WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

ABRIDGED FINAL REPORT

OF THE

NINTH SESSION

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C O N T E N T S

LIST OF RESOLUTIONS ADOPTED BY THE SESSION

LIST OF RECOMMENDATIONS ADOPTED BY THE SESSION

LIST OF PERSONS ATTENDING THE SESSION

1. Officers of the session

J. R. Neilon	president
A. A. Vasiliev	vice-president

2. Representatives of Members of WMO

N. O. Yermeche	principal delegate	Algeria
A. Kerbachi	delegate	
M. Khadir	delegate	
M. R. Noune	delegate	
R. B. Crowder	principal delegate	Australia
G. B. Love	alternate	
H. Maier	principal delegate	Austria
H. Gmoser	delegate	
E. De Dycker	principal delegate	Belgium
C. G. De Ridder	delegate	
B. Sekwati	principal delegate	Botswana
J. Arimatéa	principal delegate	Brazil
H. P. A. Jaafar (Mrs)	principal delegate	Brunei Darussalam
H. A. Kadir bin Tengah	delegate	
V. Andreev	principal delegate	Bulgaria
O. Delev	delegate	
Ju. M. Pokoumeiko	principal delegate	Byelorussian SSR
R. J. Mills	principal delegate	Canada
B. W. Attfield	delegate	
J. Kruus	delegate	
S. Gomes Ramos (Ms)	principal delegate	Cape Verde
M. Ndiaye	principal delegate	Chad
M. D. Nembontar	delegate	
E. Rousseau Farias	principal delegate	Chile
T. A. Godoy (Mrs)	alternate	
Luo Jibin	principal delegate	China
Huang Gensheng	delegate	
Li Zechun	delegate	

2. Representatives of Members of WMO (contd.)

M. C. Calvo	principal delegate	Cuba
A. Papez	principal delegate	Czechoslovakia
M. Ondrás	delegate	
H. H. Krarup	principal delegate	Denmark
A. M. El-Masry	principal delegate	Egypt
A. M. Rebba	delegate	
J. Riissanen	principal delegate	Finland
M. H. Alestalo	delegate	
F. Duvernet	principal delegate	France
J. A. Bedel	alternate	
N. Bériot	delegate	
J. Ndong	principal delegate	Gabon
K. Richter	principal delegate	German Democratic Republic
H. Veit	delegate	
T. Mohr	principal delegate	Germany, Federal Republic of
M. Kurz	alternate	
W. Bopp	delegate	
D. Fickel	delegate	
C. Lemensieck	delegate	
J. B. Dankwa	principal delegate	Ghana
G. A. Wilson	delegate	
N. G. Prezerakos	principal delegate	Greece
L. Diallo	delegate	Guinea
M. Camara	delegate	
Chiu Ying Lam	principal delegate	Hong Kong
A. Kapovits	principal delegate	Hungary
M. A. Einarsson	principal delegate	Iceland
N. Sen Roy	principal delegate	India
H. Wayarabi	principal delegate	Indonesia
Kusmanu	delegate	
A. Tobing (Ms)	delegate	
B. Diyanati	principal delegate	Iran, Islamic Republic of
A. Es-Hagui	delegate	
A. Sedaghat Kerdar	delegate	
H. Minassian	principal delegate	Iraq

2. Representatives of Members of WMO (contd.)

W. H. Wann	principal delegate	Ireland
J. Hamilton	delegate	
R. Sorani	principal delegate	Italy
E. Boschi	alternate	
L. Casarsa	delegate	
C. Di Gesú	delegate	
F. Prodi	delegate	
S. Tibaldi	delegate	
R. Tatehira	principal delegate	Japan
A. Saleh	principal delegate	Jordan
E. A. Mukolwe	principal delegate	Kenya
B. L. Giurnazi	delegate	Libyan Arab Jamahiriya
M. A. Issa	delegate	
Z. M. Shafix	delegate	
A. Majeed	principal delegate	Maldives
J. A. Romero Conteno	principal delegate	Mexico
Z. Batjargal	principal delegate	Mongolia
S. Benarafa	principal delegate	Morocco
H. Daan	principal delegate	Netherlands
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C. F. Reudink	principal delegate	Netherlands Antilles
A. A. Neale	principal delegate	New Zealand
M. Saloum	principal delegate	Niger
J. O. Adekoya	principal delegate	Nigeria
O. H. Bremnes	principal delegate	Norway
L. Acosta	principal delegate	Peru
D. Grabowski	principal delegate	Poland
J. M. Simôes Cristina	principal delegate	Portugal
Chun-woo Lee	principal delegate	Republic of Korea
Tae-chul Chung	delegate	
S. O. Baazim	principal delegate	Saudi Arabia
N. Murshid	delegate	
M. Yattara	principal delegate	Senegal

2. Representatives of Members of WMO (contd.)

C. Callejas Cotrina (Ms)	delegate	Spain
J. Garcia-Meras	delegate	
M. Huerta	delegate	
A. Labajo Salazar	delegate	
M. Perez Delgado	delegate	
J. Segovia	delegate	
A. Sabah Elkheir	principal delegate	Sudan
S. Bodin	principal delegate	Sweden
P. Rauh	principal delegate	Switzerland
Y. Ganter	delegate	
S. Jabbour	principal delegate	Syrian Arab Republic
S. Tumsaroch	principal delegate	Thailand
A. Ben Jemaa	principal delegate	Tunisia
T. Jedidid	delegate	
M. Ormeci	principal delegate	Turkey
A. Algan	delegate	
S. Sipahioglu	delegate	
P. C. Okot	principal delegate	Uganda
B. Apuuli	delegate	
N. F. Tokar	principal delegate	Ukrainian SSR
J. Sedunov	principal delegate	Union of Soviet Socialist Republics
A. A. Vasiliev	alternate	
V. Blatov	delegate	
N. F. Fakhrutdinova (Ms)	delegate	
I. R. Gamaiouv	delegate	
B. V. Smirnov	delegate	
D. N. Axford	principal delegate	United Kingdom
A. J. Gadd	delegate	
J. M. Nicholls	delegate	
R. J. Sowden	delegate	
M. J. Nestor	observer	
P. A. Msafiri	principal delegate	United Republic of Tanzania
E. W. Friday, Jr.	principal delegate	United States of America
J. R. Neilon	alternate	
G. D. Cartwright	delegate	
A. L. Hernhuter	delegate	
W. J. Hussey	delegate	
F. S. Zbar	delegate	
R. D. McPherson	observer	

2. Representatives of Members of WMO (contd.)

R. R. Silva	principal delegate	Uruguay
H. Sanz López	principal delegate	Venezuela
A. A. Ahmed	delegate	Yemen
M. S. Jovasevic	principal delegate	Yugoslavia
V. Jurcec (Mrs)	delegate	
Iyagwi-kath Nvendo	delegate	Zaire
M. C. Zinyowera	principal delegate	Zimbabwe
K. J. Gordon	delegate	
J. Mhondiwa	delegate	

3. Representatives of international organizations

R. Gommes	Food and Agriculture Organization of the United Nations (FAO)
Y. Tréglos	Intergovernmental Oceanographic Commission (IOC)
F. A. L. Oliveira	International Civil Aviation Organization (ICAO)
P. Hogendijk L. Engvall	International Telecommunication Union (ITU)
M. Sow-Alassane A. Kandine M. Sissako	Agency for Air Safety in Africa and Madagascar (ASECNA)
D. Söderman H. Böttger J. K. Gibson	European Centre for Medium-Range Weather Forecasts (ECMWF)
G. Bridge	European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
M. H. Tunis	Organization of African Unity (OAU)

4. Technical Conference on Operational Weather Forecasting (TECOFOR)

G. K. Weiss	scientific director
A. C. Ferguson	Canada
H. Wagner B. Nielsen	Denmark

4. Technical Conference on Operational Weather Forecasting (TECOFOR) (contd.)

D. Dedenbach K.-H. Sülflow	Germany, Federal Republic of
Sz. Aigner	Hungary
F. Fantauzzo	Italy
A. G. Cornejo Garrido	Peru
H. Trabelsi	Tunisia

5. WMO Secretariat

T. D. Potter	Representative of the Secretary-General
S. Mildner	Secretary of Committee A
H. McCombie	Secretary of Committe B and TECOFOR

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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. OPENING OF THE SESSION (agenda item 1)

1.1 The ninth session of the Commission for Basic Systems (CBS) was held in the Geneva International Conference Centre (CICG) from 25 January to 5 February 1988. The session was opened at 10.00 a.m. on 25 January by the president of the Commission, Mr J. R. Neilon (USA).

1.2 On behalf of the Secretary-General, Mr J. P. Bruce welcomed the participants to the ninth session of CBS. He said that Tenth Congress had reaffirmed that the World Weather Watch was the basic Programme of WMO on which all other technical programmes depended and that the further development of the World Weather Watch had the highest priority within the Organization. Mr Bruce noted that 1988 marked the twenty-fifth anniversary of the World Weather Watch and recalled the endorsement by Fourth Congress in 1963 of the WWW concept: to integrate the national and international efforts of Meteorological Services in making observations, producing analyses and forecasts, and distributing these to national, regional and world centres under an overall, co-ordinated plan. He drew attention to the establishment by Fifth Congress in 1967 of the WMO Voluntary Assistance Programme (now Voluntary Co-operation Programme, VCP) through which developed countries could assist less-developed countries in contributing to, and benefiting from, the World Weather Watch. Mr Bruce highlighted the remarkable development of the World Weather Watch into a truly co-operative global programme, unique in the United Nations system.

1.3 Mr Bruce pointed out, however, that much remained to be done, particularly with regard to the widening gap in technology and methodology between developed and developing countries. To bridge the gap in services provided by Meteorological Services, a vigorous, expanding technical co-operation programme had developed, involving support from UNDP, trust funds and VCP. He noted that the budget for technical co-operation in 1988 was more than US $29 million.

1.4 The development of the World Weather Watch needed careful planning and Mr Bruce drew attention to the WWW Plan and Implementation Programme 1988-1997 which had been adopted by Tenth Congress as part of the Second WMO Long-term Plan and which included new conceptual approaches aimed at the full integration of the major components of the system to support and co-ordinate the implementation of the World Weather Watch.

1.5 One promising approach, the establishment of Regional/Specialized Meteorological Centres (RSMCs) on a co-operative basis, was highlighted by Mr Bruce as an opportunity for all Members to benefit from advances in meteorology. As several centres were on the verge of being launched in developing regions, the ninth session of CBS would need to examine the concept carefully and provide guidance on the procedures for designating such RSMCs.

1.6 Mr Bruce further stressed the need for CBS to be alert to new challenges and requirements for specific support from the WWW to meet new international agreements and conventions. As an example, he noted the recent agreement on the use of the GTS in support of the Convention on Early Notification in case of a Nuclear Accident.

1.7 Turning to the work programme of CBS, Mr Bruce listed several areas which had recently gained importance because of rapid developments in science and technology. As examples, he cited:

- The implementation and consolidation of new observing systems, such as ASDAR and ASAP;
- The introduction of modern combined telecommunication-computer techniques, including satellite communications, and their consequences for the structure of the GTS;
- The development of new structures to monitor the availability and quality of meteorological data as part of the feedback needed for improved overall WWW data management; and
- The transition to binary codes.

1.8 In emphasizing that the combined efforts of the Commission, regional associations, Members and the Secretariat would be needed for the successful implementation of support activities, Mr Bruce emphasized that efficiency would have to be the watchword as WMO was facing a period of considerable financial uncertainty.

1.9 Mr Bruce then paid tribute to Mr J. R. Neilon, president of CBS since 1978, and expressed his sincere appreciation for the skilful and highly professional way in which Mr Neilon had guided the Commission through 10 challenging years. He expressed the hope that Mr Neilon would continue to provide wise counsel to CBS in the future.

1.10 In Mr Neilon's presidential address, the fourth since taking office in 1978, he welcomed new members and remarked that several of the older members had been active in the Commission as long, or longer, than he himself had. Commission members were aware of the everyday responsibilities and challenges of operating national Meteorological Services, and the attendance at the session of so many was testimony to the importance they placed on solving problems by international co-operation.

1.11 The present session of CBS was characterized by Mr Neilon as being the ideal opportunity to begin implementation of the Second WMO Long-term Plan. He pointed out that the Long-term Plan, which had been carefully and thoroughly prepared, had been approved by Tenth Congress; the time for action had arrived.

1.12 Mr Neilon drew the Commission's attention to the rapid developments in science and technology that were affecting meteorology. The immense increase in computing power, the development of a space-based observing system offering the capability for a truly global observing system, and the increase in telecommunication capacity had given meteorology an unparalled opportunity and challenge. To meet them, the Commission had to address itself to the most important subject of data management and how to transform those data into useful information.

1.13 In the light of such changes, Mr Neilon considered it opportune that a Technical Conference on Operational Weather Forecasting had been arranged as part of the session of the Commission and that an equipment exhibition was to be held illustrating some of the latest technological advances.

1.14 In closing his address, Mr Neilon expressed his belief that the vital issues confronting the Commission should be seen as opportunities for achievement rather than as problems. He pointed out that the Commission was clearly not satisfied with the status quo and that it felt the potential benefits of improvement to greatly exceed the risks. In celebrating the twenty-fifth anniversary of the World Weather Watch, and aiming at the 21st century, Mr Neilon urged the Commission to adopt as its motto the simple phrase "Why not?", to emphasize its belief that problems were not hurdles to be overcome but rather stepping-stones to a more successful World Weather Watch, bringing benefits to developed and less-developed countries alike.

1.15 There were 154 participants at the session. These included representatives of 75 Members of WMO and eight international organizations. A complete list of participants is given at the beginning of 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 presented a provisional list of participants which was accepted as a first report on credentials; further reports were submitted to the session at ensuing plenary meetings. It was decided not to establish a Credentials Committee.

2.2 Adoption of the agenda (agenda item 2.2)

The provisional agenda was adopted by the session. The final agenda is reproduced at the beginning of this report, together with an indication of relevant documents and the numbers of resolutions and recommendations adopted.

2.3 Establishment of committees (agenda item 2.3)

2.3.1 Two working committees were set up to examine in detail the various agenda items:

(a) Committee A to consider agenda items 5 and 6.1 to 6.4.
Dr T. Mohr (Federal Republic of Germany) was elected chairman and Mrs H. P. A. Jaafar (Brunei Darussalam) vice-chairman of the committee;

(b) Committee B to consider agenda items 6.5, 6.6, 8, 9 and 11.
Dr A. A. Vasiliev (USSR) was elected chairman and Mr R. J. Mills (Canada) vice-chairman of the committee.

These officers were elected unanimously.

2.3.2 In accordance with Regulation 23 of the WMO General Regulations, the Commission established a Nominations Committee and a Co-ordination Committee. The Nominations Committee was composed of the principal delegates of China, Hungary, Indonesia, Mexico, Morocco and Uruguay. The Co-ordination Committee was composed of the president and vice-president of CBS, the chairmen of Committees A and B and the representative of the Secretary-General. Mr E. Rousseau (Chile) was appointed rapporteur on previous recommendations and resolutions of the Commission.

2.4 Other organizational questions (agenda item 2.4)

Under this agenda item, the Commission agreed that, in accordance with WMO General Regulation 109, no minutes of the session would be prepared and that statements by delegations would be reproduced and distributed as and when requested, in accordance with Regulation 110. The Commission agreed on the working hours for the duration of the session.

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

3.1 The Commission noted with appreciation the report of its president, which reviewed the activities of the Commission since its last (extraordinary) session (CBS-Ext.(85)) (Hamburg, October/November 1985). A more detailed analysis of the activities of the Commission was given in the reports of the chairmen of the four working groups and the rapporteurs on the use of NWP products and on TOVS data-retrieval methods. Items in the report requiring action by the Commission were considered under the relevant agenda items. Satisfaction was expressed that the Commission for Basic Systems, as at 26 October 1987, had 246 members from 119 Members of WMO.

3.2 The Commission noted further that the work programme of CBS since its extraordinary session in 1985 had been accomplished satisfactorily and had focused on the following main activities:

(a) Finalization of the draft WWW Programme as part of the Second WMO Long-term Plan;

(b) Follow-up of CBS-Ext.(85) decisions, in particular its resolutions and recommendations;

(c) Convening of sessions of the CBS Working Groups on the GDPS, GOS and GTS and their study groups;

(d) Convening of three sessions of the CBS Advisory Working Group (April 1986, April 1987 and October 1987), providing overall guidance and co-ordination of CBS activities and on the decisions taken by the president on behalf of the Commission.

3.3 The adoption of the World Weather Watch Programme by Tenth Congress as part of the Second WMO Long-term Plan was welcomed by the Commission as representing a sound basis for mobilizing efforts towards achieving the long-term objectives of the basic Programme of WMO. The Commission recognized the importance of one of the modifications adopted by Tenth Congress concerning WMO activities in support of international efforts to mitigate the effects of the accidental release of hazardous materials into the atmosphere.

3.4 The Commission was informed of and approved the decisions taken by the president on behalf of CBS since its extraordinary session in 1985. It was pointed out that one of the most important actions had been the approval by the president, for experimental use on the GTS as from May 1987, of the proposed Binary Universal Form for Representation (BUFR) code following its review and evaluation by the Working Group on Codes. This was a very important development which had considerable implications for the future work of the Commission.

3.5 The valuable work carried out by the CBS Advisory Working Group at its twelfth, thirteenth and fourteenth sessions was acknowledged by the Commission. The finalization and submission to Tenth Congress of the Second WMO Long-term Plan was one of the main activities of the Group. Guidance was provided on the introduction of the concept of Regional/Specialized Meteorological Centres (RSMCs) and the further development of the Data Management (DM) concept which are part of the WWW Programme (1988-1997). Particular attention was paid to developments leading to the implementation of the Aircraft to Satellite Data Relay (ASDAR) system and the Automated Shipboard Aerological Programme (ASAP) as part of the Global Observing System. The Operational WWW Systems Evaluation-North Atlantic (OWSE-NA) and preparations for the Operational WWW Systems Evaluation-Africa (OWSE-AF) also received close attention, as did matters relating to the development of the meteorological satellite programmes. Co-ordination with other technical commissions and their programmes was continued and intensified. WWW support to other international programmes was closely monitored and guided by the Advisory Working Group.

3.6 Turning to the future work programme, the Commission noted with concern that the funding of the WWW Programme faced severe constraints resulting from an overall limitation of resources available to WMO and to the UN system in general. The Commission agreed that extrabudgetary funding and co-operative efforts in implementing certain WWW projects, such as ASDAR, ASAP, the NWP intercomparison and the OWSEs, would therefore be of increasing importance in the future. The Commission expressed its appreciation to those Members which had contributed in the past to the implementation of such WWW projects and expressed the hope that they would continue to do so.

3.7 Several items were addressed which should receive special attention in the future work programme of the Commission:

(a) Development of the Data Management concept;

(b) Establishment of RSMCs;

(c) Planning and conduct of OWSEs;

(d) Strengthening of WWW support functions (implementation support and implementation co-ordination);

(e) Further development of composite observing systems and implementation of new system components, particularly covering data-sparse areas;

(f) Introduction of a space-based communication system as an integral part of the GTS.

Other items mentioned by members of the Commission as meriting attention were:

- Finalization and implementation of the BUFR code;
- Future role of CBS;
- Studies on the economic benefits of the WWW, especially in developing countries.

3.8 The Commission recognized the integrating role of data management functions for the major components of the WWW system and the fact that the further development and implementation of the Data Management concept provided the key for the optimization of the WWW.

3.9 The Commission reviewed and approved the broad outline of the Advisory Working Group's proposals concerning the establishment and terms of reference of working groups and rapporteurs for the next intersessional period. Resolutions concerning those proposals were discussed under the relevant agenda items.

3.10 The Commission commended the CBS Advisory Working Group for the valuable work it had accomplished and agreed that the Group should be re-established with slightly amended terms of reference to take into account the successful completion of the Integrated WWW System Study (ISS).

3.11 The president expressed his sincere appreciation to all CBS members who had participated in the activities of the Commission for their enthusiastic co-operation. In particular, he thanked the vice-president, Dr A. A. Vasiliev, 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 successive Directors of the World Weather Watch Department, for their untiring support and co-operation. Lastly, the president expressed his gratitude to the Permanent Representative of the USA with WMO for having allowed him the time and resources to carry out his tasks as president for the previous 10 years.

3.12 Many members of the Commission then took the floor to pay tribute Mr Neilon. His leadership and wise guidance were acknowledged by the Commission as being among the principal factors in the successful conduct of the Commission's activities. His dedication and untiring efforts in the 10 years of his presidency would be sorely missed and it was hoped that he would still be able to provide advice and insight into the problems facing the Commission in the future.

4. CONSIDERATION OF THE DECISIONS OF TENTH CONGRESS (agenda item 4)

Second WMO Long-term Plan

4.1 The Commission noted that Tenth Congress had approved the Second WMO Long-term Plan (SLTP) as the single planning document of WMO and in line with the programme and budget of the Organization for the tenth financial period 1988-1991. The WWW Plan and Implementation Programme 1988-1997, included in Part II, Volume 1 of the SLTP, therefore constituted the overall work programme of the Commission and its working groups for the current financial period.

4.2 The Commission also noted that Congress had requested that the status of implementation of the SLTP should be monitored, the results of the monitoring to be reported to Eleventh Congress, the Executive Council and to CBS and its working groups. The monitoring results will be complemented by reports on annual and special WWW implementation monitoring exercises.

4.3 To enable the Commission to meet its obligations in respect of achieving the objectives and tasks of the SLTP, it was agreed that the Advisory Working Group, besides assisting the president of the Commission in the short- and long-term planning of its work, would also be responsible for the overall co-ordination, guidance and further development of the WWW support functions:

(a) WWW Implementation Support Activity (ISA);

(b) WWW Implementation Co-ordination (IC).

Each technical working group of the Commission would have responsibility for meeting the overall objectives of the WWW Plan and Implementation Programme 1988-1997.

Third WMO Long-term Plan

4.4 Tenth Congress had decided that the Third WMO Long-term Plan should be prepared for the period 1992-2001. EC-XLII (1990) would approve the draft TLTP for submission to Cg-XI (1991). The Commission, noting that an extraordinary session of CBS was planned for late 1990, agreed that the following issues should merit particular consideration when preparing the WWW Plan and Implementation Programme within the TLTP:

- New observing techniques;
- The role of satellites in the WWW;
- The continued development of the WWW as an integrated system through appropriate data-management functions;
- Modern telecommunication techniques in the WWW;
- Data- and product-presentation techniques;
- Verification of forecast products.

WMO satellite activities

4.5 CBS was informed that Tenth Congress, in considering the involvement of all major WMO Programmes in satellite-related activities, had requested the Executive Council to continue its role in the overall co-ordination of WMO satellite-related matters.

4.6 The Executive Council, at its thirty-ninth session (1987), re-established its Panel of Experts on Satellites and included the president of CBS as a member with the additional role of interacting with the presidents of other technical commissions on matters related to WMO satellite activities and conveying their inputs to the Panel.

4.7 The Commission stressed the need for it to be kept informed by the satellite operators on their future plans for operations of meteorological satellites. It was particularly important that information about planned changes to the operational system affecting the contents or format of the data and services should be widely distributed in sufficient time to enable users to make any necessary changes to their receiving systems.

4.8 The Commission also stressed the need to have a strong role in satellite activities, which were very important to the World Weather Watch; such a role was particularly important in formulating requirements for satellite data and services. It was noted that continued participation in the Co-ordination on Geostationary Meteorological Satellites (CGMS) and other similar groups was important so as to ensure their maximum contribution to the World Weather Watch. The satellite activities of CBS should also include the use of data from polar-orbiting satellites. The value of data from experimental satellites and the possible inclusion of such data in World Weather Watch applications should be studied by CBS.

4.9 The Commission noted with appreciation the work to update publication WMO-No. 411 - Information on Meteorological Satellite Programmes Operated by Members and Organizations. The need to update or prepare new satellite-related publications was emphasized in order that information about data and services and the applications of such information could be kept up to date and readily available. The Commission noted with appreciation the offer by the Federal Republic of Germany to assist in this exercise.

5. STATUS OF WWW IMPLEMENTATION AND OPERATION (agenda item 5)

Status of implementation of the WWW

Global Observing System (GOS)

5.1 The Commission noted that:

(a) The percentage of observations carried out in relation to the number of observations required in regional basic synoptic networks was approximately 89 per cent for surface observations and 82 per cent for upper-air observations (radiowind and radiosonde), corresponding to 3600 surface observations and 725 upper-air observations at each standard observation time;

(b) In addition to the stations included in the regional basic synoptic networks, the GOS surface-based subsystem also included some 4500 supplementary stations established to meet national needs, 7400 voluntary observing ships, three fixed ocean stations, some 220 drifting buoys and more than 600 stations with meteorological radars;

(c) The space-based subsystem included four polar-orbiting and five geostationary meteorological satellites. These satellite-based systems provided observation (imagery, vertical soundings, etc.) as well as data collection (from data collection platforms) and meteorological information dissemination services.

Global Data-processing System (GDPS)

5.2 The Commission noted that:

(a) The three WMCs Melbourne, Moscow and Washington continued to carry out and to disseminate more than 300 analyses and forecasts daily;

(b) More than 2300 analyses and forecasts were prepared daily at the 26 RMCs. In addition, a number of specialized centres (such as the World Area Forecast Centres, the Regional Area Forecast Centres and the European Centre for Medium Range Weather Forecasts) transmitted products over the GTS;

(c) The three WMCs, 16 RMCs and 15 NMCs used computerized numerical weather-prediction methods;

(d) The WMO GRID and GRIB codes were being increasingly used for disseminating processed information.

Global Telecommunication System (GTS)

5.3 The Commission noted that:

(a) The 21 circuits in the Main Telecommunication Network (MTN) were in operation and that 16 of them were telephone-type circuits, 11 of which were operating at a speed of 9600 bit/s;

(b) A total of 220 circuits out of the 259 point-to-point circuits included in the regional meteorological telecommunication networks were in operation (195 satellite/cable/microwave circuits and 46 HF circuits), 12 circuits were operated at 9600 bit/s and 28 other circuits were operated at speeds higher than 1200 bit/s;

(c) The three WMCs, 13 RTHs situated on the MTN, 12 other RTHs and 32 NMCs were automated;

(d) Twenty-three RTT and 25 radiofacsimile transmissions were made by the RTHs to disseminate observational data and processed information;

(e) Telecommunication procedures in conformity with CCITT Recommendation X.25 (at least link level or OSI layer 2) were in operation on 13 GTS circuits, eight of which formed part of the MTN. The full X.25 procedures (including packet level), which permit the exchange of data in binary form (for example, in GRIB or BUFR code form), were implemented on three circuits of the MTN.

Internationally co-ordinated non-real-time monitoring carried out in October 1987

5.4 The Commission reviewed the results of the internationally co-ordinated non-real-time monitoring carried out in October 1987 from 95 Members.

5.5 Members reported to the Commission that the main causes of interruption in observation programmes at the stations and in transmission on circuits were the following:

(a) Lack of staff;

(b) Lack of consumables for upper-air observations;

(c) Electricity supply failures at observation stations;

(d) Failure of instruments used for upper-air observations and of telecommunication equipment (particularly HF SSB transceivers);

(e) Failure in the operation of telecommunication circuits (particularly breaks in PTT circuits and poor radio-electrical propagation on HF circuits);

(f) Specific situation in the country (countries) concerned.

The Commission noted in that connection that telecommunication procedures, such as those set out in the Manual on the GTS, were not always respected, which could result in losses during relay of bulletins over the GTS, particularly at the automated centre level.

5.6 The Commission was informed that, during the annual global monitoring period in October 1987, the average number of SYNOP and TEMP reports from stations included in the list for global exchange available daily at MTN centres amounted to approximately 7300 and 1200 respectively, corresponding to 77 per cent and 82 per cent of the expected number of SYNOP and TEMP reports. The results were similar to those of the October 1986 annual global monitoring. The Commission noted with satisfaction that the number of reports received from Regions I and III, for which the percentages of availability remained the lowest, had increased slightly.

5.7 As regards AIREP/CODAR, SHIP and BATHY/TESAC reports, the Commission found that the results of the annual global monitoring carried out in October 1987 showed a wide disparity among the different centres. It was explained that that was due primarily to differences in the monitoring operations at the various centres, in particular for non-fixed stations (see also paragraph 5.5). The Commission agreed that the question should be addressed by the Working Group on Data Management (see also paragraph 6.4.17). The representative of IOC drew the attention of the Commission to the need to ensure that all relevant oceanographic data were available to all centres concerned.

5.8 The Commission noted that the percentage of CLIMAT and CLIMAT TEMP reports from stations included in the lists for global exchange available at MTN centres during the period of the annual global monitoring carried out in October 1987 in relation to the expected number of reports was approximately 73 per cent. During the period of the annual global monitoring carried out in October 1987, the results from some centres showed that a significant number of CLIMAT reports and CLIMAT TEMP reports relating to stations which were not included in the list for global exchange were available at GTS centres. The Commission invited Members to update, as necessary, the information contained in Volume A relating to their CLIMAT and CLIMAT TEMP stations and invited regional associations to review their regional networks of CLIMAT and CLIMAT TEMP stations. The Commission requested the Secretariat to draw the attention of regional associations to the subject.

Matters relating to the operation of the WWW in RA VI

5.9 The Commission noted that deficiencies in the operation of the WWW still remained in the south-eastern part of Region VI and invited the president and vice-president of CBS to support the efforts of Members concerned to eliminate those deficiencies.

5.10 The experts from Greece and Turkey indicated that difficulties in the operation of the main regional circuit Athens - Rome and the regional circuit Rome - Ankara were being experienced. The expert from Italy informed the Commission that new telecommunications equipment was to be installed at RTH Rome in the near future and that the requirements of GTS centres connected to RTH Rome would be met as soon as possible.

6. SPECIFIC WWW MATTERS, INCLUDING REPORTS BY THE CHAIRMEN OF WORKING GROUPS AND RAPPORTEURS (agenda item 6)

6.1 Global Data-processing System (GDPS)(agenda item 6.1)

Report by the chairman of the Working Group on the GDPS

6.1.1 The Commission noted with appreciation the report by the chairman of the Working Group on the Global Data-processing system (GDPS), Mr F. Duvernet (France), and acknowledged his valuable contributions as chairman of the Working Group during the previous 10 years. Noting with regret Mr Duvernet's wish to resign as chairman of the Working Group on the GDPS, the Commission expressed the hope that he would continue to provide advice on problems facing the Commission and wished him every success in the future.

6.1.2 The work accomplished by the Working Group on various items was considered very successful. The Commission also noted with appreciation the work carried out by the rapporteurs of the Working Group.

The use of numerical weather prediction (NWP) products by National Meteorological Centres (NMCs)

6.1.3 The Commission received with appreciation the report by the rapporteur on the Application of Improved Forecasting Methods and Required Technology for Operational Use, Dr A. J. Gadd (United Kingdom). A number of issues concerning wider and more extensive use of NWP products by NMCs were discussed as recorded in the following paragraphs.

6.1.4 The Commission noted that many digital NWP products had become available in GRID (FM 47-V) and GRIB (FM 92-VIII Ext.) code forms for dissemination over the GTS. However, GRIB products could be transmitted over only relatively few segments of the GTS, due to the requirement for telecommunications protocols suitable for binary data, while GRID products could pass over all parts of the GTS. The Commission acknowledged that the quantity of products that could be handled on low-speed circuits was severely limited. In addition, some RTHs seemed to have difficulties in ensuring reliable reception of the required products at NMC level.

6.1.5 The Commission was informed that manual decoding of GRID (FM 47-V) was still being applied in many NMCs. The Commission also considered that this method, although labour intensive, had allowed experience to be gained in the use of NWP products and had contributed to the improvement of meteorological services in various areas of application.

6.1.6 The Commission noted that NMCs equipped with appropriate hardware and software could automate the decoding, storing and plotting of NWP products. In that connection, it was considered important that effective in-house expertise should be developed as quickly as possible so that modest software modifications could be carried out without high cost when new products became available.

6.1.7 The Commission also took note of additional requirements for new kinds of NWP products, especially for small geographical areas as well as for the tropics. Further areas of interest included the interpretation of NWP products and the presentation of services to end-users. The Commission agreed to the proposal of the rapporteur to include the following in the future work programmes of the Commission and its relevant working groups:

(a) Distribution of available NWP products over the GTS should be increased where necessary. Even where low-speed circuits were in use, a small selection of products should be transmitted routinely;

(b) NMCs should be encouraged to implement manual decoding and plotting of selected GRID products at the earliest opportunity to gain experience in advance of the implementation of computerized procedures;

(c) Where computer systems were installed for the processing of incoming NWP products, NMCs should ensure that the software obtained was capable of handling the specific NWP products they wished to receive and use;

(d) The Working Group on the GDPS should investigate whether new types of numerical products could be developed to meet the needs of NMCs in the tropics in particular;

(e) NMCs were encouraged to undertake systematic assessment of incoming analyses and forecasts as soon as possible, and relay their findings back to the producing centres;

(f) More efforts should be made to establish statistical interpretation techniques at NMCs for application to incoming numerical products. Collaboration with modelling centres, and with centres experienced in statistical interpretation, would be required.

Exchange of software

6.1.8 The Commission noted that the CBS Working Group on the GDPS had initiated the production of a catalogue of meteorological software to facilitate the exchange of software among centres, especially in promoting more extensive use of NWP products by NMCs. The Commission considered that to be a way of transferring technology from advanced to less-advanced countries. CBS-Ext.(85) had endorsed the idea and stressed the need to update the documentation frequently.

6.1.9 The Commission was informed that the work had been undertaken by the Secretary-General with the help of the expert designated by the CBS Working Group on the GDPS. Close co-operation had also been established with the Technical Co-operation Department of the WMO Secretariat within the framework of the new Software Help in Applications, Research and Education (SHARE) Project (UNDP-VCP).

Procedures for the designation of Regional/Specialized Meteorological Centres (RSMCs)

6.1.10 Tenth Congress had agreed that, with the introduction in the WWW Plan of the concept of Regional/Specialized Meteorological Centres having geographical and/or activity specializations, there was a need to establish step-by-step procedures for the designation of new centres. It therefore requested the Commission for Basic Systems to develop such procedures and to make appropriate recommendations to EC-XL on the matter. In that connection, Tenth Congress expressed its agreement, in general, with the designation procedures for new RSMCs as suggested by the Secretariat and reviewed by the CBS Advisory Working Group during its thirteenth session (Geneva, 6-10 April 1987).

6.1.11 In the light of that directive, the Commission discussed in some detail the proposed procedures for the designation of new Regional/Specialized Meteorological Centres (RSMCs) and emphasized that the main objective for introducing such a mechanism was to ensure that the functions and responsibilities of GDPS centres were defined and accepted in accordance with stated requirements and recognized capabilities. The Commission felt in particular that CBS, through its working groups and in close co-operation with other WMO constituent bodies and their subsidary groups, had an important role in co-ordinating the activities and services of RSMCs within the framework of the WWW and in the interest of a smooth and efficient operation of its components as a fully integrated system.

6.1.12 After a thorough discussion of the procedural and technical aspects of the proposed designation procedure for the RSMCs, the Commission agreed on a revised version which is contained in Recommendation 1 (CBS-IX).

Transition of existing RMCs into RSMCs

6.1.13 The Commission was aware that RMCs in their present functions in general met the requirements for geographical specialization of RSMCs in the new WWW Plan. Although several delegations voiced their concern about the state of implementation of some of the present RMCs, the Commission agreed to recommend the transition of existing RMCs into RSMCs with geographical specialization without applying the new designation procedure for RSMCs.

6.1.14 The Commission noted that Norrköping (Sweden) had expressed its intention to cease its function as an RMC. An enquiry was carried out among Members in Regional Association VI to determine their opinions on the proposed withdrawal of the Norrköping RMC. The Commission noted that no objection had been received and agreed to delete Norrköping from the list of RMCs. The Commission noted that Norrköping would continue its functions as a Regional Telecommunication Hub (RTH). The Commission expressed its sincere appreciation to Sweden for having operated RMC Norrköping for many years with a high level of performance and reliability.

6.1.15 Recommendation 2 (CBS-IX) on the redesignation of existing RMCs as RSMCs with geographical specialization was adopted.

Adoption of activity specialization by existing GDPS centres

6.1.16 The Commission noted information collected from the RMCs on possibilities of providing specialized products under the RSMC concept to cover global and/or regional requirements in the following fields of application:

- Marine meteorology;
- Tropical cyclones;
- Meteorological/environmental hazards;
- Drought monitoring and climate diagnosis.

6.1.17 While welcoming such offers, the Commission felt that further steps would be needed to specify in more detail the capabilities for providing specialized products and services and to determine whether there was a requirement to expand an existing RSMC or to establish a new RSMC. The Commission agreed that there was a need to keep up to date requirements for WWW products as well as information on capabilities of GDPS centres. The Commission requested the Secretary-General to initiate a survey on requirements and capabilities for consideration by the Working Group on the GDPS and constituent bodies as appropriate. It also felt that the information compiled in that process would merit regular updating. In the interim, the Commission asked the Secretary-General to inform the constituent bodies concerned of the offered RSMC capabilities.

6.1.18 The Commission recognized that some centres designated as RSMCs also provided specialized meteorological services to international civil aviation, primarily under the World Area Forecast System (WAFS) which depended to a large extent on the World Weather Watch. In that connection, the observer from the International Civil Aviation Organization (ICAO) reported that there was no additional international civil aviation requirement for any RSMC. Requirements were being adequately covered by the present WAFS which was expected to approach its final phase - when only two meteorological centres would provide the required WAFS services on a global scale - soon. Similar information was received from the International Air Transport Association (IATA). The Commission agreed that services to international civil aviation, although strongly dependent on the WWW system, should not be considered under the RSMC concept unless specifically requested by ICAO through CAeM, in accordance with existing working arrangements between WMO and ICAO.

Establishment of new RSMCs

6.1.19 The Commission noted with appreciation the offers made by Members aiming at the establishment of RSMCs either through co-operative efforts or individually. It emphasized, however, the important role of regional associations and other constituent bodies in defining the requirements for WWW products and services and identifying appropriate capabilities to meet such requirements.

6.1.20 Having noted the information provided on various projects to establish new RSMCs such as the African Centre of Meteorological Applications for Development (ACMAD), the Latin American and Caribbean Centre for Atmospheric Sciences (LACCAS), the ASEAN Centre, the Antarctic Meteorological Centre(s) and the tropical cyclone forecasting centres Nadi and Réunion, the Commission agreed that no specific steps were required by CBS-IX in that regard. The Working Group on the GDPS was requested to review the progress of those projects and advise CBS on appropriate follow-up action.

6.1.21 The Commission was informed by France of its capabilities to provide specialized products in case of nuclear accidents or emergency situations resulting from a chemical accident. It noted the formal offer by France to serve as an RSMC in that capacity. The Commission was informed by Spain on the efforts that were being made to promote the proposed Centre for Western Mediterranean Meteorological Studies (CEMMO) in Palma de Mallorca which was intended to seek solutions to meteorological problems in the region, particularly those involving dangerous weather phenomena. Furthermore, Greece indicated its readiness to accept the functions of an RSMC provided adequate telecommunications support could be arranged, e.g. a new link of suitable capacity to be set up between Athens - Offenbach or Athens - Paris, or upgrading and maintaining in perfect order the GTS link Athens - Rome.

6.1.22 The Commission noted with appreciation that a Mediterranean Meteorology Emergency Centre was being established in Italy within the framework of activities of the World Laboratory, to make available specialized products relating to emergencies of a meteorological nature (including flash floods, landslides, avalanches, storm surges, wind storms, droughts, accidental release of chemical and/or radioactive material into the atmosphere, etc.). The Commission also noted the formal offer from Italy that the Centre should serve in that capacity as an RSMC and agreed that, pending its formal designation, the Centre should be encouraged to disseminate its specialized products to interested Members.

6.1.23 With respect to the tropical cyclone forecasting centres Miami, New Delhi and Tokyo, the Commission noted that those centres were already carrying out the required functions and agreed that the relevant provisions of the designation procedure could be considered as implemented. It therefore recommended the designation of those RSMCs with activity specialization in tropical cyclone forecasting. The newly designated RSMCs were requested to arrange for a demonstration of their functions and services at the next session of the Commission which could provide a useful example for similar presentations of RSMCs in future.

6.1.24 The Commission also noted with pleasure a decision by the Council of the European Centre for Medium Range Weather Forecasts offering to serve as an RSMC within the WWW. In view of the fact that requirements for medium-range weather forecasts had already been stated by CBS and that the capabilities of the ECMWF had been amply demonstrated, the Commission took the view that the relevant provisions of the designation procedure as set out in Recommendation 2 (CBS-IX) had been complied with and recommended that ECMWF should be designated an RSMC. In that connection, requirements for additional global products of ECMWF were stated by a number of delegations. It was agreed that ECMWF would try to satisfy those requirements to the maximum extent possible, in accordance with the procedures outlined in Recommendation 1 (CBS-IX).

6.1.25 Recommendation 3 (CBS-IX) on the designation of new RSMCs with activity specialization was adopted.

Revision of the Manual on the Global Data-processing System

6.1.26 The Commission was aware that the Manual on the Global Data-processing System (WMO-No. 485) needed to be updated to reflect the introduction of the RSMC concept as well as the designation of new RSMCs. It felt in particular that the inclusion of RSMC functions both in regard to geographical and activity specialization would require fundamental changes to the relevant parts of the Manual in order to provide a clear picture of the functions and obligations of each individual RSMC. The Commission therefore entrusted its Working Group on the GDPS to develop proposals for appropriate amendments to the Manual on the GDPS in collaboration with the Working Group on Data Management.

6.2 Global Observing System (GOS) (agenda item 6.2)

Report of the chairman of the Working Group on the GOS

6.2.1 The Commission noted with appreciation the report of the chairman of the Working Group on the Global Observing System, Dr T. Mohr (Federal Republic of Germany). The Commission expressed particular gratitude for the very substantial amount of work accomplished by the Working Group through its specialized study groups and rapporteurs. Details of the chairman's report, as well as his proposals for the future work programme of the Group, were discussed under the various items of the agenda.

Manual on the Global Observing System

6.2.2 The Commission recalled that the present edition of the Manual on the Global Observing System (WMO-No. 544), dating from 1981, had been recognized as incomplete. The need to expand Part III (dealing with the surface-based subsystem) to include more information on certain types of observing stations and to reorganize the text so as to facilitate reference to information on each particular type of station had already been identified. It was also considered necessary to include regulatory material concerning instruments and methods of observation.

6.2.3 The approval by Tenth Congress of the WWW Plan and Implementation Programme 1988-1997 had called for further amendments to be made to the Manual concerning the desirable horizontal resolution and frequency of surface and upper-air observations and the vertical resolution required for certain elements. Furthermore, Congress had invited the Commission for Basic Systems to make proposals to the Executive Council on the amendments to the WMO Technical Regulations and WWW manuals and guides to ensure the proper and efficient functioning of the WWW system in the case of transboundary flow of hazardous material in the atmosphere.

6.2.4 Almost all the required amendments had been incorporated in a new version of Part III of the Manual prepared by the Working Group on the Global Observing System, based in part on suggestions made by the president of CIMO. The remainder, dealing with hazardous materials in the atmosphere, were covered in Part II, the amendments to which were prepared in the light of the recommendations of the EC ad hoc Group of Experts on Operational Meteorological Aspects concerning the Emission of Hazardous Materials into the

Atmosphere and Atmospheric Emergency Responses. The Commission congratulated the Working Group on the large amount and the quality of work that had been accomplished and also thanked the president of CIMO for his assistance and co-operation.

6.2.5 The Commission thoroughly examined the proposed texts; following suggestions made by several members and by ICAO, a number of changes were made to the Working Group's proposals. The Commission recommended that the revised Part III of the Manual and the amendments to Part II which had been submitted to the ninth session should be forwarded to the Executive Council for approval. Recommendation 4 (CBS-IX) was adopted.

6.2.6 The Commission noted that regional associations had relaxed requirements for the spacing of surface stations in the regional basic synoptic networks, the minimum regional separation of stations (250 km) having become no more than that proposed for the composite global observing system. Recognizing that regional forecasts in some areas required the support of a denser network of stations, the Commission invited the regional associations to consider their observational network design in the light, firstly, of new observing technologies and, secondly, of demands for data in support of present and future forecasting services.

6.2.7 In addition, the Commission, mindful of its responsibility to incorporate requirements of other commissions and programmes, noted the increasing importance of the study of climate change and the corresponding need for data from background pollution stations. The Commission was prepared to consider specific proposals in that respect if and when requested to do so by CCl or CAS.

6.2.8 The Commission's attention was drawn also to the lack of definition of a "gust" or of any guidance on how to measure gusts. It was therefore requested that the Working Group on the Global Observing System, in consultation with CIMO, should develop suitable texts for inclusion in both the Manual and the Guide on the Global Observing System.

6.2.9 Finally, it was recognized that practices and procedures for tide-gauge stations should be co-ordinated with the regulations of IOC and that the Global Sea Level Observing System Implementation Plan (1985-1990) should be taken into account. The Commission for Marine Meteorology was invited to consider the matter.

Guide on the Global Observing System

6.2.10 At its eighth session the Commission had noted that, with the publication of the 1981 edition of the Manual on the Global Observing System, it had become necessary to rewrite the Guide on the Global Observing System. It had requested that a draft of a completely revised and expanded version of the Guide be submitted to CBS-IX with a view to publication. The task had been assigned to the Working Group on the Global Observing System.

6.2.11 In reviewing the draft of the revised Guide, the Commission congratulated the Working Group, and in particular its Study Group on the Manual and Guide, for the excellent work it had achieved, much of it by correspondence. The Commission noted that account had been taken where necessary and appropriate of the World Weather Watch Plan and Implementation Programme 1988-1997 as adopted by Tenth Congress. Some of the information included in the Plan, particularly the tables, had been incorporated in the Guide as had a number of additional tables which had been prepared as part of the Integrated System Study for possible inclusion in the Long-term Plan.

6.2.12 The Commission expressed its pleasure that particular attention had been given to ensuring adequate co-ordination and consistency and to avoiding duplication with the Guide to Meteorological Instruments and Methods of Observation. The president of CIMO, in making a number of constructive comments and suggestions for amendments which were taken into account in the final draft of the Guide on the GOS, had expressed the view that the new Guide would very satisfactorily fill the gap between the Manual on the GOS and the Guide to Meteorological Instruments and Methods of Observation.

6.2.13 Following suggestions and comments made by individual members, the Commission agreed on a limited number of further amendments to the draft which it considered essential before publication. Having made those amendments, and subject to further editorial verification, the Commission approved the revised Guide for publication. The Secretary-General was requested to arrange for its immediate publication in English and in the other working languages as soon as possible thereafter.

6.2.14 The Commission noted that one or two sections would have to be completed after publication, e.g. the sections dealing with special stations and the management of automatic station networks. The Commission requested the Working Group on the Global Observing System to consider how the development and introduction of the new observing systems and techniques (i.e. ASAP, ASDAR) should best be reflected in the GOS guidance material and to develop guidance material on methods and procedures for measuring and monitoring new meteorological parameters/variables or atmospheric constituents. The revised Guide should be published in a form which would allow easy insertion of amendments and additions as they became available.

Status of implementation of specific systems

6.2.15 The Commission was given an in-depth review of the status of implementation of the Automated Shipboard Aerological Programme (ASAP), the Aircraft to Satellite Data Relay (ASDAR) programme and the buoy programme. It recalled that both Congress and various sessions of the Executive Council had given special attention to the development of each of these as part of the improved WWW. It also noted that these programmes had their roots in successful development activities which had been carried out during the Global Weather Experiment (FGGE). In the instance of ASDAR, the Commission was informed that up to five of the original 17 prototype ASDAR systems deployed during FGGE were still in use providing valuable information, especially from the southern hemisphere.

6.2.16 The Commission recognized that the integration of new observing systems into the WWW required a high level of co-ordination among participants with respect to equipment design, data processing, development of operational codes and data communications. Note was taken that problems with organizational costs had been encountered. While the close co-ordination of activities had resulted in substantially lower costs, it had been necessary to find alternative funding strategies. For ASDAR, the participants had contributed to development and operational funds which were held in trust by the Secretary-General. For buoys, national and bilateral arrangements and COST-43 had been primary vehicles, with important organizational and administrative support being provided by the Drifting Buoy Co-ordination Panel, a joint activity of WMO and IOC. The Commission expressed its great appreciation to the Members participating in these programmes for the important improvements to the GOS which had resulted. In that regard, it recognized the substantial support which had been provided by the Secretary-General.

ASAP

6.2.17 The Commission was informed that eight Members were co-operating in the ASAP Co-ordinating Committee (ACC) and that 11 ASAP systems were in operational use. The session noted that an additional five systems were to be implemented during 1988. The Commission took special note of the work carried out by the ACC, including the preparation of the ASAP programme plan and ASAP functional specifications (available as WMO/TD-No. 113, 1986), conducting an interevaluation of ASAP processing systems (the results of which were made available to CIMO), and participation in the OWSE-North Atlantic.

6.2.18 The session, having been informed that ASAP was a fully developed concept which was commercially available, recommended that ASAP should be seriously considered by Members as an effective way of increasing the amount of upper-air data available from data-sparse ocean areas.

6.2.19 In discussing the ASAP programme, the session took note of serious satellite communications problems which had developed over the North Atlantic. The DCS mission over the North Atlantic was being carried out on an emergency basis through an agreement between EUMETSAT and the USA. The DCS mission on the experimental METEOSAT had failed and was being replaced on a temporary basis by an ageing GOES-series satellite moved to 43° west longitude. Due to interference problems and the unusual measures required of EUMETSAT to acquire signals, substantial data losses had occurred throughout 1987 and were continuing in 1988. The data losses had affected all DCS users including, in addition to ASAP, shipboard systems reporting surface observations, ASDAR and land-based stations. The Commission was grateful to learn of the plans of EUMETSAT to launch the P-2 and MOP-1 satellites in April 1988 and late 1988 respectively, which were expected to resolve the problems.

ASDAR

6.2.20 The Commission was informed that progress had been made with the ASDAR programme. The development activities were nearing completion with certification for use on commercial aircraft of the B-747 and DC-10 types to be completed in 1988. In addition, 13 production units were on order for delivery beginning in the second half of 1988. The Commission expressed its appreciation to the participants in the Consortium for ASDAR Development (CAD) and the Operating Consortium of ASDAR Participants (OCAP) for their work. In that regard, the United Kingdom noted that two of its units either currently on order or planned for future delivery would be made a part of VCP and that it was in the process of seeking suitable participation from potential VCP recipient countries. The United Kingdom also noted the possibility that some units, to be purchased from regular funds, might be made available for use on air carriers of other Members, assuming suitable arrangements could be agreed upon.

6.2.21 Australia informed the Commission of its work to provide automated aircraft observations using VHF communications on board certain aircraft of its national airlines. VHF communications are line-of-sight and are thus limited to areas where ground receivers have been installed. A prototype of the technique had been demonstrated successfully during FGGE. The Australian Meteorological Service, however, had greatly extended the capabilities of the system to include such features as profiles on take-off and landing and information on turbulence. In that regard, the data obtained from the Australian system, currently operating on some 30 aircraft, paralleled closely those of the operational ASDAR.

6.2.22 During the discussion, the Commission noted that airlines themselves were actively engaged in the development of both VHF and satellite communications systems for the transmission of company and passenger information. Further, the Commission noted that an extensive aircraft modernization programme was under way by many airlines, which offered the possibility of obtaining automated meteorological data through several different communications systems. For that reason, some consideration needed to be given to a "family" of automated systems, of which ASDAR would be one member.

6.2.23 The Commission expressed the view that, given the importance of meteorological data from aircraft and the broad range of activities in aircraft communications, the possibilities of obtaining meteorological data from commercial aircraft should be kept under review. After discussion of how to proceed, it was agreed that the Secretary-General should be requested to propose to the participants in OCAP a suitable expansion of its terms of reference. The Commission also proposed that the chairmen of the CBS Working Group on the GOS and OCAP should work closely together to keep CBS informed of developments.

Buoys and other marine platforms

6.2.24 The Commission was informed that, at the present time, some 18 countries were operating drifting-buoy programmes in support of a variety of meteorological and oceanographic research and operational activities, including the World Weather Watch (WWW) and World Climate Research Programme (WCRP) of WMO. Data from drifting buoys were normally collected using the Argos Data Collection and Platform Location System (DCPLS) which was flown on the NOAA satellites and operated as a co-operative venture involving CLS/Service Argos (France) and NOAA (USA). In 1987, governmental users of the Argos system contracted for a total of 575 platform-years for data collection and location.

6.2.25 The total of platform-years included platforms other than drifting buoys and not all the drifting buoys currently deployed had their data distributed over the GTS. According to the October 1987 Argos monthly status report, some 521 buoys were reporting via CLS/Service Argos of which 123 had their reports distributed over the GTS in DRIBU code via RTH Paris. It was noteworthy that the ratio (24 per cent) of buoys whose reports were available over the GTS represented a decrease from the figures for March 1985 (92 of 333 reports) and March 1986 (161 of 400 reports). In addition to those reports, DRIBU reports from a number of buoys (probably greater than 40) received via Local User Terminals (LUTs) were also inserted onto the GTS.

6.2.26 A permanent archive for drifting-buoy data was established by the Canadian Marine Environmental Data Service, which had been accorded the status of a Responsible National Oceanographic Data Centre (RNODC) for drifting-buoy data within IOC. Unfortunately, not only do many drifting-buoy operators not make their buoy data available in real time over the GTS, they have also not agreed that their data should go into the permanent global archive established in Canada. That was a special problem with respect to research oceanographers in universities and similar institutions.

6.2.27 A variety of other semi-automatic and automatic marine stations, including in particular moored buoys and fixed platforms (e.g. on oil rigs), were also operated by a number of countries. A total of 110 moored buoys and 93 platforms were operated by 17 countries. They generally reported via geostationary satellite or directly to shore using MF/HF/VHF radio and the data distributed over the GTS in SHIP code (or occasionally SYNOP code for fixed platforms).

6.2.28 Although in a number of countries the data from moored buoys and fixed ocean platforms were archived (from the GTS reports) along with the ship's reports as part of the Marine Climatological Summaries scheme, there was at present no formalized arrangement within WMO (or IOC) for the specific archiving of such data, such as presently existed for ships' reports and drifting-buoy data.

Drifting Buoy Co-operation Panel

6.2.29 The Executive Council, at its thirty-seventh session (Resolution 10 (EC-XXXVII)), decided to sponsor a Drifting Buoy Co-operation Panel for the purposes of enhancing co-operation and co-ordination amongst drifting buoy programmes in support of the WWW, the WCRP and various other programmes of WMO and IOC. Subsequently, the IOC Executive Council accepted the invitation of the WMO Executive Council to co-sponsor the panel with WMO. The first panel session took place in Toulouse, France, in October 1985, and the second session in Geneva in October 1986. The intersessional period was largely taken up with activities on the part of both the WMO and IOC Secretariats aimed at the appointment of a full-time technical co-ordinator for the Panel who began work on 1 June 1987.

6.2.30 The third session of the Panel (Paris, October 1987) reviewed the initial activities of the technical co-ordinator, which included improving the flow of buoy data over the GTS. The Panel agreed that the co-ordinator had already achieved very valuable results and approved funds for the continuation of the position for the second year.

6.2.31 The Commission expressed its strong support for the work of the Drifting Buoy Co-operation Panel, noting its importance to the provision of meteorological data over ocean areas. The Commission noted that various problems had been encountered concerning data quality and availability and considered that continued improvement in buoy performance was closely linked to the activities of the Panel. It also noted with appreciation the decision of the Panel to fund the work of a technical co-ordinator, one task being to assist in the OWSE-NA evaluation. It expressed the hope that both the work of the Panel and the co-ordinator would be supported by as many other Members as possible.

6.2.32 The Commission took note of the developments in the implementation of buoy and other automated marine platforms and expressed concern over the significant amount of useful information that was not being exchanged over the GTS or that was not being included in archived data banks. It asked the participants in the Drifting Buoy Co-operation Panel to consider ways of overcoming the difficulties as a matter of priority. The Commission expressed the belief that the support of the Secretariat in that regard was important.

Further implementation support

6.2.33 In considering the activities of Members, other organizations and the Secretariat in the implementation of ASDAR, ASAP and buoy programmes, the Commission noted the critical role played by satellite communications. It expressed serious concern, for example, over the difficulties encountered by Members with respect to the DCS covering the eastern part of the North Atlantic. It warmly welcomed the efforts of EUMETSAT to quickly implement an operational programme. It also recognized that the availability of adequate satellite communications was crucial to the success of the broad implementation of certain observing programmes, as well as for such activities as the OWSE-Africa and OWSE-North Atlantic. The Commission, therefore, strongly urged those Members operating satellites with communications capabilities suitable for the WWW to take all appropriate steps, as a matter of priority, to ensure the continuation of those capabilities. It further suggested that participants in programmes like ASAP, ASDAR and that on drifting buoys should carefully examine back-up modes of communication and, as appropriate, incorporate alternative capabilities into the design of their systems. Resources permitting and as appropriate, the Commission asked the Secretariat to assist Members and/or other organizations in defining ways in which the communication of observational data from platforms, especially in data-sparse areas, could be made more secure.

