

**WORLD METEOROLOGICAL ORGANIZATION**

**COMMISSION  
FOR MARINE METEOROLOGY**

**ABRIDGED FINAL REPORT  
OF THE  
TENTH SESSION**

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## GENERAL SUMMARY OF THE WORK OF SESSION

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

1.1 The tenth session of the Commission for Marine Meteorology was opened by the president of the Commission, Mr F. Gérard, at 9.30 a.m. on 8 February 1989 in the Unesco Conference Centre, Paris, France.

1.2 On behalf of the Minister of Transport and of the Sea of the Government of France, the Director of the national Meteorological Service of France and Permanent Representative of France with WMO, Mr A. Lebeau, welcomed delegates to the session and to France. He said that it was both an honour and a pleasure for France to welcome specialists in marine meteorology to Paris, where, at the end of the 19th century, international meteorological co-operation was born. Mr Lebeau also expressed his very warm thanks to the Director-General of Unesco, Professor F. Mayor, for having allowed the session to take place within Unesco, further proof of the close co-operation which existed between WMO and Unesco and in particular the latter's Intergovernmental Oceanographic Commission.

1.3 Mr Lebeau noted that the traditional needs of mariners for marine meteorological services remained even today a major concern of national Meteorological Services. That the applications of marine meteorology were also becoming very diverse was evident from a glance at the extensive agenda for the session. In that context, Mr Lebeau underlined a number of major topics of importance in the field of marine meteorology: marine telecommunications, essential for both data collection and the dissemination of products, which were undergoing major transformations with the introduction of systems such as NAVTEX and INMARSAT and the recent modifications to SOLAS; specialized marine meteorological services such as ship routing and assistance to fisheries, which were often very closely linked with oceanographic services; specialized education and training in the field of marine meteorology and physical oceanography; and the developing awareness, particularly in the context of climate-related programmes, that the atmosphere and the ocean must be observed and studied as a single environment, the realization of which was becoming increasingly possible with the advent of oceanographic satellites.

1.4 In closing his remarks, Mr Lebeau wished the delegates a successful and profitable session and a most enjoyable stay in Paris.

1.5 On behalf of WMO, Professor G. O. P. Obasi, Secretary-General, welcomed delegates to the tenth session of the Commission for Marine Meteorology. He expressed his appreciation to the Government and people of France for having offered to host the session in Paris, and to the Director-General of Unesco for having placed the conference facilities of Unesco at the disposal of the session. Professor Obasi also expressed his appreciation to Mr Lebeau for his efforts towards ensuring that the session would run smoothly. He then paid tribute to the president of CMM, Mr F. Gérard, for his very able leadership and guidance of the Commission over the previous four and a half years and wished him every success in his future career.

1.6 In noting the crucial impetus which the marine meteorological service requirements of the maritime community had given to the initial

development of organized international meteorology, Professor Obasi stressed that the importance of marine meteorology globally had increased in recent years. In addition to the requirements for basic marine meteorological services in support of the safety of life and property at sea, as specified under the International Convention for the Safety of Life at Sea (SOLAS), there was now a substantial increase in requirements for more specialized services, often of considerable economic value, in support of specific maritime activities or user groups. At the same time, the clear recognition of the significance of the oceans in global climate processes on all time scales had placed even greater emphasis on the importance of marine meteorological and oceanographic observing systems. Professor Obasi noted that, in this context, the Commission for Marine Meteorology had a continuing and major role to play in assisting national Meteorological Services in developing and expanding their marine observing, communications and services systems in support of a wide variety of applications.

1.7 Professor Obasi then referred to the very successful Technical Conference on Ocean Waves which had immediately preceded the Commission session. He said that the results of the conference would have a major impact in assisting national Meteorological Services to provide wave-related services to maritime users. In this context, he noted that the development of marine meteorological services could only take place within the overall development of national meteorological institutions, a development to which WMO as a whole was fully committed. The international co-operation necessary for such development had always been a hallmark of WMO and Professor Obasi was confident that this co-operative spirit would be fully manifest during the present session.

1.8 In concluding, the Secretary-General assured the session of the full support of the WMO Secretariat in its work and wished it every success in its deliberations. He also wished delegates a very pleasant stay in Paris.

1.9 The Director-General of Unesco, Professor F. Mayor, then welcomed the delegates to Unesco headquarters. In doing so, he noted that the co-operation which existed between meteorologists and oceanographers had never before been so extensive or so vital. This co-operation had been stated in very concrete terms by previous heads of both Unesco and WMO, and continued to be manifest today in the major activities undertaken jointly by WMO and the Intergovernmental Oceanographic Commission of Unesco. These included joint data gathering by meteorologists and oceanographers, joint studies of atmosphere/ocean processes, and the provision of joint services based on those data and an acquired understanding of the underlying processes. Ultimately, such co-operation was not merely beneficial but essential to the Member States of the Organizations and to their peoples. Professor Mayor also expressed his pleasure that the co-operation included the vital fields of training, education and mutual assistance. In conclusion, he wished the session every success in its work.

1.10 There were 103 participants at the session. These included representatives of 44 Members of WMO and 10 international organizations. A complete list of participants is given in Annex I to this report.

2. ORGANIZATION OF THE SESSION (agenda item 2)

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

At the first plenary meeting the representative of the Secretary-General presented a list of delegates whose credentials had been found valid. This list was accepted as the first report on credentials. Reports on credentials were submitted to subsequent plenary meetings and were accepted by the Commission. It was decided not to set up a Credentials Committee.

2.2 Adoption of the agenda (agenda item 2.2)

The provisional agenda was adopted without amendment at the first plenary meeting on the understanding that, at any time during the session, additions or alterations could be made. The agenda finally adopted is reproduced as Annex II to this report.

2.3 Establishment of committees (agenda item 2.3)

2.3.1 Working Committees

Two working committees were established to deal with specific agenda items:

- (a) Committee A to deal with agenda items 5, 6, 7.4 and the relevant parts of 4 and 16. Mr R. C. Landis (USA) was elected chairman and Dr Lim Joo Tick (Malaysia), vice-chairman;
- (b) Committee B to deal with agenda items 7.1, 7.2, 7.3, 8, 9 and the relevant parts of 4 and 16. Mr R. J. Shearman (UK) was elected chairman and Dr S. S. Lappo (USSR), vice-chairman.

The session decided to deal with agenda items 10, 11, 12, 13 and 14 as a Committee of the Whole chaired by the president of the Commission.

2.3.2 Co-ordination Committee

In accordance with Regulation 27 of the WMO General Regulations, a Co-ordination Committee was established consisting of the president, the vice-president, the chairmen of the working committees and the Secretary-General's representative.

2.3.3 Nominations Committee

To facilitate the election of the officers of the Commission, a Nominations Committee was established consisting of the principal delegates of Argentina, Canada, France, Japan, New Zealand and the United Republic of Tanzania.

2.4 Other organizational matters (agenda item 2.4)

Under this item, the Commission decided on its working hours for the duration of the session. It was agreed that, in accordance with the WMO General Regulations, no minutes of the session would be prepared, but that statements by delegations might be reproduced and distributed as and when requested, in accordance with Regulation 110.

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

3.1 In his report, Mr F. Gérard, president of CMM, gave a brief account of the activities of the Commission since its ninth session. Over the previous four years the Commission membership had grown from 130 members from 79 Members of WMO at the time of CMM-IX to 166 members from 94 Members as of 1 October 1988. The ninth session had established five working groups and two rapporteurs and a variety of substantive activities had been undertaken, both within WMO and elsewhere, in co-ordination with related organizations and programmes, in the areas of marine meteorological services, marine telecommunications, marine observing systems, marine climatology, sea ice, the WMO wave programme and specific technical problems. With regard to the coming intersessional period, Mr Gérard indicated that the Commission would have to look very carefully at its work priorities and internal organization in order to ensure that maximum benefits were achieved for Members within the increasingly limited budgetary resources. In this context, the president noted that the future work programme and Commission structure would have to ensure that high-quality basic marine meteorological services would be provided in accordance with the requirements of SOLAS; that Members would be provided with appropriate guidance and assistance in the provision of specialized marine meteorological services; that the marine climatological and oceanographic data base would be maintained in support of the World Weather Watch (WWW) and World Climate Programme (WCP); that marine observing systems would be expanded and upgraded using the most recent technological developments, including satellites; and that co-operation and co-ordination with related organizations in these activities would be maximized.

3.2 Mr Gérard then noted that the close co-operation which already existed between CMM, other technical commissions and international organizations such as IOC (Unesco), IMO and FAO had contributed greatly to the implementation of ocean-related programmes. The president thanked all members of CMM, particularly the vice-president, the chairmen and members of working groups and rapporteurs, for their major contributions to the work of the Commission over the previous four years. Finally, he expressed his appreciation to the Secretary-General and his staff in the WWW Department for their valuable assistance during his term of office.

3.3 The Commission expressed its satisfaction and appreciation for the report of the president of CMM and the activities of the Commission since its ninth session and paid a special tribute to the president for his leadership during his term of office. During the general discussion of the presidential report and the reports by the chairmen of working groups and by the rapporteur which followed, many comments and suggestions were made by delegates. Some of the subjects which were given particular attention by the Commission are described in the following paragraphs.

3.4 The Commission noted the vital importance of marine telecommunication systems, both for the collection of marine meteorological data and for the dissemination of data and products to users. In this context, current major developments in these systems such as NAVTEX, INMARSAT and the overall Global Maritime Distress and Safety System of IMO were of particular significance and the Commission agreed that they constituted a priority area for work during the coming intersessional period.

3.5 The Commission also noted the vital importance of ocean observing systems, in the context of the World Climate Programme and climate change



studies, as well as their traditional applications to the World Weather Watch and marine meteorological services. It therefore agreed on the need to give special attention to improving and expanding ocean observation programmes, including in particular observations from the forthcoming oceanographic satellites.

3.6 The Commission agreed that the major activities now being undertaken in the collection, processing and archival of marine climatological and sea-ice data were of great importance in the context of climate research as well as for marine service activities, and should be continued. It further agreed that attention should be given to the closer integration of marine climatology within the CLICOM project during the coming intersessional period.

3.7 In the context of technical studies and support for Members, the Commission agreed on the importance in future of undertaking multidisciplinary ocean studies, particularly in fields such as marine pollution. It also noted the potential value to all Members of the technical reports published in the series Marine Meteorology and Related Oceanographic Activities, and requested Members to consider the possibility of assisting in the translation of these documents into the other languages of the Organization.

3.8 The Commission stressed very strongly the importance and value of the marine meteorological services seminar series and hoped that it would be continued in the future, if possible with greater financial support to allow the attendance of larger numbers of participants. The Commission also noted the importance of increased material assistance to Members, of longer-term training in marine meteorology and physical oceanography, and of future co-operation between WMO and IOC in this regard.

3.9 The Commission expressed the belief that there was a need to re-establish the CMM Advisory Working Group which should continue to assist the president of the Commission in the co-ordination and direction of the work of its working groups and rapporteurs, in the monitoring of the implementation of the Second WMO Long-term Plan and the preparation of the Third WMO Long-term Plan, and in furthering co-operation with other WMO bodies and with international organizations such as IOC. Specific action taken in this regard is recorded under agenda item 15.

3.10 The Commission considered the future work programme in the light of the general policy guidance and priority activities outlined by Tenth Congress and the specific objectives and tasks for the WMO Marine Meteorology Programme as detailed in the Second WMO Long-term Plan. It adopted the list of major tasks proposed for CMM for 1989-1993 (see Annex III).

#### 4. REPORT BY THE CHAIRMEN OF WORKING GROUPS AND BY RAPPORTEURS (agenda item 4)

4.1 The Commission noted the reports of the chairmen of the working groups and the rapporteur and expressed its appreciation for their excellent work and for the time and effort spent in carrying out their tasks. These reports are discussed in detail under the relevant agenda items.

#### 5. MARINE METEOROLOGICAL SERVICES (agenda item 5)

5.1 The Commission considered the report submitted by Mr R. C. Landis (USA), chairman of the Working Group on Marine Meteorological Services, and

expressed its appreciation to the working group for the work carried out during the intersessional period. With regard to the activities of this working group in general, the Commission noted that Tenth Congress had identified marine meteorological services as being of the highest priority within the Marine Meteorology and Associated Oceanographic Activities Programme for the tenth financial period. These services covered both basic services in support of the safety of life and property at sea, as required under the Safety of Life at Sea (SOLAS) Convention and as outlined in the Manual on Marine Meteorological Services (WMO-No. 558), and also the more specialized services which were increasingly being required by specific user groups. The Commission agreed that both types of service were of major importance to Members and to the maritime community and that every effort should be made to enhance the implementation of this part of the marine programme following the guidance given in the Second WMO Long-term Plan. Specific aspects of the implementation of marine meteorological services are discussed in the following paragraphs.

#### Standard format for weather forecasts for offshore platforms

5.2 The Commission recalled that, at its ninth session, it had briefly discussed a draft standard format for weather forecasts for offshore platforms and had referred this draft format to the Working Group on Marine Meteorological Services for further action. Following a recommendation of the working group, the format was circulated to members of CMM for their consideration and consultation with users. Members were generally in agreement with the format and proposed a number of minor amendments which were incorporated into a new draft. The Commission agreed that this new draft format did provide useful guidance to Members in the provision of this important type of specialized marine meteorological service, although it noted that the format could only have the status of a "suggestion" since such services were normally tailored to suit specific user requirements. The Commission agreed that the format should be included in the Guide on Marine Meteorological Services (WMO-No. 471) on this basis, and adopted Recommendation 1 (CMM-X).

#### WMO storm surge project

5.3 The Commission noted with interest that a storm surge project for the Bay of Bengal and the Arabian Sea had been adopted in 1986 by the WMO/ESCAP Panel on Tropical Cyclones. The object of the project was to assist Members in the region to implement and upgrade their tropical cyclone storm surge forecast and warning services and a number of activities under the project had already been initiated. The Commission agreed that storm surge forecasting was a particular marine meteorological service of great importance to many maritime Members and therefore welcomed the project as an excellent means of furthering capabilities in this field. It also agreed to provide technical advice to the project as required, and requested the Working Group on Basic Marine Meteorological Services to continue to monitor the progress of the project. The Commission also noted with interest that a storm surge project had also recently been adopted by the first session of the IOC Regional Committee for the Central Indian Ocean (Islamabad, July 1988). The Commission agreed that every effort should be made to ensure that appropriate co-ordination took place between these two projects, to minimize duplication of effort and ensure maximum benefit for Members. It therefore requested the Secretariat to convey this information to the WMO/ESCAP Panel on Tropical Cyclones for its consideration.

5.4 In the wider context, the Commission noted that storm surges were a major problem for Members in other tropical cyclone-affected regions as well as in areas not affected by tropical cyclones, and was also of concern in organizations and bodies outside WMO. It agreed that this was an area of work which depended on continuing close co-operation among meteorologists, oceanographers, hydrologists, hydrographers and many others. At the same time, it noted that substantial assistance was required by Members by way of technical guidance, model development and data-collection facilities and support for seminars and workshops. It therefore referred the question of storm surges generally to the Working Group on Basic Marine Meteorological Services for detailed study, during the intersessional period, of ways in which the storm surge-related services of all concerned Members might be improved and expanded.

#### Meteorological support for marine pollution emergency operations

5.5 The Commission noted that operations at sea or along the coast in response to marine pollution emergencies were fundamentally dependent on the support of meteorological services. Such support might include some or all of the following:

- (a) Basic meteorological forecasts and warnings for the area(s) concerned;
- (b) The observation, analysis and forecasting of the values of specific meteorological variables required as input to models describing the movement, dispersion, dissipation and dissolution of marine pollution;
- (c) In some cases, the operation of these models;
- (d) In some cases, access to national and international telecommunications facilities;
- (e) Other operational support.

At present, such support was generally provided by individual national Meteorological Services, on request, with any international co-ordination taking place on an ad hoc basis.

5.6 In view of the obvious international character, and present lack, of defined responsibilities for pollution events which occurred on the high seas, the Commission agreed that there was an urgent need to develop an internationally co-ordinated system for meteorological support in such cases. Such a system might involve a limited number of clearly identified countries or even specific meteorological centres, each with defined areas of responsibility, which would co-ordinate with other national or international authorities responsible for pollution emergency operations, notably in the provision of timely and appropriate meteorological support. In many cases, these centres would themselves provide the required support directly. It was noted that this system might be related - although not necessarily be identical - to the proposed revised system of high seas forecast and warning centres which is discussed under agenda item 6.2.

5.7 The Commission agreed that urgent action to develop such a system of marine pollution emergency response centres should be undertaken by the Working Group on Basic Marine Meteorological Services. It also noted the

direct interest of IMO, UNEP and IOC in the matter and agreed that these organizations should be invited to participate in the study, which should also be closely co-ordinated with the WMO regional associations. Recommendation 2 (CMM-X) on the subject was adopted. Finally, the Commission noted with appreciation the offers made during the session by the delegates of a number of Members to consider operating centres which might be proposed under the system. The Commission requested the working group to take these and similar proposals into account when developing the system.

#### Specialized marine meteorological services

5.8 The Commission considered the proposals made by the Executive Council for improved guidance material with regard to certain specialized marine meteorological services, viz.:

- (a) Coastal marine services (including forecasting techniques and automatic observing instrumentation);
- (b) The weather routing of ships;
- (c) Marine pollution monitoring and control;
- (d) Services for fisheries;
- (e) Services for ports, harbours and confined waterways;
- (f) Consolidated information for users of the marine products and services currently offered by maritime Members.

5.9 In this connection, the Commission noted and approved the actions already under way on certain specific matters, viz.:

- (a) The preparation by a rapporteur, Mr D. Linforth (Australia) of a concise handbook on marine meteorological services;
- (b) The preparation by Dr E. Martinsen (Norway) of a rapporteur's study on drift calculations of surface objects and marine pollutants;
- (c) The preparation by Mr E. Smaland (Norway), in collaboration with a rapporteur from the Commission for Agricultural Meteorology (CAgM), of a study on the meteorological and climatological aspects of marine fisheries.

The Commission expressed its appreciation to these rapporteurs for their efforts.

5.10 The Commission considered that the other three items mentioned in paragraph 5.8 above were of considerable importance to many Members and therefore agreed that rapporteurs' studies should be undertaken on these topics within the Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services. The study on services for ports, harbours and confined waterways could possibly be undertaken in co-ordination with other appropriate technical commissions, such as CHy. Further action on this matter was taken under agenda item 15.

Regional rapporteurs' reports

5.11 The Commission considered the reports submitted by the regional rapporteurs on marine meteorological services and expressed its appreciation for their contributions to the work of the session. It agreed that many of the topics raised by the rapporteurs would be considered under the relevant agenda items. However, it noted that some of them were common and appeared in all or most of the reports. These included in particular the impact of the seminars on marine meteorological services that had taken place in the Regions during the intersessional period and the need for holding them regularly; the need to recruit more VOS and improve the services provided by the port meteorological officers; and the need for increased material support for Members relating to the provision of marine meteorological services.

