WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

EXTRAORDINARY SESSION

HELSINKI, 8–18 AUGUST 1994

ABRIDGED FINAL REPORT WITH RESOLUTIONS AND RECOMMENDATIONS

WMO-No. 815

Secretariat of the World Meteorological Organization - Geneva - Switzerland
1995

ISBN 92-63-10815-3

NOTE

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Meteorological Organization concerning the legal status of any country, territory, city or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

CONTENTS

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE SESSION (agenda item 1)

1.1 The extraordinary session (1994) of the Commission for Basic Systems (CBS) was held in Helsinki from 8 to 18 August 1994 at the invitation of the Government of Finland. The session, which took place in the Marina Congress Center, was opened at 10 a.m. on 8 August 1994 by the president of the Commission, Dr A. A. Vasiliev.

1.2 The Secretary-General of the World Meteorological Organization (WMO) Professor G. O. P. Obasi, welcomed the participants to the session on behalf of the Organization. He expressed his satisfaction that the session was being held in Finland, and in Helsinki in particular, and expressed his gratitude to the Government of Finland for its kind invitation, for having provided such magnificent facilities, and for making all the necessary arrangements for the session. As to the session itself, the Secretary-General recalled that CBS was responsible for ensuring that the basic systems provided the necessary support not only for the World Weather Watch (WWW) but that it also met the needs of other research and applications programmes. This was reflected in the proposed new terms of reference of the Commission, which had been drawn up at the tenth session of CBS and endorsed by the Executive Council for the anticipated approval by Congress in 1995. He noted with satisfaction the prominence given in the agenda to the follow-up to the United Nations Conference on Environment and Development (UNCED) and the support for the Global Climate Observing System (GCOS). Central to this support, said Professor Obasi, was the integrating function of data management and, here, he emphasized the importance of data quality as well as quantity.

1.3 Looking to the future, the Secretary-General stressed the ever-growing role of satellites both as an observational tool and as a means of rapid and reliable transmission of information. He indicated that lessons had been learned in this regard from the Operational WWW Systems Evaluations (OWSE)-Africa and hoped that further progress would be made in the implementation of new satellite telecommunication technologies in developing countries. In this connection, he stressed the need to ensure a coordinated transfer of technology and acknowledged with thanks the assistance being rendered by many donor countries, including Finland through its technical cooperation arm, FINNIDA, to strengthening WWW facilities. He referred to two other particularly important items on the agenda, namely public weather services and the requirements for the international exchange of data and products and hoped that the Commission would give thorough consideration to, and make appropriate proposals on, these subjects. Professor Obasi also hoped that the session would consider future ways and means of increasing the participation of developing countries in the work of technical commissions and in CBS, in particular. He wished the session every success.

1.4 On behalf of the Government of Finland, the Minister of Trade and Industry, Mr Seppo Kääriäinen, welcomed the participants to Finland. He emphasized the international nature of meteorology and the need for international cooperation in finding common solutions to global problems, which had been an indispensable part of meteorological activities since the establishment of WMO and its predecessor, the International Meteorological Organization (IMO), more than 120 years ago. Finland had for long recognized that the economic situation of many countries meant that external support was required to allow them to play their full part in the gathering and exchange of weather data and was doing what it could to provide such support. The minister, being responsible for matters related to energy production in Finland, was fully aware of the contribution to be made by meteorology in this regard. He mentioned in particular the need for meteorological data in the event of a nuclear accident. He considered that the foundations for every Meteorological Service were the agreements concerning the global exchange of weather and climate data, for which CBS had a major responsibility. He wished all participants a pleasant and memorable stay in Finland.

1.5 The Lord Mayor of Helsinki, Mr Kari Rahkamo, welcomed the participants to Helsinki. He referred to the fact that the city had a meteorological history dating back more than 160 years. Efforts were being made to make Helsinki more visible internationally. He drew attention to the many natural attractions which it offered and to its reputation as a centre of innovative art. The mayor invited the participants to enjoy some of the many events that were currently taking place in the city and assured them of a warm welcome by its people. He hoped these visits would be both interesting and pleasant.

1.6 On behalf of the local organizers and in particular the Finnish Meteorological Institute, its Director General, Professor Erkki Jatila, stated how pleased and honoured Finland was to host its second major WMO meeting, the first having been more than 20 years earlier. He stressed the importance of the basic systems to the operation of national Meteorological Services and referred to the fact that over the past 25 years Finland had provided nearly US $30 million for projects in some 40 countries to strengthen observing and telecommunication networks. He stressed the importance of weather data from both the site and surrounding area of any

nuclear accident and, in this regard, pointed to the need to ensure regular and reliable observations from eastern Europe. He and his staff would do everything possible to ensure the smooth running of the meeting and to make the participants' stay in Helsinki a memorable one.

1.7 The president of the Commission, Dr A. A. Vasiliev, thanked the Government of Finland and the Finnish Meteorological Institute for their generosity in hosting this meeting of the Commission for Basic Systems. He spoke of the many new and broader responsibilities of the Commission in supporting all WMO Programmes and including public weather services and satellite activities. He referred to the many challenges facing the Commission, such as the potential impact of the commercialization of meteorological services and the growing gap between the rapidly developing data processing techniques and the slower evolution of observing systems. He acknowledged the great devotion, hard work and skill of many individuals throughout the world who had contributed to the progress made by the Commission in meeting its heavy responsibilities. The combined wisdom, experience and enthusiasm of its members were at the core of its success.

1.8 The president added that one of those who had contributed more than most over the last 25 years or so was Mr James R. Neilon (United States), who had given much to the development of the World Weather Watch and who had shown outstanding leadership as president of the Commission from 1978 to 1988. The CBS Advisory Working Group had recommended that Mr Neilon be awarded an appropriately worded certificate in recognition of his long and outstanding service to the Commission. The certificate was presented by the Secretary-General to Mr Neilon.

1.9 There were 122 participants at the session which included representatives of 61 Members of WMO and seven international organizations. A complete list of participants is given in Appendix A to this report.

2. ORGANIZATION OF THE SESSION (agenda item 2)

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

At the first plenary meeting, the representative of the Secretary-General reported that credentials had been received from a large number of delegations and others were still being received at the opening of the session. A full list of participants would be issued as soon as possible and a further report on credentials would be given at the next plenary meeting.

2.2 ADOPTION OF THE AGENDA (agenda item 2.2)

The provisional agenda was adopted by the session with the understanding that the documents on environmental emergency response would be considered under item 5.1 and not item 4, as indicated in the documents. The final agenda is reproduced in Appendix B to this report.

2.3 ESTABLISHMENT OF COMMITTEES (agenda item 2.3)

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

P. Ryder (United Kingdom), item 5.1;
R. A. Sonzini (Argentina), item 5.2;
E. A. Mukolwe (Kenya), item 5.3;
J. Riissanen (Finland), item 5.4;
Yan Hong (China), item 5.5;
F. S. Zbar (United States), item 5.6;
H. Allard (Canada), items 6 and 8;
G. B. Love (Australia), items 7 and 11.

Items 4, 9 and 10 would be considered in a Committee of the Whole, chaired by the vice-president, Mr S. Mildner (Germany) and the remainder of the items would be considered in plenary, chaired by the president. Mr P. A. Mwingira (United Republic of Tanzania) was appointed Rapporteur on Previous Recommendations and Resolutions of the Commission.

2.3.2 In accordance with WMO General Regulation 28, a Coordination Committee was established comprising the president and vice-president of CBS, the representative of the Secretary-General, and Professor J. Riissanen (Finland), one of the chairmen of the working committee.

2.4 OTHER ORGANIZATIONAL QUESTIONS (agenda item 2.4)

It was agreed that summarized minutes of plenary meetings did not need to be prepared, but any statements made by delegations would be reproduced and distributed if and when requested. The working hours for the duration of the session were agreed upon. A full list of documents presented at the session is contained in Appendix C to this report.

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

3.1 The Commission noted with appreciation the report of the president, which provided information on the activities of the Commission since its tenth session. It noted with satisfaction that all five working groups had had full sessions in the 21-month period and that they had accomplished a great deal of work. The Commission was also pleased to learn that much greater use had been made of the expert meeting/task team approach in dealing with specific issues.

3.2 The Commission expressed its appreciation for the extensive guidance provided by the two sessions of the Advisory Working Group and for the various actions and decisions taken by the president especially as regarded the participation of the Commission in the work of other constituent bodies. Detailed discussion on the issues raised in the report was taken up under the various agenda items.

3.3 In recognizing the substantial progress that had been made, the session considered that a number of major issues and challenges were still before the Commission and should be kept in mind in dealing with the details of its work programme. Among these were:

(*a*) The wider support of the basic systems to other programmes both within and outside WMO;
(*b*) The important links between meteorology and sustainable development;

(*c*) The needs of developing countries and those with economies in transition for support in improving the implementation of basic systems;
(*d*) The exploitation of new technologies;
(*e*) Enhancing cooperation with the marine science community;
(*f*) Contributing to climate monitoring (and avoiding duplication of networks);
(*g*) Improving the participation of developing countries in the planning and decision-making process regarding basic systems.

3.4 The president expressed his sincere appreciation for the enthusiastic cooperation of all CBS members who had participated in the activities of the Commission. In particular, he thanked the vice-president, Mr S. Mildner, the chairmen of working groups and study groups, and the rapporteurs for their outstanding work, which had made his task so much easier. On behalf of CBS, the president also thanked the Secretary-General of WMO and the staff of the Secretariat, in particular the World Weather Watch Department, for their support and cooperation.

4. Role of the basic systems in WMO and other international programmes, including the Global Climate Observing System (GCOS) and the follow-up to the United Nations Conference on Environment and Development (UNCED) (agenda item 4)

Follow-up to the United Nations Conference on Environment and Development

4.1 The Commission noted with appreciation the report of the Rapporteur on the Follow-up to UNCED, Mr S. Mildner, vice-president of the Commission. It was noted that the Executive Council Working Group on the Follow-up of UNCED, including Capacity Building had prepared an excellent analysis of the relevant parts of the UNCED report, Agenda 21 and the Framework Convention on Climate Change (FCCC), inviting all Members and WMO constituent bodies to take appropriate follow-up action. The WMO Secretariat had actively responded in promulgating the results of UNCED-related discussions, in issuing a brochure on the follow-up to UNCED as guidance to Members, and in conducting an inquiry on relevant action taken by Members. More importantly, the Secretary-General had established a separate unit entrusted with raising funds specifically to support Members in meeting the aims of Agenda 21.

4.2 The Commission was pleased to note that, during their sessions, all CBS working groups had dealt with the subject of the follow-up to UNCED on the basis of background information provided by the rapporteur and had developed a number of detailed proposals and ideas. The Advisory Working Group had also discussed the issue at its sessions in October 1993 and April 1994, and had analysed the latest developments and advised on further action to be taken.

4.3 It was recalled that the tenth session of CBS had already identified the need to provide support to programmes which were directly related to climate change and environmental monitoring. GCOS was recognized as the programme to which CBS could contribute in practical terms mainly by making available the WWW basic observational, telecommunications and data management infrastructures to start up the atmospheric component of GCOS. By the involvement of the president of CBS and two members of the Advisory Working Group, as well as the Director of the WWW Department, in the planning process of the GCOS/Joint Scientific and Technical Committee (JSTC) and through close cooperation with the Joint Programme Office (JPO) for GCOS, the use of the WWW system as a basis for the initial GCOS was offered and had found broad acceptance. The translation of the somewhat broad guidelines of the JSTC into practical measures was being pursued by several panels established by JSTC to develop detailed plans for early implementation. The Commission, as well as the Secretariat, had contributed directly to the Panels on Atmospheric Observations and on Data Management, which met in March and April 1994, respectively and which would submit their results to the next session of the JSTC in September 1994. The relevant proposals for the Commission's action were discussed under agenda items 4, 5.1, 5.2 and 5.4 of the session. They comprised, in particular, the development of a GCOS Data Management Plan and the establishment of a network of base-line stations as a subset of the Global Observing System (GOS). The role of CBS in support of GCOS is described in more detail in paragraphs 4.7 to 4.20 below.

4.4 As regarded the specific activities of CBS which could contribute to the follow-up to UNCED, the Commission agreed that many of the activities under the WWW Progamme already complied with the objectives set out in Agenda 21. The Commission identified five broad areas of activity relevant to CBS. These are listed in Annex I to this report. It was stressed that these activities were aimed essentially at the development and strengthening of national Meteorological Services so that they could, in turn, make their full contribution to sustainable development.

4.5 Considering that many of these activities were likely to require external funding, the Commission stressed that innovative ways would need to be developed for seeking additional funds over and above the efforts being undertaken by the WMO Secretariat through established WMO channels. It was agreed that the Commission should take initiatives to attract funding from the private industry on a bilateral or multilateral basis. This would require appropriately coordinated and consolidated proposals for coordinated projects by CBS, in order to approach, in cooperation with individual Members, industry groupings or individual companies. The session invited the Advisory Working Group, in consultation with the Secretariat, to try to generate appropriate publicity material to complement fund-raising activities.

4.6 The Commission recognized that both the preparation of publicity material and fund-raising efforts must be coordinated within WMO to avoid unnecessary overlap between the programmes and projects. The

issue should, therefore, be raised by the president on the occasion of the Meeting of Presidents of Technical Commissions with a view to establishing closer cooperation between those responsible within the various constituent bodies. One objective would be the issuance of a joint publication illustrating the UNCED follow-up actions of all WMO Programmes, identifying relevant projects and soliciting funding from the above external sources.

GLOBAL CLIMATE OBSERVING SYSTEM (GCOS)

4.7 The Commission recognized that GCOS was still in the definition stage and that there was not yet a clear understanding of the extent to which GCOS would be based on, or would depend on, the various WWW components. However, given the already stated policy that GCOS, at least in its initial stages, was to be built on existing systems, particularly the basic systems of the WWW, the Commission felt that it could and should take a more active role in GCOS planning and implementation by developing proposals on how CBS could contribute in practical terms. It agreed as follows.

General

4.8 The primary contribution of CBS would arise from its experience in the planning, development and operation of an integrated system with many functional elements common to that envisaged for GCOS. Clearly, the CBS contribution would relate mainly to the atmospheric component of GCOS and, more specifically, to observational systems and networks — both surface-based and spaced-based — and to data management, although telecommunications and data processing might also make significant contributions. The fact that the WWW was also a truly global system, with adequate provisions and safeguards to ensure that developing countries not only participated fully in the system but also reaped the benefits therefrom, could also be put to good use in the development of GCOS.

4.9 In addition, CBS had reviewed and proposed revisions to its terms of reference (expected to be approved by Congress in May 1995) precisely so that it could provide support to other programmes, such as GCOS. In this connection, CBS was prepared to develop and adopt new working mechanisms to facilitate coordination with other programmes and disciplines in the planning and implementation of systems and networks, such as the Global Atmosphere Watch (GAW), the Global Environment Monitoring System (GEMS) and the Global Ocean Observing System (GOOS). In order to meet many of the anticipated requirements of GCOS, CBS would examine ways and means of improving the flexibility in its working arrangements and structures and of introducing "fast-track" mechanisms for development, testing and approval as a general introduction of procedures and systems to meet new requirements without compromising the integrity of existing operational systems.

4.10 In practical terms, arrangements would be made to make CBS experts available to GCOS and for CBS working groups to include GCOS-related issues in their work programmes, which would necessitate coordination with GCOS task groups and panels, including the participation of experts from one in the activities of the other. CBS was also taking steps to enhance inter-programme data management coordination through expert meetings specifically conducted for this purpose. The Commission would ensure close cooperation between CBS and other technical commissions concerned with GCOS, in particular the Commissions for Climatology (CCl), for Atmospheric Sciences (CAS), for Hydrology (CHy) and for Marine Meteorology (CMM).

Observing systems

4.11 The first priority in the GCOS strategy was to define and develop an Initial Operational System (IOS) for observations and data for which there was a clearly justified requirement, using proven technology, with some guarantee of data reliability and continuity, and a long-term commitment for support. It was clear that the GOS of the WWW, which was based on much the same premises and which already provided many of the observed parameters required by the atmospheric component of GCOS, would make the major contribution. It was noted, in this context, that an additional effort would be needed to ensure the homogeneity and quality of data, adequate instruments and calibration, as well as observing methods, which were critical for meeting the special requirements of climate monitoring. As it was, the GOS was designed to obtain data required for operational meteorology and, in conjunction with other data sources, these data were used in non-real time for climate monitoring and research. The GOS comprised observing facilities on land, at sea, in the air, and in outer space; virtually every country in the world contributed to the system in accordance with an agreed plan, the implementation of which was overseen by CBS with observing practices and procedures laid down in a series of manuals and guides.

4.12 The ability of the GOS to meet changing requirements for observational data was constantly reviewed and updated, experimental networks and relevant new observing systems were periodically evaluated and, where appropriate, incorporated in the global system especially with a view to filling some of the gaps that existed in the observational coverage over parts of Africa, South America and ocean areas, especially in the southern hemisphere. These processes could be adapted and used to address many of the special requirements of GCOS. There was a synergy between GOS and GCOS that should be fostered for the benefit of both.

4.13 In addition, the Regional Basic Synoptic Networks (RBSNs), which formed the major part of the surface-based component of the GOS and comprised over 4 000 stations required to make eight observations per day (two per day for upper-air observations), would provide an ideal basis from which to select stations to meet the GCOS requirement for a network of baseline stations representative of air masses on a regional scale, and operated on a long-term basis with the required degree of regularity and observational accuracy. Stations, at locations where none presently existed, could be added to the network and be given priority for

implementation within the WWW programme. CBS would also be prepared to arrange for the exchange of additional data from these stations, such as snow depth, soil moisture and solar radiation, to meet the requirements of GCOS.

4.14 In this connection, and taking into account the results of the meeting of the GCOS Atmospheric Observations Panel (Hamburg, April 1994), a proposed GCOS baseline upper-air network of some 150 stations had been drawn up, as a component of the GCOS Initial Operational System, based on certain criteria (uniformity of coverage, station quality and performance, and length of historical record). Most of these stations were already fully operational but some were new, some would require upgrading in terms of equipment or trained personnel, and some would require a long-term commitment to keep them operational beyond the current experiment period for which they were in operation. The Commission agreed that the list given in Annex II to this report should be considered by the Working Group on Observations with a view to providing additional technical guidance on feasibility, representativity, optimal geographic coverage and homogeneity as regarded historical record and data quality. This list should also be reviewed by Members at the regional level to consider the practicability of implementation and the possibility of making long-term commitments to the operation of the stations. Recommendation 1 (CBS-Ext.(94)) was adopted.

4.15 As regarded the space-based subsystem of the GOS, which currently comprised geostationary and polar orbiting satellites, one of the main activities of CBS and its Working Group on Satellites was to collect and interpret statements of the satellite data, products and services required by WMO Members, and to promote these to potential providers. Among the most important of these would certainly be requirements related to climate monitoring and research. Coordination with GCOS satellite data requirements would be essential and mutually beneficial.

Data management, exchange and processing

4.16 One of the most crucial problems to be faced in the planning of GCOS and in implementing the IOS was the need to develop a comprehensive data management system which specified procedures for the collection, quality control, comparison, archiving, retrieval dissemination and utilization of observational data from a wide variety of sources and over a range of time and space scales. CBS had already done much to develop such a system to meet the needs of operational meteorology within the WWW, and had long experience in the development of data representation forms and formats, telecommunication procedures and protocols, quality assurance procedures and system monitoring. The synergy between WWW Data Management (DM) initiatives and GCOS requirements was obvious and both programmes should jointly undertake the effort. An initial joint effort of WWW/DM and GCOS was the preparation of a GCOS Data Management Plan closely aligned with the distributed databases (DDB) concept. This work was undertaken at a meeting (Offenbach, March 1994) of an ad hoc GCOS Data Management Task Team with CBS participation.

4.17 The WWW was composed of observing and data processing components linked by a Global Telecommunication System (GTS) which connected all participating countries and transmitted both data and products. At present, the GTS, using agreed standards of transmission and codes, had a wide range of capabilities depending on the individual national components. With its responsibilities broadened to include support to other WMO Programmes, such as GCOS, CBS was currently redesigning the GTS, with a view to its upgrading and modernization, including satellite-based components and more flexible protocols.

4.18 In the WWW/DDB concept, the assignment of specific responsibilities above the national level to individual data centres would be by international agreement through CBS. In order to provide timely and efficient routine collection and distribution of data and rapid access for special purposes, sets or subsets of data were to be held at centres distributed in relation to geographic or other criteria. As regarded subsets of data of different types, e.g. provided by different types of observing system, the DDBs would include added information, such as quality control data and metadata. Data would also be provided selectively to meet routine needs or specific requirements.

4.19 Plans for a more modernized GTS were being made to ensure that the global DDBs were connected through high speed links to ensure a rapid and flexible data exchange on a global basis and that there was a comprehensive request/reply mechanism for real-time and non-real-time requests. Access to the databases would be by dedicated circuits or by non-permanent connections conforming to agreed standards. To maximize the use of current and future investment in data management systems, it would appear essential that GCOS participate in the further development of the WWW system and build on it to meet its own particular requirements.

4.20 Finally, the Commission concluded that the CBS contribution to GCOS could include advice, assistance and participation in data management planning, procedures and systems; arrangements for the exchange of new data (over and above WWW requirements); guidance on data structures, availability and quality for long-term operational systems; advice on data archiving and retrieval; and system monitoring and quality assurance procedures. In the area of data processing, GCOS could take advantage of numerical weather prediction (NWP) techniques for climate modelling and could use NWP models to produce long-term uniform data sets for climate research. The WWW data-processing centres could provide advice on data assimilation techniques and assist in GCOS data quality control through the application of procedures already in force and their further development in response to GCOS requirements. For example, the

GCOS requirement for near-real-time monitoring of the functioning of the GCOS base-line stations, including direct feedback in case of failure, could be incorporated in the WWW monitoring schemes for the availability and quality of data and products through designated lead centres.

5. CONSIDERATION OF INTER-SESSIONAL ACTIVITIES, INCLUDING REPORTS BY THE CHAIRMEN OF WORKING GROUPS (agenda item 5)

5.1 DATA PROCESSING (agenda item 5.1)

REPORT OF THE CHAIRMAN AND REPORT OF THE EIGHTH SESSION OF THE CBS WORKING GROUP ON DATA PROCESSING

5.1.1 The Commission noted with appreciation the report of the chairman of the CBS Working Group on Data Processing, Mr H. Allard (Canada) and noted that the working group has addressed several issues related to the implementation and operation of the Global Data-processing System (GDPS) at its Expert Meeting on Planning and Implementation of GDPS Centres (May 1993), as well as at its eighth session (November 1993).

REQUIREMENTS FOR BASIC OBSERVATIONAL DATA

5.1.2 The Commission reviewed the observational data requirements developed by the working group and, subsequently, refined by a joint GOS/GDPS Task Team (March 1994). By its Recommendation 2 (CBS-Ext.(94)), the Commission endorsed the procedures for the elaboration of observational data requirements and the updated statement of observational data requirements of GDPS centres for global and regional exchange (see annexes 2 and 3 of the recommendation).

IMPLEMENTATION OF WORLD METEOROLOGICAL CENTRES (WMCs) AND REGIONAL SPECIALIZED METEOROLOGICAL CENTRES (RSMCs) WITH GEOGRAPHIC SPECIALIZATION

5.1.3 The Commission noted with appreciation the continued improvements being implemented, or planned to be implemented, on the forecasting systems of WMCs. WMC Moscow was planning to upgrade its functions to meet the required global coverage. RSMC operations were satisfactory in Regions II, IV, V and VI, where constant improvements in forecasting systems and computer facilities were undertaken by many RSMCs. RSMCs in Region III were in the process of upgrading their computing capabilities to run better regional models. In Region I, however, RSMCs did not have appropriate data processing equipment to perform fully the expected functions of RSMCs. The Commission supported the view that major GDPS centres should each co-sponsor at least one or two developing centres with a view to cooperate and assist the centres in upgrading their facilities and services as GDPS centres.

GUIDELINES ON THE REVIEW OF THE IMPLEMENTATION OF FUNCTIONS AND SERVICES OF RSMCs WITH GEOGRAPHIC SPECIALIZATION

5.1.4 The Commission recommended guidelines for the review of the capabilities of the RSMCs with geographic specialization. The Commission agreed that the guidelines given in annex 1 to Recommendation 2 (CBS-Ext.(94)) be included in the *Manual on the Global Data-processing System* (WMO-No. 485) as a new Attachment I.5.

IMPLEMENTATION OF RSMCs WITH ACTIVITY SPECIALIZATION

5.1.5 The Commission endorsed the recommendations of the First International Workshop on Users' Requirements for the Provision of Atmospheric Transport Model Products for Environmental Emergency Response, (Montreal, September 1993) as reviewed by the CBS Working Group on Data Processing.

5.1.6 The coordinated requirements of WWW products and specialized products for tropical cyclone forecasting and warning services developed by the First Technical Coordination Meeting on Operational Tropical Cyclone Forecasting and Dissemination of Results, (Tokyo, December 1992) was endorsed by the eighth session of the CBS Working Group on Data Processing. On the provision by GDPS centres other than those with activity specialization in tropical cyclones, of guidance on occurrence of severe weather, it was agreed that, to avoid confusion which might arise when such information was used by unauthorized recipients, this guidance be contained explicitly but in coded form in GRID and GRIB products issued by centres running global models. Also, there was provision for issuing coded bulletins reporting in character form the position, status and expected development of individual storm systems. Other forms of guidance information could be provided through bilateral agreements between the relevant authority and the selected originating centre. It would be expected of the centres issuing the guidance to clarify that these were advisories and, in addition, the receiving centres should also consider the bulletins and advisories issued by the RSMC specializing in the activity in the region.

POTENTIAL EMERGING CENTRES

5.1.7 The Commission noted with appreciation the significant progress made in implementing the ASEAN Specialized Meteorological Centre (ASMC), which became operational as from January 1993. This had been achieved with the cooperation and sponsorship of the Japan Meteorological Agency (JMA) which provided its models for adaptation and implementation at the centre. The Commission noted that the ASMC experienced difficulties in finding trained staff for the operation and further development of the centre and invited members operating fully-developed GDPS centres to consider providing support to the ASMC by offering specific training in data processing and data management.

5.1.8 The Commission was informed of progress made by emerging centres, such as the African Centre of Meteorological Applications for Development (ACMAD) in Niamey, the Drought Monitoring Centres (DMCS) in Nairobi and Harare, and the Fiji Tropical Cyclone Warning Centre. It was noted that these centres had plans to improve their modest equipment and to train staff at various levels. The Commission recommended that major GDPS centres involved in relevant activity

specialization should co-sponsor these centres with a view to cooperate and assist them in upgrading their facilities and services, as well as in staff development.

GENERATION OF CLIMATE DIAGNOSTIC PRODUCTS, LONG-RANGE FORECASTS AND OUTLOOKS

5.1.9 The Commission noted that a meeting of experts from the CCl and the CBS Working Groups on Data Processing, on Telecommunications and on Data Management was organized (January 1994) to clarify CCl requirements for support from CBS and developed procedures and a demonstration project for the exchange of GDPS-generated climate diagnostic and long-range prediction products on the GTS. Achievements of the project, to date, included:

(*a*) Updating the contents of the *Manual on Codes* (WMO-No. 306), Volume A as it referred to CLIMAT and CLIMAT TEMP messages in Region III. Monitoring of these messages was progressing;

(*b*) The satisfactory exchange of alphanumeric products;

(*c*) The difficulty in the exchange of graphical products. Further work would be undertaken to resolve the problems associated with the exchange of these products.

MARINE POLLUTION EMERGENCY RESPONSE SUPPORT SYSTEM (MPERSS)

5.1.10 The Commission, noting that the operations at sea in response to marine pollution emergencies were fundamentally dependent on the support from Meteorological Services and in response to a request from CMM, agreed that as part of the GDPS support to other programmes, this activity should be considered for broadening the functions of existing RSMCs and for designating new RSMCs, as appropriate. It invited CMM to follow the CBS designation procedure in the identification of such centres, as specified in Attachment I.2 of the *Manual on the GDPS*. It urged CMM to develop a detailed statement of requirements and to clarify to potential centres the detailed operational tasks those centres accepting RSMC responsibility were expected to assume and the products they were expected to deliver.

PROVISION OF HIGH QUALITY WAVE DATA, WAVE ANALYSIS AND FORECAST SERVICES

5.1.11 The Commission, noting the increasing requirement of members for wave analysis and forecast services and in response to a request from CMM, agreed that the designation of RSMCs for ocean wave modelling and prediction would be appropriate. It invited CMM to follow the CBS designation procedures in the identification of such centres. It encouraged CMM to develop a detailed statement of requirements and to clarify the details of concrete services to be provided by potential RSMCs.

EXCHANGE OF NUMERICAL WEATHER PREDICTION PRODUCTS

5.1.12 There was still a problem of identifying products which were transmitted on the GTS for which previous stated requirements had lapsed or expired. Members were, therefore, invited to indicate, on a routine basis to the upstream Regional Telecommunication Hub (RTH), when the corresponding bulletin was no longer required.

5.1.13 It seemed likely that two transmission strategies for the supply of boundary conditions to limited area models (LAMs) would exist side by side for the foreseeable future. These would include the now common bilateral arrangements between originating and receiving centres and a generalized dissemination of model fields from originating centres, leaving it to each potential user to tailor the transmitted data to his particular requirements. The Commission urged GDPS centres to disseminate to its users information on the regular tuning of models and invited users to provide feedback to generating centres on identified systematic errors.

LIMITED AREA MODELS AND POST-PROCESSING

5.1.14 The Commission agreed that, when supercomputing resources and/or high resolution models or data were not available, it might be best to use available computing resources to improve post-processing of numerical products available on the GTS. It also noted that a good alternative to LAM might be a global or hemispheric variable resolution model.

5.1.15 The Commission recognized, however, the need for certain RSMCs/national Meteorological Centres (NMCs) in developing countries to carry out modelling activities by using appropriate models developed to meet local needs. In this connection, the Commission urged advanced centres to assist these developing centres by making supercomputing resources available through remote access to facilitate the production of numerical weather products specific to their areas of responsibility. The advanced RSMCs could further assist these centres through training of their scientists who were involved in the development and application of models. This could be achieved through the attachment of scientists to the advanced centres or through the organization of short- or medium-term courses geared specifically towards meeting the needs of these centres.

GUIDANCE ON MINIMUM REQUIREMENTS FOR REAL-TIME DATA PROCESSING FACILITIES AT NATIONAL METEOROLOGICAL CENTRES

5.1.16 It was desirable that WMO provided guidance for the development of software systems meeting a minimum set of NMC requirements. Donors and vendors of such processing systems needed to have CBS-endorsed, clear specifications of WMO requirements. Consultants working closely with a member of the working group had prepared a draft set of system specifications suitable for use in the upgrading of an NMC. These specifications would be distributed to all WMO Members and GDPS centres for their use, as appropriate.

POTENTIAL ROLE OF THE GDPS IN THE FOLLOW-UP ACTION TO THE UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT

5.1.17 The Commission noted the role of GDPS activities in mitigating the adverse effects on human health caused by environmental pollution and, in particular, the

provision of early warnings on the occurrence of environmental events that could impinge on the socio-economic activities of a region. It also agreed that there was considerable potential for the GDPS in providing support to enhance the scientific capacity of centres, through education and training, to respond to the challenges of sustainable development.

5.1.18 In response to Chapter 12, Programme Area A of Agenda 21 and the Framework Convention on Climate Change, "Strengthening the knowledge base and developing information and monitoring systems for regions prone to desertification and drought, including the economic and social aspects of these ecosystems", the Commission encouraged the action taken and those planned to be taken by more advanced GDPS centres in providing products and training facilities to less developed centres and, in particular, the emerging DMCs and the ACMAD. It urged members to explore possibilities for the further development and expansion of the scope of operation of these centres.

CAPACITY BUILDING

5.1.19 The Commission noted that the implementation of minimum hardware and software systems at NMCs would upgrade the NMC capacity to respond to environmental issues more effectively. Other issues which should be addressed included:

(*a*) The development of regional and national expertise in climate diagnostic studies and numerical modelling, in particular limited area numerical weather prediction;

(*b*) The assignment of responsibility to regional centres for the development, adaptation and maintenance of software to assure sustainability;

(*c*) The formulation of research activities to gain insight into the possible cause factors for drought, climate change/variability and environmental degradation;

(*d*) The provision of reliable means of communication to facilitate the exchange of data and products between GDPS centres;

(*e*) The encouragement of the developments of informal working arrangements between the more developed and the less developed GDPS centres.

RECENT SCIENTIFIC AND TECHNOLOGICAL ADVANCES WITH IMPACT ON THE OPERATION OF THE GDPS

5.1.20 The Commission noted that the current ability of GDPS centres to specify accurate initial analysis fields would continue to be hampered by the lack of sufficient dense observational data and that the only feasible remedy within the foreseeable future would be to rely on ground- and space-based remote sensing observational systems. It was an important challenge to find a way to properly assimilate such data. Current developments of variational assimilation systems seemed to be promising in this respect.

5.1.21 Various approaches were being pursued including the use of very high resolution models and the refinement of parameterization schemes to further improve the models' ability to simulate more accurately the physical processes of the atmosphere. Trends in numerical modelling schemes included the wider use of spectral methods and the introduction of more economical time integration schemes based on combined semi-Lagrangian and semi-implicit methods. This had made the variable mesh method a viable alternative to the conventional nested model approach, and in addition some centres had started experimenting with the non-hydrostatic model while others had begun evaluating the ensemble forecasting technique.

5.1.22 The availability of lower cost mainframe computers and workstations might lead both to the proliferation of NWP model developments and to more centres implementing workstations for pre- and post-processing of NWP data. The emergence of massively parallel computers could require new organization of the codes. The Commission recognized the need for NWP models to keep abreast with this technology.

MONITORING OF THE QUALITY OF OBSERVATIONS

5.1.23 The Commission noted with satisfaction the success achieved by the lead centres in monitoring data quality. Other participating centres were invited to exchange monitoring results and to produce monthly lists of suspect stations based on agreed criteria.

5.1.24 As regarded the monitoring of the quality of land surface observations, the lead centres RSMCs Tokyo, Montreal, Melbourne and Offenbach covered the activity in their Regions, RSMC Buenos Aires had accepted responsibility as a lead centre for Region III and WMC Melbourne was performing the quality monitoring for Region I pending designation of a lead centre for this Region. The potential interest of ACMAD for this role at some point in the future was noted. The Commission also noted that global coverage was now achieved for this programme. It stressed the importance of the establishment of standardized methodology for land surface monitoring and welcomed the fact that Australia had offered to monitor the entire southern hemisphere to facilitate inter-comparison of results. The Commission encouraged Regional Association (RA) I to identify a lead centre for that Region, noting that advice and support of such a centre might be forthcoming from existing lead centres.

5.1.25 The Commission agreed that the criteria developed by the lead centres for the production of monthly lists of suspect surface stations, as given in annex 4 to Recommendation 2 (CBS-Ext.(94)), be included in Attachment II.15 to the *Manual on the GDPS*.

5.1.26 The Commission noted with satisfaction that monitoring centres had established a list of focal points to facilitate exchange between themselves of relevant monitoring information using electronic mail available where possible.

VERIFICATION OF NUMERICAL WEATHER PREDICTION

5.1.27 The following progress had been achieved:

(*a*) The monthly exchange of verification scores using agreed standards had been consolidated among centres: Offenbach, Bracknell, Washington, Tokyo, Toulouse, Montreal, Moscow and the European Centre for Medium Range Weather Forecasts (ECMWF);

(*b*) The updated list of upper air stations to be used in verification were notified by ECMWF, in agreement with the other participating centres, through the WWW Monthly Newsletter;

(*c*) Observations which were rejected by the corresponding verifying analysis were excluded from use in verification programmes;

(*d*) A limited set of basic scores was included in annual WWW Technical Progress Reports on the GDPS. It provided a convenient reference on the overall skill of the various numerical forecasting systems that were operational around the world.

5.1.28 The Commission welcomed the fact that the Working Group on Data Processing was looking into a number of items, e.g. bias corrections, including ways of exchanging this data by using electronic mail, indicating when corrections had been applied to verifying observations, adding northern and southern hemisphere station sets in addition to the present tropical and regional stations sets, and keeping under review the question of standardization of verification of direct-model output of weather parameters.

MANUAL AND GUIDE ON THE GLOBAL DATA-PROCESSING SYSTEM

5.1.29 The Commission noted with satisfaction that the new 1993 edition of the *Guide on the Global Data-processing System* (WMO-No. 305) had been published.

5.1.30 The new WWW Technical Progress Reports on the GDPS contained valuable information which had been made available by a large number of national Meteorological Services on the status of the GDPS centres. The Commission urged all WMO Members including those data-processing national centres which were operated manually to contribute to the Technical Progress Reports by providing a short summary of the status of their data-processing services and their future plans.

5.1.31 The Commission agreed on the need to update the 1985 edition of the *Guide on the Automation of Data-processing Centres* (WMO-No. 636) and noted with satisfaction that its Working Group on Data Processing had taken up this task.

FOURTH LONG-TERM PLAN (4LTP) — GDPS ASPECTS

5.1.32 Comments on the draft *Fourth Long-term Plan* made by the CBS WG-VIII had been provided to the Executive Council Working Group on Long-term Planning.

FUTURE WORK PROGRAMME

5.1.33 The Commission identified the following issues that should be addressed by the Working Group on Data Processing:

(*a*) The distribution of resources (observing/computing/telecommunications/ human): There was a need to identify the main factors that could enhance predictive skill in order to achieve the optimum investment of resources;

(*b*) The future of LAMs versus variable resolution models and of mainframes versus workstations: The way forward was not absolutely clear. There was a need to keep the issue under review and to give formal guidance if and when the position became clearer;

(*c*) The best use of computing resources at RSMCs: The relative benefits of devoting available computing resources to LAMs versus post-processing of products and deterministic versus probabilistic long-range forecasts needed to be defined;

(*d*) Review of the *Manual on the Global Data-processing System* and the *Guide on the Automation of Data-processing Centres*: Both publications needed to be reviewed;

(*e*) The man/machine mix: The man/machine mix was changing with the introduction of new technology and expert systems. The impact of these changes on the forecasting process required better definition;

(*f*) Designation of centres: The process of designating centres by geographical/activity specialization had expanded in recent years. The appropriateness and purpose of this process should be reviewed;

(*g*) Training: The impact of increasing availability of technology on the training needs related to the GDPS should be studied with a view to advising and giving high priority on future training activities;

(*h*) Potential use in operations of long-range weather forecasts: Interest in the subject was increasing; the potential and limits of its usefulness needed to be reviewed.

ENVIRONMENTAL EMERGENCY RESPONSE

5.1.34 The Commission noted with satisfaction the results of the First International Workshop on Users' Requirements for the Provision of Atmospheric Transport Model Products for Environmental Emergency Response (Montreal, September 1993). It noted that the workshop addressed users' requirements, including those of the International Atomic Energy Agency (IAEA), the operational and modelling capabilities of RSMCs, the specific needs of countries which required such services, and the operational arrangements required.

5.1.35 The Commission noted with appreciation that the workshop developed a number of recommendations, proposed actions, and global and regional arrangements including standards for the provision of international services. It noted that the CBS Working Group on Data Processing and other basic system working groups had reviewed and endorsed the substance of these proposals. The Commission endorsed the report of the workshop on the possibility of using existing codes to transmit specialized products and invited its Working Group on Data Management to study, as a matter of urgency, this requirement. The Commission endorsed the recommendation of the workshop that WMO and the IAEA be invited to coordinate jointly a wider review, within the users community and meteorological centres, of the standards in the provision of international services by RSMCs for radiological environmental emergency response. The Commission endorsed and adopted the substance of these recommendations as incorporated into its Recommendation 3 (CBS-Ext.(94)).

5.1.36 The Commission noted with satisfaction the conclusions and recommendations of the Expert Meeting on Environmental Emergency Response Activities (Bracknell, March 1994). It endorsed the recommendations of the meeting and agreed that:

(*a*) The Working Group on Telecommunications should develop GTS procedures to enable T4 facsimile products to be readily and widely disseminated;

(*b*) The Working Group on Data Management should define standard reliable procedures to ensure that critical data, such as weather messages for test purposes only or modelling assumptions, could be transmitted as part of a GRIB message;

(*c*) The IAEA and delegated authorities requesting a service from an RSMC should provide the initial and updated basic information to be used to refine input data for the next run of the model;

(*d*) Summarized and tabulated representative radiological data measured/observed by monitoring networks should be made available within a few days to RSMCs by the IAEA for use in enhancing and updating products and for verification purposes. A more scientific set of measured data would be collected by IAEA and provided subsequently;

(*e*) The IAEA should generate and disseminate, via the convention information (CI) structure event-related information, by various means of telecommunications, including, the GTS connections between the IAEA, RTH Vienna and RTH Offenbach (as back up);

(*f*) The important requirement for training was that of staff at national Meteorological Services (NMSs) and the identification of training needs should be done in consultation with users. This was best addressed at the regional level through cooperation between the two RSMCs in each Region and in consultation with their associated NMSs. Training approaches could include:

  (i) The training of trainers of Regional Meteorological Training Centres (RMTC);

  (ii) The use of distance learning methods by training packages;

(*g*) Designated RSMCs should provide support and technology transfer to NMSs seeking RSMCs status and that such centres should contact RSMCs.

5.1.37 One delegation noted that the proposed arrangements for the dissemination of products associated with radiological events might not be welcomed by some WMO Members because of the differing ways of providing the information on nuclear accidents to the public in each nation.

5.1.38 The Commission noted with satisfaction that the designated RSMCs Bracknell, Montreal, Toulouse and Washington, in collaboration with the IAEA and the WMO Secretariat, had carried out an informal test of the provision of transport model products in case of a simulated nuclear accident. The IAEA confirmed, as an outcome of this test, that:

(*a*) The meteorological information provided would have significantly improved their understanding and assessment of the accident situation;

(*b*) They would have redistributed these products to the agreed points of contact of the IAEA;

(*c*) They found the coordinated joint assessment of the meteorological products provided by the RSMCs very valuable.

The Commission further noted the proposals made by the IAEA to repeat such a test periodically, in the future, in order to improve iteratively the arrangements for the provision, the presentation and the quality of the products, and invited the designated RSMCs to pursue this matter, possibly with the active participation of other interested members.

5.1.39 The Commission shared the view of the IAEA that the arrangement developed between WMO and the IAEA was an excellent example of the cooperation that existed between agencies within the United Nations system for the benefit of the Member countries/States.

5.1.40 The Commission was informed of progress made in the operational implementation of supercomputing facilities at the GDPS centre in Beijing. It noted with pleasure the offer of China for RSMC Beijing to broaden its responsibilities to include the provision of transport model products for environmental emergency response in Region II. The Commission looked forward, in due course, to a demonstration of the capabilities of the centre in accordance with the designation procedures.

5.1.41 The Commission noted the development being made in the Japan Meteorological Agency (JMA) in the area of transport models. JMA was invited to further improve its models for environmental emergency response with a view to meeting the requirements of an RSMC with activity specialization in this field in Region II.

5.1.42 The Commission was informed that the GDPS centre in Moscow had implemented transport/dispersion/deposition models for national applications in environmental emergency response and was ready to supply the relevant information on request. It was also noted that, as stated at the eleventh session of Regional Association VI (Oslo, May 1994), a number of NMCs in Europe (Denmark, Finland, Germany, Norway, Sweden) had implemented transport models and appropriate operational capabilities to support national authorities in cases of environmental emergency response. These products were available to Members, as requested, on a bilateral basis.

5.1.43 The Commission noted that, at its session, Regional Association VI had considered and adopted a resolution on data requirements in case of an environmental emergency. In particular, RA VI had requested CBS to arrange for a review and update of data requirements for transport model applications. This should be carried out in the light of very critical requirements for access to all up-to-the minute observational data stated by the designated RSMCs for the provision of transport model products in case of an emergency, and also taking into account the concern expressed by some Members of the ability of NMS to perform their duties in environmental emergencies. The review should also assess the requirements, procedures and facilities needed to exchange the data and products. In this connection, the

Commission adopted Resolution 1 (CBS-Ext.(94)) and agreed to establish a task team with the terms of reference and composition given in that resolution. It invited the chairman of the CBS Working Group on Observations, Mr F. S. Zbar (United States) to chair this task team. It was expected that most of the work of the task team would be accomplished by correspondence.

5.2 Observations (agenda item 5.2)

Report of the chairman and report of the sixth session of the CBS Working Group on Observations

5.2.1 The Commission noted with appreciation the report of the chairman of the Working Group on Observations, Mr F. S. Zbar (United States). The Commission expressed its gratitude for the substantial amount of work accomplished by the working group, and in particular by its Task Team on the *Manual* and the *Guide on the Global Observing System*, during the intersessional period.

Development and operation of specialized observing systems

5.2.2 The Commission noted that the working group had continued to review the development of specialized observing systems such as the Automated Shipboard Aerological Programme (ASAP), the Automated Aircraft Observing and Reporting Systems, and wind profilers and their introduction into the GOS. The chairmen of the ASAP Coordinating Committee and the Operational Consortium for ASDAR had provided regular reports to the working group on the status of the implementation of these systems, as requested by the tenth session of CBS.

5.2.3 The Commission emphasized the synergy between the various observing systems and reiterated its commitment to the continuation of a composite system, the value of which would be far greater than the sum of its parts as was being demonstrated by the Composite Observing System for the North Atlantic (COSNA). The importance of exploring all possibilities for the joint funding of such systems was also stressed, with priority being given to the data-sparse areas of the southern hemisphere.

5.2.4 The Commission further noted the increasing use of automatic observing systems and their great utility, especially in remote areas, even though visually determined parameters such as cloud type/amount and visibility were not observed. The developments in lightning detection networks were considered very promising and the Working Group on Observations was requested to stay informed of progress in this area and to provide advice to Members. It was noted that, as a result of discussions with the president of the Commission for Instruments and Methods of Observation (CIMO), a CIMO study group was created to examine the quality of various types of networks.

5.2.5 As regarded the requirements of numerical weather prediction, the Commission recognized that modern data assimilation systems were becoming available, which could use a broader range of observational data in terms of methods of observation and resolutions than those used up to now, and that climate diagnostics would require more real-time data from surface observations than was available at present.

Automated Shipboard Aerological Programme (ASAP)

5.2.6 The Commission confirmed the fact that despite the very slow progress in the wide deployment of ASAP systems, particularly outside the North Atlantic, they still had great potential for the GOS and the GCOS. The Comission was, therefore, very pleased to learn that Spain had very recently deployed a system south of the Canary Islands near the African coast, that Sweden — in cooperation with Iceland — would operate a first system during early 1995 and a second somewhat later, and that the United States planned to deploy three systems, one in each of the years 1996, 1997 and 1998. It was understood that the United States systems were small, flexible and cost-effective. The Commission urged that work be continued to develop further this concept. It was also learned that the United States ship Discoverer would be contributing ASAP soundings within months as a result of the equipment provided by Canada.