6.2.34 The new ASDAR code (FM 42-IX ASDAR) and changes to the ASAP ship code (FM 36-V TEMP SHIP) were taken up under agenda item 6.4 and approved for implementation. The Commission noted that there was some urgency in the implementation of ASDAR and ASAP, and proposed implementation dates of 1 May 1988 for the ASDAR code and 1 November 1988 for the ASAP changes. The Commission urged all Members, particularly those participating in the two programmes and those operating RTH facilities, to do their best to meet the very stringent time constraints.

Baseline Upper-air Network (BUAN)

6.2.35 The Commission recalled that CBS-Ext.(85) had asked the USA to organize an evaluation of the BUAN concept. BUAN had been proposed as a method of obtaining additional and/or more representative sounding data from satellite radiance information. It was agreed, however, that sufficient information was not available to enable a decision to be made on the need for or the design of an operational BUAN. Considering the potential cost to Members and other operational factors, the Commission believed an evaluation should be carried out prior to any implementation of BUAN.

6.2.36 In 1987, the president of CBS, in collaboration with the National Weather and Satellite Services of the USA, prepared an evaluation plan. In all, some 99 radiosonde and rocketsonde stations would participate with soundings co-ordinated with the overpassage of polar-orbiting satellites. The plan was circulated by the Secretary-General to potential participants in

September 1987. As of the starting date of 15 January 1988, 20 Members, representing 69 stations had agreed to participate as well as at least three ASAP ships and two ocean weather ships.

6.2.37 The Commission was informed that data were beginning to be received at WMC Washington for analysis. Some initial difficulties had been encountered at the beginning, particularly in receiving information over the GTS, on the times of satellite overpassage, and some stations had not yet begun their participation. The president of CBS noted that some additional stations would be welcome, particularly in the latitude bands 30°-45°N and 15°-45°S, for the evaluation phase scheduled to be completed on 15 July 1988. He expected that, during any operational phase of BUAN, only a relatively few stations would be required. The evaluations, of course, were aimed at determining the number of stations required and their location, assuming the need for an operational BUAN had been demonstrated.

6.2.38 In addition to data analyses to be carried out in the USA, the BUAN evaluation plan encouraged other Members and/or groups to carry out data analyses. One such group encouraged by CBS was the International TOVS Study Conference. The Commission was informed that ECMWF had agreed to examine the timeliness and quality of data from BUAN stations as part of the overall evaluation and that a preliminary report was in preparation. The Commission expressed its satisfaction with the work under way and looked forward to the early presentation of results.

Availability and use of satellite data

6.2.39 The Commission received with appreciation the report of the two rapporteurs on TIROS Operational Vertical Sounder (TOVS) Data Retrieval Methods, Dr J. Le Marshall (Australia) and Dr W. P. Menzel (USA). In discussing their report, the session took particular note of the growing importance of quantitative satellite data for a wide range of forecast problems in both developing and developed countries. It was especially interested to learn, for example, of the rapid growth in the number of Members which could process satellite-sounding data. A significant part of that growth had come about through the direct efforts of Members, organizations and universities participating in the International TOVS Study Conference. An important development noted by the Commission had been the ability to use microcomputers to obtain useful local soundings.

6.2.40 The Commission was further informed of the substantial progress being made to develop improved data-processing algorithms for the calculation of satellite soundings and of the greater use being made of fields of information, such as water vapour. For certain areas, such as over the southern hemisphere and northern oceans, quantitative satellite data were vital for the production of forecast products.

6.2.41 The Commission noted, however, that the broader use of quantitative satellite data could only come about through the careful implementation of proven techniques. Due to the nature of the atmosphere, the mathematics involved in data processing and the inherent capabilities of the satellite sounders themselves, the quantitative satellite data did not necessarily have the same value in all parts of the world. The Commission also noted that the situation was changing rapidly due to better algorithms for data processing and better assimilation techniques. The Commission was furthermore informed that improved satellite systems were planned for the coming decade which could provide more information with a finer vertical and horizontal resolution than at present. The Commission agreed, therefore, that it was essential that the work of the rapporteurs should be continued so that new developments in sounders, data processing and data applications could be brought to the attention of CBS and Members.

6.2.42 In considering the future work of the rapporteurs, the Commission believed that even closer collaboration between the ITOVS Study Conference and CBS was highly important. An effective way to achieve this was to ask the rapporteurs to provide periodic reports on satellite activities - including those of ITOVS - directly to the chairman of the Working Group on the GOS and, as appropriate, to provide him with assistance on relevant satellite matters. This request is reflected in the terms of reference for the TOVS rapporteurs which were adopted by the Commission as Resolution 6 (CBS-IX).

6.2.43 The delegate from China informed the session that his country had been making active use of microcomputers to derive satellite soundings. His country had gained experience that might be useful to other Members and his service was willing to share that experience in an appropriate manner. The Commission welcomed his offer and requested the Advisory Working Group to consider the matter.

6.2.44 In that regard, the Commission asked the Advisory Working Group to arrange at CBS-Ext.(90) a demonstration of the local reception, processing and use of satellite soundings and any other appropriate techniques for obtaining and using quantitative satellite data. Special emphasis should be put on those techniques and facilities which could be of benefit to developing countries.

6.2.45 The Commission noted the recommendation of the rapporteurs on TOVS data-retrieval methods that the ITOVS should be encouraged to participate in the data-analysis phases of the BUAN evaluation. The session supported that recommendation and asked for the appropriate liaison to be made with ITOVS during its fourth session in March 1988.

6.3 Global Telecommunication System (GTS) (agenda item 6.3)

Report of the chairman of the Working Group on the GTS

6.3.1 The Commission noted with appreciation the report of the chairman of the Working Group on the GTS on its activities since the CBS extraordinary session (Hamburg, October/November 1985). The Commission underlined the importance of the Working Group for the development of the GTS, which was an essential element for the efficient and reliable operation of the whole WWW system. The Commission agreed that regular sessions of the Working Group were required for carrying out an effective work programme on complex and highly technical matters. The Commission noted that the next session of the Working Group was scheduled for 1990 and that six years would therefore have elapsed since its last (eleventh) session (Geneva, October/November 1984).

6.3.2 The Commission also noted with great appreciation the work carried out by the Study Group on Communication Techniques and Protocols (SG-CTP) and the Study Group on Operational Matters, and reaffirmed their vital role for the development of the GTS. The Commission particularly highlighted the essential task entrusted to the SG-CTP of recommending adequate protocols and techniques for the GTS selected from amongst a considerable number of ISO standards and CCITT recommendations on data communications, and the considerable impact of SG-CTP on a cost-effective development of the GTS. The Commission agreed that regular sessions of these two study groups should be organized, at least on a two-year basis. The Commission requested the Secretary-General to make all possible efforts to organize regular sessions of the Working Group on the GTS and its two study groups. The Commission was informed that a meeting of each study group was scheduled for 1989, and that all efforts would be made to maintain those two meetings despite the financial situation of the Organization. The Commission urged that, if at all possible, the meeting of the Study Group on Operational Matters should be moved forward to 1988.

Technical matters relating to the Global Telecommunication System

6.3.3 The Commission noted that the third session of the Study Group on Communication Techniques and Protocols (December 1986) had considered several technical matters in order to further develop GTS procedures and techniques and to update the Manual on the GTS. The Commission also noted the future work programme elaborated by the SG-CTP, and referred it to the consideration of the Working Group on the GTS.

Communication procedures of OSI layers 2, 3 and 4

6.3.4 The Commission endorsed the opinion of the Study Group that the installation and operation of the packet-switched mode of operation on the MTN would be premature, taking into account the lack of operational compatibility between the relevant equipment provided by different manufacturers. The Commission was of the opinion that, in the present situation of operation of the MTN, the most important improvement would result from the full implementation of the X.25 procedures on point-to-point circuits and the introduction of the transport layer protocol. The Commission also felt that use of the public packet-switched data networks for meeting special transmission requirements between centres and for back-up purposes offered interesting opportunities which should be examined closely.

6.3.5 Noting the conclusions of the Study Group, the Commission agreed that a transport protocol should be employed on the GTS in accordance with CCITT Recommendation X.224. It agreed that the Class 2 transport procedures would be the basic transport protocol for use on the GTS, including the optional elements of procedure for multiplexing, explicit flow control and expedited data transfer. The Commission was informed that software packages made available so far by manufacturers for the implementation of the transport protocol required the use of "virtual call" of layer 3 and were not yet compatible with the use of permanent virtual circuit (PVC). The Commission was of the opinion that, with a view to gaining experience in the operation of the transport protocol, virtual call might be used on an interim basis and by bilateral agreement between centres for facilitating the operation of the transport protocol.

6.3.6 The Commission felt that further work was urgently required for the further development of data-communication procedures, with a view to selecting different possible options within international standards and preventing possible divergence in the implementation of procedures and protocols by different centres. The Commission requested its Working Group on the GTS, and in particular the Study Group on Communication Techniques and Protocols, to pursue its work on those questions.

Coded digital facsimile techniques

6.3.7 The Commission considered that CCITT Group 4 facsimile apparatus offered features which could improve the exchange of pictorial information over the GTS. It agreed that Group 4 facsimile procedures should be included in the Manual on the GTS as a possible standard. It also agreed to update accordingly the procedures for transmission of pictorial information by coded digital facsimile, by inclusion of a reference to CCITT Recommendation T.73 - Document interchange protocol for the telematic procedures applicable for the exchange of a document generated by Group 4 facsimile equipment.

Data communication requirements for WWW Data Management

6.3.8 The Commission endorsed the opinion of the SG-CTP that WWWDM functions would introduce new transmission requirements, and requested its Working Group on the GTS to study and develop the communication procedures and mechanisms required, in co-ordination with the Working Group on WWW Data Management.

Amendment to the Manual on the GTS, Volume I, Part II and Part III

6.3.9 The Commission agreed that the Manual on the GTS, Volume I, Part II and Part III should be amended to include the new procedures mentioned, and adopted Recommendation 5 (CBS-IX) and 6 (CBS-IX) to that effect.

Telecommunication procedures

6.3.10 On the basis of the report of the chairman of the Study Group on Operational Matters, the Commission identified several questions on telecommunication procedures which required urgent resolution. Although consideration of those matters should be pursued through correspondence, the Commission expressed the opinion that, due to the complex nature of some problems, only a meeting of the Study Group could draw conclusions (see also paragraphs 6.3.1-6.3.2 above).

Routeing of processed information and observational data

6.3.11 The Commission recalled that, at its last extraordinary session (Hamburg, October/November 1985), specifications had been adopted for the coding of abbreviated headings, greatly increasing the flexibility of allocation. The Commission felt that further improvements could be made, in particular for GRIB and GRID code messages, BUFR messages and messages containing pictorial data.

6.3.12 The Commission noted that the abbreviated heading allocated to messages related to the early notification of a nuclear accident, i.e. WNXX 01 IAEA YYGGgg, ensured that such messages were routed over the GTS for global distribution with the highest priority. It was also noted that, although the GTS procedures would make it possible for the country concerned to insert such messages onto the GTS itself, that would lead to a considerable number of additional abbreviated headings for this type of message. The Commission considered that a very limited number of abbreviated headings for this type of message would greatly facilitate their proper identification and the initiation of subsequent action, as well as the regular testing of agreed arrangements.

Further development of various procedures

6.3.13 The further development of monitoring procedures was discussed under agenda item 6.4. The Commission agreed that procedures for the routeing of addressed messages as well as those for request-reply to data banks needed further consideration, in co-ordination with relevant development of the WWW Data Management concept.

Operational aspects of collection and dissemination by satellite

6.3.14 The Commission noted with appreciation that consideration of this matter had been initiated, and requested the Working Group on the GTS to pursue its work with a view to ensuring that these developments followed the established practices and procedures of the GTS so as to avoid difficulties at centres making use of these systems.

Radio frequencies for meteorological satellite data-collection system

6.3.15 Serious radio interferences have occurred on some frequencies allocated to the international DCPs, jeopardizing the efficient operation of the data-collection system, in particular for ASDAR and ASAP. Consultations with the International Frequency Registration Board (IFRB) were carried out by the WMO Secretariat with a view to determining possible action to overcome present difficulties and to improve the protection of frequencies assigned to the DCPs in the future. In accordance with the regulations, the Meteorological Satellite Service, which has a secondary service allocation, can claim protection in the band 402-403 MHz from harmful interferences from other stations of other radiocommunication services which have a secondary status, provided that interferences are not caused by meteorological aids which have a primary service allocation. IFRB would organize a monitoring campaign to identify the source of harmful interference at the request of a national telecommunication administration. It was stressed that the IFRB should be notified of frequencies assigned to DCPs, through the relevant national telecommunications administration, to serve as a basis for co-ordination and protection.

6.3.16 The Commission was informed that any change in the present regulations concerning the Meteorological Satellite Service with a view to improving future protection against possible harmful interferences could be considered only by the next Administrative Conference on Space Radiocommunications, scheduled for 1992. Taking into account that collection of data from DCPs was expected to play an increasing role in the WWW system, the Commission requested its Working Group on the GTS to develop, in co-ordination with CGMS, a proposal for submission to the next ITU Administrative Conference concerned, aimed at improving the protection of data-collection services operated through geostationary meteorological satellites against harmful interferences.

Organization of the GTS

The use of INMARSAT for the collection of ships' weather reports and the dissemination of meteorological information

6.3.17 The Commission recalled that Tenth Congress, by its Resolution 15 (Cg-X), urged, inter alia,

(a) Those Members operating CESs which had not yet done so, to accept ships' weather reports and oceanographic reports transmitted through their CESs, free of charge to ships;

(b) Those Members in Regions where the introduction of INMARSAT has produced recognized changes in patterns of data collection, to develop interregional, regional, subregional or bilateral agreements for cost-sharing, as appropriate;

and also requested the Executive Council, with the assistance of the presidents of CBS and CMM and the Secretary-General, to consider the formulation of appropriate cost-sharing schemes for the reception of marine environmental reports through INARSAT.

6.3.18 The Commission considered that the formulation of appropriate cost-sharing schemes for the reception of ships' weather reports was unlikely to be feasible in the near future. Noting that only six INMARSAT Coastal Earth Stations (CESs) amongst the 20 CESs in operation were accepting ships' weather reports free of charge to ships at present, the Commission was of the opinion that an increase in the number of CESs accepting ships' weather reports would alleviate the present financial burden on a small number of Members. In that regard, the delegate of the USSR informed the Commission that the CESs operated by his country were likely to accept ships' weather reports in the very near future. The president of CBS was requested, in consultation with the president of CMM and the Secretary-General, to approach INMARSAT and ITU once more on the question of tariffs for the transmission of meteorological information.

6.3.19 The observer from IOC drew the attention of the Commission to the fact that only two CESs were accepting BATHY/TESAC reports free of charge to ships. It was felt that the financial impact of accepting BATHY/TESAC for the four other CESs accepting ships' weather reports would be very limited, but that it would considerably improve the availability of oceanographic data.

6.3.20 The Commission noted with appreciation that trials at sea of the Enhanced Group Call (EGC) system had begun in June 1987. The system is intended for the dissemination, through INMARSAT, of marine safety information, including information for navigation, gale warnings, weather forecasts and shore-to-ship distress alerts. The trials were conducted in conjunction with the CESs at Southbury (USA), Goonhilly (UK) and Eik (Norway).

Main Telecommunication Network and interregional circuits

6.3.21 The Commission noted that Regional Association I, at its ninth session (Harare, 8-15 December 1986), had recommended that CBS should consider the inclusion of the circuit Algiers - Paris in the Main Telecommunication Network (MTN). Noting that the circuit Algiers - Paris has been operating for about 10 years at medium speed (9600 bit/s with multiplexed channels) and that RTH Algiers was actually connected with several other RTHs, the Commission agreed to the recommendation to include the circuit Algiers – Paris in the MTN.

6.3.22 The Commission noted that Regional Association I had also recommended that CBS should include as interregional circuits the existing circuit Algiers - Jeddah and the planned Nairobi - New Delhi circuit. It noted that Regional Association II, at its eighth session (Geneva, 5-16 November 1984), had supported the inclusion of those two circuits in the GTS plan as interregional circuits. The delegate from Kenya requested the Commission to defer discussion of the Nairobi - New Delhi circuit until after the completion of the work of the RA I Working Group on WWW Systems Planning, Co-ordination and Implementation. The Commission was of the opinion that additional circuits which could not be implemented should not be included in the GTS plan. The Commission agreed to include as an interregional circuit the existing circuit Algiers - Jeddah. At its sixth session (Guangzhou, 7-11 September 1987), the RA II Working Group on Meteorological Telecommunications had recommended the inclusion of the existing circuit Moscow - Hanoi as an additional interregional circuit between Regions VI and II. The Commission noted that this recommendation would be submitted for consideration to the next session of Regional Association II.

6.3.23 The Commission adopted Recommendation 7 (CBS-IX).

6.3.24 As regards inclusion of new circuits in the GTS, and particularly in the MTN, the Commission agreed that clear principles and procedures should be developed for that purpose, taking into account transmission requirements, circuit capacity and needs for appropriate redundancy in the GTS network. The Commission invited the Working Group on the GTS to develop such procedures as a matter of urgency.

Satellite-based communication systems

6.3.25 The World Weather Watch programme for the period 1988-1997 described in the Second WMO Long-term Plan indicated that special satellite-based data collection and/or dissemination systems would play an important role in the World Weather Watch and would be integrated into the GTS as an essential element of the global, regional and national telecommunication networks.

6.3.26 The Commission noted that the data-collection platforms (DCPs) linked with the geostationary meteorological satellites GOES (USA), METEOSAT (EUMETSAT-Europe) and GMS (Japan) provided a reliable system of data collection which was particularly valuable in zones where conventional telecommunication systems were not available or were too cumbersome. It also noted that, during its ninth session (Harare, 8-15 December 1986), Regional Association I had agreed that the installation of METEOSAT data-collection platforms and associated reception systems would mitigate deficiencies in the regional telecommunication network with regard to both national data collection and transmission from the NMCs to the RTHs. In that respect, the Commission was informed that the Operational WWW Systems Evaluation in Africa (OWSE-Africa) was aimed at obtaining precise information on the impact on the operation of the WWW of operating DCPs and the system of retransmitting data from the DCPs.

6.3.27 The Commission noted that the METEOSAT operational programme included a service for distribution of data and information in alphanumeric and coded digital facsimile form (MDD). In view of the multi-regional coverage of that service, Regional Association VI, at its ninth session (Potsdam, 8-19 September 1986), considered that its integration as an element of the GTS should be considered by CBS. Tenth Congress noted that the data-collection mission, the data-retransmission mission and the MDD mission, included in the METEOSAT operational programme, would greatly contribute to overcoming the existing deficiencies in Africa with respect to national collection of observations, transmission of national data bulletins over the GTS and the availability of data and products at NMCs, in full compliance with the principles of organization of the GTS. The Commission was also informed that the operation of a data-distribution service through the GMS satellite operated by Japan for the distribution of GRID code products and charts was planned for approximately 1990. At its sixth session (Guangzhou, 7-11 September 1987), the RA II Working Group on Meteorological Telecommunications agreed that the new service should be integrated into the GTS.

6.3.28 In view of the foregoing, the Commission was of the opinion that the data-collection and data-distribution systems provided by geostationary meteorological satellites would efficiently complement the GTS point-to-point circuits, and agreed that they should be integrated into the GTS. It requested its Working Group on the GTS to develop the appropriate amendments to the Manual on the GTS.

6.3.29 The Commission noted that the organizations responsible for the operation of specialized telecommunication satellites at the global, regional and national levels provided bi-directional point-to-multipoint telecommunication services which had attractive capabilities for meeting the WWW communication requirements. The possibility of establishing specialized satellite-based point-to-point links, the cost of which was independent of distance, had also led to the creation of additional links between remote meteorological centres. This type of link could not be foreseen at the time of establishing the principles for organizing the GTS. The Commission requested its Working Group on the GTS to further study the impact on the GTS and its organization of new telecommunication means and techniques.

6.3.30 The Commission noted with satisfaction current efforts by both WMO and ICAO at studying the possible joint utilization of satellite-based distribution systems to meet GTS and World Area Forecast System (WAFS) data-distribution requirements, thereby enabling States to avoid unnecessary duplication of effort, communication facilities and expense in the reception of meteorological processed information.

Co-operation with the International Telecommunication Union

6.3.31 The Commission was informed by the observer from ITU of several regional telecommunication projects, which could greatly facilitate meeting the WWW telecommunication requirements. The Commission noted that the requirements of WMO for circuits were regularly communicated to the World and Regional Plan Committees of the CCITT, and expressed its appreciation for the excellent collaboration between ITU and WMO.

6.4 WWW Data Management (DM) (including codes) (agenda item 6.4)

WWW Data Management concept and functions

6.4.1 WWW Data Management (WWWDM) is a new concept which had been introduced in the WWW Programme of the Second WMO Long-term Plan, leading to an integration and the effective use of the GDPS, GOS and GTS. Tenth Congress noted the growing importance of the WWWDM functions and emphasized that the implementation of the WWWDM concept would be one of the priority actions to ensure the operation of the WWW as a fully integrated system. The Commission reviewed the WWW Data Management concept and functions, on the basis of the WWW Programme of the Second WMO Long-term Plan, and the activities of a CBS Expert Meeting on WWW Data Management held in Geneva in September 1986.

6.4.2 The Commission noted that the Open Systems Interconnections (OSI) reference model adopted by ISO and CCITT as an international standard provided a conceptual and functional framework for the interconnection aspects of co-operation between systems capable of performing information processing and/or information transfer. Its final aim is to allow, by application of its related standards, the interconnection of computer systems from different manufacturers under different management of different levels of complexity and through different communication networks. Noting that the aim of the WWWDM concept should be to integrate the various elements within the WWW and to develop interfacing specifications which ~~were missing or not adequately~~ defined in the present system, the Commission agreed that the WWWDM concept should be developed in full compliance with the Open Systems Interconnections (OSI) reference model and related standards. The Commission agreed upon the identification of a scheme of four conceptual functional components within the WWW system which fit easily with the OSI reference model, on the understanding that there was no one-to-one correspondence between the functional components identified and the three basic elements of the WWW.

6.4.3 The four conceptual functional components are the following:

(a) WWW Observing component

This component comprises all aspects of atmospheric observations, including conventional surface and upper-air stations, automatic stations, ships, aircraft, meteorological satellite systems and all other observing systems;

(b) WWW Product Generation component

This component comprises the production of analysed and forecast weather information and all information closely related to these products, for example quality control of data done by the data assimilation process, statistical data for climatological studies or forecast interpretation;

(c) WWW Data Management component

This component provides to the Observing system and the Product Generation system the services of meteorological data management which they need for their operations. The WWWDM corresponds to the session layer, presentation layer and application layer of the Open Systems Interconnection architecture, taking into account that the OSI application layer addresses only the functions and procedures required to enable different types of application processes to interwork;

(d) WWW Data Transport component

This component provides the WWWDM with the data-transport service that it needs. The Data Transport component corresponds to the first four OSI layers (i.e. physical layer, link layer, network layer and transport layer) and its functions are defined according to ISO/CCITT standards.

6.4.4 When reviewing the WWW Data Management functions, the Commission agreed in principle that the concept of distributed data bases should be introduced in the WWW system to improve the co-ordinated handling of observational data and processed information available within the system. The Commission was of the opinion, nevertheless, that careful studies should be carried out on the implications of the concept for the WWW system. In particular, the Commission stressed that the compilation of data subsets for meeting requirements should not cause delays in the availability of observational data. The Commission was also of the opinion that the development of the concept of distributed data bases should concentrate on meeting national and regional requirements for data and products as expressed in the present WWW system. Based on experience gained on a national level, some concern was expressed that real-time access to data bases could lead to considerable overload of communications circuits and centres. The Commission agreed that the question of access to data bases should be discussed as a matter of urgency by the Working Groups on the GTS and Data Management.

6.4.5 The Commission was of the opinion that quality control of observational data and processed information should be performed within the WWW Observing and Product Generation components and that WWWDM should address all the mechanisms required for handling and supplying the information on the quality of observational data and processed products.

6.4.6 The Commission agreed upon the following specific functions of WWWDM:

(a) Data definition

Defining the meaning that is assigned to data, in terms of meteorological observational elements, accuracies, types of product, parameters, etc.;

(b) Design of a concept for distributed data bases to meet WWW requirements;

(c) Provision of mechanisms for addition of data to and supply of data from WWW data bases. It would include, in particular:

  (i) Co-ordinated updating of the various data bases;

  (ii) Real-time status of data/product availability within the data bases;

  (iii) Compilation of standard data subsets;

(d) Presentation of observational data and products within the WWW system using suitable code forms, formats and representation (binary, character and graphics). It would include, in particular:

  (i) Detailed definition and maintenance of data representation (BUFR, GRIB, etc.);

  (ii) Procedures for presentation conversions;

(e) Monitoring the operation of the WWW system. It would include, in particular:

  (i) Reporting on quality control of data and products;

  (ii) Provision of information on the operational status of WWW;

  (iii) Real-time and non-real-time monitoring.

6.4.7 The Commission noted with interest a document submitted by the ECMWF on the development of graphics standards and their possible application in meteorology. The Commission agreed to refer the question to the Working Group on Data Management.

Monitoring of WWW Operations

Monitoring of the GDPS

6.4.8 The Commission noted the report by Miss M. J. Atkins (UK), Working Group on the GDPS, rapporteur on Monitoring Procedures of the GDPS, and expressed its appreciation for her excellent work during the past years. The Commission expressed its satisfaction with the progress made on the implementation of Recommendations 2 and 3 (CBS-Ext.(85)) concerning the monitoring activities on the GDPS since the CBS extraordinary session. The Commission also noted with appreciation the joint action taken by the rapporteurs of the Working Groups on the GOS and GDPS, Mr F. Delsol (France) and Miss M. J. Atkins, concerning the development of a format for the exchange of the results of the data monitoring.

6.4.9 The Commission noted that, since CBS-Ext.(85), a detailed format for the exchange of verification results had been devised and circulated to Members concerned. The Commission also noted that positive responses had been received; a few of the GDPS centres had already started and some other centres intended to start the verification procedures and exchange results. The Commission agreed that, at present, there was no need to take any further action with regard to the standardized verification procedures, although it would be desirable for the relevant working groups to keep those activities under review.

6.4.10 As regards the continuation of the CAS NWP Data Study/Intercomparison project, the fourteenth session of the CBS Advisory Working Group (Geneva, 14-16 October 1987) considered that completing a 10-year period of comparisons (1979-1988) would also have the benefit of providing two years of parallel activities with the CBS Standardized Verification Procedures. The Commission noted with appreciation that the Permanent Representative of Finland had agreed to provide staff support for the continuation of the project through 1988.

6.4.11 When considering what future action should be taken with regard to monitoring the quality of observations, the Commission endorsed, in principle, the proposals made by the rapporteur concerning the identification of time-scales:

(a)	Real time	where problems were identified and remedial action taken in time for the data to be useful for forecasting purposes;
(b)	Non-real time, short term	where problems were identified and remedial action taken within a few weeks;
(c)	Non-real time, long term	where problems needed more detailed investigation and/or remedial action required major investment.

The Commission considered that this division could also be applied to other monitoring and remedial activities, e.g. those concerning the operation of the GTS.

6.4.12 The Commission considered and agreed to the proposals made by the rapporteurs concerning the sharing of responsibility of monitoring the various kinds of observation among designated lead centres. The Commission noted that some GDPS centres had offered to take the lead role in monitoring various kinds of observation, for example RMC Bracknell for marine surface observations, WMC Washington for aircraft and satellite observations, and ECMWF for radiosonde and pilot observations. The Commission considered that there was a need to amend the procedures on monitoring the quality of observations as contained in the Manual on the GDPS. Recommendation 8 (CBS-IX) was adopted.

6.4.13 Concerning the procedures for the exchange of the results of the monitoring, the Commission considered that the present arrangements for the exchange of results should be applied both for the verification of NWP products and the monitoring of the quality of observations. However, the Commission considered that, for further developments on the exchange of results in terms of time periods, for compilation of the results and for the regular publishing of the results, more studies were needed. Therefore, the Commission requested the relevant working groups to include the study of those problems in their future work programme.

Internationally co-ordinated non-real-time monitoring

Ideal lists of stations from which SYNOP, TEMP, PILOT (radiowind), CLIMAT and CLIMAT TEMP reports should be globally exchanged

6.4.14 The Commission noted that, in accordance with the procedures described in the Manual on the GTS concerning the updating of the list of stations from which reports were to be exchanged globally, those stations whose observational programme had ceased or for which telecommunication collecting facilities had become inadequate could be deleted from the list at the request of the Member concerned, after approval by the president of CBS. The Commission was of the opinion that the analyses of results of monitoring the WWW did not fully reflect the operation of the WWW as a whole, bearing in mind the intended aims, since the deficient stations were often not included in the monitoring statistics.

6.4.15 The Commission expressed the belief that it would be useful to establish an ideal list of stations which would reflect the objective to be attained as regards the basic set of observational data for global exchange. The Commission agreed that the ideal lists of stations from which SYNOP, TEMP, PILOT (radiowind), CLIMAT and CLIMAT TEMP reports should be exchanged globally should be the lists of stations included in the regional basic synoptic networks for each respective type of report. The Commission also agreed that the lists of stations from which reports were to be exchanged globally would be established on the basis of the ideal lists taking into account the stations actually in operation (observations and telecommunications). The Commission agreed that the Manual on the GTS, Volume I, Part I should be amended accordingly (see Recommendation 7 (CBS-IX)).

Monitoring procedures

6.4.16 The Commission noted that the results of monitoring the operation of the WWW provided by the various centres showed discrepancies which could be attributed to differences in the implementation and operation of monitoring activities. More precision was required in the monitoring results to provide a comparison between the availability of data at various centres and to determine gaps in the system.

6.4.17 The Commission agreed to request the Working Group on the GTS, in conjunction with the Working Group on Data Management:

(a) To define the criteria to be applied in choosing the level at which monitoring was carried out at the centres, particularly at automated centres: at the telecommunication level or at the data processing level, after quality control;

(b) To develop standard procedures for counting reports which could appear in several bulletins for the same time of observation (retard RRx, corrected CCx and duplicated bulletins);

(c) To develop standard procedures for counting reports from mobile sources such as ships and aeroplanes, since the results provided by the centres at present indicated a wide disparity.

6.4.18 The Commission considered that, with a view to improving the results of the next internationally co-ordinated monitoring to be carried out in October 1988, some improvements of the monitoring procedures, particularly as regards SHIP and AIREP/CODAR reports, should be developed urgently by the Secretariat in consultation with the president and in co-ordination with the WMC/RTHs which provided monitoring results for the global observational data set for the global monitoring carried out in October 1987.

Monitoring periods

6.4.19 The Commission noted that, in conformity with the procedures in operation at present, the automated centres compiled statistics on the availability of data from individual stations over a period of 15 days (1-15 October) whereas manually operated centres provided statistics for a period of five days (6-10 October).

6.4.20 Taking into account the fact that CLIMAT and CLIMAT TEMP reports should be transmitted as soon as possible after the end of the month and not later than the fifth day of the following month, the Commission decided that the period for which manually operated centres provided statistics should be the period 1-5 October instead of the period 6-10 October.

6.4.21 The Commission agreed that, in order for a precise comparison to be made between the results provided by the various centres, it would be highly desirable if the automated centres were to provide, in addition to the statistics for the period 1-15 October, statistics for the period for which manually operated centres provided statistics (1-5 October).

6.4.22 The Commission adopted Recommendation 9 (CBS-IX).

Specific monitoring exercises for limited geographical areas

6.4.23 The Commission was of the opinion that specific monitoring exercises for limited geographical areas, and possibly for specific types of data, were particularly useful for determining deficiencies in the WWW in a precise and comprehensive manner. The Commission agreed that the results of these specific monitoring exercises, relating to the availability of individual reports, did not always enable the exact causes of deficiency to be determined and that the analysis of problems could be improved by monitoring the exchange of bulletins received and relayed by various centres.

6.4.24 The Commission agreed to request the Working Group on the GTS, in conjunction with the Working Group on Data Management, to develop procedures for monitoring bulletins.

General aspects of monitoring

6.4.25 The Commission noted that the procedures for non-real-time monitoring had, until the present, related only to conventional observational data and that Tenth Congress had requested CBS to develop procedures for monitoring the availability of processed data. The Commission agreed to give this task to the Working Groups on the GTS and the GDPS in co-ordination with the Working Group on Data Management.

6.4.26 The Commission noted with appreciation that the Secretariat was envisaging the use of data-processing techniques to facilitate as well as to improve the analysis of results of monitoring exercises provided by centres. The use of an appropriate data-processing medium - e.g. magnetic tape or diskettes - would facilitate data acquisition prior to analysis by the Secretariat and would, moreover, facilitate the preparation of results and their exchange by automated centres. The Commission agreed to invite the Working Group on the GTS, in conjunction with the Working Group on Data Management, to develop a structure and form of presentation for the monitoring results on an adequate data-processing medium.

Radiosonde data quality and monitoring

6.4.27 The Commission noted that, at the ECMWF/WMO Workshop on Radiosonde Data Quality and Monitoring (Reading, 14-16 December 1987), upper-air instrument experts (including representatives from CIMO and radiosonde manufacturers, as well as members of CBS and operational users of radiosonde data) had discussed the data deficiencies, both in terms of availability and quality, and had made recommendations for improvements in the performance of the observational radiosonde network. Major improvements in the numerical analysis and forecasting systems have led to a significantly higher-quality numerical product: today's five-day forecasts are of a quality similar to the three-day forecasts of less than 10 years ago. The numerical systems are supported by a higher quality of observation. The quality of radiosonde observations at 10 hPa at present equals that of 100 hPa-level observations of 30 years ago. However, the lack of radiosonde data from large areas, the variable quality of the equipment used and inadequacies in the procedures have led to severe deficiencies in the overall performance of the radiosonde network, causing great concern.

6.4.28 The Commission further noted that monitoring studies have provided evidence of a large spread in the quality of radiosonde observations which can only partly be explained by instrument differences. The equipment and its calibration, as well as ground procedures including the application of corrections and the timely distribution of the data, were equally important for a well-performing radiosonde network. The Commission was informed that ECMWF had published the proceedings of the ECMWF/WMO Workshop on Radiosonde Data Quality and Monitoring, which were available on request.

Application of the results of the WMO Radiosonde Intercomparison

6.4.29 The Commission expressed its appreciation for the work carried out by CIMO regarding the WMO Radiosonde Intercomparison (Phase I, UK in 1984 and Phase II, USA in 1985). It noted that the final results of the intercomparison had been published as No. 30 in the Instruments and Observing Methods Series. While the existence of systematic differences in the upper-air data as produced by the global radiosonde network had been noted, a performance improvement was expected from the application of corrections derived from the WMO Radiosonde Intercomparison. The Commission supported the envisaged RA II/RA VI Regional Radiosonde Intercomparison. It noted in particular that China had expressed interest in participating in the intercomparison if financial support could be provided. The aim was to improve the performance of all radiosondes to the highest standards. One important step in that direction would be to apply the results of the WMO Radiosonde Intercomparison and bring them into operational use. Recommendation 10 (CBS-IX) was adopted.

Technical information required in codes

6.4.30 The Commission noted that more sophisticated use of radiosonde data required that additional real-time information on technical aspects of each radiosonde observation be made available. At present, details on the timing of the launch of the sonde, the position, instrument types and wind-finding systems were not distributed over the GTS in real time. Meteorological analysis centres required such information for defining the need and the numerical value of temperature/geopotential height adjustments for application to radiosonde reports to compensate for radiation and other systematic errors. Such adjustments were necessary to ensure the consistency of the radiosonde thermodynamic data. They required, in addition, real-time information on instrument types and computational methods in use for a particular observation; information about the precise release time and ascent rate of the balloon was also required. The Commission invited its president to take the appropriate action to amend the radiosonde reporting code to provide the information needed for each report.

Pilot study to improve the performance of the global radiosonde network

6.4.31 The Commission noted that a highly beneficial impact was expected from an enhanced information flow between the data producers and the users. Data users were lacking up-to-date information on the instrumentation, operating schedules and performance objectives. Similarly, the data producers should have more feedback on the system performance and notification of any operational incidents or degradation in the observations. The Commission discussed a pilot study to evaluate the beneficial impact of such real-time two-way feedback between the data producers and the users. Such exchanges would be complementary to those envisaged in paragraphs 5.19 to 5.21 of the general summary of the final report of CBS-Ext.(85). Recommendation 11 (CBS-IX) was adopted.

Codes (including the report of the chairman of the Working Group on Codes)

Report by the chairman of the Working Group on Codes

6.4.32 The Commission noted with appreciation the report by the chairman of the Working Group on Codes, Mr C. F. Reudink (Netherlands Antilles). The Commission expressed its great satisfaction with the important work carried out by the Group at its seventh session (Geneva, 20-31 October 1986), by various subgroups of the Working Group and also those activities accomplished by correspondence since CBS-Ext.(85). The matters covered in the report of the chairman are discussed in detail under the various sub-items of this agenda item.

6.4.33 The Commission recognized the valuable contribution made by Mr G. Doumont (Belgium) while serving as chairman of the Working Group on Codes during the 20 years up to September 1986. His distinguished service to the Working Group on Codes and to the Commission was noted with appreciation. The Commission wished Mr Doumont every success in the future.

Requirements of CAgM for global and regional exchange of additional observational data including guidance to regional associations

6.4.34 The Commission considered proposals by the seventh session of the Working Group on Codes and agreed on new procedures including guidance to regional associations in order to meet these requirements as follows:

(a) Snow-depth data

The Commission endorsed the Working Group's proposal to include in the regulations related to Group 4E'sss, Section 3 of SYNOP, the mandatory character of reporting data on actual snow cover (E'). It further agreed that, in accordance with a regional decision, snow depth may be included in the report. The Commission was informed that the standardization of measurement procedures presently being undertaken by CIMO would soon be completed;

(b) Precipitation data

The Commission agreed with the Working Group's proposals and recommended amendments to global regulations of SYNOP. It requested that regional associations should be invited to amend regional regulations with respect to use of groups $6RRRt_R$ in Sections 1 and 3 and group (7....) in Section 3 so that the group $6RRRt_R$ in Section 1 of SYNOP reports could be related to precipitation data in time periods which are multiples of six hours at main standard times, and that the group $6RRRt_R$ in Section 3 of SYNOP reports could be related to precipitation data over the preceding three hours or other periods required for regional exchange. It agreed that the group $7R_{24}R_{24}R_{24}R_{24}$ could, by regional decision, be related to precipitation data over the preceding 24 hours;

(c) Daily amount of evaporation (evapotranspiration), net-radiation and sunshine data

The Commission agreed with the Working Group's proposals and recommended amendments to global regulations and specifications of SYNOP. It requested that regional associations should be invited to amend regional regulations and specifications with respect to the use of the groups $(5j_1j_2j_3j_4(j_5j_6j_7j_8j_9))$ so that their forms $5EEEi_E$ $s_nF_nF_nF_nF_n$ and 55SSS could be used to report daily evaporation (evapotranspiration) in tenths of millimetres, net radiation in joules per square centimetre and duration of sunshine in hours and tenths.

The Commission noted that agricultural meteorological stations were required to measure global as well as net radiation. The Commission considered that the requirements for other types of solar-radiation data - e.g. global short-wave radiation - should be referred back to other commissions, including CAgM, and that the Working Group on Data Management should be invited to develop the code in the light of further requirements.

6.4.35 Recommendation 12 (CBS-IX) was adopted.

Standardization of station-level pressure reporting procedures and procedures for coding past weather by automatic stations

6.4.36 The Commission noted with appreciation that, due to the urgent nature of the proposals, the president of CBS had approved the procedures in accordance with Regulation 74 of the WMO General Regulations. It further noted with satisfaction that the President of WMO, on behalf of the Executive Council, had approved the procedures as contained in Recommendation 15 (CBS-87) for implementation as from 1 November 1987.

Minor modifications to FM 32-V PILOT, FM 33-V PILOT SHIP, FM 35-V TEMP, FM 36-V TEMP SHIP, FM 85-VI SAREP and editorial improvements to specification of symbolic letters of DRIBU code

6.4.37 The Commission considered proposals by the seventh session of the Working Group on Codes required for the ASAP programme and agreed to the inclusion of the ship's call sign in Section I of PILOT SHIP and TEMP SHIP and the re-activation in Part B of TEMP SHIP, the currently reserved Section 7, to report sea-surface temperature and identify sounding systems and techniques used by appending two optional groups $0s_nT_wT_wT_w$ $r_ar_as_rs_as_a$ to form that section.

6.4.38 The Commission noted that, as a result of recent developments, analysis techniques using the Dvorak method had sufficient accuracy to identify the intensity of a cyclone in every 0.5 step in the current intensity (CI) number. The Commission therefore agreed to introduce the 0.5 step in the CI number and consequential modifications to FM 85-VI SAREP to give effect to the change.

6.4.39 As regards editorial improvements to specifications of symbolic letters of the DRIBU code, the Commission noted with appreciation that the president of CBS had approved the improved specifications proposed by the seventh session of the Working Group on Codes.

6.4.40 In respect of paragraph 6.4.37 above, the Commission noted the difficulty of implementating the procedures at a fixed date. It agreed that Members which were able to implement the procedures at an earlier date should notify the Secretariat of their intention to do so in advance. Recommendation 13 (CBS-IX) was adopted.

General revision of Code table 4677 ww - Present weather and consequently Code table 4561 W_1W_2 - Past weather

6.4.41 The Commission was in agreement with the conclusion of the seventh session of the Working Group on Codes that, in the opinion of the majority of Members, general revision of Code table 4677 ww and of Code table 4561 W_1W_2 was not necessary at the present time.

6.4.42 The Commission noted with satisfaction that the president of CBS had approved editorial changes to the specification of code figure 07 of Code table 4677 ww in order to allow a coastal land station to report blowing spray.

6.4.43 The Commission noted that the Working Group considered all other proposed new specifications for ww under development of the international $S_PS_Ps_ps_p$ code table.

ODAS code

6.4.44 The Commission noted the decision of Regional Association VI to retain the code as a possible option until a code for wave spectra was adopted.

WAVEOB code

6.4.45 The Commission noted the requirement for development of codes for real-time exchange and reporting of marine surface data, including directional wave spectra, as detailed in Recommendation 2 (CMM-IX). While reviewing the work accomplished by the seventh session of the Working Group on Codes on development of a new code form FM 65-IX WAVEOB - Report of spectral wave information from a sea station, the Commission was informed that the code form had been reviewed by national focal points on the WMO Wave Programme. It noted that, in the course of the review, some national focal points had proposed a considerably revised version to cater for their requirements.

6.4.46 In that connection, the general question was raised whether the introduction of another character code would be appropriate in view of recent developments in the use of bit-oriented codes which offered advantages with regard to more efficient transmission of data and transformation to self-evident tabular presentation. While appreciating the potential benefits of binary codes, the Commission agreed that the transition to those code forms would need careful preparation to enable all Members to profit. In particular, the question of transformation between bit-oriented codes and other forms of character presentation and their exchange in both forms over the GTS would need to be studied. The Commission therefore agreed that a study should be undertaken by its Working Group on WWW Data Management.

6.4.47 While agreeing that, in principle, new character codes should not be introduced, the Commission acknowledged that an urgent requirement existed for the real-time transmission of spectral-wave data and therefore agreed to adopt the proposed WAVEOB code as an interim measure pending the completion of studies on the use of bit-oriented codes or tables. Recommendation 14 (CBS-IX) was adopted.

ASDAR presentation forms

6.4.48 The Commission agreed with the conclusion of the Working Group on Codes that, since transformation from the CGMS-agreed bit form to BUFR representation at the ground station was possible, there was no need for adoption of a special bit form for ASDAR for ground-to-ground exchanges.

ASDAR character code form

6.4.49 The Commission considered the new code FM 42-IX - ASDAR - Aircraft report (aircraft to satellite data relay) proposed by the seventh session of the Working Group on Codes and recommended its adoption. Recommendation 15 (CBS-IX) was adopted.

Continuation of the study on the structure of the Manual on Codes,

Volume I

Definitions

6.4.50 The Commission reviewed definitions of terms used in the newly adopted $S_PS_Ps_ps_p$ - Supplementary information code table, and approved their inclusion in Volume I of the Manual. The approved definitions are given in the annex to Recommendation 16 (CBS-IX).

6.4.51 The Commission agreed that the structure of the Manual should be kept under review in the light of the impact of the new bit-oriented data representation forms. As regards implementation of Recommendation 8 (CBS-VIII), the Commission agreed that this had been overtaken by new developments and therefore its validity should expire.

Development of an international code table for supplementary

information to replace the different regional code tables for

$S_PS_Ps_ps_p$

6.4.52 The Commission reviewed the proposed $S_PS_Ps_ps_p$ - Supplementary information code table, as developed by the seventh session of the Working Group on Codes and subsequently refined by the Group's subgroup. It noted with satisfaction that the proposed code table covered most of the requirements stated by Members and contained in the present regional code tables. It further noted that the developed table also addressed in sufficient detail the requirements for additional new specifications for present and past weather. The Commission reviewed and agreed with the proposals of the Working Group as amplified and further elaborated by its Subgroup on Supplementary Information Code Table. The Commission adopted the proposed Code table 3778 by its Recommendation 16 (CBS-IX).

BATHY and TESAC codes

6.4.53 The Commission considered proposed modifications to code forms FM 63-VIII Ext. BATHY and FM 64-VIII Ext. TESAC to include the station identification group $A_1b_wn_bn_bn_b$ since the identifier D....D for oil- and gas-production platforms had been replaced by the group $A_1b_wn_bn_bn_b$ as from 1 November 1987. The Commission adopted Recommendation 17 (CBS-IX) to give effect to these modifications.

TAF code

6.4.54 The Commission considered proposed modification of regulations of FM 51-V Ext. TAF taking into account recent amendments to paragraph [C.3.1.] 6.2.11 of the WMO Technical Regulations. The Commission adopted Recommendation 18 (CBS-IX) to give effect to these modifications.

Minor modification of regulations of METAR, SPECI and TAF

6.4.55 The Commission considered a proposal to add explanatory notes to METAR Regulation 15.1, SPECI Regulation 16.1.1 and TAF Regulation 51.1.1 to accommodate current MOTNE procedures for compilation of bulletins. The Commission agreed that the following note should be added to Regulations 15.1, 16.1.1 and 51.1.1 respectively:

"NOTE: By agreement between the authorities concerned, the code name METAR, SPECI and TAF may be omitted from the text of the bulletin."

Data representation on weather charts

6.4.56 The Commission reviewed proposed amendments and additions to the Manual on the Global Data-processing System, Attachment II-4, arising from the adoption of Recommendations 5 (CBS-Ext.(85)) and 15 (CBS-87) in respect of station-level pressure and present and past weather reported from both manned and automatic stations. The Commission considered that the proposals needed further study and requested its Working Group on Data Management to study the question and to make recommendations on revised procedures for data representation on weather charts.

Amendments to FM 92-VIII Ext. GRIB

6.4.57 The Commission reviewed specific proposals to amend and extend specifications of FM 92-VIII Ext. GRIB. The Commission approved the suggested minor amendments and agreed to the extensions which would generalize the representation of spherical harmonic components and enable polar stereographic representation to be accommodated.

6.4.58 Recommendation 19 (CBS-IX) was adopted.

Binary Universal Form for Data Representation FM 94-IX BUFR

6.4.59 The Commission was informed tha since CBS-Ext.(85) the Binary Universal Form for Data Representation (BUFR) had been further developed with the active participation of experts from centres with extensive experience in the use of binary representation for exchange, archival and retrieval of meteorological data. In the course of its development BUFR was reviewed by the Expert Meeting on WWW Data Management (Geneva, 22-25 September 1986), the seventh session of the CBS Working Group on Codes and the CBS Advisory Working Group. The Commission noted that, since May 1987, the president had approved the structure of the BUFR form for experimental use over the GTS.

6.4.60 The Commission recalled its decision during CBS-Ext.(85) to encourage the further development of BUFR with a view to completing the work prior to the present session and noted recent developments, proposed changes and amendments which were endorsed by an expert meeting on data representation held at ECMWF from 7 to 11 December 1987. The Commission considered the proposed FM 94-IX BUFR as presented to the session and considered that there was a need to adopt a standard binary universal form for data representation. Members/centres using the experimental BUFR had expressed their satisfaction with all aspects, including arrangements and procedures for transformation to other codes as might be required by non-automated centres or other users, and recommended its adoption for use between appropriately equipped automated centres. Recommendation 20 (CBS-IX) was adopted.

6.4.61 The Commission considered timely procedures for revision and distribution of code tables associated with binary representation forms during intersessional periods and agreed to entrust the activity to a subgroup of the Working Group on Data Management. The subgroup would establish a suitable mechanism for the exchange of opinion among all centres concerned and procedures for distribution of proposed final versions of agreed code tables to them. The subgroup would make recommendations to the chairman of the Working Group on Data Management who would review them and recommend agreed changes to code tables associated with binary representation forms to the president of CBS. The Commission authorized its president to approve, on its behalf (without recourse to WMO Regulation 74) during intersessional periods, recommended changes to code tables associated with binary representation forms.

6.4.62 The delegate of France informed the Commission that a group of European countries involved in the research action COST-73 on the exchange of radar measurements in Europe had entrusted him with the task of presenting to the Commission a draft extension of the BUFR code to describe radar data. The proposal had been studied by the meeting of experts which took place at the ECMWF in December 1987. The meeting was of the opinion that the extensions proposed by the COST-73 group should be given consideration. The Commission proposed that they should be considered with a view to their introduction into the BUFR code according to the procedures described in paragraph 6.4.61 above.

6.5 WWW Implementation Support Activity (ISA) (agenda item 6.5)

6.5.1 The Commission noted that Tenth Congress, when adopting the Second WMO Long-term Plan, had expressed the view that the implementation of new components and the rapid introduction of advanced technology might lead to difficulties in some parts of the world. A strong WWW Implementation Support Activity (ISA), covering extensive training activities and technical support programmes, must be developed urgently to support the integrated WWW, building upon the existing WMO technical co-operation and education and training programmes.

6.5.2 The Commission agreed that implementation problems in various parts of the globe should be studied in detail and high priority given to WWW implementation support activities, particularly in the key areas of the system. All possible support resources should be used in a co-ordinated and cost-effective way. To achieve this, plans for technical co-operation and education and training should be made available, especially for those geographical regions where the WWW was experiencing major difficulties regarding the implementation and operation of its various components.

6.5.3 The Commission also noted that the consolidated programme and budget of the Organization for 1988-1991 foresaw a number of important activities of the ISA in support of implementing the WWW Plan and for improving the day-to-day operations of the WWW. The main thrust of the activities was to make available to planners, managers and operators of WWW facilities information on tested and suitable technology and on operational experience using proven technology.

6.5.4 The Commission agreed that the ISA had a basic supportive role to play in the implementation of the WWW Plan and thereby of the whole integrated WWW system. It was agreed that the individual activities of the ISA should be carefully monitored and progress evaluated. The Secretary-General was requested to submit a detailed report on the WWW Implementation Support Activity and achievements to the next session of the Commission.

6.6 WWW Implementation Co-ordination (IC) (agenda item 6.6)

6.6.1 The Commission noted that the Implementation Co-ordination (IC) is one of the important support activities included in the Second WMO Long-term Plan designed to assist Members in their implementation of an improved WWW. In particular, the Commission expressed its satisfaction with the way that the concept of Operational World Weather Watch Systems Evaluations (OWSEs) had been implemented by Members, assisted by the Secretariat. It especially appreciated the status reports on the OWSE-North Atlantic (OWSE-NA) and the OWSE-Africa (OWSE-AF).

6.6.2 The OWSE-NA was the first to be organized and was initiated on 1 January 1987. To date, substantial improvements in the availability of data had been achieved through implementation of Automated Shipboard Aerological Programme (ASAP) radiosonde systems, buoys (both fixed and drifting) and satellite communication of surface ship observations, as well as the augmentation of certain coastal surface and upper-air observations. Four special RTH data-monitoring periods had been carried out and the information was being disseminated to analysts to assess the impact of the OWSE-NA on the exchange of data. Several processing centres had carried out computer studies to examine the impact of the enhanced data base on analyses. In addition, individual case studies were being planned to examine specific weather situations in detail and to assess the impact of the improved observing system on forecasts. The results, expected to be available in 1989, would provide information on (a) the most cost-effective composite observing system for the North Atlantic to meet the requirements of Members, and (b) the advantages and disadvantages of implementing such observing systems in other parts of the WWW.

6.6.3 The Commission was pleased to learn of the substantial progress which had been achieved in organizing the OWSE-Africa. Two planning meetings had been held in 1987 which resulted in agreement on an operational plan for the first OWSE-AF, an overall timetable and an implementation programme. Participants to date included 15 Members in RA I, six additional donor Members and EUMETSAT. The planning was being carried forward with the assistance of the chairman of the RA I Working Group on Regional WWW Systems Planning, Co-ordination and Implementation.

6.6.4 The Commission was informed that the organizing meeting for the first OWSE-AF was scheduled to be held in June 1988 and that the build-up phase would begin shortly thereafter. Note was taken that the initial part of the first OWSE-AF would concentrate on the use of DCPs to improve the availability of observational data in Region I at processing centres and over the GTS. Substantial contributions had already been made available through VCP donations, bilateral agreements and from UNDP. The Commission believed that such levels of co-ordination provided a good example of how limited resources could be brought together in an effective way to improve specific elements of the WWW.

6.6.5 While expressing its appreciation to Members and organizations participating in co-ordinated implementation activities (e.g. OWSEs, ASAP, ASDAR and buoys) for their strong support, the Commission also recognized the very real limitations imposed on implementation by both their respective national budgets and that of WMO. Such limitations, it noted, placed even further emphasis on co-ordinated implementation. The Commission further noted that, as an essential part of such implementation, the WMO Secretariat was being asked to take on responsibilities not fully reflected in the WMO budget. It appreciated the efforts of the Secretary-General to be responsive to the changing requirements and to provide critical support whenever possible. It was understood, however, that the ability to be responsive was very limited in view of the financial difficulties of WMO. The Commission also believed that valuable time and effort had been spent on fund-raising activities by participants which could have been better spent on advancing the programme if alternative funding procedures had been defined.

6.6.6 The Commission, therefore, urged that those Members directly involved with planning and carrying out co-ordinated implementation activities should carefully consider the full range of support required and make adequate provision for funding that support. Recognizing that the implementation co-ordination activities of WMO were likely to expand over the coming years, the Commission requested the Secretary-General to give special attention to proposing ways by which such activities could be properly funded.

6.6.7 The Commission noted that results of the OWSE-NA were expected to be available in 1989 or 1990 and that preliminary results from the OWSE-AF were expected at about the same time. It asked, therefore, that a full report on available OWSE results be provided to CBS-Ext.(90).

7. RESULTS OF THE TECHNICAL CONFERENCE ON OPERATIONAL WEATHER FORECASTING (agenda item 7)

7.1 The Commission expressed its great appreciation for the convening of the Technical Conference on Operational Weather Forecasting (TECOFOR) which was held over a three-day period in conjunction with its ninth session. It placed on record its gratitude for the excellent preparatory work and organization by the president of the Commission, the CBS Advisory Working Group as the organizing committee, the scientific director and the Secretariat. It also expressed its thanks to the session chairmen and to the 16 lecturers for the high quality of their presentations which had generated lively discussions in each of the five conference sessions.

7.2 The Technical Conference provided information on current and projected developments in operational forecasting at all time scales, on interpretation techniques of NWP products, on the forecasting of specific meteorological elements, and on the preparation of tailored products and arrangements for their distribution to end-users. Detailed information was provided on the implementation of a nowcasting project, on dynamical and statistical product-interpretation techniques, and on examples of various means of disseminating information to users within countries.

7.3 The Conference recognized that forecasters in tropical regions were confronted with very difficult scientific problems. While it was agreed that further research in tropical meteorology and the further development of appropriate numerical weather prediction techniques were required, the elimination of the existing deficiencies in observing and telecommunications was a sine qua non for improved weather forecasting in the tropics on all time scales. Concerning the provision of forecasts and warnings - of tropical cyclones in particular - it was felt that special attention should be paid to improved public education and awareness and that better use should be made of mass media and other distribution systems to disseminate forecasts, information and warnings to local authorities and users concerned. The difficulties of many developing countries in that regard were recognized.

7.4 Presentations on the automation of GDPS and GTS functions at WWW centres were made and descriptions of automation projects and their positive impact on the quality and effectiveness of services to users were given. Current and projected uses of inexpensive computer systems and stand-alone work stations as important tools for forecasters were reviewed. The potential of computer graphics and interactive processing for the enhancement of forecasting services were particularly stressed. The Commission noted that the WMO Secretariat had established a support programme for the exchange of software for computers at WWW centres.