Marine services programme to the year 2000

5.12 The Commission recalled that, at its ninth session, it had placed a high value on the document "Marine services programme to the year 2000" as a planning document for the future development of marine meteorological services in response to user requirements, and that it had requested its Working Group on Marine Meteorological Services to review and revise it for consideration at the present session. The Commission therefore noted with interest the draft updated version of the document which had been prepared by the Canadian members of the Working Group on Marine Meteorological Services, Mr M. A. Macleod and Mr A. Campbell. It expressed its appreciation to these experts for their efforts and agreed that the new document again constituted a very valuable planning aid both for the further development of marine meteorological services in support of user requirements and for the preparation of the Marine Meteorology Programme section of the Third WMO Long-term Plan. In the context of its application to the preparation of the TLTP, the Commission noted the need for possible modifications to take into account:

- (a) Comments and concerns of user organizations such as IMO, ICS and IFSMA;
- (b) A possible future division of marine meteorological services with respect to user groups rather than geographical zones.

The Commission therefore requested:

- (a) That the document should be distributed to all members of the Commission for their information and assistance;
- (b) That the document should be sent to user organizations, such as IMO, ICS and IFSMA, for their consideration and comments;
- (c) That the revised document should be taken into account when preparing relevant parts of the Marine Meteorology and Associated Oceanographic Activities Programme for the Third WMO Long-term Plan.

Finally, the Commission requested the Working Group on Basic Marine Meteorological Services to continue reviewing and updating the document on a regular basis, in line with the preparation schedule for future long-term plans.

Monitoring of user requirements for marine meteorological services

5.13 The Commission noted with interest a report provided by the USSR on the results of a monitoring of the requirements of their shipping fleet for marine meteorological services. It agreed that these results were of value to all Members providing marine meteorological services, not just the Members directly concerned, and it encouraged Members generally to continue such monitoring and to make the results available as widely as possible. It further requested the Working Group on Basic Marine Meteorological Services to study ways in which these results might be co-ordinated and summarized for the benefit of all service providers.

Marine meteorological services in the Antarctic

5.14 The Commission noted that it had been requested by the Executive Council to assist in the provision of appropriate technical advice to a study being undertaken jointly by WMO, SCAR and IOC for the possible upgrading of marine meteorological and sea-ice services provided in the Antarctic. Such a study had been requested by the XIVth Antarctic Treaty Consultative Meeting and was being undertaken in the context of the WMO Long-term Plan proposals for Antarctic meteorology. The first step in the study was to be a joint WMO/SCAR/IOC expert meeting to take place in Leningrad, USSR, in late February 1989.

5.15 In this context, the Commission noted with interest a report prepared by Mr D. Linforth (Australia), on behalf of the Working Group on Marine Meteorological Services, on existing marine meteorological data availability and services in the Antarctic Region. The Commission expressed its appreciation to Mr Linforth for his report, which it agreed would provide very valuable background information for the proposed study. It therefore requested that the report should be made available to the expert meeting for its consideration. Further aspects of the study relating to sea-ice services were considered under agenda item 9.

6. MARINE TELECOMMUNICATIONS (agenda item 6)

6.1 Marine telecommunication arrangements for data collection and transmission (agenda item 6.1)

OBS classification for meteorological messages

6.1.1 The Commission noted with considerable concern the actions which had been taken within the CCITT of ITU and its subsidiary bodies to remove the prefix OBS and the special classification given to meteorological messages. It agreed with the Working Group on Marine Meteorological Services that such moves would:

- (a) Double the cost of collecting these messages;
- (b) Remove the special priority of meteorological observations, thus causing a potential loss or delay of data through message blockage at coastal radio stations with the consequent degradation of forecasts and warnings;

- (c) Make it difficult for national Meteorological Services to be charged directly for the cost of collecting the messages, thus shifting the charges to the ships themselves.

The Commission also noted the concern expressed on the matter by Tenth Congress, which had " . . . urged Members, together with CMM and CBS, to make every effort to ensure the retention of this special classification. "

6.1.2 The Commission viewed this development with extreme concern, since it might rapidly result in substantial reductions in the number of ships' weather reports collected through coastal radio stations. The Commission therefore requested the Secretary-General to continue his representations to ITU and its subsidiary bodies on behalf of WMO Members on this matter. At the same time, it agreed on the requirement for national PTTs, which were normally the Members of ITU, to be made aware of the importance to national Meteorological Services of this special classification and of the value to meteorological services generally of the continued collection of ships' weather reports. The Commission therefore urged Members, whenever possible, to bring this matter to the attention of their national PTTs so that these organizations might in turn act on behalf of national Meteorological Services within ITU. The Commission also encouraged Members to consider alternative methods for collection of ships' observations such as INMARSAT, Argos and the International Data Collection System (IDCS).

#### The Argos system

6.1.3 The Commission noted with interest that the Argos system for the collection and location of environmental data from remote data collection platforms had undergone considerable development and expansion during the previous four years. In addition to the collection and location of reports from drifting buoys, which were subsequently inserted onto the GTS in DRIBU code by CLS Service Argos, the system also provided for the collection and dissemination over the GTS of SHIP and BATHY reports, as well as the collection of data from remote land stations.

6.1.4 The Commission further noted with appreciation that WMO, in association with IOC and CLS Service Argos, continued to host the annual joint tariff agreement meetings, whereby governmental users of the Argos system negotiated with CLS Service Argos a favourable global tariff for the use of the system for the following year. This global tariff represented a considerable reduction for such users (including national Meteorological Services) over the tariff applicable to commercial users, which was of great assistance to Members in developing their drifting buoy and related programmes. The Commission therefore encouraged Members to make use of the Argos system and of the favourable global tariff, whenever possible, for the collection of meteorological and oceanographic data from remote platforms, and for their subsequent insertion onto the GTS, for the greater benefit of meteorological services generally.

#### Coastal radio stations accepting BATHY/TESAC reports

6.1.5 The Commission recalled that the network of coastal radio stations operated by Members for the real-time collection of ships' weather reports was also an essential component of the communications facilities employed by IGOSS for the collection of ships' oceanographic data and their subsequent global distribution over the GTS as BATHY and TESAC reports. In this connection,

however, the Commission noted with concern that, of the 323 coastal radio stations operated by 105 Members for the collection of ships' weather reports, only 129 were available for the collection of BATHY/TESAC reports free of charge to ships. The Commission agreed that this situation represented a substantial impediment to the efficient collection and dissemination of oceanographic data within IGOSS, to the ultimate detriment of marine meteorological services and all other users of such data. It therefore urged Members operating coastal radio stations to make them available for the collection of BATHY/TESAC reports free of charge to ships, and to ensure the subsequent insertion onto and dissemination over the GTS of the reports. It also urged Members to notify the WMO Secretariat promptly of any changes to the status of their coastal radio stations, for inclusion in WMO Publication No. 9.

#### Use of the International Data Collection System (IDCS)

6.1.6 The Commission recalled that an informal group for the Co-ordination of Geostationary Meteorological Satellites (CGMS) had in recent years attempted to co-ordinate the services offered by these satellites. A most successful example of this co-ordination was the establishment of the International Data Collection System (IDCS). This service was currently supported by Europe (METEOSAT), Japan (GMS) and USA (GOES). In approximately a year, this network was expected to become fully global, with the planned launch of the GOMS satellite by the USSR. The IDCS was greatly under-subscribed: only some five or six channels out of a possible 33 were currently in use. This data collection and relay service, which was designed for use with platforms moving through the fields of view of two or more satellites, was provided free of charge by the satellite operators for meteorological ocean observations destined for the GTS. CGMS considered that the system should be further promoted, since it would offer considerable capacity for the collection and relay of observational data in the years to come. Further information on this system could be obtained from the CGMS Secretariat, EUMETSAT, Am Elfengrund 45, 6100 Da-Eberstadt, Federal Republic of Germany, Tel. (49) 61 51 53920, Telex: 4197335, Fax (49) 61 51 53 92 25. The Commission urged Members to consider making use of this valuable addition to the overall marine data collection system.

#### The use of INMARSAT for the collection of ships' weather reports and oceanographic reports

6.1.7 The Commission noted with appreciation that at present seven of the 20 operational INMARSAT Coast Earth Stations (CESs) were available for the collection of ships' weather reports free of charge to ships (in France, Japan, Saudi Arabia, Singapore, UK and USA (2)). Of these only three (Saudi Arabia and USA) were also accepting BATHY/TESAC reports. It was further noted with appreciation that CESs in China and the USSR would also shortly be available for the collection of ships' weather reports. At the same time, the acceptance and use of INMARSAT by the shipping industry was expanding rapidly, with 15 per cent of Voluntary Observing Ships (VOS) currently equipped with INMARSAT Ship Earth Stations (SESS) and therefore likely to be sending their weather reports via the INMARSAT system.

6.1.8 The Commission recalled that Tenth Congress, by Resolution 15 (Cg-X) urged:



- (a) Those Members operating CESs, who have 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, sub-regional or bilateral agreements for cost-sharing, as appropriate.

The Commission 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 INMARSAT.

6.1.9 The Commission agreed that the present distribution of INMARSAT usage for the collection of ships' meteorological and oceanographic reports was placing an unnecessarily high financial burden on those few Members operating CESs which were accepting ships' reports. In this regard, it noted and agreed with the opinions expressed by CBS-IX, and in particular:

- (a) Urged all Members operating CESs to enter into arrangements with their CESs for the collection of ships' meteorological and oceanographic reports free of charge to ships, for the greater benefit of all WMO Members;
- (b) Encouraged Members to enter into bilateral or regional cost-sharing arrangements, where appropriate, for the collection of such reports via INMARSAT;
- (c) Requested the president of CMM, in consultation with the president of CBS and the Secretary-General, to continue negotiations with ITU and INMARSAT concerning a possible favourable tariff for the collection of ships' weather and BATHY/TESAC reports via INMARSAT.

6.2 Marine telecommunication arrangements for product dissemination  
(agenda item 6.2)

6.2.1 The Commission recalled that the present system for the provision of high seas forecasts and warnings in support of the safety of life and property at sea, which had essentially been in place since the 1940s, was designed and implemented on the basis of:

- (a) The need to provide global coverage of the world's oceans;
- (b) The responsibilities assumed by countries under the SOLAS convention;
- (c) National requirements and capabilities for the provision of marine meteorological services;
- (d) Broadcasts of meteorological information to shipping to be made through coastal radio stations;
- (e) The location and operating procedures for these coastal radio stations.

It was agreed that this system had worked reasonably effectively and efficiently to date in satisfying the requirements of the maritime community for meteorological forecast and warning services. Regulatory and other material relating to the system was given in the WMO Manual on Marine Meteorological Services.

6.2.2 At the same time, the Commission noted that there were a number of developments which had recently occurred or were currently taking place which called for a substantial reassessment and possible rationalization of the existing system for the provision of meteorological forecasts and warnings to shipping, in the interests of both national Meteorological Services and the marine user community. These developments included, in particular:

- (a) The entry into force of the 1988 amendments to the 1974 SOLAS convention to introduce the Global Maritime Distress and Safety System (GMDSS) of IMO. These included, inter alia, a requirement for the broadcast to shipping on the high seas of maritime safety information (MSI), including meteorological forecasts and warnings, through the INMARSAT Enhanced Group Call (EGC) SafetyNET system;
- (b) The demonstrated capability of the INMARSAT EGC SafetyNET system to ensure the receipt by shipping of MSI, in geographical areas designated by the information provider, on a global basis;
- (c) The continuing implementation of the NAVTEX system for the broadcast of MSI to shipping in coastal waters and the assignment by the World Administrative Radio Conference for the Mobile Services 1987 (WARC-MOB 87) of additional frequencies for NAVTEX-type services.

6.2.3 The Commission noted that there were various other factors which would have a bearing on any reassessment and rationalization of the existing system for high seas forecasts and warnings, including:

- (a) The relatively low quoted end-user charge for broadcast via INMARSAT EGC SafetyNET of around \$US 0.50 per kilobit;
- (b) The capabilities of a certain number of national Meteorological Services to provide marine meteorological services over very large ocean areas, or even globally;
- (c) Financial and other difficulties being faced by national Meteorological Services necessitating a rationalization of activities at the national level;
- (d) The need to minimize costs to Members in the provision of basic marine meteorological services to the high seas;
- (e) The continuing obligations of Members, and of WMO, under SOLAS;
- (f) The existing World Wide Navigational Warning Service (WWNWS) NAVAREA system and the potential advantages of co-ordinating the WMO and WWNWS systems.

6.2.4 In the light of the above developments and other factors, the Commission agreed that there was an urgent need for action to be undertaken which would lead to the development and implementation of a rationalized WMO system for the provision of meteorological forecast and warning services to shipping on the high seas. It agreed that the basic criterion for the new system should be that broadcasts to these areas would generally be made through the INMARSAT EGC SafetyNET system. Other criteria to be used in the rationalization included:

- (a) Continued global ocean coverage;
- (b) Better co-ordination and possible reduction of the designated areas of responsibility;
- (c) Co-ordination, wherever possible, with the WWNWS NAVAREAs;
- (d) Ease of access, by Members accepting responsibility, to INMARSAT CESs;
- (e) Willingness and capabilities of Members to accept responsibility for designated areas;
- (f) Co-ordination of designated areas within the INMARSAT EGC SafetyNET system coverage.

6.2.5 In addition to these criteria, a number of other factors needed to be taken into account in the rationalization, in particular:

- (a) Means of access to CES. Where the responsible national Meteorological Service and the CES were located in the same country, access would be at national discretion but would normally be by landline (telex). Payment for such access would also be at national discretion. Where international transfer was necessary, it might be effected over the GTS or by using an INMARSAT Standard-C terminal. In the case of the GTS, the procedures to accommodate INMARSAT requirements proposed by the national Meteorological Service of France and endorsed by the CMM Working Group on Marine Meteorological Services and the CBS Working Group on the GTS should be employed. Final landline charges should be agreed between the Members concerned. Costs of transfer from CES to network co-ordination station, as required, should be borne by INMARSAT;
- (b) Language. Plain language broadcasts should be in English and, if required, also in the national language, as recommended in the Manual on Marine Meteorological Services and by IMO for MSI;
- (c) Broadcast schedules. Meteorological forecasts may continue to be broadcast at scheduled times, as at present; warnings may be broadcast on receipt and at regularly scheduled times after that (e.g. every three hours). Warning cancellation and updating procedures should be considered. If possible, meteorological warnings should be co-ordinated with navigational warnings. The need for message repeats, in the

light of EGC capabilities to ensure receipt, should be addressed, including the question of who would pay for them;

- (d) Monitoring. Any requirement for monitoring by national Meteorological Services of message receipt should be considered.

6.2.6 The Commission agreed that the studies and actions outlined in the preceding paragraphs should be undertaken by its Working Group on Basic Marine Meteorological Services and that they should be completed by the end of 1990, to ensure that Members would be able to make a smooth and timely transition to the new system in concert with the entry into force of the 1988 SOLAS amendments. The Commission felt that the working group should at all times work in close consultation with representatives of IMO, IHO, ITU and INMARSAT in this study and should also take into account the views of the regional associations on the matter.

6.2.7 The Commission further agreed that the working group must also consider the global requirements for the co-ordination of MSI services, which were expressed by the WARC-MOB 87, as part of this study. These included, in particular, co-ordination of NAVTEX-type services.

6.2.8 The Commission adopted Recommendation 3 (CMM-X) on this topic. In doing so, it emphasized that the new system being proposed related only to the provision of meteorological services to shipping on the high seas, as detailed in the Manual on Marine Meteorological Services. All Members would, of course, remain free to provide any other marine meteorological services they wished, in response to national requirements.

### 6.3 Requirements for reporting codes (agenda item 6.3)

6.3.1 The Commission noted with appreciation that a number of minor amendments to marine reporting codes FM 13-VIII Ext. - SHIP, FM 14-VIII - DRIBU, FM 63-VIII Ext. - BATHY and FM 64-VIII Ext. - TESAC had been adopted by both CBS-Ext.(85) and CBS-IX. The amendments were designed to improve the ability of these codes to handle modern requirements for reporting marine meteorological and oceanographic data. The Commission also noted with appreciation that the code FM 62-VIII Ext. - TRACKOB had become operational for the reporting of oceanographic data obtained along a ship's track and that some data of this type were appearing on the GTS.

6.3.2 The Commission recalled that at its ninth session, in the context of the WMO wave programme, an urgent need had been expressed for a code for the real-time reporting of spectral wave data. Subsequent development work for such a code was consequently undertaken by CMM experts Mr J. R. Keeley (Canada) and Mr M. Longworth (UK), the CBS Working Group on Codes and the national focal points for the WMO wave programme. This had eventually led to the adoption of code FM 65-IX - WAVEOB by CBS-IX. The Commission noted these actions with appreciation and agreed that the new WAVEOB code would greatly facilitate the expanded use of measured spectral wave data for a variety of applications.

6.3.3 In noting that CBS had decided not to proceed with the adoption of an ODAS code, the Commission agreed that the requirements for such a code no longer existed at the global level, particularly in the light of the adoption of the WAVEOB and BUFR codes (see paragraph 6.3.4 below).

6.3.4 Considerable interest was expressed by the Commission in the expanding application of bit-oriented codes for the efficient representation, exchange and storage of observational data and in particular in the adoption by CBS-IX of the code FM 94-IX - BUFR. The Commission agreed with CBS that the widespread implementation of BUFR would nevertheless take some time and that the transformation between bit-oriented codes and other forms of character representation would need careful study if all Members were to benefit from these developments. In the context of marine reporting codes, it was agreed that the transformation in particular of WAVEOB into a bit-oriented format should be studied further by the Working Group on Basic Marine Meteorological Services during the intersessional period.

6.3.5 The Commission noted with interest the work being undertaken within IGOSS for the development of a new flexible coding scheme for IGOSS purposes (the IFC). In particular, it was noted with approval that a character-oriented, table-driven code was being developed for immediate application, while appropriate modifications to BUFR were to be proposed for the future efficient transmission of oceanographic data. In stressing the need to reduce, wherever possible, the existing multiplicity of single-purpose codes while at the same time providing for a smooth transition between the conventional character codes and BUFR, the Commission agreed that the proposed IFC, while not replacing existing oceanographic codes, would nevertheless assist substantially in both situations. It urged that every effort should be made to ensure compatibility between IFC and BUFR, and suggested that the IGOSS Group of Experts on Operations and Technical Applications should liaise closely with the CBS Working Group on WWW Data Management in this regard. The Commission also agreed on the need to have its own focal point on the question and proposed that this focal point could be the CMM representative nominated to the CBS Working Group on Data Management.

6.3.6 It was recalled by the Commission that at its ninth session it had discussed briefly the requirements for the global real-time transmission of sea-level data over the GTS. In this context, it noted the developing requirements for such data transmission, at the present time within the IGOSS Sea Level Project in the Pacific and in the near future in support of similar sea-level projects in other ocean basins. Such projects were making a valuable contribution to the analysis and forecasting of short-term climatic fluctuations and required the GTS transmission of sea-level data on a global basis. The Commission further noted and supported the opinion of the fifth session of the Joint IOC/WMO Working Committee for IGOSS that the transmission of sea-level data would represent the first application of the new IFC, and therefore strongly supported the development and implementation of the IFC as a matter of priority.