5.2.7 The Commission received a brief report on the meeting of the ASAP Coordinating Committee (ACC), which had been held in April 1994. It noted with interest the efforts being undertaken to develop an automatic launching facility. It also noted the information on monitoring the availability of ASAP reports, which indicated that while most operators had experienced acceptable levels of performance using the Meteosat DCP system, INMARSAT-C transmissions were better than Meteosat at higher latitudes and could be very cost-effective. The Commission was of the view that the ACC should continue to coordinate the development and deployment of ASAP systems as an independent body.

Omega and Loran radionavigation systems

5.2.8 In connection with the ASAP, the Commission considered the problem of the uncertainties in the continued operation of the Omega radionavigation system for upper-air wind findings on which some 20 per cent (192 stations) of the worldwide network depended. It was noted that there were eight stations in the Omega network, and while Liberia had operated intermittently, the United States informed the Commission that the network was expected to continue in operation at least until 1 October 1997, including the jointly operated station in Australia.

5.2.9 In expressing its serious concern about this situation, the Commission noted that while there were reasonable prospects of alternative systems being introduced, so as to avoid any major deterioration in the quality and quantity of available upper-air data, there was no clear time-frame for their introduction and costs were likely to be higher, at least initially. In this connection, it was noted that alternative technologies for upper-wind observations were becoming available which might reduce the required number of conventional upper-air stations worldwide.

5.2.10 In the meantime, the Commission urged members making use of the Omega system to keep the situation closely under review and to stay informed of the plans of radiosonde suppliers to use alternative systems. The Working Group on Observations was requested to give this matter high priority in its work programme and to work in close consultation with CIMO. The Secretary-General was requested to maintain close contact with the Omega operating authorities in an effort to ensure the continued operation of the system until such time as feasible alternatives were found.

5.2.11 The projected life of the Loran C system was based in part upon the United States Radionavigation Plan, which currently stated that Loran C would remain operational at least until the year 2003. However, it was now being proposed that the system should be shut down earlier. The situation would be reviewed in the United States in 1995.

AUTOMATED AIRCRAFT OBSERVING AND REPORTING SYSTEMS

5.2.12 Noting the excellent progress made in the implementation of an automated aircraft reporting system, where an ever-increasing number of systems were coming into operation with huge increases in the amount of data available, the Commission emphasized the importance of coordination in the conversion of the data into standard WMO formats for exchange on the GTS. This was especially important in the light of the fact that a standard reporting format suitable for both VHF and satellite reporting through the future aeronautical telecommunication network had been developed by the International Civil Aviation Organization (ICAO). The Commission requested the Working Group on Data Management to pursue this issue. It also recommended that all aircraft reports should include a means of identifying the source aircraft (in addition to the flight number) to facilitate feedback of the quality control information, and that ascent and descent data were very important to improving the GOS.

WIND PROFILERS

5.2.13 In recent years, good progress had been achieved in the development of wind-profiler networks in Europe and in the United States. The Commission recognized that the wind profilers had been operated successfully, that they had been proven useful for meteorological purposes and could be deployed on an operational basis, although financial and other constraints might limit their deployment. The Commission requested the Working Group on Observations to provide members with information on costs and benefits of wind profilers in order to assist them in determining the best mix of observing systems in their geographical areas. Noting that frequency allocations for operational wind profilers still remained the most important and pressing problem, the Commission strongly recommended that WMO be represented at all future meetings on frequency allocations for wind-profiling radars. In this connection, the Commission noted that the issue of frequency allocation was generally becoming more and more difficult, as there was an ever-growing demand for communication bandwidths for many applications. The Commission requested the Working Group on Telecommunications to give this issue priority in its work programme, consulting, as necessary, the chairman of the Working Group on Observations and experts from other interested groups.

REQUIREMENTS FOR VISUAL OBSERVATIONS

5.2.14 In the light of the advances in recent years in remote sensing technologies, in numerical prediction techniques, and in other areas related to the provision of meteorological services, the Commission felt that it was opportune to re-examine the requirements for visual observations, particularly from ships. It, therefore, requested the Working Group on Observations to study this question in consultation with other technical commissions such as the Commissions for Marine Meteorology (CMM), for Aeronautical Meteorology (CAeM), and for Instruments and Methods of Observation (CIMO).

REVIEW OF THE REGIONAL BASIC SYNOPTIC NETWORKS

5.2.15 The Commission recalled that its tenth session had requested the Working Group on Observations to collaborate with regional associations in reviewing and redesigning the RBSNs. It noted that substantial progress had been made in this field in Region VI, where software had been developed by the regional rapporteur on the RBSN, Mr H. Daan (Netherlands) both for calculating distances between observing stations and for the graphical display of network density to assist in redesigning the RBSN. Rapporteurs on the GOS in other regions had been provided with documentation and operating instructions for the software, which was expanded for reference in redesigning the RBSNs in all WMO Regions.

COORDINATION OF THE REAL-TIME REPORTING OF VOLCANIC ASH

5.2.16 Following a request by ICAO and taking into account the potential hazards of volcanic activity to aviation, new procedures dealing with surface observations and reporting of volcanic activity and the movement of volcanic ash cloud had been included in the *Manual on the Global Observing System* (WMO-No. 544). Noting that much valuable information could also be obtained from satellite data, the Commission was pleased to learn that, at the recent session of the Coordination Group for Geostationary Meteorological Satellites (CGMS), Japan and some other satellite operators had reported positive results of volcanic ash cloud monitoring carried out with the use of current Geostationary Meteorological Satellite (GMS) visible and infrared data for the detection of ash clouds, caused by large eruptions, and their temporal variation. In addition, the twenty-second session of CGMS had endorsed the concept of a global volcanic ash warning service and had proposed that an implementation plan be developed in collaboration with ICAO, which was implementing an International Airways Volcanic Watch (IAVW). The Commission requested the Working Group on Observations to monitor this development.

MANUAL ON THE GLOBAL OBSERVING SYSTEM

5.2.17 The Commission endorsed the amendments to Part II of the *Manual on the GOS* which had been proposed by the Task Team on the *Manual* and *Guide on the GOS*. These included a statement of the performance of elements of the GOS which were likely to be achievable by the year 2005 as well as the procedures for the elaboration of observational data requirements, which had been prepared on the basis of proposals made by a Joint GOS/GDPS Task Team on Data Requirements. It was recognized that it might take longer in some areas than in others to meet the requirements and the Commission emphasized that greater efforts might have to be made to arrange assistance and support for some regions and countries.

5.2.18 The Commission also noted that the Working Groups on Observations and on Satellites planned to coordinate their work on the definition of requirements for observational data to ensure compatibility, while recognizing the different purposes for which the resulting statements were required. The need for special attention to be given to the requirements for satellite radiances was stressed.

5.2.19 The Commission also endorsed the amendments to Part III of the *Manual on the GOS* concerning ozone sounding stations and background pollution monitoring stations. These amendments had been developed by the Task Team on the *Manual* following the adoption by the forty-fourth session of the Executive Council of Volume I, Chapter B.2 — Global Atmosphere Watch of the *Technical Regulations* (WMO-No. 49) Recommendation 4 (CBS-Ext.(94)) was adopted.

GUIDE ON THE GLOBAL OBSERVING SYSTEM

5.2.20 The Commission approved substantial amendments to Part II (Requirements for Observational Data) of the *Guide on the Global Observing System* (WMO-No. 488) including new Attachments II.1 and II.3. It agreed that Part VIII (Improved Operational Observing Systems) be deleted as the substantial content of this part had been incorporated into the proposed amendments of Part II. New data requirements and technological developments should be continuously reviewed, with a view to updating the relevant sections of the *Guide*.

5.2.21 The Commission expressed its appreciation to the United Kingdom Meteorological Office for the preparation of a draft text concerning the procedures for monitoring marine surface data quality. The proposed text had been reviewed by the task team and the Commission approved its inclusion in Part VII of the *Guide on the GOS*. The approved amendments to Parts II and VII are given in Annex III to this report.

INTERRELATION BETWEEN THE GLOBAL OBSERVING SYSTEM AND THE GLOBAL CLIMATE OBSERVING SYSTEM

5.2.22 As noted under agenda item 4, the Commission anticipated that the GOS would have an increasing role in the future development of the GCOS and confirmed that GCOS requirements for detecting, monitoring and predicting climate change would necessitate an enhancement of certain elements of the existing GOS. The interaction between GOS and GCOS should focus on the following areas:

(*a*) The analysis of requirements and the design, establishment and maintenance of GCOS base-line networks, both surface and upper air;
(*b*) Selective integration of experimental observing systems into the GCOS;
(*c*) Monitoring of GCOS operation through CBS mechanisms.

FOURTH LONG-TERM PLAN — GOS ASPECTS

5.2.23 The Commission noted with satisfaction that the Working Group on Observations, at the sixth session, had provided general guidance on the drafting of the GOS programme of the *Fourth Long-term Plan*. The proposals and modifications made by the working group had been subsequently incorporated in the draft of the *4LTP*.

FUTURE WORK PROGRAMME

5.2.24 The Commission agreed on the following work programme of the Working Group on Observations:

(*a*) To provide planning assistance to the GCOS Programme in defining currently-supported observing programmes to benefit GCOS and define enhancements and strategies in meeting more stringent requirements than currently being met by the WWW Programme through the use of GCOS/GOS expert meetings;
(*b*) To continue to review and advise on the design and implementation of the GOS with an emphasis placed upon new specialized observational systems, such as the aircraft meteorological data relay (AMDAR), ASAP, drifting buoys, wind profilers, automated weather stations, and lightning detection networks;
(*c*) To keep under review the results of the monitoring of the status of the GOS subsystems with respect to the availability and quality of data and to advise on the maintenance of the existing networks;
(*d*) To review user requirements and provide advice to the Working Groups on Satellites and on Data Processing;
(*e*) To review the planning and implementation aspects of observing networks on the North Atlantic;
(*f*) To monitor the implementation of Volcanic Ash Warning Services through interactions with CGMS and in coordination with ICAO;
(*g*) To improve the *Manual* and *Guide on the GOS* by bringing them up-to-date with respect to new specialized observing systems;
(*h*) To improve coordination with CIMO in activities relating to surface and upper-air observations and in matters of inconsistencies between the *Guides on the GOS* and *to Meteorological Instruments and Methods of Observation* (WMO-No. 8) and of the inclusion of regulatory material in the *Manual on the GOS*;
(*i*) To keep under review the needs for education and training in the field of observations and to advise on the preparation and organization of relevant training events and courses.

5.3 TELECOMMUNICATIONS (agenda item 5.3)

REPORT OF THE CHAIRMAN OF THE WORKING GROUP ON TELECOMMUNICATIONS

5.3.1 The Commission noted with appreciation the report of the chairman of the CBS Working Group on Telecommunications, Mr M. Fischer (France), including the work accomplished by the thirteenth session of the Working Group on Telecommunications (Geneva, February 1994). The topics covered were discussed in detail under the various sub-items below. The Commission expressed serious concern about the very long time that had elapsed between the two sessions of the working group, and emphasized that four-year sessions would not enable the working group to keep pace with the rapid evolution of requirements put on the GTS and to develop appropriate plans. Recognizing budget constraints, the Commission requested the Secretary-General to consider flexible arrangements for holding appropriate expert meetings during the inter-sessional period of the working group to alleviate the problem.

STATUS OF IMPLEMENTATION AND OPERATION OF THE GLOBAL TELECOMMUNICATION SYSTEM

POINT-TO-POINT CIRCUITS AND CENTRES

5.3.2 All 23 main telecommunication network (MTN) circuits were in operation and all MTN centres were automated. Twenty circuits were operating at data signalling rates higher than 2.4 Kbps, including three circuits at 64Kbps. Sixteen circuits were operating with X.25 procedures and three circuits with LAPB (X.25 layer 2 only). Besides the MTN, an increasing number of GTS circuits were leased circuits, including telephone type circuits. Important progress had been made in the implementation of X.25 procedures. However, there was still a significant number of radio HF circuits in some areas, particularly in Region I. The Commission appreciated the economic difficulties that many Meteorological Services had in leasing telecommunication circuits. It encouraged members to negotiate special arrangements with their telecommunication authorities and requested the WMO Secretariat to assist to the largest extent possible.

MULTIPOINT TELECOMMUNICATION SERVICES VIA SATELLITE AND RADIO BROADCASTS

5.3.3 As regarded the meteorological data distribution (MDD) service via Meteosat, Toulouse planned to operate a third 2 400 bit/s channel by the end of 1994. France was operating a satellite-based distribution system called Retim, via the Eutelsat II satellite, which included two 9 600 bit/s channels and which served Region VI and the northern part of Region I. In 1995, the total capacity of the system was planned to be upgraded to 64 Kbit/s. Germany planned to implement a satellite-based distribution system starting in 1995, which would operate at a data rate of 64 Kbit/s. The WMC in Moscow was planning the distribution of data and facsimile products via the new geostationary meteorological satellite planned to be launched in 1994.

5.3.4 Regional Association IV approved the plan for the new Regional Meteorological Telecommunication Network (RMTN) based on two-way multipoint telecommunication services via satellite using VSAT technology. Its implementation was planned for the fourth quarter of 1994 by the U.S. National Weather Service, in coordination with the implementation of the ICAO World Area Forecast System (WAFS) satellite-based broadcast for the Americas. Within the framework of ICAO, the United States planned to implement the WAFS satellite-based broadcast for the Pacific in 1995 and the United Kingdom had been requested to implement a satellite-based telecommunication system for the distribution of WAFS products, so-called Sadis, to serve Europe, Africa and the Middle East.

5.3.5 Several members, including Argentina, Canada, China, France, India, Indonesia, Mexico, Saudi Arabia, Thailand and the United States, had implemented or had firm plans for the implementation of satellite-based multipoint telecommunication systems for their national MTNs.

5.3.6 Several RTHs were transmitting bulletins and warnings for maritime activities on the Inmarsat SafetyNET service, for broadcast to ships. Ships were progressively equipped with Inmarsat-C terminals, although this evolution was relatively slow in some areas, and Inmarsat broadcast would eventually supersede the radiofacsimile and radio teleprinter broadcasts for ships. The collection of ship reports through Inmarsat coastal Earth stations was a routine and efficient service.

5.3.7 The high recurrent costs for the operation of radiobroadcasts was stressed by the Commission, and many operating centres planned to minimize this expense by taking advantage of more cost-effective means of transmission, in particular satellite-based multipoint distribution systems. Nevertheless, radiobroadcasts remained a useful means of telecommunication in some areas.

MONITORING RESULTS

5.3.8 As regarded the 1993 annual global monitoring of the operation of the WWW, a total of 107 centres provided monitoring results, and 36 centres, including nine RTHs on the MTN, provided results on floppy disks in compliance with the agreed procedures. The increasing number of centres providing monitoring results was noted with appreciation, and all centres were urged to participate actively in the global annual monitoring, particularly all RTHs on the MTN to provide global monitoring results on floppy disks.

TELECOMMUNICATION TECHNIQUES AND PROCEDURES

OPEN SYSTEMS INTERCONNECTION (OSI) LAYER 1 TO 4 TECHNIQUES AND PROCEDURES

5.3.9 The use of X.25 procedures on GTS circuits was a key element in achieving a wide-area network-supporting WWW activities. Logical multiplexing (virtual circuits) provided by the X.25 procedures enabled centres to draw full benefit from the total circuit capacity. The RTHs, in particular on the MTN, were encouraged to set up virtual

circuits in replacement of the physical multiplexing carried out by modems (e.g. V29) on circuits operating at 9 600 bit/s or less. Members were also encouraged to give consideration to the introduction of packet switch equipment which would significantly improve the effectiveness of the circuits. It was noted that such equipment had been implemented at RTH Tokyo and that a digital circuit had been established for the MTN circuit Tokyo-Melbourne.

5.3.10 The use of V.29 modems on analogue circuits was now becoming obsolete as the use of equivalent digital circuits was more cost-effective in many cases. When analogue circuits must be used, the use of V32/V33 modems, rather than V.29, was recommended if a data rate greater than 9.6 Kbps (up to 14.4 Kbps) was required. Under bilateral agreements, V.42 and V.42 bis modems could be adopted.

5.3.11 There were serious practical difficulties in implementing the ISO/ITU-T X.224 Transport Protocol on the GTS and many centres preferred the Transmission Control Protocol/ Internet Protocol (TCP/IP) and File Transfer Protocol (FTP). Although the TCP/IP protocol was not an OSI standard, it was a de facto open standard in that its use was vendor independent and there was an international standard defining the encapsulation of TCP/IP over X.25 procedures. Furthermore, studies had been undertaken within the International Telecommunications Union (ITU) Telecommunication Standardization Sector on the harmonization between Internet protocols (TCP/IP, FTP) and ITU-T recommendations. In the short-term, TCP/IP offered a readily available method of meeting the new requirements placed upon the GTS, for example support to file transfer and access to distributed databases. This development could co-exist with the continued use of OSI protocols.

Operational matters

5.3.12 The Commission noted that members experienced difficulties in implementing new or modified operational procedures, and agreed on two areas for improvement. First, any new or modified procedure considered for adoption must be tested in an appropriate way, for example, by several centres implementing it on an experimental basis and making the results available to the Working Group on Telecommunications and/or through implementation coordination meetings for evaluation. The specifications of the procedures, consolidated, as necessary, by the results of the experimental phase, could then be submitted to CBS for approval as proposed amendments to the *Manual on the Global Telecommunication System* (WMO-No. 386). Second, the Commission agreed that each new or revised procedure, once approved, should be accompanied with an implementation schedule and by guidelines which included practical examples. It also felt that the monthly letter on the operation of the WWW was a convenient means of providing guidance information on the implementation of GTS procedures and of calling attention on milestone dates for the coordinated implementation of new or revised procedures.

Addressed messages

5.3.13 There was an urgent requirement for the standardization of request-reply mechanisms, in particular for the request of GTS messages which already existed within the GTS and which were available at RTHs, in compliance with the agreed responsibility of RTHs to store messages for a period of 24 hours. The requests for GTS messages were to be used either for requesting a repetition of a message or for requesting an already existing GTS message, which was not included in the routine programme. The development of a format for request-reply messages which was related to having access to databases, including requests for data which were not already compiled within an existing GTS bulletin, was under consideration by the Working Group on Data Management, in coordination with the Working Group on Telecommunications.

5.3.14 The Commission endorsed the recommendation of the Working Group on Telecommunications on the format of the text of addressed messages for requests for, and replies to, GTS messages and on the relevant amendments to the *Manual on the GTS*, Volume I, Part II. It requested the chairman of the working group to consolidate the revised Attachment II-6 giving several examples of request and reply messages. The recommended date for final implementation of this procedure would be 1 November 1995. The Commission requested that the necessary guidance material for implementation be made available to WWW centres as soon as possible. It also requested the working group to develop further the procedures for possible requests for a set of bulletins (e.g. by time period, by data type, etc.), including, in particular, bulletins which contained a BBB group in their abbreviated headings.

Segmentation into bulletins

5.3.15 The Commission agreed that the medium- and long-term solution for the exchange of large files was the transport protocol, and that the implementation of the Pxx procedure, as adopted at its tenth session, should be limited to the most basic form, requiring limited implementation efforts from centres to meet present requirements on the GTS to handle some bulletins larger than 3 800 or 15 000 octets. The Commission also agreed on an amendment to the procedure, consisting of the use of the PZx group to indicate the last segment of the sequence.

Tables B1 and C1 of Attachment II-5, Manual on the Global Telecommunication System, Volume I, Part II

5.3.16 The Commission endorsed the recommended inclusion of new data type designators T_2 in Table B1 and new geographical designators A_1A_2 in Table C1, which had been assigned to new WMO Member States. The Commission noted that ICAO expressed a requirement for the allocation of new data type designators in Table B1 for tropical cyclones and volcanic ash advisory messages, and for GAMET and AIRMET messages, which included meteorological information for low-level flights. The Commission requested the Working Group

on Telecommunications to consider the matter and to propose appropriate action as a matter of urgency, and invited ICAO to provide the necessary background information.

DATA MANAGEMENT FUNCTIONS RELATED TO THE GTS, INCLUDING MONITORING ACTIVITIES

5.3.17 The Commission noted that the Working Group on Telecommunications had agreed on some refinements of the format for the presentation of monitoring results on floppy disks to be consolidated in consultation with the centres concerned. It also agreed on a few improvements of monitoring procedures, including the definition of time period for counting BUOY, AIREP and AMDAR bulletins, and to paragraph 5.2 of Table D, Attachment I-5, *Manual on the GTS*, Volume I, Part I related to duplicated reports. The Commission also strongly recommended that identical procedures be used for both global and special monitoring, including in particular Antarctic monitoring, with a view to facilitate the workload required at monitoring centres.

5.3.18 Subsequent to the above discussion, the Commission adopted Recommendation 5 (CBS-Ext.(94)) concerning the amendments to be made to the *Manual on the GTS*, Volume I, Parts I and II.

ORGANIZATION AND STRUCTURE OF THE GTS

REQUIREMENTS OF THE GTS

5.3.19 The Commission reviewed the requirements of the GTS, taking due account of the WMO Long-term Plan, and agreed upon the requirements for the further development of the MTN, which are given in Annex IV to this report.

ENVIRONMENTAL EMERGENCY RESPONSE (EER)

5.3.20 The Commission reviewed the GTS operational arrangements required in response to environmental emergencies and underlined that the GTS would have a wider and more important role than was the case at present. The Commission did not foresee difficulties with respect to the exchange of emergency-related data and observations on the GTS, including the first IAEA notification message, assuming that these data and observations would have a fairly limited volume. It stressed that the relevant messages to be exchanged, as well as the exchange requirements (sources and receiving centres), be defined with a view to implementing the necessary routeing lists at GTS centres, and in particular at RTHs. It also recommended that test exercises of the transmission of notification messages and related messages on the GTS be carried out regularly, with a view to ensuring that adequate operational arrangements were in place.

5.3.21 With respect to the dissemination of EER specialized products, the Commission noted that a graphical format did not facilitate wide dissemination of these products on the GTS and felt that other formats should be considered, in addition to graphical representation forms, in the light of the requirements to exchange such products on the GTS.

TELECOMMUNICATION SUPPORT TO OTHER PROGRAMMES

5.3.22 Due consideration was also given to the GTS support for, and coordination with, other WMO and international programmes (particularly GCOS and GOOS), and the Commission agreed that their data exchange requirements be duly taken into account when reviewing and further developing telecommunication procedures and GTS plans. The Commission noted the requirement expressed by CAS, at its last session, to consider the feasibility of exchanging an increased amount of remote sensed data over the GTS. It requested the Working Groups on Data Processing and on Telecommunications to study the matter. It noted that the System for Technology Exchange for Natural Disasters (STEND) project was considering means for the dissemination of forecasts and warnings of natural disasters, such as earthquakes and volcanic eruptions. It was felt that the GTS might provide such services. If this were the case, then the Commission would consider the requirements expressed under the STEND project.

5.3.23 The Commission noted that the ICAO/WAFS satellite-based telecommunication systems were entering the implementation phase, in particular in Regions III and IV. In Region IV, the WAFS data dissemination requirements, combined with the WWW data exchange requirements, had lead to a joint system combining a one-way and a two-way multipoint system with a view to minimizing the installation and operating costs both for the ICAO and the WMO community.

FURTHER INTRODUCTION OF SATELLITE-BASED SYSTEMS

5.3.24 The Commission noted with appreciation that an Expert Meeting on Satellite-based Telecommunication System for the GTS (Beijing, May 1993) was held and that the meeting report and documents were distributed as WWW Technical Report Series No. 15 (WMO/TD-No. 567). It also noted with appreciation that Regional Association VI established a steering group for the development of an upgraded RMTN which was likely to comprise satellite-based communication to a large extent. The Commission re-emphasized the increasing role that multipoint satellite-based telecommunication systems were to play in the further development and upgrade of RMTNs. It also stressed the necessity of coordinating regional efforts for implementing these systems, which in most cases covered more than one region, between regional Working Groups on the WWW and the CBS Working Group on Telecommunications. It noted, in this regard, that a study on the implications, on a regional basis, of the relevant national and international telecommunication regulations, including tariffs, was an essential initial step for the design and implementation of systems based on multipoint telecommunication services via satellite.

OPERATIONAL STRUCTURE OF THE MAIN TELECOMMUNICATION NETWORK

5.3.25 The Commission endorsed the improved MTN concept which had been developed by the Study Group on Communication Techniques and Protocols at its fifth session. It had been further consolidated by an ad hoc

group of the study group, and recommended by the thirteenth session of the Working Group on Telecommunications. Annex V to this report contains the planning document which describes the concept. The improved MTN utilized X.25 high speed circuits and would support the TCP/IP and OSI protocols. The MTN concept was based on the notion of peer nodes (no master) with individual centres free to equip their node when they were ready and able to proceed. The Commission underlined the importance of registering an Internet domain name and a data network identification code for the GTS.

5.3.26 The Commission noted with appreciation that at least four RTHs on the MTN were planning to implement the concept in 1995, with a view to testing and consolidating the various possible detailed specifications. A coordination meeting between these four centres (Bracknell, Offenbach, Toulouse and Washington) was planned for October 1994, and an implementation coordination meeting on the MTN, planned to be held in December 1994 in Melbourne, Australia, would, *inter alia*, explore and consolidate technical options and develop an implementation plan and guidance material.

Structure of the Global Telecommunication System

5.3.27 The Commission underlined that the current and future evolution of the GTS, particularly through the increasing role of multipoint telecommunication services via satellite, required a review of the functions and the number of RTHs on the MTN and of other RTHs. It recalled that, at its extraordinary session (London, 1990), the geographical concept of areas of responsibility of RTHs was replaced by a more flexible concept of associated NMCs. The Commission requested its Working Group on Telecommunications to review the functions and responsibilities of the centres on the GTS which undertook international responsibilities. It also requested the Working Group on Telecommunications to develop a methodology for the determination of requirements and verification of the capabilities of centres, and for designating centres carrying out international responsibilities on the GTS. The Commission agreed that these procedures for designating GTS nodes (i.e. RTHs on the MTN and RTHs) should be, as far as possible, in line with those for the designation of RSMCs.

Radio frequencies for meteorological activities

International Telecommunications Union (ITU) activities

5.3.28 Following the decisions of the Additional Plenipotentiary Conference in 1992 on the reorganization of the ITU, the International Radio Consultative Committee (CCIR) and the International Frequency Registration Board (IFRB) ceased to exist and the new Radiocommunication Sector (ITU-R) came into force on 1 March 1993. The Radiocommunication Sector was composed of the World and Regional Radiocommunication Conferences, the Radiocommunication Assembly and Study Groups, the Radio Regulation Board, the Radiocommunication Advisory Group and the Radiocommunication Bureau. The functions of the former CCIR and IFRB secretariats were included in the new Radiocommunication Bureau. The former International Telegraph and Telephone Consultative Committee (CCITT) had also been reorganized into the new Telecommunication Standardization Sector (ITU-TS), and a Telecommunication Development Bureau had been established.

5.3.29 The Radiocommunication Assembly approved, in November 1993, the work programme and structure of the Radiocommunication Study Groups. Several questions directly related to meteorological activities were assigned to study groups, in particular SG7 and 8, for the 1994–1995 study period. The questions directly related to meteorological activities, with an indication of the relevant groups, are given in Annex VI to this report.

Frequencies for wind profiler radars

5.3.30 Task Group 8/2 on radio-frequencies for wind profiler radars, which was established by the ITU Radiocommunication Sector, completed its tasks in October 1993 by preparing a draft recommendation on technical and operational characteristics of wind profiler radars and by identifying candidate bands around 50 MHz, 450 MHz and 900–1300 MHz for allocation of frequencies for wind profiler radars. The question of allocation of frequencies for wind profiler radars had been included in the agenda of the 1997 World Radiocommunication Conference.

Meteorological satellite service in the band 401–403 MHz

5.3.31 The primary service requirements for the meteorological satellite service in the band 401–403 MHz, considered by WARC 92, has also been included in the agenda of the 1997 World Radiocommunication Conference.

Meteorological requirements in upper frequency bands (above 50 GHz)

5.3.32 The Commission emphasized the importance of obtaining protection for the frequency bands (in particular within the 50–60 GHz band) which were used or would be used in the future by passive microwave sounders on board meteorological satellites, both for operational and research purposes. It emphasized that active participation in Radiocommunication Study Group 7 was required on this matter, with a view to its inclusion in the agenda of the 1997 World Radiocommunication Conference, as well as the preparation of the appropriate proposals for frequency allocations.

Working Group on Telecommunications/Study Group on radio-frequency matters (SF-RF)

5.3.33 Radio-frequency matters were of a long-term nature, and required WMO's coordinated participation in relevant study groups of the ITU Radiocommunication Sector. Furthermore, active and urgent preparation for the 1997 World Radiocommunication Conference was needed. The Commission, therefore, fully supported the proposal of the thirteenth session of the Working Group on Telecommunications that a study group on radio-frequency coordination (SG-RF) be established. The terms

of reference and composition of the study group are given in Annex VII to this report. The Commission underlined that, a meeting of the study group was necessary, and requested the Secretariat to consider the possibility of holding a meeting preferably by the end of 1994 or the very beginning of 1995.

5.3.34 The Commission noted that the WMO Secretariat had issued circular letters urging WMO Members to register with their national telecommunication administration all meteorological radiocommunication stations and frequencies used. A memorandum of understanding was agreed upon by ITU and WMO and was sent to ITU Member Administrations and to WMO Members with a view to facilitating the registration of receiving stations in the meteorological satellite service, in particular in the 137–138 MHz and 1675–1710 MHz bands. The Commission re-emphasized the extreme importance of properly registering meteorological radio-communication stations and frequencies used by Meteorological Services.

5.3.35 The Commission acknowledged with appreciation the active coordination role of the Secretariat on radio-frequency matters, including its participation in relevant ITU meetings and requested the Secretary-General to pursue and expand this coordination, including the required support to the new study group. The Commission also urged members to approach their national telecommunication administration to ensure that the importance of frequency bands allocated to meteorological activities was well understood, and to seek their support in the international arena; this coordination should also aim at the inclusion of meteorological experts in national delegations to relevant ITU meetings. The Commission stressed that these contacts should be undertaken as a continuing effort by the upper management of Meteorological Services, with a view to ensuring adequate credit and effectiveness.

FUTURE WORK PROGRAMME OF THE WORKING GROUP ON TELECOMMUNICATIONS

5.3.36 The Commission noted that at its thirteenth session, the Working Group on Telecommunications agreed on its future work programme and tasks allocated to the study groups.

5.4 DATA MANAGEMENT, INCLUDING CODES AND DATA REPRESENTATION (agenda item 5.4)

REPORT OF THE CHAIRMAN OF THE WORKING GROUP ON DATA MANAGEMENT

5.4.1 The Commission noted with appreciation the report of the chairman of the Working Group on Data Management, Dr G. B. Love (Australia) on the work accomplished by the working group, the Subgroup on Data Representation and Codes, and the expert task team developing the distributed databases concept.

GUIDE ON WORLD WEATHER WATCH DATA MANAGEMENT

5.4.2 As the *Guide on World Weather Watch Data Management* (WMO-No. 788) had already been printed and distributed, the Commission agreed that two instructional texts on the use of BUFR and GRIB should be published first as WWW Technical Documents and then should be considered for inclusion in the *Guide*.

5.4.3 The Commission called for the development of a data management plan for the basic systems. The plan should convey all the information needed by those groups served by the working group regarding the latter's plans and activities. The Commission decided that an integrated data management effort which cut across many programmes and disciplines was essential and invited the chairman of the Working Group on Data Management to prepare a draft of such a document to be presented at the eleventh session of the Commission.

WMO DISTRIBUTED DATABASES (DDB)

5.4.4 The scientific world was making increasing use of Internet and of other communication systems, which were providing users with access to a wide variety of data and products without the technical constraints germaine to today's GTS. If the basic systems were going to service effectively GCOS, GOOS and programmes aimed at improving weather forecasting, then use must be made of new powerful communications technologies.

5.4.5 In this context, the Commission re-emphasized the value of the Distributed Databases (DDBs) concept which was confirmed by a technical survey carried out among the members of the CBS working groups and the CCl Working Group on Climate Data, and agreed on its purpose as follows:

> "The DDBs are to meet the requirements for a system to provide data and information needed by WMO, and related international programmes but not routinely exchanged on the GTS."

5.4.6 The implementation of DDBs should proceed after a trial implementation had been undertaken at DDB volunteer centres, followed by more detailed implementation, until the long-term goal of a series of on-line databases accessible as a single database was reached. As a first step towards implementation, the Commission recommended that DDBs centres should develop file servers to provide access to data via the Internet. These facilities should provide:

(*a*) Sets of data files which could be down loaded using an appropriate file transfer mechanism (e.g. FTP);
(*b*) Files structured according to the type of data they contained;
(*c*) An information directory accessible at the top level of the directory structure;
(*d*) Optional facilities to transfer users to appropriate subdirectories;
(*e*) Files named according to agreed file naming conventions.

The development of distributed databases would be undertaken to expand the ability of all Members to make ad hoc requests for data held in databases of Members who were willing to share specific data. With the rapid development of Internet over the past three years, the world had seen a number of "prototype" distributed

databases. The Working Group on Data Management believed that, in order to enable all Members to participate, WMO's own communication system should be the basis of the distributed databases. Furthermore, recognizing that not all Members would have the same level of technology available, they should be able to make requests to databases via the GTS, and get their requests fulfilled through communication channels outside the GTS, such as through conventional mail.

5.4.7 The Commission, recognizing that the Working Group on Data Management could not, by itself, implement a system of DDBs, identified the following tasks which would need to be carried out by the Working Groups on Data Management, on Telecommunications, and on Data Processing:

(*a*) Working Group on Data Management:
  (i) Develop a logical model for the DDBs, which provided sufficient detail for other working groups to be able to implement the required functionality within their systems;
  (ii) Develop the necessary data representation standards to enable implementation of the logical model of the DDBs;

(*b*) Working Group on Telecommunications:
  (i) Develop a strategy for achieving "Internet-like" capability on the GTS;
  (ii) Implement the strategy between centres proposing to participate in the WMO DDBs;

(*c*) Working Group on Data Processing:
  Develop and implement the client/server functionality described in the logical model of the DDBs.

5.4.8 The Commission reviewed the principles and functions of the DDBs concept endorsed by the tenth session of the Commission and agreed that they were still valid. It, then, endorsed the guidelines for the implementation of the DDBs concept listed below:

(*a*) The DDBs should be globally coordinated and serve all WMO Members;
(*b*) The DDBs should provide a standard set of functions including the identification of the existence, location(s), accessibility and delivery of the data;
(*c*) The DDBs should conform to a set of implementation standards including request/reply mechanisms, request/reply content and transmission mechanism(s), and data representation;
(*d*) A method of ensuring conformity between DDBs and the above standards should be developed.

5.4.9 The Commission agreed that an appropriate five-year goal would be the development of a series of linked distributed databases. These systems could be implemented as a client/server process or as an interactive process accessed through remote log-in. The long-term goal would be a series of on-line systems accessible as if it were a single database.

MONITORING RESULTS

5.4.10 The 1993 monitoring results showed that about 73 per cent of the SYNOP and 64 per cent of TEMP reports expected from the RBSNs were available at MTN centres. The availability of SYNOP and TEMP reports remained relatively low in certain areas, in particular in Region I (45 and 27 per cent, respectively) and in Region III (50 and 26 per cent, respectively). Compared to 1992, there was a slight increase in the availability of SYNOP reports from all Regions (1 to 4 per cent), but also a slight decrease in the availability of TEMP reports from Regions II, III, V and VI.

5.4.11 The number of reports actually received at MTN centres were significantly less than expected according to *Weather Reporting* (WMO-No. 9), Volume A. These differences might reveal GTS deficiencies, but were also possibly due to deficiencies in the GOS. However, a detailed analysis had not been possible as very few centres had provided information on the actual observation programmes. It was recommended that Members should be invited to provide such information at the time of monitoring exercises, as well as to review and update the information contained in *Weather Reporting*, Volume A.

5.4.12 The Commission noted with satisfaction the preliminary results of the demonstration project to monitor the distribution of CLIMAT messages over the GTS. One part of the demonstration project was being focussed specifically on Region III and was attempting to monitor all the CLIMAT messages in the Region which were intended to be distributed over the GTS and received at World Data Centre A in Asheville, North Carolina, United States. Members of Regional Association III had provided information on all stations reporting CLIMAT and CLIMAT TEMP messages, and these lists had been compared with the information contained in *Weather Reporting*, Volume A. Serious discrepancies had been found. Tables had been drafted for each Member, marking the differences between this publication and each country's proposal; these might be used in any future revision of this publication. Even so, uncertainty remained about the data declared by some Members (one Member, for instance, had declared that all its stations issued CLIMAT TEMP messages). As a result of this task and by means of special software that had been developed, RTH Buenos Aires was now ready to perform a monthly automatic monitoring of the CLIMAT/CLIMAT TEMP traffic, at least with those NMCs directly linked to it. The results of this monthly test would be made available to the NMCs, to the climate analysis and data centres, and to WMO. In a second stage, an attempt would be made to include also the NMCs of RTH Maracay. The second part of the project was directed towards improving the exchange of climate monitoring products over the GTS.

COOPERATION WITH OTHER PROGRAMMES

5.4.13 The Commission expressed satisfaction with the coordination between the Working Group on Data Management and other WMO and related international Programmes. It endorsed the demonstration experiment for the exchange of climate products on the GTS for Regions I and III. The Commission further expressed satisfaction at the close cooperation with the

Intergovernmental Oceanographic Commission (IOC), the International Oceanographic Data Exchange (IODE) and the Group of Experts on the Technical Aspects and Data Exchange (TADE) and recommended that the WMO and IOC groups continue the joint development of data representation forms.

5.4.14 The Commission expressed satisfaction for the coordination that existed between GCOS and CBS data management planning; it supported the participation of the chairman of the Working Group on Data Management as a member of the GCOS Data Management Task Group, and recommended his continued participation to assist in achieving consistency between the GCOS plans and the data management practices of CBS.

5.4.15 The Commission reviewed the summary of the draft GCOS Data Management Plan, agreed that it was a good start, and recommended that, after the plan was approved by the Joint Scientific and Technical Committee for GCOS, further steps should be taken towards its implementation. It requested its Working Group on Data Management to continue to work closely with GCOS to ensure that WMO DDB's were developed with GCOS as well as with WWW requirements in mind. Furthermore, the Working Group on Data Management should use its restricted session, as approved by the forty-fifth session of the Executive Council, to review the GCOS Data Management Plan in detail and to develop specific plans on how the basic systems could contribute to its implementation. In this connection, it also requested its Working Group on Telecommunications to consider GCOS requirements when planning upgrades to the capabilities of the MTN of the GTS.

5.4.16 The Commission expressed satisfaction with the demonstration experiment for the exchange of climate products on the GTS. The experiment aimed at demonstrating the capability to exchange climate data on the GTS in various formats (alphanumeric, hand-drawn graphics and computer-produced graphics in GRIB) and make them available for use in near-real time. The Commission requested that it be informed of the results of this experiment at its next session.

5.4.17 The Commission noted with satisfaction that IOC was working actively with CBS in developing the BUFR code to include capabilities for all types of oceanographic data. The operational oceanographic community (e.g. through the Integrated Global Ocean Services System (IGOSS)/IODE) had accepted that BUFR should increasingly be used for their data exchange and ocean data management systems which were now being structured around it. Furthermore, the representative of the IOC stated that the oceanographic community had much to learn from the experience of CBS in developing the DDB concept, that there was increasing recognition of the value of integrated meteorological/oceanographic data management, and that IOC would, therefore, wish to continue to be closely involved in the ongoing work of the Working Group on Data Management.

DATA REPRESENTATION AND CODES

5.4.18 The Commission noted with appreciation the work of the Subgroup on Data Representation and Codes of the Working Group on Data Management and thanked the previous chairman, Dr J. Stackpole (United States), who retired recently, for his excellent leadership and contribution to the WWW system, in particular for his leading role in developing the binary data representation forms BUFR and GRIB.

5.4.19 The Commission endorsed the few additions that had been approved by its president during the intersessional period regarding new entries for radiosonde systems and clarification of definitions related to code form FM 71-X CLIMAT. It noted Recommendations 15 (CBS-93) and 16 (CBS-94), approved by its president and by the President of WMO, on binary data representation forms FM 92-IX Ext. GRIB and FM 94-IX Ext. BUFR tables (for corresponding recent additions to character codes, WAVEOB codes equivalences, storm surge and tide information, RADAR data, wind profiler data, ERS-1 data, and ozone data) for implementation on 2 November 1994.

5.4.20 Noting the successful experimental use of the representation of quality control information in BUFR, the Commission adopted Recommendation 6 (CBS-Ext.(94)) defining the necessary extensions to binary data representation form FM 94-X BUFR for implementation on 8 November 1995, as part of the third edition of BUFR.

5.4.21 The Commission considered the requirements expressed by the IOC and IGOSS, for reporting within the code form FM 63-IX BATHY information on probe, recorder type and equation used and for identifying other instrumentation used to collect temperature data. It adopted Recommendation 7 (CBS-Ext.(94)), amending FM 63-IX BATHY, for implementation as from 8 November 1995. The Commission noted that the IOC had stated the fact that it was absolutely essential that this amendment be adopted for implementation on the date proposed, as the new information to be included was critical for the future processing of subsurface temperature data within IGOSS/IODE and the Tropical Ocean and Global Atmosphere Programme (TOGA)/World Ocean Circulation Experiment (WOCE) as well as for following up research programmes, such as Climate Variability and Predictability (CLIVAR).

5.4.22 The Commission considered the requirement for the reporting of the location of the radiosonde or radiowind and the actual time of measurement at the standard levels, in view of the increasing resolution of NWP models and the emergence of four-dimension variational data assimilation schemes. It adopted Recommendation 8 (CBS-Ext.(94)) making it mandatory for the transmission in TEMP reports, Part B, section 7 of the two groups related to time of launch and type of radiosonde used, for implementation as from 8 November 1995.

5.4.23 The Commission considered the requirement to report synoptic observations from mobile land stations in support of environmental emergency monitoring needs and adopted, for that purpose, Recommendation 9 (CBS-Ext.(94)) defining the new code form FM 14-X Ext. SYNOP MOBIL, for use as from 8 November 1995.

5.4.24 Concerning the introduction of unique tables which would be referenced within all the code forms, and which would be listed in a new Part C of the *Manual on Codes*, the Commission adopted Recommendation 10 (CBS-Ext.(94)) for inclusion in the *Manual* and for implementation as from 8 November 1995.

5.4.25 The Commission noted with appreciation the progress made in developing a flexible character code called Character Form for the Representation and Exchange of Data (CREX).

5.4.26 It was noted that the CREX code would serve fundamental purposes, such as:

(*a*) To provide a character representation of data held in the BUFR data representation form for human readability (visualization function), by a simple and straightforward conversion mechanism;

(*b*) To provide a safe form for exchanging new data types (transport function) in alphanumeric form, which could not be represented in traditional character codes, and which would, otherwise, have required an additional "fixed structure" character code form;

(*c*) To provide a character representation of data which could be easily converted into, and from, the BUFR data representation (it would be relatively easy to develop the encoder/decoder software for CREX).

5.4.27 The Commission, noting that there was a requirement for a new character code to facilitate the exchange of ozone concentration measurement data, recommended that CREX, as described in Annex VIII to this report, be used on an experimental basis, in particular for the exchange of ozone data, as from 2 November 1994.

5.4.28 With regard to aeronautical meteorological codes (i.e. METAR, SPECI, TAF), the Commission noted that these codes had been revised by an expert group of CAeM (30 May–3 June 1994) based on the aeronautical requirements stated by ICAO. It was expected that these aeronautical codes would be reviewed by the tenth session of CAeM, to be held in October 1994. It was understood that the president of CBS would approve the resulting updates to the codes between the inter-sessional period, in time for their applicability date foreseen for 1996.

VALIDATION OF PROPOSALS FOR CHANGES TO CODES, DATA REPRESENTATION FORMS AND GTS PROCEDURES

5.4.29 The Commission received with appreciation the proposals made by the chairman of the Working Group on Data Management to put in place an agreed set of validation procedures to be completed before the Commission submitted its consideration of changes to WMO codes, data representation forms and GTS procedures to the eleventh session of CBS.

5.4.30 In reviewing the proposals the Commission noted that, in the past, changes to the WMO character codes, GTS bulletin header tables and the tables and regulations of the binary data representation forms had been approved by CBS without adequate testing by technical experts. As a consequence, in a small number of instances, this had caused substantial operational difficulties upon implementation, which had, at times, required modifications to be made to the CBS-approved changes.

5.4.31 The Commission agreed that the following procedures should be implemented on a trial basis with respect to proposed changes to WMO codes, data representation forms and GTS procedures:

(*a*) The need for, and the purpose of, all proposed changes should be fully documented;

(*b*) The proposed changes should be fully documented. This included not only a description of the proposed change, but also the results of non-operational testing of the changes;

(*c*) 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 Working Group on Data Management/Subgroup on Data Rpresentation and Codes with a view to verifying the technical specifications. For new or modified GTS procedures, proposed changes should be tested by at least two centres implementing them on an experimental basis and making the results available to the Working Group on Telecommunications with a view to consolidating and verifying the technical specifications;

(*d*) When changes were being submitted to CBS, they must be made available to all members three months prior to the next session of CBS;

(*e*) CBS might either approve or not approve, but not alter, the proposals for changes to WMO codes, data representation forms or GTS procedures which were brought before it;

(*f*) Members who, at a CBS session, opposed the approval of proposed changes to codes, data representation forms or GTS procedures should provide a written explanation, from their technical experts, of their reasons for not supporting the proposal, and, where possible, they should offer counter proposals for later consideration.

5.4.32 The Commission considered that these new procedures had the potential to encourage cooperation and consultation between members and ensure that recommendations for changes to the operational systems were prepared and tested in detail prior to presentation at CBS sessions. The Commission requested all its working groups to review these procedures comprehensively and commence trial implementations as soon as possible with a view to the preparation of appropriate recommendations for the eleventh session of CBS.

FUTURE WORK PROGRAMME

5.4.33 The Commission reviewed the proposals made by the Working Group on Data Management and concluded that the future work programme of the group should include close liaison with GCOS data management planning and the preparation of a basic system data management plan, the further development of the CREX table-driven character code, and the enhancement of the binary data representation forms to meet new needs and cooperative work with the Working Groups on Telecommunications and on Data Processing in order to move towards the implementation of the distributed databases concept within the basic system.

5.5 SATELLITE MATTERS (agenda item 5.5)

5.5.1 The Commission noted with appreciation the report of the chairman of the Working Group on Satellites, Dr P. Ryder (United Kingdom). Dr Ryder had been appointed to this position following the resignation of Dr T. Mohr (Germany). The Commission placed on record its gratitude for the outstanding contribution which Dr Mohr had made to the work of the Commission over a period of more than 20 years, especially as its vice-president and as chairman of the Working Group on the Global Observing System, in addition to his recent responsibility as chairman of the Working Group on Satellites.

