Dubrovnik
25 March–2 April
2009

Commission for Basic Systems

Fourteenth session

World Meteorological Organization

WMO-No. 1040

Weather • Climate • Water

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Abridged final report with resolutions and recommendations

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CONTENTS

Page

RESOLUTIONS ADOPTED BY THE SESSION

Page

RECOMMENDATIONS ADOPTED BY THE SESSION

ANNEXES

Page

GENERAL SUMMARY OF THE WORK OF THE SESSION

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

1.1 At the kind invitation of the Government of Croatia, the fourteenth session of the Commission for Basic Systems (CBS-XIV) was held in Dubrovnik, Croatia from 25 March to 2 April 2009. The session was declared open by Mr Alexander Gusev, president of the Commission, at 10.00 a.m. on Wednesday, 25 March 2009, at the Dubrovnik Palace Hotel.

1.2 Mr Gusev expressed his appreciation to the Government of Croatia, represented by the Meteorological and Hydrometeorological Service of Croatia (DHMZ), for hosting the session in Dubrovnik and for the excellent arrangements made.

1.3 The president welcomed participants to this extremely beautiful and ancient city of Dubrovnik. He noted that the NMHSs play an increasingly important role in their countries as society realizes the importance of meteorological and hydrological services to social and economic fields. Not only do NMHSs need to continuously improve these traditional services but they need to provide new services that support sustainable development. CBS has a major role and is responsible for the extremely successful World Weather Watch (WWW) which is the basis for these services supported by hundreds of thousands of observations every day for monitoring the globe. Because of this no NMHS can operate alone.

1.4 He noted that the WWW provides crucial support to WMO's disaster risk reduction and the early warning systems. The Public Weather Service is an important programme and a showcase of the organization. The President highlighted the Integrated Global Observing System and noted the lessons learned from the technical conference on the WMO Integrated Observing System (WIGOS) held just before this current session of CBS and noted his own commitment to the free and unrestricted sharing of those observations essential to the functioning of WWW.

1.5 The president concluded by reiterating his appreciation to the host and in particular the Hydrological and Meteorological Service of Croatia.

1.6 Mr Ivan Čačić, Permanent Representative of Croatia with WMO, welcomed all to Dubrovnik noting the relevance of the location of Dubrovnik as a historic centre with a strong scientific connection spanning hundreds of years. As well as being the site of the first Croatian meteorological measurements nearly 160 years ago, the city has a connection to the arts central to the life of Croatia itself and is known as the jewel of the Adriatic. He highlighted that Croatia was particularly happy to be able to host such a group of experts represented at this CBS meeting only seventeen years after the admission of Croatia into the WMO. He emphasized that the progress of the Croatian Meteorological and Hydrometeorological Service reflected the welcoming nature of the WMO community.

1.7 Mr Čačić highlighted some of Croatia's contributions in recent times such as the feasibility study on the modernization of NMHS in south-east Europe and Croatia's contribution to the International Conference on Secure and Sustainable Living held in Madrid. He also noted future activities such as planning a Croatian DCPC on marine services as a sub regional centre of expertise relevant to marine safety.

1.8 Mr Čačić expressed his appreciation to the significant local support DHMZ received to facilitate hosting the session of CBS. This included the active involvement and financial support of the Croatian Government, the Ministry of Science Education and Sports, the Ministry of Foreign Affairs, the town of Dubrovnik and the Croatian National Tourist Board. He also noted the contribution of the DHMZ team and partner agency Adriatic Luxury Services in supporting participants during the session.

1.9 Mr Mario Dabelió, Representative of the City of Dubrovnik, addressed the session on behalf of the Mayor, the city and the city board. He noted that the bringing together of information and knowledge to share among experts from so many different parts of the world is of great benefit to such an institution. He wished all a very cordial welcome and hoped this type of event could be organized again in the City of Dubrovnik. He wished the session every success and wished everyone a pleasant stay.

1.10 Mr Michel Jarraud, Secretary-General of WMO, in his address, expressed the appreciation of WMO to the Government and people of Croatia for their kind offer to host the session as well as the CBS technical conference on the WMO Integrated Global Observing System (WIGOS). He expressed his special gratitude to Dr Ivan Čačić, Director of Croatia's Meteorological and Hydrological Service and Permanent Representative of Croatia with WMO. He thanked him and all his staff for the warm hospitality and the excellent arrangements made to ensure the success of the session of CBS as they had for the Technical Conference on the WIGOS that had preceded the session of CBS.

1.11 The Secretary-General thanked the president of CBS, Mr Alexander Gusev, for his leadership of the Commission and for the work accomplished since the extraordinary session of CBS, held in Seoul, Republic of Korea during November 2006. He also thanked Prof. Geerd Hoffmann, Vice-president of the Commission, and the chairpersons and members of the Open Programme Area Groups, their expert teams, and the coordinators and rapporteurs for their key services. In addition he extended a warm welcome to the representatives of WMO Members, partner organizations and all participants in the session.

1.12 Noting the recommendations of the WMO Congress on strategic planning, the Secretary-General highlighted the role of this session to consider the CBS Operating Plan and arrangements of the Commission to be aligned with the new WMO Strategic Plan. He described several of the key elements to achieving the Expected Results of WMO including the work of the Data Processing and Forecast Systems (DPFS), Public Weather Services (PWS) and Disaster Risk Reduction (DRR) in supporting Members to take an increasingly effective role in their governments' decision making processes with projects such as the Severe Weather Warning Demonstration Projects. He also noted the important potential from the work on WIGOS and the underlying importance for many activities of achieving the timely implementation of the WMO information system (WIS).

1.13 Highlighting the importance of the Commission's contribution to monitoring climate and adapting to climate change ensuring the monitoring of the Essential Climate Variables (ECV), he called attention of the CBS to the third World Climate Conference (WCC-3) which will be held in Geneva from 31 August to 4 September 2009 with a theme of "Climate Prediction and Information for Decision-making". The Secretary-General appealed to members of the Commission and their respective countries to fully participate in WCC-3. He urged the Commission to remember the importance of full participation in expert groups of scientists from both developing and developed countries.

1.14 The Secretary-General reiterated his gratitude to the Government of Croatia, for hosting this fourteenth session of the Commission for Basic Systems (CBS) and wished all the delegates an enjoyable stay in Dubrovnik and a most successful and productive session.

1.15 The president thanked all the speakers for their kind words and warm wishes, and closed the opening ceremony.

1.16 A complete list of participants is given in the appendix to the present report.

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

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

In accordance with General Regulations 20 to 23, the Commission noted and approved the report of the representative of the Secretary-General as the first report on credentials

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

The agenda for the session was unanimously adopted, as contained in document CBS-XIV/Pink 1 & 2, Appendix B.

2.3 ESTABLISHMENT OF COMMITTEES *(agenda item 2.3)*

In accordance with Regulations 22 to 31, the session decided to establish a Nomination Committee and a Coordination Committee. The Nomination Committee comprised F. Uirab (Namibia) as the Chair, H. Ichijo (Japan), J. Mauro de Rezende (Brazil), A. Simard (Ms) (Canada), P. Kreft (New Zealand) and T. Frei (Switzerland). The Coordination Committee comprised the president of the Commission, the vice-president of the Commission, the representative of the Secretary-General and a representative of the host country. The Commission agreed that the work of the session would be carried out in plenary. General Plenary would be chaired by the president of the Commission and consider agenda items 1, 2, 3, 4, 5, 11.3, 12, 13, 14, and 15; while Plenary A would be chaired by the vice-president and consider agenda items 6, 7, 8, 9, 10, 11, and 12.1.

2.4 OTHER ORGANIZATIONAL QUESTIONS *(agenda item 2.4)*

The session agreed on the working hours of the session. It was agreed that minutes of plenary meetings were not required in view of the technical nature of discussions. In accordance with Regulation 3, the Commission agreed to suspend for the duration of the whole session Regulation 109.

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

3.1 The Commission noted with appreciation the report of its president, Mr A. Gusev (Russian Federation), which provided information on the activities of the Commission since its extraordinary session in February 2006.

3.2 The Commission recalled with satisfaction that within its current structure, CBS OPAG Expert Teams, the Implementation Coordination Teams and the Rapporteurs, which together included more than 160 experts, had accomplished a great deal of work during the reporting period. There had been more than 50 meetings, workshops and seminars on matters falling under the Commission's purview or otherwise related to the WWW. Details on those activities and major accomplishments were provided in the reports of the chairpersons of the OPAGs 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 at Fifteenth Congress and the sessions of Executive Council, and in numerous other meetings providing a consolidated input to their deliberations. The Commission particularly noted the activities related to THORPEX, IPY, QMF, DRR and GEO.

3.4 The Commission noted that the CBS-MG at its seventh (June 2007), eighth (June 2008) and ninth (November 2008) sessions continued to review and guide the work of four OPAGs, making necessary adjustments in their work programmes and advising the president on relevant issues especially as regards the participation of the Commission in the work of other constituent bodies and for representing the Commission at Congress and sessions of the Executive Council. In that regard, the Commission noted that Cg-XV reaffirmed that the WWW is and will continue to be the backbone Programme of the WMO that also actively contributes to cross-cutting activities, and had agreed with the need for reciprocal input from cross-cutting activities towards the strengthening of the WWW structure. The Commission appreciated the important role of the CBS-MG in coordinating the work of the four OPAGs, in making necessary adjustments in the intersessional period and in advising the president on relevant issues. The Commission therefore decided to re-establish the CBS Management Group by adopting Resolution 1 (CBS-XIV) – CBS Management Group.

3.5 The Commission noted that Cg-XV confirmed the leading role of CBS in the further development of the WIS, and also re-affirmed that WIS was serving all WMO Programmes. The Commission expressed its appreciation for the crucial contributions of cross-cutting nature made by the OPAG on ISS to directly support the WIS development and coordination work of the Intercommission Coordination Group on the WMO Information System (ICG-WIS), and stressed the importance of pursuing this thrust.

3.6 The Commission noted that EC-LX emphasized the leading role of CBS in the implementation of the WIGOS concept. In view of the crucial role and contribution of surface-based and space-based observing systems within CBS's responsibility, the Commission agreed that the OPAG on IOS should contribute to the development of the WIGOS initiative and directly support the EC-WG on WIGOS and WIS, and specifically its subgroup on WIGOS.

3.7 The 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 Open Programme Area Groups and the Expert Teams as well as the rapporteurs for their dedicated and outstanding work. On behalf of CBS, the president also thanked the Secretary-General of WMO and the staff of the Secretariat, in particular the OBS and WDS Departments, for their support and cooperation.

3.8 The Commission expressed its appreciation to the president for his commitment and hard work for the Commission during his time as president and in the preceding period as vice-president. It noted that his contribution to CBS also benefited WMO and its Members as a whole.

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

4.1 The decisions taken by Fifteenth Congress and the fifty-ninth and sixtieth sessions of Executive Council that are relevant to its work were reviewed by the Commission. The Commission discussed the relevant impact on the future work programme of the Commission and included its conclusions in the general summary under their respective agenda items, including in particular cross-cutting programme areas: WMO Integrated Global Observing System (agenda item 10), WMO Information System (agenda item 9), WMO Space Programme (agenda item 7) and other cross-cutting activities (agenda item 11).

4.2 The Commission discussed its contribution to the WMO Strategic Plan, its related CBS Operating Plan as well new working methods with a view to improving efficiency and cost-effectiveness and included its conclusions in the general summary under the respective agenda item: CBS Programme and Planning – ERs 10 & 11 (agenda item 12) and sub-items. The Commission noted that the Executive Council expected CBS to review its Terms of Reference as regards its alignment with the Strategic Thrusts and relevant ERs, and develop recommendations for EC starting with EC-LXI in 2009; the Commission agreed to request its Management Group to review the CBS Terms of Reference and assist the president of CBS in developing and submitting relevant recommendations to EC-LXI and EC-LXII.

5. STATUS OF WORLD WEATHER WATCH IMPLEMENTATION AND OPERATION *(agenda item 5)*

Availability of observational data from fixed and mobile stations

5.1 During the period 2006–2008, the percentages of SYNOP, TEMP, CLIMAT and CLIMAT TEMP reports available at MTN centres in comparison with the reports required from the Regional Basic Synoptic and climatological Networks (RBSN/RBCN) stations were as follows:

- 79 per cent for SYNOP reports;
- 71 per cent for TEMP reports;

- 72 per cent for CLIMAT reports;
- 79 per cent for CLIMAT TEMP reports.

5.2 There were still deficiencies in the availability of reports from certain areas, in particular in Region I (56 and 29 per cent of SYNOP and TEMP reports respectively received from RBSN stations in October 2008), in Region III (65 and 45 per cent) and in Region V (73 and 63 per cent).

5.3 The trend towards an increase in the availability of reports that was reported for the period 2004–2006 before CBS-Ext.(06) continued to prevail during the period 2006–2008, but with a lower gradient. The availability of SYNOP reports in the Regions I, III and V mentioned in paragraph 5.2 with the lowest percentages continued to progress, while the availability of TEMP reports in these Regions in 2008 was similar to or lower than that of 2004.

5.4 There was a significant increase in the number of CLIMAT and CLIMAT TEMP reports available during the period 2006–2008 in comparison with the period 2004–2005: from about 66 per cent to 72 per cent for CLIMAT reports, and from about 67 per cent to 79 per cent for CLIMAT TEMP reports. The Commission expressed its appreciation to the CBS Lead Centres for GCOS and to the GCOS Surface Network Monitoring Centres for their efforts towards increasing the number of these reports, and encouraged the Centres to continue their support to further improve the data availability.

5.5 The Commission noted the difficulties met by developing and least developed countries in the operation and maintenance of their observing and telecommunication networks, which led to deficiencies in the availability of observational data. The Commission stressed the need to assist these countries in the capacity building of their networks, in particular as regards the purchase of equipment and consumables, and the training of staff. The Commission noted the importance of cost-effective solutions for the equipment and guidelines for their implementation and operation. Taking as an example the support provided by Egypt in the calibration and maintenance of instruments in Region I, the Commission further encouraged sharing existing facilities or capacities between Members.

5.6 The daily average number of SHIP reports received by MTN centres for main synoptic hours oscillated around 2900 reports during the period 2004–2008. There was no significant change in the availability of TEMP SHIP (about 17 ASAP reports each day). The number of BUOY reports increased from 33,000 to 43,000 during the period 2006–2008; this is in particular due to an increase in the frequency of the collection of data from the buoys.

5.7 The daily average number of aircraft reports distributed on the GTS steadily increased from 197,000 to over 260,000 during the period 2006 to 2008. The overall increase in the number aircraft reports distributed on the GTS can be directly attributed to the increase in the number of reporting aircraft from existing AMDAR Panel Members and new Members joining the AMDAR Panel. The number of AIREP reports oscillated between 5000 and 6200. The number of aircraft reports presented in the Traditional Alphanumerical Code (TAC) FM 42-XI AMDAR has levelled off; this is primarily due to the migration from this TAC form to the Table Driven Code Form (TDCF) FM94-XIII Ext. BUFR. The number of BUFR aircraft reports increased from 155,000 to 211,400 during the period 2006–2008.

5.8 The Commission noted the valuable information contained in the monitoring reports and the improvements made by the Secretariat in their accessibility and presentation on the WMO server. While recognizing the value in continuing the monitoring of the historically defined networks, the Commission requested the Secretariat, with advice from the OPAG-IOS, to progressively include measures, that indicate the state of progress in the evolution of the surface-based component of the GOS as endorsed by CBS in the Implementation Plan for Evolution of Space and Surface-Based Sub-Systems of the GOS (WMO/TD-No. 1267), and post the relevant monitoring information on the WMO server. The Commission noted that some suitable information could already be available at major NWP Centres that may provide a suitable basis.

5.9 The Commission agreed that monitoring information on the quality of the observational data should be more widely accessible from the Internet and invited the Lead Centres for the data quality to make their monitoring reports available through the WMO server.

6. WORLD WEATHER WATCH PROGRAMME, SUPPORT FUNCTIONS AND PUBLIC WEATHER SERVICES, INCLUDING THE REPORTS BY THE CHAIRS OF THE OPEN PROGRAMME AREA GROUPS *(agenda item 6)*

6.1 INTEGRATED OBSERVING SYSTEMS (OIS) (*agenda item 6.1)*

6.1.1 The Commission expressed its appreciation to the Chair of the OPAG-IOS, Dr James Purdom and his Co-Chair Dr Sue Barrell, for their comprehensive report on the performance and further development of the surface-based and space-based subsystem of the GOS. It noted that the GOS, through coordinated efforts of Members, continued to provide sustainable observational data and information on the state of the Earth and its atmosphere to meet evolving requirements of various users. It underlined that along with the broadening satellite data and services, especially through R&D satellites, further improvements were achieved in the availability of data produced by other components of the GOS, notably marine and AMDAR data.

6.1.2 The Commission noted with satisfaction that in accordance with standing TORs and work plans, the major activities of the OPAG-IOS were concentrated on the evolution of the GOS, coordination and advice on satellite system matters, satellite utilization and products, requirements and representation of data from AWSs, scientific evaluation of OSEs and OSSEs, cooperation with GCOS, integration of AMDAR in WWW operations, revision and updating of GOS regulatory material. The Commission expressed its gratitude to all experts who contributed to the effective work of expert teams and rapporteurs established under OPAG-IOS.

6.1.3 The Commission reviewed the activities and results achieved under various areas under the OPAG-IOS responsibilities and considered the following.

Implementation and operation of the GOS

6.1.4 The Commission noted with satisfaction increased sustainability in implementation of surface based subsystem of the GOS.

6.1.5 It recognized the need to develop simple tools to assist Regional Rapporteurs on GOS with the design and optimization of Regional Basic Synoptic Networks (RBSNs) or Regional Basic Climate Networks (RBCNs).

Evolution of the GOS

6.1.6 The Commission reviewed the “Vision for the GOS in 2025”, noted the valuable contributions from various expert teams and other collaborators and adopted Recommendation 1 (CBS-XIV) – Vision for the Global Observing System in 2025.

6.1.7 It endorsed the OPAG-IOS report on progress on the Implementation Plan for the Evolution of Space and Surface-Based Sub-Systems of the GOS (EGOS-IP), (see Reference No. 5, Appendix II) and requested OPAG-IOS to maintain and update EGOS-IP, taking into account the developments with respect to GEOSS, in close cooperation with the regional associations, their Working Groups on Planning and Implementation of the WWW and concerned technical commissions.

6.1.8 Following the review of the “Vision for the GOS in 2025” and the Implementation Plan for Evolution of Space and Surface-Based Sub Systems of the GOS (EGOS-IP), requested OPAG-IOS to develop a new version of the EGOS-IP that will incorporate information included in the adopted “Vision for the GOS in 2025”. The Commission also requested that ET-EGOS gives consideration to related requirements that may have implications for the future GOS, and potentially WIGOS, such as requirements for Tsunami monitoring.

6.1.9 It requested those Members who have not yet nominated a National Focal for reporting progress and plans in their country related to EGOS-IP to do so.

6.1.10 It requested OPAG-IOS to find ways of improving the engagement of Members related to EGOS-IP.

6.1.11 It reviewed the need to establish a new Expert Team on Surface-based Remotely-Sensed Observations (ET-SBRSO) and adopted its establishment.

6.1.12 It requested the OPAG-IOS, in collaboration with CAS, CIMO and other relevant Commissions and programmes within WMO to consider the development of a strategy to sustain key components of IPY and THORPEX observational networks beyond the end of their respective experiments.

6.1.13 It requested the OPAG-IOS to continue assisting ASECNA management in its role of providing long-term sustainability of the AMMA network.

Satellite systems

6.1.14 The Commission welcomed the substantial enhancement of space-based observations called for by the new Vision for the GOS in 2025 and highlighted the new paradigm it implied for global satellite mission planning, data sharing and interoperability. It was clarified that, in the Vision, the missions listed as “Additional operational missions in appropriate orbits” were supposed to be operational with long-term continuity like the previous categories. As concerns “Operational pathfinders and technology demonstrators”, it was suggested that cloud radars and cloud/aerosol lidar missions be considered as well in future iterations of this Vision.

6.1.15 It endorsed the guidelines developed to facilitate the transition of relevant R&D missions to operational status, as a critical process for the implementation of this new Vision (see Recommendation 1 (CBS-XIV)).

6.1.16 It acknowledged the set of four reference documents describing respectively the satellite programmes of the GOS, the Earth Observation satellites and their instruments, the Gap Analysis of planned capabilities against user requirements and the expected product accuracy, and requested the further maintenance of such reference documentation to support planning activities.

6.1.17 It stressed that the CEOS-WMO Database on User Requirements and Observing Capabilities needs to be maintained within the Secretariat and recommended that a review be undertaken to redesign the current database with the aim of reducing resources required for maintenance.

6.1.18 It acknowledged a need to investigate the establishment of an Inter-Commission Team on Space Weather (see agenda item 7).

Satellite utilization and products

6.1.19 The Commission confirmed the need to monitor the progress of satellite data access and use by WMO Members through the biennial questionnaire or other means.

6.1.20 It requested that Members respond to the biennial questionnaire of the status of availability and use of satellite data and products and that Regional Rapporteurs to the WMO Space Programme assist with this activity.

6.1.21 It requested to consider actions to address the limitations expressed by WMO Members for satellite data access and use.

6.1.22 It reviewed the training conducted by the GCMS/WMO Virtual Laboratory for Satellite Data Utilization, confirmed the need for this training to continue, and endorsed the expansion of the network of Centres of Excellence to include centres in South Africa and the Russian Federation, and a further possible centre to be established in India.

6.1.23 It endorsed the new five-year strategy for the Virtual Laboratory (see Annex I to the present report) and requested the Secretariat to inform Regional Associations and Members. The Russian Federation suggested updating the diagram in future versions of the training strategy document in order to reflect the implementation of a Centre of Excellence in the Russian Federation.

6.1.24 It noted the progress of the Integrated Global Data Dissemination Strategy (IGDDS) project and the need to express requirement for data access; stressed the need for GEO imagery to be available in all regions primarily through DVB-S services and requested that OPAG-IOS investigate the continuity of such services over South America.

6.1.25 It recommended to expand the Space Programme Office in order to enable providing all the benefit expected from this programme, including the satellite utilization aspects.

Requirements and representation of data from AWSs

6.1.26 The Commission reviewed the revised Functional Specifications for Automatic Weather Stations based on input from other technical commissions and adopted Recommendation 2 (CBS-XIV) – Revised functional specifications for automatic weather stations.

6.1.27 It requested the OPAG-ISS to develop BUFR descriptors for all the variables listed in the "Functional Specifications for Automatic Weather Stations" and to develop metadata compliant with the WMO metadata profile.

6.1.28 It reviewed the "Basis Set of variables to be Reported by a Standard AWS for Multiple Users" and adopted Recommendation 3 (CBS-XIV) – Basic set of variables for a standard automatic weather station for multiple users.

6.1.29 It requested the OPAG-IOS to continue development of the four AWS metadata catalogues, namely: (a) variables measured; (b) instruments used; (c) data processing procedures used; and (d) data QC procedures.

6.1.30 It noted that there is no dedicated expert team within the Commission dealing with the operational issues related to the surface observing networks, agreed to rename the ET on Requirements and Representation of Data from AWS (ET-AWS) to the ET on Requirements and Implementation of AWS Platforms (ET-AWS) and agreed on new Terms of Reference for the ET-AWS.

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

6.1.31 The Commission reviewed the conclusions and recommendations of the fourth Workshop on the Impact of Various Observing Systems on the NWP, and noted the appearance of new satellite observing systems and that, as a consequence, although the overall impact of observations has increased, the impact of most individual observing systems has decreased since the last Workshop in 2004.

6.1.32 It endorsed the recommendations from the Workshop, including recommendations about: (a) interactions between NWP centres, data providers and data users; (b) recommendations about observational data requirements; and (c) recommendations about future studies that are indicated in the Annex II to the present report.

6.1.33 It requested the OPAG-IOS to interact more closely on observational issues with CAS and the EC Panel of Experts on Polar Observations, Research and Services in accordance with THORPEX, AMMA and IPY activities; taking into account the need for legacy of these experiments and campaigns for the future of the GOS, establish a sustainable coordination mechanism with regional associations.

6.1.34 It encouraged NWP centres to keep stimulating the studies of observation targeting strategies in coordination with the THORPEX ad hoc groups.

6.1.35 It requested the OPAG-IOS and the Secretariat to organize the fifth Workshop on the Impact of Various Observing Systems on the NWP to be held in 2012.

AMDAR matters

6.1.36 The Commission acknowledged that following the assessment of the global availability and sustainability of the provision of AMDAR data for the operations of the NMHSs, the AMDAR Panel declares the AMDAR Programme operational. Currently, this declaration refers to wind, temperature and pressure observations collected through AMDAR systems and in use by the meteorological community. It also noted that the AMDAR, as a GOS observing system component, has the potential for expanding its capabilities to increase data coverage and add other observational elements. Following the AMDAR being operational, the AMDAR activities are expected to gradually integrate into WMO WWW Programme, CBS and CIMO structures.

6.1.37 It noted the development of a water vapour sensor to provide AMDAR humidity data and supported the OPAG-IOS suggestion that data validation be performed not only with operational radiosondes and NWP models but also with dedicated sensors in research aircraft.

6.1.38 The Commission noted that the integration of AMDAR into the Commissions working structure necessitated the need for a new Expert Team on Aircraft-based Observations (ET-AIR) and adopted its establishment.

6.1.39 Many areas of the world are considered as data sparse in regard to the availability of upper-air observations. The Commission noted that AMDAR data could alleviate this problem, and encouraged all operational AMDAR programmes to collect and distribute AMDAR data outside their national territories as part of their contribution to WWW.

6.1.40 It was also recognized that there is a requirement for increased horizontal density of AMDAR data, particularly over Africa and the tropics, and the Commission requested AMDAR programmes to support this requirement.

Marine Systems

6.1.41 The Commission invited more Members to participate in the ASAP Panel of the JCOMM Ship Observations Team (SOT) for providing in situ aerological profiles from data sparse ocean areas as complementary data to AMDAR.

6.1.42 The Commission invited Members to continue efforts for adding pressure sensors to the complete drifting buoy network of 1250 buoys. The Commission noted that approximately half of the network has now been upgraded to provide pressure data.

6.1.43 The Commission noted with appreciation that the Argo profiling float programme reached completion in November 2007 with the establishment of 3000 operational units. The Commission stressed that the Argo network requires sustainability over decadal timescales, and encouraged that such support be found.

6.1.44 The Commission recalled that the concerns of ship owners and masters regarding availability of VOS ship position and identification data on public Websites – mainly for ship security reasons for VOS recruited by Members – had been addressed quite effectively through Resolution 27 (EC-LIX) as complying masking schemes have been implemented. However, the Commission noted the concerns expressed by marine climate users, through JCOMM, regarding some limitations concerning access in delayed mode of unmasked VOS reports that may impact the quality of marine climatology products made available to end users.

6.1.45 The Commission noted with appreciation that the Statement of Guidance (SoG) for Ocean Applications has been substantially updated to reflect requirements and gap analysis for

Met-Ocean Forecasts and Services (MOFS), including marine services and ocean mesoscale forecasting. It urged Members to address the deficiencies noted in the SoG (waves, sea-level, visibility).

GCOS matters

6.1.46 The Commission recalled that the GOS provides the foundation for the atmospheric component of GCOS.

6.1.47 The Commission noted that there are now nine CBS Lead Centres for GCOS and that new Terms of Reference for these CBS Lead Centres for GCOS have been developed and adopted Recommendation 4 (CBS-XIV) – Revised list of CBS lead centres for the GCOS including their areas of responsibility and their terms of reference. It requested Lead Centres to consider expanding the scope of their activities to cover all Regional Basic Climatological Networks (RBCN) stations.

6.1.48 The Commission was advised that the GCOS Reference Upper-Air Network (GRUAN), a specialized network of 30 to 40 reference sites to provide long-term high quality climate data, is being developed. The Richard Assmann Observatory in Lindenberg has been designated by WMO as the lead centre for the GRUAN network. The Commission requested the OPAG-IOS to investigate the feasibility of establishing GRUAN as a WIGOS Pilot Project.

6.1.49 The Commission noted that there has been discussion about the need to continue CLIMAT TEMP reports and that further investigation is being performed before any recommendation is made.

Impact of new instrumentation on the GOS

6.1.50 The Commission was advised that 50 Members had replied to a questionnaire on the Impact of New Instrumentation on the GOS. The questionnaire identified that a global priority was investment in AWS systems. Additionally satellite reception equipment and upper-air systems also featured highly in Members instrumentation procurements.

Future composite GOS and its impact on developing countries

6.1.51 The Commission recommended that the evolution of the GOS must take into account upgrading, restoring, substitution and capacity building (especially in the use of new technologies), taking into consideration both the use of the data and the production of the data.

GOS-related regulatory material

6.1.52 The Commission noted that the revised *Guide on the GOS* (WMO-No. 488) was published in 2007. In addition, Volume II of the *Manual on the GOS* (Regional Aspects) (WMO-No. 544) is in the process of adoption by the regional associations. The Commission invited regional associations to ensure the updating of their component of the Manual be completed as soon as possible.

6.1.53 The Commission was advised that there are certain regional elements in the *Manual on the GOS* that would benefit from better harmonization, including classification of stations, procedures for updating and amending RBSN/RBCN and basic definitions. The Commission requested the OPAG-IOS to ensure harmonization occurred.

6.2 INFORMATION SYSTEMS AND SERVICES (ISS) *(agenda item 6.2)*

6.2.1 The Commission thanked Mr Peiliang Shi, Chairperson of the OPAG, for his report. It noted with satisfaction the progress and achievements made, covering a wide range of tasks. The Commission expressed its thanks to the many experts who had served on the various OPAG's teams.

Status of implementation and operation of the GTS

6.2.2 The Main Telecommunication Network (MTN), and especially the Improved MTN, provides a very efficient core communication network. All the 23 MTN circuits were in operation. Eleven MTN circuits were implemented through MPLS data-communication network services (access speed from 128 Kbit/s to 4 Mbit/s), four circuits through Frame Relay (16Kbit/s to 768 Kbit/s), five circuits via leased line (64 Kbit/s and one at 9.6 Kbit/s) and two circuits via VSAT (64 Kbit/s and 19.6 Kbit/s). All MTN circuits (but one) were operating with TCP/IP or had a firm plan for the migration to TCP/IP; in this regard, the Commission noted with appreciation the firm plan for the operational migration to TCP-IP of the MTN circuit RTH Dakar-RTH Toulouse in July 2009. The Commission was pleased with the significant progress made in the implementation of IMTN and RMTNs, but it noted that serious shortcomings still existed in some Regions at the regional and national levels.

6.2.3 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 (EUMETCast and RETIM-Africa) and data-collection systems (METEOSAT/DCS) continue to play a crucial role. There were still serious shortcomings in several countries, in particular as regards the national data collection and an effective connection of the NMC to the GTS. Satellite-based telecommunications was playing a crucial role in the central and western part of the Region, also including Madagascar and Comoros, through the ASECNA VSAT network and in the eastern part with the implementation of a VSAT network operated by RTH Nairobi.

6.2.4 Most of Region II GTS circuits were operating at medium or high speed, but there were still a few low-speed connections. The RMTN in Region II, particularly in its eastern and southern parts, was being improved by the continued implementation of data communication services, such as MPLS IP-VPN and Frame Relay services, complemented by satellite-based distribution systems (PCVSAT and FengYunCast operated by China and MeteoInform by the Russian Federation) and the use of the Internet. Most of the current GTS circuits had been migrated to TCP/IP. Firm plans of telecommunications providers to discontinue Frame Relay services as well as low-speed dedicated circuit services was a serious issue that needed urgent coordination plans. Three RMTN circuits connected with RTH Tokyo migrated from Frame Relay services to an MPLS based IP-VPN in March 2009 in order to avoid interruption of the GTS operation due to the discontinuation of the Frame Relay service. The migration plan was coordinated by RTH Tokyo in cooperation with the related centers. The Commission was pleased to note that significant improvement of traffic throughput with cost-effectiveness was confirmed through the operational evaluation of the MPLS based IP-VPN. Linkage via the Internet was increasing, and using VPN techniques for ensuring operational security was highly recommended. The Commission noted with appreciation that RTH Jeddah (Saudi Arabia) had started a satellite based dissemination service (DVB-S) with regional coverage.

6.2.5 In South America, the plan for the actual implementation of the RA III Regional Meteorological Data Communication Network (RMDCN) did not proceed due to administrative and financial constraints in several countries. IP-VPN connection via Internet is being used between some NMCs and RTHs, and comprehensive tests are under way. All 13 NMCs were equipped with receiving systems of the International Satellite Communication System (ISCS) operated by the United States of America. EUMETCast receiving systems were also installed in most countries of the Region.

6.2.6 In Region IV, the International Satellite Communication System (ISCS) operated by the United States was providing for the RMTN as well as data distribution over Regions III and V. This network has been operating well using TCP/IP procedures with an increased capacity. Some NMCs were planning an upgrade of their current operational GTS application software to ensure the most effective operations.

6.2.7 Region V RMTN continued using Frame Relay services and satellite-based communications (ISCS). The Emergency Managers Weather Information Network (EMWIN) is also

a crucial source of data, warnings and forecasts for the Pacific, in particular for small island countries. The use of Internet had increased considerably, in particular for the collection of observational reports and for linking small nations in the Pacific. The current RANET project and a Pacific HF digital e-mail network were under further development. The cessation of Frame Relay services was also affecting centres in Region V and needed urgent coordinated action.

6.2.8 The RA VI RMDCN, managed by the ECMWF, initially based on Frame Relay, had migrated in June 2007 to a MPLS IPVPN. The RMDCN interconnects 40 RTHs and NMCs, as well as ECMWF and EUMETSAT sites. The contractual arrangement for the new network 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 when cost-effective. Satellite-based distribution systems based on DVB-S (RETIM, PCVSAT, MeteoInform, NUBIS and EUMETCast/MDD) were also playing an important role.

6.2.9 The Commission expressed its appreciation for the extensive implementation and significant technological upgrades of satellite-based multipoint telecommunications systems, especially using digital video broadcasting (DVB) or digital audio broadcasting (DAB) techniques, 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 national or subregional level.

GTS-WIS Communication Structure

6.2.10 The Commission recalled that Fifteenth Congress (Cg-XV) emphasized that the WIS implementation should build upon existing WMO information systems in a smooth and evolutionary process, and agreed that the WIS implementation plan has two parts that would be developed in parallel:

(a) Part A: the continued consolidation and further improvements of the GTS for time-critical and operation-critical data, including its extension to meet operational requirements of all WMO Programmes (including improved management of services); highest priority should be given to overcoming the persisting shortcomings in the current GTS implementation;

(b) Part B: an extension of the information services through flexible data discovery, access and retrieval services to authorized users, as well as flexible timely delivery services.

6.2.11 The Commission noted that two concepts had been under consideration for the WIS real-time network structure:

(a) A Global Meteorological Data Communication Network, consisting of a single coordinated global network based on data-communication network services, resulting from the evolution of parts of the current GTS while integrating other parts;

(b) Area Meteorological Data Communication Networks (AMDCN), in which each GISC would be responsible for ensuring that telecommunication links and data flow in its area of responsibility are coordinated appropriately.

6.2.12 The Commission agreed that while the concept of a *single* global network was very attractive from the technical viewpoint, the administrative constraints would make it extremely difficult to implement and manage. It requested the OPAG-ISS to consolidate the concept of area networks (AMDCN) coordinated by each GISC, for the WIS real-time network structure. The Commission confirmed and emphasized that satellite-based data-distribution systems based on standard technology (e.g. DVB-S) with preferably wide coverage (e.g. multi-regional), should be integrated components of the WIS communication structure for the distribution of large volume of information.

6.2.13 The WIS real-time network would be composed of a small number of Area Meteorological Data Communication Networks (AMDCNs) and a WIS core network interconnecting the GISCSs and AMDCNs together. GISCs would be responsible for ensuring that their AMDCNs are developed and maintained and, where the appropriate agreements are in place, the traffic between WIS centres in different AMDCNs is managed. The Commission recognized that not only GISCs' efforts but also cooperation of all WIS centres (i.e. DCPCs and NCs) are important to develop and maintain AMDCNs appropriately.

6.2.14 The Commission endorsed the AMDCNs implementation design principles as follows:

- An AMDCN should be mainly based on a cost-effective network service appropriate for its area of responsibility;
- A GISC should, possibly in cooperation with other GISC(s), ensure that appropriate arrangements are in place for the overall technical and administrative management (e.g. traffic, security, monitoring, backup arrangement, competitive procurement, contract, funding coordination) of its AMDCN, and that where multiple networks are used that these are all managed effectively as are the links between them, taking account of WMO guidance;
- New applications taking place of message switching mechanisms should be developed to ensure sophisticated communication without undue delay, especially between any WIS centres within an AMDCN;
- An AMDCN should keep scalability and flexibility to respond to new global and regional requirements, and to keep up with technology development;
- Gateway facilities/functions and guidelines to promote the migration to cost-effective network services should be provided.

6.2.15 The Commission noted that several issues related to WIS real-time network structure were still requiring further studies, such as:

- The connection of DCPCs and NCs operated by non-NMHSs with GISC;
- Backup solutions for GISCs;
- Role of gateway centres for data exchange between centres under different network conditions in the AMDCNs and for protecting against unauthenticated access from outside of the AMDCNs;
- Administrative hurdles to realize the AMDCNs on a large scale, such as consensus process of all participants, coordinated procurement on one-stop contract procedure, overall operational management scheme and governance.

WIS core network

6.2.16 The Commission noted the requirements for all GISCs to synchronize large volume of data and products with their metadata catalogues on a real-time basis through the WIS core network. Therefore indispensable requirements for the core network are predictability and stability in available throughput (bandwidth and network latency), reliability for continuous operation on 24 x 7 basis without interruption and security against malicious attacks such as intrusion, denial of service, tampering, spoofing and snooping.

6.2.17 To meet such requirements, a closed network services with a definite Service Level Agreement (SLA) would be needed. The public Internet cannot provide this type of service and should not be used in this case. The Commission agreed that the Improved MTN should evolve into the core WIS network.

Improved MTN project (IMTN)

6.2.18 The Commission noted that the Improved MTN project (IMTN) implementation had facilitated a progressive and rapid implementation of effective and reliable data-communication network services for the core GTS services towards the core network for WIS. It expressed its great appreciation for the collaborative and fruitful efforts made by the NMHSs concerned.

6.2.19 With respect to Network I ("Cloud I"), the Commission noted that it was still using Frame Relay services and that the current contract was due to end in December 2009, requiring a new contractual arrangements. It also noted that RTHs Brasilia and Buenos Aires had not yet joined Network I and were still connected to RTH/WMC Washington via 64 Kbit/s digital leased circuits.

6.2.20 Network II ("Cloud II") was implemented through the extension of the RA VI-RMDCN managed data-communication services. The ECMWF, in the framework of the WMO-ECMWF agreement, was managing the network and monitoring, on behalf of all participating centres, the quality of service and the contractor's adherence to the Service Level Agreements. The Commission noted with appreciation the successful migration of Network II ("Cloud II") to MPLS-based IPVPN in June 2007, leading to significant improvement in cost-effectiveness for the benefit of the IMTN Network II. The Commission noted that RTH Melbourne had announced its firm intention join the IMTN Network II, and that RTH Washington had also indicated a similar intention.

Planning and implementation strategy

6.2.21 The Commission stressed the need of a clear strategy, at regional and global levels, for the implementation of an adequate data communication infrastructure for WIS; it endorsed the Planning and implementation strategy guidelines as included in Annex III to the present report.

Data discovery, access and retrieval services, including timely delivery services

6.2.22 The Commission agreed that Data Discovery, Access and Retrieval (DAR) services based on request/reply “pull” mechanism with relevant data management functions should comply with policy principles as follows:

(a) Procedures for managing access rights, control of data retrieval, registration and identification of users, should be defined, as and when required;

(b) Anonymous downloading is technically possible, but depends on whether a NC permits that feature;

(c) DAR mechanisms have no system-inherent features that would violate international legal frameworks.

6.2.23 To comply with the principles, DAR components and connection networks with necessary protocols and procedures should be based on universal standards and independent from specific vendor architectures. Inevitably DAR services are implemented essentially through the Internet with HTTP, FTP and other Internet based protocols. The WIS core network is expected to support the services with synchronization of metadata catalogues

Data-communication systems and techniques

TCP/IP and related protocols on the GTS

6.2.24 The Commission noted the status of development and acceptance of the IPv6 protocol suite in the industry, including tests conducted by the ECMWF, and agreed that it was still too early for any recommendation on the timeframe for IPv6 to become a viable solution for WMO purposes, and IPv6 testing studies of possible migration strategies should be pursued.

6.2.25 The Commission noted that the VGISC project in RA VI included the use of an authentication scheme to implement data access policies, where users and data are defined to be part of certain domains. It requested its OPAG to urgently consider such schemes that are necessary for the development of GISCs and DCPCs.

Guidance for implementation of data communication facilities (GTS & Internet) at WWW Centres

6.2.26 The Commission noted with appreciation that the Guide on IT Security had been updated, and could be considered by NMHSs as a reference security document. Additions have been made in particular on Intrusion Detection and Intrusion Prevention systems, and to update some reference material.

6.2.27 The Commission noted that the Internet is used to provide GTS connection in a significant number of centres. E-mail is the most widely used protocol in such implementations. It was also noted that although this proved to be successful in many cases, there were many examples of unreliable/insecure Internet. In particular, very remote areas such as small islands in the Pacific proved to pose very special problems that even the Internet could not solve. In view of the inherent risks of the Internet, the Commission agreed that this type of operational use should be considered case by case, when no other affordable means were available. It noted that the Guide on Internet Practices had been updated. The Commission also noted with interest that tests were carried out on the possible use for WMO related information exchange of some innovative Internet techniques (e.g. “blog based technology”).

6.2.28 The Commission noted that IP VPN technology over the Internet had been extensively tested by ECMWF and RA VI RMDCN countries for possible backup connections providing for any-to-any connectivity. The Guide on IP-VPN was updated accordingly, and some issues needed to be further tested.

6.2.29 The Commission noted with satisfaction that the file naming convention as described in Attachment II.15 (Use of TCP/IP on the GTS) was successfully implemented and used in a number of NMHSs. The Commission urged all centres to implement this procedure facilitating a migration from bulletin to file exchange and to complete the transition as soon as possible.

6.2.30 Noting the importance of efficient data-collection systems at national level implemented under the responsibility of NMHSs, the Commission asked the OPAG-ISS to develop a guide focused on data-communications and data management techniques, procedures and practices that are the most appropriate for the implementation and operation of data-collection systems.

GTS operation and information exchange

Procedures for collection, routing and distribution of data and products

6.2.31 In accordance with the Manual on the GTS, the limits for meteorological bulletins for alphanumeric and binary data had been increased to 15 000 and 500 000 octets respectively as from November 2007. The Commission noted that some WWW centres encountered problems in receiving or transmitting such bulletins when the size limits configured on their circuits are less than these limits. This hampered the exchange of data and products on the GTS, and in particular the migration to TDCF. The Commission urged Members to apply the procedures related to the length of meteorological bulletins as included in the Manual on the GTS. The Commission invited RTHs to monitor the application of the procedures and rectify any problems caused by inadequate configuration of the size limits in the message receiving and transmitting systems in their areas of responsibility.

6.2.32 The data designators of the abbreviated headings of certain bulletins exchanged on the GTS, in particular satellite bulletins, are not included in Attachment II-5 of the Manual on the GTS or are used for different data types than those mentioned in Attachment II-5. Noting that this could lead to errors in handling and processing the relevant bulletins, the Commission urged the centres

that were inserting such bulletins on the GTS to make available, for example through the Internet, the definitions of these special data designators; It also urged Members to comply with the recommended procedures, as included in the Manual on the GTS, for the allocation and use of data designators.

6.2.33 Noting that the Manual on the GTS calls for global exchange of observations, the Commission stressed that this exchange requirement should be independent of the data encoding form as long as it was a standard WMO form. The Commission confirmed the final goal for a global exchange of WMO required data and products in TDCF. It therefore urged the OPAG-ISS to review the Manual on the GTS to reflect this.

6.2.34 The Commission agreed to recommend amending the Manual on the GTS with a view to allocating:

- A geographical designator for Montenegro, and designators for RARS data and SYNOP data and surface observations from one hour period in Attachment II-5 – Data designators $T_1T_2A_1A_2ii$ in abbreviated headings;

- A two-letter code to be used by international organizations in the field <location indicator> of the general file naming conventions.

The Commission adopted Recommendation 5 (CBS-XIV) – Amendments to the *Manual on the Global Telecommunication System* (WMO-No. 386), Volume I, Part II. The Commission also requested the OPAG-ISS to urgently develop appropriate filenaming extension for the exchange of XML files.

Global monitoring of the operation of the WWW

6.2.35 The present scheme of the global monitoring of the operation of the WWW coordinated by the Secretariat includes the Annual Global Monitoring (AGM), the Special MTN Monitoring (SMM) and the Integrated WWW Monitoring (IWM). The Secretariat also coordinates the Specific Monitoring on the exchange of Antarctic data (SAM). CBS-Ext.(06) agreed to move from the test phase to a pre-operational phase of the IWM as from October 2007. WMO Members were invited to stop producing AGM reports as soon as they prepare IWM reports. Both IWM and the SMM are therefore expected to replace the AGM.

6.2.36 The Commission was pleased to note that a guide on the implementation of the IWM prepared by the OPAG-ISS was available in the WMO server and that it includes procedures for the monitoring of the availability of BUFR/CREX reports. The planning and implementation of the IWM was relying on the action taken by RTHs. The Commission noted that ten RTHs participated in the 2008 IWM. It urged all RTHs to participate in the IWM and to coordinate the implementation of the IWM with their associated NMCs.

6.2.37 Noting that, within the framework of the SMM, RTHs were contributing or had committed to contribute to the monitoring of certain data types presented in BUFR, including surface and upper-air observations from RBSN stations and aircraft reports, the Commission invited RTHs to also contribute to the monitoring of other types of observational data presented in BUFR, particularly climate and marine data.

6.2.38 The Commission urged RTHs and NMCS to examine the analysis of the monitoring exercises as provided and posted by the Secretariat on the WMO server, and to take further action to mitigate the deficiencies observed.

Radio frequencies for meteorological activities

6.2.39 The Commission noted with much appreciation that the World Radiocommunication Conference (WRC-07, Geneva, 2007) had a very favourable outcome as regards several agenda items that were directly related to meteorology, attributable to the active preparation and

participation of WMO. The relevant positions of the World Meteorological Organization (WMO) were presented in a comprehensive document prepared by the SG-RFC.

6.2.40 The Commission noted that the agenda of the next World Radiocommunication Conference (WRC-11) included several items of serious importance for WMO, and it concurred with the WMO preliminary position on WRC-11 developed by the SG-RFC meeting and being submitted to relevant ITU-R groups. It noted with satisfaction that the update of the joint ITU-WMO publication which was now entitled *"Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction"* was finalized and was being published in six languages mainly as an electronic publication, jointly with the ITU-R. It noted with satisfaction that a Workshop on "Radio-frequencies for Weather, Water and Climate Monitoring and Prediction" was planned in the fourth quarter of 2009, as a joint WMO/ITU event co-sponsored by the two Organizations. The handbook is an important common reference for both NMHSs and national Radiocommunication Authorities. The Commission also noted with satisfaction that the SG-RFC activities were an important contribution to the respective GEO task.
(Documentation available at http://www.wmo.int/pages/prog/www/TEM/WMO_RFC/index_en.html)

6.2.41 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 Ultra Wide Band (UWB) devices, i.e. radiocommunication systems operating with very large bandwidth. The Commission asked the Steering Group on Radio-Frequency Coordination to actively pursue its activities, including preparatory activities for WRC-11.

6.2.42 The Commission, recalling Resolution 3 (Cg-XV), confirmed the importance of NMHSs being aware of the criticality of issues related to the various radio frequency bands used by meteorological and related systems. It urged Members to ensure that their respective national Radiocommunication Authorities were fully aware of the impact of relevant issues for WMO related operations and research, and to seek their cooperation and support. The Commission welcomed the approach taken by the United Kingdom of Great Britain and Northern Ireland towards Radio Frequency Coordination with the UK National Regulator and encouraged members to follow this approach as an example of Best Practice. The UK NMHS hosts annual meetings with the Regulator that highlight the socio-economic benefits of meteorology and its use of the radio spectrum. There is a focal point who attends key meetings of the Regulator and other relevant UK bodies to make sure that the national and international meteorological implications of the decisions by the Regulator are clear, and accompanies the Regulator as part of the UK delegation to international meetings on radio frequency matters. The key to success has been close communication with the regulator that has emphasized the socio-economic impacts of decisions.

Data Management matters

Data representation and codes

6.2.43 The Commission noted that the CBS Management Group had agreed to test the direct adoption of recommendations for amendments to the Manuals between CBS sessions with a view to saving time during the CBS sessions and reducing delays in the approval of amendments. Draft procedures were agreed by correspondence and a pilot project to test the draft procedures was successfully carried out. The Commission therefore recommended endorsing these procedures and agreed on a revision of the procedures for amending the *Manual on Codes*, including the fast track procedure, the procedure for adoption during CBS sessions and the procedure for adoption between CBS sessions. The Commission adopted Recommendation 6 (CBS-XIV) – Amendments to the *Manual on Codes* (WMO-No. 306), Introduction chapters of Volumes I.1 and I.2.

6.2.44 The Commission noted that the Secretariat was informing Members about amendments by providing an updated electronic version of the relevant part of the *Manual on Codes*, which were also posted in the four languages on the WMO Web server; distribution of supplements was discontinued.

6.2.45 The Commission agreed that the NMHSs running automated processing systems such as encoders, decoders and translators require the code tables in an electronic format suitable for these systems and that all these users currently had to translate these tables. The electronic format of presentation of the code tables should also facilitate the management of the changes to the Manual. The Commission therefore requested the Secretariat to make available the code tables in an appropriate electronic format with the assistance of experts of the OPAG-ISS, and to adapt the form of presentation of the *Manual on Codes* in this respect.

6.2.46 The list of Master Tables in the *Manual on Codes* includes Master Table 10 for oceanography maintained by the International Oceanographic Commission (IOC). Noting the progress made in the development of Master Table 10, the Commission agreed that it was time to clarify the respective role of IOC and WMO in its management and recommended that CBS and JCOMM jointly develop a proposal in this respect.

Modifications to the *Manual on Codes*

6.2.47 The Commission recalled the scheme agreed upon by CBS-Ext.(02) (see WMO-No. 955, paragraph 6.2.66) which defined a three-step mechanism for modifications to BUFR, CREX and GRIB 2 tables. The Commission endorsed the outcome and recommendations of the OPAG concerning additions to data representation tables, including those approved during the intersessional period for operational and pre-operational use, as summarized in the following paragraphs.

6.2.48 The Commission concurred with a set of additions to the Code Tables approved as operational by the chair of OPAG on ISS, the vice-president and the president of CBS during the intersessional period in:

– GRIB Edition 2: for TIGGE products, Earth model representation, precipitation rates, event Probabilities, quantitative precipitation forecasting, WAFS products and sign convention for fluxes;

– In BUFR: cloud information;

– In CREX and BUFR: regulations related to use of units, especially for aviation information;

– In Common Code Tables:
  – A scheme for radiosonde numbers;
  – Definitions of centres and sub-centres, in particular for the satellites data exchange RARS system, satellites data types, sub-categories for surface data, instruments for water temperature profile measurement.

6.2.49 The Commission agreed to a set of additions of parameters in GRIB 2 Tables for templates for chemicals and for data representation template for run length packing with level values.

6.2.50 The Commission agreed to additions to BUFR/CREX Tables:

– For satellite data: GHRSST data, SBUV/2 ozone data, JASON2 OGDR data, entries for GOME Experiment, METOP GOME-2 template, SMOS data and for encoding all sky radiance data

– Templates for SYNOP data manually encoded in CREX, METAR/SPECI and TAF coded in BUFR or CREX;

– BUFR Templates for surface observations from one-hour period, representation of SYNOP data with one-hour observations, synoptic reports from fixed land stations and for maritime data from coastal and island stations;

– Sequence for locust data, descriptors for radiation, for Air Chemistry, for GFA (Graphical Forecast AIRMET) data.

6.2.51 The Commission agreed to insert a note in the text of Code FM 54-X Ext ROFOR (Route forecast for aviation) to notify the end of ICAO requirement for the message, upon ICAO's request.

6.2.52 The Commission adopted Recommendation 7 (CBS-XIV) – Amendments to the *Manual on Codes* (WMO-No. 306), Volume I.2, and Recommendation 8 (CBS-XIV) – Amendment to the *Manual on Codes* (WMO-No. 306), Volume I.1. It recommended operational implementation of the amendments on 4 November 2009.

6.2.53 The Commission stressed the importance for all WMO Programmes to review their requirements in terms of data representation and codes, and to submit relevant proposals for amendments to the *Manual on Codes* to the Expert Team on Data Representation and Codes (ET-DRC).

Migration to Table Driven Code Forms (TDCF)

6.2.54 About ten per cent of the surface and upper-air reports from the RBSN stations were received in BUFR form at MTN centres in 2008. The Commission noted the continued slow progress in the migration since CBS-Ext.(06).

6.2.55 EC-LX (2008) urged all WMO Members to finalize and implement plans for the migration in accordance to the international migration plan approved by Congress. The Commission noted that the replies to the 2007 questionnaire on the migration to TDCF showed a significant increase in the development of national Migration Plans that should lead to a significant increase of BUFR data exchange. However, noting the limited number of replies, the Commission urged the WMO focal points for code and data representation matters to be more responsive to such questionnaires and to contribute information on the migration of their countries. The Commission agreed that the 2003 and 2007 questionnaires provided valuable insight into the migration progress including the identifications of issues, and agreed to pursue this practice.

6.2.56 The available guidance, self-training and encoder-decoder software developed by the CBS expert teams, regional coordinators/rapporteurs and Members are instrumental in facilitating the migration by Members. The Commission noted with satisfaction that the Secretariat distributed to Members a guidance document prepared by the CT-MTDCF with a view to increasing the awareness of the benefit of the migration by the NMHSs. The Commission was also pleased to note that Canada provided a template-oriented BUFR library and API as well as a template writing guide, that Brazil provided BUFR encoding and decoding tools, that Italy made available a license-free software package for both manned and automatic stations to encode TAC and BUFR format bulletins, and that ECMWF provided a web verification service for BUFR/CREX data. The Commission stressed the important role of the regional coordinators/rapporteurs in monitoring and supporting the migration in their Regions.

6.2.57 The Commission noted possible arrangements for facilitating a step-by-step migration by zones. When the migration for a type of data is completed within the zone of responsibility of an RTH, the parallel exchange of data in both TAC and TDCF is not required anymore. The systematic exchange of the data in TAC from centres within such a zone, called type B, may be discontinued if appropriate gateway arrangements are made between this zone B and other zone(s) still needing TAC bulletins, called type A. These arrangements for a step-by-step migration by zones could consist in:

• Establishing a gateway function ensuring conversion of the forms of representation of data (TDCF/TAC) between zones; some centres may agree to contribute to such a gateway;

- And/or continuing the parallel relay of TAC and TDCF data from (some) NMCs or RTHs only from zone B to zones A.

6.2.58 The Commission noted the survey on the capabilities of RTHs and NMCs to encode and decode BUFR and convert data between TAC and BUFR. WMO focal points for code and data representation matters were invited to provide/confirm the dates when their country was in a position to send and receive data in TDCF and discontinue receiving data in TAC. The Commission invited RTHs to continue compiling such information from their zone of responsibility and the focal points to continue updating such information, to facilitate RTHs planning a step-by-step migration. The Commission invited RTHs to consider facilitating the step-by-step migration by assisting in the definition of arrangements between zones of responsibility of MTN centres and RTHs, and by monitoring the exchange of TDCF bulletins and reports on the GTS.

6.2.59 The Commission agreed to give the highest priority for technical cooperation activities to support the migration to the training on TDCF in the WMO Regional Training centres, and to the development and implementation of projects for the migration to TDCF. The Commission encouraged NMHSs to collaborate in the development of projects, for example within a zone of responsibility of an RTH, and to submit requests for support, if required, through the WMO Voluntary Cooperation Programme. Noting the capacity building efforts made in Region I, the Commission emphasized the importance and expected impact of establishing a Migration Implementation Project (MIP) for the Region, with support from the Secretariat and donors.

6.2.60 The Commission emphasized that the WMO Integrated Global Observing System (WIGOS) demonstration and pilot projects should address the generation and exchange of data in TDCF where appropriate. It requested that these projects be reviewed in this respect, and integrate specific migration activities or Migration Implementation Project (MIP).

6.2.61 The Commission confirmed the migration matrix given in Annex IV to the present report. The Commission recognized that some Members were having difficulty making the transition to table-driven codes and so it accepted that the schedule more realistically indicated time-lines for exchange between RTHs rather than production at NMHSs. Nevertheless, Members were urged to make every effort to meet the timescales of the migration matrix.

Assessment of and policy on data representation systems

6.2.62 The Commission noted with satisfaction that the Expert Team on the Assessment of Data Representation System (ET-ADRS) within the OPAG-ISS was established and started its work on assessing advantages and disadvantages of different Data Representation Systems (DRSs). The preliminary analysis of the team indicated that GRIB and BUFR are the most suitable DRSs for the real-time operational exchange of information between NMHSs, whereas the other DRSs offer some advantages for the distribution of information to the end users such as aeronautical users.

6.2.63 The Commission requested the OPAG-ISS to cooperate with the NetCDF and the Climate and Forecast (CF) communities with a view to:

- Develop proposals for a coordination mechanism to drive forward the NetCDF format and the CF metadata standards to be fit for operational meteorology (WMO requirement);

- Consider the question of the resources (e.g. at NMHS level) required to support the data format and metadata standard development;

- Develop a model for the governance.

6.2.64 The Commission agreed that the CBS policy on Data Representation Systems (DRS) should be driven by users' requirements. It stressed the importance of the interoperability between the different DRS that were utilized.

6.2.65 The Commission agreed that the application of the ISO 191xx series of geographic information standards to the development of a WMO conceptual model of data representation should be considered as a fundamental element of a CBS policy on data representation systems, in particular with a view to:

- Applying a standard approach for data representation, leading to the development of a WMO core profile of the ISO 191xx series for data and metadata, encompassing the WMO core profile of the ISO metadata standard, in line with other initiatives such as INSPIRE); the application schemata and associated tables used to represent data in BUFR, CREX, XML, NetCDF or HDF, such as the BUFR/CREX/GRIB tables, may be used to develop this WMO core profile for data and metadata, in particular to develop the relevant ISO 191xx feature catalogues, application schema(ta) and data product specification(s);

- Facilitating the interoperability and data interchange between applications based on data representations systems associated to BUFR, CREX, GRIB, XML, NetCDF and HDF.

6.2.66 The Commission was pleased to note the establishment of the CAeM-CBS Expert Team on OPMET Data Representation (ET-ODR) tasked to specifically address the requirements of aeronautical meteorology, including ICAO, for Data Representation systems. The Commission noted the development of a pilot project for the presentation of OPMET data in XML and requested the OPAG-ISS to pursue the development of the project in collaboration with CAeM and ICAO.

6.2.67 Common Alerting Protocol (CAP) (see ITU Recommendation X.1303) is a content standard designed for all-hazards and all-media public alerting. The Commission noted that some NMHSs are already using or migrating to CAP-enabled systems, in particular the US NWS and in Europe (EUMETNET) for “MeteoAlarm”, and that a WIS CAP Implementation Workshop was held (Geneva, December 2008). The Commission noted the benefits of using CAP for the dissemination of weather, climate and water related alerts and warnings. It considered that wide implementation of CAP will contribute to make it a very cost effective tool and facilitate the support of a virtual all hazards network within the WIS-GTS.