7.5 It was considered that the direct and more specialized applications of meteorological forecasting techniques would allow forecasting services to have a much greater impact and would provide increasingly valuable guidance to users. Closer co-operation and better dialogue between end-users and meteorologists would be mutually beneficial and would facilitate the provision of specialized information to meet the various economic and social needs of all nations; there was also, however, a growing need to inform the end-users of the capabilities and limitations of the services.

7.6 During a presentation on the future development of meteorological services in the light of new technology, it became clear that forecasters would continue to have a key role in operational weather forecasting in the future, even in highly automated services. However, a higher level of training might be required to provide the necessary skills.

7.7 The Commission considered that effective methods would have to be developed to educate the public about the influences of weather, the meaning of meteorological terms and events, and the services that could be provided to it.

7.8 The conclusions were taken into account by the Commission in developing its future work programme. Furthermore, considering the contribution the Technical Conference had made as background to the work of the session, the Commission requested its president to take appropriate action to organize, in association with the tenth session of the Commission, a technical conference on data-management activities or the interface between meteorologists and users.

8. EDUCATION AND TRAINING RELATED TO CBS ACTIVITIES (agenda item 8)

8.1 The Commission examined with great interest the information on the implementation of the relevant education and training activities of the Organization since its last session. Several delegates from both developing and developed countries emphasized the usefulness and effectiveness of various projects within the Education and Training Programme to activities related to CBS. It was also agreed that the CBS Advisory Working Group should continue to co-ordinate education and training activities within the Commission.

8.2 In noting the results of the world-wide survey of Members' training requirements and capabilities undertaken during 1985 and 1986 by the WMO Secretariat, the Commission agreed that there was a need for increased co-operation among Members in meeting their training requirements in appropriate fields, in particular through co-ordinated group-training activities and greater use of roving seminars.

8.3 With regard to the next such survey planned for 1988-1989, the Commission considered that the subjects of weather forecasting and weather analysis should be included in the survey questionnaire.

8.4 The Commission was reminded of the relevant training events which had been approved by Tenth Congress for implementation during 1988-1991 and, more specifically, by the Executive Council for the biennium 1988-1989. The Commission emphasized the importance of the organization of training events in such fields as satellite data interpretation and operational use of NWP products. It was agreed that a workshop on telecommunication procedures for RA I, to be held in 1988 or 1989, was highly desirable. The offer of the USSR to provide specialized training in telecommunications and numerical weather prediction was noted.

8.5 The Commission also noted the information on the awarding of fellowships and on the offers made by a number of Members for fellowships in specialized fields.

8.6 In response to the lack of training aids and, in particular, audiovisual training materials in the training institutions of many Member countries, the Commission requested that Members should make such materials available to the Secretariat which would in turn provide them to Members in need of them. The Commission noted with appreciation the offer by the Federal Republic of Germany to make available synoptic chart series and slide sets, the offer by the United States of America to make available lecture notes, video tapes and slides on satellite-imagery interpretation for the tropics, and the offer of the United Kingdom to provide audiovisual training aids as a part of its VCP contribution for use in the training of personnel engaged in WWW activities.

8.7 The Commission noted with appreciation the preparation and translation of relevant training publications undertaken by WMO with the assistance of some Members. It requested the Secretary-General to take action to update Volume I, Part 3 of publication WMO-No. 364 (Synoptic Meteorology) and to reprint Volume I, Part 1 of publication WMO-No. 364 (Dynamic Meteorology) and Volume I of publication WMO-No. 266 (Earth Science).

8.8 Due to the need for updating publication WMO-No. 258 - Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology, the Commission agreed that the syllabi for training various classes of meteorological personnel with specialization in meteorological telecommunications, data processing and numerical weather prediction should be reviewed. In that connection, the Commission noted that the terms of reference of its appropriate working groups included that task, which should preferably be entrusted to an expert. The president was therefore authorized to select a rapporteur to review and update the relevant parts of the publication.

9. RELATIONSHIP OF THE WWW WITH OTHER WMO AND INTERNATIONAL PROGRAMMES (agenda item 9)

Accidental release of radioactive material into the atmosphere

9.1 The Commission noted with appreciation the actions which had been undertaken within WMO, in close co-ordination with the International Atomic Energy Agency (IAEA) and other international organizations, for urgently meeting the requirements defined in the IAEA conventions on early notification and assistance in case of a nuclear accident. It noted in particular that Tenth Congress had requested the Commission for Basic Systems to consolidate the requirements for meteorological, radiological and other relevant data, as well as for specialized products which, within the WWW system, were to be made available over the GTS to Members in the event of a transboundary flow of hazardous materials. The Commission had also been asked to make proposals and recommendations to the Executive Council on those matters, if appropriate.

9.2 The Commission was in agreement that full WWW support should be given to efforts, in close co-operation with other international organizations, toward urgent implementation at national, regional and global levels of the objectives of the IAEA conventions on early notification and assistance in case of a nuclear accident. All working groups of the Commission should be actively involved within their respective areas of responsibility.

Use of the GTS in case of a nuclear accident

9.3 The Commission noted that an agreement had been reached between WMO and IAEA on the use of the GTS for prompt exchange of information, described in Article 5.1 of the Convention on Early Notification of a Nuclear Accident, and that practical tests had been carried out in co-operation with IAEA headquarters, national IAEA focal points and selected GTS centres. The messages issued by IAEA contain information from the site of the accident and should be exchanged with highest priority over the GTS. The necessity for global availability of information concerning an accident to Meteorological Services was particularly stressed. It was noted that, if the information was inserted onto the GTS by IAEA headquarters, a global exchange would be achieved. Some delegates expressed the view that requirements might exist in some countries for the direct insertion of the information onto the GTS by the concerned country itself. In that case, IAEA headquarters would also be informed (e.g. by telex) and could be obliged to provide this information promptly, upon request, to international organizations concerned such as WMO. In order to achieve a reliable global exchange in the case of such an event, the Commission asked the Working Group on the GTS to study possible arrangements and to propose adequate procedures.

Availability of meteorological and radiological data in case of accidents

9.4 Requirements for the availability of source-term data (characteristics of the radioactive release), additional meteorological data and radiological data in case of a nuclear accident had been formulated by several WMO and joint WMO/IAEA expert groups. The Commission reviewed those requirements and stressed the particular importance of precipitation data including weather radar precipitation data. The need to have meteorological observing stations around nuclear power plants was strongly emphasized. It was agreed that:

(a) The requirements for additional meteorological data should be included in the Manual on the GOS (see item 6.2);

(b) IAEA should be approached with a view to obtaining its agreement and support for the requirements for source-term and radiological data, and that those data, to the extent available, should be exchanged over the GTS in the event of a nuclear accident with transboundary flow of radioactive material.

Preliminary data requirements developed by a joint WMO/IAEA expert group are contained in the Annex to this report. Information on suitable instruments for various radioactivity measurements should be requested from the IAEA.

9.5 In respect of the development of WWW codes and GTS procedures for real-time exchange of radiological data in case of an accident, the Commission requested the chairmen of the Working Groups on the GTS and on Data Management to take urgent action so that the president of CBS could submit relevant recommendations to the Executive Council on its behalf. In this respect, the opinion was expressed that data representation in a standard binary form would be preferable.

Routine radiological data over the GTS

9.6 Regarding the routine monitoring of radiological data and the exchange of those data over the GTS, the Commission was informed of the views of the EC ad hoc Group of Experts on Operational Meteorological Aspects concerning the Emission of Hazardous Materials into the Atmosphere and Atmospheric Emergency Responses and on the actions taken by some Members in RA VI to exchange daily and in a special code radiological data over the GTS. Some delegations informed the Commission that they were not in agreement with a routine exchange of radiological data. It was also noted that several countries had national coding practices for collection of their radiological data. The Commission, noting the above, decided that only one set of WWW codes should be used for the exchange over the GTS of radiological data both in case of an accident and, if required, on a routine basis. It therefore requested the chairman of the Working Group on Data Management to consider this when taking action regarding codes.

Availability of special forecast products in case of an accident

9.7 The Commission noted that, in the event of a nuclear accident with transboundary flow of radioactive material, there was a need for Members to receive atmospheric transport/dispersion/deposition model output products over the GTS. Several delegations informed the Commission about their current systems and capabilities to prepare trajectories as well as predict dispersion and deposition fields. The delegate of France informed the Commission that the GDPS centre in Paris was ready to insert onto the GTS, on request, trajectories (both prognostic and analytic) and, in the near future, predicted dispersion and deposition fields. NMC Paris could, if so required, take the responsibility as an RSMC with specialization in special products in the case of an accidental release of hazardous materials into the atmosphere.

9.8 The Commission expressed its appreciation for this offer from France. It decided that, in addition, selected WWW and other advanced processing centres should be approached urgently and their agreement sought to make specific products available over the GTS in the event of a nuclear accident. The chairman of the Working Group on Data Management should, in close co-operation with the major centres concerned, take action to develop the necessary formats (preferably binary codes) for the exchange of such products over the GTS. The president of the Commission was asked to follow up this matter and to decide on relevant recommendations for approval by the Executive Council.

Joint WMO/IAEA project on validation of model output

9.9 The Commission was informed of the ongoing activities regarding the joint WMO/IAEA project on validation of atmospheric transport/dispersion/deposition models and the creation of special meteorological data bases for such events as the Chernobyl accident at World Data Centres A and B and for radiological data at IAEA headquarters. The Commission was pleased to learn that the Data Centres Washington and Moscow had agreed to assemble those special meteorological data bases. It noted with satisfaction that 40 countries had submitted additional precipitation data to the World Data Centre A. The Commission strongly supported the joint WMO/IAEA model validation project and urged Members to participate in that international validation exercise.

ICAO aspects regarding nuclear accidents

9.10 The observer from ICAO brought to the attention of the Commission concerns which had been expressed by the aviation community regarding the need for early notification of appropriate air traffic services units regarding nuclear and chemical accidents. He further advised the Commission that a study was being conducted at ICAO on the issue and that WMO would, in due course, be informed of the results and would probably be invited to participate in a system whereby aeronautical authorities would be notified of the expected trajectories of those pollutants.

Exchange of seismic data over the GTS

9.11 The Commission noted that the president of the UN Conference on Disarmament had contacted the Secretary-General of WMO on 21 August 1986 concerning the further support of WMO for transmitting Level I and Level II seismic data over the GTS. He informed WMO that the further work of the Conference's ad hoc Group of Scientific Experts would include planning and carrying out a large-scale experiment on the exchange of Level II data.

9.12 The Commission was informed that the *ad hoc* Group was considering the design of a modern international seismic data-exchange system based on the expeditious exchange of waveform (Level II) and parameter (Level I) data. The envisaged global system would consist of:

(a) International Data Centres (IDC) in Canberra, Moscow, Stockholm and Washington to collect and analyse seismic waveform and parameter data, and to distribute the results of the analyses;

(b) The inter-IDC communication system, connecting IDCs through dedicated high-speed computer-to-computer links;

(c) A global network of seismograph stations (at least 50) submitting Level I and Level II seismic data to IDCs through National Data Centres (NDCs) which would, in addition, receive data and information from IDCs;

(d) A communication system connecting the NDC in each participating State to one IDC, using the most efficient communication means available.

9.13 The flow of data based on regular Level II data exchange would be considerably increased compared to the regular Level I data exchange, but the exact specification of the volume of data to be exchanged awaited the results of further study and testing. The *ad hoc* Group noted that GTS circuits might be utilized for the exchange of data between NDCs and IDCs and a study group was entrusted to develop a system concept on the data exchange between NDCs and IDCs using the GTS.

9.14 The Commission expressed its appreciation for the co-operation between WMO and the Conference on Disarmament and felt that WMO should continue to contribute to the international exchange of seismic data over the GTS. However, taking into account that the GTS faced an increasing volume of observational data and processed products to be exchanged, the Commission was of the opinion that the transmission over the GTS of a significant amount of additional data could induce a serious overload on the GTS by cumulative effects on some segments at various centres. The Commission therefore agreed that the possible transmission over the GTS of Level II seismic data should be studied in detail, with due consideration to data volume, routeing schemes and the capacity of circuits and GTS centres involved. It also noted that special telecommunication arrangements for linking and interfacing NMCs concerned with the national bodies responsible for seismic data would also be required.

9.15 The Commission decided to entrust the Working Group on the GTS with the task of studying in detail the possible transmission of Level II seismic data over the GTS, in liaison with the *ad hoc* Group of Scientific Experts of the Conference on Disarmament and its relevant study group, with the assistance of the WMO Secretariat.

Atmospheric volcanic activity

9.16 The Commission was informed of steps being taken by WMO concerning ash clouds of volcanic origin. It noted the valuable work carried out on the subject by the ICAO Study Group on Volcanic Ash Warnings which had been established to respond to the serious threat to the safety of civil aviation posed by volcanic ash clouds. The observer from ICAO thanked WMO for its co-operation and very useful contribution to the work of the study group. The Commission further noted that, while procedures had been established to disseminate warnings of such clouds, no techniques had been implemented to detect and routinely forecast their development and displacement.

9.17 The Commission agreed that the Working Group on the Global Observing System should be requested to consider how real-time observational data on atmospheric evidence of volcanic activity could be obtained from existing observing networks. It further agreed to invite CAS to consider the possibility of developing suitable diffusion models for the prediction of the development and displacement of volcanic ash clouds.

Boundary conditions for limited-area models

9.18 The Commission was informed of a request emanating from the ninth session of the Commission for Atmospheric Sciences (Sofia, 6-17 October 1986) concerning boundary data for limited-area models. The delegate from the United States informed the session that, along with the United Kingdom, his country was prepared to provide information on boundary conditions to those wishing to receive it. The Commission considered that, until such time as the number of requests created difficulties, needs could be met on a bilateral basis.

FAO requirements for meteorological data

9.19 The observer from FAO brought to the attention of the session his organization's requirements for meteorological data for monitoring agricultural production and desert locust control. FAO wished to have simple but complete weather data to calculate water balances which affected crop production. The primary need was for summarized precipitation data, preferably in the form of five- or 10-day totals of recent past rainfall in Africa.

9.20 The Commission agreed that such information could, in principle, be furnished to FAO in Rome. There were, however, difficulties with respect to the continuing problems in RA I related to the transmission of data over the GTS. The Commission requested that the Secretary-General and the Working Group on the GTS co-operate with the appropriate RA I working group and CAgM in an attempt to meet the needs of FAO.

Activities of other WMO programmes relevant to the WWW

9.21 The session received both written and oral briefings on activities of the World Climate Programme and the Technical Co-operation Programme relevant to the World Weather Watch. Mentioned in some detail was the World Climate Data Programme which had three activities of interest to CBS, namely the exchange of CLIMAT data, the transfer of technology in climate data-management user services (CLICOM) and Climate System Monitoring. The Commission noted that CLICOM could play an important role in the integration of overall data management.

9.22 As regards technical co-operation activities, the briefing dealt mainly with the automation of the GTS and GDPS in a number of countries, the improvement of telecommunications in RA I through the use of satellite communication facilities and the development of regional centres in Africa, particularly the African Centre of Meteorological Applications for Development (ACMAD). The Commission noted that these were funded from a variety of sources (VCP, UNDP and trust funds) and recognized their importance for the development and implementation of the WWW as a whole.

10. CBS WORK PROGRAMME, ESTABLISHMENT OF WORKING GROUPS, NOMINATION OF MEMBERS OF WORKING GROUPS AND NOMINATION OF RAPPORTEURS (agenda item 10)

General role of CBS

10.1 When considering its future work programme, the Commission noted that rapid developments in science and technology demanded that CBS evaluate and assimilate new techniques and methods as they become available for the WWW. The Commission noted that some developments of great importance to the WWW had taken place outside CBS. The Commission recognized, however, that certain technical developments in the past were necessarily dealt with initially by competent groups making the best use of experts and capabilities as they became available.

10.2 The Commission stressed that such developments should be co-ordinated as far as possible through CBS and its working groups in accordance with their established terms of reference. That would require a high degree of flexibility in responding to problems as they arose. The Commission was confident that the existing structure of its working groups, study groups and rapporteurs provided adequate capabilities to fulfill its role in guiding, co-ordinating and monitoring developments relevant to the WWW. It emphasized the need to involve the Members of CBS as much as possible to ensure the development of the WWW as a joint effort.

Future work programme

10.3 On the basis of the Second WMO Long-term Plan and detailed discussions under the relevant agenda items, the Commission agreed on its work programme to be carried out during the next intersessional period. In accordance with the established structures of the Commission, specific tasks were assigned to the Working Groups on the GDPS, GOS, GTS and WWWDM respectively. These are reflected in the following paragraphs.

Work programme of the Working Group on the GDPS

10.4 The Commission agreed on the following work programme concerning the Working Group on the GDPS during the intersessional period:

(a) To review the requirements of Members and relevant international organizations for WMC data and products and, in view of the results, to issue recommendations on the need for further improvement of WMC output programmes, particularly in respect of upgraded WMC services in the tropical belt and southern hemisphere;

(b) To review the requirements of Members for the processing of incoming products from WMCs and RSMCs and to provide guidance on appropriate hardware and exchange of software for application of products to local forecasting needs;

(c) To review the monitoring methods of the GDPS, including availability and quality of processed products prepared by RSMCs and WMCs;

(d) To review the monitoring results, in particular concerning the verification of NWP and identification of areas for further development;

(e) To consider observational data requirements for operational large-scale and mesoscale NWP products;

(f) To review scientific results in the field of medium- and long-range prediction with a view to recommending methods for operational application;

(g) To review scientific results and technological possibilities in the field of very-short-range and short-range predictions;

(h) To review and update the Manual and Guide on the GDPS.

Work programme of the Working Group on the GOS

10.5 The Commission agreed on the following work programme concerning the Working Group on the GOS during the intersessional period:

(a) To review and update the Manual and the Guide on the GOS, particularly in the light of the introduction of new observing systems into the GOS and of developments in the field of space-based subsystems;

(b) To review matters related to the development of new observing components such as ASDAR, ASAP and drifting buoys and their introduction into the GOS;

(c) To review the results of the OWSE-North Atlantic and the OWSE-Africa (observational aspects) and apply the results in the planning and implementation of future OWSEs and the GOS as a whole;

(d) To review the results of the feasibility study of a baseline upper-air network and to elaborate proposals for the operational baseline upper-air network based on the results;

(e) To review procedures for monitoring and evaluating the performance of observing systems and their communication interfaces and for seeking remedial actions based on the results of such monitoring;

(f) To consider how real-time observational data on atmospheric evidence of volcanic activity could be obtained from existing observational networks.

Work programme of the Working Group on the GTS

10.6 The Commission agreed on the following work programme concerning the Working Group on the GTS during the intersessional period:

(a) To review the organization of the GTS, and in particular the MTN, to make proposals and recommendations for its planning taking into due account the new telecommunication means available, in particular satellite-based communication techniques;

(b) To formulate recommendations on techniques, equipment and GTS planning with a view to remedying shortcomings;

(c) To further develop data-communication techniques and procedures to be used on the GTS, taking into due account the relevant international standards;

(d) To further develop monitoring procedures and data-management functions related to the GTS, in co-ordination with the CBS Working Group on Data Management;

(e) To review the results of the OWSE-Africa and take them into account in planning OWSEs as well as the GTS as a whole.

10.7 In view of urgent tasks in connection with the introduction of the Data Management concept, the fundamental revision of the WWW monitoring procedures and the development of a new generation of meteorological codes, the Commission decided to form a Working Group on Data Management on the understanding that it would absorb the tasks of the former Working Group on Codes.

Work programme of the Working Group on Data Management

10.8 The Commission agreed on the following work programme concerning the Working Group on Data Management during the intersessional period:

(a) Further development of the conceptual scheme of functional subsystems of the WWW and identification of existing and required functions in the WWW system recognizing the Open Systems Interconnections (OSI) reference model;

(b) Identification of international standards, especially with respect to layers 5, 6 and 7 of the OSI model as they are developed, and consideration of their application in WMO standards and recommended practices within the WWW;

(c) Specification of management procedures for real-time and non-real-time monitoring of the operation of WWW including:

   (i) The exchange of relevant information in regard to the status of operation;

   (ii) The continued development of standards for monitoring the quality of data and products and the exchange of that information;

(iii) Monitoring of reports from mobile observing stations;

(d) Updating of existing code forms, specifications and code tables as appropriate to the requirements stated;

(e) Conceptual design of distributed data bases for the WWW, recognizing the need to evolve from the currently employed systems; an implementation strategy should also be addressed;

(f) Development of new forms of observational and processed data representation to meet stated requirements, particularly including:

(i) The efficient representation of data for storage and exchange;

(ii) The graphical representation of data;

(iii) The requirements for conversion of data from one form to another;

(iv) The application of international standards;

(g) To make recommendations on the application of standard data structures as interfaces to data-processing applications to promote portability of software (e.g. high-level programming language structures, arrays, etc.).

Establishment of working groups and rapporteurs

10.9 In accordance with the discussions on its future work programme, the Commission decided to re-establish its Advisory Working Group and to establish Working Groups on the GDPS, GOS and GTS. In addition, it established a new Working Group on Data Management which would include a sub-group entrusted to carry out the tasks of the former Working Group on Codes. The Commission invited Mr C. F. Reudink (Netherlands Antilles) to serve as chairman of this sub-group. The Commission further appointed two rapporteurs on satellite data-retrieval methods and use of quantitative satellite data. Resolutions 1, 2, 3, 4, 5 and 6 (CBS-IX) were adopted.

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

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

11.2 The Commission noted that the action on most of its previous recommendations had either been completed or their content included in the relevant WMO manuals and decided not to keep them in force. As regards implementation of Recommendation 8 (CBS-VIII), the Commission agreed that it had been overtaken by new developments and that the resolution was therefore no loyer valid (see paragraph 6.4.51). Resolution 7 (CBS-IX) was adopted.

11.3 The Commission then examined the Executive Council's resolutions within the field of CBS and agreed that Resolution 4 (EC-XXXV) and Resolution 4 (EC-XXXVIII) no longer needed to be kept in force. It decided to recommend that Resolutions 1, 2, 3 and 4 (EC-XXXVI), Resolutions 2 and 3 (EC-XXXVII) and Resolution 1 (EC-XXXIX) should be kept in force. Recommendation 21 (CBS-IX) was adopted.

12. ELECTION OF OFFICERS (agenda item 12)

Dr A. A. Vasiliev (USSR) was unanimously elected president of the Commission and Dr T. Mohr (Federal Republic of Germany) was unanimously elected vice-president.

13. DATE AND PLACE OF NEXT SESSION (agenda item 13)

The delegate of the United Kingdom informed the session that his Government was prepared, in principle, to provide host facilities for the next session of the Commission in London in September/October 1990. He expected that a formal offer would be submitted soon when details of the exact dates and location had been determined. The Commission requested its president, in consultation with the Secretary-General, to make the necessary arrangements when the offer was received.

14. CLOSURE OF THE SESSION (agenda item 14)

14.1 In his closing address, the president of the Commission, Mr J. R. Neilon, reviewed the work of the ninth session which, he felt, had been highly successful. There had been major accomplishments in the period leading up to the session and a number of very important forward-looking decisions taken by the Commission which would determine its future work and the shape of the World Weather Watch for many years to come. The technical conference held in the middle of the session had also been a major success and had provided very valuable background and stimulus to the discussions.

14.2 The president thanked the participants for their valuable contributions and for the spirit of friendly co-operation in which the deliberations had been conducted, allowing the session to achieve so much in a relatively short time. He thanked all those who had contributed to the smooth running of the session, particularly the chairmen and vice-chairmen of the committees and members of the ad hoc sub-groups who had worked long and hard. He expressed his appreciation for the services provided by the Secretariat.

14.3 As the ninth session was his fourth and last as president of the Commission, Mr Neilon paid tribute to the support, advice and assistance he had received over the 10-year period from a large number of people, particularly the vice-president, Dr Vasiliev, the chairmen of the working groups and members of the Advisory Working Group. He was confident that the Commission was in very capable hands under the new leadership of Dr Vasiliev and Dr Mohr and he wished them every success in their work.

14.4 On behalf of all members of the Commission, Dr Vasiliev thanked Mr Neilon for his devoted and extremely able leadership of CBS over the years. His period of office had been a landmark in the life of the Commission, and one of remarkable achievements. Dr Vasiliev expressed his pleasure that Mr Neilon's vast knowledge and experience of CBS activities would not be lost to the Commission and that his wise counsel would be available in the Advisory Working Group.

14.5 The session closed at 12.00 on Friday, 5 February 1988.

RESOLUTIONS ADOPTED BY THE SESSION

Res. 1 (CBS-IX) - 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-VIII) - 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 co-ordination and planning,

DECIDES:

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

(a) To advise the president of the Commission, as necessary, in his functions of expressing opinions or taking action on urgent or non-controversial matters;

(b) To assist the president in short- and long-term planning of the work of the Commission and of its working groups;

(c) To assist the president in the co-ordination, guidance and development of the WWW support functions;

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

(e) To assist the president in the co-ordination of the activities of CBS;

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

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

(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 the GDPS, GOS, GTS and DM

Mr D. J. Gauntlett (Australia)
Mr Luo Jibin (China)
Mr E. A. Mukolwe (Kenya)

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

Res. 2 (CBS-IX) - WORKING GROUP ON THE GLOBAL DATA-PROCESSING SYSTEM (GDPS)

THE COMMISSION FOR BASIC SYSTEMS,

NOTING Resolution 5 (CBS-VIII) - Working Group on the Global Data-processing System,

CONSIDERING that there is a need for the continuation of the work of the working group established by Resolution 5 (CBS-VIII),

DECIDES:

(1) To re-establish the Working Group on the Global Data-processing System with the following terms of reference:

(a) To keep abreast of scientific and technical developments relating to the method of meteorological analysis and forecasting for general purposes and to consider the implementation of new techniques;

(b) 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;

(c) To consider the co-ordination of observational data requirements of the WWW and provision of advice on the formulation of requirements to be met by the Global Observing System;

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

(e) To co-ordinate the production of analysed and forecast data by WMCs and RSMCs taking account of requirements of Members for new kinds of products;

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

(g) To develop proposals on matter relating to real-time and non-real-time quality control, storage and retrieval of data in co-ordination with the Working Group on Data Management;

(h) 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;

(i) To provide co-ordination 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;

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

(k) To keep under review and up to date the Manual and Guide 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;

(2) To give the working group the following composition:

(a) An expert designated by each regional association;

(b) An expert nominated by each of the Members responsible for the operation of a World Meteorological Centre (WMC);

(c) Experts nominated by Members, or groups of Members, operating Regional Specialized Meteorological Centres (RSMCs);

(d) Experts nominated by other Members wishing to participate actively in the work of the group;

(e) Experts who may be nominated by presidents of other technical commissions;

(3) To select, in accordance with Regulation 31 of the General Regulations, Dr N. F. Veltishchev (USSR) 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 next session.

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

Res. 3 (CBS-IX) - WORKING GROUP ON THE GLOBAL OBSERVING SYSTEM (GOS)

THE COMMISSION FOR BASIC SYSTEMS,

NOTING Resolution 4 (CBS-VIII) - Working Group on the Global Observing System,

CONSIDERING that there is a need for the Working Group on the Global Observing System to be re-established to keep under constant review observational requirements of the WWW, WCP, WCRP, IGOSS as well as other international programmes,

DECIDES:

(1) To re-establish the Working Group on the Global Observing System with the following terms of reference:

(a) To review and advise on the observational data requirements of the WWW, other WMO programmes and other international programmes;

(b) To review and advise on the design and implementation of the Global Observing System taking account of:

- Established requirements for data;

- The cost, capabilities and performance of observing systems including information received from OWSEs;

(c) To review the procedures for monitoring and quality control of observational data in co-operation with the CBS Working Groups on the GDPS, GTS and DM;

(d) To keep the Manual and Guide on the GOS under review and to make recommendations for amendments;

(e) To provide inputs to Operational WWW Systems Evaluations (OWSEs), to analyse the information acquired during OWSEs and to apply it in planning the GOS as a whole;

(f) To keep abreast of developments in advanced satellite remote sensing and surface-based remote sensing;

(g) To keep under review matters related to the development and introduction of new observing systems into the GOS;

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

(i) To keep up to date relevant training syllabi and to suggest training materials and the holding of seminars and symposia;

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

(k) To act upon matters referred to the working group by the president of CBS;

(2) To give the working group the following composition:

(a) An expert designated by each regional association;

(b) Experts nominated by other Members wishing to participate actively in the work of the working group;

(c) Experts designated by the presidents of the Commission for Marine Meteorology and the Commission for Instruments and Methods of Observation;

(d) Experts who may be nominated by presidents of other technical commissions;

(3) To select, in accordance with Regulation 31 of the General Regulations, Mr F. S. Zbar (USA) as chairman of the working group;

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

Note: This resolution replaces Resolution 4 (CBS-VIII) which is no longer in force

Res. 4 (CBS-IX) - WORKING GROUP ON THE GLOBAL TELECOMMUNICATION SYSTEM (GTS)

THE COMMISSION FOR BASIC SYSTEMS,

NOTING Resolution 7 (CBS-VIII) - Working Group on the Global Telecommunication System (GTS),

CONSIDERING:

(1) That the implementation of the World Weather Watch Plan 1988-1997 will require a series of technical studies on the GTS,

(2) That the evolution in data-exchange requirements stemming from the World Weather Watch, other WMO programmes and joint programmes between WMO and other organizations, entail a constant review of the world-wide telecommunication system,

DECIDES:

(1) To re-establish the Working Group on the Global Telecommunication System, with the following terms of reference:

(a) To keep under review the organizational and planning aspects of the entire Global Telecommunication System of the World Weather Watch, including the collection and distribution of meteorological information through meteorological and communications satellites;

(b) To keep under review the organizational, technical and procedural aspects of the Main Telecommunication Network, including its interfaces with Regional Meteorological Telecommunication Networks;

(c) To keep under review the further development of real-time and non-real-time monitoring procedures relating to the GTS operation, in co-ordination with the Working Group on Data Management;

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

(f) To keep in touch with the relevant activities of working groups of regional associations;

(g) To co-ordinate its activities with the work of the Working Group on Data Management and of other working groups of CBS, with a view to integrating the GDPS, GOS and GTS subsystems into a WWW system conceived as an entity;

(h) To provide inputs to OWSEs, analyse the information acquired during OWSEs relating to telecommunications and apply the results in planning the GTS;

(i) To keep abreast of the activities of the International Telecommunication Union, the International Organization for Standardization, the International Civil Aviation Organization, the International Maritime Organization and other international organizations concerned on matters pertaining to meteorological telecommunications;

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

(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 keep the regulatory and guidance material under review;

(m) To establish 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;

(2) To give the following composition to the working group:

(a) The chairmen of the Working Groups on Meteorological Telecommunications of regional associations and the rapporteurs on Regional Meteorological Telecommunications;

(b) An expert to be nominated by each of the Members responsible for the operation of World Meteorological Centres and the Regional Telecommunication Hubs on the Main Telecommunication Network;

(c) Experts nominated by Members responsible for the operation of Regional Telecommunication Hubs which are not on the Main Telecommunication Network;

(d) Experts nominated by other Members wishing to participate actively in the work of the group;

(e) Experts who may be nominated by presidents of other technical commissions;

(3) To select, in accordance with Regulation 31 of the General Regulations, Mr J. Arimatéa (Brazil) 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 next session.

Note: This resolution replaces Resolution 7 (CBS-VIII) which is no longer in force.

Res. 5 (CBS-IX) - WORKING GROUP ON DATA MANAGEMENT (DM)

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) Resolution 25 (Cg-X) - Second WMO Long-term Plan (Volume 1, Part II - The World Weather Watch Plan and Implementation Programme),

CONSIDERING:

(1) That orderly overall real-time data management is an essential prerequisite for the efficient operation of a flexible, integrated WWW system, to cope with the rapid evolution of meteorological requirements and techniques and to ensure that WWW data and products are available to Members in a timely and convenient fashion,

(2) That in view of the diversity and complexity of problems relating to WWW management functions, it is desirable to entrust their solution to a permanent group of experts on these subjects,

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 main WWW elements (GOS, GDPS and GTS) in both real time and non-real time, i.e.:

(i) Co-ordination 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 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 the various WWW centres;

(c) To consolidate and co-ordinate statements received from other bodies, Members, regional associations, other technical commissions and appropriate international organizations on the need for new international forms of presentation of observational data and products within the WWW system using suitable code forms, formats and data representation forms (binary, character and graphic);

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

(e) To monitor progress on implementation of relevant parts of the Second 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;

(2) *To give the working group the following composition:*

(a) An expert designated by each regional association;

(b) Experts to be nominated by Members responsible for the operation of World Meteorological Centres and/or advanced Regional/Specialized Meteorological Centres, and other Members wishing to participate actively in the work of the group;

(c) Experts designated by the chairmen of the CBS Working Groups on the GOS, GDPS and GTS;

(d) Experts who may be nominated by presidents of other technical commissions;

(3) To select, in accordance with Regulation 31 of the General Regulations, Mr R. J. Sowden (UK) 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 next session.

Note: This resolution replaces Resolution 6 (CBS-VIII) which is no longer in force.

Res. 6 (CBS-IX) - RAPPORTEURS ON SATELLITE DATA RETRIEVAL METHODS AND USE OF QUANTITATIVE SATELLITE DATA

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The importance of quantitative satellite data to the forecast and service programmes of both developing and developed countries,

(2) The rapid advances being made in the application of quantitative satellite data,

(3) The improvements under way or planned for the near future in satellite data-processing techniques and satellite sensing systems,

(4) The large areas of the globe where the data base is not sufficient to meet Members' needs,

(5) The important activities of several international organizations and/or bodies, such as the International TOVS Study Conference, to develop new or improved techniques for the production of quantitative meteorological information from satellite data,

CONSIDERING the urgent need of Members to be informed of these new developments in regard to quantitative satellite data,

DECIDES:

(1) To appoint two rapporteurs on satellite data retrieval methods and the use of quantitative satellite data with the following terms of reference:

(a) To keep under review the progress being made with respect to vertical soundings of the atmosphere, giving particular attention to polar-orbiting satellites but also giving attention to soundings from geostationary satellites as may be appropriate to provide a comprehensive review of the status of satellite data retrieval methods. This review should include, but not necessarily be limited to:

(i) Satellite instrumentation for soundings; performance characteristics, calibration and related factors which influence the retrieval of atmospheric soundings from satellite data;

(ii) Procedures for transmission, reception and quality control of sounding data since these influence the retrieval methods; and

(iii) Data retrieval methods by which radiance information is converted into soundings, including any supporting calibration techniques and/or information required during the retrieval process;

(iv) Results of the Baseline Upper-Air Network evaluation;

(b) As appropriate, to keep under review the use of satellite sounding data to assess the utility of the retrieval methods and to identify their strengths and/or weaknesses;

(c) To keep under review the application and impact of quantitative satellite data in analyses and forecasts;

(d) To keep under review new techniques and/or methods for data retrieval, especially those which could be of practical use to developing countries;

(e) To liaise with the International TOVS Study Group or similar organizations as a means of exchanging information on data retrieval methods and on problems regarding the impact of satellite sounding data;

(f) To provide periodic reports to the chairman of the CBS Working Group on the GOS and, as appropriate, to assist him with relevant satellite matters;

(g) To assist the president of CBS as required in the matter of satellite data retrieval methods;

(h) To report on the above matters to CBS/Ext.(90) and CBS-X;

(2) To invite Dr J. Le Marshall (Australia) and Dr W. P. Menzel (USA) to serve as the rapporteurs.

Res. 7 (CBS-IX) - REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION FOR BASIC SYSTEMS

THE COMMISSION FOR BASIC SYSTEMS,

CONSIDERING that Resolution 1 (CBS-Ext.(85)) should be reviewed,

NOTING the action taken on the resolutions and recommendations adopted prior to its ninth session,

DECIDES:

(1) To replace Resolutions 1, 3, 4, 5, 6 and 7 (CBS-VIII) by new resolutions;

(2) To replace Recommendation 14 (CBS-Ext.(85)) by a new recommendation;

(3) Not to keep in force the other recommendations adopted prior to its ninth session.

RECOMMENDATIONS ADOPTED BY THE SESSION

Rec. 1 (CBS-IX) - PROCEDURE FOR THE DESIGNATION OF REGIONAL/SPECIALIZED METEOROLOGICAL CENTRES (RSMCs)

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The Second WMO Long-term Plan, Part II, Volume 1 - World Weather Watch,

(2) The final report of the thirteenth session of the CBS Advisory Working Group, paragraph 6.4,

(3) The abridged report of the Tenth World Meteorological Congress, paragraph 3.1.1.2,

CONSIDERING that there is a need to establish procedures for the designation of new Regional/Specialized Meteorological Centres (RSMCs),

RECOMMENDS the following procedure for broadening the functions of existing RSMCs and for the designation of new RSMCs be introduced with effect from 1 July 1988:

(1) Statement of requirements for WWW products and services initiated and endorsed by the WMO constituent body or bodies concerned;

(2) Identification of capabilities of relevant existing RSMCs and/or candidate RSMCs, to meet the requirements;

(3) Determination in principle whether there is a requirement to:

(a) Broaden the functions of an existing RSMC; and/or

(b) Establish a new RSMC;

(4) Formal commitment by a Member or a group of co-operating Members to fulfill the required function(s) of a centre;

(5) Demonstration of the capabilities to CBS and the constituent body or bodies referred to under (1);

(6) Recommendation by CBS to include in the Manual on the GDPS:

(a) The new function(s) of the existing centre; or

(b) The identification and function(s) of the new centre;

(7) Acceptance of the CBS recommendation by Congress or the Executive Council.

Rec. 2 (CBS-IX) - REDESIGNATION OF REGIONAL METEOROLOGICAL CENTRES (RMCs) AS REGIONAL/SPECIALIZED METEOROLOGICAL CENTRES (RSMCs) WITH GEOGRAPHICAL SPECIALIZATION

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) That Tenth Congress had agreed with the introduction in the Second WMO Long-term Plan of the concept of Regional/Specialized Meteorological Centres having geographical and/or activity specializations,

(2) The requirements for global and regional analyses and forecasts to be provided by designated GDPS centres under the WWW programmes,

CONSIDERING:

(1) That GDPS centres located at Algiers, Antananarivo, Beijing, Bracknell, Brasilia, Buenos Aires, Cairo, Dakar, Darwin, Jeddah, Khabarovsk, Lagos, Melbourne, Miami, Montreal, Moscow, Nairobi, New Delhi, Novosibirsk, Offenbach, Rome, Tashkent, Tokyo, Tunis/Casablanca and Wellington have commited themselves to provide their regional analysis and forecast products and services within the framework of the WWW,

(2) The existence of long-standing arrangements and capabilities established by Members to meet the needs for a timely availability of such products in all NMCs concerned,

(3) The intentions of Members regarding the implementation of GDPS centres and the further development of capabilities to maintain an appropriate level of performance,

RECOMMENDS the redesignation of those GDPS centres which have served as RMCs under the WWW programme and have expressed their intention to continue such services, as RSMCs with geographical specialization with effect from 1 July 1988.

REQUESTS:

(1) Members operating the designated RSMCs to make every effort to meet the requirements of NMCs for regional analyses and forecasts and to co-ordinate their operational RSMC functions through the appropriate regional bodies and CBS;

(2) The Secretary-General to arrange for the inclusion of these designated RSMCs with geographical specialization, together with an outline of their functions and products, in the Manual on the GDPS after approval of this recommendation by the Executive Council.

Rec. 3 (CBS-IX) - DESIGNATION OF REGIONAL/SPECIALIZED METEOROLOGICAL CENTRES (RSMCs) WITH ACTIVITY SPECIALIZATION

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) That Tenth Congress had agreed with the introduction in the Second WMO Long-term Plan of the concept of Regional/Specialized Meteorological Centres having geographical and/or activity specializations,

(2) The requirements for specialized WWW products in connection with the Tropical Cyclone Programme as stated in the Second WMO Long-term Plan, Part II, Volume 1, Programme 1.7, paragraphs 19 and 20,

(3) The requirements for medium-range forecasts stated by CBS-VII,

CONSIDERING:

(1) That RMCs Miami, New Delhi and Tokyo provide tropical cyclone forecasts and advisory services on an operational basis,

(2) That medium-range weather forecast products are routinely made available over the GTS by the European Centre for Medium Range Forecasts (ECMWF),

RECOMMENDS:

(1) That the meteorological centres Miami, New Delhi and Tokyo be designated as RSMCs with activity specialization in tropical cyclone analysis, tracking and forecasting with effect from 1 July 1988;

(2) That the ECMWF be designated as an RSMC with activity specialization in global medium-range weather forecasts within the framework of the World Weather Watch with effect from 1 July 1988;

REQUESTS:

(1) Members operating the designated RSMCs to continue to make available their specialized products, as required, to Members concerned on a regional or global basis and co-ordinate such activities within the relevant programmes of the Second WMO Long-term Plan, i.e. the Tropical Cyclone Programme and the World Weather Watch Programme;

(2) The designated RSMCs Miami, New Delhi and Tokyo to demonstrate their capabilities, products and operational services relating to the activity specialization concerning tropical cyclones during the next session of CBS;

(3) The Secretary-General to arrange for the inclusion of the newly designated RSMCs and an outline of their specialized functions in the Manual on the GDPS as soon as the Executive Council has approved this recommendation.

Rec. 4 (CBS-IX) - AMENDMENTS TO THE MANUAL ON THE GLOBAL OBSERVING SYSTEM

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 2 (Cg-X) - World Weather Watch Programme 1988-1991,

(2) Resolution 25 (Cg-X) - Second WMO Long-term Plan,

(3) Resolution 4 (Cg-X) - Meteorological and hydrological aspects concerning the accidental release of hazardous materials with potential transboundary effects,

CONSIDERING:

(1) The need to expand the Manual on the Global Observing System to include more detailed information on certain types of stations,

(2) The need to reorganize the text of Part III of the Manual to facilitate reference to information on each type of station,

(3) The need for additional regulatory material on instruments and methods of observation to be included in the Manual on the Global Observing System,

(4) That the Manual should be consistent with the relevant parts of the Second WMO Long-term Plan adopted by Tenth Congress,

RECOMMENDS:

(1) That Part II of the Manual on the Global Observing System be amended as indicated in Section A of the annex to this recommendation;

(2) That Part III of the Manual on the Global Observing System be amended and restructured as given in Section B of the annex to this recommendation;

(3) That these amendments come into force on 1 November 1988;

REQUESTS the Secretary-General to arrange for these amendments to be included in the Manual on the Global Observing System.

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* *

Annex to Recommendation 4 (CBS-IX) - Amendments to the Manual on the Global Observing System

Section A:

1. Proposed amendments to Part II of the Manual on the GOS in response to Resolution 4(Cg-X) - Meteorological and hydrological aspects concerning accidental release of hazardous materials with potential transboundary effects

1.1 In the opening section of Part II "Requirements for observational data" insert the following paragraph:

> "1.4 Requirements in the event of an accidental release of radioactive material into the environment
>
> Requirements in the event of an accidental release of radioactive material into the environment should be related to the meteorological observational data needed by Members for taking the appropriate preventive and remedial action; these data are specified in Attachment II.4. Meteorological data from the site of the accident should promptly be made available in accordance with the Convention on Early Notification of a Nuclear Accident (Article 5)."

2. Amendments to Part II of the Manual on the GOS resulting from the adoption of the Second WMO Long-term Plan

2.1. Paragraph 96 and Table 5 of the WWW Plan present the basic set of global observational data to be met by the GOS in the late 1990s. This table (Appendix I) should replace Attachment II.2 in the Manual (both Tables A and B).

2.2 Attachment II.3 regarding requirements for horizontal spacing and reporting frequency, should be amended to read as shown in Appendix II, to reflect the objectives as given in paragraph 17 of the WWW Implementation Programme 1988-1997.

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ATTACHMENT II.2

<u>Basic set of global observational data required and to be met by the GOS by the late 1990s**</u>
(Both in-situ observations and remotely sensed data)

		Horizontal resolution	Vertical resolution	Observational error (rms)	Frequency of observation
i.	Upper-air temperature [T]	250 km (A)	10 layers in troposphere 5 layers in stratosphere	0.5-1°C in troposphere 1-2°C in stratosphere	2-4 per day
ii.	Upper-air wind vector [V]	250 km	10 layers in troposphere 5 layers in stratosphere	1-2 m s^{-1} in troposphere 2-3 m s^{-1} in stratosphere	2-4 per day
iii.	Upper-air relative humidity [RH]	250 km	4 layers	10%	2-4 per day
iv.	Sea-surface temperature [T]	250 km	-	0.5°C with systematic difference among observing systems eliminated on 3-day averages	Instantaneous measurements averaged over 3 days
v.	Surface pressure [P] temp [T, Td] wind vector [V]	250 km	-	± 1 hPa ± 0.5°C temperature ± 1-2 m s^{-1}	4 per day
	State of surface and soil	*	*	*	*
vi.	Satellite imagery (B)	At least 3 km horizontal resolution of imagery	At least 3 layers - low, middle, high - and cloud top height	To be determined; will be function of latitude for geostationary satellites	8 per day

(A) Tropics: 500 km resolution sufficient for temperature.

(B) Satellite imagery included here because of its use in computing vertical motion and divergence fields, as well as for determination of synoptic distribution of water vapor, precipitable water and cloudiness.

* Includes precipitation, soil moisture, soil temperature, emissivity, albedo, snow and ice coverage. Resolution, accuracy and frequency not yet determined; information required from other commissions.

** This table defines a basic set of the global observational data requirements which generally can be met by the GOS and, therefore, should be used in the design and implementation of the GOS.

ATTACHMENT II.3

REQUIREMENTS FOR HORIZONTAL SPACING AND FREQUENCY OF REPORTING FROM THE REGIONAL NETWORKS

Type of observation	Density		Frequency
	Adequate	Minimum for sparsely populated and oceanic areas	
Land surface	250 km	300 km	8 per day, at the main and intermediate standard times
Oceanic surface	250 km	500 km	4 per day, at the main standard times
Surface-based upper air	250 km	1 000 km	2 to 4 per day, at the main standard times with priority to 0000 and 1200 UTC. 1 to 2 per day in the tropics at 0000 and/or 1200 UTC

*

* *

ATTACHMENT II.4

OBSERVATIONAL REQUIREMENTS IN THE EVENT OF A RELEASE OF RADIOACTIVE MATERIAL TO THE ENVIRONMENT

A. During early phase of an accident*

1. Meteorological data from the site of the nuclear accident should promptly be provided to WMO Members and should include if available:

(a) Wind, temperature and humidity upper-air data. These data should be derived from fixed or mobile radiosoundings; towers, pilot balloon ascents, indirect sensors might be used as substitutes;

(b) Precipitation data, type and amount;

(c) Mixing height (if available);

(d) Surface air temperature in tenths of degrees Celsius;

(e) Total cloud cover in oktas of sky and height of cloud base;

(f) Surface wind direction;

(g) Surface wind speed;

(h) Atmospheric pressure;

(i) Standard deviation of surface wind direction, three-minute averages (if available).

2. Supplementary meteorological information including observed history since the commencement of an accident at the site, i.e. surface wind, temperature, cloud cover and precipitation amounts, hourly and three-hourly, should be made available to WMO Members.

B. During intermediate phase of an accident**

1. For monitoring and mesoscale forecasting purposes, in addition to routine data and the information exchanged over the GTS, non-standard meteorological information from meteorological stations and platforms (e.g. within the area of about 2000 km from the accident site) should be obtained for the duration of the release of the radioactivity and a few days afterward, including:

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* The early phase of an accident includes the first few hours after the commencement of the release.

** The intermediate phase of an accident covers the period of the time from the first few hours to a few days after the onset of the accident.

(a) Hourly (if possible) surface meteorological data, including precipitation amounts (e.g. automatic stations) from routinely operated national synoptic networks and six-hourly precipitation amounts from other stations to reach a resolution of 50 x 50 km;

(b) Six-hourly vertical profiles of temperature, humidity and wind from ordinary radiosonde/radiowind stations, if possible, with increased vertical resolution;

(c) Vertical soundings from mobile radiosonde stations;

(d) Data from vertical sounders;

(e) Drop soundings;

(f) Data from aircraft, helicopters, weather radar and satellites.

Annex to Recommendation 4 (CBS-IX) - Amendments to the Manual on the Global Observing System

Section B: Amended and restructured Part III of the Manual (new texts indicated by vertical line in right hand margin)

1. COMPOSITION OF THE SUBSYSTEM

The surface-based subsystem is composed of main elements, which shall consist of:

(a) The regional basic synoptic networks:

(i) Surface synoptic stations;
(ii) Upper-air synoptic stations;

(b) Other networks of synoptic stations:

(i) Land stations:

- Manned surface stations;
- Automatic surface stations;*
- Upper-air stations:
    - Rawinsonde stations;
    - Radiosonde stations;
    - Radiowind stations;
    - Pilot-balloon stations;

* Data may be asynoptic when collected via satellite

(ii) Sea stations:

- Fixed sea stations:

  - Ocean weather stations;
  - Lightship stations
  - Fixed platform stations;
  - Anchored platform stations;
  - Island and coastal stations;

- Mobile sea stations:

  - Selected ship stations;
  - Supplementary ship stations
  - Auxiliary ship stations;
  - Ice-floe stations;

- Automatic sea stations:*

  - Fixed sea stations;
  - Mobile sea stations;
  - Drifting buoy stations;

(c) Aircraft meteorological stations;

and other elements, which shall consist of:

(d) Aeronautical meteorological stations;

(e) Research and special-purpose vessel stations;

(f) Climatological stations:

(i) Reference climatological stations;
(ii) Principal climatological stations;
(iii) Ordinary climatological stations;
(iv) Precipitation stations;
(v) Climatological stations for specific purposes;
(vi) Automatic climatological stations;

(g) Agricultural meteorological stations:

(i) Principal agricultural meteorological stations;
(ii) Ordinary agricultural meteorological stations;
(iii) Auxiliary agricultural meteorological stations;
(iv) Agricultural meteorological stations for specific purposes;

(h) Special stations, which shall include:

(i) Weather radar stations;
(ii) Radiation stations;

* Data may be asynoptic when collected via satellite

(iii) Atmospherics detection stations;
(iv) Meteorological reconnaissance aircraft stations;
(v) Meteorological rocket stations;
(vi) Ozone sounding stations;
(vii) Background pollution stations;
(viii) Planetary boundary-layer stations;
(ix) Tide-gauge stations.

NOTES: (1) The definitions of stations listed above will be found in the definitions section of this Manual.

(2) Any station may fall under more than one of the above categories.

2. IMPLEMENTATION OF THE SUBSYSTEM

2.1 General

2.1.1 The specifications for each of the above elements as well as network configurations, observing programmes and frequency of observations should be as laid down by decisions of Congress, the Executive Council, the technical commissions and regional associations concerned.

NOTE: These specifications are published in the Technical Regulations (WMO-No.49) and its annexes (e.g. this Manual, the Manual on Codes) and in other relevant WMO publications such as the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983)) which set forth the technical and meteorological aspects in detail.

2.1.2 In implementing the GOS surface-based subsystem, Members should ensure that the observing system meets the requirements placed on the subsystem.

2.1.3 In implementing the surface-based subsystem, Members should strive to meet the provisions indicated in 2.1.1 above as closely as possible, in particular as regards the main elements of the surface-based subsystem.

2.1.4 Regional basic synoptic networks of both surface and upper-air stations shall form the main part of the surface-based subsystem.

2.1.5 The regional basic synoptic networks shall be established to meet the requirements laid down by the regional associations.

NOTES: (1) The regional associations will continue to examine their plans to meet any new international requirements.

(2) Details of known regional requirements are given in Volume II.

2.1.6 Members shall implement the regional basic synoptic networks.

2.1.7 Each station should be located at a site that permits correct exposure of the instruments and satisfactory non-instrumental observations.

2.1.8 In general, observing stations shall be spaced at an interval and with observations taken frequently enough to permit an accurate description of the atmosphere for users of the observations for the purpose intended.

2.1.9 If in certain desert and other sparsely populated areas it is not possible to establish networks with the recommended densities, networks with densities as near as possible to those recommended should be established. Special efforts should be made to establish an adequate network in such an area when it borders a populated area or is traversed by a regularly used air route.

2.1.10 Members shall ensure that a record of all surface and upper-air observations is made and preserved.

2.2 Surface synoptic stations

2.2.1 General

2.2.1.1 Surface synoptic stations may be manned or partly or fully automated and shall include principal and supplementary land stations and fixed and mobile sea stations.

2.2.1.2 Each synoptic station shall be located so as to give meteorological data representative of the area in which it is situated.

2.2.1.3 Although observations from more widely separated stations are also very valuable, surface land stations should not be further apart than 300 km.

2.2.1.4 The main standard times for surface synoptic observations shall be 0000, 0600, 1200 and 1800 UTC.

2.2.1.5 The intermediate standard times for surface synoptic observations shall be 0300, 0900, 1500 and 2100 UTC.

2.2.1.6 Atmospheric pressure observations should be made at exactly the standard time while the observation of other elements should be made within the ten minutes preceding the standard time.

2.2.1.7 Every effort should be made to obtain surface synoptic observations four times daily at the main standard times, with priority being given to the 0000 and 1200 UTC observations required for global exchanges.

2.2.1.8 When it is difficult for any reason to provide sufficient staff for 24-hour operations, partially or fully automated stations should supplement or replace manned surface stations including those in the basic synoptic network to provide observations at least at the main standard times.

2.2.2 Land stations

General

2.2.2.1 A synoptic station on land shall be identified by a station index number assigned by the Member concerned within the allocations made to that Member, in compliance with the scheme prescribed in the Manual on Codes (WMO-No.306)

2.2.2.2 When a Member establishes a synoptic station on land (or an ocean weather station) the Member shall send the following information to the Secretariat at least two months before the station becomes operational:

(a) Name and, where appropriate, station index number (stating whether the station is automatic or manned and, if both, the time of each);

(b) Geographical co-ordinates in degrees and minutes of arc and elevation in whole metres;

(c) Geopotential of the datum level in whole metres to which the pressure is reduced, or the reference isobaric surface the geopotential of which is reported;

(d) Times at which synoptic observations are made and reported;

(e) Topographical situation;

(f) Any other information required for completion of the entries in Weather Reporting (WMO-No.9), Volume A - Observing Stations.

2.2.2.3 Members shall send the necessary amendments to the information supplied under 2.2.2.2 (a) - (f) above to the Secretariat as soon as possible.

2.2.2.4 Any change in index number of synoptic stations included in the international exchanges should be notified to the Secretariat at least six months before becoming effective.

2.2.2.5 Each Member should publish a description, in sufficient detail to enable departures from the representativeness of observations to be assessed, of each of its synoptic stations whose reports are included in international exchanges.

2.2.2.6 All changes in the station index number of a synoptic station shall be effective from 1 January or 1 July.

Location and composition

2.2.2.7 Principal land stations, including those in the regional basic synoptic network, should be spaced at intervals not exceeding 250 km.

2.2.2.8 Surface synoptic observations recorded at a principal land station shall consist of observations of the following elements:

(a) Present weather;

(b) Past weather;

(c) Wind direction and speed;

(d) Amount of cloud;

(e) Type of cloud;

(f) Height of cloud base;

(g) Visibility;

(h) Temperature;

(i) Humidity;

(j) Atmospheric pressure;

together with such of the following elements as are determined by regional association resolutions:

(k) Pressure tendency;

(l) Characteristic of pressure tendency;

(m) Extreme temperature;

(n) Amount of precipitation;

(o) State of ground;

(p) Direction of cloud movement;

(q) Special phenomena.

2.2.2.9 A surface synoptic observation at a principal automatic land station shall consist of observations of the following elements:

(a) Atmospheric pressure;

(b) Wind direction and speed;

(c) Temperature;

(d) Precipitation, yes or no (at least in tropical areas);

together with the following elements which should be included if possible:

(e) Amount of precipitation;

(f) Humidity;

(g) Intensity of precipitation;

(h) Visibility;

(i) Height of cloud base;

(j) Special phenomena.

Frequency and timing of observations

2.2.2.10 At principal land stations the frequency of surface synoptic observations should be eight per day at the main and intermediate standard times in extra-tropical areas and four times per day at the main standard times in the tropics.

2.2.2.11 At a principal (manned or automatic) land station, surface synoptic observations shall be made and reported at least at the main standard times.

2.2.3 Sea stations

General

2.2.3.1 When more economic means are not available, ocean weather stations and some other fixed sea stations should provide essential and detailed meteorological and oceanographic data from critical locations or ocean areas.

NOTES: (1) In this role, these stations are an integral part of regional and national networks.

(2) Fixed sea stations also provide reference-level data and a basis for calibration of soundings by remote sensing from satellites and are thus important in the analysis of phenomena on a large or planetary scale.

(3) A fixed sea station other than an ocean weather station or a moored buoy may be identified by a station index number if considered to be in the same category as a land station.

2.2.3.2 Since mobile ships are one of the main sources of surface observations over the oceans, Members shall recruit as many ships as possible that traverse data-sparse areas and regularly follow routes through areas of particular interest.

2.2.3.3 Members concerned shall provide the Secretariat, not later than 1 March each year, with a list of their selected and supplementary ship stations in operation at the beginning of the year or amendments to the previous list giving the name, call sign and route or route designator of each ship.

