observing equipment
	0 10 004	Pressure
	0 02 115	Type of surface observing equipment
	0 13 003	Relative humidity
	2 02 000	Cancel change scale
	2 01 000	Cancel change data width
	0 02 115	Type of surface observing equipment
	0 11 001	Wind direction
	0 11 002	Wind speed
	0 02 115	Type of surface observing equipment
	1 02 002	Replicate 2 descriptors 2 times
	0 12 101	Temperature/dry bulb temperature
	0 04 024	Time displacement (hour)
	0 02 115	Type of surface observing equipment
	0 12 103	Dew-point temperature
	0 12 102	Wet bulb temperature
	1 01 003	Replicate 1 descriptor 3 times
	0 20 012	Cloud type
	0 20 011	Cloud amount
	0 20 013	Height of base of cloud
	1 01 002	Replicate 1 descriptor 2 times
	0 20 003	Present weather

						(Radiosonde duration of flight and termination information)
3	03	040	0	08	041	Data significance (7 = "flight level termination point")
			0	04	025	Time displacement (minute)
			0	04	026	Time displacement (second)
			3	01	021	Latitude and longitude (high accuracy)
			3	01	122	Date/time (to hundredths of second)
			2	01	131	Change data width
			2	02	129	Change scale
			0	25	069	Flight level pressure correction
			0	07	004	Pressure
			0	13	003	Relative humidity
			2	02	000	Cancel change scale
			2	01	000	Cancel change data width
			0	02	013	Solar and infrared radiation correction
			0	12	101	Temperature/dry bulb temperature
			0	10	009	Geopotential height
			1	02	002	Replicate 2 descriptors 2 times
			0	08	040	Flight level significance
			0	35	035	Reason for termination
						(Radiosonde complete registration and surface observation)
3	09	060	3	01	123	Radiosonde full header information
			3	01	121	Radiosonde launch point location
			3	02	050	Radiosonde surface observation
			3	03	040	Radiosonde duration of flight and termination information
						(Raw PTU)
3	09	061	3	01	120	Radiosonde abbreviated header and launch information
			0	08	041	Data significance (6 = "flight level observation")
			3	01	122	Date/time (to hundredths of second)
			2	01	131	Change data width
			2	02	129	Change scale
			0	25	069	Flight level pressure correction
			0	07	004	Pressure
			2	02	000	Cancel change scale
			2	01	000	Cancel change data width
			0	33	007	Per cent confidence (for pressure)
			0	33	035	Manual/automatic quality control (for pressure)
			0	33	015	Data quality-check indicator (for pressure)
			0	13	009	Relative humidity
			0	33	007	Per cent confidence (for relative humidity)
			0	33	035	Manual/automatic quality control (for relative humidity)
			0	33	015	Data quality-check indicator (for relative humidity)
			0	02	013	Solar and infrared radiation correction
			0	12	101	Temperature/dry bulb temperature
			0	33	007	Per cent confidence (for temperature)
			0	33	035	Manual/automatic quality control (for temperature)
			0	33	015	Data quality-check indicator (for temperature)
						(Raw GPS unsmoothed wind)
3	09	062	3	01	120	Radiosonde abbreviated header and launch information
			0	08	041	Data significance (6 = "flight level observation")
			3	01	122	Date/time (to hundredths of second)

	0 05 001	Latitude (high accuracy)
	0 33 035	Manual/automatic quality control (for latitude)
	0 33 015	Data quality-check indicator (for latitude)
	0 06 001	Longitude (high accuracy)
	0 33 035	Manual/automatic quality control (for longitude)
	0 33 015	Data quality-check indicator (for longitude)
	0 07 007	Height
	0 33 035	Manual/automatic quality control (for height)
	0 33 015	Data quality-check indicator (for height)
	0 11 003	U-component
	0 33 035	Manual/automatic quality control (for u-component)
	0 33 015	Data quality-check indicator (for u-component)
	0 11 004	V-component
	0 33 035	Manual/automatic quality control (for v-component)
	0 33 015	Data quality-check indicator (for v-component)
	0 33 007	Per cent confidence (for raw GPS unsmoothed wind)

		(Raw GPS smoothed wind)
3 09 063	3 01 120	Radiosonde abbreviated header and launch information
	0 08 041	Data significance (6 = “flight level observation”)
	3 01 122	Date/time (to hundredths of second) sequence
	0 05 001	Latitude (high accuracy)
	0 33 035	Manual/automatic quality control (for latitude)
	0 33 015	Data quality-check indicator (for latitude)
	0 06 001	Longitude (high accuracy)
	0 33 035	Manual/automatic quality control (for longitude)
	0 33 015	Data quality-check indicator (for longitude)
	0 07 007	Height
	0 33 035	Manual/automatic quality control (for height)
	0 33 015	Data quality-check indicator (for height)
	0 11 003	U-component
	0 33 035	Manual/automatic quality control (for u-component)
	0 33 015	Data quality-check indicator (for u-component)
	0 11 004	V-component
	0 33 035	Manual/automatic quality control (for v-component)
	0 33 015	Data quality-check indicator (for v-component)
	0 33 007	Per cent confidence (for raw GPS smoothed wind)
		(Processed PTU)
3 09 064	3 01 120	Radiosonde abbreviated header and launch information
	0 08 041	Data significance (6 = “flight level observation”)
	3 01 122	Date/time (to hundredths of second)
	2 01 131	Change data width
	2 02 129	Change scale
	1 04 002	Replicate 4 descriptors 2 times
	0 25 069	Flight level pressure correction
	0 07 004	Pressure
	0 33 035	Manual/automatic quality control (for pressure)
	0 33 015	Data quality-check indicator (for pressure)
	0 13 003	Relative humidity
	0 33 035	Manual/automatic quality control (for relative humidity)
	0 33 015	Data quality-check indicator (for relative humidity)
	2 02 000	Cancel change scale
	2 01 000	Cancel change data width
	1 04 002	Replicate 4 descriptors 2 times

			0	02	013	Solar and infrared radiation correction
			0	12	101	Temperature/dry bulb temperature
			0	33	035	Manual/automatic quality control (for temperature)
			0	33	015	Data quality-check indicator (for temperature)
			0	12	103	Dew-point temperature
			0	33	035	Manual/automatic quality control (for dew-point temperature)
			0	33	015	Data quality-check indicator (for dew-point temperature)
			0	10	009	Geopotential height
			0	33	035	Manual/automatic quality control (for geopotential height)
			0	33	015	Data quality-check indicator (for geopotential height)
						(Processed GPS)
3	09	065	3	01	120	Radiosonde abbreviated header and launch information
			0	08	041	Data significance (6 = “flight level observation”)
			3	01	122	Date/time (to hundredths of second)
			0	05	001	Latitude (high accuracy)
			0	33	035	Manual/automatic quality control (for latitude)
			0	33	015	Data quality-check indicator (for latitude)
			0	06	001	Longitude (high accuracy)
			0	33	035	Manual/automatic quality control (for longitude)
			0	33	015	Data quality-check indicator (for longitude)
			0	07	007	Height
			0	33	035	Manual/automatic quality control (for height)
			0	33	015	Data quality-check indicator (for height)
			0	11	003	U-component
			0	33	035	Manual/automatic quality control (for u-component)
			0	33	015	Data quality-check indicator (for u-component)
			0	11	004	V-component
			0	33	035	Manual/automatic quality control (for v-component)
			0	33	015	Data quality-check indicator (for V-component)
						(Standard and significant levels)
3	09	066	3	01	120	Radiosonde abbreviated header and launch information
			0	08	041	Data significance (6 = “flight level observation”)
			3	01	122	Date/time (to hundredths of second)
			0	08	040	Flight level significance
			2	01	131	Change data width
			2	02	129	Change scale
			0	25	069	Flight level pressure correction
			0	07	004	Pressure
			0	13	003	Relative humidity
			2	02	000	Cancel change scale
			2	01	000	Cancel change data width
			0	02	013	Solar and infrared radiation correction
			0	12	101	Temperature/dry bulb temperature
			0	12	103	Dew-point temperature
			0	10	009	Geopotential height
			0	10	007	Height
			0	11	002	Wind speed
			0	11	001	Wind direction

Proposals for sequence descriptors for PILOT and TEMP observation type data

Following sequence descriptors are proposed:

						(Identification of launch site and instrumentation for wind measurements)
3	01	110	3	01	001	WMO block number, WMO station number
			0	01	011	Ship or mobile land station identifier
			0	02	011	Radiosonde type
			0	02	014	Tracking technique/status of system used
			0	02	003	Type of measuring equipment used

						(Identification of launch site and instrumentation for P, T, U and wind measurements)
3	01	111	3	01	001	WMO block number, WMO station number
			0	01	011	Ship or mobile land station identifier
			0	02	011	Radiosonde type
			0	02	013	Solar and infrared radiation correction
			0	02	014	Tracking technique/status of system used
			0	02	003	Type of measuring equipment used

						(Identification of launch point and instrumentation of dropsonde)
3	01	112	0	01	006	Aircraft identifier
			0	02	011	Radiosonde type
			0	02	013	Solar and infrared radiation correction
			0	02	014	Tracking technique/status of system used
			0	02	003	Type of measuring equipment used

						(Date/time of launch)
3	01	113	0	08	021	Time significance (= 18 (launch time))
			3	01	011	Year, month, day of launch
			3	01	013	Hour, minute, second of launch

NOTE: Time of launch shall be reported with the highest possible accuracy available. If the launch time is not available with second accuracy, then the entry for seconds shall be put to zero.

						(Horizontal and vertical coordinates of launch site)
3	01	114	3	01	021	Latitude (high accuracy)
						Longitude (high accuracy)
			0	07	030	Height of station ground above mean sea level
			0	07	031	Height of barometer above mean sea level
			0	07	007	Height of release of sonde above mean sea level
			0	33	024	Station elevation quality mark (for mobile stations)

						(Cloud information reported with vertical soundings)
3	02	049	0	08	002	Vertical significance
			0	20	011	Cloud amount (of low or middle clouds N_h)
			0	20	013	Height of base of cloud (h)
			0	20	012	Cloud type (low clouds C_L)
			0	20	012	Cloud type (middle clouds C_M)
			0	20	012	Cloud type (high clouds C_H)
			0	08	002	Vertical significance (= missing value)

						(Wind data at a pressure level with radiosonde position)
3	03	050	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	004	Pressure
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	11	001	Wind direction
			0	11	002	Wind speed

NOTES: (1) Long time displacement 0 04 086 represents the time offset from the launch time 3 01 013 (in seconds).

(2) Latitude displacement 0 05 015 represents the latitude offset from the latitude of the launch site. Longitude displacement 0 06 015 represents the longitude offset from the longitude of the launch site.

						(Wind shear data at a pressure level with radiosonde position)
3	03	051	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	004	Pressure
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	11	061	Absolute wind shear in 1 km layer below
			0	11	062	Absolute wind shear in 1 km layer above

NOTE: Notes (1) and (2) under definition of sequence 3 03 050 shall apply.

						(Wind data at a height level with radiosonde position)
3	03	052	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	009	Geopotential height
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	11	001	Wind direction
			0	11	002	Wind speed

NOTE: Notes (1) and (2) under definition of sequence 3 03 050 shall apply.

						(Wind shear data at a height level with radiosonde position)
3	03	053	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	009	Geopotential height
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	11	061	Absolute wind shear in 1 km layer below
			0	11	062	Absolute wind shear in 1 km layer above

NOTE: Notes (1) and (2) under definition of sequence 3 03 050 shall apply.

						(Temperature, dew-point and wind data at a pressure level with radiosonde position)
3	03	054	0	04	086	Long time period or displacement (since launch time)
			0	08	042	Extended vertical sounding significance
			0	07	004	Pressure
			0	10	009	Geopotential height
			0	05	015	Latitude displacement since launch site (high accuracy)
			0	06	015	Longitude displacement since launch site (high accuracy)
			0	12	101	Temperature/dry-bulb temperature (scale 2)

			0	12	103	Dew-point temperature (scale 2)
			0	11	001	Wind direction
			0	11	002	Wind speed

NOTE: Notes (1) and (2) under definition of sequence 3 03 050 shall apply.

Common sequences for representation of PILOT code and TEMP observation type data

						(Sequence for representation of PILOT, PILOT SHIP and PILOT MOBIL observation type data with pressure as the vertical coordinate)
3	09	050	3	01	110	Identification of launch site and instrumentation for wind measurements
			3	01	113	Date/time of launch
			3	01	114	Horizontal and vertical coordinates of launch site
			1	01	000	Delayed replication of 1 descriptor
			0	31	002	Extended delayed descriptor replication factor
			3	03	050	Wind data at a pressure level
			1	01	000	Delayed replication of 1 descriptor
			0	31	001	Delayed descriptor replication factor
			3	03	051	Wind shear data at a pressure level

						(Sequence for representation of PILOT,PILOT SHIP and PILOT MOBIL observation type data with height as the vertical coordinate)
3	09	051	3	01	110	Identification of launch site and instrumentation for wind measurements
			3	01	113	Date/time of launch
			3	01	114	Horizontal and vertical coordinates of launch site
			1	01	000	Delayed replication of 1 descriptor
			0	31	002	Extended delayed descriptor replication factor
			3	03	052	Wind data at a height level
			1	01	000	Delayed replication of 1 descriptor
			0	31	001	Delayed descriptor replication factor
			3	03	053	Wind shear data at a height level

						(Sequence for representation of TEMP, TEMP SHIP and TEMP MOBIL observation type data)
3	09	052	3	01	111	Identification of launch site and instrumentation for P, T, U and wind measurements
			3	01	113	Date/time of launch
			3	01	114	Horizontal and vertical coordinates of launch site
			3	02	049	Cloud information reported with vertical soundings
			0	22	043	Sea water temperature
			1	01	000	Delayed replication of 1 descriptor
			0	31	002	Extended delayed descriptor replication factor
			3	03	054	Temperature, dew-point and wind data at a pressure level
			1	01	000	Delayed replication of 1 descriptor
			0	31	001	Delayed descriptor replication factor
			3	03	051	Wind shear data at a pressure level
						(Sequence for representation of TEMP DROP observation type data)
3	09	053	3	01	112	Identification of launch point and instrumentation of dropsonde
			3	01	113	Date/time of launch
			3	01	114	Horizontal and vertical coordinates of launch site
			1	01	000	Delayed replication of 1 descriptor
			0	31	002	Extended delayed descriptor replication factor
			3	03	054	Temperature, dew-point and wind data at a pressure level

	1	01	000	Delayed replication of 1 descriptor
	0	31	001	Delayed descriptor replication factor
	3	03	051	Wind shear data at a pressure level

COMMON SEQUENCES FOR AIRCRAFT ASCENT/DESCENT PROFILE *(SUITABLE FOR AMDAR PROFILE DATA)*

Element	**FM 94 BUFR descriptor/ sequence descriptor (BUFR Table B/D)**	**Notes**	**CREX descriptor**
Single descriptor defining aircraft ascent/descent profile	3 11 008		D 11 008
Aircraft identification	0 01 008		B 01 008
Year, month, Day	3 01 011	Date/time and position of first level in profile	D 01 011
Hour, min, second	3 01 013		D 01 013
Latitude, Longitude	3 01 021		D 01 021
Phase of flight	0 08 004	Ascent or descent profile	B 08 004
Delayed replication of one descriptor	1 01 000		R 01 000
Delayed descriptor replication factor	0 31 001	Number of levels following	
3 11 006	*Aircraft ascent/descent profile data for one level (as below)*		***D 11 006***
Flight level	0 07 010		B 07 010
Wind direction	0 11 001		B 11 001
Wind speed	0 11 002		B 11 002
Roll angle quality	0 02 064		B 02 064
Temperature/dry-bulb temperature	0 12 101		B 12 101
Dew-point temperature	0 12 103		B 12 103
3 11 009	Single descriptor defining aircraft ascent/descent profile *with lat. long given for each level*		D 11 009
Aircraft identification	0 01 008		B 01 008
Year, month, Day	3 01 011	Date/time and position of first level in profile	D 01 011
Hour, min, second	3 01 013		D 01 013
Latitude, longitude	3 01 021		D 01 021
Phase of flight	0 08 004	Ascent or descent profile	B 08 004
Delayed replication of one descriptor	1 01 000		R 01 000
Delayed descriptor replication factor	0 31 001	Number of levels following	
3 11 007	*Aircraft ascent/descent profile data for one level with lat. long. indicated*		***D 11 007***
Flight level	0 07 010		B 07 010
Latitude, longitude	3 01 021		D 01 021
Wind direction	0 11 001		B 11 001
Wind speed	0 11 002		B 11 002
Roll angle quality	0 02 064		B 02 064
Temperature/dry-bulb temperature	0 12 101		B 12 101
Dew-point temperature	0 12 103		B 12 103

Satellite radio occultation data in BUFR

New Table B descriptors

F X Y	Element name	BUFR				CREX		
0 07 040	Impact parameter	m	1	62000000	22	m	1	8
0 10 035	Earth's local radius of curvature	m	1	62000000	22	m	1	8
0 10 036	Geoid undulation	m	2	-15000	15	m	2	6
0 15 036	Atmospheric refractivity	N-units	3	0	19	N-units	3	6
0 15 037	Bending angle	Radians	8	-100000	23	Radians	8	7
0 33 039	Quality flags for radio occultation data	Flag table	0	0	16	Flag table	0	6

Additional notes to Table B

Class 07:

(8) For an atmospheric limb sounder, the "impact parameter" is the distance between the ray asymptote and the centre of curvature of the Earth's surface at the tangent point.

Class 10:

(4) The "geoid undulation" is the difference between the reference ellipsoid (WGS-84) and the geoid height (EGM96) at the geographic location of the observation, both referenced to the centre of mass of the Earth.

Class 15:

(5) The refractivity, N, is related to the refractive index, n by the formula $N = 10^6 (n - 1)$. N is therefore dimensionless but values computed by the formula are by convention described as being in 'N-units'.

New Flag table

Descriptor	***Bit***	
0 33 039	1	Non-nominal quality
	2	Offline product
	3	Ascending occultation flag
	4	Excess phase processing non-nominal
	5	Bending angle processing non-nominal
	6	Refractivity processing non-nominal
	7	Meteorological processing non-nominal
	8-13	Reserved
	14	Background profile non-nominal
	15	Background (i.e. not retrieved) profile present
	All 16	Missing value

New Table D entry – common sequence

		(Satellite radio occultation data)
3 10 026	3 10 022	Satellite, instrument and product information
	0 25 060	Software identification
	0 08 021	Time significance ('17' = start of phenomenon)
	3 01 011	Year, month, day
	3 01 012	Hour, minute
	2 01 138	Change width to 16 bits
	2 02 131	Change scale to 3

0 04 006	Second
2 02 000	Change scale back to Table B
2 01 000	Change width back to Table B
0 33 039	Quality flags for radio occultation data
0 33 007	Per cent confidence (for whole message)
3 04 030	Location of platform
3 04 031	Speed of platform
0 02 020	Satellite classification
0 01 050	Platform transmitter ID number
2 02 127	Change scale to 1
3 04 030	Location of platform
2 02 000	Change scale back to Table B
3 04 031	Speed of platform
2 01 133	Change width to 18 bits
2 02 131	Change scale to 3
0 04 016	Time increment
2 02 000	Change scale back to Table B
2 01 000	Change width back to Table B
3 01 021	Latitude, longitude (high accuracy)
3 04 030	Location of point
0 10 035	Earth’s local radius of curvature
0 05 021	Bearing or azimuth
0 10 036	Geoid undulation
1 13 000	Delayed replication of 13 descriptors
0 31 002	Replication factor (16 bits)
3 01 021	Latitude, longitude (high accuracy)
0 05 021	Bearing or azimuth
1 08 000	Delayed replication of 8 descriptors
0 31 001	Replication factor
0 02 121	Mean frequency
0 07 040	Impact parameter
0 15 037	Bending angle
0 08 023	First-order statistics (‘13’ = r.m.s.)
2 01 125	Change width to 20 bits
0 15 037	Bending angle
2 01 000	Change width back to Table B
0 08 023	First-order statistics (‘63’ = missing)
0 33 007	Per cent confidence (all data for current replication)
1 08 000	Delayed replication of 8 descriptors
0 31 002	Replication factor (16 bits)
0 07 007	Height
0 15 036	Atmospheric refractivity
0 08 023	First-order statistics (‘13’ = r.m.s.)
2 01 123	Change width to 14 bits
0 15 036	Atmospheric refractivity
2 01 000	Change width back to Table B
0 08 023	First-order statistics (‘63’ = missing)
0 33 007	Per cent confidence (all data for current height)
1 16 000	Delayed replication of 16 descriptors
0 31 002	Replication factor (16 bits)
0 07 009	Geopotential height
0 10 004	Pressure
0 12 001	Temperature
0 13 001	Specific humidity
0 08 023	First-order statistics (‘13’ = r.m.s.)
2 01 120	Change width to 6 bits
0 10 004	Pressure
2 01 000	Change width back to Table B
2 01 122	Change width to 6 bits
0 12 001	Temperature
2 01 000	Change width back to Table B

2 01 123	Change width to 9 bits
0 13 001	Specific humidity
2 01 000	Change width back to Table B
0 08 023	First-order statistics (‘63’ = missing)
0 33 007	Per cent confidence (all data for current height)
0 08 003	Vertical significance (‘0’ = surface)
0 07 009	Geopotential height
0 10 004	Pressure
0 08 023	First-order statistics (‘13’ = r.m.s.)
2 01 120	Change width to 6 bits
0 10 004	Pressure
2 01 000	Change width back to Table B
0 08 023	First-order statistics (‘63’ = missing)
0 33 007	Per cent confidence (for surface data)

ANNEX 3 TO RECOMMENDATION 4 (CBS-XIII)

ADDITIONS TO FM 94-XII EXT. BUFR AND FM 95-XII EXT. CREX FOR A NEW EDITION

ADDITIONS TO BUFR FOR REPRESENTATION OF PROBABILITIES AND OTHER FORECAST DATA

New descriptors and operators:

0 33 045	Probability of following event	%	0	0	7
B 33 045		%	0		3
0 33 046	Conditional probability of following event with respect to specified conditioning event	%	0	0	7
B 33 046		%	0		3
2 41 000	Define event				
C 41 000					
2 41 255	Cancel define event				
C 41 999					
2 42 000	Define conditioning event				
C 42 000					
2 42 255	Cancel define conditioning event				
C 42 999					
0 33 042	Type of limit represented by following value	Code table	0	0	3
B 33 042	Code table		0		1

New Code table:

0 33 042 - Type of limit represented by following value

Code Figure	Meaning
0	Exclusive lower limit (>)
1	Inclusive lower limit (>=)
2	Exclusive upper limit (<)
3	Inclusive upper limit (=<)
4-6	Reserved
7	Missing value

Add the following notes under BUFR/CREX Class 33:

(1) When using descriptor 0 33 045 or 0 33 046, operator 2 41 000 shall be used in order to define the following event to which the reported probability value applies.

(2) When using descriptor 0 33 046, operator 2 42 000 shall precede the occurrence of this descriptor in order to define the event upon which the reported probability value is conditioned.

(3) When defining an event for use with descriptor 0 33 045 or 0 33 046, descriptor 0 33 042 may be employed in order to indicate that the following value is actually a bound for a range of values.

Add the following new operators for categorical forecasts:

2 43 000 Categorical forecast values follow
C 43 000

2 43 255 Cancel categorical forecast values follow
C 43 999

Add a new note under BUFR Table C and under CREX Table C:

A categorical forecast value represents a “best guess” from among a set of related, and often mutually-exclusive, data values or categories. Operator 2 43 000 may be used to designate one or more values as being categorical forecast values, and descriptor 0 33 042 may be employed preceding any such value in order to indicate that that value is actually a bound for a range of values.

NEW OPERATOR WITHIN BUFR TABLE C TO SIMPLIFY THE PROCEDURE OF INCREASING DESCRIPTOR PRECISION

New BUFR Table C operator descriptor:

Table reference:
2-07-Y

Operator name:
Increase scale, reference value and data width

Operator definition:
For Table B elements, which are not CCITT IA5 (character data), code tables, or flag tables:

1. Add Y to the existing scale factor
2. Multiply the existing reference value by 10^Y.
3. Calculate $((10 \times Y) + 2) \div 3$, disregard any fractional remainder and add the result to the existing bit width.

Reword of notes to BUFR Table C as follows:

(1) The operations specified by operator descriptors 2 01, 2 02, 2 03, 2 04, and 2 07 remain defined until cancelled or until the end of the subset.

(4) Nesting of operator descriptors must guarantee unambiguous interpretation. In particular, operators defined within a set of replicated descriptors must be cancelled or completed within that set, and the 2 07 operator may not be nested within any of the 2 01, 2 02, and 2 03 operators, nor vice-versa.

NEW OPERATOR WITHIN BUFR TABLE C CHANGING DATA WIDTH FOR CCITTIA5 ELEMENTS

New BUFR Table C operator descriptor:

Table reference:
2-08-*Y*

Operator name:
Change width of CCITT IA5 field.

Operation definition:
Y characters from CCITT International Alphabet #5 (representing *Y* * 8 bits in length) replace the specified data width given for each CCITT IA5 element in Table B.

Note that the maximum value for *Y* is 255 and the rewording of Note (1) to BUFR Table C as follows:

(1) The operations specified by operator descriptors 2 01, 2 02, 2 03, 2 04, 2 07, and 2 08 remain defined until cancelled or until the end of the subset.

MODIFY REGULATION 94.1.3 TO READ:

94.1.3 Each section included in the code form shall always contain an integer multiple of 8 bits (octet). This rule shall be applied by appending bits set to zero to the section where necessary.