Metadata development and implementation

6.2.68 The initial version 1.0 of the WMO core profile of the ISO Metadata standard included extensions of the ISO 19115 standard, i.e. additional elements and extensions to the code lists, which may lead to difficulties, for example when using existing software applications to create or interpret the metadata. Draft version 1.1 of the WMO core profile of the ISO Metadata standard WMO had therefore been developed, in which the additional elements were deleted and the extensions of code lists were reviewed. The Commission endorsed the WMO core profile version 1.1 of the ISO Metadata standard (available at http://wis.wmo.int), and requested to submit proposals to add the extensions of the code lists to the ISO 19115 to the ISO Technical Committee 211 responsible for the ISO 19100 series of geographical information standards.

6.2.69 The Commission stressed the importance for all WMO Programmes to review their requirements in terms of metadata and to submit relevant proposals for the further development of the WMO core profile of the ISO Metadata standard.

6.2.70 The operational catalogues, such as Discovery, Access and Retrieval (DAR) catalogues (sets of WMO core profile metadata descriptions), Volumes A and C1 of WMO Publication No. 9, have to be considered as ISO “data sets”. The ISO 19100 standards provide methods for the development of schemas of data sets but provide standard schemas only for metadata data sets. The ISO 19100 standards recommend the development of Feature Data Dictionaries and Feature Catalogues with a view to harmonizing the definition of features between catalogues. The Commission agreed that it will take time to develop these Feature Data Dictionaries and Feature Catalogues and that their contents must be defined within the respective WMO Programmes responsible for the data to be described. It recommended that the development of catalogues,

such as the catalogue of variables measured by a standard observing station, or the catalogue of instruments used for variables measured by standard observing stations should not wait for the development of these Feature Data Dictionaries and Feature Catalogues.

6.2.71 The requirements for the maintenance of operational catalogues are basically common across the WMO operational catalogues. The mechanisms and procedures defined for any of these catalogues could be applied to the others. The Commission recalled the responsibilities of GISCs and DCPCs for the maintenance of the DAR catalogues, each centre being responsible to collect catalogue entries, e.g. DAR metadata descriptions, from the WMO Members countries located in their zones of responsibility.

6.2.72 The Commission noted with appreciation that Météo-France had developed an application for the conversion of the GTS operational information, such as Volume C1 of WMO Publication No. 9 and the *Manual on Codes*, into metadata required for the operation of the WIS GISCs and that this application is provided by Météo-France to all potential GISCs and DCPCs.

6.2.73 The Commission recommended that the following procedures be implemented by the WIS centres for the creation and validation of metadata:

- To define the roles (creator, reviewer, administrator) in the WIS centre;
- To establish mechanism(s) for providing advisories and assistance (for example at GISCs);
- To filter the entries in order to remove undesirable contents;
- To validate the XML schemas.

6.2.74 The Commission was pleased to note that the IPET-MI had initiated the drafting of a "best practice" guide for the implementation of the WMO Core Profile of the ISO Metadata standard. This guide should include information on how to use available software packages, such as the open source software application "Geonetwork", originally developed by FAO, to create metadata, in particular from templates.

6.2.75 The Commission further recommended investigating the availability of training on the ISO standards, in particular on how to apply UML/GML, and that implementers and users should be able to access help desks for assistance, and users should be able to provide feedback to metadata originators.

6.2.76 WMO and CBS would benefit from closer cooperation with the Open Geospatial Consortium (OGC), that sets standards for web access to geospatial information, by:

- Having access to technical experts with resources to conduct technical demonstrations on six monthly timescales;
- Giving a wider visibility of the specific needs of WMO, contributing to ERs 6,7 and 8;
- Influencing future international standards and profiles, and revisions of current ones, of direct impact on WMO Members.

CBS invited the Secretary-General to establish a formal Memorandum of Understanding with OGC encompassing meteorology, hydrology and oceanography.

Future activities

6.2.77 The Commission reviewed the key tasks of the OPAG on ISS for the forthcoming CBS intersessional period (2009–2010); it endorsed the OPAG's proposals including its expert teams, and their respective terms of reference, to reflect priorities, progress achieved, and looking for cost efficiencies for undertaking the activities (see agenda item 12.2).

6.3 DATA-PROCESSING AND FORECASTING SYSTEMS (DPFS), INCLUDING EMERGENCY RESPONSE ACTIVITIES (ERA) *(agenda item 6.3)*

6.3.1 The Commission thanked the active participation of many experts which resulted in considerable progress achieved by the OPAG on DPFS under the chairmanship of Mr Bernard Strauss (France), and noted the GDPFS programme, including ERA, is one of the core components of the Members' operational infrastructure, the World Weather Watch System, and as well underpins a wide range of forecasting-related and environmental services that WMO Members provide, including public weather and warning services as well as services to many socio-economic sectors. The GDPFS and ERA programmes are both operational and contribute directly to WMO's Expected Results (ER): ER 1 (production of forecasts and warnings), ER 2 (climate information and prediction), ER 6 (disaster risk reduction), ER 7 (services and applications), ER 9 (capacity building), and indirectly to others.

6.3.2 In its future structure and work programme, the OPAG on DPFS will pay special attention to how it contributes to Expected Results, and to disaster risk reduction goals, e.g., provision of early warnings, more effective use of NWP in severe and high-impact weather forecasting including support to environmental emergency response, seasonal forecasting for adapting to climate variability and change, and with improved linkages with research outputs and technology transfer, such as in ensemble prediction and probabilistic forecasting methods such as through THORPEX (TIGGE/GIFS), and NWP verification.

6.3.3 The Commission encouraged centres running global models to consider providing boundary conditions to NMCs running LAMs, and as well, assist in the evaluation and possibly providing the necessary computing and telecommunications infrastructure for undertaking and sustaining the implementation of the LAM. It is also important that RSMCs running models ensure dissemination of the products to NMHSs of countries covered by their models' footprint.

6.3.4 The Commission noted that Members could successfully adopt the concept of a "consortium" in which a group of NMHSs share expertise, knowledge and resources, using the same NWP modelling system to enhance progress in development and improvement of the model and the use of its products, leading, in particular, to better forecasts and warnings of severe weather.

Severe Weather Forecasting and the Severe Weather Forecasting Demonstration Project

6.3.5 The Commission noted the GDPFS contributes directly to day-to-day forecasting and the forecasting of severe and high-impact weather phenomena, over a wide range of forecast timescales, spanning from the very short-range (within first 12 hours) to the long-range. As NWP and EPS systems improve, many NMHSs, especially those of developing countries, seek similar benefits to meteorological services, especially for the provision of advisories and warnings of severe weather events with increased lead-times, already being realized by other countries. The Severe Weather Forecasting Demonstration Project (SWFDP) represents an approach that facilitates improved access to, training in the interpretation and use of, existing NWP/EPS products by forecasters in developing countries.

6.3.6 Ensemble forecasts are increasingly being used for predicting severe or high-impact weather. A number of new diagnostics, including feature-based diagnostics, have been developed for identification of risks of high-impact weather. The Commission strongly encouraged further development of such techniques, particularly to improve the prediction of tropical weather systems including tropical convection.

6.3.7 The Commission noted the SWFDP in its first implementation in southeast Africa completed its one-year field phase in November 2007. It focused on improving weather forecasting and warning services for heavy rain and strong winds and involved global and regional centres to build the forecasting capacity of the NMHSs of Botswana, Madagascar, Mozambique, the United Republic of Tanzania, and Zimbabwe. It also noted the critical support provided by the participating global centres: ECMWF, NCEP (United States), and the Met Office (United Kingdom), and the

regional centres: RSMC Pretoria (South Africa) and RSMC La Réunion (France). It noted a key element to the success of the project as the important operational functions performed at RSMC Pretoria, including the production of the RSMC Daily Guidance Product, and operation of the RSMC's dedicated Website and portal, both parts of the "Cascading forecasting process", which increased the efficiency of access and effective use of all available products by the NMHSs. Forecasting capability will continue to improve over time as forecasters in both NMCs and RSMCs increase their knowledge and skill with increased experience and use of existing NWP/EPS products.

6.3.8 The project was able to demonstrate:

(a) An accelerated implementation into operational use of outputs of advanced NWP/EPS systems;

(b) Continuous learning by forecasters as an effective way of capacity building;

(c) A sustainable "tight" cycle of demonstration, adapting to regional needs, evaluation, and operational implementation;

(d) Its contribution to adopting probabilistic forecasting methods;

(e) Increase in the visibility, credibility, and value of meteorological services in public and economic sectors;

(f) A possible new role of RSMCs of the GDPFS to synthesize and to provide forecasting guidance on severe weather forecasting to regional groups of NMCs.

6.3.9 The Commission noted that the SWFDP provides an opportunity for smaller NMHSs to gain a better understanding of NWP through the advanced centres' products, including their verification. The knowledge and experience gained can assist in Members deciding whether to plan future implementation of LAMs or continue the cost-effective use of the ever improving outputs from the advanced global and regional centres.

6.3.10 The Commission noted that Cg-XV (2007) and EC-LX (2008) had learned of the success of the first demonstration project and agreed to continue to explore the possibilities of expanding or setting up other SWFDP projects in other WMO Regions. Therefore, the Commission requested its SWFDP Steering Group to continue to give guidance and monitor the further development of existing and new projects focused on building the capacity of countries involved for severe weather forecasting and warning services, such as in:

(a) RA I: the five NMHSs that participated in the SWFDP in southeast Africa requested the demonstration project be established operationally following its successful one-year demonstration. The Meteorological Association of Southern Africa (MASA) requested, on behalf of its members, that the SWFDP be sustained and expanded to include the NMHSs of its members. EC-LX suggested a transition of the demonstration project to an operational state and the inclusion of the NMHSs of the MASA members. The Commission also requested SWFDP be developed in other regions of Africa, including northern and western Africa;

(b) RA III: planning has commenced to organize a SWFDP-RA III for the region of central and southern South America, with the possible involvement of the NMHSs of Paraguay, Uruguay, Chile, Bolivia, Peru, Argentina (RSMC Buenos Aires) and Brazil (RSMC Brasilia, CPTEC). The Commission encouraged centres in RA III to work with the Centro Internacional para la Investigación del Fenómeno de El Niño (CIIFEN, International Research Centre on El Niño, Guayaquil, Ecuador), where appropriate. This initiative has been proposed to build on several severe weather related projects of the region, in particular one entitled: "Virtual Centre for Disaster Risk in South America";

(c) RA V: planning has commenced to organize a SWFDP-RA V, named as the Severe Weather Forecasting and Disaster Risk Reduction Demonstration Project "SWFDDP", as a mechanism to improve weather forecasting and warning services for the South Pacific Islands, including the possible involvement of the NMHSs of Solomon Islands, Vanuatu, Samoa, Fiji (RSMC Nadi), Australia (RSMC Darwin) and New Zealand (RSMC Wellington).

6.3.11 The Commission noted that funds necessary to support extending existing SWFDP projects or to commence new projects were very limited. The Commission commended the efforts of the Secretariat in supporting the SWFDP through optimizing activities across WMO programmes and in seeking support from aid donors. The Commission urged Members similarly to seek funds from potential development partners and other agencies who stand to benefit from the important results of the SWFDP.

6.3.12 The Commission noted the importance of the services provided by NMHSs that benefit the public at large, and that the effective communication of forecasts and warnings represented a critical step in realizing the full value of the investment in improving the forecasting process. It agreed the following aspects of public weather service delivery were of high priority:

(a) Ensuring that forecasters are fully aware of the needs of each user group;

(b) Ensuring that users are fully aware of the limitations of the forecasting process;

(c) Development of improved communication skills within the forecaster community;

(d) Assessments of user satisfaction with the forecast and warning services provided by the NMHS;

(e) Two particular user groups are of greatest importance: Disaster Management and Civil Protection Authorities (DMCPA), and the Media.

Very Short-range Forecasting

6.3.13 The Commission noted for the first 12 hours of the forecast period a suitable blending of observational data and high-resolution NWP outputs is possible while recognizing that data assimilation was a major technical challenge. Nevertheless, it noted that significant progress was made in that direction, and therefore encouraged investment in suitable additional observations, which could in addition both support statistical post-processing of NWP outputs as well as improve verification of forecasts.

6.3.14 The Commission noted that the: "Table of possible blending approaches with model and observational data combinations for very short-range forecasting" developed by CBS experts should be made available to Members as a guide. The table is found in Annex V to the present report.

Extended and Long-range Forecasting

6.3.15 The Commission noted in relation to Global Producing Centres (GPC) of Long-range Forecasts that three additional centres have been proposed for designation: Roshhydromet Centre (Moscow), CPTEC (Sao Paulo, Brazil), and RSMC Pretoria (South Africa). Noting that the Expert Team and the OPAG's Implementation Coordination Team have reviewed these proposals, the session concluded Roshhydromet Centre (Moscow) and RSMC Pretoria (South Africa) are fully compliant with the required criteria for GPC designation and recommended them for GPC designation, and that they be included in the list of designated GPCs in the Manual on the GDPFS. The proposed amendment to the Manual is given in Annex 1 to Recommendation 9 (CBS-XIV).

6.3.16 The session also highlighted its appreciation of the significant progress that CPTEC (Sao Paulo, Brazil) had made toward attaining full compliance, however it noted some aspects of

verification were still missing. The Commission encouraged Brazil to complete the remaining necessary work to meet full compliance and to re-submit its request to the President of CBS for GPC designation in the near future.

6.3.17 The Commission agreed that GPCs may supply additional products on request by RCCs or NMHSs from a list of products and services, in addition to the minimum requirement, and recommended the list be included as a new Attachment II-11 of the Manual on the GDPFS. The Commission also approved minor changes to the definition of the minimum criteria and recommended their inclusion in Appendix II-6 of the Manual. These proposed amendments are given in Annex 1 to Recommendation 9 (CBS-XIV).

6.3.18 The Commission welcomed the newly developed guidelines to assist and encourage RCCs and NMHSs to provide feedback to GPCs on their products and services and recommended these guidelines are proposed to be included as a new Attachment II-13 of the Manual on the GDPFS, as given in Annex 1 to Recommendation 9 (CBS-XIV).

6.3.19 The Commission noted with appreciation a rapid development of the capabilities of a Lead Centre for Long-range Multi-model Ensemble Forecasts (LC-LRFMME) jointly by GPCs Seoul and Washington, following endorsement of the concept by Cg-XV. The developing LC-LRFMME provides much of the recommended functionality including collection of forecast data from GPCs and provision of a Website from which RCCs, NMHSs and other approved centres can visualize forecasts in common graphical formats and, for GPCs that allow it, to download the forecasts in digital format. Multi-model ensemble products continue to be developed. The detailed specification of the data that are to be supplied by GPCs to LC-LRFMMEs will be listed on the Lead Centre Websites, and are found in Annex VI to the present report. Access to data provided to the LC-LRFMME should be managed in a way that is consistent with the data policy of the originator of those data.

6.3.20 The Commission agreed GPC Seoul and GPC Washington have jointly developed capacity for an LC-LRFMME with responsibility for a Web portal of GPC and MME products with global coverage, and recommended their designation and inclusion in the Manual on the GDPFS, as proposed amendments to the Manual on the GDPFS as given in Annex 1 to Recommendation 9 (CBS-XIV).

6.3.21 The Commission agreed with the list of functions of the Lead Centre for LC-LRFMME, and noted that more than one such Lead Centre could exist, with different regional or activity specializations.

6.3.22 The Commission noted with appreciation close collaboration between CBS and CCl and much progress achieved, which has resulted in proposed designation criteria for Regional Climate Centres (RCC) and recommended their inclusion in the Manual on the GDPFS, as found in Annex 1 to Recommendation 9 (CBS-XIV).

6.3.23 The Commission noted these criteria include a set of functions that are mandatory for RCC designation, and a list of 'highly recommended' functions RCCs will be encouraged to undertake. RCC functions for a region may be undertaken within one or more single (multifunctional) centre(s). Alternatively, a region may establish a RCC-Network in which the mandatory (and possibly other) RCC functions are distributed amongst various centres, or nodes. It is strongly advised that a region select one structure or another, and not mix the two types in the same region. The Commission also suggested that a list of GPC and RCC contact points be maintained by the WMO Secretariat, and used to facilitate exchange of information and increased cooperation.

6.3.24 The Commission received a request from China for the session to consider its nomination of Beijing Climate Centre (BCC) to be designated as a RCC in RA II. The session, after reviewing the request, including supporting documentation relative to the criteria and procedure for designation, agreed that the nomination is fully compliant and recommended the BCC for designation as a RCC in RA II. The Commission recommended that this designation be included in

the list of designated RCC for RA II in the Manual on the GDPFS, as included in the proposed amendment to the Manual given in Annex 1 to Recommendation 9 (CBS-XIV).

6.3.25 The Commission received a request from Japan for the session to consider its nomination of Tokyo Climate Centre (TCC) to be designated as a RCC in RA II. The session, after reviewing the request, including supporting documentation relative to the criteria and procedure for designation, agreed that the nomination is fully compliant and recommended the TCC for designation as a RCC in RA II. The Commission recommended that this designation be included in the list of designated RCC for RA II in the Manual on the GDPFS, as included in the proposed amendment to the Manual given in Annex 1 to Recommendation 9 (CBS-XIV).

6.3.26 The Commission was very pleased to note that other Members are making extensive efforts towards meeting the criteria for establishing RCCs through their respective Regional Associations, and in coordination with the CCl.

6.3.27 The Commission noted the draft proposals for the Global Framework for Climate Services being developed for WCC-3 and that the GPCs would be expected to play a major role in providing global climate predictions from seasonal to longer time-scales. Given the operational nature of the GPCs, the Commission agreed that its ET on Extended- and Long-Range Forecasting should keep the issue under review and ensure that it was consulted if and when ToRs were to be developed for a few GPCs with responsibility for predictions longer than the seasonal timescales in consultation with the relevant Technical Commissions. The Commission adopted Recommendation 9 (CBS-XIV)) – Amendments to the *Manual on the Global Data-Processing and Forecasting System* (WMO-No. 485).

Probabilistic Forecasting and Ensemble Prediction Systems and Applications

6.3.28 The Commission noted that Ensemble Prediction Systems (EPS) are becoming increasingly integrated into operational NWP systems in the more advanced centres. The products of EPS are increasingly used in operational forecasting, and the technique is also starting to be used in improved data assimilation systems. Regional EPS is developing rapidly, as are applications and ensembles of application models.

6.3.29 The Commission noted a single window of verification information for global EPS is provided by the Lead Centre for EPS Verification, hosted by JMA (Japan). The Lead Centre has already updated its Web pages to account for the agreed change in verification procedures which adopted new thresholds for probabilistic forecasts based around quantiles of the climate distribution. However, the revised Website is lacking in content due to only one EPS producing centre conforming to the revised standard by providing verification results every month. The Commission requested all other EPS centres to commence providing verification data to the Lead Centre.

6.3.30 Multi-model ensemble research being conducted under the THORPEX TIGGE project is showing some benefits in terms of improved probabilistic forecasts. CAS is developing plans for a new GIFS (Global Interactive Forecast System) evolving from the TIGGE project. The Commission noted that the DPFS though its Chairperson of the ET-EPS has worked closely with the GIFS-TIGGE WG to ensure the evolving GIFS plans are suitable for eventual operational use and to meet the needs of WMO Members for GDPFS. Further, the Commission felt its interest in multi-model ensembles should focus on global EPS at the present time, while monitoring progress of research results of EPS formulations of Limited Area Models.

6.3.31 The Commission noted the continuing support to capacity building in relation to the use of EPS products in weather forecasting and provision of services, especially in developing countries, e.g., associated with the Severe Weather Forecasting Demonstration Project. The Commission expressed its gratitude to the GDPFS' centres that have provided EPS-based products, in some cases with guidance, for use by forecasters of NMHSs of developing countries.

6.3.32 The Commission noted that the skill set for probabilistic forecasting, including the production of warnings, is not the same as that for communicating forecasts that contain probabilistic information. Exploitation of ensemble forecasts requires education of forecasters in understanding of the NWP/EPS systems and also in how to communicate uncertainty. To facilitate this, the Commission recommended that the joint involvement of GDPFS and PWS continue, including through the SWFDP framework.

6.3.33 The Commissioned encouraged that developments of EPS post-processing be designed with innovative diagnostic and visualization methods in mind, to provide early detection of possible severe weather, tracking of important features such as depressions and dynamical forcing features, and probabilistic classification of weather regimes that could possibly discriminate between severe weather producing regimes from others. Such an approach would greatly assist forecasters to improve advisories and warnings of severe weather.

NWP Forecast Verification

6.3.34 The Commission noted that standard procedures for the verification of NWP predictions exist and are given in the WMO Manual on the GDPFS. While verification scores for EPS and LRF outputs are maintained and reviewed by the relevant expert teams of the OPAG, there has been no regular review of the scores for deterministic NWP predictions.

6.3.35 Therefore the Commission requested a review of the standard verification with the aim to bring it up to date with state-of-the-art in NWP, to make it as simple and as easy to implement as possible, and to establish a consistent implementation across participating centres, in particular in the interpolation, climatology and use of observations. It encouraged all relevant NWP centres to implement the verification scores in the standardized way, which will facilitate reliable comparison of outputs among centres.

6.3.36 The Commission noted Regional NWP verification is also important and integral to NWP operations, and needs careful coordination, for example, in the assessment of performance of high resolution models and the prediction of severe or high impact weather (e.g. precipitation), suitable regional datasets and new verification methods are of common interest to many NMHSs.

6.3.37 The Commission requested the OPAG to consider establishing a lead centre for deterministic NWP verification in a similar way to what has already been done for EPS and LRF.

Emergency Response Activities – Atmospheric Transport Modelling (ATM)

6.3.38 The Commission noted faxing is the official transmission method of RSMC products that support operational nuclear emergency response. Maintaining up-to-date fax numbers and contact information is problematic and time consuming. Regular fax tests by the RSMCs show a significant rate of delivery failure.

6.3.39 The Commission agreed that e-mail distribution and retrieval from RSMC Web pages is preferred, and that fax distribution could be maintained by exception only (if requested by the designated NMHS Operational Contact Point). An implementation plan for this change will be developed by the end of 2009. The Commission urged the planners to make provision for regular updating of the e-mail addresses of product recipients, and to provide target dates for an implementation schedule. A change in the IAEA Request Form has been decided in order to clarify actual operational procedures. In these respects the Commission proposed amendments to the Manual on the GDPFS found in Annex 2 to Recommendation 9 (CBS-XIV).

6.3.40 The Commission noted the important achievements from the CTBTO-WMO collaboration in a series of coordinated numerical experiments with several WMO Centres (RSMCs and other Centres) over the past few years, which has lead to the implementation of an operational ATM backtracking system on 1 September 2008.

6.3.41 The Commission noted WMO has received correspondence from Germany wherein it indicated its intention to carry out the operational responsibilities for an RSMC with Activity Specialization in Atmospheric Transport Modelling in Backtracking, following successful demonstration of its capabilities during numerous tests in conjunction with the CTBTO. In this context, the Commission proposed an amendment to the Manual on the GDPFS to add RSMC Offenbach to the list of specialized centres, found in Annex 2 to Recommendation 9 (CBS-XIV.

6.3.42 The Commission was informed of the good work on ATMs by the eight RSMCs-ATM and further considered that more effective progress on ATM ensembles would occur if a lead centre (RSMC) for ATM ensembles is designated to focus and lead the development of ensemble techniques for ERA applications.

6.3.43 In relation to updating the document "Meteorological and Hydrological Aspects of Siting and Operations of Nuclear Power Plants" (WMO/TD-No. 170), the Commission noted Cg-XV (2007) suggested that this matter would require the cooperation with the International Atomic Energy Agency (IAEA) and involve several WMO Technical Commissions, including Basic Systems, Climatology, and Hydrology.

6.3.44 The Commission noted that a demonstration experiment was carried out on ATM backtracking capabilities during 29 February to 3 March 2008, with the participation of RSMCs Beijing, Exeter, Melbourne and Washington, and encouraged this activity to be repeated with increased participation of WMO centres, further development of procedures for requesting and provision of emergency response services, and exchange of examples of applications (e.g. on WMO Website).

6.3.45 The Commission noted the WMO Technical Document entitled: "Documentation on RSMC Support for Environmental Emergency Response" (WMO-TD/No. 778), which includes operational procedures published in the Manual of the GDPFS, has been updated as part of the ERA Web pages of the WMO Website.

Future activities

6.3.46 The Commission recalled that EC-LX endorsed the initiative of CAS and CBS to assist Members to gain better access to services related to sand and dust storm prediction and warnings through the development of the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS). In response to EC's call for collaboration between CBS and CAS, the Commission requested appropriate experts in CBS to review the draft SDS-WAS Implementation Plan as requested by EC-LX "to clarify the future of the SDS-WAS centres in the context of the GDPFS and RSMC structures". The Commission recommended using the CBS RSMC designation process for the establishment of the sand and dust warning advisory centres. This will ensure operational sustainability. Written comments should be provided in time for CAS-XV (Nov 2009). It delegated final approval of the CAS-led SDS-WAS Implementation Plan in 2010 to the CBS Management Group.

6.3.47 The Commission reviewed the key tasks of the OPAG on DPFS for the intersessional period 2009–2012 and agreed on a proposed structure, including:

(a) Implementation Coordination Team on Data-Processing and Forecasting Systems;

(b) Coordination Group on Forecast Verification;

(c) Expert Team on Ensemble Prediction Systems;

(d) Rapporteur on Infrastructure for Numerical Weather Prediction (NWP);

(e) Expert Team on Extended- and Long-range Forecasting;

(f) Coordination Group on Nuclear Emergency Response Activities;

(g) Expert Team on Modelling of Atmospheric Transport for Non-nuclear ERA;

(h) Rapporteur on the Application of NWP to Severe Weather Forecasting.

6.3.48 The Commission reviewed the key tasks of the OPAG on DPFS for the forthcoming CBS inter-sessional period (2009–2010). It endorsed the OPAG's proposals including its expert teams and their respective terms of reference to reflect priorities, progress achieved, and looking for cost efficiencies for undertaking the activities (see agenda item 12.2).

The Manual on the GDPFS and its future evolution

6.3.49 The Commission considered the status of the *Manual on the GDPFS* (WMO-No. 485 Vols I and II). Volume I had been issued in 1992 and had most recently been amended in November 2007 (i.e., Supplement 11). For Volume II, there was an amendment (2003, Supplement 2); otherwise, it had not been updated since it was issued in 1992.

6.3.50 The Commission noted that many sections of material (especially the Attachments and Appendices) dealt in detail with procedures relating to analysis and forecasting, transmission of products and data management that had been superseded.

6.3.51 The Commission also noted that Volume I of the *Manual (*Global Aspects) forms part of the *Technical Regulations* and is referred to as Annex IV to the *Technical Regulations* and as such the Commission has been requested by Congress (Resolution 32 of Cg-XV) to review such publications according to quality management principles to ensure their suitability as part of the WMO Quality Management Framework.

6.3.52 The Commission also recognized that there were fundamental changes under way on other parts of the Basic Systems, including the development of WIGOS and WIS. It decided that along with any review and update of the Manual on the GDPFS there should also be work done on the future evolution of the GDPFS taking into account the WIGOS, WIS, experiences from Severe Weather Forecasting Demonstration Projects, and anticipated results from THORPEX-TIGGE, including research and development into a Global Interactive Forecast System.

6.3.53 Noting the urgency of the requirement to update the Manual on the GDPFS, the Commission agreed that a comprehensive review of the Manual be undertaken and requested the OPAG on DPFS to conduct such a review with assistance from the Secretariat. The Commission also recommended that best use of modern technologies be made to ensure that a revised Manual on the GDPFS is easily maintained and welcomed the offer made by the United Kingdom to facilitate this process.

6.3.54 With regard to Volume I, the Commission noted that Appendix I-1 listed 25 RSMCs with geographical specialization. However, the Manual provided no definition of the geographical area covered by each RSMC, other than a related reference to zones of responsibility, listed by countries, in the Annex to Appendix I-5 with respect to backup services by 22 RSMCs to UN Humanitarian Missions. The Commission requested that the OPAG on DPFS investigate the possibility of specifying more precisely the area of responsibility of each RSMC, for consideration by the next session of CBS.

6.3.55 The Commission noted that Volume I of the Manual on the GDPFS does not provide guidelines for reviewing the status of RSMCs with activity specialization However, RSMCs with activity specialization in Atmospheric Transport Modelling and Global Producing Centres for Long-range Forecasts have established procedures for monitoring, and providing information, on ongoing compliance. The Commission requested the OPAG on DPFS to consider generalization of these principles to RSMCs with other types of activity specialization.

6.3.56 With regard to Volume II (Regional Aspects), the Commission noted that many sections of material were out of date. For instance, there were references to archiving and exchanging data on nine-track magnetic tape and microfilm, outdated references to products produced under the

World Area Forecast System, and requirements for superseded products including nephanalyses. The Commission discussed the need for Volume II of the Manual on the GDPFS and asked the OPAG on DPFS to develop a proposal for EC which would see Volume II be withdrawn with some material consolidated into Volume I and some material discontinued.

6.4 OPERATIONAL INFORMATION SERVICE (OIS) *(agenda item 6.4)*

6.4.1 Fifteenth Congress noted that some parts of the operational information were not completed or timely updated by Members, and agreed that such deficiencies hampered the management, including the monitoring of the operation, of the World Weather Watch. The overall efficiency of the Operational Information Service (OIS) is dependent on the prompt notifications of changes and updated information from NMHSs. The Commission made the following recommendations to overcome deficiencies in the updating of the operational information.

6.4.2 Noting that several MTN centres had not implemented the maintenance of their parts of the catalogue of meteorological bulletins (Volume C1 of WMO-No. 9) and/or had not provided updates of their routeing catalogue, the Commission urged these centres to fully implement the procedures for the maintenance of the catalogue of meteorological bulletins and the updating of the routeing catalogues.

6.4.3 The Secretariat quarterly prepares, together with the analysis of the SMM statistics, comparisons between the abbreviated headings in Volume C1, in the RTH routeing catalogues and in the SMM monitoring results and posts them on the WMO server. The Commission urged RTHs to review the comparisons, identify deficiencies and accordingly update their part of Volume C1 and their routeing catalogue.

6.4.4 MTN centres were experiencing difficulties in improving the parts of Volume C1 they are responsible for when checking the consistency between the bulletins received and the contents of the catalogue. The Commission agreed to amend the procedures for the maintenance of the catalogue of meteorological bulletins detailed in Annex III – Annex to paragraph 4.2.18 – of the general summary of CBS-Ext.(98) as given in Annex VII to the present report.

6.4.5 Noting the deficiencies in the updating and presentation of Volume C2 of WMO-No. 9 – Transmission programmes, the Commission recommended urging WMO Members to review the contents of Volume C2 and to send amendments to the WMO Secretariat as required.

6.4.6 CBS-Ext.(06) agreed that the Guide on WWW Data Management should be designed for electronic publication and that the guide should include only those aspects of the Guide that described best practices in the general framework of the Operational Information Service. The Commission was pleased to note that the Secretariat had posted a document on the “Best practices for the management of the operational information” on the WMO server.

6.5 SYSTEM SUPPORT ACTIVITIES, INCLUDING TECHNICAL COOPERATION *(agenda item 6.5)*

6.5.1 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 Public Weather Services during the period 2007–2008. The Commission agreed on guidelines for the allocation of priorities for technical cooperation support as given below. The Commission invited the OPAGs to review the process for the prioritization of requests and to provide suggestions to the Management Group on ways for improvement. This would in particular have the effect of limiting the number of proposals with the “highest” and “high” priorities; this would help the donors and the recipient countries in making the best use of limited available funds.

Integrated Observing Systems (IOS)

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

(a) Highest priority should be given to the projects aiming at improving and restoring the existed and building the new upper-air observational capabilities of the RBSN/RBCN, in particular GUAN stations, with emphasis to the activation of silent upper-air stations and the improvement of coverage over data-sparse areas;

(b) High priority should be given to the projects related to the improvement of data quality, regularity and coverage of surface observations of the RBSN/RBCN with emphasis to the activation of silent stations and the improvement of coverage over data-sparse areas;

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

(d) Medium priority should be given to the projects related to the improvement/upgrading of stations not included in RBSN/RBCN list of stations.

Information Systems and Services (ISS)

6.5.3 The Commission agreed on the following guidelines for the allocation of priorities for cooperation activities for the ISS:

(a) Highest priority to the implementation of the connection of each 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 the use of managed data communication networks and the reception of satellite-based data distribution systems;

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

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

(d) Highest priority for training on TDCF in the WMO Regional Training centres, and for the development and implementation of projects for the migration to TDCF;

(e) Highest priority for activities on capacity building facilities and use of 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 virtual private network (VPN) connections via the Internet as a backup for the exchange of data, in particular for RTHs.

6.5.4 The WMO goals for meteorological satellite reception are that every Member has access to polar-orbiting and geostationary meteorological satellite data and products. The Integrated Global Data Dissemination service (IGDDS) strategy recommends using multipurpose Digital Video Broadcast by Satellite (DVB-S) services when available for efficiently meeting these goals, in association with adequate data hardware and software for data handling and product visualization. The Commission agreed on the following guidelines for the allocation of priorities for satellite data receiving systems:

(a) Highest priority for a multipurpose DVB-S receiver system providing space-based observation data and products if the WMO Member is within the area covered by such as a dissemination service;

(b) Second highest priority for meteorological satellite direct broadcast receivers for those Members who are not within the area covered by a DVB-S service providing satellite data and products, and who are without any direct broadcast receiver;

(c) igh priority for direct broadcast geostationary or polar-orbiting receiver for those Members who are not covered by any DVB-S service and who have either no geostationary or no polar-orbiting satellite receiver respectively;

(d) Medium priority for high resolution satellite direct broadcast receiver for those Members who have only low resolution direct broadcast receivers and cannot be covered by any DVB-S service.

Data-processing and Forecasting Systems (DPFS)

6.5.5 The Commission agreed on the following guidelines for the allocation of priorities for cooperation activities for the DPFS:

(a) Highest priority for establishing access at NMHSs to NWP products from advanced centres, for viewing and use as guidance for forecasting applications, in particular severe weather forecasting;

(b) Highest priority for automation of operational data-processing functions, including the processing of observations and post-processing of NWP products, for improvement of all weather forecasting applications, in particular nowcasting;

(c) High priority for training on use of NWP products, in particular use of relevant EPS products, and applications to probabilistic forecasting;

(d) High priority for training on operational data-processing, including on the implementation of post-processing of NWP products and running of a Limited Area Model.

Public Weather Services (PWS)

6.5.6 The Commission agreed on the following guidelines for the allocation of priorities for the PWS:

(a) Highest priority for TV/media presentation systems comprising high performance computing and communications hardware, peripherals and software, video equipment for television production, as well as the 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 public weather services, and promote the use of official consistent information;

(d) Highest priority for training related to national PWS plans; that included but not limited to training in media skills (writing and presentation), product design, and public education awareness and support to the civil protection community;

(e) Highest priority for fixed and mobile communications systems for the dissemination of public weather warnings and forecasts, preferably modern telephone and communication services (e.g. mobile telephones, pagers/short message system and fax-on-demand), RANET;

(f) Medium priority for VHF radios to provide radio broadcast and warning alert systems.

CBS software registry

6.5.7 The CBS software registry provides information to Members on the software packages offered by individual Members through the WMO Web server. Stressing that the World Weather Watch is dependent on computer-based solutions for its operation, the Commission reaffirmed the importance for WWW centres to share meteorological application software, and invited the WWW centres to consider offering meteorological application software for free exchange among Members and to provide the Secretariat with the information required to update the CBS software registry available from the WMO server.

Report of the chair of the EC Working Group on Capacity Building

6.5.8 The Commission was informed that the first formal meeting of the Executive Council Working Group on Capacity Building (EC-CB), which met jointly with the Informal Planning Meeting (IPM) of the Voluntary Cooperation Programme (VCP), in Dubrovnik from 18 to 20 March 2009, had addressed several matters pertinent to CBS. A report on those matters was made to the Commission by the Chairman of the EC-CB.

6.5.9 The EC–CB referred to the fact that there were several aspects in its Terms of Reference that were relevant to the CBS Workplan. It noted that CBS and EC-CB goals align in supporting and implementing robust and sustained global observing and service delivery systems. While CBS provides for the technical specifications and implementation plans, EC-CB seeks to mobilize resources to support or augment the networks (and systems), particularly in Developing and Least Developed Countries (LDCs). EC-CB therefore requested the CBS to work closely with the EC-CB, through its Workplan, to ensure that the EC-CB captures all related assistance needs and to support the EC-CB in focusing its advocacy and resource mobilization activities towards implementation and sustainability of systems at the developing country level.

6.5.10 The EC-CB identified several specific areas for which such close collaboration with the Commission was immediately necessary:

(a) The implementation of and full participation in WIS and WIGOS.
Articulation of the benefits with clear and urgent implementation plans at a country or regional scale have been called for by Members. This would include assistance in the migration to Table Driven Code Forms (TCDF), improving Metadata and the introduction of Quality Management Systems;

(b) Support for the sustainability of Global Observing Systems in Developing and Least Developed Countries.
The upper air observations from the GCOS Upper Air Network (GUAN) stations constitute a "global public good", but resources for the reactivation of silent stations and the provision of consumables for these and other stations in the Developing Countries and LDCs were not systematically available. The ad-hoc request-based mechanism of the Voluntary Cooperation Programme (VCP) was not a suitable funding mechanism for these stations.
The EC-CB therefore requested CBS to support efforts by the WMO Secretary-General and all GCOS partners in communicating the need for such essential data through World Climate Conference-3 (WCC-3) and to the processes of the UN Framework Cooperation on Climate Change (UNFCCC) with the aim of activating the provision in UNFCCC documents to fund the cost of essential global climate monitoring observations at the Fifteenth Conference of Parties (COP-XV) at Copenhagen in 2009.

(c) Support for Technical Cooperation Activities in the Secretariat.
EC-CB is concerned that the time taken for achieving technical approval within the Secretariat of VCP and Emergency Assistance projects has been greater than would be desired. EC-CB therefore requested CBS, through its relevant bodies, to assist the Secretariat by developing a mechanism for identifying groups of experts, coordinated by the chair of the IPM on the VCP, to help in the procurement process of goods and services through the VCP (F), Emergency Assistance or Trust Fund projects.

(d) Promote the use of Ensemble NWP Products
The EC-CB has noted the increasing interest expressed by developing countries in the use of *ensemble NWP products* in the early warnings of hazardous weather events, as shown through projects such as the Severe Weather Forecasting Demonstration Project (SWFDP) in Southern Africa. EC-CB requested CBS to consider the relevant training requirements in their work plan for 2008-2011 to assist the EC-CB and the Panel of Experts on Education and Training to mobilize resources accordingly.

6.5.11 The Commission thanked the EC-CB for its report and agreed that there was great merit in close collaboration between CBS and EC-CB in the overall planning of the implementation of projects in Developing and Least Developed Countries. Noting the request made by EC-CB, the Commission supported the proposal to establish an informal Task Team comprising the chair of the EC-CB, the president and vice-president of CBS assisted by the chairs of the OPAGs, and the chair of the IPM on the VCP to identify the technical support required for project implementation plans, including guidance materials, technical specifications and project documentation for resource mobilization activities. The Commission agreed to appoint a Coordinator on Capacity Building (agenda item 12.2), who would also participate in the informal Task Team. In specific reference to the implementation and sustainability of WIS and WIGOS, the Commission agreed to work towards greater liaison between all Technical Commissions, the EC-CB and the GCOS governing mechanisms, especially in relation to the GSN/GUAN silent stations. The Commission also requested the Secretariat to ensure a coordinated support to these activities (see above 6.5.10 (b)).

6.5.12 The Commission recognized the need to assist the WMO Secretariat with the development and implementation of specific projects by developing a mechanism for identifying groups of experts to help in the procurement process of goods and services (see above 6.5.10(c)).

7. WMO SPACE PROGRAMME (*agenda item* 7)

7.1 The Commission emphasized the role of space-based observing systems in support of all WMO and co-sponsored technical programmes. Space-based observation is a critical source of data for operational weather forecasting and its applications, providing the major part of input data to NWP; it also plays an irreplaceable role for climate programmes, atmospheric research, environment and disaster monitoring, and should provide an increasingly substantial contribution to hydrology.

7.2 The Commission expressed its appreciation to the Members operating satellite systems contributing to the GOS, whether in operational or research and development programmes, and to all involved space agencies. The Commission highlighted that Jason-2 represented a transition to operational status for ocean surface topography, and urged Members to confirm the plans ensuring continuity of such reference altimetry observation. The Commission noted that the geostationary and polar-orbiting coverage was currently nominal but that after 2009, the operation of GOES-10 would be discontinued and the geostationary coverage could no longer be ensured every 15 minutes over the whole of South America until further notice. The Commission noted also that EUMETSAT was filling a gap over the Indian Ocean with the Meteosat Indian Ocean Data Coverage (IODC) mission and wished that this mission be extended until a new programme can provide long-term continuity for the essential coverage of the Indian Ocean. The Commission also stressed the need for a follow-on to the current demonstration constellation of radio-occultation sounding.

7.3 China informed the Commission that data from its new generation polar-orbiting FY-3A satellite were disseminated in L-band, X-band (Medium Resolution Picture Transmission) and via FengYunCast, and that the geostationary satellite FY-2E was in commissioning stage. Canada reported that the Canadian Space Agency had approved the Phase A Feasibility Study for the Polar Communications and Weather Mission (PCW, or POLARSAT), a two-satellite constellation in highly-elliptical orbit that would provide every 15/30 minutes multi-spectral imaging of the Arctic circumpolar region with a focus on monitoring high-resolution winds, sea and lake ice, snow, and

vegetation cover, and detection of volcanic ash and other aerosols for the full circumpolar region. If fully approved after Phase A, the mission would be on orbit from 2016 to 2023. Canada will continue to work with the WMO Space Programme, especially within the IGEOLAB Focus Group on Highly Elliptical Orbits, and directly with other nations, to maximize the contribution of POLARSAT to the Space-based GOS. The Republic of Korea informed the Commission on the Communication, Oceanographic and Meteorological Satellite (COMS) to be launched in the last quarter of 2009.

7.4 The Commission welcomed the increasing number of space faring nations that were planning to provide a contribution to the space-based GOS and encouraged them to respond to the challenges of implementing the space-based component of the Vision for the GOS in 2025 introduced under item 6.1. It highlighted in particular the expected commitments for long-term continuity of observation required for climate monitoring, the need for timely and open data sharing, and the requirement for accurate and consistent data calibration to ensure proper integration of different satellite systems. It expected the space-based GOS to be a major component of WIGOS and of the Group on Earth Observations (GEO) Global Earth Observation System of Systems (GEOSS).

7.5 The Commission acknowledged the development of the global RARS network that improved the timeliness of ATOVS satellite sounding data for use in NWP. It welcomed the progress of the IGDDS project, its full integration into the WIS, and the setting up of a Task Force on Satellite Data Codes (TFSDC). The Commission stressed the need to enhance data distribution and ensure that high-priority data sets such as geostationary imagery be available in all Regions in a timely manner through low user-cost receiving systems. It encouraged the further expansion of Digital Video Broadcast by Satellite (DVB-S) services and the systematic inclusion of high-priority data in the dissemination services. It expected that these services would become components of the WIS and encouraged their operators to take steps towards registration as DCPC.

7.6 The Commission welcomed and further encouraged close cooperation among WMO, the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS) through the WMO Space Programme Office.

7.7 The Commission recalled the Space Programme goal to expand the benefit of space-based observation and services to WMO Members and noted that this Programme provided a major contribution to the Open Programme Area Group on Integrated Observing Systems (OPAG IOS) as reported in 6.1.12 to 6.1.23 above. The Commission reaffirmed that in order to enable Members to retrieve full benefit from space-based capabilities and investments, the Space Programme should pursue its activities in support of global planning of space-based observing systems, enhancing access to satellite data and products, and building capacity within WMO Members in particular the least developed countries. The Commission noted the discrepancy between the available resources and the necessary activities of the Space Programme. It acknowledged the restructuring within the Secretariat and stressed the need for adequate Secretariat support in the Space Programme Office. Therefore the Commission strongly urged Members to increase their support to Space Programme activities and adopted Recommendation 10 (CBS-XIV) – WMO Space Programme.

7.8 The Commission highlighted the importance of spreading the benefits of the Space Programme throughout all WMO Members while taking into account the specific needs and constraints of each WMO Region. It underlined the role of regional Rapporteurs for the Space Programme, in particular to assist in monitoring the use of satellite data in the Region, consolidating regional needs, and promoting user information adapted to the regional context. In this respect it welcomed the initiative of the Rapporteur in RA II to propose a Pilot Project for satellite information.

7.9 The enquiries performed in 2006 and 2008 highlighted that 76% of the respondents had stated an increase in access to satellite data over the past two years; however, four Members declared not receiving any satellite data. The latest enquiry shows that data access has improved in particular in Region VI with the DVB-S dissemination services of EUMETSAT (EUMETCast); it

also highlighted the interest of WMO Members for R&D satellites when their data is available on a quasi-operational basis such as Aqua and Terra, Quikscat, Envisat, ERS, Jason-1 and TRMM. Limiting factors are reported to be of both a financial and technical nature as well as the lack of knowledge, in spite of 56% of respondents reporting an increase in staff training. In this respect, the Commission emphasized the importance of the training provided by the Virtual Laboratory Centres of Excellence, as described under item 6.1.22. The Commission recommended that the Space Programme takes action to address the needs and limitations identified through these enquiries within each Region.

7.10 The Commission was informed of the initial implementation of Sustained Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM, previously named R/SSC-CM). It noted that this concept was aimed at fostering cooperation, sharing resources and expertise to provide quality-controlled products related to satellite observation of Essential Climate Variables (ECVs) in response to GCOS requirements. The concept and structure also have the potential to advance the transition from research to operations for the provision of satellite products. The Commission expected that the SCOPE-CM Executive Panel would report to the next session of the CBS on the outcome of the SCOPE-CM Pilot Projects and the designation of SCOPE-CM centres. The Commission encouraged Members to support the SCOPE-CM concept and suggested future expansion of the concept to other areas of applications of satellite data.

7.11 The Commission acknowledged the considerable impact of Space Weather on meteorological infrastructure and important human activities, and the potential synergy between meteorological and Space Weather services. It noted that the Executive Council had endorsed the principle of WMO activities in Space Weather, focusing on:

(a) Harmonization of observation requirements, sensors and standards within WIGOS;

(b) Definition of products in interaction with major application sectors;

(c) Exchange and delivery of Space Weather information through the WIS;

(d) Issuance of emergency warnings in the context of multi-hazard WMO activities;

(e) Encouraging the dialogue between the research and operational space weather communities.

7.12 The Executive Council had requested that CBS and CAeM develop plans for WMO activities in Space Weather. The Council had also urged WMO Members to consider the provision of resources through secondments and Trust Fund donations for Space Weather coordination activities. The Commission noted that more than fifty WMO Members were conducting activities in Space Weather and stressed the need for WMO coordination in this area. Reviewing the recommendation from the Expert Team on Satellite Systems that CBS and CAeM investigate the establishment of an Inter-Commission Team on Space Weather, the Commission decided to establish an Inter-programme Coordination Team on Space Weather (ICTSW) involving experts to be identified by both the Aeronautical Meteorology Programme and the Space Programme (See agenda item 12.2). The Russian Federation, and Canada through its involvement in the International Space Environment Service (ISES), expressed readiness to contribute to the ICTSW. The International Civil Aviation Organization (ICAO) welcomed the establishment of the ICTSW and expressed its willingness to participate in this effort.

8. PUBLIC WEATHER SERVICES, INCLUDING THE REPORT BY THE CHAIR OF THE OPEN PROGRAMME AREA GROUP *(agenda item 8)*

8.1 The Commission considered and appreciated the report of the chairperson of the OPAG on PWS, Mr Gerald Fleming (Ireland). It recalled that the work of the OPAG was coordinated through three expert teams and an Implementation Coordination Team (ICT) and commended the respective team members for delivering on their mandate. The Commission

expressed satisfaction with the continued evolution of the PWS Programme (PWSP) and the new innovative initiatives it was implementing in accordance with the decisions of Congress and CBS.

8.2 The Commission reiterated the role of public weather services as a critical element of NMHSs, to deliver and communicate high quality, useful, relevant and timely, weather and related information and services on a daily basis so as to enable users to make informed and timely decisions. In this regard, the Commission welcomed the adoption by Cg-XV (May 2007) of the definition of core elements of a national public weather services programme and urged its members to make every effort to ensure that these elements were put in place.

Services and Products Improvement for PWS

8.3 As regards the RA II Pilot Project on the Provision of City-Specific Numerical Weather Prediction (NWP) Products to Developing Countries via the Internet, the Commission welcomed the steady progress made in its implementation. City-specific forecast time series products, provided by Hong Kong, China; Japan and Republic of Korea, have been launched on their respective websites since January 2006. By the end of December 2008, 18 RA II Members had joined the project. Forecasts time series for a total of 160 cities were being provided to 13 participating Members. The Commission requested the OPAG on PWS to report on the progress of this Pilot Project at its next session. An indication as to when, and under what conditions, the pilot project might become operational will also be provided by the OPAG on PWS in consultation with Japan, the Republic of Korea and Hong Kong, China at the next session of CBS. The Commission urged Members from developing countries of RA II who had not done so, to participate in the project.

8.4 The Commission considered the results of the Survey on Improving the Delivery of Public Weather Services compiled by the PWS Expert Team on Services and Products Improvement (ET/SPI) and made available on the PWS Website. The survey results showed that NMHSs considered capacity building as the most important issue in attaining high quality service delivery and that there was need for continuous training of staff at higher levels of specialization in all the areas related to PWS. In this regard, the Commission requested that PWS and the Education and Training Programmes explore the possibility of encouraging tertiary institutions to develop post-graduate training courses in the business management of meteorological services. Other priorities concerned new and innovative methods to ensure cost-effective transfer of knowledge to staff of NMHSs and end-users; and improvement of nowcasting capabilities for more accurate and timely warnings of severe weather. The Commission requested the PWS Programme and the OPAG on PWS to consider these priority areas in shaping the future work of the OPAG.

Communication Aspects of PWS

8.5 The Commission welcomed the development of a set of examples of ‘best practices’ (WMO/TD-No. 1409 (PWS-17)) by the Expert Team on Communication Aspects of PWS (ET/COM) on how to effectively communicate weather information, across a range of services delivery methods and information types. Examples include graphical presentations, use of icons and other weather symbols, as well as effective verbal communication on radio. Noting that the publication had been distributed and was available on the WMO Website, the Commission encouraged NMHSs to make maximum use of the publication. The Commission requested that special attention be given to guidance in the development and design of weather portals and websites as a means of communicating weather information effectively and improving the visibility of NMHSs, especially in developing countries.

8.6 Following the participation of the Secretariat in the Third RANET-Africa Leadership Team (RALT) Meeting (Arusha, United Republic of Tanzania 2008), the Commission noted the progress made in the implementation of the RANET project in Africa, the Pacific, and in RA IV, especially Costa Rica and Panama, where it is expected to be extended to all of central America. It requested the ET/COM to collaborate closely with the national and international implementers of RANET so that the project could benefit from the expertise of the ET/COM.

8.7 The Commission recognized the continuing work within the OPAG on PWS on the use and interpretation of probabilistic forecast information. It particularly welcomed the publication of the "Guidelines on the Communication of Forecast Uncertainty" (PWS-18 – WMO/TD-No. 1422) which had been produced by the ET/COM assisted by a group of experts from the OPAGs on DPFS and PWS in 2007. The Commission requested the PWS Programme to ensure wide access to and use of this publication by NMHSs. The Commission expressed its appreciation to the Russian Federation for translating this Guideline document into Russian as a contribution to PWS, and recommended that these should be made available through the PWS pages on the WMO website. To complement these Guidelines, the Commission requested that consideration be given to organizing roving workshops in different regions on the interpretation of probabilistic forecasts and communication of forecast uncertainty.

PWS in Support of Disaster Prevention and Mitigation

8.8 The Commission recalled its request to the OPAG on PWS to assist NMHSs to improve their nowcasting capabilities. It welcomed the organizing of a Workshop on Warnings of Real-Time Hazards (Sydney, Australia, 2006), and the subsequent establishment of the Joint Nowcasting Applications and Services (JONAS) Steering Committee in April 2007 to guide the advance of nowcasting in NMHSs. JONAS brought together experts from the Commission for Atmospheric Sciences (CAS) and the OPAG on Public Weather Services as an excellent example of cross-Commission working teams. The Commission requested that JONAS continue to be engaged in the application of nowcasting to public weather services.

International Exchange of Public Weather Forecasts and Warnings

8.9 The Commission commended the WMO Website 'World Weather Information Service (WWIS)' (http://worldweather.wmo.int/), for winning the Stockholm Challenge Award – Environmental Category in 2008. The Website, which is coordinated by Hong Kong, China, is provided in the following languages (and hosted by the Members as indicated); Arabic (Oman), Chinese (China), English (Hong Kong, China), French (France), German (Germany), Portuguese (Portugal), and Spanish (Spain). Noting that first coordination meeting of the host countries was held in 2007; and that a second coordination meeting is planned for May 2009, the Commission requested that efforts be made towards organizing these meetings on a more frequent basis in order that the host Members be assisted in providing the best possible services in the context of the rapidly evolving technology. The Commission noted the continuing upward trend in the use of the WWIS and the Severe Weather Information Services (SWIC) Websites which had been initiated through the work of the OPAG on PWS. Noting that some Members used the raw data underlying the WWIS website for the dissemination of forecasts to their users, the Commission encouraged Members to make use of these raw data in producing official and authentic weather forecasts. This use of the data emphasizes the need for Members to ensure that forecasts supplied through this system are of the highest possible quality. The Commission thanked the host countries for their continued provision of technical and logistical support, and urged Members to promote the use of the information, as well as increase their contribution of information to these Websites.

8.10 The Commission welcomed the strong and mutually supportive links that had developed between the SWIC Website and the MeteoAlarm project, an initiative of EUMETNET. The Commission urged both communities to continue to work closely together to promote international exchange of national warnings of severe and high impact weather.

Social and Economic Applications of PWS

8.11 The Commission stressed that demands from social and economic sectors for meteorological products and services should be the driving force for the development of the underpinning technical systems. There was a need for a better understanding of these needs and requirements. In this regard, the Commission highlighted the emphasis which Resolution 16 of Cg-XV had put on the social and economic benefits which communities could gain through the development of appropriate public weather services, and followed Cg-XV in urging Members to

quantify these benefits. The Commission recognized that NMHS managers should be assisted as necessary in the preparation of business cases and noted that the effective communication of societal and economic benefits was a powerful tool in securing due support from governments for NMHSs.

8.12 The Commission welcomed the establishment by the Secretary-General of a 'Task Force on Social and Economic Applications of Meteorology and Hydrology' (subsequently renamed as "WMO Forum: Social and Economic Applications and Benefits of Weather, Climate, and Water Services"). The purpose of the Forum is to improve interactions between providers and users of weather, climate and water services, and to contribute to the implementation of the Madrid Action Plan, which was a product of the Madrid Conference (Madrid, 2007). The Forum membership covers a wide spectrum including NMHSs, government departments, NGOs, the World Bank, academia and the media. Recognizing that public weather services played a key role in service delivery, the Commission requested the OPAG on PWS to coordinate its work with that of the Forum in addressing the socio-economic applications of PWS, especially in preparation for the Madrid + 5 Conference.

8.13 The Commission recognized that for assessing, quantifying and demonstrating benefits of weather, climate and water services to user sectors such as health, energy, tourism, transport and urban environment, many NMHSs would require assistance and guidance. In this regard, it urged its members to make optimum use of the decision-support tools provided at: http://www.wmo.int/pages/prog/amp/pwsp/socioeconomictools.htm. The Commission further requested the Secretary-General that WMO training workshops on the assessment of socio-economic benefits of meteorological and hydrological services similar to that held in Sofia, Bulgaria in 2008 be organized on a regional basis.

8.14 The Commission welcomed the continued collaboration and participation by the PWSP in the work of the THORPEX Social and Economic Research and Application (SERA) Working Group. It noted that the Chair of the Working Group is a member of the WMO Forum, and that the interests of the PWSP continue to be represented through the participation of the Chair of the OPAG on PWS in the SERA Working Group. The Commission requested the OPAG on PWS to continue collaborating with SERA to address issues of mutual interest for the benefit of both communities.

8.15 The Commission appreciated the information provided by the UK delegation on the socio-economic benefits to UK citizens from the work of the Met Office PWS Advisors. It learned that, since their introduction in 2005, the PWS Advisors have become an integral and essential partner within the UK Civil Protection community. They had ensured that the Met Office forecasts and warnings services are the basis around which many responders build their emergency plans. There is clear evidence that, as a result of the services provided by the PWS Advisors, the UK Civil Protection community is now better prepared in dealing with weather-related emergencies. The UK offered to assist interested Members in learning more about this approach, and the Commission requested the PWS OPAG to facilitate this activity.

PWS Demonstration Projects

8.16 Recalling the strategic decision of the OPAG on PWS to put emphasis on the implementation of expert advice and guidance, as discussed at CBS-Ext.(06), the Commission noted that action following its decision had resulted in the "Learning through Doing" concept developed by the ICT on PWS at its meeting in Muscat, Oman in 2007. The Learning through Doing concept involves building capacity of NMHSs using a coordinated training and mentoring programme. It is implemented with the aim of developing new and/or improved range of products and services to benefit targeted social and economic sectors identified by the countries themselves. The Commission was pleased to learn that projects following this concept had already commenced in Region III (Chile and Peru). In RA I, the project has started in Madagascar and resulted in the formation of a Working Group on Weather, Climate and Health. It requested the Secretariat to implement more LTD projects as a mechanism to initiate dialogue between users and providers and to build collaborative partnerships between the two communities.

8.17 The Commission appreciated the strong engagement of the OPAG with the World Expo Nowcasting Services (WENS) Demonstration Project which had been initiated by WMO and the Shanghai Meteorological Bureau of the China Meteorological Administration, and which will run from 2008 to 2011. It approved the objectives of the WENS Demonstration Project, which were: to demonstrate how nowcasting applications can enhance multi-hazard early warning services, using the opportunity of the Shanghai 2010 World EXPO; and to promote the understanding and enhance the capability, as appropriate, of WMO Members in Nowcasting Services.

8.18 The Commission reviewed the WENS Project Implementation Plan, and approved the structure whereby the Demonstration Project would be overseen by the WENS Science Steering Group, while the work "on the ground" would be coordinated by the WENS Working Group, who would establish working teams to deal with different aspects of the project. The Commission approved the Terms of Reference and Membership of both the WENS-SSG and the WENS-WG.

8.19 The Commission observed that the Severe Weather Forecast Demonstration Project (SWFDP), an initiative of the OPAG on DPFS, had grown in scope to encompass the enhanced communication of forecast products and services to user groups. The Commission commended the cooperation between the OPAGs on DPFS and PWS in relation to this project, and requested that both OPAGs continue to work closely together to assist Members get the maximum benefit from advances in numerical weather prediction, in providing timely forecasts and warnings of severe weather, and its potential impacts, to their users and to the public. The Commission recognized that an understanding of the social and economic benefits that can be offered to Southern African NMHSs will lead to a better understanding and application of weather services, and in this regard appreciated the significant impact of the PWS Programme as an integral part of the SWFDP since 2007. The Commission recommended that PWS Programme build capacity among Southern African NMHSs on understanding and promoting social and economic benefits through the Severe Weather Forecasting Demonstration Project.

Public Education and Outreach

8.20 The Commission recalled its recommendation that the Expert Group on Public Education and Outreach should prepare strategies and guidelines on these important topics, and was pleased to learn that the Strategy for Developing Public Education and Outreach (WMO/TD-No. 1354/PWS-14) were produced and were made available on the WMO Website. It requested the OPAG on PWS to ensure that this topic is kept in view and to encourage the application of the guidance contained in the stated publication.