5.5.2 The CBS Working Group on Satellites had met in Geneva in March 1994. The working group, in reviewing its terms of reference and tasks established at the tenth session of CBS, had identified groups of tasks that could best be undertaken by subgroups and rapporteurs. Subgroups had been established on Satellite Data, Products and Service Requirements, on Improvement of Satellite System Utilization and on Small Ground Stations. Rapporteurs had been established for Education and Training, for Satellite Soundings, for Cloud Track Winds, and for Monitoring, Archiving and Radio Frequency Allocation.

5.5.3 The Working Group on Satellites had maintained contact with the Coordinating Group for Meteorological Satellites (CGMS) and with the Committee for Earth Observation Satellites (CEOS) through both the chairman and the Secretariat.

5.5.4 The Commission noted that the workplan of the Subgroup on Satellite Data, Products and Service Requirements would lead to a critical review of WMO requirements for satellite data, products and allied services. The subgroup would liaise with the CBS Working Group on Observations to harmonize its statements with those being made in respect of the whole GOS. It was also confirmed that the subgroup would prepare suitable material for consideration by the Working Group on Observations for inclusion in the *Guide* and *Manual on the Global Observing System*.

5.5.5 The Commission noted that the critical review would be targeted upon the potential providers of satellite data, products and services with a view to providing an authoritative statement on behalf of all WMO Members. However, it also encouraged the involvement of individual users in the programme boards and other technical bodies of the satellite agencies, to further encourage a close match between what was needed and what was supplied.

5.5.6 The Commission learned of the objectives and workplan of the Subgroup to Improve Satellite System Utilization. It noted that these were targeted on application areas of great interest to CBS members, including NWP, nowcasting, classical weather forecasting and the provision of services to end users. In this connection, the Commission also noted the value of satellite data in temperature and humidity sounding, wind and rainfall intensity estimation, cloud detection and visualization of atmospheric processes. It welcomed the planned effort to improve WMO's capabilities to distribute high volumes of data and products and encouraged close liaison between the Working Group on Satellites and the Working Groups on Telecommunications and on Data Management to facilitate this. The Commission also encouraged efforts to gain real-time access to potentially useful data, preferably the BUFR code, from non-operational earth observing satellites, such as ERS-1 and 2, and from the Defence Meteorological Satellite Programme (DMSP) series. It further encouraged efforts to achieve compatible data transmission standards by operators, where possible.

5.5.7 The Commission welcomed the proposals of the Subgroup on Small Ground Stations, noting in particular that these were intended to guide and complement the efforts of the industry, and not to duplicate or compete with them. The Commission recommended that the planned system specification should encourage the adoption of an open system architecture to ensure that data captured by a ground station could be transferred to, and used by, workstations and other subsystems in the data processing chain.

5.5.8 The Commission was most concerned to learn from a 1992 survey that some 77 Members of WMO had no satellite reception facilities and endorsed the view that a low-cost ground reception facility should be developed with a view to ensuring that all Members had at least one satellite reception facility.

5.5.9 The Commission was briefed on the status of the new strategy for education and training in satellite matters, which had been approved, since the tenth session of CBS, by the forty-fifth session of the Executive Council. The working group had considered three major issues:

(*a*) The further refinement of the strategy approved by the forty-fifth session of the Executive Council in the light of consultation with satellite operators, with other WMO Programmes, and with other relevant organizations involved in satellite education and training matters;

(*b*) Assistance to the Executive Council Panel of Experts on Education and Training in identifying RMTC candidates at which Specialized Satellite Training Centres could be located;

(*c*) The preparation of a costed plan to implement the strategy for education and training.

5.5.10 The Commission noted that the strategy for education and training had been presented to the twenty-first session of CGMS, which was held in Beijing in 1993. The objectives of the strategy, including the objective of training the trainers, were explained at that session of CGMS including the proposal to establish six Specialized Satellite Training Centres at RMTCs. Concerning the proposal that each satellite operator adopted at least one centre, CGMS had agreed, in principle, with the strategy and was ready to discuss further the proposal with WMO. CGMS had suggested that WMO should identify further specific needs to aid potential CGMS supporters in evaluating resource requirements for such sponsorship, with proposed implementation dates.

5.5.11 The Commission expressed great appreciation for these efforts and several members, responsible for RMTCs (Argentina, China, Egypt, India, Kenya), offered to host such Specialized Satellite Training Centres. The representatives of the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and the United States confirmed that they were each actively considering the sponsorship of one or more of the centres. The Commission supported the idea of a trial project and expressed the hope that it would be well under way by the time of its next session.

5.5.12 The Commission endorsed the following proposals concerning satellite soundings:

Regarding the use of TIROS Operational Vertical Sounder (TOVS) data in climate studies:

(*a*) TOVS data (from 1978 to the present) represented a unique source of information for climate studies. It was important that the archive of Level 1B data at full resolution be maintained and made accessible for use in these studies. Access to long-period, global TOVS data sets remained a significant impediment to climate studies at many institutes. A policy of open access to data at reasonable cost should be encouraged. It was also important that appropriate "housekeeping" information accompanied the Level 1B data, to make the processing to this level reversible (as far as possible) and to allow correction for instrument drifts, etc.;

(*b*) Operational centres were encouraged to include the generation of products for climate studies from TOVS (and other environmental satellite) data in their real-time processing;

Regarding the use of TOVS data in Numerical Weather Prediction (NWP):

(*c*) To enable continued operational use of satellite sounder and imager data in local and regional NWP models, real-time direct-broadcast data were required. Present plans of the National Oceanic and Atmospheric Administration (NOAA), EUMETSAT and the National Aeronautics and Space Administration (NASA) to continue direct broadcast of such data were strongly encouraged;

(*d*) With the anticipated wider use of global satellite radiances at NWP centres, the present limited bandwidth of much of the GTS would prevent their full utilization. Increased bandwidth was required to accommodate these data;

(*e*) Providers of sounding products, including — but not limited to — brightness temperatures and temperature/humidity profiles, should supply users with the expected error characteristics (biases and covariances) of their products;

Regarding preparations for Advanced TIROS Operational Vertical Sounder (ATOVS) data:

(*f*) The plans of NOAA and EUMETSAT to collaborate on the production of an "international ATOVS processing package" (including ingest modules) were noted and welcomed. Full international availability of the source code was highly desirable. Support for the development and maintenance of such software was recognized as an important issue requiring long-term funding by WMO Members;

(*g*) Increased international activity was required on the science of ATOVS data pre-processing and retrieval to produce algorithms of high quality and to exploit these data fully. The revised schedule for the launch of NOAA-K (currently planned for 1995) represented a significant problem in terms of the readiness of the user community to use the full data stream immediately after launch because of a possible software delivery delay;

Regarding future systems:

(*h*) For future operational sounding and imaging instruments, it was desirable that common meteorological requirements and compatible instrument specifications and data formats be developed;

(*i*) There was an urgent need for an operational infrared sounder of high spectral resolution, along with complementary imaging, microwave sounding instruments and wind lidar. Satellite agencies were strongly encouraged to develop plans to implement such systems;

(*j*) Full exploitation of advanced sounder data would require improvements in atmospheric transmittance modelling. The development and validation activities of the International Radiation Committee (IRC) Working Group on the Inter-comparison of Transmittance and Radiance Algorithms (ITRA), in collaboration with the International TOVS Working Group (ITWG), were endorsed;

Regarding education and training:

(*k*) With the rapid and continuing growth in the user community for satellite sounding data, there was a growing need for coordinated international training programmes. The offer of ITWG to help with appropriate workshops and training sessions was noted.

5.5.13 The Commission further expressed the wish that ATOVS data be made available in BUFR data representation form.

5.5.14 The Commission noted the present status of monitoring of satellite data within WMO and the fact

that the global monitoring of the WWW operation covered adequately SYNOP, TEMP CLIMAT, AIREP and SHIP reports but did not consider satellite-derived data encoded in such forms as SATOB, SATEM or SARAD. Consequently, no reference was made either to the quality or to the availability of satellite data in the part dealing with the annual global monitoring of the operation of the WWW under agenda item 5 of the abridged final report of the tenth session of CBS.

5.5.15 The Commission believed that the appropriate annual monitoring of satellite data was necessary and suggested that:

(*a*) Nominated monitoring centres should be encouraged to consolidate and expand their monitoring activities considering that new products (for example radiances from sounding instruments distributed on the GTS) would become more important in the future. Modifications that could be implemented included the production of bias and root-mean-square statistics, monitoring of radiances from sounding instruments, monitoring of sea-surface temperature (SST), and the presentation of long-term monitoring results;

(*b*) Data encoded in the SATEM, SATOB and SARAD forms should be included in the annual monitoring of the operation of the WWW;

(*c*) Monitoring the quality of the calibration and navigation of radiances from sounding and imaging instruments should be performed;

(*d*) New standards for the monitoring of satellite data should be developed and should be flexible enough to cover data from new instruments or satellites, e.g., scatterometer data, and should not only include data in the WWW but also from the climatological programmes.

5.5.16 The Commission was informed of the current activities of WMC Washington as the lead centre for monitoring satellite data. The United States expressed the willingness to work with other monitoring centres recommended by the Commission.

5.5.17 The Commission endorsed the activities of the Working Group on Satellites, in consultation with the Working Group on Data Management, in assisting members to meet their needs for archived satellite data and products efficiently and effectively. It agreed that this was an increasingly important problem for members. It noted that many new uses for such information — in climate and environmental studies — were emerging, that the optimum source and availability of information was uncertain and that the required volume of data and, hence, resource requirements were high. Noting the high cost of archiving satellite data, the Commission requested the working group to develop proposals for minimizing such costs, involving the satellite operators, as appropriate.

5.5.18 The Commission endorsed the working group's proposal to participate, through a rapporteur, in the activities of a study group on radio-frequency coordination being set up by the CBS Working Group on Telecommunications. In this connection, it was noted that a master list of frequencies necessary for present and planned remote sensing satellite instruments, using microwave frequencies, was being prepared.

5.5.19 The Commission was advised that the emerging results from the recently launched GOES-8 satellite were of excellent quality and were expected to be available operationally during October 1994. It was also announced that NOAA-J would be launched in December 1994 and that a new policy for the development and operation of future polar orbiting satellites had been approved. This was designed to meet national needs from a single constellation of satellites and to seek international involvement in the programme.

5.5.20 Several members sought clarification of the recently announced EUMETSAT data policy and were advised by its representative that a new series of briefings would be made widely available shortly.

5.5.21 Concern was expressed at the unavailability of geostationary satellite data in the vicinity of 70°E. In this regard, the limited availability of basic data from the Indian INSAT-II satellite and the postponement of the Russian Federation GOMS satellite were noted. The Commission was informed that the GOMS satellite was planned to be launched by the end of 1994. India indicated that, due to technical limitations, only some of the products derived from the INSAT-II were available for exchange on a bilateral basis. The EUMETSAT representative indicated that, at present, his Organization did not have a spare Meteosat satellite to serve better this region of the globe, noting that it was providing a backup service to the west of the meridian. The Commission encouraged all members to make the maximum amount of satellite data available to other members.

5.5.22 The issues of using the same satellite identifier in character and binary representation forms and of using different identifiers for different satellites should be referred to the relevant CBS working groups, as appropriate.

5.6 SYSTEMS SUPPORT (agenda item 5.6)

5.6.1 The Commission noted with appreciation that the conclusions and recommendations contained in the final reports of the OWSE-Africa had been reviewed by all its working groups. The recommendations covered performance specifications, installation programmes, systems support and management at national and regional levels, training and maintenance aspects as well as the application of WMO operational procedures, interfaces with operational systems, budgetary aspects and coordination with the satellite operators. The implementation of these recommendations required carefully coordinated efforts by RA I member countries, donors, manufacturers and the WMO Secretariat.

5.6.2 The Commission took note of the follow-up actions to OWSE-Africa:

(*a*) The data collection platform (DCP)/DCP data relay system (DRS)/MDD systems had been carried over to operational use;

(*b*) Arrangements were made through the Voluntary Cooperation Programme (VCP) fund, regular budget

and coordinated actions between donors, recipients, and manufacturers to provide spare parts and software to bring faulty systems back into operation;

(c) A training course for local technicians was held at Nairobi and Khartoum in November/December 1993. After the training course, three stations in participating countries resumed their operation.

The Commission invited supporting and operating countries, equipment manufacturers, and the Secretariat to consider further coordinated actions aiming at the restoration of existing faulty equipment, particularly DCPs, where feasible and cost-effective.

5.6.3 The Commission noted with interest that RSMC/RTH Nairobi had been designated as the Centralized Monitoring Centre for DCP and MDD operation. To support the establishment of these monitoring functions, an MDD system, which had been in use at the WMO Headquarters for the OWSE-Africa, and three personal computers were transferred to RSMC/RTH Nairobi.

5.6.4 The Commission believed that the DCP and MDD systems had the potential for major improvement of the exchange of observational data from, and of the availability of data and products in, Region I. The Commission recommended to RA I and its member countries to proceed with the implementation of DCP and MDD equipment as an integrated part of the WWW systems, taking into account the conclusions and recommendations of OWSE-Africa, and relevant guidelines developed by the CBS working groups. It expressed its appreciation and thanks for the considerable and continuing support provided by donor countries.

5.6.5 The Commission emphasized the importance of appropriate follow-up action directed at an effective and efficient integration of DCP and MDD systems in the WWW, especially with regard to equipment specifications, training activities, national and regional management, and operational arrangements.

5.6.6 The Commission recognized that during the implementation period of DCP and MDD systems, a strongly coordinated approach would be necessary for the effective management of the systems. The Commission, hence, recommended that a broad-based procurement, training, and installation programme should be developed. This effort should involve equipment manufacturers, satellite operators, supporting and operating countries, and the WMO Secretariat.

WWW Operational Information Service (OIS)

5.6.7 The Commission reaffirmed that an efficient WWW Operational Information Service (OIS) was an essential support function of the WWW, which would have an increasing importance in the framework of services provided by the WWW system to other WMO and international Programmes.

5.6.8 The Commission agreed that improvements were necessary in order for the OIS to provide comprehensive and accurate information in a timely manner so as to increase the benefits that could be drawn from the service. The short-term requirement was to provide information in a computer format and media (e.g. data file on diskette) with a view to facilitating its use for operational purposes by WWW centres and users, although a printed version would still be needed for some time. Arrangements should also be made to facilitate the more timely updating of information by Members, and its handling by the Secretariat. A longer-term objective should be to provide interactive access services. The Commission recalled that, at its tenth session, it already had agreed upon an improved catalogue of meteorological bulletins which would be maintained as a database, and recommended that routeing catalogues of RTHs on diskette should be made available to WWW centres. It noted, with appreciation, that several RTHs were providing this service.

5.6.9 The Commission welcomed the proposed study on the improvement of the OIS, which would be carried out by the Secretariat. The study was expected to result in the development of an upgraded service that would build on DDB functions and better meet the needs of WWW users and those of other programmes, such as GCOS and GOOS. The Commission noted, with great appreciation, that several of its members indicated their willingness to provide technical assistance to the Secretariat for this project, with a view to gaining benefit from the experience gained in their own centres.

5.6.10 The Commission urged all members to provide updated information related to *Weather Reporting* (WMO-No. 9) in a timely manner, in compliance with the agreed format, with a view to ensuring its distribution. It stressed again the importance of this information, in particular for validating monitoring results.

6. Demonstration of the Capabilities of Regional Specialized Meteorological Centres (RSMCs) (agenda item 6)

Designation of RSMCs with activity specialization

6.1 The Commission noted the report of RA V that there was a requirement for specialized transport/dispersion/deposition model products to be made available to members in the Region and the IAEA in case of a nuclear accident or other environmental emergencies. It noted the recommendation of RA V that steps be taken leading to the designation of the GDPS centre in Melbourne as RSMC with activity specialization on the provision of transport model products. The Commission was informed of the formal commitment of Australia that its centre would fulfil the functions of an RSMC on the provision of transport model products. The Commission also appreciated the presentations made at the session of the capabilities of the centre. It noted the capability of the centre to generate and make available operationally, upon request, the required products in the event of an accident, and agreed that the relevant provisions of the designation procedures had been fulfilled by the centre. The Commission, therefore, recommended the designation of the GDPS centre in Melbourne as RSMC with activity specialization on the provision of

transport model products for environmental emergency response. The Commission adopted Recommendation 11 (CBS-Ext.(94)).

6.2 The Commission noted the request of Eleventh Congress that the recommendation of RA V on the designation of Nadi, Fiji as an RSMC with activity specialization in tropical cyclones should be given early consideration. The Commission received with appreciation, and in accordance with the provisions of Attachment I.2 of the *Manual on the GDPS*, the formal commitment of Fiji to fulfil the functions of an RSMC in tropical cyclones for the South-west Pacific. Following a presentation on the capabilities of the centre, the Commission noted the modest but significant levels of implementation of the operational and scientific capabilities reached by the centre and the plans to develop further these capabilities. The Commission urged Fiji, as a matter of urgency, to implement the planned communications upgrade to Melbourne in order to access and use NWP product guidance and to upgrade their access to, and use of, high resolution satellite imagery, particularly from the GOES satellite. The Commission noted that the centre was already carrying out most of the required functions and agreed that the relevant provisions of the designation procedures had been fulfilled by the centre and recommended the designation of Nadi, Fiji as an RSMC on tropical cyclones provided the communications upgrade to Melbourne was implemented. The Commission invited its president to consult with the president of RA V concerning the state of implementation of the telecommunication upgrade to Melbourne, and to inform the forty-seventh session of the Executive Council accordingly. The Commission requested that Fiji provide a progress report on the above upgrades to the eleventh session of CBS. It adopted Recommendation 12 (CBS-Ext.(94)) on the designation of an RSMC on tropical cyclones.

7. REQUIREMENTS FOR THE INTERNATIONAL EXCHANGE OF DATA AND PRODUCTS (agenda item 7)

7.1 The Commission noted with considerable satisfaction the activities undertaken by the president of the Commission, by the Advisory Working Group, and by the Secretariat in preparing the CBS response to Resolution 20 (EC-XLV) which had, *inter alia*, requested the Commission to "examine urgently, in consultation with other technical commissions concerned, the content and scope of the data and products required for WMO Members' current and future requirements".

7.2 The Commission also took the guidance of the forty-sixth session of the Executive Council, which, by its Resolution 20 (EC-XLVI) urged Members to "strengthen their commitment to free and unrestricted exchange of meteorological and related data and products" and to "provide to the research and education communities free and unrestricted access to data and products for their non-commercial activities".

7.3 The Commission examined in detail a draft Report on the Exchange of Data and Products for all WMO Programmes. In this regard, CBS noted the need to increase the flow of free and unrestricted data and products to developing countries for their use in carrying out WMO Programmes. The Commission endorsed the approach taken by the Secretariat in the report which was to assume that, at least as far as WWW was concerned, most of the Members' requirements were reflected in the WWW *Manuals on the GOS, on the GTS,* and *on the GDPS* and in *Weather Reporting* (WMO-No. 9). It was recognized, however, that additional requirements might exist which were not yet incorporated in the appropriate *Manuals* and that some attempt had to be made to identify future requirements. The Commission agreed that a certain amount of information of this type could be gleaned from the *Third,* and draft *Fourth WMO Long-term Plans.* It was also agreed that the final version of the listing of observational data requirements should include information on frequency, and vertical and horizontal spacing, as approved under agenda item 5.1 and that the list of products should include, where possible, the product identifier, temporal and spatial resolution and geographical coverage. The Commission urged Members to provide the information required for the listings and requested the Secretariat to complete a consolidated report.

7.4 Considering the requirement to involve the other technical commissions in examining the content and scope of the data and products required to meet Members' current and future needs in support of all WMO Programmes, the Commission agreed that the presidents of the WMO technical commissions be invited to nominate representatives to an intercommission task team on data and product requirements. The Commission proposed that the terms of reference for the intercommission task team (see Annex IX to this report) should be finalized by the presidents of technical commissions and that they should jointly consider having an appropriate geographical balance, involving representatives of developing and developed countries, when nominating members to the task team.

7.5 The Commission requested that the task team should address the issues with all urgency in order to ensure that preliminary recommendations were provided to the president of CBS for inclusion in his report to Twelfth Congress. In this connection, it was noted that as part of a project conducted by the Executive Council Working Group on the Commercialization of Meteorological and Hydrological Services (WGCOM), eight Members[1] had completed detailed tables on data and products actually being disseminated from their country and had requested that all information assembled in this project should be made available to the task team in carrying out its work.

---

[1] Argentina, Australia, Chile, Côte d'Ivoire, France, Russia, Spain and United Kingdom.

7.6 The Commission, while considering the requests made by the forty-sixth session of the Executive Council regarding implementation of the proposed new practice for the exchange of meteorological and related data and products, recognized that many related technical issues had to be addressed, as discussed below. It felt that progress could be made in spite of the concern it expressed on the availability of adequate resources and time to complete the requested tasks.

7.7 In order to deal with those issues within the scope of CBS, the Commission decided to form a CBS Expert Group on the Exchange of Data and Products. It, therefore, adopted Resolution 2 (CBS-Ext.(94)).

7.8 The CBS expert group, as a priority, would develop and provide information and recommendations on the technical impacts of implementing the proposed new practice for input to the third session of the WGCOM and to Twelfth Congress. To this end, comments on the Draft Guidelines for Members to Use in Defining Tiers 1 and 2, for the third session of the WGCOM, should be developed by correspondence among the expert group members and should be communicated to the WGCOM by the president. These comments should take into account all relevant information, including that assembled in the project referred to in paragraph 7.5 above.

7.9 Furthermore, it was recommended that the CBS expert group should meet at least once before Twelfth Congress. The group would report to the president of CBS who would forward its findings, including the qualitative estimates of technical costs to Members for implementing the proposed new practice, to Twelfth Congress, and to the WGCOM, as available. The Commission requested that the expert group address the issues with all urgency. Reports on full studies of the issues would be communicated to the WGCOM and to Members as they were completed.

7.10 Another aspect of the WGCOM project referred to in paragraphs 7.5 and 7.8 above was the examination by participating Members of "their experiences in interpreting and assessing the ease of use of the draft guidelines" and their report on the results of applying the proposed criterion and guidelines to the data and products which they were making available on the GTS. The Commission was informed that the participants generally found the guidelines to be understandable, applicable and consistent with WMO's intention to broaden and enhance the international exchange of meteorological and related data and products. The Commission noted that comprehensive estimates of the costs of implementation were not available and proposed that the WGCOM should seek information on costs from the participants in the original project and provide this information to the CBS expert group.

7.11 The Commission recognized that WMO was in the process of making significant changes with a proposed new practice for the exchange of data and products. Some members were firmly opposed to any restrictions on the exchange of data and products believing that such restrictions might lead to further reductions in data and to an increase in unmet needs. Other members indicated that the only restriction introduced by the proposed new practice, compared with the existing practice, was the control on the re-exportation of data for commercial purposes[2]. Those members also noted that the volume of data and products being exchanged under the current practice was already decreasing, that Members' needs were not being met, and that they fully supported the proposed new practice as a means of preventing further reductions and with its potential to enhance the volume exchanged.

7.12 The Commission was also advised that modifications to the current data exchange practice were required to ensure that free and unrestricted exchange of data and products continued among Members with different expectations for the funding of their Meteorological and Hydrological Services. Some Members were sustaining WWW and other WMO Programmes wholly from public funds (tax revenues), while others required contributions from the beneficiaries of meteorological and related services for the support of such activities.

7.13 Noting the urgency of the request that CBS convey to the WGCOM its views on the technical feasibility of applying the guidelines, as a preliminary step, the Commission agreed that this issue should be studied by the forthcoming joint Implementation Coordination Meeting on the MTN, Telecommunications and Data Management, which was planned for the end of 1994 and that the information from the coordination meeting should be made available to the CBS Expert Group on the Exchange of Data and Products. Furthermore, both the Draft Report on the Exchange of Data and Products prepared by the Secretariat as well as the information from the WGCOM project on interpreting and assessing the ease of use of the draft guidelines should be made available for the joint GTS coordination meeting as well as to the CBS expert group.

7.14 The Commission supported the views already expressed by the Working Group on Telecommunications and the Advisory Working Group to the effect that, as the GTS would continue for many years to be a mix of telecommunication technologies and systems, only limited capabilities were available for controlling traffic on the GTS. The implementation of the proposed new practice would depend largely on the goodwill of Members, it being understood also that any limitation to the distribution of Tier 2 data could not be expected to be applied where existing technology restricted a Member's ability to apply them (e.g. with radiofacsimile broadcasts).

7.15 The responsibilities of CBS in relation to the technical and the policy issues surrounding the proposed new practice were discussed. The dividing line between the two types of issues could not be conclusively

---

[2] Extract from Resolution 21 (EC-XLVI), Annex I "Tier 2 data and products will be made available without charge but only on the condition that they are not re-exported for commercial purposes, directly or subsequently, from the territory of a Member or of a group of Members forming a single legal territory, by the receiving Member."

determined, but it was agreed that CBS's major responsibility was to provide technical recommendations to the Executive Council, through the WGCOM, and to Congress, which were the bodies responsible for policy issues.

7.16 The Commission was unanimous in its desire that the most important goal for the proposed new practice, in the spirit of the WMO Convention, should be to improve the data and product exchange practices to meet Members' needs. However, a number of differing views on the impacts of implementing the proposed new practice were expressed:

(*a*) **Goal**: To increase data and product availability to meet Members' requirements.
Issue: Some CBS members viewed the proposed new practice as a mechanism that would offer a positive stimulus so that more data and products would be made available for distribution among Members to be used in WMO Programmes. Other members felt that the controlled re-exportation of Tier 2 data for commercial purposes as well as the process, itself, of introducing any restrictions — no matter how limited their intended scope was — would place a constraint on the availability of data and products for Members' use in meeting WMO Programme requirements;

(*b*) **Goal**: To provide sufficient information for Twelfth Congress to take a decision.
Issue: Some members felt that a comprehensive assessment of impacts, including costs, should be documented and presented to Twelfth Congress. Other members felt that sufficient information would be available from WGCOM and other bodies to allow Twelfth Congress to take a decision to start the implementation of the proposed new practice;

(*c*) **Goal**: To minimize any negative financial impact to Members in implementing the proposed new practice.
Issue: On the basis of the WGCOM pilot project involving eight Members, some members concluded that the financial impacts of the operational implementation of the proposed new practice would not be heavier than those associated with other technical changes recommended by the Commission, e.g. code changes. Other members felt that insufficient data and analyses would be available to estimate the magnitude of increases in costs, particularly with respect to the new communication technology expected to be available in the next decade;

(*d*) **Goal**: To maximize the availability of environmental satellite information to Members.
Issue: Some members felt that the controlled re-exportation of Tier 2 data would, eventually, cause satellite operators to limit high resolution satellite data particularly in data-sparse areas such as the oceanic environment. Other members felt that the availability of satellite data would increase because of added protection from the proposed new practice, which satellite operators would be requested to reflect within their own policies;

(*e*) **Goal**: To continue the current communication and data management systems and procedures.
Issue: Some members felt that the experience gained from the pilot project indicated that administrative arrangements would be straightforward to implement. Other members felt that maintaining two different communication streams and managing properly authorized access would be complex and would require considerable administrative resources;

(*f*) **Goal**: To increase the availability of data and products to developing countries. In this regard, the Commission was convinced that communication and data-processing technology in developing countries should be enhanced to ensure their ability to have access to data and products.
Issue: Some members were convinced that the proposed new practice would, in fact, increase the availability of data to developing countries for WMO Programmes due to the protection offered by the proposed new practice. Other members felt that the proposed new practice would restrict the data needed for studies and for decisions related to sustainable development, particularly as they applied to the regional management of environmental quality and energy use.

7.17 The Commission also agreed that if the proposed new practice was implemented, then:

(*a*) Members should provide assistance to those Members experiencing difficulty in implementing the proposed new practice;

(*b*) Members should increase the range and content of data and products available for exchange under the proposed new practice, given the protection of Tier 2;

(*c*) Goals for implementing the proposed new practice should include:
  (i) Minimizing the complexity of communications and databases needed to deal with it so that Members and the WMO Secretariat were not faced with inordinate costs;
  (ii) Making more data available to Members for WMO Programmes, subject to the availability of the necessary technological means;

(*d*) Aircraft reports should be included in the minimum set of Tier 1 data, given that harm was not expected from their re-exportation.

7.18 The Commission requested the president of CBS to include in his report to the third session of WGCOM information on the formation of the Intercommission Task Team on Data and Product Requirements and on the CBS Expert Group on the Exchange of Data and Products and their terms of reference as well as any preliminary information available on the work of the expert group.

7.19 The Commission also proposed that the WGCOM:

(*a*) Investigate further and explain the benefits to implementing the decision by Twelfth Congress regarding data and product exchange;

(*b*) Invite the participants in the original WGCOM project to comment on the costs which would be associated with implementing the proposed new practice. This information should be provided to the expert group for use in its work.

7.20 The Commission requested all of its working groups to examine carefully the implications of the proposed new practice and to provide relevant information to the CBS Expert Group on the Exchange of Data and Products.

7.21 The Commission agreed that its report to Twelfth Congress should include all relevant information, including the formation of the intercommission task team, the CBS expert group, their terms of reference and the timetables established for implementing the technical aspects of the proposed new practice.

8. PUBLIC WEATHER SERVICES (PWS) (agenda item 8)

8.1 The Commission considered the report of the Expert Meeting on Public Weather Services, which was held in March 1994, including, the proposed text for the *Fourth WMO Long-term Plan (4LTP)* for this programme. All those who had participated in the group were commended for their excellent work and for making a very significant step forward in the development of this programme. The Commission was in broad agreement with the approach taken, with the recommendations, and with the proposed text for the *4LTP* which had been reviewed and amended by the Advisory Working Group.

8.2 With a few suggested additions, the Commission agreed with the proposed framework for the *Guide on Public Weather Service Practices* (see Annex X to this report). However, as this would take several years to complete, it suggested that high priority be given to producing, as soon as possible, at least partial or preliminary guidance material — possibly as WWW technical reports. This could be based on available information rather than on a survey among Members, which might not be required at the present time. Coordination with the relevant activities of other technical commissions and programmes would be necessary, for example, in the areas of climate and the environment.

8.3 Noting the proposal to foster a common approach on the format, presentation and dissemination of public weather information and forecasts, the Commission emphasized that conditions, needs and capabilities differed widely from country to country and that it was up to each one to do what was best in its own particular circumstances given full information and advice on what could be done. The Commission placed particular emphasis on the recommendation of the expert meeting to study and make proposals on the question of potential conflict and on the need for cooperation between national Meteorological and Hydrological Services (NMHSs) and private international broadcasters. In this regard, the Commission sought an analysis of the situation and an investigation on the possibility of coordination and referral of forecasts and warnings. It also hoped that a "best practice" would emerge which could be used by Members in securing such cooperation.

8.4 The Commission noted with satisfaction that the draft *4LTP* called for a number of activities in the area of education and training in the PWS and stressed the importance of this aspect of the programme in which the RMTCs could play a role. In this connection, it was noted with appreciation that two seminars on the subject of TV presentations of weather information were already planned to be held in Africa and Asia.

8.5 The Commission noted the relationship of the PWS to the objectives of the International Decade for Natural Disaster Reduction (IDNDR) and the contribution that the programme could make to meeting these objectives. It was also suggested that, in addition to weather forecasts, information on the effects of the weather on day-to-day activities should be part of the services to the public, especially in urban areas. The Commission also stressed the need to address the issue of warnings related to mesoscale severe weather phenomena that were particular to certain geographical areas and which might affect more than one country.

8.6 The Commission fully supported the proposal that further work on this programme should be continued, at least until the eleventh session of CBS, by a group of experts volunteered among interested members, supported by the Secretariat, and coordinated by a member of the Advisory Working Group, Dr H. Yan (China). It was agreed that discussion of an appropriate organizational mechanism for carrying out the work related to the PWS should be deferred until further progress could be evaluated at the next full session of the Commission.

8.7 The Commission paid particular attention to the comments and guidance of the Executive Council as regarded the PWS. It requested all of the CBS working groups to coordinate their activities related to the PWS. It was noted that the Executive Committee had encouraged the involvement of regional associations Working Groups on the WWW in the programme, particularly with respect to the preparation of guidance material that was relevant to their respective regions, that it had called for studies on the problem of the proliferation of public forecasts from different sources, and that CBS had been requested to assist in the preparation of material for World Meteorological Day 1995, the theme of which was to be Public Weather Services.

9. CONSIDERATION OF THE *FOURTH WMO LONG-TERM PLAN* (agenda item 9)

9.1 The Commission examined the draft *Fourth WMO Long-term Plan*, Part II, Volume 1 — The World Weather Watch Programme, together with the comments and proposals of the Executive Council. It was noted that all the working groups of the Commission had had the opportunity to comment on the draft and that the resulting proposed amendments were either to be incorporated by the Secretariat as editorial changes or had been taken into account by the Executive Council in formulating its comments and proposals.

9.2 The Commission endorsed, in general terms, the draft of Part II, Volume 1, including the comments and suggestions formulated by its working groups, which had been considered by the Executive Council. The Commission agreed that Part II, Volume 1, should highlight Public Weather Services and should include a cross-reference to Part, II, Volume 4. The Commission also made a few comments of an editorial nature, which would be included in the revised draft by the Secretariat.

9.3 Several members seriously questioned the utility of Part II, Volume 1 in its present form, taking into account the cost of its preparation and publication, and the critical financial situation of the Organization. The Commission noted that the question was addressed by the forty-sixth session of the Executive Council, which recommended that the matter be reviewed comprehensively by Twelfth Congress.

10. SCIENTIFC LECTURES (agenda item 10)

10.1 The vice-president of CBS, Mr S. Mildner, introduced the two distinguished experts who had been invited to deliver the following lectures:

Lessons learned from an experimental network of atmospheric wind profilers in the United States
(Mr T. W. Schlatter, National Oceanic and Atmospheric Administration Forecast Systems Laboratory, United States)

Observing system studies and the sensitivity of forecast error to initial data
(Dr A. Hollingsworth, European Centre for Medium Range Weather Forecasts, United Kingdom).

Each lecture was followed by a lively discussion.

10.2 The Commission thanked the experts for their excellent presentations, which had contained a wealth of information directly relevant to the work of the Commission.

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

11.1 In accordance with established practice, the Commission examined those resolutions and recommendations of the Commission adopted prior to its extraordinary session, which were still in force.

11.2 As regarded the previous resolutions of the Commission, it was agreed that the implementation of Resolution 1 (CBS-X) had been completed and that Resolution 9 (CBS-X) should be replaced by a new resolution. Resolutions 2 to 8 (CBS-X) concerning the establishment of working groups and a rapporteur should remain in force. It was further agreed that action on previous recommendations, most of which concerned amendments to manuals, had been completed, but that Recommendation 1 (CBS-X) proposing revised terms of reference for the Commission should remain in force until approved by Twelfth Congress. Resolution 3 (CBS-Ext.(94)) was adopted.

11.3 The Commission also examined the resolutions of the Executive Council based upon recommendations of CBS or related to the WWW and concluded that Resolutions 1 and 2 (EC-XXXVI) and 5 (EC-XLII) should remain in force. It was agreed that Resolution 16 (EC-XLIII) concerning environmental emergency response should be updated in a new resolution. Recommendation 13 (CBS-Ext.(94)) was adopted.

12. DATE AND PLACE OF THE ELEVENTH SESSION OF THE COMMISSION (agenda item 12)

The delegate of Egypt informed the Commission that his Government wished to invite the Commission to hold its eleventh session in Cairo some time during the fourth quarter of 1996. In noting with appreciation this generous offer to provide host facilities, the Commission requested its president and the Secretary-General, in consultation with the Government of Egypt, to make the necessary arrangements. The Commission was also informed that the provisional reservation for its eleventh session made at the Geneva International Conference Centre from 4 to 15 November 1996 would be retained until other arrangements had been finalized.

13. CLOSURE OF THE SESSION (agenda item 13)

13.1 In his closing address, the president of the Commission, Dr A. A. Vasiliev, reviewed the work of the extraordinary session which, he felt, had been highly successful and had been conducted in an excellent spirit of cooperation despite the complexity and sensitivity of some of the issues under consideration. He thanked the participants for their valuable contributions and hard work, which had allowed the Commission to achieve much in a relatively short time. He thanked all those who had contributed to the smooth running of the session, particularly the chairmen of the working committee and the members of the various subgroups. He expressed his appreciation for the highly efficient work of the WMO and local secretariats.

13.2 On behalf of the Commission and the participants, the president extended a special thanks to the Government of Finland and to the Finnish Meteorological Institute for the use of the excellent facilities and especially for their most generous hospitality. He was sure that all delegates had had an extremely pleasant and memorable stay in Helsinki.

13.3 After Dr Vasiliev received expressions of appreciation for his very efficient conduct of the session, the extraordinary session of the Commission for Basic Systems closed at 1 p.m. on Thursday, 18 August 1994.

RESOLUTIONS ADOPTED BY THE SESSION

RESOLUTION 1 (CBS-Ext.(94))

TASK TEAM ON DATA REQUIREMENTS FOR ENVIRONMENTAL EMERGENCY RESPONSE ACTIVITIES

THE COMMISSION FOR BASIC SYSTEMS,

NOTING Resolution 6 (XI-RA VI) — Data requirements for emergency response activities,

CONSIDERING that:

(1) There is a need to review and update observational data, including event-related information required from RA VI in transport model applications related to nuclear emergencies,

(2) There is a need to review requirements, procedures and facilities needed to generate and exchange such observational data,

DECIDES:

(1) To establish a Task Team on Data Requirements for Environmental Emergency Response Activities with the following terms of reference:

(*a*) To review and update observational data, including event-related information required from Regional Association VI for transport model applications related to nuclear emergencies;

(*b*) To review the procedures and facilities needed to generate and exchange such observational data;

(*c*) To liaise with the designated RSMCs and the relevant working groups of CBS;

(*d*) On the basis of the above, to prepare guidance for Members on their responsibilities in support of environmental emergency response activities;

(*e*) To submit a report to the president of CBS as a matter of urgency (not later than 31 January 1995);

(2) That the composition of the Task Team on Data Requirements for Environmental Emergency Response Activities shall be as follows:

Chairman of the CBS Working Group on Observations (chairman)
one expert from Belarus
one expert from Finland
one expert from France
one expert from Germany
one expert from Ukraine
one expert from United Kingdom
one expert from the International Atomic Energy Agency or other national or international agencies concerned with the response to nuclear emergencies.

RESOLUTION 2 (CBS-Ext.(94))

CBS EXPERT GROUP ON THE EXCHANGE OF DATA AND PRODUCTS

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 21 (EC-XLVI) — Proposed new practice for the exchange of meteorological and related data and products,

(2) The requests for action by CBS contained in Resolution 23 (EC-XLVI) — Report for consideration by Congress from the Executive Council Working Group on the Commercialization of Meteorological and Hydrological Services (WGCOM),

CONSIDERING the importance that the views of CBS are available to WGCOM and to Twelfth Congress during their consideration of the proposed new practice on the exchange of meteorological and related data and products,

DECIDES:

(1) To establish an Expert Group on the Exchange of Data and Products with the following terms of reference:

(*a*) As a matter of urgency:

(i) To study and develop recommendations on the technical feasibility of applying the draft "Guidelines for Members to Use in Defining Tiers 1 and 2" as proposed in Resolution 21 (EC-XLVI);

(ii) To develop qualitative estimates of technical impacts including costs and, to the extent possible, benefits to Members of implementing the proposed new practice;

(iii) To submit a preliminary report on these issues to the president of the Commission for Basic Systems by 15 October 1994 for onward transmission to the WGCOM and a fuller report by 15 February 1995 for onward trans-mission to Twelfth Congress;

(*b*) Following a decision by Congress regarding data and product exchange, to complete necessary studies on:

(i) The process for examining any necessary modifications to the structure and/or procedures of the GTS and their cost implications;

(ii) Mechanisms to enable effective monitoring of the impacts of implementing the decision of Congress;

(iii) Estimates of technical impacts on Members from implementing the decision of Congress, in addition to those identified in (*b*) (i) above;

(iv) The technical impact of the decision of Twelfth Congress on other data and product exchange systems, and on producers and users of other environmental data and products;

(v) Other technical issues regarding the implementation of the decision of Twelfth Congress;

(vi) A plan and timetable for completing its tasks;

(2) That the composition of the Expert Group on the Exchange of Data and Products shall be as follows:

Chairman of the Working Group on Data Management (chairman);

Experts designated by:

Argentina
France
Kenya
Saudi Arabia
United Kingdom
United States.

RESOLUTION 3 (CBS-Ext.(94))

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

THE COMMISSION FOR BASIC SYSTEMS,

NOTING the action taken on the resolutions and recommendations adopted prior to its extraordinary session (94),

CONSIDERING that all the resolutions and recommendations adopted prior to its extraordinary session (94) and still in force have been reviewed,

DECIDES:

(1) To keep in force Resolutions 2, 3, 4, 5, 6, 7 and 8 (CBS-X);

(2) To keep in force Recommendation 1 (CBS-X);

(3) Not to keep in force the other resolutions and recommendations adopted before its extraordinary session (94);

(4) To publish in the final report of the extraordinary session (94) the texts of the recommendation and resolutions which are to be kept in force.

NOTE: The texts of the resolutions and recommendation which were kept in force are reproduced in the annex to this resolution.

ANNEX TO RESOLUTION 3 (CBS-Ext.(94))

RESOLUTIONS AND RECOMMENDATION OF THE COMMISSION FOR BASIC SYSTEMS ADOPTED PRIOR TO ITS EXTRAORDINARY SESSION (94) AND MAINTAINED IN FORCE

Resolution 2 (CBS-X) — Advisory Working Group of the Commission for Basic Systems

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Paragraph 7.13.5 of the general summary of the abridged final report of Fifth Congress,

(2) Resolution 1 (CBS-IX) — Advisory Working Group of the Commission for Basic Systems,

CONSIDERING that a working group is of value in advising the president of the Commission and in assisting him in his duties of coordination and planning,

DECIDES:

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

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

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

(*c*) To review the internal structure and working methods of the Commission;

(*d*) To advise the president on policy matters related to the exchange of data and products;

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

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

(*g*) To keep under review the work of the Commission;

(*h*) To assist the president in the coordination, guidance and development of the WWW support functions;

(*i*) To keep under review the development and implementation of the Public Weather Services Programme directed towards strengthening that component of national Meteorological Services;

(*j*) To formulate specific plans for the education and training activities in the field of responsibility of CBS;

(2) That the composition of the Advisory Working Group shall be as follows:
President of CBS (chairman)
Vice-president of CBS
Past president of CBS
Chairmen of the CBS Working Groups on Data Processing, on Observations, on Telecommunications, on Data Management, and on Satellites
Mr E. A Mukolwe (Kenya)
Mr P. Ryder (UK)
Mr R. A Sonzini (Argentina)
Mr H. Yan (China)

NOTE: This resolution replaces Resolution 1 (CBS-IX) which is no longer in force.

Resolution 3 (CBS-X) — Working Group on Data Processing

THE COMMISSION FOR BASIC SYSTEMS,

CONSIDERING:

(1) That there is a need for the continuation of the work of the Working Group established by Resolution 2 (CBS-IX),

(2) Recommendation 1 (CBS-X) — Revised Terms of Reference of the Commission for Basic Systems,

DECIDES:

(1) To establish the Working Group on Data Processing with the following terms of reference:

(*a*) To keep abreast of scientific and technical developments relating to the methods of meteorological analysis and forecasting for general purposes, to consider the implementation of new techniques, and to keep under review organizational and planning aspects of the GDPS;

(*b*) To provide coordination and guidance on the use of modern data-processing techniques for meteorological analysis and forecasting including the processing and interpretation of incoming products by NMCs;

(*c*) To identify problems associated with meteorological analysis and forecasting at various scales and time ranges requiring study and research and to bring them to the attention of the president of CBS, with a view to referring them to the relevant technical commission, as required;

(*d*) To coordinate observational data requirements of the WWW and Public Weather Services and to provide advice on the formulation of requirements to be met by the Global Observing System;

(*e*) To review requirements of Members and relevant constituent bodies for WMC and RSMC products;

(*f*) To coordinate the production of analysed and forecast data by WMCs and RSMCs taking account of the requirements of Members for new kinds of products;

(*g*) To consider the transmission priorities of processed products to meet the requirements of NMCs and other users;

(*h*) To keep under review and further develop real-time and non-real-time monitoring relating to the GDPS, in coordination with the Working Group on Data Management, in order to assist Members in improving their data processing;

(*i*) To keep under review the established procedures for standardized verification of numerical products and for monitoring the quality of observations, and to develop additional proposals, where necessary, in consultation with the Working Group on Data Management;

(*j*) To monitor progress on implementation of relevant parts of the WMO Long-term Plan on matters related to the GDPS;

(*k*) To keep under review and up to date the *Manual on the GDPS*;

(*l*) To keep under review and up to date relevant training syllabi as required and to suggest training materials and the holding of seminars and symposia;

(*m*) To establish, as necessary, study groups composed of experts, or to appoint rapporteurs, for consideration of specific problems of a technical or operational nature;

(*n*) To act upon matters referred to the Working Group by the president of CBS;

(*o*) To coordinate its activities with the work of the Working Group on Data Management and of other working groups of CBS, with a view to the integration of the WWW system conceived as an entity;

(2) That the Working Group on Data Processing shall have the following composition:

(*a*) The expert designated by each regional association, as rapporteur/coordinator with respect to regional aspects of the GDPS;

(*b*) An expert nominated by each of the Members responsible for the operation of a World Meteorological Centre (WMC);
(*c*) An expert from one RSMC in each of the WMO Regions, to be nominated by the president of the corresponding regional association;
(*d*) An expert nominated by the chairman of the CBS Working Group on Data Management;
(*e*) Experts nominated by other Members or groups of Members, wishing to participate actively in the work of the Working Group;
(*f*) Experts who may be nominated by presidents of other technical commissions and by international organizations according to the work programme;

(3) To select, in accordance with Regulation 32 of the General Regulations, Mr H. Allard (Canada), as chairman of the Working Group;
(4) To request the chairman to submit a report to the Commission not later than six months before its sessions.

NOTE: This resolution replaces Resolution 2 (CBS-IX) which is no longer in force.