2.2.3.4 Members shall include in the lists of selected and supplementary ship stations information on the method of obtaining sea-surface temperature, type of barometer, psychrometer, barograph, radio equipment and other instruments aboard the ship and radiowatch hours.

2.2.3.5 Each Member shall arrange for the recruitment of ships that are on the national register of that Member as mobile sea stations.

2.2.3.6 Members should also recruit ships carrying the flags of other countries to furnish meteorological reports.

2.2.3.7 Members recruiting a ship carrying the flag of another Member should, in each case, notify the Member concerned of the action taken, unless a port in the country of the Member that recruits the ship is considered to be its home port.

2.2.3.8 Observers on board ships on the national register of the Member concerned should be contacted and instructed by port meteorological officers having maritime experience.

2.2.3.9 Port meteorological officers should maintain liaison with the owners of local agents of ships of all nationalities, with a view to enlisting the ships' co-operation in furnishing reports, provided that the ships' basic instructions for making and reporting observations are not modified by such action.

2.2.3.10 Complaints about meteorological work aboard an observing ship should be directed to the Member with which the ship is registered.

2.2.3.11 Guidance should be given on the maintenance and inspection of meteorological instruments installed on board these ships.

2.2.3.12 Meteorological instruments on board ships should be checked and other advice or assistance in meteorological matters should be given by port meteorological officers having maritime experience, upon request by the master of any ship, irrespective of its State of registry.

2.2.3.13 If the ship in question was recruited by another Member, the Member receiving the complaint should forward it to the Member concerned.

2.2.3.14 A Member that has accepted the responsibility for collecting ships' reports should have them examined periodically in conjunction with synoptic charts, in order to detect significant recurring errors in reports from individual ships and bring these errors to the attention of the Members with which the ships are registered.

NOTE: For instructions on duties of port meteorological officers, see Guide to Marine Meteorological Services (WMO-No.471).

2.2.3.15 Members should consider using fixed or mobile automatic sea stations or drifting buoy stations in the data-sparse areas of persistent cloudiness, where remote sounding by satellite is hampered.

NOTE: These stations are located on fixed or mobile ships, fixed or anchored platforms and on drifting platforms and ice floes.

2.2.3.16 Environmental data buoy stations shall be identified by the International Identifier System.

NOTE: This identifier system is used by the Intergovernmental Oceanographic Commission and WMO universally (see Recommendation 8 (CBS-Ext.(76)), as approved by the Executive Committee through its Resolution 3 (EC-XXIX).

Location and composition

2.2.3.17 Each fixed sea station should be located so as to provide data which are representative of the marine area. As a minimum observations should be taken at the main synoptic times. The observations should include as many elements of a full synoptic report as possible.

2.2.3.18 Members should establish, either individually or jointly, ocean weather stations or other suitable observational facilities in ocean areas where there are large gaps in the global network.

NOTE: Information describing the station should be sent to the Secretariat as for synoptic land stations (see paragraph 2.2.2.2)

2.2.3.19 In its recruitment programme, each Member should aim at making the maximum possible contribution from mobile sea stations towards attaining an adequate density of observations in all oceanic areas.

NOTE: An adequate density of surface reports in oceanic areas is one per 250 km and they should not be further apart than 500 km.

2.2.3.20 It shall be possible to determine the position of a fully automatic mobile sea station.

2.2.3.21 At ocean weather stations, a surface synoptic observation shall consist of observations of the following elements:

(a) Present weather;

(b) Past weather;

(c) Wind direction and speed;

(d) Amount of cloud;

(e) Type of cloud;

(f) Height of cloud base;

(g) Visibility;

(h) Temperature;

(i) Humidity;

(j) Atmospheric pressure;

(k) Pressure tendency;

(l) Characteristic of pressure tendency;

(m) Ship's course and speed;

(n) Sea temperature;

(o) Direction of movement of waves;

(p) Period of waves;

(q) Height of waves;

(r) Sea ice and/or icing of ship superstructure, when appropriate;

(s) Special phenomena.

2.2.3.22 At a selected ship station, a surface synoptic observation should consist of observations of elements (a) to (r) in 2.2.3.21 above.

2.2.3.23 At a supplementary ship station, a surface synoptic observation should consist of observations of elements (a) to (h), (j) and (r) in 2.2.3.21 above.

2.2.3.24 At an auxiliary ship station, a surface synoptic observation should consist of observations of elements (a) to (d), (g), (h), (j) and (r) in 2.2.3.21 above.

2.2.3.25 At a lightship, a manned platform, coastal and island stations a surface synoptic observation should consist of observations of the elements (a) to (r) with the exception of (m) in 2.2.3.21 above.

2.2.3.26 At a principal fixed automatic sea station, surface synoptic observations shall consist of observations of the following elements:

(a) Atmospheric pressure;

(b) Wind direction and speed;

(c) Temperature;

(d) Sea temperature.

In addition to the elements listed above, a surface synoptic observation made at a principal fixed automatic sea station should include, if possible, the following elements:

(e) Precipitation, yes or no (especially in tropical areas);

(f) Waves.

2.2.3.27 At a drifting automatic sea station (drifting buoy) a surface synoptic observation should consist of as many as possible of the elements (a) to (d) and (f) in paragraph 2.2.3.26 above.

NOTE: The position of the drifting buoy shall also have to be determined

2.2.3.28 Members should endeavour to equip mobile ships to make sub-surface observations and report them in the BATHY/TESAC code form in accordance with the IGOSS/WWW plan.

NOTE: Guidance on steps to be taken while recruiting a selected, supplementary or auxiliary observing ship, on the organization needed to collect ships' weather reports and on the use of marine meteorological logs on board ships, is contained in the Guide to Marine Meteorological Services (WMO-No.471).

Frequency and timing of observations

2.2.3.29 At an ocean weather station surface synoptic observations shall be made and reported at both the main and intermediate standard times.

2.2.3.30 At a principal automatic station surface observations shall be made and reported at least at the main standard times.

2.2.3.31 At lightship stations, fixed and anchored platform stations, and at automatic sea stations, surface synoptic observations shall be made and reported at least at the main standard times.

2.2.3.32 At a mobile sea station surface synoptic observations should be made and reported at the main standard times.

2.2.3.33 When operational difficulties on board ship make it impracticable to make a surface synoptic observation at a main standard time, the actual time of observation should be as near as possible to the main standard time.

2.2.3.34 Whenever storm conditions threaten or prevail, surface synoptic observations should be made and reported from a mobile sea station more frequently than at the main standard times.

2.2.3.35 When sudden and dangerous weather developments are encountered at sea stations, surface observations should be made and reported as soon as possible without regard to the standard time of observation.

NOTE: For specific instructions relative to the furnishing by ships of special reports, in accordance with the International Convention for Safety of Life at Sea, see Weather Reporting (WMO-No.9).

2.2.3.36 Members should arrange for timely transmission of observations.

NOTE: Details of observing and reporting programmes are described in Chapter 5 of the Guide to Marine Meteorological Services (WMO-No.471). In case of difficulties resulting from fixed radiowatch hours on board single-operator ships, the procedures given in the Manual on the Global Telecommunication System (WMO-No.386), Attachment I-1, should be followed.

2.2.3.37 An increasing number of ships have a restricted radio watch and to remedy this situation Members should, in addition, endeavour to install automatic observing and transmission equipment whenever possible, as this will promote the prompt and accurate transmission of data.

2.3 Upper-air synoptic stations

General

2.3.1 Although observations from more widely separated stations are also very valuable, upper-air stations making observations of pressure, temperature, humidity, and wind should not be farther apart than 1000 km in sparsely populated and ocean areas.

2.3.2 The standard times of upper-air synoptic observations shall be 0000, 0600, 1200 and 1800 UTC.

2.3.3 As upper-air data from the ocean areas are particularly sparse, Members should give consideration to equipping suitable ships to make soundings and, if possible, to measure upper winds.

2.3.4 In the tropics priority should be given to upper-wind observations.

2.3.5 Upper-air synoptic stations shall be identified as provided under 2.2.2.1 to 2.2.2.6 above.

Location and composition

2.3.6 Upper-air land stations, including those in the regional basic synoptic network, should be spaced at intervals not exceeding 250 km.

2.3.7 An upper-air synoptic observation shall consist of observations of one or more of the following elements:

(a) Atmospheric pressure;

(b) Air temperature;

(c) Humidity;

(d) Wind speed and direction.

Frequency and timing of observations

2.3.8 At an upper-air synoptic station, the frequency of synoptic observations should be four per day at the standard times of upper-air synoptic observations.

2.3.9 At an upper-air synoptic station, upper-air observations shall be made and reported at least at 0000 UTC and 1200 UTC.

2.3.10 At ocean weather stations, upper-air synoptic observations should comprise rawinsonde observations at 0000 and 1200 UTC and/or radiowind observations at 0600 and 1800 UTC.

2.3.11 The actual time of regular upper-air synoptic observations should be as close as possible to (H-30) and should not fall outside the time range (H-45) to H.

NOTE: The actual time of a pilot-balloon observation may deviate from the range indicated above if, by doing so, wind observations to considerably greater heights can be expected.

2.3.12 In areas where it is not possible to meet the frequency requirements mentioned above, every effort should be made to obtain at least the following observations:

(a) Upper-air observations from the regional basic synoptic networks and other networks of stations on land and at sea, twice daily, at 0000 and 1200 UTC;

(b) In the tropics, at stations where two complete radiosonde/radiowind observations are not made, priority should be given to the implementation of one complete radiosonde/radiowind observation and one radiowind observation daily.

2.3.13 The coded report containing data obtained from upper-air synoptic observations up to and including the 100 hPa level should be presented to the telecommunication system within 75 minutes of the standard time of the observation.

2.4 Aircraft meteorological stations

General

2.4.1 Each Member shall arrange for observations to be made by aircraft of its registry operating on international air routes for the recording and reporting of these observations.

NOTE: Further information on aircraft observations and reports may be found in the Technical Regulations (WMO-No.49), Volume II - Meteorological Service for International Air Navigation, [C.3.1.] 5.

2.4.2 Members accepting responsibility for collecting aircraft reports for synoptic purposes shall promptly make these available, in agreed code forms, to other Members.

2.4.3 Members should give special consideration to the use of an automated aircraft meteorological system.

Location and composition

2.4.4 Aircraft reports shall, at a minimum, satisfy the requirements of International Air Navigation (for details see WMO Technical Regulations (WMO-No.49) Vol. II [C.3.1.] 5):

(a) Routine aircraft observations should be made at the designated ATS/MET reporting points;

NOTE: Lists of designated ATS/MET reporting points are prepared by and available from ICAO Regional Offices.

(b) Special aircraft reports shall be made whenever specified phenomena affecting flight safety are encountered;

(c) Observations shall be made by all aircraft of meteorological conditions encountered during the climb-out or approach phases of flight, not previously reported to the pilot-in-command, which in his opinion are likely to affect the safety of other aircraft operations.

Frequency and timing of observations

2.4.5 The meteorological elements contained in air reports are:

(a) Air temperature;

(b) Wind;

(c) Turbulence;

(d) Aircraft icing;

(e) Supplementary information.

In addition, reports of volcanic activity observed by the flight crew are also included.

2.4.6 Observations shall also be made by aircraft:

(a) If a meteorological office providing meteorological service for a flight makes a request for specific data; or

(b) By agreement between a Meteorological Authority and an operator.

2.5 Aeronautical meteorological stations

General

2.5.1 Members should establish an adequate network of aeronautical meteorological stations to meet the requirements of aviation.

NOTE: Detailed information on aeronautical meteorological stations, observations and reports is given in the WMO Technical Regulations (WMO-No.49), Volume II - Meteorological Service for International Air Navigation, [C.3.1.] 4.

2.5.2 The data relating to the elevation of an aeronautical meteorological station on land shall be specified in whole metres.

2.5.3 An aeronautical meteorological station on land shall be identified by a station index number assigned by the Member concerned in compliance with the scheme prescribed in Annex II of the WMO Technical Regulations - Manual on Codes (WMO-No.306), Volume I.

2.5.4 If a change of index number of an aeronautical meteorological station on land, the reports of which are included in international exchanges, is necessary, such change should be made effective on 1 January or 1 July.

Location and composition

2.5.5 Aeronautical meteorological stations shall be established at aerodromes and other points of significance to international air navigation.

2.5.6 Aeronautical observations should consist of the following elements:

(a) Surface wind direction and speed;

(b) Visibility;

(c) Runway visual range, when applicable;

(d) Present weather;

(e) Cloud amount, type and height of base;

(f) Air temperature;

(g) Dew point temperature;

(h) Atmosphere pressure (QNH and/or QFE).

Frequency and timing of observations

2.5.7 Routine observations shall be made at intervals of one hour, or, if so determined by regional air navigation agreement, at intervals of one half-hour. Special observations shall be made in accordance with criteria established by the Meteorological Authority in consultation with the appropriate Air Traffic Services Authority.

2.6 Research and special-purpose vessel stations

General

2.6.1 Members operating research and special-purpose vessels should do their utmost to ensure that all such vessels make meteorological observations.

Location and composition

2.6.2 In addition to as many as possible of the elements of surface and upper-air observations, sub-surface temperature observations, down to the thermocline, should also be made and transmitted (in real time), in accordance with the procedures agreed between WMO and the Intergovernmental Oceanographic Commission.

Frequency and timing of observations

2.6.3 In addition to meeting requirements for research, special-purpose vessels should, when possible, make surface and upper-air observations that meet and supplement basic synoptic requirements.

2.7 Climatological stations

General

2.7.1 Each Member shall establish in its territory a network of climatological stations.

2.7.2 The network of climatological stations should give a satisfactory representation of the climate characteristics of all types of terrain in the territory of the Member concerned (e.g. plains, mountainous regions, plateaux, coasts, islands, etc.).

2.7.3 Each Member shall establish and maintain at least one reference climatological station.

2.7.4 Each Member should maintain an up-to-date directory of the climatological stations in its territory, giving the following information for each station:

(a) Name and geographical co-ordinates;

(b) Elevation of station;

(c) A brief description of the local topography;

(d) Category of station and details of observing programmes;

(e) Exposure of instruments, including height above ground of thermometers, raingauges and anemometers;

(f) A station history (date of beginning of records, changes of site, closure or interruption of records, changes in the name of the station and important changes in the observing programme);

(g) The name of the supervising organization or institution;

(h) The datum level to which atmospheric pressure data of the station refer.

Location and composition

2.7.5 Each climatological station should be located at a place and under an arrangement that will provide for the continued operation of the station for at least ten years, and for the exposure to remain unchanged over a long period, unless it serves a special purpose that justifies its functioning for a shorter period.

2.7.6 Each reference climatological station should be sited with an adequate and unchanged exposure where the observations can be made in representative conditions. The surroundings of the station should not alter in time to such an extent as to affect the homogeneity of the series of observations.

2.7.7 The data relating to the elevation of a climatological station should be specified at least to the nearest five metres, except that for a station with a barometer the elevation should be specified to the nearest metre.

2.7.8 At a principal climatological station, observations shall be made of all or most of the following elements:

(a) Weather (See Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8), fifth edition, 1983);

(b) Wind;

(c) Amount of cloud;

(d) Type of cloud;

(e) Height of cloud base;

(f) Visibility;

(g) Temperature (including extreme temperatures);

(h) Humidity;

(i) Atmospheric pressure;

(j) Precipitation;

(k) Snow cover;

(l) Sunshine and/or solar radiation;

(m) Soil temperature.

2.7.9 At a principal climatological station, soil temperature should be measured at some or all of the following depths: 5, 10, 20, 50, 100, 150 and 300 cm.

2.7.10 At an ordinary climatological station, observations shall be made of extreme temperatures and amount of precipitation and, if possible, of some of the other elements listed in 2.7.8 above.

2.7.11 At an automatic climatological station, records should be made of elements selected from those in 2.7.8 above.

Frequency and timing of observations

2.7.12 Each Member should arrange that observations at any climatological station are made at fixed hours, according to either Co-ordinated Universal Time (UTC) or Local Mean Time, which remain unchanged throughout the year.

2.7.13 When two or more observations are made at a climatological station, they should be arranged at times that reflect the significant diurnal variations of the climatic elements.

2.7.14 When changes are made in a network of the times of climatological observations, simultaneous observations should be carried out at a skeleton network of representative stations for a period covering the major climatic seasons of the area at the old times of observation and at the new ones.

2.8 Agricultural meteorological stations

General

2.8.1 Each Member should establish in its territory a network of agricultural meteorological stations.

2.8.2 The desirable density of the network of each category of agricultural meteorological stations should be adequate to delineate weather parameters on the scale required for agrometeorological planning and operation, taking into account the agricultural features of the country.

2.8.3 Each Member should maintain an up-to-date directory of the agricultural meteorological stations in its territory, giving the following information for each station:

(a) Name and geographical co-ordinates;

(b) Elevation of station;

(c) A brief description of the local topography;

(d) Natural biomass, main agrosystems and crops of the area;

(e) Types of soil, physical constants and profile of soil;

(f) Category of station, details of observing programme and reporting schedule;

(g) Exposure of instruments, including height above ground of thermometers, raingauges and anemometers;

(h) A station history (date of beginning of records, changes of site, closure or interruption of records, changes in the name of the station and important changes in the observing programme);

(i) The name of the supervising organization or institution.

Location and composition

2.8.4 Each agricultural meteorological station should be located at a place that is representative of agricultural and natural conditions in the area concerned, preferably:

(a) At experimental stations or research institutes for agriculture, horticulture, animal husbandry, forestry, hydrobiology and soil sciences;

(b) At agricultural and allied colleges;

(c) In areas of present or future importance for agricultural and animal husbandry;

(d) In forest areas;

(e) In national parks and reserves.

2.8.5 At an agricultural meteorological station, the observing programme should, in addition to the standard climatological observations, include some or all of the following:

(a) Observations of physical environment:

(i) Temperature and humidity of the air at different levels in the layer adjacent to the ground (from ground level up to about ten metres above the upper limit of prevailing vegetation), including extreme values of these elements;

(ii) Soil temperature at depths of 5, 10, 20, 50 and 100 cm and at additional depths for special purposes and in forest areas;

(iii) Soil water (volumetric content) at various depths, with at least three replications when the gravimetric method is used;

(iv) Turbulence and mixing of air in the lower layer (including wind measurements at different levels);

(v) Hydrometeors and water-balance components (including hail, dew, fog, evaporation from soil and from open water, transpiration from crops or plants, rainfall interception, runoff and water table);

(vi) Sunshine, global and net radiation as well as the radiation balance over natural vegetation, and crops and soils (over 24 hours);

(vii) Observations of weather conditions producing direct damage to crops, such as frost, hail, drought, floods gales and extremely hot dry winds;

(viii) Observations of damage caused by sandstorms and duststorms, atmospheric pollution and acid deposition as well as forest, bush and grassland fires.

(b) Observations of a biological nature:

(i) Phenological observations;

(ii) Observations on growth (as required for the establish- ment of bioclimatic relationships);

(iii) Observations on qualitative and quantitative yield of plant and animal products;

(iv) Observations of direct weather damage on crops and animals (adverse effects of frost, hail, drought, floods, gales);

(v) Observations of damage caused by diseases and pests;

(vi) Observations of damage caused by sandstorms and duststorms and atmospheric pollution, as well as forest, bush and grassland fires.

Frequency and timing of observations

2.8.6 Observations of a physical nature should be made at the main synoptic times. Observations of a biological nature should be made regularly or as frequently as significant changes occur and should be accompanied by meteorological observations.

2.9 Special stations

2.9.1 General

2.9.1.1 In addition to the stations discussed previously, Members should establish special stations.

NOTE: In some cases, these special stations are co-located with surface or upper-air stations of the regional basic synoptic networks.

2.9.1.2 Members should co-operate in the establishment of special stations for particular purposes.

2.9.1.3 Special stations shall include:

(a) Weather radar stations;

(b) Radiation stations;

(c) Atmospherics detection stations;

(d) Meteorological reconnaissance aircraft stations;

(e) Meteorological rocket stations;

(f) Ozone sounding stations;

(g) Background pollution stations;

(h) Planetary boundary-layer stations;

(i) Tide-gauge stations.

2.9.1.4 A special station should be identified by its name and geographical co-ordinates, and elevation.

2.9.2 Weather radar stations

General

2.9.2.1 Members should establish an adequate network of weather radar stations, either nationally or in combination with other Members of the Region, in order to secure information about areas of precipitation and associated phenomena and about the vertical structure of cloud systems, for both operational meteorology and research.

Location and composition

2.9.2.2 Weather radars shall be located in such a manner as to minimize interference from surrounding hills, buildings and electromagnetic sources. They should provide good coverage of population centres and geographic features affecting stream and river flows, major thoroughfares and other facilities of importance.

Frequency and timing of observations

2.9.2.3 As a minimum observations should be taken and reported at hourly intervals. Observations should be more frequent when heavy convective activity or heavy widespread precipitation is occurring.

2.9.3 Radiation stations

General

2.9.3.1 Members should establish at least one principal radiation station in each climatic zone of their territory.

2.9.3.2 Members should maintain a network of radiation stations of sufficient density for the study of radiation climatology.

2.9.3.3 Each Member should maintain an up-to-date directory of the radiation stations in its territory, including ordinary and principal stations, giving the following information for each station:

(a) Name and geographical co-ordinates in degrees and minutes of arc;

(b) Elevation of station in whole metres;

(c) A brief description of local topography;

(d) Category of station and details of the observing programme;

(e) Details of radiometers in use (type and serial number of each instrument, calibration factors, dates of any significant changes;

(f) Exposure of radiometers, including height above ground, details of the horizon of each instrument and nature of the surface of the ground;

(g) A station history (date of beginning of records, changes of site, closure or interruption of records, changes in the name of the station and important changes in the observing programme);

(h) Name of the supervising organization or institution.

Location and composition

2.9.3.4 Each radiation station shall be sited, as far as possible, with an adequate exposure, where the observations can be made in representative conditions.

NOTE: The exposure and surroundings of the stations should not alter in time to such an extent as to affect the homogeneity of the series of observations.

2.9.3.5 At principal radiation stations, the observing programme should include:

(a) Continuous recording of global solar radiation and sky radiation, using pyranometers of the first or second class;

(b) Regular measurements of direct solar radiation;

(c) Regular measurements of net radiation (radiation balance) over natural and crop soil cover (throughout 24 hours);

(d) Recording of duration of sunshine.

NOTE: The terminology of radiation qualities and measuring instruments and the classification of pyranometers is given in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983).

2.9.3.6 At ordinary radiation stations, the observing programme should include:

(a) Continuous recording of global solar radiation;

(b) Recording of duration of sunshine.

2.9.3.7 Pyrheliometric measurements shall be expressed in accordance with the World Radiometric Reference (WRR).

Frequency and timing of observations

2.9.3.8 When automatic recording is not available, measurements of direct solar radiation should be made at least three times a day, provided the sun and the sky in the vicinity are free from cloud, corresponding to three different solar heights, one of them being near the maximum.

2.9.3.9 During clear-sky conditions, measurements of long-wave effective radiation should be made every night, one of them being made soon after the end of the evening civil twilight.

2.9.4 Atmospherics detection stations

General

2.9.4.1 Members should establish atmospherics detection stations.

NOTE: Methods in use are described in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983).

Location and composition

2.9.4.2 Atmospherics (spherics) detection stations should be located so as to measure this phenomenon in areas of frequent convective activity. The spacing and number of ground stations should be in keeping with the technique used, coverage and accuracy of location desired.

Frequency and timing of observations

2.9.4.3 Continuous monitoring by the station should be maintained, with an indication of direction and distance, at about 10-minute intervals.

2.9.5 Meteorological reconnaissance aircraft stations

General

2.9.5.1 Members should organize and communicate, either individually or jointly, routine and special aircraft weather reconnaissance flights.

Location and composition

2.9.5.2 Aircraft reconnaissance facilities should be located near prevalent storm tracks in data-sparse areas. Reconnaissance flights should be initiated in locations where additional observational information is required for the investigation and prediction of developing or threatening storms.

2.9.5.3 Meteorological reconnaissance flight observations should include:

(a) Altitude and position of aircraft;

(b) Observations made at frequent intervals during a horizontal flight at low level;

(c) Observations made during flights at higher levels, as near as possible to standard isobaric surfaces;

(d) Vertical soundings, either by aircraft or by dropsonde.

2.9.5.4 The elements to be observed during meteorological reconnaissance flights should include:

(a) Atmospheric pressure at which the aircraft is flying;

(b) Temperature;

(c) Humidity;

(d) Wind velocity (type of wind, wind direction and speed);

(e) Present and past weather;

(f) Turbulence;

(g) Flight conditions (cloud amount);

(h) Significant weather changes;

(i) Icing and contrails.

NOTES: (1) For detailed guidance regarding observations made during meteorological reconnaissance flights, see the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983).

(2) Type of wind refers to how the wind was determined and whether it was a mean or a spot wind.

Frequency and timing of observations

2.9.5.5 Reconnaissance flights should be scheduled in response to requirements for data from data-sparse areas, or in response to special phenomena.

2.9.5.6 Flight times and frequency should be selected so that reconnaissance information supplements upper-air information.

2.9.6 Meteorological rocket stations

General

2.9.6.1 Members should establish meteorological rocket stations.

NOTE: When establishing and operating these stations, appropriate safety precautions are considered necessary and need to be co-ordinated with the relevant air traffic control authorities.

Location and composition

2.9.6.2 Members establishing rocket stations should co-ordinate their locations through WMO so that continuous networks can be maintained. Elements to be measured include:

(a) Wind direction and speed;

(b) Temperature;

(c) Solar radiation;

(d) Electrical variables;

(e) Minor chemical constituents.

Frequency and timing of observations

2.9.6.3 Because of cost, frequency and timing launches should be co-ordinated among Members concerned to allow simultaneous sampling at rocket network stations. Information on launches should be communicated to the WMO Secretariat.

2.9.7 Ozone sounding stations

General

2.9.7.1 Members should establish an adequate network of ozone sounding stations.

Location and composition

2.9.7.2 Members establishing ozone stations should co-ordinate their locations through WMO so that the adequacy of the network may be maintained. Elements to be measured include:

(a) Total ozone;

(b) Vertical profile of ozone in the troposphere;

(c) Vertical profile of ozone in the stratosphere;

(d) Temperature;

(e) Wind direction and speed;

(f) Aerosol optical thickness in the relevant wavelengths.

Frequency and timing of observations

2.9.7.3 As a minimum:

(a) Total ozone should be observed daily;

(b) Vertical profile of ozone in the troposphere, best done through ozone balloonsondes, should be observed once every two weeks;

(c) Vertical profile of ozone in the stratosphere, by the so-called Umkehr method, should be done daily;

(d) Observations of temperature, wind and aerosol optical thickness, to be most useful, should be done concurrently with ozone observations.

2.9.8 Background pollution stations

General

2.9.8.1 Each Member should establish on its territory at least one background air pollution monitoring station to serve the WMO BAPMoN (Background Air Pollution Monitoring Network).

Location and composition

2.9.8.2 The location of each background pollution station (global and regional air pollution station) should meet the siting criteria as described in the WMO International Operations Handbook for Measurement of Background Atmospheric Pollution (WMO-No.491), so that the observations made are representative for the area it covers.

2.9.8.3 The desirable density of background pollution stations is one station per 500 000 km^2. Each main climatic zone should be covered.

2.9.8.4 A principal climatological station should be located at or near the air pollution station.

2.9.8.5 At global (formerly called "baseline") air pollution stations the observing programme should give priority to the measurement of the following:

(a) Carbon dioxide (including, if possible, isotopic composition);

(b) Chemical constituents, pH, acidity/alkalinity and conductivity of wet precipitation;

(c) Solar radiation (including turbidity) observed at several wavelengths;

(d) N_2O, CO, CH_4, surface O_3, halocarbons and environmentally relevant trace gases (SO_2, NO_x, etc.);

(e) Condensation nuclei, suspended particulate matter (mass and main chemical components)

2.9.8.6 At regional air pollution stations the observing programme should give priority to the measurement of the following atmospheric constituents:

(a) Suspended particulate matter (including mass concentration and chemical composition);

(b) Chemical constituents and pH, acidity/alkalinity and conductivity of wet precipitation;

(c) Aerosol optical depth (turbidity) at several wave lengths;

(d) Surface O_3.

2.9.8.7 At regional air pollution stations with an extended programme, also called "continental stations", the observing programme should, in addition to the constituents listed in 2.9.8.6 above, give priority to the measurement of the following atmospheric constituents:

(a) Carbon dioxide;

(b) Gaseous sulphur and nitrogen compounds.

NOTE: Guidance on these measurements is given in the WMO International Operations Handbook for Measurement of Background Atmospheric Pollution (WMO-No.491).

Frequency and timing of observations

2.9.8.8 The frequency of observations should be as follows:

(a) CO_2 - preferably continuous, but if not possible, by grab (flask) sampling;

(b) Aerosol optical depth (turbidity) - at least three times per day;

(c) Other gas sampling - continuous or at 24-hour (midnight to midnight) averages;

(d) Precipitation - when precipitation occurs, the individual sampling period not exceeding one week;

(e) Suspended particulate matter - 24 or 48 hours (midnight to midnight) every four to six days.

2.9.9 Planetary boundary-layer stations

General

2.9.9.1 Members should establish an adequate network of stations for making measurements in the planetary boundary layer.

Location and composition

2.9.9.2 Members should, whenever possible, provide a capability to obtain detailed knowledge of the profiles of temperature, humidity, pressure and wind in the lowest 1 500 m of the atmosphere.

NOTES:

(1) This information is required in the study of diffusion of atmospheric pollution, the transmission of electromagnetic signals, the relation between free-air variables and boundary-layer variables, severe storms, cloud physics, convective dynamics, etc.

(2) The accuracy of measurements of several variables and the height intervals at which they are required depend upon the nature of the problems under study.

(3) Some of the vertical and horizontal sounding systems which could be applied to specific problems for limited periods in a variety of locations are described in the Guide on the Global Observing System (WMO-No.488).

2.9.10 Tide-gauge stations

General

2.9.10.1 Members should establish an adequate network of tide-gauge stations along coasts subject to storm surges.

Location and composition

2.9.10.2 Gauges should be placed in a manner that allows determination of the full range of water heights.

Frequency and timing of observations

2.9.10.3 Observations of tide height should be made at the main synoptic times, 0000, 0600, 1200, and 1800 UTC. In coastal storm situations, hourly observations should be made.

2.9.11 Asynoptic observations

General

2.9.11.1 Asynoptic observations should be taken when necessary to supplement observations from the Basic Synoptic Network.

Location and composition

2.9.11.2 Observations should be taken in areas where special phenomena are occurring or expected to develop. As many elements of standard observations as possible should be reported.

Frequency and timing of observations

2.9.11.3 Observations should be taken in a manner which increases the spatial or temporal frequency of the main synoptic networks. Information should be communicated in real time.

NOTE: Drifting buoys and aircraft can also report at asynoptic times.

2.10 Equipment and methods of observation

2.10.1 General requirements of a meteorological station

2.10.1.2 All stations shall be equipped with properly calibrated instruments and adequate observational and measuring techniques, so that the measurements and observations of the various meteorological elements are accurate enough to meet the needs of synoptic meteorology, aeronautical meteorology, climatology and of other meteorological disciplines.

NOTE: For detailed guidance on instruments and methods of observation, see the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983) and Weather Reporting (WMO-No. 9), Volume D - Information for Shipping.

2.10.1.3 The exposure of instruments for the same type of observation at different stations shall be similar in order that observations may be compatible.

2.10.1.4 A reference height shall be established at each meteorological station.

2.10.1.5 In order to ensure maintenance of a high standard of observations and the correct functioning of instruments stations shall be inspected periodically.

2.10.1.6 Station inspections should be carried out by experienced personnel and should ensure that:

(a) The siting and exposure of instruments are known, recorded and acceptable;

(b) Instruments have approved characteristics, are in good order and regularly verified against relevant standards;

(c) There is uniformity in the methods of observation and in the procedure for reduction of observations;

(d) The observers are competent to carry out their duties.

2.10.1.7 All synoptic land stations should be inspected not less than once every two years.

2.10.1.8 Agricultural meteorological and special stations should be inspected at least once every year.

2.10.1.9 Principal climatological stations should be inspected at least once every year; ordinary climatological and precipitation stations should be inspected at least once every three years. If possible, relevant inspections should occasionally be carried out during the winter season.

2.10.1.10 Automatic stations should be inspected not less than once every six months.

2.10.1.11 At sea stations, barometers should be checked at least twice a year with reference to a standard barometer.

2.10.2 General requirements of instruments

2.10.2.1 Meteorological instruments should be reliable and accurate.

2.10.2.2 Instruments in operational use shall be periodically compared directly or indirectly with the relevant national standards.

2.10.2.3 Where automated instrument systems are employed reference (or check) values shall be measured additionally.

2.10.2.4 At reference climatological stations, any change in instrumentation should be such as not to decrease the degree of accuracy of any observations as compared with the earlier observations, and any such change should be preceded by an adequate overlap (at least two years) with the earlier instrumentation.

2.10.2.5 Unless otherwise specified, instruments designated as regional and national standards should be compared by means of travelling standards at least once every five years.

2.10.2.6 In order to control effectively the standardization of meteorological instruments on a national and international scale, a system of national and regional standards, as adopted by the World Meteorological Organization, shall be applied in the GOS.

NOTE: For information on measurement standards and types of standard instrument see Attachment III.6.

2.10.3 Surface Observations

2.10.3.1 General

2.10.3.1.1 An observation should be made in such a way that:

- A representative temporally smoothed value of the variable can be found in the vicinity of the station;
- A representative extreme value (or other indicator of dispersion) can be determined, if required;
- All synoptic-scale discontinuities (e.g. fronts) can be identified as soon as possible after the observation is made.

2.10.3.1.2 To satisfy these requirements, observational methods should be selected so as to achieve:

(a) Suitable temporal and/or spatial samples of each variable;

(b) A justifiable accuracy for the measurement of each variable;

(c) A representative observation height above the ground.

2.10.3.1.3 To avoid the effect of small-scale fluctuations, the meteorological variable should be sampled continuously or repeatedly over a suitable time for the purpose of observing representative mean and extreme values. Alternatively, instruments with a suitable lag or damping effect should be used to eliminate or substantially reduce high-frequency noise.

2.10.3.1.4 The averaging time should be short compared with the temporal scale of such discontinuities as fronts or squall lines, which usually delineate air masses of different characteristics whilst removing the effects of small-scale disturbances. For example, for synoptic purposes an average taken over one to ten minutes will suffice for the measurement of atmospheric pressure, air temperature, air humidity, wind, sea-surface temperature and visibility.

2.10.3.1.5 Instrumental readings shall be corrected and reduced as appropriate.

2.10.3.2 Atmospheric pressure

2.10.3.2.1 Atmospheric pressure shall be determined either from a mercury barometer or by other sensors (aneroid, electronic barometer) of equal accuracy.

2.10.3.2.2 In order for mercury barometer readings made at different times and at different places to be comparable, the following corrections should be made:

(a) Correction for index error;

(b) Correction for gravity;

(c) Correction for temperature.

2.10.3.2.3 Each Member shall apply the International Barometer Conventions given in Attachment III.2.

2.10.3.2.4 Whenever it is necessary to compute the theoretical local value of the acceleration due to gravity, each Member shall follow the procedure given in Attachment III.3.

2.10.3.2.5 Atmospheric pressure at a station shall be reduced to mean sea-level, except at those stations where regional association resolutions prescribe otherwise.

2.10.3.2.6 The results of comparisons of national and regional reference standard barometers shall be reported to the Secretariat for communication to all Members concerned.

2.10.3.2.7 Regional comparisons of national standard barometers with a regional standard barometer shall be arranged at least once every ten years.

2.10.3.2.8 Reference standards for comparison purposes may be provided by mercury barometers or by reference pressure sources of equivalent or better accuracy. Using such comparisons, the calibration of the station barometer shall be directly traceable to a national or regional primary standard for atmospheric pressure.

2.10.3.2.9 In calibration against a standard barometer whose index errors are known and allowed for, tolerances for a station barometer stated in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983) should not be exceeded:

2.10.3.3 Air temperature

2.10.3.3.1 An instrument height of between 1.25 and 2.0 m above ground is considered satisfactory to obtain representative air temperature measurements. However, at a station where considerable snow cover may occur, a greater height is permissible or, alternatively, a moveable support can be used allowing the thermometer housing to be raised or lowered in order to keep the correct height above the snow surface.

2.10.3.3.2 Thermometer screens should be constructed so as to minimize radiation effects and at the same time allow free influx and circulation of air.

2.10.3.3.3 Thermometers should be checked against a reference standard instrument every two years.

NOTE: The required accuracies are given in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983).

2.10.3.3.4 For psychrometric purposes thermometers shall be read to at least 0.1°C.

2.10.3.4 Humidity

NOTE: Definitions and specifications of water vapour in the atmosphere are given in Attachment III.4.

2.10.3.4.1 In surface observations, at temperatures above 0°C values of humidity should be derived from the readings of a psychrometer or other instrument of equal or greater accuracy.

2.10.3.4.2 If forced ventilation of psychrometers is used the airflow past the thermometer bulbs should be between 2.5 m s^{-1} and 10 m s^{-1}.

2.10.3.4.3 In surface observations the height requirements for humidity measurements shall be the same as for air temperature measurements.

2.10.3.5 Surface wind

2.10.3.5.1 The exposure of wind instruments over level, open terrain shall be ten metres above the ground.

NOTE: Open terrain is defined as an area where the distance between the anemometer and any obstruction is at least ten times but preferably 20 times the height of the obstruction.

2.10.3.5.2 At aeronautical stations the wind sensors should be exposed to provide measurements representative of conditions six to ten metres above the runway at the average lift-off and touch-down areas.

2.10.3.5.3 Wind speed should be measured to the nearest unit (metres per second, kilometres per hour or knots), and should represent, for synoptic reports, an average over ten minutes or, if the wind changes significantly in the ten-minute period, an average over the period after the change.

NOTE: In observations used at an aerodrome for aircraft taking off and landing, the averaging period is two minutes and the speed is reported in metres per second, kilometres per hour or knots with an indication of the unit used.

2.10.3.5.4 Wind direction should be measured in degrees and reported to the nearest ten degrees and should represent a scalar average over ten minutes or, if the wind changes significantly in the ten-minute period, an average over the period after the change.

2.10.3.5.5 "Calm" should be indicated when the average wind speed is less than 0.5 m s^{-1}. The direction in this case is not measured for synoptic purposes.

2.10.3.5.6 In the absence of an anemometer, the wind speed may be estimated using the Beaufort scale.

NOTE: The Beaufort scale is given Attachment III.5.

2.10.3.5.7 At sea stations, in the absence of appropriate instruments, the wind direction may be estimated by reference to the Beaufort scale and the wind direction by observing the motion of sea waves.

2.10.3.6 Clouds

2.10.3.6.1 For all cloud observations, the tables of classification, definitions and descriptions of general species and varieties of clouds as given in the International Cloud Atlas (WMO-No.407), Volume I - Manual on the Observation of Clouds and other Meteors (Annex I to the Technical Regulations), shall be used.

2.10.3.6.2 Height of cloud base should preferably be determined by measurement.

2.10.3.7 Weather

Members shall use the term "weather" as defined in the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983).

NOTE: The term "phenomenon" is used in the definition referred to above with the same meaning as in the International Cloud Atlas (WMO-No.407), Volume I - Manual on the Observation of Clouds and other Meteors.

2.10.3.8 Precipitation

2.10.3.8.1 The amount of precipitation shall be the sum of the amounts of liquid precipitation and the liquid equivalent of solid precipitation.

2.10.3.8.2 Daily amounts of precipitation should be measured to the nearest 0.2 mm and, if feasible, to the nearest 0.1 mm. Daily measurements of precipitation should be made at fixed times.

2.10.3.8.3 The design and exposure of a raingauge should be such as to minimize the effects of wind, evaporation and splashing, these being the most frequent sources of error.

NOTE: In general, objects should not be closer to the gauge than a distance twice their height above the gauge orifice.

2.10.3.9 Sea temperature

The method used at manned sea stations for measuring sea-surface temperature shall be entered in the relevant meteorological logbook.

2.10.3.10 Waves

When separate wave systems are clearly distinguishable, each of them should be recorded.

2.10.3.11 Radiation

The comparison of radiation instruments on a regional or a global level should be performed at least once every five years. The calibration of radiation instruments should be checked and recalibrated, if necessary, at least once a year against existing standards.

NOTE: For details of calibration of other radiation sensors, refer to the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983), Chapters 9.3 to 9.6.

2.10.3.12 Soil temperature

2.10.3.12.1 Measurements should be made to detect diurnal variations of soil temperature at depths of 5, 10, 20 and, in some cases, 50 cm.

2.10.3.12.2 Soil-surface temperature measurements are recommended for special purposes.

2.10.3.13 Soil moisture

Gravimetric estimation of soil moisture should be taken as the average of at least three samples from each depth.

2.10.3.14 Evapotranspiration

Observations of evapotranspiration should be representative of the plant cover and moisture conditions of the general surroundings of the station. Separate statements of evapotranspiration from irrigated areas should be provided.

2.10.3.15 Evaporation

2.10.3.15.1 Evaporation should be measured by means of evaporation tanks. The design and exposure of the evaporation tanks should ensure the required comparability of observations.

2.10.3.15.2 Water temperature and wind run records should be taken at each observation.

2.10.3.15.3 The amount of evaporation should be read in millimetres.

2.10.4 Upper-air observations

2.10.4.1 At a synoptic upper-air station, atmospheric pressure, temperature and humidity (PTU) observations shall be made by means of a radiosonde attached to a fast-ascending free balloon.

NOTE: For detailed guidance on the radiosonde and balloon techniques, see the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8, fifth edition, 1983), Chapters 13 and 14.

2.10.4.2 Computations of upper-air observations shall be based on the relevant definitions of physical functions and values of constants given in Attachment III.1.

2.10.4.3 At a synoptic upper-air station, upper-wind observations should be made by tracking of the fast-ascending free balloon by electronic means (e.g. radio theodolite, radar or NAVAID).

NOTE: At stations where the skies are generally clear upper winds may be determined by optical tracking of a balloon.

2.10.4.4 Each upper-air station should have an appropriate manual of instructions.

2.10.4.5 Each synoptic upper-air station shall promptly report on any changes of the types of radiosonde and windfinding systems in operational use to the Secretariat for communication to all Members, at least on a quarterly basis.

2.10.4.6 International comparisons of widely used radiosonde types shall be made at least once every four years.

2.10.4.7 New radiosonde types should be compared with sondes accepted as having the most stable and accurate performance before adoption to operational use.

2.10.4.8 At a meteorological reconnaissance aircraft station, electronic means (NAVAID) should be used when a vertical profile of upper winds is to be determined by means of a dropsonde.

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Rec. 5 (CBS-IX) - AMENDMENTS TO THE MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM, VOLUME I - GLOBAL ASPECTS, PART II - OPERATIONAL PROCEDURES FOR THE GLOBAL TELECOMMUNICATION SYSTEM

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 2 (Cg-X) - World Weather Watch Programme for 1988-1991,

(2) The Second WMO Long-term Plan, Part II, Volume I - The World Weather Watch Programme (1988-1997) (WMO-No. 691),

RECOMMENDS the adoption of the amendments to the Manual on the Global Telecommunication System, Volume I - Global Aspects, Part II - Operational Procedures for the Global Telecommunication System, given in the annex to this recommendation, with effect from 1 November 1988;

REQUESTS the Secretary-General to make the appropriate amendments, as given in the annex to this recommendation, to the Manual on the Global Telecommunication System, Volume I - Global Aspects, Part II - Operational Procedures for the Global Telecommunication System;

AUTHORIZES the Secretary-General to make any consequent purely editorial amendments as regards Volume I of the Manual on the Global Telecommunication System, in consultation with the president of CBS.

Annex to Recommendation 5 (CBS-IX)

AMENDMENTS TO THE MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM, VOLUME I - GLOBAL ASPECTS, PART II - OPERATIONAL PROCEDURES FOR THE GLOBAL TELECOMMUNICATION SYSTEM

A. Paragraph 2.12.3:

Add the following text at the end of the sentence:

"..., and are given in Attachment II-15."

B. Paragraph 2.12.3.2:

Add the following note at the end of the paragraph:

"Note: International Standard ISO 7776 - Information Processing Systems - Data communications - High-level data link control procedures - Description of the X.25 LAPB-compatible DTE data link procedures, describes the X.25 level 2 procedures as viewed by the DTE for DTE to DCE operation and for DTE to DTE operation without an intervening packet-switched network."

C. Paragraph 2.12.3.3:

Add the following note at the end of the paragraph:

"Note: International Standard ISO 8208 - Information processing systems - Data communications - X.25 Packet Level Protocol for Data Terminal equipment, describes the X.25 packet level procedures as viewed by the DTE for DTE to DCE operation and for DTE to DTE operation without an intervening packet-switched network."

D. Paragraph 2.12.3.4:

Replace the text by the following:

"A transport protocol should be employed in accordance with CCITT Recommendation X.224. When implemented, the Class 2 procedures, including those for multiplexing, explicit flow control and expedited data transfer, shall be used. Class 3 or Class 4 transport protocol may be provided in addition to Class 2, when and where considered appropriate."

E. Attachment II-11, Table A:

(i) Replace the definition of S_1 by:

	S_1
- Uncoded digital fax:	0
- Digital fax coded according to CCITT Recommendation T.4 - one-dimensional:	1
- Digital fax coded according to CCITT Recommendation T.4 - two-dimensional:	2
- Digital fax coded according to CCITT Recommendations T.6 and T.73:	3

(ii) Add the following note to Table A:

"NOTE: When S_1 has a value of 3, the values of $S_2S_3S_4$ are not significant and should be set to 0. The characteristics identified by these fields are, in this case, contained within the structured T.73 format."

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Rec. 6 (CBS-IX) - AMENDMENTS TO THE MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM, VOLUME I - GLOBAL ASPECTS, PART III - TECHNICAL CHARACTERISTICS AND SPECIFICATIONS FOR THE GLOBAL TELECOMMUNICATION SYSTEM

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 2 (Cg-X) - World Weather Watch Programme for 1988-1991,

(2) The Second WMO Long-term Plan, Part II, Volume I - The World Weather Watch Programme (1988-1997) (WMO-No. 691),

RECOMMENDS the adoption of the amendments to the Manual on the Global Telecommunication System, Volume I - Global Aspects, Part III - Technical Characteristics and Specifications for the Global Telecommunication System, given in the annex to this recommendation, with effect from 1 November 1988;

REQUESTS the Secretary-General to make the appropriate amendments, as given in the annex to this recommendation, to the Manual on the Global Telecommunication System, Volume I - Global Aspects, Part III - Technical Characteristics and Specifications for the Global Telecommunication System;

AUTHORIZES the Secretary-General to make any consequent purely editorial amendments as regards Volume I of the Manual on the Global Telecommunication System, in consultation with the president of CBS.

Annex to Recommendation 6 (CBS-IX)

AMENDMENTS TO THE MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM, VOLUME I - GLOBAL ASPECTS, PART III - TECHNICAL CHARACTERISTICS AND SPECIFICATIONS FOR THE GLOBAL TELECOMMUNICATION SYSTEM

A. Delete paragraphs 8.1.2 to 8.2 and replace by the following:

"8.1.2.1 The following provisions, based on CCITT Recommendation T.4 - Standardization of Group 3 facsimile apparatus for document transmission, applying to an ISO A4 document shall be used:

(a) 1728 picture elements along the scan line of 215 mm ± 1%;

(b) A normal resolution and a higher resolution of 3.85 lines/mm ± 1% and 7.7 lines/mm ± 1% respectively in a vertical direction;

(c) A coding scheme as defined in CCITT Recommendation T.4, paragraph 4.1.

8.1.2.2 In addition to the basic A4 format specified in paragraph 8.1.2.1, the following characteristics may be used:

(a) Useful line length: 456 mm

(b) Number of picture elements per line: 1728, 3456

(c) Horizontal resolution: 3.79, 7.58 lines/mm

(d) Vertical resolution: (1) 3.79 lines/mm (IOC 576)
(2) 1.89 lines/mm (IOC 288)

8.1.3 Other standards

The following provisions, based on CCITT Recommendation T.5 - General aspects of Group 4 facsimile apparatus, applying to an ISO A4 document may be used:

(a) 1728 picture elements along the scan line length;

(b) A resolution of 200 X 200 picture elements per 25.4 mm (7.87 lines/mm);

(c) A coding scheme as defined in CCITT Recommendation T.6, paragraph 2.2;

(d) An interchange format as defined in CCITT Recommendation T.73, paragraph 6.3.

8.1.4 Transmission rate

The transmission rate over a point-to-point circuit shall be:

2400, 4800, 7200, 9600 bit/s."

B. Add the following new paragraph 9.3 and renumber previous paragraph 9.3 as 9.4:

"9.3 At the CCITT V.24 interface between analogue-to-digital converters and modems, black picture elements should be coded as bit set to 0 and white picture elements as bit set to 1 according to the following table:

Significant voltage levels in conformity with CCITT V.28	$V_1 < -3$ volts	$V_1 > +3$ volts
binary state	1	0
condition	OFF/Mark	ON/Space
picture element	white	black"

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Rec. 7 (CBS-IX) - AMENDMENTS TO THE MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM, VOLUME I - GLOBAL ASPECTS, PART I - ORGANIZATION OF THE GLOBAL TELECOMMUNICATION SYSTEM

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 2 (Cg-X) - World Weather Watch Programme for 1988-1991,

(2) The Second WMO Long-term Plan, Part II, Volume I - The World Weather Watch Programme (1988-1997) (WMO-No. 691),

RECOMMENDS the adoption of the amendments to the Manual on the Global Telecommunication System, Volume I - Global Aspects, Part I - Organization of the Global Telecommunication System, given in the annex to this recommendation, with effect from 1 November 1988;

REQUESTS the Secretary-General to make the appropriate amendments, as given in the annex to this recommendation, to the Manual on the Global Telecommunication System, Volume I - Global Aspects, Part I - Organization of for the Global Telecommunication System;

AUTHORIZES the Secretary-General to make any consequent purely editorial amendments as regards Volume I of the Manual on the Global Telecommunication System, in consultation with the president of CBS.

Annex to Recommendation 7 (CBS-IX)

AMENDMENTS TO THE MANUAL ON THE GLOBAL TELECOMMUNICATION SYSTEM, VOLUME I - GLOBAL ASPECTS, PART I - ORGANIZATION OF THE GLOBAL TELECOMMUNICATION SYSTEM

A. Attachment I-2:

Add, at the appropriate place, the circuit Paris - Algiers and RTH Algiers.

B. Attachment I-3:

(i) Add, at the appropriate places, relevant information resulting from the inclusion of Algiers in the MTN;

(ii) Replace the text in paragraph 2.4, subparagraph (d) by the following text:

"(d) All stations included in the regional basic synoptic networks and reporting by means of the SYNOP code form:

Synoptic surface observation reports from land stations exchanged on the MTN shall include at least Sections 0 and 1 of the SYNOP code form. As an interim measure, Section 3 of the SYNOP code form shall also be included in the global exchange on the MTN;".

C. Include the interregional circuit Algiers - Jeddah in the GTS plan.

Rec. 8 (CBS-IX) - AMENDMENTS TO THE MANUAL ON THE GLOBAL DATA-PROCESSING SYSTEM - MONITORING THE QUALITY OF OBSERVATIONS

THE COMMISSION FOR BASIC SYSTEMS,

NOTING Attachment II-14 of the Manual on the GDPS,

CONSIDERING:

(1) That there is a need to monitor the quality of observations received on the GTS by GDPS centres,

(2) That some monitoring procedures have been set up by some GDPS centres and a number of techniques which may be used for monitoring the quality of observations have been developed,

RECOMMENDS that the amendments to the Plan for Monitoring the Operation of the WWW, Attachment II-14 of the Manual on the GDPS, given in the annex to this recommendation, be adopted for inclusion in the Manual on the GDPS as well as relevant parts in the Manual on the GOS and the Manual on the GTS, with effect from 1 November 1988;

REQUESTS the Secretary-General to make the appropriate changes, as given in the annex to this recommendation, in the Manual on the Global Data-processing System;

AUTHORIZES the Secretary-General, in consultation with the president of CBS, to make any consequent purely editorial amendments as regards the Manual on the Global Data-processing System.

Annex to Recommendation 8 (CBS-IX)

AMENDMENTS TO THE MANUAL ON THE GLOBAL DATA-PROCESSING SYSTEM MONITORING THE QUALITY OF OBSERVATIONS

Paragraphs 20, 21 and 22 of the Plan for Monitoring the Operation of the WWW, Attachment II-14 of the Manual on the Global Data-processing System should be modified to read as follows:

Quality of observational data

20. Centres with global, hemispheric or near-hemispheric models should monitor the quality of one or more of the main types of observations using techniques such as those listed in Table E*. Statistics should be compiled separately for each land station by station index number, for each ship or aircraft by call sign, for each buoy by identifier, and for each satellite by identifier and for various geographic areas and levels in the atmosphere.

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* Table E is reproduced below for easy reference.

21. The centres should analyse the results and produce lists in an agreed format of observations believed to be consistently of low quality, together with information on which element of the observation (pressure, temperature, etc.) is thought to be of low quality and the evidence for considering it to be of low quality. These lists should be based on data received over one month and should be exchanged monthly between participating centres.

22. For each main type of observation the relevant lead centre* should liaise with the participating centres and co-ordinate all the results, inform the WMO Secretariat immediately of obvious problems, and produce every six months a consolidated list of observations of that particular type believed to be consistently of low quality with similar information on which element is considered to be of low quality and why. The list should be passed to the participating centres and the WMO Secretariat, which should notify Members or agencies responsible for the observations which appear to be of low quality and request them to make an investigation with a view to identifying and correcting any possible cause of error. Members should be asked to reply within a fixed period of time, reporting on any remedial action and stating if any assistance is required. Monitoring results including follow-up action should be made available to CBS, the Executive Council and Congress.

* The various lead centres are nominated from time to time by the president of CBS.

TABLE E

TECHNIQUES FOR MONITORING THE QUALITY OF OBSERVATIONS

(1) Compilation of statistics on the difference between observed values and the analysis and first-guess field;

(2) Compilation of statistics on observations which fail the routine quality-control checks;

(3) Examination of time series of observations from a particular station (particularly useful in data-sparse areas);

(4) Compilation of statistics on the differences between reported values of geopotential height and geopotential height recalculated from significant level data for radiosonde stations, using common formulae for all stations;

(5) For surface stations which report both mean sea-level pressure and station-level pressure, compilation of statistics on differences between reported mean sea-level pressure and mean sea-level pressure recomputed from reported station-level pressure and temperature and published values of station elevation;

(6) Compilation of co-location statistics.

Rec. 9 (CBS-IX) - AMENDMENTS TO THE PLAN FOR MONITORING THE OPERATION OF THE WORLD WEATHER WATCH, MANUAL ON THE GOS, VOLUME I, PART VII, MANUAL ON THE GTS, VOLUME I, PART I, ATTACHMENT I-5, MANUAL ON THE GDPS, VOLUME I, PART II, ATTACHMENT II-14

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 2 (Cg-X) - World Weather Watch Programme for 1988-1991,

(2) The Second WMO Long-term Plan, Part II, Volume I - The World Weather Watch Programme (1988-1997) (WMO-No. 691),

RECOMMENDS the adoption of the amendments to the Plan for Monitoring the Operation of the World Weather Watch, Manual on the GOS, Volume I, Part VII, Manual on the GTS, Volume I, Part I, Attachment I-5, Manual on the GDPS, Volume I, Part II, Attachment II-14, given in the annex to this recommendation, with effect from 1 November 1988;

REQUESTS the Secretary-General to make the appropriate amendments, as given in the annex to this recommendation, to the Plan for Monitoring the Operation of the World Weather Watch, Manual on the GOS, Volume I, Part VII, Manual on the GTS, Volume I, Part I, Attachment I-5, Manual on the GDPS, Volume I, Part II, Attachment II-14;

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

Annex to Recommendation 9 (CBS-IX)

AMENDMENTS TO THE PLAN FOR MONITORING THE OPERATION OF THE WORLD WEATHER WATCH, MANUAL ON THE GOS, VOLUME I, PART VII, MANUAL ON THE GTS, VOLUME I, PART I, ATTACHMENT I-5, MANUAL ON THE GDPS, VOLUME I, PART II, ATTACHMENT II-14

Delete the last sentence of paragraph 2 in Table D - Procedures for internationally co-ordinated non-real-time monitoring, and replace it by the following;

> "Statistics should be compiled by manually operated and automated centres for the period 1-5 October and the period 1-15 October respectively. In order to facilitate the comparison of results between manually operated and automated centres, automated centres should also provide results for the two periods of 1-5 October and 1-15 October."