Change entry 255 in BUFR Table A data category and CREX Table A data category:

255 Other category

NEW COMMON CODE TABLE C-13: Data sub-categories of categories defined by entries in BUFR Table A

Data categories		International data sub-categories	
BUFR octet 11 CREX nnn in group Annnmmm		BUFR octet 12 (if = 255, it means other sub-category or undefined) CREX mmm in group Annnmmm	
Code figure	Name	Code figure	Name (corresponding traditional alphanumeric codes are in backets)
000	Surface data — land	000	Hourly synoptic observations from fixed-land stations (SYNOP)
		001	Intermediate synoptic observations from fixed-land stations (SYNOP)
		002	Main synoptic observations from fixed-land stations (SYNOP)
		003	Hourly synoptic observations from mobile-land stations (SYNOP MOBIL)
		004	Intermediate synoptic observations from mobile-land stations (SYNOP MOBIL)
		005	Main synoptic observations from mobile land stations (SYNOP MOBIL)
		006	One-hour observations from automated stations
		007	n-minute observations from AWS stations
		010	Routine aeronautical observations (METAR)
		011	Special aeronautical observations (SPECI)
		020	Climatological observations (CLIMAT)
		030	Spherics locations (SFLOC)
		040	Hydrologic reports
001	Surface data — sea	000	Synoptic observations (SHIP)
		006	One-hour observations from automated stations
		007	n-minute observations from AWS stations
		020	Climatological observations (CLIMAT SHIP)
		025	Buoy observation (BUOY)
		030	Tide gauge
		031	Observed water level time series
002	Vertical soundings (other than satellite)	001	Upper-wind reports from fixed-land stations (PILOT)

		002	Upper-wind reports from ships (PILOT SHIP)
		003	Upper-wind reports from mobile-land stations (PILOT MOBIL)
		004	Upper-level temperature/humidity/wind reports from fixed-land stations (TEMP)
		005	Upper-level temperature/humidity/wind reports from ships (TEMP SHIP)
		006	Upper-level temperature/humidity/wind report from mobile-land stations (TEMPMOBIL)
		007	Upper-level temperature/humidity/wind reports from dropwinsondes (TEMP DROP)
		010	Wind profiler reports
		011	RASS temperature profiles
		020	ASDAR/ACARS profiles (AMDAR)
		025	Climatological observations from fixed-land stations (CLIMAT TEMP)
		026	Climatological observations from ships (CLIMAT TEMP SHIP)
003	Vertical soundings (satellite)	000	Temperature (SATEM)
		001	TIROS (TOVS)
004	Single level upper-air data (other than satellite)	000	ASDAR/ACARS (AMDAR)
		001	Manual (AIREP, PIREP)
005	Single level upper-air data (satellite)	000	Cloud wind data (SATOB)
006	Radar data	000	Reflectivity data
		001	Doppler wind profiles
		002	Derived products
		003	Ground radar weather (RADOB)
007	Synoptic features	000	Forecast Tropical cyclone tracks from EPS
008	Physical/chemical constituents	000	Ozone measurement at surface
		001	Ozone vertical sounding
009	Dispersal and transport	000	Trajectories, analysis or forecast
010	Radiological data	001	Observation (RADREP)
		002	Forecast (RADOF)
012	Surface data (satellite)	000	ERS-uwa
		001	ERS-uwi
		002	ERS-ura
		003	ERS-uat
		004	SSM/I radiometer
		005	Quickscat
		006	Surface temp./radiation (SATOB)
031	Oceanographic data	000	Surface observation
		001	Surface observation along track (TRACKOB)
		002	Spectral wave observation (WAVEOB)
		003	Bathythermal observation (BATHY)
		004	Sub surface floats (profile)
		005	XBT/XCTD profiles (TESAC)
		006	Waves reports

Proposed modified Section 1 for BUFR edition 4:

1-3 Length of section
4 BUFR master table

5-6 Identification of originating/generating centre (see Common Code Table C-11)
7-8 Identification of originating/generating sub-centre (allocated by originating/generating Centre-see Common Code Table C-12)
9 Update sequence number (zero for original BUFR messages; incremented for updates)
10 Bit 1 =0 No optional section
=1 Optional section follows
Bit 2-8 Set to zero (reserved)
11 Data category (Table A)
12 International data sub-category (See Common Table C-13 – see Note (3))
13 Local data sub-category (defined locally by automatic data processing (ADP) centres –see Note (3))
14 Version number of master table (currently 12 for WMO FM 94 BUFR tables – see Note (2))
15 Version number of local tables used to augment master table in use – see Note (2)

16-17 Year (4 digits) |
18 Month |
19 Day | Most typical time for the BUFR message content – see Note (4)
20 Hour |
21 Minute |
22 Second |

23- Reserved for local use by ADP centres

Replace note (3) and add new Notes:

(3) The local data sub-category is maintained for backwards-compatibility with editions 0-3 of BUFR, since many ADP centres have made extensive use of such values in the past. The international data sub-category introduced with edition 4 of BUFR is intended to provide a mechanism for better understanding of the overall nature and intent of messages exchanged between ADP centers. These two values (i.e. local sub-category vs. international sub-category) are intended to be supplementary to one another, so both may be used within a particular BUFR message.

(4) When accuracy of the time does not define a time unit, then the value for this unit is set to zero (e.g SYNOP observation at 09 UTC, then minute=0, second=0).

New edition for CREX Section 1 - Data description section:

ADDITIONS TO CREX

Group No.	Contents	Meanings	
1	Ttteevvbbww	T :	Indicator for CREX Tables
		tt :	CREX Master table used (00 for WMO standard FM 95 CREX tables)
		ee :	CREX edition number (currently 02)
		vv :	CREX table version number (currently 03)
		bb:	BUFR master table version number used (currently 12)
		ww :	Version number of local table
2	Annnmmm	A :	Indicator for CREX Table A entry
		nnn :	Data category from CREX Table A
		mmm :	International data sub-category from Common table C-13
3	Poooooppp	ooooo	Originating Centre from Common table C-11
		ppp	Originating sub-centre from Common table C-12
4	Uuu	uu	Update sequence number (00 for original message, uu for updated version)
5	Ssss	sss	Number of subsets included in the report
6	Yyyyymmdd	yyyy:	Year ¦
		mm:	Month ¦
		dd:	Day ¦ Most typical time for the CREX message content (see Note (3))
7	Hhhnn	hh:	Hour ¦
		nn:	Minute ¦

8 to n	Bxxyyy,	B, C, D:	Indicators for CREX Tables B,C,D entries
	Cxxyyy,	xxyyy:	5 digits each which indicates references from CREX Tables B, C and/or D
	Dxxyyy,		
	and/or Rxxyyy:	R:	Indicator for replication
		xx:	number of replicated descriptors
		yyy:	number of replications (delayed replication if yyy= 0)

And add a new Note:

(3) When accuracy of the time does not define a time unit, then the value for this unit is set to zero (e.g SYNOP observation at 09 UTC, then minute=0, second=0).

RECOMMENDATION 5 (CBS-XIII)

AMENDMENTS TO THE *MANUAL ON CODES* (WMO-No. 306), VOLUME I.1

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The report of the Meeting of the Expert Team on Data Representation and Codes (Kuala Lumpur, 21-26 June 2004),

(2) The report of the Meeting of the Implementation Coordination Team on ISS (Geneva, 27 September- 1 October 200),

CONSIDERING the requirement for amendments to aeronautical codes resulting from corresponding changes in ICAO Amendment 73 of Annex 3/WMO Technical Regulations [C.3.1] — *Meteorological Service for International Air Navigation*,

RECOMMENDS that the amendments to FM 15-XII Ext. METAR, FM 16-XII Ext. SPECI, FM 51-XII Ext. TAF and FM 50-VIII Ext. WINTEM, defined in the annex to this recommendation, be adopted for use as from 2 November 2005;

REQUESTS the Secretary-General to arrange for the inclusion of these amendments in Volume I.1 of the *Manual on Codes*.

ANNEX TO RECOMMENDATION 5 (CBS-XIII)

AMENDMENTS TO THE *MANUAL ON CODES* (WMO-No. 306), VOLUME I.1

MODIFICATIONS TO FM 15-XII Ext. METAR and FM 16-XII Ext. SPECI

Add in Code form: "COR" after "METAR or SPECI"; **add** "NIL" before "(AUTO)".

Delete in Code form: brackets around "AUTO".

Amend in Code form: "VVVVD_V or CAVOK" to read "VVVV or VVVV**NDV** or CAVOK.

Amend in Code form: "**NSC**" to read "**NSC** or **NCD**".

Add in Code form: at the end of NOTE (2) the following text: "The code words "COR" and "NIL" shall be used, as appropriate, for corrected and missing reports, respectively".

Delete in Regulation 15.4: brackets around "AUTO"; **Amend** the first two sentences to read: "The optional code word AUTO shall be inserted before the wind group when a report contains fully automated observations without human intervention. The ICAO requirement is that all of the specified elements shall be reported. However, if any element…."

Delete in Regulation 15.5.1, NOTE (2): "— subject to a decision which is currently under review by ICAO".

Amend in Regulation 15.5.2, first sentence: "3 knots (2 m/s or 6 km/h) or less" to read "less than 3 knots (2 m/s or 6 km/h)".

Amend in Regulation 15.5.3, first sentence: "greater than 3 knots (2 m/s or 6 km/h)" to read "3 knots (2 m/s or 6 km/h) or more",

Amend Regulation 15.6: "$VVVVD_V$" to read "VVVV**NDV**".

Amend Regulation 15.6.1 to read: "The group VVVV shall be used to report prevailing visibility. When the horizontal visibility is not the same in different directions and when the visibility is fluctuating rapidly and the prevailing visibility cannot be determined, the group VVVV shall be used to report the lowest visibility. When visibility sensors are used and they are sited in such a manner that no directional variations can be given, the abbreviation **NDV** shall be appended to visibility reported."

Delete the note following Regulation 15.6.1.

Delete Regulation 15.6.2.

Amend Regulation 15.6.3 (renumbered as 15.6.2 and other regulations appropriately) to read "When the horizontal visibility is not the same in different directions and when the minimum visibility is different from the prevailing visibility; and less than 1 500 metres or less than 50 per cent of the prevailing visibility, the group $V_N V_N V_N V_N D_V$ shall also be used to report the minimum visibility and its general direction in relation to the aerodrome indicated by reference to one of the eight points of compass. If the minimum visibility is observed in more than one direction, the D_V shall represent the most operationally significant direction."

Amend in Regulation 15.7.6, last sentence in (a) to read: "When the RVR is assessed to be more than 2 000 metres, it shall be reported as P2000".

Amend in Regulation 15.8.4, first sentence to read: "Intensity shall be indicated only with precipitation, precipitation associated with showers and/or thundershowers, duststorm or sandstorm.".

Amend Regulation 15.8.8 to read: "The qualifier **TS** shall be used whenever thunder is heard or lightning is detected at the aerodrome within the 10-minute period preceding the time of observation. When appropriate, **TS** shall be followed immediately, without a space, by relevant letter abbreviations to indicate any precipitation observed. The letter abbreviation **TS** on its own shall be used when thunder is heard or lightning detected at the aerodrome but no precipitation observed."

Amend in Regulation 15.8.10: "BLSA and BLSN" to "BLSA, BLSN and VA".

Add in Regulation 15.9: "or **NCD**" after "**NSC**".

Add in Regulation 15.9.1.1 the following as the last sentence: "When an automatic observing system is used and no clouds are detected by that system, the abbreviation **NCD** shall be used".

Add in Regulation 15.9.1.7 the following as the last sentence: "When an automatic observing system is used and the cloud type cannot be observed by that system, the cloud type in each cloud group shall be replaced by ***///***." .

Amend in Regulation 15.13.2.1: "moderate or heavy blowing snow (including snowstorm)" to read "blowing snow"; and **add** the following as the last sentence: "When an automatic observing system is used and when the type of the precipitation cannot be identified by this system, the abbreviation **REUP** shall be used for recent precipitation".

Delete in Regulation 15.14.12: "(including snowstorm)".

MODIFICATIONS TO FM 51-XII Ext. TAF

Add in Code form: "COR" after "TAF"; **add** "NIL" after YYGGggZ and "CNL" after "$Y_1Y_1G_1G_1G_2G_2$".

Delete in Code form: brackets around "AMD". **Suppress** second sentence in NOTE (3); **Add** a new NOTE (5) to read: "The code words "AMD", "CNL", "COR" and "NIL" shall be included, as appropriate, for amended, cancelled, corrected and missing forecasts, respectively.

Amend in Regulation 51.3.3, first sentence: "3 knots (2 m/s or 6 km/h) or less" to read "less than 3 knots (2 m/s or 6 km/h)".

Amend in Regulation 51.4.1 the word "minimum" to read "prevailing"; **add** the following sentence: "When the prevailing visibility cannot be forecast, the group VVVV shall be used to forecast the minimum visibility".

Delete in Regulation 51.5.1 the words "(including snowstorm)".

MODIFICATION TO FM 50-VIII Ext. WINTEM

Add NOTE (5) to read: "No aeronautical requirement for this code form is stated by ICAO for international air navigation in ICAO Annex 3/WMO Technical Regulations (C.3.1)." [*Reason: change in aeronautical requirements (Amendment 73 to Annex 3)*.]

SYMBOLIC LETTERS AND REMARKS AS TO THE METHODS OF CODING

Amend in the Definitions, part (1) of the definition of "Actual time of observation" to encompass also METARs (FM 15).

Amend in symbolic letters GGggZ: (1) to read "FM 15: actual time of observation"; (3) to read "FM 51: time of issue of forecast"; and (4) to read "FM 53, FM 54: time of origin of forecast":

Amend in $V_R V_R V_R V_R$: (1) to read: "Runway visual range shall be reported in steps of 25 metres when the runway visual range is less than 400 metres; in steps of 50 metres when it is between 400 metres and 800 metres; and in steps of 100 metres when the runway visual range is more than 800 metres. Any observed value which does not fit the reporting scale in use shall be rounded down to the nearest lower step in the scale".

Amend in $V_NV_NV_NV_N$: "maximum" to read "minimum".

NOTE: The group $V_X V_X V_X V_X$ will be renamed as $V_NV_NV_NV_N$ and the FM 15-XII METAR and FM 16-XII SPECI code and regulations will be amended to 15.6 and 15.6.3 accordingly.

CODE TABLE 4678

Amend NOTE (5), first sentence to read: "Intensity shall be indicated only with precipitation, precipitation associated with showers and/or thundershowers, duststorm or sandstorm."; **delete** the second sentence; **amend** NOTE (9), second sentence to read: "When due to blowing snow the observer cannot determine whether or not snow is also falling from cloud, then only BLSN shall be reported".
Amend in NOTE (13): "BLSA and BLSN" to read "BLSA, BLSN and VA.
Add under PRECIPITATION: UP Unknown precipitation; **add** NOTE (14): UP is to be used only in reports from fully automated stations unable to distinguish precipitation type.

RECOMMENDATION 6 (CBS-XIII)

AMENDMENTS TO THE *MANUAL ON THE GLOBAL DATA-PROCESSING AND FORECASTING SYSTEM* (WMO-No. 485)

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The *Abridged Final Report with Resolutions of the Fourteenth World Meteorological Congress* (WMO-No. 960),

(2) The *Abridged Final Report with Resolutions of the Fifty-sixth Session of the Executive Council* (WMO-No. 977),

(3) The Report of the Meeting of the CBS Expert Team on Ensemble Prediction Systems (October 2003),

(4) The Report of the CBS Meeting of Lead Centres on Verification for Long-range Forecasts (December 2003),

(5) The Report of the Meeting of the CBS Emergency Response Activities Coordination Group (March 2004),

(6) The Report of the WMO Workshop on Quality Management (October 2004),

(7) The Report of the CBS Workshop on Severe and Extreme Weather Events Forecasting (October 2004),

RECOMMENDATION 7 (CBS-XIII)

REVIEW OF RESOLUTIONS OF THE EXECUTIVE COUNCIL BASED ON PREVIOUS RECOMMENDATIONS OF THE COMMISSION FOR BASIC SYSTEMS OR RELATED TO THE WORLD WEATHER WATCH

THE COMMISSION FOR BASIC SYSTEMS,

NOTING with satisfaction the action taken by the Executive Council on the previous recommendations of the Commission for Basic Systems or related to the World Weather Watch in general,

CONSIDERING that some of the previous Executive Council resolutions are still valid,

RECOMMENDS that the following Executive Council resolutions be kept in force:

Resolutions 12, 14 and 15 (EC-LV) and Resolutions 2, 8 and 9 (EC-LVI);

RECOMMENDS that the following Executive Council resolutions be not kept in force:

Resolutions 8, 16 and 17 (EC-LV).

ANNEXES

ANNEX I

Annex to paragraph 3.8 of the general summary

RESULTS OF THE MONITORING OF THE OPERATION OF THE WWW

Figure 1: Percentage of SYNOP reports received from each WMO Region during the 2000 to 2004 October AGM, and the February, April and July 2000 to 2004 SMM, in comparison with the numbers of reports required from the RBSN stations

Figure 2: Percentage of TEMP reports received from each WMO Region during the 2000 to 2004 October AGM, and the February, April and July 2000 to 2004 SMM, in comparison with the number of reports required from RBSN stations

Figure 3: Percentage of SYNOP reports received for 0000, 0600, 1200 and 1800 UTC from each RBSN station during the October 2004 AGM in comparison with the numbers of reports required

Figure 4: Percentage of parts A of TEMP reports received for 0000 and 1200 UTC from each RBSN station during the October 2004 AGM in comparison with the numbers of reports required

Figure 5: Daily average number of reports received by SMM centres from mobile stations since 2000

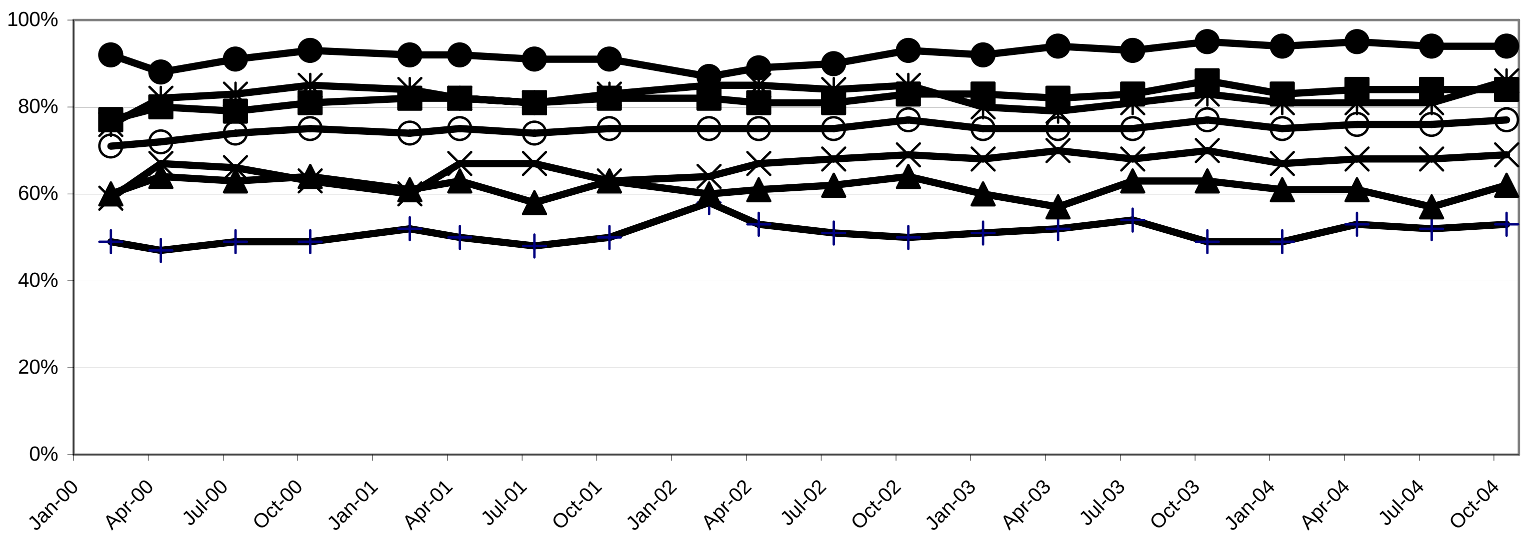
Figure 6: Locations from which SHIP reports were received for 0000, 0600, 1200 and 1800 UTC during the October 2004 SMM

Figure 7: Locations from which BUOY reports were received during the October 2004 SMM

Figure 8: Locations from which TEMP SHIP reports were received during the October 2004 SMM

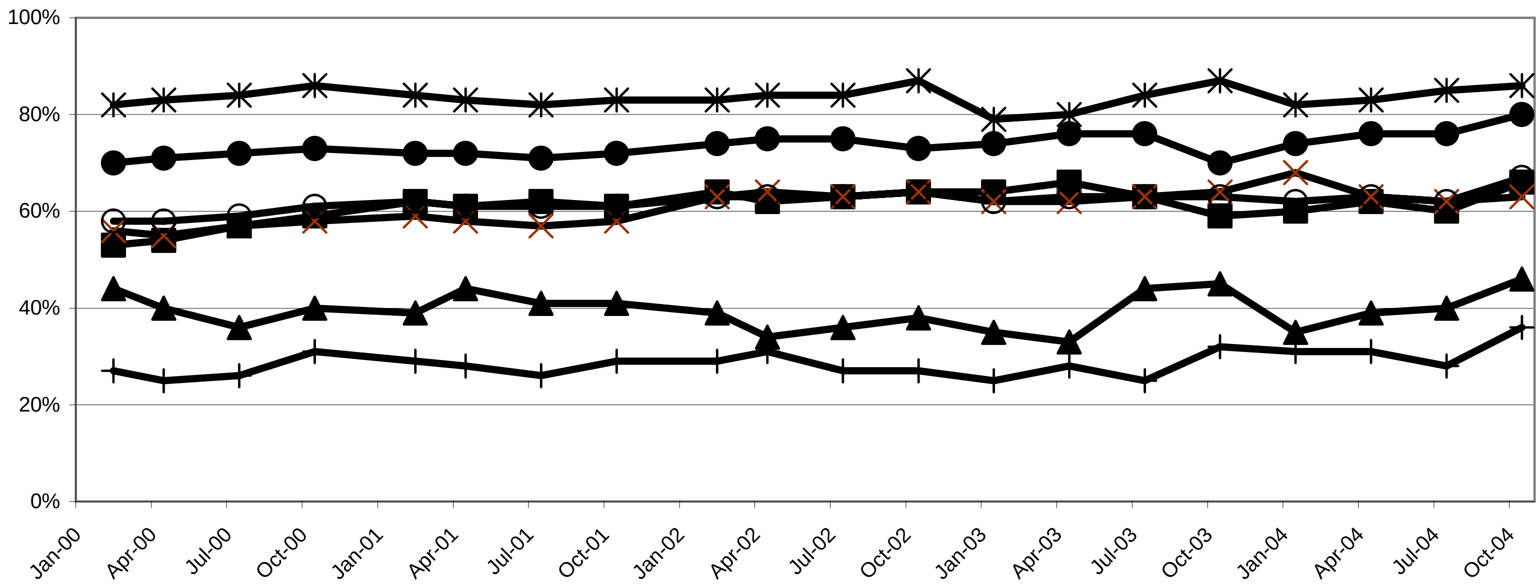
Figure 9: Locations from which AIREP, AMDAR and BUFR aircraft reports were received during the October 2004 SMM

Figure 1



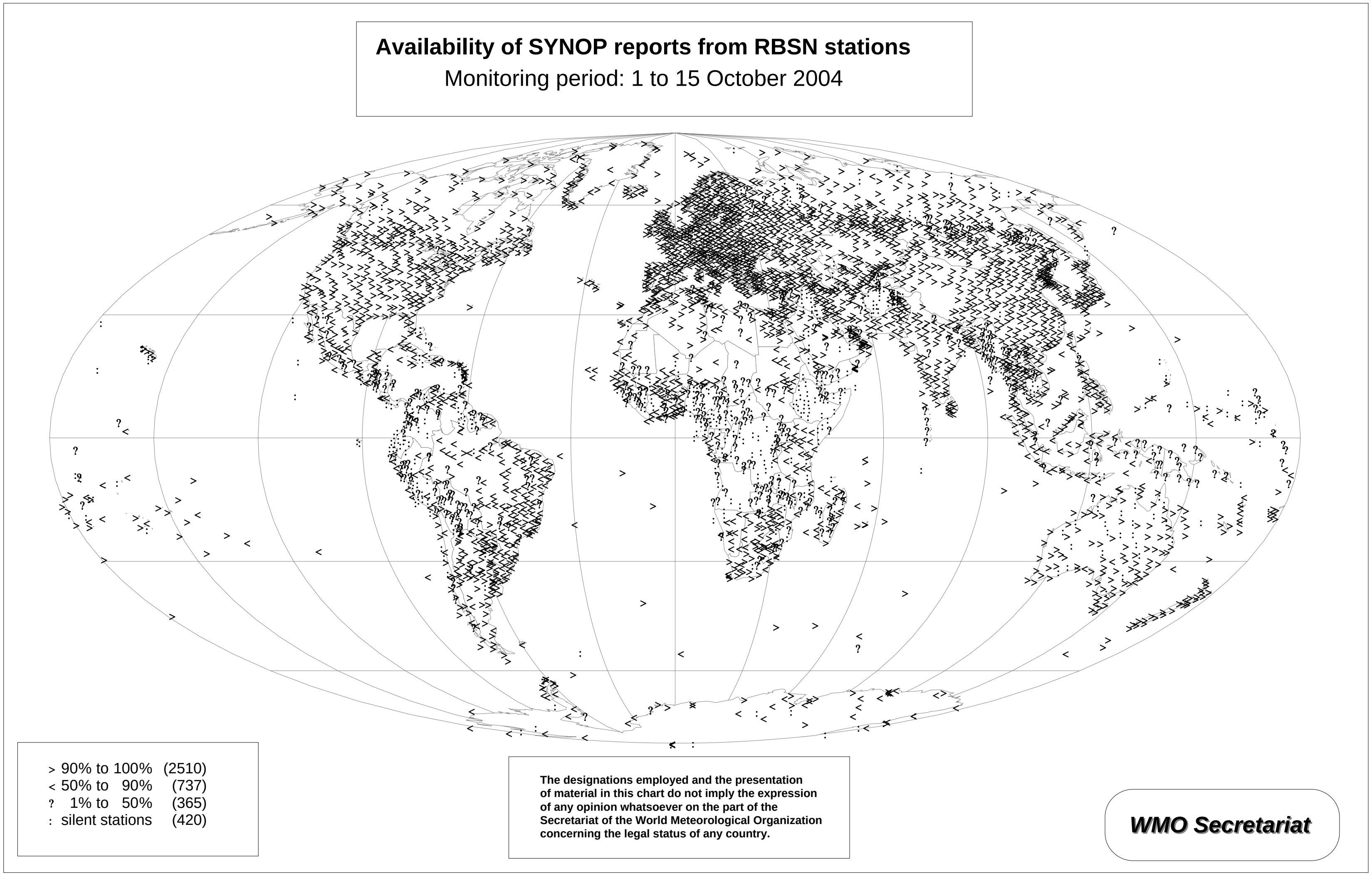
	Feb-00	Apr-00	Jul-00	Oct-00	Feb-01	Apr-01	Jul-01	Oct-01	Feb-02	Apr-02	Jul-02	Oct-02	Jan-03	Apr-03	Jul-03	Oct-03	Jan-04	Apr-04	Jul-04	Oct-04
Region I	49%	47%	49%	49%	52%	50%	48%	50%	58%	53%	51%	50%	51%	52%	54%	49%	49%	53%	52%	53%
Region II	77%	80%	79%	81%	82%	82%	81%	82%	82%	81%	81%	83%	83%	82%	83%	86%	83%	84%	84%	84%
Region III	60%	64%	63%	64%	61%	63%	58%	63%	60%	61%	62%	64%	60%	57%	63%	63%	61%	61%	57%	62%
Region IV	76%	82%	83%	85%	84%	82%	81%	83%	85%	85%	84%	85%	80%	79%	81%	83%	81%	81%	81%	86%
Region V	59%	67%	66%	63%	60%	67%	67%	63%	64%	67%	68%	69%	68%	70%	68%	70%	67%	68%	68%	69%
Region VI	92%	88%	91%	93%	92%	92%	91%	91%	87%	89%	90%	93%	92%	94%	93%	95%	94%	95%	94%	94%
Total	71%	72%	74%	75%	74%	75%	74%	75%	75%	75%	75%	77%	75%	75%	75%	77%	75%	76%	76%	77%