Resolution 4 (CBS-X) — Working Group on Observations

THE COMMISSION FOR BASIC SYSTEMS,

CONSIDERING:

(1) That there is a need for the continuation of the work of the Working Group established by Resolution 3 (CBS-IX) — Working Group on the Global Observing System,
(2) Recommendation 1 (CBS-X) — Revised Terms of Reference of the Commission for Basic Systems,

DECIDES:

(1) To establish the Working Group on Observations with the following terms of reference:
(*a*) To review and advise on the overall comprehensive observational data requirements of the WWW, other WMO Programmes, and other international programmes supported by WMO;
(*b*) To review and advise on the design and implementation of the Global Observing System taking account of:
(i) Established requirements for data;
(ii) The cost, capabilities and performance of observing systems including information received from OWSEs;
(*c*) To keep under review and further develop real-time and non-real-time monitoring relating to the Global Observing System, in coordination with the Working Group on Data Management, in order to assist Members in improving their observing system;
(*d*) To keep the *Manual* and *Guide on the GOS* under review and to make recommendations for amendments;
(*e*) To evaluate data requirements of climate monitoring with respect to the overall GOS and to recommend measures to meet those requirements, where possible;
(*f*) To keep abreast of developments in remote sensing;
(*g*) To coordinate requirements and other matters related to the space-based systems with the Working Group on Satellites;
(*h*) To coordinate with other CBS working groups on radio-frequency utilization matters;
(*i*) To keep under review matters related to the development and introduction of new observing systems into the GOS;
(*j*) To monitor progress of the implementation of the WMO Long-term Plan on matters related to the GOS;
(*k*) To keep up to date relevant training syllabi and to suggest training materials and the holding of seminars and symposia;
(*l*) To establish necessary study groups composed of experts or to appoint rapporteurs for consideration of specific problems of a technical or operational nature;
(*m*) To act upon matters referred to the Working Group by the president of CBS;
(*n*) To coordinate its activities with the work of the Working Group on Data Management and of other working groups of CBS, with a view to the integration of the WWW system conceived as an entity;

(2) That the Working Group on Observations shall have the following composition:
(*a*) The expert designated by each regional association, as rapporteur/coordinator with respect to regional aspects of the GOS;
(*b*) An expert nominated by the chairmen of the CBS Working Groups on Satellites and on Data Management;
(*c*) Experts nominated by other Members, or groups of Members, wishing to participate actively in the work of the Working Group;
(*d*) Experts designated by the presidents of the Commission for Marine Meteorology and the Commission for Instruments and Methods of Observation and of any other technical commission or international organization interested in the work of the Working Group;

(3) To select, in accordance with Regulation 32 of the General Regulations, Mr F. S. Zbar (USA), as chairman of the Working Group;
(4) To request the chairman to submit a report to the Commission not later than six months before its sessions.

NOTE: This resolution replaces Resolution 3 (CBS-IX) which is no longer in force.

Resolution 5 (CBS-X) — Working Group on Telecommuncations

THE COMMISSION FOR BASIC SYSTEMS,

CONSIDERING:

(1) That there is a need for the continuation of the work of the Working Group established by Resolution 4 (CBS-IX) — Working Group on the Global Telecommunication System,

(2) Recommendation 1 (CBS-X) — Revised Terms of Reference of the Commission for Basic Systems,

DECIDES:

(1) To establish the Working Group on Telecommunications, with the following terms of reference:

(*a*) To keep abreast of technical developments relating to telecommunications, to consider the implementation of new techniques, and to keep under review the organizational and planning aspects of the GTS, as it relates to the WWW, other WMO Programmes, and other international organizations;

(*b*) To keep under review and make proposals regarding the organization, technical and operational aspects of the entire Global Telecommunication System of the World Weather Watch, including the Main Telecommunication Network, regional and national telecommunication networks, as well as meteorological data collection and distribution systems via meteorological and communications satellites;

(*c*) To keep under review and further develop real-time and non-real-time monitoring procedures relating to the GTS operation, in coordination with the Working Group on Data Management, in order to assist Members in improving the operation of their telecommunication systems;

(*d*) To follow closely the progress on the implementation and continued operation of meteorological telecommunication systems and to formulate recommendations with a view to remedying shortcomings and effecting improvements;

(*e*) To keep the regulatory and guidance material under review;

(*f*) To keep under review developments in telecommunication techniques, procedures and equipment, including international standards on data communications, and to formulate for meteorological information exchange proposals (in binary, alphanumeric, and pictorial form) on the international standardization of operating practices, procedures and equipment;

(*g*) To keep under review allocations of radio frequency bands and assignments of radio frequencies to meteorological activities for operational requirements on telecommunications, instruments, sensors, etc. and research purposes, in coordination with the CBS Working Groups on Observations and on Satellites;

(*h*) To monitor progress of the implementation of the WMO Long-term Plan on matters related to the GTS;

(*i*) To coordinate its activities with the work of the Working Group on Data Management and of other working groups of CBS, with a view to the integration of the WWW system conceived as an entity;

(*j*) To keep abreast of the activities of the International Telecommunication Union, and in particular, of the C.C.I.R. and I.F.R.B., on frequency matters pertaining to meteorological activities, and to assist the WMO Secretariat in its participation in the C.C.I.R. work, the International Organization for Standardization, the International Civil Aviation Organization, the International Maritime Organization and other international organizations concerned on matters pertaining to telecommunications;

(*k*) To keep up to date relevant training syllabi, as requested, and to suggest training materials and the holding of seminars and symposia;

(*l*) To establish necessary study groups composed of experts, or to appoint rapporteurs, for consideration of specific problems of a technical or operational nature;

(*m*) To act upon matters referred to the Working Group by the president of CBS;

(2) That the Working Group on Telecommunications shall have the following composition:

(*a*) The expert designated by each regional association, as the rapporteur/coordinator for regional aspects of the GTS;

(*b*) An expert from one RTH in each of the WMO Regions, to be nominated by the president of the corresponding regional association;

(*c*) An expert designated by the chairman of the CBS Working Group on Data Management;

(*d*) Experts nominated by other Members, or groups of Members, wishing to participate actively in the work of the Working Group;

(*e*) Experts who may be nominated by presidents of other technical commissions and international organizations according to the work programme;

(3) To select, in accordance with Regulation 32 of the General Regulations, Mr M. Fischer (France), as chairman of the Working Group;

(4) To request the chairman to submit a report to the Commission not later than six months before its sessions.

NOTE: This resolution replaces Resolution 4 (CBS-IX) which is no longer in force.

Resolution 6 (CBS-X) — Working Group on Data Management

THE COMMISSION FOR BASIC SYSTEMS,

CONSIDERING:

(1) That full integration of WWW system components, monitoring activities and common, standardized procedures for the handling of data are essential prerequisites for an efficient and flexible operation which will be able to cope with the rapid evolution of requirements and techniques and to ensure that data are available to Members in a timely and convenient fashion,

(2) That modern technology and procedures should be utilized to achieve the maximum benefit from the resources invested in the WWW, and specific attention must be given to the situation and capabilities of the developing countries when implementing new data management functions,

(3) That, in view of the diversity, complexity and steady evolution of data management requirements, it is necessary to further develop, review and evaluate these aspects through the Working Group on Data Management,

(4) That there is a need for the continuation of the work of the Working Group established by Resolution 5 (CBS-IX) — Working Group on Data Management,

(5) Recommendation 1 (CBS-X) — Revised Terms of Reference of the Commission for Basic Systems,

DECIDES:

(1) To establish a Working Group on Data Management, with the following terms of reference:

(*a*) To keep under review the provision of services of meteorological data management supporting the WWW (GOS, GDPS, GTS) and other related programmes as required in both real-time and non-real time, e.g.:

(i) Coordination and orderly monitoring of the generation and flexible exchange of observational data and products;

(ii) Quality control, storage and retrieval of observational data and products;

(iii) Representation forms (meteorological codes and formats) and procedures for syntax conversion (binary, character and graphics) of observational data and products;

(*b*) To develop or adjust appropriate (interfacing) meteorological data-management specifications to:

(i) Provide observational data and products in an efficient manner and convenient to the various application entities;

(ii) Meet new, revised or specialized requirements for WWW facilities and services;

(iii) Ensure that mutually compatible and internally consistent subsets of data emerge from data which are being obtained in different manners on different time and space scales;

(iv) Facilitate the transfer of management and monitoring information (i.e. status of operation) among users of meteorological information and data;

(*c*) To consolidate and coordinate statements received from other bodies, Members, regional associations, other technical commissions, and appropriate international organizations on the need for new forms of presentation of meteorological and related data;

(*d*) To keep abreast of the activities of ISO on matters relating to international standards on systems architecture;

(*e*) To monitor progress on the implementation of relevant parts of the WMO Long-term Plan on matters related to data management;

(*f*) To keep up to date relevant training syllabi, as requested, and to suggest training materials and the holding of seminars and symposia;

(*g*) To keep the regulatory and guidance material under review;

(*h*) To establish necessary study groups composed of experts, or to appoint rapporteurs, for consideration of specific problems of a technical or operational nature;

(*i*) To act upon matters referred to the Working Group by the president of CBS;

(*j*) To liaise with the other working groups of CBS with a view to integrating the GDPS, GOS and GTS components into an integrated WWW system;

(2) That the Working Group on Data Management shall have the following composition:

(*a*) The expert designated by each regional association, as rapporteur/coordinator, with respect to regional aspects of data management;

(*b*) Experts designated by the chairmen of the CBS Working Groups on Observations, on Data Processing, on Satellites, and on Telecommunications in the light of the issues considered in the work programme;

(*c*) Experts to be nominated by Members, or groups of Members, wishing to participate actively in the work of the Working Group;

(*d*) Experts who may be nominated by presidents of other technical commissions and international organizations according to the work programme;

(3) To select, in accordance with Regulation 32 of the General Regulations, Mr G. Love (Australia), as chairman of the Working Group;

(4) To request the chairman to submit, through the president of the Commission, a report to the Commission not later than six months before its sessions.

NOTE: This resolution replaces Resolution 5 (CBS-IX) which is no longer in force.

Resolution 7 (CBS-X) — Working Group on Satellites

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 17 (EC-XLIII) — Executive Council Panel of Experts on Satellites,

(2) The decision of EC-XLIV to establish a CBS Working Group on Satellites, with the same terms of reference and the same composition as the Executive Council Panel,

RECOGNIZING that the CBS Working Group on Satellites will continue to function with the same membership and terms of reference as the Executive Council Panel on Satellites until the Panel is no longer maintained by the Executive Council,

DECIDES:

(1) To establish the CBS Working Group on Satellites with the following terms of reference:

(*a*) To assess the observation, collection, and analysis systems relating to the use of satellites in activities of interest to all WMO Members and to suggest ways and means for improving system capabilities, particularly to Members in developing countries;

(*b*) To collect, collate and keep under review, particularly with regard to their feasibility, the requirements for data, products and services from environmental observation satellites;

(*c*) To assess the status of implementation of the space-based sub-system of the Global Observing System and the adequacy of plans for implementation;

(*d*) To coordinate issues and requirements relating to the GOS with the Working Group on Observations;

(*e*) To make recommendations concerning standardization of satellite services and related ground receiving systems;

(*f*) To coordinate with the other working groups of CBS on relevant matters, such as the exchange, management and archiving of satellite data and radio-frequency utilization;

(*g*) To represent WMO's interests and convey WMO Members' requirements through appropriate involvement in international satellite groups including the Coordination Group for Meteorological Satellites (CGMS) and the Committee for Earth Observation Satellites (CEOS);

(*h*) To keep under review the availability, performance, continuity, and use of environmental observation satellites in WMO Programmes;

(*i*) To keep under review satellite-related education and training requirements and to evaluate the adequacy of existing and planned activities;

(*j*) To identify opportunities and/or problem areas concerning satellite technology and plans for environmental observation satellite operators;

(*k*) To assist in the continuing maintenance of a record of plans for satellite developments and operations in order to assure appropriate consideration of satellite technology in WMO Long-term Plans;

(2) That the Working Group on Satellites shall have the following composition:

(*a*) An expert designated by each of the following Members:

Australia
Brazil
China
France
India
Italy
Japan
Kenya
Russian Federation
United Kingdom
United States

(*b*) An expert nominated by each of the following:

The chairman of the CBS Working Group on Observations
The director of EUMETSAT
The presidents of other technical commissions, as appropriate
The chairman of the JSC
The chairman of the JSTC

(3) That CGMS and CEOS be invited to be represented at meetings of the CBS Working Group on Satellites, as observers;

(4) To select, in accordance with Regulation 32 of the General Regulations, Dr T. Mohr (Germany), as chairman of the Working Group;

AUTHORIZES the president of CBS, in consultation with the President of WMO, to adjust the membership and chairmanship of the Working Group on Satellites, as required;

REQUESTS:

(1) The chairman to submit, through the president of the Commission, a report to the Commission, not later than six months before its sessions;

(2) The Working Group to report annually to the Executive Council, through the president of CBS, under the World Weather Watch Programme;

DECIDES FURTHER that this resolution will take effect on 19 June 1993 consequent to a decision which will be taken by the EC-XLV concerning its Panel of Experts on Satellites.

Resolution 8 (CBS-X) — Rapporteur on the follow-up to UNCED

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The results of the UN Conference on Environment and Development, including the Rio Declaration, Agenda 21, the Statement of Forest Principle, the Convention on Biodiversity, and the Framework Convention on Climate Change,

(2) Resolutions 14 and 15 (EC-XLIV),

CONSIDERING:

(1) That there are long-term implications of the results of the UN Conference on Environment and Development for WMO and for national Meteorological and Hydrological Services,

(2) That there is international recognition of the importance of systematic observations and full and open exchange of data for sustainable development and for detection and prediction of climate change,

(3) The need for CBS to consider the role and support of the WMO basic systems in the follow-up to UNCED and their relationship with other systems,

DECIDES:

(1) To appoint a Rapporteur on the Follow-up to UNCED, to work closely with the Executive Council Working Group on the Follow-up to UNCED, including Capacity Building, and to review Agenda 21 and the Framework Convention on Climate Change in order to identify specific actions which could be taken by CBS and national Meteorological and Hydrological Services in the areas of systematic observations and exchange of data;

(2) To select, in accordance with Regulation 32 of the General Regulations, the vice-president of the Commission as rapporteur;

REQUESTS the rapporteur to prepare a report to the Commission not later than six months before its sessions.

Recommendation 1 (CBS-X) — Revised terms of reference of the Commission for Basic Systems

THE COMMISSION FOR BASIC SYSTEMS,

NOTING the request of EC-XLIV that CBS review the concept of WWW basic systems in support of all WMO and other related international Programmes and recommend any desired changes in its terms of reference or in the organization and presentation of WWW basic system programmes in the post-UNCED era,

STRESSING that WMO's basic systems provide both the common infrastructure and the database to support all WMO Programmes and relevant efforts of international organizations,

RECOGNIZING:

(1) The technological and conceptual advances available for enhancing WMO basic systems to meet requirements in new and effective ways,

(2) The growing global interest in environmental issues and the associated need for improved basic systems,

AFFIRMING that the Commission has an important role to play in further developing and coordinating these basic systems, and the competence to do so,

RECOMMENDS that the terms of reference of the Commission for Basic Systems be as given in the Annex to this recommendation.

Annex to Recommendation 1 (CBS-X)

Terms of reference of the Commission for Basic Systems

The Commission shall be responsible for matters relating to:

(*a*) Cooperation with Members, other technical commissions and relevant bodies in the development and operation of integrated systems for observing, data processing, telecommunications, and data management in response to requirements of all WMO Programmes and opportunities provided by technological developments;

(*b*) The assessment of opportunities for, and the provision of, a common infrastructure to meet the requirements defined by technical commissions and regional associations, as well as by organizations with whom WMO has relations, taking into account new applications of meteorology, hydrology, oceanography, and related environmental sciences;

(*c*) Development and implementation of the Public Weather Services Programme;

(*d*) The processing, storage and retrieval of basic data for meteorological and related purposes including, in particular, the organization of the Global Data-processing System (GDPS) of the World Weather Watch;

(*e*) The development and application of systems and techniques to meet user requirements including those of operational weather analysis and forecasting and of services for environmental emergency authorities;

(*f*) Observational systems, facilities and networks (land, sea, air, and space) as decided by Members including, in particular, all technical aspects of the Global Observing System (GOS) of the World Weather Watch;

(*g*) Telecommunication networks, radio-frequency allocation and facilities for operational, research and applications purposes including, in particular, the organization of the Global Telecommunication System (GTS) of the World Weather Watch;

(*h*) The development and application of operational procedures, schedules, and arrangements for the international exchange of observational data and processed information, in particular, through the GTS;

(*i*) The development and application of data management principles and procedures including monitoring and evaluation of the common infrastructure, in particular, of the World Weather Watch.

RECOMMENDATIONS ADOPTED BY THE SESSION

RECOMMENDATION 1 (CBS-Ext.(94))
CBS CONTRIBUTION TO THE GLOBAL CLIMATE OBSERVING SYSTEM

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 9 (Cg-XI) — Global Climate Observing System,
(2) Resolution 8 (CBS-X) — Rapporteur on the follow-up to UNCED,
(3) Report of the eighteenth session of the CBS Advisory Working Group (Offenbach, Germany, 21–23 April 1994),
(4) Final report of the first session of the GCOS/JSTC Atmospheric Observations Panel (Hamburg, Germany, 25–28 April 1994),

CONSIDERNG:

(1) That there is international recognition of the importance of systematic observations and full and open exchange of data for detection and prediction of potential climate change,
(2) That WWW basic systems provide both the common infrastructure and the database to support all WMO Programmes and relevant efforts of international organizations,
(3) That the GCOS will build, as far as possible, on existing operational and scientific observing, data management and information distribution systems, and the further enhancement of those systems,
(4) That Regional Basic Synoptic Networks (RBSNs), which form the major part of the surface-based component of the GOS, would provide an ideal basis from which to select a network of baseline stations representative of air masses on a regional scale and operated on a long-term basis with required regularity and observational accuracy,

ENDORSES the concept that the GCOS Initial Operational System be established on the basis of the World Weather Watch and other existing structures, including in particular:

(1) The establishment of GCOS baseline upper-air and surface networks;
(2) Arrangements for additional data exchange (e.g. snow depth, radiation and soil moisture);
(3) Arrangements for end-to-end monitoring and near-real-time feedback;
(4) Systematic quality control of data through the WWW lead centres on monitoring of observational data quality;
(5) Coordination of satellite data requirements and service;

CONFIRMS that CBS will play an active role in the design, development and implementation of the GCOS Initial Operational System;

RECOMMENDS:

(1) That Members, at the regional level, be invited to review, as regards the practicability of implementation, the list of upper-air stations proposed as a baseline network for inclusion in the GCOS Initial Operational System;
(2) That Members be urged to give the stations in the baseline upper-air network high priority for implementation within the RBSNs and to make long-term commitments to maintain and operate the stations;
(3) That Members be invited to initiate, where necessary and possible, joint schemes for funding and managing observing systems, to cover large data-void areas and meet the needs of GCOS;

REQUESTS the president and vice-president of CBS to maintain close contacts with other technical commissions and with GCOS/JSTC and its panels, particularly the Atmospheric Observations Panel, and to include GCOS-related issues in the work programme of the CBS Working Groups on Observations, on Satellites and on Data Management.

RECOMMENDATION 2 (CBS-Ext.(94))

PROPOSED NEW ATTACHMENTS I.3 AND I.4 AND AMENDMENTS TO ATTACHMENTS II.2 AND II.15 OF THE *MANUAL ON THE GLOBAL DATA-PROCESSING SYSTEM*

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The report of the eighth session of the Working Group on Data Processing, general summary, paragraphs 3.5, 4.19 and 6.14,

(2) Conclusions of the joint GOS/GDPS Task Team on Data Requirements (March 1994),

(3) *Manual on the Global Data-processing System*, Parts I and II,

CONSIDERING:

(1) That there is a need to provide guidelines on procedures for the review of implementation of functions and services of RSMCs with geographic specialization,

(2) That there is a need to establish procedures for the elaboration of data requirements,

(3) That there is a need to update the standards in the *Manual on the GDPS* to reflect in a comprehensive fashion observational data requirements for Public Weather Services, national Meteorological Centre services and centres operating numerical weather prediction models,

(4) The increased resolution of numerical models, the increased power of analysis-forecast models in modelling difficult physical and dynamical processes, and the ability of four-dimensional analyses schemes to assimilate observations at higher frequency than previously; all these providing the rationale for additional observational data requirements,

(5) That there is a need for the lead centres to establish and update, as appropriate, agreed criteria for the production of a monthly list of suspect surface observing stations,

RECOMMENDS:

(1) That the guidelines to review the status of RSMCs with geographic specialization given in Annex 1 to this recommendation be adopted for inclusion in the *Manual on the GDPS* as a new Attachment I.3, to take effect on 1 July 1995;

(2) That the procedures for the elaboration of observational data requirements given in Annex 2 to this recommendation be adopted for inclusion in the *Manual on the GDPS* as a new Attachment I.4 and in an appropriate place in the *Manual on the GOS* to take effect upon the approval by the Executive Council of this recommendation;

(3) That the amendments to Attachment II.2 of the *Manual on the GDPS* on updated statement of observational data requirements for GDPS centres for global and regional exchange given in Annex 3 to this recommendation be adopted for inclusion in the *Manual on the GDPS* as well as relevant parts of the *Manual on the GOS* and the *Manual on the GTS* to take effect on 1 July 1995;

(4) That the proposed amendments to Attachment II.15 to the *Manual on the GDPS* given in Annex 4 to this recommendation be adopted for use with immediate effect on the understanding that the responsibility for updating the attachment rests with the lead centres;

REQUESTS the Secretary-General to include appropriate changes, based on the annexes to this recommendation, in the *Manuals on the GDPS, on the GOS* and *on the GTS*;

AUTHORIZES the president of CBS, in consultation with the Secretary-General, to make any consequent purely editorial amendments as regards the *Manuals on the GDPS, on the GOS* and *on the GTS*.

ANNEX 1 TO RECOMMENDATION 2 (CBS-Ext.(94))

NEW ATTACHMENT I.3 TO THE *MANUAL ON THE GDPS* GUIDELINES TO REVIEW THE STATUS OF REGIONAL SPECIALIZED METEOROLOGICAL CENTRES (RSMCs) WITH GEOGRAPHIC SPECIALIZATION

1. RSMC capabilities to be reviewed

Taking into account the functions to be performed by designated RSMCs with geographic specialization, their capabilities will be examined under three aspects: their ability to communicate with other centres, their access to computing facilities to achieve specific tasks, and their ability to issue the products which are requested by the users.

Telecommunication aspects

In order to fully play their role, existing RSMCs have to be linked with neighbouring centres. The following type of links are necessary for the effective implementation of their assignments:

(*a*) Medium or high speed lines connecting the RSMC and the appropriate WMC, as well as the RSMC which is chosen to provide backup assistance;

(*b*) Lines with sufficient bandwidth to transmit the products issued by the RSMC to the users in the corresponding NMCs.

Computing facilities aspects

The computing facilities available in existing RSMCs with geographic specialization must have enough power to enable:

(*a*) Preprocessing of observational data including data in binary data representation forms;

(*b*) Objective analysis and NWP models over the geographic responsibility area;

(*c*) Postprocessing of data including display in the form of charts, time-series, tables, as well as the generation of products in binary data representation forms.

Product aspects

In order to fulfil its responsibilities, the RSMCs have to provide several products to the users, some of which are:

(*a*) Gridded fields or local forecasts in the form of maps, time-series, GRID/GRIB and BUFR messages;

(*b*) Elaborated technical guidance (maps and directives);

(*c*) Verification of the quality of the products by means of CBS approved procedures.

2. **Documents to be produced by RSMCs**

In order to demonstrate their capabilities to perform the activity related to geographic specialization, the documentation to be provided by the RSMCs should include the following:

(*a*) A description of telecommunication and data-processing facilities including contingency and backup arrangements;

(*b*) The product guide indicating the list of the products which are available and their transmission schedule;

(*c*) Monthly statistics on the availability and timeliness of the products;

(*d*) Monthly verifications of the products by means of CBS-approved procedures.

RSMCs with geographic specialization have to summarize this information in order to produce, every year, their contribution to the WWW Technical Report on the activity of the GDPS.

3. **Procedure**

A regular review of the capabilities of the RSMCs with geographic specialization should be undertaken by their regional association. In order to do so, it is suggested that regional associations request their RSMCs to produce the above-mentioned documentation. It is also suggested that regional associations obtain feedback from the users. Regional associations should inform CBS, for further action, of the results of the review of the capabilities of the RSMCs with geographic specialization in their Region.

Renumerate present attachment I.3 as I.6.

ANNEX 2 TO RECOMMENDATION 2 (CBS-Ext.(94))

NEW ATTACHMENT I.4 TO THE *MANUAL ON THE GDPS* PROCEDURES FOR THE ELABORATION OF OBSERVATIONAL DATA REQUIREMENTS

The formulation of observational data requirements is a complicated process which consists of several stages. At various levels this process involves groups of end-users, regional associations, WMO technical commissions and other bodies. In order to rationalize the formulation of the observational data requirements the following procedures (schematically shown in Figure 1) are proposed:

1. Users present to WMO Members their needs for observational data for various applications (e.g. meteorological services for aviation, marine navigation, industry, agriculture, climate research, etc.). Meteorological data might be used in two ways: directly in the provision of meteorological services, and in the preparation of meteorological products (weather analysis and prognoses) by GDPS centres. In the latter case, GDPS centres are considered as users.

2. WMO technical commissions are responsible for the consolidation of data needs presented by Members and for the formulation, on their basis, of a statement on observational data requirements/goals (usually in the form of tables) in various WMO Programmes. This should include explanatory notes and a rationale for the requirements/goals and, if possible, a statement on the incremental value of partially meeting these goals (in terms of accuracy, density, frequency, etc.). Often this will include a feedback process with users to ensure that enough information and understanding about users' needs are available. If a statement on requirements/goals is addressed to the World Weather Watch, and in particular to the WWW Global Observing System, it should be presented to the Commission for Basic Systems for consideration.

3. The Commission for Basic Systems:

(*a*) Evaluates the feasibility of stated requirements/goals through expertise by appropriate working groups, particularly the Working Groups on Observations and on Satellites. The evaluation of technical and instrumental feasibility should be conducted in collaboration with the Commission for Instruments and Methods of Observation, the WMO body responsible for the Instruments and Methods of Observation Programme (IMOP). This would probably involve a feedback process between

working groups and technical commissions. The evaluation process will result in the formulation (in the form of tables) of what portion of the statement of requirements/goals is feasible and can be achieved;

(*b*) Formulates system requirements to provide observational data to meet the requirements/goals defined by the technical commissions;

(*c*) Develop any amendments to the WMO mandatory and guidance publications on the basis of system requirements and submit them (in case of mandatory publications) to the Executive Council.

4. The Executive Council approves the amendments and requests the Secretary-General to incorporate them in appropriate WMO *Manuals*.

5. The Members will be advised on the performance of observing systems and programmes through up-dated WMO *Manuals* and *Guides* to meet users' needs for observational data.

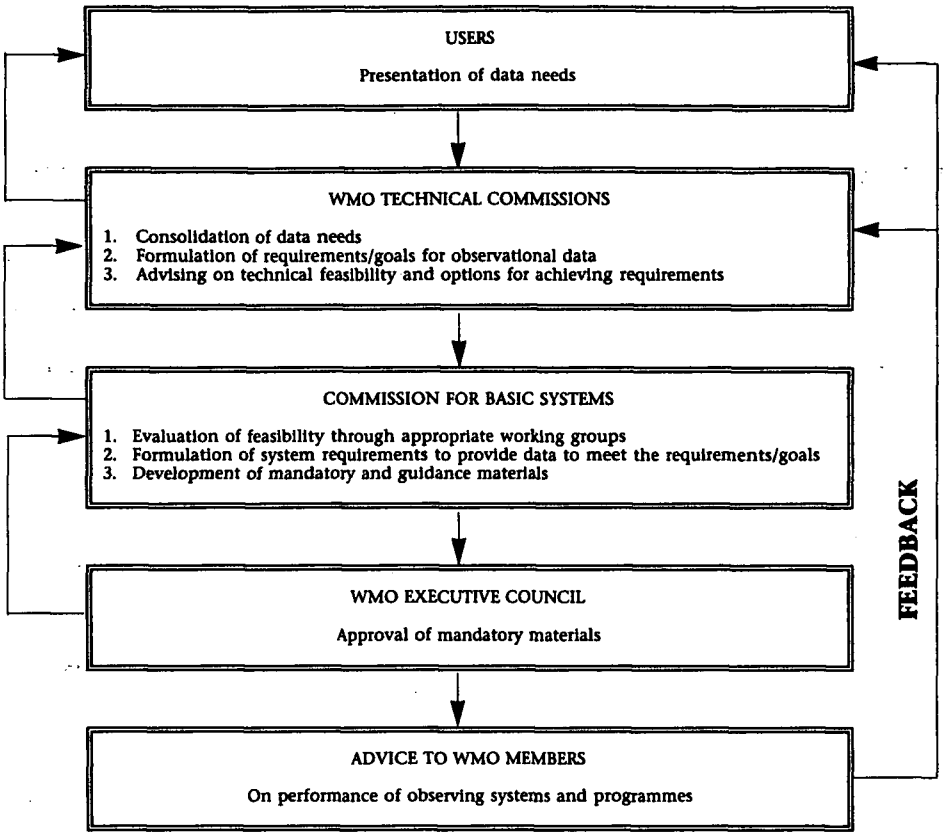

Figure 1 — Procedure for the elaboration of observational data requirements.

ANNEX 3 TO RECOMMENDATION 2 (CBS-Ext.(94))

PROPOSED AMENDMENTS TO ATTACHMENT II.2 OF THE *MANUAL ON THE GDPS*

OBSERVATIONAL DATA REQUIREMENTS OF GDPS CENTRES FOR GLOBAL AND REGIONAL EXCHANGE

Paragraphs 1, 2 and 3 state the observations required to operate all GDPS centres at national, regional and global levels. Paragraph 4 addresses the data requirements for NWP operations only.

1. The types of observation networks and platforms providing data required at data-processing centres are as follows:

(*a*) All stations included in the Regional Basic Synoptic Networks;

(*b*) The network of supplementary stations, including automatic stations;

(*c*) Automatic marine stations (drifting buoy and moored buoy programmes);

(*d*) Mobile sea stations;

(*e*) All other stations making radiowind, radiosonde/radiowind and pilot balloon observations;

(*f*) Meteorological rocket stations;

(*g*) Aircraft meteorological observations;

(*h*) Wind profilers;

(*i*) Doppler and weather watch radar systems;

(*j*) Space-based systems producing:

- (i) Imagery (including digital imagery);
- (ii) Radiance data;
- (iii) Retrieved vertical temperature profiles;
- (iv) Cloud and water vapor motion winds;
- (v) Digital information about clouds;

(vi) Satellite surface wind and precipitable water;
(vii) Manual data, for example, Australian bogus surface data;
(viii) Moisture profiles derived from satellite observations over sea areas;
(ix) Precipitation fields from multispectral cloud radiance data;
(x) Other meteorological and environmental products;

(*k*) Radiological data reporting station in case of nuclear accidents (required for GDPS centres running transport models for environmental emergency response);
(*l*) Rainfall radar composites;
(*m*) Lightning detection and location systems network.

The observational data which will be needed to obtain optimum results from NWP systems by the year 2000 are elaborated in paragraph 4 and its related three tables of this attachment.

2. The report code types which carry the data provided by the platforms listed in paragraph 1 are given below:

(*a*) BUFR and GRIB;
(*b*) TEMP — Parts A, B, C, and D;
(*c*) PILOT — Parts A, B, C, and D;
(*d*) TEMP SHIP — Parts A, B, C, and D;
(*e*) PILOT SHIP — Parts A, B, C, and D;
(*f*) TEMP MOBIL — Parts A, B, C, and D;
(*g*) PILOT MOBIL — Parts A, B, C, and D;
(*h*) COLBA;
(*i*) TEMP DROP;
(*j*) ROCOB;
(*k*) SYNOP;
(*l*) SHIP;
(*m*) Reports from automatic stations on land and at sea;
(*n*) CODAR/AIREP/AMDAR;
(*o*) Selected satellite data, such as cloud images, SATEM, SAREP, SARAD, SATOB;
(*p*) BUOY;
(*q*) CLIMAT, CLIMAT SHIP;
(*r*) CLIMAT TEMP, CLIMAT TEMP SHIP;
(*s*) BATHY, TESAC, TRACKOB;
(*t*) WAVEOB;
(*u*) RADOB;
(*v*) RADREP;

NOTES:
(1) Items (*a*) to (*v*) do not indicate priorities.
(2) BUFR can encode any of the other above data forms and many more. If BUFR is used to represent any of these data forms, in lieu of the specific alphanumeric code form, the same data requirements apply.

3. The frequency of observational reports required is as follows:

(*a*) BUFR and GRIB, as available;
(*b*) TEMP, PILOT, TEMP SHIP, PILOT SHIP, TEMP MOBIL, PILOT MOBIL, ROCOB, COLBA and TEMP DROP, as available;
(*c*) SYNOP, SHIP and reports from automatic stations on land and at sea — 0000, 0300, 0600, 0900, 1200, 1500, 1800, 2100 UTC and hourly whenever possible;
(*d*) CODAR/AIREP/AMDAR reports, as available;
(*e*) Selected satellite data, such as cloud images, SATEM, SAREP, SARAD and SATOB and digital cloud data, as available;
(*f*) BUOY as available;
(*g*) CLIMAT, CLIMAT SHIP, CLIMAT TEMP and CLIMAT TEMP SHIP — once per month;
(*h*) BATHY, TESAC, TRACKOB and WAVEOB, as available;
(*i*) RADOB and RADREP, as available.

4. Data needed for advanced NWP by the year 2000 is as follows:

INTRODUCTION

The following tables list the observational data which will be needed for advanced NWP systems by the year 2000. They include the needs for data assimilation and for analysis and model validation for global short- and medium-range forecasting (excluding long-range forecasting).

Requirements for regional modelling have also been considered. They have been mentioned in the explanatory text, where appropriate, but they have not been listed in the tables. Mesoscale modelling has not been considered.

It is most likely that data of the given specifications would benefit global NWP, if available; however, it does not mean that NWP could not be carried out without such data, as NWP models produce useful products even with the observational data set currently available. It does not mean either that data of higher specification would not be useful; on the contrary, when and where such data are produced they should be made available.

The problem of the feasibility of observing all the variables listed in these tables is not addressed. Most of the requirements stated here could only be met by satellite-borne observing systems. However, in many cases a combination of satellite and *in situ* data is needed to obtain adequate resolution and to ensure stability of calibration of remote sensing systems.

CONTENTS OF THE TABLES

The following notes provide some explanation of how the lists were prepared and some provisos on their use:

Variables

Following past convention, the observational requirements for data assimilation are stated in terms of geophysical variables. This is thought to be useful since, from a user's perspective, these are the variables on which information is required. However, it is important to note that these variables are not always observed directly (satellite systems observe none of them directly, with the exception of top-of-the-atmosphere radiation and a Doppler wind lidar). Also, it is no longer true that the users need their data exclusively in the form of geophysical parameters; recent developments in data assimilation have demonstrated the potential and the benefits of using data at the engineering level (e.g. radiances, brightness temperatures).

Horizontal resolution

(*a*) In general (and with some oversimplification), data are useful for assimilation and validation on spatial scales which the models are attempting to represent. One hundred kilometres are given as the requirement for the variables listed in the tables. However, it is possible to benefit from higher resolution data, considering the current developments towards global models with a grid length of less than 50 km;

(*b*) Regional models attempt to represent spatial scales above the mesoscale. Observational data are required at a resolution of 10 km.

Vertical resolution

(*a*) The same rationale is applied here: global NWP models are expected to have a resolution of less than one kilometre throughout the troposphere and lower stratosphere, with considerably higher resolution in the planetary boundary layer. In the mid- and upper stratosphere, a resolution of two kilometres is likely to be sufficient. The requirements for observations should be comparable;

(*b*) For regional models, observations are required at a resolution of 100 m (50 m in the planetary boundary layer).

Temporal resolution

(*a*) Just as with spatial resolution, data will be useful for assimilation and validation on temporal scales, which the models are attempting to represent. In the past, this has not been the case; so-called "four-dimensional" assimilation systems would more appropriately be described as "intermittent three-dimensional" systems, and they have not been able to make proper use of observations more frequent than the period of the data assimilation cycle (typically six hours). However, continued progress towards truly four-dimensional data assimilation is making it possible to extract useful information from observations at higher temporal frequency. With such systems, higher temporal resolution can compensate, to some extent, for poor horizontal resolution when the atmosphere is moving. A requirement of three hours for upper-air data and one hour for surface data has been specified. However, like in the case of spatial resolution, upper-air data of higher specification (up to one hour) should also be made available (e.g. cloud motion wind data from geostationary satellites, wind profiles from wind profilers);

(*b*) For regional models, both upper-air and surface data are required at a resolution of one hour.

Accuracy

The values given are intended to represent the RMS of the observation errors. The assessment of accuracy should include not only the true instrumental error but also the representativeness error (i.e. the characteristics of some observing systems, particularly *in situ* systems, which sample spatial and temporal scales that are not represented by the models). For NWP applications, such effects appear as though they were observation errors.

Timeliness

In NWP, the value of data degrades with time, and it does so particularly rapidly for variables which change quickly. Operational assimilation systems are usually run with a cut-off time of about three hours for global models and one and a half hours for regional models (although data received with longer delays remain useful). Therefore, the timeliness of data delivery must take into account the advertized initiation time of any operational model that uses that data. For observations which are expected to be used for validation, and not for analysis/assimilation in near real-time, the timeliness is less critical.

Table 1

Three-dimensional fields

	Horizontal res. (km)	*Vertical res. (km)*	*Temporal res. (hours)*	*Accuracy (RMS error)*	*Notes*
Wind (horizontal)	100	.1 up to 2 km .5 up to 16 2 up to 30	3	2 m s^{-1} in the troposphere 3 m s^{-1} in the stratosphere	(1) (2)
Temperature (T)	100	.1 up to 2 km .5 up to 16 2 up to 30	3	.5 K in the troposphere 1 K in the stratosphere	(3)
Relative humidity (RH)	100	.1 up to 2 km .5 up to tropopause	3	5 % (RH)	

NOTES:

(1) Accuracy specified as RMS vector error.

(2) Hourly wind data from geostationary satellites and from wind profilers are also required. Tropospheric horizontal and vertical resolution and accuracy can be met by a space-based Doppler wind lidar in a sun-synchronous orbit.

(3) Geopotential height can be retrieved from specified T and RH with sufficient accuracy.

Table 2
Surface fields

	Horizontal res. (km)	*Temporal res.*	*Accuracy (RMS error)*	*Notes*
Pressure	100	1 h	0.5 hPa	
Wind	100	1 h	2 m s^{-1}	(1)
Temperature	100	1 h	1 K	
Relative humidity	100	1 h	5 %	
Accumulated precipitation	100	3 h	0.1 mm	(2)
Sea surface temperature	100	1 day	0.5 K	
Soil temperature	100	3 h	0.5 K	
Sea-ice cover	100	1 day	10 %	
Snow cover	100	1 day	10 %	
Snow equivalent-water depth	100	1 day	5 mm	
Soil moisture, 0–10 cm	100	1 day	0.02 m^3 m^{-3}	
Soil moisture, 10–100 cm	100	1 week	0.02 m^3 m^{-3}	
Percentage of vegetation	100	1 week	10 % (relative)	
Soil temperature, 20 cm	100	6 h	0.5 K	
Deep soil temperature, 100 cm	100	1 day	0.5 K	
Albedo, visible	100	1 day	1 %	
Albedo, near infrared	100	1 day	1 %	
Long-wave emissivity	100	1 day	1 %	
Ocean wave height	100	1 h	0.5 m	

NOTES:

(1) Wind at 10 metres over land. Over sea, height in the range of one to 40 metres (to be transmitted with the observation).

(2) Required principally for model validation, not time critical.

Table 3
Other two-dimensional fields

	Horizontal res. (km)	*Temporal res.*	*Accuracy (RMS error)*	*Notes*
Cloud fractional cover	100	3 h	10 %	
Cloud top height	100	3 h	0.5 km	(1)
Cloud base height	100	3 h	0.5 km	(1)
Total liquid water content	100	3 h	20 %	
TOA net short-wave radiation	100	3 h	5 W m^{-2}	(2)
TOA net long-wave radiation	100	3 h	5 W m^{-2}	(2)
Multi-purpose IR/VIS imagery	5	30 min.	–	(3)

NOTES:

(1) Accuracy higher in planetary boundary layer.

(2) Required principally for model validation; not time critical.

(3) Required to assist real-time observation monitoring and analysis/forecast validation.

ANNEX 4 TO RECOMMENDATION 2 (CBS-Ext.(94))

PROPOSED AMENDMENTS TO ATTACHMENT II.15 OF THE *MANUAL ON THE GDPS*

Add a new paragraph 1.3 as follows:

1.3 Lead centres who are informed of remedial actions being taken should provide this information to all participating centres. The WMO Secretariat shall forward, every six months, the information it receives to the relevant lead centre. All lead centres shall produce for the WMO Secretariat a yearly summary of information made available to them and/or of those actions taken within their area of responsibility.

Add a new section 3 as follows:

3. **SURFACE OBSERVATIONS**

3.1 The criteria for the production of monthly list of suspect stations is as follows:

3.1.1 List 1: MSL PRESSURE Element: MSL Pressure, surface synoptic observations at 0000, 0600, 1200 or 1800 UTC compared to the first guess field of a data assimilation model (usually a six-hour forecast); Number of observations: at least 10 for at least one observation time, without distinguishing between observation times. One or more of the following: Absolute value of the mean bias ≥ 4 hPa Standard deviation ≥ 6 hPa Percentage gross error ≥ 25% (gross error limit: 15 hPa)	NOTES: (1) All monitoring centres are asked to conform to the above specified criteria. These monthly lists should be prepared for at least the regional association of the lead centre and, if possible, for other regional associations. Consolidated lists of suspect stations should be produced every six months by the lead centres (January–June and July–December) and forwarded to the WMO Secretariat for further action. (2) The stations on these consolidated lists should be those appearing on all six-monthly lists of the lead centre. Other stations could be added to the consolidated list if the lead centre judges that there is sufficient evidence for their inclusion. Each centre should send it's proposed consolidated list to all participating monitoring centres for comment. The final list would then be forwarded to the WMO Secretariat.

RECOMMENDATION 3 (CBS-Ext.(94))

PROVISION OF ATMOSPHERIC TRANSPORT MODEL PRODUCTS FOR ENVIRONMENTAL EMERGENCY RESPONSE

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Recommendation 4 (CBS-X) — Designation of Regional Specialized Meteorological Centres (RSMCs) on the provision of transport model products for environmental emergency response,

(2) Resolution 4 (EC-XLV) — Report of the tenth session of the Commission for Basic Systems,

(3) Recommendations of the First International Workshop on Users' Requirements for the Provision of Atmospheric Transport Model Products for Environmental Emergency Response (Montreal, September 1993), as endorsed by the eighth session of the CBS Working Group on Data Processing (Geneva, November 1993) and further reviewed and refined by the CBS Expert Meeting on Environmental Emergency Response Activities (Bracknell, March 1994),

CONSIDERING that there is a need to specify relevant procedures to be used by the designated RSMCs including global and regional arrangements and related standards for the provision of international environmental emergency response services,

RECOMMENDS:

(1) That the national Meteorological Service (NMS) of each country be recognized as responsible for providing environmental emergency response services to the appropriate authorities within their country, with the support of RSMCs; that the ultimate responsibility for the provision of such services rests with the NMSs and that the RSMCs provide guidance to NMSs for this purpose;

(2) That the WMO, in consultation with the IAEA, approve the new regional and global arrangements given in Annex 1 to this recommendation in replacement of the current interim arrangements;

(3) That WMO recognize that RSMCs with this specialization depend critically on the availability of, and free and direct access to, up-to-the minute global coverage weather data in order to provide operational environmental emergency response services;

(4) That for the foreseeable future, the best approach to transmit the specialized products specified in the standards in Annex 2 to this recommendation is in T4 format suitable for both group 3 facsimile machines and transmission on parts of the GTS;

(5) That the designated RSMCs be invited:

(*a*) To develop and maintain user interpretation guidelines on the atmospheric transport models and distribute them to the delegated authorities, IAEA and WMO;

(*b*) To coordinate among themselves periodic tests and comparisons of the models and operational systems;

(*c*) To implement the actions included in the standards given in Annex 2 to this recommendation;

(6) That a dedicated training programme be developed at the regional level which is designed to meet the needs of NMSs;

REQUESTS the Secretary-General to make appropriate changes, as given in Annexes 1 and 2 to this recommendation, in the *Manual on the Global Data-processing System*.

ANNEX 1 TO RECOMMENDATION 3 (CBS-Ext. (94))

NEW ATTACHMENT I.5 TO THE *MANUAL ON THE GDPS* REGIONAL AND GLOBAL ARRANGEMENTS FOR THE PROVISION OF TRANSPORT MODEL PRODUCTS FOR ENVIRONMENTAL EMERGENCY RESPONSE

Regional arrangements

The RSMCs designated by WMO for the provision of atmospheric transport model products for environmental emergency response shall:

1. Upon receipt of a request from the delegated authority of any country in its region(s) of responsibility or IAEA (for radiological emergencies), provide basic information to the national Meteorological Service of that country and to IAEA. This information will consist of an agreed set of basic products; the delegated authority will be named by each country through the Permanent Representative of the country with WMO.
2. Upon receipt of a first request related to an event, inform the WMO Secretariat and all designated RSMCs of the request.
3. Upon receipt of a request related to a nuclear incident, inform IAEA of such request if the event has not yet been confirmed by IAEA.
4. After confirmation of a significant event (by IAEA for radiological events and through other means for other emergencies), distribute basic information to all national Meteorological Services in the Region. If the event has not been confirmed by IAEA, basic information provided to the national Meteorological Service of the requesting country will not be disclosed to the public in that country nor distributed by RSMCs to other national Meteorological Services.
5. For radiological emergencies, provide, on request, support and advice to the IAEA and WMO Secretariats in the preparation of public and media statements.
6. Determine the standard set of basic products and the method of delivery in consultation with users and the IAEA for radiological emergencies.
7. Provide product interpretation guidelines to users.
8. Provide support and technology transfer to national and regional meteorological centres that want to become designated RSMCs.
9. Make arrangements to provide backup services. These would normally be between the two designated centres in a Region. Interim arrangements should be made by centres in Regions with a single designated RSMC.

Global arrangements

Until such time as new RSMCs have been designated, it is proposed that Regional Association VI designated RSMCs be responsible to provide services for radiological emergencies to Regional Associations I and II; while Regional Association IV designated RSMCs be responsible to provide services to Regional Associations III and V.

In cases of radiological emergencies where coordination is required between RSMCs of different Regions, the RSMCs of the Region where the emergency has occurred will provide this coordination.

ANNEX 2 TO RECOMMENDATION 3 (CBS-Ext. (94))

NEW ATTACHMENT II.16 TO THE *MANUAL ON THE GDPS* STANDARDS IN THE PROVISION OF INTERNATIONAL SERVICES BY RSMCS FOR RADIOLOGICAL ENVIRONMENTAL EMERGENCY RESPONSE

The designated Regional Specialized Meteorological Centres (RSMCs) shall implement agreed standard procedures and products by:

(*a*) The adoption of the following common default source parameters for the initial run of the transport/ dispersion models;

(*b*) The provision of the following standard set of basic products within two to three hours of reception of a request and according to general rules for displaying results.

1. **Default source parameters for the initial run**[1]

(*a*) Uniform vertical distribution up to 500 m above the ground;

(*b*) Uniform emission rate during six hours;

(*c*) Starting time 0000 UTC or 1200 UTC if not known;

[1] This concept is based on the understanding that the first (initial) run of the transport/dispersion models needs to be carried out with default parameters because little or no information (except location and accident time) will be available to the RSMC at this early stage. RSMCs are, however, requested to conduct subsequent model runs with more realistic parameters as they become available. This may, for example, refer to a more precise assumption of the vertical distribution or the need to conduct a model run for the release of noble gases.