6.3.7 The Commission noted with appreciation the work of the joint WMO/IOC Drifting Buoy Co-operation Panel regarding possible amendments to the SHIP code to include data from drifting buoys which, it felt, would considerably improve the capability to report data resulting from recent developments in buoy technology and observing techniques. At the same time, the Commission urged the DBCP to consult closely with the IGOSS Group of Experts on Operations and Technical Applications in this regard to ensure that the requirements of the oceanographic community for drifting buoy data were fully met, and in particular to see whether the capability could be retained of reporting simultaneous meteorological and sub-surface oceanographic observations in a single code.

7. SYSTEMS AND TECHNIQUES FOR MARINE OBSERVATION AND DATA COLLECTION  
(agenda item 7)

7.1 Marine observing methods and instrumentation (agenda item 7.1)

7.1.1 The Commission noted that CMM-IX, in considering this topic, had made a number of proposals concerning marine ice accretion, wind measurements at sea, measurement of sea-surface and sub-surface layer temperatures, drifting buoys, and the intercalibration of conventional and remotely sensed data. With regard to marine ice accretion, it was further noted that CMM-IX had proposed the convening of an international meeting for the purpose of setting and reviewing standards for the acquisition and archival of marine ice accretion data, but that unfortunately such a meeting had not taken place due to lack of funds. The Commission agreed that, while this remained an area of concern for mariners, there was little requirement for further immediate action. It therefore deferred discussion on the topic until its eleventh session.

7.1.2 The Commission expressed appreciation that the question of wind measurements at sea had been taken up by the Working Group on Marine Climatology and that a report on the subject of the reduction of such measurements to a standard level was in the process of being published in the Marine Meteorology and Related Oceanographic Activities series. With regard to the measurement of sea-surface and sub-surface layer temperatures, it was noted with appreciation that this subject was now being actively considered by a number of bodies, workshops and seminars and that recommendations had been made in reports such as that on the field workshop on intercalibration of conventional and remotely sensed sea-surface temperature data (Report No. 16 in the Marine Meteorology and Related Oceanographic Activities series).

Drifting and moored buoys and other ODAS

7.1.3 The Commission noted with interest that, at the present time, some 16 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 the World Climate Research Programme (WCRP) of WMO. Data from drifting buoys were normally collected through the Argos system and reports from some 200 buoys were currently being received through CLS/Service Argos or various local user terminals (LUTs) for insertion onto the GTS. However, it was noted with concern that this represented only a small proportion of the total number of active buoys currently using the Argos system and that, in addition, many buoy operators were not making their data available for permanent archiving in the formal global archive for such data established by the Canadian Marine Environmental Data Service. The Commission therefore urged all Members to make every effort to ensure that buoy operators in their countries made their data available for both GTS distribution and permanent archiving.

7.1.4 A number of countries were also operating a variety of other automatic marine stations, in particular moored buoys and fixed platforms, and the Commission noted with appreciation that the data from more than 180 of these were being made available for GTS distribution.

7.1.5 The Commission noted with interest that the Executive Council, at its thirty-seventh session in 1985, had established a Drifting Buoy Co-operation Panel for the purpose 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 to co-sponsor the panel jointly with WMO. The panel met annually and, since June 1987, had been served by a technical co-ordinator who was funded by voluntary contributions from panel Member countries and was located within CLS/Service Argos in Toulouse, France. Recent panel sessions, and the activities of the technical co-ordinator, had been concerned with a number of substantive technical matters relating to drifting buoys, including:

- (a) Quality control of drifting buoy data before GTS insertion;
- (b) Problems with the use of LUTs;
- (c) Improving buoy data flow over the GTS;
- (d) Co-operation between meteorologists and oceanographers in buoy instrumentation and deployment;
- (e) Use of WMO identifier numbers;
- (f) Modifications to the DRIBU code;
- (g) Support for the Operational WWW Systems Evaluation-North Atlantic (OWSE-NA);
- (h) Preparation of various publications relating to drifting buoys.

7.1.6 The Commission expressed its strong support for the Panel and for its activities. It thanked all Panel Member countries for their efforts and, in particular, those who were contributing financially towards the support of the technical co-ordinator position, which it regarded as an essential element in the Panel's work. It also expressed the hope that as many other countries as possible would support the Panel and its technical co-ordinator and that this support would come from both the meteorological and oceanographic communities.

7.1.7 The Commission noted with interest that the WOCE project of the WCRP had plans for the deployment of a large number of surface drifting platforms to study ocean surface circulation. It was further noted, however, that in general these platforms would not include atmospheric pressure or temperature sensors and that doubts had been expressed that all the data from these platforms would be made available over the GTS. The Commission viewed this with concern in view of the potential high value of data from these platforms to meteorological forecast and warning services (including marine meteorological services) and to climate analysis and forecasting. The Commission also noted that the majority of drifting buoys currently deployed or planned for the next few years were funded by various research programmes such as TOGA and WOCE. It was clear that when these programmes ended, the buoy deployments would very likely end as well, to the detriment of all national Meteorological Services. The Commission therefore strongly urged Members and the Drifting Buoy Co-operation Panel to consider ways of:

- (a) Equipping the WOCE buoys with atmospheric pressure and temperature sensors;

- (b) Ensuring the release of data from the WOCE buoys for GTS distribution and permanent archival;
- (c) Ensuring the continued operational funding of drifting buoy deployments following the termination of the TOGA and WOCE projects.

It adopted Recommendation 4 (CMM-X) on this subject.

#### Remote sensing of the oceans

7.1.8 The Commission recalled that at its ninth session it had recommended that studies and workshops should be convened on the application and calibration of remotely sensed data, in view of the impending near-operational status of satellite-based ocean remote-sensing systems and of the great potential value of remotely sensed data for both operations and research. The first activity of this type, a field workshop on intercalibration of conventional and remotely sensed sea-surface temperature data, took place in November 1984. The Commission noted with appreciation that the full report of this workshop was subsequently published as Report No. 16 in the Marine Meteorology and Related Oceanographic Activities series, which should prove of value to all Members.

7.1.9 While agreeing that the delays experienced during the previous four years in the launch schedules for the new generation of oceanographic satellites had relaxed the immediate requirement for further studies and workshops on this subject during this period, the Commission nevertheless noted the oceanographic satellite missions which were planned for the next five years. Data available from these satellites, in addition to sea-surface temperature, would include sea-surface winds, sea state, sea level and sea ice, and in many cases might be delivered operationally.

7.1.10 In noting that substantial research applications for these data were now being developed under projects such as TOGA and WOCE, the Commission also agreed that the data would have many operational applications in the provision of marine meteorological and oceanographic services. In order to realize this potential, however, certain basic questions had to be addressed, including:

- (a) What data would be available, when and how?
- (b) What would be the accuracy and spatial and temporal coverage of these data?
- (c) How could the data be blended with more conventional data?
- (d) How should the data be processed to provide operational services?
- (e) How should the data be processed and archived to provide non-operational services?

The Commission agreed that appropriate procedures, regulations and technical advice in answer to these questions needed to be developed and made available to Members at least in time to coincide with the satellite launches. It also agreed that such activities should be undertaken jointly with IGOSS and other



WMO bodies, as appropriate, and in this context it noted with appreciation the proposal of the fifth session of the Joint IOC/WMO Working Committee for IGOSS to establish jointly a group of experts on the topic.

7.1.11 In addition to satellite-based ocean remote-sensing systems, certain ground-based remote-sensing devices, in particular HF coastal ocean radars, had demonstrated potential for operational and research applications in the real-time measurement of sea-surface winds, waves and currents over large areas in coastal and near-shore waters. The Commission agreed that such instruments could be of considerable value in the provision of services in support of marine operations in harbours and coastal waters and also in the compilation of data relevant to non-operational services.

7.1.12 In view of the importance of all forms of remote-sensing ocean observation systems to the provision of marine meteorological and oceanographic services and the imminent near-operational status of such systems, the Commission agreed on the need for urgent action to be taken. It therefore adopted Recommendation 5 (CMM-X) on the topic and requested that the views of the Commission regarding the importance of remotely sensed ocean data for marine meteorological services should be made known to the satellite-operating agencies. It also agreed to establish an ad hoc group on ocean satellites and remote sensing within the Working Group on Technical Problems. Further action in this regard was taken under agenda item 15.

#### Automated shipboard systems

7.1.13 The Commission noted with interest that, at present, more than 200 ships world-wide were equipped with automated or semi-automated shipboard observing and transmission systems such as the Shipboard Environmental (Data) Acquisition System (SEAS) and the Meteorological Observing System for Ships (MOSS). These systems included a capability for both meteorological (winds, temperature, pressure, waves, ice) and oceanographic observations and their transmission to shore via geostationary satellite in a timely and effectively error-free manner. It also noted with interest that CLS/Service Argos had developed an automated system similar to SEAS but which used polar-orbiting satellites to give global capability and independent location determination for sub-surface data. It is expected that 40 ships would be equipped with the Argos system by the end of 1989. Similarly, it was noted that sea trials were under way using SEAS with INMARSAT telecommunications, and that it was intended that the software for such utilization would eventually be made generally available to Members.

7.1.14 The Commission agreed that the wider implementation of automated observation and transmission systems of these types would substantially improve the quality, quantity and availability of both meteorological and oceanographic reports over the GTS. It therefore urged Members to continue the implementation and operation of such systems as quickly as possible. The Commission further recognized the importance of ocean salinity data for a variety of operational and research applications and encouraged Members to implement automated systems for the measurement and real-time transmission over the GTS of salinity data.

7.1.15 The Commission noted with interest and appreciation the implementation by a number of countries of automated shipboard aerological programme (ASAP) packages aboard VOS. In restating the fact that over 70 per cent of the Earth's surface was covered by the oceans and that upper-air data

for this area were generally lacking, the Commission agreed that such automated instruments could provide essential atmospheric soundings over remote ocean areas. These data were important both as direct input to atmospheric models and also as ground-truth for satellite atmospheric soundings over the oceans. At present, nine ASAP-equipped ships were operating in the North Atlantic and three in the Pacific, with the number in the North Atlantic meeting the requirements for such data laid down in the Second WMO Long-term Plan. The situation in other ocean basins, however, was far from satisfactory and the Commission therefore urged that serious attention should be given to implementing ASAP on ships plying the Indian and Pacific Oceans as a matter of priority.

7.1.16 The Commission noted the problems experienced with DCS communications over the North Atlantic as a result of the failure of the DCS on METEOSAT-2. It expressed its appreciation to the satellite operators for their efforts to continue a minimum service using a spare GOES. The loss of ASAP and ships' data during the period until METEOSAT-3 could be made operational emphasized the critical importance of the DCS to the collection of marine meteorological data. The problems experienced with the data processing immediately after the launch of METEOSAT-3 underlined the need for routine monitoring of the data communications and the value of end-to-end system tests to identify the sources of incorrect or missing data.

7.1.17 Finally on this topic, the Commission noted that the Ocean Weather Ships (OWS) in the North Atlantic had for many years been providing vital meteorological and oceanographic data, including long time series of observations, from fixed stations in the North Atlantic. It therefore viewed with concern the possibility that the three remaining OWS might be withdrawn following the end of the NAOS agreement in 1989, and urged Members, particularly in RA VI, to give serious consideration to finding ways and means of continuing the operation of the OWS in the future.

## 7.2 The WMO Voluntary Observing Ships (VOS) scheme (agenda item 7.2)

7.2.1 The Commission noted with interest that the Voluntary Observing Ships (VOS) scheme was regarded as a primary source of marine meteorological data in support of the WWW and the WCRP, as well as being essential to the provision of marine meteorological services. At the same time, the Commission agreed that improvements were necessary in the quality, quantity and timeliness of VOS reports available both in real time over the GTS and through the Marine Climatological Summaries Scheme (MCSS) if the requirements of these programmes were to be fully met.

7.2.2 In this context, the Commission reviewed carefully the various activities under way, within CMM and elsewhere, directed towards improvements in the quality and availability of ships' weather reports for national Meteorological Centres and data archival centres. These included, in particular:

- (a) Various studies which were being conducted within the CMM Working Groups on Marine Meteorological Services, Marine Climatology and Technical Problems, which are discussed elsewhere in this report;
- (b) The VOS Special Observing Project-North Atlantic (VSOP-NA);
- (c) A study on VOS data availability in the South-East Pacific and South-West Atlantic Oceans;

- (d) Special GTS monitoring to establish the reasons for the discrepancies in ships' reports among various centres on the GTS.

7.2.3 The Commission noted that the VSOP-NA, which had been developed by the vice-president of CMM, Mr R. J. Shearman, in collaboration with Dr P. K. Taylor of the Committee on Climatic Changes and the Ocean (CCCCO), and initially in support of the WCRP, had formally begun in November 1987. The project was scheduled to run for three years and involved some 50 ships and six countries bordering the North Atlantic. The Commission agreed that the project represented a substantial contribution to the potential future improvement in the quality of all VOS data, in particular through the identification and elimination of systematic biases in the measurements of certain meteorological variables. It expressed its appreciation to Mr Shearman, Dr Taylor, the six Members involved (Canada, France, the Federal Republic of Germany, the Netherlands, the United Kingdom and the United States of America), their port meteorological officers and the crews of the ships themselves, and expressed the wish that the results of the study, when available, should be widely distributed to all interested Members of WMO.

7.2.4 In noting the obvious sparsity of real-time VOS reports in certain areas, particularly in the southern hemisphere, tropical oceans and parts of the Mediterranean, the Commission agreed that this might have resulted from:

- Lack of shipping
- Lack of recruitment
- Ship-shore communications problems
- GTS or national communications problems.

In this context, the Commission noted with interest the study undertaken, on behalf of Argentina and Chile, designed to improve the availability of VOS reports from the South-East Pacific and South-West Atlantic Ocean through improved selective recruitment of VOS in these areas and the identification of possible communications problems. The Commission agreed that studies of this type were very valuable to the Members concerned, and ultimately to all Members through a general improvement to the GOS, and encouraged other Members in data-sparse regions to undertake similar co-ordinated efforts to enhance VOS recruitment and data availability. In particular, it noted an urgent need for enhanced recruitment and improved data availability from VOS in the Mediterranean.

7.2.5 The Commission noted the results of the specific GTS monitoring undertaken in RA II/RA V in 1987-1988, which showed substantial discrepancies in the numbers of ships reports received at various telecommunications and analysis centres, possibly as a result of the non-adherence by GTS centres to telecommunications procedures described in the Manual on the GTS (WMO-No. 386). The Commission agreed that such data discrepancies, and probable data loss, were very discouraging to the ships' crews which made the observations and to the Members which collected them, and were ultimately detrimental to the whole of the WWW and marine meteorological services systems of WMO. It therefore encouraged the GTS centres, and Members concerned, to pay special attention to adherence to the correct telecommunications procedures for ships' weather reports in order to minimize the loss of these valuable data. It also requested the Working Group on Basic Marine Meteorological Services to consider ways of interacting with the new WWW data monitoring projects with regard, in particular, to ships' weather reports.

7.2.6 The Commission reiterated its belief in the high value of VOS reports to many of WMO's programmes and of the important work being undertaken by all Members, PMOs and ships' crews involved in the VOS scheme. It encouraged Members to enhance the recruitment of VOS, particularly in data-sparse areas, to ensure that reports were all of high quality and to increase automation in the collection and transmission of ships' weather reports whenever possible. Recommendation 6 (CMM-X) on this topic was adopted.

7.2.7 The Commission also reiterated the essential role played by the PMOs in recruiting VOS, in calibrating and maintaining their instruments, in collecting log-books and in generally encouraging the ships' crews in their marine observational activities. It therefore strongly encouraged Members to maintain, and if possible expand, their PMO network, and in particular to ensure that PMOs actively supported all VOS whenever they called at the respective ports. The Commission noted the potential value to Members of guidance material (including simple explanatory brochures) relating to the work of PMOs, and requested the Working Group on Basic Marine Meteorological Services to consider the preparation and publication of such material during the coming intersessional period.

7.2.8 Finally, the Commission noted with interest the information provided by the UK regarding plans for the monitoring of marine surface observations generally, including the role played by numerical weather prediction models in such monitoring. It agreed that the results of this monitoring, when available, would be of value to a large number of maritime Members, and therefore requested the Working Group on Basic Marine Meteorological Services to liaise with the RSMC Bracknell and the appropriate CBS working groups so that the results of the monitoring activities might become widely available for application by all those concerned with the operation of marine surface observing systems.

### 7.3 WMO wave programme (agenda item 7.3)

7.3.1 The Commission noted with appreciation that the WMO wave programme, as adopted at its ninth session, had been formally approved by EC-XXXVII. In reviewing the continuing implementation of this programme, the Commission noted that various actions had been completed during the intersessional period, in particular:

- (a) Development and adoption of a code for the real-time reporting of spectral wave data (discussed further under agenda item 6.3);
- (b) Publication of the results of a global survey on the need for and application of spectral wave data. The Commission expressed its appreciation to Mr J. Guddal and Dr S. Barstow (Norway), the authors of this report, for their valuable work;
- (c) Preparation and publication of the WMO Guide to Wave Analysis and Forecasting (WMO-No. 702). The Commission felt that the Guide was a publication of great importance to all maritime Members of WMO and expressed its appreciation to the project director, Mr E. Bouws (Netherlands), and all the authors for their efforts on behalf of WMO;

- (d) Publication of national reports on the wave programme, regularly updated. The Commission agreed that this was an important mechanism for keeping Members informed on developments in wave measurement and wave forecasting. It therefore urged national focal points for the wave programme to continue submitting reports and requested that supplements to the publication be issued at appropriate intervals;
- (e) Establishment of an ad hoc Group of Rapporteurs on Numerical Wave Modelling, which was fully endorsed by the Commission;
- (f) WMO co-sponsorship and support for the Course on Ocean Waves and Tides at the International Centre for Theoretical Physics, Trieste (discussed further under agenda item 12.1).

7.3.2 The Commission expressed its belief in the continuing importance of the wave programme in assisting Members in the provision of ocean wave-related services which were increasingly being demanded by maritime users. It fully endorsed the actions already taken in the implementation of the programme and agreed that the Working Group on Technical Problems should continue its efforts to assist Members in the provision of wave-related services during the coming intersessional period. In view of continuing rapid developments in techniques and user requirements in this field, the Commission in particular requested the Working Group on Technical Problems to revise and update, as appropriate, the WMO wave programme during the coming intersessional period.

7.3.3 The Commission reviewed with considerable interest the results of the Technical Conference on Ocean Waves which had taken place just prior to the opening of CMM-X. It thanked all the invited lecturers for their excellent presentations and requested that the full text of each presentation should be published and widely distributed as soon as possible after the session so that all the Commission members and national Meteorological Services could benefit from the information provided. The Commission also expressed its appreciation to the Conference Director, Mr F. Gérard, and other members of the Organizing Committee for the excellent programme and smooth organization which they had ensured for the Conference.