Figure 2



	Feb-00	Apr-00	Jul-00	Oct-00	Feb-01	Apr-01	Jul-01	Oct-01	Feb-02	Apr-02	Jul-02	Oct-02	Jan-03	Apr-03	Jul-03	Oct-03	Jan-04	Apr-04	Jul-04	Oct-04
Region I	27%	25%	26%	31%	29%	28%	26%	29%	29%	31%	27%	27%	25%	28%	25%	32%	31%	31%	28%	36%
Region II	53%	54%	57%	59%	62%	61%	62%	61%	64%	62%	63%	64%	64%	66%	63%	59%	60%	62%	60%	66%
Region III	44%	40%	36%	40%	39%	44%	41%	41%	39%	34%	36%	38%	35%	33%	44%	45%	35%	39%	40%	46%
Region IV	82%	83%	84%	86%	84%	83%	82%	83%	83%	84%	84%	87%	79%	80%	84%	87%	82%	83%	85%	86%
Region V	56%	55%	57%	58%	59%	58%	57%	58%	63%	64%	63%	64%	62%	62%	63%	64%	68%	63%	62%	63%
Region VI	70%	71%	72%	73%	72%	72%	71%	72%	74%	75%	75%	73%	74%	76%	76%	70%	74%	76%	76%	80%
Total	58%	58%	59%	61%	62%	61%	61%	61%	63%	63%	63%	64%	62%	63%	63%	63%	62%	63%	62%	67%

Figure 3

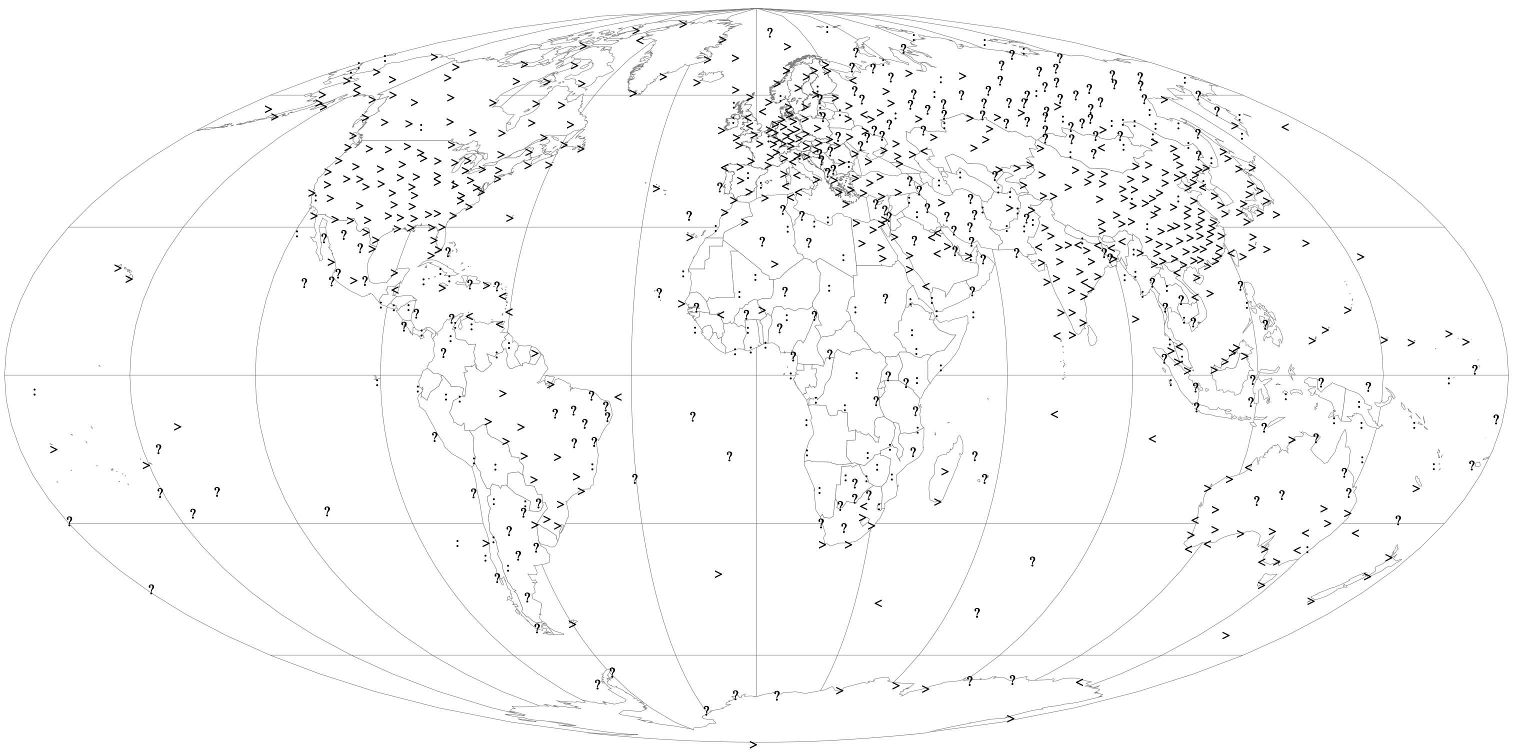


(the percentage of reports received is based on the main synoptic hours 0000, 0600, 1200 and 1800 UTC)

Figure 4

Availability of TEMP reports from RBSN stations

Monitoring period: 1 to 15 October 2004

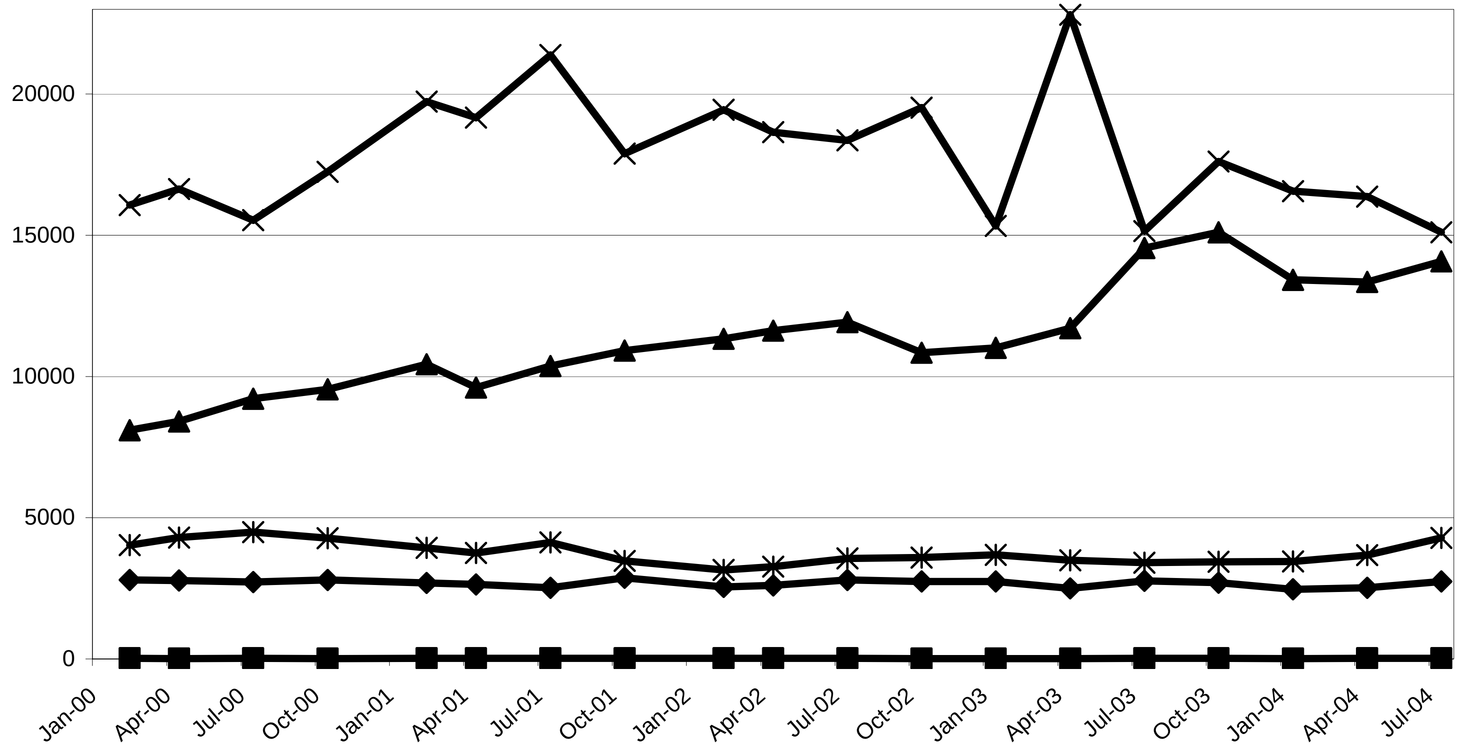


>	90% to 100%	(446)
<	50% to 90%	(138)
?	1% to 50%	(94)
:	silent stations	(144)

WMO Secretariat

(the percentage of reports received is based on TEMP Part A observation at 0000 and 1200 UTC)

Figure 5



	Feb-00	Apr-00	Jul-00	Oct-00	Feb-01	Apr-01	Jul-01	Oct-01	Feb-02	Apr-02	Jul-02	Oct-02	Jan-03	Apr-03	Jul-03	Oct-03	Jan-04	Apr-04	Jul-04
SHIP reports (00, 06, 12, 18 UTC)	2801	2777	2719	2793	2691	2631	2513	2870	2549	2603	2797	2742	2742	2499	2765	2696	2464	2518	2746
TEMP SHIP reports	18	16	18	14	19	19	17	18	18	17	19	16	15	14	21	19	15	18	23
BUOY reports	8094	8405	9215	9542	10436	9613	10374	10919	11337	11620	11924	10841	11012	11706	14549	15100	13421	13351	14079
AMDAR reports	16073	16642	15531	17252	19728	19164	21385	17886	19441	18651	18358	19514	15334	22804	15147	17611	16567	16367	15101
AIREP reports	4031	4294	4484	4278	3935	3751	4128	3475	3149	3270	3561	3592	3680	3491	3407	3438	3452	3679	4287

Figure 6

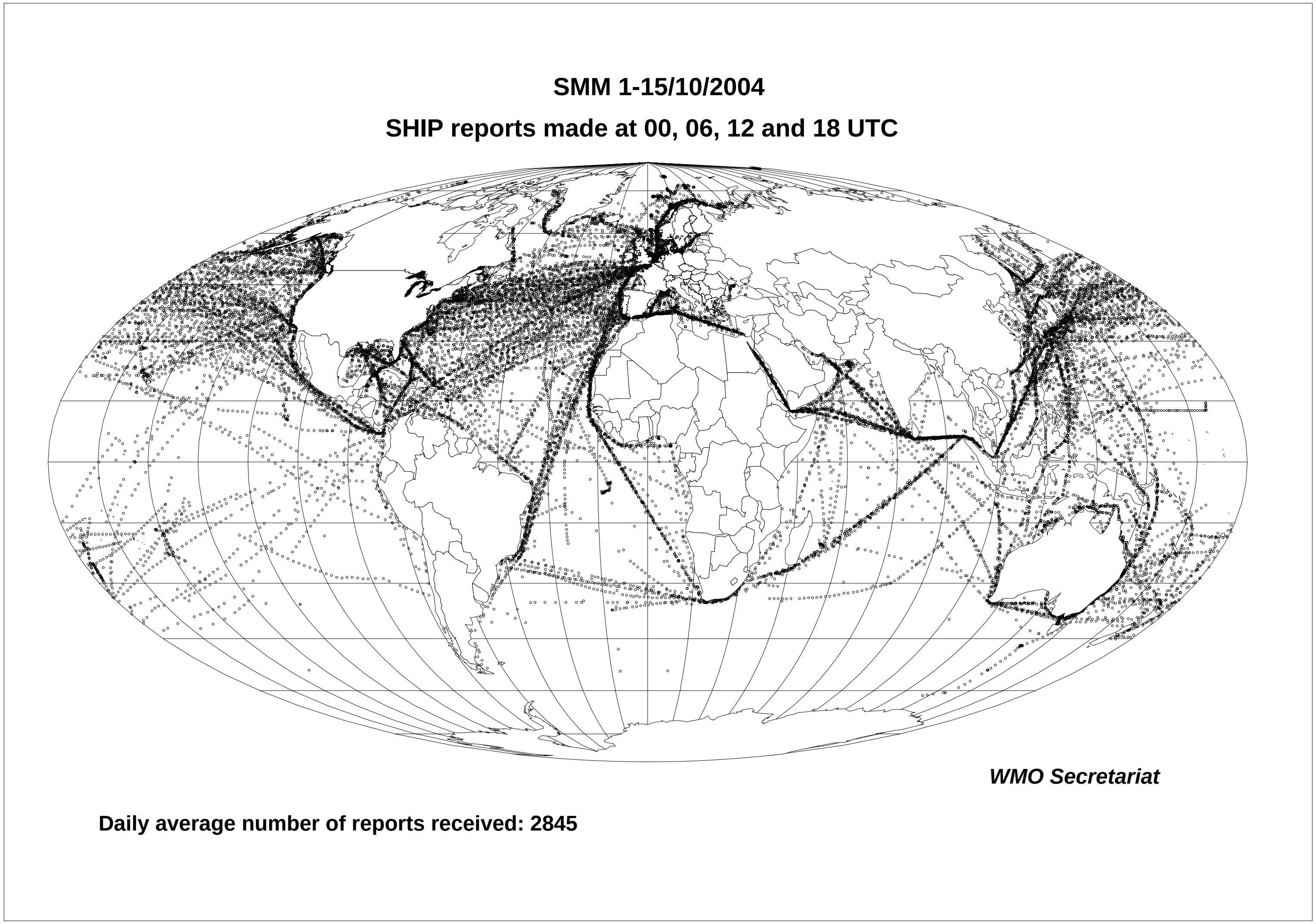
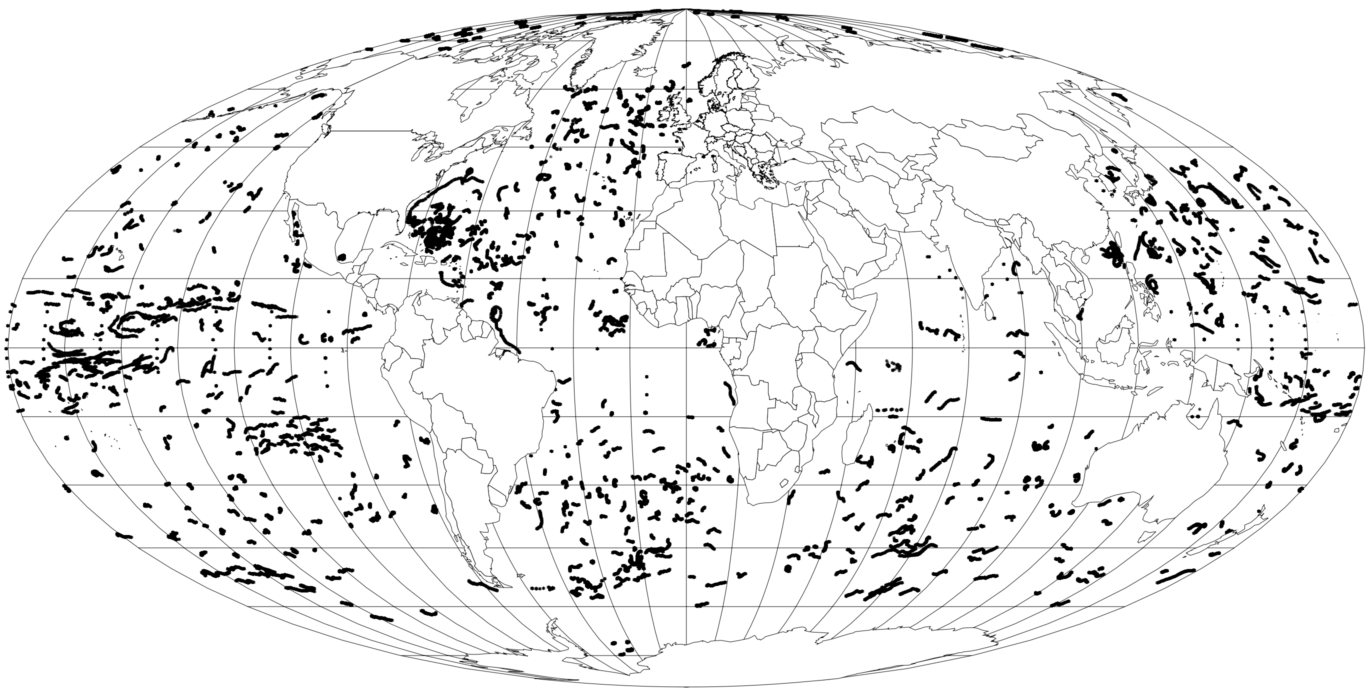

SMM 1-15/10/2004
SHIP reports made at 00, 06, 12 and 18 UTC
WMO Secretariat
Daily average number of reports received: 2845

Figure 7

SMM 1-15/10/2004

BUOY reports



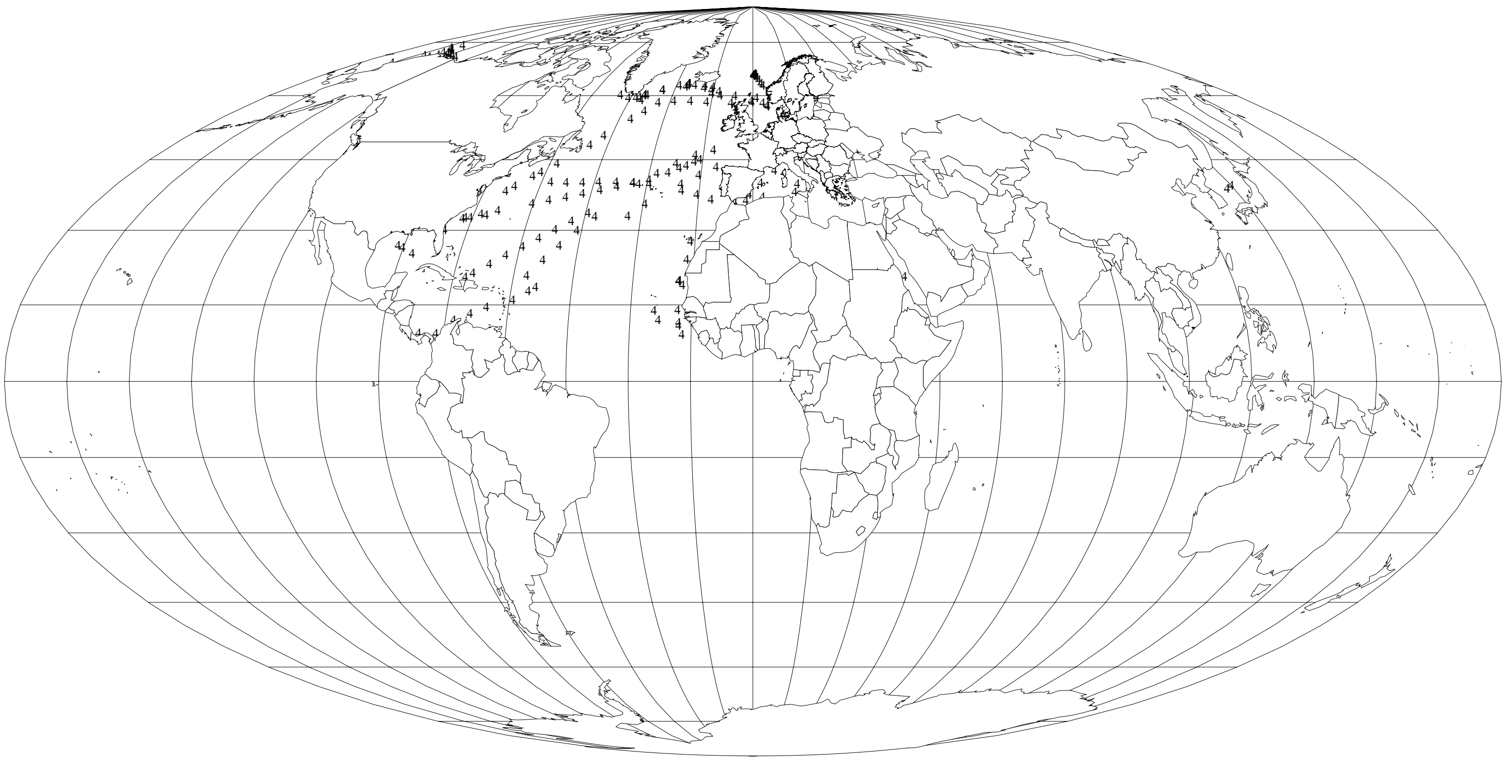
WMO Secretariat

Daily average number of reports received: 14541

Figure 8

SMM 1-15/10/2004

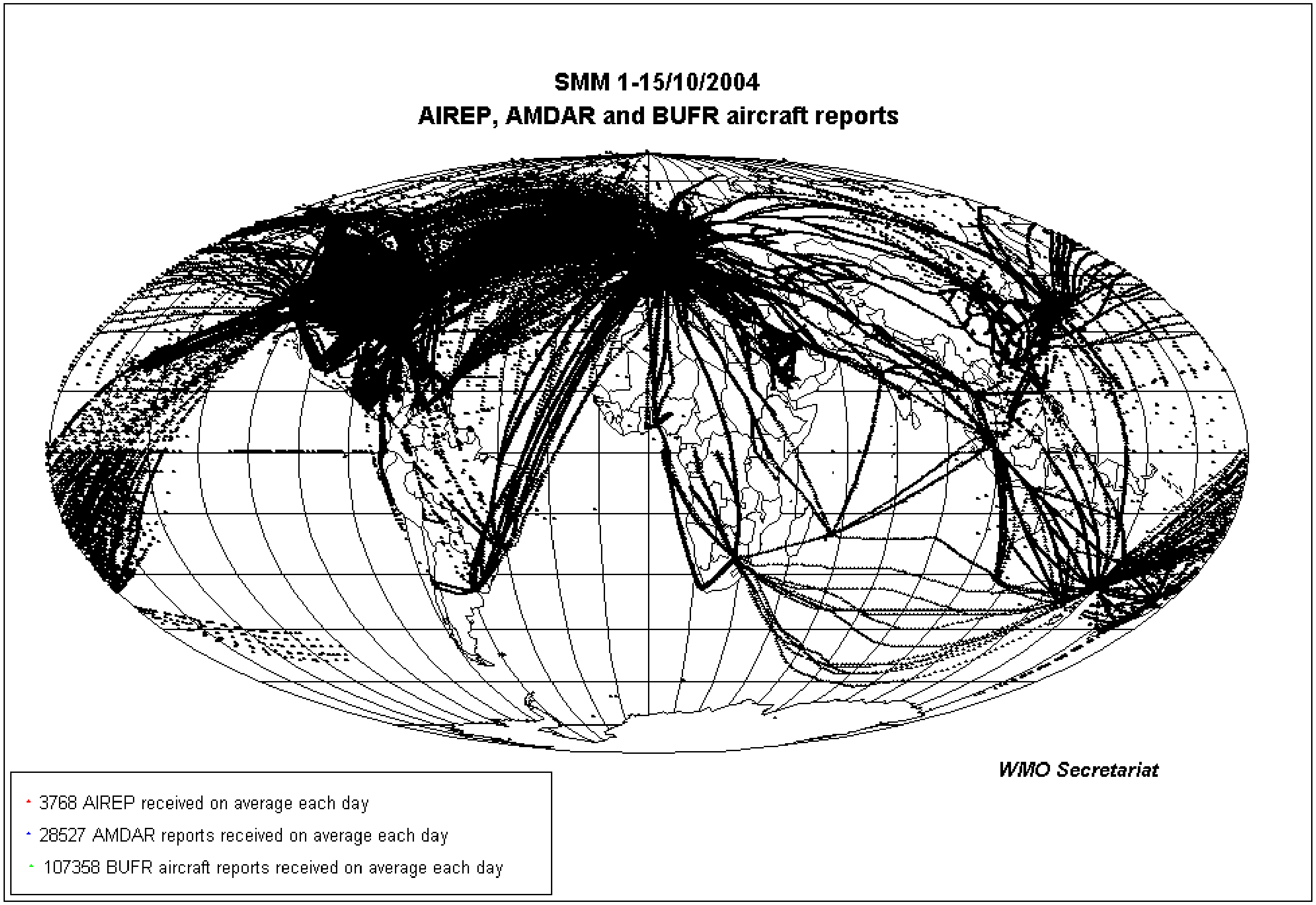
TEMP SHIP reports



WMO Secretariat

Daily average number of reports received: 13

Figure 9


SMM 1-15/10/2004
AIREP, AMDAR and BUFR aircraft reports
WMO Secretariat
3768 AIREP received on average each day
28527 AMDAR reports received on average each day
107358 BUFR aircraft reports received on average each day

ANNEX II

Annex to paragraph 4.18 of the general summary

KEY CONCLUSIONS AND RECOMMENDATIONS OF THE WMO WORKSHOP ON QUALITY MANAGEMENT (KUALA LUMPUR, MALAYSIA, 26-28 OCTOBER 2004)

- The development of a WMO Quality Management Framework and the implementation of ISO 9001 are complementary activities and not mutually exclusive ones. The ISO 9001 certification has a significant element of international credibility and recognition that must not be ignored in the development of the WMO QMF.
- With respect to the high costs often associated with ISO 9001 certification and the implicit suggestion that a WMO-own certification system would be much cheaper, it was noted that actual experiences of some certified NMSs indicate that a WMO-own certification scheme could be more expensive due to permanent staff and travel costs and the requirements for neutrality and geographic balance within a WMO certification team. If the WMO Secretariat should be requested to act as a certification authority it would need to be certified itself in the first place.
- It was currently uncertain whether an NMS could meet ICAO's recommendation on quality management systems (QMSs) through a WMO-own certification scheme. The cost of certification could be avoided or delayed to appropriate time by implementation of QMS without certification. An NMS would in any case incur the cost for the preparation and implementation of any type of QMS.
- Consideration should be given to the question of whether certification of major sources of products, such as the ICAO WAFCs was necessary so that their clients, i.e. the NMHSs, could achieve certification of their aviation, meteorological services in accordance with the pertinent ICAO recommendation.
- While a quality management system is becoming a basic requirement for all NMS, it should not focus on the ISO 9001 type alone, but consider a variety of options and each NMHS should consider its own path. The WMO QMF should include the ISO as well as other options and should not create a conflict for Members in the choice between single-track approaches of ISO or other practices.
- The Governments were amongst the main driving forces for the implementation of QMS in NMHSs and, in several cases, were not limiting the QMS to technical aspects, such as aviation meteorological services, but also embrace a much wider implementation, including e.g. staff management and human resources development.
- The use of consistent and up-to-date WMO technical regulations in the certification process of NMSs was important. Some certified NMSs reported that they experienced no problems with the relevant WMO Technical Regulations in the process of acquiring their certification.
- A basic feature of a QMS is the definition and management of processes performed in NMSs, namely production, support and management processes. The development of a process matrix, which specifies processes, process results and management responsibilities, was a useful tool for clarifying the main processes and describing the operational activities. (A sample of a process matrix was included in the WMO technical guidance material on QMF.) A set of templates should be developed to assist NMSs in describing the processes and in developing the matrices.
- In response to Resolution 27 (Cg-XIV) — Quality management, phases (*a*) and (*b*), an ad hoc expert group on quality management and quality control aspects related to observations, should be established with the recommended preliminary terms of reference as follows:
  - (*a*) Review of WMO Technical Regulations relevant to observation generation with a view to identifying and rectifying deficiencies, duplications, inconsistencies and errors;
  - (*b*) Develop a document that describes work processes typical for observation generation, making reference to the relevant WMO documents, in particular approved requirements for observation of relevant Programmes, which should also include, or refer to, quality control aspects related to observations; this document should serve as a model or template for use in process description within national QMS and introduce at the same time a quality control scheme related to the quality of observations;
  - (*c*) The membership should include one expert on observation generation from each technical commission.
- The consideration of quality control aspects related to forecasting and warning products and services should be addressed in connection with the standing task of CBS to develop standards or recommended practices on weather forecasting and the use of forecasting systems, and be based on the findings expected to be developed under that task.
- Capacity-building efforts would be required to help developing NMHSs, individually or as part of regional groups. Some help would be provided immediately through the distribution of guidance

material and presentations covering quality management at WMO regional meetings. One additional way of achieving capacity building in QMS would be through the ISO Programme for Developing Countries (DEVCO), which supports such activities as training, publications, sponsorship and technical advice.