Capacity Building

8.21 In anticipation of increased demands from Members for capacity building, the Commission reiterated its call to PWSP to continue its efforts in capacity building despite funding constraints, especially as regards developing countries and LDCs. It encouraged the developed countries to provide assistance in improving service delivery in LDCs and developing countries. The Commission welcomed the WMO VCP Training Course on the Use and Interpretation of City-specific Numerical Weather Prediction Products (for Members participating in RA II City-Specific NWP Products Pilot Project) held in Hong Kong, China in December 2008, and thanked Hong Kong, China for hosting and financing the training course. The Commission appreciated the capacity-building support of the UK Met Office to NMHSs in Africa in the form of hardware and software upgrades and training in graphic design undertaken in Nairobi, Kenya, in September 2008.

Collaborative activities with other CBS OPAGs and WMO Programmes

8.22 The Commission was pleased that the collaboration between the OPAG on PWS and the OPAG on DPFS within the Severe Weather Forecasting Demonstration Project had continued and had been strengthened. The OPAG on PWS had added substantial value to the project as reported during the Operational Phase Regional Training Workshop on the Use of GDPFS Products and Public Weather Services Aspects (Pretoria, South Africa, November 2008). It urged

similar collaboration between the OPAG on PWS and other CBS OPAGs. The Commission recognized that due to the nature of the two Programmes, there was a strong need for close collaboration between the Tropical Cyclone Programme and PWS.

International Symposium on PWS

8.23 The report of the International Symposium on Public Weather Services, held in WMO in Geneva in 2007 was considered by the Commission. It endorsed the recommendations of the Symposium and urged the OPAG on PWS and the PWSP to follow the recommendations of the Symposium, with particular attention being placed on the following areas:

(a) Provision of published Guidelines, training activities and workshops to support strengthening of PWS in NMHSs;

(b) Assisting NMHSs to develop capacity in key areas of Service Delivery and to seek out and promulgate examples of best practice in the communication of NMHSs forecasts and warnings;

(c) Supporting the "Learning through Doing" approach to training and to focus on participative learning projects which brought forecasters and users together;

(d) Best ways of incorporating by NMHSs climate and water issues into routine service delivery and develop national PWS programmes into a one-stop-shop for weather, climate and water services;

(e) The importance of familiarity by NMHSs with government long-term plans and the effective use of these plans to carry out gap analyses and shape new innovative services, as well to promote the training of senior NMHS managers so as to improve their skills in dealing with government officials, policy-makers and business leaders;

(f) Assisting Members to address the UN Millennium Development Goals, the IPCC Nairobi Work Programme, and the Madrid Action Plan through modernized, integrated service delivery;

(g) Reviewing and revising the structure of the OPAG on PWS in a manner that will best respond to the need to address social and economic aspects of public services.

Trends, developments and evolving needs

8.24 The Commission reiterated that NMHSs should keep abreast of achievements in the science of meteorology and related technologies in order to prepare for emerging trends, and to anticipate evolving needs of users. To respond to Members' needs, the Commission requested the PWSP to continue to pay particular attention to:

(a) Delivery of services in a seamless and one-stop manner;

(b) New forecasting products destined to the public, such as nowcasting products;

(c) EPS based probabilistic forecasts and the assistance needed by developing countries in their use and exploitation; extended range and trend/change forecasts;

(d) The use of the Internet and wireless delivery channels as a delivery mechanism for nowcasting products to the public on a real-time basis;

(e) The use of video-conferencing technology as a communications channel between NMHSs and RSMCs in times of severe weather as a means of exchanging warning information more effectively;

(f) The need for a host of weather warnings and indices such as UV, heat waves and cold snaps that have emerged in response to the multi-faceted demands of various community groups;

(g) Capacity building through e-learning as an efficient and cost-effective tool in training NMHS staff.

Members' priority areas

8.25 The Commission noted the Members' priority areas as follows:

(a) *Service delivery* – Identifying users in various sectors and their needs and ensuring excellence in delivering services to them, continuous evaluation of user satisfaction, total quality management, and continuous improvement;

(b) *Timely and Effective Communication of warnings* – Reaching and enabling the public to take action to safeguard life and property by using understandable language and terminology in NMHS products;

(c) *Single Official Voice for dissemination of warnings* – Promoting the authority of NMHSs as the Single Official Voice in issuing warnings of severe weather, as the established policy of WMO, to ensure an effective public response to these warnings;

(d) *Dissemination and presentation* – Equipping NMHS staff with media skills and presentation techniques to allow effective and timely dissemination and presentation of forecasts, warnings and information;

(e) *Strengthening media relationships* – Effective collaboration and partnership with media to assist NMHSs to get official messages out in a timely manner, especially during severe weather;

(f) *Public education and outreach* – To help the public be well-informed in weather and related issues so as to respond positively to the NMHS warnings and take appropriate action;

(g) *Collaborative partnerships with users* – Building partnerships with all sectors and institutions requiring weather services that can also facilitate service delivery, is essential. This will ensure NMHSs' involvement with the disaster management and media organizations in creating and testing effective disaster preparedness plans, warning systems, mitigation strategies and public education programmes;

(h) *Contributing to enhancing the economic and social well-being* – NMHSs to partner with users for product design and service delivery in key sectors such as energy, health, transport and tourism to make a direct contribution to national socio-economic sustainable development;

(i) *Strengthening relationships with Private Sector Meteorological Services Providers* – Effective collaboration and partnership with Private Sector Meteorological Services Providers to assist NMHSs in transmitting official messages to the community in a timely and consistent manner;

(j) *Manual on Public Weather Services* – Based on the work already carried out within the PWS Programme, to prepare a document on PWS that would be an annex to WMO Technical Regulations, to be eventually integrated into these regulations, and to form the basis for a Quality Management Framework for PWS.

Future directions

8.26 The Commission requested the PWS Programme to continue its focus on assisting Members to improve their national public weather services programmes through:

(a) Providing guidance on the application of new technology and scientific research in:
   (i) Service delivery;
   (ii) Data acquisition and use especially for nowcasting;
   (iii) Probabilistic forecasts and information;
   (iv) Multi-hazard warnings;
   (v) New product design and communication;

(b) Providing guidance to NMHSs on the effective transfer and communication of weather information to collaborating organizations and agencies.

(c) Capacity building through training in all aspects of PWS;

(d) Guidance on valuation of social and economic aspects of meteorological services;

(e) Guidance and advice on user-based service assessment, and product verification;

(f) Guidance on international and regional weather information exchange, including information on seasonal forecasts as appropriate.

8.27 The Commission reviewed the key tasks of the OPAG on PWS for the forthcoming CBS intersessional period (2009–2010); it endorsed the OPAG's proposals including its expert teams, and their respective terms of reference, to reflect priorities, progress achieved, and looking for cost efficiencies for undertaking the activities (see agenda item 12.2).

9. WMO INFORMATION SYSTEM *(agenda item 9)*

9.1 The Commission took note on the advances in WIS development and implementation since the extraordinary meeting of CBS and the Technical Conference on WIS held in Seoul, Republic of Korea in 2006. It thanked the Chairs and members of ICG-WIS and OPAG-ISS for their efforts in keeping the momentum of the WIS development, and recognized the work of the expert teams in resolving many of the issues highlighted in 2006.

9.2 The Commission emphasized the crucial importance of the OPAG-ISS outcome for the WIS development and implementation. The IPET-MI developed the ISO19115 and related standards for metadata that was essential to the WIS operation, and the ET-CTS developed guidance on the communications and technology architecture for WIS. The Commission recommended centres preparing metadata for their data and products use the version 1.1 of the WMO Profile of ISO19115. It requested the OPAG to, as a matter of priority, make available guidance material and some metadata entry and management tools to enable NMHS to start to create the required metadata.

9.3 The Commission endorsed the essential WIS documents and reference material that were developed by the ET-WISC in collaboration with the ICG-WIS and with the active support of the Secretariat, including the "WIS Project and Implementation Plan" (WPIP), the "WIS Functional Architecture", and the "WIS Compliance Specifications for GISC, DCPC and NC". It agreed these are important building blocks towards the future "Manual on WIS" and should continue to be developed further. The Commission re-affirmed the high priority need for the development of the Manual on WIS.

9.4 The Commission endorsed the ICG-WIS recommendation, supported by the OPAG, that a GISC be responsible for coordinating within its area of responsibility a WIS telecommunications infrastructure that can meet the WIS requirements for information exchange within the area and that can exchange agreed WIS time critical and operational critical information with other areas. Noting the role of the Secretariat in supporting the coordination process, the

Commission recognized the importance of cooperation of DCPCs and NCs with their responsible GISC.

9.5 The Commission noted the requirements from EC LX for the identification of WIS centres for EC LXI. It thanked the ICG-WIS ad hoc working group for collating and preparing a list of around 100 identified centres from over 35 countries (see Annex VIII to the present report). It noted it is important that processes now be developed to allow candidate centres to demonstrate WIS capabilities.

9.6 The Commission confirmed the establishment of an ad hoc expert team on GISC and DCPC Demonstration Processes (ET-GDDP) to:

(a) Develop guidance and management procedures for the CBS demonstration and assessment of capabilities of candidate GISC and DCPC centres in the framework of the GISC-DCPC designation procedure as endorsed by Cg-XV;

(b) Organize demonstrations of capabilities of candidate WIS centres as required, including demonstration at CBS sessions.

The Commission requested the ET-GDDP to submit its outcome on item (a) to the forthcoming ICG-WIS session (September 2009) with a view to reporting to EC-LXII (2010), and organizing demonstrations of capabilities of candidate WIS centres at the CBS extraordinary session (2010) planned in 2010, fourth quarter. CBS-Ext.(2010) would then submit relevant recommendations to Cg-XVI in 2011.

9.7 The Commission expressed its appreciation to the Secretariat in assisting Members, expert teams and working groups. It also noted the contribution to the WIGOS initiative (ER 4) and in ensuring the coordination between WIS and WIGOS as requested by Cg-XV. The Commission strongly encouraged Members and the Secretariat to continue to support the critical implementation stage of WIS. It expressed deep appreciation for the contributions and resources that were received, and emphasized the importance of providing additional support through the WIS trust fund or staff secondments to allow the Secretariat to increase capacity building activities for developing and least developed countries. It noted that priorities included the refinement of the Rolling Review of Requirements.

10. WMO INTEGRATED GLOBAL OBSERVING SYSTEM *(agenda item 10)*

10.1 The Commission considered the status of the development and implementation of the WIGOS concept adopted by the Cg-XV.

Implementation of the WIGOS initiative

10.2 The Commission took into account the strategy towards enhanced integration between the WMO observing systems adopted by Cg-XV and agreed that CBS should play a leading role in the further development and implementation of the WIGOS initiative. The Commission welcomed the fundamental work of the Commission for Instruments and Methods of Observation (CIMO) with regard to the standardization of methods of observation and integration of observing systems, and reiterated the need for close collaboration between CBS and CIMO.

10.3 The Commission responded with relevant adjustment of the CBS future working structure and by adopting new Terms of Reference (TOR) of its OPAGs, Expert Teams (ETs) and rapporteurs addressing requirements of WIGOS for integration, interoperability, standardization and homogeneity. In this regard, the Commission requested the chairs of OPAGs, ETs and relevant rapporteurs to include into their work plans, relevant tasks and activities that contribute to the further development and implementation of the WIGOS initiative.

10.4 In a spirit of having the leading role in WIGOS, the Commission agreed that the CBS president be directly responsible for overall coordination of Commission's WIGOS activities. The Commission recommended that the CBS president be, ex-officio, a member of the Executive Council Working Group on the WMO Integrated Global Observing System and the WMO Information System (EC-WG/WIGOS-WIS) as well as its Subgroup on WIGOS.

10.5 When considering the different aspects of the WIGOS initiative, the Commission agreed that its implementation should offer the opportunity to include all WMO and WMO-sponsored networks and subsystems in the integration process thus allowing WMO to more effectively respond to evolving user requirements and new challenges.

10.6 The Commission also agreed that integration should proceed in a way that recognizes and builds on the continued partnership, participation and collaboration of the bodies responsible for these observing systems as they become part of an integrated system of systems. The Commission emphasized the value of active engagement in the development of a framework for WIGOS by agencies co-sponsoring component observing systems and programs (in particular GOOS, GTOS and GCOS), recognizing the opportunities for cooperation and mutual support and the need to respect individual mandates and policies.

WIGOS Concept of Operations and Development and Implementation Plan

10.7 The Commission noted with appreciation the development of the WIGOS Concept of Operations (CONOPS) and the WIGOS Development and Implementation Plan (WDIP) developed by the EC-WG/WIGOS-WIS and requested its president to submit the Commission's proposals for an update to CONOPS and WDIP to the second session of the EC-WG/WIGOS-WIS for consideration.

10.8 The Commission welcomed, in particular, the strong message of collaboration and cooperation provided by the WIGOS vision statement, which emphasizes that "WIGOS benefits society through enhanced availability and integration of global weather, climate and water observations contributed by constituent systems".

WIGOS Pilot Projects (WPP) and Demonstration Projects (WDP)

10.9 The Commission noted with appreciation the involvement of OPAG-IOS in the development of WPPs. It supported the design and objectives of the five WPPs and supported proposals for new potential WPPs (see paragraphs 10.15 and 10.16). The Commission agreed to provide support to WPPs through the OPAG-IOS chair.

10.10 When considering the status of the implementation of individual WPPs, the Commission reiterated the decision of Cg-XV that undertaking all proposed WPPs at the earliest possible stage would be useful for addressing the WIGOS integration process and would help in a regular updating of CONOPS and WDIP.

10.11 Regarding WPP on Improvement of Dissemination of Ozone (total column, profiles and surface) and Aerosol Observations through the WIS, the Commission recognized the importance of near-real-time delivery of ozone and aerosol variables needed for NWP and that these should be addressed as a matter of priority. The Project will contribute to the design of activities that enhance the transfer of GAW data in near-real-time through WIS. The Commission noted that benefits of WIGOS include the standardization of ozone and aerosol variables observing techniques, standardization of routine collection and exchange of essential data as well as standardization of data transmission in a timely fashion to meet user requirements including those for climate studies. The Commission recognized that guidelines were needed on how to proceed with specific data-related problems encountered and that advice and collaboration from CBS was needed.

10.12 The Commission noted the recommendation of CHy-XIII and CHy-AWG-1 that SADC-HYCOS and Flash Flood Guidance System in Southern Africa should be integrated as the WIGOS Pilot Project.

10.13 As regards the WPP on Integration of AMDAR into WIGOS, the Commission expressed its support to Project activities as part of the integration of AMDAR into CBS and the WWW.

10.14 When considering the WPP on Elaboration of the Underpinning/Crosscutting Role and Responsibilities of the Instruments and Methods of Observation Programme in the context of WIGOS, the Commission agreed that a large amount of technical knowledge and expertise at the instrument and methods of observation level was needed in the process of implementation of the WIGOS concept. The Commission stressed that this area of standardization within WIGOS should be accomplished through the cross-cutting role and responsibilities of CIMO within the WIGOS framework.

10.15 Noting the good progress in the development of the WPP on Integration of Marine Meteorological and other appropriate Oceanographic Observations into the WMO Integrated Global Observing System, together with WIS interoperability aspects, the Commission agreed to provide its support to the Project on required training, as appropriate, through the WIS Project Office.

10.16 The Commission noted with appreciation the initiative of the WMO Satellite Programme to be more involved in the WPPs, especially in the Projects for Hydrology and Marine, to foster more effective integration of satellite and in-situ observations. The Commission also supported the development of a proposal for the Global Space-based Intercalibration System (GSICS) as a new WPP.

10.17 The Commission welcomed that the GCOS considered a new WPP for GRUAN and affirmed its willingness to work with GCOS to develop it following the example given by other WPPs. The Commission felt this to be a particularly important activity because of the important contribution of GUAN stations to the GOS and the collocation of many GRUAN sites with the GUAN stations.

10. 18 The Commission noted that the operational forecasting of sand and dust storms remained a difficult problem and suggested that a pilot project, including the real-time exchange of air quality data, could usefully address this issue.

10.19 The Commission further emphasized that each WPP should have a realistic implementation plan with clearly defined time frame, activities and achievable deliverables for each individual phase, taking into account WDIP guidance which foresees that activities of WPPs begun in the period 2007–2009 should be completed and evaluated preferably by June 2010 for consideration by the EC-WG/WIGOS-WIS before EC-LXII (June 2010).

10.20 In this regard, the Commission stressed that each Project Team should elaborate a detailed Implementation Plan and Work Programme with specified tasks, activities, deliverables and deadlines and make it available to the WIGOS Project Office for planning and monitoring purposes as well as support needed by the WMO Secretariat to the WPPs.

10.21 It was recommended that information related to the WPPs together with the work plan should be available at WIGOS Website (http://www.wmo.int/pages/prog/www/wigos/index_en.html).

10.22 The Commission agreed that the WPPs required active coordination and support from the WIGOS Project Office and so a suitable project management function needed to be established. This will also allow for better interaction between the Project Team responsible for each Project, the SG-WIGOS and the respective technical commission working bodies.

10.23 The Commission felt that it would be essential to identify those Data Collection or Production Centres associated with providing the interface needed for WPPs; this would require additional guidance from CBS and WIS as regards the number of such centres together with their terms of reference as well as relevant training aspects.

10.24 The Commission welcomed the progress achieved by the WIGOS Demonstration Projects (WDPs) being undertaken by NMHSs within each Regional Association, and noted that while these WDPs varied considerably in scope and character, they all provided useful perspectives on the potential impact and value at the national and/or regional level of the concept of WIGOS integration within a system of systems framework. The Commission welcomed the extent to which NMHSs participating in WDPs are able to share their experiences and/or broaden engagement within their region. The Commission requested the WIGOS Planning Office to assist with relevant guidance on the conduct of the WDPs.

10.25 The Commission encouraged those Members undertaking WDPs to elaborate a detailed Implementation Plan and Work Programme with specified tasks, activities, deliverables and deadlines, and make it available to the WIGOS Project Office for planning and monitoring purposes as well as support needed by the WMO Secretariat to the WDPs.

10.26 The Commission noted with appreciation that the current versions of the Manual and Guide on the GOS already recognized most of the WIGOS constituent systems; provided linkages to integrate them and constituted the essential framework within which the common set of standards could be agreed and promulgated.

10.27 The Commission confirmed that the current CEOS-WMO Database on User Requirements and Observing Capabilities should be further maintained as it was the basis for the Rolling Review of Requirements and should play an even larger role with WIGOS. Taking into account WIGOS and WIS requirements, it was agreed that the current database should be re-designed and extra-budgetary resources sought for this re-design and further maintenance.

10.28 The Commission expressed its concern regarding the available time frame for testing the WIGOS concept and very limited resources provided through secondments of experts and contribution to the WIGOS Trust Fund and/or redirection of existing WMO Secretariat resources in contrast to the request of EC-LX emphasizing the need of an increased level of resources required in 2008–2011. The Planning Office for WIGOS was established but is yet to be fully staffed. The Commission agreed that lack of funds would not allow for the completion of some WPPs as planned for the timely development and testing of the WIGOS concept.

10.29 The Commission agreed that the current process of implementing the WIGOS concept should be focused on the test-of-concept phase, building on development of the Pilot and Demonstration Projects initiated by technical commissions and NMHSs respectively; the later “implementation” phase would be developed in conjunction with the finalization of, and feedback from, the Pilot and Demonstration Projects, based on appropriate evaluation criteria and agreed consolidation/implementation process. The Commission recommended the early development of the evaluation criteria and consolidation/implementation process, under the auspices of the EC WG on WIGOS-WIS, and the allocation of appropriate resources.

QMF in the WIGOS framework

10.30 The Commission stressed that the further development of the WMO QMF is essential for the future of WIGOS operations. The appropriate quality management system (QMS) shall operate continuously at all points of the whole system. The owner of the observing system must accept the responsibility for implementing cost-effective QMS. This process is tied up with the quality of end-user products; therefore the issue should not be addressed and worked on just under the WIGOS umbrella, which is limited to the observational aspects. In this regard, strategic recommendations are sought from the EC-WG/WIGOS-WIS as to how the quality management framework should be developed and implemented in operational practice.

CBS Technical Conference on WIGOS

10.31 The Commission appreciated the participation of many Members, representatives of other Technical Commissions, WMO partners and cosponsors in the Technical Conference on

WIGOS (TECO-WIGOS) that had been conducted on 23–24 March 2009, prior to its fourteenth session.

10.32 The Commission noted that TECO-WIGOS had provided an excellent opportunity to review the progress achieved to date in exploring the WIGOS concept, inter alia through demonstrating its potential implementation through the range of Pilot and Demonstration Projects, to assess that progress against the timeline and objectives for WIGOS laid down by Cg-XV, and to outline both the achievements to date, the essential building blocks that exist and the challenges that remain.

10.33 The Commission welcomed and noted the TECO-WIGOS Conference Statement as given in Annex IX to the present report. The Commission requested the President to convey the Conference Statement to the EC-WG/WIGOS-WIS, to the Presidents of other Technical Commissions and the Regional Associations, and to the high-level bodies responsible for related and co-sponsored observing systems and programs, such as GOOS, GTOS, GCOS and GEOSS.

10.34 The Commission requested Members and the Secretary-General to consider providing additional resources to the WIGOS Planning Office to ensure it is fully functional to support the WIGOS Projects and assist in the further elaboration of the WIGOS concept.

10.35 The Commission noted the need for a comprehensive, costed development and implementation strategy for taking WIGOS from a concept to reality and that this strategy should address, inter alia, the technical and coordination challenges and the associated roles and responsibilities; the process for capturing the lessons-learned from WIGOS projects and other activities; capacity building requirements to ensure WIGOS benefits reach all Members; and designation of clear responsibilities across the WMO system for the further development of WIGOS. The Commission agreed to contribute to the preparation of such a strategy under the auspices of the EC-WG/WIGOS-WIS.

10.36 The Commission further emphasized that:

(a) The full functionality of WIS is essential in order to ensure that WIGOS can exploit new data access and retrieval facilities;

(b) It is essential to further engage the hydrological community in WIGOS activities;

(c) It is important to ensure that all relevant requirements and priorities of WMO observing and applications programmes are taken into account in WIGOS;

(d) Substantial effort will be required to communicate to all potential WIGOS participants, both within and external to the WMO system, the benefits of participation in WIGOS as a comprehensive, coordinated system of observing systems;

(e) WIGOS will constitute an important WMO contribution to GEOSS, and that the Commission and its experts should continue to look for ways to collaborate with GEOSS in relevant areas.

10.37 The Commission reaffirmed its commitment to work with EC-WG/WIGOS-WIS and its Sub Group on WIGOS to implement actions required to address the challenges highlighted in the TECO-WIGOS statement.

11. OTHER CROSS-CUTTING ACTIVITIES (*agenda item 11)*

11.1 GROUP ON EARTH OBSERVATIONS (*agenda item 11.1)*

11.1.1 The Commission was informed that Fifteenth Congress endorsed the participation of WMO in the Group on Earth Observations (GEO) and also endorsed the Global Earth Observation

System of Systems (GEOSS) and its 10-Year Implementation Plan. Congress requested that WMO provide full support for the GEO process and resulting GEOSS; support its implementation to the maximum extent possible within WMO's mandate; and make available all essential data as defined in WMO Resolution 40 (Cg-XII) through the GEO interoperable arrangements to serve the needs of the global community. Congress participation in GEO had to be on a basis of mutual benefit which maximized synergies and minimized duplication noting that participation in GEO will provide an opportunity to improve global observing systems, especially in areas beyond national jurisdictions. This will also facilitate the full and open exchange of data, metadata and products shared within GEOSS, while recognizing relevant international instruments and national policies and legislation.

11.1.2 The Commission was informed that GEO, established in 2005, now comprised 78 Nations, the European Commission and 56 Participating Organizations. It was informed that an updated GEO Work Plan for 2009–2011 was released in January 2009. WMO is leading and/or contributing to over 30 of the Work Plan Tasks and is co-chairing or participating in many of the GEO Committees. Furthermore, the Commission was informed that WMO continues to provide a coordinated response to GEO by the UN Agencies' co-sponsored global observing systems (GOOS, GTOS, and GCOS).

11.1.3 The Commission was informed that some of the key issues facing GEO leading up to the next Ministerial Summit in 2010 are: data sharing principles; interoperability arrangements; and, governance and sustained financing as GEO transits from a developmental to operational phase for a System of Systems.

11.1.4 The Commission was informed that if NMHS systems were compliant with WIS Standards, by definition, they would meet relevant standards that GEO/GEOSS would establish. The Commission concluded that WMO participation in GEO was of importance to CBS in particular as it related to WIS and WIGOS.

11.1.5 The Commission reaffirmed that it should continue to have a Coordinator on GEO and the CBS Management Group maintain oversight on WMO activities in GEO. It decided to designate a Coordinator on GEO/GEOSS activities related to WMO and that he/she report on a regular basis to the CBS-MG (see item 12.2).

11.1.6 The Commission suggested that, based on WMO's significant contributions to GEO/GEOSS, that the CBS Coordinator(s) for GEO closely monitor GEO documents to ensure WMO programmes and contributions are appropriately acknowledged as such.

11.2 DISASTER RISK REDUCTION *(agenda item 11.2)*

Topic 1: Opportunities for Improved Humanitarian Contingency Planning and Response through Linkages to GDPFS and WIS

11.2.1 The Commission recalled that in response to the International Decade for Natural Disaster Reduction (IDNDR, 1990–1999), WMO through the Public Weather Services (PWS) Programme in 1995, facilitated the provision of meteorological assistance and information from the National Meteorological Centres and Regional Specialized Meteorological Centres (RSMC) serving that region that would enable the UN Department of Humanitarian Assistance (DHA), the predecessor of the United Nations Office for Coordination of Humanitarian Affairs (UN-OCHA) to provide the required assistance. The procedures for this assistance were established following wide consultations within the WMO community and with DHA. The Commission noted that this initiative produced a mechanism which successfully served this purpose until the end of the IDNDR, whereby changes in operational responsibilities both in WMO and the UN resulted in conclusion of the arrangements. Furthermore, the Commission was informed that application of the procedure to some cases, which were documented by PWS, were available for further evaluation and analysis of lessons learned.

11.2.2 The Commission was informed that during the UN General Assembly discussions in late 1990s, countries expressed the need for improved international humanitarian response based on contingency planning and improved coordination across different humanitarian agencies. This led to the Inter-Agency Standing Committee (IASC) initiatives, which resulted in a new wave of humanitarian reforms in early 2000s using the cluster approach for coordination among the IASC membership. UN-OCHA, the International Federation of Red Cross and Red Crescent (IFRC), UNICEF, World Food Programme (WFP), Food and Agriculture Organization (FAO), United Nations High Commissioner for Refugees (UNHCR), World Health Organization (WHO) and the United Nations Development Programme (UNDP) were designated to lead coordination of different clusters. The Commission acknowledged that this has resulted in new opportunities for linking meteorological services and information, available through NMHSs and RSMCs, operationally and in a timely manner to humanitarian agencies for improving their contingency planning and response to potential disasters.

11.2.3 The Commission noted the emerging opportunities through the WMO Information System (WIS) for improved data management and retrieval, and that in 2006, the CBS extraordinary session emphasized the early identification of external users of WIS and the incorporation of their requirements into the planning, in particular, the international disaster risk management and the humanitarian community.

11.2.4 The Commission was informed that the humanitarian reform has led to changes in the operational procedures, and new information sharing mechanisms among humanitarian agencies. The Commission was informed of expressed interest from the humanitarian community both at the executive management and operational levels to re-establish linkages with the operational network of NMHSs and RSMCs. In this regard, the Commission stressed the need for better understanding of the humanitarian operational procedures and their requirements for meteorological information that could be available through the NMHSs and GDPFS. The Commission was informed that a background report would be available in May 2009, based on preliminary meetings in the Secretariat facilitated by the Disaster Risk Reduction (DRR) Programme and involving the PWS, GDPFS Programmes, WMO Information System (WIS) and experts from several humanitarian agencies.

11.2.5 Noting the need for an increased focus on meteorological services for improved humanitarian planning and response the Commission decided to establish a Task Team on Meteorological Services for Improved Humanitarian Planning and Response under OPAG on PWS to plan and work towards implementation of a project in this area and adopted the Terms of Reference of the Task Team (see agenda item 12.2). The Task Team is to consult, as necessary, with the OPAGs on ISS and DPFS and report back to the Commission's extraordinary session in 2010.

Topic 2: Need for Standard Guidelines for Multi-Hazards' Definition, Database, Metadata and Statistical Analysis and Mapping Tools

11.2.6 The Commission noted that a multi-hazard approach to warnings for hazards should be adopted, and that in many instances, NMHSs had responsibilities for hazards beyond those dealt with by the WMO (e.g. tsunamis and earthquakes).

11.2.7 The Commission was informed that WMO DRR country-level survey (2006) indicated that droughts, flash and river floods, strong winds, severe storms, tropical cyclones, storm surges, forest and wild land fires, heat waves, landslides and aviation hazards were the top ten hazards of concern to all Members. The survey also indicated that over 90% of the 139 NMHSs that responded to the survey requested guidance materials on standard methodologies for monitoring, archiving, analysis and mapping of meteorological, hydrological and climate-related hazards.

11.2.8 The Commission also recalled that WMO had the obligations as specified in Article X, "Statistical Services" of the agreement between the United Nations and WMO to facilitate, "… collection, analysis, publication, standardization, improvement and dissemination of statistical information in the field of meteorology and its applications, and for the supply of such statistics to

other specialized agencies …" In this regard, the Commission recalled EC-LVIII and Cg-XV requests to the Secretary-General: (i) to facilitate the development of guidelines for standardization of hazard definitions, databases, metadata, and mapping and tools through relevant WMO Programmes and Technical Commissions; and (ii) to prepare standard methodology for collection of hazard information from NMHSs, when possible and available, coordinate the collection of such information and to prepare statistical reports to inform specialized agencies of the United Nations.

11.2.9 The Commission was informed of the Shanghai Multi-Hazard Early Warning Systems Demonstration Project, *a* multi-hazard project which was initiated in 2007. This project involves technical capacity development in nowcasting and forecasting of various hazards to the NMHS, through a coordinated approach involving all relevant WMO technical programmes. This approach is being demonstrated with the goal to scale up to other countries in need of technical capacity development requiring a multi-hazard approach. One possible outcome of the project is a testing of prototypes for hazard databases, definition of terms and mapping tools. The Commission was informed that the impact of severe weather, climate- and water-related severe events is increasing and requested that, in the future development of this project, particular note be taken of the high vulnerability of developing countries.

11.2.10 The Commission was informed that initiatives for development of guidelines for standardizations of flood, drought and storm surge databases, metadata and mapping tools were underway by other WMO technical commissions. The Commission stressed the need for development of guidelines for other meteorological hazards and noted that a background report would be available in April 2009, developed by a consultant documenting needs and gaps, initiatives and providing examples of meteorological hazard analysis methodologies.

11.2.11 Noting the need for standard guidelines for meteorological hazards' definition, database, metadata and statistical analysis and mapping tools, the Commission decided to establish a Task Team on Standard Guidelines for Meteorological Hazards under OPAG on PWS to plan and work towards implementation of a project in this area and adopted the Terms of Reference of the Task Team (see agenda item 12.2). The Task Team is to consult, as necessary, with experts from the Commission for Climatology (CCl) and Commission for Atmospheric Sciences (CAS), and to report back to the Commission's extraordinary session in 2010.

11.3 QUALITY MANAGEMENT FRAMEWORK *(agenda item 11.3)*

11.3.1 The Commission noted that the Quality Management Framework (QMF) was recognized by the WMO Congress (Resolution 32 (Cg-XV)) as an appropriate holistic approach for the delivery of data, products and services. Volume IV on "Quality Management" of the Technical Regulations proposed to be generic and describe the WMO QMF as a coordinated approach to the delivery of data, products and services. A first draft circulated to members of the ICTT includes the WMO quality policy, the eight quality management principles, the roles of the WMO constituent bodies and the harmonized approaches to quality management among the technical commissions. A guide on quality management that should assist Members in the establishment of a QMS is also proposed. The Commission was informed that many Members are in urgent need of assistance in establishing their quality management systems and encouraged the early preparation by the ICTT of guidance documentation to assist these Members.

11.3.2 The Commission was advised that a number of Members have now implemented quality management systems and encouraged these Members to share their expertise and experiences with others, particularly those in developing countries, so that future implementations of quality management systems by Members could be done as cost effectively as possible. The Commission was also informed of a pilot project in Tanzania Meteorological Agency (TMA) that aims to make the TMA's Aviation Meteorological Service ISO 9000 compliant, and also to generate standard documentation that could be used as a template by other small aviation meteorological services in their work to achieve ISO 9000 compliance. It is currently expected that this project will be completed in the third quarter of 2009. The Commission asked to be kept informed of this project's progress.

11.3.3 The Commission recalled that a *Guide on the Quality Management System for the Provision of Meteorological Service for International Air Navigation* (WMO – No. 1001), published jointly with ICAO, provided useful guidance for aeronautical meteorological services that are addressing with the requirement stated in ICAO Annex 3/WMO Technical Regulations C.3.1.

11.3.4 Concerning WIGOS, the Commission stressed that the further development of the WMO QMF is essential for the future of its operations. The appropriate quality management system (QMS) shall operate at all components of WIGOS, and it fundamentally affects the quality of end-user products, and so for the implementation of a cost effective QMS, strategic recommendations should be sought from the EC Working Group on WIGOS and WIS as to how the quality management framework should be developed and implemented in operational practice. The Commission considered that principles and templates of QM should be incorporated into the regulatory documents as soon as possible, and further stressed that this would be a valuable opportunity to update the content of these documents where necessary.

11.3.5 The Commission agreed that the consideration of quality management and quality control aspects related to forecasting and warning products and services should be addressed in the overall context of developing standards or recommended practices on weather forecasting and delivery of related services. The Commission therefore requested that quality management as applied to public weather services delivery be taken into consideration when establishing the WMO QMF and that full use be made of the materials produced by the OPAG on PWS on this subject.

11.3.6 The Commission noted that WMO is now recognized as an international standardizing body by the International Organization for Standardization (ISO) and the agreement between ISO and WMO was adopted in September 2008, giving WMO the status and authority for the development of international standards related to meteorological, climatological, hydrological, marine and related environmental data, products and services. The Commission encouraged relevant OPAGs and projects to consider which of the Manuals and Guides should be proposed as common ISO/WMO Standards.

11.3.7 The Commission also noted that while the WMO is now recognized as an international standardizing body and that WMO standards may be referred to in the implementation of systems certified as ISO 9000 compliant, WMO has no role in the definition of ISO 9000 standards. However, WMO has an important role in assisting its Members who choose to adopt ISO 9000 standards through the issuance of guidance materials and by coordinating the sharing of relevant experience and expertise amongst its Members.

11.3.8 The Commission adopted the TOR for its Rapporteur on QMF (see agenda item 12.2).

11.4 WORLD WEATHER RESEARCH PROGRAMME (WWRP), INCLUDING THE THORPEX PROGRAMME *(agenda item 11.4)*

11.4.1 The Commission recognized the progress of CAS's WWRP-THORPEX programme to deliver the THORPEX Interactive Grand Global Ensemble (TIGGE) archive, to conduct research that identifies areas where forecast skill and confidence might be improved by the multi-model approach and to demonstrate the concept of a multi-centre Global Interactive Forecast System (GIFS) by delivering tropical cyclone tracks in real-time. The Commission further noted the encouragement of TIGGE activities by EC-LX, including demonstrations of the potential value of GIFS in operational forecasting aimed at reducing human suffering, mitigate costs and deliver benefits and thus recommended:

(a) Regional, CBS, and CAS-related entities in the WMO collaborate with the THORPEX GIFS-TIGGE Working Group to plan and execute a series of GIFS Forecast Demonstration Projects (GIFS-FDPs) with special emphasis on benefiting Members in the developing world. A special meeting of the GIFS-TIGGE WG should be convened which would involve other THORPEX Working Group members, the THORPEX IPO, experts from CBS, and from the planned GIFS FDPs to discuss the way forward on the GIFS vision;

(b) To take advantage of existing and planned activities, infrastructure and experience, wherever possible, GIFS FDPs will be carried out in conjunction with CBS regional SWFDPs (Severe Weather Forecasting Demonstration Projects), which have an effective mechanism for cascading the benefit of new forecast systems to decision-makers in WMO Members States. In regions where they have not been established yet, the formation of SWFDPs is encouraged to take full advantage of GIFS developments;

(c) Following the direction of EC-LX regarding the continuation of real time exchange of Tropical Cyclone (TC) track data, GIFS FDPs will first focus on tropical cyclone forecasts. The Commission encouraged the participation of the relevant TIGGE data providers, TIGGE archive centres, Tropical Cyclone Warning Centres (TCWCs) and Regional Specialized Meteorological Centres (RSMCs including RSMCs with activity specialization in Tropical Cyclones) in executing such GIFS FDPs, which will require training and the development of a common set of products;

(d) Subsequently, GIFS FDPs should focus on improving prediction of heavy rainfall and other problems of high priority interest to the needs of Members, such as improving food security;

(e) The WMO Secretariat, THORPEX and the TIGGE data providers need to work to develop a suitable data policy that will allow these GIFS FDPs to proceed in order to reduce human suffering, mitigate costs and deliver benefits;

(f) The Commission recognizes the critical role that SWFDPs can play in developing GIFS prototypes and therefore asks the current (and any future SWFDP project) to nominate a liaison for GIFS development;

(g) The Commission recommends that all GIFS development be made consistent with WIS and offers to nominate a CBS liaison for GIFS development;

(h) For the longer term, CBS, including WIS, SWFDP and tropical cyclone experts, should work with the THORPEX community to develop a way forward with the GIFS vision. The CBS Management Group should endeavour to develop strong working relationships between CBS and THORPEX.

11.4.2 The Commission urged participation of operational modelling centres to contribute to the TIGGE LAM (Limited Area Modelling) archive to enable researchers to test whether the benefits of the TIGGE approach extends to high resolution modelling.

11.4.3 The Commission noted the request of EC-LX to the Secretary-General and Members to support the efforts of THORPEX Africa to conduct research and improve both operational prediction and society's capacity to utilize weather information. The Commission urged Members within Africa to provide comments on the THORPEX Africa Science and Implementation Plans and to name points of contact for participation by their NMHSs. The Commission urged Members within and outside of Africa to support the operational components of the THORPEX Africa Plan.

11.4.4 The Commission gratefully acknowledged the activities of the WWRP, especially those activities that resulted in the transfer of state-of-the-art research activities directly into operational practices, such as the MAP D-PHASE FDP and the Beijing 08 FDP. The Commission also noted the planned cooperation between CBS and CAS-WWRP-THORPEX on TIGGE-GIFS, the Joint Committee between CAS and CBS on Nowcasting, planned cooperation between CBS and CAS on verification and the cooperation between CBS and CAS that result in operational training activities often coinciding with CAS Research Workshops, Symposium and Conferences. The Commission recalled that EC-LX had encouraged links between the CAS's WWRP effort and operational forecasting including developing prototype forecasting systems from a variety of WWRP research programmes, development of operational products based on research results and operational support of research field campaigns. Thus, the Commission requested appropriate experts in CBS to review the WWRP Strategic Plan and provide written comments from the

viewpoint of operational interactions in time for CAS-XV (November 2009). In addition, it was requested that a liaison person be assigned from CBS to the WWRP's Joint Science Committee (JSC) and the Commission identified the Chair of the OPAG DPFS for this purpose.

11.4.5 The Commission noted that a list of major operationally directed recommendations was made by the Sixth WMO International Workshop on Tropical Cyclone (IWTC VI) in order to improve the prediction and public response to tropical cyclones (WMO/TD-No. 1383). The Commission encouraged the Operational Centres, RSMCs with activity specialization in Tropical Cyclones, and TCWCs to consider and, where appropriate, to act upon these operationally-directed recommendations.

11.4.6 The Commission noted the EC-LX endorsement and request for broad WMO involvement in a technical workshop focused on issues associated with the changing environment in NMHSs This changing environment includes a growing tendency for forecasting systems run locally on workstations and local networks, demanding new user requirements, an increased reliance on visualization, and an evolving role of human forecasters with pressure for increased automation. The Commission requests OPAG DPFS to partner with CAS-WWRP in the planning, implementation, and support of such a workshop, which should have a strong focus on Members from developing nations.

11.5 INTERNATIONAL POLAR YEAR 2007–2008 *(agenda item 11.5)*

11.5.1 The Commission noted with satisfaction the remarkable progress made in the implementation of IPY 2007–2008. During its two action-packed years, researchers from more than 60 countries had observed exciting new phenomena, made fundamental scientific discoveries, developed new methods and tools, advanced interdisciplinary and international links in polar science and, most importantly, gained new understanding of the role of the polar regions in the total Earth system. A report "The State of Polar Research" was publicly presented to WMO and ICSU Executive Heads by IPY Joint Committee on 25 February 2009 at the WMO headquarters. The Commission recognized that success of IPY had inspired many nations to continue IPY projects beyond IPY "official" period and an official closure of IPY is planned to be at IPY Science Conference (Oslo, Norway, 8–12 June, 2010).

11.5.2 The Commission emphasized a few IPY achievements primarily related to CBS specific areas of responsibility:

(a) Extension of surface-based meteorological networks in polar regions through establishment or modernization of new stations as well as by the intensive deployment of automatic weather stations and upper-air systems;

(b) Development of new integrated observing systems in Arctic and Southern Oceans based on the wide use of modern technologies such as gliders, ice-tethered profilers, marine animals equipped with sensors, Argo floats;

(c) Creation of an impressive array of new satellite data and products, thanks to the coordinated approach adopted by the space agencies; and

(d) Implementation of new initiatives in hydrological cycle and cryosphere studies.

11.5.3 The Commission noted the establishment of the EC Panel of Experts on Polar Observations, Research and Services to provide, *inter-alia,* a high-level WMO partnership in activities aimed to secure the IPY observing system legacy in close communication with operational agencies in Member countries and international organizations. The technical commissions were requested to guide the extension of IPY observing systems beyond the IPY experimental phase. The Commission requested its OPAG on IOS to assist the EC Panel in building partnership with the IPY observing legacy initiatives, such as Sustaining Arctic Observing Networks, Southern Ocean Observing System, Global Cryosphere Watch, Polar Satellite Constellation and others, and

encouraged further efforts to develop regional observing systems in both polar regions to reinforce existing global observing systems.

11.5.4 Recognizing that one of the challenges of the IPY process is data exchange and preservation, the Commission urged Members to ensure free and unrestricted exchange of IPY data. It noted that the IPY Subcommittee on Data has been contacting individual nations with specific data management requests and timelines; federation of the data portals was being established and interoperability arrangements developed. The WMO Information System is seen as a central mechanism to assist with data sharing and interoperability. Regarding the long-term preservation of data the Commission noted that ICSU was beginning to address this issue through the creation of the World Data System. Ultimately, however, the issue needed to be addressed by individual nations, funding agencies, and institutions. The Commission, therefore, requested its OPAG on ISS to assist the EC Panel to facilitate acquisition, exchange, and archiving of observational data from polar regions in compliance with WIGOS requirements related to instruments and data exchange to support provision of services required for safety of operations in the polar regions.

12. CBS PROGRAMME AND PLANNING *(agenda item 12)*

12.1 LONG-TERM PLANNING RELEVANT TO THE COMMISSION *(agenda item 12.1)*

12.1.1 The Commission noted that WMO has adopted the Results-based Management approach and that Strategic Planning, the WMO Operating Plan as well as Monitoring and Evaluation are an integral part thereof. The Commission further recognized the trends in many countries reveal a move to a similar strategic planning framework.

12.1.2 The Commission noted with appreciation that its vice-president, with the cooperation of the CBS Management Group and OPAG chairs, prepared a CBS Operating Plan, including planned programme implementation, for the period 2008–2011 to take into account the WMO strategic plan and expected results as approved by Fifteenth Congress. The Commission requested the Management Group to identify the high priority objectives within the Operating Plan for the period 2008–2011 and provide these in an executive summary to the Operating Plan by the end of the calendar year 2009.

12.1.3 It further noted that EC-LX had endorsed the schedule for finalizing the draft WMO Strategic Plan for the period 2012–2015 by the end of 2009. The Commission also noted that EC-LX had recommended optimizing the number of Expected Results and associating them with well formulated Key Performances Indicators (KPIs). The Commission discussed on the future thrust of its activities. It emphasized that, while moving to the new framework, the effective coordination between CBS and related Regional Associations activities should be preserved. It requested its Management Group to consolidate the required CBS contribution to the draft WMO Strategic Plan for the period 2012–2015.

12.2 FUTURE WORK PROGRAMME *(agenda item 12.2)*

12.2.1 The Commission thanked all the chairs and members of the expert teams and the rapporteurs for their contribution to the CBS Open Programme Area Groups (OPAGs), and in particular those who will 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 these positions for their important contribution to the work of the Commission over many years.

12.2.2 The Commission agreed on its work programme, taking into account the detailed discussions under the various agenda items. The Commission decided to re-establish the four Open Programme Area Groups on Integrated Observing Systems, on Information Systems and Services, on Data Processing and Forecasting System, and on Public Weather Services. It also decided to appoint a Rapporteur on Quality Management Framework, a Coordinator on Disaster Risk Reduction, a Coordinator on Capacity Building and a Coordinator on GEO/GEOSS activities

related to WMO, and to establish an Inter-Programme Coordination Team on Space Weather. The Commission adopted Resolution 2 (CBS-XIV) – Open Programme Area Groups.

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

12.2.4 The list of chairpersons, co-chairpersons, coordinators and rapporteurs who were designated by the Commission, is given in Annex XI to the present report.

12.2.5 The Commission requested the CBS Management Group to establish the membership of the teams. It invited the chairpersons of the OPAGs and 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.

12.3 REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND RELEVANT EXECUTIVE COUNCIL RESOLUTIONS *(agenda Item 12.3)*

In accordance with established practice, the Commission examined those resolutions and recommendations adopted prior to the present session which were still in force and adopted Resolution 3 (CBS-XIV) – Review of previous resolutions and recommendations of the Commission for Basic Systems and Recommendation 11 (CBS-XIV) – Review of resolutions of the Executive Council based on previous recommendations of the Commission for Basic Systems or concerning the Commission.

12.4 WORKING METHODS AND ADOPTION OF NON-CONTROVERSIAL DOCUMENTS BETWEEN SESSIONS *(agenda item 12.4)*

12.4.1 Noting the opportunities provided by a greater use of electronic documentation, the Council encouraged the Management Groups of Technical Commissions to consider new methods of working. It had also asked technical commissions, in view of increasing requirements, to seek creative means for conducting the important technical work of Commissions. The Commission noted that its Management Group addressed this request and developed proposals for working methods that are expected to improve the effectiveness and efficiency of the work of the Commission. The proposed working methods are included in Annex XII to the present report.

12.4.2 The Commission agreed that new methods of working aimed at improving the effectiveness and efficiency of the work was of special importance in the context of the WMO Strategic Planning as well as the current Zero Nominal Growth Budget. The Commission agreed to endorse in principle the proposed working methods and to carry out a test phase of the new working methods for part or all of its activities during the forthcoming intersessional period. It requested its Management Group to urgently develop the procedures in more detail and to organize, with the support of the Secretariat, appropriate tests, with a view to submitting the assessment of new methods of working and relevant consolidated proposals to its next extraordinary session (2010).

12.4.3 The Commission also requested all OPAG Chairs and the Management Group to consider implementing detailed work plans in response to their Terms of Reference. These work plans should include tasks, actions, responsible parties, deadlines and deliverables. Each task should reflect an Expected Result while the deliverables should be formed in terms of key performance indicators.

12.5. DATE AND PLACE OF THE EXTRAORDINARY SESSION IN 2010 *(agenda item 12.5)*

The Commission received with appreciation the declaration of intent by the delegation of Namibia to host the extraordinary session of CBS in the fourth quarter of 2010. 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. ELECTION OF OFFICERS *(agenda item 13)*

The Commission elected Mr Fredrik R. Branski (United States of America) as president and Ms Susan L. Barrell (Australia) as vice-president of the Commission for Basic Systems.

14. ANY OTHER BUSINESS *(agenda item 14)*

There was no other business.

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

The fourteenth session of the Commission for Basic Systems was closed at 12.00 noon on 2 April 2009.

RESOLUTIONS ADOPTED BY THE SESSION

Resolution 1 (CBS-XIV)

CBS MANAGEMENT GROUP

THE COMMISSION FOR BASIC SYSTEMS,

Recalling:

(1) The *Abridged Final Report with Resolutions of the Fourteenth World Meteorological Congress* (WMO-No. 960), general summary, paragraph 3.1.0.10,

(2) The *Abridged Final Report with Resolutions of the Sixtieth Session of the Executive Council* (WMO-No. 1032), general summary, paragraph 3.4.43,

(3) Resolution 1 (CBS-XIII) – CBS Management Group,

(4) Resolution 2 (CBS-XIII) – Open Programme Area Groups,

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 prioritize activities, 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 re-establish the CBS Management Group (CBS-MG) with the following terms of reference:

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

   (b) To provide inputs to the president as regards priorities and the planning, coordination, monitoring and evaluation of the work of the Commission, its open programme area groups (OPAGs), expert teams and rapporteurs;

   (c) To advise the president as regards the provision of CBS input to the WMO Strategic Plan and the Operating Plan, and the monitoring and evaluation of activities relevant to the CBS-related expected results;

   (d) To manage and evaluate OPAG activities, with special attention to WMO high-priority issues, mainly the WMO Integrated Global Observing System (WIGOS), the WMO Information System (WIS) and disaster risk reduction, and to advise the president on the Sub-Group on WIGOS and the Intercommission Coordination Group on WIS (ICG-WIS);

   (e) To keep under review the internal structure and working methods of the Commission and make necessary adjustments;

(f) To advise the president on matters related to cooperation and collaboration with other technical commissions and regional associations in support of other WMO and related international programmes;

(g) To coordinate the activities of the Commission with respect to the Global Earth Observation System of Systems (GEOSS);

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

(i) To review and endorse the membership of CBS expert teams;

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

(a) President of CBS (chairperson);

(b) Vice-president of CBS;

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

(d) CBS Coordinator for the GEOSS;

(e) CBS Coordinator for Disaster Risk Reduction;

(f) CBS Coordinator on Capacity-Building.

Resolution 2 (CBS-XIV)

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 systems,

(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 Resolutions 9 (EC-LVI), 18 (EC-LVII) and 15 (EC-LVIII) – Global Earth Observation System of Systems (GEOSS),

Decides:

(1) To re-establish:

(a) The Open Programme Area Group (OPAG) on Integrated Observing Systems (IOS);

(b) The OPAG on Information Systems and Services (ISS);

(c) The OPAG on Data-processing and Forecasting Systems (DPFS);

(d) The OPAG on Public Weather Services (PWS);

(2) To maintain the terms of reference for each OPAG as given in Resolution 4 (CBS-Ext.(98)) – Open Programme Area Groups (OPAGs) of the Commission for Basic Systems, and, in addition, to request:

(a) The OPAG on ISS to contribute to the development and implementation planning of the WMO Information System (WIS) and coordinate with the Intercommission Coordination Group on WIS (ICG-WIS);

(b) The OPAGs on IOS and ISS to contribute to the development and implementation planning of the concept of the WMO Integrated Global Observing System (WIGOS) and coordinate with the Sub-Group on WIGOS of the Executive Council Working Group on WIGOS and WIS;

(c) Each OPAG to develop contributions to the activities of the Disaster Risk Reduction Programme;

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

(a) L.-P. Riishojgaard (United States) as chairperson and J. Dibbern (Germany) as co-chairperson of the OPAG on Integrated Observing Systems;

(b) P. Shi (China) as chairperson and S. Foreman (United Kingdom) as co-chairperson of the OPAG on Information Systems and Services;

(c) B. Strauss (France) as chairperson and Y. Honda (Japan) as co-chairperson of the OPAG on Data-processing and Forecasting Systems;

(d) G. Fleming (Ireland) as chairperson and M. Ndabambi (South Africa) as co-chairperson of the OPAG on Public Weather Services;

Decides further:

(1) To designate a Rapporteur on Quality Management Framework with the following terms of reference:

(a) To review, as appropriate, CBS documents addressing quality issues so as to ensure that the terminology used therein is in agreement with the definitions of the quality-related terms given in the ISO 9000:2005 standard;

(b) To represent the Commission and actively participate in the work of the Inter-Commission Task Team on Quality Management Framework (ICTT-QMF);

(c) To update yearly, in coordination with the OPAGs, the list of valid CBS guidance documents to be used by Members;

(d) To report to the Commission and advise the Commission on activities that should be undertaken to support the WMO QMF as an integral part of Commission activities;

(2) To request the CBS Management Group to select the Rapporteur on Quality Management Framework;

(3) To establish an Inter-programme Coordination Team on Space Weather (ICT-SW) with the following terms of reference:

(a) To standardize and enhance space weather data exchange and delivery through the WMO Information System (WIS);

(b) To harmonize the definition of end products and services, including, for example, quality assurance guidelines and emergency warning procedures, in interaction with aviation and other major application sectors;

(c) To integrate space weather observations, through the review of space- and surface-based observation requirements, harmonize sensor specifications and monitor plans for space weather observation;

(d) To encourage the dialogue between the research and operational space weather communities;

(4) To request the CBS Management Group to select the CBS co-chairperson of the Inter-programme Coordination Team on Space Weather (ICT-SW);

(5) To designate a Coordinator on Disaster Risk Reduction (DRR) with the following terms of reference:

(a) To coordinate Commission activities, across its relevant OPAGs, related to DRR and advise Commission members on activities that will contribute fully to the DRR Programme, including relevant enhanced operation of the World Weather Watch (WWW);

(b) To provide the CBS Management Group with appropriate information and recommendations concerning the Commission's DRR-related activities;

(6) To designate M. Jean (Canada) to serve as the Coordinator on Disaster Risk Reduction;

(7) To designate a Coordinator on Capacity-Building with the following terms of reference:

(a) To review and consolidate the CBS contribution to the Technical Cooperation Programme and the Programme for the Least Developed Countries;

(b) To identify the technical support required for project implementation plans, including guidance materials, technical specifications and project documentation for resource mobilization activities;

(8) To designate J. Kongoti (Kenya) to serve as the Coordinator on Capacity-Building;

(9) To designate a Coordinator on the Group on Earth Observations (GEO)/Global Earth Observation System of Systems (GEOSS) activities related to WMO with the following terms of reference:

(a) To coordinate Commission activities, across its relevant OPAGs, related to implementation aspects of the GEOSS 10-Year Implementation Plan and advise OPAGs on activities that will contribute fully to the development and implementation of GEOSS, including enhanced operation of the WWW relevant to GEOSS;

(b) Through the GEO Secretariat, and with the support of the WMO Secretariat, to keep GEO informed of the relevant activities of the Commission;

(c) To liaise with other regional and technical commission GEOSS rapporteurs, with the support of the WMO Secretariat, on relevant GEOSS activities;

(d) To provide the CBS Management Group with appropriate information and recommendations on the Commission's GEOSS-related activities;

(10) To select A. Gusev (Russian Federation) to serve as the Coordinator on GEO/GEOSS activities related to WMO;

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 Rapporteur on Quality Management Framework, the chairperson of the Inter-programme Coordination Team on Space Weather, the Coordinator on Disaster Risk Reduction, the Coordinator on Capacity-Building and the Coordinator on GEO/GEOSS activities related to WMO:

(a) To prepare an activity report at the end of 2009 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-XIV)

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

THE COMMISSION FOR BASIC SYSTEMS,

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

Decides:

(1) To keep in force Resolution 2 (CBS-Ext.(98)), Resolution 1 (CBS-XII) and Resolution 1 (CBS-Ext.(06));

(2) To keep in force Recommendation 1 (CBS-Ext.(06));

(3) Not to keep in force other resolutions and recommendations adopted before its fourteenth session (2009).

RECOMMENDATIONS ADOPTED BY THE SESSION

Recommendation 1 (CBS-XIV)

VISION FOR THE GLOBAL OBSERVING SYSTEM IN 2025

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) The third session of the Expert Team on Evolution of the Global Observing System (ET-EGOS-3) preparation of a draft Vision for the Global Observing System (GOS) in 2025,

(2) The fourth session of the Expert Team on Evolution of the Global Observing System (ET-EGOS-4) review and thorough update of the Vision for the GOS in 2025 from both surface-based and space-based perspectives,

Considering the consultation with other CBS expert teams and interested parties regarding the Vision for the GOS in 2025,

Recommends that the Vision for the GOS in 2025 be adopted (see annex).

Annex to Recommendation 1 (CBS-XIV)

VISION FOR THE GLOBAL OBSERVING SYSTEM IN 2025

PREAMBLE

This Vision provides high-level goals to guide the evolution of the Global Observing System (GOS) in the coming decades. These goals are intended to be challenging but achievable.

The future GOS will build upon existing sub-systems, both surface- and space-based, and capitalize on existing, new and emerging observing technologies not presently incorporated or fully exploited. Incremental additions to the GOS will be reflected in better data, products and services from the National Meteorological and Hydrological Services (NMHSs); this will be particularly true for developing countries and LDCs.

The future GOS will play a central role within the WMO Integrated Global Observing System (WIGOS).[1] This evolved integrated observing system will be a comprehensive "system of systems" interfaced with WMO co-sponsored and other non-WMO observing systems, making major contributions to the Global Earth Observation System of Systems (GEOSS); and will be delivered through enhanced involvement of WMO Members, Regions and technical commissions. The space-based component will rely on enhanced collaboration through partnerships such as the Coordination Group for Meteorological Satellites (CGMS) and the Committee on Earth Observation Satellites (CEOS). Portions of the surface and space-based sub-systems will rely on WMO partner organizations: the Global Terrestrial Observing System (GTOS), the Global Ocean Observing System (GOOS), the Global Climate Observing System (GCOS), and others.

[1] Assuming WIGOG is adopted at Cg-XVI.

The scope of these changes to the GOS will be major and will involve new approaches in science, data handling, product development and utilization, and training.

1. GENERAL TRENDS AND ISSUES

Response to user needs

- The GOS will provide comprehensive observations in response to the needs of all WMO Members and Programmes for improved data products and services, for weather, water and climate;
- It will continue to provide effective global collaboration in the making and dissemination of observations, through a composite and increasingly complementary system of observing systems;
- It will provide observations when and where they are needed in a reliable, stable, sustained and cost-effective manner;
- It will routinely respond to user requirements for observations of specified spatial and temporal resolution, accuracy and timeliness; and,
- It will evolve in response to a rapidly changing user and technological environment, based on improved scientific understanding and advances in observational and data-processing technologies.

Integration

- The GOS will have evolved to become part of the WIGOS,[1] which will integrate current GOS functionalities, which are intended primarily to support operational weather forecasting, with those of other applications: climate monitoring, oceanography, atmospheric composition, hydrology, and weather and climate research;
- Integration will be developed through the analysis of requirements and, where appropriate, through sharing observational infrastructure, platforms and sensors, across systems and with WMO Members and other partners;
- Surface and space-based observing systems will be planned in a coordinated manner to cost-effectively serve variety of user needs with appropriate spatial and temporal resolutions.

Expansion

- There will be an expansion in both the user applications served and the variables observed;
- This will include observations to support the production of Essential Climate Variables, adhering to the GCOS climate monitoring principles;
- Sustainability of new components of the GOS will be secured, with some R&D systems integrated as operational systems;
- The range and volume of observations exchanged globally (rather than locally) will be increased;
- Some level of targeted observations will be achieved, whereby additional observations are acquired or usual observations are not acquired, in response to the local meteorological situation.

Automation

- The trend to develop fully automatic observing systems, using new observing and information technologies will continue, where it can be shown to be cost-effective;
- Access to real-time and raw data will be improved;
- Observing system test-beds will be used to intercompare and evaluate new systems and develop guidelines for integration of observing platforms and their implementation; and
- Observational data will be collected and transmitted in digital forms, highly compressed where necessary. Data processing will be highly computerized.