(*d*) Total pollutant release 1 unit (arbitrary);
(*e*) Type of radionuclide CS 137.

2. **Standard set of basic products**

Five maps consisting of:

(*a*) Three dimensional trajectories starting at 500, 1 500 and 3 000 m above the ground, with particle locations at synoptic hours;
(*b*) Time integrated pollutant concentration within the 500 m layer above the ground, in Unit·s/m^3, for each of the three time periods. The duration of the first time period is between 12 and 24 hours. It starts at the release time. For a release before 1200 UTC, it ends at 0000 UTC; for a release after 1200 UTC, it ends at 1200 UTC the next day. The second time period is the 24 hours following the first time period. The third time period is the 24 hours following the second time period;
(*c*) Total deposition (wet + dry) in Unit/m^2 from the release time to the end of the third time period.

3. **General rules for displaying results**

In order to make the interpretation of the maps easier, the producing centres should:

(*a*) Adopt a maximum of four concentration contours corresponding to powers of 10;
(*b*) Indicate, if possible, the maximum of the concentration;
(*c*) Provide sufficient geographic background (latitudes, longitudes, shore lines, etc.) on the maps to be able to locate precisely the contours;
(*d*) Include, for each map, a label where the input hypotheses are clearly summarized. The label will indicate if this is a test, an unconfirmed event or an IAEA confirmed event. If the default source is used, the following statement will be added: "RESULTS BASED ON DEFAULT INITIAL VALUES".

The RSMCs will normally provide the products in the ITU-T T4 format suitable for both group 3 facsimile machines and transmission on parts of the GTS.

RECOMMENDATION 4 (CBS-Ext.(94))

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM* — PARTS II AND III

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 2 (Cg-XI) — World Weather Watch Programme for 1992–1995,
(2) Resolution 3 (EC-XLIV) — Technical Regulations of the World Meteorological Organization,
(3) Final report of the sixth session of the CBS Working Group on Observations, general summary, Chapter 7,
(4) Final report of the first session of the Task Team on the *Manual* and the *Guide on the GOS*,

CONSIDERING:

(1) That there is a need to meet growing requirements for observational data specified by GDPS, GCOS and other WMO Programmes,
(2) That there is a need to establish procedures for the elaboration of observational data requirements,

RECOMMENDS that the *Manual on the Global Observing System*, Parts II and III be amended as indicated in the annex to this recommendation and to take effect on 1 July 1995.

ANNEX TO RECOMMENDATION 4 (CBS-Ext.(94))

AMENDMENTS TO THE *MANUAL ON THE GLOBAL OBSERVING SYSTEM*

PART II

Insert after paragraph 1.5 a new section 2, with the following text and Figure II.1:

2. ELABORATION OF REQUIREMENTS

2.1 The formulation of observational data requirements is a complicated process which consists of several stages. At various levels this process involves groups of end-users, regional associations, WMO technical commissions and other bodies. In order to rationalize the formulation of the observational data requirements the following procedures (schematically shown in Figure II.1) are applied.

2.2. Users present to WMO Members their needs for observational data for various applications (e.g. meteorological services for aviation, marine navigation, industry, agriculture, climate research, etc.). Meteorological data might be used in two ways: directly in the provision of meteorological services, and in the preparation of meteorological products (weather analysis and prognoses) by GDPS centres. In the latter case, GDPS centres are considered as users.

2.3 WMO technical commissions are responsible for the consolidation of data needs presented by Members and for the formulation, on their basis, of a statement on observational data requirements/goals (usually in the form of tables) in various WMO Programmes. This should include explanatory notes and a rationale for the requirements/ goals and, if possible, a statement on the incremental value of partially meeting these goals (in terms of accuracy, density, frequency, etc.). Often this will include a

feedback process with users to ensure that enough information and understanding about users' needs are available. If a statement on requirements/goals is addressed to the World Weather Watch, and in particular to the WWW Global Observing System, it should be presented to the Commission for Basic Systems for consideration.

2.4 The Commission for Basic Systems:

(*a*) Evaluates the feasibility of stated requirements/ goals through expertise by appropriate working groups, particularly the Working Groups on Observations and on Satellites. The evaluation of technical and instrumental feasibility should be conducted in collaboration with the Commission for Instruments and Methods of Observation, the WMO body responsible for the Instruments and Methods of Observation Programme (IMOP). This would probably involve a feedback process between working groups and technical commissions. The evaluation process will result in the formulation (in the form of tables) of what portion of the statement of requirements/goals is feasible and can be achieved;

(*b*) Formulates system requirements to provide observational data to meet the requirements/ goals defined by the technical commissions;

(*c*) Develop any amendments to the WMO mandatory and guidance publications on the basis of system requirements and submit them (in case of mandatory publications) to the Executive Council.

2.5 The Executive Council approves the amendments and requests the Secretary-General to incorporate them in appropriate WMO *Manuals*.

2.6 The Members will be advised on the performance of observing systems and programmes through updated WMO *Manuals* and *Guides* to meet users' needs for observational data.

Renumber old sections and corresponding paragraphs 2 and 3, as 3 and 4.

Delete in old section 2, second line, last sentence "The networks of stations of the surface-based subsystem shall be the main source of these data" and NOTE.

Insert after old paragraph 3.1.3, the following:

NOTE: See Figure II.1 in the *Guide on the Global Observing System* (WMO-No. 488).

Delete in old paragraph 3.2.1, first line, the words "which are primarily for quantitative observational data."

Change the text in old paragraph 3.2.2 to read:

The observational programme should provide meteorological data which have the necessary accuracy, spatial and temporal resolution to describe the state of temporal and spatial changes in the meteorological phenomena and processes occurring on the large and planetary scales.

Delete NOTE (2) in old paragraph 3.2.2.

Delete NOTE (1) in old paragraph 3.2.3.

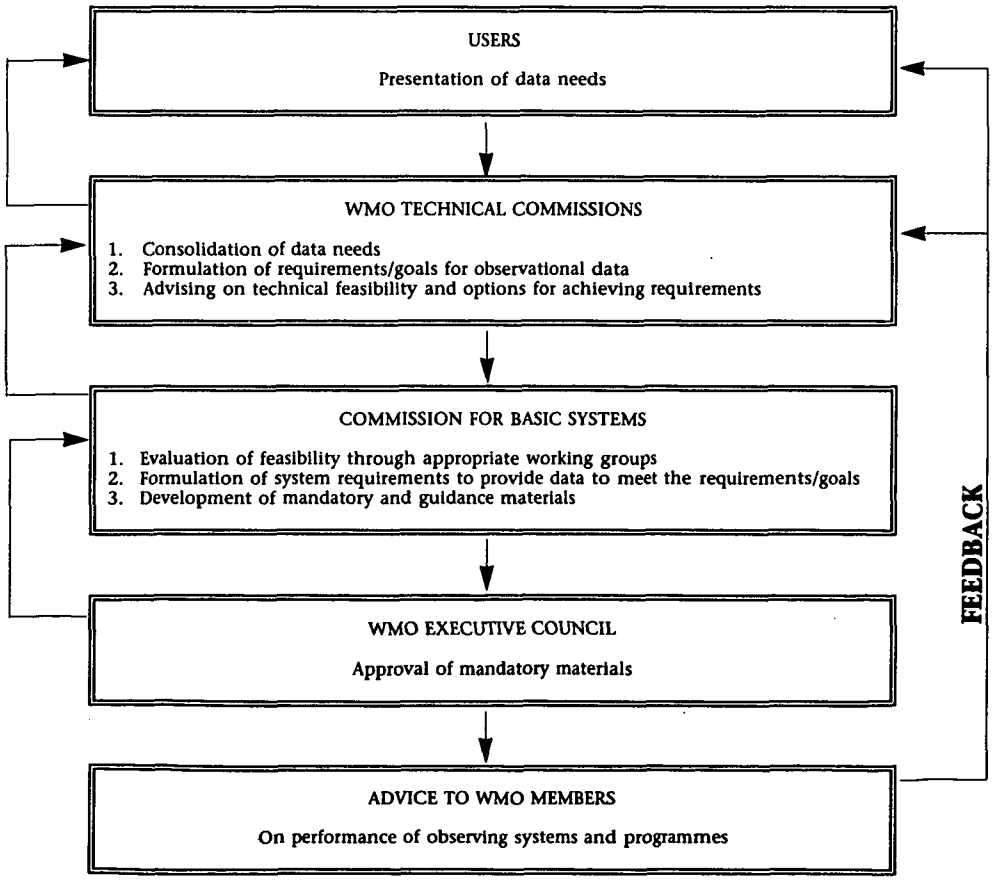

Figure II.1 — Procedure for the elaboration of observational data requirements.

Change NOTE (2) in old paragraph 3.2.3 as follows:

NOTE (1) For a specification of spatial and temporal resolutions and the accuracy achievable within ten years for the global network see Attachment II.2.

Renumber NOTE (3) in old paragraph 3.2.3 as NOTE (2).

Delete in old paragraph 3.3.1, first line, the words "which are for both quantitative and qualitative observational data".

Replace NOTE in old paragraph 3.3.2 by:

NOTE: For a general summary of the requirements for horizontal spacing and frequency of reporting from the regional networks see Attachment II.3.

Replace old Attachment II.2 by new Attachment II.2.

ATTACHMENT II.2

Performance of elements of the GOS achievable by the year 2005

(1) Upper air observations

Meteorological variable	*Observing system*	*Horizontal resolution*	*Estimated coverage*	*Vertical resolution*	*Estimated vertical range*	*Frequency of observation*	*Observational error (RMS)*
Horizontal wind vector	Rawinsonde + pilot	≥ 250 km	Best over land, limited over oceans and sparsely populated areas	0.3–1.2 km	*0.1–35 km	1–4/day	1–3 m s^{-1}
	Aircraft	100 km	Limited to regular flight routes	0.1 km	Cruise level + ascent/descent	1–24/day	1–3 m s^{-1}
	Wind profiler radar	≤ 250 km	Able to improve resolution over land	0.1–1.2 km	*0.1–20 km	1–24/day	1–3 m s^{-1}
	Satellite cloud and moisture motion winds	100 km	Most useful at low latitudes, largest errors for upper cloud	0.5–4 km (depends on cloud type)	At available levels	When available, maximum possible 24/day	2–8 m s^{-1}
Temperature	Rawinsonde	≥ 250 km	Best over land, limited over oceans and sparsely populated areas	< 0.1 km	*0.1–35 km	1–4/day	0.3–1°C
	Satellite remote sensing	50 km	Global coverage, but largest errors in cloudy locations	2–8 km	0–50 km	Minimum of 4/day	1–2°C
	Surface-based remote sensing	≤ 250 km	Used to improve resolution over land	0.2–1 km	*0–6 km	1–24/day	0.5–2°C
	Aircraft	100 km	Limited to regular flight routes	< 0.1 km	Cruise level + Ascent/descent	1–24/day	0.5–1°C
Relative humidity	Rawinsonde	≥ 250 km	Best over land, limited over oceans and sparsely populated areas	< 0.1 km	**0–12 km	1–4/day	** 5 %
	Satellite remote sensing	50 km	Global coverage	2–4 km	0–12 km	Minimum of 4/day	10 %
	Surface based remote sensing + aircraft	Operational systems under development, but performance characteristics not yet available					

* Vertical range depends on equipment used.

** Vertical resolution degraded at heights above 8 km to between 0.5 and 1 km, and observation error at 10 %.

(2) Surface observations

Meteorological variable	*Observing system*	*Horizontal resolution*	*Estimated coverage*	*Frequency of observations*	*Observational error (RMS)*
Sea surface temperature (T)	Satellite	10 km	Global	≤ 4/day	0.5°C
	Ship	250 km	Global shipping lanes		0.5°C
	Buoy	250 km	Global		0.2°C
Surface pressure (P) Temperature (T, T_d)	Conventional land surface network and land AWS	≤ 250 km	Global	1–24/day	0.2–1 hPa (P) 0.5°C (T,T_d)
Wind vector (V)	Ship (P,T,T_d,V) Buoy (P,T,T_d,V)	≤ 250 km ≤ 250 km	Global ocean (limited coverage of T_d by moored buoy)		1–2 m s^{-1} (V)
	Satellite (V)	50 km	Global ocean	2/day	(ERS-1 specs)
	Surface-based remote sensing (V) (HF radar)	10 km	Mainly coastal regions		
Precipitation amount	Conventional land surface network and land AWS	≤ 250 km	Overland	4/day	5 %
	Weather radar	10 km	Overland	1–24/day	
	Satellite	50 km	Global	1/day	

PART III

Replace sections 2.9.7 and 2.9.8 by the following:

2.9.7 **Global Atmospheric Watch stations**

General

2.9.7.1 Members should establish a network of Global Atmosphere Watch (GAW) stations designed to meet the need for monitoring, on a global and regional basis, the chemical composition and related characteristics of the atmosphere.

2.9.7.2 The network of GAW stations should comprise:

(*a*) Global GAW stations to provide measurements needed to address atmospheric environment issues of global scale and importance (e.g. atmospheric composition, climate change, depletion of ozone layer);

(*b*) Regional GAW stations to provide measurements to address primarily regional aspects of global environmental problems but also issues of a purely regional nature.

2.9.7.3 Members should cooperate in the establishment of a minimum of 30 global GAW stations and at least 300 regional GAW stations.

Location and composition

2.9.7.4 Global Atmosphere Watch stations should be established only at sites where direct pollution effects can be avoided.

2.9.7.5 Global Atmosphere Watch stations should be co-located with or located near a surface and/or an upper-air synoptic station.

NOTE: For further information on the location of GAW stations, see WMO *Technical Regulations* Volume 1, Chapter B.2 (WMO-No. 49), as well as the *Manual on the Global Atmosphere Watch* (in preparation) and the *Guide on the Global Observing System* (WMO-No. 488).

2.9.7.6 At each global GAW station, measurements should be carried out on all or most of the following variables:

(*a*) Greenhouse gases (concentration near the surface, total column density and vertical profile): carbon dioxide; chlorofluorocarbons, their substitutes, intermediates and final products; methane, nitrous oxide, tropospheric ozone, water vapour;

(*b*) Ozone (concentration near the surface, total column density and vertical profile) and related precursor gases, e.g. volatile organic compounds ((VOCs) NO_x);

(*c*) Radiation and the optical depth or transparency of the atmosphere: turbidity, solar radiation, ultraviolet B radiation, visibility, total aerosol load (concentration near the surface, in a marine or continental background, and, where possible, vertical profile up to the tropopause);

(*d*) Chemical composition of rain, snow and clouds;

(*e*) Reactive gas species (concentration near the surface, total column density and vertical profile): sulphur dioxide, reduced sulphur species, oxides of nitrogen, reduced nitrogen species, carbon monoxide, VOCs, peroxyacetyl nitrate (PAN), hydrogen peroxide (H_2O_2) and others;

(*f*) Physical and chemical characteristics of atmospheric particles, including mineral aerosols and their vertical distribution;

(*g*) Radionuclides, krypton-85, radon, tritium, isotopes of selected substances;

(*h*) Routine measurements of the classical meteorological elements (in particular wind direction and speed, wet- and dry-bulb air temperature, relative humidity, atmospheric pressure, present weather, aerological soundings);

(*i*) Chemical composition of water in the soil and plants, in collaboration with other interested organizations;

(*j*) Cloud condensation nuclei and ice nuclei;

(*k*) Integrated air samples for archiving.

2.9.7.7 At regional GAW stations, measurements shall be made of as many or as few of the variables listed in 2.9.7.6 (*a*) to (*k*) above and others as the needs of the region or country dictate. However, the following variables shall constitute the core measurement programme at GAW regional stations, with the highest priority given to the first five:

(*a*) Ozone concentration near the surface;

(*b*) Precipitation chemistry;

(*c*) Carbon black (in precipitation and in aerosols);

(*d*) Meteorological parameters;

(*e*) Solar radiation (visible, ultraviolet B);

(*f*) Methane;

(*g*) Carbon monoxide;

(*h*) Total ozone;

(*i*) Aerosol composites.

Frequency and timing of observations

2.9.7.8 (to be developed later)

Renumber old sections 2.9.9 to 2.9.11 as 2.9.8 to 2.9.10.

RECOMMENDATION 5 (CBS-EXT.(94))

AMENDMENTS TO THE *MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM*, VOLUME I, GLOBAL ASPECTS, PARTS I AND II

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 2 (Cg-XI) — World Weather Watch Programme for 1992–1995,

(2) The *Manual on the Global Telecommunication System*, Volume I, Parts I and II,

RECOMMENDS that the *Manual on the Global Telecommunication System*, Volume I, Parts I and II be amended as given in the annex to this recommendation, with effect from 1 November 1995;

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

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

ANNEX TO RECOMMENDATION 5 (CBS-Ext.(94))

AMENDMENTS TO THE *MANUAL ON THE GTS*, VOLUME I

PART I

Amend in Attachment I-5, Table D, paragraph 2, indent (*e*), second line of the text, the indicated time as follows, and **amend** Formats E, F and G accordingly:

....reports compiled from 2100 to 0259 UTC, 0300 to 0859 UTC, 0900 to 1459 UTC and 1500 to 2059 UTC and available....

Add to Attachment I-5, Table D, at the end of paragraph 5.2, and as a footnote in Format J:

Questions 7, 8 and 10 are only applicable to SYNOP, TEMP, PILOT, CLIMAT and CLIMAT TEMP reports.

PART II

Replace paragraphs 2.5 to 2.5.4 by the following:

2.5 **Requests for GTS messages**

2.5.1 An existing GTS message shall be the smallest unit requested. All requests for GTS messages, and in particular requests for repetition, shall be made as soon as possible; otherwise the requested message(s) may no longer be available (see also 2.10.2.2).

2.5.2 ***Request messages***

2.5.2.1 Requests for GTS messages shall be made by addressed message-requests for GTS messages (see 2.4.1.2, 2.4.2 for abbreviated headings and 2.4.3 for the first line of the text of the message).

2.5.2.2 The requested messages shall be identified by their abbreviated headings, and all designators shall be used to specify a particular message. One request message shall not contain more than eight requests.

2.5.2.3 Each line of the text of the message shall begin with the indicator AHD (except the first line, see 2.4.3). Each line will end with the report separation signal. Each line should contain a single abbreviated heading of a requested message.

2.5.3 ***Request for repetition***

2.5.3.1 Requests for repetition of GTS messages shall be made by addressed messages as requests for GTS messages, transmitted to the adjacent centre upstream.

2.5.3.2 The messages requested for repetition may be identified in the request by their transmission sequence numbers on the circuit concerned. In this case, the second line of the text of the message shall begin with the indicator SQN, followed by the transmission sequence number or a series of sequence numbers separated by "/", or consecutive sequence numbers (nnn – nnn).

2.5.3.3 One request-for-repetition message shall only contain a single type of identification for requested messages, i.e. abbreviated headings or transmission sequence numbers.

2.5.4 ***Replies to requests for GTS messages***

2.5.4.1 A reply shall use the format for addressed data messages (see 2.4.1.4). By bilateral agreement between adjacent centres, in particular for replies to requests for repetition, replies may be made in the format of a routine message.

2.5.4.2 An addressed data message in reply to a request for GTS messages shall contain a single GTS message.

2.5.4.3 Requests shall be answered in all cases. If a requested message is not available, an addressed data message (see 2.4.1.4) shall be sent to the originator of the request with the indicator NIL followed by the identifier of the message concerned. If a request for GTS messages is incorrect, an addressed data message should be sent to the originator of the request with the indicator ERR followed by the incorrect identifier, when possible.

2.5.4.4 Replies to messages requesting repetitions shall be transmitted within 30 minutes of the filing time of the requests.

NOTE: If all the requests cannot be met at one time, the remainder of the replies may be transmitted later.

Add to paragraph 2.12.3.3 the following sentence before the first NOTE:

Multiplexing provided by logical channels (PVCs and/or VCs) should be used in preference to multiplexing provided at the physical layer (e.g. by V.29 modems).

Add the following paragraph 2.12.4:

2.12.4 ***TCP/IP protocol***

The TCP/IP (Transmission Control Protocol/ Internet Protocol) could be used on GTS circuits operating X.25 procedures.

Add to Attachment II-5, Table B1, the following data type designators:

Designator	*Data type*	*Code form (name)*
	In Section T_1 = A *Analyses*:	
G	Hydrological/marine	[TEXT]
W	Weather summary	[TEXT]
	In Section T_1 = F *Forecasts*:	
L	Local/area	[TEXT]
	In Section T_1 = S *Surface data*:	
L	Table-driven coded reports	FM 95 CREX
	In Section T_1 = W *Warnings*	
F	Tornado	[TEXT]
G	Hydrological/river flood	[TEXT]
H	Marine/coastal flood	[TEXT]
T	Tropical cyclone (typhoon/ hurricane)	[TEXT]
U	Severe thunderstorm	[TEXT]
	In Section T_1 = N *Notices*	
G	Hydrological	[TEXT]
H	Marine	[TEXT]
T	TEST MSG [System related]	[TEXT]
W	Warning related and/ or cancellation	[TEXT]

Add to Attachment II-5, Table C1, Part I, the following geographical designators:

CZ	Czech Republic
EO	Estonia
KY	Kyrgyzstan
KZ	Kazakhstan
LT	Lithuania
LV	Latvia
SQ	Slovakia
TR	Turkmenistan
UZ	Uzbekistan
VG	Saint Vincent and the Grenadines

Replace Attachment II-6 by the revised content (to be consolidated by the chairman of the Working Group on Telecommunications).

Add to Attachment II-12, at the end of paragraph 3, the following:

xx = Zx for the last bulletin containing the last segment (e.g: AA = part 1, AB = part 2, ZC = third and last part).

The values of the first x can be A through Y and the values of the second x can be A through Z.

RECOMMENDATION 6 (CBS-Ext.(94))

EXTENSIONS TO FM 94-X BUFR FOR THE REPRESENTATION OF QUALITY CONTROL INFORMATION

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-X) — Working Group on Data Management,

(2) The report of the first session of the CBS Working Group on Data Management/Subgroup on Data Representation and Codes (September 1993),

(3) The report of the second session of the CBS Working Group on Data Management (February 1994),

CONSIDERING the successful experimentation of the representation of quality control information in BUFR and that there is a need to introduce the corresponding extensions into the binary data representation form FM 94-X BUFR for the representation of quality control information, making edition 3 of BUFR,

RECOMMENDS that the amendments to FM 94-X BUFR given in the annex to this recommendation be adopted for use as from 8 November 1995;

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

ANNEX TO RECOMMENDATION 6 (CBS-Ext.(94))

EXTENSIONS TO FM 94-X BUFR FOR THE REPRESENTATION OF QUALITY CONTROL INFORMATION

Add the following regulation:

94.5.5.3

A data present bit-map shall be defined as a set of N one bit values corresponding to N data entities described by N element descriptors (including element descriptors for delayed replication, if present); the data description of a data present bit-map is comprised of a replication operator followed by the element descriptor for the data present indicator.

NOTES:

(1) Where an operator descriptor requires a data present bit-map of length N to complete the operator definition, the N consecutive element descriptors which correspond to the N data entities to which the N bit values refer shall end with the element descriptor which immediately precedes the first such operator, or with the element descriptor which immediately precedes the first occurrence of such an operator following the occurrence of a cancel backward reference operator.

(2) All references to previously defined element descriptors effected through the application of operators which are qualified by data present bit-maps shall refer to the element descriptors concerned including any modifications resulting from change data width, change reference value, and change scale factor.

(3) The define data present bit-map for re-use operator enables a data present bit-map to be defined and later re-used; the definition of a data present bit-map shall remain defined until the occurrence of a cancel defined data present bit-map operator or a cancel backward data reference operator.

(4) Where an operator descriptor is qualified by a data present bit-map of length N there shall be defined a number of values of the type indicated by that operator together with subsequent appropriate element descriptors; the number of values defined shall correspond to the number of bits set to zero in the data present bit-map; the description of each data item shall be obtained by substituting the appropriate element descriptors, modified by the operator, at each subsequent occurrence of a marker operator.

Add the following entry to Note (2) of Regulation 94.6.3:

(viii) when operators qualified by a data present bit-map are present, it is required that the length and contents of the bit-map shall be identical for each data subset if data compression is to be used.

Add in Table B, Class 01 the following new descriptor and Notes:

F	X	Y	*Element name*	*Unit*	*Scale*	*Ref value*	*Data width*
0	01	032	Generating application	Code table	0	0	8

NOTES:

(3) Where a center other than the originating center generates quality information, replacement or substitute values, and/or statistical information, the center may be indicated by using 0 01 031.

(4) A generating center may wish to indicate a reference to the application that generated quality information, etc.; it may use descriptor 0 01 032 for this purpose. However, the corresponding code tables will vary from center to center.

(5) Code table 0 01 032 is to be generated by each centre.

Add in Table B, Class 08 the following new descriptors and Notes:

F	X	Y	*Element name*	*Unit*	*Scale*	*Ref value*	*Data width*
0	08	023	First order statistics	Code table	0	0	6
0	08	024	Difference statistics	Code table	0	0	6

(3) First order statistics have values with a similar range and the same dimensions as the corresponding reported values (e.g., maxima, minima, means, etc.).

(4) Difference statistics are difference values; they have dimensions similar to the corresponding reported values with respect to units, but assume a range centred on zero (e.g., the difference between reported and analysed values, the difference between reported and forecast values, etc.).

Add in Table B, Class 31 the following new descriptor and Notes:

F	X	Y	*Element name*	*Unit*	*Scale*	*Ref value*	*Data width*
0	31	031	Data present indicator	Flag table	0	0	1

(2) Descriptor 0 31 031, used in conjunction with quality control or statistics operators 2 22 YYY through 2 32 YYY, shall indicate the presence of quality control information when the indicator value is set to zero. It may be used, in conjunction with the replication operator 1 01 YYY, to construct a table of data present/not present indicators, forming a data present bit-map as defined in Regulation 94.5.5.3. This makes it possible to present quality control information and statistical information for selected data corresponding to element descriptors which precede the 0 22-32 YYY operators.

(3) Other applications of the data present indicator may be developed.

Add in Table B, a new class of descriptors:

Class 33 — Quality information

F	X	Y	*Element name*	*Unit*	*Scale*	*Ref value*	*Data width*
0	33	001	Reserved				
0	33	002	Quality information	Code table	0	0	2
0	33	003	Quality information	Code table	0	0	3
0	33	004	Reserved				
0	33	007	Per cent confidence	%	0	0	7

Add in Table C the following new operators:

F	X	*Operand*	*Operator Name*	*Operation Definition*
2	21	YYY	Data not present	Data values present in Section 4 (data section) corresponding to the following YYY descriptors shall be limited to data from Classes 1–9, and Class 31.
2	22	000	Quality information follows	The values of Class 33 elements which follow relate to the data defined by the data present bit-map.
2	23	000	Substituted values operator	The substituted values which follow relate to the data defined by the data present bit-map.
2	23	255	Substituted values marker operator	This operator shall signify a data item containing a substituted value; the element descriptor for the substituted value is obtained by the application of the data present bit-map associated with the substitued values operator.
2	24	000	First order statistical values follow	The statistical values which follow relate to the data defined by the data present bit-map.
2	24	255	First order statistical values marker operator	This operator shall signify a data item containing a first order statistical value of the type indicated by the preceding 0 08 023 element descriptor; the element descriptor to which the first order statistic relates is obtained by the application of the data present bit-map associated with the first order statistical values follow operator; first order statistical values shall be represented as defined by this element descriptor.
2	25	000	Difference statistical values follow	The statistical values which follow relate to the data defined by the data present bit-map.
2	25	255	Difference statistical values marker operator	This operator shall signify a data item containing a difference statistical value of the type indicated by the preceding 0 08 024 element descriptor; the element descriptor to which the first order statistic relates is obtained by the application of the data present bit-map associated with the difference statistical values follow operator; difference statistical values shall be represented as defined by this element descriptor, but with a reference value of -2^n and a data width of $(n+1)$, where n is the data width given by the original descriptor. This special reference value allows the statistical difference values to be centred around zero.
2	32	000	Replaced/retained values follow	The replaced/retained values which follow relate to the data defined by the data present bit-map.
2	32	255	Replaced/retained value marker operator	This operator shall signify a data item containing the original of an element which has been replaced by a substituted value. The element descriptor for the retained value is obtained by the application of the data present bit-map associated with the substituted values operator.

The following operators, not defined in the set of extensions approved for experimental use, were found to be useful. They eliminate ambiguity and also enable data present bit-maps to be defined once, then re-used any number of times.

2	35	000	Cancel backward data reference	This operator terminates all previously defined backward reference and cancels any previously defined data present bit-map; it causes the next data present bit-map to refer to the data descriptors which immediately precede the operator to which it relates.
2	36	000	Define data present bit-map	This operator defines the data present bit-map which follows for possible re-use; only one data present bit-map may be defined between this operator and the cancel use defined data present bit-map operator.
2	37	000	Use defined data present bit-map	This operator causes the defined data present bit-map to be used again.
2	37	255	Cancel use defined data present bit-map	This operator cancels the re-use of the defined data present bit-map.

Add in Table C the following Notes:

(12) If "Replaced/retained" values are indicated, this shall imply that the data element in the original part of the message has been replaced with a (presumably) better value; the original value has been retained in the message following the replaced/retained operator. If multiple replacements for the same data element are to be included, they shall be ordered such that the original datum shall be last, the first replacement shall precede it, the next precede that, etc. Each (set of) replaced/ retained data values shall be indicated by the inclusion of the 2 32 000 operator.

(13) If "Substituted values" are indicated, this shall imply that the data element in the original part of the message is thought to be of poor quality. However, it has been left in the original message as received; an improved value has been placed within the message following the substituted values operator. If multiple substitutions for the same data element are to be included, they shall be ordered such that the first substitution shall be first, the next substitution shall follow it, the next follow that, etc. Thus, the (presumed) "best" value will be found at the end of the collection of substituted values. Each (set of) substituted data values shall be indicated by the inclusion of the 2 23 000 operator.

(14) Operator 2 21 YYY allows for the construction of a BUFR message containing only coordinate (Class 1–9), delayed replication (Class 31) and quality control information. The message could be linked back to the original data-containing message by comparison of the coordinate information in the two messages, or, in a local context, through "database" information in Section 2.

(15) First order statistics have values with a similar range and the same dimensions as the corresponding reported values (e.g. maxima, minima, means, etc.).

(16) Difference statistics are difference values; they have dimensions the same as the corresponding reported values with respect to units, but assume a range centred on zero (e.g. the difference between reported and analysed values, the difference between reported and forecast values, etc.).

Add the following new code tables:

0 08 023
First order statistics

Code figure	*Meaning*
0	Reserved
1	Reserved
2	Maximum value
3	Minimum value
4	Mean value
5	Median value
6	Modal value
7	Mean absolute error
8–9	Reserved
10	Standard deviation
11–31	Reserved
32–62	Reserved for local use
63	Missing

NOTE: All first order statistics are in the units defined by the original data descriptors.

0 08 024
Difference statistics

Code figure	*Meaning*
0	Reserved
1	Reserved
2	Observed minus maximum
3	Observed minus minimum
4	Observed minus mean
5	Observed minus median
6	Observed minus mode
7–10	Reserved
11	Observed minus climatology (anomaly)
12	Observed minus analysed value
13	Observed minus initialized analysed value
14	Observed minus forecast value
15–20	Reserved
21	Observed minus interpolated value
22	Observed minus hydrostatically calculated value
23–31	Reserved
32–62	Reserved for local use
63	Missing

NOTES:

(1) Difference statistics are difference values; they have dimensions the same as the corresponding reported values with respect to units, but assume a range centred on zero (e.g., the difference between reported and analysed values, the difference between reported and forecast values, etc.).

(2) Where observed minus forecast values are represented, the period of the forecast shall be indicated by an appropriate descriptor from Class 4.

0 31 031
Data present indicator

Bit No.	*Value*	*Meaning*
1	0	Data present
	1	Data not present

0 33 002
Quality information

Code figure	*Meaning*
0	Data not suspect
1	Data suspect
2	Reserved
3	Quality information not given

0 33 003
Quality information

Code figure	*Meaning*
0	Data not suspect
1	Data slightly suspect
2	Data highly suspect
3	Data considered unfit for use
4–6	Reserved
7	Quality information not given

RECOMMENDATION 7 (CBS-Ext.(94))

AMENDMENTS TO FM 63-IX BATHY

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-X) — Working Group on Data Management,

(2) The report of the first session of the CBS Working Group on Data Management/Subgroup on Data Representation and Codes (September 1993),

(3) The report of the second session of the CBS Working Group on Data Management (February 1994),

CONSIDERING the requirements expressed by IOC and IGOSS for reporting within the code form FM 63-IX BATHY information on probe, recorder type and equation used,

RECOMMENDS that the amendments to FM 63-IX BATHY given in the annex to this recommendation be adopted for use as from 8 November 1995;

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

ANNEX TO RECOMMENDATION 7 (CBS-Ext.(94))

AMENDMENTS TO FM 63-IX BATHY

Replace the title and code form to read:

FM 63-X Ext. BATHY-Report of bathythermal observation

SECTION 1	$M_iM_iM_jM_j$	YYMMJ	GGgg/	$Q_cL_aL_aL_aL_a$ (i_uddff)	$L_oL_oL_oL_oL_o$ ($4s_nTTT$)
SECTION 2	$8888k_1$	$I_xI_xI_xX_RX_R$	$z_oz_oT_oT_oT_o$	.....	$z_nz_nT_nT_nT_n$

Replace Note (3) Section number 2 to read:

Section number	*Symbolic figure group*	*Contents*
2	8888	Type of instrumentation and temperatures at either significant or selected depths

Add a new regulation 63.3.1 and **renumber** present regulations 63.3.1 and 63.3.2 as 63.3.2 and 63.3.3:

63.3.1

The group $I_xI_xI_xX_RX_R$ is mandatory and follows immediately after the $8888k_1$ group.

Add two new definitions of symbolic letters:

$I_xI_xI_x$ – Instrument type for XBT with fall rate equation coefficients (FM 63)

X_RX_R – Recorder types (FM 63)

Add two new code tables:

1770

$I_xI_xI_x$ — Instrument type for XBT with fall rate equation coefficients

Code figure	*Instrument, equation coefficients a and b*
001	Sippican T-4, 6.472, -2.16
002	Sippican T-4, 6.691, -2.25
011	Sippican T-5, 6.828, -1.82
021	Sippican Fast Deep, 6.346, -1.82
031	Sippican T-6, 6.472, -2.16
032	Sippican T-6, 6.691, -2.25
041	Sippican T-7, 6.472, -2.16
042	Sippican T-7, 6.691, -2.25
051	Sippican Deep Blue, 6.472, -2.16
052	Sippican Deep Blue, 6.691, -2.25
061	Sippican T-10, 6.301, -2.16
071	Sippican T-11, 1.779, -0.255
201	TSK T-4, 6.472, -2.16
202	TSK T-4, 6.691, -2.25

Code figure	*Instrument, equation coefficients a and b*
211	TSK T-6, 6.472, -2.16
212	TSK T-6, 6.691, -2.25
221	TSK T-7, 6.472, -2.16
222	TSK T-7, 6.691, -2.25
401	Spartan XBT-1, 6.301, -2.16
411	Spartan XBT-3, 5.861, -0.0904
421	Spartan XBT-4, 6.472, -2.16
431	Spartan XBT-5, 6.828, -1.82
441	Spartan XBT-5DB, 6.828, -1.82
451	Spartan XBT-6, 6.472, -2.16
461	Spartan XBT-7, 6.472, -2.16
471	Spartan XBT-7DB, 6.472, -2.16
481	Spartan XBT-10, 6.301, -2.16
491	Spartan XBT-20, 6.472, -2.16
501	Spartan XBT-20DB, 6.472, -2.16
800	Mechanical BT
810	Hydrocast
820	Thermistor chain
830	CTD

NOTES:

(1) The depth is calculated from coefficients a and b and time t, as follows: $z = at + 10^{-3}bt^2$.

(2) All unassigned numbers are reserved.

4770

X_RX_R — Recorder types

This table encodes the various recorders used to log temperatures from the instruments listed.

Code figure	*Recorder*
01	Sippican Strip Chart Recorder
02	Sippican MK2A/SSQ-61
03	Sippican MK-9
04	Sippican AN/BHQ-7/MK8
05	Sippican MK-12
10	Spartan SOC BT/SV Processor Model 100
20	Argos XBT-ST
21	CLS-ARGOS / Protecno XBT-ST model 1
22	CLS-ARGOS / Protecno XBT-ST model 2
30	BATHY Systems SA-810
31	Scripps Metrobyte controller
32	Murayama Denki Z-60-16 III
33	Murayama Denki Z-60-16 II
34	Protecno ETSM2
35	Nautilus Marine Service NMS-XBT
40	TSK MK-2A
41	TSK MK-2S
42	TSK MK-30
43	TSK MK-30N
99	Unknown

NOTE: All unassigned numbers are reserved.

Add in code table 2582 a new line FM 63-X Ext. BATHY and place YY in column M_jM_j (Comment: to distinguish the new code form from the old one which may be in use at the same time for a certain period).

RECOMMENDATION 8 (CBS-Ext.(94))

AMENDMENTS TO FM 35-IX EXT. TEMP, FM 36-IX EXT. TEMP SHIP, FM 37-IX EXT. TEMP DROP, FM 38-IX EXT. TEMP MOBIL

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-X) — Working Group on Data Management,

(2) The report of the first session of the CBS Working Group on Data Management/Subgroup on Data Representation and Codes (September 1993),

(3) The report of the eighth session of the CBS Working Group on Data Processing (15–19 November 1993),

(4) The report of the second session of the CBS Working Group on Data Management (February 1994),

CONSIDERING the requirement for the reporting of the type of radiosonde and the actual time of measurement of the wind at the standard levels,

RECOMMENDS that the amendments to FM 35-IX Ext. TEMP, FM 36-IX Ext. TEMP SHIP, FM 37-IX Ext. TEMP DROP, FM 38-IX Ext. TEMP MOBIL given in the annex to this recommendation be adopted for use as from 8 November 1995;

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

ANNEX TO RECOMMENDATION 8 (CBS-Ext.(94))

AMENDMENTS TO FM 35-IX EXT. TEMP, FM 36-IX EXT. TEMP SHIP, FM 37-IX EXT. TEMP DROP, FM 38-IX EXT. TEMP MOBIL

Amend the code form, Part B to read:

SECTION 7 31313 $s_r r_a r_a s_a s_a$ 8GGgg $(9s_n T_w T_w T_w)$

Replace the text of regulation 35.3.3 by:

Section 7 — Sounding system indication, radiosonde, system status, launch time, sea-surface temperature groups

Section 7 is a mandatory section and shall always be reported. The groups $s_r r_a r_a s_a s_a$ and 8GGgg are mandatory for all TEMP reports: TEMP, TEMP SHIP, TEMP DROP and TEMP MOBIL. In TEMP SHIP reports, the group $9s_n T_w T_w T_w$ shall also be included.

RECOMMENDATION 9 (CBS-EXT.(94))

NEW CODE FORM FM 14-X EXT. SYNOP MOBIL

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-X) — Working Group on Data Management,

(2) The report of the first session of the CBS Working Group on Data Management/Subgroup on Data Representation and Codes (September 1993),

(3) The report of the second session of the CBS Working Group on Data Management (February 1994),

CONSIDERING the requirement to report synoptic observations from mobile land stations in support of environmental emergency monitoring needs,

RECOMMENDS that the new form FM 14-X Ext. SYNOP MOBIL given in the annex to this recommendation be adopted for use as from 8 November 1995;

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

ANNEX TO RECOMMENDATION 9 (CBS-Ext.(94))

NEW CODE FORM FM 14-X EXT. SYNOP MOBIL

Change in Section A the title of the code form to read:

FM 12-X SYNOP Report of surface observation from a fixed land station

Add in Section A the following title and code form:

FM 14-X Ext. SYNOP MOBIL Report of surface observation from a mobile land station

Amend the code form, footnotes and Notes to read:

SECTION 0 D....D**** IIiii*

$M_i M_i M_j M_j$ or $YYGGi_w$ or

$A_1 b_w n_b n_b n_b$** $99L_a L_a L_a$ $Q_c L_o L_o L_o L_o$****

$MMMU_{La} U_{Lo}$*** $h_o h_o h_o h_o i_m$***

* Used in FM 12 only.
** Used in FM 13 only.
*** Used in FM 14 only.
**** Used in FM 13 and FM 14.

NOTES:
(1) The code form FM 12 SYNOP is used for reporting synoptic surface observations from a fixed land station, manned or automatic. **The code form FM 14 SYNOP MOBIL is used for surface observations from an automatic or manned land station and not at a fixed location.**
(2) A SYNOP report from a fixed land station is identified by the symbolic letters $M_iM_iM_jM_j$ = AAXX.
(3) The SHIP report from a sea station is identified by the symbolic letters $M_iM_iM_jM_j$ = BBXX.
(4) **A SYNOP MOBIL report from a mobile land station is identified by the symbolic letters $M_iM_iM_jM_j$ = OOXX.**

Renumber the existing Notes (4) and (5) as (5) and (6).
Amend section number 1 of new Note (6) to read:

Section number	*Symbolic figure group*	*Contents*
1	—	Data for global exchange which are common to the SYNOP, SHIP, and the **SYNOP MOBIL** code form

Amend the following regulation to read:
12.1.1 The code name SYNOP, SHIP, or **SYNOP MOBIL** shall not be included in the report.
12.1.1.1 **SYNOP MOBIL is intended for encoding meteorological observations from a non-fixed location. SYNOP MOBIL shall not be used as a replacement to SYNOP from a fixed location.**

NOTE: An example of the intended application is to temporarily monitor meteorological parameters in the area of an environmental emergency.

12.1.2	Use of groups $M_iM_iM_jM_j$	**D...D**** or **$A_1b_wn_bn_bn_b$***	$YYGGi_w$

* **Used in FM 13 only.**
** **Used in FM 13 and FM 14 only.**

12.1.2.2 In a bulletin of SHIP reports from sea stations **or SYNOP MOBIL reports from mobile land stations,** the group $M_iM_iM_jM_j$ shall be included only as the first line of the text, and the groups

D...D**
or **$YYGGi_w$ shall be included in every report.**
$A_1b_wn_bn_bn_b$*

NOTE: See Regulation 12.1.7.

* **Used in FM 13 only.**
** **Used in FM 13 and FM 14 only.**

12.1.3.1 Reports from a **fixed or mobile** land station shall always contain at least Sections 0 and 1. When a report from a coastal land station contains maritime data, that report shall also include Section 2. The identification and position of a **fixed** land station shall be indicated by means of the group IIiii.
12.1.3.2 **The identification of a mobile land station shall be indicated by the group D...D. The observing station shall indicate its position by means of the groups $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $MMMU_{La}U_{Lo}$ for mobile land stations. In addition, a mobile land station shall include the group $h_oh_oh_oh_oi_m$ to indicate the elevation of the station including the units of measure for the elevation and the accuracy of the elevation.**
12.1.3.3 **Mobile land station shall include (in addition to Sections 0 and 1), whenever the corresponding data are available, Section 3 containing at least the groups with indicator figures 5, 8, and 9.**

Renumber Regulations 12.1.3.2 to 12.1.3.5 as 12.1.3.4 to 12.1.3.7.
Amend regulation 12.1.5 to read:
12.1.5 A fixed sea station (other than an ocean weather station or a moored buoy), which is considered by the Member operating it to be in the same category as a **fixed** land station, shall report its identification and position by means of the group IIiii.
Add in regulation 12.1.7 the following:
(c) **In reports from a mobile land station, only in the absence of a suitable call sign, the word MOBIL shall be used for D...D.**
Amend the following symbolic letters to read:
D...D
— Call sign, consisting of three or more alphanumeric characters, for mobile land station making surface or upper-air observations or issuing a radiological report on a routine basis and/or in case of accident. **(FM 14, ...)**

$h_oh_oh_oh_o$	Elevation of a mobile land station making either **surface** or upper-air observation, in either metres or feet as indicated by i_m. (**FM 14**, ...)
i_m	(**FM 14**, ...)
$L_aL_aL_a$	(... **FM 14**, ...)
$L_oL_oL_oL_o$	(... **FM 14**, ...)
M_iM_i	(... **FM 14**, ...)
MMM	(**FM 14**, ...)
Q_c	(... **FM 14**, ...)
U_{La}	(**FM 14**, ...)
U_{Lo}	(**FM 14**, ...)

Add in Code Table 2582 a new line FM 14-X Ext. SYNOP MOBIL and place letters OO in the land station column.