#### 7.4 Observational data requirements (agenda item 7.4)

7.4.1 The Commission noted that the World Weather Watch (WWW) and the World Climate Research Programme (WCRP) had clearly stated requirements for marine meteorological and surface oceanographic data as part of their overall data requirements which were expressed in, respectively, the Second WMO Long-term Plan, Part II, Volume 1 - WWW Programme 1988-1997, and the First Implementation Plan for the WCRP. The Commission noted further that these requirements for the late 1990s, when looked at together, included:

- (a) Two upper-air soundings per day from 45 ASAP-equipped ships;
- (b) Four synoptic reports per day from VOS with an average spacing of 250 km in the northern hemisphere and 300 to 500 km in the southern hemisphere;
- (c) Four reports per day of at least surface pressure and sea-surface and air temperatures from at least 250 drifting buoys and 75 moored buoys (including at least 100 buoys in the Southern Ocean);

(d) Various data from oceanographic satellites.

7.4.2 With regard to the current status of marine observing systems, the Commission recalled that it had reviewed these in detail under agenda items 7.1 and 7.2. In summary, these systems included:

- (a) 150-200 drifting buoys reporting over the GTS, of which some 60 were located in the Southern Ocean;
- (b) A concentration of ships' weather reports in the North Atlantic and North Pacific Oceans;
- (c) Nine ASAP-equipped ships operating in the North Atlantic and three in the North Pacific.

7.4.3 The Commission acknowledged that, from the point of view of both WWW and WCRP requirements, data deficiencies existed at the present time in all ocean areas, in particular the tropical and southern hemisphere oceans and the Mediterranean. The Commission therefore urged Members to give priority attention to recruiting additional VOS sailing in known data-sparse areas, to deploying additional drifting buoys in the Southern Ocean, and to implementing additional ASAP units in the Pacific and Indian Oceans.

7.4.4 The Commission noted with interest that an Operational WWW Systems Evaluation for the North Atlantic (OWSE-NA) had taken place during the period 1985-1988. The principal objectives of the OWSE-NA were:

- (a) To determine the Composite Observing System for the North Atlantic (COSNA) which most closely satisfied the requirements of national Meteorological Services in terms of both operational performance and cost;
- (b) To promote guidance which could be used within WMO for implementation of the WWW in other parts of the world.

7.4.5 The main activities of the OWSE-NA included:

- (a) The operation in the North Atlantic of a combined observing system comprising satellites, ASAP, ASDAR, drifting buoys, OWS and VOS, with all data being distributed over the GTS;
- (b) The evaluation of the impact of data from various observing systems on the quality of meteorological analyses and forecasts;
- (c) The evaluation of the cost-effectiveness of the various observing systems.

Although the formal operational phase for the OWSE-NA had ended in December 1988, it was expected that the evaluations would continue during 1989 with the final report to be issued in several stages, probably extending into 1990.

7.4.6 The Commission agreed that the OWSE-NA was a project of great interest to all Members of WMO and particularly to those Members involved in the implementation and operation of marine observing systems. It expressed

the hope that the results of the OWSE-NA would be made available as soon as possible, both to Members and to competent bodies such as the Drifting Buoy Co-operation Panel, so that they might be taken into account in the design and implementation of composite marine observing systems in other ocean basins. In particular, the Commission requested its Advisory Working Group to study carefully the results of the OWSE-NA with a view to including recommendations to the Commission with regard to the VOS scheme and drifting buoy systems. Finally, the Commission noted the likely conclusions of the scientific evaluation for the OWSE-NA regarding the continuing value of the OWS for meteorological operations, and urged Members in the region to take these into account when considering the future of the OWS after the termination of the NAOS agreement.

8. MARINE CLIMATOLOGY (agenda item 8)

8.1 Contribution of CMM to the World Climate Programme  
(agenda item 8.1)

8.1.1 The Commission noted with interest that the thirty-eighth session of the Executive Council (Geneva, June 1986) had agreed, in principle, to the establishment of a special Marine Climatology Data Centre in support of the Tropical Ocean/Global Atmosphere (TOGA) project of the World Climate Research Programme (WCRP). TOGA had a major and continuing requirement for marine climatological data from the global tropical zone with a time limit which was not at present possible through the existing Marine Climatological Summaries Scheme (MCSS). The Executive Council therefore noted that modifications would perhaps be necessary for the MCSS to satisfy the TOGA requirements.

8.1.2 A detailed proposal for the TOGA Marine Climatology Data Collection Scheme was discussed and agreed upon at the fifth session of the Working Group on Marine Climatology (Geneva, November 1986) and subsequently approved by the thirty-ninth session of the Executive Council (Geneva, June 1987). Essentially, the scheme involved the operation of a centre to which contributing Members would submit data for the tropical zone (30°S to 30°N) within a maximum time limit of three months from the observation time. The centre was located in the United Kingdom Meteorological Office and began operation on 1 January 1988, for all data from 1 January 1987.

8.1.3 The Commission expressed its appreciation to the Executive Council, the Working Group on Marine Climatology and the United Kingdom for their efforts in developing, establishing and operating this scheme which, it agreed, constituted a substantial contribution to TOGA and to the WCRP generally. The Commission also noted that experiences gained with this special TOGA centre would ultimately be of benefit in highlighting ways to improve the MCSS generally. The Commission expressed some concern, however, that at present less than 50 per cent of potential contributing Members had met the requirements for timely submission of data to the TOGA centre. It therefore urged all Members to endeavour to forward their data within the required time limit.

8.1.4 In connection with other support provided to, or required by, the WCP, the Commission:

- (a) Noted the implementation of the VOS Special Observing Project for the North Atlantic (VSOP-NA) in support of the WCRP, which was discussed in detail under agenda item 7.2;

- (b) Agreed that the sub-group on marine climatology should consider ways of inputting marine climatological data to the Climate System Monitoring (CSM) project of the WCDP;
- (c) Agreed that the sub-group on marine climatology should also consider procedures for inputting marine climatological data at national centres into the Climate Data Management System (CLICOM) of the WCDP and should develop software applications in the marine field for CLICOM;
- (d) Agreed that the sub-group on marine climatology should look at the question of providing long time series of ocean data in support of the WCRP projects TOGA and WOCE.

## 8.2 Marine Climatological Summaries Scheme (agenda item 8.2)

8.2.1 The Commission noted with satisfaction that the Marine Climatological Summaries Scheme (MCSS), which was first established by fourth Congress in 1963 and later incorporated into the Manual on Marine Meteorological Services, had proved to be a unique and very successful system for the collection, archival and processing of marine climatological data of value to both operations and research. At the same time, it was agreed by the Commission that major developments in recent years, in both user requirements for marine climatological data and the technologies available to deliver such data, had highlighted certain disadvantages in the present scheme and the need for modifications. These disadvantages related in particular to the timeliness of data availability, lack of a true global archive of uniform quality, likely data losses and/or duplication, and problems with an accurate data inventory.

8.2.2 In the light of these identified deficiencies in the existing MCSS, the Commission discussed a proposal from its Working Group on Marine Climatology for a simple modification to the scheme. Essentially, this modification required that Members contributing data to the scheme (contributing Members) should send their complete data sets to all eight responsible Members at each data dispatch, rather than the geographically separated sets as at present. The Commission agreed that such a modification, if implemented, would have a number of advantages, in particular:

- (a) The timeliness of data availability would be improved;
- (b) It would be possible to provide multiple global data sets, with consequent improvements in the services to be provided to users;
- (c) Each global data base would be of internally uniform quality whereas at present, a user requiring global data was confronted with having to merge data from eight separate geographical areas, with each data stream of a different quality;
- (d) The risk of data loss would be minimized;
- (e) The existing responsibilities of Members for the provision of summaries would be maintained.



8.2.3 At the same time, however, the Commission noted some disadvantages with the proposed scheme, in particular:

- (a) The eight global data sets would not necessarily be homogeneous. This could cause confusion among users whose data needs were presently being serviced satisfactorily by different centres;
- (b) Some responsible Members might carry an increased burden in the application of quality-control procedures to global data sets. The extent of this burden depended on the degree of automation of the procedures;
- (c) Some contributing Members whose VOS operated in only one or two areas of responsibility might incur increased costs by sending copies of data to all eight responsible Members.

8.2.4 In view of these disadvantages, the Commission agreed that it was unable to accept the proposal of the Working Group on Marine Climatology without statistical evidence in support of the advantages and disadvantages listed above. However, it also strongly agreed on the need to improve and streamline the MCSS in line with modern technology and developing user requirements. It therefore referred the matter to the new Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services, for urgent study during the coming intersessional period. The Commission drew the working group's attention to the TOGA Marine Climatology Data Centre, which could be one source of the required information.

### 8.3 Marine climatological data banks (agenda item 8.3)

8.3.1 The Commission recalled that a regular inventory service for marine climatological data and summaries had been established by CMM-VIII. It was also recalled, however, that CMM-IX had noted with concern certain discrepancies which had appeared in the first such inventory between the total numbers of observations archived by Members contributing to the summaries scheme and the numbers of observations appearing in the inventory. CMM-IX had therefore instructed the Working Group on Marine Climatology to undertake an investigation to establish reasons for the discrepancies and provide possible solutions to the problem.

8.3.2 The Commission noted that, following a survey of Members involved in the MCSS, the Working Group on Marine Climatology had identified a number of possible contributing factors to the discrepancies, which were partly inherent in the original inventory scheme and partly due to differing interpretations of procedures by contributing Members. The working group had therefore decided to develop a new inventory, based on clearer criteria for assessing numbers of observations.

8.3.3 These criteria were subsequently detailed in a new inventory survey prepared and distributed by the Secretariat in 1988. The Commission noted the interim results of the latest inventory exercise as presented verbally to the session. The Commission particularly considered the following factors:

- Differing archival practices made it impossible to identify the country of origin of data and hence to match the contents of the archive with the original data contributions;

- The cost of retrieving the information regarding country of origin was too high to be justified by the final objective;
- Data from earlier years (before 1984) had already been processed (or stored on different media) and were no longer available in their original form;
- The number of replies received was not sufficient to draw any meaningful conclusion regarding discrepancies between the amounts of data transmitted and stored.

In view of the above, the Commission recognized that it was not possible to compare the amount of data contributed by Members with that stored by the responsible Members. It therefore decided that the inventory should be discontinued but encouraged Members to contribute as much data as possible. It further requested responsible Members to acknowledge receipt of all data contributions.

8.3.4 The Commission recalled that, at its ninth session, it had noted that a comparison of quality-control procedures for marine climatological data employed by various Members had shown that they were far from being uniform and in some cases did not reach an acceptable standard. It had therefore instructed the Working Group on Marine Climatology to consider the development of minimum standards for such quality-control procedures. The working group had subsequently studied this question at its fifth session and agreed on a set of minimum controls which it recommended for application by contributing Members before the dispatch of data to the responsible Members.

8.3.5 The Commission reviewed the draft minimum quality-control standards and agreed that this set should be included as an annex to Part II, Section 5 of the Manual on Marine Meteorological Services, as a recommendation to contributing Members. It adopted Recommendation 7 (CMM-X) on the subject.

8.3.6 It was noted by the Commission that the Advisory Working Group of CMM at its sixth session had requested the Working Group on Marine Climatology to study appropriate definitions for terminology related to the computerized storage of data. The Commission agreed with the working group that the interchangeability of some such terms, at least in the English language, created difficulties when translated into other languages. It was therefore desirable for a set of commonly accepted definitions to be adopted for recommended use within CMM, although such definitions could carry no formal status within WMO. The Commission therefore agreed that these definitions, as published by the International Organization for Standardization, should be adopted as recommended terminology. The Commission adopted Recommendation 8 (CMM-X).

#### 8.4 Other matters related to marine climatology (agenda item 8.4)

8.4.1 The Commission recalled that, at its ninth session, it had recommended that a Guide to Applications of Marine Climatology should be prepared which would effectively document the extensive experience gained by certain Members in the application of marine climatological information for the benefit and guidance of all Members. The Commission noted with appreciation that this recommendation had been approved by EC-XXXVII and that Tenth Congress had urged that this work should be completed as a matter of priority.

8.4.2 The Commission noted with approval that the preparation of the Guide had been discussed in detail by the Working Group on Marine Climatology at its fifth session (Geneva, November 1986). The working group had adopted a modified outline for the Guide and agreed that preparation should be undertaken by a team of corresponding authors under the guidance of a project director and a small editorial board. The Commission expressed its sincere appreciation to the project director, Mr A. Saulesleja (Canada), and to all members of the editorial board for agreeing to undertake this difficult but important task, and to the Members and organizations concerned for having made these experts available for the work.

8.4.3 The Commission was informed that the present timetable for the project envisaged that editing and final revision of the complete English text for the Guide would take place during 1989, with the final version expected to be submitted for publication in late 1989 or early 1990. It urged that subsequent translation into and publication in the other languages of the Organization should take place as quickly as possible in view of the considerable potential value of this Guide to all maritime Members. Guide  
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8.4.4 The Commission further recalled that, at its ninth session, it had instructed the president of CMM to consult with the president of the Commission for Climatology (CC1) with a view to removing the statutory requirement for the preparation of a marine section of the World Climatic Atlas, since it had felt that for a variety of reasons, including the prior existence of a number of other global and regional marine climatic atlases, the need for such an atlas was diminishing. In this regard, the Commission noted that the question had been discussed by CC1 at its ninth session (Geneva, December 1985). CC1-IX had essentially agreed with CMM regarding the diminishing requirement for this marine climatic atlas and had therefore recommended that Resolution 14 (EC-XXVI), which provided the statutory authorization for the preparation of the atlas, should be amended accordingly.

8.4.5 Subsequently, EC-XXXVIII approved the recommendation of CC1-IX and adopted Resolution 10 (EC-XXXVIII) on the subject of regional climatic atlases, which replaced the earlier Resolution 14 (EC-XXVI). As the text of this resolution made no reference to the preparation of a marine climatic atlas (or marine section to the World Climatic Atlas) and also noted the views of CMM in this regard, the Commission agreed that a statutory requirement no longer existed for the preparation of this atlas. The Commission expressed its appreciation to the Commission for Climatology and to the Executive Council for their actions on this matter.

8.4.6 The Commission noted that the deletion of the requirement for a marine climatic atlas necessitated some slight modification to the text of the Manual on Marine Meteorological Services; it therefore adopted appropriate modifications in this regard when it considered the revised version of Part II, Section 5 of the Manual under agenda item 10.

8.4.7 The Commission agreed with the opinion of the Working Group on Marine Climatology concerning the value of global and regional marine climatic atlases which might be produced by individual Members. It therefore encouraged individual Members willing to do so to prepare such atlases and, where possible, to make additional copies of these atlases available for limited distribution within WMO.

8.4.8 The Commission noted and approved the request by the USA to include five extra items in the programme of work of the Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services for the coming intersessional period. These items were:

- (a) Considering the advisability of creating an archive of tropical cyclone track information by asking Regional Specialized Meteorological Centres to forward data annually to World Data Centres A and B in the format recommended by the CAS Working Group on Tropical Meteorology;
- (b) Developing a standard code based on the use of latitude and longitude to replace the octant code in IMMT (code table 3300) and the quadrant code in FM 13-IX - SHIP (code table 3333), thereby avoiding the mislocation of data which frequently occurred;
- (c) Investigating the possibility of eliminating the weather data indicator and making weather code (7ww W<sub>1</sub>W<sub>2</sub>) and cloud group (8N<sub>n</sub>C<sub>1</sub>C<sub>m</sub>C<sub>H</sub>) mandatory; also, changing the sign convention for wet bulb/dew point temperature code in IMMT to agree with WMO code table 3845;
- (d) Investigating means of indicating the time over which a reported wind speed has been averaged;
- (e) Amending the procedures associated with collection of data for the International List of Selected, Supplementary and Auxiliary Ships (WMO-No. 47) to include additional details of the observing platform.

8.4.9 The Commission expressed its appreciation to the outgoing chairman of the Working Group on Marine Climatology, Mr C. Korevaar (Netherlands), and to all the members of the group for their excellent work during the past intersessional period. It agreed that there remained many outstanding items to be dealt with in the field of marine climatology during the coming intersessional period, and therefore decided to establish a sub-group on marine climatology within the new Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services. The action taken in this regard is recorded under agenda item 15.

## 9. SEA ICE (agenda item 9)

9.1 The Commission noted with appreciation the report of Dr V. Savtchenko (USSR), chairman of the Working Group on Sea Ice, and expressed its thanks to Dr Savtchenko and to all the members of the working group for the excellent work accomplished during the intersessional period. It noted in particular the major advances made by the group towards the establishment of a global digital sea-ice data bank and urged that this work should continue during the coming intersessional period as a matter of priority. To this end, the Commission agreed to maintain in force Recommendation 7 (CMM-IX), with the deletion of point 4 of the annex to this recommendation, as proposed by the working group. Further action in this regard is recorded under agenda item 16.

9.2 The Commission noted with interest and approval the high priority given by the working group to the further development and operational im-

plementation of remote-sensing techniques for sea-ice observations. In particular, it agreed that this should continue to be one of the major ongoing work areas for the group and that every effort should be made to convince the satellite-operating agencies of the operational and research value of remotely sensed sea-ice data. The Commission approved the proposal of the working group to convene a seminar on the topic of the remote sensing of sea ice in 1990 and expressed its appreciation to Canada for offering to host the seminar. It requested the Secretariat to liaise with Canada and the chairman of the working group with regard to the organization of and support for the seminar. Finally, the Commission noted with interest the proposal to convene a technical conference on the remote sensing of the oceans in conjunction with CMM-XI and referred the proposal to its Advisory Working Group for further consideration and action.

9.3 The Commission recalled that, at its ninth session, it had requested that actions be taken towards the preparation of both guidance material for mariners on marine meteorological services in sea-ice areas and of a guide for navigators in sea-ice areas. Subsequently, the Advisory Working Group of CMM agreed with the chairman of the Working Group on Sea Ice that the preparation of guidance material for navigators could not be considered a task for meteorologists/oceanographers and that the two proposals of CMM should be combined into a single task for the Working Group on Sea Ice. The Commission approved the recommendation of the Advisory Working Group in this regard.

9.4 The Commission noted that the Working Group on Sea Ice at its fifth session had proposed that the development of such guidance material should be undertaken on the basis of specific, recognized geographical sea-ice areas of concern to mariners and that, as a first step, a handbook on sea-ice navigation in the Southern Ocean should be prepared. This proposal is based in part on the request of the XIVth Antarctic Treaty Consultative Meeting, addressed to WMO, SCAR and IOC, for advice on improving marine meteorological and sea-ice information services in the Treaty Area of the Southern Ocean.

9.5 The Commission approved this proposal by the Working Group on Sea Ice. It agreed in particular that the publication of relevant guidance material relating to sea ice in the Southern Ocean was a necessary step to improving marine meteorological and sea-ice services in the region. It also agreed that the handbook should, if possible, be published in all four languages of WMO, since these are also the official languages of the Antarctic Treaty parties and such publication would maximize the potential benefit to mariners. Finally, the Commission agreed that the acceptance of a handbook of this type within the maritime community was likely to be enhanced if IMO were involved in both its preparation and publication. In this regard, it noted that the thirty-fifth session of the IMO Sub-committee on Safety of Navigation (NAV 35/14 section 12) had considered this matter and agreed that the handbook would be very useful in assisting safety of navigation and should therefore be promoted by IMO. The Sub-committee invited the fifty-seventh session of the IMO Maritime Safety Committee to urge WMO to provide the draft texts for possible comments before they were published and to include consideration of the handbook in its work programme. The Commission expressed its appreciation to IMO for this support and adopted Recommendation 9 (CMM-X) on the topic.