*

* *

Rec. 10 (CBS-IX) - COMPATIBILITY OF RADIOSONDE DATA

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) The final report of the WMO Radiosonde Intercomparison (1984/85) published as No. 30 in the Instruments and Observing Methods Series,

(2) The existing systematic differences in upper-air data produced by the global radiosonde network,

CONSIDERING the importance of high quality radiosonde performance to Members for improving their analysis methods and quality of forecasts,

RECOMMENDS bringing the results of the WMO Radiosonde Intercomparison to the attention of Members;

REQUESTS the president of CIMO to take the necessary steps to specify proper corrections derived from the intercomparison for each of the tested radiosondes and to arrange for distributing these corrections to all Members;

URGES:

(1) Members to apply as appropriate these corrections in their national radiosonde network;

(2) Members, in co-operation with their national radiosonde manufacturers, to report on all changes of radiosonde types and/or performance characteristics to the Secretary-General for inclusion in the WMO Monthly Letter as well as in the WMO Catalogue of Radiosondes and Upper-Air Wind Systems in Use by Members;

INVITES the Secretary-General to arrange for a regional radiosonde intercomparison of RA II/RA VI as a supplementary part to the WMO Radiosonde Intercomparison.

Rec. 11 (CBS-IX) - PILOT STUDY TO ESTABLISH THE VALUE OF INFORMATION EXCHANGE BETWEEN ECMWF AND NATIONAL FOCAL POINTS FOR RADIOSONDE SYSTEMS

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Paragraph 20 of the Plan for Monitoring the Operation of the WWW, Attachment II-14 of the Manual on the Global Data-processing System concerning the monitoring of the quality of observations,

(2) That the full potential of current radiosonde systems for generating high-quality data is not being achieved consistently,

(3) The willingness and capability of ECMWF to monitor and report on the quality and availability of radiosonde data received at the Centre,

CONSIDERING:

(1) The great importance of high-quality radiosonde observations for numerical weather prediction,

(2) That information on apparent deficiencies in the performance of their radiosonde stations would assist system managers to achieve optimum performance,

(3) That up-to-date information on the characteristics of radiosonde systems in use, their planned operating schedules and performance objectives would assist monitoring centres to better assess the quality and availability of data being received,

RECOMMENDS that a pilot study, as defined in the annex to this recommendation, be set up to establish the value of information exchanged between ECMWF and national focal points for radiosonde systems, for their respective operations;

INVITES Members to participate in the pilot study;

REQUESTS ECMWF to collect reports on their work from participating Members and to submit a final report to the next extraordinary session of CBS.

Annex to Recommendation 11 (CBS-IX)

PILOT STUDY TO ESTABLISH THE VALUE OF INFORMATION EXCHANGE BETWEEN ECMWF AND NATIONAL FOCAL POINTS FOR RADIOSONDE SYSTEMS

The pilot study will start on 1 October 1988 and continue for a period of one year. All Members are invited to participate and to nominate national focal points. Preferably, such focal points will have responsibility for national or regional radiosonde operations.

Direct contacts will be established between ECMWF and the national focal points. Information will be exchanged routinely on a monthly basis and occasionally as necessary.

To each focal point, ECMWF will provide, in graphical and tabular form, summaries of differences between radiosonde data (geopotential and wind) and relevant first-guess fields, for land-based and marine stations for which the focal point is responsible.

Each focal point will specify to ECMWF the planned observing programme, sonde systems to be used and the performance objectives of their radiosonde stations. He will also report any actions taken partially or wholly in response to monitoring information.

ECMWF will collect reports on their work from the participating Members and present a report on the pilot study at the next extraordinary session of CBS.

Rec. 12 (CBS-IX) - PROPOSED MODIFICATIONS TO REGULATIONS OF FM 12-VIII EXT. SYNOP AND FM 13-VIII EXT. SHIP TO MEET ADDITIONAL DATA REQUIREMENTS

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) The abridged final report of EC-XXXVI, general summary, paragraph 3.1.3.4,

(3) The abridged final report of CBS-Ext.(85), general summary, paragraphs 7.2.7 to 7.2.12,

CONSIDERING that there is an expressed requirement by CAgM for precipitation and snow-depth data for global exchange and evaporation (evapotranspiration), net-radiation and duration of bright sunshine data for regional exchange,

RECOMMENDS:

(1) That the amendments to the global regulations and associated code table of FM 12-VIII Ext. SYNOP and FM 13-VIII Ext. SHIP given in the annex to this recommendation be adopted for use as from 1 November 1989;

(2) That regional associations be invited to amend, where appropriate, regional regulations with respect to the SYNOP/SHIP code in accordance with guidance given in the annex to this recommendation, for use as from 1 November 1989;

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

Annex to Recommendation 12 (CBS-IX)

PROPOSED MODIFICATIONS TO REGULATIONS OF FM 12-VIII Ext. SYNOP AND FM 13-VIII Ext. SHIP TO MEET ADDITIONAL DATA REQUIREMENTS

REGULATIONS

1. Snow-depth data

Regional associations are invited to specify regulations to the effect that snow-depth data (group 4E'sss) should be reported by all stations capable of doing so, and included at least once daily at specified times.

2. Precipitation data

- Amend Regulation 12.2.5.1 to read:

  "When precipitation data are to be exchanged in time periods of 6 hours at main standard times (i.e. to report the amount of precipitation over the preceding 6, 12, 18 and 24 hours), this group shall be included in Section 1."

- Amend Regulation 12.2.5.2 to read:

  "When precipitation data are to be exchanged in time periods of 3 hours or other periods required for regional exchange this group shall be included in Section 3."

- Amend Regulation 12.4.8.2 to read:

  "The decision to implement Regulation 12.2.5.2 shall be taken at the regional level."

- Regional associations are invited to:

  (a) Amend regional regulations with respect to group $6RRRt_R$ (Section 1) to the effect that:

  "This group shall be included in Section 1 of the synoptic report at the main standard times 00 GMT, 06 GMT; 12 GMT and 18 GMT.";

  (b) Amend regulations with respect to group $6RRRt_R$ (Section 3) to the effect that:

  (i) This group shall be included in Section 3 of the synoptic report at least at the intermediate standard times, and at the main standard times, as required;

  (ii) RRR shall indicate the amount of precipitation during the 3-hour period preceding the time of observation or during other periods required for regional exchange;

  (c) Amend regulations with respect to group (7....) to the effect that:

  (i) This group shall be used in the form $7R_{24}R_{24}R_{24}R_{24}$;

  (ii) The group $7R_{24}R_{24}R_{24}R_{24}$ may, by regional decision, be reported by all stations capable of doing so, and included at least once daily at either 00 GMT, 06 GMT, 12 GMT or 18 GMT.

- Amend specification for t_R to read as follows:

  "Duration of period of reference for amount of precipitation, ending at the time of the report (code table 4019)."

3. Daily amount of evaporation (evapotranspiration), net-radiation and duration of sunshine data

Amend Regulation 12.4.7.1.1 to read as follows:

"When the group $5j_1j_2j_3j_4$ is used in the form of $5EEEi_E$, the supplementary group $j_5j_6j_7j_8j_9$ shall be added in the form of $s_nF_nF_nF_nF_n$ when relevant data are available. The latter group shall not be used in association with other symbolic expressions of the group $5j_1j_2j_3j_4$."

Note: If data for the group $5EEEi_E$ is not available, the group shall be included as 5//// whenever the supplementary group $s_nF_nF_nF_nF_n$ is included.

- Amend Regulation 12.4.7.1.2 (a) to read as follows:

"$5EEEi_E$ $s_nF_nF_nF_nF_n$
to report the daily amount of either evaporation or evapotranspiration, and the daily amount of net-radiation;".

- Amend Regulation 12.4.7.1.2 (c) to read as follows:

"55SSS
to report the daily hours of sunshine".

- Amend Regulation 12.4.7.2 to read as follows:

"12.4.7.2 Daily evaporation or evapotranspiration, and daily net-radiation

12.4.7.2.1 The symbolic expression $5EEEi_E$ shall be used to report either daily evaporation or evapotranspiration, and the supplementary symbolic expression $s_nF_nF_nF_nF_n$ shall be used to report the daily net-radiation, when available.

12.4.7.2.2 EEE shall indicate the amount of either evaporation or evapotranspiration, in tenths of millimetres, during the preceding 24 hours at either 00 GMT, 06 GMT or 12 GMT.

12.4.7.2.3 $F_nF_nF_nF_n$ shall indicate the absolute value of the amount of net-radiation, in joules per square centimetre, during the preceding 24 hours at either 00 GMT, 06 GMT or 12 GMT.".

- Amend Regulations 12.4.7.4 through 12.4.7.4.2, as follows:

12.4.7.4

Duration of sunshine

12.4.7.4.1

The symbolic expression SSS shall be used to report the daily hours of sunshine in hours and tenths.

12.4.7.4.2

In the form 55SSS, this group shall, by regional decision, be reported by all stations capable of doing so and included at either 00 GMT, 06 GMT, 12 GMT or 18 GMT.

- Regional associations are invited to amend regulations with respect to group ($5j_1j_2j_3j_4(j_5j_6j_7j_8j_9)$) to the effect that:

  (i) "In the form $5EEEi_E$ $s_nF_nF_nF_nF_n$ and 55SSS, these groups shall be included by all stations capable of doing so, when appropriate.

  Note: Other forms of these groups may be included by all stations capable of doing so, when appropriate."

SPECIFICATION OF SYMBOLIC LETTERS AND CODE TABLES

- Add new specifications and code tables as follows:

EEE — Amount of either evaporation or evapotranspiration, in tenths of millimetres, during the preceding 24 hours

i_E — Indicator of type of instrumentation for evaporation measurement or type of crop for which evapotranspiration is reported. (Code table 1806)

$F_nF_nF_nF_n$ — Amount of net-radiation, in joules per square centimetre, over a 24-hour period

SSS — Duration of sunshine in hours and tenths

- Add new code table:

1806

i_E - Indicator of type of instrumentation for evaporation measurement or type of crop for which evapotranspiration is reported

Code figure	Instrumentation or crop type	Type of data
0	USA open pan evaporimeter (without cover)	Evaporation
1	USA open pan evaporimeter (mesh-covered)	
2	GGI - 3000 evaporimeter (sunken)	
3	20 m^2 tank	
4	Others	

5	Rice	)
6	Wheat	)
7	Maize	) Evapotranspiration
8	Sorghum	)
9	Other crops	)

- Add as a first specification to Code table 1819 as follows:

i_R - Indicator for inclusion or omission of precipitation data

Code figure	Precipitation data are reported:	Group $6RRRt_R$ is:
0	In Sections 1 and 3	Included in both sections

- Add new code table:

4019

t_R - Duration of period of reference of amount of precipitation ending at time of report

Code figure	
1	Total precipitation during the 6 hours preceding the observation
2	Total precipitation during the 12 hours preceding the observation
3	Total precipitation during the 18 hours preceding the observation
4	Total precipitation during the 24 hours preceding the observation
5	Total precipitation during the 1 hour preceding the observation
6	Total precipitation during the 2 hours preceding the observation
7	Total precipitation during the 3 hours preceding the observation
8	Total precipitation during the 9 hours preceding the observation
9	Total precipitation during the 15 hours preceding the observation

Notes:

(1) If the duration of the period of reference is not covered by code table 4019 or the period does not end at the time of the report, t_R shall be coded 0.

(2) Members are recommended to avoid any deviations from international practices which require the use of code figure 0. The specification of code figure 0 should be indicated in Volume II under National coding procedures.

Rec. 13 (CBS-IX) - MINOR MODIFICATIONS TO FM 32-V PILOT, FM 33-V PILOT SHIP, FM 35-V TEMP, FM 36-V TEMP SHIP, FM 85-VI SAREP AND EDITORIAL IMPROVEMENTS TO SPECIFICATIONS OF SYMBOLIC LETTERS OF DRIBU CODE

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) The abridged final report of CBS-VIII, general summary, paragraph 8.19 (d),

(3) Marine meteorology and related oceanographic activities report No. 10,

CONSIDERING:

(1) That there is a need to modify Section 1, Parts A, B, C and D of PILOT SHIP and TEMP SHIP to include the ships call sign to facilitate identification of ships, and Section 7, Part B of the TEMP SHIP code to meet ASAP requirements for sea-surface temperature, sounding system identification and techniques used,

(2) That there is a need to modify Part A of FM 85-VI SAREP code to meet recent developments in satellite data-analysis techniques with a view to higher accuracy in identifying the intensity of cyclones,

(3) That there is a need to improve the specifications of the symbolic expressions Q_2 and Q_4 in the DRIBU code,

NOTES the editorial improvements to specifications of symbolic letters of the DRIBU code, approved by the president of CBS, for inclusion in the Manual on Codes as given in the annex to this recommendation;

RECOMMENDS that the modifications to FM 32-V PILOT, FM 33-V PILOT SHIP, FM 35-V TEMP, FM 36-TEMP SHIP and FM 85-VI SAREP codes given in the annex to this recommendation be adopted for use as from 1 November 1988;

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

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*   *

Annex to Recommendation 13 (CBS-IX)

MINOR MODIFICATIONS TO FM 32-V PILOT, FM 33-V PILOT SHIP, FM 35-V TEMP, FM 36-V TEMP SHIP, FM 85-VI SAREP AND EDITORIAL IMPROVEMENTS TO SPECIFICATIONS OF SYMBOLIC LETTERS OF DRIBU CODE

1. MODIFICATIONS TO FM 32-V PILOT, FM 33-V PILOT SHIP, FM 35-V TEMP AND FM 36-V TEMP SHIP

(a) CODE FORM

(i) Modify code forms FM 32-V PILOT and FM 33-V PILOT SHIP as follows:

Parts A, B, C, D

Section 1 $M_iM_iM_jM_j$ D.....D** $YYGGa_4$ .....;

(ii) Modify code forms FM 35-V TEMP and FM 36-V TEMP SHIP as follows:

Parts A, B, C and D

Section 1 $M_iM_iM_jM_j$ D.....D** $YYGGI_d$ .....;

(iii) Modify code forms FM 35-V TEMP and FM 36-V TEMP SHIP, Part B, reactivate Section 7 as follows:

Part B

Section 7 (31313 $Os_nT_wT_wT_w$ $r_ar_as_rs_as_a$)

(b) REGULATIONS

(i) Change Regulation 32.2.1 to read:

32.2.1

Section 1 - Identification and position

The identification of a sea station shall be indicated by the group D.....D. The observing stations shall indicate its position by means of the group IIiii for a land station or the groups $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $MMMU_{La}U_{Lo}$ for a sea station.

(ii) Change Regulation 35.2.1 to read:

35.2.1

Section 1 - Identification and position

The identification of a sea station shall be indicated by the

** Used in FM 33-V and FM 36-V

group D.....D. The observing stations shall indicate its position by means of the group IIiii for a land station or the groups $99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $MMMU_{La}U_{Lo}$ for a sea station, aircraft or a carrier balloon.

(ii) Add new Regulation 35.3.3 to read as follows:

35.3.3

Section 7 - Sea surface temperature, sounding system identification, radiosonde, and system status groups

In TEMP SHIP reports Section 7 when included shall report the sea-surface temperature, sounding system identification, radiosonde type, radiation correction and system status.

Renumber present Regulation 35.3.3 through 35.3.5 as 35.3.4 through 35.3.6.

(c) SPECIFICATION OF SYMBOLIC LETTERS

Add the following specifications of symbolic letters:

r_ar_a Sounding System/radiosonde used. (Code table 3685)

s_r Radiation correction (code table xxxx)
s_as_a Status of System and its components (Code tables yyyy)

(d) CODE TABLES

Add the following Code tables:

3685

r_ar_a - Radiosonde/system used

Code figure	
00	Not used
01	Not used
02	RS 80-15/Version I
03	RS 80-15/Microcora
04	RS 80-15/Digicora
05)	
06)	
07)	
08)	
09)	Available for allocation
10)	
11)	
12)	
13)	
14)	RS 80-19/Digicora
.	
.	Available for allocation
.	
99	

xxxx - yyyy

s_r	Radiation correction code
$s_a s_a$	Status of the System and its components - Code tables to be developed

2. MODIFICATIONS TO FM 85-VI SAREP CODE

(a) CODE FORM

$M_i M_i M_j M_j$ YYGGg (IIiii
(or
$(99L_aL_aL_a$ $Q_cL_oL_oL_oL_o$

name of cyclone $n_tn_tL_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $1A_tW_fa_tt_m$ $2S_tS_t//$ $(9d_sd_sf_sf_s)$

D....D

(b) REGULATION

Change Regulation 85.2.7 to read as follows:

85.2.7

When two or more tropical cyclones are detected on the same photograph and thereby given the same time, the groups $n_tn_tL_aL_aL_a$ $Q_cL_oL_oL_oL_o$ $1A_tW_fa_tt_m$ $2S_tS_t//$ $(9d_sd_sf_sf_s)$ shall be repeated for each cyclone, preceded by the name whenever it is known.

(c) SPECIFICATION OF SYMBOLIC LETTERS

Delete symbolic letter S_t and its specification

Insert the following after the specification for S_fS_f.

S_tS_t Intensity of the tropical cyclone (Code table 3790) (FM 85-VI)

(d) CODE TABLE

Delete code table 3752

Insert the following code table after code table 3780.
Values included are the latest data.

*

*   *

3790

S_tS_t - Intensity of the tropical cyclone

Code figure	Current intensity (CI Number)	Maximum sustained wind speed (knots)	Maximum sustained wind speed (m/s)
00	Decaying		
15	1.5	25	13
20	2	30	15
25	2.5	35	18
30	3	45	23
35	3.5	55	28
40	4	65	33
45	4.5	77	39
50	5	90	46
55	5.5	102	52
60	6	115	59
65	6.5	127	65
70	7	140	72
75	7.5	155	79
80	8	170	87
99	Becoming extratropical		
//	Undetermined		

Note: The procedures for determining the Current Intensity (CI) Number from satellite imagery are explained in the Guide on the Global Data-processing System (WMO-No. 305).

3. EDITORIAL IMPROVEMENTS TO SPECIFICATIONS OF SYMBOLIC LETTERS OF DRIBU CODE

(a) SPECIFICATION OF SYMBOLIC LETTERS

Change specifications for Q_2 and Q_4 to read as follows:

Q_2 Quality of the housekeeping parameter (second word in first Block of Argos Platforms transmitter Terminal sensor data) (Code table 3363)

Q_4 Quality of the measurement of air temperature (Code table 3363).

(b) CODE TABLES

Change the headings of code table 3363 as indicated in the specifications above, and delete code table 3365.

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* *

Rec. 14 (CBS-IX) - FM 65-IX WAVEOB - REPORT OF SPECTRAL WAVE INFORMATION FROM A SEA STATION

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) Recommendation 2 (CMM-IX) - WMO Wave Programme,

(3) Resolution 8 (EC-XXXVII) - Report of the ninth session of the Commission for Marine Meteorology,

(4) The existence of measured spectral wave data from a variety of sources including moored buoys and ship-borne wave recorders, and the rapid expansion in the development of such instruments,

(5) The imminent operational deployment of both satellite and surface-based remote-sensing systems for the measurement of wave spectra,

CONSIDERING:

(1) That such extensive wave spectral data, if available in real time, would have an important application as initial data input to numerical wave models,

(2) That numerical wave models already exist, or are under development, which can assimilate spectral wave data from a variety of sources, including satellites,

(3) That a strong requirement exists for the real-time transmission of spectral wave data,

RECOMMENDS that the code FM 65-IX WAVEOB for the real-time transmission of spectral wave data, as given in the annex to this recommendation, be adopted as from 1 November 1989;

REQUESTS the Secretary-General to arrange for the inclusion of the new code in Volume I of the Manual on Codes.

*

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Annex to Recommendation 14 (CBS-IX)

FM 65-IX WAVEOB - REPORT OF SPECTRAL WAVE INFORMATION FROM A SEA STATION OR FROM A REMOTE PLATFORM (AIRCRAFT OR SATELLITE)

Section 0	$M_iM_iM_jM_j$	(D....D) ** (or) ($A_1b_wn_bn_bn_b$) (or) ($I_1I_2I_2$//)	YYMMJ GGgg/	(IIiii*) (or) ($Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$**)

$00I_aI_mI_p$ 1hhhh $2H_sH_sH_sH_s$ $3P_pP_pP_pP_p$ $(4H_mH_mH_mH_m)$ $(5P_aP_aP_aP_a)$

$(6H_{se}H_{se}H_{se}H_{se})$ $(7P_{sp}P_{sp}P_{sp}P_{sp})$ $(8P_{sa}P_{sa}P_{sa}P_{sa})$ $(9d_dd_dd_sd_s)$

Section 1 $(111B_TB_T$ SSSS/ D'D'D'D'/ BB/// $1f_1f_1f_1x$ $1f_df_df_dx$ ... BB/// $nf_nf_nf_nx$ $nf_df_df_dx)$

Section 2 (2222x $C_mC_mC_mn_mn_m$ $1c_1c_1c_2c_2$ $3c_3c_3c_4c_4$ ... $n{-}1c_{n-1}c_{n-1}c_nc_n$ (or nc_nc_n//))

Section 3 (3333x $C_{sm}C_{sm}C_{sm}n_{sm}n_{sm}$ $1c_{s1}c_{s1}c_{s2}c_{s2}$ $3c_{s3}c_{s3}c_{s4}c_{s4}$ ... $n{-}1c_{sn-1}c_{sn-1}c_{sn}c_{sn}$ (or $nc_{sn}c_{sn}$//))

Section 4 (4444 $1d_{a1}d_{a1}d_{a2}d_{a2}$ $1r_1r_1r_2r_2$ $2d_{a1}d_{a1}d_{a2}d_{a2}$ $2r_1r_1r_2r_2$ ... $nd_{a1}d_{a1}d_{a2}d_{a2}$ $nr_1r_1r_2r_2)$

Section 5 $(5555I_b$ $1A_1A_1A_1x$ $(1d_1d_1d_sd_s)$ $2A_2A_2A_2x$ $(2d_2d_2d_sd_s)$ ... $nA_nA_nA_nx$ $(nd_nd_nd_sd_s))$

NOTES: (1) WAVEOB is the name of the code for reporting spectral wave data from a sea station, or from an aircraft or satellite platform.

(2) A WAVEOB report is identified by MiMiMjMj = MMXX.

---

* Included in fixed sea station report only

** Included in sea station and remote platform report only

*

* *

(3) The code is divided into six sections. (Sections 1-5 are optional):

Section	Symbolic figure	Contents
0	-	Data for reporting identification (type, buoy identifier, date, time, location), indication of wave number or frequency, method of calculation, type of station, water depth, significant wave height and spectral peak period, or wave number, and optional wave parameters.
1	111	Sampling interval and duration (or length) of record, and description of measurement system bands.
2	2222	Maximum non-directional spectral density from heave sensor, and ratios of individual spectral densities to the maximum value.
3	3333	Maximum non-directional spectral density from slope sensor, and ratios of individual spectral densities to the maximum value.
4	4444	Directional wave functions. Mean and principal wave directions and first and second normalized polar Fourier coefficients, for bands described in section 1.
5	5555	Directional or non-directional spectral estimates by frequency or wave number, as indicated, and direction with directional spread.

REGULATIONS

65.1

General

6.5.1.1

The code name WAVEOB shall not be included in the report.

65.1.2

Use of groups $M_iM_iM_jM_j$ (D....D)** YYMMJ GGgg/ (IIiii*)
(or) (or)
($A_1b_wn_bn_bn_b$) ($Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$)**
(or)
($I_1I_2I_2$//)

NOTE: See Regulation 14.4.1, Notes (1), (2) and (3).

---

* Included in a fixed sea station report only
** Included in sea station and remote platform reports

65.1.2.1

Each individual WAVEOB report, whether or not included in a bulletin of such reports, shall contain as the first group, the identification group $M_iM_iM_jM_j$.

65.1.2.2

A sea station shall be indicated by either the group D....D or $A_1b_wn_bn_bn_b$. The position of a sea station shall be indicated by the groups $Q_cL_aL_aL_aL_a$ $L_oL_oL_oL_oL_o$. A satellite shall be indicated by the group $I_1I_2I_2$// and an aircraft shall report ///// for $I_1I_2I_2$//. A fixed sea station (other than an ocean weather station and a moored buoy), which is considered by the Member operating it to be in the same category as a land station, shall report its identification and position by means of the group IIiii.

NOTE: Data may be transmitted from a sea station or from a remote platform (aircraft or satellite).

65.1.2.3

In a report from a sea station (including an ocean weather station and a moored buoy) the latitude and longitude shall be encoded with the actual location of the station. In a satellite or aircraft report the latitude and longitude shall indicate the (approximate) centre of the area observed.

65.1.3

Use of Section 0 and 1.

65.1.3.1

The first three data groups in Section 0 after the location shall contain indicators showing if data are expressed as frequency or wave number, the method of calculation of data and type of platform, data on the water depth in meters, significant wave height in centimetres (or tenths of metres) and spectral peak period in tenths of a second or spectral peak wave length in metres. Optional groups, when included, shall contain data on the maximum wave height, average wave period or average wave length, estimate of significant wave height from slope sensors, spectral peak wave period or peak wave length derived from slope sensors, average wave period or average wave length derived from slope sensors, and dominant wave direction and directional spread.

65.1.3.2

When used, Section 1 shall contain the section identifier, the total number of bands described in the section, the sampling interval (in tenths of a second or in metres), the duration in seconds of record of the wave or the length in tens of metres, the number (BB) of bands described in the next two groups, the first centre frequency (H_z) or first centre wave number (metres)$^{-1}$ and the increment added to obtain the next centre frequency (H_z) or the next centre wave number (metres)$^{-1}$ and their associated exponents.

65.1.3.3

Except when BB = 00, the two groups for the first centre frequency or first centre wave number and the increment added to obtain the next centre frequency or the next centre wave number (each time preceded by BB) shall be repeated (n) times as required to describe band distribution.

NOTE: If sets of data groups are greater than 9, the group identifier (n) for the tenth set will be 0, the group identifier for the eleventh will be 1, etc.

65.1.3.4

BB shall be encoded BB = 00 when no increments are given and the following (n) groups are actual centre frequencies or actual centre wave numbers.

NOTE: The note under Regulation 65.1.3.3 applies if data groups are greater than 9.

65.1.4

Use of Sections 2 and 3.

65.1.4.1

When used, Section 2 shall contain the section identifier, an exponent associated with the first data group on the maximum value for non-directional spectra ($C_mC_mC_m$) in m^2/H_z for frequencies or m^3 for wave numbers from wave heave sensors, given as a three-digit number. The band number (n_mn_m) in which the maximum value for non-directional spectra occurs shall be included in the same group as the value. Subsequent groups shall contain ratios of individual spectra to the maximum (c_1c_1 to c_nc_n) as a percentage (00-99), with 00 meaning either zero or 100%.

NOTE: Confusion between a zero ratio and the maximum ratio (100%) should not arise since the band number (n_mn_m) for the maximum has already been identified.

65.1.4.2

Each group containing ratios shall begin with an odd number representing the unit value of the first band in the group. Thus, the number 1 shall identify values for the first and second or eleventh and twelfth or twenty-first and twenty-second etc. bands. The last group shall contain two ratios for even numbers of bands and one ratio for odd numbers of bands. In the case of odd numbers of bands the last two characters in the group shall be encoded as //.

65.1.4.3

When used, Section 3 shall contain a section identifier and non-directional spectral data derived from wave slope sensors, analogous to Section 2. Regulations 65.1.4.1, with the exception of the section identifier, and 65.1.4.2 shall apply.

65.1.5

Use of Section 4

65.1.5.1

When used, Section 4 shall contain a section identifier and pairs of data groups of mean direction and principal direction from which waves are coming for the band indicated, relative to true north, in units of four degrees and the first and second normalized polar co-ordinate derived from Fourier coefficients. The pairs of groups shall be repeated (n) times as required to describe the total number of bands given in Section 1.

NOTES: (1) The note under Regulation 65.1.3.3 applies if pairs of data groups are greater than 9.

(2) The mean direction and principal direction from which waves are coming will range from 00 (actual value 358° to less than 2°) to 89 (actual value from 354°to less than 358°). A value of 99 indicates the energy for the band is below a given threshold.

(3) Placing $d_{a1}d_{a1}$ and $d_{a2}d_{a2}$ for each band in the same group, with r_1r_1 and r_2r_2 for the same band in the next group, allows a quick visual check of the state of the sea.

(4) If $d_{a1}d_{a1} \approx d_{a2}d_{a2}$ and $r_1r_1 > r_2r_2$, there is a single wave train in the direction given by the common value of $d_{a1}d_{a1}$ and $d_{a2}d_{a2}$

(5) If the coded value of $|\, d_{a1}d_{a1} - d_{a2}d_{a2} \,| > 2$ and $r_1r_1 < r_2r_2$, a confused sea exists and no simple assumption can be made about the direction of the wave energy.

65.1.6

Use of Section 5

When used, this section shall contain the section identifier, an indicator (I_b) indicating whether the section includes directional or non-directional data, pairs of data groups of spectral estimates of the first to the nth frequencies or wavenumbers and the direction from which waves are coming in units of four degrees for spectral estimates (1) to (n) and their directional spread in whole degrees.

NOTES: (1) When non-directional spectra are transmitted, the group containing direction and directional spread may be omitted.

(2) Complete directional spectra may be coded by repeating as many duplets as needed to define the entire spectrum. A partial directional spectrum may be coded by selecting the largest spectral estimate for any one frequency or wave number band over all directions and coding this for each frequency or wave number band. Secondary peaks may not be coded unless the full directional spectrum is transmitted.

(3) For non-directional frequency spectra, the spectral estimates are in m^2/Hz. For non-directional wavenumber spectra, the spectral estimates are in m^3. For a complete directional frequency spectrum, spectral estimates are in m^2/Hz/radian. For a complete directional wave number spectrum, the spectral estimates are in m^4. For incomplete directional spectra, whether in frequency or wave number, the units of the spectral estimates should be m^2/Hz or m^3. That is, the total integrated energy within a frequency band is given rather than just that of the peak. If the spectral estimate is less than ($.100*10^{-5}$), the value of 0 must be used. The exception to this occurs when all subsequent estimates at higher frequencies are also 0, in which case only the zero immediately after the last non-zero spectral estimate need be included; all others need not be coded.

(4) There may be cases when spectral estimates are given in integrated units, such as m^2, and it is necessary to convert these to the units of the code. This is done by calculating the bandwidth at a frequency by determining the frequency difference between midpoints on either side of the frequency in question. The integrated spectral estimate is then divided by this computed bandwidth.

SPECIFICATIONS OF SYMBOLIC LETTERS USED IN WAVEOB (and not already defined)

$A_1A_1A_1$. $A_nA_nA_n$ — Spectral estimate of the first to nth frequencies (or wave numbers if so indicated).
(FM 65-IX)

(1) The use of frequency or wave number is indicated by the symbolic letter I_a.

BB — Number of bands described by the next two groups, except that BB = 00 indicates each of the following groups represents only a centre frequency or wave number.
(FM 65-IX)

B_TB_T — Total number of bands described.
(FM 65-IX)

$C_mC_mC_m$ — Maximum non-directional spectral density derived from heave sensors, in m^2/Hz for frequencies and m^3 for wave numbers.
(FM 65-IX)

$C_{sm}C_{sm}C_{sm}$ — Maximum non-directional spectral density derived from slope sensors, in m^2/Hz for frequencies and m^3 for wave numbers.
(FM 65-IX)

c_1c_1 : c_nc_n — The ratio of the spectral density derived from heave sensors for a given band, to the maximum spectral density given by $C_mC_mC_m$.
(FM 65-IX)

(1) A coded value of 00 may indicate either zero, or that the band contains the maximum spectral density. Since the band containing the maximum value will have been identified, it will be obvious which meaning should be assigned.

$c_{s1}c_{s1}$: $c_{sn}c_{sn}$ — The ratio of the spectral density derived from slope sensors for a given band, to the maximum spectral density given by $C_{sm}C_{sm}C_{sm}$.
(FM 65-IX)

(1) See note (1) under c_1c_1 ... c_nc_n.

D'D'D'D' — Duration of record of wave, in seconds, or length of record of wave in tens of metres.
(FM 65-IX)

(1) The use of frequency or wave number is indicated by the symbolic letter I_a.

$d_{a1}d_{a1}$ — Mean direction from which waves are coming, for the band indicated, relative to true north, in units of four degrees. (Code table 0880)
(FM 65-IX)

(1) A value of 99 indicates the energy for that band is below a given threshold.

$d_{a2}d_{a2}$ — Principal direction from which waves are coming, for the band indicated, relative to true north, in units of four degrees. (Code table 0880)
(FM 65-IX)

(1) See note (1) under $d_{a1}d_{a1}$.

d_dd_d — True direction from which dominant wave is coming, in units of four degrees. (Code table 0880)
(FM 65-IX)

d_sd_s — Directional spread, in whole degrees, of the dominant wave.
(FM 65-IX)

(1) The value of the directional spread is normally less than one radian (about 57°).

d_1d_1 : d_nd_n — True direction from which the waves are coming, in units of four degrees. (Code table 0880)
(FM 65-IX)

$f_1f_1f_1$: $f_nf_nf_n$ — The first centre frequency in a series, in Hz or wave number in $(\text{metres})^{-1}$, the exponent being given by symbolic letter x.
(FM 65-IX)

$f_df_df_d$ — The increment to be added to the previous centre frequency or previous centre wave number to obtain the next centre frequency or the next centre wave number in the series, in Hz or $(\text{metres})^{-1}$, the exponent being given by symbolic letter x.
(FM 65-IX)

$H_mH_mH_mH_m$ Maximum wave height, in centimetres.
(FM 65-IX)

(1) In the event wave height can only be reported in tenths of metres, the final digit in the group shall be encoded as /.

$H_sH_sH_sH_s$ Significant wave height ($H_{1/3}$), in centimetres.
(FM 65-IX)

(1) See note (1) under $H_mH_mH_mH_m$.

$H_{se}H_{se}H_{se}H_{se}$ Estimate of significant wave height from slope sensors, in centimetres.
(FM 65-IX)

(1) See note (1) under $H_mH_mH_mH_m$.

hhhh Water depth, in metres.
(FM 65-IX)

I_a Indicator for frequency or wavenumber. (Code table 1731)
(FM 65-IX).

I_b Indicator for directional or non-directional spectral wave data. (Code table 1732)
(FM 65-IX)

I_m Indicator for method of calculation of spectral data. (Code table 1744)
(FM 65-IX)

I_p Indicator for type of platform. (Code table 1747)
(FM 65-IX)

n_mn_m Number of the band in which the maximum non-directional spectral density determined by heave sensors lies.
(FM 65-IX)

$n_{sm}n_{sm}$ Number of the band in which the maximum non-directional spectral density determined by slope sensors lies.
(FM 65-IX)

$P_aP_aP_aP_a$ Average wave period, in tenths of a second, or average wave length in metres.
(FM 65-IX)

$P_pP_pP_pP_p$ Spectral peak period derived from heave sensors, in tenths of a second or spectral peak wave length in metres.
(FM 65-IX)

$P_{sa}P_{sa}P_{sa}P_{sa}$ Average period derived from slope sensors, in tenths of a second, or average wave length in metres.
(FM 65-IX)

$P_{sp}P_{sp}P_{sp}P_{sp}$ Spectral peak period derived from slope sensors, in tenths of a second, or spectral peak wave length in metres.
(FM 65-IX)

r_1r_1 First normalized polar co-ordinate derived from Fourier coefficients.
(FM 65-IX)

r_2r_2 Second normalized polar co-ordinate derived from Fourier coefficients.
(FM 65-IX)

SSSS Sampling interval (in tenths of a second or in metres).

x Exponent for spectral wave data. (Code table 4800)
(FM 65-IX).

WAVEOB CODE TABLES

0880

$d_{a1}d_{a1}$ – Mean direction from which waves are coming, in units of four degrees, for the band indicated
$d_{a2}d_{a2}$ – Principal direction from which waves are coming, in units of four degrees, for the band indicated
d_dd_d – True direction from which dominant wave is coming, in units of four degrees
d_1d_1 – True direction, in units of four degrees, from which waves
... are coming
d_nd_n

Code figure	
00	358° to less than 2°
01	2° to less than 6°
02	6° to less than 10°
....	
89	354° to less than 358°
90-98	Not used
99	Ratio of the spectral density for the band to the maximum is less than 0.005

1731

I_a - Indicator for frequency or wave number

Code figure	
0	Frequency, in (Hz)
1	Wavenumber, in $(m)^{-1}$

1732

I_b - Indicator for directional or non-directional spectral wave data

Code figure	
0	Non-directional
1	Directional

1744

I_m - Indicator for method of calculation of spectral data

Code figure	
0	Not applicable
1	Longuet-Higgins (1964)
2	Longuet-Higgins (F_3 method)
3	Maximum likelihood method
4	Maximum entropy method
....	
	(remainder for future specifications)

1747

I_p - Indicator for type of platform

Code figure	
0	Sea station
1	Automatic data buoy
2	Aircraft
3	Satellite

4800

x - Exponent for spectral wave data

Code figure	
0	10^{-5}
1	10^{-4}
2	10^{-3}
3	10^{-2}
4	10^{-1}
5	10^{0}
6	10^{1}
7	10^{2}
8	10^{3}
9	10^{4}

*

* *

Rec. 15 (CBS-IX) - FM 42-IX ASDAR - AIRCRAFT REPORT (AIRCRAFT TO SATELLITE DATA RELAY)

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) The abridged final report of CBS-VIII, general summary, paragraph 8.19 (c),

(3) The abridged final report of CBS-Ext.(85), general summary, paragraph 7.2.38,

(4) The development of a new ASDAR system as part of the GOS,

CONSIDERING that there is an urgent need for the development and implementation of suitable codes for ground to ground transmission of ASDAR data with adequate proviso for efficient transmission of ascent- and descent-phase data,

RECOMMENDS that the code form FM 42-IX ASDAR - Aircraft Report (Aircraft to Satellite Data Relay) given in the annex to this recommendation be adopted for use as from 1 May 1988;

INVITES the President of WMO to approve this recommendation as a matter of urgency, on behalf of the Executive Council;

REQUESTS the Secretary-General to arrange for the inclusion of the new code in Volume I of the Manual on Codes.

Annex to Recommendation 15 (CBS-IX)

FM 42-IX ASDAR - Aircraft Report (Aircraft to Satellite Data Relay)

CODE FORM:

SECTION 1 ASDAR YYGG

SECTION 2 $i_pi_pi_p$ $I_A...I_A$ $L_aL_aL_aL_aA$ $L_oL_oL_oL_oL_oB$ GGgg $S_hh_Ih_Ih_I$

$$SST_AT_AT_A \left(\begin{array}{c} SST_dT_dT_d \\ \text{or} \\ UUU \end{array} \right) \text{ddd/fff} \quad \underline{T}BB_A \quad \underline{S}s_1s_2s_3$$

NOTES:

(1) ASDAR is the name of the code for an automated aircraft report transmitted by relay through a satellite.

(2) ASDAR reports may only be transmitted from selected wide-body jets, equipped with "black boxes" which collect meteorological data from the host aircraft's avionics equipment. Relay of these reports through geostationary meteorological satellites allows near-real-time aircraft reports from remote regions of the Earth, between about 80° north latitude and 80°south latitude.

(3) Data transmitted from the aircraft are encoded in binary and are translated into the quasi-AIREP format for the convenience of human users.

REGULATIONS:

42.1

General

42.1.1

In a bulletin of ASDAR reports, the contents of Section 1 (the code name ASDAR and the group YYGG) shall be included only as the first line of the bulletin.

42.1.2

Reporting data groups

42.1.2.1

Each ASDAR report shall include all mandatory data groups contained in Section 2.

42.1.2.2

Use of solidi

Data shall be encoded as solidi when not available, when the DCP cannot acquire correct data, or in the event of parity errors.

42.1.3

Frequency of observations

The frequency of observation shall vary according to the phase of the flight (ascent, level flight or descent).

42.1.3.1

Observations during ascent

During ascent, observations shall be made as the aircraft passes through certain pressure levels, as follows. The first level shall be the nearest multiple of 10 hPa less than pressure at take-off. The next nine observations shall be at intervals of 10 hPa. The eleventh level shall be the first multiple of 50 hPa less than the tenth level. Observations shall continue at 50 hPa intervals until ascent is completed.

NOTE: For example, if the pressure at take-off was 1012 hPa, the first level to be reported would be 1010 hPa.

42.1.3.2

Observations during level flight

42.1.3.2.1

Routine observations

Routine observations during level flight shall be made at set intervals of time. The first observation shall be made at the first integral minute after the level-flight phase has been continuously occupied for at least 15 seconds. Subsequent observations shall be made at seven-minute intervals. If level flight is interrupted by unsteady flight, the timing sequence shall begin again upon resumption of level flight.

42.1.3.2.2

Highest wind encountered

Highest wind encountered shall be reported when the aircraft is in level flight at a pressure level less than 600 hPa, according to the following scheme. Smoothed wind speed shall be sampled at one-second intervals, and a wind speed maxima shall be reported if and only if the wind speed:

(a) Is greater than 60 knots;
(b) Exceeds the observed wind speed at the previous routine observation by 10 knots or more; and
(c) Exceeds the observed wind speed at the subsequent routine observation by 10 knots or more.

42.1.3.3

Observations during descent

During descent, observations shall be made as the aircraft passes through certain pressure levels, as follows. The first level shall be the nearest multiple of 50 hPa greater than the pressure at the last observation before descent. Subsequent observations shall be at intervals of 50 hPa, until a pressure level of 700 hPa is reached. From that level observations shall continue at 50 hPa intervals, but supplemented by observations at intervals of 10 hPa.

42.2

Phase of flight indicator $i_pi_pi_p$

42.2.1

An indicator shall be included in each report, to show both phase of flight (unsteady, level, ascent, or descent) and, in the case of level flight, the type of observation (routine or maximum wind).

42.2.2

Whenever a predetermined roll threshold has been exceeded, the phase of flight shall be considered to be unsteady and no information shall be transmitted by the ASDAR unit.

42.2.3

A routine observation in level flight shall be indicated by encoding the phase of flight indicator as LVR.

42.2.4

Highest wind encountered in level flight shall be indicated by encoding the phase of flight indicator as LVW.

42.2.5

An observation during ascent shall be indicated by encoding the phase of flight indicator as ASC.

42.2.6

An observation during descent shall be indicated by encoding the phase of flight indicator as DES.

42.3

Meteorological data

42.3.1

Temperature

Each observation shall include the air temperature at the given pressure altitude. The precision of the temperature shall be indicated by s_3. If observed, either dewpoint temperature or relative humidity at the given pressure altitude shall be included.

42.3.2

Wind

Each observation shall include a value for the observed wind. Direction, relative to true north, shall be reported in whole degrees. Wind speed shall be reported in whole knots.

42.3.3

Turbulence

Each observation shall include a report of turbulence, encoded by the indicator letters TB followed by a single digit value for the turbulence.

Add to Section B (Meaning of symbolic words, figures and groups):

ASDAR	Aircraft to Satellite Data Relay. (FM 42-IX)
S	Indicator letter for type of navigation system, status of ACARS interface, and temperature precision. (FM 42-IX)
TB	Indicator letters for turbulence. (FM 42-IX)

Add to Section C (Specifications of symbolic letters):

B_A Turbulence. (code table 0302)
(FM 42-IX)

Add this second definition for ddd:

ddd True direction, in whole degrees, from which wind is blowing.
(FM 42-IX)

Add this fourth definition for fff:

fff Wind speed, in knots, at the level given by $h_I h_I h_I$.
(FM 42-IX)

Add this fourth definition for GG:

GG Actual time rounded downwards to the nearest hour GMT of the first ASDAR report in the bulletin.
(FM 42-IX).

Under the specifications for GGgg, add (FM 42-IX).

$h_I h_I h_I$ Pressure altitude, in hundreds of feet.
(FM 42-IX)

(1) Pressure altitude is a measure of height relative to the standard datum plane of 1013.2 hPa.

$I_A \ldots I_A$ Aircraft identifier.
(FM 42-IX)

(1) The aircraft identifier is an alphanumeric which, by convention, ends with the letter Z. It includes the following data, either directly or indirectly: airline identifier, aircraft identifier, and ASDAR flight unit identification.

$i_p i_p i_p$ Indicator for phase of flight and type of observation.
(FM 42-IX)

(1) See Regulation 42.2.

S_h Sign of the pressure altitude.
(FM 42-IX)

(1) If pressure altitude is zero or positive (aircraft is at or above the standard datum plane of 1013.2 hPa), S_h shall be encoded as the letter F.

(2) If pressure altitude is negative (aircraft is below the standard datum plane of 1013.2 hPa), S_h shall be encoded as the letter A.

SS Sign of the temperature.
(FM 42-IX)

(1) If temperature is zero or positive SS shall be encoded as the letters PS.

(2) If temperature is negative SS shall be encoded as the letters MS.

s_1 Type of navigation system. (Code table 3866)
(FM 42-IX)

s_2 Status of ACARS interface. (Code table 3867)
(FM 42-IX)

s_3 Temperature precision. (Code table 3868)
(FM 42-IX)

$T_AT_AT_A$ Air temperature, in tenths of degrees Celsius, at the level given by $h_Ih_Ih_I$.
(FM 42-IX).

Add new code table:

0302

B_A – Turbulence

Code figure	
0	None (acceleration less than 0.15 g)
1	Light (acceleration from 0.15 to, but not including, 0.5 g)
2	Moderate (acceleration from 0.5 to 1.0 g)
3	Severe (acceleration > 1.0 g)

Note: These accelerations, which may be positive or negative, are deviations from the normal acceleration of gravity (1.0 g).

Add the following code tables:

3866

s_1 – Type of navigation system

Code figure	
0	Inertial Navigation System
1	OMEGA

3867

s_2 – Status of ACARS interface

Code figure	
0	Interface is inoperative
1	Interface is operative

3868

s_3 - Temperature precision

Code figure	
0	Low (precision near 2.0°C)
1	High (precision near 1.0°C)

Rec. 16 (CBS-IX) - SUPPLEMENTARY INFORMATION CODE TABLE

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) The abridged final report of CBS-VIII, general summary, paragraph 8.19 (e),

(3) The final report of CBS/WGC-VII, general summary, paragraphs 6.2-6.4,

CONSIDERING:

(1) The need for a standardized international supplementary information code table to replace the different regional $S_pS_ps_ps_p$ code tables for special phenomena,

(2) The various requirements stated by Members for inclusion of additional new specifications or amplification of existing specifications for present and past weather,

RECOMMENDS that the $S_pS_ps_ps_p$ - Supplementary Information Code Table and associated amendments to the Manual on Codes, given in the annex to this recommendation, be adopted for use as from 1 November 1989.

REQUESTS the Secretary-General to arrange for the inclusion of the Supplementary Information Code Table and associated amendments in Volumes I and II of the Manual on Codes.

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Annex to Recommendation 16 (CBS-IX)

Supplementary Information Code Table

FM 12-VIII Ext. SYNOP AND FM 13-VIII Ext. SHIP

1. REGULATIONS

Change Regulations 12.2.6.4.1 and 12.4.10 as follows:

12.2.6.4.1

If more than one form of weather is observed, the highest applicable code figure shall be selected for the group $7wwW_1W_2$. Other weather may be reported in Section 3, using the group 960ww or $961w_1w_1$, repeated as necessary. In any case, in the group $7wwW_1W_2$ code figure 17 shall have precedence over figures 20-49.

12.4.10

Group ($9S_PS_Ps_ps_p$)

The use of this group and the specifications for the supplementary information shall be as specified in Code table 3778.

CODE TABLE 3778

$S_PS_Ps_ps_p$ - Supplementary information

NOTE: The group $9S_PS_Ps_ps_p$ is used to give (additional) information about certain phenomena occurring at the time of observation and/or during the period covered by ww or W_1W_2. The relevant time or time period may be indicated by inclusion of one or more time groups (decade 00-09), when and where appropriate.

$9S_PS_Ps_ps_p$

Decade 00-09: Time and variability

900tt	Time of commencement) of weather phenomenon reported
900zz	Variability, location or intensity) by ww in the group $7wwW_1W_2$
901tt	Time of ending of weather phenomenon reported by ww in the group $7wwW_1W_2$
902tt	Time of commencement) of weather phenomenon reported
902zz	Variability, location or intensity) in the following group $9S_PS_Ps_ps_p$
903tt	Time of ending of weather phenomenon reported in the preceding group $9S_PS_Ps_ps_p$
904tt	Time of occurrence of weather phenomenon reported in the following group $9S_PS_Ps_ps_p$
905tt	Duration of non-persistent weather) reported by ww in the phenomenon or time of commencement) group $7wwW_1W_2$ of persistent weather phenomenon)

906tt	Duration of non-persistent weather phenomenon or time of commencement of persistent weather phenomenon)	reported in the following group $9S_PS_Ps_ps_p$
907tt	Duration of period of reference, ending at the time of observation, of weather phenomenon reported in the following group $9S_PS_Ps_ps_p$	
908	Not used	
$909R_td_c$	Time at which precipitation given by RRR began or ended and duration and character of precipitation	

Decade 10-19: Wind and squall

910ff	Highest gust during the ten-minute period immediately preceding the observation	
911ff	Highest gust)	During the period covered by W_1W_2 in group $7wwW_1W_2$ unless a different period of reference is indicated by the group 907tt; or during the ten-minute period immediately preceding the time of observation indicated by the group 904tt
912ff	Highest mean wind speed)	
913ff	Mean wind speed)	
914ff	Lowest mean wind speed)	
915dd	Direction of the wind	
916tt	Pronounced clockwise shift in wind direction (veering)	
917tt	Pronounced anticlockwise shift in wind direction (backing)	
$918s_qD_p$	Nature and/or type of squall, and direction from which it approaches the station	
$919M_wD_a$	Water spout(s), tornadoes, whirlwinds, dustdevils	

NOTES:

(1) When the wind speed reaches or exceeds 99 units (knots or m s^{-1} as indicated by i_w), two groups shall be used in the same manner as is used in Section 1 of the code form. For example, to report a gust of 135 knots during the ten-minute period preceding the observation, the two groups would be coded 91099 00135.

(2) The mean wind speed referred to in groups 912ff and 914ff is defined as time-averaged instantaneous wind speed over a ten-minute interval throughout the period covered by W_1W_2 or as indicated by a preceding time group.

(3) A significant change in wind speed and/or direction is reported by two 913ff and/or 915dd groups giving the speed and/or direction before and after the change. The time of change is given by the group 906tt preceding the second 913ff and/or 915dd group. Variation in speed and/or direction of light and variable winds would not normally be reported, nor would a gradual change in speed and/or direction of a strong wind; by "significant" change is meant a sudden onset or cessation of a strong wind or a sudden change in speed and/or direction of a strong wind.

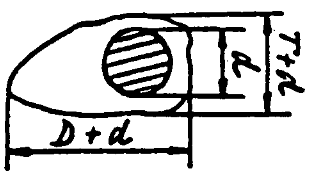
Decade 20-29: State of the sea, icing phenomena and snow cover

$920SF_x$	State of the sea and maximum wind force ($F_x \leqq 9$ Beaufort)
$921SF_x$	State of the sea and maximum wind force ($F_x > 9$ Beaufort)
$922S'V'_s$	State of the water surface and visibility at a seaplane alighting area
$923S'S$	State of the water surface in the alighting area and state of the sea in the open sea
$924SV_s$	State of the sea and visibility seawards (from a coastal station)
925	Not used
$926S_oi_o$	Hoar frost or coloured precipitation
$927S_6T_w$	Frozen deposit
$928S_7S'_7$	Character and regularity of snow cover
$929S_8S'_8$	Drift snow

Decade 30-39: Amount of precipitation or deposit

930RR	Amount of precipitation)	During the period covered by W_1W_2 in group $7wwW_1W_2$ unless a different period of reference is indicated by the group 907tt
931ss	Depth of newly fallen snow)	
932RR	Maximum diameter of hailstones)	
933RR	Water equivalent of solid precipitation on ground)	At the time of observation
934RR	Diameter of the deposit of glaze)	
935RR	Diameter of the deposit of rime)	
936RR	Diameter of compound deposit)	
937RR	Diameter of the deposit of wet snow)	
938nn	Rate of accrual of glaze on a surface, in mm h^{-1}	
$939h_gh_g$	Height above the ground in metres at which diameter of deposit reported in preceeding $9S_PS_Ps_ps_p$ group is observed	
939nn	Maximum diameter of hailstones in mm	

Note: Diameter of the deposit is taken as the greatest distance along the axis of a cross-section of the deposit minus the diameter of the measuring rod (see figure below)



D - Diameter of the deposit of glaze or rime
T - Thickness of the deposit of glaze or rime
d - Diameter of the measuring rod

Decade 40-49: Clouds

$940Cn_3$	Evolution of clouds
$941CD_p$	Direction from which clouds are moving
$942CD_a$	Location of maximum concentration of clouds
$943C_LD_p$	Direction from which low-level clouds are moving
$944C_LD_a$	Location of maximum concentration of low-level clouds
$945h_th_t$	Height of the tops of the lowest clouds, or the lowest cloud layer or fog
$946C_cD_a$	Direction of coloration and/or convergence of clouds associated with a tropical disturbance
947Ce'	Elevation of clouds
$948C_oD_a$	Orographic clouds
$949C_aD_a$	Clouds of vertical development

Decade 50-59: Cloud conditions over mountains and passes, or in valleys or plains observed from a higher level

$950N_mn_3$	Cloud conditions over mountains and passes	
$951N_vn_4$	Fog, mist or low cloud in valleys or plains, observed from a station at a higher level	
952) .) .) 957)	Not used	
$958E_hD_a$	Location of maximum concentration of cloud)	reported in
$959v_pD_p$	Forward speed and direction from which clouds are moving))	preceding group $9S_PS_Ps_ps_p$

Decade 60-69: Present weather and past weather

960ww	Present weather phenomenon observed simultaneously with and/or in addition to weather phenomenon reported by ww in the group $7wwW_1W_2$
$961w_1w_1$	Present weather phenomenon observed simultaneously with and/or in addition to weather phenomenon reported by ww in the group $7wwW_1W_2$, or amplification of present weather phenomenon reported by ww in the group $7wwW_1W_2$
962ww) $963w_1w_1$)	Amplification of weather phenomenon during the preceding hour but not at the time of observation and reported by ww = 20–29 in the group $7wwW_1W_2$
964ww) $965w_1w_1$)	Amplification of weather phenomenon during the period covered by W_1W_2 and reported by W_1 and/or W_2 in the group $7wwW_1W_2$
966ww) $967w_1w_1$)	Weather phenomenon occurring at the time or during the period indicated by associated $9S_PS_Ps_ps_p$ time group(s)
968	Not used

$9696D_a$	Rain at the station not associated with thunderstorm in distance, direction D_a
$9697D_a$	Snow at the station not associated with thunderstorm in distance, direction D_a
$9698D_a$	Shower at the station not associated with thunderstorm in distance, direction D_a

Decade 70-79: Location and movement of phenomena

$970E_hD_a$)		(ww in group $7wwW_1W_2$
$971E_hD_a$)		(ww in group 960ww
$972E_hD_a$)	Location of maximum concentration,	(w_1w_1 in group $961w_1w_1$
$973E_hD_a$)	phenomenon reported by	(W_1 in group $7wwW_1W_2$
$974E_hD_a$)		(W_2 in group $7wwW_1W_2$

$975v_pD_p$)		(ww in group $7wwW_1W_2$
$976v_pD_p$)	Forward speed and direction from	(ww in group 960ww
$977v_pD_p$)	which it is moving, phenomenon	(w_1w_1 in group $961w_1w_1$
$978v_pD_p$)	reported by	(W_1 in group $7wwW_1W_2$
$979v_pD_p$)		(W_2 in group $7wwW_1W_2$

Decade 80-89: Visibility

$980V_sV_s$	Visibility towards the sea
981VV	Visibility to NE
982VV	Visibility to E
983VV	Visibility to SE
984VV	Visibility to S
985VV	Visibility to SW
986VV	Visibility to W
987VV	Visibility to NW
988VV	Visibility to N
$989V_bD_a$	Variation of visibility during the hour preceding the observation time and the direction in which this variation has been observed

Decade 90-99: Optical phenomena and miscellaneous

$990Z_oi_o$	Optical phenomena
$991AD_a$	Mirage
99190	St. Elmo's fire
$992N_tt_w$	Condensation trails
$993C_SD_a$	Special clouds
$994A_3D_a$	Day darkness
995nn	Lowest atmospheric pressure reduced to mean sea-level during the period covered by W_1W_2 unless otherwise indicated by associated $9S_PS_Ps_ps_p$ time group(s), the tens and units of the value of hPa
$996T_vT_v$	Sudden rise in air temperature, in whole degrees Celsius
$997T_vT_v$	Sudden fall in air temperature, in whole degrees Celsius
$998U_vU_v$	Sudden rise in relative humidity, in per cent
$999U_vU_v$	Sudden fall in relative humidity, in per cent

Note: Groups $996T_vT_v$, $997T_vT_v$, $998U_vU_v$ and $999U_vU_v$ should <u>not</u> be used to report normal diurnal changes in temperature or humidity.