[1] Assuming WIGOS is adopted at Cg-XVI.

Consistency and homogeneity

- There will be increased standardization of instruments and observing methods;
- There will be improvements in calibration of observations and the provision of metadata, to ensure data consistency and traceability to absolute standards;
- There will be improved methods of quality control and characterization of errors of all observations;
- There will be increased interoperability, between existing observing systems and with newly implemented systems; and,
- There will be improved homogeneity of data formats and dissemination via the WIS.

2. THE SPACE-BASED COMPONENT

Instruments:	**Geophysical variables and phenomena:**
Operational geostationary satellites. At least 6, separated by no more than 70 deg longitude	
High-resolution multi-spectral Vis/IR imagers	Cloud amount, type, top height/temperature; wind (through tracking cloud and water vapour features); sea/land surface temperature; precipitation; aerosols; snow cover; vegetation cover; albedo; atmospheric stability; fires; volcanic ash
IR hyper-spectral sounders	Atmospheric temperature, humidity; wind (through tracking cloud and water vapour features); rapidly evolving mesoscale features; sea/land surface temperature; cloud amount and top height/temperature; atmospheric composition
Lightning imagers	Lightning (in particular cloud to cloud), location of intense convection.
Operational polar-orbiting sun-synchronous satellites distributed within 3 orbital planes (~13:30, 17:30, 21:30 ECT)	
IR hyper-spectral sounders	Atmospheric temperature, humidity and wind; sea/land surface temperature; cloud amount, water content and top height/temperature; atmospheric composition
MW sounders	
High-resolution multi-spectral Vis/IR imagers (including thermal IR water vapour absorption channel)	Cloud amount, type, top height/temperature; wind (high latitudes, through tracking cloud and water vapour features); sea/land surface temperature; precipitation; aerosols; snow and ice cover; vegetation cover; albedo; atmospheric stability
Additional operational missions in appropriate orbits (classical polar-orbiting, geostationary, others)	
MW imagers – at least 3 – some polarimetric	Sea ice; total column water vapour; precipitation; sea surface wind speed [and direction]; cloud liquid water; sea/land surface temperature; soil moisture
Scatterometers – at least 2 on well separated orbital planes	Sea surface wind speed and direction; sea ice; soil moisture
Radio occultation constellation – at least 8 receivers	Atmospheric temperature and humidity; ionospheric electron density
Altimeter constellation including a reference mission in a precise orbit, and polar-orbiting altimeters for global coverage	Ocean surface topography; sea level; ocean wave height; lake levels; sea and land ice topography
IR dual-angle view imager	Sea surface temperature (of climate monitoring quality); aerosols; cloud properties
Narrow-band high-spectral and hyperspectral resolution Vis/NIR imagers	Ocean colour; vegetation (including burnt areas); aerosols; cloud properties; albedo
High-resolution multi-spectral Vis/IR imagers – constellation	Land-surface imaging for land use and vegetation; flood monitoring
Precipitation radars operated in conjunction with passive MW imagers in various orbits	Precipitation (liquid and solid)
Broad-band Vis/IR radiometer + total solar irradiance sensor – at least 1	Earth radiation budget (supported by imagers and sounders on polar-orbiting and geostationary satellites) and collocated aerosols and cloud properties measurements

Instruments:	Geophysical variables and phenomena:
Atmospheric composition instruments constellation, including high spectral resolution UV sounder on geostationary orbit and at least a UV sounder on am + pm orbit	Ozone; other atmospheric chemical species; aerosols – for greenhouse gas monitoring, ozone/UV monitoring, air quality monitoring
Synthetic aperture radar	Wave heights, directions and spectra; floods; sea ice leads; ice shelf and icebergs
Operational pathfinders and technology demonstrators, including	
Doppler wind lidar on LEO	Wind; aerosol; cloud-top height [and base]
Low-frequency MW radiometer on LEO	Ocean surface salinity; soil moisture
MW imager/sounder on GEO	Precipitation; cloud water/ice; atmospheric humidity and temperature
High-resolution, multi-spectral narrow-band Vis/NIR and CCD imagers on GEOs	Ocean colour, cloud studies and disaster monitoring
Vis/IR imagers on satellites in high inclination, highly elliptical orbits (HEO)	Winds and clouds at high latitudes; sea ice; high latitude volcanic ash plumes; snow cover; vegetation; fires
Gravimetric sensors	Water volume in lakes, rivers, ground, etc.
Polar and geo platforms / instruments for space weather	
Solar imagery Particle detection Electron density	Solar radiation storms, high-energy particle rain, ionospheric and geomagnetic storms, radio black-out by X-ray photons

3. THE SURFACE-BASED COMPONENT

Station type:	Geophysical variables and phenomena:
Land – upper-air	
Upper-air synoptic and reference stations	Wind, temperature, humidity, pressure
Remote sensing upper-air profiling remote stations	Wind, cloud base and top, cloud water, temperature, humidity, aerosols
Aircraft	Wind, temperature, pressure, humidity, turbulence, icing, thunderstorms, dust/sandstorms, volcanic ash/activity, and atmospheric composition variables (aerosols, greenhouse gases, ozone, air quality, precipitation chemistry, reactive gases)
Atmospheric composition stations	Aerosol optical depth, atmospheric composition variables (aerosols, greenhouse gases, ozone, air quality, precipitation chemistry, reactive gases)
GNSS receiver stations	Water vapour
Land – surface	
Surface synoptic and climate reference stations	Surface pressure, temperature, humidity, wind; visibility; clouds; precipitation; present and past weather; radiation; soil temperature; evaporation; soil moisture; obscurations
Atmospheric composition stations	Atmospheric composition variables (aerosols, greenhouse gases, ozone, air quality, precipitation chemistry, reactive gases)
Lightning detection system stations	Lightning (location, density, rate of discharge, polarity, volumetric distribution)
Application specific stations (road weather, airport/heliport weather stations, agromet stations, urban meteorology, etc)	Application specific observations
Land – hydrology	
Hydrological reference stations	Water level
National hydrological network stations	Precipitation, snow depth, snow water content, lake and river ice thickness/date of freezing and break-up, water level, water flow, water quality, soil moisture, soil temperature, sediment loads
Ground water stations	Ground water measurements
Land – weather radar	
Weather radar station	Precipitation (hydrometeor size distribution, phase, type), wind, humidity (from refractivity), sand and dust storms

Station type:	Geophysical variables and phenomena:
Ocean – upper air	
Automated Shipboard Aerological Platform (ASAP) ships	Wind, temperature, humidity, pressure
Ocean – surface	
HF Coastal Radars	Surface currents, waves
Synoptic sea stations (ocean, island, coastal and fixed platform)	Surface pressure, temperature, humidity, wind; visibility; cloud amount, type and base-height; precipitation; weather; sea-surface temperature; wave direction, period and height; sea ice
Ships	Surface pressure, temperature, humidity, wind; visibility; cloud amount, type and base-height; precipitation; weather; sea surface temperature; wave direction, period and height; sea ice
Buoys – moored and drifting	Surface pressure, temperature, humidity, wind; visibility; sea surface temperature; 3D & 2D wave spectrum, wave direction, period and height
Ice buoys	Surface pressure, temperature, wind, ice thickness
Tide stations	Sea water height, surface air pressure, wind, salinity, water temperature
Ocean – sub-surface	
Profiling floats	Temperature, salinity, current, dissolved oxygen, CO_2 concentration
Ice tethered platforms	Temperature, salinity, current
Ships of opportunity	Temperature
R&D and Operational pathfinders – examples	
UAVs	Wind, temperature, humidity, atmospheric composition
Gondolas	Wind, temperature, humidity
GRUAN stations	Reference quality climate variables, cloud structure
Aircraft	Chemistry, aerosol, wind (lidar)
Instrumented marine animals	Temperature
Ocean gliders	Temperature, salinity, current, dissolved oxygen, CO_2 concentration

4. SYSTEM-SPECIFIC TRENDS AND ISSUES

4.1 Space-based

- There will be an **expanded** space-based observing **capability** both on operational and research satellites;
- There will be an **expanded community** of space agencies contributing to the GOS;
- There will be **increased collaboration** between space agencies, to ensure that a broad spectrum of user requirements for observations are met in the most cost-effective manner, and that system reliability is assured through arrangements for mutual back-up;
- Observational capability demonstrated on **R&D** satellites will be progressively transferred to **operational** platforms, to assure the reliability and sustainability of measurements;
- **R&D satellites** will continue to play an important role in the GOS; although they cannot guarantee continuity of observations, they offer important contributions beyond the current means of operational systems. Partnerships will be developed between agencies to extend the operation of functional **R&D** and other satellites to the maximum useful period;
- Some user requirements will be met through **constellations** of satellite, often involving collaboration between space agencies. Expected constellations include: altimetry, precipitation, radio occultation, atmospheric composition and Earth radiation budget;
- **Higher spatial, temporal and spectral resolution** will considerably enhance the information available, particularly to monitor and predict rapidly-evolving, small-scale phenomena, whilst increasing the demand on data exchange, management and processing capability;
- **Improved availability and timeliness** will be achieved through operational cooperation among agencies and new communications infrastructure;
- **Improved calibration and inter-calibration** will be achieved through mechanisms such as GSICS.

4.2 Surface-based

The surface-based GOS will provide:

- Improved detection of mesoscale phenomena;
- Data that cannot be measured by space-based component;
- Data for calibration and validation of space-based data;
- Enhanced data exchange of regional scale observing data and product from weather radar, hydrological networks, etc.;
- High vertical resolution profiles from radiosondes and other ground based remote-sensing systems, integrated with other observations to represent the atmospheric structure;
- Improved data quality with defined standards on availability, accuracy and quality control;
- Long-term datasets for the detection and understanding of environmental trends and changes to complement those derived from space-based systems;
- Maintenance of stations with long historically-uninterrupted observing records.

Radiosondes networks will:

- Be optimized, particularly in terms of horizontal spacing which will increase in data-dense areas, and taking account of observations available from other profiling systems;
- Be complemented by the **aircraft (AMDAR)** ascent/descents profiles and other ground-based profiling systems;
- Maintain the **GUAN** subset of stations for climate monitoring;
- Include a **GCOS Reference Upper-Air Network** (**GRUAN**) to serve as a reference network for other radiosonde sites, for calibration and validation of satellite records, and for other applications.

Aircraft observing systems

- Will be available from most airport locations, in all regions of the world;
- Flight-level and ascent/descent data will be available at user-selected temporal resolution;
- Will observe humidity and some components of atmospheric composition, in addition to temperature, pressure and wind;
- Will also be developed for smaller, regional aircraft with flight levels in the mid-troposphere and providing ascent/descent profiles into additional airports.

Land-surface observations systems

- Will come from a wider variety of surface networks (e.g., road networks, mobile platforms) and multi-application networks;
- Will be primarily automated and capable of reproducing or substituting for measurements previously obtained subjectively (weather phenomena, cloud type, etc.);
- Will include the **GSN** subset of surface stations for climate monitoring.

Surface marine observations

- From drifting buoys, moored buoys, ice buoys and Voluntary Observing Ships will complement satellite observations;
- With improved temporal resolution and timeliness, through reliable and cost-effective satellite data communication systems;

Ocean sub-surface observing technology will be improved, including cost-effective multi-purpose *in-situ* observing platforms, ocean gliders, and instrumented marine animals.

Remote-Sensing observing systems:

- **Weather radar** systems will provide enhanced precipitation products but with increased data coverage. They will increasingly provide information on other atmospheric variables. There will

be much improved data consistency and new radar technology. Collaborative multi-national networks will deliver composite products;
- **Coastal HF Radars** will provide for ocean currents and wave data;
- **Profilers** will be developed and used by more applications. A wider variety of technologies will be used, including lidars, radars and microwave radiometers. These observing systems will be developed into coherent networks and integrated with other surface networks;
- **Global Navigation Satellite System** (e.g., GPS, GLONASS and GALILEO) receiver networks, for observing total column water vapour, will be extended;
- These systems will be integrated into "intelligent" profiling systems and integrated with other surface observing technologies.

Lightning detection systems

- **Long-range lightning detection systems** will provide cost-effective, homogenized, global data with a high location accuracy, significantly improving coverage in data sparse regions including oceanic and polar areas;
- **High-resolution lightning detection systems** with a higher location accuracy, cloud-to-cloud and cloud-to-ground discrimination for special applications.

Surface-based observations of **atmospheric composition** (complemented by balloon- and aircraft-borne measurements) will contribute to an integrated three-dimensional global atmospheric chemistry measurement network, together with a space-based component. New measurement strategies will be combined to provide near real-time data delivery.

Surface-based observations will support **nowcasting and very short-range forecasting** through the widespread integration of radar, lightning and other detection systems, with extension to continental and global scales of the networks.

Recommendation 2 (CBS-XIV)

REVISED FUNCTIONAL SPECIFICATIONS FOR AUTOMATIC WEATHER STATIONS

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) The request of CBS-Ext.(06) to revise automatic weather station (AWS) functional specifications,

(2) The Expert Team on Requirements for Data from Automatic Weather Stations (ET-AWS) Work Plan 2007–2008 to revise AWS functional specifications,

Considering that the AWS functional specifications have been reviewed and updated based on the inputs and proposals of other technical commissions,

Recommends that the revised Functional Specifications for Automatic Weather Stations (see annex) be approved;

Requests that the Secretary-General make arrangements for the publication of the updated *Guide to the Global Observing System* (WMO-No. 488).

Annex to Recommendation 2 (CBS-XIV)

Functional Specifications for Automatic Weather Stations

VARIABLE [1]	Maximum Effective Range [2]	Minimum Reported Resolution [3]	Mode of Observation [4]	BUFR / CREX [5]
ATMOSPHERIC PRESSURE				
Atmospheric Pressure	500 – 1080 hPa	10 Pa	I, V	0 10 004
TEMPERATURE [9]				
Ambient air temperature (over specified surface)	-80 °C – +60 °C	0.1 K	I, V	0 12 101
Dew-point temperature	-80 °C – +60 °C	0.1 K	I, V	0 12 103
Ground (surface) temperature (over specified surface)	-80 °C – +80 °C	0.1 K	I, V	0 12 113
Soil temperature	-50 °C – +50 °C	0.1 K	I, V	0 12 130
Snow temperature	-80 °C – 0 °C	0.1 K	I, V	N
Water temperature – river, lake, sea, well	-2 °C – +100 °C	0.1 K	I, V	0 13 082
HUMIDITY [9]				
Relative humidity	0 – 100%	1%	I, V	0 13 003
Mass mixing ratio	0 – 100%	1%	I, V	N
Soil moisture, volumetric or water potential	0 – 10^3 g kg^{-1}	1 g kg^{-1}	I, V	N
Water vapour pressure	0 – 100 hPa	10 Pa	I, V	0 13 004
Evaporation/evapotranspiration	0 – 0.2 m	0.1 kg m^{-2}, 0.0001 m	T	0 13 033
Object wetness duration	0 – 86 400 s	1 s	T	N
WIND				
Direction	0 [11,13]; 1° – 360°	1°	I, V	0 11 001
Speed	0 – 75 m s^{-1}	0.1 m s^{-1}	I, V	0 11 002
Gust Speed	0 – 150 m s^{-1}	0.1 m s^{-1}	I, V	0 11 041
X,Y,Z component of wind vector (horizontal and vertical profile)	0 – 150 m s^{-1}	0.1 m s^{-1}	I, V	N
Turbulence type (Low levels and wake vortex)	up to 15 types	BUFR Table	I, V	N
Turbulence intensity	up to 15 types	BUFR Table	I, V	N
RADIATION [6]				
Sunshine duration	0 – 86 400 s	60 s	T	0 14 031
Background luminance	$1 \cdot 10^{-6}$ – $2 \cdot 10^4$ Cd m^{-2}	$1 \cdot 10^{-6}$ Cd m^{-2}	I, V	N
Global downward solar radiation	0 – $6 \cdot 10^6$ J m^{-2}	1 J m^{-2}	I, T, V	N
Global upward solar radiation	0 – $4 \cdot 10^6$ J m^{-2}	1 J m^{-2}	I, T, V	N
Diffuse solar radiation	0 – $4 \cdot 10^6$ J m^{-2}	1 J m^{-2}	I, T, V	0 14 023
Direct solar radiation	0 – $5 \cdot 10^6$ J m^{-2}	1 J m^{-2}	I, T, V	0 14 025
Downward long-wave radiation	0 – $3 \cdot 10^6$ J m^{-2}	1 J m^{-2}	I, T, V	0 14 002
Upward long-wave radiation	0 – $3 \cdot 10^6$ J m^{-2}	1 J m^{-2}	I, T, V	0 14 002
Net radiation	0 – $6 \cdot 10^6$ J m^{-2}	1 J m^{-2}	I, T, V	0 14 016
UV-B radiation [8]	0 – $1.2 \cdot 10^3$ J m^{-2}	1 J m^{-2}	I, T, V	N
Photosynthetically active radiation	0 – $3 \cdot 10^6$ J m^{-2}	1 J m^{-2}	I, T, V	N
Surface albedo	1 – 100%	1%	I, V	0 14 019

VARIABLE [1]	Maximum Effective Range [2]	Minimum Reported Resolution [3]	Mode of Observation [4]	BUFR / CREX [5]
CLOUDS				
Cloud base height	0 – 30 km	10 m	I, V	0 20 013
Cloud top height	0 – 30 km	10 m	I, V	0 20 014
Cloud type, convective vs. other types	up to 30 classes	BUFR Table	I	0 20 012
Cloud hydrometeor concentration	1 – 700 hydrometeors dm^{-3}	1 hydrometeor dm^{-3}	I, V	N
Effective radius of cloud hydrometeors	$2{\cdot}10^{-5}$ – $32{\cdot}10^{-5}$ m	$2{\cdot}10^{-5}$ m	I, V	N
Cloud liquid water content	$1{\cdot}10^{-5}$–$1.4{\cdot}10^{-2}$ kg m^{-3}	$1{\cdot}10^{-5}$ kg m^{-3}	I, V	N
Optical depth within each layer	Not specified yet	Not specified yet	I, V	N
Optical depth of fog	Not specified yet	Not specified yet	I, V	N
Height of inversion	0 – 1 000 m	10 m	I, V	N
Cloud cover	0 – 100%	1%	I, V	0 20 010
Cloud amount	0 – 8/8	1/8	I, V	0 20 011
PRECIPITATION				
Accumulation [7]	0 – 1000 mm	0.1 kg m^{-2}, 0.0001 m	T	0 13 011
Depth of fresh snowfall	0 –1000 cm	0.001 m	T	0 13 015
Duration	up to 86 400 s	60 s	T	0 26 020
Size of precipitating element	$1{\cdot}10^{-3}$ – 0.5 m	$1{\cdot}10^{-3}$ m	I, V	N
Intensity – quantitative	0 – 2000 mm h^{-1}	0.1 kg m^{-2} s^{-1}, 0.1 mm h^{-1}	I, V	0 13 155
Type	up to 30 types	BUFR Table	I, V	0 20 021
Rate of ice accretion	0 – 1 kg dm^{-2} h^{-1}	$1{\cdot}10^{-3}$ kg dm^{-2} h^{-1}	I, V	N
OBSCURATIONS				
Obscuration type	up to 30 types	BUFR Table	I, V	0 20 025
Hydrometeor type	up to 30 types	BUFR Table	I, V	0 20 025
Lithometeor type	up to 30 types	BUFR Table	I, V	0 20 025
Hydrometeor radius	$2{\cdot}10^{-5}$ – $32{\cdot}10^{-5}$ m	$2{\cdot}10^{-5}$ m	I, V	N
Extinction coefficient	0 – 1 m^{-1}	0.001 m^{-1}	I, V	N
Meteorological Optical Range [10]	1 – 100 000 m	1 m	I, V	N
Runway visual range	1 – 4 000 m	1 m	I, V	0 20 061
Other weather type	up to 18 types	BUFR Table	I, V	0 20 023
LIGHTNING				
Lightning rates of discharge	0 – 100 000	Number h^{-1}	I, V	0 13 059
Lightning discharge type (cloud to cloud, cloud to surface)	up to 10 types	BUFR Table	I, V	N
Lightning discharge polarity	2 types	BUFR Table	I, V	N
Lightning discharge energy	Not specified yet	Not specified yet	I, V	N
Lightning – distance from station	0 – $3{\cdot}10^{4}$ m	10^{3} m	I, V	N
Lightning – direction from station	1° – 360°	1 degree	I, V	N

VARIABLE [1]	Maximum Effective Range [2]	Minimum Reported Resolution [3]	Mode of Observation [4]	BUFR / CREX [5]
HYDROLOGIC AND MARINE OBSERVATIONS				
Flow discharge – river	0 – $2.5 \cdot 10^5$ $m^3 s^{-1}$	0.1 $m^3 s^{-1}$	I, V	0 23 017
Flow discharge – well	0 – 50 $m^3 s^{-1}$	0.001 $m^3 s^{-1}$	I, V	0 23 017
Ground water level	0 – 1 800 m	0.01 m	I, V	N
Ice surface temperature	-80 °C – +0 °C	0.5 K	I, V	N
Ice thickness – river, lake	0 – 50 m	0.01 m	I, V	N
Ice thickness – glacier, sea	0 – 4 270 m	1 m	I, V	0 20 031
Water level	0 – 100 m	0.01 m	I, V	0 13 071 0 13 072
Wave height	0 – 50 m	0.1 m	V	0 22 021
Wave period	0 – 100 s	1 s	V	0 22 011
Wave direction	0 [13]; 1 – 360 degrees	1 degrees	V	0 22 001
1D spectral wave energy density	0 – 5×10^5 $m^2 Hz^{-1}$	10^{-3} $m^2 Hz^{-1}$	V, T	0 22 069
2D spectral wave energy density	0 – 5×10^5 $m^2 Hz^{-1}$	10^{-3} $m^2 Hz^{-1}$	V, T	0 22 069
Sea salinity	0 – 40 % [12] [0 – 400 psu]	10^{-4} % [10^{-3} psu]	I, V	0 22 059 0 22 062 0 22 064
Conductivity	0 – 600 S m^{-1}	10^{-6} S m^{-1}	I, V	0 22 066
Water pressure	0 – 11×10^7 Pa	100 Pa	I, V	0 22 065
Ice thickness	0 – 3 m	0.015 m	T	0 20 031
Ice mass	0 – 50 kg m^{-1}	0.5 kg m^{-1} (on 32 mm rod)	T	N
Snow density (liquid water content)	100 – 700 kg m^{-3}	1 kg m^{-3}	T	N
Tidal elevation with respect to local chart datum	-10 – +30 m	0.001 m	I, V	0 22 035 0 22 038
Tidal elevation with respect to national land datum	-10 – +30 m	0.001 m	I, V	0 22 037
Meteorological residual tidal elevation (surge or offset)	-10 – +16m	0.001 m	I, V	0 22 036 0 22 039 0 22 040
Ocean Current – Direction	0 [13]; 1° – 360°	1°	I, V	0 22 004 0 22 005
Ocean Current – Speed	0 – 10 m s^{-1}	0.01 m s^{-1}	I, V	0 22 031 0 22 032
OTHER SURFACE VARIABLES				
Runway conditions	up to 10 types	BUFR Table	I, V	020 085
Braking action/friction coefficient	up to 7 types	BUFR Table	I, V	020 089
State of ground	up to 30 types	BUFR Table	I, V	0 20 062
Type of surface specified	up to 15 types	BUFR Table	I, V	0 08 010
Snow depth	0 – 25 m	0.01 m	T	0 13 013
OTHER				
Gamma radiation dose rate	1 – 10^3 nSv h^{-1}	0.1 nSv h^{-1}	I, T	N
Categories of stability	9 types	BUFR Table	I, V	0 13 041

Notes:

1. Name of variable, in line with WMO vocabulary and Technical Regulations.
2. Maximum Effective Range – Maximum range of measuring capability; units traceable to SI.

3. Minimum Reported Resolution – Lower resolution of reporting is not permitted.

4. Mode of Observation – Type of data being reported:

   I: Instantaneous – 1-minute value (instantaneous as defined in WMO-No. 8, Part II, paragraph 1.3.2.4);

   V: Variability – Average (mean), Standard Deviation, Maximum, Minimum, Range, Median, etc. of samples – those reported depend upon meteorological variable;

   T: Total – Integrated value during defined period (over a fixed period(s)); maximum 24 hours for all parameters except radiation which requires a maximum of one hour (exception, see note 6), and precipitation accumulation (6 hours maximum).

   A: Average (mean) value.

5. BUFR/CREX – Present ability to represent variable by BUFR Tables, N = not existing, to be defined (registered).

6. Radiation energy amounts are given over a 24-hour period.

7. Maximum interval: 6 H.

8. Definition of UV-B according to WMO-No. 8 (Vol. 1, Chapter on Radiation).

9. Humidity related variables (*i.e.* dew point) expressed as temperature are collected under temperature.

10. MOR uniquely related to "extinction coefficient", σ, by MOR = -ln(5%)/σ.

11. Direction to indicate 0 (zero) if speed = 0.

12. Salinity of 1% (1 g of salt per 100 g of water), or 10 ‰ converts to 10.000 ppm (parts per million), which equals 10 psu (practical salinity units). Ocean water is about 3.5% salt, *i.e.* 35.000 ppm or 35 psu. Lake Asal (Ethiopia) is the most saline body of water on earth with 34.8% [348 psu] salt concentration. BUFR/CREX table references 0 22 0590, 22 0620 and 22 064, however, only allow for a maximum of 163.830 "Part per thousand" [or psu], less than the required maximum range.

13. Calm.

Recommendation 3 (CBS-XIV)

BASIC SET OF VARIABLES FOR A STANDARD AUTOMATIC WEATHER STATION FOR MULTIPLE USERS

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) The request of CBS-Ext.(06) to revise the basic set of variables to be reported by a standard automatic weather station (AWS),

(2) The Expert Team on Requirements for Data from Automatic Weather Stations (ET-AWS) Work Plan 2007–2008 to revise the list of the basic set of variables to be reported by a standard AWS for multiple users,

Considering that:

(1) The *Manual on the Global Observing System* (WMO-No. 544) prescribes the variables to be measured by the various types of weather observing stations,

(2) Differences exist between the set of variables measured by synoptic, ocean weather, aeronautical, hydrological, agrometeorological and climatological stations, which result in ambiguities when exchanged between disciplines,

(3) There is a need for the standardization of observations,

(4) A standard set of variables shall be measured for all these disciplines, whereas other variables should be measured as recommended by technical commissions or regional associations,

(5) The basic set of variables to be reported by a standard AWS has been reviewed and updated based on the proposals received from other technical commissions,

Recommends that the revised basic set of variables to be reported by a standard AWS (see annex) be approved for inclusion in the *Manual on the Global Observing System* (WMO-No. 544);

Requests that the Secretary-General make arrangements for the publication of the updated *Manual on the Global Observing System*.

Annex to Recommendation 3 (CBS-XIV)

BASIC SET OF VARIABLES TO BE REPORTED BY THE STANDARD AWS FOR MULTIPLE USERS

Variables	*SYNOP Land Stations*[14)]	*[Fixed] Ocean Weather Stations*[14)]	*Ocean observing platforms*[9)]	*Aeronautical meteorological station*[14)]	*Principal climatological station*[14)]	***STANDARD AWS***
Atmospheric Pressure	M A	M A	M A	X [1)]	X	**A**
Pressure tendency & characteristics	[M]	M	[M] [A]			**[A]**
Air temperature	M[2)] A	M A	M [A]	X	X[3)]	**A**
Humidity[5)]	M A	M	[M] [A]	X[4)]	X	**A**
Surface wind[6)]	M A	M A	M [A]	X	X	**A**
Cloud Amount and Type	M	M	[M]	X[11)]	X	**A**[11)]
Extinction profile/Cloud-base	M [A]	M		X	X	**A**[12)]
Direction of Cloud movement	[M]					
Weather, Present & Past	M	M	M	X	X	**A**[12)]
State of the Ground	[M]	n/a	n/a		X[7)]	**[A]**
Special Phenomena	[M] [A]	M	[M]			
Visibility	M [A]	M	M	X	X	**A**
Amount of Precipitation	[M] [A]	[A]	[A]		X	**A**
Precipitation Yes/No	A	[A]	[A]		X	**A**
Intensity of precipitation	[A]		[A]			
Soil temperature		n/a	n/a		X	**A**

Variables	*SYNOP Land Stations*[14)]	*[Fixed] Ocean Weather Stations*[14)]	*Ocean observing platforms*[9)]	*Aeronautical meteorological station*[14)]	*Principal climatological station*[14)]	***STANDARD AWS***
Sunshine and/or Solar radiation			[A]		X	**A**
Waves		M [A]	[M] [A]			**A**[8)]
Sea temperature		M A	[M] A			**A**[8)]
Sea ice and/or icing	n/a	M	M			
Ship's course and speed	n/a		[M] [A]	[13)]		**[A]**[8)]
Sea level		[10)]	[M] [A]	n/a		**[A]**[8)]

Explanation

M = Required for manned stations
[M] = Based on a regional resolution
A = Required for automatic stations
[A] = Optional for automatic stations
X = Required

Notes:
[1]) Also QNH & QFE
[2]) Optional: extreme temperatures
[3]) Inclusive extreme temperatures
[4]) Dew point temperature
[5]) Dew point temperature and/or RH and air temperature
[6]) wind speed and direction
[7]) snow cover
[8]) sea and coastal stations only
[9]) Proposed by the representative of JCOMM, to become valid for VOS, drifting and moored buoys, rigs and platforms, tide gauges, profiling floats (for review after consultation with JCOMM Expert Teams)
[10]) Coastal stations and off shore platforms only
[11]) Cloud amount, TCU and CB only
[12]) Restricted to what is feasible
[13]) Only for helidecks on ships
[14]) Source: Manual on the GOS

Recommendation 4 (CBS-XIV)

REVISED LIST OF CBS LEAD CENTRES FOR GCOS, INCLUDING THEIR AREAS OF RESPONSIBILITY AND THEIR TERMS OF REFERENCE

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) The establishment by the thirteenth session of CBS of CBS Lead Centres for the Global Climate Observing System (GCOS),

(2) The first GCOS/CBS Lead Centers Coordination Meeting, held in Tehran, the Islamic Republic of Iran, in November 2007,

Considering that:

(1) The Coordination Meeting updated the list of CBS Lead Centres for GCOS and their areas of responsibility,

(2) The Coordination Meeting provided revised terms of reference for the CBS Lead Centres for GCOS,

Recommends that:

(1) The revised list of CBS Lead Centres for GCOS and their areas of responsibility be adopted as in Annex 1 to this recommendation;

(2) The revised terms of reference of the CBS Lead Centres for GCOS be adopted as in Annex 2 to this recommendation.

Annex 1 to Recommendation 4 (CBS-XIV)

THE LIST OF CBS LEAD CENTERS FOR GCOS AND THEIR AREAS OF RESPONSIBILITY

- **Morocco (RA I)** is responsible for GSN and GUAN Stations in: Algeria, Benin, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Congo, Côte d'Ivoire, Egypt, Equatorial Guinea, Gabon, Ghana, Gambia, Guinea, Guinea-Bissau, Liberia, Libyan Arab Jamahiriya, Madagascar, Mali, Niger, Nigeria, Mauritania, Morocco, Senegal, Sierra Leone, Sao Tome and Principe, Sudan, Togo and Tunisia.
- **Mozambique (RA I)** is responsible for GSN and GUAN Stations in: Angola, Botswana, Burundi, Canary Islands, Comoros, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, the Ocean Islands (Saint Helena Island, Ascension Island, Martin de Vivies, Crozet Islands, Kerguelen Islands), Rwanda, Seychelles, Somalia, South Africa, Swaziland, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.
- **Islamic Republic of Iran (RA II and part of RA VI)** is responsible for GSN and GUAN Stations in: Afghanistan, Armenia, Azerbaijan, Bahrain, India, Islamic Republic of Iran, Jordan, Kazakhstan, Kyrgyzstan, Maldives, Nepal, Oman, Pakistan, Qatar, Russian Federation, Saudi Arabia, Sri Lanka, Syrian Arab Republic, Tajikistan, Turkey, United Arab Emirates and Yemen.
- **Japan (RA II)** is responsible for GSN and GUAN Stations in: Brunei Darussalam; Cambodia; China; Hong Kong, China; Japan; Lao People's Democratic Republic; Malaysia; Mongolia; Myanmar; Philippines; Republic of Korea; Singapore, Thailand; and Viet Nam.
- **Chile (RA III)** is responsible for all GSN and GUAN Stations in RA III.
- **United States (RA IV)** is responsible for most GSN and GUAN Stations in RA IV plus Hawaii.
- **Australia (RA V)** is responsible for most RA V, except those countries noted for Japan and Hawaii (United States).
- **Germany (RA VI)** is responsible for most RA VI, except those countries noted for the Islamic Republic of Iran.
- **United Kingdom (British Antarctic Survey)** is responsible for all GSN and GUAN stations in Antarctica.

Annex 2 to Recommendation 4 (CBS-XIV)

REVISED TERMS OF REFERENCE OF THE CBS LEAD CENTRES FOR GCOS

1. Diagnose problems in the GSN and GUAN by using the monitoring reports produced by the GCOS Monitoring and Analysis Centres;

2. Liaise with nominated National Focal Points for GCOS and related Climatological Data, and other responsible officials, to improve data and metadata availability and quality;

3. Coordinate activities with other GCOS Centres and/or other centres as appropriate;

4. Monitor and report to CBS and GCOS on actions taken, progress achieved, concerns and recommendations on a yearly basis in a time frame that corresponds to planned AOPC and CBS meetings;

5. Assist AOPC in the revisions of GSN and GUAN stations;

6. Assist the WMO Secretariat in maintaining the list of National Focal Points for GCOS and related Climatological Data.

Recommendation 5 (CBS-XIV)

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

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) Resolution 1 (Cg-XV) – Technical Regulations of the World Meteorological Organization,

(2) Resolution 2 (Cg-XV) – World Weather Watch Programme for 2008–2011,

(3) The *Manual on the Global Telecommunication System* (WMO-No. 386), Volume I – Global Aspects, Part II,

Recommends that the *Manual on the Global Telecommunication System*, Volume I – Global Aspects, Part II, be amended as given in the annex to this recommendation, with effect from 4 November 2009;

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 – Global Aspects, Part II;

Authorizes the Secretary-General to make any consequent purely editorial amendments to the *Manual on the Global Telecommunication System*.

Annex to Recommendation 5 (CBS-XIV)

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

PART II, OPERATIONAL PROCEDURES FOR THE GLOBAL TELECOMMUNICATION SYSTEM

Attachment II-5

Add the following allocations in Table C1 – Part I

A_1A_2	*Country*
MK	Montenegro

Add the following allocations in Table C6

TTA	ii	Data type	TAC correspondence	Data Category/ Sub-Category (Common Table C13)
INA		Satellite data (AMSUA)		003003
INB		Satellite data (AMSUB)		003004
INH		Satellite data (HIRS)		003005
INM		Satellite data (MHS)		003006
ISI	01-45	Intermediate synoptic observations from fixed land stations	SYNOP (SIxx)	000/001 000/051
ISM	01-45	Main synoptic observations from fixed land stations	SYNOP (SMxx)	000/002 000/052
ISN	01-45	Synoptic observations from fixed land stations at non-standard time (i.e. 01, 02, 04, 05, ... UTC)	SYNOP (SNxx)	000/000 000/050

Add the following allocations in Table C7

TTA	ii	Data type	TAC correspondence	Data Category/ Sub-Category (Common Table C13)
KSI	01-45	Intermediate synoptic observations from fixed land stations	SYNOP (SIxx)	000/001 000/051
KSM	01-45	Main synoptic observations from fixed land stations	SYNOP (SMxx)	000/002 000/052
KSN	01-45	Synoptic observations from fixed land stations at non-standard time (i.e. 01, 02, 04, 05, ... UTC)	SYNOP (SNxx)	000/000 000/050

Attachment II-15

In the part related to the general file naming conventions

After the sentences:

“<location indicator> defines the producer: Country, organization and the production centre; the country shall be represented by the official ISO 3166 standard 2 letter code. Example: <gb-metoffice-exeter>. Each field shall be separated by “-” symbol.”

add the sentence:

“The ISO 3166 standard 2 letter code xx shall be used for international organizations and shall therefore be the two first characters of the location indicator of international organizations, e.g. "xx-eumetsat-darmstadt", "xx-ecmwf-reading".”

Add two lines at the end of Table 4.3 as follows

Table 4.3 Accepted type values

type	Meaning
met	The file is a metadata file pair which describes the content and format of the corresponding information file with the same name
tif	TIFF file
gif	GIF file
png	PNG file
ps	Postscript file
mpg	MPEG file
jpg	JPEG file
txt	text file
htm	HTML file
bin	a file containing data encoded in a WMO binary code form such as GRIB or BUFR
doc	a Microsoft Word file
wpd	a Corel WordPerfect file
hdf	HDF file
nc	NetCDF file
pdf	Portable Document Format file

Recommendation 6 (CBS-XIV)

AMENDMENTS TO THE *MANUAL ON CODES* (WMO-No. 306), INTRODUCTION TO VOLUMES I.1 AND I.2

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) Resolution 1 (Cg-XV) – Technical Regulations of the World Meteorological Organization,

(2) Resolution 2 (Cg-XV) – World Weather Watch Programme for 2008–2011,

(3) The *Manual on Codes* (WMO-No. 306),

Considering the requirements for:

(1) Fast-track procedures for the adoption of amendments to the *Manual on Codes*,

(2) Procedures for the adoption of amendments to the *Manual on Codes* between CBS sessions,

(3) Procedures for the adoption of amendments to the *Manual on Codes* during CBS sessions,

Recommends that the procedures for amending the *Manual on Codes* defined in the annex to this recommendation be applied as from 1 July 2009;

Requests the Secretary-General to arrange for the inclusion of these procedures in the introduction to Volumes I.1 and I.2 of the *Manual on Codes*;

Authorizes the Secretary-General to make any consequent purely editorial amendments to the Manual on Codes – Introduction to Volumes I.1 and I.2.

Annex to Recommendation 6 (CBS-XIV)

PROCEDURES FOR AMENDING THE *MANUAL ON CODES*

To replace the procedures for amending the *Manual on Codes* by the new following ones:

PROCEDURES FOR AMENDING THE *MANUAL ON CODES*

1. General validation and implementation procedures

1.1 Amendments to the *Manual on Codes* must be proposed in writing to the WMO Secretariat. The proposal shall specify the needs, purposes and requirements and include information on a contact point for technical matters.

1.2 The Expert Team on Data Representation and Codes (ET-DRC),[1] supported by the Secretariat, shall validate the stated requirements (unless it is consequential to an amendment to the WMO Technical Regulations) and develop a draft recommendation to respond to the requirements, as appropriate.

1.3 A draft recommendation of the ET-DRC must be validated. A draft recommendation of the ET-DRC must be endorsed by the Implementation/Coordination Team (ICT-ISS) of the Open Programme Area Group on Information Systems and Services (OPAG-ISS). The ET-DRC should define a date of implementation in order to give sufficient time to the WMO Members to implement the amendments after the date of notification; the ET-DRC should document the reasons to propose a time span less than six months.

1.4 Depending on the type of amendments, the ET-DRC may select one of the following procedures for the approval of the amendments:

[1] The ET-DRC, the ICT-ISS and the OPAG-ISS are the current bodies dealing with data representation and codes within CBS. If they were replaced by other bodies performing the same function, the same rules would apply, by replacing the names of the entities appropriately.

- Fast track procedure (see section 2 below);
- Procedure for the adoption of amendments between CBS sessions (see section 3 below);
- Procedure for the adoption of amendments during CBS sessions (see section 4 below).

1.5 Once amendments to the *Manual on Codes* are adopted, an updated version of the relevant part of the Manual shall be issued in the four languages: English, French, Russian and Spanish. The Secretariat will inform all WMO Members of the availability of a new updated version of that part at the date of notification mentioned in section 1.3.

2. Fast track procedure

2.1 Fast track mechanism can be used for additions to BUFR or CREX Tables A, B, and D with associated code tables or flag tables, to code tables or templates in GRIB and to common tables C.

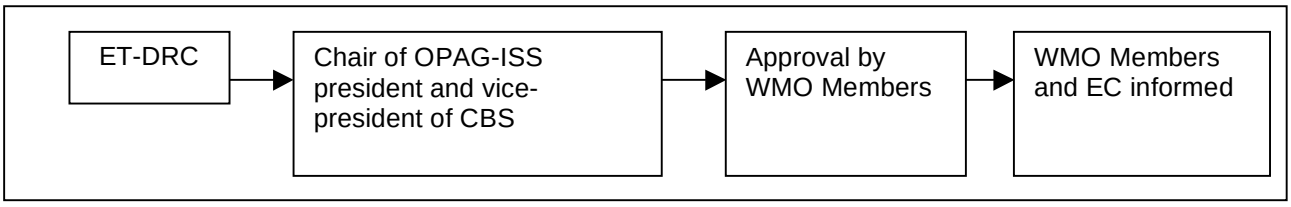
2.2 A draft recommendation of the ET-DRC must be validated in accordance with the procedures given in section 6 below. Draft recommendations developed by the ET-DRC must be endorsed by the Chair of OPAG-ISS. The filling of reserved and unused entries in the existing code and flag tables is considered as minor adjustments, and will be done by the Secretary-General in consultation with the president of CBS. For other types of amendments, the English version of the draft recommendation, including a date of implementation, should be distributed to the focal points for codes and data representation matters for comments, with a deadline of two months for the reply. It should then be submitted to the president of CBS for its adoption on behalf of the Executive Council.

2.3 The implementation of amendments approved through the fast track procedure shall normally be limited to one per year. If the Chair/co-Chair of ET-DRC and OPAG-ISS agree that an exceptional situation exists, a second fast track implementation can be initiated.

3. Procedures for the adoption of amendments between CBS sessions

For the direct adoption of amendments between CBS sessions, as a first step, the ET-DRC submits its recommendation, including a date of implementation of the amendments, to the Chair of OPAG-ISS, president and vice-president of CBS. In a second step, upon approval of the president of CBS, the Secretariat sends the recommendation in the four languages (English, French, Russian and Spanish), including a date of implementation of the amendments, to all WMO Members for comments within two months; WMO Members are invited to designate a focal point responsible to discuss any comments/disagreements with the ET-DRC. If the discussion between the ET-DRC and the focal point cannot result in an agreement on a specific amendment by a WMO Member, this amendment will be reconsidered by the ET-DRC. Those WMO Members having not replied within the two months following the dispatch of the amendments are implicitly considered as having agreed with the amendments. In a third step, once amendments are agreed by WMO Members, and after consultation with the Chair and co-Chair of the OPAG-ISS, president and vice-president of CBS, the Secretariat notifies at the same time the WMO Members and the members of the Executive Council (EC) of the approved amendments and of the date of their implementation.

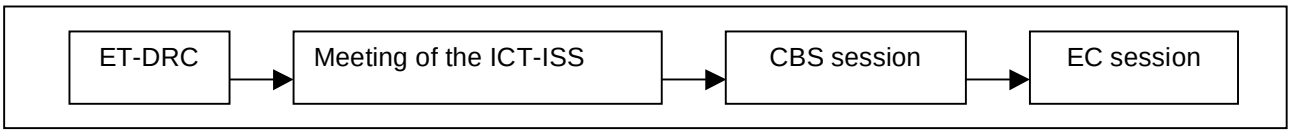
Figure 1- Adoption of amendments between CBS sessions



4. Procedures for the adoption of amendments during CBS sessions

For the adoption of amendments during CBS sessions, the ET-DRC submits its recommendation, including a date of implementation of the amendments, to the ICT-ISS. The recommendation is then submitted to a CBS session and then to an EC session.

Figure 2 – Adoption of the amendments through a CBS session



5. Procedures for the correction of existing entries in the BUFR and CREX tables

5.1 If an erroneous specification of an entry is found in an operational BUFR or CREX Element descriptor or Sequence descriptor, a new descriptor should preferably be added to the appropriate table through the fast track procedure or the procedure for adoption of amendments between CBS sessions. The new descriptor should be used instead of the old one for encoding (especially if it concerns data width). An appropriate explanation shall be added to the notes of the table to clarify the practice along with the date of the change. This situation is considered a minor adjustment according to subsection 2.2 above.

5.2 As an exceptional measure for erroneous entries in Table B, if it is found absolutely necessary to correct an erroneous specification of an existing entry by changing its specification, the following rules shall apply:

5.2.1 The name and unit of an element descriptor shall remain unchanged except for minor clarifications.

5.2.2 Scale, reference value and bit width may be corrected to required values.

5.2.3 Such a change will be submitted through the fast-track procedure.

5.2.4 The version number of the master will be incremented.

6. Validation procedures

6.1 The need for, and the purpose of, the proposal for changes should be documented.

6.2 This documentation must include the results of validation testing of the proposal as described below.

6.3 For new or modified WMO code and data representation forms, proposed changes should be tested by the use of at least two independently developed encoders and two independently developed decoders which incorporated the proposed change. Where the data originated from a necessarily unique source (for example the data stream from an experimental satellite), the successful testing of a single encoder with at least two independent decoders would be considered adequate. Results should be made available to the ET-DRC with a view to verifying the technical specifications.

7. Urgent introduction of new descriptors or entries in BUFR, CREX and GRIB edition 2 tables

As agreed by CBS (see CBS-Ext.(02), paragraph 6.2.66 of the general summary), a three-step mechanism for the introduction of new descriptors or entries in BUFR, CREX and GRIB edition 2 tables accommodates urgent user needs, as follows:

(a) Approval (by the chairperson of ET-DRC, the chairperson of OPAG-ISS and the president of CBS) of allocated entries after an expression of requirements. The list of allocated entries awaiting validation is kept on-line on the WMO web server;

(b) After validation (according to 6.1, 6.2 and 6.3), declaration of pre-operational use (after approval by the chairperson of ET-DRC, the chairperson of OPAG-ISS and the president of CBS). The list of pre-operational entries is kept on-line on the WMO web server;

(c) Finally, adoption of the amendments in accordance with the procedures detailed in above sections 2, 3 or 4.

Recommendation 7 (CBS-XIV)

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

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) Resolution 1 (Cg-XV) – Technical Regulations of the World Meteorological Organization,

(2) Resolution 2 (Cg-XV) – World Weather Watch Programme for 2008–2011,

(3) The *Manual on Codes* (WMO-No. 306), Volume I.2,

Considering the various requirements:

(1) In GRIB Edition 2 for:

- New templates for chemicals
- New data representation template for run length packing with level values

(2) In BUFR and CREX for:

- GHRSST data
- SBUV/2 ozone data
- Descriptors for encoding JASON2 OGDR data
- Entries for GOME Experiment
- Template for METOP GOME-2
- SMOS satellite data
- Encoding all sky radiance data
- Template for SYNOP data manually encoded in CREX
- Templates for METAR/SPECI and TAF coded in BUFR or CREX
- Template for surface observations from one-hour period
- Template for representation of SYNOP data with supplementary information on one-hour observations
- Template for synoptic reports from fixed land stations suitable for SYNOP data and for maritime data from coastal and island stations
- A new sequence for locust data
- Modified descriptors for reporting correctly radiation
- Air chemistry
- New descriptors for GFA (Graphical Forecast AIRMET) data
- Wind reporting at pole
- New descriptors for intensity of precipitation
- Addition of code figure (cloud observation)

Recommends that the following amendments be adopted for operational use as from 4 November 2009:

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

(2) Additions to FM 94-XIII Ext. BUFR, FM 95-XIII Ext. CREX and to common code tables defined in Annex 2 to this recommendation;

Requests the Secretary-General to arrange for the inclusion of these amendments in the *Manual on Codes* (WMO-No. 306);

Authorizes the Secretary-General to make any consequent purely editorial amendments to *the Manual on Codes*, Volume I.2.

Annex 1 to Recommendation 7 (CBS-XIV)

AMENDMENTS TO THE *MANUAL ON CODES*, VOLUME I.2, FOR FM 92-XIII EXT. GRIB

NEW TEMPLATES FOR CHEMICALS

Addition of:

- a new category to Product Discipline 0 in Code Table 4.1
- a set of new parameters in Code Table 4.2
- a new Section 4 Code Table occupying 2 octets: Code Table 4.230, referring to a new ***Common Code Table C-14:*** **Atmospheric chemical or physical constituent type**
- new Product Definition Templates which include the new Code Table 4.230: **4.40 to 4.43**

In Code Table 4.1 proposed new entry:

Product Discipline 0:	**Meteorological products**
Category Description	
20	***Atmospheric chemical constituents***
21-189	Reserved

In Code Table 4.2 the following addition:

Product Discipline 0: Meteorological products, Parameter Category 20: Atmospheric chemical constituents

Number	**Parameter**	**Units**
0	Mass density (concentration)	kg m^{-3}
1	Column-integrated mass density (see Note[1])	kg m^{-2}
2	Mass mixing ratio (mass fraction in air)	kg kg^{-1}
3	Atmosphere emission mass flux	kg m^{-2} s^{-1}
4	Atmosphere net production mass flux	kg m^{-2} s^{-1}
5	Atmosphere net production and emission mass flux	kg m^{-2} s^{-1}

[1] FirstFixedSurface and SecondFixedSurface of Code Table 4.5 (Fixed surface types and units) to define the vertical extent, i.e. FirstFixedSurface can be set to 1 (Ground or water surface) and SecondFixedSurface set to 7 (Tropopause) for a restriction to the troposphere.

Number	**Parameter**	**Units**
6	Surface dry deposition mass flux	kg m^{-2} s^{-1}
7	Surface wet deposition mass flux	kg m^{-2} s^{-1}
8	Atmosphere re-emission mass flux	kg m^{-2} s^{-1}
9-49	Reserved	
50	Amount in atmosphere	mol
51	Concentration in air	mol m^{-3}
52	Volume mixing ratio (fraction in air)	mol mol^{-1}
53	Chemical gross production rate of concentration	mol m^{-3} s^{-1}
54	Chemical gross destruction rate of concentration	mol m^{-3} s^{-1}
55	Surface flux	mol m^{-2} s^{-1}
56	Changes of amount in atmosphere (see Note [1])	mol s^{-1}
57	Total yearly average burden of the atmosphere	mol
58	Total yearly averaged atmospheric loss (see Note [1])	mol s^{-1}
59-99	Reserved	
100	Surface area density (aerosol)	m^{-1}
101	Atmosphere optical thickness	m
102-191	Reserved	
192-254	Reserved for local use	
255	Missing	

Code Table 4.230: **Atmospheric chemical constituent type**
(see Common Code Table C-14)

Proposed new Product Definition Templates

The following proposed Product Definition Templates are based on existing templates with the inclusion of the new proposed Code Table 4.230.

Product Definition Template 4.40: Analysis or forecast at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents

Octet Number(s)	**Contents**
10	Parameter category (see Code Table 4.1)
11	Parameter number (see Code Table 4.2)
12-13	***Atmospheric chemical constituent type (see Code Table 4.230)***
14	Type of generating process (see Code Table 4.3)
15	Background generating process identifier (defined by originating centre)
16	Analysis or forecast generating process identifier (defined by originating centre)
17-18	Hours of observational data cutoff after reference time (see Note 1)
19	Minutes of observational data cutoff after reference time
20	Indicator of unit of time range (see Code Table 4.4)
21-24	Forecast time in units defined by octet 20
25	Type of first fixed surface (see Code Table 4.5)
26	Scale factor of first fixed surface
27-30	Scaled value of first fixed surface
31	Type of second fixed surface (see Code Table 4.5)
32	Scale factor of second fixed surface
33-36	Scaled value of second fixed surface

Note:
1. Hours greater than 65534 will be coded as 65534.

Product Definition Template 4.41: Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents

Octet Number(s)	Contents
10	Parameter category (see Code Table 4.1)
11	Parameter number (see Code Table 4.2)
12-13	***Atmospheric chemical constituent type (see Code Table 4.230)***
14	Type of generating process (see Code Table 4.3)
15	Background generating process identifier (defined by originating centre)
16	Forecast generating process identifier (defined by originating centre)
17-18	Hours after reference time of data cutoff (see Note 1)
19	Minutes after reference time of data cutoff
20	Indicator of unit of time range (see Code Table 4.4)
21-24	Forecast time in units defined by octet 20
25	Type of first fixed surface (see Code Table 4.5)
26	Scale factor of first fixed surface
27-30	Scaled value of first fixed surface
31	Type of second fixed surface (see Code Table 4.5)
32	Scale factor of second fixed surface
33-36	Scaled value of second fixed surface
37	Type of ensemble forecast (see Code Table 4.6)
38	Perturbation number
39	Number of forecasts in ensemble

Note:

1. Hours greater than 65534 will be coded as 65534.

Product Definition Template 4.42: Average, accumulation, and/or extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents

Octet Number(s)	Contents
10	Parameter category (see Code Table 4.1)
11	Parameter number (see Code Table 4.2)
12-13	***Atmospheric chemical constituent type (see Code Table 4.230)***
14	Type of generating process (see Code Table 4.3)
15	Background generating process identifier (defined by originating centre)
16	Analysis or forecast generating process identifier (defined by originating centre)
17-18	Hours after reference time of data cutoff (see Note 1)
19	Minutes after reference time of data cutoff
20	Indicator of unit of time range (see Code Table 4.4)
21-24	Forecast time in units defined by octet 20 (see Note 2)
25	Type of first fixed surface (see Code Table 4.5)
26	Scale factor of first fixed surface
27-30	Scaled value of first fixed surface
31	Type of second fixed surface (see Code Table 4.5)
32	Scale factor of second fixed surface
33-36	Scaled value of second fixed surface
37-38	Year
39	Month
40	Day
41	Hour
42	Minute
43	Second
44	n - Number of time range specifications describing the time intervals used to calculate the statistically processed field
45-48	Total number of data values missing in statistical process

Octet Number(s)	Contents
	49-60 Specification of the outermost (or only) time range over which statistical processing is done
49	Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10)
50	Type of time increment between successive fields used in the statistical processing (see Code Table 4.11)
51	Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4)
52-55	Length of the time range over which statistical processing is done, in units defined by the previous octet
56	Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4)
57-60	Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4)
	*61-nn These octets are included only if n>1, where nn = 48 + 12 * n*
61-72	As octets 49 to 60, next innermost step of processing
73-nn	Additional time range specifications, included in accordance with the value of n. Contents as octets 49 to 60, repeated as necessary.

Notes:

1. Hours greater than 65534 will be coded as 65534.
2. The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
3. An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.
4. The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 50, 62, 74 …). For all but the innermost (last) time range, the next inner range is then processed using these references and forecast times as the initial reference and forecast time.

Product Definition Template 4.43: Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents

Octet Number(s)	Contents
10	Parameter category (see Code Table 4.1)
11	Parameter number (see Code Table 4.2)
12-13	***Atmospheric chemical constituent type (see Code Table 4.230)***
14	Type of generating process (see Code Table 4.3)
15	Background generating process identifier (defined by originating centre)
16	Forecast generating process identifier (defined by originating centre)
17-18	Hours after reference time of data cutoff (see Note 1)
19	Minutes after reference time of data cutoff
20	Indicator of unit of time range (see Code Table 4.4)
21-24	Forecast time in units defined by octet 20 (see Note 2)
25	Type of first fixed surface (see Code Table 4.5)
26	Scale factor of first fixed surface
27-30	Scaled value of first fixed surface
31	Type of second fixed surface (see Code Table 4.5)
32	Scale factor of second fixed surface
33-36	Scaled value of second fixed surface
37	Type of ensemble forecast (see Code Table 4.6)

Octet Number(s)	Contents
38	Perturbation number
39	Number of forecasts in ensemble
40-41	Year of end of overall time interval
42	Month of end of overall time interval
43	Day of end of overall time interval
44	Hour of end of overall time interval
45	Minute of end of overall time interval
46	Second of end of overall time interval
47	n - Number of time range specifications describing the time intervals used to calculate the statistically processed field
48-51	Total number of data values missing in statistical process
	52-63 Specification of the outermost (or only) time range over which statistical processing is done
52	Statistical process used to calculate the processed field from the field at each time increment during the time range (see Code Table 4.10)
53	Type of time increment between successive fields used in the statistical processing (see Code Table 4.11)
54	Indicator of unit of time for time range over which statistical processing is done (see Code Table 4.4)
55-58	Length of the time range over which statistical processing is done, in units defined by the previous octet
59	Indicator of unit of time for the increment between the successive fields used (see Code Table 4.4)
60-63	Time increment between successive fields, in units defined by the previous octet (see Notes 3 and 4)
	*64-nn These octets are included only if n>1, where nn = 51 + 12 * n*
64-75	As octets 52 to 63, next innermost step of processing
76-nn	Additional time range specifications, included in accordance with the value of n. Contents as octets 52 to 63, repeated as necessary.

Notes:

1. Hours greater than 65534 will be coded as 65534.
2. The reference time in section 1 and the forecast time together define the beginning of the overall time interval.
3. An increment of zero means that the statistical processing is the result of a continuous (or near continuous) process, not the processing of a number of discrete samples. Examples of such continuous processes are the temperatures measured by analogue maximum and minimum thermometers or thermographs, and the rainfall measured by a rain gauge.
4. The reference and forecast times are successively set to their initial values plus or minus the increment, as defined by the type of time increment (one of octets 53, 65, 77 …). For all but the innermost (last) time range, the next inner range is then processed using these reference and forecast times as the initial reference and forecast time.