9.6 The Commission noted with satisfaction that, following a decision taken at its ninth session, the Working Group on Sea Ice had prepared a draft outline of a handbook on the analysis and forecasting of sea ice. The

Commission agreed that the publication of such a handbook was an excellent means for technology transfer in the area of sea ice to countries which did not have enough experience in the field, particularly developing countries. It therefore adopted Recommendation 10 (CMM-X), noting that this work should have second priority to the preparation of the handbook agreed in paragraph 9.5 above, in view of the urgency of that task and the limited budgetary resources available for the support of both projects. In addition, the Commission requested Members to give serious consideration to assisting in the translation of both handbooks into the other official languages of WMO. Finally, the Commission requested the Working Group on Sea Ice to give consideration to the possibility of including information relating to ice accretion on shipping in both publications, in view of the importance of this problem to mariners.

9.7 The Commission recalled that the establishment of the global digital sea-ice data bank should be based on the SIGRID format for the archival and exchange of sea-ice data in digital form. This digitizing format was initially developed in support of the World Climate Programme and was being extensively used by many sea-ice services for the archiving and exchange of sea-ice data. Nevertheless, the format had no formal status within WMO and the Commission noted that this might create problems for its use as the official exchange format for sea-ice data for the proposed global sea-ice data bank.

9.8 The Commission therefore agreed that the SIGRID format should be included as an appendix to Part II of the Manual on Marine Meteorological Services and adopted Recommendation 11 (CMM-X) on this subject.

10. REVIEW OF TECHNICAL REGULATIONS OF INTEREST TO CMM (agenda item 10)

#### The Manual on Marine Meteorological Services

10.1 The Commission recalled that two recommendations concerning revisions to the Manual on Marine Meteorological Services referring respectively to the Marine Climatological Summaries Scheme (MCSS) and to the International Maritime Meteorological Punch Card (IMMPC)/International Maritime Meteorological Tape (IMMT), had been adopted by CMM-VIII and approved by EC-XXXIV. Together, these required a relatively complex revision of the existing text and annexes of Section 5, Part II, Volume I of the Manual. The Working Group on Marine Climatology had therefore prepared a draft revised text for the Manual which it considered in detail at its fifth session (Geneva, November 1986). It was further noted by the Commission that the working group at its fifth session had also developed various other minor amendments to the text which were subsequently incorporated by the working group into a final agreed revised text for the consideration of the Commission.

10.2 The Commission expressed its appreciation to the Working Group on Marine Climatology for the work done in revising this section of the Manual on Marine Meteorological Services. It agreed that the Marine Climatological Summaries Scheme represented a unique and most successful system for the collection, archival and processing of marine climatological data in support of a large number of applications and that the details of the scheme, as incorporated in the Manual, should be kept up to date in the light of developments in technology and users' requirements. Recommendation 12 (CMM-X) was therefore adopted. The Commission further noted that the revised text for the Manual still contained references to both the IMMPC and to the use of

punch cards for data transfer. Some doubt was expressed as to the utility of retaining these references in view of the decreasing utilization of punch cards by Members. The Commission therefore requested the Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services to investigate this question further during the intersessional period, with a view to making a specific recommendation to CMM-XI.

10.3 The Commission recalled that, at its ninth session, it had noted inaccuracies in the Spanish section of the multilingual glossary contained in Appendix II.2 of the Manual, as well as elsewhere in the Manual and other publications. The Commission requested the Secretary-General to ensure that these inaccuracies were corrected during the forthcoming revision to the Manual.

## 11. GUIDES AND OTHER TECHNICAL PUBLICATIONS (agenda item 11)

11.1 The Commission noted with satisfaction that the new WMO Guide to Wave Analysis and Forecasting had been published, so far in the English-language version only, during 1988. It expressed its appreciation to Mr E. Bouws (Netherlands) and the other authors for their work in preparing this new Guide to replace the former Handbook on Wave Analysis and Forecasting and agreed that the Guide would provide invaluable assistance to all Members in developing their wave forecast services. The Commission urged that the other language versions of the Guide should be prepared and published as soon as practicably possible.

11.2 The Commission noted that the revised Marine Cloud Album (WMO-No. 659) and Cloud Sheet had also been published during the intersessional period and expressed its appreciation to the rapporteur, Mr C. Knaack (Federal Republic of Germany) for his work on these two publications. It considered that each was a valuable observational and educational aid, as well as being attractive, and urged all Commission Members to consider distributing the publications as widely as possible within their respective countries.

11.3 The Commission noted with appreciation that Mr H. Erdmann (Federal Republic of Germany) was serving on the CIMO Working Group on Surface Data and, in this capacity, was assisting in the updating of Chapter 17 - Marine Observations - of the Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8). It also noted with appreciation that Mr W. S. Richardson (US) was assisting in the updating of Chapter 22 - Automatic meteorological stations - of this Guide.

11.4 The Commission noted the ten new publications which had been issued in the series Marine Meteorology and Related Oceanographic Activities - Reports Nos. 12, 12 Supplement No. 1 and 13-20 - and the five new publications relating to IGOSS published jointly by WMO and IOC. It also noted that Report No. 10 in this series had been fully revised and reissued. The Commission appreciated that this WMO report series served as an efficient means of distributing information on the work being undertaken or accomplished in the context of CMM and commended all the authors for their valuable contributions. While the Commission understood very well the difficulties being faced by the Secretariat in preparing and issuing publications, due in particular to financial and workload problems, it nevertheless expressed the hope that everything possible would be done to continue the publication of guidance and technical support documents in a timely manner since this

material was of enormous value to Members in their provision of marine meteorological services to the marine user community.

11.5 The Commission then considered the requirements for new publications, taking into account priorities for guidance material. It noted first the proposal by the fifth session of the Joint IOC/WMO Working Committee for IGOSS concerning the preparation and publication of a guide to moored buoys and other ODAS, similar to the IOC/WMO Guide to Drifting Data Buoys published recently (IOC Manuals and Guides 20). The Commission agreed that such a publication would be very useful for many Members, and therefore requested the president, in consultation with the chairman of the Joint IOC/WMO Working Committee for IGOSS, to appoint a rapporteur to undertake the preparation of this guide.

11.6 The Commission also noted the potential value to Members of a users' guide to meteorological and oceanographic applications of the INMARSAT system. In this connection, the Commission was informed by the observer from INMARSAT that such a guide, referring to the applications of INMARSAT to maritime safety information (MSI) generally, was being prepared by INMARSAT in collaboration with the IMO Working Group on MSI. The Commission welcomed this information and requested the Working Group on Basic Marine Meteorological Services to liaise with IMO and INMARSAT to ensure that meteorological and oceanographic interests were properly catered for in this guide. Finally, the Commission noted a requirement for the preparation of guidance material for Members on the applications of data from ocean satellites and other remote-sensing techniques. It agreed on the importance of such information, and referred the matter to the Working Group on Technical Problems for further action.

12. EDUCATION AND TRAINING, TECHNOLOGY TRANSFER AND IMPLEMENTATION SUPPORT ACTIVITIES IN THE FIELD OF CMM (agenda item 12)

12.1 Specialized education and training activities (agenda item 12.1)

12.1.1 The Commission reviewed the WMO Education and Training Programme activities of particular relevance to CMM that had taken place during the intersessional period. The Commission agreed that, in general, the activities undertaken in this field had been particularly successful, especially with regard to the workshops and regional training seminars which were considered to be of great value in stimulating and assisting the further development of marine meteorological services in developing countries. The Commission noted with pleasure that Cg-X had agreed that related seminars should continue in the future as often as possible.

12.1.2 The Commission noted that despite efforts made by Members and the availability of some limited courses and programmes at RMTCs, in particular at the RMTC in Manila, Philippines, there continued to exist an unfulfilled demand for specialized long-term training in marine meteorology. The Commission regarded such training as absolutely essential for the further development of marine-related activities and services within national Meteorological Services. The Commission further agreed that marine meteorology and physical oceanography were very closely related and should be studied together, in view also of the growing requirements of users for combined meteorological and oceanographic services. In this context, it noted the recommendation made by the fifth session of the Joint IOC/WMO Working Committee for IGOSS on the subject and requested that high priority should be



given to the establishment, as soon as possible, of a specialized course in marine meteorology and physical oceanography at the RMTTC Nairobi, Kenya. Recommendation 13 (CMM-X) on this topic was adopted.

12.1.3 The Commission stressed that the proposed course in Nairobi should be regarded as a pilot project for similar courses in other RMTTCs, and in this regard noted the strong requirement for such courses in support of national Meteorological Services in French- and Spanish-speaking countries. It therefore recommended that attention should also be given as soon as possible to the establishment of courses in the RMTTCs Oran, Algeria and Buenos Aires, Argentina. Finally, the Commission noted the importance of combining specialized education and training with direct technical assistance in the field of marine meteorology and physical oceanography, in order that countries might make the best use of the training acquired. It therefore advised Members to make specific requests for such technical assistance as necessary and requested that high priority should be given to meeting such requests through the VCP, UNDP projects, or otherwise as appropriate.

12.1.4 The Commission felt that the regional workshops and roving seminars were of considerable value to national Meteorological Services and the maritime user community, and should continue. It urged the Organization to consider, within the funds available, continuing at least one regional seminar per year. It also suggested that funding to support these training activities might be sought from user communities which would benefit directly from improved marine meteorological services (fisheries, coastal engineering, oil industry, etc.). Such involvement would also help to improve understanding of the requirements of user communities for these services.

12.1.5 The Commission was very appreciative of the success of the course on ocean waves and tides organized by the International Centre for Theoretical Physics and jointly sponsored by the International Atomic Energy Agency (IAEA), the United Nations Educational, Scientific and Cultural Organization (Unesco) and WMO. The Commission considered that this type of course was a very useful means of expanding WMO's education and training activities and encouraged the continued sponsorship of events of this type.

12.1.6 The Commission noted with pleasure that the publication of training materials for all levels had continued during the intersessional period and noted especially the publication of some existing compendia in languages other than English. The Commission recalled its recommendation for updating of appropriate training material and considered that, in addition to the revision of the Compendium of Lecture Notes in Marine Meteorology for Class III and Class IV Personnel (WMO-No. 434), which was under way, steps should be taken to review and update the Compendium of Meteorology for Use by Class I and Class II Meteorological Personnel (WMO-No. 364), Volume II, Part 3 - Marine meteorology, which dated from 1979. This revision should include, inter alia, new techniques for the observation of variables of interest to mariners, new technology for modelling and forecasting of ocean waves, and telecommunication developments such as INMARSAT, CLS/Service Argos and the facilities offered by the geostationary meteorological satellites, in particular through the International Data Collection System.

12.1.7 The Commission was highly appreciative of the fellowships which had been awarded by WMO for studies specifically related to marine meteorology and physical oceanography. With regard to the future of education and training activities, the Commission strongly supported the main objectives of

the Education and Training Programme of the Second WMO Long-term Plan. The Commission felt that this training component was vital for Members to be able to establish and/or develop their national marine services programmes. It also noted the need of a number of Members for expert missions to advise on the further development of specialized education and training facilities in their countries.

12.1.8 In view of the survey on training requirements by Members which will be undertaken by the Secretariat in 1989, the Commission requested its members to study carefully the training requirements in their respective countries and to submit their responses to the Secretariat in a timely manner. The Commission also urged Members to give high priority to training in marine meteorology and physical oceanography when stating their training requirements.

12.1.9 The Commission agreed that there was a strong need for enhanced co-operation and co-ordination between WMO and IOC in training, education and mutual assistance in the field of marine meteorology and physical oceanography, both in the context of IGOSS and also more widely. It noted the existing co-operative education and training activities between WMO and Unesco in hydrology and felt that similar co-operation could also exist with respect to marine questions. In this context, it noted with interest the proposal by IOC for a joint IOC/WMO working group to study and develop a joint proposal to fund agencies for the broader development of education and training facilities in marine meteorology and physical oceanography, with initial specific application to East Africa. The Commission agreed that this was a very useful proposal and instructed its Working Group on Basic Marine Meteorological Services to take up the matter as soon as possible during the coming intersessional period.

## 12.2 Technology transfer and implementation support activities (agenda item 12.2)

12.2.1 The Commission noted the opinion of Tenth Congress that continuing high priority should be given to assisting Members in the further implementation of marine meteorological services. These services included both basic marine meteorological services provided in support of the safety of life and property at sea according to regulatory material contained in the Manual on Marine Meteorological Services as well as a variety of more specialized services in response to the requirements of specific user groups. It also noted that implementation support was included as one of the eight major projects within the Marine Meteorology and Associated Oceanographic Activities Programme of the Second WMO Long-term Plan, while substantial support to Members in all aspects of their operations was provided in the context of the WMO Technical Co-operation Programme.

12.2.2 The Commission was informed of various implementation support activities which had taken place during the intersessional period since CMM-IX, or were soon to take place, including:

- Expert missions to advise on the further development of marine meteorological services in Brunei Darussalam, Chile, Ethiopia, the Islamic Republic of Iran, Tunisia and Uruguay;
- Consultant assistance in marine meteorological services in Malaysia and Morocco;

- WMO support for UNDP project proposals by Brunei Darussalam and Colombia;
- Secretariat studies in support of marine data collection for Argentina and Chile.

12.2.3 In expressing its approval of these activities, the Commission noted that they had taken place at the specific request of the Members concerned. The Commission urged other Members, where appropriate, to submit similar requests for assistance to facilitate the further development of their marine meteorological services in support of the whole marine community and in the context of the implementation of the Marine Meteorology Programme within the guidelines provided by the Second WMO Long-term Plan. In this context, it noted that the transfer of technology was very closely linked to specialized education and training activities and suggested that Members should emphasize this linkage in their requests for support in the further development of their marine meteorological activities. The Commission also noted the potential high value to national Meteorological Services of a detailed study on the costs and benefits of marine meteorological services to the marine user community. It therefore requested the Working Group on Basic Marine Meteorological Services to consider the preparation of such a study during the coming intersessional period, if possible in close collaboration with the Joint IOC/WMO Working Committee for IGOSS, in view of the growing user requirements for combined meteorological and oceanographic services.

12.2.4 The Commission noted that considerable scope existed for regional co-operation in support of marine meteorological services in a number of areas and put forward a variety of suggestions in this regard. In particular, it noted that the agreement established in 1980 for the co-operative development of the Regional Marine Meteorology Project in the Gulf region had been suspended in November 1982. As this venture was of considerable potential value to the countries concerned, the Commission urged that every effort should be made to reactivate the agreement. The Commission further noted the possibilities for similar regional activities in areas such as East and West Africa, the Caribbean and South-East Asia, and urged the countries concerned to investigate those possibilities.

### 13. RELATIONSHIP WITH OTHER WMO PROGRAMMES AND THOSE OF OTHER ORGANIZATIONS AND BODIES (agenda item 13)

13.1 The Commission recalled that, following the Inter-Secretariat Committee on Scientific Programmes Relating to Oceanography (ICSPRO) agreement, WMO had seconded a scientific officer to the IOC Secretariat to work on joint programmes and related activities and to co-operate generally with IOC in a variety of ocean-related activities including:

- (a) The Integrated Global Ocean Services System (IGOSS);
- (b) The World Climate Programme (WCP), particularly the World Climate Research Programme (WCRP) and the World Climate Data Programme (WCDP);
- (c) Drifting buoy programmes through the Drifting Buoy Co-operation Panel;
- (d) The Long-term and Expanded Programme of Oceanic Exploration and Research (LEPOR);

- (e) Training, education and mutual assistance in the marine sciences (TEMA).

The Commission strongly reiterated the importance of co-operation between meteorologists and oceanographers generally, at both national and international level, in developing solutions to problems of mutual concern and emphasized specifically the high value it placed on co-operation between WMO and IOC in the field of marine meteorological and oceanographic services and research. The observer from IOC also stressed the value of this co-operation to IOC and expressed the appreciation of IOC for the support provided by WMO for the various joint programmes. Finally, the Commission expressed the opinion that co-operation at the international level among organizations such as WMO, IOC, SCOR, ICES, etc. often had a very positive influence on support of co-operation nationally between meteorological and oceanographic institutions.

13.2 The Commission noted with interest the present rapid growth in IGOSS implementation and the substantial contribution which IGOSS was already making in terms of oceanographic data and services in support of both operational and research users. It agreed that, while IGOSS services largely complemented those provided within the marine meteorological services system, there were nevertheless important areas in which co-operation between the Marine Meteorology Programme and IGOSS should be strengthened, since:

- (a) Many marine users now required services involving both meteorological and oceanographic information;
- (b) The expanding drifting buoy programmes might become much more cost-effective if they satisfied both meteorological and oceanographic data requirements;
- (c) The WMO VOS and the network of PMOs had a potentially important role to play in the IGOSS ships-of-opportunity programme;
- (d) The new oceanographic satellites would be of great significance to both programmes and would require joint study to ensure their most effective use.

For these reasons, the Commission agreed on the need to appoint a special IGOSS rapporteur to advise and assist in the co-ordination of activities. This appointment was effected under agenda item 15.

13.3 The fifth session of the Joint IOC/WMO Working Committee for IGOSS took place in Paris from 14 to 23 November 1988. Decisions or recommendations made by the Joint Working Committee at this session which required specific action or comment by CMM are dealt with elsewhere in this report under the appropriate agenda items. In addition, the Commission noted with interest the following results of the session:

- Proposals for improved monitoring of IGOSS data flow
- Increased emphasis on IGOSS products, including preparation and distribution of a products bulletin
- Expansion of the IGOSS sea-level programme
- Adoption of the IGOSS Plan and Implementation Programme 1989-1995.

The Commission agreed that these results clearly indicated the present healthy progress of IGOSS in the collection and distribution of oceanographic data and products in response to expanding user requirements for such information; they also emphasized the need for enhanced co-operation and co-ordination between CMM and IGOSS as discussed in paragraph 13.2 above.

13.4 The Commission noted with appreciation the high level of co-operation which existed among WMO and the other ICSPRO agencies and between WMO and other international organizations and bodies such as IHO, INMARSAT, CPPS, ICS and SCOR in the area of marine services and research. The Commission expressed a particular interest in being kept informed of developments in the implementation of the UN Convention on the Law of the Sea and stressed the importance of ensuring the continued smooth operation of marine observing systems, including in particular VOS and drifting buoys, within the context of the new ocean regime. With regard to drifting buoys in particular, it noted with approval the involvement of WMO, at a technical level, in the preparatory work for the development of a draft International Convention on the Legal Status of Ocean Data Acquisition Systems (ODAS) being undertaken jointly with IOC and IMO.

13.5 The Commission also noted with appreciation the co-ordination and co-operation which occurred between the Marine Meteorology Programme and other WMO programmes such as the WWW, WCP, RDP, AgMP, ETR and TCP. With regard to the WWW, it agreed that co-ordination could be enhanced by the nomination of experts to represent CMM on the CBS Working Groups on the GOS, the GTS and WWW Data Management and requested the president of CMM to arrange for this representation.

13.6 The Commission noted with interest the involvement of WMO, through the Research and Development Programme, in various marine pollution activities. It agreed in particular on the importance of the involvement of meteorological services in oil pollution emergency operations and requested the president of CMM, in consultation with the WMO Secretariat, IMO and UNEP, to study ways of enhancing such involvement. Additional action on this topic is recorded under agenda item 5.