ANNEX III

Annex to paragraph 5.1.3 of the general summary

IMPLEMENTATION PLAN FOR THE EVOLUTION OF SPACE- AND SURFACE-BASED SUBSYSTEMS OF THE GOS
(September 2004)

1. Background

1.1 CBS requested the OPAG on IOS and specifically the Expert Team on Observational Data Requirements and Redesign of the Global Observing System (ET-ODRRGOS) to: (*a*) continue the rolling requirements review (RRR), under which requirements for observations to meet the needs of all WMO Programmes are compared with the capabilities of present and planned observing systems to provide them; (*b*) suggest changes in the GOS filling gaps identified by the RRR; and (*c*) draft an implementation plan for the re-design (or more appropriately the evolution) of the GOS.

1.2 The significant findings that have formed the basis for the implementation plan were:

(*a*) The RRR is readily applied to a diversity of applications areas, provided the database of user requirements and observing system capabilities is accurate;

(*b*) Working with the Rapporteurs on Regional and Global Observing System Experiments (OSEs), it was found that hypothetical changes to the GOS can be explored in OSEs with NWP centre assistance, provided data assimilation procedures are well understood and impact studies are conducted in a statistically significant way. Furthermore, it was made apparent that Observing Systems Simulation Experiments (OSSEs) require huge human and computer resources and were beyond the available resources;

(*c*) The future GOS should build upon existing subsystems, both surface- and space-based, and capitalize on existing and new observing technologies not presently incorporated or fully exploited; each incremental addition to the GOS will be reflected in better data, products and services from the NMHSs;

(*d*) The scope of the changes to the GOS during the next decades will be so massive that new revolutionary approaches for science, data handling, product development, training and utilization will be required. There is an urgent need to study comprehensive strategies for anticipating and evaluating changes to the GOS.

1.3 Several major additional working results by the ET-ODRRGOS influenced the content of the Plan. They were:

(*a*) Users requirements and observing system capabilities were charted in 10 application areas (after engaging experts in each area). The RRR was pursued and Statements of Guidance were issued in all 10 areas (available in the *Preliminary Statement of Guidance Regarding How Well Satellite Capabilities Meet WMO User Requirements in Several Application Areas* (WMO/TD-No. 913, SAT-21; WMO/TD-No. 992, SAT-22); the *Statement of Guidance Regarding How Well Satellite and IN Situ Sensor Capabilities Meet WMO User Requirements in Several Application Areas* (WMO/TD-No. 1052, SAT-26 and summarized in the final report of the July 2002 ET-ODRRGOS Meeting);

(*b*) Several Observing System Experiments were pursued to test possible re-configurations of the GOS (these are summarized in section 5 of this annex);

(*c*) Candidate Observing Systems (space-based and ground-based) for the coming decade were studied (reported in *Observing Systems Technologies and their Use in the Next Decade* (WMO/TD-No.1040, WWW-20);

(*d*) Special challenges and issues concerning developing countries were considered and addressed (see section 4 of this annex);

(*e*) Recommendations for the evolution of space-based and surface-based subsystems of the GOS were drafted and endorsed by CBS (available in the final report of the October 2002 ICT Meeting);

(*f*) A vision for the GOS of 2015 and beyond was drafted and endorsed by CBS and the Executive Council.

1.4 Beneficial input was received from the Expert Team on Satellite System Utilization and Products (ET-SSUP) stemming from their evaluations of the Biennial Questionnaire for the WMO Strategy to Improve Satellite System Utilization, training experiences with the CGMS/WMO Virtual Laboratory, and recommendations on Advanced Dissemination Methods (ADM). The Expert Team on Automatic Weather Systems (ET-AWS) offered guidance with regard to measurement standards and technology developments in ground-based observations.
1.5 The resulting Implementation Plan for the Evolution of the GOS (see section 3) presents a coherent approach for implementing the necessary changes to the space-based and surface-based subsystems of the GOS so that the vision for the GOS of 2015 can be realized.

2. Recommendations for the evolution of the GOS

2.1 Forty-seven recommendations included in the Implementation Plan provided the framework for the evolution of the GOS. Those recommendations reflect the Statements of Guidance produced in 10 applications areas; results from regional programmes (such as the Composite Observing System for the North Atlantic (COSNA), EUCOS and North Atlantic Ocean Stations (NAOS)); conclusions from the Toulouse and Alpbach Workshops on Impact of Various Observing Systems on NWP (see the *Proceedings of the Second CGC/WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Predictions (Toulouse, France, 6-8 March 2000*) (WMO/TD–No. 1034, WWW-19) and the *Third WMO Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction (Alpbach, Austria, 9-12 March 2004)* (WMO/TD-No. 1228), respectively), and results of specific OSEs carried out to asses possible reconfiguration of the GOS.

3. Implementation Plan for the Evolution of GOS

3.1 Recommendations for the evolution of the space-based subsystem of the GOS

Calibration

S1. Calibration - There should be more common spectral bands on GEO and low Earth orbit (LEO) sensors to facilitate intercomparison and calibration adjustments; globally distributed GEO sensors should be routinely intercalibrated using a given LEO sensor and a succession of LEO sensors in a given orbit (even without the benefit of overlap) should be routinely inter-calibrated with a given GEO sensor.

Comment: A major issue for effective use of satellite data, especially for climate applications, is calibration. The advent of high spectral resolution infrared sensors will enhance accurate intercalibration.

Progress: CGMS-XXXI discussed GCOS Climate Monitoring Principles, intercalibration of visible sensors, and intercalibration of infrared sensors on all GEOs with HIRS and AVHRR (reporting on the last item remains as a permanent action of CGMS). CGMS-XXXII considered improved infrared inter-calibration capabilities using advanced infrared sounders (AIRS) data; the implications for GCOS Climate Monitoring Principles were discussed. CEOS hosted a calibration workshop in October 2004.

Next action: The WMO Space Programme to continue discussions with space agencies, via CGMS.

Schedule: Continue activity with current sensors and expand to infrared atmospheric sounding interferometer (IASI) by CGMS in 2006.

GEO satellites

S2. GEO imagers - Imagers of future geostationary satellites should have improved spatial and temporal resolution (appropriate to the phenomena being observed), in particular for those spectral bands relevant for depiction of rapidly developing small-scale events and retrieval of wind information.

Progress: All operators reported plans at CGMS: NOAA, EUMETSAT and Russia reported plans for a SEVIRI-like capability by 2015.

Next action: The WMO Space Programme to continue discussions with space agencies, via CGMS.

Schedule: Firm plans to reach this goal should be in place by CGMS in 2006.

S3. GEO sounders - All meteorological geostationary satellites should be equipped with hyper-spectral infrared sensors for frequent temperature/humidity sounding as well as tracer wind profiling with adequately high resolution (horizontal, vertical and time).

Comment: This was to be demonstrated by the geostationary imaging Fourier transform spectrometer (GIFTS). However, for budgetary reasons, NASA has recently curtailed the GIFTS mission to assemble and vacuum test Engineering Design Unit; realization of a GIFTS demonstration in geostationary orbit is a task to be undertaken by the international community, possibly within the International Geostationary Laboratory (IGeoLab).

Progress: All operators reported plans at CGMS: NOAA has firm plans including this capability for the GOES-R series; EUMETSAT has it under consideration for the MTG series; China and India have plans for capability similar to current GOES sounder before 2010. CGMS endorsed the concept of the IGeoLab that would be a joint undertaking to provide a platform for demonstrations from geostationary orbit of new sensors and capabilities. GIFTS is one of two systems being considered for IGeoLab. Roshydromet and Roskosmos are negotiating with NOAA the possibility to install GIFTS on board the subsequent geostationary satellite "ELEKTRO".
Next action: The WMO Space Programme to coordinate a GIFTS demonstration on IGeoLab with space agencies and to report plans at CGMS in 2005 (note Next action on S13).
Schedule: Plans from all space agencies for hyperspectral geostationary sounding should be in place by CGMS 2006.

S4. GEO imagers and sounders - To maximize the information available from the geostationary satellite systems, they should be placed "nominally" at a 60-degree sub-point separation across the equatorial belt. This will provide global coverage without serious loss of spatial resolution (with the exception of the polar regions). In addition, this provides for a more substantial backup capability should one satellite fail. In particular, continuity of coverage over the Indian Ocean region is of concern.
Comment: In recent years, contingency planning has maintained a five-satellite system, but this is not a desirable long-term solution.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS and WMO Consultative Meetings on High-level Policy on Satellite Matters, the strategy for implementation with attention to the problems of achieving required system reliability and product accuracy.
Schedule: Plan should be available by CGMS in 2006.

LEO satellites

S5. LEO data timeliness - More timely data are needed. Improved communication and processing systems should be explored to meet the timeliness requirements in some applications areas (e.g. regional NWP).
Progress: EARS data are now available with a delay of less than 30 minutes; the data are used operationally at some NWP centres and planned at others. The National Polar-orbiting Environmental Satellite System (NPOESS) plans are for data delivery in less than 30 min and thus consistent with this requirement.
Next actions: The WMO Space Programme to plan, with Members and CGMS, the development of ADMs and an Integrated Global Data Dissemination Service (IGDDS), to include: (1) the extension and enhancement of EARS; (2) the implementation of similar systems, with a goal of achieving timely retransmission of local datasets covering the globe; (3) an equivalent system for net primary productivity (NPP) data; (4) expansion of EARS and equivalent systems to include Infrared Atmospheric Sounding Interferometre (IASI) data; and (5) establishment of equivalent systems for the LEO data from satellites of other agencies.
Schedule: Plan for IGDDS, including above elements, prepared by mid-2005, with the goal for completion of phased implementation of global ATOVS retransmission service by mid-2006.

S6. LEO temporal coverage - Coordination of orbits for LEO missions is necessary to optimize temporal coverage while maintaining some orbit redundancy.
Progress: This is now the subject of a permanent action of CGMS.
Next action: The WMO Space Programme to collaborate with space agencies, via CGMS, on a target system that will be implemented and to take steps towards achieving it.
Schedule: Target system agreed upon by CGMS in 2006.

S7. LEO sea-surface wind - Sea-surface wind data from R&D satellites should continue to be made available for operational use; six-hourly coverage is required. In the NPOESS and METOP era, sea surface wind should be observed in a fully operational framework. Therefore it is urgent to assess whether the multi-polarization passive medium wave radiometry is competitive with scatterometry.
Progress: Three months of data has been made available to the Windsat science team.
Next action: The WMO Space Programme, via CGMS, to request assessment of Windsat performance and to consider the implications for the evolved GOS.
Schedule: Assess Windsat performance by 2005. Assess implications and provide feedback to NOAA by 2005.

S8. LEO altimeter - Missions for ocean topography should become an integral part of the operational system.
Progress: Agreement has been reached to proceed with JASON-2.

Next action: The WMO Space Programme to discuss with space agencies, via CGMS and the WMO Consultative Meetings on High-level Policy on Satellite Matters, the continuity of operational provision after JASON-2.
Schedule: Plans for operational follow-on should be reported at CGMS in 2006.

S9. LEO Earth radiation budget - Continuity of ERB type global measurements for climate records requires immediate planning to maintain broad-band radiometers on at least one LEO satellite.
Comment: There are no current plans for ERB-like measurements after Aqua. There are also concerns about the continuity of absolute measurements of incoming solar radiation.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS.
Schedule: Plans for continuity of capability should be available by CGMS in 2006.

R&D satellites

S10. LEO Doppler winds - Wind profiles from Doppler lidar technology demonstration programme (such as Atmospheric Dynamics Mission - Aeolus) should be made available for initial operational testing; a follow-on long-standing technological programme is solicited to achieve improved coverage characteristics for operational implementation.
Comment: Plans for Aeolus demonstration are proceeding on schedule, but there are no plans for operational follow on.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS and WMO Consultative Meetings on High-level Policy on Satellite Matters, to assure demonstration with Aeolus and initiation of operational systems for wind profile measurement.
Schedule: To confirm plans for near real-time data distribution by CGMS in 2005. Plans for continuity of a Doppler winds capability following Aeolus should be formed by CGMS in 2006.

S11. GPM - The concept of the Global Precipitation Measurement Missions (combining active precipitation measurements with a constellation of passive microwave imagers) should be supported and the data realized should be available for operational use, thereupon, arrangements should be sought to ensure long-term continuity to the system.
Progress: The Tropical Rainfall Measuring Mission (TRMM) continues to provide valuable data for operational use. Early termination of TRMM after 2004 will adversely affect WMO Members. At CGMS-XXXII, NASA, ESA and JAXA reported plans for a GPM mission in 2008. ESA's European Global Precipitation Measurement (EGPM) launch will be decided if and when this mission is selected.
Next action: The WMO Space Programme to continue discussions with space agencies, via CGMS.
Schedule: Plans should be reported at CGMS in 2006.

S12. RO-sounders - The opportunities for a constellation of radio occultation sounders should be explored and operational implementation planned. International sharing of ground network systems (necessary for accurate positioning in real time) should be achieved to minimize development and running costs.
Progress: CHAMP and SAC-C data have been available to some centres but not in near real-time. NWP OSE has shown positive impact with small number of occultations. Climate applications are being explored. There has been good progress in planning for NRT distribution of METOP/GRAS and COSMIC data.
Next actions: The WMO Space Programme to discuss with space agencies, via CGMS, (1) the proposal to develop a shared ground network system and (2) operational constellations following COSMIC.
Schedule: Plan for shared ground network should be available by CGMS in 2006. Plan for operational follow-on should be drafted by CGMS in 2006.

S13. GEO Sub-mm - An early demonstration mission on the applicability of sub-mm radiometry for precipitation estimation and cloud property definition from geostationary orbit should be provided, with a view to possible operational follow-on.
Progress: EUMETSAT, NESDIS and WMO prepared a paper for CGMS on the IGeoLab that would be a joint undertaking to provide a platform for demonstrations from geostationary orbit of new sensors and capabilities. Geo sub-mm is one of two systems being considered for IGeoLab.
Next action: The WMO Space Programme to continue dialogue with space agencies, via CGMS
Schedule: Plan for IGeoLab should be drafted by CGMS in 2005.

S14. LEO MW - The capability to observe ocean salinity and soil moisture for weather and climate applications (possibly with limited horizontal resolution) should be demonstrated in a research mode (as with ESA's soil moisture and ocean salinity (SMOS) and NASA's Office of the Chief Engineer) for possible operational follow-on. Note that the horizontal resolution from these instruments is unlikely to be adequate for salinity in coastal zones and soil moisture on the mesoscale.

Recent progress: ERS data sets have provided monthly global soil moisture maps since 1991 at 50 km resolution.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS
Schedule: The WMO Space Programme to report to the Expert Team following CGMS in 2006.

S15. LEO SAR - Data from SAR should be acquired from R&D satellite programmes and made available for operational observation of a range of geophysical parameters such as wave spectra, sea ice, land surface cover.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS, (1) access by WMO Members to ENVISAT SAR data, and (2) continuity of such missions.
Schedule: Assessment of status and plans completed by CGMS in 2006.

S16. LEO Aerosol - Data from process study missions on clouds and radiation as well as from R&D multi-purpose satellites addressing aerosol distribution and properties should be made available for operational use.
Progress: Cloudsat will carry a R&D aerosol instrument. NPOESS is adding an aerosol instrument. This issue has been referred to the CEOS SIT and CGMS.
Next action: The WMO Space Programme to continue discussions with space agencies, via CGMS and CEOS.
Schedule: Plans for data distribution should be drafted by CGMS in 2006. The WMO Space Programme to report to the Expert Team following CGMS in 2006.

S17. Cloud Lidar - Given the potential of cloud lidar systems to provide accurate measurements of cloud top height and to observe cloud base height in some instances (Stratocumulus, for example), data from R&D satellites should be made available for operational use.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS
Schedule: The WMO Space Programme to report to the Expert Team following CGMS in 2005.

S18. LEO Far IR - An exploratory mission should be implemented, to collect spectral information in the Far IR region, with a view to improve understanding of water vapour spectroscopy (and its effects on the radiation budget) and the radioactive properties of ice clouds.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS
Schedule: The WMO Space Programme to report to the Expert Team following CGMS in 2005.

S19. Limb sounders - Temperature profiles in the higher stratosphere from already planned missions oriented to atmospheric chemistry exploiting limb sounders should be made operationally available for environmental monitoring.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS, progress/plans for distribution of data from MIPAS and SCIAMACHY on ENVISAT, from MLS and HIRDLS on AURA, and from similar instruments.
Schedule: Plans for data distribution should be documented by CGMS in 2006.

S20. Active water vapour sensing - There is need for an exploratory mission demonstrating high-vertical resolution water vapour profiles by active remote sensing (for example by DIAL) for climate monitoring and, in combination with hyper-spectral passive sensing, for operational NWP.
Next action: The WMO Space Programme to discuss with space agencies, via CGMS.
Schedule: The WMO Space Programme to report to the Expert Team following CGMS in 2005.

3.2 Recommendations for the evolution of the surface-based subsystem of the GOS

Data coverage, distribution and coding

G1. Distribution - Some observations made routinely are not distributed in near real-time but are of interest for use in meteorological applications.

(*a*) Observations made with high temporal frequency should be distributed globally at least hourly.
Comment: Recent studies have shown that 4D-Var data assimilation systems or analysis systems with frequent update cycles can make excellent use of hourly data, e.g. from SYNOPs, buoys, profilers, and other automated systems, in particular automatic weather systems.
Next Actions: CBS to urge WMO Members to implement this recommendation at the earliest possible date.

(*b*) Observational data that are useful for meteorological applications at other NMHSs should be exchanged internationally, taking into account 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). Examples include high resolution radar measurements (i.e. products, both reflectivity and radial winds, where available) to provide information on precipitation and wind, surface observations, including those from local or regional mesonets, such as high spatial resolution precipitation networks, but also other observations, such as soil temperature and soil moisture, and observations from wave rider buoys. WMO Members summarize the data available in their regions and strive to make these data available via WMO real time or near-real-time information systems, whenever feasible.

Next actions: Rapporteurs/Coordinators on Regional Aspects of the GOS, via letter from Secretariat, be requested to provide information on data potentially available in this category. [The letter should request supply and alert potential users to plans]. ET-ODRRGOS in 2005 should review input and consider which potentially available data merit further action.

G2. Documentation - All observational data sources should be accompanied by good documentation including metadata, quality control and monitoring.

Next actions: (1) The WMO Secretariat to draft a letter to Members (NWP centres) requesting report of specific problems inhibiting effective use of available data. [In these letters Members should be asked to address problem areas for each data type. Reports should be specific and indicate what problems are preventing users from using data effectively.]; (2) ET-ODRRGOS will review responses; (3) Based on the analysis of 1 and 2 above, such information should become accessible through a centralized WMO Web page (late 2005).

G3. Timeliness and completeness - There should be a timely distribution of radiosonde observations with all observation points (not just mandatory levels) included in the message (together with the time and the position of each data point; information on instrument calibration prior to launch, and information on sensor type and sub-sensor type). Appropriate coding standards should be used to assure that the content (e.g. vertical resolution) of the original measurements, sufficient to meet the user requirements, is retained during transmission.

Comment: NWP OSEs have demonstrated the usefulness of full resolution data for NWP. The NWP OSE Workshop (Alpbach, 2004) reiterated the need for near real-time distribution of full resolution RAOB data.

Next actions: CBS to urge all Members with the existing capability of producing full vertical resolution sounding data to implement the transmission as soon as possible, starting in November 2005. Furthermore, CBS to ask all Members to generate, as soon as possible, sounding data in table-driven code forms (BUFR or CREX), following the technical specifications defined by CBS in the Guidance for Migration (See http://www.wmo.ch/web/www/documents.html#CodeTables). In the interest of timely data delivery, the first BUFR (or CREX) message should be sent when level 100 hPa is reached and the second message should be sent when the whole sounding is completed (containing all observation points). The delivery of the profile data in several stages may be necessary to accommodate the interests of other application areas, such as nowcasting and aeronautical meteorology. Collaboration with CIMO and various code groups should be established.

G4. Baseline system - Provide comprehensive and uniform coverage with at least 12-hour frequency of temperature, wind, and moisture profiles over mid-latitude continental areas and coastal regions. In tropical regions the wind profile information is particularly important.

Comment: Regional forecasting systems continue to show benefit from a comprehensive and uniform coverage with at least 12-hour frequency of temperature, wind, and moisture profiles over mid-latitude continental areas and coastal regions. In tropical regions the wind profile information is considered to be of particular importance. At this stage, the radiosonde and PILOT network still plays an important role in meeting these requirements (NWP OSE Workshop, Alpbach 2004). Profile data will continue to be collected from a mix of observing system components and will in the future be complemented by the utilization of satellite data over land. In polar regions, this need has not been addressed, however the linkage between CBS, CAS's THORPEX, and the International Polar Year should give guidance for that data-sparse region.

Next action: The OPAG on IOS chairperson in consultation with the chairpersons of the Regional Working Group on Planning and Implementation of WWW to ensure that operators and managers of regional observing systems are made aware of developments in this area (CBS in 2005).

G5. Stratospheric observations - Requirements for a stratospheric global observing system should be refined. The need for radiosonde, radiance, wind, and humidity data should be documented, noting the availability and required density of existing data sources, including GPS sounders, MODIS winds, and other satellite data.

Comment: The NWP OSE Workshop (Alpbach, 2004), suggested that OSE results on the usefulness of stratospheric observations should be consolidated. It also noted that the COSMIC satellite mission will likely provide a substantial enhancement to the stratospheric observing system. Furthermore, AOPC has noted that current *in situ* measurement capabilities for upper tropospheric and lower stratospheric water vapour are not meeting climate requirements and stressed the need for further technology development.
Next action: The ET-ODRRGOS to initiate further OSEs to include the use of COSMIC data when available. Results of OSEs to be reviewed and consolidated at that stage (2008).

Broader use of ground-based and in situ observations

G6. Ozone sondes - Near real-time distribution of ozone sonde data is required for calibration and validation of newly launched instruments and for potential use in NWP. [This recommendation is supported by information from the joint ECMWF/WMO Expert Team Meeting on Real-time Exchange of Ground-based Ozone Measurements (ECMWF, 17-18 October 1996), and the Third WMO Workshop on the Impact of Various Observing Systems on NWP (Alpbach, Austria, 912 March 2004)]

Next action: CBS and CAS to request WMO Members making ozone profile measurements to place data on the GTS in near real-time in BUFR/CREX format at the earliest possible date. The Secretariat to inform Members of this requirement and request Members to inform WMO of their implementation plans (November 2005).

Moving towards operational use of targeted observations

G7. Targeted observations - Observation targeting to improve the observation coverage in data-sensitive areas for NWP should be transferred into operations once the methodology has matured. Non-linear methods in targeting have been studied and should also be considered. The operational framework for providing information on the sensitive areas and responding to such information needs to be developed.

Comment: The proof of the observation targeting concept was given by United States Weather Service in the north-eastern Pacific winter storms and land-falling hurricane situations. THORPEX has declared observation targeting a core research activity in its implementation plan (2.3 ii), has successfully carried out jointly with EUCOS the NA-TreC campaign, and has benefited from the lessons learned from FASTEX.
Next action: The OPAG on IOS chairperson to maintain liaison and ensure targeting strategies developed by THORPEX are made available to the CBS.