2. SPECIFICATION OF SYMBOLIC LETTERS (or groups of letters)

A Mirage. (Code table 0101)

A_3 Day darkness, worst in direction D_a. (Code table 0163)

C_s Special clouds. (Code table 0521)

C_a Nature of clouds of vertical development. (Code table 0531)

C_c Coloration, and/or convergence of clouds associated with a tropical disturbance. (Code table 0533)

C_o Orographic clouds. (Code table 0561)

D_a Direction in which the phenomenon indicated is observed or in which conditions specified in the same group are reported. (Code table 0700)

D_p Direction from which the phenomenon indicated is coming. (Code table 0700)

d_c Duration and character of precipitation given by RRR. (Code table 0833)

(1) If only one period of precipitation has occurred during the period covered by W_1W_2, the duration is defined as the time elapsed from the beginning (a) until the end of the period of precipitation, if precipitation is not occurring at the time of observation, or (b) until the time of observation, if precipitation is occurring at the time of observation.

(2) If two or more periods of precipitation have occurred during the period covered by W_1W_2, the duration of precipitation is defined as the time elapsed from the beginning of the first period of precipitation, all or part of which occurred during the period covered by W_1W_2, (a) until the end of the last period of precipitation, if precipitation is not occurring at the time of observation, or (b) until the time of observation, if precipitation is occurring at the time of observation.

E_h Elevation above the horizon of the base of anvil of Cumulonimbus or of the summit of other phenomena. (Code table 0938)

e' Angle of elevation of the top of the phenomenon above horizon; that is, the angle between the horizontal plane through the eye of the observer and the straight line from the eye of the observer to the top of the phenomenon. (Code table 1004)

F_x Maximum force of the wind in the period covered by W_1W_2 on the Beaufort scale (0 = 10 Beaufort; 1 = 11 Beaufort; 2 = 12 Beaufort, etc.).

Note: The Beaufort scale of wind is given in Section F of this Manual

h_gh_g Height above the ground in metres at which diameter of deposit observed. (Coded 99 for 99 m or more)

h_th_t Height of the tops of the lowest clouds or height of the lowest cloud layer. (Code table 1677)

i_o Intensity of the phenomenon. (Code table 1861)

M_w Waterspout(s), tornadoes, whirlwinds, dust devils. (Code table 2555)

N_m Cloud conditions over mountain passes. (Code table 2745)

N_t Condensation trails. (Code table 2752)

N_v Cloud conditions observed from a higher level. (Code table 2754)

n_3 Evolution of clouds. (Code table 2863)

n_4 Evolution of clouds observed from a station at a higher level. (Code table 2864)

nn Unit is either mm or tens and units of the value of hPa. (Coded 99 for 99 or more units)

R_t Time at which precipitation given by RRR began or ended. (Code table 3552)

(1) When precipitation is occurring at the time of observation or has ended during the hour preceding the observation, the time reported is the "time precipitation began". When precipitation is not occurring at the time of observation and has not occurred in the hour preceding the observation, the time reported is the "time precipitation ended". When two or more periods of precipitation occur during the period covered by W_1W_2, the time (beginning or ending) of the last period of precipitation is reported.

RR Amount of precipitation or water equivalent of solid precipitation, or diameter of solid deposit. (Code table 3570)

S_o Hoar frost or coloured precipitation. (Code table 3761)

S_6 Type of deposit. (Code table 3764)

S_7 Character of the snow cover. (Code table 3765)

S_8 Snow-storm phenomena (snow raised by the wind). (Code table 3766)

S' State of the water surface in an alighting area. (Code table 3700)

S'_7 Regularity of the snow cover. (Code table 3775)

S'_8 Evolution of drift snow. (Code table 3776)

ss Depth of newly fallen snow. (Code table 3870)

$S_PS_Ps_ps_p$	Supplementary information. (Code table 3778)
s_q	Nature and/or type of squall. (Code table 3848)
T_w	Variation of temperature during the period covered by W_1W_2, associated with glaze or rime. (Code table 3955)
T_vT_v	Variation in air temperature, in whole degrees Celsius.
t_w	Time of commencement of a phenomenon before the hour of observation. (Code table 4055)
tt	Units and tenths of hour before observation. (Code table 4077)
U_vU_v	Variation in relative humidity, in per cent.
V_b	Variation of visibility during the hour preceding the observation. (Code table 4332)
V_s	Visibility seawards (from a coastal station). (Code table 4300)
V'_s	Visibility over the water surface of an alighting area. (Code table 4300)
V_sV_s	Visibility towards the sea. (Code table 4377)
v_p	Forward speed of phenomenon. (Code table 4448)
w_1w_1	Present weather phenomenon not specified in Code table 4677, or specification of present weather phenomenon in addition to the group $7wwW_1W_2$. (Code table 4687)
Z_o	Optical phenomena. (Code table 5161)
zz	Variation in phenomena. (Code table 4077)

3.

CODE TABLES

0101

A – Mirage

Code figure	
0	No specification
1	Image of distant object raised (looming)
2	Image of distant object raised clear above the horizon
3	Inverted image of distant object
4	Complex, multiple images of distant object (images not inverted)
5	Complex, multiple images of distant object (some images being inverted)
6	Sun or Moon seen appreciably distorted
7	Sun visible, although astronomically below the horizon
8	Moon visible, although astronomically below the horizon

Note: When code figures 4, 5 or 6 apply, recognition of the objects is liable to be difficult.

0163

A_3 - Day darkness, worst in direction D.

Code figure	
0	Day darkness, bad
1	Day darkness, very bad
2	Day darkness, black

0521

C_S - Special clouds

Code figure	
1	Nacreous clouds
2	Noctilucent clouds
3	Clouds from waterfalls
4	Clouds from fires
5	Clouds from volcanic eruptions

Note: A description of these clouds may be found in the International Cloud Atlas (WMO-No. 407), Volume I - Manual on the observation of clouds and other meteors, Chapter II.6.

0531

C_a - Nature of clouds of vertical development

Code figure			
0	Isolated	)	Cumulus humilis and/or
1	Numerous	)	Cumulus mediocris
2	Isolated	)	Cumulus congestus
3	Numerous	)	
4	Isolated	)	Cumulonimbus
5	Numerous	)	
6	Isolated	)	Cumulus and
7	Numerous	)	Cumulonimbus
8	Not used		
9	Not used		

0533

C_c - Coloration and/or convergence of clouds associated with a tropical disturbance

Code figure	
0	Not used
1	Slight coloration of clouds at sunrise

(Code table 0533 - contd)

2	Deep-red coloration of clouds at sunrise	
3	Slight coloration of clouds at sunset	
4	Deep-red coloration of clouds at sunset	
5	Convergence of C_H clouds at a point below 45°)	Forming or
6	Convergence of C_H clouds at a point above 45°)	increasing
7	Convergence of C_H clouds at a point below 45°)	Dissolving or
8	Convergence of C_H clouds at a point above 45°)	diminishing
9	Not used	

0561

C_o - Orographic clouds

Code figure	
1	Isolated orographic clouds, pileus, incus, forming
2	Isolated orographic clouds, pileus, not changing
3	Isolated orographic clouds, pileus, incus, dissolving
4	Irregular banks of orographic cloud, Föhn bank, etc., forming
5	Irregular banks of orographic cloud, Föhn bank, etc., not changing
6	Irregular banks of orographic cloud, Föhn bank, etc., dissolving
7	Compact layer of orographic cloud, Föhn bank, etc., forming
8	Compact layer of orographic cloud, Föhn bank, etc., not changing
9	Compact layer of orographic cloud, Föhn bank, etc., dissolving

0833

d_c - Duration and character of precipitation given by RRR

Code figure		
0	Lasted less than 1 hour)	only one period of precipitation has
1	Lasted 1-3 hours)	occurred during the period covered by
2	Lasted 3-6 hours)	W_1W_2
3	Lasted more than 6 hours)	
4	Lasted less than 1 hour)	two or more periods of precipitation have
5	Lasted 1-3 hours)	occurred during the period covered by
6	Lasted 3-6 hours)	W_1W_2
7	Lasted more than 8 hours)	
8	Not used	
9	Unknown	

0938

E_h - Elevation above the horizon of the base of anvil of Cumulonimbus or of the summit of other phenomena

Code figure	
1	Very low on the horizon
3	Less than 30° above the horizon
7	More than 30° above the horizon

1861

i_e - Intensity of the phonomenon

Code figure	
0	Slight
1	Moderate
2	Heavy or strong

2555

M_w - Waterspout(s), tornadoes, whirlwinds, dust devils

Code figure	
0	Waterspout(s) within 3 km of station
1	Waterspout(s) more than 3 km from station
2	Tornado clouds within 3 km of station
3	Tornado clouds more than 3 km from station
4	Whirlwinds of slight intensity
5	Whirlwinds of moderate intensity
6	Whirlwinds of severe intensity
7	Dust devils of slight intensity
8	Dust devils of moderate intensity
9	Dust devils of severe intensity

2745

N_m - Cloud conditions over mountains and passes

Code figure	
0	All mountains open, only small amounts of cloud present
1	Mountains partly covered with detached clouds (not more than half the peaks can be seen)
2	All mountain slopes covered, peaks and passes free
3	Mountains open on observer's side (only small amounts of cloud present), but a continuous wall of cloud on the other side
4	Clouds low above the mountains, but all slopes and mountains open (only small amounts of cloud on the slopes)
5	Clouds low above the mountains, peaks partly covered by precipitation trails or clouds
6	All peaks covered but passes open, slopes either open or covered
7	Mountains generally covered but some peaks free, slopes wholly or partially covered
8	All peaks, passes and slopes covered
9	Mountains cannot be seen owing to darkness, fog, snowstorm, precipitation, etc.

2752

N_1 - Condensation trails

Code figure	
5	Non-persistent condensation trails
6	Persistent condensation trails covering less than 1/8 of the sky
7	Persistent condensation trails covering 1/8 of the sky
8	Persistent condensation trails covering 2/8 of the sky
9	Persistent condensation trails covering 2/8 or more of the sky

2754

N_v - Cloud conditions observed from a higher level

Code figure	
0	No cloud or mist
1	Mist, clear above
2	Fog patches
3	Layer of slight fog
4	Layer of thick fog
5	Some isolated clouds
6	Isolated clouds and fog below
7	Many isolated clouds
8	Sea of clouds
9	Bad visibility obscuring the downward view

2863

n_3 - Evolution of clouds

Code figure	
0	No change
1	Has become cumuliform
2	Has lifted slowly
3	Has lifted rapidly
4	Has lifted and become stratified
5	Has become lower slowly
6	Has become lower rapidly
7	Has become stratified
8	Has become stratified and lower
9	Rapid variations

2864

n_4 - Evolution of clouds observed from a station at a higher level

Code figure	
0	No change
1	Decrease and elevation
2	Decrease
3	Elevation
4	Decrease and lowering
5	Increase and elevation

(Code table 2864 - contd)

6	Lowering
7	Increase
8	Increase and lowering
9	Intermittent fog at the station

3552

R_t - Time at which precipitation given by RRR began or ended

Code figure	
1	Less than 1 hour before time of observation
2	1 to 2 hours before time of observation
3	2 to 3 hours before time of observation
4	3 to 4 hours before time of observation
5	4 to 5 hours before time of observation
6	5 to 6 hours before time of observation
7	6 to 12 hours before time of observation
8	More than 12 hours before time of observation
9	Unknown

3570

RR - Amount of precipitation or water equivalent of solid precipitation, or diameter of solid deposit

Code figure	mm	Code figure	mm	Code figure	mm	Code figure	mm
00	0	26	26	52	52	78	280
01	1	27	27	53	53	79	290
02	2	28	28	54	54	80	300
03	3	29	29	55	55	81	310
04	4	30	30	56	60	82	320
05	5	31	31	57	70	83	330
06	6	32	32	58	80	84	340
07	7	33	33	59	90	85	350
08	8	34	34	60	100	86	360
09	9	35	35	61	110	87	370
10	10	36	36	62	120	88	380
11	11	37	37	63	130	89	390
12	12	38	38	64	140	90	400
13	13	39	39	65	150	91	0•1
14	14	40	40	66	160	92	0•2
15	15	41	41	67	170	93	0•3
16	16	42	42	68	180	94	0•4
17	17	43	43	69	190	95	0•5
18	18	44	44	70	200	96	0•6
19	19	45	45	71	210	97	A little precipitation, non-measurable
20	20	46	46	72	220		
21	21	47	47	73	230		
22	22	48	48	74	240	98	More than 400 mm
23	23	49	49	75	250		
24	24	50	50	76	260	99	Measurement impossible
25	25	51	51	77	270		

3761

S_0 - Hoar frost or coloured precipitation

Code figure	
0	Hoar frost on horizontal surfaces
1	Hoar frost on horizontal and vertical surfaces
2	Precipitation containing sand or desert dust
3	Precipitation containing volcanic ash

3764

S_6 - Type of frozen deposit

Code figure	
0	Glaze
1	Soft rime
2	Hard rime
3	Snow deposit
4	Wet snow deposit
5	Freezing wet snow deposit
6	Compound deposits (at the same time glazed ice and rime, or rime and freezing wet snow, etc.)
7	Ground ice*
8	Not used
9	Not used

*Note: Ice or ice-encrusted snow on the surface of the ground. This forms as a result of freezing liquid precipitation - rain, drizzle, thick fog droplets, wet snow, and also as a result of freezing snowmelt on the surface of the ground. Ground ice also includes snow which is compacted and ice-encrusted as a result of road traffic movement. Ground ice, as distinct from glaze, is observed only on the surface of the ground, and most often on the road.

3765

S_7 - Character of the snow cover

Code figure	
0	Light, fresh snow
1	Fresh snow blown into drifts
2	Fresh compact snow
3	Old snow, loose
4	Old snow, firm
5	Old snow, moist
6	Loose snow, with surface crust
7	Firm snow, with surface crust
8	Moist snow, with surface crust

3766

S_8 - Snow-storm phenomena (snow raised by the wind)

Code figure	
0	Snow haze
1	Drifting snow, slight or moderate, with or without snow falling
2	Drifting snow, heavy, without snow falling
3	Drifting snow, heavy, with snow falling
4	Blowing snow, slight or moderate, without snow falling
5	Blowing snow, heavy, without snow falling
6	Blowing snow, slight or moderate, with snow falling
7	Blowing snow, heavy, with snow falling
8	Drifting and blowing snow, slight or moderate, impossible to determine whether snow is falling or not
9	Drifting and blowing snow, heavy, impossible to determine whether snow is falling or not

3775

S'_7 - Regularity of the snow cover

Code figure	
0	Even snow cover, ground frozen, no drifts
1	Even snow cover, ground soft, no drifts
2	Even snow cover, state of ground unknown, no drifts
3	Snow cover moderately uneven, ground frozen, slight drifts
4	Snow cover moderately uneven, ground soft, slight drifts
5	Snow cover moderately uneven, state of ground unknown, slight drifts
6	Snow cover very uneven, ground frozen, deep drifts
7	Snow cover very uneven, ground soft, deep drifts
8	Snow cover very uneven, state of ground unknown, deep drifts

3776

S'_8 - Evolution of drift snow

Code figure	
0	Drift snow ended before the hour of observation
1	Intensity diminishing
2	No change
3	Intensity increasing
4	Continues, apart from interruption lasting less than 30 minutes
5	General drift snow has become drift snow near the ground
6	Drift snow near the ground has become general drift snow
7	Drift snow has started again after an interruption of more than 30 minutes

3848

s_q - Nature and/or type of squall

Code figure	
0	Calm or light wind followed by squall
1	Calm or light wind followed by succession of squalls
2	Gusty weather followed by squall
3	Gusty weather followed by a succession of squalls
4	Squall followed by gusty weather
5	General gusty weather with squall at intervals
6	Squall approaching station
7	Line squall
8	Squall with drifting or blowing dust or sand
9	Line squall with drifting or blowing dust or sand

3870

ss - Depth of newly fallen snow

Code figure	mm	Code figure	mm	Code figure	mm	Code figure	mm
00	0	26	260	52	520	78	2800
01	10	27	270	53	530	79	2900
02	20	28	280	54	540	80	3000
03	30	29	290	55	550	81	3100
04	40	30	300	56	600	82	3200
05	50	31	310	57	700	83	3300
06	60	32	320	58	800	84	3400
07	70	33	330	59	900	85	3500
08	80	34	340	60	1000	86	3600
09	90	35	350	61	1100	87	3700
10	100	36	360	62	1200	88	3800
11	110	37	370	63	1300	89	3900
12	120	38	380	64	1400	90	4000
13	130	39	390	65	1500	91	1
14	140	40	400	66	1600	92	2
15	150	41	410	67	1700	93	3
16	160	42	420	68	1800	94	4
17	170	43	430	69	1900	95	5
18	180	44	440	70	2000	96	6
19	190	45	450	71	2100	97	Less than 1 mm
20	200	46	460	72	2200	98	More than 4000 mm
21	210	47	470	73	2300		
22	220	48	480	74	2400	99	Measurement impossible or inaccurate
23	230	49	490	75	2500		
24	240	50	500	76	2600		
25	250	51	510	77	2700		

3955

T_w - Variation of temperature during the period covered by W_1 W_2 associated with glaze or rime

Code figure	
0	Temperature steady
1	Temperature falling, without going below 0°C
2	Temperature rising, without going above 0°C
3	Temperature falling to a value below 0°C
4	Temperature rising to a value above 0°C
5	Irregular variation, oscillation of temperature passing through 0°C
6	Irregular variation, oscillations of temperature not passing through 0°C
7	Variation of temperature not observed
8	Not allocated
9	Variation of temperature unknown owing to lack of thermograph

4055

t_w - Time of commencement of a phenomenon before the hour of observation

Code figure	
0	0 to 1/2 hour
1	1/2 to 1 hour
2	1 to 1-1/2 hours
3	1-1/2 to 2 hours
4	2 to 2-1/2 hours
5	2-1/2 to 3 hours
6	3 to 3-1/2 hours
7	3-1/2 to 4 hours
8	4 to 5 hours
9	5 to 6 hours

4077

tt - Time before observation or duration
zz - Variation, location or intensity of phenomena

Code figure		
00	At observation	
01	0 hour	6 minutes
02	0 hour	12 minutes
03	0 hour	18 minutes
04	0 hour	24 minutes
05	0 hour	30 minutes
06	0 hour	36 minutes
07	0 hour	42 minutes
08	0 hour	48 minutes
09	0 hour	54 minutes
10	1 hour	0 minutes
11	1 hour	6 minutes
12	1 hour	12 minutes

(Code table 4077 - contd)

Code figure		
13	1 hour	18 minutes
14	1 hour	24 minutes
15	1 hour	30 minutes
16	1 hour	36 minutes
17	1 hour	42 minutes
18	1 hour	48 minutes
19	1 hour	54 minutes
20	2 hours	0 minutes
21	2 hours	6 minutes
22	2 hours	12 minutes
23	2 hours	18 minutes
24	2 hours	24 minutes
25	2 hours	30 minutes
26	2 hours	36 minutes
27	2 hours	42 minutes
28	2 hours	48 minutes
29	2 hours	54 minutes
30	3 hours	0 minutes
31	3 hours	6 minutes
32	3 hours	12 minutes
33	3 hours	18 minutes
34	3 hours	24 minutes
35	3 hours	30 minutes
36	3 hours	36 minutes
37	3 hours	42 minutes
38	3 hours	48 minutes
39	3 hours	54 minutes
40	4 hours	0 minutes
41	4 hours	6 minutes
42	4 hours	12 minutes
43	4 hours	18 minutes
44	4 hours	24 minutes
45	4 hours	30 minutes
46	4 hours	36 minutes
47	4 hours	42 minutes
48	4 hours	48 minutes
49	4 hours	54 minutes
50	5 hours	0 minutes
51	5 hours	6 minutes
52	5 hours	12 minutes
53	5 hours	18 minutes
54	5 hours	24 minutes
55	5 hours	30 minutes
56	5 hours	36 minutes
57	5 hours	42 minutes
58	5 hours	48 minutes
59	5 hours	54 minutes
60	6 hours	0 minutes
61	6 to 7 hours	
62	7 to 8 hours	
63	8 to 9 hours	

(Code table 4077 - contd)

Code figure	
64	9 to 10 hours
65	10 to 11 hours
66	11 to 12 hours
67	12 to 18 hours
68	More than 18 hours
69	Time unknown
70	Began during observation
71	Ended during observation
72	Began and ended during observation
73	Changed considerably during observation
74	Began after observation
75	Ended after observation
76	At station
77	At station, but not in distance
78	In all directions
79	In all directions, but not at station
80	Approaching station
81	Receding from station
82	Passing station in distance
83	Seen in distance
84	Reported in vicinity, but not at station
85	Aloft, but not near the ground
86	Near the ground, but not aloft
87	Occasional; occasionally
88	Intermittent; intermittently
89	Frequent; frequently; at frequent intervals
90	Steady; steady in intensity; steadily; no appreciable change
91	Increasing; increasing in intensity; has increased
92	Decreasing; decreasing in intensity; has decreased
93	Fluctuating; variable
94	Continuous; continuously
95	Very light; very weak; greatly below normal; very thin; very poor
96	Light; weak; below normal; thin; poor
97	Moderate; normal; average thickness; fair; gradually
98	Heavy; severe; thick; above normal; good, suddenly
99	Very heavy; killing; very severe; dense; greatly above normal; very thick; very good

Notes:

(1) Code figures 00 to 69, which are used exclusively for tt, refer to the standard time of observation or, when duration of a phenomenon is reported, to the time period between its commencement and cessation.

(2) Code figures 70 to 75, which combine time and variation, refer to the actual time the elements were observed.

(3) Code figures 76 to 99, which are used exclusively for zz, refer to:
(a) The location of the phenomenon in relation to the station (76 to 86);
(b) Variation (87 to 94);
(c) Intensity (95 to 99).

4332

V_b - Variation of visibility during the hour preceding the observation

Code figure		
0	Visibility has not varied (Sun* visible))	
1	Visibility has not varied (Sun* invisible))	
2	Visibility has increased (Sun* visible))	towards direction D_a
3	Visibility has increased (Sun* invisible))	
4	Visibility has decreased (Sun* visible))	
5	Visibility has decreased (Sun* invisible))	
6	Fog coming from direction D_a	
7	Fog has lifted, without dissipating)	
8	Fog has dispersed)	without regard to direction
9	Morning patches or banks of fog)	

* Or sky (if Sun is low), or Moon or stars at night

4448

V_p - Forward speed of phenomenon

Code figure			
0	less than 5 knots	less than 9 km h^{-1}	less than 2 m s^{-1}
1	5-14 knots	10-25 km h^{-1}	3-7 m s^{-1}
2	15-24 knots	26-44 km h^{-1}	8-12 m s^{-1}
3	25-34 knots	45-62 km h^{-1}	13-17 m s^{-1}
4	35-44 knots	63-81 km h^{-1}	18-22 m s^{-1}
5	45-54 knots	82-100 km h^{-1}	23-27 m s^{-1}
6	55-64 knots	101-118 km h^{-1}	28-32 m s^{-1}
7	65-74 knots	119-137 km h^{-1}	33-38 m s^{-1}
8	75-84 knots	138-155 km h^{-1}	39-43 m s^{-1}
9	85 knots or more	156 km h^{-1} or more	44 m s^{-1} or more

4687

w_1w_1 - Present weather (in addition to code table 4677)

Decade 00-09

00) 01) 02) 03)	Not used
04	Volcanic ash suspended in the air aloft
05	Not used
06	Thick dust haze, visibility less than 1 km
07	Blowing spray at the station
08	Drifting dust (sand)
09	Wall of dust or sand in distance (like haboob)

(Code table 4687 - contd)

Decade 10-19

10	Snow haze
11	Whiteout
12	Not used
13	Lightning, cloud to surface
14	Not used
15	Not used
16	Not used
17	Dry thunderstorm
18	Not used
19	Tornado cloud (destructive) at or within sight of the station during preceding hour or at the time of observation

Decade 20-29

20	Deposition of volcanic ash
21	Deposition of dust or sand
22	Deposition of dew
23	Deposition of wet snow
24	Deposition of soft rime
25	Deposition of hard rime
26	Deposition of hoar frost
27	Deposition of glaze
28	Deposition of ice crust (ice slick)
29	Not used

Decade 30-39

30	Duststorm or sandstorm with temperature below 0°C
31)	
32)	
33)	
34)	
35)	Not used
36)	
37)	
38)	
39	Blowing snow, impossible to determine whether snow is falling or not

Decade 40-49

40	Not used
41	Fog on sea
42	Fog in valleys
43	Arctic or Antarctic sea smoke
44	Steam fog (sea, lake or river)

(Code table 4687 - contd)

45	Steam fog (land)
46	Fog over ice or snow cover
47	Dense fog, visibility 60-90 m
48	Dense fog, visibility 30-60 m
49	Dense fog, visibility less than 30 m

Decade 50-59

50)		(less than 0.10 mm h^{-1}
51)		(0.10 - 0.19 mm h^{-1}
52)		(0.20 - 0.39 mm h^{-1}
53)	Drizzle, rate of fall	(0.40 - 0.79 mm h^{-1}
54)		(0.80 - 1.59 mm h^{-1}
55)		(1.60 - 3.19 mm h^{-1}
56)		(3.20 - 6.39 mm h^{-1}
57)		(6.4 mm h^{-1} or more
58	Not used	
59	Drizzle and snow (ww = 68 or 69)	

Decade 60-69

60)		(less than 1.0 mm h^{-1}
61)		(1.0 - 1.9 mm h^{-1}
62)		(2.0 - 3.9 mm h^{-1}
63)	Rain, rate of fall	(4.0 - 7.9 mm h^{-1}
64)		(8.0 - 15.9 mm h^{-1}
65)		(16.0 - 31.9 mm h^{-1}
66)		(32.0 - 63.9 mm h^{-1}
67		64.0 mm h^{-1} or more
68	Not used	
69	Not used	

Decade 70-79

70)		(less than 1.0 cm h^{-1}
71)		(1.0 - 1.9 cm h^{-1}
72)		(2.0 - 3.9 cm h^{-1}
73)	Snow, rate of fall	(4.0 - 7.9 cm h^{-1}
74)		(8.0 - 15.9 cm h^{-1}
75)		(16.0 - 31.9 cm h^{-1}
76)		(32.0 - 63.9 cm h^{-1}
77)		(64.0 cm h^{-1} or more
78	Snow or ice crystal precipitation from a clear sky	
79	Wet snow, freezing on contact	

Decade 80-99

80	Precipitation of rain (ww = 87-99))	
81	Precipitation of rain, freezing (ww = 80-82))	
82	Precipitation of rain and snow mixed)	
83	Precipitation of snow)	
84	Precipitation of snow pellets or small hail)	
85	Precipitation of snow pellets or small hail, with rain)	(ww = 26-27)
86	Precipitation of snow pellets or small hail, with rain and snow mixed)	(ww = 68 or 69) (ww = 87-99)
87	Precipitation of snow pellets or small hail, with snow)	
88	Precipitation of hail)	
89	Precipitation of hail, with rain)	
90	Precipitation of hail with rain and snow mixed)	
91	Precipitation of hail, with snow)	
92	Shower(s) or thunderstorm over sea	
93	Shower(s) or thunderstorm over mountains	
94)		
95)		
96)	Not used	
97)		
98)		
99)		

5161

Z_e - Optical phenomena

Code figure	
0	Brocken spectre
1	Rainbow
2	Solar or lunar halo
3	Parhelia or anthelia
4	Sun pillar
5	Corona
6	Twilight glow
7	Twilight glow on the mountains (Alpenglühen)
8	Mirage
9	Zodiacal light

4. DEFINITIONS OF TERMS USED IN THE SUPPLEMENTARY INFORMATION CODE TABLE

Alpine glow:

Pink or yellow colouring assumed by mountain tops opposite the sun when it is only just below the horizon before it rises and after it sets. This phenomenon vanishes after a brief interval of blue colouring, when the Earth's shadow reaches these summits.

Day darkness:

Sky covered with clouds with very strong optical thickness (dark clouds) having a threatening appearance.

Dry thunderstorm:

A thunderstorm without precipitation reaching the ground (distinct from a nearby thunderstorm with precipitation reaching the ground but not at the station at the time of observation).

Dust wall or sand wall:

Front of a duststorm or sandstorm, having the appearance of a gigantic high wall which moves more or less rapidly.

Haboob:

A strong wind and duststorm or sandstorm in the northern and central Sudan. Its average duration is three hours; the average maximum wind velocity is over 15 m s^{-1}. The dust and sand form a dense whirling wall which may be 1000 m high; it is often preceded by isolated dust whirls. Haboobs usually occur after a few days of rising temperature and falling pressure.

Ice crust (ice slick):

(1) A type of snow crust; a layer of ice, thicker than a film crust, upon a snow surface. It is formed by the freezing of melt water or rain water which has flowed into it.

(2) Same as ice rind.

Ice rind:

A thin but hard layer of sea ice, river ice or lake ice. Apparently, this term is used in at least two ways: (a) for a new encrustation upon old ice; and (b) for a single layer of ice usually found in bays and fjords where fresh water freezes on top of slightly colder sea water.

Purple light:

Glow with a hue varying between pink and red, which is to be seen in the direction of the sun before it rises and after it sets and is about 3° to 6° below the horizon. It takes the form of a segment of a more-or-less large luminous disc which appears above the horizon.

Snow haze:

A suspension in the air of numerous minute snow particles, considerably reducing the visibility at the Earth's surface (visibility in snow haze often decreases to 50 m). Snow haze is observed most frequently in Arctic regions, before or after a snow storm.

Sun pillar:

Pillar of white light, which may or may not be continuous, which may be observed vertically above or below the sun. Sun pillars are most frequently observed near sunrise or sunset; they may extend to about

20° above the sun, and generally end in a point. When a sun pillar appears together with a well-developed parhelic circle, a sun cross may appear at their intersection.

Twilight glow:

See Purple light.

Twilight glow in the mountains (Alpenglühen):

See Alpine glow.

Whiteout:

Uniformly white appearance of the landscape when the ground is snow covered and the sky is uniformly covered with clouds. An atmospheric optical phenomenon of the polar regions in which the observer appears to be engulfed in a uniformly white glow. No shadows, horizon or clouds are discernible; sense of depth and orientation are lost; only very dark, nearby objects can be seen. Whiteout occurs over an unbroken snow cover and beneath a uniformly overcast sky, when, with the aid of the snowblink effect, the light from the sky is about equal to that from the snow surface. Blowing snow may be an additional cause. The phenomenon is experienced in the air as well as on the ground.

Zodiacal light:

White or yellowish light which spreads out, in the night sky, more or less along the zodiac from the horizon on the side on which the sun is hidden. It is observed when the sky is sufficiently dark and the atmosphere sufficiently clear.

Rec. 17 (CBS-IX) - AMENDMENTS TO CODE FORMS FM 63-VIII Ext. BATHY AND FM 64-VIII Ext. TESAC

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Recommendation 5 (CBS-Ext.(85)) - Amendments to code forms FM 12-VII SYNOP and FM 13-VII SHIP,

(2) Resolution 4 (EC-XXXVIII) - Report of the extraordinary session of the Commission for Basic Systems,

(3) Resolution 6 (CBS-VIII) - Working Group on Codes,

CONSIDERING:

(1) That BATHY and TESAC observations are made by ships and oil- and gas-production platforms and that these observations may also be made by moored data buoys,

(2) That the present code forms FM 63-VIII Ext. BATHY and FM 64-VIII Ext. TESAC include an identifier, but only in the form of D....D,

(3) That, effective 1 November 1987, the identifier D....D for oil- and gas-production platforms was replaced by the group $A_1 b_w n_b n_b n_b$,

RECOMMENDS that the amendments to code forms FM 63-VIII Ext. BATHY and FM 64-VIII Ext. TESAC, given in the annex to this recommendation, be adopted for use as from 1 November 1988;

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

Annex to Recommendation 17 (CBS-IX)

AMENDMENTS TO CODE FORMS FM 63-VIII Ext. BATHY AND FM 64-VIII Ext. TESAC

1. CODE FORMS

1.1 Delete the ship's call sign from Section 3 of FM 63-VIII Ext. BATHY.

1.1.2 Add new Section 4 to FM 63-VIII Ext. BATHY as follows:

	(	D....D
SECTION 4	(	or
	(	99999 $A_1 b_w n_b n_b n_b$

1.2 Delete the ship's call sign from Section 4 of FM 64-VIII Ext. TESAC.

1.2.1 Add new Section 5 to FM 64-VIII Ext. TESAC as follows:

	(	D....D
SECTION 5	(	or
	(	99999 $A_1 b_w n_b n_b n_b$

1.3 Revise Note 3 of BATHY and TESAC to read "four or five sections, as appropriate:".

1.3.1 Add Sections 4 and 5 to Note 3 of BATHY and TESAC as follows:

Section number	Symbolic figure group	Contents
4 or 5	-	Ship's call sign or
	or	station identification
	99999	group $A_1 b_w n_b n_b n_b$

2. REGULATIONS

Change Regulations 63.5 and 64.6 to read as follows:

63.5 64.6
Section 4 and Section 5

Ship's call sign D....D or identifier group 99999 together with station identification group $A_1 b_w n_b n_b n_b$

The ship's call sign D....D or identifier group 99999 together with the station identification group $A_1b_wn_bn_bn_b$, if not already included in the message, shall be added by the coastal radio station receiving the report or the national collecting centre when preparing the report for inclusion in bulletins, as appropriate and required.

NOTES:

(1) See Regulation 12.1.7.

(2) See Regulation 14.4.1, Notes (1), (2) and (3).

Rec. 18 (CBS-IX) - MODIFICATIONS TO REGULATIONS OF FM 51-VIII Ext. TAF

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) WMO Technical Regulations, Regulation [C.3.1.] 6.2.11,

CONSIDERING that there is an expressed need by CAeM to modify the regulations of FM 51-VIII Ext. TAF to take into account a recent amendment to Regulation [C.3.1.] 6.2.11 of the WMO Technical Regulations,

RECOMMENDS that the modifications to the regulations of FM 51-VIII Ext. TAF given in the annex to this recommendation be adopted for use as from 1 November 1988;

REQUESTS the Secretary-General to arrange for the inclusion of the modifications in Volume I of the Manual on Codes.

Annex to Recommendation 18 (CBS-IX)

MODIFICATIONS TO REGULATIONS OF FM 51-VIII EXT. TAF

Replace Regulations 51.6 to 51.6.4 with the following:

51.6

Group $N_sCCh_sh_sh_s$

51.6.1

This group shall be repeated to indicate different layers or masses of cloud forecast. The number of groups shall not exceed three except that Cumulonimbus clouds, when forecast, shall always be included, so that the total number shall not exceed four.

51.6.2

The inclusion of forecast layers or masses of cloud shall be made in accordance with the following criteria:

1st group: the lowest individual layer (mass) of any amount (N_s = 1 or more);

2nd group: the next individual layer (mass) of which the amount is greater than N_s = 2 (N_s = 3 or more);

3rd group: the next higher individual layer (mass) of which the amount is greater than N_s = 4 (N_s = 5 or more);

4th group: Cumulonimbus clouds, when forecast, if not already included in one of the three groups above.

51.6.3

Subject to Regulation 51.6.2, in any cloud group, N_s shall be the total amount of cloud that the forecaster expects to be at the level given by $h_sh_sh_s$.

51.6.4

When clear sky is forecast, the cloud group shall not be used except after a change group when the abbreviation SKC shall be used. When N_s = 1 to 9, cloud groups shall always be used unless Regulation 51.6.6 applies.

51.6.5

When in the first cloud group N_s = 9 is forecast, this group shall be coded $9//h_sh_sh_s$, where $h_sh_sh_s$ shall be the vertical visibility.

51.6.6

When so determined by regional air navigation agreement, cloud information shall be limited to cloud of operational significance, i.e. cloud below 1500 m (5000 ft) or the highest minimum sector altitude, whichever is greater, and Cumulonimbus whenever forecast. In applying this limitation, when no Cumulonimbus and no cloud below 1500 m (5000 ft) or below the highest minimum sector altitude, whichever is greater, are forecast, and "CAVOK" or "SKC" are not appropriate, the abbreviation "NSC" shall be used.

NOTE: See Regulation 51.7.

Rec. 19 (CBS-IX) - AMENDMENTS TO FM 92-VIII Ext. GRIB

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) Resolution 5 (CBS-VIII) - Working Group on the GDPS,

CONSIDERING that there is an urgent requirement to amend and extend specifications for FM 92-VIII Ext. GRIB to cater for, among others, additional parameters, averages and accumulations, rotation and stretching of co-ordinate systems, simple and complex packing and polar-stereographic projections,

RECOMMENDS that the amendments to specifications and tables of FM 92-VIII Ext. GRIB in the annex to this recommendation be adopted for use as from 1 November 1988;

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

Annex to Recommendation 19 (CBS-IX)

AMENDMENTS TO FM 92-VIII Ext. GRIB

1. ADDITIONS TO CODE TABLE 2

Specific proposals for additions to FM 92 - GRIB by a Member to include five parameters in code table 2 was accepted as follows:

Code figure	Field parameter(s)	Unit
17	4-layer lifted index	1°C
48	Convective precipitation amount	1 mm
55	Non-convective precipitation amount	1 mm
141	Vertical velocity	1 hPa s^{-1}
190	Quality indicators (for generating model)	

It was felt that code table 2 needed a complete revision to make it more suitable for GRIB and that this would result in sufficient space being available for extra parameters to be added in the future. Together with such revision, the opportunity should be taken to include some editorial amendments to harmonize the terminology used in GRIB and BUFR.

2. DOCUMENTATION ERROR

It was agreed that the definition of the ECMWF representation mode in code table 10 should be amended as follows:

Code figure	
1	The complex numbers X_n^m (see code table 9 above) are stored for $m \geqq 0$ as pairs of real numbers $Re(X_n^m)$, $Im(X_n^m)$ ordered with n increasing from m to N(m), first for m = 0 and then for m = 1,2,...M. The real part of the (0,0) coefficient is stored in octets 12-15 of the binary data block. The imaginary part of the (0,0) coefficient and the remaining coefficients are packed, and are stored in octets 16 onwards of the binary data block.

3. GRIB EDITION NUMBER

The following definition of Block 1 was agreed in order to give the GRIB code an edition number (in a similar way to BUFR), the current FM 92-VIII Ext. being considered as Edition 0:

Block 1 - Product definition block

Octet No.	Contents
1-3	Length of block
4	Edition number of GRIB specification
5	Identification of centre (see F_1F_2 (FM 47-V, FM 49-VII). See publication WMO-No. 386, Volume I, Part II, Attachment II-9, Table A.)

4. AVERAGES AND ACCUMULATIONS

The GRIB code, as currently defined, does not permit the averaging or accumulation of values over a number of forecasts or analyses. Since a need exists for this type of data to be included, extensions to the GRIB code are necessary. The following proposal was recommended:

Block 1 - Product definition block

Octet No.	Contents
13-17	Reference time of data Date and time of start of averaging or accumulation period
19	Time 1 Forecast period (0 for analyses and initialized analyses)
20	Time 2 Interval between successive forecasts, analyses or initialized analyses
22-23	Number averaged (to include any which may be missing in the given period)
24	Number missing This octet is currently not used, but added to give an even number of octets in Block 1
21	Time range indicator (code table 5 entries) 113 Average of N forecasts (or initialized analyses), forecast period T1 (T1 = 0 for analyses), at intervals of T2 114 Accumulation of N forecasts (or initialized analyses), forecast period T1 (T1 = 0 for analyses), at intervals of T2

123 Average of N uninitialized analyses, at intervals of T2 (T1 = 0)

124 Accumulation of N uninitialized analyses, at intervals of T2 (T1 = 0)

5. ROTATION OF THE CO-ORDINATE SYSTEM

The current definition implicitly refers to a co-ordinate system in which the poles of the system coincide with the conventional "geographic" North and South Poles, and in which the origin of longitude is the Greenwich meridian. Three parameters define a general latitude/longitude co-ordinate system, formed by a general rotation of the sphere. One choice for these parameters is:

1. The geographic latitude in degrees of the southern pole of the co-ordinate system, θ_p for example.

2. The geographic longitude in degrees of the southern pole of the co-ordinate system, λp for example.

3. The angle of rotation in degrees about the new polar axis (measured clockwise when looking from the southern to the northern pole) of the co-ordinate system, assuming the new axis to have been obtained by first rotating the sphere through λp degrees about the geographic polar axis, and then rotating through $(90 + \theta p)$ degrees so that the south pole moved along the (previously rotated) Greenwich meridian.

It was agreed that these requirements could be met by additional entries in code table 6 - Data representation type, and adding corresponding Block 2 - Grid description block definitions.

Additional entries in code table 6:

Code figure	Meaning
10	Rotated latitude/longitude grid
14	Rotated Gaussian latitude/longitude grid
60	Rotated spherical harmonic coefficients

For Gaussian and regular latitude/longitude grids, Block 2 for rotated grids shall be similar to those for the normal grids, but with the following extensions:

Octet No.	Contents
33–35	Latitude of the southern pole in degrees x 1000 (integer)
36–38	Longitude of the southern pole in degrees x 1000 (integer)
39–42	Angle of rotation (represented in the same way as the reference value)

For spherical harmonic data the same extensions would apply, and the vertical co-ordinate parameters shall start at octet 43 instead of 33.

6. STRETCHING OF THE CO-ORDINATE SYSTEM

The stretching is defined by three parameters:

1. The latitude in degrees (measured in the model co-ordinate system) of the "pole of stretching".

2. The longitude in degrees (measured in the model co-ordinate system) of the "pole of stretching".

3. The stretching factor C.

The stretching is defined by representing data uniformly in a co-ordinate system with longitude λ and latitude θ^1, where

$$\theta^1 = \sin^{-1} \frac{(1-c^2)+(1+c^2)\sin\theta}{(1+c^2)+(1-c^2)\sin\theta}$$

and λ and θ are longitude and latitude in a co-ordinate system in which the "pole of stretching" is the north pole. c=1 gives uniform resolution, while c > 1 gives enhanced resolution around the pole of stretching.

It was agreed that this could be implemented in the same way as rotation of the system: additional entries in code table 6 and new grid description definitions. For spherical harmonic data the vertical co-ordinate parameters begin in octet 43.

Additional entries in code table 6:

Code figure	Meaning
20	Stretched latitude/longitude grid
24	Stretched Gaussian latitude/longitude grid
70	Stretched spherical harmonics

Block 2 definitions:

Octet No.	Contents
33-35	Latitude of pole of stretching in degrees x 1000 (integer)
36-38	Longitude of pole of stretching in degrees x 1000 (integer)
39-42	Stretching factor (representation as for the reference value)

7. STRETCHED AND ROTATED CO-ORDINATE SYSTEMS

These should be implemented as in 5 and 6 above.

Additional entries in code table 6:

Code figure	Meaning
30	Stretched and rotated latitude/longitude grids
34	Stretched and rotated Gaussian latitude/longitude grids
80	Stretched and rotated spherical harmonic coefficients

Block 2 definitions:

Octet No.	Contents
33-35	Latitude of the southern pole in degrees x 1000 (integer)
36-38	Longitude of the southern pole in degrees x 1000 (integer)
39-42	Angle of rotation (represented in the same way as the reference value)
43-45	Latitude of pole of stretching in degrees x 1000 (integer)
46-48	Longitude of pole of stretching in degrees x 1000 (integer)
49-52	Stretching factor (representation as for the reference value)

For spherical harmonic data, vertical co-ordinate parameters begin in octet 53.

8. SIMPLE AND COMPLEX PACKING

GRIB code allows only a simple, straightforward packing of data, with slightly different structure for data in grid-point or spherical harmonic format. There is a need for more flexibility, especially for spherical harmonic data.

In a spherical harmonic representation of meteorological data, amplitudes can be much larger for the components of the lowest few wave numbers than for higher wave numbers, and packing error could become serious for high wave number components, particularly if derivatives of unpacked fields are to be calculated. This is recognized in the current GRIB code by separately storing the real part of the (0,0) coefficient and packing the set of remaining coefficients.

The following modifications to the GRIB definition to include extra parameters provides the option of reducing these problems. No attempt, however, was made to define complex packing of grid data. For spherical harmonic data the following were agreed upon:

CODE TABLE RELATIVE TO BLOCK 4

Code table 11 - Flag (first 4 bits only - bits 3-4 set to zero (reserved))

Bit	Value	Meaning
1	0	Grid-point data
	1	Spherical harmonic coefficients
2	0	Simple packing
	1	Complex packing

Block 4 - Binary data block

Octet No.	Contents
1-3	Length of block
4	Flag (see code table 11 (first 4 bits). Number of unused bits at end of Block 4 (last 4 bits)
5-6	Scale factor (E)
7-10	Reference value (minimum of packed values)
11	Number of bits containing each packed value
12-	Variable, depending on the flag value in octet 4.

Grid point data - Simple packing

Octet No.	Contents
12-	Binary data

Spherical harmonic coefficients - Simple packing

Octet No.	Contents
12-15	Real part of (0,0) coefficient (stored in the same manner as the reference value (octets 7-10))
16-	Binary data

Grid point data - Complex packing

To be developed

Spherical harmonics - Complex packing

Octet No.	Contents
12-13	N
14-15	P
16	J^1
17	K^1
18	M^1
19	Binary data
. .	Unpacked binary data represented in 4 octets in the same way as the reference value (pairs of coefficients)
N	Packed binary data

Add Note (3) as follows:

Note (3) For Spherical harmonics - Complex packing J^1, K^1, M^1 are the pentagonal resolution parameters specifying the truncation of a subset of the data, which shall be represented unpacked (as is the reference value) and shall precede the packed data.

P defines a scaling factor by which is packed not the field itself, but the modulus of ∇^{2m} of the field, where ∇^2 is the Laplacian operator. Thus, the co-efficients ϕ_n^m will be multiplied by $(m(n+1))^P$ before packing, and divided by this factor after unpacking.

N is a pointer to the start of the packed data (i.e. gives octet number)

$(J^1, K^1, M^1 > 0$ and P 0, + or −)

The representation mode (code = 2 in code table 10) in Block 2 shall indicate this type of packing, but as Block 2 is optional the flag field in Block 4 may also be used to indicate the more complex method.

9. POLAR-STEROGRAPHIC PROJECTIONS

Block 2, Code table 6 add extra entry:

Code table 6 - Data representation type

Code figure	Meaning
5	Polar stereographic

Block 2 - Grid description block, add extra definition:

Grid Definition - polar stereographic

Octet No.	Contents
7-8	Nx - Number of points along x-axis
9-10	Ny - Number of points along y-axis
11-13	Lal - Latitude of origin (lower left)
14-16	Lol - Longitude of origin (lower left)
17	Reserved
18-20	LoV - The orientation of the grid; i.e. the longitude value of the meridian which is parallel to the y-axis (or columns of the grid) along which latitude increases as the y-co-ordinate increases (Note: the orientation longitude may or may not appear on a particular grid)
21-23	Dx - x-direction increment (see Note (2))
24-26	Dy - y-direction increment (see Note (2))
27	Projection centre flag (see Note (5))
28	Scanning mode (see Note (6))
29-32	Set to zero (reserved)

NOTES:

(1) Latitude and longitude are in thousandths of degrees.

(2) Increments are in units of metres, at the 60° latitude circle nearest to the pole on the projection plane.

(3) Latitude values are limited to the range 0 - 90 000. Bit 1 is set to 1 to indicate south latitude.

(4) Longitude values are limited to the range 0 - 360 000. Bit 1 is set to 1 to indicate west longitude.

(5) Octet 27 (projection centre flag) is:
set to 0 if the North Pole is on the projection plane;
set to 1 if the South Pole is on the projection plane.

(6) Octet 28 (scanning mode) is composed as follows:
bit 1 - set to 0 to indicate left to right;
bit 2 - set to 0 to indicate top to bottom;
bit 3 - set to 0 to indicate the points scan along the x-axis first and then along the y-axis.

(7) Where items are not given, the appropriate octet(s) shall have all bits set to 1.

Rec. 20 (CBS-IX) - FM 94-IX BUFR Binary Universal Form for Data Representation

THE COMMISSION FOR BASIC SYSTEMS,

NOTING:

(1) Resolution 6 (CBS-VIII) - Working Group on Codes,

(2) Resolution 5 (CBS-VIII) - Working Group on the GDPS,

(3) Abridged final report of the eighth session of CBS, general summary, paragraph 8.19,

(4) Abridged final report of the CBS extraordinary session (1985), general summary, paragraph 7.2.30,

CONSIDERING:

(1) That there is a need for adoption of a standard Binary Universal Form for Data Representation,

(2) That Members/centres using the experimental BUFR form have expressed their satisfaction with all aspects, including arrangements and procedures for transformation to other codes as may be required by non-automated centres or other users,

RECOMMENDS:

(1) That the representation form FM 94-IX BUFR - Binary Universal Form for Data Representation, given in Annex I to this recommendation, be adopted for use between appropriately equipped automated centres as from 1 November 1988;

(2) That the definition of FM 94-IX BUFR using Backus Naur Form (BNF) given in Annex II to this recommendation, and the reference list given in Annex III to this recommendation, be included as attachments to the Manual on Codes, without Technical Regulation status;

REQUESTS the Secretary-General to arrange for the inclusion of the FM 94-IX BUFR in Volume I of the Manual on Codes.

Annex I to Recommendation 20 (CBS-IX)

UNIVERSAL FORM FOR DATA REPRESENTATION

FM 94-IX BUFR - Binary Universal Form for the Representation of Meteorological Data

REPRESENTATION FORM:

Section 0	BUFR
Section 1	Identification section
Section 2	(Optional section)
Section 3	Data description section
Section 4	Data section
Section 5	7777

Notes:

(1) BUFR is the name of a binary code for the exchange and storage of data.

(2) The BUFR message consists of a continuous bit-stream made of a sequence of octets (1 octet = 8 bits).

(3) The terms "BUFR message" and "section" describe logical entities to assist BUFR definition.

(4) A BUFR message consists of one or more subsets of related meteorological data defined, described and represented by a single BUFR entity. For observational data, each data subset usually corresponds to one observation.

(5) The octets of a BUFR message are grouped in sections:

Section No.	Name	Contents
0	Indicator section	BUFR
1	Identification section	Length of section, identification of the message
2	Optional section	Length of section and additional items for local use by automatic data-processing centres
3	Data Description section	Length of section, number of data subsets, type of BUFR message flag, data compression flag and a collection of descriptors which define the form and content of individual data elements
4	Data section	Length of section and binary data
5	End section	7777

(6) It will be noted that the BUFR representation is not suitable for visual data recognition without computer interpretation.

(7) The representation of data by means of a series of bits is independent of any particular machine representation.

(8) Section length is expressed in octets. Section 0 and Section 5 have a fixed length of 4 octets. Sections 1, 2, 3 and 4 have a variable length which is included in the first three octets of each section.

REGULATIONS:

94.1

General

94.1.1

The BUFR form shall be used for the binary representation of meteorological data for exchange and storage. BUFR is particularly suitable for meteorological data that cannot be represented using FM 92-VIII Ext. GRIB.

94.1.2

The beginning and the end of the code form shall be identified by four octets coded according to International Alphabet No. 5 to represent, respectively, the indicators "BUFR" and "7777" in Indicator section 0 and End section 5. All other octets included in the code shall represent data in binary form.

94.1.3

Each section included in the code form shall always contain an even number of octets. This rule shall be applied by appending bits set to zero to the section where necessary.

94.1.4

By convention, reserved values in Sections 1 to 4 shall be set to zero.

94.1.5

Missing values shall be set to fields of all ones (e.g. each octet shall be set to 11111111 binary). This shall apply to code and flag tables as well as data elements.

94.1.6

The convention for representing missing data for compressed data within the binary data section shall be to set the corresponding increments to fields of all ones.

94.1.7

When a local reference value for a set of element values for compressed data is represented as all ones, this shall imply that all values in the set are missing.

94.2

Section 0 (Indicator section)

94.2.1

Section 0 shall always be four octets long, character-coded according to International Alphabet No. 5 as BUFR.

94.3

Section 1 (Identification section)

94.3.1

The length of the section, in units of octets, shall be expressed in binary form over the group of the first three octets of the section.

94.3.2

Octet number 8 of the section shall be used to indicate the inclusion or omission of Section 2.

94.4

Section 2 (Optional section)

94.4.1

Regulation 94.3.1 shall apply.

94.4.2

Octet number 5 and subsequent octets shall contain additional items as may be defined within each centre for its own use.

94.5

Section 3 (Data description section)

94.5.1

Regulation 94.3.1 shall apply.

94.5.2

Octet numbers 5 and 6 of the section shall be used as a 16-bit number to indicate the number of data subsets within the BUFR message. Octet number 7 shall be used to indicate whether observed data or other data are reported, and whether data are compressed or not. Octet number 8 and subsequent octets shall contain a collection of descriptors which define the form and content of individual data elements in the data section. A "data subset" shall be defined as the subset of data described by one single application of this collection of descriptors.

94.5.3

Data description syntax for BUFR

94.5.3.1

Data description shall consist of one or more descriptors. Each descriptor shall occupy two octets and contain three parts: F (2 bits), X (6 bits) and Y (8 bits).

94.5.3.2

If F=0 the descriptor shall be called an "element descriptor". An element descriptor shall define a single data item by reference to Table B.

Notes:

(1) X denotes the Table B class, Y denotes the element within that class. The corresponding data item is depicted according to the definition contained in Table B, unless otherwise modified.

(2) The definition(s) of one or more data item(s) may be modified by means of data description operators.

94.5.3.3

Element descriptors corresponding to the following classes in Table B shall remain in effect until superseded by redefinition:

00	Reserved
01	Identification
02	Instrumentation
03	Reserved
04	Location (time)
05	Location (horizontal 1)
06	Location (horizontal 2)
07	Location (vertical)
08	Significance qualifiers
09	Reserved

Note: Redefinition is effected by the occurrence of element descriptors which contradict the preceding element descriptors from these classes. If two or more elements from the same class do not contradict one another they all apply.

94.5.3.4

The consecutive occurrence of two identical element descriptors or identical sets of element descriptors from classes 04 to 07 inclusive shall denote a range of values bounded by the corresponding element values. This enables the definition of time periods, areas, layers and volumes.

94.5.3.5

The consecutive occurrence of two or more non-identical element descriptors from classes 04 to 07 inclusive shall imply that all such elements remain in effect until redefined, unless such elements define an increment.

94.5.3.6

Data items defined by element descriptors in class 10 or above shall not behave as co-ordinates with respect to subsequent data.

94.5.3.7

Any occurrence of an element descriptor from classes 04 to 07 inclusive which defines an increment shall indicate that the location corresponding to that class should be incremented by the corresponding data value.

94.5.4

The replication operation

94.5.4.1

If F=1 the descriptor shall be called a "replication descriptor". For this case X shall indicate the number of descriptors to be repeated, and Y the total number of occurrences (replications) of the repeated sub-sequence.

94.5.4.2

A value of Y=0 associated with the replication descriptor shall indicate delayed replication. In this case the replication data description operator shall be completed by the next element descriptor, which shall define a data item indicating the number of replications. The data item may also indicate that the following datum is to be replicated.

94.5.4.3

The occurrence of a replication descriptor immediately following one or more element descriptors from classes 04 to 07 inclusive, each of which defines location increments, shall imply that all such increments should be applied for each replication; the application of the increments shall have effect from the beginning of each defined replication, including the first.

94.5.5

Further operations on element and sequence descriptors

94.5.5.1

If F=2 the descriptor shall be called an "operator descriptor". An operator descriptor shall define an operation by reference to Table C.

Notes:

(1) X denotes the value corresponding to an operator defined within Table C.

(2) Y contains a value to be used as an operand in completing the defined operation.

94.5.6

Indirect reference to descriptors

94.5.6.1

If F=3 the descriptor shall be called a "sequence descriptor". A sequence descriptor shall define a list of element descriptors, replication descriptors, operator descriptors and/or sequence descriptors by reference to Table D.

Note: X denotes the Table D category, Y denotes the entry within the category. Table D entries contain lists of commonly associated descriptors for convenience.

94.5.6.2

A sequence descriptor shall be equivalent to the corresponding list of descriptors in Table D.

94.6

Section 4 (Data section)

94.6.1

Regulation 94.3.1 shall apply.

94.6.2

Reported values shall be coded using the number of bits for each parameter indicated by reference to the sequence descriptors, replication descriptors, operator descriptors, element descriptors and associated tables.

94.6.3

Values shall be coded in the order indicated by the sequence descriptors, replication descriptors, operator descriptors and element descriptors.

Notes:

(1) Where more than one data subset is included in a single BUFR message without data compression:

 (i) The first set of data values shall be in the order defined by the data description, and shall represent the first data subset;
 (ii) Subsequent sets of data values shall also be in the order defined by the data description, representing subsequent data subsets.

(2) Where more than one data subset is included in a single BUFR message, data compression may be used as follows:

 (i) Values for each data element are grouped into sets, and the sets shall be in the order defined by the data description; the first value in each set shall represent a minimum value for the set; this value is termed a "local reference value", R°, with respect to the subsequent set of data;
 (ii) Local reference values shall be coded according to 94.6.2;
 (iii) If all values of an element are missing, R° shall be coded with all bits set to ones;
 (iv) The local reference value shall be followed by a 6-bit quantity specifying the number of bits for each increment, or if characters are being compressed, the number of octets is specified in the 6-bit quantity. Next, a list of increments (differences between the local reference value and the "actual value" corresponding) shall follow, one for each value corresponding to the set of values for one data element;

(v) Actual values, V, will then be obtained as:

$$V = R + R^{\circ} + I$$

where R = Table reference value
R° = Local reference value
I = Increment;

(vi) Missing values will be denoted by setting all bits of the corresponding I to ones;

(vii) Data elements all having the same value throughout a set shall be signified by coding the number of bits required for storing I as zero; in such cases the increments shall be omitted.