13.7 Finally, the Commission also noted with interest that the terms of reference of the Commission for Agricultural Meteorology now included "fisheries - (food aspects only)" and that this activity was to be implemented in close co-ordination with CMM. In this context, it approved the decision of the president of CMM to appoint Mr E. Smaland (Norway) as rapporteur to act jointly with the CAgM rapporteur on the meteorological and climatological aspects of marine fisheries.

#### 14. WMO LONG-TERM PLAN (agenda item 14)

14.1 The Commission noted that Tenth Congress had approved the Second WMO Long-term Plan (SLTP) as the single planning document of WMO and that the programme and budget of the Organization for the tenth financial period (1988-1991) had been developed to effect the implementation programme given in the SLTP. The Marine Meteorology and Associated Oceanographic Activities Programme 1988-1997 included in Part II, Volume 4 of the SLTP therefore constituted the overall objectives and broad work programme of the Commission and its working groups and rapporteurs for the coming intersessional period. On this basis, the Commission developed a list of major tasks to be accomplished in the period 1989-1991. The terms of reference of working

groups and rapporteurs adopted by the Commission were also directed towards achieving the objectives of the SLTP. These are recorded under agenda item 15.

14.2 The Commission also noted that Tenth Congress had requested that the status of implementation of the SLTP should be monitored, with the results to be reported to Eleventh Congress, the Executive Council and to CMM. The Commission therefore instructed its working groups and rapporteurs to monitor the implementation of those sections of the Marine Meteorology and Associated Oceanographic Activities Programme for which they had specific responsibility. It also instructed the Advisory Working Group to monitor implementation of the overall programme and to prepare summary results of this monitoring for consideration by the Executive Council, Cg-XI and CMM-XI.

14.3 Tenth Congress also decided that the Third WMO Long-term Plan (TLTP) should be prepared for the period 1992-2001. The draft TLTP is to be approved by EC-XLII (1990) for submission to Cg-XI (1991). The Commission agreed that the following general priority areas should merit particular consideration when preparing the Marine Meteorology and Associated Oceanographic Activities Programme part of the TLTP:

- (a) Improving the quality and effectiveness of basic forecast and warning services including for sea ice and in support of the safety of life and property at sea;
- (b) Monitoring user requirements for, and assisting Members in the implementation of specialized marine meteorological services such as for fisheries, ports and harbours, offshore industry, other coastal services, pollution monitoring and response, etc.;
- (c) Monitoring the cost-effectiveness of marine meteorological services, including assessment of economic impact;
- (d) Expanding marine observation, data collection and data processing and archival systems (including in situ, automated and various remote-sensing observation systems) as part of an overall ocean monitoring programme in support of the WWW, marine meteorological services, IGOSS and the WCP;
- (e) Applying modern marine telecommunications techniques and facilities to both marine data collection and the dissemination of information to users;
- (f) Expanding and improving education and training facilities in marine meteorology and physical oceanography, including associated technology transfer and the provision of appropriate technical facilities to all Members.

14.4 With regard to procedures for the preparation of the TLTP, the Commission noted that this was to be done essentially in the form of amendments to the SLTP. It therefore instructed its working groups and rapporteurs to develop specific proposals for amendments to the SLTP, for consolidation by the Secretariat. The Commission also agreed that close consideration should be given to the revised document "Marine meteorological services to the year 2000" in preparing these amendments. The full draft Marine Meteorology and Associated Oceanographic Activities Programme part of

the TLTP should be reviewed by the Advisory Working Group of CMM prior to its submission to EC-XLII.

15. ESTABLISHMENT OF WORKING GROUPS AND NOMINATION OF RAPPORTEURS  
(agenda item 15)

15.1 Under this agenda item, the Commission first considered in detail what general structure would be required for its working groups and rapporteurs to meet the major challenges and priority issues which it would be facing during the coming intersessional period. In this context, the Commission recalled that during the past few decades it had attained many noteworthy accomplishments that had significantly improved meteorological services to the maritime community and had contributed to a better and more modern World Weather Watch. The preparation and publication of the Guide to and Manual on Marine Meteorological Services, the terminology and nomenclature for sea ice and the Marine Cloud Album had provided a set of guidance material that would assure a basic standard of global marine meteorological services to mariners in polar, temperate and tropical areas. In addition, the procedures established for voluntary observing ships had contributed to the many successful research programmes such as GATE and FGGE which had led to improvements in the World Weather Watch.

15.2 At the same time, the Commission agreed that the challenges and opportunities facing it over the next decade were different, although no less important, than those of the past. The availability of new observing technology including satellites, buoys and automated observing systems; the improved capability for providing numerical guidance and other forecast techniques; the emerging major change in telecommunications, particularly for ocean areas; the emergence of meteorological services to increase financial and economic benefits to Members; the increased requirements for ocean observations, including sea ice, to meet the objectives of WWW and WCP; recognition of the role of the oceans in global climate processes and of the need to study atmosphere and ocean as elements of a single system; the increasing role of meteorological services in international responses to pollution of the marine environment; the growing needs of Members to enhance marine meteorological and climatological services; and the continuing need to maintain basic up-to-date marine meteorological warning services on a global basis as a part of WMO's contribution to SOLAS were specific issues included in the Marine Meteorology Programme section of the Second WMO Long-term Plan. In order to address these issues adequately, the Commission agreed that modifications and changes needed to be made to its organizational structure.

15.3 The Commission agreed that several different types of task would be required. The first and perhaps most important task was to ensure that a mechanism was available to continue to review basic meteorological services provided to ensure the safety of life and property in ocean areas. This kind of task was usually best accomplished by a continuing group of Members involved in providing the services on a national or regional basis. Another type of task required the attainment of specific objectives such as the preparation of a technical document or development of a technical procedure. This type of task was often best accomplished by small groups of technical experts with specific terms of reference and a fixed time limit. The formal continuation of such groups was usually not necessary. The final type of task usually required a study on a specific topic such as the feasibility of a new technology or technique. Such studies usually resulted in recommendations to the Commission. This type of task was often accomplished by a rapporteur.

In addition, the Commission noted that while the issues and activities of CMM would continue to increase, it was expected that there would not be a parallel growth in financial and personnel resources available to WMO for their support. The structure of the Commission would therefore need to be established so that tasks could be carried out in the most efficient manner.

15.4. In keeping with these requirements, the Commission agreed that the following basic structure would be appropriate:

- (a) An Advisory Working Group;
- (b) A Working Group on Basic Marine Meteorological Services to include:
  - A sub-group on warning and forecast preparation
  - A sub-group on marine observations and telecommunications
  - A sub-group of regional rapporteurs on education and training
  - A rapporteur on IGOS;
- (c) A Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services, to include:
  - A sub-group on marine climatology;
- (d) A Working Group on Sea Ice;
- (e) A Working Group on Technical Problems to include:
  - An ad hoc group on ocean satellites and remote sensing
  - An ad hoc group on wave modelling
  - Other rapporteurs on specific technical topics.

Within this structure, various other sub-groups and rapporteurs could be appointed by the Commission, the president or chairmen of the working groups to deal with specific issues as and when they arose. A diagram of the structure is given in Annex IV to this report.

15.5 The Commission agreed that, in addition to satisfying the requirements given above, the proposed new structure would also:

- (a) Allow the continuance of the important work now being undertaken in marine climatology and sea ice;
- (b) Give sufficient flexibility to allow the incorporation of new ad hoc groups of experts such as that on wave modelling;
- (c) Allow an appropriate treatment of marine telecommunication problems;
- (d) Allow an appropriate consideration of ocean satellite and other remote-sensing problems.

In keeping with the budgetary constraints, the Commission further agreed that, in general, groups should work mostly by correspondence and that when large



formal working group sessions were required, participation of members in such sessions should be funded as much as possible from national sources. In this way, the limited available programme funds within the Secretariat could be used to deal with high priority and/or urgent issues, usually involving only sub-groups or small numbers of experts.

15.6 With regard to membership of the working groups, the Commission agreed on the following general approach:

- (a) The Advisory Working Group should be composed of the president, past president, vice-president and chairmen of the other working groups, together with one or two other members, bearing in mind the need to include appropriate technical expertise and as wide a geographical representation as possible;
- (b) The Working Group on Basic Marine Meteorological Services should be open, but with the sub-group chairmen and the rapporteur on IGOSS selected by the session;
- (c) The Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services should be open, but with a core group of representatives of the responsible Members for the Marine Climatological Summaries Scheme;
- (d) The Working Group on Sea Ice should be composed of a group of members selected by the session to include appropriate regional representatives;
- (e) The Working Group on Technical Problems should be selected by the session or appointed subsequently by the president of the Commission.

15.7 In order to establish these working groups, the Commission adopted Resolutions 1 (CMM-X), 2 (CMM-X), 3 (CMM-X), 4 (CMM-X) and 5 (CMM-X). Details of terms of reference and membership of each group are included in the respective resolutions.

16. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND OF RELEVANT RESOLUTIONS OF THE EXECUTIVE COUNCIL (agenda item 16)

16.1 In accordance with the current practice, the Commission examined those resolutions and recommendations adopted prior to its tenth session and which were still in force. It noted that the action on most of its previous recommendations had already been taken and completed, or their substance incorporated in the Manual on Marine Meteorological Services and the Guide to Marine Meteorological Services as appropriate. Resolution 6 (CMM-X) was adopted.

16.2 The Commission also examined the Executive Council resolutions within the fields of activity of CMM. Recommendation 14 (CMM-X) was adopted.

## 17. ELECTION OF OFFICERS (agenda item 17)

17.1 The Commission elected Mr. R. J. Shearman (UK) as president of CMM and Dr Lim Joo Tick (Malaysia) as vice-president.

## 18. DATE AND PLACE OF THE ELEVENTH SESSION (agenda item 18)

18.1 In the absence of any formal invitation from delegations at the session, the Commission decided that the date and place of its eleventh session should be determined by its president, after consultation with the Secretary-General and in accordance with the provisions of Regulation 181 of the General Regulations.

## 19. CLOSURE OF THE SESSION (agenda item 19)

19.1 In his closing address, the president of the Commission, Mr F. Gérard, reviewed the major achievements of the Commission during the past intersessional period and at the tenth session. In doing so, he noted that the Commission had been very successful in fulfilling its dual role, firstly as an applications commission providing services and information for the marine user community and secondly in providing basic marine meteorological and oceanographic data from 70 per cent of the Earth's surface, in support of other WMO programmes and activities. With regard to the future, Mr Gérard noted that the coming intersessional period would require the consolidation and development of activities in the priority areas identified at the present session, in particular in the areas of new communications facilities, remote sensing of the oceans and support for climate monitoring and analysis.

19.2 Mr Gérard then expressed his gratitude to the vice-president and president-elect, Mr R. J. Shearman, to the chairmen and members of the working groups, to the rapporteurs and to all the members of the Commission for their efforts on behalf of the Commission and for the co-operative spirit in which they worked, which had contributed so much to the success of the Commission during the previous four years. He also warmly thanked the staff of the WMO Secretariat for their assistance and support throughout the intersessional period and during the tenth session of the Commission and extended his thanks to the Unesco support staff for their contributions to a very successful session. Finally, Mr Gérard conveyed greetings from Mr A. Lebeau, Director of the national Meteorological Service of France and Permanent Representative of France with WMO, who was unfortunately unable to be present at the closing ceremony. He then wished the Commission and its incoming officers every success during the next four years and all delegates a safe trip home.

19.3 Speaking on behalf of all delegates to the session, Mr R. J. Shearman expressed his thanks to the president for his excellent guidance and leadership throughout his period of office and for the very effective way in which he had conducted the session. Mr Shearman noted that this period had seen an increase in membership of the Commission, the maintenance of excellent relations with other organizations and the achievement of a very substantial programme of work despite major financial and other difficulties. He welcomed the continuing involvement of Mr Gérard in the work of the Commission through his membership in the Advisory Working Group and he wished Mr Gérard every success in his future career. Other delegates who wished to be associated with these remarks and who also expressed appreciation to the Government of France and to the Secretariat for

an excellent session included Mr R. Landis (USA), Mr M. Moeini Najafabadi (Islamic Republic of Iran), Mr Y. Salahu (Nigeria), Mr Wu Xianwei (China), Ms M.-L. Komulainen (Finland), Mr M. Rebolledo (Argentina), Mr D. Linforth (Australia) and Dr D. O'Neill (Canada).

19.4 On behalf of the Secretary-General of WMO, Professor G.O.P. Obasi, Dr T. Potter expressed his appreciation to the Government and national Meteorological Service of France for having hosted the session in Paris, to the Director-General of Unesco for providing such excellent facilities and support for the session and to the president of CMM and all the delegates for a very co-operative and successful session. Dr Potter also thanked the interpreters and all WMO and Unesco staff for their efforts throughout the session. Finally, Dr Potter thanked the president and delegates for their kind words to the Secretariat and wished the Commission a productive and successful intersessional period.

19.5 The tenth session of the Commission for Marine Meteorology closed at 10.45 a.m. on 17 February 1989.

RESOLUTIONS ADOPTED BY THE SESSION

Res. 1 (CMM-X) - ADVISORY WORKING GROUP OF CMM

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

- (1) Resolution 1 (CMM-IX) - Advisory Working Group of CMM,
- (2) Resolution 14 (Cg-X) - Marine meteorology and associated oceanographic activities for the period 1988-1991,
- (3) Resolution 25 (Cg-X) - Second WMO Long-term Plan,

CONSIDERING:

- (1) The need of the Commission to promote marine meteorological and related oceanographic programmes and activities,
- (2) The contributions of the Commission to the WWW and the WCP,
- (3) The need to co-ordinate the work of CMM with that of IOC and other appropriate international organizations and their subsidiary bodies,
- (4) The need for continued overall co-ordination of the work programme of the Commission and for advice on matters referred to it by the Executive Council or Congress,

DECIDES:

- (1) To establish an Advisory Working Group with the following terms of reference:
  - (a) To advise the president in the short- and long-term planning of the future work of the Commission, including preparation of the relevant section of the Third WMO Long-term Plan;
  - (b) To advise on the methods of carrying out projects and activities referred to CMM for action by WWW, WCP, IGOSS and other programmes;
  - (c) To assist the president in the co-ordination of activities of working groups and rapporteurs of CMM;
  - (d) To advise the president on matters requiring co-ordination with IOC and other international organizations;
  - (e) To monitor the implementation of the Marine Meteorology and Associated Oceanographic Activities Programme within the Second WMO Long-term Plan, with particular reference to the development and implementation of marine meteorological services,

(2) That the Advisory Working Group will be composed of:

- The president of CMM;
- The vice-president of CMM;
- The chairman of the CMM Working Group on Basic Marine Meteorological Services;
- The chairman of the CMM Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services;
- The chairman of the CMM Working Group on Sea Ice;
- The chairman of the CMM Working Group on Technical Problems;
- The past president of CMM;
- Mr A. Morán (Uruguay).

Res. 2 (CMM-X) - WORKING GROUP ON BASIC MARINE METEOROLOGICAL SERVICES

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) Resolution 2 (CMM-IX) - Working Group on Marine Meteorological Services,

(2) Resolution 14 (Cg-X) - Marine meteorology and associated oceanographic activities for the period 1988-1991,

(3) Second WMO Long-term Plan, Part II, Volume 4 - The WMO Applications of Meteorology Programme (WMO-No. 694),

(4) The report of the sixth session of the Advisory Working Group of CMM,

(5) The report of the chairman of the Working Group on Marine Meteorological Services to CMM-X,

(6) Recommendation 2 (CMM-X) - Meteorological support for marine pollution emergency operations,

(7) Recommendation 3 (CMM-X) - Areas of responsibility for the issue of weather and sea bulletins,

CONSIDERING:

(1) The continuing user demand for meteorological services and information, the increasing need for marine meteorological forecasts and warnings and the expected major changes in telecommunications technology used in coastal and ocean areas, particularly the use of NAVTEX, INMARSAT and HF maritime safety information services as components of the Global Maritime Distress and Safety System,

(2) The need to keep under review the requirements of Members for guidance and assistance in the implementation of their obligations as specified in the Manual on Marine Meteorological Services (WMO-NO. 558),

(3) The need to co-ordinate closely with IMO, ITU, IHO and marine user groups with regard to meeting new telecommunication regulations,

(4) The need to improve marine observing, data collection and processing systems in support of other major programmes such as WWW and WCP,

(5) The need for improved education and training in the field of marine meteorology and physical oceanography.

DECIDES:

(1) To establish a Working Group on Basic Marine Meteorological Services with the following terms of reference:

(a) To keep under review marine user requirements and to make recommendations for relevant marine meteorological services including possible amendments to the Manual on and Guide to Marine Meteorological Services (WMO-No. 471);

(b) To develop a proposal for the provision of marine meteorological services within the framework of the 1988 amendments to the 1974 SOLAS convention, in co-ordination with IMO, ITU, IHO and INMARSAT;

(c) To keep under review the contents of the Guide to Marine Meteorological Services, particularly with respect to the need for further guidance material;

(d) To provide advice on the implementation and development of marine meteorological services, in compliance with the requirements of the Manual on Marine Meteorological Services;

(e) To co-ordinate with other bodies involved in marine observations and forecast services, including the appropriate working groups of CBS, with regard to monitoring the flow and quality of marine meteorological and oceanographic data;

(f) To develop a proposal for a co-ordinated global system for meteorological support for marine pollution emergency operations;

(g) To provide advice and guidance on requirements for specialized education and training in the field of marine meteorology and physical oceanography;

(h) To take action on matters referred to the working group by the president of CMM;

(2) That the working group will include:

(a) A sub-group of experts on warning and forecast preparations;

(b) A sub-group of experts on marine observations and telecommunications;

(c) A sub-group of regional rapporteurs on education and training;

(d) A rapporteur on the Integrated Global Ocean Services System;

(3) That the working group will be essentially open, with a composition as follows:

(a) Experts to be appointed by the president of CMM;

(b) Regional rapporteurs appointed by regional associations;

(c) Experts nominated by Members of WMO;

(4) To elect, in accordance with Regulation 31 of the General Regulations, Mr R. Landis (USA) as chairman of the working group; Dr D. O'Neill (Canada) as chairman of the sub-group on warning and forecast preparation; Capt. G. Mackie (UK) as chairman of the sub-group on marine observations and telecommunications; Mr S. Ragoonaden (Mauritius) as chairman of the sub-group of regional rapporteurs on education and training; and Mr R. Keeley (Canada) as the rapporteur on the Integrated Global Ocean Services System;

REQUESTS the Secretary-General to invite IMO, IHO, ITU, IOC, ICS, IFSMA and INMARSAT to participate in the work of the group.