Optimization of rawinsonde distribution and launches

G8. RAOBs - Optimize the distribution and the launch times of the rawinsonde subsystem (allowing flexible operation while preserving the GUAN network and taking into consideration regional climate requirements of the RBCN). Examples include avoiding duplication of ASAP soundings whenever ships are near a fixed rawinsonde site (freeing resources for observations at critical times) and optimizing rawinsonde launches to meet the local forecasting requirements. [This recommendation is supported by information from the EUCOS studies.]

Comment: Observation targeting requires a flexible observing practice. THORPEX has included this concept in their considerations.
Next actions: The ET-ODRRGOS to follow the THORPEX Implementation Plan and to learn from the THORPEX experience. When appropriate, ET-ODRRGOS to request Secretariat to inform Rapporteurs/Coordinators on Regional Aspects of the GOS and managers of observing systems of the requirements for adapting to flexible observing practices including taking observations on demand, while safeguarding the integrity of the baseline observing system.

Development of the AMDAR Programme

G9. AMDAR technology should provide more ascent/descent profiles, with improved vertical resolution, where vertical profile data from radiosondes and pilot balloons are sparse as well as into times that are currently not well observed such as 2300 to 0500 local times. [This recommendation is supported by information from the Toulouse report, ECMWF northern hemisphere AMDAR impact study, OSEs 4, 5, 8]

Progress: The AMDAR Panel plans to coordinate homogeneous coverage of AMDAR data over 24 hours over as many regions as possible and to improve the value of upper-air data through a combination of:
(*a*) Expanding the number of operational national and regional programmes;
(*b*) Development and use of new onboard software and alternative AMDAR technologies;
(*c*) Selective deployment of humidity/water vapour sensors;
(*d*) Provision of targeted observations into data-sparse areas and special weather situations;
(*e*) Use of optimization systems to improve cost effectiveness;
(*f*) Improvements in the monitoring, quality control;

(*g*) Efforts to encourage and pursue the free exchange of data; and
(*h*) Improvements in user awareness and training plus operational forecasting tools and systems.

The AMDAR Programme implementation table is as follows:

Programme items	2005-2006	2008	2010
Operational programmes (Australia, E-AMDAR*, New Zealand, USA, South Africa)	Expanding	Stable	Stable
Emerging programmes (Hong Kong, China, Saudi Arabia, Japan, Canada, central-western Africa)	Expanding	Expanding /stable	Stable
Developing programmes (Chile, Argentina, United Arab Emirates, Republic of Korea, China)	First data	Expanding	Stable
Planned programmes (eastern-central Europe**, Russian Federation, Oman, Egypt, Morocco, Kenya, Pakistan, India, Iran, Israel, Libya))		First data	Expanding
Development of software and technologies	Work in progress	Operational	Stable
Humidity/water vapour sensors	Operational trials	Expanding	Operational
Targeted data	Partly operational	Expanding	Expanding
Optimisation systems	Partly operational	Expanding	Expanding
Data monitoring, quality control and data exchange	Ongoing	Ongoing	Ongoing
Awareness and training	Ongoing	Ongoing	Stable
Development of operational forecasting tools	In progress	Operational	Operational

* E-AMDAR: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom

** Eastern-central Europe: Poland, Romania, Ukraine, Czech Republic

Next actions: The ET-ODRRGOS to continue to monitor progress of the AMDAR Programme in the above activities. Several Members expressed their willingness to participate actively in the AMDAR programme supporting the need for training experts from developing countries.

G10. Transmission of AMDAR reports - Optimize the transmission of AMDAR reports taking into account, en route coverage in data-sparse regions, vertical resolution of ascent/descent reports and targeting related to the weather situation. [This recommendation is supported by information from the Toulouse and Alpbach NWP OSE Workshop reports, ECMWF northern hemisphere AMDAR impact study].

Comment: AMDAR coverage is both possible and sorely needed in several currently data-sparse regions, especially Africa and South America, the Canadian arctic, northern Asia and most of the world's oceans. More T, U/V, Q profiles, but especially winds, are needed in the tropics. Moreover, the timing and location of reports, whose number is potentially very large, can be optimized while controlling communications costs.
Next action: The Rapporteur on AMDAR Matters to report progress to ET-ODRRGOS. Members in the Regions must assume responsibility of implementation.

G11. Humidity sensors on AMDAR - Further development and testing of water vapour sensing systems is strongly encouraged to supplement the temperature and wind reports from AMDAR. [This recommendation is supported by information from the Toulouse and Alpbach NWP OSE Workshop reports]

Progress: Demonstration of WVSS-2 is expected in 2004-2005. This system employs an absolute measurement of water vapour content that is expected to be accurate from the ground to flight altitudes.
Next action: The Rapporteur on AMDAR Matters to report progress of AMDAR programme to ET-ODRRGOS.

Alternative AMDAR systems

G12. TAMDAR and AFIRS - To expand ascent/descent profile coverage to regional airports, the development of TAMDAR, and use of AFIRS should be monitored with a view towards operational use.

Comment: A range of systems including TAMDAR, AFIRS and MDS could supplement conventional AMDAR and radiosonde data by providing lower level en route observations and profiles over additional, regional airports not served by larger AMDAR compatible aircraft. Instrumentation would not necessarily be designed to function in the high troposphere and would therefore be less expensive.

Next action: The ET-ODRRGOS to review progress under the AMDAR and EUCOS Programmes. First data from TAMDAR and AFIRS are expected in late 2004.

Atmospheric moisture measurements

G13. Ground GPS - Develop further the capability of ground-based GPS systems for the inference of vertically-integrated moisture with an eye toward operational implementation. Ground-based GPS processing (zenith total delay (ZTD) and precipitable water, priority for ZTD) should be standardized to provide more consistent data sets. Data should be exchanged globally. [This recommendation is supported by information from the NWP OSE Workshop in Alpbach.]

Comment: Such observations are currently made in Europe, North America and Asia. It is expected that the global coverage will expand over the coming years. The COSNA/SEG, NAOS, JMA reports provide useful background information.

Next Actions: CBS to urge Members to collect and exchange the ground-based GPS data. Members should take the appropriate action to ensure that the data processing be standardized by November 2005. Collaboration with CIMO should be established.

Regarding improved observations in ocean areas

G14. More profiles over oceans - Increase the availability of high vertical resolution temperature, humidity and wind profiles over the oceans. Consider as options ASAP and dropsondes by designated aircraft.

Next action: The ET-ODRRGOS to request a review from JCOMM on the current status and plans of ASAP.

G15. Telecommunications - Considering the expected increase in spatial and temporal resolution of in situ marine observing platforms (from include drifting buoys, profiling floats, XBTs for example) and the need for network management, the bandwidth of existing telecommunication systems should be increased (in both directions) or new relevant satellite telecommunications facilities should be established for timely collection and distribution.

Comment: The JCOMM Operations Plan provides background for actions in this area.

Next action: The ET-ODRRGOS to request information on progress regarding distribution of increased temporal and spatial resolution in situ marine observations from JCOMM.

G16. Tropical moorings - For both NWP (wind) and climate variability/climate change (sub-surface temperature profiles), the tropical mooring array should be extended into the tropical Indian Ocean at resolution consistent with that presently achieved in the tropical Pacific and Atlantic Oceans. [The JCOMM Operations Plan provides background for actions in this area.]

Next action: ET-ODRRGOS to request information on progress in extending the tropical mooring array from JCOMM.

G17. Drifting buoys - Adequate coverage of wind and surface pressure observations from drifting buoys in the Southern Ocean in areas between 40°S and the Antarctic Circle should be assured using an adequate mix of SVPB (surface pressure) and WOTAN technology (surface wind). The pressure observations are a valuable complement to the high-density surface winds provided by satellite. [This recommendation is supported by information in the Toulouse NWP OSE Workshop Report and the ET-ODRRGOS OSE studies.]

Comment: Plans from agencies other than JCOMM need to be considered.

Next actions: (1) The ET-ODRRGOS to request information from JCOMM on plans for preserving/enhancing the network; (2) The ET-ODRRGOS to review requirement for surface pressure observations in ocean areas based in results of OSE studies (EUCOS).

G18. XBT and Argo - For ocean weather forecasting purposes, improve timely delivery and distribute high vertical resolution data for sub-surface temperature/salinity profile data from XBTs and Argo floats.

Note: The JCOMM Operations Plan provides background for actions in this area.

Next actions: (1) The ET-ODDRGOS to request information on progress from JCOMM for the next ET-ODRRGOS meeting. (2) The ET-ODRRGOS to review adequacy for WMO requirements.

G19. Ice buoys - For NWP purposes, coverage of ice buoys should be increased (500 km horizontal resolution is recommended) to provide surface air pressure and surface wind data.

Note: The JCOMM Operations Plan provides background for actions in this area.
Action: The ET-ODRRGOS to request information on progress regarding ice buoys from JCOMM.

Improved observations over tropical land areas

G20. More profiles in tropics - Temperature, wind and if possible humidity profile measurements (from radiosondes, PILOTs, and aircraft) should be enhanced in the tropical belt, in particular over Africa and tropical America.

Comment: There is evidence from recent impact studies with the radiosonde/PILOT balloon network over the Indonesian/Australian region that such data give a better depiction of winds in the tropics and occasionally strongly influence the adjacent mid-latitude regions.
Action: Rapporteurs on AMDAR and GCOS Matters to report to ET-ODRRGOS. CBS to urge Members to consider activation of silent stations through a shared funding programme.

New observing technologies

G21. AWS - Noting the widespread adoption of AWS, there should be coordinated planning that includes:

- Appropriate codes and reporting standards;
- Global standard for quality management and the collection/sharing of metadata; and
- Expanded range of measured parameters.

Next action: The ET-AWS to be asked to provide a summary of standards for coding and reporting, sharing of metadata, and advances in technology for ET-ODRRGOS.

G22. New systems - In the context of THORPEX, the feasibility of new systems should be demonstrated as much as possible. These possible operational sub-systems include but are not limited to:

- Ground-based interferometers and radiometers (e.g. microwave) that could provide continuous vertical profiles of temperature and humidity in selected areas;
- Unmanned aeronautical vehicles (UAVs);
- High altitude balloons;
- Lidars.

Action: The OPAG on IOS chairperson to liaise with the THORPEX ICSC and keep the relevant ETs informed. Collaboration with CIMO should be established.

3.3 Additional high priority recommendations for the evolution of the GOS

Interaction between NWP centres, data providers and users

N1. New data types - NWP centres should receive early (advance) information about, and experience with, new data types; this includes: (*a*) early access to test data and observations during the cal/val phase to prepare for the operational use of the data; and (*b*) information on the characteristics of the data and products (e.g. AMVs which may be representative of atmospheric layers rather than just one level over layers). [This recommendation is supported by information contained in the report from the Alpbach NWP OSE Workshop.]

Comment: Data assimilation and modelling capabilities have grown and are under constant development to make optimal use of current and future observing systems.
Action: The ET-ODRRGOS through the OPAG on IOS chairperson and CBS/CGMS to encourage data producers to provide metadata on observations and observing systems as early as possible. Several Members expressed their willingness to participate actively in providing regional ATOVS retransmission services with other NMHSs concerned.

N2. Data from research satellites – R&D systems provide valuable data for NWP, which should be made available in a timely fashion. Research satellite data provide NWP centres with an excellent opportunity to prepare for new satellite data streams, which will become part of the operational global observing system. Effective learning of how to make use of new data types can best be achieved through operational use of any experimental data streams. [This recommendation is supported by information contained in the report from the Alpbach NWP OSE Workshop.]

Action: The WMO Space Programme, in coordination with ET-ODRRGOS, through CBS and CGMS, to encourage operators of R&D satellites to provide early access to observations.

N3. Timely data delivery – Data-processing and delivery systems should strive to meet NWP requirements of 30 minutes as much as possible.

Comment: The requirements for early delivery and frequent updates of forecast guidance have evolved over recent years. NWP centres have significantly reduced their data cut-off times at the expense of available observations in their data assimilation processes. Timeliness requirements for observational data are becoming more stringent for NWP centres. HH + 20 to 90 minute data cut-off times are currently applied for many NWP short-range runs. Late data can only be assimilated in update runs with long data collection times (several hours). Within the next few years, a data processing and delivery time of approximately 20 to 30 minutes is expected to be the operational requirement used in medium and short-range forecasts. Any minute gained is useful because observation arrival drives the rest of the forecast production chain.

Action: The WMO Space Programme, in coordination with ET-ODRRGOS, through CBS and CGMS, bring to the attention of data producers the more stringent timeliness requirements for observational data at NWP centres (NWP OSE Workshop, Alpbach 2004).

O1. Observing system study - support well-resourced studies of re-designed observing systems. This is an ongoing process.

Next actions: The ET-ODRRGOS to monitor and learn from EUCOS and THORPEX demonstration studies of observing system capabilities. EUCOS studies evaluating the relative importance and the impact of the ground-based and space-based sub-systems will soon be commissioned (2005). This will result in an information exchange through documentation and workshops as appropriate.

T1. Training and information exchange for GOS utilization – Support for sustained training must be realized as a primary means to assist WMO Members towards full exploitation of surface-based and satellite-based sub-systems of the GOS. Training must address data access, data use, and training of trainers. Networks for information exchange toward improved utilization of the GOS must be encouraged.

Recent progress: A review process has been initiated and will be continued by the ET-SSUP with the issuance of a biennial questionnaire. Analysis of the questionnaire provides input to the CBS for WWW utilization.

Next actions: For sustained training and education programme, CBS continue to solicit support from Members (e.g. capacity-building training) and space agencies (e.g. CGMS/WMO Virtual Laboratory). The WMO Space Programme, in collaboration with WMO Members and CGMS, continue to foster international groups and networks such as the International TOVS Working Group, the International Winds Workshops, and the International Precipitation Working Group that provide forums for information and algorithm exchange.

4. Considerations for the evolution of the GOS in developing countries

4.1 In drafting this implementation plan, it was considered that in many areas of Africa, Asia and Latin America (Regions I, II and III and some tropical areas between 25°N and 25°S), the current GOS provides no observations, whereas in other areas observations should be improved. When looking at candidate observing systems, consideration must be given not only to NWP but also to many other applications, including human forecasting. The evolution of the GOS in developing countries must address some of the issues that fall in three categories: (*a*) lack of public infrastructure such as electricity, telecommunication, transport facilities, etc.; (*b*) lack of expertise from people to do the job, training, etc.; and (*c*) funding for equipment, consumables, spare parts, manpower, etc. The lack of infrastructure and expertise may be the result of a lack of funding.

4.2 The evolution must take into account upgrading, restoring, substitution and capacity-building (especially in the use of new technologies). Two aspects need to be considered: the data production and the data use. It is possible that some countries do not and will not be able to produce data and will therefore only be users of data. To help developing countries produce data for international exchange, due consideration must be given to the three issues previously identified, i.e. public infrastructure, expertise and funding.

4.3 Possible approaches towards the redesign have been discussed. A first step should be to identify observing systems that are less dependent on local infrastructure. In some circumstances, these include satellite, AMDAR, dropsondes and AWS. Nonetheless, a minimum set of reliable radiosonde observations (RAOBs) is required as a backbone to GUAN and RBCN; these are also used to validate the satellite observations. Migration toward the table-driven codes (BUFR or CREX) as a reliable representation of the data is expected.

4.4 However, obtaining vertical profiles by AMDAR in many data-sparse areas is worth testing. It must be recognized that AMDAR ascent/descent and en route data will provide little stratospheric information and currently no humidity data (although humidity sensors are being tested). It is imperative that useful approaches be drafted for studying the impact of additional observations (e.g. AMDAR) in regions of scarce conventional observations (e.g. RAOBS) and discuss possible observing system experiments to explore enhancing the observations on these areas. More generally, the role of developing countries in THORPEX through the regional associations should be explored.

4.5 It was felt that capacity-building in some countries needed further attention. Some countries have satellite receiving stations or receive satellite data through the GTS, but lack the expertise to utilize the information to their benefit. Some countries are acquiring Doppler radar but need training on how to retrieve the information. For example, Region I has benefited with expanded access to conventional data and satellite imagery through the PUMA project. This type of project should be expanded to include other data types for routine application (synoptic, aviation, nowcasting).

4.6 If resources are available, the highest priority should go to: (*a*) maintaining the RBSN and RBCN, noting that GSN and GUAN stations are part of the RBSN; and (*b*) rehabilitate observing sites in critical locations.

4.7 Finally, the following recommendations should be taken into account when addressing the evolution of the GOS in developing countries:

(*a*) Define geographical areas using advanced techniques to help identify where priority should be if additional funding was available;

(*b*) Encourage regional associations in concert with CBS to define trial field experiments over data-sparse areas, for a limited time, to evaluate how additional data would contribute to improve performance at the regional and global scale. A clearly demonstrated impact might make it easier to agree on some coordinated funding mechanism for areas concerned including funding from the Global Environment Facility (GEF) for climate and radiation stations;

(*c*) Examine whether automated stations could become a viable, cost effective alternative to manned stations for the surface network in the future;

(*d*) In data-sparse areas of the world, it may be more cost-effective to make full use of AMDAR ascent/descent data at major airports; however the RAOB network still plays an important role in human forecasting;

(*e*) When changes are made to the climate observing systems, the GCOS Climate Monitoring Principles should be followed;

(*f*) The telecommunication problems should be referred to the OPAG on ISS and looked at as a priority;

(*g*) Prioritize where the needs are most pressing for VCP or other funding;

(*h*) High priority should be given by the region and the Secretariat to maintain a minimum RAOB network with acceptable performance within data challenged regions.

5. Specific OSEs carried out to asses possible reconfiguration of the GOS

In the course of the development a global approach to redesign of the GOS, the ET-ODRRGOS kept under permanent review the impact assessments studies being conducted by NWP centres under regional programmes such as COSNA, EUCOS and NAOS. The ET-ODRRGOS found that findings of COSNA, EUCOS and NAOS as well as conclusions and recommendations of the Toulouse and Alpbach Workshops on Impact of Various Observing Systems on NWP provided essential input to the redesign process of the GOS. Accordingly, the ET-ODRRGOS strongly supported the workshop recommendation that impact studies should be carried out for a sufficiently long period, preferably in each of four seasons and that the statistical significance of the results should be established. In addition, the ET-ODRRGOS suggested nine OSEs for consideration by NWP centres and asked the OSE/OSSE Rapporteurs (Jean Pailleux and Nobuo Sato) to engage as many as possible in this work. Good response was received and results are coming in. The OSEs name and the initial results from the contributing NWP centres are listed below:

1. Impact of hourly versus six-hourly surface pressures. Using 4D-VAR assimilation ECMWF found positive impact especially over the north Atlantic and southern oceans.
2. Impact of denial of radiosonde data globally above the tropopause. The Canadian AES report found positive impact from RAOB data above the tropopause.
3. Information content of the Siberian radiosonde network and its changes during last decades. The Main Geophysical Observatory in St Petersburg found that information content was ascending until 1985, descending thereafter. NCEP related a decrease in performance of 500 hPa height analysis over North America to a decrease in Siberian RAOBs.
4. Impact of AMDAR data over Africa through data denial in a 4D-VAR analysis and forecasting system. ECMWF showed that denial over the northern hemisphere of observations below 350 hPa has large significant impact in summer and winter. Investigation of African AMDAR large significant negative impact is pending at *Météo-France*.
5. Impact of tropical radiosonde data. The Met Office varied the density of South-East Asia RAOBs used in assimilation and produced high impact on winds at all levels with occasional propagation of impact to mid-latitudes. Temperature and wind information is the most important potential measurements from AMDAR in less well-observed tropical areas (e.g. Africa, Central America).

6. Impact of three LEO AMSU-like sounders (NOAA –15, - 16, and -17 plus AQUA). ECMWF showed large positive impact from two AMSUs over one MSU. The Met Office showed positive impact of three over two AMSU when NOAA-17 was added to the GOS.
7. Impact of AIRS data. ECMWF found that addition of one AIRS to a baseline observing system without satellites showed more impact than addition of one AMSU. Furthermore, AIRS impact on the full GOS was positive (but initially small).
8. Impact of better than three-hourly ascent descent AMDAR data. Preliminary northern hemisphere AMDAR ascent/descent impact suggests positive effect of higher frequency data. EUCOS arranged higher frequency observations in 2003 to enable this study by the Met Office and ECMWF.
9. Impact of polar winds from MODIS water vapour imagery. Initial 30-day impact study at ECMWF and NASA DAO showed that forecasts of the geopotential height for the Arctic, northern hemisphere extratropics, and Antarctica are improved significantly. Subsequent usage at more than 10 NWP centres has confirmed positive impact of MODIS polar WV winds.

6. Dates of update for Statements of Guidance

Synoptic Meteorology (April 2001)
Nowcasting and Very-Short-Range Forecasting (April 2001)
JCOMM Ocean Applications Areas (January 2002)
Seasonal to Inter-annual Forecasts (November 2003)
Aeronautical Meteorology (November 2003)
Global Numerical Weather Prediction (December 2003)
Numerical Weather Prediction (January 2004)
Agrometeorology (July 2004)
Hydrology (July 2004)
Atmospheric Chemistry (July 2004)

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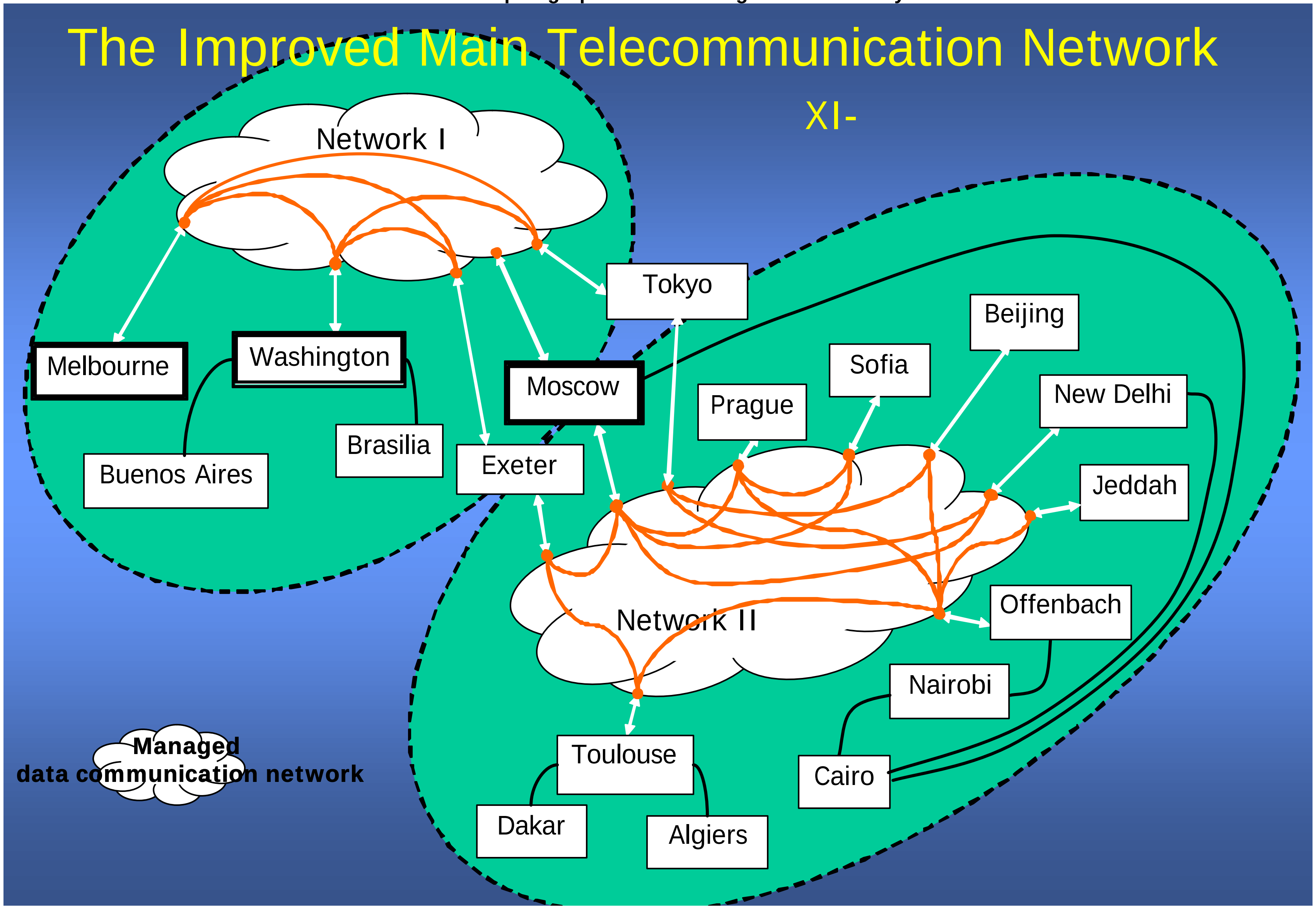

ANNEX V

Annex to paragraph 5.2.71 of the general summary

CODE MIGRATION SCHEDULE

Category ®	**Cat.1: common**	**Cat. 2: satellite observations**	**Cat. 3: aviation[1]**	**Cat. 4: maritime**	**Cat. 5[2]: miscellaneous**	**Cat. 6[2]: almost obsolete**
Lists of ® ***Traditional code forms*** ***Schedule*** ¯	SYNOP SYNOP MOBIL PILOT PILOT MOBIL TEMP TEMP MOBIL TEMP DROP CLIMAT CLIMAT TEMP	SAREP SATEM SARAD SATOB	METAR SPECI TAF AMDAR ROFOR	BUOY TRACKOB BATHY TESAC WAVEOB SHIP CLIMAT SHIP PILOT SHIP TEMP SHIP CLIMAT TEMP SHIP	RADOB IAC IAC FLEET GRID*(to GRIB)* MAFOR HYDRA HYFOR RADOF	CODAR ICEAN GRAF NACLI etc. SFAZI SFLOC SFAZU RADREP ROCOB ROCOB SHIP ARFOR WINTEM
Start experimental exchange[3]	**Nov. 2002** for some data (AWS SYNOP, TEMP USA)	Current at some Centres	**2006** **2002** at some Centres for AMDAR	**2005** **2003** for Argos data (BUOY, sub-surface floats, XBT/XCTD)	**2004**	Not applicable
Start operational exchange[3]	**Nov. 2005**	Current at some Centres	**2008** **2003** for AMDAR	**2007** **2003** for Argos data (BUOY, sub-surface floats, XBT/XCTD)	**2006**	Not applicable
Migration complete	**Nov. 2010**	**Nov. 2006**	**2015** **2005** for AMDAR	**2012** **2008** for Argos data (BUOY, sub-surface floats, XBT/XCTD)	**2008**	Not applicable

(1) Aviation codes require ICAO coordination and approval, except for AMDAR.