NEW COMMON CODE TABLE C-14:
Atmospheric chemical or physical constituent type

Code figure	Meaning	Chemical formula
0	Ozone	O_3
1	Water vapour	H_2O
2	Methane	CH_4
3	Carbon dioxide	CO_2
4	Carbon monoxide	CO
5	Nitrogen dioxide	NO_2

Code figure	Meaning	Chemical formula
6	Nitrous oxide	N_2O
7	Formaldehyde	HCHO
8	Sulphur dioxide	SO_2
9	Ammonia	NH_3
10	Ammonium	NH_4^+
11	Nitrogen monoxide	NO
12	Atomic oxygen	O
13	Nitrate radical	NO_3
14	Hydroperoxyl radical	HO_2
15	Dinitrogen pentoxide	N_2O_5
16	Nitrous acid	HONO
17	Nitric acid	HNO_3
18	Peroxynitric acid	HO_2NO_2
19	Hydrogen peroxide	H_2O_2
20	Molecular hydrogen	H
21	Atomic nitrogen	N
22	Sulphate	SO_4^{2-}
23	Radon	Rn
24	Elemental mercury	Hg(0)
25	Divalent mercury	Hg^{2+}
26	Atomic chlorine	Cl
27	Chlorine monoxide	ClO
28	Dichlorine peroxide	Cl_2O_2
29	Hypochlorous acid	HClO
30	Chlorine nitrate	$ClONO_2$
31	Chlorine dioxide	ClO_2
32	Atomic bromine	Br
33	Bromine monoxide	BrO
34	Bromine chloride	BrCl
35	Hydrogen bromide	HBr
36	Hypobromous acid	HBrO
37	Bromine nitrate	$BrONO_2$
38-9999	Reserved	
10000	Hydroxyl radical	OH
10001	Methyl peroxy radical	CH_3O_2
10002	Methyl hydroperoxide	CH_3O_2H
10004	Methanol	CH_3OH
10005	Formic acid	CH_3OOH
10006	Hydrogen Cyanide	HCN
10007	Aceto nitrile	CH_3CN
10008	Ethane	C_2H_6
10009	Ethene (= Ethylene)	C_2H_4
10010	Ethyne (= Acetylene)	C_2H_2
10011	Ethanol	C_2H_5OH
10012	Acetic acid	C_2H_5OOH
10013	Peroxyacetyl nitrate	$CH_3C(O)OONO_2$
10014	Propane	C_3H_8
10015	Propene	C_3H_6
10016	Butanes	C_4H_{10}
10017	Isoprene	C_5H_{10}
10018	Alpha pinene	$C_{10}H_{16}$
10019	Beta pinene	$C_{10}H_{16}$
10020	Limonene	$C_{10}H_{16}$
10021	Benzene	C_6H_6
10022	Toluene	C_7H_8
10023	Xylene	C_8H_{10}
10024-10499	reserved for other simple organic molecules (e.g. higher aldehydes, alcohols, peroxides,…)	
10500	Dimethyl sulphide	CH_3SCH_3 (DMS)
10501-20000	Reserved	

Code figure	Meaning	Chemical formula
20001	Hydrogen chloride	
20002	CFC-11	
20003	CFC-12	
20004	CFC-113	
20005	CFC-113a	
20006	CFC-114	
20007	CFC-115	
20008	HCFC-22	
20009	HCFC-141b	
20010	HCFC-142b	
20011	Halon-1202	
20012	Halon-1211	
20013	Halon-1301	
20014	Halon-2402	
20015	Methyl chloride (HCC-40)	
20016	Carbon tetrachloride (HCC-10)	
20017	HCC-140a	CH3CCl3
20018	Methyl bromide (HBC-40B1)	
20019	Hexachlorocyclohexane (HCH)	
20020	Alpha hexachlorocyclohexane	
20021	Hexachlorobiphenyl (PCB-153)	
20022-29999	Reserved	
30000-59999	Reserved	
60000	HOx radical (OH+HO2)	
60001	Total inorganic and organic peroxy radicals (HO_2 + RO_2)	RO_2
60002	Passive Ozone	
60003	NOx expressed as nitrogen	NO_x
60004	All nitrogen oxides (NOy) expressed as nitrogen	NO_y
60005	Total inorganic chlorine	Cl_x
60006	Total inorganic bromine	Br_x
60007	Total inorganic chlorine except HCl, ClONO2: ClOx	
60008	Total inorganic bromine except HBr, BrONO2: BrOx	
60009	Lumped Alkanes	
60010	Lumped Alkenes	
60011	Lumped Aromatic Compounds	
60012	Lumped Terpenes	
60013	Non-methane volatile organic compounds expressed as carbon	NMVOC
60014	Anthropogenic non-methane volatile organic compounds expressed as carbon	aNMVOC
60015	Biogenic non-methane volatile organic compounds expressed as carbon	bNMVOC
60016	Lumped oxygenated hydrocarbons	OVOC
60017-61999	Reserved	
62000	Total aerosol	
62001	Dust dry	
62002	Water in ambient	
62003	Ammonium dry	
62004	Nitrate dry	
62005	Nitric acid trihydrate	
62006	Sulphate dry	
62007	Mercury dry	
62008	Sea salt dry	
62009	Black carbon dry	
62010	Particulate organic matter dry	
62011	Primary particulate organic matter dry	
62012	Secondary particulate organic matter dry	
62013-65534	Reserved	
65535	Missing	

Update Code Table 4.0:

Code Table 4.0: Product Definition Template Number

Number	Description
0	Analysis or forecast at a horizontal level or in a horizontal layer at a point in time
1	Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time
2	Derived forecast based on all ensemble members at a horizontal level or in a horizontal layer at a point in time
3	Derived forecasts based on a cluster of ensemble members over a rectangular area at a horizontal level or in a horizontal layer at a point in time
4	Derived forecasts based on a cluster of ensemble members over a circular area at a horizontal level or in a horizontal layer at a point in time
5	Probability forecasts at a horizontal level or in a horizontal layer at a point in time
6	Percentile forecasts at a horizontal level or in a horizontal layer at a point in time
7	Analysis or forecast error at a horizontal level or in a horizontal layer at a point in time
8	Average, accumulation, extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval
9	Probability forecasts at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval
10	Percentile forecasts at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval
11	Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval
12	Derived forecasts based in all ensemble members at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval
13	Derived forecasts based on a cluster of ensemble members over a rectangular area, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval
14	Derived forecasts based on a cluster of ensemble members over a circular area, at a horizontal level or in a horizontal layer, in a continuous or non-continuous interval
15-19	Reserved
20	Radar product
21-29	Reserved
30	Satellite product (deprecated)
31	Satellite product
32-39	Reserved
40	Analysis or forecast at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents
41	Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer at a point in time for atmospheric chemical constituents
42	Average, accumulation, and/or extreme values or other statistically processed values at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents
43	Individual ensemble forecast, control and perturbed, at a horizontal level or in a horizontal layer in a continuous or non-continuous time interval for atmospheric chemical constituents
44-253	Reserved
254	CCITT IA5 character string
255-999	Reserved
1000	Cross section of analysis and forecast at a point in time
1001	Cross section of averaged or otherwise statistically processed analysis or forecast over a range of time
1002	Cross-section of analysis and forecast, averaged or otherwise statistically processed
1003-1099	Reserved
1100	Hovmöller-type grid with no averaging or other statistical processing
1101	Hovmöller-type grid with averaging or other statistical processing
1102-32767	Reserved
32768-65534	Reserved for local use
65535	Missing

NEW DATA REPRESENTATION TEMPLATE FOR RUN LENGTH PACKING WITH LEVEL VALUES

New entry to the Code Table 5.0

200 Run length packing with level values

New Data Representation Template

5.200 Grid point data - Run length packing with level values

12 Number of bits used for each packed value in the run length packing with level values
13-14 MV - Maximum value within the levels that are used in the packing
15-16 MVL - Maximum value of level (Predefined)
17 Decimal scale factor of representative value of each level
18-19+2*(lv-1) List of MVL scaled representative values of each level from lv=1 to MVL

Annex 2 to Recommendation 7 (CBS-XIV)

AMENDMENTS TO THE *MANUAL ON CODES*, VOLUME I.2, FOR FM 94-XIII Ext. BUFR and FM 95-XIII Ext. CREX

CONTENTS

DESCRIPTORS FOR ATMOSPHERIC CHEMISTRY

Element Descriptor	Element name	Unit	Scale	Reference Value	Data Width
0-02-071	Spectrographic wavelength	m	13	0	30
0-08-026	Matrix significance	Code Table	0	0	6
0-08-043	Atmospheric chemical or physical constituent type	Code Table	0	0	8
0-08-090	Decimal scale of following significands	Numeric	0	-127	8
0-15-008	Significand of volumetric mixing ratio	Numeric	0	0	10
0 15 021	Integrated mass density	kg/m**2	11	0	31
0-15-024	Optical depth	Numeric	4	0	24
0-25-143	Linear coefficient	Numeric	6	-5000000	24

Note 1:
Descriptor 0 08 090 is to be used to establish the decimal scale of one or more subsequent numerical element descriptors requiring a large dynamic range of values. The numerical element descriptor(s) will contain the scaled value of the measurement(s) with the required number of significant digits. The actual value will be obtained, at the application level, by multiplying the scaled value by the given decimal scale: (scaled value * 10decimal scale).
Note 2:
When descriptor 0 08 043 is used to specify particulate matter (PM) under a given size threshold, descriptor 0 08 045 may also be used to further specify a subset of the PM population on the basis of ion composition.
Note 3:
Descriptor 0 25 143 is intended for numerical, non-dimensional values to be used as coefficients in statistical or linear processing. Each instance of 0 25 143 should be characterized by using an appropriate significance qualifier, such as 0 08 026.

Code Tables

0 08 026 - Matrix significance

Code figure	*Meaning*
0	Averaging kernel matrix
1	Correlation matrix (C)
2	Lower triangular correlation matrix square root (L from $C=LL^T$)
3	Inverse of lower triangular correlation matrix square root (L^{-1})
4-42	Reserved
43-62	Reserved for local use
63	Missing or undefined significance

0 08 043 - Amospheric chemical or physical constituent type

Note: The last column in the table contains the associated registry number from the Chemical Abstracts Service (CAS) of the American Chemical Society.

Code figure	Meaning		
	Name	Formula	CAS Number (if applicable)
0	Ozone	O_3	10028-15-6
1	Water vapour	H_2O	7732-18-5
2	Methane	CH_4	74-82-8
3	Carbon dioxide	CO_2	124-38-9
4	Carbon monoxide	CO	630-08-0
5	Nitrogen dioxide	NO_2	10102-44-0
6	Nitrous oxide	N_2O	10024-97-2
7	Formaldehyde	HCHO	50-00-0
8	Sulfur dioxide	SO_2	7446-09-5
09-24	reserved		
25	Particulate Matter < 1.0 microns		
26	Particulate Matter < 2.5 microns		
27	Particulate Matter < 10 microns		
28	Aerosols (generic)		
29	Smoke (generic)		
30	Crustal Material (generic dust)		
31	Volcanic Ash		
32-200	reserved		
201-254	reserved for local use		
255	missing		

DESCRIPTORS TO BE USED WHEN EXCHANGING GLOBAL OCEAN DATA ASSIMILATION EXPERIMENT (GODAE) HIGH RESOLUTION SEA SURFACE TEMPERATURE (GHRSST) DATA:

Table Reference	***Element name***	***BUFR***				***CREX***		
F X Y		***Unit***	***Scale***	***Ref. value***	***Data width (bits)***	***Unit***	***Scale***	***Data width (chars)***
0 25 037	SST bias	K	2	-127	8	K	2	3
0 14 035	Solar Radiation Flux	W m^{-2}	1	0	14	W m^{-2}	1	5
0 25 022	GHRSST Rejection Flag	Flag table	0	0	9	Flag table	0	3
0 25 023	GHRSST Confidence Flag	Flag table	0	0	9	Flag table	0	3
0 25 024	GHRSST data quality	Code table	0	0	4	Code table	0	2
0 01 028	Aerosol optical Depth (AOD) source	Code table	0	0	5	Code table	0	2
0 01 024	Wind Speed source	Code Table	0	0	5	Code Table	0	2

Table Reference	***Element name***	***BUFR***				***CREX***		
F X Y		***Unit***	***Scale***	***Ref. value***	***Data width (bits)***	***Unit***	***Scale***	***Data width (chars)***
0 01 029	SSI Source	Code Table	0	0	5	Code Table	0	2
0 01 038	Source of Sea Ice Fraction	Code Table	0	0	5	Code Table	0	2
0 25 038	Difference between SST and analysis	K	1	-127	8	K	1	3
0 22 046	Sea Ice Fraction	Numeric	2	0	7	Numeric	2	3

Flag tables:

0 25 022 - GHRSST Rejection Flag

Bit No.	
1	Unprocessed
2	Land suspected.
3	Wind speed too large
4	Ice detected.
5	Rain detected (Microwave retrievals only)
6	Cloudy detected (Infra-red retrievals only)
7	Cosmetic value
8	SST out of range
All 9	Missing value

0 25 023 - GHRSST Confidence Flag

Bit No.	
1	Default confidence value has been used
2	Default bias and standard deviation has been used
3	Sun glint suspected
4	Sea ice retrieval for microwave data
5	High wind speed retrieval
6	Inaccurate SST due to low SST (< 285K) (Only applies to the TMI instrument)
7	Relaxed rain contamination suspected
8	Potential side lobe contamination
All 9	Missing value

Codes Tables

0 25 024 – GHRSST proximity confidence.

Code figure	
0	Unprocessed infrared retrieval
1	Cloudy retrievals
2	Bad: Data that are probably contaminated by cloud
3	Suspect data
4	Acceptable data
5	Excellent data
6	Cool skin suspected
7-9	Reserved
10	Unprocessed microwave retrieval
11	Questionable microwave retrieval that may be contaminated
12	Acceptable microwave retrieval
13	High probability of diurnal variability
14	Reserved
15	Missing value

0 01 028 - Aerosol optical Depth (AOD) source

Code figure	
0	No AOD data available
1	NESDIS
2	NAVOCEANO
3	NAAPS
4	MERIS
5	AATSR
6-30	Reserved for future use
31	**Missing value**

0 01 024 - Wind Speed source

Code figure	
0	No wind speed data available
1	AMSR-E data
2	TMI data
3	NWP: ECMWF
4	NWP: UK Met Office
5	NWP: NCEP
6	Reference climatology
7	ERS_Scatterometer
8-30	Reserved for future use
31	**Missing value**

0 01 029 - SSI Source

Code figure	
0	No SSI data available
1	MSG_SEVIRI
2	GOES East
3	GOES West
4	ECMWF
5	NCEP
6	UK Met Office
7-30	Reserved for future use
31	**Missing value**

0 01 038 - Source of Sea Ice Fraction

Code figure	
0	No sea ice set
1	NSIDC SSM/I Cavalieri et al (1992)
2	AMSR-E
3	ECMWF
4	CMS (France) cloud mask used by Medspiration
5	EUMETSAT OSI-SAF
6-30	Reserved for future use
31	**Missing value**

Table of Acronyms

Acronym	*Expansion*
AATSR	Advanced Along-Track Scanning Radiometer.
AMSR-E	Advanced Microwave Scanning Radiometer.
AOD	Aerosol optical depth.
CMS	Centre de Meteorologie Spatiale (Lannion, France).
ERS	European Remote-sensing Satellite.
EUMETSAT	European organization for the exploitation of meteorological satellites.
GHRSST-PP	GODAE High Resolution Sea Surface Temperature Pilot Project.
GODAE	Global Ocean Data Assimilation Experiment.
GOES	Geostationary Operational Environment Satellite.
IR	Infra-red.
MERIS	Medium Resolution Imaging Spectrometer.
MSG	Meteosat Second Generation.
MW	Microwave.
NAAPS	Navy Aerosol Analysis and Prediction System.
NAVOCEANO	Naval Oceanographic Office (United States of America).
NCEP	National Centers for Environmental Prediction.
NESDIS	National Environmental Satellite, Data, and Information Service. (United States of America).
NWP	Numerical weather prediction.
OSI-SAF	Ocean and Sea Ice Satellite Applications Facility.
RF	Radio frequency.
SEVIRI	Spinning Enhanced Visible and Infrared Imager
SSI	Surface Solar Irradiance.
TMI	Tropical Rainfall Measuring Mission (TRMM) Microwave Imager.

TM D07089 - TEMPLATE FOR SYNOPTIC REPORTS FROM FIXED LAND STATIONS SUITABLE FOR SYNOP DATA MANUALLY ENCODED IN CREX

D 07 089		**Sequence for representation of synoptic reports from a fixed land station suitable for SYNOP data manually encoded in CREX**
	D 07 087	"Instantaneous" parameters of sequence D07089
	D 07 088	"Period" parameters of sequence D07089

Notes:

(1) "Instantaneous" parameter is a parameter that is not coupled to a time period descriptor, e.g. B04024.

(2) "Period" parameter is a parameter that is coupled to a time period descriptor, e.g. B04024.

This CREX template for synoptic reports from fixed land stations further expands as follows:

D 07 087			**"Instantaneous" parameters of sequence D07089**		
			Surface station identification, time, horizontal and vertical coordinates		**in CREX**
	D 01 001	B 01 001	WMO block number	**II**	Numeric, 0, 2
		B 01 002	WMO station number	**iii**	Numeric, 0, 3
	B 02 001		Type of station	**(i_x)**	Code table, 0, 1
	D 01 011	B 04 001	Year		Year, 0, 4
		B 04 002	Month		Month, 0, 2
		B 04 003	Day	**YY**	Day, 0, 2
	D 01 012	B 04 004	Hour	**GG**	Hour, 0, 2
		B 04 005	Minute	**gg**	Minute, 0, 2
	D 01 023	B 05 002	Latitude (course accuracy)		Degree, 2, 4
		B 06 002	Longitude (course accuracy)		Degree, 2, 5
	B 07 030		Height of station ground above msl		m, 1, 5

D 07 087			**"Instantaneous" parameters of sequence D07089**	
	B 07 031		Height of barometer above msl	m, 1, 5
			Pressure data	
	D 02 001	B 10 004	Pressure **$P_oP_oP_oP_o$**	Pa, –1, 5
		B 10 051	Pressure reduced to mean sea level **PPPP**	Pa, –1, 5
		B 10 061	3-hour pressure change **ppp**	Pa, –1, 4
		B 10 063	Characteristic of pressure tendency **a**	Code table, 0, 2
	B 10 062		24-hour pressure change **$p_{24}p_{24}p_{24}$**	Pa, –1, 4
	B 07 004		Pressure (standard level) **a_3** = 925, 850, 700, ..hPa = missing for lowland stations	Pa, –1, 5
	B 10 009		Geopotential height of the standard level **hhh** = missing for lowland stations	gpm, 0, 5
			Temperature and humidity	
	B 07 032		Height of sensor above local ground (for temperature measurement)	m, 2, 5
	B 12 101		Temperature/dry-bulb temperature (sc. 2) **s_nTTT**	°C, 2, 4
	B 12 103		Dew-point temperature (sc. 2) **$s_nT_dT_dT_d$**	°C, 2, 4
	B 13 003		Relative humidity	%, 0, 3
	B 07 032		***Height of sensor above local ground*** (set to missing to cancel the previous value)	m, 2, 5
			Visibility	
	B 20 001		Horizontal visibility **VV**	m, –1, 4
			Cloud data	
	D 02 004	B 20 010	Cloud cover (total) **N** If N = 9, then B 20 010 = 113 %, if N = /, then B 20 010 = missing.	%, 0, 3
		B 08 002	Vertical significance if C_L are observed, then B 08 002 = 7 (low cloud), if C_L are not observed and C_M are observed, then B 08 002 = 8 (middle cloud), if only C_H are observed, B 08 002 = 0, if N = 9, then B 08 002 = 5, if N = 0, then B 08 002 = 62, if N = /, then B 08 002 = missing.	Code table, 0, 2
		B 20 011	Cloud amount (of low or middle clouds) **N_h** If N = 0, then B 20 011 = 0, if N = 9, then B 20 011 = 9, if N = /, then B 20 011 = missing.	Code table, 0, 2
		B 20 013	Height of base of cloud **h** If N = 0 or /, then B 20 013 = missing.	m, –1, 4
		B 20 012	Cloud type (low clouds) **C_L** B 20 012 = C_L + 30, if N = 0, then B 20 012 = 30, if N = 9 or /, then B 20 012 = 62.	Code table, 0, 2
		B 20 012	Cloud type (middle clouds) **C_M** B 20 012 = C_M + 20, if N = 0, then B 20 012 = 20, if N = 9 or / or C_M = /, then B 20 012 = 61.	Code table, 0, 2
		B 20 012	Cloud type (high clouds) **C_H** 0 20 012 = C_H + 10, if N = 0, then B 20 012 = 10, if N = 9 or / or C_H = /, then B 20 012 = 60.	Code table, 0, 2
	R 01 000		Delayed replication of the next 1 descriptor	
	D 02 005	B 08 002	Vertical significance In any Cb layer, B 08 002 = 4 , else: in the first replication: if N = 9, then B 08 002 = 5,	Code table, 0, 2

D 07 087			**"Instantaneous" parameters of sequence D07089**	
			if N = /, then B 08 002 = missing, else B 08 002 = 1; in the other replications B 08 002 = 2, 3, 4**.**	
		B 20 011	Cloud amount **N_s** In the first replication: If N = /, then B 20 011 = missing, else B 20 011 = **N_s**; in the other replications B 20 011 = **N_s**.	Code table, 0, 2
		B 20 012	Cloud type **C** if N = 9 or /, then B 20 012 = missing, else B 20 012 = **C**.	Code table, 0, 2
		B 20 013	Height of base of cloud **h_sh_s**	m, -1, 4
D 07 088			**"Period" parameters of sequence D 07 089**	
			Present and past weather	
	B 20 003		Present weather **ww**	Code table, 0, 3
	B 04 024		Time period At 00, 06, 12, 18 UTC **= - 6.** At 03, 09,15, 21 UTC **= - 3.**	Hour, 0, 4
	B 20 004		Past weather (1) **W_1**	Code table, 0, 2
	B 20 005		Past weather (2) **W_2**	Code table, 0, 2
			Evaporation	
	B 04 024		Time period in hours **= - 24**	Hour, 0, 4
	B 02 004		Type of instrument for evaporation or crop type for evapotranspiration **i_E**	Code table, 0, 2
	B 13 033		Evaporation /evapotranspiration **EEE**	kg m^{-2}, 1, 4
			Sunshine	
	R 02 002		Replicate next 2 descriptors 2 times	
	B 04 024		Time period in hours In the first replication **= - 24,** in the second replication **= - 1.**	Hour, 0, 4
	B 14 031		Total sunshine in minutes In the first replication **SSS** in the second replication **SS**	Minute, 0, 4
			Precipitation	
	R 02 002		Replicate next 2 descriptors 2 times	
	B 04 024		Time period in hours **t_R**	Hour, 0, 4
	B 13 011		Total precipitation **RRR** no precipitation = 0 trace = - 0.1	kg m^{-2}, 1, 5 Encoded as: -00001
			Extreme temperatures	
	B 07 032		Height of sensor above local ground (for temperature measurement)	m, 2, 5
	B 04 024		Time period in hours **= - 12**	Hour, 0, 4
	B 12 111		Maximum temperature at height and over period specified **$s_nT_xT_xT_x$**	°C, 2, 4
	B 04 024		Time period in hours **= - 12**	Hour, 0, 4
	B 12 112		Minimum temperature at height and over period specified **$s_nT_nT_nT_n$**	°C, 2, 4

D 07 087			**“Instantaneous” parameters of sequence D07089**	
			Wind data	
	B 07 032		Height of sensor above local ground (for wind measurement)	m, 2, 5
	B 02 002		Type for instrumentation for wind measurement **i_w**	Flag table, 0, 2
	B 08 021		Time significance **= 2** (time averaged)	Code table, 0, 2
	B 04 025		Time period **= - 10** (or number of minutes after a significant change of wind, if any)	Minute, 0, 4
	B 11 001		Wind direction **dd** If dd = 00 (calm) or dd = 99 (variable), B 11 001 = 0.	Degree true, 0, 3
	B 11 002		Wind speed **ff**	m s^{-1}, 1, 4
	B 08 021		Time significance (set to **missing** to cancel the previous value)	Code table, 0, 2

Notes:

(1) CREX Edition 1 is recommended for manual encoding of data.

(2) If the addition of another “instantaneous” parameter is required, the sequence descriptor D07089 shall be replaced by D07087 D07088, and the B-descriptor for this parameter shall be placed between D07087 and D07088.

(3) If the addition of another “period” parameter is required, the sequence D 07 089 shall be supplemented by the relevant B-descriptor provided no additional “instantaneous” parameter is needed.

Example

CREX++

T000103 A000 D07089++

63 894 1 2006 02 22 06 00 -0687 03920 00552 00564 10062 10122 //// // 0000 ///// ///// 00125 2900 2320 071 ///// 2500 038 07 03 0073 31 20 10 0001 01 03 08 0073 005 -0006 00 00 -0024 01 0085 -0024 0690 -0001 0060 -0024 00000 //// ///// 00125 //// //// -0012 2210 01000 14 02 -0010 060 0025 //++
7777

Example with optional check digits:

CREX++

T000103 A000 D07089 E++

063 1894 21 32006 402 522 606 700 8-0687 903920 000552 100564 210062 310122 4//// 5// 60000 7///// 8///// 900125 02900 12320 2071 3///// 42500 5038 607 703 80073 931 020 110 20001 301 403 508 60073 7005 8-0006 900 000 1-0024 201 30085 4-0024 50690 6-0001 70060 8-0024 900000 0//// 1///// 200125 3//// 4//// 5-0012 62210 701000 814 902 0-0010 1060 20025 3//++
7777

NEW PROPOSED METAR/SPECI AND TAF TEMPLATES

Proposal for modification of B-descriptors for representation of visibility

Newly proposed B-descriptors for prevailing and minimum horizontal visibility with a Note to be added under Class 20:

Table reference		BUFR				CREX		
F X Y	Element name	Unit	Scale	Reference value	Data width	Unit	Scale	Data width
0 20 060	Prevailing horizontal visibility (5)	m	-1	0	10	m	-1	4
0 20 059	Minimum horizontal visibility	m	-1	0	9	m	-1	3

(5) A prevailing visibility value of 10000 m before scaling (after scaling 1000) shall be used to report prevailing visibility 10 km or more.

Unambiguous conversion from TDCF data to TAC data

Unambiguous conversion from TDCF data to TAC data is requested by ICAO as well as by many end users, it is proposed to add two notes under the BUFR Table D, Category 7:
Notes:

(x) Within 3 07 045, 3 07 048 and 3 07 053, wind speed shall be reported in the same units as in the original TAC data and:
0 11 083 shall be set to missing, if wind speed is reported in knots or m s^{-1} in TAC data,
0 11 084 shall be set to missing, if wind speed is reported in km h^{-1} or m s^{-1} in TAC data.

(y) Within 3 07 045, 3 07 048 and 3 07 053, maximum wind speed (gusts) shall be reported in the same units as in the original TAC data and:
0 11 085 shall be set to missing, if maximum wind speed is reported in knots or m s^{-1} in TAC data,
0 11 086 shall be set to missing, if maximum wind speed is reported in km h^{-1} or m s^{-1} in TAC data.

Following the Notes (x) an (y), the wind speed (and the maximum wind speed) will be reported only in meters per second in the BUFR message if these parameters are reported in meters per second in the original TAC data.

Below are the METAR/SPECI/TAF templates and BUFR/CREX B and D descriptors with the proposed modifications, corrections and additions. It should replace the current file in the WMO Server.

Proposed additions to BUFR Table D

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
		(Main part of METAR/SPECI), replacing 3 07 011	
3 07 045	0 01 063	ICAO location indicator	CCCC
	0 08 079	Aviation product status (routine, special, corrected, not available)	**METAR SPECI COR**
	0 02 001	Type of station	(**AUTO**)
	3 01 011	Year, month, day	YY
	3 01 012	Hour, minute	GGgg
	3 01 023	Latitude-longitude (coarse accuracy)	
	0 07 030	Height of station ground above mean sea level	
	0 07 031	Height of barometer above mean sea level	
	0 07 032	Height of sensor above local ground = 10m (if the actual value is not available)	
	0 11 001	Wind direction	ddd
	0 11 016	Extreme counterclockwise wind direction of a variable wind	$d_nd_nd_n$
	0 11 017	Extreme clockwise wind direction of a variable wind	$d_xd_xd_x$
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 083	Wind speed (km/h) (see Note (x))	ff

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
	0 11 084	Wind speed (knots) (see Note (x))	ff
	0 11 002	Wind speed (m/s) (see Note (x))	ff
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 085	Maximum wind speed (gusts) (km/h) (see Note (y))	f_mf_m
	0 11 086	Maximum wind speed (gusts) (knots) (see Note (y))	f_mf_m
	0 11 041	Maximum wind speed (gusts) (m/s) (see Note (y))	f_mf_m
	0 08 054	Qualifier for wind speed or wind gusts = missing (to cancel the previous value)	
	0 07 032	Height of sensor above local ground = 2m (if the actual value is not available)	
	0 12 023	Temperature (Celsius)	T´T´
	0 12 024	Dew point (Celsius)	$T´_dT´_d$
	0 07 032	Height of sensor above local ground = missing (to cancel the previous value)	
	0 10 052	Altimeter setting (QNH)	**Q**$P_HP_HP_HP_H$
	0 20 009	General Weather Indicator TAF/METAR	**CAVOK**
		(METAR/SPECI visibility)	
3 07 046	0 20 060	Prevailing visibility	VVVV or VVVV**NDV**
	1 02 000	Delayed replication of two descriptors	
	0 31 001	Number of replication (up to 2)	
	0 05 021	Bearing or azimuth (direction of minimum visibility observed)	D_v
	0 20 059	Minimum visibility	$V_NV_NV_NV_N$
		(METAR/SPECI/TAF clouds), replacing 3 07 015	
3 07 047	1 05 000	Delayed replication of 5 descriptor	
	0 31 001	Number of replications	
	0 08 002	Vertical significance	
	0 20 011	Cloud amount	$N_sN_sN_s$
	0 20 012	Cloud type	CC
	0 20 013	Height of base of cloud (m)	$h_sh_sh_s$
	0 20 092	Height of base of cloud (feet)	$h_sh_sh_s$
	0 20 002	Vertical visibility (m)	**VV**$h_sh_sh_s$
	0 20 091	Vertical visibility (feet)	**VV**$h_sh_sh_s$
		(Trend type forecast), replacing 3 07 018	
3 07 048	0 08 016	Change qualifier for trend type forecast	TTTTT **NOSIG**
	1 02 000	Delayed replication of two descriptors	
	0 31 001	Number of replications (0, 1 or 2)	
	0 08 017	Qualifier for time of forecast change	TT
	3 01 012	Time of change	GGgg
	1 12 000	Delayed replication of twelve descriptors	
	0 31 000	Short delayed replication count (0 or 1)	
	0 07 032	Height of sensor above local ground = 10m (if the actual value is not available)	
	0 11 001	Wind direction	ddd
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 083	Wind speed (km/h) (see Note (x))	ff
	0 11 084	Wind speed (knots) (see Note (x))	ff
	0 11 002	Wind speed (m/s) (see Note (x))	ff
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 085	Maximum wind speed (gusts) (km/h) (see Note (y))	f_mf_m
	0 11 086	Maximum wind speed (gusts) (knots) (see Note (y))	f_mf_m
	0 11 041	Maximum wind speed (gusts) (m/s) (see Note (y))	f_mf_m
	0 08 054	Qualifier for wind speed or wind gusts = missing (to cancel the previous value)	
	0 07 032	Height of sensor above local ground = missing (to cancel the previous value)	

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
	0 20 009	General weather indicator	**CAVOK NSW NSC**
	1 01 000	Delayed replication of one descriptor	
	0 31 000	Short delayed replication count (0 or 1)	
	0 20 060	Prevailing visibility	VVVV
	07 014	Weather intensity and phenomena	w'w'
	3 07 047	METAR/SPECI/TAF clouds	$N_sN_sN_sh_sh_sh_s$
		(Sea conditions WT_sT_s/SS')	
3 07 049	1 02 000	Delayed replication of 2 descriptors	
	0 31 000	Short delayed replication factor (0 or 1)	
	0 22 043	Sea/water temperature	T_sT_s
	0 22 021	Height of waves	S'
		(Runway state $R_RR_RE_RE_RC_Re_Re_RB_RB_R$)	
3 07 050	1 01 000	Delayed replication of one descriptor	
	0 31 000	Short delayed replication factor (0 or 1)	
	0 20 085	General condition of runway	**SNOCLO**
	1 02 000	Delayed replication of two descriptors	
	0 31 001	Number of replications	
	0 01 064	Runway designator	D_RD_R
	0 20 085	General condition of runway	**CLRD//**
	1 05 000	Delayed replication of 5 descriptors	
	0 31 001	Number of replications	
	0 01 064	Runway designator	D_RD_R
	0 20 086	Runway deposits	E_R
	0 20 087	Runway contamination	C_R
	0 20 088	Depth of runway deposits	e_Re_R
	0 20 089	Runway friction coefficient	B_RB_R
		(Full METAR/SPECI), *replacing 3 07 021*	
3 07 051	3 07 045	Main part of METAR/SPECI data	
	3 07 06	Visibility	VVVV or VVVV**NDV** $V_NV_NV_NV_Nv_v$
	3 07 013	Runway visual range	**R**$D_RD_R/V_RV_RV_RV_R$
	3 07 014	Weather intensity and phenomena	w'w'
	3 07 047	Clouds	$N_sN_sN_sh_sh_sh_s$
	3 07 016	Recent weather phenomena	**RE**w'w'
	3 07 017	Runway shear	**WS R**D_RD_R
	3 07 049	Sea conditions	**W**T_sT_s/SS'
	3 07 050	Runway state	**R**D_RD_R $E_RC_Re_Re_RB_RB_R$
	1 01 000	Delayed replication of one descriptor	
	0 31 001	Replication count (0 to 3 normally)	
	3 07 048	Trend type forecast	
		(Aerodrome forecast identification and time interval)	
3 07 052	0 01 063	ICAO location identifier	CCCC
	0 08 039	Time significance = 0 (Issue time of forecast)	
	3 01 011	Year, Month, Day	YY
	3 01 012	Hour, Minute	GGgg
	0 08 079	Aviation product status	**COR CNL AMD NIL**
	0 08 039	Time ignificance = 1 (Time of commencement of period of the forecast)	
	3 01 011	Year, Month, Day	Y_1Y_1
	3 01 012	Hour, Minute	G_1G_1
	0 08 039	Time significance = 2 (Time of ending of period of the forecast)	
	3 01 011	Year, Month, Day	Y_2Y2
	3 01 012	Hour, Minute	G_2G_2

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
	3 01 023	Latitude-longitude (coarse accuracy)	
	0 07 030	Height of station ground above mean sea level	
	0 07 031	Height of barometer above mean sea level	
		(Forecast weather at an aerodrome)	
3 07 053	0 07 032	Height of sensor above local ground = 10m (if the actual value is not available)	
	0 11 001	Wind direction	ddd
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 083	Wind speed (km/h) (see Note (x))	ff
	0 11 084	Wind speed (knots) (see Note (x))	ff
	0 11 02	Wind speed (m/s) (see Note (x))	ff
	0 08 054	Qualifier for wind speed or wind gusts	**P**
	0 11 085	Maximum wind speed (gusts) (km/h) (see Note (y))	f_mf_m
	0 11 086	Maximum wind speed (gusts) (knots) (see Note (y))	f_mf_m
	0 11 041	Maximum wind speed (gusts) (m/s) (see Note (y))	f_mf_m
	0 08 054	Qualifier for wind speed or wind gusts = missing (to cancel the previous value)	
	0 07 032	Height of sensor above local ground = missing (to cancel the previous value)	
	0 20 009	General weather indicator	**CAVOK NSW NSC**
	0 20 060	Prevailing visibility	VVVV
	3 07 014	Weather	w'w'
	3 07 047	Cloud layer(s)	$N_sN_sN_sh_sh_sh_s$
		(Forecast of extreme temperatures)	
3 07 054	0 07 032	Height of sensor above local ground = 2m (if the actual value is not available)	
	0 08 039	Time significance = 3 (Forecast time of maximum temperature)	
	0 04 003	Day	
	0 04 004	Hour	G_FG_F
	0 08 023	First order statistics = 3 (Minimum)	
	0 12 023	Temperature (Celsius)	T_FT_F
	0 08 039	Time significance = 4 (Forecast time of minimum temperature)	
	0 04 003	Day	
	0 04 004	Hour	G_FG_F
	0 08 023	First order statistics = 2 (Maximum)	
	0 12 023	Temperature (Celsius)	T_FT_F
	0 08 023	First order statistics = missing (to cancel the previous value)	
	0 07 032	Height of sensor above local ground = missing (to cancel the previous value)	
		(Change indicator and forecast changes)	
3 07 055	0 33 045	Probability of following event	C_2C_2
	0 08 016	Change qualifier for an aerodrome forecast	TTTTTT
	0 08 039	Time significance = 5 (Time of beginning of the forecast change)	
	0 04 003	Day	
	3 01 012	Hour, Minute	GGgg
	0 08 039	Time significance = 6 (Time of ending of the forecast change)	
	0 04 003	Day	
	3 01 012	Hour, Minute	G_eG_e
	3 07 053	Forecast conditions during or after change	

F X Y	Reference	Element/Sequence name	METAR/SPECI/TAF Representation
		(Aerodrome forecast – full TAF)	
3 07 056	3 07 052	Identification and time interval	
	3 07 053	Forecast	
	3 07 054	Extreme temperatures forecast	
	1 01 000	Delayed replication of one descriptor	
	0 31 001	Replication factor	
	3 07 055	Forecast change	

The following notes are proposed to be included under BUFR Table D, Category 7.

Notes:

(x) Within 3 07 045, 3 07 048 and 3 07 053, wind speed shall be reported in the same units as in the original TAC data and:
0 11 083 shall be set to missing, if wind speed is reported in knots or m s^{-1} in TAC data,
0 11 084 shall be set to missing, if wind speed is reported in km h^{-1} or m s^{-1} in TAC data.

(y) Within 3 07 045, 3 07 048 and 3 07 053, maximum wind speed (gusts) shall be reported in the same units as in the original TAC data and:
0 11 085 shall be set to missing, if maximum wind speed is reported in knots or m s^{-1} in TAC data,
0 11 086 shall be set to missing, if maximum wind speed is reported in km h^{-1} or m s^{-1} in TAC data.

Proposed additions to BUFR/CREX table B.

Table reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Reference	Width	Unit	Scale	Width
0 08 039	Time significance (Aviation forecast)	Code table	0	0	6	Code table	0	2
0 08 054	Qualifier for wind speed or wind gusts	Code table	0	0	3	Code table	0	1
0 11 083	Wind speed	km h^{-1}	0	0	9	km h^{-1}	0	3
0 11 084	Wind speed	knot	0	0	8	knot	0	3
0 11 085	Maximum wind gust speed	km h^{-1}	0	0	9	km h^{-1}	0	3
0 11 086	Maximum wind gust speed	knot	0	0	8	knot	0	3
0 12 023	Temperature	Celsius	0	-99	8	Celsius	0	2
0 12 024	Dew point temperature	Celsius	0	-99	8	Celsius	0	2
0 20 059	Minimum horizontal visibility	m	-1	0	9	m	-1	3
0 20 60	Prevailing horizontal visibility (5)	m	-1	0	10	m	-1	4
0 20 085	General condition of runway	Code table	0	0	4	Code table	0	1
0 20 086	Runway deposits	Code table	0	0	4	Code table	0	1
0 20 087	Runway contamination	Code table	0	0	4	Code table	0	1
0 20 088	Depth of runway deposits	m	3	0	12	m	0	4
0 20089	Runway friction coefficient	Code table	0	0	7	Code table	0	2
0 20 092	Height of base of cloud	Foot	-2	0	10	Foot	-2	3
0 20 091	Vertical visibility	Foot	-2	0	10	Foot	-2	3

The following Note (5) is proposed to be included under Class 20:

(5) A prevailing visibility value of 10000 m before scaling (after scaling 1000) shall be used to report prevailing visibility 10 km or more.

Proposed additions to BUFR Code/Flag tables

0 08 039	
Time significance (Aviation forecast)	
Code figure	
0	Issue time of forecast
1	Time of commencement of period of the forecast
2	Time of ending of period of the forecast
3	Forecast time of maximum temperature
4	Forecast time of minimum temperature
5	Time of beginning of the forecast change
6	Time of ending of the forecast change
7…62	Reserved
63	Missing
0 08 054	
Qualification of wind speed or wind gusts	
0	Wind speed or gust is as reported
1	Wind speed is greater than that reported (**P** in **METAR/TAF/SPECI**)
2-6	Reserved
7	Missing
0 20 085	
General condition of runway	
0	Cleared (**CLRD**//)
1	All runways closed (**SNOCLO**)
2-14	Reserved
15	Missing

0 20 086	
Runway deposits	
Code figure	
0	Clear and dry
1	Damp
2	Wet with water patches
3	Rime and frost covered (depth normally less than 1 mm)
4	Dry snow
5	Wet snow
6	Slush
7	Ice
8	Compacted or rolled snow
9	Frozen ruts or ridges
10-14	Reserved
15	Missing or not reported (e.g. due to runway clearance in progress)

0 20 087	
Runway contamination	
Code figure	
0	Reserved
1	Less than 10% of runway covered
2	11% to 25% of runway covered
3-4	Reserved
5	25% to 50% of runway covered
6-8	Reserved
9	51% to 100% of runway covered
10-14	Reserved
15	Missing or not reported (e.g. due to runway clearance in progress)

0 20 089	
Runway friction coefficient	
0	0.00
1	0.01
2…88	0.02…0.88
89	0.89
90	0.90
91	Braking action poor
92	Braking action medium to poor
93	Braking action medium
94	Braking action medium to good
95	Braking action good
96-98	Reserved
99	Unreliable
100-126	Reserved
127	Missing, not reported and/or runway not operational.

Proposed additions to BUFR Code table 0 08 079

0 08 079	
Aviation product status	
Code figure	
0	Normal issue
1	Correction to a previously issued product (**COR**)
2	Amendment to a previously issued product (**AMD**)
3	Correction to a previously issued amended product (**COR AMD**)
4	Cancellation of a previously issued product (**CNL**)
5	No product available (**NIL**)
6	Special report (**SPECI**)
7	Corrected special report (**SPECI COR**)
8…14	Reserved
15	Missing or not applicable

FOR SBUV/2 OZONE DATA

New Table D sequence

		(Ozone data)
3 10 019	0 01 007	Satellite identifier
	0 02 019	Satellite instruments (“624” = SBUV/2)
	3 01 011	Date
	3 01 013	Time
	3 01 023	Lat/Long
	0 07 025	Solar zenith angle
	0 08 021	Time significance (“28” = Start of scan)
	0 07 025	Solar zenith angle
	0 08 021	Time significance (“29” = End of scan)
	0 07 025	Solar zenith angle
	0 08 021	Time significance (“Missing” = Cancel)
	0 08 029	Remotely-sensed surface type
	0 05 040	Orbit number
	0 08 075	Ascending/descending orbit qualifier
	0 08 003	Vertical significance (“0” = Surface)
	0 10 004	Pressure (terrain)
	0 08 003	Vertical significance (“Missing” = Cancel)
	2 07 002	Increase scale, reference value and data width
	0 15 001	Total ozone
	2 07 000	Cancel increase scale, reference value and data width
	0 33 070	Total ozone quality
	0 15 030	Aerosol contamination index

	2 07 002	Increase scale, reference value and data width
	0 20 081	Cloud amount in segment (cloud fraction)
	2 07 000	Cancel increase scale, reference value and data width
	0 08 003	Vertical significance (“2” = Cloud top)
	0 33 042	Type of limit represented by following value (“0” = Exclusive lower limit)
	0 07 004	Pressure
	2 07 002	Increase scale, reference value and data width
	0 15 001	Total ozone (below cloud top pressure)
	2 07 000	Cancel increase scale, reference value and data width
	0 08 003	Vertical significance (“Missing” = Cancel)
	1 13 021	Repeat next 13 descriptors 21 times
	0 07 004	Pressure (at bottom of layer)
	0 07 004	Pressure (at top of layer)
	2 07 002	Increase scale, reference value and data width
	0 08 021	Time significance (“27” = First guess)
	0 15 005	Ozone p
	0 08 021	Time significance (“Missing” = Cancel)
	0 15 005	Ozone p
	0 33 007	% confidence
	2 07 000	Cancel increase scale, reference value and data width
	0 08 026	Matrix significance (“4” = Row of averaging kernel matrix)
	1 01 020	Repeat next descriptor 20 times
	0 25 143	Linear coefficient
	0 08 026	Matrix significance (“Missing” = Cancel)
	0 08 043	Atmospheric chemical type (“0” = Ozone)
	1 09 015	Repeat next 9 descriptors 15 times
	0 07 004	Pressure
	0 08 090	Decimal scale of following Table B values
	2 07 006	Increase scale, reference value and data width
	0 15 008	Scaled mixing ratio (volumetric)
	2 07 000	Cancel increase scale, reference value and data width
	0 08 090	Decimal scale of following Table B values (“Missing” = Cancel)
	2 07 002	Increase scale, reference value and data width
	0 33 007	% confidence
	2 07 000	Cancel increase scale, reference value and data width
	0 08 043	Atmospheric chemical type (“Missing” = Cancel)
	0 33 071	Profile ozone quality
	1 08 008	Repeat next 8 descriptors 8 times
	2 02 124	Change scale
	2 01 107	Change data width
	0 02 071	Spectrographic wavelength
	2 01 000	Cancel change data width
	2 02 000	Cancel change scale
	2 07 002	Increase scale, reference value and data width
	0 20 081	Cloud amount in segment (cloud fraction)
	2 07 000	Cancel increase scale, reference value and data width

New Table B descriptors

Table Reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Ref. value	Data width	Unit	Scale	Data width
0 15 030	Aerosol contamination index (see Note 6)	Numeric	2	-1000	12	Numeric	2	4
0 33 070	Total ozone quality	Code table	0	0	4	Code table	0	2
0 33 071	Profile ozone quality	Code table	0	0	4	Code table	0	2

BUFR Code Tables for SBUV/2 Data:

0-33-070 Total ozone quality

0	Good retrieval
1	Bad aerosol information flag or NOAA-16 radiance anomaly
2	Solar zenith angle greater than 84 degrees
3	380nm residue greater than limit
4	Ozone inconsistency
5	Difference between profile ozone and step 3 total ozone exceeds threshold (set to 25 DU)
6	Step 1 ozone iteration did not converge
7	Any channel residue greater than 16 or bad radiance
8-14	Reserved
15	Missing

0-33-071 Profile ozone quality

0	Good retrieval
1	Solar zenith angle greater than 84 degrees
2	Difference between step 3 and profile total ozone greater than limit (25 DU)
3	Average final residue for wavelengths used in retrieval greater than threshold
4	Final residue greater than 3 times a priori error
5	Difference between retrieved and a priori greater than 3 times a priori error
6	Non-convergent solution
7	Upper level profile anomaly or stray light anomaly
8	Initial residue greater than 18.0 N-value units
9-14	Reserved
15	Missing

Add the following note to BUFR/CREX Class 15:

(6) For this descriptor, numbers less than -1 indicate a predominance of scattering aerosols, increasing in concentration as the number becomes more negative. Numbers greater than +1 indicate a predominance of absorptive aerosols, increasing in concentration as the number becomes more positive. Numbers between -1 and +1 indicate clouds or noise.

Add the following entries to the existing code table for
0-08-029 Remotely-sensed surface type

4	Low inland (below sea level)
5	Mix of land and water
6	Mix of land and low inland
7-254	Reserved

FOR SATELLITE DATA EXCHANGES

Addition of the following entries to Common Code Table C-13:

Category 003 - Vertical soundings (satellite)
Please add:
002 - ATOVS
003 - AMSU-A
004 - AMSU-B
005 - HIRS
006 - MHS
007 - IASI

Category 012 - Surface data (satellite)
Please add
007 - ASCAT

The acronyms have the following meanings:

ATOVS = Advanced TIROS Operational Vertical Sounder (TIROS = Television and Infrared Observation Satellite)
AMSU-A = Advanced Microwave Sounding Unit-A
AMSU-B = Advanced Microwave Sounding Unit-B
HIRS = High Resolution Infrared Radiation Sounder
MHS = Microwave Humidity Sounder
IASI = Infrared Atmospheric Sounding Interferometer
ASCAT = Advanced Wind Scatterometer

MODIFIED DESCRIPTORS FOR REPRESENTATION OF RADIATION DATA

The modified descriptors for representation of radiation data and Notes (1) and (2) under Class 14 are proposed to be introduced in Version 14 of WMO FM 94 BUFR tables.

a) Insufficient range of values

It is proposed to modify data widths and reference values of descriptors for representation of radiation data to become:

Table reference	Element name	Unit	Scale	Refer. value	Data width	kJ m^{-2}		J cm^{-2}	
						max upward	max downward	max upward	max downward
0 14 001	Long-wave radiation, integrated over 24 hours	J m^{-2}	–3	**–65536**	**17**	-65536	65534	-6553.6	6553.4
0 14 002	Long-wave radiation, integrated over period specified	J m^{-2}	–3	**–65536**	**17**	-65536	65534	-6553.6	6553.4
0 14 003	Short-wave radiation, integrated over 24 hours	J m^{-2}	–3	**–65536**	**17**	-65536	65534	-6553.6	6553.4
0 14 004	Short-wave radiation, integrated over period specified	J m^{-2}	–3	**–65536**	**17**	-65536	65534	-6553.6	6553.4
0 14 011	Net long-wave radiation, integrated over 24 hours	J m^{-2}	–3	**–65536**	**17**	-65536	65534	-6553.6	6553.4
0 14 012	Net long-wave radiation, integrated over period specified	J m^{-2}	–3	**–65536**	**17**	-65536	65534	-6553.6	6553.4
0 14 013	Net short-wave radiation, integrated over 24 hours	J m^{-2}	–3	**–65536**	**17**	-65536	65534	-6553.6	6553.4
0 14 014	Net short-wave radiation, integrated over period specified	J m^{-2}	–3	**–65536**	**17**	-65536	65534	-6553.6	6553.4
						min	max	min	max
0 14 028	Global solar radiation (high accuracy), integrated over period specified	J m^{-2}	-2	0	**20**	0	104857.4	0	10485.74
0 14 029	Diffuse solar radiation (high accuracy), integrated over period specified	J m^{-2}	-2	0	**20**	0	104857.4	0	10485.74
0 14 030	Direct solar radiation (high accuracy), integrated over period specified	J m^{-2}	-2	0	**20**	0	104857.4	0	10485.74

b) Sign of downward and upward radiation

It is proposed to modify the **Notes (1) and (2) under Class 14** to read:

(1) Downward radiation shall be assigned positive values.
(2) Upward radiation shall be assigned negative values.

c) Correction of 0 14 017 and 0 14 018

The existing descriptors 0 14 017 and 014 018 are proposed to be modified in Version 14 of WMO FM 94 BUFR tables to read:

Table reference	Element name	Unit	Scale	Reference value	Data width
0 14 017	Instantaneous long-wave radiation	W m^{-2}	**0**	**-512**	**10**
0 14 018	Instantaneous short-wave radiation	W m^{-2}	**0**	-2048	12

NATIONAL AND WMO STATION IDENTIFICATION AND THE AWS BUFR TEMPLATES

Table reference		BUFR				CREX		
F X Y	Element name	Unit	Scale	Reference value	Data width	Unit	Scale	Data width
0 01 101	State identifier	Code table	0	0	10	Code table	0	z
0 01 102	National station number	Numeric	0	0	30	Numeric	0	9

Table reference	Table reference	Element name
3 01 089		*National station identification*
	0 01 101	State identifier
	0 01 102	National station number

Table reference	Element name
3 07 091	*BUFR template for surface observations from one-hour period with national and WMO station identification*

Code Table 0 01 101: State identifier

Code figure	
0-99	Reserved
100	Algeria
101	Angola
102	Benin
103	Botswana
104	Burkina Faso
105	Burundi
106	Cameroon
107	Cape Verde

Code figure	
108	Central African Republic
109	Chad
110	Comoros
111	Congo
112	Cote d'Ivoire
113	Democratic Republic of the Congo
114	Djibouti
115	Egypt
116	Eritrea
117	Ethiopia
118	France (RA I)
119	Gabon
120	Gambia
121	Ghana
122	Guinea
123	Guinea-Bissau
124	Kenya
125	Lesotho
126	Liberia
127	Libyan Arab Jamahiriya
128	Madagascar
129	Malawi
130	Mali
131	Mauritania
132	Mauritius
133	Morocco
134	Mozambique
135	Namibia
136	Niger
137	Nigeria
138	Portugal (RA I)
139	Rwanda
140	Sao Tom and Prince
141	Senegal
142	Seychelles
143	Sierra Leone
144	Somalia
145	South Africa
146	Spain
147	Sudan
148	Swaziland
149	Togo
150	Tunisia
151	Uganda
152	United Kingdom of Great Britain and Northern Ireland (RA I)
153	United Republic of Tanzania
154	Zambia
155	Zimbabwe
156 -199	Reserved for Region I (Africa)
200	Afghanistan
201	Bahrain
202	Bangladesh

Code figure	
203	Bhutan
204	Cambodia
205	China
206	Democratic People's Republic of Korea
207	Hong Kong, China
208	India
209	Iran, Islamic Republic of
210	Iraq
211	Japan
212	Kazakhstan
213	Kuwait
214	Kyrgyz Republic
215	Lao People's Democratic Republic
216	Macao, China
217	Maldives
218	Mongolia
219	Myanmar
220	Nepal
221	Oman
222	Pakistan
223	Qatar
224	Republic of Korea
225	Republic of Yemen
226	Russian Federation (RA II)
227	Saudi Arabia
228	Sri Lanka
229	Tajikistan
230	Thailand
231	Turkmenistan
232	United Arab Emirates
233	Uzbekistan
234	Viet Nam, Socialist Republic of
235 -299	Reserved for Region II (Asia)
300	Argentina
301	Bolivia
302	Brazil
303	Chile
304	Colombia
305	Ecuador
306	France
307	Guyana
308	Paraguay
309	Peru
310	Suriname
311	Uruguay
312	Venezuela
313 -399	Reserved for Region III (South America)
400	Antigua and Barbuda
401	Bahamas
402	Barbados
403	Belize

Code figure	
404	British Caribbean Territories
405	Canada
406	Colombia
407	Costa Rica
408	Cuba
409	Dominica
410	Dominican Republic
411	El Salvador
412	France (RA IV)
413	Guatemala
414	Haiti
415	Honduras
416	Jamaica
417	Mexico
418	Netherlands Antilles and Aruba
419	Nicaragua
420	Panama
421	Saint Lucia
422	Trinidad and Tobago
423	United Kingdom of Great Britain and Northern Ireland (RA IV)
424	United States of America (RA IV)
425	Venezuela
426 - 499	Reserved for Region IV (North America, Central America and the Caribbean)
500	Australia
501	Brunei Darussalam
502	Cook Islands
503	Fiji
504	French Polynesia
505	Indonesia
506	Kiribati
507	Malaysia
508	Micronesia, Federated States of
509	New Caledonia
510	New Zealand
511	Niue
512	Papua New Guinea
513	Philippines
514	Samoa
515	Singapore
516	Solomon Islands
517	Tonga
518	United Kingdom of Great Britain and Northern Ireland (RA V)
519	United States of America (RA V)
520	Vanuatu
521 – 599	Reserved for Region V (South-West Pacific)
600	Albania
601	Armenia
602	Austria
603	Azerbaijan
604	Belarus

Code figure	
605	Belgium
606	Bosnia and Herzegovina
607	Bulgaria
608	Croatia
609	Cyprus
610	Czech Republic
611	Denmark
612	Estonia
613	Finland
614	France (RA VI)
615	Georgia
616	Germany
617	Greece
618	Hungary
619	Iceland
620	Ireland
621	Israel
622	Italy
623	Jordan
624	Kazakhstan
625	Latvia
626	Lebanon
627	Lithuania
628	Luxembourg
629	Malta
630	Monaco
631	Montenegro
632	Netherlands
633	Norway
634	Poland
635	Portugal (RA VI)
636	Republic of Moldova
637	Romania
638	Russian Federation (RA VI)
639	Serbia
640	Slovakia
641	Slovenia
642	Spain
643	Sweden
644	Switzerland
645	Syrian Arab Republic
646	The Former Yugoslav Republic of Macedonia
647	Turkey
648	Ukraine
649	United Kingdom of Great Britain and Northern Ireland (RA VI)
650 - 699	Reserved for Region VI (Europe)
700 – 999	Reserved
1000 – 1022	Not used
1023	Missing value

BUFR template for surface observations from one-hour period

TM 307091

			Unit, scale
3 01 089		National station identification	
	0 01 101	State identifier (1)	Code table, 0
	0 01 102	National station number (1)	Numeric, 0
3 01 090		Fixed surface station identification; time, horizontal and vertical co-ordinates	
	3 01 004	Surface station identification	
		WMO block number(1)	Numeric, 0
		WMO station number(1)	Numeric, 0
		Station or site name	CCITT IA5, 0
		Type of station	Code table, 0
	3 01 011	Year(2)	Year, 0
		Month(2)	Month, 0
		Day(2)	Day, 0
	3 01 012	Hour(2)	Hour, 0
		Minute(2)	Minute, 0
	3 01 021	Latitude (high accuracy)	Degree, 5
		Longitude (high accuracy)	Degree, 5
	0 07 030	Height of station ground above mean sea level	m, 1
	0 07 031	Height of barometer above mean sea level	m, 1
0 08 010		Surface qualifier (for temperature data)	Code table, 0
3 01 091		Surface station instrumentation	
	0 02 180	Main present weather detecting system	Code table, 0
	0 02 181	Supplementary present weather sensor	Flag table, 0
	0 02 182	Visibility measurement system	Code table, 0
	0 02 183	Cloud detection system	Code table, 0
	0 02 184	Type of lightning detection sensor	Code table, 0
	0 02 179	Type of sky condition algorithm	Code table, 0
	0 02 186	Capability to detect precipitation phenomena	Flag table, 0
	0 02 187	Capability to detect other weather phenomena	Flag table, 0
	0 02 188	Capability to detect obscuration	Flag table, 0
	0 02 189	Capability to discriminate lightning strikes	Flag table, 0
3 02 001	0 10 004	Pressure	Pa, –1
	0 10 051	Pressure reduced to mean sea level	Pa, –1
	0 10 061	3-hour pressure change(3)	Pa, –1
	0 10 063	Characteristic of pressure tendency(3)	Code table, 0
0 07 004		Pressure (standard level)	Pa, –1
0 10 009		Geopotential height of the standard level	gpm, 0
3 02 072		Temperature and humidity data	
	0 07 032	Height of sensor above local ground	m, 2
	0 07 033	Height of sensor above water surface	m, 1
	0 12 101	Temperature/dry-bulb temperature (scale 2)	K, 2
	0 12 103	Dew-point temperature (scale 2)	K, 2
	0 13 003	Relative humidity	%, 0
1 03 000		Delayed replication of 3 descriptors	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
1 01 005		Replicate 1 descriptor five times	
3 07 063	0 07 061	Depth below land surface	m, 2
	0 12 130	Soil temperature (scale 2)	K, 2
0 07 061		Depth below land surface (set to missing to cancel the previous value)	m, 2
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 069		Visibility data	
	0 07 032	Height of sensor above local ground	m, 2

			Unit, scale
	0 07 033	Height of sensor above water surface	m, 1
	0 33 041	Attribute of following value	Code table, 0
	0 20 001	Horizontal visibility	m, –1
0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, 2
0 07 033		Height of sensor above water surface (set to missing to cancel the previous value)	m, 1
1 05 000		Delayed replication of 5 descriptors	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
0 20 031		Ice deposit (thickness)	m, 2
0 20 032		Rate of ice accretion	Code table, 0
0 02 038		Method of sea surface temperature measurement	Code table, 0
0 22 043		Sea/water temperature (scale 2)	K, 2
3 02 021	0 22 001	Direction of waves	Degree true, 0
	0 22 011	Period of waves	s, 0
	0 22 021	Height of waves	m, 1
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 078		State of ground and snow depth measurement	
	0 02 176	Method of state of ground measurement	Code table, 0
	0 20 062	State of ground (with or without snow)	Code table, 0
	0 02 177	Method of snow depth measurement	Code table, 0
	0 13 013	Total snow depth	m, 2
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 073		Cloud data	
	0 20 010	Cloud cover (total)	%, 0
	1 05 004	Replicate 5 descriptors four times	
	0 08 002	Vertical significance	Code table, 0
	0 20 011	Cloud amount	Code table, 0
	0 20 012	Cloud type	Code table, 0
	0 33 041	Attribute of following value	Code table, 0
	0 20 013	Height of base of cloud	m, -1
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 074		Present and past weather	
	0 20 003	Present weather[4]	Code table, 0
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 20 004	Past weather (1) [4]	Code table, 0
	0 20 005	Past weather (2) [4]	Code table, 0
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 075		Intensity of precipitation, size of precipitation element	
	0 08 021	Time significance (= 2 (time averaged))	Code table, 0
	0 04 025	Time period (= - 10 minutes)	Minute, 0
	0 13 055	Intensity of precipitation	Kg m^{-2} s^{-1}, 4
	0 13 058	Size of precipitation element	m, 4
	0 08 021	Time significance (= missing value)	Code table, 0
1 02 000		Delayed replication of 2 descriptors	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
0 04 025		Time period (= - 10 minutes)	Minute, 0
3 02 076		Precipitation, obscuration and other phenomena	
	0 20 021	Type of precipitation	Flag table, 0
	0 20 022	Character of precipitation	*Code table, 0*
	0 26 020	Duration of precipitation [5]	Minute, 0
	0 20 023	Other weather phenomena	Flag table, 0
	0 20 024	Intensity of phenomena	Code table, 0
	0 20 025	Obscuration	Flag table, 0

			Unit, scale
	0 20 026	Character of obscuration	Code table, 0
3 02 071		Wind data from one-hour period	
	0 07 032	Height of sensor above local ground	m, 2
	0 07 033	Height of sensor above water surface	m, 1
	0 08 021	Time significance (= 2 (time averaged))	Code table, 0
	0 04 025	Time period (= - 10 minutes, or number of minutes after a significant change of wind, if any)	Minute, 0
	0 11 001	Wind direction	Degree true, 0
	0 11 002	Wind speed	m s^{-1}, 1
	0 08 021	Time significance (= missing value)	Code table, 0
	1 03 002	Replicate next 3 descriptors 2 times	
	0 04 025	Time period (= - 10 minutes in the first replication, = - 60 minutes in the second replication)	Minute, 0
	0 11 043	Maximum wind gust direction	Degree true, 0
	0 11 041	Maximum wind gust speed	m s^{-1}, 1
	0 04 025	Time period (= - 10 minutes)	Minute, 0
	0 11 016	Extreme counterclockwise wind direction of a variable wind	Degree true, 0
	0 11 017	Extreme clockwise wind direction of a variable wind	Degree true, 0
3 02 077		Extreme temperature data	
	0 07 032	Height of sensor above local ground	m, 2
	0 07 033	Height of sensor above water surface	m, 1
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 12 111	Maximum temperature (scale 2) at height and over period specified	K, 2
	0 12 112	Minimum temperature (scale 2) at height and over period specified	K, 2
	0 07 032	Height of sensor above local ground (for ground temperature)	m, 2
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 12 112	Minimum temperature (scale 2) at height and over period specified (for ground temperature)	K, 2
0 07 033		Height of sensor above water surface (set to missing to cancel the previous value)	m, 1
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 079		Precipitation measurement	
	0 07 032	Height of sensor above local ground	m, 2
	0 02 175	Method of precipitation measurement	Code table, 0
	0 02 178	Method of liquid water content measurement of precipitation	Code table, 0
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 13 011	Total precipitation / total water equivalent of snow	kg m^{-2}, 1
0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, 2
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 080		Evaporation measurement	
	0 02 185	*Method of evaporation measurement*	Code table, 0
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 13 033	Evaporation /evapotranspiration	kg m^{-2}, 1
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 081		Total sunshine data	
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 14 031	Total sunshine	Minute, 0
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0

			Unit, scale
3 02 082		Radiation data	
	0 04 025	Time period (= - 60 minutes)	Minute, 0
	0 14 002	Long-wave radiation, integrated over period specified	J m^{-2}, -3
	0 14 004	Short-wave radiation, integrated over period specified	J m^{-2}, -3
	0 14 016	Net radiation, integrated over period specified	J m^{-2}, -4
	0 14 028	Global solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
	0 14 029	Diffuse solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
	0 14 030	Direct solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
1 02 000		Delayed replication of 2 descriptors	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
0 04 025		Time period (= - 10 minutes)	Minute, 0
0 13 059		Number of flashes	Numeric, 0
1 01 000		Delayed replication of 1 descriptor	
0 31 000		Short delayed descriptor replication factor	Numeric, 0
3 02 083		First order statistics of P, W, T, U data	
	0 04 025	Time period (= -10 minutes)	Minute, 0
	0 08 023	First order statistics (= 9 (best estimate of standard deviation)) (6)	Code table, 0
	0 10 004	Pressure	Pa, –1
	0 11 001	Wind direction	Degree true, 0
	0 11 002	Wind speed	m s^{-1}, 1
	0 12 101	Temperature/dry-bulb temperature (scale 2)	K, 2
	0 13 003	Relative humidity	%, 0
	0 08 023	First order statistics (= missing value)	Code table, 0
0 33 005		Quality information (AWS data)	Flag table, 0
0 33 006		Internal measurement status information (AWS)	Code table, 0

Notes:

(1) 0 01 101 (WMO Member State identifier) and 0 01 102 (National AWS number) shall be used to identify a station within the national numbering system that is completely independent of the WMO international numbering system. The WMO international identification 0 01 001 (WMO block number) and 0 01 002 (WMO station number) shall be reported if available for the particular station.