Res. 3 (CMM-X) - WORKING GROUP ON SPECIALIZED MARINE METEOROLOGICAL SERVICES, INCLUDING MARINE CLIMATOLOGICAL SERVICES

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) Resolution 5 (CMM-IX) - Working Group on Marine Climatology,

(2) The Second WMO Long-term Plan, Part II, Volume 4 - Applications of Meteorology Programme (WMO-No. 694),

(3) The report of the president of the Commission for Marine Meteorology to CMM-X,

(4) The report by the chairman of the Working Group on Marine Climatology to CMM-X,

CONSIDERING:

(1) That the projects and corresponding tasks of CMM for the intersessional period in the field of specialized marine meteorological services will require action by a working group,

(2) That the Marine Climatological Summaries Scheme requires continued development and co-ordination among the Members responsible for specific ocean areas,

(3) That the World Climate Programme and other climate-related activities of WMO require continuing support in the area of marine climatology,

(4) That there is a developing requirement to assist Members, through the provision of specialized guidance material and in other ways, in the development and implementation of specialized marine meteorological services in support of the requirements of specific user groups,

DECIDES:

(1) To establish a Working Group on Specialized Marine Meteorological Services, including Marine Climatological Services with the following terms of reference:

- (a) To keep under review the requirements of users for specialized marine meteorological services, including services for fisheries, weather routing of ships, marine pollution, etc.;
- (b) To develop guidance material and provide assistance to Members, as required, in the implementation and strengthening of specialized marine meteorological services;
- (c) To co-ordinate marine climatological requirements with the World Climate Programme (WCP), with particular emphasis on the World Climate Data Programme (WCDP) and the World Climate Research Programme (WCRP);
- (d) To consider the provision of long time series of ocean data in support of WCRP projects and input of marine climate data and applications software to WCDP;
- (e) To provide technical advice on the exchange and archiving of marine climatological data and to develop a standard set of quality-control procedures for use by responsible Members;
- (f) To keep under review material in WMO regulations, manuals and guides relevant to marine climatology and specialized marine meteorological services;
- (g) To advise on methods of archiving and exchange for operationally and scientifically useful marine climate data from all observing systems (e.g. remote-sensing and numerical analysis activities as well as ships' reports);
- (h) To finalize preparation for publication of a Guide to Applications of Marine Climatology;
- (i) To investigate problems and advances in the following areas of interest:
  - (i) The use of microcomputers and their software for marine climate work, particularly in information storage and exchange;
  - (ii) The exchange and archiving of data from El Niño-related experiments such as TOGA and EPOCS and the preparation of a special El Niño data set for use in research projects;



- (j) To take action on requests referred to the working group by the president of CMM;
- (k) To co-ordinate with the Commission for Climatology (CCl), as required;

(2) That the working group will include a sub-group on marine climatology and will be composed of:

- (a) An expert designated by each Member responsible for an ocean area under the Marine Climatological Summaries Scheme;
- (b) Experts nominated by other Members wishing to participate actively in the work of the group;
- (c) An expert designated by the president of CCl;

(3) To elect, in accordance with Regulation 31 of the General Regulations, Mr D. Linforth (Australia) as chairman of the working group and Dr L. Kanfeld (FRG) as chairman of the sub-group on marine climatology;

REQUESTS the Secretary-General to invite IOC and other international organizations and programmes concerned to participate in the work of the working group.

Res. 4 (CMM-X) - WORKING GROUP ON SEA ICE

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

- (1) Resolution 6 (CMM-IX) - Working Group on Sea Ice,
- (2) The report of the chairman of the Working Group on Sea Ice to CMM-X,
- (3) The Second WMO Long-term Plan, Part II, Volume 4 - Applications of Meteorology Programme (WMO-No. 694),
- (4) Recommendation 7 (CMM-IX) - Global sea-ice data bank,
- (5) Recommendation 9 (CMM-X) - Handbook on sea-ice navigation in the Southern Ocean,
- (6) Recommendation 10 (CMM-X) - Handbook on the analysis and forecasting of sea ice,

CONSIDERING:

(1) That there is a continuing need for a Working Group on Sea Ice to carry out relevant tasks and projects included in the work programme of the Commission,

(2) That this working group is to be considered as a nucleus of sea-ice experts which will draw on other expertise as necessary,

(3) That the WCP requires continued support in the field of sea ice,

DECIDES:

(1) To re-establish a Working Group on Sea Ice with the following terms of reference:

- (a) To review and promote international co-operation in improving the methodology for the acquisition, exchange, processing, storage, presentation and dissemination of sea-ice information for operational as well as climatic purposes. The work should include:
  - (i) Studies of the requirements for sea-ice information associated with marine meteorological services and the objectives of WCP and other WMO programmes and projects, as well as the development of recommendations in accordance with identified needs;
  - (ii) Preparations for and implementation of new methods in the observation of sea ice, with special emphasis on remote-sensing techniques in the light of the new microwave satellites planned for the early 1990s;
  - (iii) Review of the means of information exchange (including nomenclature, codes and symbols) and the provision of support in accordance with the interests of marine users, SCAR, the Executive Council Working Group on Antarctic Meteorology, the WCP and other WMO and joint WMO/IOC programmes as well as the programmes of IMO;
  - (iv) Arranging for a seminar on remote sensing of sea ice in co-operation with the Secretariat and an appointed rapporteur. If appropriate, the seminar should include related ice forecasting and modelling techniques;
- (b) To review and promote intercomparisons of sea-ice data from in situ and various remote-sensing sources with a view to establishing a recommended validation scheme for remotely sensed sea-ice data, and to update specifications which are useful for the remote sensing of sea-ice data;
- (c) To assist in the preparation of:
  - (i) A handbook on the analysis and forecasting of sea ice;
  - (ii) A handbook on sea-ice navigation in the Southern Ocean;
- (d) To continue work towards the establishment of a global, computer-compatible sea-ice data bank, to ultimately include sea-ice data covering a 30-year period but with first priority being given to the period 1979-1988;

- (e) To consider any other matters referred to the group by the president of CMM;
- (2) To elect, in accordance with Regulation 31 of the General Regulations, Dr I. Frolov (USSR) as chairman of the Working Group on Sea Ice;
- (3) To invite the following experts to serve on the working group:
  - An expert from
  - Argentina
  - Canada
  - Denmark
  - Japan
  - Sweden
  - USA.

Res. 5 (CMM-X) - WORKING GROUP ON TECHNICAL PROBLEMS

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

- (1) Resolution 3 (CMM-IX) - Working Group on Technical Problems,
- (2) The report of the president of CMM to CMM-X,
- (3) The report of the chairman of the Working Group on Technical Problems to CMM-X,
- (4) The Second WMO Long-term Plan, Part II, Volume 4 - Applications of Meteorology Programme (WMO No. 694),
- (5) The final report of the fifth session of the Joint IOC/WMO Working Committee for IGOSS,

CONSIDERING:

- (1) That the coming decade will see the implementation of operational ocean observation satellites and other remote-sensing devices and that:
  - (a) Data from these remote-sensing devices will be of great value to the Marine Meteorology and Associated Oceanographic Activities Programme,
  - (b) Use of these data will have important consequences for the organization and operation of marine meteorological services,
  - (c) It is important to make known the data requirements of marine meteorological services to the operators of remote-sensing devices,
- (2) That the continued implementation of the WMO Wave Programme requires constant attention,

(3) That there remain many other technical problems which require further study in order to continue improvements in the Marine Meteorology and Associated Oceanographic Activities Programme of WMO,

DECIDES:

(1) To re-establish the Working Group on Technical Problems with the following terms of reference:

- (a) To prepare annually a report on the development of the main remote-sensing programmes relevant to marine meteorology and physical oceanography;
- (b) To analyse the requirements of marine meteorology and physical oceanography for remote-sensing data;
- (c) To prepare recommendations to meteorological and oceanographic analysis centres relating to satellite data analysis and user requirements for such data;
- (d) To prepare proposals for satellite-operating agencies relating to procedures for the exchange of satellite data of value to marine meteorological services, in co-ordination with the other working groups of CMM;
- (e) To monitor and report on the application of ground-based HF and microwave radars to the provision of marine meteorological services;
- (f) To monitor the state-of-the-art in operational wave modelling, both on a global and regional application basis, and to provide guidance and assistance to Members, as appropriate, in the implementation of wave models and the provision of wave-related services;
- (g) To assess specific requirements for the modelling of the boundary-layer wind field in order to comply with the modelled wave-generation mechanism;
- (h) To assess the application of observed data in conjunction with real-time forecasting;
- (i) To monitor the progress in assimilation of remotely sensed wave data, in particular with regard to satellites launched in the early 1990s;
- (j) To monitor recent studies within wave and marine wind climatology, such as hindcast studies for particular sea areas;
- (k) To compile the above information into guidance material supplementing the WMO Guide to Wave Analysis and Forecasting (WMO-No. 702), as well as other relevant MMS guides;
- (l) To review and revise as appropriate the WMO Guide to Wave Analysis and Forecasting;

- (m) To undertake specific studies or prepare specific reports in the following areas:
- (i) Monitoring the development of coupled atmosphere/ocean models;
  - (ii) Joint applications of atmospheric, wave and ocean modelling for the purpose of integrated marine environmental monitoring, including the transport of pollutants and the physical conditions for marine ecology;
  - (iii) Recent developments in in situ marine meteorological observation techniques, including for wind profiling and sea-surface variables;
  - (iv) User requirements for ocean surface data, including experience with the WAVEOB code;
  - (v) Moored ocean data buoys and other ODAS;
- (n) To undertake other studies as may be referred to it by the president of CMM;

(2) That the working group will be composed as follows:

(a) An ad hoc group on ocean satellites and remote sensing to include:

- (i) A chairman designated by the president of CMM;
- (ii) Two experts designated by the president of CMM;
- (iii) Two experts designated by the chairman of the Joint IOC/WMO Working Committee for IGOS;
- (iv) Two experts designated by the president of the EC Working Group on Satellites;

(b) An ad hoc group on wave modelling, to include a chairman and five experts designated by the president of CMM;

(c) Rapporteurs as follows:

- Dr S. Lappo (USSR) on coupled atmosphere/ocean models
- An expert on integrated marine environmental modelling applications
- An expert on in situ marine observation techniques
- An expert on user requirements
- Dr G. Hamilton (USA) on moored buoys and other ODAS;

(3) To select, in accordance with Regulation 31 of the General Regulations, Mr J. Guddal (Norway) as chairman of the working group, and Dr A. Laing (New Zealand) as chairman of the ad hoc group on wave modelling.

Res. 6 (CMM-X) - REVIEW OF THE RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION FOR MARINE METEOROLOGY

THE COMMISSION FOR MARINE METEOROLOGY,

CONSIDERING that all resolutions adopted prior to its tenth session are now obsolete,

CONSIDERING that all recommendations adopted prior to its tenth session and still in force have been reconsidered,

NOTING the action taken on the recommendations adopted prior to its tenth session,

DECIDES:

- (1) Not to keep in force Resolutions 1-8 (CMM-IX);
- (2) To keep in force Recommendations 1 and 2 (CMM-VIII), and 2, 3 and 4 (CMM-IX);
- (3) To keep in force with a small modification Recommendation 7 (CMM-IX), with the deletion of point 4 of the annex to this recommendation;
- (4) To publish in the final report of the tenth session the texts of the recommendations which are kept in force.

RECOMMENDATIONS ADOPTED BY THE SESSION

Rec. 1 (CMM-X) - SUGGESTED FORMAT FOR WEATHER FORECASTS FOR OFFSHORE PLATFORMS

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) The abridged final report of CMM-IX, paragraph 5.6 of the general summary,

(2) The final report of the fourth session of the Working Group on Marine Meteorological Services, paragraphs 5.2 and 5.3 of the general summary,

CONSIDERING:

(1) That the Guide to Marine Meteorological Services (WMO-No. 471) offers basic guidance material to Members in the provision of all types of marine meteorological services;

(2) That the demand for marine meteorological services specifically tailored to the operational requirements of offshore oil and gas platforms and similar users was expanding worldwide;

(3) That the experience already gained in the provision of those services in areas such as the North Sea would be of benefit to many other national Meteorological Services,

RECOMMENDS:

(1) That a suggested standard format for weather forecasts for offshore platforms be included as an annex to the Guide to Marine Meteorological Services;

(2) That to effect this, the amendments given in the annex to this recommendation be included in the Guide to Marine Meteorological Services.

Annex to Recommendation 1 (CMM-X)

AMENDMENTS TO PUBLICATION NO. 471 - GUIDE TO MARINE METEOROLOGICAL SERVICES

- A. Guide to Marine Meteorological Services, Part I, Chapter 4, section 4.3.1

Replace the sentence "An example of such a bulletin is given in Annex I-4.J to this Chapter." with the sentence "A suggested format for such a bulletin (for guidance only) is given in Annex I-4.J to this Chapter."

B. Guide to Marine Meteorological Services, Part I, Chapter 4

Replace existing Annex I-4.J with the following:

SUGGESTED STANDARD FORMAT FOR WEATHER FORECASTS - OFFSHORE PLATFORMS

0. Source, date, destination (rig name or number)
1. Synoptic situation (including explicit mention of warnings)
  - 2.1 Forecast for selected times up to h+12 hours
    - 2.1.1 Wind direction
    - 2.1.2 Wind speed and maximum wind gust at 10 m (knots or m/s)
    - 2.1.3 Wind speed and maximum wind gust at requested level (knots or m/s) (usually 50 m)
    - 2.1.4 Sea wave mean period (in s)  
Sea wave maximum height (in m or ft)\*  
Sea wave extreme height during storm periods (in m or ft)\*\*
    - 2.1.5 Swell direction (in compass-points) if angle between sea and swell is at least 30 degrees or if swell period differs significantly from sea wave period  
  
Swell significant wave height (in m or ft)  
  
Swell mean period (in s)
    - 2.1.6 Combined significant wave height/combined maximum wave height
    - 2.1.7 Weather elements (fog, thunderstorm, rain, etc.)
    - 2.1.8 Cloud amount
    - 2.1.9 Visibility to be divided into 10 km and above, or below 10 km (or equivalent in n.mi.). In the latter case the visibility range to be specified as much as possible
    - 2.1.10 Air temperature in degrees Celsius (on request)  
Sea-surface temperature in degrees Celsius (on request)

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\* The maximum wave height is defined as the probable height of the highest wave height within a period of 20 minutes.

\*\* The extreme wave height is defined as the probable height of the highest wave height within a period of 3 hours.



- 2.1.11 Icing risk (on request)
  
- 2.2 Forecast (h+12) +12 hours

  - 2.2.1 2.1.1 to 2.1.11 will be given  
to
  - 2.2.11

  
- 2.3 Forecast (h+24) +24 hours

  - 2.3.1 2.1.1 to 2.1.7 plus 2.1.11 will be given,  
to thus no cloud amount, visibility, temperature
  - 2.3.8

  
- 2.4 Outlook (h+48) +24 hours (+24 hours +24 hours) in general  
terms

Rec. 2 (CMM-X) - METEOROLOGICAL SUPPORT FOR MARINE POLLUTION EMERGENCY OPERATIONS

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) The Second WMO Long-term Plan, Part II, Volume 4 - Applications of Meteorology Programme (WMO-No. 694),

(2) The abridged report of EC-XL, paragraph 6.3.2 of the general summary,

(3) The final report of the twenty-sixth session of the IMO Marine Environment Protection Committee, section 13,

(4) The UNEP system of Regional Oil Combatting Centres established under the UNEP Regional Seas Programme,

(5) The regional marine pollution combatting centres established with the support of IMO,

(6) The marine pollution research and monitoring programmes of IOC being implemented in co-operation with UNEP,

CONSIDERING that operations at sea in response to marine pollution emergencies are fundamentally dependent on the support of meteorological services,

BEARING IN MIND that many national Meteorological Services already provide meteorological support for such emergency operations, at least for waters under national jurisdiction,

## CONSIDERING FURTHER:

(1) That marine pollution emergency events on the high seas are essentially international in character,

(2) That no co-ordinated system currently exists for meteorological input to operations in response to such events,

(3) That considerable benefits would accrue to all coastal States through the establishment of such a co-ordinated system for meteorological input,

## RECOMMENDS:

(1) That an international system of marine meteorological centres be established, designed to co-ordinate and implement required meteorological support for marine pollution emergency operations on the high seas;

(2) That this system take into account the existing or revised WMO system of high seas forecast and warning centres;

(3) That consideration be given to designating appropriate centres for marine pollution emergency support;

(4) That this system be developed in close co-ordination with both IMO and UNEP, as well as with the WMO regional associations;

## REQUESTS:

(1) The Working Group on Basic Marine Meteorological Services to undertake, as a matter of urgency, a study leading to a detailed proposal for such an international system for presentation to the Executive Council for approval;

(2) The Secretary-General to provide, as resources permit, appropriate support in the conduct of this study.

Rec. 3 (CMM-X) - AREAS OF RESPONSIBILITY FOR THE ISSUE OF WEATHER AND SEA BULLETINS

## THE COMMISSION FOR MARINE METEOROLOGY,

NOTING the Manual on Marine Meteorological Services (WMO-No. 558), Volume I, Part II, Appendix II.I - Ocean and sea areas of responsibility for the issue of weather and sea bulletins,

## FURTHER NOTING:

(1) The entry into force on 1 February 1992 of the 1988 amendments to the 1974 International Convention for the Safety of Life at Sea (SOLAS), to introduce the IMO Global Maritime Distress and Safety System (GMDSS),

(2) The demonstrated capability of the INMARSAT Enhanced Group Call (EGC) SafetyNET system to ensure receipt by shipping in designated ocean areas of broadcast maritime safety information (MSI),

(3) The requirements of the revised Chapter IV of the 1974 SOLAS convention for the carriage by ships sailing in sea areas outside NAVTEX coverage of communication equipment capable of receiving INMARSAT EGC SafetyNET broadcasts,

(4) The World Wide Navigational Warning Service (WWNWS) NAVAREAs defined by IMO Assembly Resolution A419 (XI) and co-ordinated by IHO,

(5) The resolution on the global co-ordination of MSI services expressed by the World Administrative Radio Conference for the Mobile Services 1987,

CONSIDERING:

(1) The responsibilities of Members which are contracting governments to the SOLAS convention to provide meteorological forecast and warning services in support of the safety of life and property at sea,

(2) The need to revise the existing areas of responsibility for the issue of weather and sea bulletins in the light of recent developments in marine telecommunications capabilities and requirements,

(3) The need to ensure global ocean coverage for marine meteorological services,

(4) The potential advantages in co-ordinating WMO areas of responsibility with the WWNWS NAVAREAs,

BEARING IN MIND:

(1) The national requirements and capabilities of Members for the provision of marine meteorological services to shipping,

(2) The need to minimize costs to Members in the provision of marine meteorological services to shipping,

RECOMMENDS:

(1) That a study be undertaken by the CMM Working Group on Basic Marine Meteorological Services leading to a rationalization of the WMO areas of responsibility for the issue of weather and sea bulletins;

(2) That the criteria for and other factors to be considered in this study should be as detailed in the annex to this recommendation;

(3) That the study should be completed by the end of 1990 for subsequent circulation to Members for their consideration and comment prior to further action by the Commission;

(4) That the end product of the study should be a draft revision to relevant parts of the Manual on Marine Meteorological Services (WMO-No. 558);

(5) That the study must also cover relevant aspects of the requirements for global co-ordination of MSI services;

(6) That IMO, IHO, ITU and INMARSAT be invited to participate in this study;

INVITES:

(1) Members to participate actively in this study through their representatives on the Working Group on Basic Marine Meteorological Services;

(2) Regional associations to participate actively in this study through their nominated representatives to the Working Group on Basic Marine Meteorological Services;

(3) The president of CBS to nominate representatives from the CBS Working Groups on the Global Telecommunication System and the Global Data-processing System to participate in the study;

REQUESTS the Secretary-General to arrange for appropriate support to ensure the completion of this study by the recommended date.