94.7

Section 5 (End section)

94.7.1

The End section shall always be four octets long, character-coded according to International Alphabet No. 5 as 7777.

SPECIFICATION OF OCTET CONTENTS

Notes:

(1) Octets are numbered 1, 2, 3... etc., starting at the beginning of each section.

(2) In the following, bit positions within octets are referred to as bit 1 to bit 8, where bit 1 is the most significant and bit 8 is the least significant bit. Thus, an octet with only bit 8 set 1 would have the integer value 1.

Section 0 (Indicator section)

Octet No.	Contents
1-4	BUFR (Coded CCITT-IA No. 5)

Section 1 (Identification section)

Octet No.	Contents
1-3	Length of section
4	Edition number corresponding to BUFR specification and tables used
5-6	Originating centre (to be defined)
7	Update sequence number (NOTE: = 0 for original BUFR messages; incremented for updates)

8	Bit 1 = 0 = 1 Bits 2-8	No optional section Optional section follows Set to zero (reserved).
9	BUFR message type (Table A)	
10	BUFR message sub-type (defined by local ADP centres)	
11-12	Zero if standard WMO FM 94-IX BUFR tables used, or local tables version number	
13	Year of century)	Most typical for the BUFR message contents
14	Month)	
15	Day)	
16	Hour)	
17	Minute)	
18-	Reserved for local use by ADP centres	

Section 2 (Optional section)

Octet No.	Contents
1-3	Length of section
4	Set to zero (reserved)
5	Reserved for local use by ADP centres

Section 3 (Data description section)

Octet No.	Contents	
1-3	Length of section	
4	Set to zero (reserved)	
5-6	Number of data subsets	
7	Bit 1 = 1 = 0	Observed data Other data
	Bit 2 = 1 = 0	Compressed data Non-compressed data
	Bits 3-8	Set to zero (reserved)
8-	A collection of element descriptors, replication descriptors, operator descriptors and sequence descriptors which define the form and content of individual data elements comprising one data subset in the data section.	

Notes:

(1) The collection of descriptors, beginning at octet 8, is called the "data description".

(2) Each descriptor occupies two octets and contains three parts:

F 2 bits	X 6 bits		Y 8 bits

(3) If F=0, the descriptor is an element descriptor. The values of X and Y refer directly to a single entry in Table B, X indicating the class and Y the entry within that class.

(4) If F=1 the descriptor is a replication descriptor defining the replication data description operator according to 94.5.4.1 and 94.5.4.2. The values of X and Y define the scope of the operator and the number of replications respectively. If Y=0, delayed replication is defined. The next element descriptor will define a data item giving the number of replications; this data may also indicate the following datum which is to be replicated.

(5) If F=2 the descriptor is an operator descriptor. The value of X indicates an operation in Table C. The meaning of Y depends on the operation.

(6) If F=3, the descriptor is a sequence descriptor. The values of X and Y refer directly to a single entry in Table D. Each entry in Table D contains a list of element descriptors, data description operators and/or sequence descriptors. A sequence descriptor is defined to be equivalent to the corresponding list of descriptors at the Table D entry.

Section 4 (Data section)

Octet No.	Contents
1-3	Length of data section (octets)
4	Set to zero (reserved)
5-	Binary data as defined by sequence descriptors

Notes:

(1) The binary data in non-compressed form may be described as follows:

$$
\begin{array}{l}
R_{11},\ R_{12},\ R_{13},\ \ldots\ldots\ldots\ldots\ R_{1s} \\
R_{21},\ R_{22},\ R_{23},\ \ldots\ldots\ldots\ldots\ R_{2s} \\
\quad\vdots \qquad \vdots \qquad \vdots \\
R_{n1},\ R_{n2},\ R_{n3},\ \ldots\ldots\ldots\ldots\ R_{ns}
\end{array}
$$

where R_{ij} is the j^{th} value of the i^{th} data subset;
s is the number of values per data subset;
n is the number of data subsets in the BUFR message.

The data subsets each occupy an identical number of bits, unless delayed replication is used, and are <u>not</u> necessarily aligned on octet boundaries.

(2) Binary data in compressed form may be described as follows:

R_1^o, $NBINC_1$, I_{11}, I_{12} ...... I_{1n}
R_2^o, $NBINC_2$, I_{21}, I_{22} ...... I_{2n}
. . . . .
. . . . .
R_s^o, $NBINC_s$, I_{s1}, I_{s2} ...... I_{sn}

where R_1^o, R_2^o, ..., R_s^o are local reference values for the set of values for each data element (number of bits as Table B);
$NBINC_1$ ... $NBINC_s$ contain, as 6-bit quantities, the number of bits occupied by the increments (I_{11} ...I_{1n}) ... (I_{s1} ...I_{sn});
s is the number of data elements per data subset;
n is the number of data subsets per BUFR message.

If $NBINC_i$=0, all values of element i are equal to R_i; in such cases the increments shall be omitted. If characters are being compressed then NBINC shall contain the number of octets occupied by the increments.

(3) Associated fields are treated as separate data items and precede the data:

e.g.

A/F	DATA
N bits	M bits

Binary data with associated fields may be described as follows:

A_{11}, R_{11}, A_{12}, R_{12}, ... A_{1s}, R_{1s}
A_{21}, R_{21}, A_{22}, R_{22}, ... A_{2s}, R_{2s}
. . . . . .
. . . . . .
. . . . . .
A_{n1}, A_{n1}, A_{n2}, R_{n2}, ... A_{ns}, R_{ns}

where A_{ij} R_{ij} is the j^{th} combined associated field value and data value of the i^{th} data subset;
s is the number of values per data subset;
n is the number of data sub-sets in the BUFR message.

A_{ij} will only exist if R_{ij} has defined units (i.e. is not numeric or a character string, a code table value, or a flag table value), and while the "add associated field" operation is in effect.

(4) Binary data in compressed form with associated fields may be described as follows:

A_1°, $NBINC_{A1}$, I_{A11}, I_{A12} .... I_{A1n}
R_1°, $NBINC_{R1}$, I_{R11}, I_{R12} .... I_{R1n}
. . . . . .
. . . . . .
. . . . . .
A_s°, $NBINC_{Qs}$, I_{As1}, I_{As2} .... I_{Asn}
R_s°, $NBINC_{Rs}$, I_{Rs1}, I_{Rs2} .... I_{Rsn}

where A_1°, R_1°, ... A_s°,R_s° are local reference values (number of bits as Table B) for the set of associated field values and the set of values for each data element.

Section 5 (End Section)

Octet No.	Contents
1-4	7777 (Coded CCITT-IA No. 5)

BUFR tables and code tables

FM 94-IX BUFR references three types of tables: BUFR tables, code tables, and flag tables.

BUFR tables

Tables containing information used to describe, classify and define the contents of a BUFR message are called BUFR tables. Four BUFR tables are defined: Tables A, B, C and D.

Code tables and flag tables

BUFR Table B defines some elements by means of code tables or flag tables. Within this general description are included code tables referenced by code figures, and flag tables where each bit is set 0 or 1 to indicate a false or true value with respect to a specific criterion. The concept of a flag table is especially useful where combinations of criteria are represented. Within BUFR all code tables and flag tables refer to elements defined within BUFR Table B; they are numbered according to the X and Y value of the corresponding Table B reference.

BUFR TABLE RELATIVE TO SECTION 1

BUFR TABLE A (Data category)

Code	Meaning
0	Surface data - land
1	Surface data - sea
2	Vertical soundings (other than satellite)
3	Vertical soundings (satellite)
4	Single-level upper-air data (other than satellite)

5	Single-level upper-air data (satellite)
6	Radar data
7-30	Reserved
31	Oceanographic data
32-100	Reserved
101	Image data
102-253	Reserved

CODE TABLES RELATIVE TO SECTION 3

BUFR TABLE B

Classification of elements

F	X	Class	Comments
0	00	Reserved	
0	01	Identification	Identifies origin and type of data
0	02	Instrumentation	Defines instrument types used
0	03	Reserved	
0	04	Location (time)	Defines time and time derivatives
0	05	Location (horizontal 1)	Defines geographical position, including horizontal derivatives, in association with class 06. (First dimension of horizontal space.)
0	06	Location (horizontal 2)	Defines geographical position, including horizontal derivatives, in association with class 05. (Second dimension of horizontal space.)
0	07	Location (vertical)	Defines height, altitude, pressure level, including vertical derivatives of position
0	08	Significance qualifiers	Defines special character of data
0	09	Reserved	
0	10	Vertical elements and pressure	Height, altitude, pressure and derivatives observed or measured, NOT defined as a vertical location
0	11	Wind and turbulence	Wind speed, direction, etc.
0	12	Temperature	
0	13	Hygrographic and hydrological	Humidity, rainfall, snowfall, etc.

0	14	Radiation and radiance	
0	20	Observed phenomena	Defines present/past weather, special phenomena, etc.
0	21	Radar	Not yet defined
0	22	Oceanographic	
0	30	Image	Not yet defined
0	31	Data description operator qualifiers	Elements used in conjunction with data description operators

Notes:

(1) Where a code table or flag table is appropriate, "code table" or "flag table" respectively is entered in the UNITS column.

(2) The code tables and flag tables associated with Table B are numbered to correspond with the F, X and Y part of the table reference.

(3) To encode values into BUFR, the data (with units as specified in the UNITS column) must be multiplied by ten to the power SCALE. Then subtract the REFERENCE VALUE to give the coded value found in Section 4 of the BUFR message. For example, a measured latitude is -45.76 degrees. The coarse accuracy descriptor is 0 05 002 and the encoded value is $-45.76 \times 10^2 - (-9000) = 4424$.

(4) Where UNITS are given as CCITT IA5, data shall be coded as character data left justified within the field width indicated using CCITT International Alphabet No. 5, and blank filled to the full field width indicated.

(5) Classes 54 to 63 are reserved for local use; all other classes are reserved for future development.

(6) Entries 192 to 255 within all classes are reserved for local use.

*

*　　　　*

BUFR TABLE B

Class 01 - Identification

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	01	001	WMO block number	numeric	0	0	7
0	01	002	WMO station number	numeric	0	0	10
0	01	003	WMO Region number	numeric	0	0	3
0	01	004	WMO Region sub-area	numeric	0	0	3
0	01	005	BUOY/platform identifier	numeric	0	0	17
0	01	006	Aircraft identifier	CCITT IA5	0	0	48
0	01	007	Satellite identifier	code table	0	0	10
0	01	011	SHIP call sign	CCITT IA5	0	0	72
0	01	012	Direction of motion of moving observing platform	degrees true	0	0	9
0	01	013	Speed of motion of moving observing platform	$m\ s^{-1}$	0	0	10
0	01	063	ICAO location indicator	CCITT IA5	0	0	64

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BUFR TABLE B

Class 02 - Instrumentation

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	02	001	Type of station	code table	0	0	2
0	02	002	Type of instrumentation for wind measurement	flag table	0	0	4
0	02	003	Type of measuring instrument used	code table	0	0	3
0	02	011	Radiosonde type	code table	0	0	8
0	02	012	Radiosonde computational method	code table	0	0	4
0	02	021	Satellite instrument data used in processing	flag table	0	0	9
0	02	022	Satellite data-processing technique used	flag table	0	0	8
0	02	023	Cloud motion computational method	code table	0	0	4
0	02	024	Integrated mean humidity computational method	code table	0	0	4
0	02	025	Satellite channel	flag table	0	0	25
0	02	031	Method of current measurement	code table	0	0	5
0	02	032	Indicator for digitization	code table	0	0	2
0	02	033	Method of salinity/depth measurement	code table	0	0	3
0	02	061	Aircraft navigational system	code table	0	0	3

Notes:

(1) This class shall contain elements to describe the instrumentation used to obtain the meteorological elements reported.
(2) This class may also contain elements relating to observational procedures.
(3) Some indication of expected accuracy may be implied in conjunction with certain elements in this class.

BUFR TABLE B

Class 04 - Location (time)

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	04	001	Year	Year	0	0	12
0	04	002	Month	Month	0	0	4
0	04	003	Day	Day	0	0	6
0	04	004	Hour	Hour	0	0	5
0	04	005	Minute	Minute	0	0	6
0	04	006	Second	Second	0	0	6
0	04	011	Time increment	years	0	-1024	11
0	04	012	Time increment	months	0	-1024	11
0	04	013	Time increment	days	0	-1024	11
0	04	014	Time increment	hours	0	-1024	11
0	04	015	Time increment	minutes	0	-2048	12
0	04	016	Time increment	seconds	0	-4096	13
0	04	021	Time period or displacement	years	0	-1024	11
0	04	022	Time period or displacement	months	0	-1024	11
0	04	023	Time period or displacement	days	0	-1024	11
0	04	024	Time period or displacement	hours	0	-1024	11
0	04	025	Time period or displacement	minutes	0	-2048	12
0	04	026	Time period or displacement	seconds	0	-4096	13

Notes:

(1) The significance of time periods or displacements shall be indicated using the time significance code corresponding to table reference 008021.

(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 ordering 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 displacement preceding the currently defined time.

BUFR TABLE B

Class 05 - Location (horizontal 1)

TABLE REFERENCE			ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
F	X	Y					
0	05	001	Latitude (high accuracy)	degrees	5	-9000000	25
0	05	002	Latitude (coarse accuracy)	degrees	2	-9000	15
0	05	011	Latitude increment (high accuracy)	degrees	5	-9000000	25
0	05	012	Latitude increment (coarse accuracy)	degrees	2	-9000	15
0	05	021	Bearing or azimuth	degrees true	2	0	16
0	05	022	Solar azimuth	degrees true	2	0	16

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.

(4) Bearing or azimuth shall only be used with respect to a stated location and shall not redefine that location.

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BUFR TABLE B

Class 06 - Location (horizontal 2)

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	06	001	Longitude (high accuracy)	degrees	5	−18000000	26
0	06	002	Longitude (coarse accuracy)	degrees	2	−18000	16
0	06	011	Longitude increment (high accuracy)	degrees	5	−18000000	26
0	06	012	Longitude increment (coarse accuracy)	degrees	2	−18000	16
0	06	021	Distance	m	−1	0	13

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.

(4) Distance shall only be used with respect to a stated location and a bearing, azimuth or elevation; it shall not redefine that location.

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BUFR TABLE B

Class 07 - Location (vertical)

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	07	001	Height of station	m	0	-400	15
0	07	002	Height of altitude	m	-1	-40	16
0	07	003	Geopotential	$m^2 s^{-2}$	-1	-400	17
0	07	004	Pressure	Pa	-1	0	14
0	07	021	Elevation	degrees	2	-9000	15
0	07	022	Solar elevation	degrees	2	-9000	15
0	07	061	Depth below land surface	m	2	0	14
0	07	062	Depth below sea surface	m	1	0	17

Note: Elevation shall only be used with respect to a stated location and a bearing, azimuth, or distance; it shall not redefine that location.

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BUFR TABLE B

Class 08 - Significance qualifiers

TABLE REFERENCE			ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
F	X	Y					
0	08	001	Vertical sounding significance	flag table	0	0	7
0	08	002	Vertical significance (surface observations)	code table	0	0	6
0	08	003	Vertical significance (satellite observations)	code table	0	0	6
0	08	004	Phase of aircraft flight	code table	0	0	3
0	08	011	Horizontal significance	code table	0	0	6
0	08	012	Land/sea qualifier	code table	0	0	2
0	08	021	Time significance	code table	0	0	5
0	08	022	Total number (with respect to accumulation or average)	numeric	0	0	16

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 008022.

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BUFR TABLE B

Class 10 - Vertical elements and pressure

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	10	001	Height of land surface	m	0	-400	15
0	10	002	Height	m	-1	-40	16
0	10	003	Geopotential	$m^2\ s^{-2}$	-1	-400	17
0	10	004	Pressure	Pa	-1	0	14
0	10	051	Pressure reduced to MSL	Pa	-1	0	14
0	10	052	Altimeter setting (QNH)	Pa	-1	0	14
0	10	061	3 hour pressure change	Pa	-1	-500	10
0	10	062	24 hour pressure change	Pa	-1	-1000	11
0	10	063	Characteristic of pressure tendency	code table	0	0	4

Note: Vertical elements and pressure shall be used to define values of these elements independent of the element or variable denoting the vertical co-ordinate.

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BUFR TABLE B

Class 11 - Wind and turbulence

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	11	001	Wind direction	degrees true	0	0	9
0	11	002	Wind speed	$m\ s^{-1}$	1	0	12
0	11	003	u-component	$m\ s^{-1}$	1	-4096	13
0	11	004	v-component	$m\ s^{-1}$	1	-4096	13
0	11	005	w-component	$Pa\ s^{-1}$	1	-512	10
0	11	006	w-component	$m\ s^{-1}$	2	-4096	13
0	11	011	Wind direction at 10 m	degrees true	0	0	9
0	11	012	Wind speed at 10 m	$m\ s^{-1}$	1	0	12
0	11	013	Wind direction at 5 m	degrees true	0	0	9
0	11	014	Wind speed at 5 m	$m\ s^{-1}$	1	0	12
0	11	021	Relative vorticity	$1\ s^{-1}$	9	-65536	17
0	11	022	Divergence	$1\ s^{-1}$	9	-65536	17
0	11	023	Velocity potential	$m^2\ s^{-1}$	-2	-65536	17
0	11	031	Degree of turbulence	code table	0	0	4
0	11	032	Height of base of turbulence	m	-1	-40	16
0	11	033	Height of top of turbulence	m	-1	-40	16
0	11	041	Maximum wind speed (gusts)	$m\ s^{-1}$	1	0	12
0	11	042	Maximum wind speed (10 min mean wind)	$m\ s^{-1}$	1	0	12
0	11	061	Absolute wind shear in 1-km layer below	$m\ s^{-1}$	1	0	12
0	11	062	Absolute wind shear in 1-km layer above	$m\ s^{-1}$	1	0	12

Notes:

(1) West to east u-components shall be assigned positive values.

(2) South to north v-components shall be assigned positive values.

(3) Upward w-components shall be assigned positive values where units are $m\ s^{-1}$.

(4) Downward w-components shall be assigned positive values where units are $Pa\ s^{-1}$.

BUFR TABLE B

Class 12 - Temperature

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	12	001	Temperature/dry bulb temperature	K	1	0	12
0	12	002	Wet bulb temperature	K	1	0	12
0	12	003	Dew point temperature	K	1	0	12
0	12	004	Dry bulb temperature at 2 m	K	1	0	12
0	12	005	Wet bulb temperature at 2 m	K	1	0	12
0	12	006	Dew point temperature at 2 m	K	1	0	12
0	12	011	Maximum temperature, at height and over period specified	K	1	0	12
0	12	012	Minimum temperature, at height and over period specified	K	1	0	12
0	12	013	Ground minimum temperature past 12 hours	K	1	0	12
0	12	014	Maximum temperature at 2 m, past 12 hours	K	1	0	12
0	12	015	Minimum temperature at 2 m, past 12 hours	K	1	0	12
0	12	016	Maximum temperature at 2 m, past 24 hours	K	1	0	12
0	12	017	Minimum temperature at 2 m, past 24 hours	K	1	0	12
0	12	030	Soil temperature	K	1	0	12
0	12	061	Skin temperature	K	1	0	12
0	12	062	Equivalent black body temperature	K	1	0	12
0	12	063	Brightness temperature	K	1	0	12

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.

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BUFR TABLE B

Class 13 - Hygrographic and hydrological

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	13	001	Specific humidity	$g\ g^{-1}$	5	0	14
0	13	002	Mixing ratio	$g\ g^{-1}$	5	0	14
0	13	003	Relative humidity	%	0	0	7
0	13	004	Vapour pressure	Pa	-1	0	10
0	13	005	Vapour density	$g\ m^{-3}$	0	0	7
0	13	011	Total precipitation/total water equivalent	m	4	-1	14
0	13	012	Depth of fresh snow	m	2	-2	12
0	13	013	Total snow depth	m	2	-2	16
0	13	014	Rainfall/water equivalent of snow (averaged rate)	$m\ s^{-1}$	7	0	12
0	13	015	Snowfall (averaged rate)	$m\ s^{-1}$	7	0	12
0	13	016	Precipitable water	m	3	0	7
0	13	020	Total precipitation past 3 hours	m	4	-1	14
0	13	021	Total precipitation past 6 hours	m	4	-1	14
0	13	022	Total precipitation past 12 hours	m	4	-1	14
0	13	023	Total precipitation past 24 hours	m	4	-1	14
0	13	031	Evapotranspiration	m	3	0	7

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".

BUFR TABLE B

Class 14 - Radiation and radiance

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	14	001	Long-wave radiation, integrated over 24 hours	$J\ m^{-2}$	-3	-2048	12
0	14	002	Long-wave radiation, integrated over period specified	$J\ m^{-2}$	-3	-2048	12
0	14	003	Short-wave radiation, integrated over 24 hours	$J\ m^{-2}$	-3	-2048	12
0	14	004	Short-wave radiation, integrated over period specified	$J\ m^{-2}$	-3	-2048	12
0	14	011	Net long-wave radiation, integrated over 24 hours	$J\ m^{-2}$	-3	-2048	12
0	14	012	Net long-wave radiation, integrated over period specified	$J\ m^{-2}$	-3	-2048	12
0	14	013	Net short-wave radiation, integrated over 24 hours	$J\ m^{-2}$	-3	-2048	12
0	14	014	Net short-wave radiation, integrated over period specified	$J\ m^{-2}$	-3	-2048	12
0	14	021	Global radiation	$J\ m^{-2}$	-4	0	15
0	14	031	Total sunshine	minutes	0	0	6
0	14	032	Total sunshine	hours	0	0	10

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.

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BUFR TABLE B

Class 20 - Observed phenomena

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	20	001	Horizontal visibility	m	-1	0	13
0	20	002	Vertical visibility	m	-1	0	7
0	20	003	Present weather	code table	0	0	9
0	20	004	Past weather (1)	code table	0	0	5
0	20	005	Past weather (2)	code table	0	0	5
0	20	010	Cloud cover (total)	%	0	0	7
0	20	011	Cloud amount	code table	0	0	4
0	20	012	Cloud type	code table	0	0	6
0	20	013	Height of base of cloud	m	-1	-40	11
0	20	014	Height of top of cloud	m	-1	-40	11
0	20	015	Pressure at the base of cloud	Pa	-1	0	14
0	20	016	Pressure at the top of cloud	Pa	-1	0	14
0	20	017	Cloud top description	code table	0	0	4
0	20	031	Ice deposit (thickness)	m	2	0	7
0	20	032	Rate of ice accretion	code table	0	0	3
0	20	033	Cause of ice accretion	flag table	0	0	4
0	20	034	Sea ice concentration	code table	0	0	5
0	20	035	Amount and type of ice	code table	0	0	4
0	20	036	Ice situation	code table	0	0	5
0	20	037	Ice development	code table	0	0	5
0	20	038	Bearing of ice edge	degrees true	0	0	12
0	20	039	Ice distance	m	-1	0	13
0	20	041	Airframe icing	code table	0	0	4
0	20	061	Runway visual range (RVR)	m	0	0	12
0	20	062	State of ground (with or without snow)	code table	0	0	5
0	20	063	Special phenomena	code table	0	0	10

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BUFR TABLE B

Class 22 - Oceanographic

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	22	001	Direction of waves	degrees true	0	0	9
0	22	002	Direction of wind waves	degrees true	0	0	9
0	22	003	Direction of swell waves	degrees true	0	0	9
0	22	004	Direction of current	degrees true	0	0	9
0	22	011	Period of waves	s	0	0	6
0	22	012	Period of wind waves	s	0	0	6
0	22	013	Period of swell waves	s	0	0	6
0	22	021	Height of waves	m	1	0	10
0	22	022	Height of wind waves	m	1	0	10
0	22	023	Height of swell waves	m	1	0	10
0	22	031	Speed of current	$m\ s^{-1}$	2	0	13
0	22	042	Sea temperature	K	1	0	12
0	22	043	Sea temperature	K	2	0	15
0	22	044	Sound velocity	$m\ s^{-1}$	1	0	14
0	22	061	State of sea	code table	0	0	4
0	22	062	Salinity	PPT	2	0	14
0	22	063	Total water depth	m	0	0	14

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BUFR TABLE B

Class 31 - Data descriptor operator qualifiers

TABLE REFERENCE F	X	Y	ELEMENT NAME	UNITS	SCALE	REF VALUE	DATA WIDTH (BITS)
0	31	001	Delayed descriptor replication factor	numeric	0	0	8
0	31	002	Extended delayed descriptor replication factor	numeric	0	0	16
0	31	011	Delayed descriptor and data repetition factor	numeric	0	0	8
0	31	012	Extended delayed descriptor and data repetition factor	numeric	0	0	16
0	31	021	Additional field significance	code table	0	0	6

Note: When a run-length encoding method is used, the "data repetition factor" is both the count of the repeated descriptors and the repeated (identical) data items.

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BUFR TABLE C

Data description operators

TABLE REFERENCE F	TABLE REFERENCE X	OPERAND	OPERATOR NAME	OPERATION DEFINITION
2	01	Y	Change data width	Add (Y-128) bits to the data width given for each data element in Table B, other than a code or flag table.
2	02	Y	Change scale	Multiply scale given for each non-code data element in Table B by $_{10}(Y-128)$. Negative reference values shall be represented by a positive integer with the left-most bit (bit 1) set to 1 (on).
2	03	Y	Change reference values	Subsequent element descriptors define new reference values for corresponding Table B entries. Each new reference value is represented by Y bits in the data block. Definition of new reference values is concluded by coding this operator with Y=255.
2	04	Y	Add associated field	Precede each data element with Y bits of information. This operation associates a data field (e.g. quality-control information) of Y bits with each data element.
2	05	Y	Signify character	Y characters (CCITT IA5) are inserted as a data field of Y x 8 bits in length.

Notes:

(1) The operations specified by operator descriptors 201, 202, 203 and 204 remain defined until cancelled.

(2) Cancellation of the use of the redefined value shall be effected by the inclusion of the appropriate operand with Y set to 0. The value shall then revert back to the original Table B value.

(3) Nesting of operator descriptors must guarantee unambiguous interpretation; in particular, operators defined within a set of replicated descriptors must be cancelled or completed within that set.

(4) The operation 205 permits the inclusion of plain language.

BUFR TABLE D

Lists of common sequences

F	X	Category of sequence
3	00	Reserved
3	01	Non-meteorological sequences
3	02	Meteorological sequences common to surface data
3	03	Meteorological sequences common to vertical soundings data
3	04	Meteorological sequences common to satellite observations
3	05	Reserved
3	06	Meteorological or oceanographic sequences common to oceanographic observations
3	07	Surface report sequences (land)
3	08	Surface report sequences (sea)
3	09	Vertical soundings sequences (conventional data)
3	10	Vertical soundings sequences (satellite data)
3	11	Single-level report sequences (conventional data)
3	12	Single-level report sequences (satellite data)
3	13	Reserved
3	14	Reserved
3	15	Oceanographic report sequences

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BUFR TABLE D

Category 01 - Non-meteorological sequences

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
3	01	001	0	01	001	WMO block number
			0	01	002	WMO station number
3	01	002	0	01	003	WMO Region number
			0	01	004	WMO Region sub-area
			0	01	005	BUOY/platform identifier
3	01	003	0	01	011	SHIP call sign
			0	01	012	Direction of motion of moving observing platform
			0	01	013	Speed of motion of moving observing platform
3	01	011	0	04	001	Year
			0	04	002	Month
			0	04	003	Day
3	01	012	0	04	004	Hour
			0	04	005	Minute
3	01	013	0	04	004	Hour
			0	04	005	Minute
			0	04	006	Second
3	01	021	0	05	001	Latitude
			0	06	001	Longitude
3	01	022	0	05	001	Latitude
			0	06	001	Longitude
			0	07	001	Height of station
3	01	023	0	05	002	Latitude) coarse
			0	06	002	Longitude) accuracy
3	01	024	0	05	002	Latitude) coarse
			0	06	002	Longitude) accuracy
			0	07	001	Height of station
3	01	031	3	01	001	WMO block and station number
			0	02	001	Type of station
			3	01	011	Date
			3	01	012	Time
			3	01	022	Latitude, longitude (high accuracy), height of station

BUFR TABLE D

Category 01 - Non-meteorological sequences (contd.)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
3	01	032	3	01	001	WMO block and station number
			0	02	001	Type of station
			3	01	011	Date
			3	01	012	Time
			3	01	024	Latitude, longitude (coarse accuracy), height of station
						(BUOY/platform - fixed)
3	01	033	0	01	005	BUOY/platform identifier
			0	02	001	Type of station
			3	01	011	Date
			3	01	012	Time
			3	01	021	Latitude and longitude (high accuracy)
						(BUOY/platform - fixed)
3	01	034	0	01	005	BUOY/platform identifier
			0	02	001	Type of station
			3	01	011	Date
			3	01	012	Time
			3	01	023	Latitude and longitude (coarse accuracy)
						(BUOY/platform - moving)
3	01	035	0	01	005	BUOY/platform identifier
			0	01	012	Direction of motion of moving observing platform
			0	01	013	Speed of motion of moving observing platform
			0	02	001	Type of station
			3	01	011	Date
			3	01	012	Time
			3	01	023	Latitude and longitude (coarse accuracy)
						(SHIP)
3	01	036	3	01	003	SHIP call sign and motion
			0	02	001	Type of station
			3	01	011	Date
			3	01	012	Time
			3	01	023	Latitude and longitude (coarse accuracy)

BUFR TABLE D

Category 01 - Non-meteorological sequences (contd.)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
						(Land station for vertical soundings)
3	01	037	3	01	001	WMO block and station number
			0	02	011	Radiosonde type
			0	02	012	Radiosonde computational method
			3	01	011	Date
			3	01	012	Time
			3	01	022	Latitude and longitude (high accuracy), station height
						(Land station for vertical soundings)
3	01	038	3	01	001	WMO block and station number
			0	02	001	Radiosonde type
			0	02	012	Radiosonde computational method
			3	01	011	Date
			3	01	012	Time
			3	01	024	Latitude and longitude (coarse accuracy), station height
						(SHIP for vertical soundings)
3	01	039	3	01	003	SHIP call sign and motion
			0	02	011	Radiosonde type
			0	02	012	Radiosonde computational method
			3	01	011	Date
			3	01	012	Time
			3	01	023	Latitude and longitude (coarse accuracy)
3	01	041	0	01	007	Satellite identifier
			0	02	021	Satellite instrument data used in processing
			0	02	022	Satellite data-processing technique used
			3	01	011	Date
			3	01	012	Time
3	01	042	3	01	041	Satellite identifier, data used, and data-processing technique; date and time
			3	01	021	Latitude, longitude

BUFR TABLE D

Category 01 - Non-meteorological sequences (contd.)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
3	01	043	0	01	007	Satellite identifier
			0	02	023	Cloud motion computational method
			3	01	011	Date
			3	01	013	Time
			3	01	021	Latitude, longitude
3	01	044	0	01	007	Satellite identifier
			0	02	024	Integrated mean humidity computational method
			3	01	011	Date
			3	01	013	Time
			3	01	021	Latitude, longitude
3	01	051	0	01	006	Aircraft identifier
			0	02	061	Navigational system
			3	01	011	Date
			3	01	012	Time
			3	01	021	Latitude and longitude
			0	08	004	Phase of aircraft flight

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BUFR TABLE D

Category 02 - Meteorological sequences common to surface data

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
3	02	001	0	10	004	Pressure (at station level)
			0	10	051	Pressure reduced to MSL
			0	10	061	3-hour pressure change
			0	10	063	Characteristic of pressure tendency
						(High altitude station)
3	02	002	0	10	004	Pressure (at station level)
			0	07	004	Pressure level
			0	10	003	Geopotential of pressure level
			0	10	061	3-hour pressure change
			0	10	063	Characteristic of pressure tendency
3	02	003	0	11	011	Wind direction (10 m)
			0	11	012	Wind speed (10 m)
			0	12	004	Temperature (2 m)
			0	12	006	Dew point (2 m)
			0	13	003	Relative humidity
			0	20	001	Horizontal visibility
			0	20	003	Present weather
			0	20	004	Past weather (1)
			0	20	005	Past weather (2)
3	02	004	0	20	010	Cloud cover (total)
			0	08	002	Vertical significance (significant cloud layer)
			0	20	011	Cloud amount
			0	20	013	Height of base of cloud
			0	20	012	Cloud type (C_L)
			0	20	012	Cloud type (C_M)
			0	20	012	Cloud type (C_H)
3	02	005	0	08	002	Vertical signficance (cloud layer)
			0	20	011	Cloud amount
			0	20	012	Cloud type
			0	20	013	Height of base of cloud
						(Low altitude station)
3	02	011	3	02	001	Pressure and pressure change
			3	02	003	Wind, temperature, humidity, visibility, weather
			3	02	004	Significant cloud layer

BUFR TABLE D

Category 02 - Meteorological sequences common to surface data (contd.)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
						(High altitude station)
3	02	012	3	02	002	Pressure and pressure change
			3	02	003	Wind, temperature, humidity, visibility, weather
			3	02	004	Significant cloud information
3	02	021	0	22	001	Direction of waves
			0	22	011	Period of waves
			0	22	021	Height of waves
3	02	022	0	22	002	Direction of wind waves
			0	22	012	Period of wind waves
			0	22	022	Height of wind waves
3	02	023	0	22	003	Direction of swell waves
			0	22	013	Period of swell waves
			0	22	023	Height of swell waves
3	02	024	3	02	022	Wind waves
			3	02	023	Swell waves
			3	02	023	Swell waves

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BUFR TABLE D

Category 03 - Meteorological sequences common to vertical soundings data

TABLE REFERENCE F	X	Y	TABLE REFERENCES	MEANING
3	03	001	0 07 003	Geopotential
			0 11 001	Wind direction
			0 11 002	Wind speed
3	03	002	0 07 004	Pressure
			0 11 001	Wind direction
			0 11 002	Wind speed
3	03	003	0 07 004	Pressure
			0 10 003	Geopotential
			0 12 001	Temperature
			0 12 003	Dew point
3	03	004	0 07 004	Pressure
			0 10 003	Geopotential
			0 12 001	Temperature
			0 12 003	Dew point
			0 11 001	Wind direction
			0 11 002	Wind speed
3	03	011	0 07 003	Geopotential
			0 08 001	Vertical sounding significance
			0 11 001	Wind direction
			0 11 002	Wind speed
3	03	012	0 07 004	Pressure
			0 08 001	Vertical sounding significance
			0 11 001	Wind direction
			0 11 002	Wind speed
3	03	013	0 07 004	Pressure
			0 08 001	Vertical sounding significance
			0 10 003	Geopotential
			0 12 001	Temperature
			0 13 003	Relative humidity
			0 11 001	Wind direction
			0 11 002	Wind speed
3	03	014	0 07 004	Pressure
			0 08 001	Vertical sounding significance
			0 10 003	Geopotential
			0 12 001	Temperature
			0 12 003	Dew point
			0 11 001	Wind direction
			0 11 002	Wind speed

BUFR TABLE D

Category 03 - Meteorological sequences common to vertical soundings data (contd.)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
3	03	021	0	07	004	Pressure 1) defines
			0	07	004	Pressure 2) layer
			2	04	007	Add associated field of 7 bits
			0	31	021	Associated field significance
3	03	022	3	03	021	Layer, quality
			0	10	003	Geopotential (layer mean thickness)
			2	04	000	Cancel add associated field
3	03	023	3	03	021	Layer, quality
			0	12	001	Temperature (layer mean)
			2	04	000	Cancel add associated field
3	03	024	3	03	021	Layer, quality
			0	13	016	Precipitable water
			2	04	000	Cancel add associated field
3	03	025	0	02	025	Satellite channel
			2	04	007	Add associated field of 7 bits
			0	31	021	Quality-control method
			0	12	063	Brightness temperature
			2	04	000	Cancel add associated field
3	03	026	0	07	004	Pressure
			0	08	003	Vertical significance
			2	04	007	Add associated field of 7 bits
			0	31	021	Associated field significance
			0	12	001	Temperature
			2	04	000	Cancel add associated field
3	03	027	0	07	004	Pressure
			2	04	007	Add associated field of 7 bits
			0	31	021	Quality control method
			0	10	003	Geopotential
			2	04	000	Cancel add associated field
3	03	031	0	07	004	Pressure
			0	08	003	Vertical significance (base of sounding)
			0	07	021	Elevation (local zenith)
			0	07	022	Solar elevation (solar zenith)
			0	08	012	Land/sea qualifier
			0	12	061	Skin temperature
3	03	032	0	20	011	Cloud amount
			0	20	016	Pressure at top of cloud

BUFR TABLE D

Category 04 - Meteorological sequences common to satellite observations

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
3	04	001	0	08	003	Vertical significance
			0	10	004	Pressure
			0	12	001	Temperature
			0	11	001	Wind direction
			0	11	002	Wind speed
3	04	002	0	08	003	Vertical significance
			0	10	004	Pressure
			0	11	001	Wind direction
			0	11	002	Wind speed
3	04	003	0	08	003	Vertical significance
			0	12	001	Temperature
3	04	004	0	08	003	Vertical significance
			0	10	004	Pressure
			0	20	010	Cloud cover (total)
			0	12	001	Temperature
3	04	005	0	02	024	Integrated mean humidity computational method
			0	07	004	Pressure 1) defines
			0	07	004	Pressure 2) layer
			0	13	003	Relative humidity
3	04	006	0	14	001	Outgoing long-wave radiation
			0	14	001	Incoming long-wave radiation
			0	14	003	Outgoing short-wave radiation

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BUFR TABLE D

Category 06 - Meteorological or oceanographic sequences common to oceanographic observations

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
3	06	001	0	02	032	Indicator for digitization
			1	02	000	Delayed replication of two descriptors
			0	31	001	Replication factor
			0	07	062	Depth below surface
			0	22	042	Sub-surface sea temperature
3	06	002	0	02	031	Method of current measurement
			0	22	004	Direction of current
			0	22	031	Speed of current
3	06	003	0	02	002	Wind instrumentation
			0	11	011	Wind direction (10 m)
			0	11	012	Wind speed (10 m)
			0	12	004	Dry bulb temperature (2 m)
3	06	004	0	02	032	Indicator for digitization
			0	02	033	Method of salinity/depth measurement
			1	03	000	Delayed replication of three descriptors
			0	31	001	Replication factor
			0	07	062	Depth below surface
			0	22	042	Sub-surface sea temperature
			0	22	062	Salinity
3	06	005	0	02	031	Method of current measurement
			1	03	000	Delayed replication of three descriptors
			0	31	001	Replication factor
			0	07	062	Depth below surface
			0	22	004	Direction of current
			0	22	031	Speed of current

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BUFR TABLE D

Category 07 - Surface report sequences (land)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
						(Low altitude station)
3	07	001	3	01	031	Identification, type, date/time, position, (high accuracy), height
			3	02	011	Basic surface report
						(Low altitude station)
3	07	002	3	01	032	Identification, type, date/time, position (coarse accuracy), height
			3	02	011	Basic surface report
						(Low altitude station)
3	07	003	3	07	001	Location (high accuracy) and basic report
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	02	005	Cloud layer information
						(Low altitude station)
3	07	004	3	07	002	Location (coarse accuracy) and basic report
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	02	005	Cloud-layer information
						(Low altitude station)
3	07	005	3	07	001	Location (high accuracy) and basic report
			1	01	004	Replicate one descriptor four times
			3	02	005	Cloud-layer information (four layers)
						(Low altitude station)
3	07	006	3	07	002	Location (coarse accuracy) and basic report
			1	01	004	Replicate one descriptor four times
			3	02	005	Cloud layer information (four layers)

BUFR TABLE D

Category 07 - Surface report sequences (land) (contd.)

TABLE REFERENCE			TABLE REFERENCES			MEANING
F	X	Y				
						(High altitude station)
3	07	007	3	01	031	Identification, type, date/time, position (high accuracy), height
			3	02	012	Basic surface report
						(High altitude station)
3	07	008	3	01	032	Identification, type, date/ time position (coarse accuracy), height
			3	02	012	Basic surface report

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BUFR TABLE D

Category 08 - Surface report sequences (sea)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
						(BUOY/platform - fixed)
3	08	001	3	01	033	Identification, type, date/time, position (high accuracy)
			3	02	011	Basic surface report
			0	22	042	Sea-surface temperature
						(BUOY/platform - fixed)
3	08	002	3	01	034	Identification, type, date/time, position (coarse accuracy)
			3	02	011	Basic surface report
			0	22	042	Sea-surface temperature
						(BUOY/platform - moving)
3	08	003	3	01	035	Identification, movement, type, date/time, position (coarse accuracy)
			3	02	011	Basic surface report
			0	22	042	Sea-surface temperature
						(SHIP)
3	08	004	3	01	036	Identification, movement, type, date/time, position (coarse accuracy)
			3	02	011	Basic surface report
			0	22	042	Sea-surface temperature
3	08	005	3	08	004	Basic SHIP report
			3	02	024	Wind waves and swell waves

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BUFR TABLE D

Category 09 - Vertical soundings sequences (conventional data)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
						(PILOT)
3	09	001	3	01	037	Identification, etc. (land station, high accuracy position)
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	011	Winds at heights
						(PILOT)
3	09	002	3	01	038	Identification, etc. (land station, coarse accuracy position)
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	011	Winds at heights
						(PILOT)
3	09	003	3	01	037	Identification, etc. (land station, high accuracy position)
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	012	Winds at pressure levels
						(PILOT)
3	09	004	3	01	038	Identification, etc. (land station, coarse accuracy position)
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	012	Winds at pressure levels
						(TEMP with relative humidity)
3	09	005	3	01	037	Identification, etc. (land station, high accuracy position)
			3	02	004	Significant cloud information
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	013	Pressure, geopotential, temperature and wind data

BUFR TABLE D

Category 09 - Vertical soundings sequences (conventional data) (contd.)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
						(TEMP with relative humidity)
3	09	006	3	01	038	Identification, etc. (land station, coarse accuracy position)
			3	02	004	Significant cloud information
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	013	Pressure, geopotential, temperature and wind data
						(TEMP with dew point data)
3	09	007	3	01	037	Identification, etc. (land station), high accuracy position
			3	02	004	Significant cloud information
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	014	Pressure, geopotential, temperature and wind data
						(TEMP with dew point data)
3	09	008	3	01	038	Identification, etc. (land station, coarse accuracy position)
			3	02	004	Significant cloud information
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	014	Pressure, geopotential, temperature and wind data
						(PILOT SHIP)
3	09	011	3	01	039	SHIP identification, etc.
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	011	Winds at heights

BUFR TABLE D

Category 09 - Vertical soundings sequences (conventional data) (contd.)

TABLE REFERENCE F	X	Y	TABLE REFERENCES			MEANING
						(PILOT SHIP)
3	09	012	3	01	039	Ship identification, etc.
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	012	Winds at pressure levels
						(TEMP SHIP with relative humidity)
3	09	013	3	01	039	Ship identification, etc.
			3	02	004	Significant cloud information
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	013	Pressure, geopotential, temperature and wind data
						(TEMP SHIP with dew point data)
3	09	014	3	01	039	Ship identification, etc.
			3	02	004	Significant cloud information
			1	01	000	Delayed replication of one descriptor
			0	31	001	Replication factor
			3	03	014	Pressure, geopotential, temperature and wind data

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BUFR TABLE D

Category 10 - Vertical soundings sequences (satellite data)

TABLE REFERENCE			TABLE REFERENCES			MEANING
F	X	Y				
						(TOVS, brightness temperatures)
3	10	001	3	01	042	Identification, method, date/time
			3	03	031	Significance data, land/sea, skin temperature
			3	03	032	Cloud
			1	01	026	Replicate one descriptor 26 times
			3	03	025	Satellite channel and brightness temperature
						(TOVS, low level)
3	10	002	3	01	042	Identification, method, date/time
			3	03	031	Significance data, land/sea, skin temperature
			3	03	032	Cloud
			1	01	009	Replicate one descriptor 9 times
			3	03	023	Layer mean temperatures
						(TOVS, high level)
3	10	003	3	01	042	Identification, etc.
			3	03	031	Significance data, etc.
			3	03	032	Cloud
			1	01	006	Replicate one descriptor six times
			3	03	023	Layer mean temperature
						(TOVS, precipitable water)
3	10	004	3	01	042	Identification, etc.
			3	03	031	Significance data, etc.
			3	03	032	Cloud
			1	01	003	Replicate one descriptor three times
			3	03	024	Precipitable water

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BUFR TABLE D

Category 11 - Single-level report sequences (conventional data)

TABLE REFERENCE			TABLE REFERENCES			MEANING
F	X	Y				
3	11	001	3	01	051	(ASDAR/AIREP) ASDAR aircraft identifier, navigational system, date, time, position, phase of flight
			0	07	002	Altitude
			0	12	001	Temperature
			0	11	001	Wind direction
			0	11	002	Wind speed
			0	11	031	Degree of turbulence
			0	11	032	Height of base of turbulence
			0	11	033	Height of top of turbulence
			0	20	041	Airframe icing

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BUFR TABLE D

Category 12 - Single-level report sequences (satellite)

TABLE REFERENCE			TABLE REFERENCES			MEANING
F	X	Y				
3	12	001	3	01	043	Satellite identifier, instrumentation, location, date and time
			3	04	001	Cloud top pressure, temperature, wind
3	12	002	3	01	043	Satellite identifier, instrumentation, location, date and time
			3	04	002	Cloud top pressure, wind
3	12	003	3	01	042	Satellite identifier, instrumentation, location, date and time
			3	04	003	Surface temperature
3	12	004	3	01	042	Satellite identifier, instrumentation, location, date and time
			3	04	004	Cloud cover
3	12	005	3	01	042	Satellite identifier, instrumentation, location, date and time
			0	20	014	Height of top of cloud
3	12	006	3	01	044	Satellite identifier, instrumentation, location, date and time
			3	04	005	Layer mean relative humidity
3	12	007	3	01	042	Satellite identifier, instrumentation, location, date and time
			3	04	006	Radiation

Notes:

(1) Separation of single-level satellite data into sets of BUFR messages aids compression and results in efficient data transmission and storage.

(2) Each BUFR message may contain data for a number of locations; the BUFR compression technique involves negligible overheads for data items that are invariant.

(3) Compound BUFR messages may be described within the data description section, if required (e.g. 30141, 330401, 30402, 30403, 30404, 30405, 30406).

BUFR TABLE D

Category 15 - Oceanographic report sequences

TABLE REFERENCE			TABLE REFERENCES			MEANING
F	X	Y				
						Typically reported BATHY without optional fields
3	15	001	0	01	011	SHIP call sign
			3	01	011	Date
			3	01	012	Time
			3	01	023	Latitude and longitude (coarse accuracy)
			3	06	001	Depths and temperatures
						Typically reported TESAC without optional fields
3	15	002	0	01	011	SHIP call sign
			3	01	011	Date
			3	01	012	Time
			3	01	023	Latitude and longitude (coarse accuracy)
			3	06	004	Depths, temperature, salinity

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Notes:

(1) From a conceptual point of view, Table D is not necessary:

(a) The data description section can fully and completely describe the data using only element descriptors, operator descriptors and the rules of description;

(b) Such a means of defining the data would involve considerable overheads in terms of the length of the data description section. Table D is a device to reduce these overheads;

(c) Each entry within Table D contains a list of descriptors. Each sequence descriptor that references to Table D may be "expanded" by replacing it with the list corresponding to that entry. The process of "expansion" is well defined, provided it results in a set of element descriptors and operator descriptors;

(d) Descriptors listed in entries to Table D may themselves refer to Table D, provided no circularity results on repeated expansion;

(e) The initial Table D has been limited to lists of descriptors likely to be frequently used. Every attempt has been made to avoid producing initial tables that are too comprehensive. Minor differences of reporting practice can be accommodated by not endeavouring to reduce each observation type to a single descriptor. Indeed, much more flexibility is retained if the data description section is envisaged as containing three or four descriptors.

(2) It should be noted that, initially, effort has been concentrated on the requirements for observational data. Extensions to forecast data, time series data, products, etc. follow logically, and can be added at an appropriate future date.

(3) Category 1 contains common sequences of non-meteorological descriptors; categories 2 to 6 contain common sequences of meteorological descriptors; categories 7 to 15 contain sequences which define reports, or major subsets of reports.

(4) BATHY and TESAC are included, with some minor omissions, to illustrate the facility of describing data with slightly different contents.

(5) TOVS have been split to maximize the benefits of data compression. Compound combinations may easily be defined using the descriptors available.

(6) SATOB data benefit enormously from being split into fragments (1, 2, 3 ... 7), then applying data compression to many locations within each fragment. Again, BUFR flexibility enables compound forms to be defined if desired.

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CODE TABLES ASSOCIATED WITH BUFR TABLE B

Note: In developing code tables associated with BUFR Table B to specify units of elements, the following principles should be applied:

(a) Code tables specifying the units for an element which is defined in the Manual on Codes by a single symbolic letter, shall be compatible with the relevant existing WMO code tables;

(b) Code tables combining two or more existing WMO code tables to specify the units for an element which is defined in the Manual on Codes by a group of symbolic letters, shall be compatible with the combined code figures of the relevant group of symbolic letters;

(c) Code tables combining two or more existing WMO code tables to specify the units for an element which is defined in the Manual on Codes by different symbolic letters, shall be compatible with the code figures of the relevant symbolic letters with successive tens or hundreds values added as appropriate;

(d) Code tables and flag tables should only be used for reporting qualitative information. Quantitative information should be reported as observed using entries in Table B. "Data description operators" from Table C should be applied when a "scale change" or "data width change" is required;

(e) Reference to existing specification(s) and code table(s) in the WMO Manual on Codes with explanation of possible deviations, shall be given in an additional table annexed to the code tables associated with BUFR Table B.

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001007

Satellite identifier

Code figure	Allocated to:	
0-99		European Community
100-199		Japan
200-299		USA
300-399		USSR
400-499		India
500-1022	Reserved	
1023	Missing value	

Notes:

(1) Actual code values will be supplied by the operator within the ranges allocated above.

(2) Odd decades indicate polar-orbiting satellites.

(3) Even decades indicate geostationary satellites.

002001

Code figure	Type of station
0	Automatic station
1	Manned station
2	Reserved
3	Missing value

002002

Type of instrumentation for wind measurement

Bit number	Type of instrumentation and original units for wind measurement, measured in m s^{-1} unless otherwise indicated.
1	Certified instruments
2	Originally measured in knots
3	Originally measured in km h^{-1}
All 4	Missing value

002003

Type of measuring equipment used

Code figure	
0	Pressure instrument associated with wind-measuring equipment
1	Optical theodolite
2	Radio theodolite
3	Radar
4-6	Reserved
7	Missing value

002011

Radiosonde type

(to be developed)

002012

Radiosonde computational method

(to be developed)

002021

Satellite instrument data used in processing

Bit number	
1	High resolution infra-red sounder (HIRS)
2	Microwave sounding unit (MSU)
3	Stratospheric sounding unit (SSU)
4-8	Reserved
All 9	Missing value

002022

Satellite data-processing technique used

Bit flags denoting the elements included in processing sounding data

Bit number	Definition
1	Processing technique not defined
2	Automated statistical regression
3	Clear path
4	Partly cloudy path
5	Cloudy path
6-7	Reserved
All 8	Missing value

Notes:

(1) Clear path means the sounding has been generated from clear radiances derived from actual clear-spot measurements. Tropospheric and stratospheric HIRS data, as well as MSU and SSU data, have been used.

(2) Partly cloudy path means the sounding has been generated from clear radiances which have been calculated from partly cloudy spots. Tropospheric and stratospheric HIRS data, as well as MSU and SSU data, have been used.

(3) Cloudy path means the sounding has been generated only from stratospheric HIRS data, MSU data and SSU data. Tropospheric HIRS data have not been used because of cloudy conditions.

002023

Cloud motion computational method

(to be developed)

002024

Integrated mean humidity computational method

(to be developed)

002025

Satellite channel

Bit flags denoting the instrument and/or channels used in obtaining various physical parameters. If, in any grouping of parameters, all bits = 0, then no retrieval was made for that parameter or set of parameters.

Bit number	Instrument (channels)
1	Reserved

Group 1 - Layer precipitable water for the layers surface to 700 hPa, 700 to 500 hPa, and 500 to 300 hPa

2	HIRS
3	MSU
4-5	Reserved

Group 2 - Tropopause temperature and pressure

6	HIRS
7	MSU
8-9	Reserved

Group 3 - Total ozone

10	HIRS (1, 2, 3, 8, 9, 16, 17)
11	HIRS (1, 2, 3, 9, 17)
12	MSU
13-14	Reserved

Group 4 - Mean temperature for the layers surface to 850 hPa, 850 to 700 hPa, 700 to 500 hPa, 500 to 400 hPa, 400 to 300 hPa, 300 to 200 hPa, and 200 to 100 hPa

15	HIRS
16	HIRS*
17	MSU
18	SKINTK (ocean only)
19-20	Reserved

Group 5 - Channel combinations used to obtain mean temperatures for the layers 100 to 70 hPa, 70 to 50 hPa, 50 to 30 hPa, 30 to 10 hPa, 10 to 5 hPa, 5 to 2 hPa, 2 to 1 hPa, 1 to 0.4 hPa

21	HIRS*
22	SSU
23	MSU (3, 4)
24	Reserved

Note: HIRS* is equivalent to: HIRS channels 1 (669 cm^{-1})
2 (679 cm^{-1})
3 (690 cm^{-1})
4 (2358 cm^{-1})

All 25 Missing

002031

Method of current measurement

Code figure

0	Reserved	Between H-1 and H
1	Instantaneous	
2	Averaged over three minutes or less	
3	Averaged over more than three minutes, but six at the most	
4	Averaged over more than six minutes, but 12 at the most	
5	Instantaneous	
6	Averaged over three minutes or less	Between H-2 and H-1
7	Averaged over more than three minutes, but six at the most	
8	Averaged over more than six minutes, but 12 at the most	
9	Vector or Doppler current profiling method not used	
10	Reserved	
11	One hour or less	
12	More than one hour but two at the most	
13	More than two hours but four at the most	
14	More than four hours but eight at the most	
15	More than eight hours but 12 at the most	
16	More than 12 hours but 18 at the most	
17	More than 18 hours but 24 at the most	
18	Reserved	
19	Drift method not used	
20-30	Reserved	
31	Missing value	

Notes:

(1) Codes 1-9, duration and time of current measurement (Vector or Doppler current profiling method).

(2) Codes 11-19, period of current measurement (drift method).

(3) H = time of observation.

002032

Indicator for digitization

Code figure

Code figure	
0	Values at selected depths (data points fixed by the instrument or selected by any other method)
1	Values at significant depths (data points taken from traces at significant depths)
2	Reserved
3	Missing value

002033

Method of salinity/depth measurement

Code figure

Code figure	
0	No salinity measured
1	*In situ* sensor, accuracy better than 0.02‰
2	*In situ* sensor, accuracy less than 0.02‰
3	Sample analysis
4-6	Reserved
7	Missing value

002061

Aircraft navigational system

Code figure

Code figure	
0	Inertial navigator system
1	Omega
2-6	Reserved
7	Missing value

008001

Vertical sounding significance

Bit number

Bit number	
1	Surface
2	Standard level
3	Tropopause level
4	Maximum wind level
5	Significant level, temperature
6	Significant level, wind
All 7	Missing value

008002

Vertical significance (surface observation)

Code figure	
0	Reserved
1	First significant cloud layer
2	Second significant cloud layer
3	Third significant cloud layer
4	Cumulonimbus layer
5-62	Reserved
63	Missing value

008003

Vertical significance (satellite observation)

Code figure	
0	Surface
1	Base of satellite sounding
2	Cloud top
3-62	Reserved
63	Missing value

008004

Phase of aircraft flight

Code figure	
0-2	Reserved
3	Level flight, routine observation (LVR)
4	Level flight, highest wind encountered (LVW)
5	Ascending (ASC)
6	Descending (DES)
7	Missing value

008011

Horizontal significance

Code figure	
0	Quasi-stationary front at the surface
1	Quasi-stationary front above the surface
2	Warm front at the surface
3	Warm front above the surface
4	Cold front at the surface
5	Cold front above the surface
6	Occlusion
7	Instability line
8	Intertropical front
9	Convergence line
10-62	Reserved
63	Missing value

008012

Land/sea qualifier

Code figure	
0	Land
1	Sea
2	Reserved
3	Missing value

008021

Time significance

Code figure	
0	Reserved
1	Time series
2	Time averaged
3	Accumulated
4	Forecast
5	Forecast time series
6	Forecast time averaged
7	Forecast accumulated
8	Ensemble mean
9	Ensemble mean time series
10	Ensemble mean time averaged
11	Ensemble mean accumulated
12	Ensemble mean forecast
13	Ensemble mean forecast time series
14	Ensemble mean forecast time averaged
15	Ensemble mean forecast accumulated
16-30	Reserved
31	Missing value

Notes:

(1) "Time averaged" indicates that values are continuously averaged over a period of time.