(2) The time identification refers to the end of the one-hour period.

(3) 0 10 061 (3-hour pressure change) and 0 10 063 (Characteristic of pressure tendency) are included in this template, although they refer to 3-hour period preceding the time of observation.

(4) Present weather may be represented only by 0 20 003, especially if reported from a manned non-automated station. When encoding present weather reported from an automatic weather station, the sequence of descriptors (proposed under 3 02 076) should be used, if applicable.

(5) Duration of precipitation (in minutes) represents number of minutes in which any precipitation was registered.

(6) Best estimate of standard deviation is counted out of a set of samples (signal measurements) recorded within the period specified; it should be reported as a missing value, if the measurements of the relevant element are not available from a part of the period specified by 0 04 025.

(7) If reporting nominal values is required, the template shall be supplemented with 3 07 093.

NEW DESCRIPTORS FOR GFA (GRAPHICAL FORECAST AIRMET) DATA

Proposed Table B entries

Table Reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Ref. value	Data width	Unit	Scale	Data width
0 01 039	Graphical Area Forecast (GFA) sequence identifier	CCITT IA5	0	0	40	Character	0	5
0 20 006	Flight Rules	Code Table	0	0	3	Code Table	0	1

Add the following new code/flag table values for BUFR/CREX Table B descriptors:

0 08 040

34 Freezing level base
35 Freezing level top
36 Flight level base
37 Flight level top

0 08 041

8 IFR Ceiling and Visibility
9 Mountain obscuration
10 Strong surface wind
11 Freezing level
12 Multiple freezing level

0 20 023

13 Wind shear

0 20 025

14 Cloud
15 Precipitation

Code tables for proposed new Table B descriptors:

Code Figure	**0 20 006 Flight Rules**
0	Low Instrument Flight Rules - Ceiling < 500 feet and/or Visibility < 1 mile
1	Instrument Flight Rules - Ceiling < 1000 feet and/or Visibility < 3 miles
2	Marginal Visual Flight Rules – 1000 feet <= Ceiling < 3000 feet and/or 3 miles <= Visibility < 5 miles
3	Visual Flight Rules - Ceiling >= 3000 feet and/or Visibility >= 5 miles
4-6	Reserved
7	Missing value

New Table D descriptors:

		(Graphical AIRMET Sierra)
3 16 071	3 01 014	Time period (for which AIRMET is valid)
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 075	GFA IFR Ceiling and Visibility
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 076	GFA Mountain Obscuration
		(Graphical AIRMET Tango)
3 16 072	3 01 014	Time period (for which AIRMET is valid)
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 077	GFA Turbulence
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 078	GFA Strong Surface Wind
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 079	GFA Low-Level Wind Shear

		(Graphical AIRMET Zulu)
3 16 073	3 01 014	Time period (for which AIRMET is valid)
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 080	GFA Icing
	1 01 000	Delayed replication
	0 31 002	Replication Factor
	3 16 081	GFA Freezing Level

		(GFA Identifier and Observed/Forecast Location)
3 16 074	0 01 039	GFA sequence identifier
	0 08 021	Time significance, 4=Forecast, 16=Analysis
	3 01 014	Time period (for which hazard is being observed/forecast)
	3 01 027	Description of Feature
	0 08 021	Time Significance, Missing=Cancel

		(GFA IFR Ceiling and Visibility)
3 16 075	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD, 4=CNL
	0 08 041	Data significance, 8=IFR Ceiling and Visibility
	3 16 074	GFA Identifier and Observed/Forecast Location
	0 20 006	Flight rules, 1=IFR
	0 33 042	Type of limit represented by following (cloud base) value, 2=Exclusive upper limit, 7=Missing
	0 20 013	Height of base of cloud
	0 33 042	Type of limit represented by following (visibility) value, 2=Exclusive upper limit, 7=Missing
	0 20 001	Horizontal visibility
	0 20 025	Obscuration
	0 20 026	Character of obscuration, 6=Blowing, 15=Missing
	0 08 041	Data significance, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel
		(GFA Mountain Obscuration)
3 16 076	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD, 4=CNL
	0 08 041	Data significance, 9=Mountain obscuration
	3 16 074	GFA Identifier and Observed/Forecast Location
	0 20 006	Flight rules, 1=IFR
	0 20 025	Obscuration
	0 20 026	Character of obscuration, 6=Blowing, 15=Missing
	0 08 041	Data significance, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel
		(GFA Turbulence)
3 16 077	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD, 4=CNL
	0 08 011	Meteorological feature, 13=Turbulence
	3 16 074	GFA Identifier and Observed/Forecast Location
	0 11 031	Degree of turbulence, 6=Moderate
	0 08 011	Meteorological feature, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel
		(GFA Strong Surface Wind)
3 16 078	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD, 4=CNL
	0 08 041	Data significance, 10=Strong surface wind
	3 16 074	GFA Identifier and Observed/Forecast Location
	0 33 042	Type of limit represented by following (wind speed) value, 0=Exclusive lower limit

	0 11 012	Wind speed at 10 m
	0 08 041	Data significance, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel

		(GFA Low-Level Wind Shear)
3 16 079	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD, 4=CNL
	0 08 011	Meteorological feature, 16=Phenomenon
	3 16 074	GFA Identifier and Observed/Forecast Location
	0 20 023	Other weather phenomena, bit 12=Wind shear
	0 20 024	Intensity of phenomena
	0 08 011	Meteorological feature, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel

		(GFA Icing)
3 16 080	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD, 4=CNL
	0 08 011	Meteorological feature, 15=Airframe Icing
	3 16 074	GFA Identifier and Observed/Forecast Location
	0 20 041	Airframe icing, 4=Moderate Icing
	0 08 011	Meteorological feature, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel
		(GFA Freezing Level)
3 16 081	0 08 079	Product Status, 0=Normal, 1=COR, 2=AMD, 3=COR AMD, 4=CNL
	0 08 041	Data significance, 11=Freezing level, 12=Multiple freezing level
	3 16 074	GFA Identifier and Observed/Forecast Location
	0 08 041	Data significance, Missing=Cancel
	0 08 079	Product Status, Missing=Cancel

FOR THE ENCODING OF THE JASON2 OGDR DATA

It is proposed to use the following sequence of entries for the encoding of the JASON2 OGDR data (new entries are in *italicized and underlined*):

BUFR	Description	Unit	Scale	Reference	Width
F X Y	**Satellite**				
0 01 007	SATELLITE IDENTIFIER				
0 02 019	SATELLITE INSTRUMENTS				
0 01 096	ACQUISITION STATION IDENTIFIER				
0 25 061	SOFTWARE IDENTIFICATION				
0 05 044	SATELLITE CYCLE NUMBER				
0 05 040	ORBIT NUMBER				
0 01 030	NUMERICAL MODEL IDENTIFIER				
	Datation				
0 04 001	YEAR				
0 04 002	MONTH				
0 04 003	DAY				
0 04 004	HOUR				
0 04 005	MINUTE				
0 04 007	SECONDS WITHIN A MINUTE				
	Location and Surface Type				
0 05 001	LATITUDE (HIGH ACCURACY)				
0 06 001	LONGITUDE (HIGH ACCURACY)				

BUFR	Description	Unit	Scale	Reference	Width
0 08 029	REMOTELY SENSED SURFACE TYPE				
0 08 074	ALTIMETER ECHO TYPE				
0 08 077	*RADIOMETER SENSED SURFACE TYPE*	*CODE TABLE*	*0*	*0*	*7*
	Flags				
0 40 011	*INTERPOLATION FLAG*	*FLAG TABLE*	*0*	*0*	*8*
0 25 097	*THREE DIMENSIONAL ERROR ESTIMATE OF THE NAVIGATOR ORBIT*	*CODE TABLE*	*0*	*0*	*4*
0 25 095	ALTIMETER STATE FLAG	CODE TABLE			
0 25 098	*ALTIMETER DATA QUALITY FLAG*	*FLAG TABLE*	*0*	*0*	*9*
0 25 099	*ALTIMETER CORRECTION QUALITY FLAG*	*FLAG TABLE*	*0*	*0*	*9*
0 21 144	ALTIMETER RAIN FLAG				
0 25 096	RADIOMETER STATE FLAG				
0 40 012	*RADIOMETER DATA QUALITY FLAG*	*FLAG TABLE*	*0*	*0*	*8*
0 40 013	*RADIOMETER BRIGHTNESS TEMPERATURE INTERPRETATION FLAG*	*CODE TABLE*	*0*	*0*	*3*
0 21 169	*ICE PRESENCE INDICATOR*	*CODE TABLE*	*0*	*0*	*2*
	Altimeter: Ku Band				
0 22 151	KU BAND OCEAN RANGE				
0 22 162	*RMS OF 20 Hz KU BAND OCEAN RANGE*	*M*	*3*	*0*	*16*
0 22 163	*NUMBER OF 20Hz VALID POINTS FOR KU BAND*	*NUMERIC*	*0*	*0*	*10*
0 25 160	*KU BAND NET INSTRUMENTAL CORRECTION*	*M*	*4*	*-120000*	*18*
0 25 133	SEA STATE BIAS CORRECTION ON KU BAND				
0 22 156	KU BAND SIGNIFICANT WAVE HEIGHT				
0 22 164	*RMS 20 HZ KU BAND SIGNIFICANT WAVE HEIGHT*	*M*	*3*	*0*	*16*
0 22 165	*NUMBER OF 20HZ VALID POINTS FOR KU BAND SIGNIFICANT WAVE HEIGHT*	*NUMERIC*	*0*	*0*	*10*
0 22 166	*KU BAND NET INSTRUMENTAL CORRECTION FOR SIGNIFICANT WAVE HEIGHT*	*M*	*3*	*-1000*	*11*
0 21 137	KU BAND CORRECTED OCEAN BACKSCATTER COEFFICIENT				
0 21 138	STD KU BAND CORRECTED OCEAN BACKSCATTER COEFFICIENT				
0 22 167	*NUMBER OF VALID POINTS FOR KU BAND BACKSCATTER*	*NUMERIC*	*0*	*0*	*10*
0 21 139	KU BAND NET INSTRUMENTAL CORRECTION FOR AGC				
0 21 118	ATTENUATION CORRECTION ON SIGMA-0				

BUFR	Description	Unit	Scale	Reference	Width
0 21 145	KU BAND AUTOMATIC GAIN CONTROL	DB	2	0	13
0 21 146	RMS KU BAND AUTOMATIC GAIN CONTROL	DB	2	0	8
0 21 147	NUMBER OF VALID POINTS FOR KU BAND AUTOMATIC GAIN CONTROL	NUMERIC	0	0	5
	Altimeter: C band				
0 22 168	C BAND OCEAN RANGE	M	3	0	31
0 22 169	RMS OF C BAND OCEAN RANGE	M	3	0	16
0 22 170	NUMBER OF 20Hz VALID POINTS FOR C BAND	NUMERIC	0	0	10
0 25 161	C BAND NET INSTRUMENTAL CORRECTION	M	4	-120000	18
0 25 162	SEA STATE BIAS CORRECTION ON C BAND	M	4	-6000	13
0 22 171	C BAND SIGNIFICANT WAVE HEIGHT	M	3	0	16
0 22 172	RMS 20HZ C BAND SIGNIFICANT WAVE HEIGHT	M	3	0	16
0 22 173	NUMBER OF 20HZ VALID POINTS FOR C BAND SIGNIFICANT WAVE HEIGHT	NUMERIC	0	0	10
0 22 174	C BAND NET INSTRUMENTAL CORRECTION FOR SIGNIFICANT WAVE HEIGHT	M	3	-1000	11
0 21 170	C BAND CORRECTED OCEAN BACKSCATTER COEFFICIENT	DB	2	-32768	16
0 21 171	RMS C BAND CORRECTED OCEAN BACKSCATTER COEFFICIENT	DB	2	-32768	16
0 22 175	NUMBER OF VALID POINTS FOR C BAND BACKSCATTER	NUMERIC	0	0	10
0 21 172	C BAND NET INSTRUMENTAL CORRECTION FOR AGC	DB	2	-2048	12
0 21 118	ATTENUATION CORRECTION ON SIGMA-0				
0 21 173	C BAND AUTOMATIC GAIN CONTROL	DB	2	0	13
0 21 174	RMS C BAND AUTOMATIC GAIN CONTROL	DB	2	0	9
0 21 175	NUMBER OF VALID POINTS FOR C BAND AUTOMATIC GAIN CONTROL	NUMERIC	0	0	10
	Radiometer				
0 02 153	SATELLITE CHANNEL CENTRE FREQUENCY				
0 12 063	BRIGHTNESS TEMPERATURE				
0 02 153	SATELLITE CHANNEL CENTRE FREQUENCY				
0 12 063	BRIGHTNESS TEMPERATURE				
0 02 153	SATELLITE CHANNEL CENTRE FREQUENCY				
0 12 063	BRIGHTNESS TEMPERATURE				
0 13 090	RADIOMETER WATER VAPOR CONTENT				
0 13 091	RADIOMETER LIQUID CONTENT				

BUFR	Description	Unit	Scale	Reference	Width
	Wind				
0 07 002	HEIGHT OR ALTITUDE				
0 11 097	*WIND SPEED FROM ALTIMETER*	*M/S*	*2*	*0*	*12*
0 11 098	*WIND SPEED FROM RADIOMETER*	*M/S*	*2*	*0*	*12*
0 07 002	HEIGHT OR ALTITUDE				
0 11 095	U COMPONENT OF THE MODEL WIND VECTOR				
0 11 096	V COMPONENT OF THE MODEL WIND VECTOR				
	Dynamic Topography				
0 10 096	*MEAN DYNAMIC TOPOGRAPHY*	*M*	*3*	*-131072*	*18*
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 10 101	*SQUARED OFF NADIR ANGLE OF THE SATELLITE FROM WAVEFORM DATA*	*DEGREES ^2*	*2*	*-32768*	*16*
0 25 132	IONOSPHERIC CORRECTION FROM MODEL ON KU BAND				
0 25 163	*ALTIMETER IONOSPHERIC CORRECTION ON KU BAND*	*M*	*3*	*-32768*	*16*
025 126	MODEL DRY TROPOSPHERIC CORRECTION				
0 25 128	MODEL WET TROPOSPHERIC CORRECTION				
0 25 164	*RADIOMETER WET TROPOSPHERIC CORRECTION*	*M*	*4*	*-5000*	*13*
0 10 085	MEAN SEA SURFACE HEIGHT				
0 10 097	*MEAN SEA SURFACE HEIGHT FROM ALTIMETER ONLY*	*M*	*3*	*-131072*	*18*
0 10 086	GEOID'S HEIGHT				
0 10 087	OCEAN DEPTH/LAND ELEVATION				
0 10 092	SOLID EARTH TIDE HEIGHT				
0 10 088	GEOCENTRIC OCEAN TIDE HEIGHT SOLUTION 1				
0 10 089	GEOCENTRIC OCEAN TIDE HEIGHT SOLUTION 2				
0 10 098	*LOADING TIDE HEIGHT GEOCENTRIC OCEAN TIDE SOLUTION 1*	*M*	*4*	*-2000*	*12*
0 10 099	*LOADING TIDE HEIGHT GEOCENTRIC OCEAN TIDE SOLUTION 2*	*M*	*4*	*-2000*	*12*
0 10 090	LONG PERIOD TIDE HEIGHT				
0 10 100	*N0N-EQUILIBRIUM LONG PERIOD TIDE HEIGHT*	*M*	*4*	*-2000*	*12*
0 10 093	GEOCENTRIC POLE TIDE HEIGHT				
0 25 127	SEA SURFACE HEIGHT CORRECTION DUE TO PRESSURE LOADING				
0 40 014	*HIGH FREQUENCY FLUCTUATIONS OF THE SEA SURFACE TOPOGRAPHY CORRECTION*	*M*	*4*	*-3000*	*13*

It is proposed to allocate the **Table D entry *3 40 005*** for the above sequence.

Proposal for code and flag tables

0 08 077

Radiometer sensed surface type

Code figure	
0	Land
1	Sea
2	Coastal
3	Open ocean or semi-enclosed sea
4	Enclosed sea or lake
5	Continental ice
6-126	Reserved
127	Missing value

0 40 011

Interpolation flag

Bit number	
1	Mean sea surface (MSS) interpolation flag
2	Ocean tide solution 1 interpolation flag (0=4 points over ocean, 1=less than 4 points)
3	Ocean tide solution 2 interpolation flag (0=4 points over ocean, 1=less than 4 points)
4	Meteorological data interpolation flag (0=4 points over ocean, 1=less than 4 points)
5	Spare
6	Spare
7	Spare
All 8 bits	Missing

0 25 090

Orbit state flag

Code figure	
0	Orbit computed during a manoeuvre
1	Adjusted mission operations orbit
2	Extrapolated mission operations orbit
3	Adjusted (preliminary/precise) orbit
4	(preliminary/precise) orbit is estimated during a manoeuvre period
5	(preliminary/precise) orbit is interpolated over a tracking data gap
6	(preliminary/precise) orbit is extrapolated for a duration less than 1 day
7	(preliminary/precise) orbit is extrapolated for a duration that ranges from 1 day to 2 days
8	(preliminary/precise) orbit is extrapolated for a duration larger than 2 days, or that the orbit is extrapolated just after a manoeuvre
9	DORIS† DIODE‡ navigator orbit
10 - 14	Reserved
15	Missing value

† DORIS stands for “Doppler Orbitography and Radio-positioning Integrated by Satellite”.
‡ DIODE means "Détermination Immédiate d'Orbite par Doris Embarqué" or immediate onboard orbit determination by DORIS. It is part of the DORIS instrument, which calculates the satellite's position and velocity.

0 25 097

Three dimensional error estimate of the navigator orbit

Code figure	
0	Ranges between 0 and 30 cm
1	Ranges between 30 and 60 cm
2	Ranges between 60 and 90 cm
3	Ranges between 90 and 120 cm
4	Ranges between 120 and 150 cm
5	Ranges between 150 and 180 cm
6	Ranges between 180 and 210 cm
7	Ranges between 210 and 240 cm
8	Ranges between 240 and 270 cm
9	Ranges larger than 270 cm
10 - 14	Reserved
15	Missing value

0 25 098

Altimeter data quality flag

Bit number	(0 is good, 1 is bad)
1	Ku band range
2	C band range
3	Ku band SWH*
4	C band SWH*
5	Ku band backscatter coefficient
6	C band backscatter coefficient
7	Off nadir angle from Ku band waveform parameters
8	Off nadir angle from platform
All 9 bits	Missing

* SWH stands for “Significant wave height”

0 25 099

Altimeter correction quality flag

Bit number	(0 is good, 1 is bad)
1	Ku band range instrumental correction
2	C band range instrumental correction
3	Ku band SWH* instrumental correction
4	C band SWH* instrumental correction
5	Ku band backscatter coefficient instrumental correction
6	C band backscatter coefficient instrumental correction
7	Spare
8	Spare
All 9 bits	Missing

* SWH stands for “Significant wave height”

0 40 012

Radiometer data quality flag

Bit number	(0 is good, 1 is bad)
1	18.7 GHz brightness temperature
2	23.8 GHz brightness temperature
3	34 GHz brightness temperature
4	Spare
5	Spare
6	Spare
7	Spare
All 8 bits	Missing

0 40 013

Radiometer brightness temperature interpretation flag

Code figure	
0	Interpolation with no gap between JMR§ data
1	Interpolation with gaps between JMR§ data
2	Extrapolation of JMR§ data
3	Failure of extrapolation and interpolation
4 - 6	Reserved
7	Missing

§ JMR stands for “JASON-1 Microwave Radiometer”

0 21 169

Ice presence indicator

Code figure	
0	No ice present
1	Ice present
2	Reserved
3	Missing

FOR SMOS SATELLITE DATA

Proposed new Table B entries

Table Reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Ref. value	Data width	Unit	Scale	Data width
001144	Snapshot identifier	Numeric	0	0	31	Numeric	0	10
015012	Total electron count per square metre	1/M**2	-16	0	6	1/M**2	-16	2
012165	Direct sun brightness temperature	K	0	0	23	K	0	7
012166	Snapshot accuracy	K	1	-4000	13	K	1	4
012167	Radiometric accuracy (pure polarisation)	K	1	0	9	K	1	3
012168	Radiometric accuracy (cross polarisation)	K	1	0	9	K	1	3
030010	Number of grid points	Numeric	0	0	13	Numeric	0	4
001124	Grid point identifier	Numeric	0	0	24	Numeric	0	8
007012	Grid point altitude	M	2	-50000	20	M	2	7
013048	Water fraction	%	1	0	10	%	1	4
012080	Brightness temperature real part	K	2	-10000	16	K	2	5
012081	Brightness temperature imaginary part	K	2	-10000	16	K	2	5
012082	Pixel radiometric accuracy	K	2	0	12	K	2	4
025081	Incidence angle	Degree	3	0	17	Degree	3	6
025082	Azimuth angle	Degree	3	0	19	Degree	3	6
025083	Faraday rotational angle	Degree	3	0	19	Degree	3	6
025084	Geometric rotational angle	Degree	5	0	26	Degree	5	8
027010	Footprint axis 1	M	-1	0	14	M	-1	5
028010	Footprint axis 2	M	-1	0	14	M	-1	5
025174	SMOS information flag	Flag table	0	0	14	Flag table	0	5
002099	Polarisation	Code table	0	0	3	Code table	0	1
033028	Snapshot overall quality	Code table	0	0	3	Code table	0	1

Note: In full polarisation the Level1c SMOS brightness temperature (BT) is complex number. The components of the complex BT are related to the Stokes parameters which are harmonic components of the brightness temperature. Third and fourth Stoke parameters can be negative, leading to negative values of the complex BT.

Proposed new BUFR Table D sequence for SMOS data

312070	001007
	002019
	001144
	001124
	030010
	301011
	301013
	301021
	007012
	015012
	012165
	012166
	012167
	012168
	027010
	028010
	002099
	013048
	025081
	025082
	025083
	025084
	012080
	012081
	012082
	025174
	033028

Add new Code tables:

0 33 028 - Snapshot overall quality

Code	Meaning
1	Nominal
2	Degraded by SW error; any error reported by the algorithms
3	Degraded by instrument error
4	Degraded by corrupted /missing ADF
5-6	Reserved
7	Missing value

0 02 099 Polarisation

Code	Meaning
0	HH polarisation
1	VV polarisation
2	HV polarisation real valued component
3	HV polarisation imaginary valued component
4-6	Reserved
7	Missing value

Add new Flag table:

0 25 174 - SMOS information flag

Bit number	Meaning
1	Pixel is affected by RFI effects
2	Pixel is located in the hexagonal Alias direction centred on Sun alias
3	Pixel is close to the border delimiting the extended Alias free zone
4	Pixel is inside the extended Alias free zone
5	Pixel is inside the exclusive of Alias free zone
6	Pixel is located in a zone where a Moon Alias was reconstructed
7	Pixel is located in a zone where Sun reflection has been detected
8	Pixel is located in a zone where Sun Alias was reconstructed
9	Flat target transformation has been performed during image reconstruction of this pixel
10	Scene has been combined with an adjustment scene in opposite polarisation during image reconstruction to account for cross-polarisation leakage
11	Direct Moon correction has been performed during image reconstruction of this pixel
12	Reflected Sun correction has been performed during image reconstruction of this pixel
13	Direct Sun correction has been performed during image reconstruction of this image
All 14	Missing value

Add the following new Sub category in Common Code Table C-13:

Data category	International sub-category
101 Image data (satellite)	007 SMOS data

Add the following new satellite identifier in Common Code Table C-5:

46 SMOS

Add the following new satellite instrument in Common Code Table C-8:

176	ESA	Radiometer	MIRAS	Microwave Imaging Radiometer Using Aperture Synthesis

FOR GOME EXPERIMENT DATA

3–10–018 Ozone data

001007 **–** Satellite identifier
005040 **–** Orbit number
004001 – Year
004043 **–** Day of year
004004 – Hour
004005 – Minute
004006 **–** Second
207002 **–** Increase scale, reference value and data width
026030 – Measurement integration time
207000 **–** Cancel increase scale, reference value and data width
005002 **–** Latitude
006002 **–** Longitude
033072 – Ozone error
007025 **–** Solar zenith angle
005022 **–** Solar azimuth angle
207002 **–** Increase scale, reference value and data width
015001 **–** Total ozone
207000 **–** Cancel increase scale, reference value and data width
008003 - Vertical significance (“0” = surface)
207001 **–** Increase scale, reference value and data width
010004 – Pressure (terrain)

207000 - Cancel increase scale, reference value and data width
008003 - Vertical significance (“Missing” = Cancel)
008003 - Vertical significance (“2” = Cloud top)
033042 - Type of limit represented by following value (“0” = Exclusive lower limit)
207001 - Increase scale, reference value and data width
007004 – Pressure
207000 **–** Cancel increase scale, reference value and data width
207002 **–** Increase scale, reference value and data width
015001 **–** Total ozone (below cloud top pressure)
207000 **–** Cancel increase scale, reference value and data width
008003 – Vertical significance (“Missing” = Cancel)
207002 **–** Increase scale, reference value and data width
020081 – Cloud amount in segment (cloud fraction)
207000 **–** Cancel increase scale, reference value and data width
020065 – Snow cover
008029 – Remotely-sensed surface type
207004 **–** Increase scale, reference value and data width
015030 **–** Aerosol contamination index
207000 **–** Cancel increase scale, reference value and data width
008075 **–** Ascending/descending orbit qualifier

Table Reference	Element name	BUFR				CREX		
F X Y		Unit	Scale	Ref. value	Data width	Unit	Scale	Data width
0 26 030	Measurement integration time	Second	2	0	8	Second	2	3
0 33 072	Ozone error	Code table	0	0	5	Code table	0	2

0-33-072 Ozone error

0	Good retrieval
1	Reflectivity out of range
2	Larger Pixels (Number of cross-track pixels less than 32) or backward scans Error
3	Solar zenith angle greater than 88
4	Latitude/longitude out of range
5	Viewing zenith angle or solar zenith angle out of range
6	Step-one process failed in general
7	First guess ozone out of range
8	Too many iterations (exceed 8)
9	Step-one residue calculation failed
10	Step-two process failed in general
11	First guess ozone profile out of range
12	Step-two ozone value out of range
13	Step-two residue calculation failed
14	Step-three process failed in general
15	Polarization Correction Accuracy Alert
16	Radiance or irradiance less or equal to zero
17-30	Reserved
31	Missing

METOP GOME-2 BUFR TEMPLATE

3 22 028

		ELEMENT NAME
1	001007	SATELLITE IDENTIFIER
2	002019	SATELLITE INSTRUMENTS
3	004001	YEAR
4	004002	MONTH
5	004003	DAY
6	004004	HOUR
7	004005	MINUTE
8	004006	SECOND
9	005001	LATITUDE (HIGH ACCURACY)
10	006001	LONGITUDE (HIGH ACCURACY)
11	027001	LATITUDE (HIGH ACCURACY)
12	028001	LONGITUDE (HIGH ACCURACY)
13	027001	LATITUDE (HIGH ACCURACY)
14	028001	LONGITUDE (HIGH ACCURACY)
15	027001	LATITUDE (HIGH ACCURACY)
16	028001	LONGITUDE (HIGH ACCURACY)
17	027001	LATITUDE (HIGH ACCURACY)
18	028001	LONGITUDE (HIGH ACCURACY)
19	010001	HEIGHT OF LAND SURFACE
20	014019	SURFACE ALBEDO
21	007025	SOLAR ZENITH ANGLE
22	010080	VIEWING ZENITH ANGLE
23	005023	SUN TO SATELLITE AZIMUTH DIFFERENCE
24	020010	CLOUD COVER (TOTAL)
25	008003	VERTICAL SIGNIFICANCE (SATELLITE OBSERVATIONS)
26	007004	PRESSURE
27	014026	ALBEDO AT THE TOP OF CLOUDS
28	020014	HEIGHT OF TOP OF CLOUD
29	013093	CLOUD OPTICAL THICKNESS
30	105000	DELAYED REPLICATION OF FIVE DESCRIPTORS
31	031001	DELAYED DESCRIPTOR REPLICATION FACTOR
32	007004	PRESSURE
33	007004	PRESSURE
34	008043	ATMOSPHERIC CHEMICAL OR PHISICAL CONSTITUENT TYPE
35	008044	CAS REGISTRY NUMBER
36	015021	INTEGRATED MASS DENSITY

A new category 22 for Chemical and Aerosol sequences is proposed to be used.

BUFR TABLE D AND CODE TABLE ENTRIES FOR ENCODING OF ALL SKY RADIANCE DATA

New code table entries

In order to describe the type of clouds from which cloudy radiances are associated, it is necessary to add three new entries to the code table 0-08-003, “Vertical significance (satellite observations)”, highlighted in grey as follows:

"Vertical significance (satellite observations)", 0-08-003

Code	Meaning
0	Surface
1	Base of Satellite sounding
2	Cloud Top
3	Tropopause
4	Precipitable water
5	Sounding Radiances
6	Mean Temperatures
7	Ozone
8	Low cloud
8	Med cloud
8	High cloud
11-62	Reserved
63	Missing value

New sequence descriptors

It is proposed to add three new sequence descriptors to Table D for the encoding of all sky radiance data. These are described below:

Sequence	**Number of descriptors**	**Descriptors / sub-sequences**
All sky radiance product main sequence		
310027	12	301071 Product information
		301011 Date
		301013 Time
		301021 Latitude / longitude
		030021 Number of pixels per row
		030022 Number of pixels per column
		010002 Orbit height
		304036 All sky radiance cloud coverage
		002152 Satellite instrument used
		002167 Radiance computational method
		101011 Replication operator
		304035 All sky radiance data
Cloud coverage		
304036	12	020082 Amount of segment cloud free
		008012 Land-Sea Qualifier: Sea
		020082 Amount of segment cloud free (sea)
		008012 Cancel qualifier
		020081 Cloud amount in segment
		008003 Vertical significance: Low cloud
		020081 Cloud amount in segment (low cloud)
		008003 Vertical significance: Mid cloud
		020081 Cloud amount in segment (mid cloud)
		008003 Vertical significance: High cloud
		020081 Cloud amount in segment (high cloud)
		008003 Cancel significance
All sky radiance data		
304035	15	002153 Satellite channel centre frequency
		002154 Satellite channel band width
		012063 Brightness temperature
		008001 Pixel type: clear
		012063 Brightness temperature (clear)
		008001 Pixel type: cloudy
		012063 Brightness temperature (cloudy)
		008001 Cancel type
		008003 Vertical significance: low cloud
		012063 Brightness temperature (low cloud)
		008003 Vertical_significance: mid cloud
		012063 Brightness temperature (mid cloud)
		008003 Vertical_significance: high cloud
		012063 Brightness temperature (high cloud)
		008003 Cancel_significance

BUFR TEMPLATE FOR REPRESENTATION OF SYNOP DATA WITH SUPPLEMENTARY INFORMATION ON ONE-HOUR OBSERVATIONS

This template is proposed to be used for representation of surface observation data from both automatic stations and manned stations. This template is also suitable for SYNOP observation data, by including parameters covering periods longer than one hour.
Entries from the SYNOP BUFR template **TM 307080** are indicated by an asterisk ***** in the column **S**. Entries from the AWS BUFR template **TM 307091** are indicated by an asterisk ***** in the column **A**.
Entries used by both templates are not marked.

TM 307096 - BUFR template for representation of SYNOP data with supplementary information on one-hour observations

3 07 096		**Sequence for representation of SYNOP data with supplementary information on one-hour observations**
	3 01 090	Fixed surface station identification, time, horizontal and vertical coordinates
	3 01 089	**National station identification**
	0 08 010	Surface qualifier (for temperature data)
	3 01 091	Surface station instrumentation
	3 02 084	**"Instantaneous" data of sequence 307096**
	3 02 085	**"Period" data of sequence 307096**
	0 33 005	Quality information (AWS data)
	0 33 006	Internal measurement status information (AWS)

This BUFR template further expands as follows:

				S	**A**		**Unit, scale**
3 01 090						**Surface station identification; time, horizontal and vertical co-ordinates**	
	3 01 004					**Surface station identification**	
		0 01 001				WMO block number	Numeric, 0
		0 01 002				WMO station number	Numeric, 0
		0 01 015				Station or site name	CCITT IA5, 0
		0 02 001				Type of station	Code table, 0
	3 01 011	0 04 001				Year	Year, 0
		0 04 002				Month	Month, 0
		0 04 003				Day	Day, 0
	3 01 012	0 04 004				Hour	Hour, 0
		0 04 005				Minute	Minute, 0
	3 01 021	0 05 001				Latitude (high accuracy)	Degree, 5
		0 06 001				Longitude (high accuracy)	Degree, 5
	0 07 030					Height of station ground above mean sea level	m, 1
	0 07 031					Height of barometer above mean sea level	m, 1
3 01 089					*	**National station identification**	
	0 01 101				*	State identifier (see Note 1)	Code table, 0
	0 01 102				*	National station number (see Note 1)	Numeric, 0
0 08 010					*****	Surface qualifier (for temperature data)	Code table, 0
3 01 091					*****	**Surface station instrumentation**	
	0 02 180				*****	Main present weather detecting system	Code table, 0
	0 02 181				*****	Supplementary present weather sensor	Flag table, 0
	0 02 182				*****	Visibility measurement system	Code table, 0
	0 02 183				*****	Cloud detection system	Code table, 0
	0 02 184				*****	Type of lightning detection sensor	Code table, 0
	0 02 179				*****	Type of sky condition algorithm	Code table, 0
	0 02 186				*****	Capability to detect precipitation phenomena	Flag table, 0
	0 02 187				*****	Capability to detect other weather phenomena	Flag table, 0
	0 02 188				*****	Capability to detect obscuration	Flag table, 0

				S	A		Unit, scale
	0 02 189				*	Capability to discriminate lightning strikes	Flag table, 0
3 02 084						**"Instantaneous" data of sequence 307096**	
	3 02 031					**Pressure data**	
		3 02 001	0 10 004			Pressure	Pa, –1
			0 10 051			Pressure reduced to mean sea level	Pa, –1
			0 10 061			3-hour pressure change	Pa, –1
			0 10 063			Characteristic of pressure tendency	Code table, 0
		0 10 062		*		24-hour pressure change $\mathbf{p_{24}p_{24}p_{24}}$	Pa, –1
		0 07 004				Pressure (standard level)	Pa, –1
		0 10 009				Geopotential height of the standard level	gpm, 0
	3 02 072					**Temperature and humidity data**	
		0 07 032				Height of sensor above local ground	m, 2
		0 07 033			*	Height of sensor above water surface	m, 1
		0 12 101				Temperature/dry-bulb temperature (scale 2)	K, 2
		0 12 103				Dew-point temperature (scale 2)	K, 2
		0 13 003				Relative humidity	%, 0
	1 03 000					Delayed replication of 3 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	1 01 005				*	Replicate one descriptor five times	
	3 07 063	0 07 061			*	Depth below land surface	m, 2
		0 12 130			*	Soil temperature (scale 2)	K, 2
	0 07 061				*	Depth below land surface (set to missing to cancel the previous value)	m, 2
						Visibility data	
	1 01 000					Delayed replication of 1 descriptor	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	3 02 069	0 07 032				Height of sensor above local ground	m, 2
		0 07 033			*	Height of sensor above water surface	m, 1
		0 33 041			*	Attribute of following value	Code table, 0
		0 20 001				Horizontal visibility	m, –1
	0 07 032				*	Height of sensor above local ground (set to missing to cancel the previous value)	m, 2
	0 07 033				*	Height of sensor above water surface (set to missing to cancel the previous value)	m, 1
						Marine data	
	1 05 000					Delayed replication of 5 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	0 20 031				*	Ice deposit (thickness)	m, 2
	0 20 032				*	Rate of ice accretion	Code table, 0
	0 02 038				*	Method of sea surface temperature measurement	Code table, 0
	0 22 043				*	Sea/water temperature (scale 2)	K, 2
	3 02 021	0 22 001			*	Direction of waves	Degree true, 0
		0 22 011			*	Period of waves	s, 0
		0 22 021			*	Height of waves	m, 1
						State of ground and snow depth measurement	
	1 01 000					Delayed replication of 1 descriptor	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	3 02 078	0 02 176			*	Method of state of ground measurement	Code table, 0
		0 20 062				State of ground (with or without snow)	Code table, 0
		0 02 177			*	Method of snow depth measurement	Code table, 0
		0 13 013				Total snow depth	m, 2
	0 12 113			*		Ground minimum temperature (scale 2), past 12 hours $\mathbf{s_nT_gT_g}$	K, 2

				S	A		Unit, scale
						Cloud data	
	1 01 000					Delayed replication of 1 descriptor	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	3 02 004	0 20 010				Cloud cover (total)	%, 0
		0 08 002		*		Vertical significance	Code table, 0
		0 20 011		*		Cloud amount (of low or middle clouds) **N_h**	Code table, 0
		0 20 013		*		Height of base of cloud **h**	m, –1
		0 20 012		*		Cloud type (low clouds C_L) **C_L**	Code table, 0
		0 20 012		*		Cloud type (middle clouds C_M) **C_M**	Code table, 0
		0 20 012		*		Cloud type (high clouds C_H) **C_H**	Code table, 0
	1 05 000					Delayed replication of 5 descriptors	
	0 31 001			*		Delayed descriptor replication factor	Numeric, 0
	0 08 002					Vertical significance	Code table, 0
	0 20 011					Cloud amount	Code table, 0
	0 20 012					Cloud type	Code table, 0
	0 33 041				*	Attribute of following value	Code table, 0
	0 20 013					Height of base of cloud	m, -1
						Clouds with bases below station level	
	3 02 036	1 05 000		*		Delayed replication of 5 descriptors	
		0 31 001		*		Delayed descriptor replication factor	Numeric, 0
		0 08 002		*		Vertical significance	Code table, 0
		0 20 011		*		Cloud amount **N'**	Code table, 0
		0 20 012		*		Cloud type **C'**	Code table, 0
		0 20 014		*		Height of top of cloud **H'H'**	m, -1
		0 20 017		*		Cloud top description **C_t**	Code table, 0
	1 01 000					Delayed replication of 1 descriptor	
	0 31 000					Short delayed descriptor replication factor	Numeric, 0
				*		**Direction of cloud drift $6D_LD_MD_H$**	
	3 02 047	1 02 003		*		Replicate 2 descriptors 3 times	
		0 08 002		*		Vertical significance (7= low cloud, 8= middle cloud, 9 = high cloud)	Code table, 0
		0 20 054		*		True direction from which clouds are moving **$D_LD_MD_H$**	Degree true, 0
	0 08 002			*		Vertical significance (set to missing to cancel the previous value)	Code table, 0
				*		**Direction and elevation of cloud $57CD_ae_C$**	
	1 01 000					Delayed replication of 1 descriptor	
	0 31 000					Short delayed descriptor replication factor	Numeric, 0
	3 02 048	0 05 021		*		Bearing or azimuth **D_a**	Degree true, 2
		0 07 021		*		Elevation angle **e_C**	Degree, 2
		0 20 012		*		Cloud type **C**	Code table, 0
		0 05 021		*		Bearing or azimuth (set to missing to cancel the previous value)	Degree true, 2
		0 07 021		*		Elevation angle (set to missing to cancel the previous value)	Degree, 2
3 02 085						**"Period" data of sequence 307096**	
						Present and past weather data	
	1 05 000					Delayed replication of 5 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	0 20 003					Present weather (see Note 2)	Code table, 0
	1 03 002					Replicate 3 descriptors 2 times	
	0 04 024					Time period (= -1 hour in 1. replication, -x hours in 2. replication, x corresponding to the time period of W_1W_2 in the SYNOP report)	Hour, 0

				S	A		Unit, scale
	0 20 004					Past weather (1)	Code table, 0
	0 20 005					Past weather (2)	Code table, 0
					*	**Intensity of precipitation, size of precipitation element**	
	1 01 000					Delayed replication of 1 descriptor	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	3 02 075	0 08 021			*	Time significance (= 2 (time averaged))	Code table, 0
		0 04 025			*	Time period (= - 10 minutes)	Minute, 0
		0 13 055			*	Intensity of precipitation	kg $m^{-2}s^{-1}$, 4
		0 13 058			*	Size of precipitation element	m, 4
		0 08 021			*	Time significance (= missing value)	Code table, 0
						Precipitation, obscuration and other phenomena	
	1 02 000					Delayed replication of 2 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	0 04 025				*	Time period (= - 10 minutes)	Minute, 0
	3 02 076				*	Precipitation, obscuration and other phenomena	
		0 20 021			*	Type of precipitation	Flag table, 0
		0 20 022			*	Character of precipitation	Code table, 0
		0 26 020			*	Duration of precipitation (see Note 3)	Minute, 0
		0 20 023			*	Other weather phenomena	Flag table, 0
		0 20 024			*	Intensity of phenomena	Code table, 0
		0 20 025			*	Obscuration	Flag table, 0
		0 20 026			*	Character of obscuration	Code table, 0
						Lightning data	
	1 02 000					Delayed replication of 2 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	0 04 025				*	Time period (= - 10 minutes)	Minute, 0
	0 13 059				*	Number of flashes	Numeric, 0
						Wind data	
	0 07 032					Height of sensor above local ground	m, 2
	0 07 033				*	Height of sensor above water surface	m, 1
	0 08 021					Time significance (= 2 (time averaged))	Code table, 0
	0 04 025					Time period (= - 10 minutes, or number of minutes after a significant change of wind)	Minute, 0
	0 11 001					Wind direction	Degree true, 0
	0 11 002					Wind speed	m s^{-1}, 1
	0 08 021					Time significance (= missing value)	Code table, 0
	1 03 003					Replicate next 3 descriptors 3 times	
	0 04 025					Time period (= -10 minutes in 1. replication, = - 60 minutes in 2. replication, = - 60*3 or 60*6 minutes in 3. replication)	Minute, 0
	0 11 043					Maximum wind gust direction	Degree true, 0
	0 11 041					Maximum wind gust speed	m s^{-1}, 1
	0 04 025				*	Time period (= - 10 minutes)	Minute, 0
	0 11 016				*	Extreme counterclockwise wind direction of a variable wind	Degree true, 0
	0 11 017				*	Extreme clockwise wind direction of a variable wind	Degree true, 0
						Extreme temperature data	
	3 02 077	0 07 032			*	Height of sensor above local ground	m, 2
		0 07 033			*	Height of sensor above water surface	m, 1
		0 04 025			*	Time period (= - 60 minutes)	Minute, 0
		0 12 111			*	Maximum temperature (scale 2) at height and over period specified	K, 2
		0 12 112			*	Minimum temperature (scale 2) at height and over period specified	K, 2

				S	A		Unit, scale
		0 07 032			*	Height of sensor above local ground (for ground temperature)	m, 2
		0 04 025			*	Time period (= - 60 minutes)	Minute, 0
		0 12 112			*	Minimum temperature (scale 2) at height and over period specified (for ground temperature)	K, 2
	0 07 033				*	Height of sensor above water surface (set to missing to cancel the previous value)	m, 1
	3 02 041	0 07 032		*		Height of sensor above local ground (for temperature measurement)	m, 2
		0 04 024		*		Time period	Hour, 0
		0 04 024		*		Time period (see Notes 4 and 5)	Hour, 0
		0 12 111		*		Maximum temperature (scale 2) at height and over period specified $s_nT_xT_xT_x$	K, 2
		0 04 024		*		Time period	Hour, 0
		0 04 024		*		Time period (see Note 5)	Hour, 0
		0 12 112		*		Minimum temperature (scale 2) at height and over period specified $s_nT_nT_nT_n$	K, 2
						Precipitation measurement	
	1 06 000					Delayed replication of 6 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	0 07 032					Height of sensor above local ground	m, 2
	0 02 175				*	Method of precipitation measurement	Code table, 0
	0 02 178				*	Method of liquid water content measurement of precipitation	Code table, 0
	1 02 005					Replicate 2 descriptors 5 times	
	0 04 024					Time period in hours t_R (= - 1 hour in the first replication, = - 3, -6, -12 and - 24 hours in the other replications)	Hour, 0
	0 13 011					Total precipitation / total water equivalent of snow	kg m^{-2}, 1
	0 07 032				*	Height of sensor above local ground (set to missing to cancel the previous value)	m, 2
						Evaporation data	
	1 03 000					Delayed replication of 3 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	0 02 185				*	Method of evaporation measurement	Code table, 0
	1 01 002					Replicate 1 descriptor 2 times	
	3 02 044	0 04 024		*		Time period in hours (= -1 hour in 1. replication, = -24 hours in 2. replication)	Hour, 0
		0 02 004		*		Type of instrument for evaporation measurement or type of crop	Code table, 0
		0 13 033				Evaporation /evapotranspiration	kg m^{-2}, 1
						Total sunshine data	
	1 02 000					Delayed replication of 2 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	1 01 002			*		Replicate 1 descriptor 2 times	
	3 02 039	0 04 024		*		Time period in hours (= -1 hour in 1. replication, = -24 hours in 2. replication)	Hour, 0
		0 14 031				Total sunshine	Minute, 0
						Radiation data	
	1 02 000					Delayed replication of 2 descriptors	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	1 01 002			*		Replicate 1 descriptor 2 times	

				S	A		Unit, scale
	3 02 045	0 04 024		*		Time period in hours (= -1 hour in 1. replication, = -24 hours in 2. replication)	Hour, 0
		0 14 002				Long-wave radiation, integrated over period specified	J m^{-2}, -3
		0 14 004				Short-wave radiation, integrated over period specified	J m^{-2}, -3
		0 14 016				Net radiation, integrated over period specified	J m^{-2}, -4
		0 14 028				Global solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
		0 14 029				Diffuse solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
		0 14 030				Direct solar radiation (high accuracy), integrated over period specified	J m^{-2}, -2
				*		**Temperature change** gr. $\mathbf{54g_0s_nd_T}$	
	1 01 000					Delayed replication of 1 descriptor	
	0 31 000					Short delayed descriptor replication factor	Numeric, 0
	3 02 046	0 04 024		*		Time period or displacement	Hour, 0
		0 04 024		*		Time period or displacement (see Note 6)	Hour, 0
		0 12 049		*		Temperature change over period specified $\mathbf{s_nd_T}$	K, 0
					*	**First order statistics of P, W, T, U data**	
	1 01 000					Delayed replication of 1 descriptor	
	0 31 000				*	Short delayed descriptor replication factor	Numeric, 0
	3 02 083	0 04 025			*	Time period (= -10 minutes)	Minute, 0
		0 08 023			*	First order statistics (see Note 7) (= 9 (best estimate of standard deviation))	Code table, 0
		0 10 004			*	Pressure	Pa, –1
		0 11 001			*	Wind direction	Degree true, 0
		0 11 002			*	Wind speed	m s^{-1}, 1
		0 12 101			*	Temperature/dry-bulb temperature (scale 2)	K, 2
		0 13 003			*	Relative humidity	%, 0
		0 08 023			*	First order statistics (= missing value)	Code table, 0
0 33 005					*	Quality information (AWS data)	Flag table, 0
0 33 006					*	Internal measurement status information (AWS)	Code table, 0

Notes:

(1) The WMO international identification 0 01 001 (WMO block number) and 0 01 002 (WMO station number) shall be reported **as mandatory** if available for the particular station. 0 01 101 (WMO Member State identifier) and 0 01 102 (National AWS number) **may** be used to identify a station within the national numbering system. **If the WMO station identification is not available for the particular station, the National station identification shall be used**.

(2) When reported, present weather shall be always represented by 0 20 003. When encoding present weather reported from an automatic weather station, the sequence of descriptors (proposed under 3 02 076) should also be used, if applicable.

(3) Duration of precipitation represents number of minutes in which precipitation was registered.

(4) Within RA IV, the maximum temperature at 1200 UTC is reported for the previous calendar day (i.e. the ending time of the period is not equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

(5) Within RA III, the maximum day-time temperature and the minimum night-time temperature is reported (i.e. the ending time of the period may not be equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

(6) To construct the required time range, descriptor 004024 has to be included two times.

(7) Best estimate of standard deviation is counted out of a set of samples (signal measurements) recorded within the period specified; it should be reported as a missing value, if the measurements of the relevant element are not available from a part of the period specified by 0 04 025.

(8) Additional parameters required by regional or national reporting practices shall be accommodated in **a similar way as recommended in Regulations B/C 1.9 and B/C 1.14** – Regulations for reporting SYNOP data in TDCF.

BUFR TEMPLATE FOR SYNOPTIC REPORTS FROM FIXED LAND STATIONS SUITABLE FOR SYNOP DATA AND FOR MARITIME DATA FROM COASTAL AND ISLAND STATIONS

Proposals

a) A new descriptor 0 20 058 (Visibility seawards from a coastal station) is proposed:

		BUFR				*CREX*		
Table reference	Element name	Unit	Scale	Reference value	Data width	Unit	Scale	Data width
0 20 058	Visibility seawards from a coastal station	m	-1	0	13	m	-1	4

b) TM 307079 as included in the ANNEX is proposed for pre-operational usage, provided that testing of the template takes place by the end of 2008.

TM 307079 - BUFR template for synoptic reports from fixed land stations suitable for SYNOP data and for maritime data from coastal and island stations

3 07 079		**Sequence for representation of synoptic reports from fixed land stations suitable for SYNOP data and for maritime data from coastal stations**
	3 01 090	Fixed surface station identification, time, horizontal and vertical coordinates
	3 02 031	Pressure data
	3 02 035	Basic synoptic “instantaneous” data
	3 02 036	Clouds with bases below station level
	1 01 000	Delayed replication of 1 descriptor
	0 31 000	Short delayed descriptor replication factor
	3 02 047	Direction of cloud drift
	0 08 002	Vertical significance
	1 01 000	Delayed replication of 1 descriptor
	0 31 000	Short delayed descriptor replication factor
	3 02 048	Direction and elevation of cloud
	3 02 037	State of ground, snow depth, ground minimum temperature
	1 02 000	Delayed replication of 2 descriptors
	0 31 000	Short delayed descriptor replication factor
	0 22 061	State of the sea
	0 20 058	Visibility seawards from a coastal station
	1 01 000	Delayed replication of 1 descriptor
	0 31 000	Short delayed descriptor replication factor
	3 02 056	Sea/water surface temperature, method of measurement, depth below water surface
	1 01 000	Delayed replication of 1 descriptor
	0 31 000	Short delayed descriptor replication factor
	3 02 055	Icing and ice
	3 02 043	Basic synoptic “period” data
	3 02 044	Evaporation data
	1 01 000	Delayed replication of 1 descriptor
	0 31 001	Delayed descriptor replication factor
	3 02 045	Radiation data
	1 01 000	Delayed replication of 1 descriptor
	0 31 000	Short delayed descriptor replication factor
	3 02 046	Temperature change

TM 307079 (BUFR template for synoptic reports from fixed land stations suitable for SYNOP data and for maritime data from coastal and island stations) further expands as follows:

				Unit, scale
3 01 090			**Fixed surface station identification, time, horizontal and vertical coordinates**	
	3 01 004	0 01 001	WMO block number **II**	Numeric, 0
		0 01 002	WMO station number **iii**	Numeric, 0
		0 01 015	Station or site name	CCITT IA5, 0
		0 02 001	Type of station (i_x)	Code table, 0
	3 01 011	0 04 001	Year	Year, 0
		0 04 002	Month	Month, 0
		0 04 003	Day **YY**	Day, 0
	3 01 012	0 04 004	Hour **GG**	Hour, 0
		0 04 005	Minute **gg**	Minute, 0
	3 01 021	0 05 001	Latitude (high accuracy)	Degree, 5
		0 06 001	Longitude (high accuracy)	Degree, 5
	0 07 030		Height of station ground above mean sea level	m, 1
	0 07 031		Height of barometer above mean sea level	m, 1
3 02 031			**Pressure data**	
	3 02 001	0 10 004	Pressure $\mathbf{P_0P_0P_0P_0}$	Pa, –1
		0 10 051	Pressure reduced to mean sea level **PPPP**	Pa, –1
		0 10 061	3-hour pressure change **ppp**	Pa, –1
		0 10 063	Characteristic of pressure tendency **a**	Code table, 0
	0 10 062		24-hour pressure change $\mathbf{p_{24}p_{24}p_{24}}$	Pa, –1
	0 07 004		Pressure (standard level) $\mathbf{a_3}$	Pa, –1
	0 10 009		Geopotential height of the standard level **hhh**	gpm, 0
3 02 035			**Basic synoptic "instantaneous" data**	
			Temperature and humidity data	
	3 02 032	0 07 032	Height of sensor above local ground (for temperature and humidity measurement)	m, 2
		0 12 101	Temperature/dry-bulb temperature(sc.2) $\mathbf{s_nTTT}$	K, 2
		0 12 103	Dew-point temperature (scale 2) $\mathbf{s_nT_dT_dT_d}$	K, 2
		0 13 003	Relative humidity	%, 0
			Visibility data	
	3 02 033	0 07 032	Height of sensor above local ground (for visibility measurement)	m, 2
		0 20 001	Horizontal visibility **VV**	m, –1
			Precipitation past 24 hours	
	3 02 034	0 07 032	Height of sensor above local ground (for precipitation measurement)	m, 2
		0 13 023	Total precipitation past 24 hours $\mathbf{R_{24}R_{24}R_{24}R_{24}}$	kg m^{-2}, 1
	0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, 2
			Cloud data	
	3 02 004	0 20 010	Cloud cover (total) **N**	%, 0
		0 08 002	Vertical significance	Code table, 0
		0 20 011	Cloud amount (of low or middle clouds) $\mathbf{N_h}$	Code table, 0
		0 20 013	Height of base of cloud **h**	m, –1
		0 20 012	Cloud type (low clouds C_L) $\mathbf{C_L}$	Code table, 0
		0 20 012	Cloud type (middle clouds C_M) $\mathbf{C_M}$	Code table, 0
		0 20 012	Cloud type (high clouds C_H) $\mathbf{C_H}$	Code table, 0
			Individual cloud layers or masses	
	1 01 000		Delayed replication of 1 descriptor	
	0 31 001		Delayed descriptor replication factor	Numeric, 0
	3 02 005	0 08 002	Vertical significance	Code table, 0
		0 20 011	Cloud amount (N_s) $\mathbf{N_s}$	Code table, 0
		0 20 012	Cloud type (C) **C**	Code table, 0
		0 20 013	Height of base of cloud (h_sh_s) $\mathbf{h_sh_s}$	m, -1

				Unit, scale
			Clouds with bases below station level	
3 02 036	1 05 000		Delayed replication of 5 descriptors	
	0 31 001		Delayed descriptor replication factor	Numeric, 0
	0 08 002		Vertical significance	Code table, 0
	0 20 011		Cloud amount **N'**	Code table, 0
	0 20 012		Cloud type **C'**	Code table, 0
	0 20 014		Height of top of cloud **H'H'**	m, -1
	0 20 017		Cloud top description $\mathbf{C_t}$	Code table, 0
			Direction of cloud drift gr. $\mathbf{56D_LD_MD_H}$	
1 01 000			Delayed replication of 1 descriptor	
0 31 000			Short delayed descriptor replication factor	Numeric, 0
3 02 047	1 02 003		Replicate 2 descriptors 3 times	
	0 08 002		Vertical significance = 7 (low cloud) = 8 (middle cloud) = 9 (high cloud)	Code table, 0
	0 20 054		True direction from which clouds are moving $\mathbf{D_L, D_M, D_H}$	Degree true, 0
0 08 002			Vertical significance (set to missing to cancel the previous value)	Code table, 0
			Direction and elevation of cloud gr. $\mathbf{57CD_ae_C}$	
1 01 000			Delayed replication of 1 descriptor	
0 31 000			Short delayed descriptor replication factor	Numeric, 0
3 02 048	0 05 021		Bearing or azimuth $\mathbf{D_a}$	Degree true, 2
	0 07 021		Elevation angle $\mathbf{e_C}$	Degree, 2
	0 20 012		Cloud type **C**	Code table, 0
	0 05 021		Bearing or azimuth (set to missing to cancel the previous value)	Degree true, 2
	0 07 021		Elevation angle (set to missing to cancel the previous value)	Degree, 2
			State of ground, snow depth, ground minimum temperature	
3 02 037	0 20 062		State of ground (with or without snow) **E** or **E'**	Code table, 0
	0 13 013		Total snow depth **sss**	m, 2
	0 12 113		Ground minimum temperature (scale2), past 12 hours $\mathbf{s_nT_gT_g}$	K, 2
			State of the sea	
1 02 000			Delayed replication of 2 descriptors	
0 31 000			Short delayed descriptor replication factor	Numeric, 0
0 22 061			State of the sea **S**	Code table, 0
0 20 058			Visibility seawards from a coastal station $\mathbf{V_S}$	m, -1
			Sea/water surface temperature, method of measurement, and depth below sea surface	
1 01 000			Delayed replication of 1 descriptor	
0 31 000			Short delayed descriptor replication factor	Numeric, 0
3 02 056	0 02 038		Method of sea/water temperature measurement	Code table, 0
	0 07 063		Depth below sea/water surface (for sea surface temperature measurement)	m, 2
	0 22 043		Sea/water temperature $\mathbf{s_sT_wT_wT_w}$ or $\mathbf{925T_wT_w}$	K, 2
	0 07 063		Depth below sea/water surface (set to missing to cancel the previous value)	m, 2
			Icing and ice	
1 01 000			Delayed replication of 1 descriptor	
0 31 000			Short delayed descriptor replication factor	Numeric, 0
3 02 055	0 20 031		Ice deposit (thickness) $\mathbf{E_sE_s}$	m, 2
	0 20 032		Rate of ice accretion $\mathbf{R_s}$	Code table, 0
	0 20 033		Cause of ice accretion $\mathbf{I_s}$	Flag table, 0
	0 20 034		Sea ice concentration $\mathbf{c_i}$	Code table, 0

				Unit, scale
	0 20 035		Amount and type of ice **b_i**	Code table, 0
	0 20 036		Ice situation **z_i**	Code table, 0
	0 20 037		Ice development **S_i**	Code table, 0
	0 20 038		Bearing of ice edge **D_i**	Degree true, 0
3 02 043			**Basic synoptic "period" data**	
			Present and past weather	
	3 02 038	0 20 003	Present weather **ww**	Code table, 0
		0 04 024	Time period in hours	Hour, 0
		0 20 004	Past weather (1) **W_1**	Code table, 0
		0 20 005	Past weather (2) **W_2**	Code table, 0
			Sunshine data (from 1 hour and 24 hour period)	
	1 01 002		Replicate 1 descriptors 2 times	
	3 02 039	0 04 024	Time period in hours	Hour, 0
		0 14 031	Total sunshine **SS** and **SSS**	Minute, 0
			Precipitation measurement	
	3 02 040	0 07 032	Height of sensor above local ground (for precipitation measurement)	m, 2
		1 02 002	Replicate next 2 descriptors 2 times	
		0 04 024	Time period in hours **t_R**	Hour, 0
		0 13 011	Total precipitation / total water equivalent of snow **RRR**	kg m^{-2}, 1
			Extreme temperature data	
	3 02 041	0 07 032	Height of sensor above local ground (for temperature measurement)	m, 2
		0 04 024	Time period or displacement	Hour, 0
		0 04 024	Time period or displacement (see Notes 1 and 2)	Hour, 0
		0 12 111	Maximum temperature (scale 2) at height and over period specified **$s_nT_xT_xT_x$**	K, 2
		0 04 024	Time period or displacement	Hour, 0
		0 04 024	Time period or displacement (see Note 2)	Hour, 0
		0 12 112	Minimum temperature (scale 2) at height and over period specified **$s_nT_nT_nT_n$**	K, 2
			Wind data	
	3 02 042	0 07 032	Height of sensor above local ground (for wind measurement)	m, 2
		0 02 002	Type of instrumentation for wind measurement **i_w**	Flag table, 0
		0 08 021	Time significance (= 2 (time averaged))	Code table, 0
		0 04 025	Time period (= - 10 minutes, or number of minutes after a significant change of wind)	Minute, 0
		0 11 001	Wind direction **dd**	Degree true, 0
		0 11 002	Wind speed **ff**	m s^{-1}, 1
		0 08 021	Time significance (= missing value)	Code table, 0
		1 03 002	Replicate next 3 descriptors 2 times	
		0 04 025	Time period in minutes	Minute, 0
		0 11 043	Maximum wind gust direction	Degree true, 0
		0 11 041	Maximum wind gust speed 910**f_mf_m**, 911**f_xf_x**	m s^{-1}, 1
	0 07 032		Height of sensor above local ground (set to missing to cancel the previous value)	m, 2
			Evaporation data	
3 02 044	0 04 024		Time period in hours	Hour, 0
	0 02 004		Type of instrument for evaporation or crop type for evapotranspiration **i_E**	Code table, 0
	0 13 033		Evaporation /evapotranspiration **EEE**	kg m^{-2}, 1
			Radiation data (from 1 and/or 24 hour period)	
1 01 000			Delayed replication of 1 descriptor	
0 31 001			Delayed descriptor replication factor	Numeric, 0
3 02 045	0 04 024		Time period in hours	Hour, 0

				Unit, scale
	0 14 002		Long-wave radiation, integrated over period specified 553SS 4**FFFF** or 553SS 5**FFFF,** 55SSS 4$\mathbf{F_{24}F_{24}F_{24}F_{24}}$ or 55SSS 5$\mathbf{F_{24}F_{24}F_{24}F_{24}}$	J m^{-2}, -3
	0 14 004		Short-wave radiation, integrated over period specified 553SS 6**FFFF,** 55SSS 6$\mathbf{F_{24}F_{24}F_{24}F_{24}}$	J m^{-2}, -3
	0 14 016		Net radiation, integrated over period specified 553SS 0**FFFF** or 553SS 1**FFFF,** 55SSS 0$\mathbf{F_{24}F_{24}F_{24}F_{24}}$ or 55SSS 1$\mathbf{F_{24}F_{24}F_{24}F_{24}}$	J m^{-2}, -4
	0 14 028		Global solar radiation (high accuracy), integrated over period specified 553SS 2**FFFF,** 55SSS 2$\mathbf{F_{24}F_{24}F_{24}F_{24}}$	J m^{-2}, -2
	0 14 029		Diffuse solar radiation (high accuracy), integrated over period specified 553SS 3**FFFF,** 55SSS 3$\mathbf{F_{24}F_{24}F_{24}F_{24}}$	J m^{-2}, -2
	0 14 030		Direct solar radiation (high accuracy), integrated over period specified 55408 4**FFFF,** 55508 5$\mathbf{F_{24}F_{24}F_{24}F_{24}}$	J m^{-2}, -2
			Temperature change group **54$\mathbf{g_0s_nd_T}$**	
1 01 000			Delayed replication of 1 descriptor	
0 31 000			Short delayed descriptor replication factor	Numeric, 0
3 02 046	0 04 024		Time period or displacement	Hour, 0
	0 04 024		Time period or displacement (see Note 3)	Hour, 0
	0 12 049		Temperature change over period specified **$\mathbf{s_nd_T}$**	K, 0

Notes:

1) Within RA IV, the maximum temperature at 1200 UTC is reported for the previous calendar day (i.e. the ending time of the period is not equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

2) Within RA III, the maximum day-time temperature and the minimum night-time temperature is reported (i.e. the ending time of the period may not be equal to the nominal time of the report). To construct the required time range, descriptor 004024 has to be included two times. If the period ends at the nominal time of the report, value of the second 004024 shall be set to 0.