RECOMMENDATION 10 (CBS-Ext.(94))

NEW PART C IN THE *MANUAL ON CODES*, VOLUME 1: COMMON TABLES C-1 AND C-2

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-X) — Working Group on Data Management,

(2) The report of the first session of the CBS Working Group on Data Management/Subgroup on Data Representation and Codes (September 1993),

(3) The report of the second session of the CBS Working Group on Data Management (February 1994),

CONSIDERING the need for the introduction of unique tables which would be referenced within all the code forms, and which would be listed in a new Part C of the *Manual on Codes*,

RECOMMENDS that the new Part C of the *Manual on Codes*, as given in the annex to this recommendation, be adopted for use as from 8 November 1995, with the tables included in this Part C of the manual replacing the existing tables in Parts A and B;

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

ANNEX TO RECOMMENDATION 10 (CBS-Ext.(94))

NEW PART C IN THE *MANUAL ON CODES*

COMMON CODE TABLE C-1: IDENTIFICATION OF CENTRE

Common Code Table: **(F_1F_2 for alphanumeric codes**
(Code Table 0 in GRIB
(Code Table 0 01 031 in BUFR

Code figure for: F_1F_2	*Octet 5 in GRIB Sect. 1*	*Centre identifiers Octet 6 in BUFR Sect. 1*	
00	00	00	Reserved
			01–09: WMCs
01	01	01	Melbourne
02	02	02	Melbourne
03	03	03	)
04	04	04	Moscow
05	05	05	Moscow
06	06	06	)
07	07	07	US National Weather Service, National Meteorological Centre (NMC)

COMMON CODE TABLE C-1: IDENTIFICATION OF CENTRE *(continued)*

Code figure for: F_1F_2	*Octet 5 in GRIB Sect. 1*	*Centre identifiers Octet 6 in BUFR Sect. 1*	
08	08	08	US National Weather Service Telecommunications Gateway (NWSTG)
09	09	09	Reserved for USA
			10–25: Centres in Region I
10	10	10	Cairo (RSMC/RAFC)
11	11	11	)
12	12	12	Dakar (RSMC/RAFC)
13	13	13	)
14	14	14	Nairobi (RSMC/RAFC)
15	15	15	)
16	16	16	Antananarivo (RSMC)
17	17	17	)
18	18	18	Tunis–Casablanca (RSMC)
19	19	19	)
20	20	20	Las Palmas (RAFC)
21	21	21	Algiers (RSMC)
22	22	22	Lagos (RSMC)
23	23	23	)
24–25	24–25	24–25	Reserved for other centres in Region I
			26–40: Centres in Region II
26	26	26	Khabarovsk (RSMC)
27	27	27	)
28	28	28	New Delhi (RSMC/RAFC)
29	29	29	)
30	30	30	Novosibirsk (RSMC)
31	31	31	)
32	32	32	Tashkent (RSMC)
33	33	33	Jeddah (RSMC)
34	34	34	Tokyo RSMC, Japan Meteorological Agency
35	35	35	)
36	36	36	Bangkok
37	37	37	Ulan Bator
38	38	38	Beijing (RSMC)
39	39	39	)
40	40	40	Seoul
			41–50: Centres in Region III
41	41	41	Buenos Aires (RSMC/RAFC)
42	42	42	)
43	43	43	Brasilia (RSMC/RAFC)
44	44	44	)
45	45	45	Santiago
46	46	46	Brazilian Space Agency — INPE
47–50	47–50	47–50	Reserved for other centres in Region III
			51–63: Centres in Region IV
51	51	51	Miami (RSMC/RAFC)
52	52	52	Miami RSMC, National Hurricane Center
53	53	53	Montreal (RSMC)
54	54	54	)
55	55	55	San Francisco
56	56	56	Reserved

COMMON CODE TABLE C-1: IDENTIFICATION OF CENTRE (*continued*)

Code figure for: F_1F_2	*Octet 5 in GRIB Sect. 1*	*Centre identifiers Octet 6 in BUFR Sect. 1*	
57	57	57	U.S. Air Force – Air Force Global Weather Central
58	58	58	Fleet Numerical Meteorology and Oceanography Center, Monterey, CA
59	59	59	The NOAA Forecast Systems Laboratory, Boulder, CO, USA
60–63	60–63	60–63	Reserved for other centres in Region IV
			64–73: Centres in Region V
64	64	64	Honolulu
65	65	65	Darwin (RSMC)
66	66	66	)
67	67	67	Melbourne (RSMC)
68	68	68	Reserved
69	69	69	Wellington (RSMC/RAFC)
70	70	70	)
71–73	71–73	71–73	Reserved for other centres in Region V
			74–99: Centres in Region VI
74	74	74	UK Meteorological Office — Bracknell
75	75	75	)
76	76	76	Moscow (RSMC/RAFC)
77	77	77	Reserved
78	78	78	Offenbach (RSMC)
79	79	79	)
80	80	80	Rome (RSMC)
81	81	81	)
82	82	82	Norrköping
83	83	83	)
84	84	84	Reserved
85	85	85	Toulouse
86	86	86	Helsinki
87	87	87	Belgrade
88	88	88	Oslo
89	89	89	Prague
90	90	90	Episkopi
91	91	91	Ankara
92	92	92	Frankfurt/Main (RAFC)
93	93	93	London (WAFC)
94	94	94	Copenhagen
95	95	95	Rota
96	96	96	Athens
97	97	97	European Space Agency (ESA)
98	98	98	ECMWF, RSMC
99	99	99	De Bilt
n.a.	100 to	$N_1N_1N_1$	Reserved for centres in Region I which are not in the list above
n.a.	$N_1N_1N_1$+1 to	$N_2N_2N_2$	Reserved for centres in Region II which are not in the list above and so on
n.a.	...	...	...
n.a.	$N_5N_5N_5$+1 to	254	Reserved for centres in Region VI which are not in the list above
n.a.	255	255	Not used

NOTES:

(1) The closed bracket sign) indicates that the corresponding code figure is reserved for the previously named centre.

(2) n.a. means not available.

(3) With GRIB or BUFR, if there is a need to define subcentres, the following procedure should be applied:
Use in GRIB of Octet 26 of section 1 or use in BUFR of Octet 5 of section 1 with the following meaning:
Code figure for Octet 26 of GRIB section 1 or for Octet 5 of BUFR section 1:
0 Centre as defined by Octet 5, section 1 of GRIB or Octet 6, section 1 of BUFR.
1 to 254 Sub-centre identifier allocated by centre as defined by Octet 5, section 1 of GRIB or Octet 6, section 1 of BUFR.

COMMON CODE TABLE C-2: RADIOSONDE/ SOUNDING SYSTEM USED

(Alphanumeric codes:

Common Code Table: (3685 $r_a r_a$ — Radiosonde/sounding system used

(BUFR: 0 02 011 Radiosonde type

Code figure for alphanumeric (Code Table 3685)	*Code figure for BUFR (Table 0 02 011)*	
00–01	0–1	Reserved
02	2	No radiosonde – passive target (e.g. reflector)
03	3	No radiosonde – active target (e.g. transponder)
04	4	No radiosonde – passive temperature-humidity profiler
05	5	No radiosonde – active temperature-humidity profiler
06	6	No radiosonde – radio-acoustic sounder
07–08	7–8	No radiosonde – . . . (reserved)
09	9	No radiosonde – system unknown or not specified
10	10	VIZ type A pressure-commutated (USA)
11	11	VIZ type B time-commutated (USA)
12	12	RS SDC (Space Data Corporation – USA)
13	13	Astor (no longer made — Australia)
14	14	VIZ Mark I MICROSONDE (USA)
15	15	EEC Company type 23 (USA)
16	16	Elin (Austria)
17	17	Graw G. (Germany)
18	18	Reserved for allocation of radiosonde
19	19	Graw M60 (Germany)
20	20	Indian Meteorological Service MK3 (India)
21	21	VIZ/Jin Yang Mark I MICROSONDE (South Korea)
22	22	Meisei RS2-80 (Japan)
23	23	Mesural FMO 1950A (France)
24	24	Mesural FMO 1945A (France)
25	25	Mesural MH73A (France)
26	26	Meteolabor Basora (Switzerland)
27	27	AVK-MRZ (Russian Federation)
28	28	Meteorit Marz2-1 (Russian Federation)
29	29	Meteorit Marz2-2 (Russian Federation)
30	30	Oki RS2-80 (Japan)
31	31	VIZ/Valcom type A pressure-commutated (Canada)
32	32	Shanghai Radio (China)
33	33	UK Met Office MK3 (UK)
34	34	Vinohrady (Czechoslovakia)
35	35	Vaisala RS18 (Finland)
36	36	Vaisala RS21 (Finland)
37	37	Vaisala RS80 (Finland)
38	38	VIZ LOCATE Loran-C (USA)
39	39	Sprenger E076 (Germany)
40	40	Sprenger E084 (Germany)
41	41	Sprenger E085 (Germany)
42	42	Sprenger E086 (Germany)
43	43	AIR IS - 4A - 1680 (USA)
44	44	AIR IS - 4A - 1680 X (USA)
45	45	RS MSS (USA)
46	46	Air IS - 4A - 403 (USA)
47	47	Meisei RS2-91 (Japan)
48	48	VALCOM (Canada)
49	49	VIZ MARK II (USA)
50	50	GRAW DFM-90 (Germany)
51–59	51–59	Reserved for allocation of radiosondes
60	60	Vaisala RS80/MicroCora (Finland)
61	61	Vaisala RS80/DigiCora or Marwin (Finland)
62	62	Vaisala RS80/PCCora (Finland)

COMMON CODE TABLE C-2: RADIOSONDE/ SOUNDING SYSTEM USED (*continued*)

Code figure for alphanumeric (Code Table 3685)	*Code figure for BUFR (Table 0 02 011)*	
63	63	Vaisala RS80/Star (Finland)
64	64	Orbital Sciences Corporation, Space Data Division, transponder radiosonde, type 909-11-XX, where XX correspond to the model of the instrument (USA)
65	65	VIZ transponder radiosonde, model number 1499–520 (USA)
66–89	66–89	Reserved for additional automated sounding systems
90	90	Radiosonde not specified or unknown
91	91 Reserved	Pressure-only radiosonde
92	92 Reserved	Pressure-only radiosonde plus transponder
93	93 Reserved	Pressure-only radiosonde plus radar-reflector
94	94 Reserved	No-pressure radiosonde plus transponder
95	95 Reserved	No-pressure radiosonde plus radar-reflector
96	96 Reserved	Descending radiosonde
97–99	97–99 Reserved	Reserved for allocation of sounding systems with incomplete sondes
	100–254 Reserved	
	255 Missing value	

NOTES:
(1) References to countries in brackets indicate the manufacturing location rather than the country using the instrument.
(2) Some of the radiosondes listed are no longer in use but are retained for archiving purposes.

RECOMMENDATION 11 (CBS-Ext.(94))

DESIGNATION OF A REGIONAL SPECIALIZED METEOROLOGICAL CENTRE ON THE PROVISION OF TRANSPORT MODEL PRODUCTS FOR ENVIRONMENTAL EMERGENCY RESPONSE

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) That Eleventh Congress adopted the *Third WMO Long-term Plan* which gives priority to the establishment of Regional Specialized Meteorological Centres (RSMCs) with activity specialization in various areas,

(2) The views expressed by the forty-second session of the Executive Council that a minimum of two RSMCs for the provision of transport model products be established in each Region,

(3) The requirements stated by Regional Association V for the provision upon request of specialized transport/dispersion/ deposition model products to Members in the Regions,

(4) The request of the IAEA to receive transport model products in case of a nuclear accident or emergency,

(5) Attachment I.2 of the *Manual on the GDPS* — Procedures for broadening the functions of existing RSMCs and for designation of new RSMCs,

CONSIDERING That the GDPS centre in Melbourne can generate and make available transport/dispersion/ deposition model products operationally upon request, and have fulfilled the relevant provisions of the designation procedures for new RSMCs and/or broadening the function(s) of an existing RSMC with geographic specialization to include activity specialization,

RECOMMENDS that the GDPS centre in Melbourne be designated as an RSMC with activity specialization on the provision of transport model products for environmental emergency response to Members of Regional Association V, upon request, with effect from 1 July 1995;

REQUESTS:

(1) The Member operating the designated RSMC to continue to make available its specialized products, as required, to Members concerned on a regional basis and to coordinate such activities within the relevant programmes of the *Third WMO Long-term Plan*, i.e., the World Weather Watch Programme;

(2) The Secretary-General to arrange for the inclusion of the newly designated RSMC and the outline of its specialized functions in the *Manual on the Global Data-processing System* as soon as the Executive Council has approved this recommendation.

RECOMMENDATION 12 (CBS-Ext.(94))

DESIGNATION OF A REGIONAL SPECIALIZED METEOROLOGICAL CENTRE ON TROPICAL CYCLONES

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) That Eleventh Congress adopted the *Third WMO Long-term Plan* which gives priority to the establishment of RSMCs with activity specialization in various areas,

(2) The requirements for specialized WWW products in connection with the Tropical Cyclone Programme as stated in the *Third WMO Long-term Plan*, Part II, Volume I, Programme 1.8, paragraphs 224–226,

(3) Attachment I.2 of the *Manual on the GDPS* — Procedure for broadening the functions of existing RSMCs and for designation of new RSMCs,

(4) The Tropical Cyclone Operational Plan for the South Pacific and South-East Indian Ocean,

CONSIDERING that the Meteorological Centre in Nadi, Fiji provides tropical cyclone forecasts and advisory service on an operational basis and has fulfilled most of the relevant provisions of the designation procedures for new RSMCs,

RECOMMENDS that the Meteorological Centre in Nadi, Fiji be designated as an RSMC with activity specialization in tropical cyclone analysis, tracking, and forecasting as soon as the communications upgrade to Melbourne is implemented;

REQUESTS:

(1) The Member operating the designated RSMC to:

(*a*) Continue to make available its specialized products, as required, to Members concerned on a regional basis and to coordinate such activities within the relevant programmes of the *Third WMO Long-term Plan*, i.e. the Tropical Cyclone Programme and the World Weather Watch Programme;

(*b*) Report to the president of CBS as soon as the communication upgrade to Melbourne is implemented;

(*c*) Provide to the eleventh session of CBS a progress report on its upgrades for access and use of relevant data and processing capabilities;

(2) The Secretary-General to arrange for the inclusion of the newly designated RSMC and the outline of its specialized functions in the *Manual on the GDPS* as soon as the Executive Council has approved this recommendation.

RECOMMENDATION 13 (CBS-Ext.(94))

REVIEW OF RESOLUTIONS OF THE EXECUTIVE COUNCIL BASED ON PREVIOUS RECOMMENDATIONS OF THE COMMISSION FOR BASIC SYSTEMS OR RELATED TO THE WORLD WEATHER WATCH

THE COMMISSION FOR BASIC SYSTEMS,

NOTING with satisfaction the action taken by the Executive Council on the previous recommendations of the Commission for Basic Systems or related to the WWW in general,

CONSIDERING that some of the previous Executive Council resolutions are still valid,

RECOMMENDS:

(1) That the following Executive Council resolutions be kept in force: Resolutions 1 and 2 (EC-XXXVI) and 5 (EC-XLII);

(2) To replace Resolution 16 (EC-XLIII) with a new resolution;

(3) That the following Executive Council resolutions are no longer needed and should not be kept in force: Resolutions 8 (EC-XLIII) and 4 (EC-XLV).

ANNEXES

ANNEX I

Annex to paragraph 4.4 of the general summary

UNCED FOLLOW-UP ACTION BY CBS

Activity area	*Example for programme activity*
Data generation	- Include GCOS requirements in GOS; - Establish GCOS baseline networks under GOS; - Evaluate and implement new observing technology; - Arrange joint sponsorship for observing systems in extraterritorial areas.
Information exchange and processing	- Redesign and upgrade the GTS to meet GCOS requirements, including the introduction of satellite communication technology; - Establish standard procedures, formats, services and databases for GCOS; - Provide guidance for data exchange programmes outside the WWW; - Application of data assimilation techniques; - Optimizing the operational use of data.
Technology transfer	- Training in various areas of the WWW using advanced techniques (e.g. computer-assisted learning); - Develop model specifications and configurations for NMHSs; - Develop strategies and coordinated projects to promote better use of WWW facilities; - Promote software exchange under the WWW Programme; - Provide guidance and up-to-date regulatory material to Members and other programmes.
Capacity building	- Establish regular training for specialists in the various operational fields covered by the WWW; - Enhancing the capabilities of meteorological centres in developing countries; - Systems implementation/coordination activities; - OWSEs.
Public education	- Publications, press releases, newsletters to create public awareness of WWW facilities and aims relating to UNCED, Agenda 21 and FCCC; - Contributions to WMO activity reports and brochures; - Address decision makers and programme bodies directly.

ANNEX II

Annex to paragraph 4.14 of the general summary

GCOS BASELINE UPPER-AIR NETWORK AS PROPOSED BY THE GCOS ATMOSPHERIC OBSERVATIONS PANEL

Northern hemisphere

Station index	*Name*	*Latitude*	*Longitude*	*Status*
01001	Jan Mayen	70 56N	008 40W	A
02836	Sodankyla	67 22N	026 39E	A
03006	Lerwick	60 08N	001 11W	A
03953	Valentia observatory	51 56N	010 15W	A
04270	Narssarssuaq	61 09N	045 26W	A
08495	Gibraltar	36 09N	005 20W	A
08508	Lajes/Santa Rita (Azores)	38 44N	027 04W	A
10868	Muenchen-Oberschleissheim	48 15N	011 33E	A
16245	Pratica di Mare	41 39N	012 26E	A
17130	Ankara/Central	39 57N	032 53E	A
20674	Ostrov Dikson	73 30N	080 24E	A
21965	Ostrov Chetyrehstolbovoy	70 38N	162 24E	A
23472	Turuhansk	65 47N	087 57E	A
24266	Verhojansk	67 33N	112 26E	A
28698	Omsk	54 56N	074 23E	A
30230	Kirensk	57 46N	108 07E	A
32540	Petropavlovsk-Kamchatskij	52 58N	158 45E	A
33345	Kiev	50 24N	030 27E	A
35121	Orenburg	51 45N	055 06E	A
38880	Ashabat	37 58N	058 20E	A
41217	Abu Dhabi	24 26N	054 39E	A
45004	King's Park	22 19N	114 10E	A
47401	Wakkanai	45 25N	141 41E	A
47827	Kagoshima/Yoshino	31 38N	130 36E	A
47971	Chichijima	27 05N	142 11E	A
47991	Minamitorishima	24 18N	153 58E	A
50527	Hailar	49 13N	119 45E	A
51709	Kashi	39 28N	075 59E	A
52681	Minqin	38 38N	103 05E	A
53068	Erenhot	43 39N	112 00E	A
55299	Naggu	31 29N	092 04E	A
56778	Kunming	25 01N	102 41E	A
57494	Wuhan	30 37N	114 08E	A
60020	Santa Cruz de Tenerife	28 27N	016 15W	A
60680	Tamanrasset	22 47N	005 31E	A
70026	Barrow/W.Post W. Rogers	71 18N	156 47W	A
70308	St. Paul	57 09N	170 13W	A
70398	Annette Island	55 02N	131 34W	A
71072	Mould Bay, N.W.T.	76 15N	119 21W	A
71815	Stephenville UA, NFLD	48 34N	058 34W	A
71836	Moosone, ONT.	51 16N	080 39W	A
71934	Fort Smith UA, N.W.T.	60 02N	111 56W	A
72201	Key West/ Int., FL	24 33N	081 45W	A
72250	Brownsville/Int., TX	25 54N	097 26W	A
72293	San Diego/Miramar, NAC CA	32 51N	117 07W	A
72532	Peoria/Greater Peoria, IL	40 40N	089 41W	A
72694	Salem/Mcnary, OR	44 55N	123 00W	A
72775	Great Falls/Int., MT	47 29N	111 22W	A
78016	Bermuda Naval Air Station Kindley	32 22N	064 41W	A
91165	Lihue, Kauai, Hawaii	21 59N	159 21W	A

Tropics

Station index	*Name*	*Latitude*	*Longitude*	*Status*
43599	Gan	00 41S	073 09E	**
48455	Bangkok	13 44N	100 34E	A
48568	Songkhla	07 12N	100 36E	A
48698	Singapore/Changi Airport	01 22N	103 59E	A
61052	Niamey-Aero	13 29N	002 10E	A
61641	Dakar/Yoff	14 44N	017 30W	A
61901	St. Helena Is.	15 56S	005 40W	B
61902	Wide Awake Field (Ascension Is.)	07 58S	014 24W	•
61976	Serge Frolow (Ile Tromelin)	15 53S	054 31E	A
63450	Addis Ababa	08 59N	038 48E	A
63741	Nairobi/Dagoretti	01 18S	036 45E	A
63985	Seychelles Inter. Airport (rawinsonde station)	04 41S	055 32E	*
64700	Njamena	12 08N	015 02E	A
65578	Abidjan	05 15N	003 56W	A
67237	Nampula	15 06S	039 17E	•
78397	Kingston/Norman Manley	17 56N	076 47W	B
78526	San Juan/Int. Puerto Rico	18 26N	066 00W	A
78583	Belize/Phillip Goldstron Intl. Airport	17 32N	088 18W	B
78762	Juan Santamaría	10 00N	084 13W	•
78954	Grantley Adams	13 04N	059 29W	A
80222	Bogotá/Eldorado	04 42N	074 08W	•
81405	Cayenne/Rochambeau	04 50N	052 22W	A
82193	Belem (Aeroporto)	01 23S	048 29W	B
82332	Manaus (Aeroporto)	03 09S	059 59W	•
82397	Fortaleza	03 44S	038 33W	**
83378	Brasilia (Aeroporto)	15 52S	047 56W	•
84008	San Cristóbal (Galápagos)	00 54S	089 36W	•
84628	Lima-Callao/Aerop. Int. Jorge Chavez	12 00S	077 07W	•
91217	Guam, Mariana Is.	13 33N	144 50E	A
91285	Hilo/Gen. Lyman, Hawaii, Hawaii	19 43N	155 04W	A
91334	Truk, Caroline Is.	07 28N	151 51E	A
91376	Majuro/Marshall Is. Intnl.	07 05N	171 23E	A
91408	Koror, Palau Is.	07 20N	134 29E	A
91517	Honiara	09 25S	159 58E	A
91530	Nauru Airport	00 32S	166 55E	**
91557	Bauerfield (Efate)	17 42S	168 18E	A
91610	Tarawa	01 21N	172 55E	•
91643	Funafuti	08 31S	179 13E	A
91701	Kanton Island	02 46S	171 43W	**
91765	Pago Pago/Int. Airport	14 20S	170 43W	A
91925	Atuona	09 48S	139 02W	A
91938	Tahiti-Faaa	17 33S	149 37W	A
94035	Port Moresby M.O.	09 26S	147 13E	•
94120	Darwin Airport	12 24S	130 52E	A
94203	Broome Airport	17 57S	122 13E	A
94294	Townsville Airport	19 15S	146 45E	A
96315	Brunei Airport	04 56N	114 56E	•
96935	Surabaya/Juanda	07 22S	112 46E	A
96996	Cocos Island Airport	12 11S	096 49E	A
98223	Laoag	18 11N	120 32E	A

Southern hemisphere

61995	Vacoas (Mauritius)	20 18S	057 30E	B
61996	Martin de Vivies (Ile N. Anersterdam)	37 48S	077 32E	B
61998	Port-aux-Français (Iles Kerguelen)	49 21S	070 15E	B
67197	Fort-Dauphin	25 02S	046 57E	C

Station index	*Name*	*Latitude*	*Longitude*	*Status*
68110	Windhoek	22 34S	017 06E	A
68588	Durban (Louis Botha)	29 58S	030 57E	A
68816	Cape Town (D. F Màlàn)	33 59S	018 36E	A
68906	Gough Island	40 21S	009 53W	A
68992	Bouvet Island	54 24S	003 18E	**
68994	Marion Island	46 53S	037 52E	A
83780	Sao Paulo (Aeroporto)	23 37S	046 39W	•
85442	Antofagasta	23 26S	070 26W	A
85469	Isla de Pascua	27 09S	109 25W	*
85543	Quintero Santiago	32 47S	071 31W	A
85585	Isla Juan Fernandez	33 40S	078 59W	**
85799	Puerto Montt	41 25S	073 05W	B
87155	Resistencia Aero	27 27S	059 03W	A
87860	Comodoro Rivadavia Aero	45 47S	067 30W	A
88889	Mount Pleasant Airport	51 49S	058 27W	A
88903	Grytviken, South Georgia	54 16S	036 30W	**
89002	Neumayer	70 40S	008 15W	B
89009	Amundsen-Scott	90 00S		C
89022	Halley	75 30S	026 39W	B
89050	Bellinghausen	62 12S	058 56W	A
89532	Syowa	69 00S	039 35E	A
89564	Mawson	67 36S	062 52E	A
89611	Casey	66 17S	110 31E	A
89642	Dumont D'Urville	66 40S	140 01E	A
89664	McMurdo	77 51S	166 40E	*
91592	Noumea (Nouvelle Caledonie)	22 16S	166 27E	A
91958	Rapa	27 37S	144 20W	A
93012	Kaitaia	35 08S	173 16E	A
93844	Invercargill Aerodrome	46 25S	168 20E	A
93986	Chatham Is.	43 57S	176 34W	A
93997	Raoul Island, Kermadec Is.	29 15S	177 55W	A
94302	Learmouth Airport	22 14S	114 05E	A
94461	Giles	25 02S	128 17E	A
94510	Charleville Airport	26 24S	146 16E	A
94610	Belmont (Perth Airport)	31 56S	115 57E	A
94975	Hobart Airport	42 50S	147 29E	A
94995	Lord Howe Island	31 32S	159 04E	A
94998	Macquarie Island	54 29S	158 56E	A

NOTE: The letter grades attached to the station list (column "status") are based upon the performance of each, as determined by the average number of reports received by ECMWF in a 30-day month:

A - From 24 to 30 reports per month;

B - From 18 to 23 reports per month;

C - From 11 to 17 reports per month;

• - Less than 11 reports per month, these stations would require upgrading;

** - Represents a network enhancement.

ANNEX III

Annex to paragraph 5.2.21 of the general summary

PROPOSED AMENDMENTS TO THE *GUIDE ON THE GLOBAL OBSERVING SYSTEM*, PARTS II AND VII

PART II

Replace sections 2.2 to 2.4 by new sections 2.2 to 2.4, and **delete** Table II.1.

2.2 GLOBAL AND REGIONAL REQUIREMENTS

2.2.1 *Data requirements of GDPS*

The formulation of data requirements for NWP methods for various forecasting ranges is an ongoing process based on an evolving level of experience with observing systems, on observing system experiments and network studies, and on the introduction of new data assimilation systems and NWP models. Data requirements have been established to meet the current and expected future possibilities of the GDPS.

The tables given in Attachment II.1 list the observational data which will be needed for advanced NWP systems by the year 2000. They include the needs for data assimilation and for analysis and model validation for global short- and medium-range forecasting (excluding extended-range forecasting). Requirements for regional modelling are mentioned in the explanatory text, where appropriate. The types of observing network and platforms providing data required at data-processing centres are also given in Attachment II.1. The regional observing networks are designed in accordance with data requirements of individual regions.

2.2.2 *Other requirements for observational data*

One of the main purposes of the GOS is to provide observational data for other WMO Programmes and for other international organizations. In particular, the Global Climate Observing System (GCOS), which is being developed as a dedicated observation system designed specifically to meet the scientific requirements for monitoring the climate and for detecting and predicting climate change, will be based largely on the GOS. However, the climate monitoring and predicting objectives will necessitate a number of improvements of the observing systems both in observational accuracy, representativeness and coverage. Reliable long-term data sets with optimal vertical resolution and homogeneous horizontal global coverage will be required. In order to meet GCOS requirements, the existing elements of the GOS should be enhanced as follows:

(*a*) The number of observational stations in remote areas should be increased;

(*b*) Long-term support should be found for a set of well-distributed high-quality upper-air stations composed of existing or new sites to provide a relatively homogeneous baseline global data network;

(*c*) Networks of drifting buoys making meteorological observations should be maintained and extended over data-sparse ocean areas (e.g. Indian and Southern Oceans);

(*d*) In order to maintain continuity in climate records, procedures should be introduced to calibrate new observing systems in the operational environment against the systems being replaced; in particular, old and new systems should be operated side-by-side for a period adequate to determine long-term relationships.

2.3 NATIONAL REQUIREMENTS

National observational data are required, in addition to general GDPS requirements, for nowcasting, very short-range weather forecasting and severe weather warnings, interpretation of processed forecast fields into local weather parameters, for verification of the quality of issued forecasts and warnings, and for other (non-real-time) applications. The observational data required for this purpose include surface and upper-air data obtained from land stations and ships, aircraft and buoys, as well as weather radar data and satellite information (satellite-derived temperature, humidity, winds and high-resolution imagery).

National observing networks are, of course, designed by Members according to their needs individually or in agreement with other Members but in accordance with WMO regulatory and guidance material.

In designing these networks, account should be taken of the special requirements for observational data and forecast products of the end-user groups for whom the services are being provided. Much of the data requirements for these services are included in the set of global observational data requirements but individual services may often require additional data, denser networks or greater frequency of observations. An indication of the requirements for measured or observed and forecast variables for a selection of important end-user groups is given in Attachment II.2.

2.4 ACHIEVABLE PERFORMANCE OF THE GOS

To address global, regional and national requirements for observational data the GOS will gradually evolve. Many of the requirements stated here can

only be met by satellite-borne observing systems. However, in most cases, a combination of satellite and *in situ* data will be needed to obtain adequate resolution and to ensure stability of calibration of remote sensing systems. The GOS will, therefore, continue to be composed of the surface-based and space-based subsystems. However, resource constraints require that careful judgements be made on the value of increased quality of GDPS output products weighed against the costs of additional observations. The definition of requirements and the design of the GOS are largely influenced by cost and by the ability of countries to operate GOS components and facilities. It is, therefore, important to define realistic and achievable goals for Members' efforts in respect of the composite global observing system. An estimate of the performance to be achieved by various elements of the GOS by the year 2005 related to observational requirements for the GDPS is given in Attachment II.3. It represents what are considered to be realistic and achievable goals in terms of resolution, accuracy and frequency on a global scale. In some regions, these requirements may be surpassed.

Rename Table II.2 as Attachment II.2.
Insert Attachment II.1 after section 2.4

Attachment II.1

OBSERVATIONAL DATA REQUIREMENTS FOR GDPS CENTRES FOR GLOBAL AND REGIONAL

Paragraphs 1, 2, and 3 state the observations required to operate all GDPS centres at national, regional and global levels. Paragraph 4 addresses the data requirements for NWP operations only.

1. The types of observation networks and platforms providing data required at data-processing centres are as follows:

(*a*) All stations included in the Regional Basic Synoptic Networks;
(*b*) The network of supplementary stations, including automatic stations;
(*c*) Automatic marine stations (drifting buoy and moored buoy programmes);
(*d*) Mobile sea stations;
(*e*) All other stations making radiowind, radiosonde/radiowind and pilot balloon observations;
(*f*) Meteorological rocket stations;
(*g*) Aircraft meteorological observations;
(*h*) Wind profilers;
(*i*) Doppler and weather watch radar systems;
(*j*) Space-based systems producing:
  (i) Imagery (including digital imagery);
  (ii) Radiance data;
  (iii) Retrieved vertical temperature profiles;
  (iv) Cloud and water vapor motion winds;
  (v) Digital information about clouds;
  (vi) Satellite surface wind and precipitable water;
  (vii) Manual data, for example, Australian bogus surface data;
  (viii) Moisture profiles derived from satellite observations over sea areas;
  (ix) Precipitation fields from multispectral cloud radiance data;
  (x) Other meteorological and environmental products;
(*k*) Radiological data reporting station in case of nuclear accidents (required for GDPS centres running transport models for environmental emergency response);
(*l*) Rainfall radar composites;
(*m*) Lightning detection and location systems network.

The observational data which will be needed to obtain optimum results from NWP systems by the year 2000 are elaborated in paragraph 4 and the related three tables of this attachment.

2. The report code types which carry the data provided by the platforms listed in paragraph 1 are given below:

(*a*) BUFR and GRIB;
(*b*) TEMP — Parts A, B, C, and D;
(*c*) PILOT — Parts A, B, C, and D;
(*d*) TEMP SHIP — Parts A, B, C, and D;
(*e*) PILOT SHIP — Parts A, B, C, and D;
(*f*) TEMP MOBIL — Parts A, B, C, and D;
(*g*) PILOT MOBIL — Parts A, B, C, and D;
(*h*) COLBA;
(*i*) TEMP DROP;
(*j*) ROCOB;
(*k*) SYNOP;
(*l*) SHIP;
(*m*) Reports from automatic stations on land and at sea;
(*n*) CODAR/AIREP/AMDAR;
(*o*) Selected satellite data, such as cloud images, SATEM, SAREP, SARAD, SATOB;
(*p*) BUOY;
(*q*) CLIMAT, CLIMAT SHIP;
(*r*) CLIMAT TEMP, CLIMAT TEMP SHIP;
(*s*) BATHY, TESAC, TRACKOB;
(*t*) WAVEOB;
(*u*) RADOB;
(*v*) RADREP;

NOTES:
(1) Items (*a*) to (*v*) do not indicate priorities.
(2) BUFR can encode any of the other above data forms and many more. If BUFR is used to represent any of these data forms, in lieu of the specific alphanumeric code form, then the same data requirements apply.

3. The frequency of observational reports required is as follows:

(*a*) BUFR and GRIB, as available;
(*b*) TEMP, PILOT, TEMP SHIP, PILOT SHIP, TEMP MOBIL, PILOT MOBIL, ROCOB, COLBA and TEMP DROP, as available;
(*c*) SYNOP, SHIP and reports from automatic stations on land and at sea — 0000, 0300, 0600, 0900, 1200, 1500, 1800, 2100 UTC and hourly whenever possible;
(*d*) CODAR/AIREP/AMDAR reports, as available;
(*e*) Selected satellite data, such as cloud images, SATEM, SAREP, SARAD and SATOB and digital cloud data, as available;
(*f*) BUOY as available;
(*g*) CLIMAT, CLIMAT SHIP, CLIMAT TEMP and CLIMAT TEMP SHIP — once per month;
(*h*) BATHY, TESAC, TRACKOB and WAVEOB, as available;
(*i*) RADOB and RADREP, as available.

4. Data needed for advanced NWP by the year 2000 is as follows:

INTRODUCTION

The following tables list the observational data which will be needed for advanced NWP systems by the year 2000. They include the needs for data assimilation and for analysis and model validation for global short- and medium-range forecasting (excluding long-range forecasting).

Requirements for regional modelling have also been considered. They have been mentioned in the explanatory text, where appropriate, but they have not been listed in the tables. Mesoscale modelling has not been considered.

It is most likely that data of the given specifications would benefit global NWP, if available; however, it does not mean that NWP could not be carried out without such data, as NWP models produce useful products even with the observational data set currently available. It does not mean either that data of higher specification would not be useful. On the contrary, when and where such data are produced they should be made available.

The problem of the feasibility of observing all the variables listed in these tables is not addressed. Most of the requirements stated here could only be met by satellite-borne observing systems. However, in many cases a combination of satellite and *in situ* data is needed to obtain adequate resolution and to ensure stability of calibration of remote sensing systems.

CONTENTS OF THE TABLES

The following notes provide some explanation of how the lists were prepared and some provisos on their use:

Variables

Following past convention, the observational requirements for data assimilation are stated in terms of geophysical variables. This is thought to be useful since, from a user's perspective, these are the variables on which information is required. However, it is important to note that these variables are not always observed directly (satellite systems observe none of them directly, with the exception of top-of-the-atmosphere radiation and a Doppler wind lidar). Also, it is no longer true that the users need their data exclusively in the form of geophysical parameters; recent developments in data assimilation have demonstrated the potential and the benefits of using data at the engineering level (e.g. radiances, brightness temperatures).

Horizontal resolution

(*a*) In general (and with some oversimplification), data are useful for assimilation and validation on spatial scales which the models are attempting to represent. One hundred kilometres are given as the requirement for the variables listed in the tables. However, it is possible to benefit from higher resolution data, considering the current developments towards global models with a grid length of less than 50 km;
(*b*) Regional models attempt to represent spatial scales above the mesoscale. Observational data are required at a resolution of 10 km.

Vertical resolution

(*a*) The same rationale is applied here: global NWP models are expected to have a resolution of less than one kilometre throughout the troposphere and lower stratosphere, with considerably higher resolution in the planetary boundary layer. In the mid- and upper stratosphere, a resolution of two kilometres is likely to be sufficient. The requirements for observations should be comparable;
(*b*) For regional models, observations are required at a resolution of 100 m (50 m in the planetary boundary layer).

Temporal resolution

(*a*) Just as with spatial resolution, data will be useful for assimilation and validation on temporal scales, which the models are attempting to represent. In the past, this has not been the case; so-called "four-dimensional" assimilation systems would more appropriately be described as "intermittent three-dimensional" systems, and they have not been able to make proper use of observations more frequent than the period of the data assimilation cycle (typically six hours). However, continued progress towards truly four-dimensional data assimilation is making it possible to extract useful information from observations at higher temporal frequency. With such systems, higher temporal resolution can compensate, to some extent, for poor horizontal resolution when the atmosphere is

moving. A requirement of three hours for upper-air data and one hour for surface data has been specified. However, like in the case of spatial resolution, upper-air data of higher specification (up to one hour) should also be made available (e.g. cloud motion wind data from geostationary satellites, and wind profiles from wind profilers);

(*b*) For regional models, both upper-air and surface data are required at a resolution of one hour.

Accuracy

The values given are intended to represent the RMS of the observation errors. The assessment of accuracy should include not only the true instrumental error but also the representativeness error (i.e. the characteristics of some observing systems, particularly *in situ* systems, which sample spatial and temporal scales and which are not represented by the models). For NWP applications, such effects appear as though they were observation errors.

Timeliness

In NWP, the value of data degrades with time, and it does so particularly rapidly for variables which change quickly. Operational assimilation systems are usually run with a cut-off time of about three hours for global models and one-and a half hours for regional models (although data received with longer delays remain useful). Therefore, the timeliness of data delivery must take into account the advertized initiation time of any operational model that uses that data. For observations which are expected to be used for validation, and not for analysis/assimilation in near-real time, timeliness is less critical.

Table 1
Three-dimensional fields

	Horizontal res. (km)	*Vertical res. (km)*	*Temporal res. (hours)*	*Accuracy (RMS error)*	*Notes*
Wind (horizontal)	100	.1 up to 2 km .5 up to 16 2 up to 30	3	2 m s^{-1} in the troposphere 3 m s^{-1} in the stratosphere	(1) (2)
Temperature (T)	100	.1 up to 2 km .5 up to 16 2 up to 30	3	.5 K in the troposphere 1 K in the stratosphere	(3)
Relative humidity (RH)	100	.1 up to 2 km .5 up to tropopause	3	5 % (RH)	

NOTES:
(1) Accuracy specified as RMS vector error.
(2) Hourly wind data from geostationary satellites and from wind profilers are also required. Tropospheric horizontal and vertical resolution and accuracy can be met by a space-based Doppler wind lidar in a sun-synchronous orbit.
(3) Geopotential height can be retrieved from specified T and RH with sufficient accuracy.

Table 2
Surface fields

	Horizontal res. (km)	*Temporal res.*	*Accuracy (RMS error)*	*Notes*
Pressure	100	1 h	0.5 hPa	
Wind	100	1 h	2 m s^{-1}	(1)
Temperature	100	1 h	1 K	
Relative humidity	100	1 h	5 %	
Accumulated precipitation	100	3 h	0.1 mm	(2)
Sea surface temperature	100	1 day	0.5 K	
Soil temperature	100	3 h	0.5 K	
Sea-ice cover	100	1 day	10 %	
Snow cover	100	1 day	10 %	
Snow equivalent-water depth	100	1 day	5 mm	
Soil moisture, 0–10 cm	100	1 day	0.02 $m^3 m^{-3}$	
Soil moisture, 10–100 cm	100	1 week	0.02 $m^3 m^{-3}$	
Percentage of vegetation	100	1 week	10 % (relative)	
Soil temperature, 20 cm	100	6 h	0.5 K	
Deep soil temperature, 100 cm	100	1 day	0.5 K	
Albedo, visible	100	1 day	1 %	
Albedo, near infrared	100	1 day	1 %	
Long-wave emissivity	100	1 day	1 %	
Ocean wave height	100	1 h	0.5 m	

NOTES:
(1) Wind at 10 metres over land. Over sea, height in the range of one to 40 metres (to be transmitted with the observation).
(2) Required principally for model validation, not time critical.

Table 3

Other two-dimensional fields

	Horizontal res. (km)	*Temporal res.*	*Accuracy (RMS error)*	*Notes*
Cloud fractional cover	100	3 h	10 %	
Cloud top height	100	3 h	0.5 km	(1)
Cloud base height	100	3 h	0.5 km	(1)
Total liquid water content	100	3 h	20 %	
TOA net short-wave radiation	100	3 h	5 W m^{-2}	(2)
TOA net long-wave radiation	100	3 h	5 W m^{-2}	(2)
Multi-purpose IR/VIS imagery	5	30 min.	-	(3)

NOTES:
(1) Accuracy higher in planetary boundary layer.
(2) Required principally for model validation; not time critical.
(3) Required to assist real-time observation monitoring and analysis/forecast validation.

Insert Attachment II.3.

ATTACHMENT II.3

Performance of elements of the GOS achievable by the year 2005

(1) Upper air observations

Meteorological variable	*Observing system*	*Horizontal resolution*	*Estimated coverage*	*Vertical resolution*	*Estimated vertical range*	*Frequency of observation*	*Observational error (RMS)*
Horizontal wind vector	Rawinsonde + pilot	≥ 250 km	Best over land, limited over oceans and sparsely populated areas	0.3–1.2 km	*0.1–35 km	1–4/day	1–3 m s^{-1}
	Aircraft	100 km	Limited to regular flight routes	0.1 km	Cruise level + ascent/descent	1–24/day	1–3 m s^{-1}
	Wind profiler radar	≤ 250 km	Able to improve resolution over land	0.1–1.2 km	*0.1–20 km	1–24/day	1–3 m s^{-1}
	Satellite cloud and moisture motion winds	100 km	Most useful at low latitudes, largest errors for upper cloud	0.5–4 km (depends on cloud type)	At available levels	When available, maximum possible 24/day	2–8 m s^{-1}
Temperature	Rawinsonde	≥ 250 km	Best over land, limited over oceans and sparsely populated areas	< 0.1 km	*0.1–35 km	1–4/day	0.3–1°C
	Satellite remote sensing	50 km	Global coverage, but largest errors in cloudy locations	2–8 km	0–50 km	Minimum of 4/day	1–2°C
	Surface-based remote sensing	≤ 250 km	Used to improve resolution over land	0.2–1 km	*0–6 km	1–24/day	0.5–2°C
	Aircraft	100 km	Limited to regular flight routes	< 0.1 km	Cruise level + Ascent/descent	1–24/day	0.5–1°C
Relative humidity	Rawinsonde	≥ 250 km	Best over land, limited over oceans and sparsely populated areas	< 0.1 km	**0–12 km	1–4/day	** 5 %
	Satellite remote sensing	50 km	Global coverage	2–4 km	0–12 km	Minimum of 4/day	10 %
	Surface based remote sensing + aircraft	Operational systems under development, but performance characteristics not yet available					

* Vertical range depends on equipment used.
** Vertical resolution degraded at heights above 8 km to between 0.5 and 1 km, and observation error at 10 %.

(2) Surface observations

Meteorological variable	*Observing system*	*Horizontal resolution*	*Estimated coverage*	*Frequency of observations*	*Observational error (RMS)*
Sea surface temperature (T)	Satellite	10 km	Global	≤ 4/day	0.5°C
	Ship	250 km	Global shipping lanes		0.5°C
	Buoy	250 km	Global		0.2°C
Surface pressure (P) Temperature (T, T_d)	Conventional land surface network and land AWS	≤ 250 km	Global	1–24/day	0.2–1 hPa (P) 0.5°C (T,T_d)
Wind vector (V)	Ship (P,T,T_d,V) Buoy (P,T,T_d,V)	≤ 250 km ≤ 250 km	Global ocean (limited coverage of T_d by moored buoy)		1–2 m s^{-1} (V)
	Satellite (V)	50 km	Global ocean	2/day	(ERS-1 specs)
	Surface-based remote sensing (V) (HF radar)	10 km	Mainly coastal regions		
Precipitation amount	Conventional land surface network and land AWS	≤ 250 km	Overland	4/day	5 %
	Weather radar	10 km	Overland	1–24/day	
	Satellite	50 km	Global	1/day	

PART VII

Insert the following new text after paragraph 7.2.2.3.2:

7.2.2.3.3 *Marine surface observations*

(*a*) Monthly exchange of monitoring results for marine surface observations should include lists of observing platforms arranged as follows:

List 1: Mean sea-level pressure
List 2: Wind speed
List 3: Wind direction
} from ships, moored buoys and other fixed marine platforms

List 4: Mean sea-level pressure
List 5: Wind speed
List 6: Wind direction
} from drifting buoys

(*b*) Each list should contain the following information:

(i) Month/year;
Monitoring centre;
Standard of comparison (first guess/background field);

(ii) The following data for each selected platform:
WMO identifier;
Average latitude/longitude over the month (for Lists 4–6 only);
Number of observations received (including gross errors);
Number of observations containing gross errors;
Percentage of observations containing gross errors;
Standard deviation of the departures from the reference field;
Mean departure from the reference field;
RMS departure from the reference field;
(Gross errors should be excluded from the calculation of the mean, standard deviation and RMS departures. For Lists 3 and 5, data for which the wind speed is less than 3 m s^{-1}, either observed or calculated, should also be excluded from all the statistics);

(*c*) The selection criteria for observing platforms in each of the lists are as follows:

LIST 1: MEAN SEA-LEVEL PRESSURE FROM SHIPS, MOORED BUOYS AND OTHER FIXED MARINE PLATFORMS

Selection criteria:
For 0000, 0600, 1200 and 1800 UTC combined, at least 20 observations during the month and at least one of the following:
The absolute value of the mean difference from the reference field is at least 4 hPa;
The standard deviation of the differences from the reference field is at least 6 hPa;
At least 25 per cent of observations have gross errors.
(The gross error limit to be used for observed minus reference field is 15 hPa).

LIST 2: WIND SPEED FROM SHIPS, MOORED BUOYS AND OTHER FIXED PLATFORMS

Selection criteria:
For 0000, 0600, 1200 and 1800 UTC combined, at least 20 observations during the month and at least one of the following:
The absolute value of the mean difference from the reference field is at least 5 m s^{-1};
At least 25 per cent of observations have gross errors.
(The gross error limit to be used for observed minus reference field (vector wind difference) is 25 m s^{-1}).

LIST 3: WIND DIRECTION FROM SHIPS, MOORED BUOYS AND OTHER FIXED PLATFORMS

Selection criteria:
For 0000, 0600, 1200 and 1800 UTC combined, at least 20 observations during the month and at least one of the following:
The absolute value of the mean difference from the reference field is at least 30 degrees;
The standard deviation of the differences from the reference field is at least 80 degrees.
(The gross error limit to be used for observed minus reference field (vector wind difference) is 25 m s^{-1}).

LIST 4: MEAN SEA-LEVEL PRESSURE FROM DRIFTING BUOYS

Selection criteria:
For all data times combined, at least 20 observations during the month and at least one of the following:
The absolute value of the mean difference from the reference field is at least 4 hPa;
The standard deviation of the differences from the reference field is at least 6 hPa;
At least 25 per cent of observations have gross errors.

(The gross error limit to be used for observed minus reference field is 15 hPa).

LIST 5: WIND SPEED FROM DRIFTING BUOYS

Selection criteria:

For all data times combined, at least 20 observations during the month and at least one of the following:

The absolute value of the mean difference from the reference field is at least 5 m s^{-1};

At least 25 per cent of observations have gross errors.

(The gross error limit to be used for observed minus reference field (vector wind difference) is 25 m s^{-1}).

LIST 6: WIND DIRECTION FROM DRIFTING BUOYS

Selection criteria:

For all data times combined, at least 20 observations during the month and at least one of the following:

The absolute value of the mean difference from the reference field is at least 30 degrees;

The standard deviation of the differences from the reference field is at least 80 degrees.

(The gross error limit to be used for observed minus reference field (vector wind difference) is 25 m s^{-1}).

ANNEX IV

Annex to paragraph 5.3.19 of the general summary

REQUIREMENTS FOR THE MAIN TELECOMMUNICATION NETWORK (MTN)

The following are understood to represent the outline requirements for the Main Telecommunication Network (MTN). Comments on the requirements are given in square brackets.