(2) For category 5 consider that codes need to be reviewed in order to decide whether or not they should be migrated to BUFR/CREX. Codes in category 6 are not to be migrated.

(3) All dates above are meant as "not later than". However, Members and organizations are encouraged to start experimental exchange, and, if all relevant conditions (see below) are satisfied, to start operational exchange as soon as possible.

NOTES:

(*a*) Start of experimental exchange: data will be made available in BUFR (CREX) but not operationally, i.e. in addition to the current alphanumeric codes, which are still operational;

(*b*) Start of operational exchange: data will be made available in BUFR (CREX) whereby some (but not all) Members rely on them operationally. Still the current alphanumeric codes will be distributed (parallel distribution);

(*c*) Migration complete: at this date the BUFR (CREX) exchange becomes the standard WMO practice. Parallel distribution is terminated. For archiving purposes and at places where BUFR (CREX) exchange still causes problems, the alphanumeric codes may be used on a local basis only.

Relevant conditions to be satisfied before experimental exchange may start:

(*a*) Corresponding BUFR/CREX tables and templates are available;

(*b*) Training of concerned testing parties has been completed;

(*c*) Required software of testing parties (encoding, decoding, viewing) is implemented.

Relevant conditions to be satisfied before operational exchange may start:

(*a*) Corresponding BUFR/CREX tables and templates are fully validated;
(*b*) Training of all concerned parties has been completed;
(*b*) All required software (encoding, decoding, viewing) is operational.

ANNEX VI

Annex to paragraph 5.3.4 of the general summary

FORECAST STANDARDS, PROCEDURES AND PROCESSES AND/OR RECOMMENDED PRACTICES

Statements of WMO constituent bodies

Congress was of the view that the establishment of a WMO standard and/or recommended practices for weather forecasting techniques would assist in producing more reliable forecasts, using optimally the current levels of meteorological science and technology. CBS has been requested to study the matter with a view to taking appropriate steps to develop recommendations.

The Executive Council noted with satisfaction that CBS had started work on the development of WMO standards or recommended practices for weather forecasting as requested by Fourteenth Congress.

Objective

The ultimate objective of defining recommended practices for short-range weather forecasting is the improvement of weather forecasts.

By defining the various steps that compose the short-range forecast process, the recommended practices facilitate the task of identifying the specific step(s) that need to be adjusted and/or improved.

Factors to consider

It is not easy to define standards and/or recommended practices. The way the forecaster works depends on several factors:

(*a*) The forecast range (medium range, short range, nowcasting) and the size of the domain to be covered (globe, regional domain, small country, city);
(*b*) The geographical context and related climatology (mid-latitudes, tropical or equatorial areas, isolated islands);
(*c*) The potential risk associated with the expected weather at various ranges;
(*d*) The organization of the forecast service (multipurpose forecasters or specialized forecasters for each type of applications);
(*e*) The end-user who receives the forecasts (civil defence, aviation, marine, hydrologic and water management service, road administration, medias, public);
(*f*) The technical environment (available external and/or internal NWP products, in situ observations, satellite and radar images, lightning detection network, efficient visualization workstation adapted to the forecaster, Web access).

It is also worth noting that the skill of numerical models and statistical post-processing methods have improved significantly over the years and will continue to improve to the point that some centres are automating routine forecasts to allow forecasters to focus on high impact weather or areas where they can add significant value.

The products or forecasts that can be automated are those for which the forecasters add little or no value. Any forecast, produced either by a forecaster or automatically, has to be verified to assess the quality of the forecasts and their improvements over the years as models or techniques continue to improve. This also contributes to identify deficiencies in the models and areas for future improvements.

Relevant information

- *Guidelines for the Education and Training of Personnel in Meteorology* and *Operational Hydrology* (WMO-No. 258);
- *Guide on the Global Data-processing and Forecasting System* (WMO-No. 305);
- *Guide on the Automation of Data-processing Centres* (WMO-No. 636);
- *Guide to Practices for Meteorological Offices Serving Aviation* (WMO-No. 732);
- *Guide to Marine Meteorological Services* (WMO-No. 471);
- *Guide to Public Weather Services Practices* (WMO-No. 834);
- *Guide to Hydrological Practices* (WMO-No. 168);
- *Manual on the Global Data-processing and Forecasting System* (WMO-No. 485).

From a general point of view, it can be said that the aim of a National Meteorological Centre is to perform a clear analysis of the present weather, to provide weather forecasts, to evaluate the level of risk associated with the expected important meteorological phenomena and to issue as soon as possible pertinent warning to the concerned user.

Recommended practices

The following steps are recommended practices for the weather analysis and forecast process for the short-range forecasting process:

- Evaluating the present meteorological situation;
- Examining the quality and relevance of the analysis;
- Identifying the key elements of the meteorological situation, according to the accepted conceptual models and/or guidance/tools;
- Examining the various guidance and choosing the most likely scenario;
- Describing the evolution in the atmosphere corresponding to the chosen scenario;
- Deducing the consequences for smaller scale and specific areas;
- Describing the expected weather in terms of weather elements (including automated production techniques when applicable);
- Deciding on the opportunity/necessity to issue/end special warning;
- Distributing the various products to users;
- Evaluating according to performance measurements/verifying forecasts.

It is noted that these steps will need to be adjusted by the NMHSs depending on various factors previously described. Also, these recommended practices would need to be examined and/or refined for nowcasting forecasts and medium-range forecasts and beyond. However a performance measurement system is judged essential to ensure that products are of good quality, to assess improvements, identify deficiencies and area for improvements.

The need for training and education should be fulfilled by following the guidelines for education and training and in particular the components that relate to meteorologists.

Quality management

The Workshop on Quality Management (Kuala Lumpur, 26-28 October 2004) recommended that the consideration of quality control aspects related to forecasting and warning products and services be addressed in connection with the standing tasks of CBS. The recommended practices defined above are the first steps of this process.

It should be noted that the term ISO refers to a set of quality management standards which are process standards, not product quality standards.

The Commission agreed on these recommended practices and encouraged NMHSs to apply them and report on their experiences.

ANNEX VII

Annex to paragraph 5.3.23 of the general summary

GENERAL TERMS FOR SEVERE WEATHER FORECASTING DEMONSTRATION PROJECT

Goals:

(*a*) To improve the ability of NMCs to forecast severe/extreme weather events;
(*b*) To improve the lead time of the alerting of these events;
(*c*) To improve interaction with disaster management and civil protection agencies before and during event;
(*d*) To identify gap and areas for improvements.

Sub-goals:

(*a*) To evaluate the value of probabilistic forecasts and the skill of EPS products;
(*b*) To enhance capacity of NMCs (training, capacity-building, etc.).

Three–level approach:

(*a*) Global NWP centres: producers of products;
(*b*) Regional centres with human and technical capability to run NWP models over a limited area, to interpret products from global NWP centres;
(*c*) NMCs with sufficient capacity to benefit from the project.

Roles of each centre:

Global NWP centres:

Commitment to provide a range of NWP products over areas covered by the project for the duration of project(s): deterministic models (e.g. mesoscale where available), EPS output such as extreme weather index, probability precipitation/wind exceeding a certain threshold.

Regional centres:

(*a*) Interpret information received from global NWP centres, develop diagnostics products/guidance material on potential of severe weather based on EPS products (time frame 3-5 days ahead of time); make the information available to participating NMC(s);
(*b*) As it gets closer to the event, run mesoscale model to refine products, confirm potential for severe/extreme weather, provide more detailed information (36-48H);
(*c*) Establish communications between the regional centre and participating NMC;
(*d*) Evaluation of approach from regional centre perspective;
(*e*) Provide feedback to participating global NWP centres.

NMCs:

(*a*) Liaise with disaster management and civil protection agencies;
(*b*) Establish contacts with above agencies prior and during event;
(*c*) Interpret information received from regional centres and assess diagnostics products against available information and make adjustments as required;
(*d*) Apply nowcasting techniques;
(*e*) Issue alert, advisory, warning as appropriate;
(*f*) Evaluation of cascade approach from a forecaster perspective;
(*g*) Provide feedback to regional centre on usefulness and skill of product;
(*h*) Get feedback from users.

Criteria for participation

The project will only succeed if participating NMCs agree to meet certain pre-determined criteria. Participating centres must meet the requirements listed below.

Global NWP centres:

(*a*) Commit to provide agreed upon information during duration of project;
(*b*) Consider feedback from users as appropriate;
(*c*) Provide a contact person for the project.

Regional centres:

(*a*) Ability to interpret, use and evaluate products from global NWP centres;
(*b*) Ability to run limited area model over the region considered;
(*c*) Provision of training to participating NMCs as required;
(*d*) Provide a lead person for the duration of the project.

NMCs:

(*a*) Minimum communication bandwidth of 64 kbps;
(*b*) Operational and real-time access to satellite data and some observations from ground stations;
(*c*) Adequate telecommunication system to receive/transmit information;
(*d*) Appropriate workstation that meet data-processing standards;
(*e*) Provisions of senior forecaster for the duration of the project that must meet WMO standard training for meteorologist: meteorologist who acquired at the university an appropriate knowledge of mathematics, physics, and chemistry and completed a degree specialized in meteorology;
(*f*) Provision of a lead person for the duration of the project;
(*g*) Commitment to establish liaison with disaster management and civil protection agencies within their country.

Potential participants will have to demonstrate that they meet the above criteria.

More general criteria:

(*a*) Regional centres and NMCs would be from the same region and be able to communicate in the same language;
(*b*) Must be in area where severe weather is encountered;
(*c*) Ability and commitment to participate in the evaluation of the experiment: criteria, indicators, etc.;
(*d*) The project must be sustainable: use of existing capacity, ongoing commitment of participating centres, ongoing assessment of usefulness and skill.

ANNEX VIII

Annex to paragraph 5.3.57 of the general summary

WORKSHOP ON DEVELOPMENT OF SCOPE AND CAPABILITIES OF EMERGENCY RESPONSE ACTIVITIES: ISSUES AND STATEMENTS RELATED TO "DEVELOPMENT OF SCOPE", "DEVELOPMENT OF CAPABILITIES", "ORGANIZATIONAL ISSUES" AND "GUIDING PRINCIPLES"

(excerpt from the Report of the Workshop, Geneva, 7-10 December 2004)

………..

Development of scope of non-nuclear ERA

7.1 In the context of developing the ERA programme beyond nuclear emergency response, it was recognized that RSMCs designated in this activity specialization have on a case-by-case basis developed systems and provided emergency response support in various non-nuclear environmental emergencies. As well, there are numerous other specialized NMCs which have the capability to apply atmospheric transport and dispersion models to bear on non-nuclear emergency response situations.

7.2 The Workshop learned that many NMCs have made very significant progress in the recent few years in the development of their capabilities in atmospheric transport and dispersion modelling for non-nuclear environmental emergencies, for example regarding smoke plumes from large fires, releases from chemical accidents, volcanic ash and gases from volcanoes, airborne diseases or pests.

7.3 The Workshop emphasized the importance of recognizing that the ERA programme is focused on "emergencies", where the meteorological and hydrological support has the requirement to be rapid as well as scientifically sound. Air quality services are considered to be routine and, in that context, cover air quality extremes. The same distinction could be made of a spill of a hazardous material in water as an emergency, in contrast with routine water quality information and services.

7.4 The Workshop concluded, from the results of the survey of NMHSs, that the main area of attention in the development of scope of ERA should be in the meteorological support to emergencies related to chemical incidents, and secondarily in the area of smoke dispersion from wildland fires. The emphasis on chemical incidents was welcomed by ICAO and the International Programme on Chemical Safety (WHO/ILO/UNEP). While the primary focus would be in these areas, enhancement of capabilities should still continue on other aspects. In addition, specialized centres could be asked to contribute meteorological support in the event of a real environmental emergency, irrespective of the priorities that have been decided, for example airborne spread of a disease.

7.5 The Workshop recognized that some relevant programme development work has already been done in the area of meteorological support to chemical accidents. The CBS Ext.(1998) concluded on a number of aspects related to environmental emergency response, including definition of requirements concerning chemical incidents, the role of national meteorological Services (in environmental emergency response), and guidance for development of the interface between National Meteorological Services and other emergency response agencies in case of chemical incidents (see general summary paragraphs 4.3.29-4.3.33 in the *Abridged Final Report with Resolutions and Recommendations of the Extraordinary Session of the Commission for Basic Systems* (WMO-No.893)).

7.6 The meteorological and hydrological emergency support in the case of a sudden and acute contamination of freshwater bodies is not widely available. This aspect includes both the direct release of a hazardous substance into water as well as atmospheric deposition into the water. The modelling of river flows or currents, for example, could be modified to include the modelling of transport of hazardous substances. The meeting discussed the information needed to develop alerts systems for rivers. In this relation the meeting was informed on the recently appointed CHy expert on disaster mitigation.

7.7 With respect to volcanic eruptions, the problem of airborne ash at cruising altitudes of aircraft operations is well addressed by the experts of the ICAO's International Airways Volcano Watch Operations Group (IAVWOPSG) (whose membership include all Volcanic Ash Advisory Centres (VAACs)). Standardized products and services have been implemented for use by aircraft operations and air traffic control. Other hazards from volcanic eruptions that have atmospheric implications and public safety impacts include ash fall, or emissions of hazardous gases; these, however, require additional attention.

7.8 International organizations involved in a broad range of emergency response and relief, for example WHO, could contribute valuable knowledge and experience on the health and environmental impacts of disasters around the globe, and assist in determining the potential meteorological support needed. These international organizations could also benefit from such collaboration.

7.9 The Workshop recognized that the benefits of the expanded programme will extend to enhancing emergency preparedness and response of those countries involved in the programme.

Development of capabilities in non-nuclear ERA

7.10 The Workshop concluded that in the development of the technical capabilities, for the community of NMHSs, ranging from specialized centres to centres with limited capabilities for emergency response, a number of issues would require consideration. These include:

(*a*) The tools (e.g. numerical models) of the trade, the components for emergency response systems and the tools sets needed by the NMHSs;

(*b*) More detailed source term information for each type of incident may be needed and this could include source term modelling systems;

(*c*) Observational data (meteorological, hydrological and sampling) and remotely-sensed information are needed to facilitate the validation of numerical modelling tools and desirable to reduce uncertainties and should be made available if possible through previously agreed communication means (e.g. GTS, Internet);

(*d*) The need to understand and establish the user requirements against which NMHSs have to deliver emergency meteorological and hydrological support. The users include the national emergency management agencies and civil protection authorities;

(*e*) For international response, standards need to be defined and considered, e.g. basic products, format, information content, defaults values for unknown parameters, procedures; the method of request and delivery of products and services including response time and products updates need to be defined;

(*f*) Incidents implicate potentially a wide range of scales (time and space) and environments (including urban or populated environment), implying that possibly different kinds of capabilities (solutions) are needed;

(*g*) That the capacity of NMHSs, specialized centres and RSMCs is limited, or has a limit. Development of capabilities requires commitment of additional resources in order that the additional meteorological and hydrological support be sustainable;

(*h*) Some minimum meteorological and hydrological expertise is needed to integrate all available information and guidance (dispersion model outputs) to conclude on the meteorological and hydrological advice and support to emergency response;
(*i*) Capacity-building should require the joint commitment from the requesting NMHSs as well as the specialized centres with a view to establish self-sufficiency at the requesting NMHSs;
(*j*) Training will have to be provided. The use of past events would be most relevant; computer-aided learning type (e.g. COMET) training could be effective;
(*k*) Routine emergency response testing and exercises are needed and contribute to the training and capacity-building process;
(*l*) A meteorological and hydrological system management tool for emergency response might be helpful for NMHSs, e.g. rule based system for selecting suitable models under different kinds of incidents and incident scenarios;
(*m*) Web-based solutions should be considered, along with backup system(s), for dissemination of "emergency", time critical information between NHMSs and end-users;
(*n*) Scientific expertise to support operational capability development and response in NMHSs; a designated pool of scientific expertise in the subject domains might be required;
(*o*) There is a need to deal with "uncertainty" in the input and the output;
(*p*) Input from international organizations such as WHO, CTBTO, UNEP is needed, to ensure effective coordination of capacity building efforts. Collaborative opportunities, should be exploited;
(*q*) The need for public information regarding an emergency incident which potentially represents a requirement from, and to, the public safety authorities.

Organizational issues in the development of scope and capabilities

7.11 The Workshop concluded that in the development of the scope and capabilities, for the community of NMHSs, a number of questions and issues arose related to the organizing of the community of institutions. The institutions include: NMHSs, advanced meteorological centres and RSMCs, national emergency measures organizations, international organizations and operational centres. These include:
(*a*) The organizing of the non-nuclear ERA programme has to address both its programme of activities (plans, priorities, work to be done, changing requirements, new developments, etc), as well as operational arrangements and procedures;
(*b*) Because of the nature of the types of incidents, perhaps an organizing framework(s) should be developed within WMO regions or subregions (e.g. existing economic or political groupings). This could include a group of meteorological and hydrological offices/centres, and national or regional agencies in a region as well as several NMHSs to develop requirements, products and services;
(*c*) Identify the roles of international organizations, how they can assist, or what they would need from the WMO and NMHSs to improve their roles in emergency response (public safety and environmental protection);
(*d*) Need to establish criteria for the designation of centres (RSMC) in non-nuclear ERA;
(*e*) The goal of building capacity in the NMHSs is to establish a self-sufficient sustainable ERA programme, to minimize the need for immediate response assistance from other centre(s).

Guiding principles

7.12 Some basic principles for developing the scope and capabilities of ERA in non-nuclear incidents should be considered and established, for example:
(*a*) As much as possible, the NMHSs should lead the local meteorological support in the response, with diminishing reliance over time on the designated specialized centre; the local NMHS has to take responsibility for the needs and the provision of services of its country;
(*b*) Allow as much as possible some flexibility in the operational framework to allow capacity-building to be steadily achieved for NMHSs over a prescribed time frame;
(*c*) Recognize the importance of local knowledge in the meteorological support to emergency response;
(*d*) Capacity-building includes the tools (data, information, models) as well as expertise;
(*e*) Benefit from lessons learned in the establishment of the ERA programme in nuclear emergency response (e.g. promoting the programmes' products and services);
(*f*) While the focus is on the building of capabilities at the local NMHS, should it be required, for example in a prolonged or a very large incident, surge capacity could be sought from (pre-arranged) another NMHS or a specialized centre;
(*g*) The establishment of the ERA operational programme should conform with the guidelines for quality management.

ANNEX IX

Annex to paragraph 5.4.42 of the general summary

STATEMENT OF THE CBS TECHNICAL CONFERENCE ON PUBLIC WEATHER SERVICES (ST. PETERSBURG, RUSSIAN FEDERATION, 21-22 FEBRUARY 2005)

1. During its two days of proceedings, the conference covered four main topics: innovation and new technology for improved services; public weather services in support of disaster mitigation and prevention; communicating with the public — public weather services, the media and public-private partnerships; and the socio-economic benefits of public weather services.

2. The past decade has witnessed an explosive growth in meteorological services provided for the benefit of the community at large and a generally increased awareness of the value of public weather services for day-to-day decision-making in every country and every sector of society. Enormous progress in the scientific, technological and public policy dimensions of the provision of public weather services has produced unprecedented levels of community interest in weather information and established the delivery of public weather services as one of the most important functions of an NMHS. Although the basic role of the NMHS in the provision of public weather services is underpinned by a sound economic and public policy framework, the next few decades will present formidable challenges to NMHSs and the global meteorological enterprise as a whole in identifying the best way forward through the maze of issues that now confront them. WMO has a vital role to play in charting the way ahead and the WMO Public Weather Services Programme will provide the framework for the coordinated international effort on the provision of public weather services that is certain to bring unprecedented benefits to the global community.

3. The conference discussed some of the key advances in technology that were now impacting or had the potential to impact on the range and quality of public weather services provided by NMHSs. The continuing revolution in information exchange driven by the Internet and related technologies has almost unlimited potential to improve the range and volume of information that can be provided by NMHSs. This was demonstrated by a wide range of samples from NMHS Web sites as well as the valuable innovation of WMO Web sites for severe weather warnings and city forecasts (the Severe Weather Information Centre and the World Weather Information Service). The Internet can also be a valuable tool for educational purposes. However, it was recognized that the use of the Internet can require significant resources to maintain up to date material, develop new products and maintain electronic security.

4. Other innovative developments discussed included the advances in nowcasting, the use of ensemble prediction techniques and other probability forecasting methods to provide more useful public weather services, and the use of forecast database approaches to streamline forecast production. These developments will have a profound influence on the operations of NMHSs and the work of their staff, and offer the possibility of extending the range and type of services. It was noted that these developments present challenges in the handling of large amounts of data, and that the application of some of the methods would require careful adaptation to suit the level of development of NMHSs.

5. Improvements in observation techniques and technologies offered many opportunities to provide improved public weather services, especially in informational services and nowcasting. Particular attention was given to the marked increase in the range and quality of data available from the new generation meteorological satellites. To maximize the potential benefits of this increase in satellite data, it was important for NMHSs to have sufficient numbers of well-trained staff to exploit fully satellite data in the provision of improved public weather services. For example, the new Meteosat Second Generation satellite is able to produce images and products that assist the detection of night-time fog and dust storms. It also allows the detection of fire/smoke, thunderstorms, hurricanes, snow and sea-ice, super cooled clouds, floods, volcanic eruptions, vegetation, ocean eddies, phytoplankton and many other features.

6. In relation to satellites and new and improved observing systems, there are significant opportunities and challenges for NMHSs connected with the GEOSS plans. It is important that more NMHSs, especially from developing countries engage with GEOSS so that they will be able to take advantage of the increased Earth observation data and products that will become available through the implementation of the GEOSS. This will also enable NMHSs to enhance their provision of public weather services for the benefit of all nine socio-economic sectors identified in the GEOSS 10–year Implementation Plan.

7. Advances in meteorological workstation capability emphasized the potential benefits beginning to flow from the substantial investments by a number of NMHSs in a new generation of workstations. These could vary in complexity and expense depending on the type of use needed, ranging from high end units suitable for use in the main centres of large NMHS to less powerful units suitable for smaller offices, to units using mainly Web-based software suitable for use within an NMHS for limited purposes, or directly by end-users. Rapid

advances in visualization techniques were improving the ability of meteorologists to assimilate information and provide more relevant services efficiently to end-users.

8. The challenge of passing important warnings, forecasts and information to remote communities was given special attention. The RANET project has applied innovative approaches to broadcasting weather, climate and educational information via a communications satellite, supplemented by low power remote local radio stations, and the use of wind-up and solar powered radios to access the information, and even display this on a connected computer. The success of this project in Africa and parts of Asia warrants further efforts by WMO to encourage cooperation on this project and to assist relevant NMHSs to utilize the system to disseminate their information, including displaying their own Web sites. Several delegations expressed their appreciation to NOAA (United States) and South Africa for the support provided in the implementation of the RANET project. In this connection, it was noted that some NMHSs had difficulties in getting frequency allocation for local, low powered radio stations to disseminate RANET information.

9. The Public Weather Services Programme has been influential in achieving significant improvements in the quality and range of services provided by NMHSs, especially in developing countries and countries with economies in transition. Examples were considered such as the excellent end-to-end hurricane warning services in Cuba, the positive impact of NMHSs providing television weather presentation in a number of African countries, and the rapid expansion of sophisticated public weather services in China and Russia. It was noted however that some of the successful initiatives in developing countries now needed support for maintenance and continued modernization.

10. Despite remarkable progress in the range and quality of public weather services provided by NMHSs, the effective application of public weather services to the mitigation of natural disasters presents many opportunities and challenges in taking advantage of technology and in meeting rising community expectations that technology should decrease their vulnerability to such disasters. A particular challenge for WMO Members is to ensure that all the relevant meteorological and related information is provided in a way that enables informed decisions and actions. There is also a need to create better public awareness of natural hazards, and for NMHSs to contribute to vulnerability assessments for all potential natural threats with a view to strengthening an all-hazards community. NMHSs are encouraged to strengthen their engagement with high-level decision makers in government, civil defence and the media to enhance the effectiveness of, and support for, their efforts in PWS, and to help emphasize principles such as the need for a single authoritative voice for public warnings.

11. WMO and its Members have made substantial progress over the past decade in constructive engagement, and creation of partnerships, with the media. This sector remains very dynamic and it is important for NMHSs to anticipate trends in broadcast and other media, and to be proactive in both improving existing products and services and developing innovative approaches that meet the changing needs of this industry. It was noted that the traditional skills available within NMHSs would need to be augmented with other skills, such as visual design, verbal and non-verbal communication and editorial skills, together with a culture of creativity in order to transform meteorological information into professional and credible services for media. Achievement of this goal would require significant staff training and WMO has a key role to play, through the public weather services program, in assisting NMHSs to strengthen capacity in this area. Ensemble prediction techniques have improved measures of forecast uncertainty; the communication of these uncertainties to the public in a meaningful way presents both opportunities for, and challenges to, the meteorological-media partnership.

12. Recent developments in economic thinking and analysis, especially in relation to so-called public goods, provides new perspectives on the appropriate frameworks and funding options for meteorological services. These developments present opportunities for NMHSs to demonstrate more clearly the national economic value of services such as those offered through their public weather service activities, and the economic rationale for their support via public funding. It will be important for WMO to assist with advice on appropriate methodologies, the use of relevant economic terms, and with guidance from case studies. Given these new developments, it would be useful for WMO to convene an international conference on meteorological economics to promote awareness and sharing of knowledge and experiences in this area.