3) To construct the required time range, descriptor 004024 has to be included two times.

TEMPLATE FOR PASSING LOCUST INFORMATION

3 02 089 (LOCUST INFORMATION)

3 02 089		***Locust information***	
	0 20 101	Locust (acridian) name	**L_n**
	0 20 102	Locust (maturity) color	**L_c**
	0 20 103	Stage of development of locusts	**L_d**
	0 20 104	Organization state of swarm or band of locusts	**L_g**
	0 20 105	Size of swarm or band of locusts and duration of passage of swarm	**s_L**
	0 20 106	Locust population density	**d_L**
	0 20 107	Direction of movements of locust swarm	**D_L**
	0 20 108	Extent of vegetation	**v_e**

Extract of regulations:

B/C 1.9.1.3 Locust control-related observations

Following data shall be reported by all Members capable of doing so:
(a) Locust (acridian) name (Code table 0 20 101),
(b) Locust (maturity) color (Code table 0 20 102),
(c) Stage of development of locusts (Code table 0 20 103),
(d) Organization state of swarm or band of locusts (Code table 0 20 104),
(e) Size of swarm or band of locusts and duration of passage of swarm (Code table 0 20 105),
(f) Locust population density (Code table 0 20 106),
(g) Direction of movements of locust swarm (Code table 0 20 107),
(h) Extent of vegetation (Code table 0 20 108). [1/12.14.1]

WIND REPORTING AT POLES

To add the following note (7) to the Class 11 of the BUFR/CREX Table B
"(7) Surface wind direction measured at a station within 1° of the North Pole or within 1° of the South Pole shall be reported in such a way that the azimuth ring shall be aligned with its zero coinciding with the Greenwich 0° meridian."

NEW DESCRIPTOR FOR INTENSITY OF PRECIPITATION

To introduce a new Table B descriptor 0 13 155

Table Ref.	Element name	BUFR				CREX		
FXY		Unit	Scale	Ref. value	Data width (bits)	Unit	Scale	Data width (chars)
0 13 155	Intensity of precipitation (high accuracy)	kg m-2 s-1	5	-1	16	mm h-1	1	5

To introduce a new Table D-descriptor 3 02 175

3 02 175 = 0 08 021
0 04 025
0 13 155
0 13 058
0 08 021

To replace 0 13 055 by 0 13 155 in 3 07 091 and 3 07 096.

To replace 3 02 075 by 3 02 175 in 3 07 091 and 3 07 096.

ADDITION OF A CODE FIGURE

To add the following code figure to the BUFR/CREX Code Table 0 08 002

Code figure	
20	No clouds detected by the cloud detection system

Recommendation 8 (CBS-XIV)

AMENDMENTS TO THE *MANUAL ON CODES* (WMO-No. 306), VOLUME I.1

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) Resolution 1 (Cg-XV) – Technical Regulations of the World Meteorological Organization,

(2) Resolution 2 (Cg-XV) – World Weather Watch Programme for 2008–2011,

(3) The *Manual on Codes* (WMO-No. 306), Volume I.1,

Considering the request of the International Civil Aviation Organization (ICAO) to indicate the end of the requirement for the message FM 54-X Ext. ROFOR (route forecast for aviation),

Recommends that the following amendment be adopted for use as from 4 November 2009:

Addition of a note under FM 54-X Ext. ROFOR in the *Manual on Codes* (WMO-No. 306), Volume I.1, Part A:

> "No aeronautical requirement for this code is stated by ICAO for international air navigation in ICAO Annex 3/WMO Technical Regulations [C.3.1]."

Requests the Secretary-General to arrange for the inclusion of this amendment in Volume I.1 of the *Manual on Codes* (WMO-No. 306);

Authorizes the Secretary-General to make any consequent purely editorial amendments to the *Manual on Codes* – Volume I.1.

Recommendation 9 (CBS-XIV)

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 Fifteenth World Meteorological Congress* (WMO-No. 1026),

(2) The *Abridged Final Report with Resolutions of the Sixtieth Session of the Executive Council* (WMO-No. 1032),

(3) The report of the Meeting of the CBS Implementation Coordination Team on Data-processing and Forecasting System (September/October 2008),

(4) The *Manual on the Global Data-processing and Forecasting System* (WMO-No. 485),

Considering:

(1) The need to include in the *Manual on the Global Data-processing and Forecasting System* procedures related to the designation of centres related to long-range forecasting, including Lead Centres for Multi-model Ensembles, and Regional Climate Centres,

(2) The need to establish and include in the *Manual on the Global Data-processing and Forecasting System* a new designation and new procedures related to emergency response activities,

Recommends that the amendments to the *Manual on the Global Data-processing and Forecasting System* (WMO-No. 485*)* Volume I – Global Aspects, given in the annexes to this recommendation be adopted for inclusion in the *Manual on the Global Data-processing and Forecasting System* to take effect from 1 November 2009;

Requests the Secretary-General to make appropriate changes, as given in the annexes to this recommendation, to the *Manual on the Global Data-processing and Forecasting System* (WMO-No. 485);

Authorizes the president of CBS, in consultation with the Secretary-General, to make any consequential purely editorial amendments with respect to the *Manual on the Global Data-processing Forecasting System* (WMO-No. 485).

Annex 1 to Recommendation 9 (CBS-XIV)

PROPOSED AMENDMENTS TO THE *MANUAL ON THE GDPFS* RELATED TO LONG-RANGE FORECASTS, VOLUME I (WMO-No. 485)

The proposed amendments to the Manual on the GDPFS, Volume I, related to the designation of Centres in the activity of Long-range Forecasting, including Lead Centre for Multi-Model Ensembles, and Regional Climate Centres. The proposed amendments relate to the aspects below:

- Designation of GPCs: amendments to Part I
- Data provision by GPCs: new Attachment II-11, and amendments to Appendix II-6 and Appendix II-8
- Feedback from RCCs and NMHSs on experience with using products supplied by GPCs: new Attachment II-13
- Proposed functions of LC-LRFMME and designation Seoul/Washington Lead Centre: new attachment II-12, and amendments to Part I and Appendix II-8
- Collaboration with CCl regarding designations of Regional Climate Centres in the GDPFS: new Appendices II-10 and II-11, new Attachment I-10 and amendments to Part 1 and Part II (section 1.1.4.2).

PROPOSED AMENDMENTS TO THE MANUAL ON THE GDPFS RELATED TO LONG-RANGE FORECASTS, VOLUME I, (WMO-No. 485)

(Updates to the Manual on Global Data Processing and Forecasting System are in shaded text)

MODIFICATIONS RELEVANT TO DESIGNATION OF REGIONAL CLIMATE CENTRES

Part I: Page I-1, section 2 (Functions of the GDPFS), Section 2.1 item (e) shall be amended to read:
'Preparation of specialized products such as limited area very-fine mesh short-, medium, extended- and long-range forecasts, regional climate watches, tailored products for marine, aviation, environmental quality monitoring and other purposes;'

Part I: Page I-1, section 2 (Functions of the GDPFS), Section 2.2 item (a) shall be amended to read:
'Preparation of special products for climate-related diagnosis (e.g. 10-day or 30-day means, summaries, frequencies, anomalies and historical reference climatologies) on a global or regional scale;'

Part I: Page I-2, section 4.1.2 (Regional Specialized Meteorological Centres (RSMCs)), insert a new paragraph 4.1.2.5 after paragraph 4.1.2.4, and rename existing paragraph 4.1.2.5 as 4.1.2.6. The new paragraph shall read as follows:
'4.1.2.5 Centres designated by WMO for the provision of global long-range forecasts are called Global Producing Centres for Long-range forecasts (GPCs). Centres designated by WMO for the provision of regional long-range forecasts and other regional climate services, or groups of centres who collectively provide these forecasts and services in a distributed network, are called Regional Climate Centres (RCCs) or RCC-Networks, respectively (see notes under (e) in paragraph 1.4.1.2 of Part II).'

Part I, Appendix I-1, section 3 (The RSMCs with activity specialization are the following:), add the following text:

GPC Beijing }
GPC Exeter }
GPC Melbourne }
GPC Montreal }
GPC Moscow }
GPC Pretoria }
GPC Seoul } Global Producing Centres of Long-Range } Forecasts
GPC Tokyo }
GPC Toulouse }
GPC Washington }
GPC ECMWF }

RCC Beijing (RA II) } Regional Climate Centres providing regional
RCC Tokyo (RA II) } long-range forecasts
} and other regional climate services
RCC-Network (Region) 'CITYNAME' Node 1 }
'CITYNAME' Node 2 }
…….. }
'CITYNAME' Node n }

Part II

Part II, section 1.4.1.2 (Regional Specialized Meteorological Centres (RSMCs) with activity specialization), item (b) shall be amended to read as follows:
"'Global extended- and long-range forecasts and related mean analysed values and anomalies;'
'NOTE: Centres…."

and item (e) shall be amended to read as follows:
'Regional LRF products, climate monitoring, climate watches, drought monitoring, climate data services, and tailored climate products.'

following the modified item (e), add the following Note:

'NOTE: Centres producing regional long-range forecasts and other regional climate services or groups of centres who collectively provide these forecasts and services in a distributed network, and are recognized as such by CBS and CCl at the request of Regional Associations, are called Regional Climate Centres (RCCs) or RCC-Networks, respectively. Definitions of RCCs and RCC-Networks, the list of official recognized RCCs and RCC-Networks, and mandatory functions of RCCs and RCC-Networks can be found in APPENDIX II-10. The criteria to be recognized as an RCC or RCC-Network can be found in APPENDIX II-11.'

In Appendix II-6, it is proposed to replace in paragraph 4.2, for the Content of basic forecast output, in (a) and (b):

- "2-metre air-temperature over land" by: "2-metre air-temperature over the globe"
- "Precipitation" by: "Total precipitation"

It is proposed to add some items to Appendix II-8

1. Centres that are designated as Global Producing Centres for Long-range Forecasts (GPCs) are as follow: Beijing, Exeter, Melbourne, Montreal, Moscow, Pretoria, Seoul, Tokyo, Toulouse, Washington and ECMWF.

2. In order to be officially recognized as a GPC (Global Producing Centre of Long-range forecasts), a centre must as a minimum adhere to the following criteria:

- Fixed production cycles and time of issuance;
- Provide a limited set of products as determined by chapter 4.2 of APPENDIX II-6 of this Manual;
- Provide verifications as per the WMO SVSLRF;
- Provide up-to-date information on methodology used by the GPC;
- Make products accessible through the GPC Web site and/or disseminated through the GTS and/or Internet.

3. Additional data or products to the minimum list above could also be provided by GPCs on request by RCCs or NMCs. The RCCs and NMCs would adhere to conditions, if any, attached by the GPCs to these data and products. This additional list of data and products is given in Attachment II-11

4. Given the anticipated improvements in skill of Long-Range Forecasts (LRF) by using a multi-model ensembles (MME) approach, some GPCs can serve as collectors of global LRF data to build MME and to make MME LRF predictions. Such Centres may become Lead Centres for Long-Range Forecast of Multi-Model Ensembles predictions (LCs LRFMME). The list of such Centres and the functions of LC-LRFMME are defined in Attachment II-12. The list of data that GPCs may supply to a LC-LRFMME are defined on LRFMME Web sites.

Part II, add new Appendix II-10 as follows:

APPENDIX II-10

DESIGNATION AND MANDATORY FUNCTIONS OF REGIONAL CLIMATE CENTRES (RCCs) AND RCC-NETWORKS

1. A multifunctional centre that fulfils all the required functions of an RCC for the entire region, or for a sub-region to be defined by the Regional Association may be designated by WMO as a 'WMO Regional Climate Centre' (WMO RCC). A group of centres performing climate-related activities that collectively fulfil all the required functions of an RCC may be designated by WMO as a 'WMO Regional Climate Centre Network' (WMO RCC-Network). Each centre in a designated WMO RCC-Network will be referred to as a 'Node'. A Node will perform, for the region or sub-region defined by the Regional Association, one or several of the mandatory RCC activities (e.g. long-range forecasting (LRF), climate monitoring, climate data services,

training). Only centres or groups of centres designated by WMO will carry the title 'WMO RCC' or 'WMO RCC-Network' respectively. Recipients of RCC products and services will be NMHSs, other RCCs and international institutions recognized by the Regional Association and will be referred to as 'RCC Users'. WMO RCCs and RCC-Networks shall follow Guidance published by the Commission for Climatology on technical, climate-related matters.

2. Designated Regional Climate Centres and RCC-Networks are as follows:
RCC Beijing (RA II)
RCC Tokyo (RA II)

3. In order for a centre or a group of centres in a cooperative effort to be officially recognized as a WMO RCC (Regional Climate Centre), or a WMO RCC-Network, it shall perform the following minimum* set of functions, criteria and products for which are defined in Appendix II-11:

Notes: *- Additional requirements for RCC functions may vary in detail from Region to Region**.** A list of 'highly recommended', but not mandatory, functions is given in Attachment II-10.

- An RCC is not necessarily an NMHS, but a non-NMHS candidate for RCC designation must be nominated by the Permanent Representative of the concerned country.

- **Operational Activities for LRF*:**
  - Interpret and assess relevant LRF products from Global Producing Centres (GPCs) (some of which can be obtained through the Lead Centres for LRFMME - see Attachment II-12), make use of Lead Centre for Standard Verification System on LRF (see Attachment II-8), distribute relevant information to RCC Users; and provide feedback to GPCs;
  - Generate regional and sub-regional tailored products, relevant to RCC User needs, including seasonal outlooks etc.;
  - Perform verification of RCC quantitative LRF products, including the exchange of basic forecasts and hindcast data;
  - Generate 'consensus' statement on regional or sub-regional forecasts (see Appendix II-11 for details);
  - Provide on-line access to RCC products/services to RCC Users;
  - Assess use of RCC products and services through feedback from RCC Users.

Note: * Both dynamical and statistical, within the range of 1 month to 2 year timescale, based on regional needs.

- **Operational Activities for Climate Monitoring:**
  - Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales;
  - Establish an historical reference climatology for the region and/or sub-regions;
  - Implement a regional Climate Watch.

- **Operational Data Services, to support operational LRF and climate monitoring:**
  - Develop regional climate datasets, gridded where applicable;
  - Provide climate database and archiving services, at the request of NMHSs.

- **Training in the use of operational RCC products and services**
  - Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use;
  - Coordinate training for RCC Users in interpretation and use of mandatory RCC products.

In Part II, add new **Appendix II-11** as follows**:**

APPENDIX II-11

DETAILED CRITERIA FOR RCC MANDATORY FUNCTIONS

Functions	Activities	Criteria
	Interpret and assess relevant LRF products from Global Producing Centres (GPCs), distribute relevant information to RCC Users; and provide feedback to GPCs (see Attachment II-13)	***Product:*** assessment of the reliability and outcomes of GPCs or LCs-LRFMME products including the reasoning (make use of LC SVSLRF), for the region of interest, in the form of texts, tables, figures, etc. ***Element:*** 2-m mean temperature, total precipitation ***Update frequency:*** monthly or at least quarterly
	Generate regional and sub-regional tailored products, relevant to RCC User needs, including seasonal outlooks etc.	***Product:*** probabilities for tercile (or appropriate quantile) categories for the region or sub-region ***Element:*** 2-m mean temperature, total precipitation ***Output type:*** *rendered images (maps, charts), text, tables, digital data* ***Forecast period*****:** one month up to 6 months ***Update frequency:*** 10 days to one month
	Generate consensus* statement on regional or sub-regional forecasts. **NB: A collaborative process involves discussion with experts in the region (e.g. through Regional Climate Outlook Forums (RCOFs), teleconferencing, etc.).* *Consensus is both the agreed process, and its joint conclusion, and can be that there is limited skill in the prediction for a region or sub-region*	***Product:*** *consensus statement on regional or sub-regional forecast****.*** ***Element:*** *2-m mean temperature, total precipitation* ***Output type:*** *report* F***orecast period*****:** *a climatologically significant period (from one month to one year)* ***Update frequency:*** *at least once per year (to be defined by the region)*
	Operational Activities for LRF (both dynamical and statistical, within the range of 1 month to 2 year timescale, based on regional needs)	***Products:*** verification datasets (e.g. SVS LRF scores, Brier Skill Score; ROC; Hit Rate Skill Score) ***Element:*** 2-m mean temperature, total precipitation
	Provide on-line access to RCC products/services to RCC Users.	***Product:*** an on-line data/information portal
	Assess use of RCC products and services through feedback from RCC Users.	***Product:*** analysis of feedback (which is made available using a template) ***Update frequency:*** annually, as part of a regular reporting of RCCs to WMO RAs

Functions	Activities	Criteria
Operational Activities for Climate Monitoring	Perform climate diagnostics including analysis of climate variability and extremes, at regional and sub-regional scales	***Products:*** climate diagnostics bulletin including tables, maps and related products ***Element:*** Mean, Max and Min temperatures, Total precipitation; other elements (esp. GCOS essential climate variables) to be determined by the region, ***Update frequency:*** monthly
	Establish an historical reference climatology for the region and/or sub-regions	***Product:*** database of climatological means for various reference periods (e.g. 1931-60; 1951-80; 1961-90; 1971-2000; etc.) ***Spatial resolution:*** *by station* ***Temporal resolution:*** *monthly at a minimum* ***Elements:*** Mean, Max and Min temperatures, Total precipitation; other elements (esp. GCOS essential climate variables) to be determined by the region, ***Update frequency:*** at least 30 years, preferably 10 years
	Implement a Regional Climate Watch	***Products:*** climate advisories and information for RCC Users ***Update:*** whenever required, based on the forecast of significant regional climate anomalies.
Operational Data Services, to support operational LRF and climate monitoring	Develop quality controlled regional climate datasets, gridded where applicable	***Products:*** regional, quality controlled climate datasets, gridded where applicable, following CCl guidance on QA/QC procedures ***Elements:*** Mean, Max and Min Temperature, and Precipitation, at a minimum ***Temporal resolution:*** *daily* ***Update:*** monthly
	Provide climate database and archiving services, at the request of NMHSs	***Products:*** national databases with metadata, accessible to the NMHS in question (backup service, development site, etc). ***Elements:*** as determined by the NMHS ***Update:*** at the request of the NMHS
Training in the use of operational RCC products and services	Provide information on methodologies and product specifications for mandatory RCC products, and provide guidance on their use	***Products:*** *Manuals, guidance documents and information notes*. ***Update frequency:*** when methods/products are revised or introduced or discontinued
	Coordinate training for RCC Users in interpretation and use of mandatory RCC products	***Products:*** survey and analysis of regional training needs, and proposals for training activities.

NOTE: an RCC is expected to perform certain functions (e.g. for homogeneity testing; database management; metadata management, statistical evaluation of climate data, etc.) using procedures proposed in the WMO Guide to Climatological Practices and in other official Commission for Climatology Guidance documents.

In Part II, add new **Attachment II-10** as follows:

ATTACHMENT II-10

ADDITIONAL 'HIGHLY RECOMMENDED' FUNCTIONS OF DESIGNATED WMO RCCs OR WMO RCC-NETWORKS:

- **Climate Prediction and Climate Projection**
  - Assist RCC Users in the access and use of WCRP-CMIP climate model simulations;
  - Perform downscaling of climate change scenarios;
  - Provide information to RCC Users for use in development of climate adaptation strategies;
  - Generate, along with warnings of caution on accuracy, seasonal forecasts for specific parameters where relevant, such as:
    - onset, intensity and cessation of rainy season;
    - tropical cyclone frequency and intensity;
  - Perform verification on consensus statements for forecasts;
  - Perform assessment of other GPC products such as SSTs, winds, etc.

- **Non-operational data services:**
  - Keep abreast of activities and documentation related to WMO WIS, and work towards WIS compliance and DCPC designation;
  - Assist NMHSs in the rescue of climate data from outmoded storage media;
  - Assist NMHSs to develop and maintain historical climate datasets;
  - Assist RCC Users in the development and maintenance of software modules for standard applications;
  - Advise RCC Users on data quality management;
  - Conduct data homogenization, and advise RCC Users on homogeneity assessment and development and use of homogeneous data sets;
  - Develop and manage databases, and generate indices, of climate extremes;
  - Perform Quality Assurance/Quality Control on national datasets, on request of an NMHS;
  - Provide expertise on interpolation techniques;
  - Facilitate data/metadata exchange amongst NMHSs, including on-line access, through an agreed regional mechanism;
  - Perform Quality Assurance/Quality Control on regional datasets.

- **Coordination Functions:**
  - Strengthen collaboration between NMHSs on related observing, communication and computing networks including data collection and exchange;
  - Develop systems to facilitate harmonization and assistance in the use of LRF products and other climate services;
  - Assist NMHSs in user liaison, including the organization of climate and of multidisciplinary workshops and other forums on user needs;
  - Assist NMHSs in the development of a media and public awareness strategy on climate services.

- **Training and Capacity building:**
  - Assist NMHSs in the training of users on the application and on implications of LRF products on users;
  - Assist in the introduction of appropriate decision models for end-users, especially as related to probability forecasts;
  - Promote technical capacity building on NMHS level (e.g. acquisition of hardware, software, etc.), as required for implementation of climate services;
  - Assist in professional capacity building (training) of climate experts for generating user-targeted products.

- **Research and Development:**
  - Develop a climate Research and Development agenda and coordinate it with other relevant RCCs;
  - Promote studies of regional climate variability and change, predictability and impact in the Region;
  - Develop consensus practices to handle divergent climate information for the Region;
  - Develop and validate regional models, methods of downscaling and interpretation of global output products;
  - Promote the use of proxy climate data in long-term analyses of climate variability and change;
  - Promote application research, and assist in the specification and development of sector specific products;
  - Promote studies of the economic value of climate information.

In Part II, add new **Attachment II-11** as follows:

ATTACHMENT II-11

ADDITIONAL INFORMATION THAT MAY BE PROVIDED BY GPC'S

Other Long-Range Forecast data, products or other information, in addition to the minimum list in chapter 4.2 Appendix II-6, which could also be provided by GPCs on request by RCCs or NMCs (the RCCs and NMCs would adhere to conditions, if any, attached by the GPCs to these data and products):

1. Grid point value (GPV) products:

- hindcast and forecast data for downscaling algorithms;
- data for RCM boundary and initial conditions;
- predicted global weekly values of SST.

2. Information to assist in building capacity in areas such as:

- interpretation and use of ERF and LRF products;
- downscaling techniques (both statistical and dynamical);
- verification techniques (for local verification of RCC generated products and application outputs);
- development of local user applications from RCC downscaled products;
- use and implementation of regional climate models.

In Part II, add new **Attachment II-12** as follows:

ATTACHMENT II-12

LEAD CENTRES FOR LONG-RANGE FORECAST OF MULTI MODEL ENSEMBLE (MME) PREDICTION

1. GPC Seoul and GPC Washington are jointly recognized as a Lead Centre for Long-Range Forecast of Multi Model Ensemble (MME) predictions, including responsibility for a web portal of GPC and MME products with global coverage.

2. Functions of Lead Centres for Long-Range Forecast of Multi Model Ensemble (MME) prediction

1) Maintain a repository of documentation for the system configuration of all GPC systems
2) Collect an agreed set of forecast data from GPCs
3) Display GPCs forecasts in standard format
4) Promote research and experience in MME techniques and provide guidance and support on MME techniques to GPCs, RCCs and NMHSs.
5) Based on comparison among different models, provide feedback to GPCs about the models performance
6) Generate an agreed set of Lead Centre (LC) products (see section 3)
7) Provide Web pages to satisfy requirements for regional display of Lead Centre products (e.g. for RCOF coordinators)
8) Where possible verify the LC products using the SVSLRF.
9) Redistribute digital forecast data for those GPC's that allow it.
10) Handle requests for the password for the website and data distribution; maintain a database recording the users who have requested access to data/products and the frequency of access
11) Maintain an archive of the real-time GPC and MME forecasts.

3. Core information to be available from Lead Centres for LRFMME

3.1 GPC digital products:

Global fields of forecast anomalies as supplied by GPCs, and listed below (for GPCs that allow redistribution of their digital data):

Monthly mean anomalies for individual ensemble members and ensemble mean for at least each of three months following the month of submission e.g March, April, May if the month of submission is February:

a) Surface (2m) temperature
b) Sea Surface Temperature
c) Total Precipitation rate
d) Mean Sea Level pressure
e) 850hPa temperature
f) 500hPa geopotential height

N.B definitions of the content and format for the supply of data to the Lead Centre by GPCs and terms of exchange are available on the LC-LRFMME Web sites.

GPCs not currently able to participate in this additional exchange of data are encouraged to do so in the future.

3.2 Graphical products:

Plots and maps for each GPC forecast displayed in common format on the LC website, for the variables listed in 3.1 and for selectable regions where appropriate, showing for 3-month means or accumulations:

a) ensemble 'plumes' of Niño indices (1-month means)
b) ensemble mean anomalies
c) Probabilities of above / below median
d) Model consistency plots, i.e maps showing the proportion of models predicting the same sign anomaly.
e) multi-model probabilities of above/below median.

4. Additional information to be available from Lead Centres for LRFMME

As part of research and development Lead Centres may make available products based on forecast and hindcast data from the subset of GPCs that are able to supply them. These products are additional information to help GPCs, RCCs and NMCs to further develop MME techniques and their application.

GPCs not currently able to participate in this additional exchange of data are encouraged to do so in the future.

4.1 GPC digital products:

Global forecast fields and corresponding hindcasts for the fields listed in 3.1, and additional variables to be agreed, for those GPCs that allow redistribution.

4.2 Graphical products

Forecast maps for each GPC displayed in common format on the LC website, for the variables listed in 3.1 and for selectable regions where appropriate, showing for 3-month means or accumulations:

a) tercile category probabilities
b) model consistency plots for most likely tercile category
c) multi-model probabilities for probabilities for tercile categories, using various established and experimental multi-modelling methods.

These additional products will be distinguished from Lead Centre core products listed in 3.

5. Visualization of graphical products

The recommended temporal resolution, lead-times, variables and update frequencies for images are those prescribed for GPCs in Appendix II-6, chapter 4.2.

a) Forecasts for individual GPCs will be displayed in common graphical format in a way that allows comparison.
b) The geographical regions displayed will be interactively selectable, or at minimum:
   - Globe
   - Northern extratropics
   - Southern extratropics
   - Tropics
   - Nino regions (for SST plumes)
c) The research and development products in section 4 will be distinguished from the Lead Centre products of section 3.
d) Graphical forecast products displayed will be accompanied by disclaimers stating that the forecasts do not have precedence over the final forecast for any country or region as produced by the NMHS or RCC for that country or region.

6. Access to GPC data and visualization products held by the Lead Centres for LRFMME

a) Access to GPC data and graphical products from LC-LRFMME websites will be by website password.
b) Digital GPC data will be only re-distributed in cases where the GPC data policy allows it. In other cases, requests for GPC output should be referred to the relevant GPC.
c) Recognized GPCs, RCCs, NMHSs, and institutions hosting RCOFs such as ACMAD, ICPAC, are eligible for password protected access to information held and produced by the LC-LRFMME.
d) Potential new users not belonging to the above categories may request access from an LC-LRFMME, who will refer the request to the designated GPCs. Decisions to allow access must be unanimous. The Lead Centre will be informed of new users accepted for access.
e) A list of users provided with password access will be maintained by LC-LRFMME and reviewed by the GPCs, to measure the degree of effective use and also to review any changes in status of eligible users. The GPCs and the LC-LRFMME will report on the review to the CBS Expert Team on Extended- and Long-range Forecasting.[1]

In Part II, add new **Attachment II-13** as follows:

ATTACHMENT II-13

Suggested guidelines for feedback from RCC/NMHS to GPCs

1. Products used (from the minimum list defined in Chapter 4.2 Appendix II-6)

2. Additional products used

3. Your qualitative assessment on the following aspects of products:

   a) accessibility & timely availability
   b) completeness & quality
   c) usefulness for your purposes

4. How are the data processed? (e.g. is any post-processing/downscaling carried out?)

5. Forecast applications that have been developed using the data

6. Research studies that have been conducted using the data

7. Any other comments

[1] It is the name of the CBS Expert Team at the time of this insertion in the Manual. In the future it may be changed to another entity, but still dealing with coordination of the production of long-range forecasts.

Annex 2 to Recommendation 9 (CBS-XIV)

PROPOSED AMENDMENTS TO THE *MANUAL ON THE GDPFS* RELATED TO EMERGENCY RESPONSE ACTIVITIES, VOLUME I (WMO-NO. 485)

The proposed amendments to the Manual on the GDPFS, Volume I, include a new designation and new procedures related to the ERA which are detailed in CBS-XIV/Doc. 6.3(1), ADD. 1. The proposed amendments relate to the aspects below:

- Distribution by e-mail and Web access to replace fax (Part II, Appendix II-7, paragraph 5)
- Designation of RSMC Offenbach for ATM backtracking (Part I, Appendix I-1, paragraph 3)
- Request for WMO RSMC Support by IAEA (Part II, Appendix II-7, form)

PROPOSED AMENDMENTS TO THE MANUAL ON THE GDPFS RELATED TO EMERGENCY RESPONSE ACTIVITIES, VOLUME I, WMO-NO. 485

A. Volume I, Part II, Appendix II-7, sub-section 5, last paragraph, regarding faxing and e-mail, replace entire paragraph with:

"The RSMCs will distribute their standard products to the NMHS Operational Contact Points by email and retrieval from designated Web pages. Standard products in the ITU-T T4 format suitable for both group 3 facsimile machines and transmission on parts of the GTS will be maintained by exception and only if requested by the NMHS Operational Contact Point. The RSMC may also make use of other appropriate technologies."

B. Volume I, Part I, Appendix I-1 (paragraph 3), add "RSMC Offenbach" to list of RSMCs with Activity Specialization in Atmospheric Transport Modelling / backtracking, as follows:

3. The RSMCs with activity specialization are the following:

RSMC Nadi – Tropical Cyclone Centre

RSMC New Delhi – Tropical Cyclone Centre

RSMC Miami – Hurricane Centre

RSMC Tokyo – Typhoon Centre

RSMC La Réunion – Tropical Cyclone Centre

RSMC Honolulu – Hurricane Centre

RSMC European Centre for Medium-Range Weather Forecasts (RSMC ECMWF)

Provision of atmospheric transport modelling (for environmental emergency response and/or backtracking)

RSMC Beijing

RSMC Exeter

RSMC Melbourne

RSMC Montreal

RSMC Obninsk

RSMC Offenbach (backtracking only)

RSMC Tokyo

RSMC Toulouse

RSMC Washington

C. Volume I, Part II, Appendix II-7, modifications to the IAEA Request Form, shown in tracked changes, within Appendix II-7 (see following images of the form):

Environmental Emergency Response
Request for WMO RSMC Support by IAEA

The IAEA sends the completed form by fax to all RSMCs and RTH Offenbach.
At the same time the IAEA calls the 'Lead' RSMCs (selected on the form) to ensure receipt of this form.

Date/Time of Request: yyyy-MM-dd/HH:mm(UTC)

STATUS: ☐ **EMERGENCY** ☐ **EXERCISE**

REQUESTED RSMCS : (indicate the lead RSMCs by a checkmark below)

☐ EXETER ☐ TOULOUSE ☐ MELBOURNE ☐ MONTREAL ☐ WASHINGTON
☐ BEIJING ☐ TOKYO ☐ OBNINSK ☒ RTH Offenbach

SENDERS NAME :**INTERNATIONAL ATOMIC ENERGY AGENCY**

COMMUNICATION DETAILS: Tel .: +43 1 2600 22023 use to confirm receipt of request
Fax: +43 1 26007 29309 use to confirm receipt of request
Email: jec3@iaea.org use to confirm receipt of request

NAME OF RELEASE SITE AND COUNTRY (facility and place

GEOGRAPHICAL LOCATION OF RELEASE: . decimal degrees ☐ N ☐ S
(MUST BE COMPLETED) . decimal degrees ☐ E ☐ W

DECLARED EMERGENCY CLASS:

☐ NONE ☐ other, specify:

ACTION REQUIRED :

- ☐ NONE
- ☐ GO ON STANDBY (request for products or for assistance on weather conditions is to be expected)
- ☐ LEAD RSMCs ONLY: GENERATE PRODUCTS* AND SEND TO IAEA ONLY
- ☐ ALL RSMCs: GENERATE PRODUCTS* AND DISTRIBUTE WITHIN THEIR REGION(S)
- ☐ OTHER ACTION :

* Appendix II-7, Manual on the Global Data Processing and Forecasting System, WMO No. 485

WMO Service Request Form Page 1 of 2 Revision 2008-05-06

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Recommendation 10 (CBS-XIV)

WMO SPACE PROGRAMME

THE COMMISSION FOR BASIC SYSTEMS,

Noting:

(1) The critical importance of space-based observation as a key information source for WMO Programmes and co-sponsored programmes,

(2) The benefit of optimizing space-based capabilities and expanding their use throughout WMO Members,

(3) The role to be played by the Global Observing System (GOS), and in particular its space-based component, in support of many societal benefit areas within the Group on Earth Observations (GEO) Global Earth Observation System of Systems (GEOSS),

(4) The challenges and opportunities related to the development of space-based technology and its efficient use by WMO Members in multiple areas including, for example, climate monitoring and disaster prevention,

Considering:

(1) That the WMO Space Programme as established by Resolution 5 (Cg-XIV) has proven to be an important and efficient mechanism to foster the use of space-based capabilities and expand their benefits throughout WMO Members,

(2) That activities under this Programme are pursued, and shall be further developed, towards expanding observing systems, enhancing data access and building capacity within Members, thus contributing to many WMO expected results, in particular Expected Results 4, 5 and 9,

Recalling that:

(1) Resolution 5 (Cg-XIV) stipulated that the resources budgeted for the WMO Space Programme be supplemented by extrabudgetary funds as they become available,

(2) Resolution 5 (Cg-XIV) further urged Members to collaborate actively in, and give all possible support to, the implementation of the WMO Space Programme,

(3) The eighth Consultative Meeting on High-level Policy on Satellite Matters (CM-8) reiterated the need to increase staff resources within the Office as well as contribute to the Space Programme Trust Fund to ensure sustainability and enhancement of WMO Space Programme activities,

Recommends that:

Members consider increasing their support to WMO Space Programme activities through, for example:

- Contributions to the space-based Global Observing System;
- Support to space-related information and training activities;
- Contribution to the work of expert teams and related technical working groups;
- Secondment of experts within the Space Programme Office;
- Contribution to the Space Programme Trust Fund.

Recommendation 11 (CBS-XIV)

REVIEW OF RESOLUTIONS OF THE EXECUTIVE COUNCIL BASED ON PREVIOUS RECOMMENDATIONS OF THE COMMISSION FOR BASIC SYSTEMS OR CONCERNING THE COMMISSION

THE COMMISSION FOR BASIC SYSTEMS,

Noting with satisfaction action taken by the Executive Council on the previous recommendations of the Commission for Basic Systems or concerning the Commission,

Considering that some of the previous Executive Council resolutions are still valid,

Recommends that the following Executive Council resolutions be kept in force:

Resolution 2 (EC-LVI), Resolution 3 (EC-LIX) and Resolution 10 (EC-LIX) (with reference to Recommendation 1 (CBS-Ext.(06)) only).

ANNEXES

ANNEX I
Annex to paragraph 6.1.23 of the general summary

FIVE-YEAR STRATEGY FOR THE CGMS VIRTUAL LABORATORY FOR EDUCATION AND TRAINING IN SATELLITE METEOROLOGY

1. INTRODUCTION

1.1 Scope and definition

The CGMS Virtual Laboratory for Education and Training in Satellite Meteorology (VL) was established to help improve the worldwide utilization of satellite data and products by WMO Members.

The CGMS Virtual Laboratory (VL) is a global network of specialized training centres, named "Centres of Excellence in Satellite Meteorology (CoE)", that are supported by one or more CGMS satellite operators. These CoE, often co-located with WMO Regional Training Centres (RTC), are established in the various WMO Regions to meet user needs for increased skills and knowledge in using satellite data within their Region. Each CoE is responsible for conducting training activities and normally supports one or more Regional Focus Groups involving NMHSs from its Region.

1.2 High-level goals

Current top-level goals of the VL are:

i) To provide high quality and up-to-date training and supporting resources on current and future meteorological and other environmental satellite systems, data, products and applications;

ii) To enable the Centres of Excellence to facilitate and foster research and the development of socio-economic applications at the local level by the NMHS through the provision of effective training and links to relevant science groups.

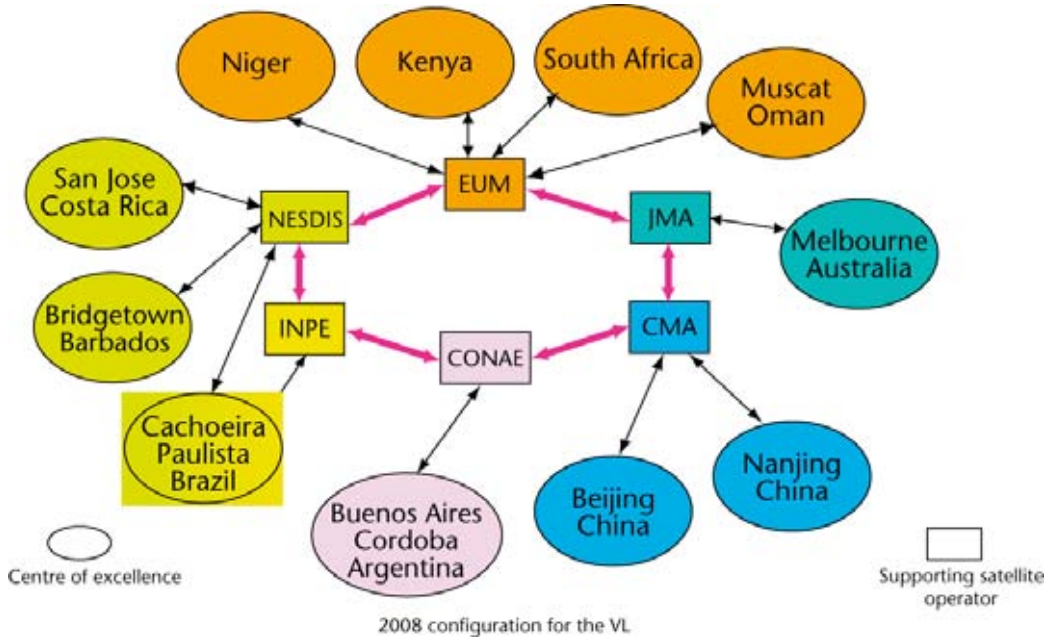
The VL activity aims at achieving these top-level goals through providing access to:

- Case study material and near real time data;
- Training and educational resources; and
- Software and expertise on how to best utilize satellite data and products.

1.3 Current status

At the present time, the VL is a collaboration between CMA, EUMETSAT, INPE, JMA and NOAA, as concerns the satellite operators; and nine CoEs that are located in Argentina, Australia, Barbados, Brazil, China, Costa Rica, Kenya, Niger, and Oman.

The figure below shows the various linkages within the VL between CoEs and their supporting satellite operators in September 2008. The continuing growth in the VL community is seen with the recent additions of INPE/CPTEC in Brazil; CMATC in Beijing, China; SAWS in South Africa; CONAE, SMN and UBA in Argentina



2008 configuration for the VL

1.4 Evolving user needs

In the coming years there will be significant changes in the user community requiring training, the way teaching and learning is carried out and the subject matter of the training. There will be significant advances in e-learning technology and increased availability of high speed low cost communications across the globe. Increased satellite capabilities will lead to new data and product application areas, over and above the traditional weather forecasting, which will become increasingly important. For example, the ability to measure precisely and understand climate change and its impact is now a global priority.

As more NMHSs take advantage of automated services, weather forecasters will require regular training to provide an expanded set of products that meet the needs of a wider range of users including for instance environmental scientists, software engineers and developers of new user-driven services. It is clear that with new satellite technologies, advanced training will become an imperative to ensure full utilization of this valuable resource.

1.5 New strategy

Building upon the experiences and successes of the VL over recent years, and taking into account the evolving user needs, this document presents a five-year strategy for the VL. It is complemented by a plan for implementing this strategy.

2. STRATEGIC OBJECTIVES FOR THE VL

2.1 Target users

The VL will aim at providing training and training resources for NMHS staff, noting that this includes a diversity of profiles from core synoptic weather forecasting to a wide range of applications to related fields, as the activity of NMHSs tends to expand.

2.2 Training areas

First of all, the VL will provide training that exploits the full potential of satellite data and products from both operational ***and*** several R&D satellites and, in so doing, prepare the various user communities for the next generation of space-borne Earth observing systems.

Secondly, and bearing in mind the ongoing establishment of various elements of the GEOSS and the emphasis now being placed upon GEO capacity building efforts, especially for the developing countries, VL training activities may in the future consider the training needs of some other GEO

Societal Benefit Areas in addition to Weather and Climate: Agriculture, Biodiversity, Disasters, Ecosystems, Energy, Health and Water.

The training programmes of the CoEs and satellite operators comply with the principles and recommendations described in the satellite meteorology component of WMO publication No. 258 "Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology". This document places major emphasis on the training of trainers and sets the standard for competence training. Therefore, VL training activities will have to closely follow any evolution in WMO publication No. 258 to meet new training needs.

Building upon the currently available expertise within the VL network, training activities should first focus upon the following topics:

(i) Satellite Remote Sensing
- Satellite capabilities
- Spectral bands and their applications
- Cloud analysis and image interpretation
- Microwave applications
- Products – Precipitation, Winds, Soundings, etc.
- Resolution, calibration, product quality

(ii) Meteorology
- Severe convective systems
- Heavy rain and floods
- Winter storms
- Tropical storms
- Impact on transportation (land, aviation, water, space, etc.)

(iii) Climate
- Inter-calibration issues
- Radiation budget
- Ocean and cryosphere
- Aerosols and ozone

(iv) Hydrometeorological and other natural disasters
- Fire, wind, etc.

Where satellite observations are of benefit, and there is a user requirement, then the focus of VL activities could be widened to support training related to:

(v) Ocean applications
(vi) Land applications
(vii) Hydrology and water management
(viii) Atmospheric chemistry, air quality
(ix) Environmental quality

Applications and Service-based training will increasingly involve the use of satellite data ***in combination*** with other data sets such as weather radar, NWP, lightning, precipitation, land information, etc., and may well be carried out in partnership with other Institutes where the relevant expertise exists.

2.3 The Virtual Resource Library

The Virtual Resource Library (VRL) is a key asset of the VL.A key goal is to ensure that this valuable repository of training resources is secured, maintained and configured in such a way that effectively supports both the contribution and use of resources. To this end, it is proposed that the VRL should be accessible through a centralized Web portal. The host of such a portal must have experience in maintaining and managing such a system. Examples of such sites might be the

Environmental Satellite Resource Centre (ESRC) hosted by COMET and the CEOS Educational Resources Portal maintained by EUMETSAT.

2.4 Role of the CoE

Each CoE is responsible for conducting international training activities, in one or more WMO working languages, for the benefit of NMHSs from its Region, along the lines of the Virtual Laboratory.

For that purpose, and considering the expanding training needs within the Regions, the CoE is expected to survey and maintain a list of training requirements for its Region, to organize and run training events, to develop and maintain proficiency in providing online training using tools such as VisitView, and to establish and support one or more Regional Focus Groups holding regular online sessions.

The CoE, through a nominated focal point and an alternate, will maintain coordination with the VL Management Group and provide the Co-chairs with a brief annual report outlining the relevant past training activities, the priority training needs for the Region, their plans to meet these needs in the coming twelve months, their overall situation and other information as appropriate.

2.5 Regional Focus Groups

For the VL to realize its potential and become a global provider of training, each CoE will need to establish and/or strengthen the Regional Focus Groups (RFG).

The RFG is a virtual meeting that is convened by the CoE on a regular basis through online sessions, using VisitView or equivalent tools, in order to maintain an active sharing of experience and know-how within the Region in between training events. The primary scope of RFG sessions can be to hold weather briefings. It also allows highlighting significant recent situations to keep abreast of new developments, and to ask and answer questions. Through this mechanism, the CoEs play an important networking role and help build a strong community of practice.

2.6 Tools and techniques

A key component of the advanced training will be greater use of blended learning, a training concept successfully implemented in recent years by a number of training centres. Blended learning combines online and traditional methods for training and is a very cost effective means of expanding the access to training materials while preserving many of the benefits of traditional training approaches. Its wider use should be regarded as a key goal of the VL. Conferencing and audio/video-supported training tools are now emerging and these developments will be assessed and incorporated by VL partners in their training programmes, as appropriate.

The course management system, Moodle, and distance learning tools like CENTRA are being adopted among the VL partners. The progression to new “tools” for use by trainers is important to the growth of the VL.

The quality of Internet connectivity is very important to support the use of video, voice and other high quality training tools in the VL environment. To provide effective training, CoEs need to have an Internet connection with a ***minimum*** data rate of 1 Mbs ***specifically dedicated*** to CoE training activities. Such a data rate is the absolute minimum needed. Status of Internet connection needs to be included in the CoE annual reports to VLMG every September.

2.7 Feedback mechanism

Increasingly, it is necessary to demonstrate the tangible benefits coming from human and financial resource investments in training. In particular, how training leads to an improvement in services provided by the NHMS. The VL will develop systematic feedback and reporting mechanisms that will lead to continuous improvement ensuring that this key objective is met.

2.8 Outreach

Past enquiries indicate that many users are not yet fully aware of the resources that the VL can provide. Information actions shall be considered to raise the awareness of WMO Members through the VL website; and at the regional level through the Centres of Excellence, the WMO Regional Associations and the Regional Rapporteurs for the Space Programme.

3. SECURING AND ENHANCING THE VL NETWORK

To implement the VL strategy in the coming years, the following three fundamentals of the VL have to be fully supported by the partners:

- Commitment = by all the partners to put effort and resources into the VL;
- Cooperation = building relationships, e.g. via the set up of Regional Focus Groups;
- Collaboration = jointly developing, delivering and exchanging training resources.

3.1 Commitment

As noted earlier, the long-term effectiveness of the VL relies on the long-term commitment of the CoEs and the satellite operators to meet training requirements coming from their various user communities. In turn, the effectiveness and success of the CoEs is highly dependent on five factors; the support from their sponsoring satellite operator, the support from local management, the availability of trained personnel, the quality of the training technical infrastructure, and political stability.

3.2 Expansion of CoEs

While the VL has existed for less than a decade, both its growth and positive impact have been dramatic. This was recognized by the WMO Congress. We expect the growth of the VL to continue with sponsorship from additional satellite agencies and inclusion of more CoEs. This growth should ensure that all countries in a particular Region can benefit from VL training activities and that training can be provided in all WMO official languages. These additional CoEs will facilitate intercontinental cooperation in training and the development and exchange of training resources in additional languages, as well as provide a risk reduction measure should a nearby CoE need assistance.

3.3 Partnership

The Eumetcal Project of EUMETNET is addressing the meteorological training needs of much of WMO Region VI (RA VI). It is reasonable to consider that the VL network could take advantage of Eumetcal satellite related training activities in RA VI. The expansion of the VL network in this manner will be carried out in partnership with established European Training Centres and others in RA VI such as the Russian Federation with its WMO Training Centres in Moscow and St Petersburg.

3.4 Coordination

Taking into account the dynamic expansion of the VL in terms of new CoEs, future Regional Focus Groups, wider scope of applications covered, and larger audiences, there is a clear need for strong project coordination. Given the decentralized nature of the VL, this can only be efficiently achieved if coordination is ensured by a dedicated person assigned to this function.

4. IMPLEMENTATION PLAN

An Implementation Plan should be developed for the five-year period and include tasks, actions, responsibilities, deadline and deliverables, directly related to the strategic goals mentioned above. Progress in the implementation should be monitored on a yearly basis by the Virtual Laboratory Management Group (VLMG) and the Plan updated as appropriate.

ANNEX II
Annex to paragraph 6.1.32 of the general summary

CONCLUSIONS AND RECOMMENDATIONS FROM THE FOURTH WORKSHOP ON IMPACT OF VARIOUS OBSERVING SYSTEMS ON NWP

The discussions on the Workshop presentations and results took also into account the reports from the preceding workshops and the latest comments made by the ET-EGOS. They led to the following conclusions and recommendations.

Almost all centres were able to identify positive impacts on forecast skill of practically all parts of the observing system. This is a testament both to the quality of the Global Observing System and to the increasing level of maturity of the models and assimilation systems used to ingest the information for numerical weather prediction. A tremendous activity is now evident in regional NWP using variational assimilation systems to explore new data types. The methodology has converged, and rapid progress is being made in many countries.

Several studies seem to indicate that the impact of simultaneous use of mass (temperature) and wind observations exceeds the sum of the individual impacts in experiments where the two types of information were used separately, especially in the tropical regions. This will have implications for the requirements of the observing system of the future as far as the balance between observations pertaining to the different model variables is concerned.

1.1 Interaction between NWP centres, data providers and data users

a) Some regional observation data sets appear to be more and more useful for regional NWP and will soon be useful also for global NWP. It is recommended to implement a global exchange of these data sets, starting by: (i) Radar data radial wind and reflectivities as the highest priority; and (ii) GPS surface networks as second priority;

b) For polar orbiting satellite instruments, the quick availability of data in real-time NWP is important for operational NWP (global and regional). It is then recommended to develop and maintain ad hoc telecommunication means allowing the quick re-transmission of some data (like the existing systems EARS and AP-RARS).

1.2 Observational data requirements

a) Because of the lack of profile-type observations in the polar latitudes, every effort should be made to maintain the existing radiosonde sites, and/or find new systems to observe the vertical structure of the atmosphere (wind, temperature, humidity) in the polar areas. The IPY year is an opportunity to have new systems deployed (e.g. drifting balloons and unmanned aerial vehicles). An exhaustive list of these IPY-specific observations should be made available to all NWP users, and the extension of some of these systems beyond the IPY should be considered;

b) One of the highest priorities in terms of observation requirements is to add more profile observations in many data-poor areas. Thus, all the AMDAR opportunities should be used to improve the wind and temperature data coverage, especially in data-poor areas like the inter-tropical regions or Central and South Africa. This implies collecting new wind and temperature profiles at certain airports by equipping some aircraft flying regularly to these airports, and also to get the data from cruise levels in these regions (which are otherwise data-poor regions). The long-term future of the AMDAR system is also an issue to consider;

c) Remote radiosonde stations are still of exceptional value (as shown with isolated islands, ASAP observations and AMMA radiosonde observations). They are essential and should not be closed although they are the most expensive. We have not yet

reached the point of satellite utilization that makes it possible to close down such stations. The work done for the AMMA campaign to re-activate some radiosonde sites and improve the radiosonde network over West Africa has been extremely beneficial and has shown the large existing potential for improving data sparse radiosonde networks;

d) The importance of hyperspectral infra-red sounders (with respect to for example AMSU) for meeting the upper-air observation requirements is a major finding of this 2008 workshop, with respect to the 2004 workshop. The assimilation of cloudy radiances from these sounders has started to give very encouraging results;

e) The rapid development of GPS-RO data has led to a situation where their role in operational global data assimilation is almost as important as the ones of the microwave or infra-red sounders. However, the current satellites providing the GPS-RO measurements are research satellites with no guarantee of continuity in the future. It becomes very important to study the issue of future GPS-RO observing systems and their operational role in the GOS;

f) The key role of THORPEX, IPY and campaigns such as AMMA, for defining observation requirements is acknowledged. This includes the activities related to observation targeting. For each research campaign, all observations should be made available on the GTS whenever possible depending on the data volumes, for real-time evaluation of these extra observations, and a list of expected extra observations should be made available to NWP centres before the campaign.

1.3 Proposals for future studies

a) The use of the adjoint technique to compute a FIO (Forecast Impact to Observation, via an adjoint computation) is highly recommended to complement OSEs and DFS, to all the centres which can afford it (the adjoint of a forecast model is needed). A somewhat systematic exchange of results between some centres (as is currently done for monitoring of observation availability and quality) is also desirable;

b) For studying rapidly and objectively the optimization of stations of the Regional Basic Synoptic Network in the WMO Regions (especially radiosondes to start with), it is recommended to study the design of a simple mathematical tool, in the form of a portable software, based on the optimal estimation theory (along the lines of Pokrovsky, 2008, in the present proceedings, but using appropriate NWP background statistics rather than climatology, and taking into account the cost of each individual station);

c) More attention should be given to the forecasts at ranges 7 to 14 days, in some future impact studies. In this context, some studies should address the requirements in surface variables such as soil moisture, SST and sea-ice and also the observation requirements in the stratosphere. Ensemble prediction systems could be a helpful tool for these future studies;

d) Concerning the stratosphere, the requirements for conventional observations will have to be studied again in the new context where GPS-RO has started to play a major role, and when ADM-AEOLUS wind data are likely to be available within few years. The current Joint OSSE project provides a testbed for studies to answer the general question of observation requirements in the stratosphere;

e) Consistent with the outcome of the previous Workshop in Alpbach, the Workshop again recognized the potential value of a properly calibrated OSSE system as a tool to provide guidance for the evolution of the GOS. The Workshop took note of the emerging Joint OSSE collaboration that is coordinated within the US by the Joint Center for Satellite Data Assimilation and that includes input also from ECMWF and KNMI. Hope was expressed that the Joint OSSE collaboration will be further developed and

expanded, and that the developers of space-based observing systems in particular will participate in funding the system and will make use of its output in their decision-making processes. One typical example is GPS radio-occultation which should be studied through OSSEs;

f) Studies related to surface emissivity over land are highly required for regional NWP in order to fully exploit the satellite observations. Some are already available, but the efforts should be increased;

g) The same approach for the organization of future observing systems impact studies and the reporting on their outcomes should be used again in a similar workshop planned for 2012. However, several other organizations are possible and worth discussing, taking into account the existence of the THORPEX Programme, active on the same scientific subject. The ET-EGOS proposed that CBS-XIV makes a recommendation for holding the 5th NWP "Impact" workshop in 2012.