1. Observational data for global and interregional exchange shall be carried on the MTN within the time required.
   [Timeliness should be quantified — e.g. a maximum of 10 minutes from an RTH making data available until the time the last RTH on the MTN receives that data. The traffic profile, particularly the peak flows, must be quantified.]
2. The products from WMCs and RSMCs which are agreed for global and interregional exchange shall be disseminated to all RTHs within the agreed time-frame after presentation at the communication node serving each RSMC.
   [The traffic profile must be quantified, particularly the peak flows.]
3. The MTN must be capable of delivering binary data and products to every RTH. Binary objects of all sizes used in the WWW must be handled efficiently. The MTN shall support file transfer. Correct (i.e. error free) delivery of the data must be guaranteed.
4. The MTN shall meet a variety of other needs for routine and special real-time data exchange between Members, including the needs of WMO Programmes, other than the WWW and of non-WMO Programmes as agreed between WMO and other organizations.
   [It is assumed that these other needs do not constitute a significant part of the total data exchange; large requirements must be explicitly stated.]
   Selected non-real-time data exchange could also be carried to take advantage of spare capacity available at some period of the day. Carriage of such data must not interfere with timeliness of delivery of real-time data. Further definition of non-real-time data exchange requirements would be beneficial.
   [An example of non-real-time data is GCOS data.]
5. The MTN must conform to the relevant standards of CBS so that the global telecommunications system works harmoniously. The MTN must also provide a standard interface with Regional Meteorological Telecommunication Networks.
6. The level of service to every Member shall meet or exceed defined criteria. The equipment selected shall be reliable and be supported for a reasonable period.
7. The MTN must be flexible in several ways. For instance, it must be able to accommodate changing requirements for global and interregional data exchanges. It must also be possible for two or more Members who agree on bilateral/multilateral data exchanges to be served by the MTN, on the understanding that additional costs arising are borne by the Members concerned.
8. The MTN must be implemented in a cost-effective manner.
   [The target is to achieve better cost-effectiveness than that of the existing MTN. All Members should benefit from this improvement.]
9. The MTN must use, wherever possible, established and 'open' standardized data communication techniques.

[OSI (e.g. X.25, etc.) and Internet (TCP/IP family) protocols are acceptable.]

10. The MTN must be secure.
[The system must be protected against improper use, access or disruption.]
11. The MTN shall facilitate a coordinated management approach.
12. The evolution from the existing status of the MTN must be achieved without disruption and with at least the same level of service as is achieved by the existing system. Members concerned must be able to choose for themselves the 'intercept point' at which they become full participants in the improved MTN.

ANNEX V

Annex to paragraph 5.3.25 of the general summary

PLANNING DOCUMENT ON THE MAIN TELECOMMUNICATION NETWORK OF THE GLOBAL TELECOMMUNICATION SYSTEM

1. Introduction

1.1 The GTS is currently based on the store and forward transmission of meteorological messages constructed with headers complying with standards as defined in the *Manual on the Global Telecommunication System*. Messages (except for administrative and service messages) are coded according to WMO codes applicable to the type of meteorological data. There are more than 90 code forms which have been progressively developed over many years to suit the requirements of various classes of meteorological data.

1.2 Message structures and code forms exist to facilitate the transmission of meteorological observations, forecasts, data in grid point format produced by numerical weather prediction (NWP) systems, pictorial data (charts and satellite pictures), and numerous other classes of meteorological data.

1.3 Traditional code forms are character oriented and were intended to provide efficient information encoding while allowing either human or computer recognition and processing. With the more recent evolution of high volume observational data, such as that produced by satellites, and the growing volume and sophistication of the output products of NWP systems, bit oriented (or binary) code forms have been developed. These codes can only be processed by computer and require high quality error-protected circuits for their transmission.

1.4 WMO adopted the ITU X.25 standard in the early 1980s for use between centres wishing to exchange binary data. This has now been implemented on the majority of circuits on the Main Telecommunication Network (MTN) of the GTS.

1.5 Although the X.25 protocol is widely used on the GTS, it is not currently a packet switched network. The current implementation is limited to the use of virtual circuits (VCs) to connect directly the computer-based message switching systems (MSSs) of neighbouring centres. All messages must, therefore, transit the MSS of intermediate centres whether or not that intermediate centre itself requires the messages.

Need for further development of the GTS

1.6 The current GTS is quite efficient for the routine delivery of meteorological data. It cannot, however, meet many emerging requirements of meteorological services, arising from research activities, advanced numerical weather prediction, studies of global climate change, and such like. Shortcomings of the existing GTS that have been identified include: lack of flexibility of the static routing table architecture, lack of adequate request/reply capability, inability to communicate directly between non- adjacent centres, inadequate file transfer/long message capability, and lack of end-to-end delivery confirmation.

1.7 The concept of distributed databases (DDBs) has been developed in order to address some of the shortcomings mentioned above. The DDBs would be additional to (not replacing) the current routine data delivery function. DDBs will be established on a voluntary basis by centres willing and able to operate a database providing particular classes of data. Examples of such databases might include satellite-derived remote sensing data, oceanographic data, NWP products, and validated observational data, catalogues and directories (metadata).

1.8 The functional requirements which the GTS must meet in order to support these facilities include:

(*a*) The ability to evolve from the existing system without disruption to service and to a time schedule acceptable to individual Members;
(*b*) Communications capability between nonadjacent centres, supporting ad hoc data requests, file transfer, remote database access and electronic mail;
(*c*) Assured timely transmission of high priority operational data (such data not to be delayed by non-real-time or low priority data exchanges); and
(*d*) Autonomy of centres in the management of "their" component of the network (communications equipment and lines connected thereto).

1.9 In order to meet these new requirements, the concept of an "improved GTS" has been proposed

covering at least the current MTN part of the GTS. The following sections describe the technical concept, implementation and operation of the improved MTN.

2. MTN technical concept

X.25 global network

2.1 The current GTS operates on point-to-point links (Figure 1) using the X.25 protocol suite (both permanent virtual circuits (PVC) and switched virtual circuits (SVC) are used). This scenario does not make full use of the X.25 capabilities. The disadvantages of this are:

(*a*) Direct communications between nonadjacent centres is not possible;
(*b*) Not possible to use alternate routes to reach destination;
(*c*) Inefficient use of existing communications links;
(*d*) Not possible to support other applications other than message switching.

2.2 To support these capabilities and other requirements it is required to use X.25 switches. These switches allow connections to be made from any port on any node to any other port and node (Figure 2). The switching (routeing) of packets is controlled in the switches itself. PVC's are not likely to be supported on these switches. The switches can be interconnected by trunks of up to at least 64 kbps and maybe more (e.g. the UK research network JANET has used their X.25 backbone with 2 Mbps links).

TCP/IP and OSI over X.25

2.3 The growing usage of the industry standard network protocol TCP/IP requires that the MTN will have to provide facilities to be able to support this protocol stack. The easiest way to do this is to allow the TCP/IP protocol to be transported over the MTN X.25 backbone. There is a standard defined for encapsulating TCP/IP over X.25 (see the Internet RFC document 877). In order to comply with WMO specifications for the use of OSI standards, the MTN will also have to support the OSI protocol stack. This should not cause any problems. OSI Connection Oriented Network Services (CONS) use X.25 as the lower level protocol and for the OSI Connectionless Network Services (CLNS), which normally are used on LANs, there is also a standard to use them over X.25 (ISO standard 8473) (Figure 3).

Use of multiprotocol routers

2.4 Multiprotocol routers are able to support a variety of protocols like TCP/IP, OSI and DECnet. Sites can choose their own router provided it supports the standards for encapsulating higher level protocols over X.25 (see paragraph 2.3 above). The routers should be connected to the X.25 backbone (as indicated in Figures 4 and 5) and initially two sites could set up a direct logical connection for TCP/IP. However, when more sites want to use TCP/IP, the use of the X.25 addresses for TCP/IP encapsulation and the TCP/IP routeing structure requires that this should be properly coordinated in order to control the flow of IP traffic over

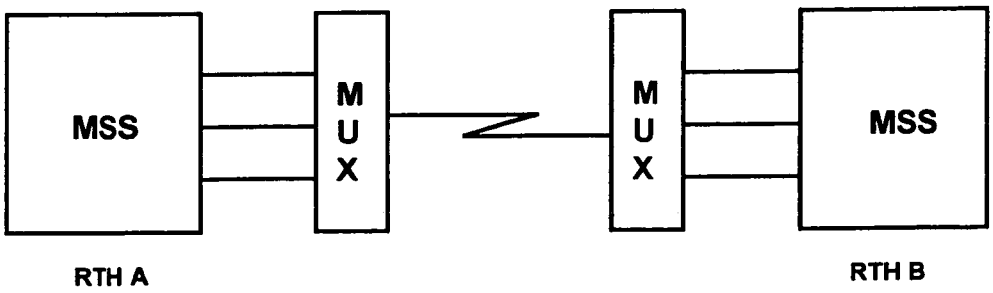

Figure 1 — A typical RTH to RTH connection in today's GTS. Multiplexed channels provide a guaranteed bandwidth for different data types.

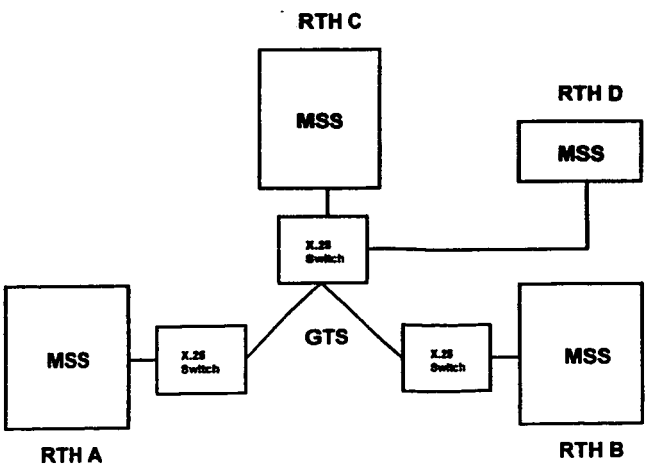

Figure 2 — Following the recommendation to start using logical multiplexing and the requirement for end-to-end connectivity between non-adjacent centres, X.25 switches can be used to provide these features.

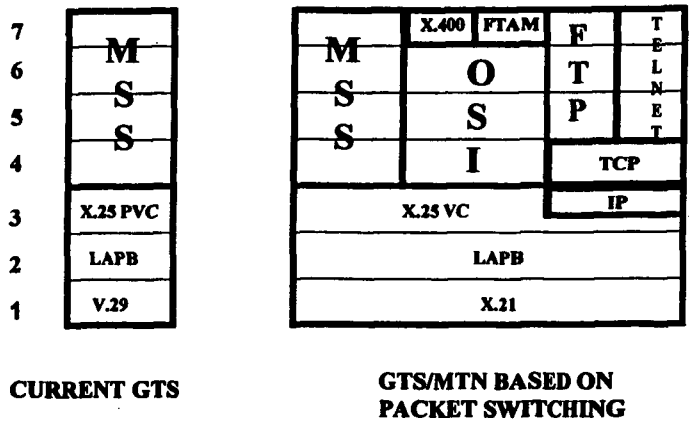

Figure 3 — Representation of existing GTS and future GTS/MTN in terms of the OSI model.

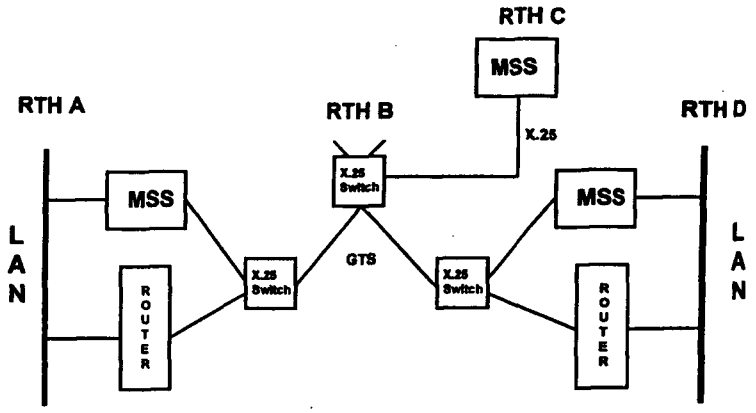

Figure 4 — As a next natural step to provide additional services multiprotocol routers can be installed. This will enable centres to make TCP/IP or OSI connections. The core network will be X.25 based.

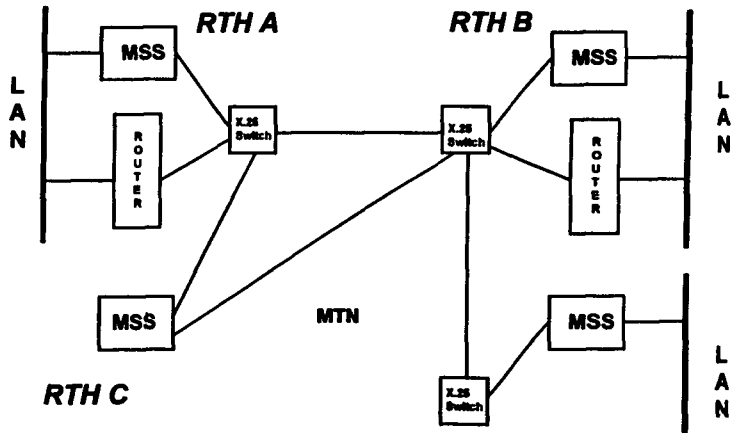

Figure 5 — This is an example of how several RTHs may be connected. All have an X.25 switch and some also have routers installed. RTH C will still be able to function fully within the network with respect to the MSS requirements. RTHs A and B are able to run IP over the X.25 network with the routers installed.

the X.25 backbone. The same applies, in principle, for the OSI traffic and OSI addressing (Appendix 1). This is further discussed in paragraphs 2.7 to 2.10 below.

Throughout guarantees

2.5 It is recommended to let the X.25 protocol dynamically control the bandwidth. All SVCs that are established on a port will, in principle, receive an equal share of the bandwith (depending on how fast the applications that set up the SVCs can transfer data). The line utilization should be closely monitored in order to predict traffic flow and to anticipate the traffic growth. For the MTN backbone, it is recommended to use digital 64 kbps circuits from the start. They are very reliable and more cost-effective than analogue circuits. Also, as there is less control over who is using the bandwidth of the communication links with X.25 SVCs, enough bandwidth should be available for so-called 'third-party' data transfer. If need be, the old-style time division multiplexing techniques (TDM) can still be used (Figure 6) to isolate a portion of the bandwidth for high priority traffic. The X.25 addressing scheme should be flexible

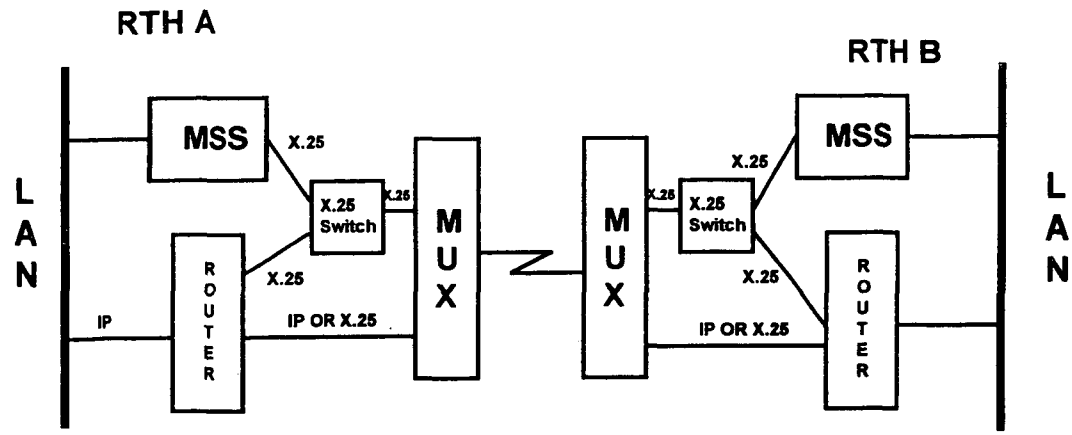

Figure 6 — In this example, physical multiplexers are used between centres to provide guaranteed bandwidth for certain traffic. This can be a bilateral decision. In this configuration, it is possible to make direct IP connections, not using X.25.

enough to allow the use of sub-addresses for switching (routeing) decisions. The management of the X.25 switches will be more difficult, e.g. how to distinguish between important data from two nonadjacent centres and the same important data from two adjacent centres: should both data travel over the allocated bandwidth or not.

Internet access (security)

2.6 The MTN should be protected from the Internet by using packet filters and/or gateways. Most multiprotocol routers provide packet filters and there are also public domain packages available (from the Internet community) to set up secure gateways. What can be done initially is only to allow certain types of applications (TCP/IP and/or OSI) to use the MTN. This screening has to be implemented by the sites connected directly to the MTN. Also an 'Acceptable Use and Guidelines' document should be defined for the higher level protocols used over the MTN. For example, no general purpose applications (like anonymous FTP servers, gopher servers, archie servers) should be allowed.

Addressing schema for X.25 and TCP/IP

2.7 X.25 addresses for use on the MTN will follow the X.121 format in use by Packet Switching Public Data Networks (PSPDN); i.e. a four digit Data Network Identification Code (DNIC) followed by a Network Terminal Number (NTN) of up to 10 digits. On PSPDNs, the DNIC is globally unique. As many Members may have PSPDN connections, it is important that the MTN has a DNIC which does not clash with any in use by a PSPDN. Therefore, it is recommended that the WMO Secretariat seek advice from ITU about how to obtain a DNIC for the MTN. Until then, or if we cannot obtain a DNIC, it is proposed that we use a DNIC of 0101, which is guaranteed not to clash with any public DNIC. It is, however, possible that this DNIC may cause a clash with private networks in some Member States. It is assumed that this is not the case but all Members should satisfy themselves that 0101 is an acceptable value (if not, others beginning with 0 may well be).

2.8 It is also necessary to define a structure for the NTN. This will consist of four fields — country, network protocol, port and sub-address. The country field will be a three-digit value, as specified in annex D of X.121 (use the lowest value where a country has more than one specified). The network protocol field will be a two-digit value indicating the network protocol in use, i.e. 00 for MSS, 11 for TCP/IP, 22 for OSI/CONS and 33 for OSI/CLNS, with other values being defined as necessary. Centres can, of course, use other values by bilateral agreement but these must be centrally registered to enable other centres to monitor traffic type. The port field will be a three-digit value identifying an end-system, and the sub-addresses field will provide routeing within an end-system. Both the port and sub-addresses fields will be specified and managed locally. This will provide ample flexibility for centres to define their own structure for port values, e.g. possibly to use the first digit to identify separate switches/routers, etc.

2.9 An example of an X.25 address could be 01012281134589, where:

0101 is the "default" DNIC;
228 is the X.121 country code for Switzerland;
11 is the indicator for a TCP/IP protocol;
345 is the nationally assigned port number; and
89 is the nationally assigned sub-address.

2.10 The IP addressing scheme should comply with the Internet organization numbering system. Each site planning to use the TCP/IP protocol over the MTN X.25 backbone should register an IP network address. The registration should be sought even if the country of the GTS centre does not have an Internet connection. It is the registration of a proper IP network address that is important. It will prevent problems later if the centre requires full Internet access. The MTN backbone sites and/or WMO could and/or should provide an Internet gateway if this is required.

Gateways to RMTN and "basic GTS"

2.11 The MTN will provide a global X.25 backbone between the main centres (e.g. between the regions; preferably two or three centres in each region should be part of this backbone). These centres will provide the gateway for the RMTN national centres. Initially, this can still be an 'old-style' structured GTS with point-to-point links, but this can be moved to an X.25 switching network like the MTN when appropriate.

3. **MTN implementation**

3.1 The implementation of the MTN must be done in stages. The building blocks of the MTN will consist of:

(*a*) A pure X.25 level 3 (OSI) backbone network;

(*b*) The message switching system (MSS) capable of protocol conversion and virtual circuit handling;

(*c*) Gateway servers capable of providing access to large databases and to external networks.

Some, or all, of these building blocks are currently in place at a number of centres on the GTS.

The backbone network

3.2 Connections between centres on the backbone network will be at level 3 of the OSI model (network level) as described in paragraph 2 above. This true packet switched network standard will allow for traffic control on the backbone and will prevent flooding by packets generated outside of the backbone. An X.25 switch will be required by each centre on the backbone. Each switch must be capable of handling switched virtual circuit connections to all other switches which comprise the backbone. Outline specifications of suitable packet switching equipment are given in Appendix 2. Network speed of 64 kbps (nominal 56 kbps in some countries) is recommended. There are two possible options which could be considered for implementation of the backbone.

Replacing the existing GTS connection with a new X.25 dedicated circuit

3.2.1 The recommended approach, which is consistent with the MTN concept described in paragraph 2 above, is to install new connections (for example at 64 kbps) and then to stage the implementation of X.25 and TCP/IP. Participants would agree on a bilateral basis on implementation details. Costs would be portioned on the basis of 50/50 split or by other formulas agreed to on a bilateral basis. Once the new circuit has stabilized, the old link can be shut down. This approach would minimize the costs to the Member countries.

Lease services from an International Value Added Network (IVAN) vendor

3.2.2 The International Value Added Network (IVAN) suppliers can provide one stop shopping for data circuits, switches, routers, bandwidth and network management at costs which may be attractive in some areas. These companies lease large amounts of bandwidth between certain countries and can offer services at prices better than those that individual countries could obtain through their national telecommunications carriers or companies. The added advantage of these IVANs is that hardware lease, configuration, implementation, network management, and security is provided. This would make implementation and operation easier. The best approach with an IVAN installation would be for a parallel circuit installation, with the old GTS circuit removed once the new one is fully operational.

The message switching system (MSS)

3.3 The message switching system (MSS) provides meteorological message routing, bulletin preparation, and protocol conversion necessary to provide connections to other systems and low speed character oriented circuits. The MSS would be connected to the backbone network (example at the major hubs) as shown in Figures 2 to 7. It could, where required, provide protocol conversion to nonstandard circuits. Most of the infrastructure required to support the MSS is available at major centres today. The MSS would provide continued connection to the MTN for "non MTN" centres as long as required by bilateral agreement with those countries connected to it.

The gateway server

3.4 Members providing access to large databases would require a "firewalled" gateway server and a router to provide access to IP at level 3 of the OSI. A multiprotocol router is recommended at each gateway location. Software configuration to support X.25, CLNP and TCP/IP should be available on the gateway. Router hardware configuration with two Ethernet connection are recommended in order to permit the separation of X.25 and CLNP with different priorities (most manufacturers) by peers on the network.

3.5 It is recommended that the routers be installed on a "firewall" external to Members' national computer centres and communications networks so that traffic on the MTN can be separated from domestic LAN circuits and can prevent intentional or accidental destruction of the databases. Kerberos authentication could be implemented on UNIX servers to further protect hosts.

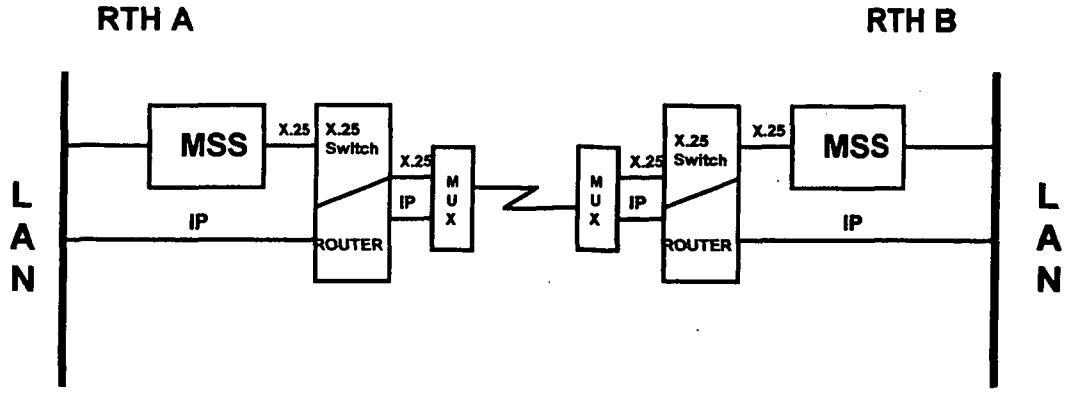

Figure 7 — A possible alternative to Figure 5 is to combine the X.25/router functionality in one physical box.

Implementation plan

3.6 A detailed architecture document needs to be drafted. Following that, an implementation plan should be completed. It is recommended that the initial participants agree on the technical details of the circuit, switch and router installations, timing, configuration and maintenance issues, and that any costs be resolved before acquisitions are made. The implementation plan should include: a list of contacts and responsibilities of each participant; circuit install dates; switch/router install dates; switch configuration; X.25 and IP addressing; host and file names; alternate site or backup procedures; stress and stability tests, including error rate and error recovery procedures; acceptance criteria; and user authentication (not to be exchanged by email).

Cutover plan

3.7 The cutover plan would include scheduled operational date/time; notification to participants; notification to vendors; acceptance testing and acknowledgement by participants in writing that new facilities are meeting operational requirements; and notification of WMO GTS Members.

Development of network services

3.8 It is highly recommended that the GTS monitoring requirements be automated and made available on gateway servers on the network. One host on the network should be declared as the main host for software distribution and a directory of available software be kept up to date on that host by participating/contributing countries. This host could also be responsible for running network management statistics.

4. MTN operation

General principles

4.1 The operation of the MTN will, to the maximum extent possible, continue the established principle of national control of equipment and telecommunications line terminations provided by Members.

4.2 It is, therefore, intended that X.25 switches, multiprotocol routers and any other equipment forming part of the MTN will be configured, maintained and generally controlled by the Member providing the equipment. There is not intended to be any central network management system which allows, in any way, external control of MTN telecommunications equipment.

Capacity management and monitoring

4.3 It will be necessary for circuit loadings to be monitored routinely to facilitate the effective management of the MTN and to allow orderly planning of switch and circuit capacity upgrades as traffic grows. In the absence of a central network management system, it will necessary for each centre to maintain statistics on its components of the MTN and to exchange these with adjacent centres and the WMO Secretariat periodically. In the initial period, quarterly exchanges of such information are proposed.

4.4 Statistical data to be gathered and exchanged should include:

(*a*) Circuit utilization (as a percentage of maximum theoretical capacity) for each trunk (international circuit) averaged over:
  (i) A day;
  (ii) The busiest hour;
  (iii) The busiest 15 minutes.
  This information does not need to be gathered every day, but could be averaged over a number of representative days within the quarterly monitoring period;

(*b*) Volume of traffic (in megabytes) originated and received by the centre over time periods as in (*a*) above;

(*c*) Daily volumes of traffic transiting, but not used, by the centre.

Address management

4.5 An addressing framework has been proposed as given in paragraph 2.7 above. This framework allows Members to assign X.25 addresses for the national component of the X.25 address. Address lists will need to be compiled and circulated by the WMO Secretariat from time to time.

4.6 Each centre will have to implement and maintain X.25 address mapping (or translation) within its packet switches, to direct calls on the appropriate MTN trunk, as required, to reach the ultimate call destination. Where appropriate, primary and secondary routes may need to be mapped, to provide automatic rerouting of calls around a temporarily out of service switching node. Care will have to be exercised to ensure that circular routing of packets can never occur.

4.7 IP addresses, as mentioned in paragraph 2.10 above will accord with national allocations obtained from the Internet organization and should not need any further management other than publicizing relevant addresses to users and potential users.

Fault management

4.8 Each centre will be responsible to monitor its equipment and lines and to act promptly to rectify any faults that occur.

Information services directory

4.9 As centres establish operating services on the MTN, such as the connection of their MSS or the establishment of databases (e.g. as part of the DDBs concept) details should be passed to the WMO Secretariat for distribution to Members.

Introduction of new centres

4.10 Implementation of new centres would be carried out by the centre concerned in close consultation with neighbouring centres with whom the new centre is to be directly connected. It would be desirable for the WMO Secretariat to be given early advice of the plans of the new centre so that other centres could have input on the preferred connection point(s) for the new centre and on the effect on the MTN topology overall.

Appendix 1
SPECIFICATION FOR MULTIPROTOCOL ROUTERS FOR THE MTN

Multiprotocol routers used on the MTN should comply with the following broad specifications:

Standards compliance:	TCP/IP routing according to RFC 1009 for Internet gateway (mandatory); CCITT 1988 for X.25 DTE/DCE interface (mandatory); X.121 addressing (mandatory); TCP/IP over X.25 according to RFC 1356 (mandatory); CLNP over X.25 (ISO document) (optional); IEEE 802.3 CSMA/CD Ethernet for local area network connection (desirable, depends on site); CCITT V.35 data link protocol for serial connections to adjacent packet switching equipment or other TCP/IP gateways (desirable, depends on site); RS232/V.24/V.28 data link protocols for serial connections to adjacent packet switching equipment (mandatory); RFC 1548 point-to-point protocol for data link exchanges with adjacent TCP/IP routers (desirable, depends on site).
Packet throughput:	10 000 packets per second minimum, for packet sizes up to 1 503 bytes (mandatory).
Traffic handling:	Configurable facility for prioritizing traffic based on input/output port, packet size and TCP port (desirable).
Input/output:	Modular I/O structure providing minimum of one Ethernet port and two serial ports (mandatory); Router must be upgradable to a total of eight serial ports and two Ethernet ports (desirable); Serial ports should be configurable for synchronous/ asynchronous operation (mandatory); Port speed should be capable of speeds between 9 600 bps and 64 Kbps (mandatory); Ports should be upgradable for speeds in excess of 64 Kbps (desirable).
Address configuration:	Router should be capable of maintaining address translation tables for IP to X.25 mappings to provide transparent IP traffic propagation through the X.25 part of the network (mandatory).
Network management:	Comprehensive configuration system from any port on the network (mandatory); SNMP agent accessible remotely (as described in the RFC 1157, 1270, 1381, 1382 (mandatory); Ability to provide usage statistics such as: Average port loading; Packet counts; Error counts; Peak traffic counts (mandatory).
Security:	Configuration facilities to be password protected and accessible only by nominated hosts (mandatory); Access list facilities to allow permit/deny of traffic controllable by source/destination address and TCP port address (mandatory).

Appendix 2
SPECIFICATION FOR PACKET SWITCHING EQUIPMENT FOR THE MTN

Packet switch equipment used on the MTN should comply with the following broad specifications:

Standards compliance:	CCITT 1988 standards for X.25 DCE/DTE interface, X.3, X.28 and X.29 for asynchronous PAD facilities and X.121 addressing.
Packet throughput:	500 packet per second minimum, for packet size up to 512 bytes.
Trunk ports:	Standard data rates up to 64 Kbps minimum; Minimum capability of four trunk ports.
Address translation:	Facilities to translate between called and calling addresses and to direct calls to specific outgoing trunks according to called number; Ability to select a secondary outgoing route in the event of a call failure on the primary route.
Input/output:	Modular I/O structure providing a minimum of eight ports configurable as synchronous or asynchronous; Physical interface to suit local requirements, based on appropriate standards, such as: X.21/V.10/V.11; RS232/V.24/V.28; Standard data rates to 64 Kbps minimum.

Network management:	Comprehensive configuration facility accessible from designated supervisory port; Ability to provide usage statistics, such as: Average trunk loading over periods from one minute to 24 hours; Packet count over the same periods as above; Packet count by calling and called address; SNMP agent desirable.
Security:	Configuration facilities to be password protected and accessible only by nominated ports.

ANNEX VI

Annex to paragraph 5.3.29 of the general summary

QUESTIONS DIRECTLY RELATED TO METEOROLOGICAL ACTIVITIES ASSIGNED TO STUDY GROUPS OF THE ITU RADIOCOMMUNICATION SECTOR FOR THE STUDY PERIOD 1994-1995

1. **Study Group 7 — Science services**
Chairman: H. G. Kimball (United States)

Working Party 7C:

Q 138-1/7: Radiocommunication systems for Earth exploration satellites, including meteorological satellites.

Q 140-1/7: Sensors used by Earth exploration satellites, including meteorological satellites.

Q 141-1/7: Command and data transmission systems of meteorological satellites.

Q 138-1/7: Radiocommunication systems for Earth exploration satellites; data collection and position location systems.

Q 144/7: Radiocommunication systems for the meteorological aids service.

Q 204-1/7: Sharing of the band 1675–1710 MHz between the mobile satellite service and the meteorological satellite and meteorological aids service.

Task Group 7/1:

Q 153/7: Protection criteria for the space services operating near 2 GHz, in particular in the bands 2025–2110 MHz and 2200–2290 MHz.

2. **Study Group 8 — Mobile, radiodetermination, amateur and related services**
Chairman: E. George (Germany)

Task Group 8/2:

Q 102-1/8: Suitable frequency bands for the operation of wind profiler radars.

Working Party 8A:

Q 103/8: Criteria for sharing between the mobile service and space research, space operation and Earth exploration satellite service space stations in the 2025–2110 MHz and 2200–2290 MHz bands.

ANNEX VII

Annex to paragraph 5.3.33 of the general summary

WORKING GROUP ON TELECOMMUNICATIONS/STUDY GROUP ON RADIO-FREQUENCY COORDINATION

1. **Terms of reference**

(*a*) To 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 coordination with other technical commissions and the CBS Working Groups on Observations and on Satellites;

(*b*) To keep abreast of the activities of the Radiocommunication Sector (ITU-R) of the International Telecommunication Union, and in particular of the Radiocommunication Study Groups, on frequency matters pertaining to meteorological activities, and assist the WMO Secretariat in its participation in ITU-R work;

(*c*) To prepare and coordinate proposals on radio-regulation matters pertaining to meteorological activities to be submitted to the competent ITU Radiocommunication Study Groups, Assembly, Regional and World Conferences;

(*d*) To facilitate the coordination between WMO Members for the use of frequency bands allocated to meteorological activities with respect to:
  (i) Coordination of frequency assignments between countries for a given radiocommunication service;
  (ii) Coordination of frequency assignments between various radiocommunication services (i.e. meteorological aids and DCPs) sharing the same band.

2. **Composition**

(*a*) Chairman: (to be designated by the chairman of the Working Group on Telecommunications, in consultation with the president of CBS);
(*b*) Three experts designated by the Working Group on Telecommunications;
(*c*) One expert each designated by the CBS Working Groups on Satellites and on Observations;
(*d*) A representative from the ITU-R (NOTE: WMO should invite the ITU to designate its representative);
(*e*) Experts designated by CAS, CAeM, CIMO and CMM to participate in specific studies pertaining to the activities of their technical commissions;
(*f*) Additional experts from WMO Member countries, and/or from international organizations to participate in specific studies, as appropriate.

ANNEX VIII

Annex to paragraph 5.4.27 of the general summary

FM 95 CREX — A CHARACTER FORM FOR THE REPRESENTATION AND EXCHANGE OF DATA

Introduction

The Commission for Basic Systems, at its ninth session, approved FM 94 BUFR for operational use with effect from 1 November 1988. Discussion concerning the transition from character based codes to binary representation forms reflected:

(*a*) The need for simple tabular forms of presentation which could be derived efficiently from BUFR;
(*b*) The need to support non-automated applications;
(*c*) The undesirability of developing complex computer software to translate from BUFR to code forms.

In an attempt to achieve this, a simple but potentially universal tabular form (BTAB – BUFR TABular Form) was drawn up; this was revised a number of times, while other alternatives were also developed (e.g. FLEX). Further consideration lead to a request from the tenth session of CBS that, if possible, a merged BTAB/FLEX type code form should be developed to cater for new types of data without the need to develop a new character code form for each such type.

Summary of revisions

The first version of BTAB included proposals for header lines, containing defined abbreviations for the elements tabulated. There was also a proposal to include "irregular" data in terms of reference–value pairs. It has been suggested that the inclusion of header lines is wasteful in terms of space, and ineffectual in an international environment where, for display purposes, it is much more appropriate for such information to be defined locally and inserted at the time of display.

The Commission for Basic Systems, at its tenth session, examined proposals for FLEX, and indicated that any development along such lines needed to result in a representation form which could be understood without the aid of computers. Many of the concepts of CREX are almost identical to corresponding concepts in FLEX, but with the preservation or addition of presentation form principles that lead to human readable data.

Methodology

The following basic principles have been followed:

(*a*) Maximize simplicity;
(*b*) Use BUFR tables A, B and D as a model;
(*c*) Remove the dependency on language-related abbreviations;
(*d*) Provide a means for ordered visual display.

General form

To achieve simplicity, the representation of data is a simple list of values, following a defined pattern. Each value is presented as an entity which relates directly to the full value to be associated with a single element, such as time, temperature, pressure, etc.

Each type or category of data which can be represented using CREX is tabulated within a table (CREX table A), using, wherever possible, the identical values for equivalent data types as are defined for BUFR in BUFR table A.

Each element capable of being represented within CREX is listed in a set of tables. This is also the method followed in BUFR, giving rise to BUFR table B. CREX table B entries define four attributes:

(*a*) The name of the element;
(*b*) The number of characters usually used with which to represent values of the element;
(*c*) The units used for values of the element;
(*d*) A scale value, representing a power of 10 by which the element value, expressed in the units given, has been multiplied in order to obtain the value coded in CREX.

CREX also uses the concept of reducing the number of references to table B required in order to define a set of data, by supporting a table which contains established lists of table B references. This is the concept used in BUFR to develop BUFR table D; as a consequence, the CREX table containing lists of table B references is CREX table D.

Element values are coded into CREX either as numeric characters or as alphanumeric characters. Wherever possible, numeric values, using the standard international system of units, are coded directly, after correcting for the tabulated scale; positive values are unsigned, but negative values are signed. Qualitative values are encoded as code figures with reference to code tables. Names are encoded as alphanumeric characters. Thus, with the exception of names, all data values are numeric and, hence, do not relate to any spoken language. Since the number of alphabetic characters used is minimal, the dependence on latin script is not excessive.

CREX data representation is partitioned into sets of tabular displays. This concept is intended to assist in the presentation of the data for human readability. There are three ways in which the data represented in CREX can be presented:

(*a*) It can be encoded such that columns within each tabular display are aligned, enhancing readability but increasing the data volume;
(*b*) It can be encoded to minimize data volume and to minimize the presentation area (e.g. paper area) when displayed, but at the cost of some degradation in readability;
(*c*) It can be subjected to a small amount of processing prior to display, enabling each tabular display to be correctly aligned, and, if desired, to be annotated according to local language and standards (e.g. column headings added according to contents, etc.).

The first two of the above are supported directly within CREX. The third option requires development by the recipient, but because of its conceived desirability is facilitated by the design of CREX. It can, thus, be achieved with the aid of relatively simple computer software.

The representation form begins with the characters CREX and ends with the characters 7777. The CREX heading is followed by an identification group Annn, where nnn indicates, with reference to CREX table A, the category of information represented. This is, then, followed by display descriptions and an error checking indicator.

CREX tabular display description

The general principles of BUFR data description are followed, with some simplification, to enable CREX tabular displays to be defined.

BUFR table B is used as a model for the table required to relate the element references to the description of the elements they represent, the units used, the scale factor applied, and the number of characters required to represent data values. CREX table B corresponds to BUFR table B, using the same reference numbers; it can be considered as an extension to appropriate entries within BUFR table B, defining those attributes appropriate to CREX listed above. Thus, the construction and future maintenance of CREX table B follows directly from inspection of BUFR table B.

Table B references may be included within the definition of a tabular display. They are referenced by quoting the reference number as a five-digit number preceded by the letter B.

For the time being, the "data description operators" of BUFR table C have not been included. Experience will define the necessity to review their inclusion at a later date. Some points to note when considering the possible future role of operators to CREX data definition are:

(*a*) The principle operation, that of replication, is implicit within a display table (the number of rows in the table);
(*b*) Other operations (change scale, change data width, etc.) may be implied by inspection, provided they are coupled together (e.g. an increase of one character in data width could imply a corresponding change in scale factor, and would be evident from inspection of the data width of the column of values concerned).

The BUFR concept of "lists of common sequences" (BUFR table D) has been added. CREX table D contains lists of CREX table B entries to define tabular displays. Ideally, common forms of observed data should be defined within BUFR by a single BUFR table D entry. This logic does not map exactly to the needs of CREX, since multiple tabular displays may be appropriate to a single observational report (e.g. for TEMP data, one tabular display might contain time, location, and surface information, while a second tabular display would depict the upper-air information; also, for a set of surface reports at a given date and time from a given WMO block number, one tabular display could depict this information once only for a number of stations which follow, while a second could display the reports station by station). Thus, the full data description for CREX should ideally be broken down into a single CREX table D entry for each tabular display required.

Examples

Introduction

The following examples are based on the proposed regulations and tables for CREX.

NOTES:

(1) Wherever possible, code tables from BUFR should be used.

(2) Values shall be signed when negative; when positive they are never signed.

Common surface code

The following example illustrates the principles embodied in the attached CREX definition with respect to the common surface code; first, the data in FM 12-VII SYNOP form:

```
SMUK22 EGRR 090600
AAXX 09064
03075 41480 62413 10073 20050 49962 55019 71562 868//=
03140 41365 82314 10095 20082 40031 55002 76165 885//=
03160 41365 82314 10100 20084 40096 56015 76162 885//=
03222 41360 82317 10098 20085 40064 57021 76166 885//=
03292 41556 82010 10090 20071 40096 57018 70522 885//=
03558 41362 82414 10083 20073 40143 56016 75152 886//=
03603 41365 82317 10095 20084 40129 56018 72163 885//=
03740 41020 82209 10078 20076 40155 56012 72854 886//=
```

Representation of this example in CREX form might give:

```
CREX0101 A000 D01126 D02126++
1989 01 09 06 03++
075 1 3000 240 013 2805 2782 09962 5 019 15 6 1 6 6 08 030 61 62+
140 1 1500 230 014 2827 2814 10031 5 002 61 6 5 8 8 05 020 61 62+
160 1 1500 230 014 2832 2814 10024 6 015 61 6 2 8 8 05 020 61 62+
222 1 1000 230 017 2830 2817 10064 7 021 61 6 6 8 8 05 020 61 62+
292 1 0600 200 010 2822 2803 10096 7 018 05 2 2 8 8 05 060 61 62+
558 1 1200 240 014 2815 2805 10143 6 016 51 5 2 8 8 06 020 61 62+
603 1 1500 230 017 2827 2816 10129 6 018 21 6 5 8 8 05 020 61 62+
740 1 0200 220 009 2810 2808 10155 6 012 28 5 4 8 8 06 000 61 62++
```

where, for the sake of this example, it is supposed that the following table D entries are defined (note that when table D entries do become defined the following entries may be completely different — they are given here only as an illustration of the mechanism proposed):

01126	B04001	year
	B04002	month
	B04003	day
	B04004	hour
	B01001	WMO block number
02126	B01002	WMO station number
	B02001	type of station
	B20001	horizontal visibility
	B11011	10 m wind direction
	B11012	10 m wind speed
	B12001	temperature /dry bulb
	B12003	dew point temperature
	B10051	pressure reduced to mean sea level
	B10063	characteristic of pressure change
	B10061	3-hour pressure change
	B20003	present weather
	B20004	past weather (1)
	B20005	past weather (2)
	B20010	cloud cover (total)
	B20011	cloud amount
	B20012	cloud type
	B20013	cloud height

In the above example, observations are displayed for eight stations for 0600 UTC on 9 January 1989. Two tabular displays are defined, one containing the date/time and WMO block information common to the eight stations, and the other containing the station numbers and meteorological data. It is easy to pick out the values represented, as they form columns of values, in the order listed above.

The CREX form also provides for an optional check digit extension, enabling checks to be carried out for missing groups, and suitable for transmission over links which are prone to transmission errors. Including this option with the above example gives rise to table rows which are too long to print one row per line within this document; however, this is not a problem for CREX, as line terminators are ignored when CREX is decoded:

CREX0101 A000 D01126 D02126 E++11989 201 309 406 503++
1075 21 33000 4240 5013 62805 72782 809962 95 0019 115 26 31 46 56 608 7030 861 962+
1140 21 31500 4230 5014 62827 72814 810031 95 0002 161 26 35 48 58 605 7020 861 962+
1160 21 31500 4230 5014 62832 72814 810024 96 0015 161 26 32 48 58 605 7020 861 962+
1222 21 31000 4230 5017 62830 72817 810064 97 0021 161 26 36 48 58 605 7020 861 962+
1292 21 30600 4200 5010 62822 72803 810096 97 0018 105 22 32 48 58 605 7060 861 962+
1558 21 31200 4240 5014 62815 72805 810143 96 0016 151 25 32 48 58 606 7020 861 962+
1603 21 31500 4230 5017 62827 72816 810129 96 0018 121 26 35 48 58 605 7020 861 962+
1740 21 30200 4220 5009 62810 72808 810155 96 0012 128 25 34 48 58 606 7000 861 962++

Note that the data definition for the above examples could have been represented explicitly, thus:

CREX0101 A000 (B04001 B04002 B04003 B04004 B01001) (B01002 B02001 B20001 B11011 B11012 B12001 B12003 B10051 B10063 B10061 B20003 B20004 B20005 B20010 B20011 B20012 B20013)

This illustrates the universal nature of CREX; provided entries appropriate to the required elements are added to table B, it is possible to represent any set of elements, and to group elements into tabular displays of a required composition in any required order.

General comments

The above examples illustrate the simplicity of CREX as a means for representing data. It is necessary only to look up the table references to establish which columns contain which data values.

CREX displays could be enhanced by the substitution of column headings, indicating which columns contain which values. Such substitution, as a computer application, could be tailored to be meaningful in terms of the language and script local to users of that application.

It is also demonstrated that the relationship between data in BUFR and data conforming to this proposal for CREX is such that it would be simple to produce and update computer programs which would convert between the two forms.

CREX is composed of sections, rows, and groups, seperated from one another by defined separator sequences. A line terminator is not one of these defined sequences, but is allowed anywhere within a CREX entity provided it is grouped together with any such defined seperator. On decoding or postprocessing, line terminator sequences are ignored. Thus, it is possible to define tabular displays comprising of rows of data of any length and, additionally, to conform to such restrictions as a maximum of 69 characters per line for GTS transmission.

While CREX is not as efficient in terms of number of characters used as the established character code forms, it is easy to encode and decode, it can provide a sufficient level of data check capability, and it is flexible with respect to the handling of new data types. It also relates to BUFR in a natural and direct way. These properties make it a suitable code form for the transmission of new data types over links which cannot handle binary data.

In the following draft specification, sample tables have been drawn up, and every attempt has been made to conform with the current BUFR specifications.

CREX – BUFR TABULAR FORM

```
-------------
| CREXeevv  |
|-----------------------------------------------------------------
| Annn ((Baaa ... Bbbb) ... (Bccc ... Bddd)) (Djjj ... Dkkk) (E) |
|-----------------------------------------------------------------
| tabular form body |
---------------------
```

NOTES:

(1) CREX is the name of a character form for the representation and exchange of meteorological data.

(2) CREX uses principles which correspond to FM 94 BUFR.

(3) CREX may be used for the exchange of new forms of data for which there is no suitable alternative character code form over telecommunications circuits which are not yet able to accommodate FM 94 BUFR.

(4) A CREX entity consists of one or more subsets of related meteorological data.

(5) It will be noted that CREX representation is suitable for the display of meteorological data in printed form, and for visualization of reported values on a visual display unit or meteorological workstation.

REGULATIONS

NN.1

General

NN.1.1

The CREX code form shall be used for the representation and exchange of meteorological data; CREX is universal in nature, and is especially suitable for the character representation of new data, for which there has been developed no suitable character code form, and which is otherwise exchanged, stored or represented using FM 94 BUFR.

NN.1.2

The beginning and ending of the representation form shall be identified by the indicator "CREX", represented according to International Alphabet No. 2 or 5.

NN.1.2.1

The characters "CREX" shall be followed by a two digit number (ee) indicating the CREX edition number used.

NN.1.2.2

The CREX version number shall be followed by a two digit number (vv) indicating the CREX table version number used.

NN.1.3

Information within CREX shall be character coded, represented according to International Alphabet No. 5. The conventions described within this regulation shall be used with respect to "special characters".