The conference recommended:

(*a*) That WMO assist NMHSs to take full advantage of the improvements in observational systems, especially the latest generation meteorological satellites, to provide enhanced public weather services, noting that the investment in meteorological satellites requires matching investment in sufficient, well-trained meteorological staff to use the products effectively and to deliver services that meet community expectations;

(*b*) That WMO should encourage and assist NMHSs to engage with the GEOSS plans and take advantage of the increased Earth observation data and products that will become available through the implementation of the GEOSS in order to enhance their provision of public weather services for the benefit of all nine socio-economic sectors identified in the GEOSS 10–year Implementation Plan;

(*c*) That WMO assist NMHSs to maximize the benefits to public weather services of improved capabilities in nowcasting, high-resolution NWP, forecast database approaches and ensemble prediction systems noting that these developments presented significant challenges in managing the volume of data generated, and that the benefit/cost ratio would require adaptation to the level of development of the NMHSs;

(*d*) That, noting the impressive development of a range of workstation capabilities including enhanced visualization techniques to suit different needs of NMHS and service delivery needs, WMO efforts should be focused on assisting NMHSs to exploit the potential of these systems to improve public weather services;

(*e*) That, noting the ability of systems such as RANET to reach remote communities, WMO should continue to facilitate cooperation on the RANET system and emphasize the importance of such systems being used to promote the role of the NMHSs in the provision of public weather services;

(*f*) That, while recognizing the significant resources necessary for the establishment and maintenance of internet services, NMHSs should further explore the potential of the Internet for dissemination of weather information and warnings (e.g. the World Weather Information System and Severe Weather Information Centre websites), to explain complex terminology, and to assist with the interpretation of concepts such as ensemble prediction products;

(*g*) Noting the marked improvements achieved through low cost investments in public weather service initiatives, WMO technical cooperation, education and training should include assistance to NMHSs in developing countries in improving their capability to access and take advantage of new observing, data processing and forecasting systems to access information and deliver improved public weather services. This effort should include strengthening the ability of existing regional PWS training facilities, assist their modernization, and encourage national support for PWS programmes of NMHSs;

(*h*) That NMHS's strengthen their engagement with high-level decision makers in government, civil defence, and the media to enhance the effectiveness of, and support for their efforts in public weather services, and to help emphasise principles such as the need for a single authoritative voice for public warnings;

(*i*) As part of their disaster mitigation efforts, NMHSs should develop the ability to effectively translate weather and related information into a form which enables improved decision-making through better communication and through making that information an integral part of effective decision support tools;

(*j*) To maximize the effectiveness of PWS disaster mitigation activities that meet national and community needs, NMHSs are encouraged to strengthen their engagement with high level decision makers in government, civil defence and the media, to emphasize the value of warnings as a public good, the importance of the NMHSs to be the single official voice for warnings, and to undertake strong public education programs;

(*k*) That NMHSs take every opportunity to involve key end user groups in future WMO and national PWS workshops, conferences, and related activities;

(*l*) That WMO maintain and strengthen its links with the international broadcast meteorology community and assist members to anticipate trends in media and be proactive in developing new products and services;

(*m*) That WMO should assist Members in the evaluation and demonstration of the social, environmental and economic benefits of their Public Weather Services through elaboration of methodologies, guidance on case studies and sponsorship of an international conference on the application of economics to meteorology and on the benefits of meteorological and related services.

ANNEX X

Annex to paragraph 9.5 of the general summmary

TERMS OF REFERENCE OF OPAG TEAMS AND RAPPORTEURS

OPAG on Integrated Observing Systems

Implementation Coordination Team on Integrated Observing System (ICT-IOS)

(*a*) Monitor, report and make recommendations on the capability and utilization of composite observing systems comprising different observing networks to meet the requirements of the WMO and other international programmes/projects such as THORPEX and IPY, including the plan for the evolution of the GOS taking into account the development with respect to GEOSS;

(*b*) Review deficiencies in coverage and performance of the existing GOS, in particular in the implementation of the RBSNs, the GSN and GUAN (of GCOS) as well as related RBCNs, on the basis of monitoring results and regional studies, and to make proposals to improve the availability of data to meet stated requirements;

(*c*) Coordinate and consolidate the development of standardized high quality observing practices and prepare related recommendations;

(*d*) Assess the impacts of introducing new technology systems into the GOS on the status of regional observing networks, particularly those affecting the role of developing countries;

(*e*) Consider and report on the issues of costing, joint funding and management of the GOS;

(*f*) Strengthen collaboration between CBS and the regional associations, by providing advice on possible solutions for newly identified requirements.

Expert Team on Evolution of the Global Observing System (ET-EGOS)

(*a*) Update and report on observational data requirements of the WWW as well as other WMO and international programmes supported by WMO;

(*b*) Review and report on the capability of both ground-based and space-based systems that are candidate components of the evolving composite GOS;

(*c*) Carry out the rolling requirements review of several application areas using subject area experts (including atmospheric chemistry through liaison with CAS, marine meteorology and oceanography through liaison with JCOMM, aeronautical meteorology through liaison with CAeM, agrometeorology through liaison with CAgM, hydrology through liaison with CHy, and climate variability and change detection through liaison with CCl and GCOS);

(*d*) Review the implications of the Statements of Guidance concerning the strengths and deficiencies in the existing GOS and evaluate the capabilities of new observing systems and possibilities for improvements and efficiencies in the GOS; taking particular care to examine the implications of changes in observing technology, in particular changes to automated techniques (such as Automated Surface Observing Stations), on the effectiveness of all WMO Programmes, and report on major consequences in a timely fashion;

(*e*) Carry out studies of hypothetical changes to the GOS with the assistance of NWP centres;

(*f*) Maintain and update the Implementation Plan for Evolution of the GOS, taking into account developments with respect to GEOSS; monitor progress against the Plan, report progress and updated Plan through ICT-IOS to CBS;

(*g*) Prepare a document to assist Members, summarizing the results from the above activities.

Expert Team on Evolution of Satellite System Utilization and Products (ET-SSUP)

(*a*) In following the rolling requirements review for the Strategy to Improve Satellite System Utilization, analyse the 2006 biennial questionnaire, compile a list of recommended actions based on that analysis and prepare a new technical document, including a summary analysis from the Virtual Laboratory for Satellite Data Utilization's Centres of Excellence;

(*b*) Extend the regional ADM concept and principles to IGDDS for operational and R&D satellites, in close coordination with the CGMS standing working group on this issue and with WIS activities aimed at harmonizing the services to the maximum extent possible;

(*c*) Review present and future R&D satellite data and products including their availability and applications in view of better utilization by WMO Members;

(*d*) Represent WMO Member needs to the Virtual Laboratory for Satellite Data Utilization in relevant areas, including:

   (i) Organize training events aiming at further increasing the number of staff and their skills in full utilization of satellite data, from both operational and R&D satellite data;

   (ii) Help ensure Members have access to training materials and courses, as well as provide advice on ways to access data, products, and algorithms from both operational and R&D satellites;

   (iii) With the Virtual Library Focus Group, evaluate the success and needs of the Virtual Library components and suggest strategies for improving its performance;

   (iv) Begin preparation for global high profile global training event to take place in 2006 or 2007;

(*e*) Prepare documents to assist Members, summarizing the results from the above activities.

Expert Team on Satellite Systems (ET-SAT)

(*a*) Provide technical advice with respect to both operational and R&D environmental satellites to assist in the integration of WMO-coordinated observing systems;

(*b*) Advise CBS through ICT-IOS on matters requiring feedback to the WMO Consultative Meetings on High-level Policy on Satellite Matters;
(*c*) Assess the observation, collection, and analysis systems relating to the use of operational and R&D environmental satellites contributing, or with the potential to contribute, to the space-based subsystem of the GOS, and to suggest improvements of system capabilities, particularly with respect to developing countries;
(*d*) Assist CBS in assessing the status of implementation of the space-based subsystem of the GOS and the adequacy of plans for implementation for meeting established requirements for satellite data and products;
(*e*) Make recommendations with respect to the transition of relevant R&D instruments to operational environmental satellites;
(*f*) Coordinate with other relevant CBS teams with a view to making recommendations on matters, such as the exchange, management, and archiving of satellite data and products, radio frequency utilization, as well as education an training and other appropriate capacity-building measures related to satellite meteorology;
(*g*) Identify and assess opportunities and/or problem areas concerning satellite technology and plans of relevant satellite operators, and inform CBS timely and comprehensively through ICT-IOS.

Expert Team on Requirements for Data from Automatic Weather Stations (ET-AWS)

(*a*) Develop, jointly with experts designated by CCl, JCOMM, CIMO, GCOS and AMDAR, the guidelines for AWS quality control procedures for future publication in all appropriate WMO documents;
(*b*) Develop, jointly with experts designated by CCl, JCOMM, CIMO, GCOS and AMDAR, standards for a basic set of variables to be reported by AWS installations;
(*c*) Develop practical examples based on the standards developed for AWS metadata;
(*d*) Develop, jointly with experts designated by CIMO and expert from manufacturers, a procedure whereby users can access information on how various AWS parameters are computed;
(*e*) Review the need for updating BUFR/CREX descriptors and templates for AWS data and suggest proposals, if needed.

Rapporteur on AMDAR Activities

(*a*) Through liaison with CAeM and the AMDAR Panel, review and report to the OPAG on IOS on the activities related to the integration of AMDAR into WWW operations;
(*b*) Study the required training activities relevant to the AMDAR data in areas where they are not currently available and develop proposals for training events including the cost estimates.

Rapporteur on GCOS Matters

Continue the preparation and maintenance of reviews of observing systems that are being designed under the auspices of GCOS (e.g. GUAN, GSN and space-based observing systems (GOSSP and CGMS)) and provide feedback to Members in maintaining the quality of the networks.

Rapporteur on Regulatory Material

Review and update regulatory and guidance material on the GOS, as required, and make recommendations for amendments.

Rapporteurs on Scientific Evaluation of OSEs and OSSEs

Prepare and maintain reviews of OSEs and OSSEs that are being undertaken by various NWP Centres around the globe and provide information for consideration by the OPAG on IOS.

Rapporteurs on Impacts of New Instrumentation on the GOS

Liaise with the HMEI, CIMO and others as appropriate for the development and introduction of new in situ instrumentation, and provide information and advice to the OPAG on IOS on the possible impacts of these on the GOS and strategies for mitigating any adverse impacts.

OPAG on Information Systems and Services

Implementation Coordination Team on Information Systems and Services (ICT-ISS)

(*a*) Assess the implementation aspects at the regional and global levels, including sustainability, of the recommendations and proposals developed by the ISS Teams;
(*b*) Review and consolidate the recommendations and proposals developed by the ISS Teams with a view to their submission to CBS;

(*c*) Monitor, assess and take follow-up action on ISS requirements emerging from the cross-cutting WMO Programmes and other international Programmes/projects such as THORPEX, IPY, DPM and GEOSS;

(*d*) Identify matters requiring the urgent consideration of the OPAG on ISS, and develop proposals for tasks and organization of activities.

Coordination Team on Migration to Table-driven Code Forms (CT-MTDCF)

(*a*) Coordinate, monitor and assess the overall implementation of the migration plan to table-driven representation forms and related training activities. Work with national and regional focal points to identify possible pilot projects;

(*b*) Identify and solve in cooperation with national and regional focal points problems that may arise during the migration phase;

(*c*) Define and review the related software projects for distribution of universal BUFR, CREX and GRIB encoding/decoding software;

(*d*) Work with ET-DRC to identify and develop additional BUFR and CREX descriptors to address the optional sections of existing code structures within the current alphanumeric code forms and to address regional and national coding and reporting practices as needed;

(*e*) Provide central coordination of activities including experimental and operational exchange. Work with the Secretariat to report on these activities in a "Migration News" section of the WWW *Operational Newsletter*;

(*f*) Work together with other relevant international bodies including ICAO, CAeM, IOC, JCOMM and satellite operators, to coordinate, agree and resolve migration issues related to specific code types;

(*g*) Monitor the impact of the migration process on the GTS and data-processing centres. Identify problems and coordinate with national and regional focal points, RTH focal points, other Teams and OPAGs as needed to develop and implement solutions;

(*h*) Coordinate and work with national migration to TDCF Steering Groups (MTSG) and national focal points to assist their development and implementation of their National Implementation Plans;

(*i*) The chairperson of CT-MTDCF would sit as a member on ET-DRC and other groups as needed.

Expert Team on Data Representation and Codes (ET-DRC)

(Requirements for changes to representation forms should be provided by the other OPAGs, especially IOS and DPFS.)

(*a*) Maintain all WMO data representation forms and further develop table-driven codes in particular BUFR, CREX, and GRIB edition 2, by defining descriptors, common sequences and data templates, including the data representation of regional practices, so they meet the requirements of all Members and other concerned international organizations, such as ICAO, most efficiently;

(*b*) Adapt and update current reporting practices in the alphanumeric code regulations for adaptation to table-driven code forms; work with the OPAG on IOS to ensure that statements on observing practices are consistent and in appropriate formats and locations;

(*c*) Invite and assist Members to participate in the experimental exchange of data encoded in modified or new formats, and provide Members with guidance on data representation of national practices, on a bilateral basis;

(*d*) Determine the continuing use of the different WMO data representation forms and recommend options for their future roles or disposition;

(*e*) Update the content of the *Manual on Codes* (WMO-No. 306) and the *Guide to WMO Table-driven Code Forms,* as required;

(*f*) Develop guidance and practices for the meteorological information representation based on XML and on NetCDF.

Inter-programme Expert Team on Metadata Implementation (IPET-MI)

(*a*) Pursue the development of the metadata[1] standard to be used in the WIS as a WMO core profile within the context of the ISO 19115 geographic information standard, and contribute to, and interact with, ISO as appropriate, including creating a core feature catalogue in compliance with ISO 19110;

(*b*) Develop WMO metadata standard extensions specific to the WWW Programme, and promote development of extensions specific to other WMO Programmes in liaison with respective technical commissions;

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[1] Used for describing information.

(*c*) Further study the use of related ISO metadata standards, especially the ISO 19100 series, for the development of the WIS;
(*d*) Coordinate the development of reference XML metadata[1] templates and reference implementation;
(*e*) Develop guidance for the implementation and use of operational information catalogues.

Rapporteur on the WMO *Guide on WWW Data Management* (WMO-No. 788)

Coordinate the revision of the WMO *Guide on WWW Data Management* and its updating.

Expert Team on WIS-GTS Communication Techniques and Structure (ET-CTS)

(Co-chairperson on Enhanced Utilization of Data Communication Techniques; co-chairperson on WIS-GTS data communication structure.)

(*a*) Develop recommended practices and technical guidance material for data communication techniques and procedures (GTS, WIS and Internet), including security aspects, with a view to ensuring efficient and safe operations of information systems, and inform Members of relevant developments in ITU and ISO;
(*b*) Review standard TCP/IP procedures and applications, including new developments (e.g. IPv6) that are relevant to WWW and other WMO Programme requirements, and develop recommended practices;
(*c*) Review and develop updates to recommended practices for data-communication and data access procedures, including OPeNDAP, NetCDF and HDF, as well as consolidation of the file naming convention for operational routeing and distribution;
(*d*) Develop the organization and design principles for the WIS data communication structure, and coordinate related pilot projects;
(*e*) Review and propose updates to the organization and design principles for the GTS to take the best benefits of ICT development, especially as regards its smooth evolution towards the core communication component of WIS;
(*f*) Provide guidance on technical, operational and administrative/financial aspects of data-communication services for WIS implementation, especially for the GTS-WIS at the global, regional and national levels, including dedicated and public services (e.g. satellite-based telecommunications, managed data-communication network services, the Internet);
(*g*) Review current and anticipated data-communication and information system requirements of the WWW and other WMO Programmes.

Expert Team on WIS GISCs and DCPCs (ET-WISC)

(Co-chair on WIS GISCs: Co-chair on WIS DCPCs.)

(*a*) Develop technical and operational specifications for the different components of the WIS GISCs;
(*b*) Develop technical and operational specifications for the different components of the WIS DCPCs;
(*c*) Develop criteria for interoperability and certification for actual implementation;
(*d*) Coordinate related pilot projects.

Steering Group on Radio-frequency Coordination (SG-RFC)

(*a*) Keep under review allocations of radio-frequency bands and assignments of radio-frequencies to meteorological activities for operational requirements (telecommunications, instruments, sensors, etc.) and research purposes, in close coordination with other technical commissions, especially CIMO and the CBS/OPAG on IOS;
(*b*) Coordinate with WMO Members, with the assistance of the WMO Secretariat, to:
   (i) Ensure the proper notification and assignment of frequencies used for meteorological purpose;
   (ii) Determine their future use of the radio spectrum for meteorological purpose;
(*c*) Keep abreast of the activities of the Radiocommunication Sector of the International Telecommunication Union (ITU-R), and in particular of the Radiocommunication Study Groups, on frequency matters pertaining to meteorological activities, and assist the WMO Secretariat in its participation in ITU-R work;
(*d*) Prepare and coordinate proposals and advice to WMO Members on radio-regulation matters pertaining to meteorological activities with a view to ITU Radiocommunication Study Groups, Radiocommunication Assembly, World Radiocommunication Conferences and related regional/global preparatory meetings;
(*e*) Facilitate the coordination between WMO Members for the use of frequency bands allocated to meteorological activities with respect to:

(i) Coordination of frequency use/assignments between countries;
(ii) Coordination of frequency use/assignments between various radio communication services (e.g. meteorological aids and data collection platforms (DCPs)) sharing the same band;

(*f*) Facilitate the coordination of WMO with other international organizations which address radio-spectrum planning, including specialized organizations (e.g. CGMS, the Space Frequency Coordination Group (SFCG) and regional telecommunication organizations, such as the European Conference of Postal and Telecommunications Administrations (CEPT), the Inter-American Telecommunication Commission (CITEL), and the Asia-Pacific Telecommunity (APT));

(*g*) Assist WMO Members, upon request, in the ITU coordination procedure of frequency assignment for radiocommunication systems sharing a frequency band with meteorological radio communication systems.

Rapporteur on WWW Monitoring

(*a*) Review and coordinate the continuous improvement of the current WWW monitoring (AGM and SMM), including ad hoc monitoring exercises especially for products and in the framework of the migration to TDCF;

(*b*) Coordinate operational trial of enhanced WWW monitoring and assess the impact, in particular as regards the resources needed at RTHs and NMCs, including the possible sharing of software applications (e.g. "WWW monitoring PC");

(*c*) Review the overall monitoring requirements for the WIS with a view to developing the WIS monitoring scheme.

Expert Team on GTS-WIS Operations and Implementation (ET-OI)

(Activities to be carried out in close coordination with the ET-DRC chairperson, the CT- MTDCF chairperson, the Rapporteur on WWW Monitoring, the Rapporteur on the WMO *Guide on WWW Data Management* and the focal points of RTHs located on the MTN, with the assistance of the Secretariat, mainly by correspondence/ e-mail.)

(*a*) Monitor the GTS-WIS operational information flow and coordinate management of operational information exchange procedures, routing and traffic; coordinate the allocation of abbreviated headings required for the exchange of data and products and for the migration to TDCF;

(*b*) Coordinate and further develop recommended practices and guidance on the management of, and access to, operational information related to WWW information exchange, specially for GTS-WIS operation (abbreviated heading tables, catalogue of bulletins and files, routing directories, etc.);

(*c*) Develop recommendations for coordinated implementation and planning of techniques, procedures and systems for the MTN and MTN centres, including towards the core communication component of WIS;

(*d*) Develop a mechanism for the allocation of unique identifiers required for file naming convention, and other identification purposes;

(*e*) Identify implementation issues requiring the urgent consideration of the OPAG on ISS.

OPAG on Data-processing and Forecasting System

Implementation Coordination Team on Data-processing and Forecasting System

(*a*) Identify new emerging requirements (input required from regional associations and other bodies);
(*b*) Determine how GDPFS Centres can best contribute to fulfill emerging requirements;
(*c*) Identify needs for workshops/training;
(*d*) Review the procedures and scope of verification statistics on the performance of forecasting systems and provide recommendations;
(*e*) Coordinate the implementation of decisions by CBS related to GDPFS;
(*f*) Review of expert teams and rapporteurs and make recommendations to CBS concerning future work.

Coordination Group for Nuclear Emergency Response Activities

(*a*) Test and improve the collective ability of all RSMCs, the IAEA, the RTH Offenbach and NMHSs in the ERA to fulfil the operational requirements specified in global and regional arrangements, according to adopted standards and procedures;

(*b*) Implement and explore further improved distribution/access methods for specialized products to NMHS, and the IAEA in collaboration with the IAEA and other relevant organizations;
(*c*) Examine the development of detailed procedures to activate additional observations in the event of nuclear accident (requires coordination with the OPAG on IOS);
(*d*) Enhance cooperation with the CTBTO, including testing of concepts of operational arrangements and participation in a technical workshop.

Expert Team on Modelling of Atmospheric Transport for Non-nuclear ERA

(*a*) Identify the needs of the NMHSs for atmospheric transport modelling;
(*b*) Examine the atmospheric transport modelling capabilities of RSMCs and other centres for support to non-nuclear emergencies, for example in volcanic eruptions, dust storms, wildland fires, chemical and biological incidents and other hazards;
(*c*) Identify the potential role of international organizations (e.g. the World Health Organization (WHO), UNEP, the United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA), etc.);
(*d*) Review the status and develop an action plan.

Expert Team on Ensemble Prediction Systems

(*a*) Develop education and training material for forecasters including rationale of concepts and strategies of EPS, and on the nature, interpretation and application of EPS products;
(*b*) Review progress on EPS and its application to severe weather forecasting including progress on multicentre ensembles and on regional model-based EPS, and prepare ways to make best operational usage of these developments;
(*c*) Review progress on the use of EPS for the targeting of observations;
(*d*) Review verification system for EPS products, provide guidance on the interpretation of verification and ensure that the verification system is adequate and meets CBS needs;
(*e*) Support the further development of the Lead Centre on Verification of EPS by reporting on verification measures and determining the best way of presenting the ensemble forecasting systems. Report on skill of available products. Provision of relevant software to NMHSs through the Lead Centre Web site;
(*f*) Review the list of fields and products that should be distributed taking into account the requirement of all relevant WMO Programmes;
(*g*) Propose an update to the *Manual on the GDPFS* (WMO-No. 485) concerning the list of output products available for international exchange and dissemination, and the verification system for EPS;
(*h*) Develop and test procedures for the exchange of EPS data, including the needs of large centres to exchange their ensembles;
(*i*) Provide requirements for the dissemination of the products to help the OPAG on ISS in determining appropriate means of dissemination to assess telecommunication implications.

Expert Team on Infrastructure for Long-range Forecasting

(*a*) On the basis of stated requirements for LRF products and their improvements, review input from the GPCs, RCCs and NMHSs and develop proposals concerning the establishment and implementation of appropriate operational infrastructure for the production, access dissemination and exchange of LRF including multimodel ensembles;
(*b*) Develop procedures for the exchange of LRF forecasts between potential centres and agencies concerned including defining products (multimodel ensemble, model output, forecast skill, etc.) and defining terms and conditions for exchange;
(*c*) Develop new interpretation guidance to facilitate the correct use of LRF anomaly forecasts;
(*d*) Enhance the exchange of long-range forecasts between GPCs and agencies;
(*e*) Report on the production, access, dissemination and exchange and provide recommendations for future consideration and adoption by CAS, CCl, CBS and other appropriate bodies.

Expert Team on Standardized Verification System for Long-range Forecasts

(*a*) Coordinate the provision of long-range forecast verification scores and related information from GPCs for use by NMHSs and RCCs;
(*b*) Encourage and monitor feedback from NMHSs and RCCs on the usefulness of verification information provided by producing centres under the scheme;
(*c*) Review the effectiveness of the verification scheme in assisting NMHSs and RCCs to use the global-scale products to provide end-user services;

(*d*) Contribute to the further development of the Lead Centre role and the Web site including the development and provision of relevant software and data sets;
(*e*) Recommend updates to operational practices to be followed in computation of verification statistics and information useful to attach to long-range forecast products in the light of the experience and progress in research on verification activities;
(*f*) In consultation with CAS (CLIVAR/Working Group on Seasonal to Interannual Prediction) and CCl, propose recommendations to CBS for improvements of the standardized verification system for long-range forecasts (SVSLRF) including for developing areas such as multimodel ensembles.

Rapporteur on the Impact of Changes to GOS on NWP

(*a*) Monitor changes to the GOS that may impact on NWP;
(*b*) Suggest studies, as appropriate, to evaluate the impact of changes to the GOS for consideration by the GDPS centres;
(*c*) Review and report on sensitivity studies undertaken by GDPFS centres as appropriate, including targeted observations.

Rapporteur on the Application of NWP to Severe Weather Forecasting

(*a*) Review the application of NWP to severe weather forecasting;
(*b*) Report on new developments and advances in severe weather forecasting;
(*c*) Review the minimum list of NWP products on the GTS in coordination with the Regional Rapporteurs on GDPFS;
(*d*) Provide advice on the proposed demonstration project(s).

OPAG on Public Weather Services

Implementation Coordination Team on Public Weather Services

(*a*) Coordinate and keep under review the work of the PWS expert teams;
(*b*) Identify and advise on the role of WMO's cross-cutting programmes relating to PWS and keep under review the progress of GEOSS;
(*c*) Continue with appropriate arrangements for consultation and collaboration with relevant technical commissions on cross-cutting issues, and with other CBS OPAGs to ensure coordination of services and systems;
(*d*) Review and report on PWS support to the WMO Natural Disaster Prevention and Mitigation Programme and THORPEX;
(*e*) Explore the mechanisms to strengthen dialogues between NMHSs and the private service providers;
(*f*) Continue to provide guidance to Members on the issue of NMHSs as the sole authority in the provision of official severe weather warnings;
(*g*) Review and report on the effectiveness of the information and guidance material produced by the PWS Programme among NMHSs and relevant media and user groups;
(*h*) Review and report on the effectiveness of PWS training activities;
(*i*) Review and report on the improvements in national PWS programmes and activities as a result of activities under the WMO PWS Programme;
(*j*) Keep abreast of the developments in the application of economics to meteorology and hydrology and on the economic benefits of PWS; develop strategies for advising NMHSs as appropriate;
(*k*) Explore the mechanism to strengthen dialogue between WMO and the International Olympics Committee (IOC) in the context of meteorological support for the Olympic Games;
(*l*) Devise means to optimize awareness and dissemination of all relevant material arising from the work of the expert teams to the PWS community.

Expert Team on Services and Products Improvement (ET-SPI)

(Formerly Expert Team on Product Development and Service Assessment)

(*a*) Monitor and report on the progress of earlier initiatives of ET-SPI and make recommendations as appropriate to the OPAG on PWS;
(*b*) Monitor and report on aspects of services and product improvements that relate to support for major WMO cross-cutting activities such as disaster prevention and mitigation, the WMO Space Programme and THORPEX;
(*c*) Identify how best to meet the needs of developing countries in their efforts to improve services and products in support of their national PWS programme;

(*d*) Identify, report and provide recommendations on emerging needs for new and improved products and services with emphasis on key PWS user groups;

(*e*) Provide guidance on the development of the World Weather Information Service (WWIS) and explore its potential both for conveying other information and for developing the Web site in other languages, in addition to Arabic, Chinese, English and Portuguese;

(*f*) Keep under review the development of user-oriented NMHS air quality and bio-meteorological forecasts and warnings;

(*g*) Explore and advise on the development of appropriate probabilistic forecast products and services enabled by advances in ensemble prediction systems;

(*h*) Keep under review developments in verification for PWS with a special emphasis on developing countries;

(*i*) Keep under review the development of quality management procedures and practices;

(*j*) Keep abreast of advances in, and promote, as appropriate, the application of emerging technology to the delivery of public weather services, in particular with emphasis on the application of database and workstation and their implications for the changing role of the forecaster;

(*k*) Report and advise on collaborative activities with other CBS OPAGs and technical commissions.