ANNEX III
Annex to paragraph 6.2.21 of the general summary

WIS DATA COMMUNICATION INFRASTRUCTURE – PLANNING AND IMPLEMENTATION STRATEGY

1. Planning and implementation strategy guidelines are as follows:

(a) Smooth evolution with a view to ensure a coordinated transition without interruption of GTS operation in an evolutionary process of the GTS, especially the Improved MTN;

(b) Extension of participating centres to include other participants, non-NMHSs, in future;

(c) Consider the different level of development of centres and the fact that availability of communications technology in each country and/or region is variable;

(d) Change the current vision from connection centric to data centric to better address the data management issues concerning all WMO and related international programmes. WIS major components, i.e. GTS, DAR and IGDDS should share a unified data management concept to assure information interoperability;

(e) Effective coordination of timeliness requirements. In each implementation phase, timeliness requirements are not necessarily fulfilled by the WIS real-time network independently of ICT improvement. Timeliness requirements (e.g. for highest priority exchange such as Tsunami Warning and Advisory) should be practically coordinated to ensure that requirements are met.

2. The strategy should include the practical outcomes of studying the following topics:

(a) Achievable goal of each implementation phase to allow centres to evaluate their position and to facilitate evolution activity;

(b) Flexible and extensible implementation to allow centres to keep up with the evolution process, enabling small centres to join the WIS without a significant increase in budget and human resources;

(c) Cost-effective, reliable and sustainable evolution, taking advantage of ICT developments, such as use of managed network services and international industry standards for protocols, software and hardware;

(d) Coordination framework for administrative issues – WIS data communication structure should be established through collaboration of multi-nations as well as the Improved MTN. There are many administrative hurdles towards a large-scale collaboration, since each nation has different rules for procurement procedures, contractual and accounting systems, and international arrangements. Establishment of a coordination framework for administrative issues in each responsible area is required for the management of an AMDCN;

(e) Coordinated salvage schemes – In spite of a flexible and scalable implementation plan, there may be a centre which is not able to catch up the evolution process. Coordinated salvage schemes in technical and financial supports are necessary to avoid stopping development;

(f) Integration of data management with network coordination – The current GTS evolving into the WIS main component should implement key data management functions, i.e. information interoperability with DAR, IGDDS and other components by harvesting and sharing of metadata and metadata catalogues, and better sharing of information on a data policy perspective, such as the compliance with WMO Resolutions 25 and 40.

ANNEX IV
Annex to paragraph 6.2.61 of the general summary

MIGRATION MATRIX

CATEGORY OF TRADITIONAL ALPHANUMERIC CODES (TAC)	Nov 2005	Nov 2006	Nov 2007	Nov 2008	Nov 2009	Nov 2010	Nov 2011	Nov 2012	Nov 2013	Nov 2014	Nov 2015	Nov 2016
1. Common: SYNOP; TEMP PILOT; CLIMAT	*Start operational exchange*					Migration complete						
2. Satellite observations: SARAD, SAREP SATEM, SATOB	*Operational exchange*	Migration complete										
3. Aviation: METAR, SPECI, TAF			*Start experimental exchange*						*Start operational exchange*			Migration complete
AMDAR	*Operational exchange*	Migration complete										
4. Maritime: BUOY, TRACKOB BATHY, TESAC WAVEOB, SHIP CLIMAT SHIP PILOT SHIP TEMP SHIP CLIMAT TEMP SHIP	*Start experimental exchange*		*Start operational exchange*					Migration complete				
5. Miscellaneous: RADOB, IAC IAC FLEET GRID, RADOF	*Experimental exchange*	*Start operational exchange*		Migration complete								
6. Obsolete: *ICEAN, GRAF, NACLI etc., SFAZI, SFLOC, SFAZU, ROCOB, ROCOB SHIP, CODAR, WINTEM, ARFOR, ROFOR, RADREP, MAFOR, HYDRA, HYFOR*												

NOT APPLICABLE

MIGRATION MATRIX NOTES:

(1) Aviation Codes require ICAO coordination and approval, except for AMDAR.

(2) SAREP and RADOB require coordination by the ESCAP/WMO Typhoon Committee.

(3) For category 5, codes need to be reviewed in order to decide whether or not they should be migrated to BUFR/CREX.

(4) Codes in category 6 are not to be migrated.

(5) 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.

– ***Start of experimental exchange*** means: data will be made available in BUFR (CREX) but not operationally, i.e. in addition to the current alphanumeric codes, which are still operational.

– ***Start of operational exchange*** means: 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).

– ***Migration complete*** means: 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:

– Corresponding BUFR/CREX-tables and templates are available;
– Training of concerned testing parties has been completed;
– Required software of testing parties (encoding, decoding, viewing) is implemented.

Relevant conditions to be satisfied before operational exchange may start:

– Corresponding BUFR/CREX-tables and templates are fully validated;
– Training of all concerned parties has been completed;
– All required software (encoding, decoding, viewing) is operational.

ANNEX V
Annex to paragraph 6.3.14 of the general summary

TABLE OF POSSIBLE BLENDING APPROACHES WITH MODEL AND OBSERVATIONAL DATA COMBINATIONS FOR VERY SHORT-RANGE FORECASTING

(from Final Report of CBS Expert Meeting on Very Short-Range Forecasting (Toulouse, Nov. 2007) ANNEX IV)

Type	Description	Time range, availability	Examples	Documents, websites	Remarks
Observations only	Object recognition, extrapolation (radar, satellite), data fusion	Nowcasting, immediate	TRT, RDT, gridded observations		Can be centrally produced (satellites)
Observations + model analysis	Indices	Nowcasting, immediate	GII, RII		
Superposition of observations and model	"Simple" accumulations from rain gauges and radar	SRF, immediate	Sum of rainfall until now + model from now		Simple but far from available
Climatological postprocessing	Comparison of model analysis or forecasts with local observations on climatological basis	SRF, available at same time as model output	Regressions, discrimination, neural networks, boosting (choice of relevant predictors)		Non linear methods can be targeted on high impact weather
Model diagnostics	Recognition of synoptic features on NWP analysis and forecasts	SRF, available at same time as model output	Troughs, dry zones, jet streams, large scale destabilization, synoptic classification		Synoptic recognition of high impact weather is possible
Adaptive postprocessing	Comparison of model analysis or forecasts with local observations based on recent observations and model runs	SRF, available at same time as model output	UMOS, Kalman filtering		Takes into account model changes. History usually too short to deal with rare events
Observation – model blending	Observations at initial state, model after a few hours	Nowcasting, SRF. Can be immediate if older model is used	INCA, Scribe module		
Inclusion of local observations into specific model	Gross atmospheric conditions provided by NWP model, supplementary local data used for specific model	Nowcasting, SRF	1d models (fog, road state), 2d surface models, hydrological models		
Choice of model with the help of observations	Choice of different models or ensemble members with recent observation	SRF	Heuristic		
Assimilation of asynoptic observations	Assimilation of radar, GPS, profiler, satellite data into NWP model	SRF	3dVar, 4dVar, Latent heat nudging		Expensive

ANNEX VI

Annex to paragraph 6.3.19 of the general summary

CONTENT AND FORMAT FOR THE SUPPLY OF DATA TO THE SEOUL/WASHINGTON LEAD CENTRE FOR LRFMME BY GPCs AND TERMS OF EXCHANGE

Data formats and file naming convention

The LC-LRFMME has proposed following standardization for data formats, and file naming convention as follows:

(a) The following variables: Z500, T850, MSLP, Precip., T2m and SST, should be submitted for each of three months following the month of submission (e.g. June, July, August if the month of submission is May);

(b) Acceptable data formats: **GRIB1**; GRIB2;

(c) The number of bits **of** GRIB data is 16-bits;

(d) The number **of** grid points **should** be **144*73** (starting from 90N and 0E);

(e) There should be one file with monthly ensemble mean anomaly. Individual members should also be provided as separate files in the same format as the ensemble mean. Therefore, if there are "n" members in the forecast, total number of files submitted will be "n+1";

(f) File naming conventions: (see LC-LRFMME Website).

Terms for exchange

The terms for exchange of data between GPCs and LC-LRFMME are as follows:

(a) GPCs provide their **monthly mean anomaly forecasts** (and full fields, for GPCs participating in this additional exchange; see Attachment II-12, section 4 for "additional exchange") to the Lead Center on a monthly basis and LC will be responsible for displaying them;

(b) GPCs who are able to do so will submit data for monthly means and for individual ensemble members;

(c) Forecast anomalies should be provided by GPCs by the 15th of the month. For example, for June-July-August seasonal forecast, data should be provided by 15th May. GPCs should inform the LC-LRFMME if any delay in submitting data is anticipated.

ANNEX VII

Annex to paragraph 6.4.4 of the general summary

AMENDMENTS TO THE PROCEDURES FOR THE MAINTENANCE OF THE CATALOGUE OF METEOROLOGICAL BULLETINS DETAILED IN ANNEX III – ANNEX TO PARAGRAPH 4.2.18 OF THE GENERAL SUMMARY OF CBS-EXT.(98)

To add the following sentence at the end of paragraph 3.5.2:

"If the responsible RTH on the MTN finds an inconsistency between the bulletins received from an RTH or NMC located in its zone of responsibility and the contents of the catalogue, the responsible RTH should send to this RTH or NMC a draft advanced notification, and invite it to confirm it. If the RTH or NMC does not reply within one month, it is considered implicitly that it agreed with the draft advanced notification. The responsible RTH will then send the finalized advanced notification to the Secretariat."

ANNEX VIII
Annex to paragraph 9.5 of the general summary

LIST OF IDENTIFIED WIS CENTRES AND THEIR FUNCTIONS AS AT 28 MARCH 2009

Member/Organization	*DCPC*	*GISC*	*FUNCTION*
Algeria	DCPC		RTH/RSMC
Australia	DCPC	GISC	WMC/RTH
Australia	DCPC		IPS
Australia	DCPC		NCC
Australia	DCPC		RSMC (Darwin)
Brazil	DCPC	GISC	RTH
Bulgaria	DCPC		RTH
Canada	DCPC		RSMC
China	DCPC	GISC	RTH
Croatia	DCPC		Marine Meteorology Centre
ECMWF	DCPC		RSMC
Egypt	DCPC		RTH
EUMETSAT	DCPC		Satellite Centre
Finland	DCPC		Arctic Data Centre
France	DCPC	GISC	RTH
France	DCPC		GPC/LRFMME
France	DCPC		RCC
France	DCPC		Regional NWP support
France	DCPC		RSMC (EER)
France	DCPC		RSMC (TC-La Réunion)
France	DCPC		VAAC (Toulouse)
Germany	DCPC	GISC	RTH
Germany	DCPC		GCC
Germany	DCPC		GPCC
Germany	DCPC		GRDC
Germany	DCPC		GRUAN
Germany	DCPC		RCC
Germany	DCPC		RSMC
Germany	DCPC		WDCC
Germany	DCPC		WDC-RSAT
Germany	DCPC		WRMC
Hong Kong, China	DCPC		WWIS & SWI Centre

Member/Organization	*DCPC*	*GISC*	*FUNCTION*
India	DCPC	GISC	RTH
India	DCPC		RSMC (TC)
Iran, Islamic Republic of	DCPC	GISC	RTH
Italy	DCPC		RSMC (Marine&Ocean)
Italy	DCPC		RTH
Japan	DCPC	GISC	RTH
Japan	DCPC		GPC/LRF
Japan	DCPC		RSMC (DPFS)
Japan	DCPC		RSMC (EER)
Japan	DCPC		RSMC (TC)
Japan	DCPC		Satellite
Japan	DCPC		Tokyo Climate Centre
Japan	DCPC		WDC (Greenhouse Gasses)
Kenya	DCPC		RIC
Kenya	DCPC		RSMC
Kenya	DCPC		RTH
Republic of Korea		GISC	NMC
Republic of Korea	DCPC		COMS
Republic of Korea	DCPC		GPC/LRFMME
Republic of Korea	DCPC		WAMIS
Netherlands	DCPC		RCC
Netherlands	DCPC		Satellite Centre
New Zealand	DCPC		RSMC
New Zealand	DCPC		RTH
Niger	DCPC		AGRHYMET
Niger	DCPC		RTH / ACNAS
Norway	DCPC		Arctic Data Centre
Russian Federation	DCPC	GISC	WMC/RTH
Russian Federation	DCPC		GDC (Solar Radiation) (St Petersburg)
Russian Federation	DCPC		RCC (Moscow)
Russian Federation	DCPC		RNODC & GDC (Obninsk)
Russian Federation	DCPC		RSMC (EER) Obninsk
Russian Federation	DCPC		RSMC (Moscow)
Russian Federation	DCPC		RTH/RSMC (Khabarovsk)
Russian Federation	DCPC		RTH/RSMC (Novosibirsk)

Member/Organization	***DCPC***	***GISC***	***FUNCTION***
Russian Federation	DCPC		WDC (ICE) (St Petersburg)
Saudi Arabia	DCPC	GISC	RTH
Saudi Arabia	DCPC		RDMEC (Drought)
Saudi Arabia	DCPC		RSMC (Jeddah)
Senegal	DCPC		RAFC
Senegal	DCPC		RSMC
Senegal	DCPC		RTH
Sweden	DCPC		IPY Data Centre
Sweden	DCPC		Nordic Radar
Sweden	DCPC		RTH
Thailand	DCPC		RTH
United Kingdom	DCPC	GISC	RTH
United Kingdom	DCPC		Marine Obs
United Kingdom	DCPC		Ocean/Wave
United Kingdom	DCPC		RCPC
United Kingdom	DCPC		RSMC (EER)
United Kingdom	DCPC		RSMC (NWP)
United States	DCPC	GISC	WMC/RTH
United States	DCPC		GOSIC
United States	DCPC		NCAR
United States	DCPC		NESDIS
United States	DCPC		NGDC
United States	DCPC		NODC
United States	DCPC		RSMC (EER)
United States	DCPC		RSMC (NWP)
United States	DCPC		RSMC (TC-Honolulu)
United States	DCPC		RSMC (TC-Miami)
United States	DCPC		WAFC
Uzbekistan	DCPC		RTH
Total	94	13	

ANNEX IX
Annex to paragraph 10.33 of the general summary

TECO-WIGOS CONFERENCE STATEMENT

1. The Commission for Basic Systems (CBS) Technical Conference on the WMO Integrated Global Observing Systems (TECO-WIGOS) welcomed the progress that had been achieved towards further understanding and articulating the concept of a comprehensive, coordinated and sustainable system of observing systems based on the observational requirements of all WMO Programmes, pursuant to the request of Congress-XV (Cg-XV), bearing in mind the rapid development of systems and technologies and the risks of divergence. The development of WIGOS as a framework for integration of the component global observing systems across WMO and relevant co-sponsored systems, in collaboration with partner agencies, recognizes the additional value that can be achieved through a more coordinated and collaborative approach. The benefits that will flow include reduced financial demands on Members, increased availability of required information, improved access, higher data quality standards, and archiving and technical innovations. However, the development of WIGOS also poses challenges at many levels that the various contributing players and partners must resolve together.

2. The TECO-WIGOS acknowledged and commended:

- The foundation role of the CBS systems, GOS and WIS, in the development of WIGOS and the need for a collaborative approach, involving all Technical Commissions and WMO Programmes, to build WIGOS so that it is greater than the sum of the individual component parts;

- The progress of the Pilot Projects, especially those focussing on AMDAR, ocean observations through JCOMM, atmospheric monitoring through CAS/GAW and the key cross-cutting role of CIMO, and the initial steps taken in addressing satellite intercalibration through the WMO Space Programme and the space community;

- The progress of the Demonstration Projects in all WMO Regions, especially integration of various observing systems, standardization and quality control of observational data at the national level, with NMHSs playing the leading role and reaching out to a wide range of stakeholders;

- The active engagement in the development of a framework for WIGOS by agencies co-sponsoring component observing systems and programs, recognizing the opportunities for cooperation and mutual support and the need to respect individual mandates and policies;

- The fundamental importance of constructing WIGOS together with the WMO Information System (WIS) so that a comprehensive and coordinated solution supporting WMO Members and other users is achieved;

- The commitment of Members and partners engaged on WIGOS activities;

- The increasing consideration of coordinated planning of space-based and surface-based component systems in the WIGOS context, noting the development of the proposed Vision for the GOS in 2025;

- The breadth of understanding of the technical complexities and the growing engagement of a broad range of experts that provide an increasingly sound foundation for WIGOS to build on.

3. TECO-WIGOS highlighted the challenges that remain, including:

- Achieving the timeline as laid out by Cg-XV and, in particular, the need for an early start to additional Pilot Projects and Demonstration Projects;

- The need for a comprehensive and costed development and implementation strategy for WIGOS that, inter alia:
  - Fully outlines the technical challenges to be addressed and the roles and responsibilities of all players;
  - Elucidates the process for capturing the lessons-learned from the Pilot Projects and Demonstration Projects;
  - Outlines a capacity building strategy to ensure the benefits of WIGOS will reach all Members;
  - Designates clear responsibilities across the WMO system for the further development of WIGOS;

- The current lack of WMO resources allocated to addressing WIGOS, which is an impediment to progress, including the need for a fully functioning WIGOS project office;

- The need to complete the full functionality of WIS so that WIGOS can exploit new data access and retrieval facilities

- The importance of engaging the hydrological community in WIGOS activities;

- The need to clarify and communicate the relationship and intersection of WIGOS with the co-sponsored observing systems, (GOOS, GTOS and GCOS) and with GEOSS;

- Finding ways to demonstrate the opportunities of WIGOS to all potential partners and users to build their ongoing support, trust and collaboration;

- Finding a way to more effectively incorporate all WMO observing activities into WIGOS and address their different requirements and priorities, especially the need to ensure WIGOS effectively supports all WMO applications programmes.

4. TECO-WIGOS encouraged CBS to focus on what it can contribute to the further development of the WIGOS concept, and in particular to construction of a comprehensive roadmap that takes WIGOS from concept to reality, and to the implementation of WIGOS, both through leadership and collaboration.

ANNEX X
Annex to paragraph 12.2.3 of the general summary

TERMS OF REFERENCE OF OPAG TEAMS, COORDINATORS AND RAPPORTEURS

OPAG on Integrated Observing Systems

Implementation Coordination Team on Integrated Observing Systems (ICT-IOS)

(a) To contribute to the development and implementation planning of concept of the WMO Integrated Global Observing System (WIGOS) and coordinate with the Sub-group on the WIGOS of the EC Working Group on the WIGOS and WIS; and provide relevant advice and support to the President of CBS.

(b) 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;
(c) 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, to make proposals to improve the availability of data to meet stated requirements, and to monitor and report on progress in the evolution of the GOS;
(d) Coordinate and consolidate the development of standardized high quality observing practices and prepare related recommendations;
(e) 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;
(f) Consider and report on the issues of costing, joint funding and management of the GOS;
(g) Strengthen collaboration between CBS and the regional associations, by providing advice on possible solutions for newly identified requirements.

Expert Team on Requirements and Implementation of AWS Platforms (ET-AWS)

(a) Address the evolution of the AWS observing network;
(b) Address requirements for integration, interoperability, standardization and homogeneity of the WIGOS concept;
(c) Monitor advances in AWS technology;
(d) Develop draft recommendation for updating of the *Manual* and the *Guide on the GOS* in the context of WIGOS concept;
(e) Provide advice to ET-EGOS and OPAG-IOS on surface in situ contributions to the GOS to address the identified requirements and overcome known deficiencies and gaps;
(f) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

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 surface-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;
(e) Carry out studies of real and hypothetical changes to the GOS with the assistance of NWP centres;
(f) Develop new version of the Implementation Plan for Evolution of the GOS based on the Vision for the GOS in 2025, taking into account developments with respect to WIGOS and GEOSS; monitor progress against the Plan, report progress and updated Plan through the ICT-IOS to CBS;
(g) Prepare documents to assist Members, summarizing the results from the above activities;
(h) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

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 the ICT-IOS;
(h) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

Expert Team on Satellite Utilization and Products (ET-SUP)

(a) In support of the strategy to improve satellite data utilization:
- Formulate a biennial questionnaire on the availability and use of satellite data, for the purpose of gathering information from WMO Members on current capabilities and deficiencies (and trends of these aspects);
- Analyse the questionnaire responses;
- Compare and combine this analysis with a summary analysis from the Centres of Excellence of the Virtual Laboratory for Satellite Data Utilization;
- Compile a list of recommendations based on these analyses;
- Prepare a new WMO SP Technical Document to publish the findings to WMO Members.

(b) Review present and future R&D satellite data and products including their availability and applications in view of increased utilization by WMO Members;
(c) Initiate activities to improve the availability of operational and R&D satellite data according to user needs, monitor these activities in close coordination with the relevant CGMS working group(s) and with WIS activities;
(d) In conjunction with the WMO Space Programme Office further clarify the needs of WMO Members for information regarding access to and utilization of satellite data, including the associated capacity building, and consider the best ways to meet these needs;
(e) Keep under review the needs of WMO Members for training in satellite meteorology and engage with the Management Group of the Virtual Laboratory for Education and Training in Satellite Meteorology to address these needs, including:
  (i) Reviewing plans for regular training events in all WMO Regions aimed at enhancing the full utilization of satellite data, from both operational and R&D satellites;
  (ii) Helping to ensure WMO Members have access to training materials and courses, as well as providing advice on ways to access data, products, and algorithms from both operational and R&D satellites;
  (iii) Evaluating, with the support of the Virtual Laboratory Management Group, the continued adequacy and relevance of the components of the Virtual Resource Library, suggesting strategies for improving its contents as necessary;
  (iv) Reviewing the implementation and achievements of the 2009–2014 Virtual Laboratory Training Strategy;
(f) Coordinate with ET-SAT and ET-EGOS on the Evolution of the GOS;
(g) Assess and further the concept of Sustained Co-ordinated Processing of Environmental Satellite Data (SCOPE) {previously named R/SSC};
(h) Prepare documents to assist Members, summarizing the results from the above activities;
(i) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

Expert Team on Surface-based Remotely-Sensed Observations (ET-SBRSO)

In the area of weather radar and other surface-based remotely-sensed observations, the team should:

(a) Assess the potential capabilities of such observing systems, in terms of their observing characteristics (spatial and temporal resolution, accuracy, timeliness, etc.);
(b) Assess the status of implementation of and plans for such observing systems by WMO Members;
(c) Document the above capabilities and implementation status/plans, through updates to the WMO/CEOS database of observing system capabilities;
(d) In collaboration with ET-EGOS, assess the contribution of such observing systems to meeting the user requirements for observations for all application areas represented by WMO and WMO-sponsored programmes, as captured by the WMO/CEOS database of user requirements for observations and the Statements of Guidance;
(e) Make recommendations on how the integration of such observing systems within the GOS might be taken forward;(f) Assess the systems for collection and distribution of data from such observing systems, and make appropriate recommendations;
(g) Monitor the status of operational networks of such observing systems and provide technical advice on such systems, including both operational and R&D systems, to WMO Members and RAs;
(h) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

Expert Team on Aircraft-based Observations (ET-AIR)

(a) Coordinate with the AMDAR Panel to develop a harmonized AMDAR work plan;
(b) Review and report to CBS on the AMDAR Programme activities including the integration of AMDAR into WIGOS;
(c) Develop future governance for the AMDAR Programme;
(d) Steer the implementation of the WIGOS AMDAR Pilot Project;
(e) Develop a data policy for AMDAR;
(f) Develop standard practices for AMDAR;
(g) Provide input into the EGOS-IP for AMDAR;
(h) Report on training requirements and activities for AMDAR;
(i) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

Co-Rapporteurs on Scientific Evaluation of Impact Studies undertaken by NWP Centres

(a) Prepare and maintain reviews of OSEs, OSSEs and other studies that are being undertaken by various NWP Centres around the globe and provide information for consideration by the OPAG on IOS;
(b) Organize the fifth Workshop on the Impact of Various Observing Systems on Numerical Weather Prediction in 2012 and chair the organizing committee;
(c) Provide input to the ET-EGOS regarding the Evolution of the GOS and to the ET-SAT on findings that might influence future satellite missions;
(d) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

Rapporteur on GCOS Matters

(a) Continue the preparation and maintenance of reviews of observing systems that are being designed under the auspices of GCOS, e.g. GUAN, GSN, GRUAN and space-based observing systems (GOSSP and CGMS); and provide feedback to Members in maintaining the quality of the networks;
(b) Provide input to the ET-EGOS on user requirements relevant to climate monitoring and to the OPAG-IOS on issues relevant to CBS;
(c) Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

Rapporteur on Regulatory Material

Review and update regulatory and guidance material on the GOS, as required, and make recommendations for amendments; and provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

Co-Rapporteurs on the 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 surface-based 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. Provide advice and support to the Chairperson of OPAG-IOS on development and implementation of WIGOS concept.

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 WIS, WIGOS, THORPEX, IPY, DRR and GEOSS;
(d) Identify matters requiring the urgent consideration of the OPAG on ISS, and develop proposals for tasks and organization of activities.

Inter-Programme Expert Team on Data Representation and Codes (IPET-DRC)

(Requirements for changes to representation forms should be provided by the WMO Programmes)

(a) Maintain WMO data representations 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 the alphanumeric code regulations for table-driven code forms; coordinate with the OPAG on IOS to ensure their observation representation requirements are met;
(c) Invite, coordinate and assist Members to validate modified or new formats, and provide Members with guidance on data representation of national practices;
(d) Monitor and coordinate the progress of migration to TDCF;
(e) Update the content of the *Manual on Codes* (WMO-No. 306) and associated reference and guidance materials as required and publish in suitable electronic formats;
(f) Publish the Code Tables in appropriate processable electronic formats;
(g) In collaboration with IPET-MDI, review and clarify the WMO data representations, to ensure efficient and effective implementations, interoperability and consistency with the WMO Metadata Core Profile and with the WMO data model that it is starting to be developed.

Inter-Programme Expert Team on Metadata and Data Interoperability (IPET-MDI)

(a) Development of a WMO core profile of the ISO 191xx series of standards for metadata and data, encompassing the WMO Metadata core profile of the ISO metadata standard, including relevant ISO 191xx feature catalogues, application schema(ta) and data product specification(s);
(b) Further develop procedures and guidance for the interoperability of metadata and data, including BUFR, CREX, GRIB, XML, NetCDF and HDF, and liaise with the NetCDF and the

Climate and Forecast (CF) communities in this respect, in particular develop and maintain a WMO conceptual data model to facilitate the interoperability of metadata and data;
(c) Develop a WMO inter-programme metadata and data representation policy, including governance;
(d) Coordinate extensions to the WMO core profile needed to satisfy the requirements of all WMO Programmes;
(e) Develop guidance for the implementation and use of the data representation systems, metadata and the WMO core profile, including training aspects;
(f) Propose extensions to the ISO 191xx series of standards required for the WMO core profile and liaise with ISO and OGC as required.

Expert Team on WIS-GTS Communication Techniques and Structure (ET-CTS)

(Co-chairperson on 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 standard bodies in particular ITU and ISO;
(b) Review standard TCP/IP procedures and applications, including new developments (e.g. IPv6) that are relevant to WIS and WMO Programme requirements, and develop recommended practices especially for the GTS;
(c) Review and further develop recommended practices for data communication and access procedures, including exchange of high priority data and products in support of a virtual all hazards network within WIS-GTS;
(d) Maintain the file naming convention, in particular for operational routeing and distribution;
(e) Develop the organization and design principles for the WIS data communication structure, and coordinate related pilot projects;
(f) Review and further develop the organization and design principles for the WIS data communication structure, in particular the smooth evolution of the GTS and the WIS core network;
(g) Provide guidance on technical, operational, administrative and contractual aspects of data communication services for WIS implementation, especially for the GTS at the global, regional and national levels, including dedicated and public services (e.g. satellite-based telecommunications, managed data-communication network services, the Internet);
(h) Advise and assist ICG-WIS on the relevant technical aspects of the Manual on WIS.

Expert Team on WIS Centres (ET-WISC)

(a) Further develop technical and operational specifications for the different components of the WIS Centres and criteria for interoperability and certification for actual implementation;
(b) Further develop specifications for the GISC, DCPC and NC interfaces, including a unified user interface for WIS components;
(c) Coordinate related pilot projects;
(d) Determine the monitoring requirements for the WIS and develop the WIS monitoring scheme;
(e) Advise and assist ICG-WIS on the relevant technical aspects of the Manual on WIS.

Ad hoc expert team on GISC and DCPC Demonstration Processes (ET-GDDP)

(c) Develop guidance and management procedures for the CBS demonstration and assessment of capabilities of candidate GISC and DCPC centres in the framework of the GISC-DCPC designation procedure as endorsed by Cg-XV;
(d) Organize demonstrations of capabilities of candidate WIS centres as required, including demonstration at CBS sessions.

Expert Team on WIS-GTS Operation and Implementation (ET-OI)

(Activities to be carried out in particular by the focal points of RTHs located on the MTN, in close coordination with the IPET-DRC chairperson with the assistance of the Secretariat, mainly by correspondence/ e-mail.)

(a) Monitor the WIS-GTS operational information flow and coordinate management of operational information exchange procedures, routing and traffic, with a particular attention to the exchange of high priority data and products in support of a virtual all hazards network within WIS-GTS;
(b) Assist in the migration to TDCF, in particular in a step-by-step migration by zones;
(c) Coordinate the implementation of the file naming convention;
(d) Coordinate the implementation of the WMO core profile of 191xx series of standards as regards the relevant exchange of data and metadata;
(e) Coordinate and further develop recommended practices and guidance on the management of, and access to, operational information related to WMO Programmes' information exchange, especially for WIS-GTS operation (abbreviated heading tables, catalogue of bulletins and files, routing directories, etc.);
(f) 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;
(g) Review, coordinate and further improve the WWW monitoring, in particular the AGM, SMM and IWM;
(h) Review the standard and recommended procedures and practices of the Manual on the GTS related to the operation of the GTS, and propose amendments as required;
(i) Develop guidance for planning and implementation of observation data collection systems for NMHSs, including interfaces with observation platforms, methods, formats and data-communication protocols;
(j) Identify implementation issues requiring the urgent consideration of the OPAG on ISS.

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 Radio-communication Sector of the International Telecommunication Union (ITU-R), and in particular of the Radio-communication Study Groups, on frequency matters pertaining to meteorological activities, and represent WMO 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 Radio-communication Study Groups, Radio-communication Assembly, World Radio-communication 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 radio-communication systems sharing a frequency band with meteorological radio communication systems.

OPAG on Data-Processing and Forecasting System

Implementation Coordination Team on Data-Processing and Forecasting System

(a) Identify new emerging requirements (input required from RAs and other bodies);
(b) Determine how GDPFS Centres can best contribute to fulfil emerging requirements;
(c) Participate in THORPEX planning groups as appropriate to advise on conditions and requirements for practical implementations in operational systems;
(d) Identify needs for training through workshops and other means of delivery;
(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 on Forecast Verification

(a) In consultation with the relevant Expert Teams, review procedures for verification of the performance of forecasting systems to ensure that they are adequate and meet CBS needs;
(b) Ensure that verification systems are appropriate to emerging forecast types such as probabilistic forecasts, very high-resolution NWP products, and nowcasting products;
(c) Develop suitable verification procedures for severe weather forecasts and warnings;
(d) Review Lead Centre activities and provide guidance as appropriate;
(e) Liaise with WWRP/WGNE as required;
(f) Provide guidance on how to implement verification systems.

Expert Team on Ensemble Prediction Systems

(a) Provide advice on EPS in relation to probabilistic forecasts in the context of short- and medium-range EPS products, focusing on applications concerned with all aspects of the EPS systems which forecast the weather on a daily basis;
(b) Review progress on EPS and its application to severe weather forecasting including progress on multi-centre ensembles and on regional model based EPS, and prepare ways to make best operational usage of these developments;
(c) Propose guidance for the generation of EPS products (e.g. EPS-grams, presentation of cyclone tracks and strike probabilities, hazard maps, calculation of probability, calibration methodologies, etc.) to ensure compatibility of EPS products supplied to WMO Members by different centres;
(d) 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;
(e) In consultation with the Coordination Group on verification, review verification system for EPS products and provide guidance on the interpretation of verification;
(f) Support the further development of the Lead Centre on Verification of EPS by reporting on verification measures and determining the best way of presenting skill of ensemble forecasting systems. Provide relevant software to NMHSs through the Lead Centre Website;
(g) To review the Manual on the GDPFS (WMO-No. 485) and propose updates as necessary concerning EPS;
(h) Develop specifications for the introduction of probabilistic information into products from RSMCs with geographical specialization;
(i) Participate in THORPEX Working Groups:

(i) To ensure that the proposed GIFS (Global Interactive Forecast System) is suitable for operational implementation and application;
(ii) To review progress on the use of EPS for targeting of observations.

Rapporteur on Infrastructure for Numerical Weather Prediction (NWP)

(a) In consultation with the relevant Expert Teams and in coordination with the Regional Rapporteurs on GDPFS, provide guidance on the NWP products to be exchanged on the GTS (WIS);
(b) Review the need for establishing standards and guidelines for the provision of initial and boundary conditions to NMCs for limited area models for operational NWP;
(c) Communicate the resulting user requirements to the OPAG/ISS to help them determine appropriate technical means of meeting these requirements;
(d) Provide guidance on the benefits of different options for capacity building concerning the infrastructure requirements for operational implementation of new NWP systems.

Expert Team on Extended- and Long-range Forecasting

(a) On the basis of requirements from Regional Climate Centres (RCCs), Regional Climate Outlook Forums (RCOFs) and NMHSs, guide future development, outputs and coordination of components in the production of LRF. The components include Global Producing Centres (GPCs), Lead Centres for Long-range Forecast Multi-model Ensembles (LC-LRFMME), and the Lead Centre for the Standard Verification System for Long-range Forecasts LC-SVSLRF);
(b) In coordination with CCl, promote the use of GPC and LC forecast and verification products by RCCs, RCOFs and NMHSs, develop new interpretation guidance to facilitate their use, and encourage feedback on usefulness and application;
(c) Report on production, access, dissemination and exchange and provide recommendations for future consideration and adoption by CAS, CCl, CBS and other appropriate bodies;
(d) In consultation with relevant experts in CAS and CCl and with the Coordination Group on Forecast Verification, review developments in verification scores and practices with a view to updating the Standard Verification System for Long-range Forecasts (SVSLRF);
(e) Assess applications for GPC status against the designation criteria and make recommendations on designation to CBS;
(f) Review the rules regarding user access to GPC and LC-LRFMME forecasts products;
(g) Establish the status of extended-range forecasting activities and recommend a timetable for developing an exchange of extended-range forecasts and verification products;
(h) Review the *Manual on the GDPFS* (WMO-No. 485) and propose updates as necessary concerning extended and long-range forecasts.

Coordination Group on Nuclear Emergency Response Activities (ERA)

(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 NMHSs, and the IAEA in collaboration with the IAEA and other relevant organizations;
(c) Collate the individual capabilities of RSMCs to produce enhanced products in support of nuclear emergencies, including ensemble techniques;
(d) Explore the operational availability of radiological monitoring data for use in the RSMC operational environment;
(e) Develop concepts of operational arrangements for atmospheric transport modelling backtracking products;
(f) Continue testing and evaluating the operational arrangements with CTBTO.

Expert Team on Modelling of Atmospheric Transport for Non-nuclear ERA

(a) Monitor the needs of the NMHSs for atmospheric transport modelling and identify those areas in which RSMCs can be of assistance;
(b) Identify and promote technical resources which can assist NMHSs in developing their atmospheric transport modelling capabilities, particularly for limited area non-nuclear emergencies such as chemical releases to the atmosphere;
(c) Monitor the atmospheric transport modelling capabilities of RSMCs and other centres for support to transboundary non-nuclear emergencies, related to emissions from various sources such as volcanic eruptions, dust storms, large fires, and biological incidents, with the goal of improving operational arrangements;
(d) Develop strategies to strengthen operational links with international organizations relevant to non-nuclear ERA, and between NMHSs and relevant national authorities.

Rapporteur on the Application of NWP to Severe Weather Forecasting

(a) Review the application of NWP to severe and high impact weather forecasting at all ranges in consultation with relevant expert teams;
(b) Report on new developments and advances in severe and high impact weather forecasting;
(c) Provide advice on the proposed demonstration project(s).

OPAG on Public Weather Services

Implementation and Coordination Team on Public Weather Services (ICT-PWS)

(a) Coordinate and keep under review the work of the PWS Expert Teams;
(b) Ensure coordination of the work of the OPAG with that of other WMO Programmes which relate to PWS;
(c) Continue to consult and collaborate as required with other technical commissions and with other CBS OPAGs to ensure coordination of services and systems;
(d) Continue to encourage stronger dialogue between NMHSs and the private sector – in particular the media – in areas relevant to PWS;
(e) Continue to provide guidance to Members on the importance of NMHSs as the sole authority in the provision of official severe weather warnings;
(f) Review and report on the effectiveness on the information and guidance material produced by the PWS Programme among NMHSs and relevant media and user groups;
(g) Review and report on the improvements in national and regional PWS activities as a result of demonstration projects and other WMO initiatives (following the “Learning through Doing” project concept) contributed to by the PWS Programme;
(h) Review and report on the effectiveness of PWS training activities;
(i) Develop and maintain a database of PWS Experts who are willing to provide contributions to training activities and workshops;
(j) Assist NMHSs in the identification and assessment of the societal and economic benefits of Public Weather Services and promotion of the benefits to be gained by users;
(k) Explore mechanisms to strengthen dialogue between WMO and the International Olympics Committee (IOC) in the context of meteorological support for the Olympic Games;
(l) Continue to promote awareness in the PWS community of all relevant material arising from the work of the Expert Teams.

Expert Team on Services and Products Improvements (ET-SPI)

(a) Monitor and report on the progress of previous ET-SPI initiatives and make recommendations as appropriate to ICT-PWS;
(b) Monitor and report on aspects of services and products improvements that relate to support of major WMO activities, including the Shanghai 2010 World EXPO Multi-Hazard Early Warning Systems project;

(c) Provide guidance in the development of training materials on the applications of probabilistic forecasting products and services for multi-hazard early warning systems;
(d) Report and advise on how to best assist developing countries with building an integrated approach to PWS products and services to improve service delivery;
(e) Explore and advise on the further development of probabilistic and other non-deterministic forecast products and services;
(f) Identify, report and provide recommendations on emerging needs for new and improved products and services with emphasis on key PWS user groups;
(g) Continue to encourage the use of verification for PWS;
(h) Keep under review the development of quality management procedures and practices relevant to PWS;
(i) Develop and maintain a list of experts in Services and Products Improvements who are willing to contribute to PWS training activities;
(j) Report and advise on collaborative activities with other CBS OPAGs and other WMO Technical Commissions;
(k) Keep abreast of advances in, and promote as appropriate, the application of emerging technology to the delivery of public weather services, with particular emphasis on the application of the database concept and the workstation and their implications for the changing role of the forecaster.

Expert Team on PWS in Support of Disaster Prevention and Mitigation (ET-DPM)

(a) Monitor and report on the progress of earlier initiatives of ET-DPM and make recommendations as appropriate to ICT-PWS;
(b) Monitor and report on aspects of disaster prevention and mitigation that relate to support of major WMO activities, including the Shanghai 2010 World EXPO Multi-hazard Early Warning Systems project;
(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) Continue to provide guidelines on the development of the World Weather Information System (WWIS) and the Severe Weather Information Centre (SWIC) to promote improved international availability and access to NMHSs' official forecasts and severe weather information via the Internet;
(e) Provide guidance on the role of PWS in the early warning process, including the development of appropriate reference material based on current practices in early warning, highlighting communication and technology aspects;
(f) Keep under review the development of cross-border exchange of warnings with reference to the published WMO guidelines;
(g) Develop reference material on the application of nowcasting to the provision of public warnings associated with mesoscale weather phenomena;
(h) Develop and maintain a list of experts in PWS aspects of Disaster Prevention and Mitigation who are willing to contribute to PWS training activities;
(i) Report and advise on the collaborative activities with other CBS OPAGs and technical commissions.

Expert Team on Communication, Outreach and Public Education Aspects of PWS (ET-COPE) (formerly Expert Team on Communications, ET-COM)

(a) Monitor and report on the progress of earlier initiatives of ET-COM and make recommendations as appropriate to ICT-PWS;
(b) Monitor and report on communication, outreach and public education aspects of PWS that relate to support of major WMO activities, including the relevant Shanghai 2010 World EXPO demonstration project components;
(c) Identify ways to meet the needs of developing countries in their efforts to improve their communication, outreach and public education relating to PWS products and services;
(d) Examine, report and recommend on how best to continue the development of positive partnerships with national and international media organizations, and of assisting NMHSs to improve relations with the media;

(e) Examine, report and recommend on the use of emerging new technologies for the communication of early warnings and other public weather services products and services;
(f) Report and advise on ways of assisting NMHSs to enhance outreach and public education with a view to ensuring more effective use of PWS and enhancing the usefulness of new products and services;
(g) Promote awareness of the impact of high-quality, well-communicated and well-delivered public weather services on the image and visibility of NMHSs;
(h) Study and report on how best to educate end-users on the concepts of forecast uncertainty in a manner which enhances the usability of PWS products and services and strengthens the credibility of the service provider;
(i) Examine how to ensure improved media attribution of the role of NMHSs in providing basic services and infrastructure which support weather presentations to the public;
(j) Continue to advise on how NMHSs might more effectively educate, and communicate with, emergency managers, the media and the public on meteorological aspects of disasters;
(k) Develop and maintain a list of experts in Communication, Outreach and Public Education who are willing to contribute to PWS training activities;
(l) Report and advise on collaborative activities with other CBS OPAGs and with other WMO Technical Commissions.

Following the discussion on agenda item 11.2 (Other cross-cutting activities; Disaster Risk Reduction) the Commission agreed to establish two Task Teams under the OPAG on PWS as follows:

(a) **Task Team on Meteorological Services for Improved Humanitarian Planning and Response** with the following Terms of Reference (TORs):

(1) Review and document the needs and requirements of the international humanitarian agencies for:
   a. Meteorological services and information for operational procedures for contingency planning, coordination and response to potential disasters;
   b. Dissemination mechanisms for exchange of meteorological services and information; and,
   c. Training with regards to the effective utilization of meteorological services and information;

(2) Review the institutional mechanisms and the documented procedures which were established through PWS in 1995 so as to allow the UN Department of Humanitarian Assistance (DHA), the predecessor of United Nations Office for Coordination of Humanitarian Affairs (UN-OCHA) request meteorological assistance and information from the National Meteorological Centres and Regional Specialized Meteorological Centres (RSMC) serving that region;

(3) Considering the needs and requirements of humanitarian agencies; lessons learnt from the experiences of PWS initiative; new institutional and operational mechanisms resulting from the humanitarian reforms; new technologies; and other relevant issues; to develop an implementation plan to facilitate the provision of meteorological assistance and information to the international humanitarian agencies from NMHSs and GDPFS.

(b) **Task Team on the preparation of prototype Guidelines on Meteorological Hazards,** with the following TORs**:**

(1) Study the methodologies and feasibility of development of guidelines for meteorological hazards and develop a list of hazards for which the Task Team will provide prototype guidelines for database, metadata, mapping, and statistical analysis methodologies;

(2) Review, analyse and evaluate existing methodologies for monitoring, archiving, mapping, and the statistical analysis of the selected hazards;

(3) Review, analyse and evaluate methodologies for dissemination of hazard information and statistical analyses being utilized by NMHSs

(4) Develop prototype guidelines for monitoring, archiving, mapping and statistical analysis methodologies for the selected hazards;

(5) In consultation with CCl, CHy, CAgM, and JCOMM, propose a prototype methodology for collection of hazard information from NMHSs, for the preparation of statistical reports aimed at informing specialized agencies of the United Nations.

ANNEX XI
Annex to paragraph 12.2.4 of the general summary

DESIGNATION OF CHAIRPERSONS, CO-CHAIRPERSONS, RAPPORTEURS AND CBS REPRESENTATIVES

Rapporteur on Quality Management Framework	To be designated	
CBS Co-chair of the Inter-Programme Coordination Team on Space Weather (ICTSW)	To be invited	
Coordinator for Disaster Risk Reduction	M. Jean (Canada)	
Coordinator on Capacity Building	J. Kongoti (Kenya)	
Coordinator on GEO/GEOSS activities related to WMO	A. Gusev (Russian Federation)	
	Chairperson	*Co-Chair or Vice-Chair*
OPAG on Integrated Observing Systems (OPAG-IOS)		
Implementation Coordination Team on Integrated Observing Systems (ICT-IOS)	L. Riishojgaard (United States)	(Co-chair) J. Dibbern (Germany)
Expert Team on Requirements and Implementation of AWS Platforms (ET-AWS)	K. Monnik (Australia)	R. Merrouchi (Morocco)
Expert Team on Evolution of the Global Observing System (ET-EGOS)	J. Eyre (United Kingdom)	Heng Zhou (China
Expert Team on Satellite Systems (ET-SAT)	Selected by Satellite Operators	
Expert Team on Satellite Utilization and Products (ET-SUP)	L. Machado (Brazil)	O. Milekhin (Russian Federation)
Expert Team on Surface-based Remotely-Sensed Observations (ET-SBRSO)	S. Goldstraw (United Kingdom)	E. Buyukbas (Turkey)
Expert Team on Aircraft-based Observations (ET-AIR)	F. Grooters (Netherlands)	G. Ilboudo (ASECNA)
Co-Rapporteurs on Scientific Evaluation of Impact Studies undertaken by NWP Centres	Y. Sato (Japan) E. Andersson (ECMWF)	
Rapporteur on GCOS Matters	M. Menne (United States)	(Co-Rapporteur) A. Zaitsev (Russian Federation)
Rapporteur on Regulatory Material	A. Vasiliev (Russian Federation)	
Co-Rapporteurs on the Impacts of New Instrumentation on the GOS	*(designated if & when need arises)*	

	Chairperson	*Co-Chair or Vice-Chair*
OPAG on Information Systems and Services (OPAG-ISS)		
Implementation Coordination Team on Information Systems and Services (ICT-ISS)	P. Shi (China)	(Co-chair) S. Foreman (United Kingdom)
Inter-Programme Expert Team on Data Representation and Codes (IPET-DRC)	S. Elliot (EUMETSAT)	J. Mauro de Rezende (Brazil)
Inter-Programme Expert Team on Metadata and Data Interoperability (IPET-MDI)	J. Tandy (United Kingdom)	G. Wang (China)
Expert Team on WIS-GTS Communication Techniques and Structure (ET-CTS)	H. Ichijo (Japan)	(Co-chair) R. Giraud (ECMWF)
Expert Team on WIS Centres (ET-WISC)	H. Knottenberg (Germany)	(Co-chair) A. Kellie (United States)
Ad hoc expert team on GISC and DCPC Demonstration Processes (ET-GDDP)	M. Dell Acqua (France)	-
Expert Team on WIS-GTS Operation and Implementation (ET-OI)	K. Wong (Australia)	(Co-chair) L. Bezruk (Russian Federation)
Steering Group on Radio-Frequency Coordination (SG-RFC)	P. Tristant (France)	G. Fournier (Canada)
OPAG on Data Processing and Forecasting System (OPAG-DPFS)		
Implementation Coordination Team on Data-Processing and Forecasting System	B. Strauss (France)	(Co-chair) Y. Honda (Japan)
Coordination Group on Forecast Verification	D. Richardson (ECMWF)	-
Expert Team on Ensemble Prediction Systems	K. Mylne (United Kingdom)	H. Haddouch (Morocco)
Rapporteur on Infrastructure for Numerical Weather Prediction (NWP)	*(designated if & when need arises)*	
Expert Team on Extended- and Long-range Forecasting	R. Graham (United Kingdom)	To be designated
Coordination Group on Nuclear Emergency Response Activities (ERA)	R. Servranckx (Canada)	—
Expert Team on Modelling of Atmospheric Transport for Non-nuclear ERA	C. Ryan (Australia)	To be designated
Rapporteur on the Application of NWP to Severe Weather Forecasting	J.-M. Carriere (France)	
OPAG on Public Weather Services (OPAG-PWS)		
Implementation and Coordination Team on Public Weather Services (ICT-PWS)	G. Fleming (Ireland)	(Co-chair) M. Ndabambi (South Africa)
Expert Team on Services and Products Improvements (ET-SPI)	J. Guiney (United States)	A. Shaka (Kenya)
Expert Team on PWS in Support of Disaster Prevention and Mitigation (ET-DPM)	Hon-Gor Wai (Hong Kong, China)	Che Gayah Ismail (Ms) (Malaysia)
Expert Team on Communication, Outreach and Public Education Aspects of PWS (ET-COPE)	J. Gill (Australia)	J. Rubiera (Cuba)
Task Team on Meteorological Services for Improved Humanitarian Planning and Response	M. Jean (Canada)	To be designated
Task Team on the preparation of prototype Guidelines on Meteorological Hazards	Z. Chen (China)	To be designated

ANNEX XII
Annex to paragraph 12.4.1 of the general summary

NEW METHODS FOR CONDUCTING THE TECHNICAL WORK OF THE COMMISSION AND IMPROVING EFFICIENCY AND COST-EFFECTIVENESS OF SESSIONS

The proposed working methods are as follows:

- The CBS sessions focus on the programme of work, priorities, and the organization of the Commission (OPAGs) to carry out the work during the next intersessional period. Normal and extraordinary sessions continue to be scheduled every 2 years; extraordinary sessions will be focused on adaptation of the working structure and addressing urgent and difficult issues only, and may be reduced to a few days. Each session will be preceded by a technical conference addressing topics of common interest;
- The review of current systems status would not be addressed by the session of the Commission, but rather be a mandatory item in the joint technical conference, complementing one or two major themes. There will be a clear distinction between Members' report on status of implementation/operation of systems, reviewed by the Technical Conference on the one hand, and, on the other hand, the collaborative Commission work – developing recommended procedures, system design, guidance material, etc., which is addressed by the session of the Commission. In view of the importance of a correct assessment of systems implementation for determining the Commission's work programme and priorities, adequate mechanisms should ensure the proper feedback of information from the Technical Conference to the Commission's session;
- OPAGs perform an executive role in organizing and carrying out the work assigned by the Commission. They establish Expert Teams to study questions and develop documents, including draft recommendations and guidance material. ETs are requested to use electronic means to the largest extent possible to carry out their work, including the use of Web "wikis" for developing documents; actual meetings are focused on organizing the activities, sharing responsibilities and addressing difficult issues;
- When adopted by OPAGs (by the respective ICT or possibly by correspondence, in case of urgent requirements), draft recommendations and proposed guidance material would be normally adopted by direct consultation of the CBS members. The process includes the request to CBS members to indicate within three months whether they agree. A copy of the request should also be provided to the Chairs of the relevant Groups in each Regional Association for information and to enable them, along with the relevant Rapporteur or Sub-Group Chair, to assist members in responding. The request is either accompanied by a CD providing the complete final text, in the working languages, of the proposed recommendation and documents, or include adequate reference to Web posted material. A threshold of replies is required for adoption (e.g. 20% of Members responding with 70% of replies positive), and all comments and reasons for disapproval, if any, receive due consideration by the OPAG. If the quorum of responses is not reached the relevant decision has to be postponed to the next session of CBS. The role and importance of OPAGs, especially their main team (OPAG' ICTs) would be strengthened, and their enhanced visibility would likely trigger more experts' participation with costs borne by Members;
- Simultaneous adoption (by CBS members) and approval (by WMO Members) by correspondence may be used for recommendations addressing regulatory documents (e.g. amendments to WMO Technical Regulations). If no objection is received from a Member during a 3-month period, the draft recommendation shall be considered to be adopted by the Commission, and such adoption is considered to constitute approval. After the approval process, the outcome will be reported to the Executive Council, in compliance with EC's responsibilities.

APPENDIX

LIST OF PARTICIPANTS

1. Officers of the session

President	A.I. Gusev (Russian Federation)
Vice-president	G-R. Hoffmann (Germany)

2. Representatives of WMO Members

Angola	
Luis Domingo Constantino	Principal Delegate
Argentina	
Eduardo A. Piacentini	Principal Delegate
Marío Jorge García	Delegate
Australia	
Susan Lesley Barrell (Ms)	Principal Delegate
Terry Hart	Delegate
Austria	
Herbert Gmoser	Principal Delegate
Azerbaijan	
Sohrab Shiraliyev	Principal Delegate
Sahib Khalilov	Delegate
Bahamas	
Basil Dean	Principal Delegate
Barbados	
Tyrone Sutherland	Principal Delegate
Belarus	
A.I. Polischuk	Principal Delegate
A.V. Sustchenia	Delegate
Belgium	
Daniel Gellens	Principal Delegate
Belize	
Ramon Frutos	Principal Delegate
Benin	
A. Dominique Agbangla	Principal Delegate
Bosnia and Hezergovina	
Enes Sarac	Principal Delegate
Muhamed Muminovic	Advisor
Botswana	
Gasewasepe Nthobatsang (Ms)	Principal Delegate
Brazil	
José Mauro de Rezende	Principal Delegate
Waldenio Gambi Almeida	Delegate
British Caribbean Territories	
T. Sutherland	Principal Delegate
Fred Sambula	Alternate
Burkina Faso	
Ernest K. Ouedraogo	Principal Delegate

Canada

Angèle Simard (Ms)	Principal Delegate
Michel Jean	Alternate
André Methot	Advisor
Jim Abraham	Delegate
Bruce Angle	Delegate
Richard Hogue	Delegate
Michael Manore	Delegate

Chile

Gastón Torres	Principal Delegate

China

Jiao Meiyan (Ms)	Principal Delegate
Yu Jixin	Alternate
Huang Zhuo	Delegate
Li Changxing	Delegate
Li Xiang (Ms)	Delegate
Shi Peiliang	Delegate
Wang Jiangshan	Delegate
Zhao Guangzhong	Delegate

Colombia

Jorge Fernando Bejarano Lobo	Principal Delegate

Costa Rica

Werner Stolz España	Principal Delegate

Croatia

Ivan Čačić	Principal Delegate
Krešo Pandžić	Alternate
Branka Ivančan Picek	Delegate

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Eva Červená (Ms)	Principal Delegate

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Jenle Flemming	Principal Delegate
Niels Jørgen Pedersen	Delegate

Egypt

Hassan Mohamed Hassan	Principal Delegate
Moheb Doss	Alternate

Ethiopia

Dula Shanko	Principal Delegate

Finland

Juhani Damski	Principal Delegate (25-28/03)
Keijo Leminen	Principal Delegate (29/03-02/04)

France

Bernard Strauss	Principal Delegate
Patrick Bénichou	Delegate
Matteo Dell'Acqua	Delegate

Gambia

Lamin Mai Touray	Principal Delegate

Germany

Geerd-Rüdiger Hoffmann	Principal Delegate
Jochen Dibbern	Delegate
Thomas Kratzsch	Delegate
Volker Kurz	Delegate
Gerhard Steinhorst	Delegate

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Ayilari-Naa Juati	Principal Delegate
Greece	
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Georgios Kyriakopoulos	Delegate
Honduras	
Erick Martinez Flores	Principal Delegate
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Hon-gor Wai	Principal Delegate
Sau-Tak Edwin Lai	Delegate
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India	
Ladu Ram Meena	Principal Delegate
Suresh C. Khurana	Delegate
Indonesia	
M. Nazamudin	Principal Delegate
Edward Trihardi	Delegate
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Fedydoon Minovi	Principal Delegate
Ireland	
Paul Halton	Principal Delegate
Gerald Fleming	Delegate
Israel	
Henia Berkovich (Ms)	Principal Delegate
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Luigi De Leonibus	Principal Delegate (30/03-02/04)
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Naoyuki Hasegawa	Delegate
Jitsuko Hasegawa (Ms)	Delegate e
Yuki Honda	Delegate
Kiyoharu Takano	Delegate
Jordan	
Dafi M. El Ryalat	Principal Delegate
Kenya	
Joseph R. Mukabana	Principal Delegate
James Kongoti	Delegate
Nicholas W. Maingi	Delegate
Libyan Arab Jamahiriya	
Hisham S. Ganedi	Principal Delegate
Bashir A. Al Siebiei	Delegate
Mahmoud A. Harram	Delegate
Lithuania	
Vida Augulienė (Ms)	Principal Delegate
Macao, China	
Tong Tin Ngai	Principal Delegate
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Malaysia
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Ye Huat Poh — Delegate
Wan Mohd Nazri Wan Daud — Delegate

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Dragan Radonjić — Delegate

Morocco
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George Simataa — Delegate

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Theo Van Stijn — Delegate

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Roar Skålin — Delegate

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OkKi Lee — Alternate
Byung-Hyun Song — Delegate
Ki-Han Youn — Delegate

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Russian Federation

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Vladimir Antsipovich	Delegate
Vasily Asmus	Delegate
Leonid Bezruk	Delegate
Alexander Gavrilov	Delegate
Alexander Gusev	Delegate
Yulia Krzheshovskaya (Ms)	Delegate
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Leonid Vasiliev	Delegate

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Perisa Sunderic	Delegate

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Swaziland

Seyama Sikelela Eric	Principal Delegate

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Estelle Grueter (Ms)	Delegate
Christian Häberli	Delegate
Roland Mühlebach	Delegate

Thailand

Somchai Baimoung	Principal Delegate

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Zoran Dimitrovski	Principal Delegate

Togo

Awadi Abi Egbare	Principal Delegate

Trinidad and Tobago

Marlon Noel	Principal Delegate

Ukraine

Vyacheslav Lipinsky	Principal Delegate

United Arab Emirates

Majed N.S. Hewaishel Al Shekaili	Principal Delegate
Faisal H.A.A. Salman Al Mehairi	Delegate
Abdulla M. Abdullah Al-Yazidi	Delegate

United Kingdom of Great Britain and Northern Ireland

Keith Groves	Principal Delegate
Steve Foreman	Alternate

John Eyre	Delegate
Simon Gilbert	Delegate
Stuart Goldstraw	Delegate

United Republic of Tanzania

Philbert F. Tibaijuka	Principal Delegate
Augustine Kanemba	Delegate

United States of America

Vickie L. Nadolski (Ms)	Principal Delegate
Fredrick R. Branski	Delegate
William C. Bolhofer	Delegate
Adrian R. Gardner	Delegate
James F.W. Purdom	Delegate

Uzbekistan

Nilufar Rakhimova (Ms)	Principal Delegate

Venezuela

Tirso Carballo	Principal Delegate

Zambia

Edson Nkonde	Principal Delegate

3. **Representatives of international organizations**

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Joseph Mbolidi

Association of Hydro-Meteorological Equipment Industry (HMEI)
Bruce Sumner
Christine Charstone (Ms)
Gerhard Pevny
Timo Roschier

Caribbean Meteorological Organization (CMO)
Tyrone Sutherland

European Centre for Medium-Range Weather Forecasts (ECMWF)
Erik Andersson
Walter Zwieflhofer

European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
Mikael Rattenborg
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International Civil Aviation Organization (ICAO)
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