NN.1.3.1

Groups of characters shall be separated by means of a single separator character; the space character shall be used for data to be exchanged using the GTS; otherwise, the tab character may be used as an alternative separator character.

NN.1.3.2

Certain special characters defined below shall also denote, in addition to their special function, the function of the separator character. The special characters which shall act also as a separator character shall include:

the row terminator;
the section separator.

NN.1.3.3

The row terminator shall be represented by the character string "+".

NN.1.3.4

The section separator shall be represented by the character string "++"; a section seperator shall additionally function as a row terminator for the last row of a tabular display.

NN.1.3.5

Line termination shall be represented by a sequence of <CR><CR><LF> when CREX is used for data to be transmitted via the GTS; otherwise any suitable line termination sequence may be used.

NN.1.3.6

A check digit, where used, shall be the first character of a data group, and shall take the units value of the number of the data group in which it appears counting along the row in which it is contained. Thus, the check digit shall take the values 1, 2, 3, ... 9, 0, 1, etc., according to its correspondence with the 1st, 2nd, 3rd, ... 9th, 10th, 11th, etc., data value as indicated by the expanded table B references which define a row of a tabular display.

NN.1.4

A missing value shall be represented as follows:

(*a*) Where an indicator character is not used, by a group of space characters, equal in number to the number of characters normally required to represent the value concerned [is this the best way??? an alternative would be to use the accepted convention of the correct number of "/" characters];

(*b*) Where a check digit is used, by the omission of the appropriate group; such omission will be detectable by consideration of the value of the check digit of any subsequent group within the row of the tabular display concerned.

NN.2

Section 1 — Indicator section

NN.2.1

Section 1 shall contain an indicator sequence, followed by an identifier sequence, followed by one or more tabular display descriptions and, optionally, a check digit extension indicator, followed by a section separator.

NN.2.2

The indicator sequence shall be comprised of the characters CREX, represented according to International Alphabet No. 5, followed by a two-digit number containing the CREX edition number, and a two-digit number containing the CREX table version number.

NN.2.3

The identifier sequence shall contain a three-digit reference to CREX table A, preceded by the letter A.

NN.2.4
Data coded in CREX shall consist of one or more tabular displays. A tabular display shall be defined by one or more references to CREX tables B and D, each preceded by the letter B and D respectively; each unbracketed reference shall define a tabular display; where multiple references are required to define a single tabular display, these shall be enclosed in brackets (e.g. (Diiiii Djjjjj) defines a single tabular form corresponding to the concatenation of the list of element references corresponding to Diiiii and that corresponding to Djjjjj).
NN.2.5
The check digit extension indicator (optional) shall take the form of the single character E.

NN.3

Section 2 — Tabular form body
NN.3.1
The tabular form body shall contain one of many tabular displays.
NN.3.2
Each tabular display shall comprise one or more rows of data values.
NN.3.3
Each row of data values shall conform to the list of element references defined by the table B and D references contained within the tabular display definition, and shall be terminated by a row terminator, or, in the case of the last row, by a section separator.
NN.3.3.1
An element reference shall be defined by CREX table B; entries in this table correspond exactly to entries with the same reference in BUFR table B; CREX table B entries expand BUFR table B entries by the addition of:
(*a*) The units to be used for data representation in CREX;
(*b*) The scale factor to be applied to the units for CREX purposes;
(*c*) The number of characters to be used in CREX to represent the corresponding data value.
NN.3.3.2
Reference values for CREX elements shall always be zero.
NN.3.3.3
Units shall be based on standard international units wherever possible, but shall be scaled by powers of 10 to provide suitable units for the display of data.
NN.3.3.4
Data values may be represented using data widths which do not conform to CREX table B. Where more characters are used, this shall imply increased precision; where fewer characters are used this shall imply reduced precision; changes in precision and, consequently, in scale factor, shall always correspond to an implied change of the scale factor by powers of 10 equivalent in magnitude, but opposite in sign to the change in the data width.
NN.3.3.5
Where check digits are present within section 1, the data width of encoded values shall be counted from the digit following the check digit to the digit which precedes the first separator character following the check digit; a null data width shall signify a missing value.
NN.3.4
Negative values only shall be signed; positive values shall be unsigned.
NN.3.5
No maximum row length shall be defined within CREX; applications which use CREX may, however, impost line length restrictions; such restrictions shall be accommodated by inserting line terminators at suitable intervals within a CREX entity, ensuring that such line terminators occur only at locations immediately following seperator characters, row terminators, or section seperators.
NOTE: This is proposed because applications to display CREX could operate using media with a wide variety of line lengths, including some with the ability to support "horizontal scroll" facilities. CREX permits line terminators to be present at any point within the code form where a separator is designated, thus, providing the option either to format a CREX entity so that it can be displayed neatly "as is", or to rely on applications which use CREX to rearrange the data to support such neatness. The resulting flexibility enables tabular displays which would, by their natural composition, require very long lines to be accommodated in circumstances where physical constraints dictate maximum line lengths insufficient to depict a complete row on one line.

CREX TABLE RELATIVE TO SECTION 1
CREX TABLE A (Data category)
BUFR table A shall apply.

CREX TABLES RELATIVE TO SECTION 2
CREX TABLE B (Classification of elements)
The classification used for BUFR shall apply (tables are defined below).

CREX Table B — *Classification of elements*

Class 01 — Identification

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
01001	WMO block number	2	Numeric	0
01002	WMO station number	3	Numeric	0
01003	WMO region number	1	Numeric	0
01004	WMO region sub-area	2	Numeric	0
01005	Buoy/platform identifier	3	Numeric	0
01006	Aircraft identifier	5	Alphabetic	0
01007	Satellite identifier	2	Code table	0
01010	Ship call sign (4 letter)	4	Alphabetic	0
01011	Ship call sign (9 letter)	9	Alphabetic	0
01012	Direction of motion of moving observing platform	3	Degrees true	0
01013	Speed of motion of moving	3	$m\ s^{-1}$	0
01021	Synoptic feature identifier	4	Numeric	0
01022	Synoptic feature name	9	Alphabetic	0
01062	ICAO location indicator	4	Alphabetic	0
01063	ICAO location indicator	8	Alphabetic	0

Class 02 — Instrumentation

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
02001	Type of station	1	Code table	0
02002	Type of instrumentation for wind measurement	1	Flag table	0
02003	Type of measuring instrument used	2	Code table	0
02004	Type of instrument for evaporation measurement	2	Code table	0
02011	Radiosonde type	3	Code table	0
02012	Radiosonde computational method	2	Code table	0
02021	Satellite instrument data used in processing	2	Flag table	0
02022	Satellite data-processing technique used	3	Flag table	0
02023	Cloud motion computational method	2	Code table	0
02024	Integrated mean humidity computational method	2	Code table	0
02025	Satellite channel	4	Flag table	0
02031	Method of ocean current measurement	2	Code table	0
02032	Indicator for digitization	2	Code table	0
02033	Method of salinity/depth measurement	2	Code table	0
02041	Method of estimating reports related to synoptic features	2	Code table	0
02061	Aircraft navigational system	2	Code table	0

NOTES:

(1) This class shall contain elements to describe the instrumentation used to obtain meteorological elements reported.

(2) This class may also contain elements relating to observational procedures.

(3) Some indication of the expected accuracy may be implied in conjunction with certain elements in this class.

Class 04 — Location (time)

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
04001	Year	4	Year	0
04002	Month	2	Month	0
04003	Day	2	Day	0
04004	Hour	2	Hour	0
04005	Minute	2	Minute	0
04006	Second	2	Second	0

Class 04 — Location (time) (*continued*)

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
04011	Time increment (years)	5	Year	0
04012	Time increment (months)	5	Month	0
04013	Time increment (days)	5	Day	0
04014	Time increment (hours)	5	Hour	0
04015	Time increment (minutes)	5	Minute	0
04016	Time increment (seconds)	5	Second	0
04021	Time period or displacement	5	Year	0
04022	Time period or displacement	5	Month	0
04023	Time period or displacement	5	Day	0
04024	Time period or displacement	5	Hour	0
04025	Time period or displacement	5	Minute	0
04026	Time period or displacement	5	Second	0
04031	Duration of time relating to following value	5	Hour	0

NOTES:

(1) The significance of the time periods or displacements shall be indicated using the time significance code corresponding to BUFR code table 0 08 021.

(2) Where more than one time period or displacement is required to define complex time structures, they shall be defined in immediate succession, and the following order shall apply:
ensemble period (if required) followed by
forecast period (if required) followed by
period for averaging or accumulation (if required).

(3) Time periods or displacements, and time increments require an initial time location to be defined prior to their use, followed, where appropriate, by a time significance definition.

(4) The time location, when used with forecast values, shall indicate the time of the initial state for the forecast, or the beginning of the forecast period; when used with ensemble means of forecast values, the time location shall indicate the initial state or the beginning of the first forecast over which ensemble means are derived.

(5) Negative time periods or displacements shall be used to indicate time periods or displacements preceding the currently defined time.

Class 05 — Location (horizontal-1)

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
05001	Latitude (high accuracy)	7	Degree	5
05002	Latitude (coarse accuracy)	5	Degree	2

NOTES:

(1) Values of latitude and latitude increments are limited to the range -90 degrees to +90 degrees.

(2) South latitude shall be assigned negative values.

(3) North to south increments shall be assigned negative values.

Class 06 — Location (horizontal-2)

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
06001	Longitude (high accuracy)	9	Degree	5
06002	Longitude (coarse accuracy)	6	Degree	2

NOTES:

(1) Values of longitude are limited to the range -180 degrees to +180 degrees.

(2) West longitude shall be assigned negative values.

(3) East to west increments shall be assigned negative values.

Class 07 — Location (vertical)

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
07001	Height of station	5	m	0
07002	Height or altitude	5	m	–1
none	Geopotential height	5	Geop. m	–2
07003	Geopotential	6	$m^2\ s^{-2}$	–1

Class 07 — Location (vertical) (*continued*)

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
07004	Pressure	5	Pa	–1
07005	Height increment	5	m	0
07006	Height above station	5	m	0
07021	Elevation	5	Degree	2
07022	Solar elevation	5	Degree	2
07061	Depth below land surface	5	m	2
07062	Depth below sea surface	6	m	1

NOTE: Elevation shall only be used with respect to a stated location and a bearing, azimuth, or distance; it shall not redefine that location.

Class 08 — Significance qualifiers

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
08001	Vertical sounding significance	2	Code table	0
08002	Vertical significance (surface observations)	2	Code table	0
08003	Vertical significance (satellite observations)	2	Code table	0
08004	Phase of aircraft flight	2	Code table	0
08011	Horizontal significance	2	Code table	0
08012	Land/sea qualifier	2	Code table	0
08021	Time significance	2	Code table	0
08022	Total number (with respect to accumulation or average)	5	Numeric	0

NOTE: Where values are accumulated or averaged (for example over a time period), the total number of values from which the accumulated or averaged values are obtained may be represented using reference 08022.

Class 10 — Vertical elements and pressure

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
10001	Height of land surface	5	m	0
10002	Height	5	m	–1
none	Geopotential height	5	Geop. m	–1
10004	Pressure	5	Pa	–1
10051	Pressure reduced to mean sea level	5	Pa	–1
10052	Altimeter setting (QNH)	5	Pa	–1
10061	3-hour pressure change	3	Pa	–1
10062	24-hour pressure change	3	Pa	–1
10063	Characteristic of pressure tendency	1	Code table	0

NOTE: Vertical elements and pressure shall be used to define values of these elements independent of the element or variable denoting the vertical coordinate.

Class 11 — Wind and turbulence

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
11001	Wind direction	3	Degree true	0
11002	Wind speed	3	m s^{-1}	0
11011	Wind direction at 10 m	3	Degree true	0
11012	Wind speed at 10 m	3	m s^{-1}	0
11013	Wind direction at 5 m	3	Degree true	0
11014	Wind speed at 5 m	3	m s^{-1}	0
11031	Degree of turbulence	2	Code table	0
11032	Height of base of turbulence	5	m	0
11033	Height of top of turbulence	5	m	0
11041	Maximum wind speed (gusts)	3	m s^{-1}	0
11042	Maximum wind speed (10-minute mean wind)	3	m s^{-1}	0
11061	Absolute wind shear in 1 km layer below	3	m s^{-1}	0
11062	Absolute wind shear in 1 km layer below	3	m s^{-1}	0

Class 12 — Temperature

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
12001	Temperature/dry bulb	4	K	1
12002	Wet bulb temperature	4	K	1
12003	Dew point temperature	4	K	1
12004	Dry bulb temperature at 2 m	4	K	1
12005	Wet bulb temperature at 2 m	4	K	1
12006	Dew point temperature at 2 m	4	K	1
12007	Virtual temperature	4	K	1
12011	Maximum temperature, at height and over period specified	4	K	1
12012	Minimum temperature, at height and over period specified	4	K	1
12013	Ground minimum temperature past 12 hours	4	K	1
12014	Maximum temperature at 2 m, past 12 hours	4	K	1
12015	Minimum temperature at 2 m, past 12 hours	4	K	1
12016	Maximum temperature at 2 m, past 24 hours	4	K	1
12017	Minimum temperature at 2 m, past 24 hours	4	K	1
12030	Soil temperature	4	K	1
12061	Skin temperature	4	K	1
12062	Equivalent black body temperature	4	K	1
12063	Brightness temperature	4	K	1

NOTE: Where the expression "at height and over period specified" is entered under ELEMENT NAME, an appropriate vertical location shall be specified using descriptors from Class 07, together with an appropriate period using descriptors from Class 04.

Class 13 — Hygrographic and hydrological

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
13001	Specific humidity	5	kg kg^{-1}	5
13002	Mixing ratio	5	kg kg^{-1}	5
13003	Relative humidity	3	%	0
13004	Vapour pressure	4	Pa	-1
13005	Vapour density	3	kg m^{-3}	3
13011	Total precipitation/total water equivalent of snow	5	kg m^{-2}	4
13012	Depth of fresh snow	4	m	2
13013	Total snow depth	5	m	2
13014	Rainfall/water equivalent of snow (averaged rate)	4	kg m^{-2} s^{-1}	7
13015	Snowfall (averaged rate)	4	m s^{-1}	7
13016	Precipitable water	3	kg m^{-2}	3
13020	Total precipitation, past 3 hours	5	kg m^{-2}	4
13021	Total precipitation, past 6 hours	5	kg m^{-2}	4
13022	Total precipitation, past 12 hours	5	kg m^{-2}	4
13023	Total precipitation, past 24 hours	5	kg m^{-2}	4
13031	Evapotranspiration	3	kg m^{-2}	3
13032	Evaporation/evapotranspiration	3	kg m^{-2}	4
13041	Pasquill-Gifford stability	2	Code table	0

NOTES:

(1) A total precipitation value of -1 shall indicate a "trace".

(2) DEPTH OF FRESH SNOW:
A depth of fresh snow value of -1 shall indicate "less than 0.5 cm".
A depth of fresh snow value of -2 shall indicate "snow cover not continuous".

(3) TOTAL SNOW DEPTH:
A total snow depth value of -1 shall indicate "less than 0.5 cm".
A total snow depth value of -2 shall indicate "snow cover not continuous".

Class 14 — Radiation and radiance

REFERENCE	ELEMENT NAME	DATA WIDTH	UNIT	SCALE
14001	Long wave radiation, integrated over 24 hours	5	J m^{-2}	–3
14002	Long wave radiation, integrated over period specified	5	J m^{-2}	–3
14003	Short wave radiation, integrated over 24 hours	5	J m^{-2}	–3
14004	Short wave radiation, integrated over period specified	5	J m^{-2}	–3
14011	Net long wave radiation, integrated over 24 hours	5	J m^{-2}	–3
14012	Net long wave radiation, integrated over period specified	5	J m^{-2}	–3
14013	Net short wave radiation, integrated over 24 hours	5	J m^{-2}	–3
14014	Net short wave radiation, integrated over the period specified	5	J m^{-2}	–3
14015	Net radiation, integrated over 24 hours	5	J m^{-2}	–3
14021	Global radiation	5	J m^{-2}	–3
14031	Total sunshine	4	Minute	0
14032	Total sunshine	4	Hour	0

NOTES:

(1) Downward radiation shall be assigned negative values.

(2) Upward radiation shall be assigned positive values.

(3) Where the expression "period specified" is entered under ELEMENT NAME, an appropriate period shall be specified using descriptors from Class 04.

Class 15 — Physical/chemical constituents

REFERENCE	ELEMENT NAME	DATA WIDTH	UNIT	SCALE
15001	Ozone	4	Dobson	0

Class 19 — Synoptic features

REFERENCE	ELEMENT NAME	DATA WIDTH	UNIT	SCALE
19001	Type of synoptic feature	3	Code table	0
19002	Effective radius of feature	4	m	3
19003	Wind speed threshold	3	m s^{-1}	0
19004	Effective radius with respect to wind speed above threshold	4	m	2
19005	Isobaric threshold	4	Pa	2
19006	Effective radius with respect to isobaric threshold	4	m	2
19007	Vertical extent of feature	3	Pa	2
19008	Direction of motion of feature	3	Degree	0
19009	Speed of motion of feature	3	m s^{-1}	1

NOTE: The effective radius of feature shall be defined with respect to the radius of the 1 000 hPa isobar at mean sea level.

Class 20 — Observed phenomena

REFERENCE	ELEMENT NAME	DATA WIDTH	UNIT	SCALE
20001	Horizontal visibility	4	m	0
20002	Vertical visibility	3	m	0
20003	Present weather	2	Code table	0
20004	Past weather (1)	2	Code table	0
20005	Past weather (2)	2	Code table	0
20010	Cloud cover (total)	1	Code table	0
20011	Cloud amount	1	Code table	0

Class 20 — Observed phenomena *(continued)*

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
20012	Cloud type	2	Code table	0
20013	Height of base of cloud	3	m	0
20014	Height of top of cloud	3	m	0
20015	Pressure at base of cloud	5	Pa	-1
20016	Pressure at top of cloud	5	Pa	-1
20017	Cloud top description	1	Code table	0
20031	Ice deposit (thickness)	3	m	2
20032	Rate of ice accretion	3	Code table	0
20033	Cause of ice accretion	3	Fag table	0
20034	Sea ice concentration	3	Code table	0
20035	Amount and type of ice	3	Code table	0
20036	Ice situation	3	Code table	0
20037	Ice development	3	Code table	0
20038	Bearing of ice edge	3	Degree true	0
20039	Ice distance	4	m	-1
20041	Airframe icing	3	Code table	0
20051	Amount of low cloud	1	Code table	0
20052	Amount of medium cloud	1	Code table	0
20053	Amount of high cloud	1	Code table	0
20061	Runway visual range (RVR)	4	m	0
20062	State of ground (with or without snow)	1	Code table	0
20063	Special phenomena	4	Code table	0

Class 22 — Oceanographic

REFERENCE	*ELEMENT NAME*	*DATA WIDTH*	*UNIT*	*SCALE*
22001	Direction of waves	3	Degree true	0
22002	Direction of wind waves	3	Degree true	0
22003	Direction of swell waves	3	Degree true	0
22004	Direction of current	3	Degree true	0
22011	Period of waves	3	s	0
22012	Period of wind waves	3	s	0
22013	Period of swell waves	3	s	0
22021	Height of waves	4	m	1
22022	Height of wind waves	4	m	1
22023	Height of swell waves	4	m	1
22031	Speed of current	4	$m\ s^{-1}$	2
22042	Sea temperature	4	K	1
22043	Sea temperature	5	K	2
22044	Sound velocity	5	$m\ s^{-1}$	1
22061	State of sea	1	Code table	0
22062	Salinity	5	PPT	2
22063	Total water depth	5	m	0

CREX Table D — ***Lists of common sequences***

Category	*Contents*
1	Non-meteorological sequences
2	Meteorological sequences common to surface data
3	Meteorological sequences for vertical soundings data
4	Meteorological sequences common to satellite observations
5	Reserved
6	Sequences common to oceanographic observations
7	Surface report sequences (land)
8	Surface report sequences (sea)
9	Vertical sounding sequences (conventional data)
10	Vertical sounding sequences (satellite data)

Category	*Contents*
11	Single level report sequences (conventional data)
12	Single level report sequences (satellite data)
13	Reserved
14	Reserved
15	Oceanographic report sequences
16	Synoptic feature sequences

(The following to be defined)

Category 1 — Non-meteorological sequences

Reference *Contents* *Meaning*

Category 2 — Meteorological sequences common to surface data

Reference *Contents* *Meaning*

Category 3 — Meteorological sequences for vertical soundings data

Reference *Contents* *Meaning*

Category 4 — Meteorological sequences common to satellite observations

Reference *Contents* *Meaning*

Category 6 — Sequences common to oceanographic observations

Reference *Contents* *Meaning*

Category 15 — Oceanographic report sequences

Reference *Contents* *Meaning*

Category 16 — Synoptic feature sequences

Reference *Contents* *Meaning*

CREX — CharacteR EXchange form Backus-Naur Form definition

The following defines CREX using the Backus-Naur Form (BNF) notation:

1.1 CREX entity

<CREX entity> :: = <indicator section>
<tabular form body>

1.2 Indicator section

<indicator section> :: = <indicator sequence>
<identifier sequence>
<tabular display description>+
<CHECK DIGIT EXTENSION INDICATOR>O
<SECTION SEPARATOR>
<LINE TERMINATOR>O

<indicator sequence> :: = <INDICATOR GROUP>
<CREX EDITION NUMBER>
<TABLE VERSION NUMBER>
<SEPARATOR>

<INDICATOR GROUP> :: = string "CREX"

<CREX EDITION NUMBER> :: = 2-digit number indicating CREX edition

<TABLE VERSION NUMBER> :: = 2-digit number indicating version of tables

<SEPARATOR> :: = string " " or string "tab";
<)>, <ROW TERMINATOR>,
and <SECTION TERMINATOR> act as <SEPARATOR> in addition to their defined function

<identifier sequence>	:: =	<A> <TABLE A REFERENCE> <SEPARATOR>
<A>	:: =	string "A".
<TABLE A REFERENCE>	:: =	3-digit reference to CREX table A.
<tabular display description>	:: =	<sequence descriptor>(1) | <(> <descriptor>+ <)>
<(>	:: =	string "("; used to indicate the beginning of a data description which describes a tabular display; may be omitted if the tabular display can be described by a single reference to CREX table D.
<descriptor>	:: =	<element descriptor> | <sequence descriptor>
<element descriptor>	:: =	<B> <TABLE B REFERENCE> <SEPARATOR>
<sequence descriptor>	:: =	<D> <TABLE D REFERENCE> <SEPARATOR> (will need modification if operators are added)
<B>	:: =	string "B".
<TABLE B REFERENCE>	:: =	integer, represented in five characters, containing a code number reference to CREX table B; this table lists, against any given reference, the element name, the units in which that element is normally represented, a scale factor, and the data width normally used to represent that element; by convention, if more or less characters are present in the corresponding data group, the scale factor shall be shifted by equivalent powers of ten to represent more or less accuracy.
<D>	:: =	string "D".
<TABLE D REFERENCE>	:: =	integer, represented in five characters, containing a code number reference to CREX table D; this table lists, against any given reference, a list of table B and table D references to be substituted for this reference; further substitution for CREX table D references within the list enables the original table D reference to be replaced by a list of table B references.
<)>	:: =	string ")"; used to indicate the end of a data description which describes a tabular display.
<CHECK DIGIT EXTENSION INDICATOR>	:: =	string "E"; when present, signifies the presence of a <CHECK DIGIT> as the first digit of each <data group>.
<SECTION SEPARATOR>	:: =	string "++"
<LINE TERMINATOR>	:: =	string "<cr><cr><lf>"; alternative forms of line terminator may also be used, but the string "<cr><cr><lf>" should always be used for GTS transmission. Note that a <LINE TERMINATOR> may be used anywhere in addition to a <SEPARATOR>; thus <LINE TERMINATOR> is accommodated within CREX purely as a device to enhance display, or to comply with external restrictions concerning maximum allowed line length. Decoding software should ignore <LINE TERMINATOR>.

1.3 Tabular form body

<tabular form body>	:: =	<tabular display>+
<tabular display>	:: =	<values line>+ <SECTION SEPARATOR>

<values line>	:: =	<data group>(n) <ROW TERMINATOR>
<ROW TERMINATOR>	:: =	string "+"
<data group>	:: =	<CHECK DIGIT>O <DATA VALUE> <SEPARATOR>
<CHECK DIGIT>	:: =	an integer represented within one character, containing the last digit of the <element descriptor> number (1 to n) of the <element descriptor> from the expanded <tabular diplay description> which corresponds to the following data group within the current row.
<DATA VALUE>	:: =	integer, of variable length, terminated by a separator; there shall be a one to one correspondence between the n <expanded data descriptors> for a <tabular display description> and the data values within each data row; missing data shall be defined by a null data value, which shall comprise all digits blank in the absence of a <CHECK DIGIT>, or the omission of the corresponding <data group> if the <CHECK DIGIT EXTENSION INDICATOR> is coded. The actual value of the parameter described within table B shall be given by dividing the data value by (10 to the power SCALE), where SCALE is adjusted if necessary according to the difference between the data width used and that given in CREX table B;

ATTACHMENT

PROPOSED CREX AND BUFR DESCRIPTION OF OZONE MESSAGES

(Bold italic descriptors and/or values are new definitions to be added to BUFR).

Identification

001001: WMO block number
001002: WMO station number
004001: Year
{004002: Month
{004003: Day
or
{004043: Day of the year (julian day) (see Note 1)
004041: Time difference (UTC - LMT) in minutes (see Note 2)

Instrumentation

002143: Instrument type
002142: Ozone instrument serial number or identifier (4-character variable) (see Note 3)

Averaged ozone measurements

004004: Hours of measurement
004005: Minutes of measurement
008021: Time significance = 8: ensemble mean
004024: Time period in hours (corresponding to the computation of the average)
004025: Time period in minutes (corresponding to the computation of the average)
008023: First order statistics = 4: mean value
002141: Measurement type (3-character variable) (see Note 4)
008022: Number of measurements
015001: Value (average) of the ozone measurement
008023: First order statistics = 10: standard deviation
015001: Value (standard deviation) of the ozone measurement
008023: First order statistics = ***11: harmonic mean (see Note 5)***
015002: Value (harmonic mean) of the air mas

Individual ozone measurements

004004: Hours of ozone measurement
004005: Minutes of ozone measurement
002141: Measurement type of ozone measurement
015001: Value of the ozone measurement
015002: Value of the air mass

Measurement type:
(3-character long)
For Brewer instruments:

DS0:	Direct sun, attenuator #0
DS1:	Direct sun, attenuator #1
DS2:	Direct sun, attenuator #2
FM_:	Focussed moon
FS_FM_:	Focussed sun
FZ_FM_:	Focussed sun corrected with adjacent sky measurements
ZS_FM_:	Zenith sky

For Dobson instruments: "_LS"
where:

L =	0	Wavelengths AD ordinary setting
	1	Wavelengths BD ordinary setting
	2	Wavelengths CD ordinary setting
	3	Wavelengths CC' ordinary setting
	4	Wavelengths AD focussed image
	5	Wavelengths BD focussed image
	6	Wavelengths CD focussed image
	7	Wavelengths CC' focussed image
	8	Reserved
	9	Reserved

S =	0	On direct sun
	1	On direct moon
	2	On blue zenith sky
	3	On zenith cloud (uniform stratified layer of small opacity)
	4	On zenith cloud (uniform or moderately variable layer of medium opacity)
	5	On zenith cloud (uniform or moderately variable layer of large opacity)
	6	On zenith cloud (highly variable opacity, with or without precipitation)
	7	On zenith cloud (fog)
	8	Reserved
	9	Reserved

For other instruments: to be defined.

Instrument type:
(7-bit numeric variable)

00	Reserved		
01	Brewer spectrophotometer	11	Oxford
02	Caver Teichert	12	Paetzold
03	Dobson	13	Regener
04	Dobson (Japan)	14	For future use
05	Ehmet	15	Vassy filter ozonometer
06	Fecker telescope	16	Carbon iodide
07	Hoelper	17	Surface ozone bubler
08	Jodmeter	18	Filter Ozoneometer M-124
09	Filter Ozonemeter M-83	19	ECC sonde
10	Mast	20–99	For future use

Reference: World Ozone Data Centre, *Catalogue of ozone stations and catalogue of ozone data for 1985–1990*, Index no. 25, Atmospheric Environment Service, Environment Canada, 121 pp.

Instrument serial number or identifier:
(4-character long)

For Japenese Dobsons, omit the leading digit(s).

NOTES:

(1) Although the use of "month" and "day" is a common practice in meteorology, julian day is widely used in the ozone field. However, conversion from one to the other is straightforward.

(2) It is defined as:
Time difference (UTC – LMT) = $TIME_{UTC} - TIME_{LMT}$ (in minutes)
where UTC stands for "Universal Time Coordinated" and LMT for "Local Mean Time". It is expressed in minutes and it ranges from –1440 to +1440. The formal BUFR definition is:

004041 Time difference, UTC–LMT	**minutes**	**0**	**–1440**	**12 bits**

A reference to local mean time is added at the request of the managers of the World Ozone Data Centre.

(3) This parameter may be alphanumeric.

(4) The measurement type is proposed as "CCITT IA5, 24 bits" and not as a table. It seems premature at the present time to define a table since only two instruments (Brewer and Dobson) have their measurement type defined. In addition, ozone experts believe that a three-character variable will meet anticipated needs.

(5) Harmonic mean air mass (multiplied by 100) is: $100*NN/\Sigma(1/A_i)$ where A_i are the air masses for each of the NN measurements.

BUFR description of ozone descriptors/code figures needed

Element name	*Unit*	*Scale*	*Reference value*	*Data width*
002143 Instrument type	Numeric	0	0	7 bits
002141 Measurement type	CCITT IA5	0	0	24 bits
002142 Ozone instrument serial number/identifier	CCITT IA5	0	0	32 bits
004041 Time difference, UTC - LMT	Minute	0	-1440	12 bits
015002 Air mass (slant path at 22 km)	Numeric	2	0	10 bits

008023 harmonic mean = 11 (new code figure)

CREX description of ozone descriptors/code figures needed

Element name	*Unit*	*Scale*	*Data width*
Instrument type	Numeric	0	2 character
Measurement type	CCITT IA5	0	3 character
Ozone instrument serial number/identifier	CCITT IA5	0	4 character
Time difference, UTC - LMT	Minute	0	5 character
Air-mass value (slant path at 22 km)	Numeric	0	3 character

NOTE: Reference values are irrelevant in CREX as the negative sign is a valid CREX character. The width for "time difference" includes the sign.

ANNEX IX

Annex to paragraph 7.4 of the general summary

DRAFT TERMS OF REFERENCE OF THE INTERCOMMISSION TASK TEAM ON DATA AND PRODUCT REQUIREMENTS

In response to the request from the forty-sixth session of the Executive Council to the Commission for Basic Systems (general summary, paragraph 17.4 (*a*)) to involve the other commissions in establishing the content and scope of Members' current and future requirements for data and products to support WMO Programmes, CBS-Ext (94) proposes that an intercommission task team on data and product requirements be formed.

The task team will be chaired by the vice-president of the Commission for Basic Systems and will consist of representatives from the technical commissions with an appropriate geographic balance, as decided by the presidents of the commissions in consultation with the Secretary-General. These individuals will be selected for their technical competence to evaluate the data and product requirements for WMO Programmes within the purview of their respective technical commission and consistent with the WMO Technical Regulations and the terms of reference of the technical commissions.

The terms of reference for the task team include:

(*a*) Establishing the content and scope of Members' current and future requirements for data and products, and a plan and timetables for completing this activity which will permit a preliminary report to Twelfth Cogress;

(*b*) Developing a process for identifying and documenting Members' future requirements.

The task team will meet at least once before Twelfth Congress and will report to the president of CBS who will forward its relevant findings to Twelfth Congress and to the Working Group on the Commercialization of Meteorological and Hydrological Services on behalf of the Commission. Future reports from the task team should be made available to Members for their reference and information.

ANNEX X

Annex to paragraph 8.2 of the general summary

FRAMEWORK FOR THE *GUIDE ON PUBLIC WEATHER SERVICE PRACTICES*

Introduction to the *Guide*

1. The *Guide* will describe the importance of public weather services to the global community and the scope of what might constitute these and related services. It will note the variability of the extent of individual national Meteorological Services' (NMSs) public weather service programmes.

2. The objectives of the WMO Public Weather Services Programme (PWSP) will be described, namely:

(*a*) To strengthen Members' capabilities to meet the needs of the community through the provision of comprehensive weather and related services with particular emphasis on public safety and welfare;

(*b*) To foster a better understanding by the public of the capabilities of national Meteorological and Hydrological Services (NMHSs) and how best to use their services;

(*c*) The relationship between the PWSP and other components of WMO Programmes will be identified.

Target audience

3. The primary audience for the *Guide* will be NMHSs, although it will be designed to facilitate the further distribution of excerpts to user groups and/or other providers of public weather services.

Guidelines

4. Guidelines will be provided on those areas of interest indicated by Members. The areas discussed will be modified to reflect the changing requirements of Members. The guidelines will be formulated to reflect timely and current broad principles and will, initially, include:

(*a*) Principles for developing public weather and related services;

(*b*) General practices;

(*c*) The formulation and content of forecasts and warnings;

(*d*) The verification of forecasts and warnings;

(*e*) Presentation and dissemination techniques;

(*f*) Public understanding, public information and education;

(*g*) The exchange and coordination of information on hazardous weather and related conditions among neighbouring countries;

(*h*) Interagency and other interactions, e.g. media;

(*i*) Programme evaluation techniques, including value studies, consultation and marketing procedures;

(*j*) Cooperation and coordination with civil defence authorities;

(*k*) Illustrative models of warning dissemination systems;

(*l*) Special topics dealing with communication with the public, including response strategies to catastrophic events, e.g. Chernobyl, tropical cyclones, Mount St.-Helens, bushfires;

To the extent possible, existing material from Members on these subjects will be adapted for inclusion in the *Guide*.

Appendices

5. Appendices to the *Guide* will be included to provide access to useful information, such as:

(*a*) Listings and definitions of the hazards for which NMSs issue warnings, including information on those which are coordinated or exchanged bilaterally;

(*b*) Information on the access to, and design of, public weather services information systems;

(*c*) Bibliographies and other references on NMSs' existing public weather services manuals and guides.

APPENDIX A

LIST OF PERSONS ATTENDING THE SESSION

A. Officers of the session

A. A. Vasiliev	President
S. Mildner	Vice-president

B. Representatives of WMO Members

Member	*Name*	*Capacity*
Algeria	M. O. Yermeche	Principal delegate
Angola	M. G. C. de Azevedo (Ms)	Principal delegate
Argentina	R. A. Sonzini	Principal delegate
	F. P. Requena	Alternate
Australia	G. B. Love	Principal delegate
Austria	H. Gmoser	Principal delegate
Belarus	I. Pokoumeiko	Principal delegate
	I. Skouratovich	Delegate
Belgium	E. De Dycker	Principal delegate
	N. De Keyser (Ms)	Delegate
	C. De Ridder	Delegate
Botswana	D. F. Molotsi	Principal delegate
	P. Phage	Delegate
Brazil	J. M. Rezende	Principal delegate
	J. P. M. Oliveira	Adviser
	C. M. Rodrigues	Adviser
Bulgaria	M. Popova (Ms)	Principal delegate
Burkina Faso	A. J. Garane	Principal delegate
Canada	H. Allard	Principal delegate
	A. Simard (Ms)	Alternate
	J. Alexander	Delegate
	R. Laurence	Delegate
China	Yan Hong	Principal delegate
	Qiu Guoqing	Delegate
	Xu Xiaofeng	Delegate
Congo	D. Evouya	Principal delegate
Croatia	K. Pandzic	Principal delegate
Czech Rep.	E. Cervena (Ms)	Principal delegate
Denmark	N. J. Pedersen (8–12.8.94)	Principal delegate
	K. Jensen (15–18.8.94)	Principal delegate
Egypt	H. M. Zohdy	Principal delegate
	A. A. Hassan	Alternate
	A. M. Rebba	Delegate
Estonia	P. Karing	Principal delegate
	H. Kotli (Ms)	Delegate
	A. Sander	Delegate
Fiji	R. Prasad	Principal delegate
Finland	J. Riissanen	Principal delegate
	M. Alestalo	Delegate
	P. Saarikivi (Ms)	Delegate
	K. Soini (Ms)	Delegate
France	D. Lambergeon	Principal delegate
	J. P. Bourdette	Alternate
	M. Fischer	Delegate
Germany	S. Mildner	Principal delegate
	M. Kurz	Delegate
Greece	D. Katsimardos	Principal delegate
Hong Kong	R. Lau	Principal delegate
Hungary	K. Vissy	Principal delegate
	A. Takacs (Ms)	Alternate
Iceland	G. Hafsteinsson	Principal delegate
India	U. S. De	Principal delegate
Iran, Islamic Republic of	B. Sanaei	Principal delegate
	S. A. Borghei	Delegate
Ireland	J. J. Logue	Principal delegate
Israel	A. Goldman	Principal delegate
Italy	G. De Florio	Principal delegate
Japan	K. Kato	Principal delegate
	Y. Watanabe	Alternate
Jordan	A. D. Karien	Principal delegate
Kenya	E. A. Mukolwe	Principal delegate
	I. K. Essendi	Alternate

Member	*Name*	*Capacity*
Latvia	M. Borisovsky	Principal delegate
Netherlands	H. Daan	Principal delegate
	S. Kruizinga	Alternate
New Zealand	N. D. Gordon	Principal delegate
Nigeria	J. O. Adekoya	Principal delegate
Norway	A. Eliassen	Principal delegate
	K. Bjørheim	Alternate
Oman	A. R. S. Al Harm	Principal delegate
	A. H. M. Al Harthy	Delegate
Poland	A. Maciazek	Principal delegate
	R. Skapski	Delegate
Portugal	M. Almeida	Principal delegate
Romania	I. Agaficioaia	Principal delegate
	M. Tudorache	Alternate
Russian Federation	A. I. Gusev	Principal delegate
	A. A. Vasiliev	Alternate
Saudi Arabia	N. A. Murshid	Principal delegate
Slovakia	M. Ondras	Principal delegate
Slovenia	M. Jurgele	Principal delegate
South Africa	K. E. Estié	Principal delegate
	T. I. J. Potgieter	Delegate
Spain	C. Martinez-Lope (Ms)	Principal delegate
	V. Cerrajeria	Alternate
	C. Belandia	Delegate
	T. Garcia-Meras	Delegate
Swaziland	E. D. Dlamini	Principal delegate
Sweden	K. Gerdin (8–12.8.94)	Principal delegate
	L. Moen (15–18.8.94)	Principal delegate
Switzerland	P. Rauh	Delegate
Thailand	S. Tansriratanawong	Delegate
Ukraine	N. Tokar (Ms)	Principal delegate
United Kingdom	P. Ryder	Principal delegate
	W. A. McIlveen	Delegate
	D. B. Shaw	Delegate
United Rep. of Tanzania	P. A. Mwingira	Principal delegate
United States of America	R. C. Landis	Principal delegate
	W. J. Hussey	Alternate
United States of America (*contd.*)	W. E. Baker	Delegate
	J. L. R. Fenix	Delegate
	F. S. Zbar	Delegate
	C. H. Dey	Adviser
Viet Nam	Tran Van Sap	Principal delegate
Yemen	N. A. Breeh	Principal delegate
	A. K. H. Mohamed	Delegate
Zimbabwe	J. Bwaila	Principal delegate

C. Past president of CBS

J. R. Neilon

D. Invited expert

N. Prezerakos

E. Invited lecturers

A. Hollingsworth
T. W. Schlatter

F. Representatives of International Organizations

Organization	*Name*
United Nations Educational, Scientific and Cultural Organization (UNESCO)	M. L. Komulainen (Ms)
International Civil Aviation Organization (ICAO)	O. M. Turpeinen
Agency for Air Safety in Africa and Madagascar (ASECNA)	J.-P. Makosso
European Centre for Medium-Range Weather Forecasts (ECMWF)	H. Böttger J. Hennessy M. Jarraud
European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)	G. Szejwach H. Verschuur
Intergovernmental Oceanographic Commission (IOC)	M. L. Komulainen (Ms)
League of Arab States	N. A. Murshid

G. WMO Secretariat

J. L. Rasmussen	Representative of the Secretary-General
D. Schiessl	
H. McCombie	
D. McGuirk	
M. E. Mlaki	
J.-M. Rainer	
P. Aber	Consultant

APPENDIX B

AGENDA

	Agenda item	*Documents*	*Resolutions and recommendations adopted*
1.	**OPENING OF THE SESSION**	PINK 1	
2.	**ORGANIZATION OF THE SESSION**	PINK 1	
2.1	Consideration of the report on credentials		
2.2	Adoption of the agenda	1; 2	
2.3	Establishment of committees		
2.4	Other organizational questions		
3.	**REPORT BY THE PRESIDENT OF THE COMMISSION**	15; PINK 2	
4.	**ROLE OF THE BASIC SYSTEMS IN WMO AND OTHER INTERNATIONAL PROGRAMMES, INCLUDING THE GLOBAL CLIMATE OBSERVING SYSTEM (GCOS) AND THE FOLLOW-UP TO THE UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT (UNCED)**	8; 18; 18, ADD. 1; 20; PINK 13	Rec. 1
5.	**CONSIDERATION OF INTER-SESSIONAL ACTIVITIES, INCLUDING REPORTS BY THE CHAIRMEN OF WORKING GROUPS**		
5.1	Data processing	4; PINK 9	Res. 1; Rec. 2; Rec. 3
5.2	Observations	12; 14; PINK 14	Rec. 4
5.3	Telecommunications	13; 16; 25; PINK 3	Rec. 5
5.4	Data management, including codes and data representation	7; 9; 23; PINK 8	Rec. 6; Rec. 7; Rec. 8; Rec. 9; Rec. 10
5.5	Satellite matters	6; PINK 11	
5.6	Systems support	11; 22; PINK 5	
6.	**DEMONSTRATION OF THE CAPABILITIES OF REGIONAL SPECIALIZED METEOROLOGICAL CENTRES (RSMCs)**	3; 3, ADD. 1; 3, ADD. 2; 24; PINK 10	Rec. 11; Rec. 12
7.	**REQUIREMENTS FOR THE INTERNATIONAL EXCHANGE OF DATA AND PRODUCTS**	5; 5, ADD. 1; 21; PINK 16	Res. 2
8.	**PUBLIC WEATHER SERVICES (PWS)**	17; PINK 15	
9.	**CONSIDERATION OF THE *FOURTH WMO LONG-TERM PLAN***	19; PINK 6	
10.	**SCIENTIFIC LECTURES**	PINK 4	
11.	**REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND RELEVANT RESOLUTIONS OF THE EXECUTIVE COUNCIL**	10; PINK 7	Res. 3; Rec. 13
12.	**DATE AND PLACE OF THE ELEVENTH SESSION OF THE COMMISSION**	PINK 12	
13.	**CLOSURE OF THE SESSION**		

APPENDIX C

LIST OF DOCUMENTS

Doc. No.	*Title*	*Agenda item*	*Submitted by*
	I. "DOC" series		
1	Provisional agenda	2.2	
2	Explanatory memorandum relating to the provisional agenda	2.2	
3	Demonstration of the capabilities of RSMCs	6	Secretary-General
	Designation of Regional Specialized Centres (RSMCs) with activity specialization		
	ADD. 1		
	ADD. 2		
4	Data processing	5.1	Chairman of the Working Group on Data Processing
	Report of the Chairman of the Working		
5	Requirements for the international exchange of data and products	7	Secretary-General
	Report on the exchange of data and products		
	ADD. 1		
6	Satellite matters	5.5	Chairman of the Working Group on Satellites
	Report of the first session of the CBS Working Group on Satellites		
7	Data management, including codes and data representation	5.4	Secretary-General
	Report of the Chairman of the Working Group on Data Management		
8	Role of the basic systems in WMO and other international programmes, including GCOS and the follow-up to UNCED	4	Vice-president of the Commission
	CBS support to GCOS		
9	Data Management, including codes and data representation	5.4	Secretary-General
10	Review of previous resolutions and recommendations of the Commission and relevant resolutions of the Executive Council	11	Secretary-General
11	Systems support	5.6	Secretary-General
	Report on the results and recommendations from the OWSE-Africa		
12	Observations	5.2	Secretary-General
	Automated Shipboard Aerological Programme (ASAP)		

Doc. No.	*Title*	*Agenda item*	*Submitted by*
13	Telecommunications Thirteenth session of the Working Group on Telecommunications	5.3	Secretary-General
14	Observations Report of the Chairman and report of the sixth session of the CBS Working Group on Observations	5.2	Chairman of the Working Group on Observations
15	Report by the president of the Commission	3	President of CBS
16	Telecommunications Report of the Chairman of the Working Group on Telecommunications	5.3	Chairman of the Working Group on Telecommunications
17	Public Weather Services	8	Secretary-General
18	Role of the basic systems in WMO and other international programmes, including GCOS and the follow-up to UNCED Environmental Emergency Response ADD. 1	4	Secretary-General
19	Consideration of the *Fourth WMO Long-term Plan*	9	Secretary-General
20	Role of the basic systems in WMO and other international programmes, including GCOS and the follow-up to UNCED	4	CBS Rapporteur on the Follow-up to UNCED
21	Requirements for the international exchange of data and products	7	New Zealand
22	Systems support Operational Information System (OIS)	5.6	Secretary-General
23	Data management including codes and data representation Validation of proposals for changes to codes, data representation forms and GTS tables	5.4	Chairman of the Working Group on Data Management
24	Demonstration of the capabilities of RSMCs Proposal for the designation of RSMC Melbourne as a centre responsible for the provision of products for environmental emergency response	6	Australia
25	Telecommunications Proposed new message-type designators to meet aeronautical requirements	5.3	International Civil Aviation Organization
26	Requirements for the international exchange of data and products	7	United States of America

Doc. No.	*Title*	*Agenda item*	*Submitted by*
	II. "PINK" series		
1	Opening of the session	1	President of CBS
	Organization of the session	2	
2	Report by the president of the Commission	3	President of CBS
3	Telecommunications	5.3	Chairman, Working Committee
4	Scientific lectures	10	Vice-president of CBS
5	Systems support	5.6	Chairman, Working Committee
6	Consideration of the *Fourth WMO Long-term Plan*	9	Chairman, Committee of the Whole
7	Review of previous resolutions and recommendations of the Commission and relevant resolutions of the Executive Council	11	Chairman, Committee of the Whole
8	Data management, including codes and data representation	5.4	Chairman, Working Committee
9	Data processing	5.1	Chairman, Working Committee
10	Demonstration of the capabilities of RSMCs	6	Chairman, Working Committee
11	Satellite matters	5.5	Chairman, Working Committee
12	Date and place of the eleventh session of the Commission	12	President of CBS
13	Role of the basic systems in WMO and other international programmes, including GCOS and the follow-up to UNCED	4	Chairman, Committee of the Whole
14	Observations	5.2	Chairman, Working Committee
15	Public Weather Services	8	Chairman, Working Committee
16	Requirements for the international exchange of data and products	7	Chairman, Working Committee