Expert Team on PWS in Support of Disaster Prevention and Mitigation (ET-DPM)

(Formerly Expert Team on Warnings and Forecasts Exchange, Understanding and Use)

(*a*) Monitor and report on the progress of earlier initiatives of ET-DPM and make recommendations as appropriate to the OPAG on PWS;

(*b*) Monitor and report on aspects of disaster prevention and mitigation that relate to support of major WMO cross-cutting activities such as disaster prevention and mitigation, the WMO Space Programme and THORPEX;

(*c*) Identify ways to assist developing countries in their efforts to improve disaster prevention and mitigation in the context of their national PWS programme;

(*d*) Provide guidelines on the development of SWIC for improved international availability and access to NMHSs' official severe weather information via the Internet;

(*e*) Define and clarify the role of PWSs in the early warning process and develop appropriate reference material based on current practices on early warning highlighting communication and technology aspects. Create general guidelines from reference materials for use by NMHSs;

(*f*) Promote awareness of, and provide guidance to, Members on the exchange of public weather forecasts and warnings on the Internet;

(*g*) Keep under review the development of cross-border exchange of warnings with reference to the published WMO guidelines;

(*h*) Develop reference material on the application of nowcasting to the provision of public warnings associated with mesoscale weather phenomena;

(*i*) Report and advise on collaborative activities with other CBS OPAGs and technical commissions.

Expert Team on Communication Aspects of PWS (ET-COM)

(Formerly Expert Team on Media Issues)

(*a*) Monitor and report on progress of earlier initiatives of ET-COM and make recommendations as appropriate to the OPAG on PWS;

(*b*) Monitor and report on communications aspects of PWS that relate to support of major WMO cross-cutting activities such as disaster prevention and mitigation, the WMO Space Programme and THORPEX;

(*c*) Identify ways to meet the needs of developing countries in their efforts to improve the communication of PWS products and services;

(*d*) Examine, report and recommend on ways of continuing to develop positive partnerships with national and international media organizations, and of assisting NMHSs to improve relations with the media;

(*e*) Examine, report and recommend on broader use of the Internet for early warnings and other public weather services products and the application of other new technologies that might enhance public weather services;

(*f*) Report and advise on ways of assisting NMHSs to enhance the education of users with a view to ensuring more effective use of PWS and enhancing the usefulness of new products and services;

(*g*) Promote awareness of the importance of the impact of high quality, well communicated and delivered public weather services on the image and visibility of the NMHS;

(*h*) Assess the use of the information compiled for the WWIS and SWIC Web sites by the media, and develop strategies for the improved exploitation of authorized and official weather information through the use of new and emerging technologies;

(*i*) Study and report on how to communicate effectively to end users the concepts of uncertainty and confidence that are increasingly available from the output of ensemble prediction systems and other probabilistic forecasting systems;

(*j*) Noting the ongoing difficulty in media attribution of the role of NMHSs in providing basic services and infrastructure to support weather presentation to the public, review how this matter might be more effectively addressed and to develop advisory material;

(*k*) Noting the major media attention given to the increasing number of weather-related disasters and with a strong connection to the role of NMHSs in the affected countries, report on and develop preliminary guidance material on how NMHSs might more effectively communicate with emergency managers, the media, and the public on meteorological aspects of disasters;

(*l*) Report and advise on collaborative activities with other CBS OPAGs and technical commissions.

ANNEX XI

Annex to paragraph 9.6 of the general summary

DESIGNATION OF CHAIRPERSONS, CO-CHAIRPERSONS, RAPPORTEURS, COORDINATORS AND CBS REPRESENTATIVES

Coordinator for Natural Disaster Prevention and Mitigation (DPM)	S.L. Barrell	Australia
Co-coordinators for the Global Earth Observation System of Systems (GEOSS)	Pierre Dubreuil	Canada
	Expert from RA III	
Rapporteur on Quality Management and CBS representative in the ICTT on Quality Management Framework	A.S. Zaitsev	Russian Federation
Co-chairperson of the THORPEX ICSC Technical Advisory Board	Walter Zwieflhofer	ECMWF
Co-chairperson of the THORPEX ICSC Data Policy and Management Working Group	Chairperson of the OPAG on ISS (Peiliang Shi)	China
CBS focal point responsible for communication with IPY mechanisms and CBS representative in the Intercommission Task Group on IPY	Vice-president of CBS (G.-R. Hoffman)	Germany

OPAG on Integrated Observing Systems

Implementation Coordination Team on Integrated Observing Systems (ICT-IOS)	Chairperson	James Purdom	United States
Expert Team on Evolution of the Global Observing System (ET-EGOS)	Chairperson	Paul Menzel	United States
Expert Team on Evolution of Satellite System Utilization and Products (ET-SSUP)	Chairperson	Jérôme Lafeuille	France
Expert Team on Satellite Systems (ET-SAT)	Chairperson	Wenjian Zhang	China
Expert Team on Requirements for Data from Automatic Weather Stations (ET-AWS)	Chairperson	Rainer Dombrowski	United States
Rapporteur on AMDAR Activities	Rapporteur	Jochen Dibbern	Germany
Rapporteur on GCOS Matters	Rapporteur	Matthew Menne	United States
Rapporteur on Regulatory Material	Rapporteur	Alexander A. Vasiliev	Russian Federation
Rapporteurs on Scientific Evaluation of OSEs and OSSEs	Rapporteur	Jean Pailleux	France
	Rapporteur	Ko Koizumi	Japan
Rapporteurs on Impacts of New Instrumentation on the GOS	Rapporteur	To be designated by the CBS Management Group	
	Rapporteur	To be designated by the CBS Management Group	

OPAG on Information Systems and Services

Implementation Coordination Team on Information Systems and Services (ICT-ISS)	Chairperson	Peiliang Shi	China
Coordination Team on Migration to Table-driven Code Forms (CT-MTDCF)	Chairperson	Fred Branski	United States
Expert Team on Data Representation and Codes (ET-DRC)	Chairperson	Milan Dragosavac	ECMWF
Inter-programme Expert Team on Metadata Implementation (IPET-MI)	Chairperson	Stephen Foreman	United Kingdom
Rapporteur on the WMO *Guide on WWW Data Management* (WMO-No. 788)	Rapporteur	José Mauro De Rezende	Brazil

Expert Team on WIS-GTS Communication Techniques and Structure (ET-CTS)	Co-chairperson EUDCS	Jean-François Gagnon	Canada
	Co-chairperson DCS	Hiroyuki Ichijo	Japan
Expert Team on WIS GISCs and DCPCs (ET-WISC)	Co-chairperson GISCs	Heinrich Knottenberg	Germany
	Co-chairperson DCPCs	Al Kellie	United States
Steering Group on Radio-frequency Coordination (SG-RFC)	Chairperson	Philippe Tristant	France
Rapporteur on WWW Monitoring	Rapporteur	Bernd Richter	Germany
Expert Team on GTS-WIS Operations and Implementation (ET-OI)	Co-chairperson	Kelvin Wong	Australia
	Co-chairperson	Leonid Bezruk	Russian Federation
OPAG on Data-processing and Forecasting System			
Implementation Coordination Team on Data-processing and Forecasting System	Chairperson	Bernard Strauss	France
Coordination Group for Nuclear Emergency Response Activities	Chairperson	René Servranckx	Canada
Expert Team on Modelling of Atmospheric Transport for Non-nuclear	Chairperson	Christopher Ryan	Australia
Expert Team on Ensemble Prediction Systems	Chairperson	Ken Mylne	United Kingdom
Expert Team on Infrastructure for Long-range Forecasting	Chairperson	Willem Landman	South Africa
Expert Team on Standardized Verification System for Long-range Forecasts	Chairperson	Normand Gagnon	Canada
Rapporteur on the Impact of Changes to GOS on NWP	Rapporteur	Expert	United States
Rapporteur on the Application of NWP to Severe Weather Forecasting	Rapporteur	Corinne Mithieux	France
OPAG on Public Weather Services			
Implementation Coordination Team on Public Weather Services	Chairperson	Gerald Fleming	Ireland
Expert Team on Services and Products Improvement (ET-SPI)	Chairperson	John Guiney	United States
Expert Team on PWS in Support of Disaster Prevention and Mitigation (ET-DPM)	Chairperson	Ming-Chung Wong	Hong-Kong, China
Expert Team on Communication Aspects of PWS (ET-COM)	Chairperson	Jon Gill	Australia

APPENDIX A

LIST OF PERSONS ATTENDING THE SESSION

A. OFFICERS OF THE SESSION

A. Gusev	Acting president
G.-R. Hoffmann	Vice-president
A.I. Bedritsky	President of WMO

B. REPRESENTATIVES OF WMO MEMBERS

Member	*Name*	*Capacity*
Algeria	M. Adimi	Delegate
	A. Terchi	Delegate
Argentina	H. Sosa	Principal delegate
Australia	R.R. Brook	Principal delegate
	K.J. O'Loughlin	Delegate
	S.L. Barrell (Ms)	Delegate
Austria	H. Gmoser	Principal delegate
Azerbaijan	S. Khalilov	Principal delegate
Bahamas	M. Stubbs	Principal delegate
Bahrain	H.A. Al-A'ali	Principal delegate
Belarus	A. V. Sushchenya	Principal delegate
	I. Skuratovich	Delegate
Belgium	E. De Dycker	Principal delegate
Belize	C. Fuller	Principal delegate
Botswana	P. Phage	Principal delegate
Brazil	J.M. de Rezende	Principal delegate
Brunei Darussalam	M. H. Aji	Principal delegate
	H.Z. Bin Pungut	Delegate
Cameroon	E. Fotso	Delegate
	M.L. Saah	Delegate
Canada	P. Dubreuil	Principal delegate
	A. Simard	Alternate
	H. Allard	Delegate
	J. St. Coeur	Delegate
	R. Street	Delegate
China	G. Zheng	Principal delegate
	G. Zhang	Delegate
	J. Yu	Delegate
	P. Shi	Delegate
	W. Zhang	Delegate
Cote d'Ivoire	G. Guehi	Delegate
Croatia	I. Cacic	Principal delegate
	K. Pandzic	Alternate
Czech Republic	E. Cervena (Ms)	Principal delegate
Denmark	F. Jensen	Principal delegate
	L. Wester-Andersen (Ms)	Alternate
Egypt	M. H. Doss	Principal delegate
	D. Ahmed	Alternate
Estonia	J. Saar	Principal delegate
Finland	M. Heikinheimo	Principal delegate
	K. Leminen	Delegate
	M. Seppänen	Delegate
France	C. Blondin	Principal delegate
	B. Strauss	Delegate
	C. Dupuy	Delegate
	D. André	Delegate
Georgia	M Arabidze (Ms)	Principal delegate
Germany	G.-R. Hoffmann	Principal delegate
	W. Kusch	Delegate
Ghana	G.A. Wilson	Principal delegate
Hong Kong, China	M.C. Wong	Principal delegate
	W.M. Ma	Alternate
Hungary	M. Buranszkiné Sallai (Ms)	Delegate
Iceland	G. Hafsteinsson	Principal delegate
India	A.K. Bhatnagar	Principal delegate
Iran, Islamic Republic of	B. Sanaei	Principal delegate
	M. Jabbari (Ms)	Delegate
	S. Tajbakhsh (Ms)	Delegate
Ireland	P. Halton	Principal delegate
	G. Fleming	Delegate
Israel	H. Berkovich (Ms)	Principal delegate
Italy	G. Tarantino	Principal delegate
	D. Villa	Alternate
Japan	T. Tsuyuki	Principal delegate
	H. Ichijo	Delegate
	A. Shimazaki	Delegate
Jordan	J. Al-Musa	Delegate
	N. Kafawin	Delegate
	T. Al-Nabulsi	Delegate
Kazakhstan	O. Abramenko (Ms)	Delegate

Member	*Name*	*Capacity*
Kenya	J.R. Mukabana S. Muchemi W. Nyakwada	Principal delegate Delegate Delegate
Liberia	A. Gar-Glahn	Principal delegate
Libyan Arab Jamahiriya	B.A. Alsiebaie H.S. Ganedi	Principal delegate Delegate
Macao, China	C.M. Ku	Principal delegate
Malaysia	Y.F. Hwang (Ms)	Principal delegate
Mauritius	B.M. Heetun	Principal delegate
Mexico	R.L. Malanche	Delegate
Mongolia	J. Tsogt	Delegate
Namibia	S.E. Ndjaba F. Uirab	Principal delegate Delegate
Netherlands	T. van Stijn	Principal delegate
New Zealand	T. Quayle	Delegate
Nigeria	T. Obidike D.T. Ngana S. Wilson G.R. Otubogun (Ms) D.T. Ngana	Principal delegate Alternate Delegate Delegate Delegate
Norway	J. Sunde R. Skalin	Principal delegate Delegate
Oman	A.H. Al Harthy S.A. Al Harthy	Principal delegate Delegate
Poland	A. Dubicki R. Klejnowski J. Orlowski	Principal delegate Alternate Delegate
Portugal	A. Serrao L. Nunes M.J. Monteiro (Ms)	Principal delegate Delegate Delegate
Republic of Korea	S-K. Chung B-H. Lim J-G. Park K-Y. Chung Dong-Il Lee	Principal delegate Delegate Delegate Delegate Delegate
Romania	E. Cordoneanu (Ms)	Delegate
Russian Federation	A.I. Bedritsky V.N. Dyadyuchenko A.A. Vasilyev A.A. Lyakhov A.B. Besprozvannykh A. Gusev A.I. Grabovsky A.S. Zaitsev B.A. Kiselev L.E. Bezruk R.M. Vilfand V.A. Ancipovich V.V. Asmus	Principal delegate Deputy Principal delegate Delegate Delegate Delegate Delegate Delegate Delegate Delegate Delegate Delegate Delegate Delegate

Member	*Name*	*Capacity*
Senegal	S. Diallo M. Sonko	Principal delegate Delegate
Serbia and Montenegro	B. Zivlak P. Sunderic	Principal delegate Delegate
Slovakia	I. Zahumenský	Principal delegate
Slovenia	G. Gregoric	Principal delegate
South Africa	G. Schulze M. Ndabambi	Principal delegate Alternate
Spain	C. Rus (Ms) C. Callejas (Ms) M. Lambas	Principal delegate Delegate Delegate
Sudan	H.A. Abdalla	Principal delegate
Sweden	T. Kvick E. Liljas	Principal delegate Alternate
Switzerland	P. Rauh T. Frei	Principal delegate Alternate
Turkey	M. Kayhan C. Oktar M. Adiguzel	Principal delegate Delegate Delegate
Uganda	M.Z. Nkalubo	Principal delegate
Ukraine	O. Kosovets	Principal delegate
United Kingdom of Great Britain and Northern Ireland	R. Hunt S. Foreman K. Groves A. Douglas	Principal delegate Alternate Delegate Delegate
United Republic of Tanzania	P. F. Tibaijuka	Principal delegate
United States of America	J.E. Jones F.R. Branski J.F.W. Purdom J.L. Guiney V.L. Nadolski W.C. Bolhofer	Principal delegate Delegate Delegate Delegate Delegate Delegate
Uzbekistan	I. Zaytseva	Principal Delegate

C. REPRESENTATIVES OF WMO REGIONAL ASSOCIATIONS

W. Nyakwada	Chairperson, Working Group on Planning and Implementation of the World Weather Watch, RA I
A.K. Bhatnagar	Chairperson, Working Group on Planning and Implementation of the World Weather Watch, RA II
H.O. Sosa	Representing chairperson, Working Group on Planning and Implementation of the World Weather Watch, RA III

C. Fuller	Chairperson, Working Group on Planning and Implementation of the World Weather Watch, RA IV
T. Hart	Chairperson, Working Group on Planning and Implementation of the World Weather Watch, RA V
G. Steinhorst	Chairperson, Working Group on Planning and Implementation of the World Weather Watch, RA VI

D. REPRESENTATIVES OF INTERNATIONAL ORGANIZATIONS

Organization	*Name*
International Civil Aviation Organization (ICAO)	O. Turpeinen
Agency for Air Navigation Safety in Africa and Madagascar (ASECNA)	A.C. Adriamalaza J. Mbolidi
European Centre for Medium-range Weather Forecasts (ECMWF)	H. Böttger M. Dell'Acqua W. Zwieflhofer
European Meteorological Services Network (EUMETNET)	J.-P. Chalon S.J. Caughey
European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)	A. Patchett K. Shmelkov L. Wolf M. Rattenborg N. Khomenol

E. REPRESENTATIVES OF NON-GOVERNMENTAL ORGANIZATIONS

J. Hörhammer	Association of Hydrometeorological Equipment Industry (HMEI), Vaisala Oyj
K. Hoogendyk	Association of Hydrometeorological Equipment Industry (HMEI)

F. INVITED EXPERTS

F. Grooters	Chairperson, AMDAR Panel
N. Bezrukova (Ms)	Central Aerological Observatory, Russian Federation
D. Kiktvev	Hydromet Centre, Russian Federation
G. Shchukin S. Chicherin	Main Geophysical Observatory, Russian Federation

G. OTHER PARTICIPANTS

E.V. Tulin O. Kulkov	Agrophysical Research Institute, St Petersburg
R. Teolis	Canadian Environmental Assistance
F. Jensen	Danish Meteorological Institute
N. Conde	Direction nationale de la météorologie, Guinea
H. Abushawashi	Foreign Ministry, Libyan Arab Jamahiriya
M. Daradur	Hydrometeorological Service, Republic of Moldova
A. Rovalino	Instituto Nacional de Meteorología e Hidrología, Ecuador
A. Tesfaye	National Meteorological Services Agency, Ethiopia
H. Esleem	Meteorological Department, Jordan
K. Irshed	Meteorological Department, Syrian Arab Republic

APPENDIX B

LIST OF ABBREVIATIONS

ADM	Advanced Dissemination Method
AIRS	Advanced Infrared Sounder
AMDAR	Aircraft Meteorological Data Relay
AMSU	Advanced Microwave Sounding Unit
APCN	APEC Climate Network
APEC	Asia-Pacific Environment Council
APT	Asia-Pacific Telecommunity
AREP	Atmospheric Research and Environment Programme
ASAP	Automated Shipboard Aerological Programme
ASECNA	Agency for Air Navigation Safety in Africa and Madagascar
ATOVS	Advanced TIROS Operational Vertical Sounder
AWS	Automatic Weather Station
CAeM	Commission for Aeronautical Meteorology
CAgM	Commission for Agricultural Meteorology
CAS	Commission for Atmospheric Sciences
CBS	Commission for Basic Systems
CCl	Commission for Climatology
CEOS	Committee on Earth Observation Satellites
CEPT	European Conference of Postal and Telecommunications Administrations
CGMS	Coordination Group for Meteorological Satellites
CIMO	Commission for Instruments and Methods of Observation
CIMSS	Cooperative Institute for Research in the Atmosphere
CIR	Committed Information Role
CIRA	Cooperative Institute for Research in the Atmosphere
CITEL	Inter-American Telecommunication Commission
CLIPS	Climate Information and Prediction Services
CLIVAR	Climate Variability and Predictability
CMA	China Meteorological Administration
CNES	National Centre for Space Studies
COMS	Communications Oceanographic and Meteorological Satellites
COSNA	Composite Observing System for the North Atlantic
CTBTO	Comprehensive Nuclear-Test-Ban Treaty Organization
DCP	Data Collection Platform
DEVCO	Programme for Developing Countries
DMCPA	Disaster Management and Civil Protection Authorities
DPFS	Data-processing and Forecasting System
DPM	Natural Disaster Prevention and Mitigation
DWD	*Deutscher Wetterdienst*
EARS	EUMETSAT ATOVS Retransmission Service
ECMWF	European Centre for Medium-range Weather Forecasts
EGM	Earth Geoid Model
EGPM	European Global Precipitation Measurement
EOS	Earth Observation Summit
EPS	Ensemble Prediction System
ERA	Emergency Response Activities
ESA	European Space Agency
ET-AWS	Expert Team on Requirements for Data from Automatic Weather Stations
ET-DR&C	Expert Team on Data Representation and Codes
ET-EGOS	Expert Team on Evolution of the Global Observing System
ET-EUDCS	Expert Team on Enhanced Utilization of Data Communication System

ET-MI	Expert Team on Media Issues
ET-MTDCF	Expert Team on Migration to Table-driven Code Forms
ET-ODRRGOS	Expert Team on Observational Data Requirements and Redesign of the GOS
ET-PDSA	Expert Team on Product Development and Service Assessment
ET-SAT	Expert Team on Satellite Systems
ET-SSUP	Expert Team on Satellite System Utilization and Products
ET-WFEU	Expert Team on Warnings and Forecast Exchange, Understanding and Use
EUCOS	European Composite Observing System
EUMETNET	European Meteorological Services Network
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FAO	Food and Agriculture Organization of the United Nations
FWIS	Future WMO Information System
GAW	Global Atmosphere Watch
GCOS	Global Climate Observing System
GDPFS	Global Data-processing and Forecasting System
GEF	Global Environment Facility
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GIFTS	Geostationary Imaging Fourrier Transform Spectrometer
GOS	Global Observing System
GSN	GCOS Surface Network
GTS	Global Telecommunication System
GUAN	GCOS Upper-air Network
HIRLAM	High-resolution Limited Area Model
HMEI	Association of Hydrometeorological Equipment Industry
HRPT	High Resolution Picture Transmission
HWRP	Hydrology and Water Resources Programme
IAEA	International Atomic Energy Agency
IASI	Infrared Atmospheric Sounding Interferometer
IAVWOPSG	International Airways Volcano Watch Operations Group
ICAO	International Civil Aviation Organization
ICG-FWIS	Intercommission Coordination Group on FWIS
ICSC	International Core Steering Committee
ICSU	International Council for Science
ICT	Implementation Coordination Team
ICTT	Intercommission Task Team
IGDDS	Integrated Global Data Dissemination Service
IGeoLab	International Geostationary Laboratory
IMD	India Meteorological Department
IMTN	Improved Main Telecommunication Network
INMARSAT	International Maritime Satellite System
IOC	Intergovernmental Oceanographic Commission
IOS	Integrated Observing Systems
IPET-MI	Interprogramme Expert Team on Metadata Implementation
IPY	International Polar Year
IRI	International Research Institute for Climate Prediction
ISCS	International Satellite Communication System
ISDR	International Strategy for Disaster Reduction
ISO	International Organization for Standardization
ISS	Information Systems and Services
ITS	Information Technology Security
ITT-FWIS	Interprogramme Task Team on FWIS
ITU-R	ITU Radiocommunication Sector
IWM	Integrated WWW Monitoring
JAXA	Japan Aerospace Exploration Agency
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology

JMA	Japan Meteorological Agency
JSC	Joint Scientific Committee
LEO	Low Earth Orbit
LRF	Long-range Forecasts
MPLS	Multi-protocol Label Switching
MSG	Meteosat Second Generation
MTDCF	Migration to Table-driven Code Forms
MTN	Main Telecommunication Network
NAOS	North Atlantic Ocean Stations
NASA	National Aeronautics and Space Administration
NCEP	National Centres for Environmental Predictions
NESDIS	National Environmental Satellite, Data and Information Service
NMC	National Meteorological Centre
NMHS	National Meteorological and Hydrological Service
NMS	National Meteorological or Hydrometeorological Service
NOAA	National Oceanic and Atmospheric Administration
NPOESS	National Polar-orbiting Environmental Satellite System
NPP	Net Primary Productivity
NWP	Numerical Weather Prediction
OIS	Operational Information Service
OPAG	Open Programme Area Group
OPMET	Operational Meteorological Information
OSE	Observing System Experiment
OSSE	Observing Systems Simulation Experiment
PUMA	Preparation for the Use of Meteosat Second Generation in Africa
PWS	Public Weather Services
QM	Quality Management
QMF	Quality Management Framework
QMS	Quality Management System
R&D	Research and Development
RANET	Radio and Internet
RAOB	Radiosonde Observation
RARS	Regional ATOVS Retransmission Services
RBCN	Regional Basic Climatological Network
RBSN	Regional Basic Synoptic Network
RCC	Regional Climate Centre
RMDCN	Regional Meteorological Data Communication Network
RMTC	Regional Meteorological Training Centre
RMTN	Regional Meteorological Telecommunication Network
ROSHYDROMET	Russian Federal Service for Hydrometeorology and Environmental Monitoring
RRR	Rolling Requirements Review
RSMC	Regional Specialized Meteorological Centre
RTH	Regional Telecommunication Hub
7LTP	Seventh WMO Long-term Plan
6LTP	Sixth WMO Long-term Plan
SFCG	Space Frequency Coordination Group
SMM	Special MTN Monitoring
SMOS	Soil Moisture and Ocean Salinity
SVSLRF	Standardized Verification System for Long-range Forecasts
SWIC	Severe Weather Information Centre
TAMDAR	Tropospheric Airborne Meteorological Data Reporting
TCP	Tropical Cyclone Programme

TCP/IP	Transmission Control Protocol/Internet Protocol
TDCF	Table-driven Code Form
TIGGE	THORPEX Interactive Grand Global Ensemble
TIP	THORPEX International Research Implementation Plan
TRMM	Tropical Rainfall Measuring Mission
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
VAAC	Volcanic Ash Advisory Centre
VCP	Voluntary Cooperation Programme
VISIT	Virtual Institute for Satellite Integration Training
VL	Virtual Library
VPN	Virtual Private Network
VSAT	Very Small Aperture Terminal
WAFS	World Area Forecast System
WCP	World Climate Programme
WCRP	World Climate Research Programme
WGNE	Working Group on Numerical Experimentation
WHO	World Health Organization
WIS	WMO Information System
WMC	World Meteorological Centre
WMO	World Meteorological Organization
WRC	World Radiocommunication Conference
WWIS	World Weather Information Service
WWRP	World Weather Research Programme
WWW	World Weather Watch
ZTD	Zenith Total Delay