(2) "Ensemble mean" indicates that a number of distinct values corresponding to a set of time locations are averaged.

(3) Time significance must be qualified by appropriate time periods being specified.

*

* *

010063

Characteristic of pressure tendency

Code figure		
0	Increasing, then decreasing; atmospheric pressure the same or higher than three hours ago	
1	Increasing, then steady; or increasing, then increasing more slowly	Atmospheric pressure now higher than three hours ago
2	Increasing (steadily or unsteadily)	
3	Decreasing or steady, then increasing; or increasing, then increasing more rapidly	
4	Steady; atmospheric pressure the same as three hours ago	
5	Decreasing, then increasing; atmospheric pressure the same or lower than three hours ago	
6	Decreasing, then steady; or decreasing, then decreasing more slowly	Atmospheric pressure now lower than three hours ago
7	Decreasing (steadily or unsteadily)	
8	Steady or increasing, then decreasing; or decreasing, then decreasing more rapidly	
9-14	Reserved	
15	Missing value	

Notes:

(1) In reports from automatic stations, code 2 shall be used when tendency is positive, 7 when negative and 4 when the pressure is the same as three hours before.

(2) In reports from tropical stations reporting 24-hour pressure changes, code 2 shall be used when tendency is positive, 7 when negative and 4 when pressure is the same as 24 hours before.

011031

Degree of turbulence

Code figure		
0	Nil in cloud	
1	Slight	in cloud
2	Moderate	in cloud
3	Severe	in cloud
4	Nil in clear air	
5	Slight	in clear air
6	Moderate	in clear air
7	Severe	in clear air
9-14	Reserved	
15	Missing value	

020003

Present weather

00-49 No precipitation at the station at the time of observation

00-19 No precipitation, fog, ice fog (except for 11 and 12), duststorm, sandstorm, drifting or blowing snow at the station* at the time of observation or, except for 09 and 17, during the preceding hour

	Code figure		
No meteors except photometeors	00	Cloud development not observed or not observable	characteristic change of the state of sky during the past hour
	01	Clouds generally dissolving or becoming less developed	
	02	State of sky on the whole unchanged	
	03	Clouds generally forming or developing	
Haze, dust, sand or smoke	04	Visibility reduced by smoke, e.g. veldt or forest fires, industrial smoke or volcanic ashes	
	05	Haze	
	06	Widespread dust in suspension in the air, not raised by wind at or near the station at the time of observation	
	07	Dust or sand raised by wind at or near the station at the time of observation, but no well-developed dust whirl(s) or sand whirl(s), and no duststorm or sandstorm seen; or, in the case of sea stations and coastal stations, blowing spray at the station	
	08	Well-developed dust whirl(s) or sand whirl(s) seen at or near the station during the preceding hour or at the same time of observation, but no duststorm or sandstorm	
	09	Duststorm or sandstorm within sight at the time of observation, or at the station during the preceding hour	
	10	Mist	
	11	Patches	shallow fog or ice fog at the station, whether on land or sea, not deeper than about 2 m on land or 10 m at sea
	12	More or less continuous	
	13	Lightning visible, no thunder heard	
	14	Precipitation within sight, not reaching the ground or the surface of the sea	
	15	Precipitation within sight, reaching the ground or the surface of the sea, but distant, i.e. estimated to be more than 5 km from the station	
	16	Precipitation within sight, reaching the ground or the surface of the sea, near to, but not at the station	
	17	Thunderstorm, but no precipitation at the time of observation	
	18	Squalls	at or within sight of the station during the preceding hour or at the time of observation
	19	Funnel cloud(s)**	

* The expression "at the station" refers to a land station or a ship.

** Tornado cloud or waterspout

20-29 Precipitation, fog, ice fog or thunderstorm at the station during the preceding hour but not at the time of observation

Code figure		
20	Drizzle (not freezing) or snow grains	Not falling as shower(s)
21	Rain (not freezing)	
22	Snow	
23	Rain and snow or ice pellets	
24	Freezing drizzle or freezing rain	
25	Shower(s) of rain	
26	Shower(s) of snow, or of rain and snow	
27	Shower(s) of hail*, or of rain and hail*	
28	Fog or ice fog	
29	Thunderstorm (with or without precipitation)	

* Hail, small hail, snow pellets

30-39 Duststorm, sandstorm, drifting or blowing snow

Code figure		
30	Slight or moderate duststorm or sandstorm	- has decreased during the preceding hour
31		- no appreciable change during the preceding hour
32		- has begun or has increased during the preceding hour
33	Severe duststorm or sandstorm	- has decreased during the preceding hour
34		- no appreciable change during the preceding hour
35		- has begun or has increased during the preceding hour
36	Slight or moderate drifting snow	generally low (below eye level)
37	Heavy drifting snow	
38	Slight or moderate blowing snow	generally high (above eye level)
39	Heavy blowing snow	

40-49 Fog or ice fog at the time of observation

Code figure		
40	Fog or ice fog at a distance at the time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer	
41	Fog or ice fog in patches	
42	Fog or ice fog, sky visible	has become thinner during the preceding hour
43	Fog or ice fog, sky invisible	

44	Fog or ice fog, sky visible	no appreciable change during the preceding hour
45	Fog or ice fog, sky invisible	
46	Fog or ice fog, sky visible	has begun or has become thicker during the preceding hour
47	Fog or ice fog, sky invisible	
48	Fog, depositing rime, sky visible	
49	Fog, depositing rime, sky invisible	

50-99 Precipitation at the station at the time of observation

50-59 Drizzle

Code figure		
50	Drizzle, not freezing, intermittent	slight at time of observation
51	Drizzle, not freezing, continuous	
52	Drizzle, not freezing, intermittent	moderate at time of observation
53	Drizzle, not freezing, continuous	
54	Drizzle, not freezing, intermittent	heavy (dense) at time of observation
55	Drizzle, not freezing, continuous	
56	Drizzle, freezing, slight	
57	Drizzle, freezing, moderate or heavy (dense)	
58	Drizzle and rain, slight	
59	Drizzle and rain, moderate or heavy	

60-69 Rain

Code figure		
60	Rain, not freezing, intermittent	slight at time of observation
61	Rain, not freezing, continuous	
62	Rain, not freezing, intermittent	moderate at time of observation
63	Rain, not freezing, continuous	
64	Rain, not freezing, intermittent	heavy at time of observation
65	Rain, not freezing, continuous	
66	Rain, freezing, slight	
67	Rain, freezing, moderate or heavy	
68	Rain or drizzle and snow, light	
69	Rain or drizzle and snow, moderate or heavy	

70-79 Solid precipitation not in showers

Code figure		
70	Intermittent fall of snowflakes	slight at time of observation
71	Continuous fall of snowflakes	
72	Intermittent fall of snowflakes	moderate at time of observation
73	Continuous fall of snowflakes	
74	Intermittent fall of snowflakes	heavy at time of observation
75	Continuous fall of snowflakes	
76	Diamond dust (with or without fog)	
77	Snow grains (with or without fog)	
78	Isolated star-like snow crystals (with or without fog)	
79	Ice pellets	

80-99 Showery precipitation, or precipitation with current or recent thunderstorm

Code figure		
80	Rain shower(s), slight	
81	Rain shower(s), moderate or heavy	
82	Rain shower(s), violent	
83	Shower(s) of rain and snow mixed, slight	
84	Shower(s) of rain and snow mixed, moderate or heavy	
85	Snow shower(s), slight	
86	Snow shower(s), moderate or heavy	
87	Shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed	- slight
88		- moderate or heavy
89	Shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder	- slight
90		- moderate or heavy
91	Slight rain at time of observation	thunderstorm during the preceding hour but not at time of observation
92	Moderate or heavy rain at time of observation	
93	Slight snow, or rain and snow mixed or hail* at time of observation	
94	Moderate or heavy snow, or rain and snow mixed or hail* at time of observation	
95	Thunderstorm, slight or moderate, without hail*, but with rain and/or snow at time of observation	thunderstorm at time of observation
96	Thunderstorm, slight or moderate, with hail* at time of observation	
97	Thunderstorm, heavy, without hail* but with rain and/or snow at time of observation	
98	Thunderstorm combined with duststorm or sandstorm at time of observation	
99	Thunderstorm, heavy, with hail* at time of observation	

* Hail, small hail, snow pellets

Code figure	Present weather reported from an automatic weather station
100	No significant weather observed
101	Clouds generally dissolving or becoming less developed during the past hour
102	State of sky on the whole unchanged during the past hour
103	Clouds generally forming or developing during the past hour
104	Haze or smoke, or dust in suspension in the air, visibility equal to, or greater than 1 km

Code figure	
105	Haze or smoke, or dust in suspension in the air, visibility less than 1 km
106	Reserved
107	Reserved
108	Reserved
109	Reserved
110	Mist
111	Diamond dust
112	Distant lightning
113	Reserved
114	Reserved
115	Reserved
116	Reserved
117	Reserved
118	Squalls
119	Reserved
120	Fog
121	PRECIPITATION
122	Drizzle (not freezing) or snow grains
123	Rain (not freezing)
124	Snow
125	Freezing drizzle or freezing rain
126	Thunderstorm (with or without precipitation)
127	BLOWING OR DRIFTING SNOW OR SAND
128	Blowing or drifting snow or sand, visibility equal to, or greater than, 1 km
129	Blowing or drifting snow or sand, visibility less than 1 km
130	FOG
131	Fog or ice fog in patches
132	Fog or ice fog, has become thinner during the past hour
133	Fog or ice fog, no appreciable change during the past hour
134	Fog or ice fog, has begun or become thicker during the past hour
135	Fog, depositing rime
136	Reserved
137	Reserved
138	Reserved
139	Reserved
140	PRECIPITATION
141	Precipitation, slight or moderate
142	Precipitation, heavy
143	Liquid precipitation, slight or moderate
144	Liquid precipitation, heavy
145	Solid precipitation, slight or moderate
146	Solid precipitation, heavy
147	Freezing precipitation, slight or moderate
148	Freezing precipitation, heavy
149	Reserved

150	DRIZZLE
151	Drizzle, not freezing, slight
152	Drizzle, not freezing, moderate
153	Drizzle, not freezing, heavy
154	Drizzle, freezing, slight
155	Drizzle, freezing, moderate
156	Drizzle, freezing, heavy
157	Drizzle and rain, slight
158	Drizzle and rain, moderate or heavy
159	Reserved
160	RAIN
161	Rain, not freezing, slight
162	Rain, not freezing, moderate
163	Rain, not freezing, heavy
164	Rain, freezing, slight
165	Rain, freezing, moderate
166	Rain, freezing, heavy
167	Rain (or drizzle) and snow, slight
168	Rain (or drizzle) and snow, moderate or heavy
169	Reserved
170	SNOW
171	Snow, slight
172	Snow, moderate
173	Snow, heavy
174	Ice pellets, slight
175	Ice pellets, moderate
176	Ice pellets, heavy
177	Reserved
178	Reserved
179	Reserved
180	SHOWER(S) or INTERMITTENT PRECIPITATION
181	Rain shower(s) or intermittent rain, slight
182	Rain shower(s) or intermittent rain, moderate
183	Rain shower(s) or intermittent rain, heavy
184	Rain shower(s) or intermittent rain, violent
185	Snow shower(s) or intermittent snow, slight
186	Snow shower(s) or intermittent snow, moderate
187	Snow shower(s) or intermittent snow, heavy
188	Reserved
189	Reserved
190	THUNDERSTORM
191	Thunderstorm, slight or moderate, with no precipitation
192	Thunderstorm, slight or moderate, with rain showers and/or snow showers
193	Thunderstorm, slight or moderate, with hail
194	Thunderstorm, heavy, with no precipitation
195	Thunderstorm, heavy, with rain showers and/or snow showers
196	Thunderstorm, heavy, with hail
197	Reserved
198	Reserved
199	Tornado

Present weather (in addition to either present weather report from a manned or automatic station)

Decade 200-209

200)	
201)	Not used
202)	
203)	
204	Volcanic ash suspended in the air aloft
205	Not used
206	Thick dust haze, visibility less than 1 km
207	Blowing spray at the station
208	Drifting dust (sand)
209	Wall of dust or sand in distance (like haboob)

Decade 210-219

210	Snow haze
211	Whiteout
212	Not used
213	Lightning, cloud to surface
214	Not used
215	Not used
216	Not used
217	Dry thunderstorm
218	Not used
219	Tornado cloud (destructive) at or within sight of the station during preceding hour or at time of observation

Decade 220-229

220	Deposition of volcanic ash
221	Deposition of dust or sand
222	Deposition of dew
223	Deposition of wet snow
224	Deposition of soft rime
225	Deposition of hard rime
226	Deposition of hoar frost
227	Deposition of glaze
228	Deposition of ice crust (ice slick)
229	Not used

Decade 230-239

230	Duststorm or sandstorm with temperature below 0°C
231)	
232)	
233)	
234)	
235)	Not used
236)	
237)	
238)	
239	Blowing snow, impossible to determine whether snow is falling or not

Decade 240-249

240	Not used
241	Fog on sea
242	Fog in valleys
243	Arctic or Antarctic sea smoke
244	Steam fog (sea, lake or river)
245	Steam fog (land)
246	Fog over ice or snow cover
247	Dense fog, visibility 60-90 m
248	Dense fog, visibility 30-60 m
249	Dense fog, visibility less than 30 m

Decade 250-259

250	Drizzle, rate of fall	less than 0.10 mm h^{-1}
251	Drizzle, rate of fall	0.10 - 0.19 mm h^{-1}
252	Drizzle, rate of fall	0.20 - 0.39 mm h^{-1}
253	Drizzle, rate of fall	0.40 - 0.79 mm h^{-1}
254	Drizzle, rate of fall	0.80 - 1.59 mm h^{-1}
255	Drizzle, rate of fall	1.60 - 3.19 mm h^{-1}
256	Drizzle, rate of fall	3.20 - 6.39 mm h^{-1}
257	Drizzle, rate of fall	6.4 mm h^{-1} or more
258	Not used	
259	Drizzle and snow	

Decade 260-269

260	Rain, rate of fall	less than 1.0 mm h^{-1}
261	Rain, rate of fall	1.0 - 1.9 mm h^{-1}
262	Rain, rate of fall	2.0 - 3.9 mm h^{-1}
263	Rain, rate of fall	4.0 - 7.9 mm h^{-1}
264	Rain, rate of fall	8.0 - 15.9 mm h^{-1}
265	Rain, rate of fall	16.0 - 31.9 mm h^{-1}
266	Rain, rate of fall	32.0 - 63.9 mm h^{-1}
267	Rain, rate of fall	64.0 mm h^{-1} or more
268	Not used	
269	Not used	

Decade 270-279

270	Snow, rate of fall	less than 1.0 cm h^{-1}
271	Snow, rate of fall	1.0 - 1.9 cm h^{-1}
272	Snow, rate of fall	2.0 - 3.9 cm h^{-1}
273	Snow, rate of fall	4.0 - 7.9 cm h^{-1}
274	Snow, rate of fall	8.0 - 15.9 cm h^{-1}
275	Snow, rate of fall	16.0 - 31.9 cm h^{-1}
276	Snow, rate of fall	32.0 - 63.9 cm h^{-1}
277	Snow, rate of fall	64.0 cm h^{-1} or more
278	Snow or ice crystal precipitation from a clear sky	
279	Wet snow, freezing on contact	

Decade 280-299

280	Precipitation of rain (ww = 87-99)	
281	Precipitation of rain, freezing (ww = 80-82)	
282	Precipitation of rain and snow mixed	
283	Precipitation of snow	
284	Precipitation of snow pellets or small hail	
285	Precipitation of snow pellets or small hail, with rain	(ww = 26-27)
286	Precipitation of snow pellets or small hail, with rain and snow mixed	(ww = 68 or 69) (ww = 87-99)
287	Precipitation of snow pellets or small hail, with snow	
288	Precipitation of hail	
289	Precipitation of hail, with rain	
290	Precipitation of hail, with rain and snow mixed	
291	Precipitation of hail, with snow	
292	Shower(s) or thunderstorm over sea	
293	Shower(s) or thunderstorm over mountains	
294) 295) 296) 297) 298) 299)	Not used	
300-507	Reserved	
508	No significant phenomena to report, present and past weather omitted	
509	Not observed, no data available, present and past weather omitted	
510	Present and past weather missing, but expected	
511	Missing value	

Notes:

(1) The middle portion of this code table (code figure 100-199) includes terms on several levels to cover simple and increasingly complex automatic stations.

(2) Generic terms for weather (e.g. fog, drizzle) are intended for use at automatic stations capable of determining types of weather but no other information. Generic terms are included in the code table using all capital letters.

(3) Code figures for generic precipitation (code figures 140-148) are arranged in order of increasing complexity. For example, a very simple station that can sense only the presence or absence of precipitation would use code figure 140 (precipitation). At the next level, an automatic station capable of sensing amount but not type would use code figure 141 or 142. An automatic station capable of sensing gross type (liquid, solid, freezing) and amount would use code figures 143-148. An automatic station capable of reporting actual types of precipitation (e.g. drizzle or rain), but not amount, would use the appropriate whole decadal number (e.g. 150 for generic drizzle, 160 for generic rain).

020004/020005

Past weather (1) and (2)

Code figure	
0	Cloud covering 1/2 or less of sky throughout the appropriate period
1	Cloud covering more than 1/2 of sky during part of the appropriate period and covering 1/2 or less during part of the period
2	Cloud covering more than 1/2 of sky throughout the appropriate period
3	Sandstorm, duststorm or blowing snow
4	Fog or ice fog or thick haze
5	Drizzle
6	Rain
7	Snow, or rain and snow mixed
8	Shower(s)
9	Thunderstorm(s) with or without precipitation
10	No significant weather observed
11	VISIBILITY REDUCED
12	Blowing phenomena, visibility reduced
13	FOG
14	PRECIPITATION
15	Drizzle
16	Rain
17	Snow or ice pellets
18	Showers or intermittent precipitation
19	Thunderstorm
20-30	Reserved
31	Missing value

Note: The weather description in code figures 10 to 19 are progressively complex, to accommodate the different levels of weather discrimination capability of various automatic stations. Stations having only basic sensing capability may use the lower code figure and basic generic descriptions (shown in capital letters). Stations with progressively higher discrimination capability shall use the more detailed descriptions (higher codes).

020011

Cloud amount

Code figure		
0	0	0
1	1 okta or less, but not zero	1/10 or less, but not zero
2	2 oktas	2/10 - 3/10
3	3 oktas	4/10
4	4 oktas	5/10
5	5 oktas	6/10

6	6 oktas	7/10 - 8/10
7	7 oktas or more, but not 8 oktas	9/10 or more, but not 10/10
8	8 oktas	10/10
9	Sky obscured by fog and/or other meteorological phenomena	
10-14	Reserved	
15	Cloud cover is indiscernible for reasons other than fog or other meteorological phenomena, or observation is not made.	

Note: For use of code figure 15, see Regulation 12.1.4.

020012

Cloud type

Code figure		CC
0	Cirrus (Ci)	CI
1	Cirrocumulus (Cc)	CC
2	Cirrostratus (Cs)	CS
3	Altocumulus (Ac)	AC
4	Altostratus (As)	AS
5	Nimbostratus (Ns)	NS
6	Stratocumulus (Sc). . . .	SC
7	Stratus (St)	ST
8	Cumulus (Cu)	CU
9	Cumulonimbus (Cb)	CB
10	No C_H clouds	
11	Cirrus fibratus, sometimes uncinus, not progressively invading the sky	
12	Cirrus spissatus, in patches or entangled sheaves, which usually do not increase and sometimes seem to be the remains of the upper part of a Cumulonimbus; or Cirrus castellanus or floccus	
13	Cirrus spissatus cumulonimbogenitus	
14	Cirrus uncinus or fibratus, or both, progressively invading the sky; they generally thicken as a whole	
15	Cirrus (often in bands) and Cirrostratus, or Cirrostratus alone, progressively invading the sky; they generally thicken as a whole, but the continuous veil does not reach 45° above the horizon	
16	Cirrus (often in bands) and Cirrostratus, or Cirrostratus alone, progressively invading the sky; they generally thicken as a whole; the continuous veil extends more than 45° above the horizon, without the sky being totally covered	
17	Cirrostratus covering the whole sky	
18	Cirrostratus not progressively invading the sky and not entirely covering it	
19	Cirrocumulus alone, or Cirrocumulus predominant among the C_H clouds	
20	No C_M clouds	
21	Altostratus translucidus	
22	Altostratus opacus or Nimbostratus	
23	Altocumulus translucidus at a single level	
24	Patches (often lenticular) of Altocumulus translucidus, continually changing and occurring at one or more levels	
25	Altocumulus translucidus in bands, or one or more layers of Altocumulus translucidus or opacus, progressively invading the sky; these Altocumulus clouds generally thicken as a whole	

26	Altocumulus cumulogenitus (or cumulonimbogenitus)
27	Altocumulus translucidus or opacus in two or more layers, or Altocumulus opacus in a single layer, not progressively invading the sky, or Altocumulus with Altostratus or Nimbostratus
28	Altocumulus castellanus or floccus
29	Altocumulus of a chaotic sky, generally at several levels
30	No C_L clouds
31	Cumulus humilis or Cumulus fractus other than of bad weather,* or both
32	Cumulus mediocris or congestus, with or without Cumulus of species fractus or humilis or Stratocumulus, all having their bases at the same level
33	Cumulonimbus calvus, with or without Cumulus, Stratocumulus or Stratus
34	Stratocumulus cumulogenitus
35	Stratocumulus other than Stratocumulus cumulogenitus
36	Stratus nebulosus or Stratus fractus other than of bad weather,* or both
37	Stratus fractus or Cumulus fractus of bad weather,* or both (pannus), usually below Altostratus or Nimbostratus
38	Cumulus and Stratocumulus other than Stratocumulus cumulogenitus, with bases at different levels
39	Cumulonimbus capillatus (often with an anvil), with or without Cumulonimbus calvus, Cumulus, Stratocumulus, Stratus or pannus
40-58	Reserved
59	Cloud not visible owing to darkness, fog, duststorm, sandstorm, or other analogous phenomena
60	C_H clouds invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or because of a continuous layer of lower clouds
61	C_M clouds invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena, or because of continuous layer of lower clouds
62	C_L clouds invisible owing to darkness, fog, blowing dust or sand, or other similar phenomena
63	Missing value

* "Bad weather" denotes the conditions which generally exist during precipitation and a short time before and after.

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020017

Cloud top description

Code figure		
0	Isolated cloud or fragments of clouds	
1	Continuous cloud	flat tops
2	Broken cloud - small breaks	flat tops
3	Broken cloud - large breaks	flat tops
4	Continuous cloud	undulating tops
5	Broken cloud - small breaks	undulating tops
6	Broken cloud - large breaks	undulating tops
7	Continuous or almost continuous waves with towering clouds above the top of the layer	
8	Groups of waves with towering clouds above the top of the layer	
9	Two or more layers at different levels	
10-14	Reserved	
15	Missing value	

020032

Rate of ice accretion

Code figure	
0	Ice not building up
1	Ice building up slowly
2	Ice building up quickly
3	Ice melting or breaking up slowly
4	Ice melting or breaking up rapidly
5-6	Reserved
7	Missing value

020033

Cause of ice accretion

Bit number	
1	Icing from ocean spray
2	Icing from fog
3	Icing from rain
All 4	Missing value

020034

Sea ice concentration

<table>
<tr><th>Code figure</th><th></th><th></th><th></th></tr>
<tr><td>0</td><td>No sea ice in sight</td><td></td><td></td></tr>
<tr><td>1</td><td>Ship in open lead more than 1.0 nautical mile wide, or ship in fast ice with boundary beyond limit of visibility</td><td></td><td></td></tr>
<tr><td>2</td><td>Sea ice present in concentration less than 3/10 (3/8), open water or very open pack ice</td><td rowspan="4">Sea ice concentration is uniform in the observation area</td><td rowspan="8">Ship in ice or within 0.5 nautical mile of ice edge</td></tr>
<tr><td>3</td><td>4/10 to 6/10 (3/8 to less than 6/8), open pack ice</td></tr>
<tr><td>4</td><td>7/10 to 8/10 (6/8 to less than 7/8), close pack ice</td></tr>
<tr><td>5</td><td>9/10 or more, but not 10/10 (7/8 to less than 8/8), very close pack ice</td></tr>
<tr><td>6</td><td>Strips and patches of pack ice with open water between</td><td rowspan="4">Sea ice concentration is not uniform in the observation area</td></tr>
<tr><td>7</td><td>Strips and patches of close or very close pack ice with areas of lesser concentration between</td></tr>
<tr><td>8</td><td>Fast ice with open water, very open or open pack ice to seaward of the ice boundary</td></tr>
<tr><td>9</td><td>Fast ice with close or very close pack ice to seaward of the ice boundary</td></tr>
<tr><td>10–13</td><td>Reserved</td><td></td><td></td></tr>
<tr><td>14</td><td>Unable to report, because of darkness, lack of visibility, or because ship is more than 0.5 nautical mile away from ice edge</td><td></td><td></td></tr>
<tr><td>15</td><td>Missing value</td><td></td><td></td></tr>
</table>

020035

Amount and type of ice

(to be defined)

020036

Ice situation

(to be defined)

020037

Ice development

(to be defined)

020041

Airframe icing

Code figure	
0	No icing
1	Light icing
2	Light icing in cloud
3	Light icing in precipitation
4	Moderate icing
5	Moderate icing in cloud
6	Moderate icing in precipitation
7	Severe icing
8	Severe icing in cloud
9	Severe icing in precipitation
10-14	Reserved
15	Missing value

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020062

State of ground

Code figure		
0	Surface of ground dry (without cracks and no appreciable amount of dust or loose sand)	without snow or measurable ice cover
1	Surface of ground moist	
2	Surface of ground wet (standing water in small or large pools on surface)	
3	Flooded	
4	Surface of ground frozen	
5	Glaze on ground	
6	Loose dry dust or sand not covering ground completely	
7	Thin cover of loose dry dust or sand covering ground completely	
8	Moderate or thick cover of loose dry dust or sand covering ground completely	
9	Extremely dry with cracks	
10	Ground predominantly covered by ice	with snow or measurable ice cover
11	Compact or wet snow (with or without ice) covering less than one-half of the ground	
12	Compact or wet snow (with or without ice) covering at least one-half of the ground but ground not completely covered	
13	Even layer of compact or wet snow covering ground completely	
14	Uneven layer of compact or wet snow covering ground completely	
15	Loose dry snow covering less than one-half of the ground	
16	Loose dry snow covering at least one-half of the ground (but not completely)	
17	Even layer of loose dry snow covering ground completely	
18	Uneven layer of loose dry snow covering ground completely	
19	Snow covering ground completely; deep drifts	
20–30	Reserved	
31	Missing value	

Notes:

(1) The definitions in code numbers 0 to 2 and 4 and 10 to 19 apply to representative bare ground and numbers 3 and 5 to 9 to an open representative area.

(2) In all instances the highest code figures applicable are to be reported.

(3) In the above code table, whenever reference is made to ice, it also includes solid precipitation other than snow.

020063

Special phenomena

(to be developed)

022061

State of sea

Code figure	Descriptive terms	Height* in metres
0	Calm (glassy)	0
1	Calm (rippled)	0 - 0.1
2	Smooth (wavelets)	0.1 - 0.5
3	Slight	0.5 - 1.25
4	Moderate	1.25 - 2.5
5	Rough	2.5 - 4
6	Very rough	4 - 6
7	High	6 - 9
8	Very high	9 - 14
9	Phenomenal	Over 14
10-14	Reserved	
15	Missing value	

Notes:

(1) * These values refer to well-developed wind waves of the open sea. While priority shall be given to the descriptive terms, these height values may be used for guidance by the observer when reporting the total state of agitation of the sea resulting from various factors such as wind, swell, currents, angle between swell and wind, etc.

(2) The exact bounding height shall be assigned for the lower code figure; e.g. a height of 4 m is coded as 5.

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031021

Additional field significance

Code figure		
0	Reserved	
1	1-bit indicator of quality	0 = good 1 = suspect or bad
2	2-bit indicator of quality	0 = good 1 = slightly suspect 2 = highly suspect 3 = bad
3-6	Reserved	
7	Percentage confidence	
8-62	Reserved	
63	Missing value	

Notes:

(1) Additional field significance shall be used initially in conjunction with the quality of observed data.

(2) Further applications may be developed.

Definitions

BUFR message	a single complete BUFR entity
category	the lists of sequence descriptors tabulated in BUFR Table D are categorized according to their application; categories are provided for non-meteorological sequences, for various types of meteorological sequences, and for sequences which define reports, or major subsets of reports
class	a set of elements tabulated together in BUFR Table B
co-ordinate class	classes 0-9 inclusive in BUFR Table B define elements which assist in the definition of elements from subsequent classes; each of these classes is referred to as a co-ordinate class
data description operator	operators which define replication or the operations listed in BUFR Table C
data entity	a single data item

data subset	a set of data corresponding to the data description in a BUFR Message; for observational data a data subset usually corresponds to one observation
descriptor	an entity entered within the data description section to describe or define data; a descriptor may take the form of an element descriptor, a replication operator, an operator descriptor, or a sequence descriptor
element descriptor	a descriptor containing a code figure reference to BUFR Table B; the referenced entry defines an element, together with the units, scale factor, reference value and data width to be used to represent that element as data
operator descriptor	a descriptor containing a code figure reference to BUFR Table C, together with data to be used as an operand
reference value	all data are represented within a BUFR message by positive integers; to enable negative values to be represented, suitable negative base values are specified as reference values. The true value is obtained by addition of the reference value and the data as represented
replication descriptor	a special descriptor is reserved to define the replication operation; it is used to enable a given number of subsequent descriptors to be replicated a given number of times
section	a logical subdivision of a BUFR message, to aid description and definition
sequence descriptor	a descriptor used as a code figure to reference a single entry in BUFR Table D; the referenced entry contains a list of descriptors to be substituted for the sequence descriptor

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Annex II to Recommendation 20 (CBS-IX)

THE DEFINITION OF FM 94-IX BUFR USING BNF

1. Introduction

The Backus Naur Form (BNF) is a powerful and unambiguous means for defining a representation form.

The notation used is as follows:

```
<lower case letters>        an entity defined to be comprised of
                            other entities

<UPPER CASE LETTERS>        an "atomic" or "terminal" entity, not
                            defined in terms of other entities

::= is comprised of

<entity>                    specific occurrence of an entity

<entity 1> <entity 2>       entity 1 followed by entity 2

<--->|<--->                 alternative entities

<---> (n)                   exactly n occurrences

<---> o                     optional entity (zero or one)

<---> *                     zero or more occurrences

<---> +                     one or more occurrences
```

2. Definition of FM 94-IX BUFR

In the following, BNF is used to define BUFR from a "top down" approach.

2.1 The BUFR message

```
<BUFR message>            ::= <START OF BUFR MESSAGE>
                              <identification section>
                              <optional section> o
                              <data description section>
                              <data section>
                              <END OF BUFR MESSAGE>

<START OF BUFR MESSAGE>   ::= string "BUFR"

<END OF BUFR MESSAGE>     ::= string "7777"
```

2.2 The Identification section

<identification section>	::= <LENGTH OF SECTION> <BUFR REVISION NUMBER> <originating centre number> <UPDATE SEQUENCE NUMBER> <OPTIONAL SECTION FLAG> <RESERVED FLAG> (7) <BUFR MESSAGE TYPE> <BUFR MESSAGE SUB-TYPE> <ALTERNATE TABLE NUMBER> <YEAR OF CENTURY> <MONTH> <DAY> <HOUR> <MINUTES> <optional part> <PADDING>*
<LENGTH OF SECTION>	::= 24-bit unsigned integer giving the length of the section in octets
<BUFR REVISION NUMBER>	::= 8-bit unsigned integer giving the BUFR revision number corresponding to this BUFR message
<originating centre number>	::= <COUNTRY NUMBER> <CENTRE NUMBER>
<COUNTRY NUMBER>	::= 8-bit unsigned integer indicating the country of origin according to code ....
<CENTRE NUMBER>	::= 8-bit unsigned integer indicating the centre of origin according to a code defined by the country of origin
<UPDATE SEQUENCE NUMBER>	::= 8-bit unsigned integer assigned by the originating centre as zero when a BUFR message is first created, and incremented each time it is updated
<OPTIONAL SECTION FLAG>	::= 1-bit flag - 1 indicates optional section 2 is present
<RESERVED FLAG>	::= 1-bit flag - reserved for future use
<BUFR MESSAGE TYPE>	::= 8-bit unsigned integer indicating the general BUFR message type according to Table A
<BUFR MESSAGE SUB-TYPE>	::= 8-bit unsigned integer indicating the BUFR message sub-type according to local convention

<ALTERNATE TABLE NUMBER>	::= 16-bit unsigned integer indicating which of a non-standard set of BUFR tables is in use: zero indicates that standard international tables are in use	
<YEAR OF CENTURY>	::= 8-bit unsigned integer - year	most typical for the BUFR message contents
<MONTH>	::= 8-bit unsigned integer - month	
<DAY>	::= 8-bit unsigned integer - day	
<HOUR>	::= 8-bit unsigned integer - hour	
<MINUTE>	::= 8-bit unsigned integer - minute	
<optional part>	::= as defined by local convention	
<PADDING>	::= sufficient binary zeros, if required, to ensure the section length is a multiple of two octets	

2.3 The Optional section

<optional section>	::= <LENGTH OF SECTION> <RESERVED OCTET> <entity for local use by ADP centres> <PADDING>*
<RESERVED OCTET>	::= 8-bit unsigned integer set to zero
<entity for local use by ADP centres>	::= defined by ADP centre concerned

2.4 The Data description section

<data description section>	::= <LENGTH OF SECTION> <RESERVED OCTET> <NUMBER OF BUFR MESSAGE SUB-SETS> <description section flags> <sub-set data description
<NUMBER OF BUFR MESSAGE SUB-SETS>	::= 16-bit unsigned integer indicating the number of sub-sets of data contained in the BUFR message
<description section flags>	::= <OBSERVED DATA FLAG> <COMPRESSED DATA FLAG> <RESERVED FLAG> (6)
<OBSERVED DATA FLAG>	::= 1-bit flag - 1 indicates observed data, 0 indicates other data
<COMPRESSED DATA FLAG>	::= 1-bit flag - 1 indicates compressed data, 0 indicates non-compressed data
<RESERVED FLAG>	::= 1-bit flag - reserved for future use

```
<subset data description>   ::= <descriptor> +

<descriptor>                ::= <element descriptor>|
                                <replication descriptor>|
                                <operator descriptor>|
                                <sequence descriptor>

<element descriptor>        ::= <table b reference>

<replication descriptor>    ::= <DESCRIPTOR CODE>
                                <REPLICATION SCOPE>
                                <NUMBER OF REPLICATIONS>
                                <table b reference>0

<DESCRIPTOR CODE>           ::= 2-bit unsigned integer defining the
                                descriptor type - value 1

<REPLICATION SCOPE>         ::= 6-bit unsigned integer defining the
                                number of subsequent descriptors to be
                                replicated

<NUMBER OF REPLICATIONS>    ::= 8-bit unsigned integer defining the
                                number of times the descriptors within
                                the scope are to be replicated; if
                                zero, the next element descriptor
                                relates to a data item containing the
                                number of replications

<operator descriptor>       ::= <table c reference>

<data description operator> ::= <replication descriptor>|
                                <replication descriptor>
                                <element descriptor>|
                                <operator descriptor>|
                                <operator descriptor>
                                <element descriptor>

<sequence descriptor>       ::= <table d reference>
```

2.5 BUFR Table B

```
<table b>                   ::= <table b entry> +

<table b entry>             ::= <table b reference>
                                <ELEMENT NAME>
                                <UNITS NAME>
                                <UNITS SCALE SIGN>
                                <UNITS SCALE>
                                <UNITS REFERENCE SIGN>
                                <UNITS REFERENCE VALUE>
                                <ELEMENT DATA WIDTH>

<table b reference>         ::= <DESCRIPTOR CODE>
                                <CLASS NUMBER>
                                <ELEMENT NUMBER>
```

<DESCRIPTOR CODE>	::= 2-bit unsigned integer - value zero
<CLASS NUMBER>	::= 6-bit unsigned integer - indicating table b class
<ELEMENT NUMBER>	::= 8-bit unsigned integer - indicating table b element
<ELEMENT NAME>	::= 40-character element name
<UNITS NAME>	::= 24-character name of SI units used: entered "CODE TABLE" if data values reference to a code; "FLAG TABLE" if values reference a flag; "NUMERIC" if values are non-dimensional; "CCITT IA5" if values are characters
<UNITS SCALE SIGN>	::= 1-bit sign of units scale value (0=positive)
<UNITS SCALE>	::= 7-bit unsigned integer giving the power of 10 by which the original data element in the units given by <UNITS NAME> is to be multiplied to give the value found in the BUFR message
<UNITS REFERENCE SIGN>	::= 1-bit sign of units reference value (0=positive)
<UNITS REFERENCE VALUE>	::= 31-bit unsigned integer containing the data element reference value, scaled according to the units scale
<ELEMENT DATA WIDTH>	::= 8-bit unsigned integer indicating data width in bits

2.6 BUFR Table C

<table c>	::= <table c entry> +
<table c entry>	::= <table c reference> <OPERAND> <OPERATOR NAME> <OPERATION DEFINITION>
<table c reference>	::= <DESCRIPTOR CODE> <OPERATION CODE>
<DESCRIPTOR CODE>	::= 2-bit unsigned integer - value 2
<OPERATION CODE>	::= 6-bit unsigned integer indicating the intended operation
<OPERAND>	::= 8-bit unsigned integer value, to be used as an operand as indicated by the operation definition

<OPERATOR NAME>	::= 40-character operator name
<OPERATION DEFINITION>	::= rules defining the operation to be performed

2.7 BUFR Table D

<table d>	::= <table d entry> +
<table d entry>	::= <table d reference> <descriptor> <descriptor> +
<table d reference>	::= <DESCRIPTOR CODE> <CATEGORY NUMBER> <SEQUENCE NUMBER>
<DESCRIPTOR CODE>	::= 2-bit unsigned integer - value 3
<CATEGORY NUMBER>	::= 6-bit unsigned integer indicating table d category
<SEQUENCE NUMBER>	::= 8-bit unsigned integer indicating table d sequence list

3. Definition of exchange forms for BUFR tables

3.1 Format for international exchange of Table B

<table b>	::= <table b entry> +
<table b entry>	::= <DESCRIPTOR FLAG> <CLASS NUMBER> <ELEMENT NUMBER> <ELEMENT NAME> <UNITS NAME> <UNITS SCALE> <UNITS REFERENCE VALUE> <ELEMENT DATA WIDTH>
<DESCRIPTOR FLAG>	::= 1-digit integer as 1 character
<CLASS NUMBER>	::= 2-digit integer as 2 characters
<ELEMENT NUMBER>	::= 3-digit integer as 3 characters
<ELEMENT NAME>	::= name in 40 characters
<UNITS NAME>	::= units in 24 characters, or "CODE TABLE", "FLAG TABLE", "NUMERIC", or "CCITT IA5"

<UNITS SCALE>	::=	4-digit signed integer as 5 characters (sign + 4 digits) giving the power of 10 by which the original data element with the units given by <UNITS NAME> is to be multiplied to give the value found in the BUFR message
<UNITS REFERENCE VALUES>	::=	14-digit signed integer as 15 characters (sign + 14 digits)
<ELEMENT DATA WIDTH>	::=	5-digit unsigned integer as 5 characters

Notes:

(1) All characters shall be represented as upper-case characters using CCITT IA5.

(2) FORTRAN notation shall be used to represent units; thus $m^2\ s^{-2}$ will be represented as M**2/S**2, etc.

(3) Each table b entry shall be represented using 95 characters.

3.2 Format for international exchange of Table D

(to be defined)

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Annex III to Recommendation 20 (CBS-IX)

REFERENCE LIST OF CODE TABLES ASSOCIATED WITH BUFR TABLE B, WITH EXISTING SPECIFICATIONS AND CODE TABLES IN THE WMO MANUAL ON CODES

BUFR code/flag table	Related specification/ code table/Regulation/ Code form	Remarks
001007	$I_1I_2I_2$ - code table 1761	with specification I_2I_2
002001*	i_x - code table 1860	revised, weather information included in table 020003
002002	i_u - code table 1853	-
002003	a_4 - code table 1265	-
002011		to be developed
002012		to be developed
002021	I_3	-
002022	I_4	flag table revised
002023		to be developed
002024		to be developed
002025		-
002031	k_3 - code table 2264	-
	k_4 - code table 2265	-
002032	k_1 - code table 2262	numerical variation in each table
002033	k_2 - code table 2263	-
002061	s_1 - code table 3866	-
004011	-	-
004014	-	-
008001	TEMP/TEMP SHIP; Section 2-6	-
008002	SYNOP/SHIP, Regulation 12.4.9.1	-
008003	-	-
008004	ASDAR, Regulation 42.2	-
008011	F_t - code table 1152	-

BUFR code/flag table	Related specification/ code table/Regulation/ Code form	Remarks
008012	-	-
008021	-	-
010063	a - code table 0200,	a note included, to cover positive or negative sign for cases of missing numerical value of 24-hour pressure change
011031	i - code table 1800, B_A - code table 0302	-
020003*	ww - code table 4677	revised, weather information from i_x code table 1860 included
	w_aw_a - code table 4680 w_1w_1 - code table 4687	
020004	W_1 - code table 4561 W_{a1} - code table 4631	-
020005	W_2 - code table 4561 W_{a2} - code table 4631	-
020011	N - code table 2700	-
020012	C - code table 0500, C_H - code table 0509, C_M - code table 0515, C_L - code table 0513	-
020017	C_t - code table 0552	-
020032	R_s - code table 3551	-
020033	I_s - code table 1751	-
020034	c_i - code table 0639	-
020035	(b_i - code table 0439)	to be developed
020036	(z_i - code table 5239)	to be developed
020037	(S_i - code table 3739)	to be developed
020041	i - code table 1800	-
020062	E - code table 0901 E' - code table 0975	-
020063	$S_PS_Ps_ps_p$ - code table 3778	

022061	S - code table 3700	-
031021	-	-

*Note: Encoding/decoding of SYNOP SHIP i_x - code table 1860 to/from BUFR code tables:

Code figure	Type of station operation	002001 type of station	020003 present weather
1	Manned (group $7wwW_1W_2$ included)	1	00-99 (200-299)
	(but actually missing)	(1)	(510)
2	Manned station (group $7wwW_1W_2$ omitted, no significant phenomenon to report)	1	508
3	Manned station (group $7wwW_1W_2$ omitted, not observed, data not available)	1	509
4	Automatic station (group $7wwW_1W_2$ included, using code tables 4677 and 4561)	0	00-99 (200-299)
	(but actually missing)	(0)	(510)
5	Automatic station (group $7w_aw_aW_{a1}W_{a2}$ omitted, no significant phenomena to report)	0	508
6	Automatic station (group $7w_aw_aW_{a1}W_{a2}$ omitted, not observed, data not available)	0	508
7	Automatic station (group $7w_aw_aW_{a1}W_{a2}$ included, using code tables 4680 and 4631)	0	100-199 (200-299)
	(but actually missing)	(0)	(510)

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Rec. 21 (CBS-IX) - REVIEW OF RESOLUTIONS OF THE EXECUTIVE COUNCIL, BASED ON PREVIOUS RECOMMENDATIONS OF THE COMMISSION FOR BASIC SYSTEMS OR RELATED TO THE WWW

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 to be implemented,

RECOMMENDS:

(1) That the following Executive Council resolutions should be kept in force:

Resolutions 1, 2, 3 and 4 (EC-XXXVI), Resolutions 2 and 3 (EC-XXXVII)

and Resolution 1 (EC-XXXIX);

(2) That the following Executive Council resolutions are no longer needed and should not be kept in force:

Resolution 4 (EC-XXXV) and Resolution 4 (EC-XXXVIII).

Annex to paragraph 9.4 of the general summary

REQUIREMENTS FOR SOURCE-TERM, METEOROLOGICAL AND RADIOLOGICAL DATA IN CASE OF A NUCLEAR ACCIDENT

SOURCE-TERM INFORMATION (from the site of the accident)

EARLY PHASE

(a) Location of accident (source): Name of location of the geographical position of the accident relative to a location, altitude (above MSL) and latitude/longitude co-ordinates to the nearest second or as accurately as possible;

(b) Time of release: Date with time in GMT/UTC to the nearest minute if known, followed by (if appropriate):

"instantaneous" - if release occurs over a period of less than five minutes;

"continuing" - if release is ongoing at time of early notification;

"detected" - indicating time when release was detected but when release start is unknown;

(c) Time of termination: Date with time in GMT/UTC to the nearest minute (if known);

(d) Characteristics of release:

(i) Amount of radioactivity released into the atmosphere up to a specified date and time (isotopic composition):

- Date and time (GMT/UTC) to the nearest minute;
- Total amount released (in Bequerels (Bq));
- If gaseous, particulate or both;
- Composition of release. Noble gases, caesiums, iodines, transuranics and/or other important radionuclides; (if available, specification in isotopes, e.g. Ce137 and amounts in Bq);

(ii) Height of stabilized nuclear cloud in metres above ground. Every height, indicated as "estimated" or "observed", should be identified whether it is the top, bottom or centre;

(iii) Chemical form of radionuclides (information will probably be available first in the intermediate phase).

INTERMEDIATE PHASE

(a) Updated information and more specified data as in the early phase;

(b) Time-dependent isotope specific release fraction and deviation. For each important radioactive isotope, the release fraction (isotope specific fraction (percentage) of the core inventory released from the accident site to the atmosphere) is required every few hours. If the release deviation is rather short, time-integrated release fractions should be sufficient. If isotope-specific fractions are not available, release fractions should be given for the groups: nobel gases, caesiums, iodines and transuranics;

(c) Chemical and physical forms. For specific isotopes or groups of elements, it should be indicated if they are in particle, gas or other form. Important chemical forms exist e.g. for iodine (methyl iodine, caesium iodine, elemental iodine, etc.) which affect the uptake into the human body;

(d) Particle size distribution;

(e) Moisture and heat content of the release (if estimated or measured). For example:

- Vapour emission rate per hour (in kg h^{-1});

- Mean heat emission rate per hour (in MW);

- Area of heat emission (in m^2).

(Note: Source term data can be submitted over the GTS in an IAEA format, developed in close co-operation with the WMO Secretariat (arrangements similar to transmission of seismic data over the GTS). Not all the required data may appear in the IAEA message.)

METEOROLOGICAL DATA

EARLY PHASE

1. Meteorological data from the site of the nuclear accident (Article 5.1 (e)) should promptly be provided to WMO Members and should, if available, include:

(a) Wind, temperature and humidity data from radiosoundings (fixed or mobile), towers, pilot balloon ascents, indirect sensors;

(b) Precipitation data, type and amount;

(c) Mixing height (if available);

(d) Surface air temperature in tenths of degrees Celsius;

(e) Total cloud cover in oktas of sky and height of cloud base;

(f) Surface wind direction;

(g) Surface wind speed;

(h) Atmospheric pressure;

(i) Standard deviation of surface wind direction, three-minute averages (if available).

2. Supplementary meteorological information which include observed history since an accident commenced at the site, i.e. surface wind, temperature, cloud cover and precipitation amounts, hourly and three-hourly, should be made available to WMO Members.

(Note: Meteorological data from the site will, if available, be included in the IAEA format.)

INTERMEDIATE PHASE

3. For monitoring and mesoscale forecasting purposes, in addition to routine data and the information exchanged over the GTS, non-standard meteorological information from meteorological stations and platforms (e.g. within an area of about 2000 km from the accident site) should be obtained for the duration of the release of the radioactivity and a few days afterward, including:

(a) Hourly (if possible) surface meteorological data, including precipitation amounts (e.g. automatic stations) from routinely operated national synoptic networks and six-hourly precipitation amounts from other stations to reach a resolution of 50 x 50 km;

(b) Six-hourly vertical profiles of temperature, humidity and wind from ordinary radiosonde/radiowind stations, if possible, with increased vertical resolution;

(c) Vertical soundings from mobile radiosonde stations;

(d) Data from vertical sounders;

(e) Drop soundings;

(f) Data from aircraft, helicopters, weather radar and satellites.

(Note: Existing WMO codes to be used.)

RADIOLOGICAL DATA (RADIOACTIVITY MONITORING DATA)

Article 5.1 (f) states that the notifying State Party shall inform of the results of environmental monitoring relevant to the transboundary release of radioactive materials.

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EARLY PHASE

From the site of the accident and other sites of the notifying State Party which are relevant to the transboundary flow of released radioactivity:

(a) γ exposure rates. Point measurement near the ground and aloft (not averaged), preferably three-hourly (in mR h^{-1} or equivalent units);

(b) Other radioactivity measurements which can be obtained quickly.

(Note: In case the source term information provided in the early phase is reliable and extensive, the modellers do not require radioactivity measurement data from the site.)

INTERMEDIATE PHASE

The requirements for radiological data in this phase from a larger area around the accident site (about 2000 km) and for the rapid transmission of these data over the GTS are based on the need for continuous monitoring of the movement and behaviour of the radioactive cloud and to verify and, if required, amend the prediction results obtained by various models:

(a) γ exposure rates. Point measurements near the ground and aloft (not averaged) at three- to six-hourly intervals (in mR h^{-1} or equivalent units);

(b) Simple β air-concentration analyses. Point measurements near the ground and aloft (not averaged) at three- or six-hourly intervals (in Bq m^{-3});

(c) Isotope-specific air concentrations near the ground and aloft. Averaged values over three hours, transmitted three-hourly, but probably with a time delay of several hours (in Bq m^{-3});

(d) Isotope-specific concentrations of activity in precipitation, including amount of precipitation. Averaged values over three hours, transmitted three-hourly, but probably with a time delay of several hours (activity in Bq l^{-1}, precipitation amounts mm h^{-1}. Note: Precipitation data should be collected at the location of radiological measurements.

(Note: Codes for the exchange of radiological data need to be developed.)

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	I. "DOC" series		
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3	Global Observing System (GOS) Manual on the GOS ADD. 1	6.2	Secretary-General
4	Global Telecommunication System (GTS)	6.3	Secretary-General
5	WWW Data Management (DM) (including codes) Supplementary Information Code Table and other code matters ADD. 1	6.4	Secretary-General
6	WWW Data Management (DM) (including codes) Report by the chairman of the Working Group on Codes	6.4	Chairman of the working group
7	Review of previous resolutions and recommendations of the Commission and relevant Executive Council resolutions	11	Secretary-General

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8	WWW Data Management (DM) (including codes) Report of the seventh session of the CBS Working Group on Codes ADD. 1	6.4	Secretary-General
9	WWW Implementation Co-ordination (IC)	6.6	Secretary-General
10	Education and training related to CBS activities	8	Secretary-General
11	Global Observing System (GOS) APPENDIX C, CORR. 1	6.2	Secretary-General
12	Global Observing System (GOS) Report of the chairman of the Working Group on the Global Observing System	6.2	Chairman of the working group
13	Global Observing System (GOS) Availability and use of satellite data	6.2	Secretary-General
14	WWW Data Management (DM) (including codes) Data representation on weather charts ADD. 1	6.4	Secretary-General

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15	Global Observing System (GOS) Guide on the Global Observing System	6.2	Secretary-General
16	WWW Data Management (DM) (including codes) Binary Universal Form for Data Representation FM 94-IX BUFR ADD. 1	6.4	Secretary-General
17	Consideration of the decisions of Tenth Congress Second WMO Long-term Plan	4	Secretary-General
18	Report of the president of the Commission APPENDIX H, CORR. 1	3	President of CBS
19	Relationship of the WWW with other WMO and international programmes Activities in response to accidental releases of radioactive material into the atmosphere APPENDIX E, ADD. 1	9	Secretary-General
20	Global Data-processing System (GDPS) Procedures for the designation of Regional/Specialized Meteorological Centres (RSMCs) ADD. 1 ADD. 1, REV. 1 ADD. 2	6.1	Secretary-General

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21	Global Data-processing System (GDPS) Assessment of monitoring activities on the GDPS	6.1	Rapporteur on Monitoring Procedures of the GDPS
22	Consideration of the decisions of Tenth Congress WMO satellite activities	4	Secretary-General
23	Global Telecommunication System (GTS) Report of the chairman of the CBS Working Group on the Global Telecommunication System	6.3	Chairman of the working group
24	WWW Implementation Support Activity (ISA)	6.5	Secretary-General
25	Relationship of the WWW with other WMO and international programmes Exchange of seismic data on the GTS	9	Secretary-General
26	Global Data-processing System (GDPS) Report by the chairman of the CBS Working Group on the GDPS	6.1	Chairman of the working group
27	Global Telecommunication System (GTS) Collection of ships' weather reports and dissemination of meteorological information through INMARSAT	6.3	Secretary-General

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28	Relationship of the WWW with other WMO and international programmes Atmospheric volcanic activity	9	Secretary-General
29	Global Telecommunication System (GTS) Report of the chairman of the Study Group on Operational Matters of the CBS Working Group on the Global Telecommunication System	6.3	Chairman of the Study Group on Operational Matters
30	CBS work programme, establishment of working groups, nomination of members of working groups and nomination of rapporteurs Role of CBS within WMO	10	Federal Republic of Germany
31	WWW Data Management (DM) (including codes)	6.4	Secretary-General
32	Global Telecommunication System (GTS) Plan for monitoring the operation of the WWW	6.3	Secretary-General
33	Global Telecommunication System (GTS) Organization of the GTS	6.3	Secretary-General
34	Relationship of the WWW with other WMO and international programmes Boundary conditions for limited-area models	9	President of CBS

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35	WWW Data Management (DM) (including codes) Proposed amendments to FM 92-VIII Ext. GRIB	6.4	Secretary-General
36	Status of implementation and operation of the WWW, including monitoring	5	Secretary-General
37	Global Telecommunication System (GTS) Meteorological satellites data collection system	6.3	Secretary-General
38	WWW Data Management (DM) (including codes)	6.4	ECMWF
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40	Global Observing System (GOS) Developments in Aircraft Meteorological Data Relay Systems (AMDAR)	6.2	Australia
41	Status of WWW implementation and operation, including monitoring WWW Data Management (DM) (including codes)	5 6.4	Secretary-General and ECMWF

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42	Global Data-processing System (GDPS) The use of numerical weather prediction (NWP) products by National Meteorological Centres (NMCs)	6.1	Rapporteur on the Application of Improved Forecasting Methods and Required Technology for Operational Use

II. "PINK" series

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1	Opening of the session Organization of the session Report by the president of the Commission	1, 2, 3	President of CBS
2	Consideration of the decisions of Ninth Congress	4	President of CBS
3	WWW Implementation Support Activity (ISA)	6.5	Chairman, Committee B
4	WWW Implementation Co-ordination (IC)	6.6	Chairman, Committee B
5	WWW Data Management (DM) (including codes) REV. 1 and CORR.	6.4	Chairman, Committee A
6	Education and training related to CBS activities	8	Vice-chairman, Committee B
7	Review of the previous resolutions and recommendations of the Commission and relevant Executive Council resolutions	11	Vice-chairman, Committee B

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8	WWW Data Management (DM) (including codes) CORR. ADD. 1	6.4	Chairman, Committee A
9	WWW Data Management (DM) (including codes) Binary Numerical Form for Data Representation FM 94-IX BUFR CORR.	6.4	Chairman, Committee A
10	Relationship of the WWW with other WMO and international programmes	9	Chairman, Committee B
11	Relationship of the WWW with other WMO and international programmes	9	Chairman, Committee B
12	Global Data-processing System (GDPS)	6.1	Chairman Committee A
13	Global Observing System (GOS) Status of implementation of specific systems Availability and use of satellite data	6.2	Vice-chairman, Committee A
14	Status of WWW implementation and operation, including monitoring ADD. 1	5	Chairman, Committee A

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15	Global Telecommunication System (GTS)	6.3	Vice-chairman, Committee A
16	Report of the Nominations Committee	12	Chairman, Nominations Committee
17	Results of the Technical Conference on Operational Weather Forecasting	7	Scientific Director of TECOFOR
18	Global Observing System (GOS) Guide on the Global Observing System	6.2	Vice-chairman, Committee A
19	Global Observing System (GOS) Report by the chairman of the Working Group on the Global Observing System. Manual on the Global Observing System	6.2	Chairman, Working Group on the GOS
20	Global Telecommunication System (GTS)	6.3	Vice-chairman, Committee A
21	WWW Data Management (DM) (including codes)	6.4	Chairman, Committee A
22	WWW Data Management (DM) (including codes) WWW monitoring	6.4	Chairman, Committee A
23	Global Data-processing System (GDPS) Procedures for the designation of Regional/Specialized Meteorological Centres (RSMCs)	6.1	Chairman, Committee A

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24	CBS work programme, establishment of working groups, nomination of members of working groups and nomination of rapporteurs	10	President'of CBS
25	Election of officers	12	President of CBS