Annex to Recommendation 3 (CMM-X)

STUDY ON WMO AREAS OF RESPONSIBILITY FOR THE PROVISION OF  
HIGH SEAS FORECASTS AND WARNINGS

Criteria for study

1. The basic criterion is that broadcasts to these areas will generally be made through the INMARSAT Enhanced Group Call (EGC) SafetyNET system.

2. Other criteria to be used:

- Global ocean coverage;
- Better co-ordination and possible reduction of designated areas of responsibility;
- Co-ordination where possible with IHO NAVAREAs;
- Ease of access to INMARSAT Coast Earth Stations (CES) by designated Members;
- Willingness and capabilities of Members to accept responsibilities;
- Co-ordination with the INMARSAT EGC SafetyNet system satellite coverage.

Other factors

1. Means of access to CES: Where the responsible national Meteorological Service and the CES are located in the same country, access will be at national discretion but would normally be by landline (telex). Payment for such access would also be at national discretion. Where international transfer is necessary, this may be effected over the GTS

or by INMARSAT Standard-C ship-Earth stations. In the case of the GTS, the procedures to accommodate INMARSAT requirements which were proposed by the national Meteorological Service of France and endorsed by the CMM Working Group on Marine Meteorological Services and the CBS Working Group on the GTS should be employed. Final landline charges should be for agreement between the Members concerned. Costs of transfer from CES to network co-ordination station, as required, should be borne by INMARSAT;

2. Language: Plain language broadcasts should be in English and, if required, also in the national language, as recommended in the Manual on Marine Meteorological Services and also by IMO;
3. Broadcast schedules: Meteorological forecasts may continue to be broadcast at scheduled times as at present. Warnings may be broadcast on receipt and at regularly scheduled times after that (e.g. every three hours). Warning cancellation and updating procedures should be considered. If possible, meteorological warnings should be co-ordinated with navigational warnings. The need for message repeats, in the light of EGC capabilities to ensure receipt, should be addressed, including the question of who pays for them;
4. Monitoring: Any requirement for monitoring by national Meteorological Services of message receipt should be considered.

Rec. 4 (CMM-X) - DRIFTING BUOYS IN SUPPORT OF MARINE METEOROLOGICAL OPERATIONS AND RESEARCH

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

- (1) Resolution 10 (EC-XXXVII) - Drifting Buoy Co-operation Panel,
- (2) The Second WMO Long-term Plan, Part II, Volume 1 - The World Weather Watch Programme (WMO-No. 691),
- (3) The Second WMO Long-term Plan, Part II, Volume 4 - The Applications of Meteorology Programme (WMO-No. 694),
- (4) The TOGA International Implementation Plan,
- (5) The WOCE Implementation Plan, WMO/TD No. 242 and No. 243,
- (6) Recommendation 2 (JWC-IGOSS-V) - Real-time distribution and archiving of oceanographic data,

FURTHER NOTING:

- (1) That the drifting buoys planned for deployment under the WOCE programme will in general carry neither atmospheric pressure nor air temperature sensors,
- (2) That the majority of drifting buoy deployments now taking place or planned over the next five years are funded through research programmes and

that these deployments are therefore likely to cease with the termination of the research programmes,

**CONSIDERING:**

(1) That drifting buoys represent a very cost-effective means for acquiring surface meteorological and oceanographic data from remote ocean areas,

(2) The stated requirements for operational drifting buoy data in support of the WWW, marine meteorological services and climate analysis and forecasting,

**RECOMMENDS:**

(1) That agencies, institutions and organizations involved in the acquisition and deployment of drifting buoys in support of WOCE be urged to equip these buoys with at least atmospheric pressure and air temperature sensors so as to enhance their potential value to a wide variety of WMO programmes;

(2) That the WOCE community also be urged to make the data from their drifting buoys available for real-time distribution over the GTS and for later permanent archival;

(3) That Members and the Drifting Buoy Co-operation Panel begin to consider ways in which the funding of drifting buoy deployments on a long-term, operational basis may be continued following the termination of the TOGA and WOCE projects;

**REQUESTS** The Secretary-General and the Drifting Buoy Co-operation Panel to bring this recommendation to the attention of Members and others concerned and to assist whenever possible in the implementation of the recommendation.

Rec. 5 (CMM-X) - THE APPLICATION OF REMOTELY SENSED MARINE DATA TO MARINE METEOROLOGICAL AND OCEANOGRAPHIC SERVICES

**THE COMMISSION FOR MARINE METEOROLOGY,**

**NOTING:**

(1) Recommendation 1 (CMM-IX) - Intercalibration of surface-based and remotely sensed marine data,

(2) "Field workshop on intercalibration of conventional and remotely sensed sea-surface temperature data", Marine Meteorology and Related Oceanographic Activities Report No. 16,

(3) The abridged final report with resolutions of EC-XL; general summary, paragraph 6.3.6,

(4) The Second WMO Long-term Plan, Part II, Volume 1 - World Weather Watch Programme (WMO-No. 691) and Volume 4 - Applications of Meteorology Programme (WMO-No. 694),

(5) The draft IGOSS plan and implementation programme 1989-1995,

(6) The final report of the fifth session of the Joint IOC/WMO Working Committee for IGOSS,

FURTHER NOTING that a number of ocean remote-sensing systems, both satellite and ground based, are likely to be operationally available within the next ten years,

CONSIDERING:

(1) That marine meteorological and surface oceanographic data from remote-sensing systems are of great potential benefit to Members for both operational and research purposes,

(2) That procedures need to be developed to facilitate the timely availability of such data on time and space scales and in formats relevant to the Members' requirements,

(3) That intercomparison of marine data obtained by conventional and remote-sensing systems should be expanded with the development of procedures to enable a coherent use of combined data for operational and research purposes,

RECOMMENDS:

(1) That studies and workshops on remotely sensed measurements of ocean variables using satellite, air and ground-based systems be continued and expanded and that these include in particular:

(a) The intercalibration of remotely sensed data with conventional ocean data;

(b) The development of procedures to facilitate the availability of remotely sensed data for operational and research purposes;

(c) Consideration of means to effect the appropriate transfer of technology to enable all Members to benefit fully from the new systems;

(2) That these studies be undertaken with the active collaboration of CIMO, CBS, the Executive Council Panel of Experts on Satellites, the Joint IOC/WMO Working Committee for IGOSS, IOC and the satellite-operating agencies, as appropriate;

INVITES Members to participate actively in these studies and workshops;

REQUESTS the Secretary-General, in consultation with the president of CMM, to arrange for or facilitate the conduct of such studies and workshops as resources permit.

Note: This recommendation replaces Recommendation 1 (CMM-IX) which is no longer in force.

Rec. 6 (CMM-X) - THE WMO VOLUNTARY OBSERVING SHIPS (VOS) SCHEME

## THE COMMISSION FOR MARINE METEOROLOGY,

## NOTING:

(1) The Second WMO Long-term Plan, Part II, Volume 1 - World Weather Watch Programme (WMO-No. 691) and Volume 4 - Applications of Meteorology Programme (WMO-No. 694),

(2) The First Implementation Plan for the World Climate Research Programme (WMO/TD-No. 80),

(3) The Ocean Observing Systems Development Programme, IOC Technical Series No. 27,

(4) The final report of the Implementation Co-ordination Meeting for the OOSDP Pilot Study on a High-quality VOS Subset, De Bilt, September 1987,

(5) The reports of the chairmen of the CMM Working Groups on Marine Meteorological Services, Marine Climatology and Technical Problems to CMM-X,

## CONSIDERING:

(1) That reports from the VOS will remain an important source of surface meteorological and oceanographic data from all ocean areas for operational, research and climatological purposes for the foreseeable future,

(2) That improvements in the quality, quantity and timeliness of such reports need to be made if the full requirements of WMO programmes for these data are to be met,

## EXPRESSES ITS APPRECIATION:

(1) To all Members already operating VOS, port meteorological officers (PMOs), coastal radio stations, INMARSAT Coast Earth Stations and SEAS/MOSS systems for the collection of ships' weather reports,

(2) Specifically to those Members, their PMOs and the ships' crews involved in the VOS Special Observing Project-North Atlantic (VSOP-NA),

## RECOMMENDS to Members:

(1) To enhance the recruitment of VOS specifically in known data-sparse regions;

(2) To apply the results of the VSOP-NA, when available, to improve the quality of VOS reports;

(3) Whenever possible, to increase automation in the collection and transmission of VOS reports;

(4) To adhere to procedures given in the Manual on the GTS (WMO-No. 386) for the transmission of ships' weather reports over the GTS so as to minimize data loss;



(5) To strongly encourage both ships and coastal radio stations to transmit ships' weather reports in real time for insertion onto the GTS;

(6) To undertake monitoring exercises for ships' weather reports on the GTS and to participate in the monitoring projects now being undertaken within the WWV, as recommended by CBS-IX;

REQUESTS the Secretary-General, the president and vice-president of the Commission and the chairmen of the relevant working groups to assist Members as much as possible in the implementation of these recommendations.

Rec. 7 (CMM-X) - MINIMUM QUALITY-CONTROL STANDARDS FOR MARINE CLIMATOLOGICAL DATA

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) The Manual on Marine Meteorological Services (WMO-No. 558), Part II, Section 5 - Marine Climatological Summaries Scheme (MCSS),

(2) The abridged final report of CMM-IX, general summary, paragraph 7.3.3,

(3) The final report of the fifth session of the CMM Working Group on Marine Climatology, Geneva, November 1986,

CONSIDERING:

(1) That the quality-control and correction procedures presently applied to marine climatological data by various contributing Members are far from uniform,

(2) That it is highly desirable that quality control applied by contributing Members should reach a minimum acceptable standard,

RECOMMENDS:

(1) That the set of minimum quality-control standards given in the annex to this recommendation should be applied by all Members contributing data to the MCSS;

(2) That this set of quality-control standards should be included as an annex to Part II, Section 5 of the Manual on Marine Meteorological Services.

## Annex to Recommendation 7 (CMM-X)

MINIMUM QUALITY CONTROL STANDARDS

Note: See specification for quality-control indicators  $Q_1$  to  $Q_{18}$  at the end of this annex  
 $\Delta$  = space (ASCCI 32)

Element	Error	Action
1	$i_r \neq 0-5$	Correct manually
2	AA $\neq$ valid year	Correct manually, otherwise reject
3	MM $\neq$ 01-12	Correct manually, otherwise reject
4	YY $\neq$ valid day of month	Correct manually, otherwise reject
5	GG $\neq$ 00-23	Correct manually, otherwise reject
6	$i_w \neq 0,1,3,4$	Correct manually, otherwise $Q_5=4$
7	Q $\neq 0-3,5-8$	Correct manually, otherwise reject
8	$L_a L_a L_a \neq 000-900$	Correct manually, otherwise reject
9	$L_o L_o L_o \neq 000-800, 900-999$ when Q = 1,2,6,7 $\neq 000-900$ when Q = 0,3,5,8	Correct manually, otherwise reject
<u>Time sequence checks</u>		
	Change in latitude $> 0.7^\circ/\text{hr}$	Correct manually, otherwise reject
	Change in longitude $> 0.7^\circ/\text{hr}$ when lat 00-39.9	Correct manually, otherwise reject
	Change in longitude $> 1.0^\circ/\text{hr}$ when lat 40-49.9	Correct manually, otherwise reject
	Change in longitude $> 1.4^\circ/\text{hr}$ when lat 50-59.9	Correct manually, otherwise reject
	Change in longitude $> 2.0^\circ/\text{hr}$ when lat 60-69.9	Correct manually, otherwise reject
	Change in longitude $> 2.7^\circ/\text{hr}$ when lat 70-79.9	Correct manually, otherwise reject
10		No checking
11	$h \neq 0-9, \Delta$  $h = \Delta$	Correct manually and $Q_1=5$ , otherwise $Q_1=4$ $Q_1=9$

Element	Error	Action
12	VV $\neq$ 90-99, $\Delta\Delta$ VV = $\Delta\Delta$	Correct manually and $Q_2=5$ , otherwise $Q_2=4$ $Q_2=9$
13	N $\neq$ 0-9, $\Delta, /$ N < $N_h$	Correct manually and $Q_3=5$ , otherwise $Q_3=4$ Correct manually and $Q_3=5$ , otherwise $Q_3=2$
14	dd $\neq$ 00-36,99, $\Delta\Delta$ dd = $\Delta\Delta$	Correct manually and $Q_4=5$ , otherwise $Q_4=4$ $Q_4=9$
	<u>dd versus ff</u> dd = 00, ff $\neq$ 00 dd $\neq$ 00, ff = 00	Correct manually and $Q_4$ or $Q_5=5$ , otherwise $Q_4=Q_5=2$ Correct manually and $Q_4$ or $Q_5=5$ , otherwise $Q_4=Q_5=2$
15	ff > 80 knots	Correct manually and $Q_5=5$ , otherwise $Q_5=3$
16	$s_n \neq 0,1$	Correct manually, otherwise $Q_6=4$
17	TTT = $\Delta$ -25 > TTT > 40	$Q_6=9$ Control manually and $Q_6=1$ , 3 or 4 and if corrected $Q_6=5$
<u>TTT versus humidity parameters</u>		
	TTT < WB [wet bulb] TTT < DP [dew point]	Correct manually and $Q_6=Q_7=5$ , otherwise $Q_6=Q_7=2$ Correct manually and $Q_6=Q_7=5$ , otherwise $Q_6=Q_7=2$
18	$s_n \neq 0,1,5,6,7,9$	Correct manually, otherwise $Q_7=4$
19	WB < = DP WB = DP = $\Delta\Delta$	Correct manually and $Q_7=5$ , otherwise $Q_7=2$ $Q_7=9$
20	930 > PPPP > 1050 hPa 870 > PPPP > 1070 hPa PPPP = $\Delta\Delta\Delta\Delta$	Control manually and $Q_8=1,3$ and if corrected $Q_8=5$ Correct manually and $Q_8=5$ , otherwise $Q_8=4$ $Q_8=9$

Element	Error	Action
21	ww = 22-24, 26, 36-39, 48, 49, 56, 57, 66-79, 83-88, 93, 94 and latitude < 20°	Correct manually and Q <sub>9</sub> =5, otherwise Q <sub>9</sub> =4
22, 23	W <sub>1</sub> = W <sub>2</sub> = 7 and latitude < 20° W <sub>1</sub> < W <sub>2</sub>	Correct manually and Q <sub>9</sub> =5, otherwise Q <sub>9</sub> =4 Correct manually and Q <sub>9</sub> =5, otherwise Q <sub>9</sub> =2
24, 25, 26, 27	N = 0, Δ, 9 and N <sub>h</sub> C <sub>L</sub> C <sub>M</sub> C <sub>H</sub> ≠ Δ	Correct manually and Q <sub>3</sub> =5, otherwise Q <sub>3</sub> =4
28	s <sub>n</sub> ≠ 0, 1	Correct manually, otherwise Q <sub>10</sub> =4
29	T <sub>w</sub> T <sub>w</sub> T <sub>w</sub> = ΔΔΔ -2.0 > T <sub>w</sub> T <sub>w</sub> T <sub>w</sub> > 37.0	Q <sub>10</sub> =9 Control manually and Q <sub>10</sub> =1, 3 or 4 and if corrected Q <sub>10</sub> =5
30	Indicator ≠ 0-7, Δ	Correct manually, make it Δ if not correctable
31	Indicator ≠ 0-9, Δ	Correct manually, make it Δ if not correctable
32	20 < P <sub>w</sub> P <sub>w</sub> < 30 P <sub>w</sub> P <sub>w</sub> > 30 ≠ 99 P <sub>w</sub> P <sub>w</sub> = ΔΔ, //	Q <sub>11</sub> =3 Q <sub>11</sub> =4 Q <sub>11</sub> =9
33	35 < H <sub>w</sub> H <sub>w</sub> < 50 H <sub>w</sub> H <sub>w</sub> = > 50 H <sub>w</sub> H <sub>w</sub> = ΔΔ, //	Q <sub>12</sub> =3 Q <sub>12</sub> =4 Q <sub>12</sub> =9
34	d <sub>w1</sub> d <sub>w1</sub> ≠ 00-36, 99, ΔΔ swell <sub>1</sub> = swell <sub>2</sub> = Δ	Correct manually and Q <sub>13</sub> =5 otherwise Q <sub>13</sub> =4 Q <sub>13</sub> =9
35	25 < P <sub>w1</sub> P <sub>w1</sub> < 30 P <sub>w1</sub> P <sub>w1</sub> > 30 and ≠ 99	Q <sub>13</sub> =3 Q <sub>13</sub> =4
36	35 < H <sub>w1</sub> H <sub>w1</sub> < 50 H <sub>w1</sub> H <sub>w1</sub> = > 50	Q <sub>13</sub> =3 Q <sub>13</sub> =4
37	I <sub>s</sub> ≠ 1-5, Δ	Correct manually, otherwise Δ
38	E <sub>s</sub> E <sub>s</sub> ≠ 00-99, ΔΔ	Correct manually, otherwise ΔΔ
39	R <sub>s</sub> ≠ 0-4, Δ	Correct manually, otherwise Δ
40	Source ≠ 0-6	Correct manually

Element	Error	Action
41	Platform $\neq$ 0-9	Correct manually
42	No call sign	Insert manually
43	No country code	Insert manually
44	Q $\neq$ 0-6,9	Correct manually
45,46		No quality control
47	$i_R \neq 1-4$ $i_R = 4$ and RRR = $\Delta\Delta\Delta,///$ $i_R = 3$ and RRR $\neq \Delta\Delta\Delta$	Correct manually and $Q_{14}=5$ , otherwise $Q_{14}=4$ $Q_{14}=9$ Correct manually and $Q_{14}=5$ , otherwise $Q_{14}=2$
48	RRR $\neq$ 001 - 999 and $i_R = 1,2$	Correct manually and $Q_{14}=5$ , otherwise $Q_{14}=2$
49	$t_R \neq 0-9$	Correct manually and $Q_{14}=5$ , otherwise $Q_{14}=4$
50	$s_n \neq 0,1,5,6,7,9$	Correct manually, otherwise $Q_7=4$
51	$W_B \geq TTT$ or $DP > TTT$	See element 17
52	$a \neq 0-8,\Delta$ $a = 4$ and $ppp \neq 000$ $a = \Delta$	Correct manually and $Q_{15}=5$ , otherwise $Q_{15}=4$ Correct manually and $Q_{15}=5$ , otherwise $Q_{15}=Q_{16}=2$ $Q_{15}=9$
53	$ppp > 150$ $ppp > 250$ $ppp = \Delta\Delta\Delta$	Correct manually and $Q_{16}=1,3$ and if corrected $Q_{16}=5$ Correct manually and $Q_{16}=5$ , otherwise $Q_{16}=4$ $Q_{16}=9$
54	$D_s \neq 0-9, \Delta$ $D_s = \Delta, /$	Correct manually and $Q_{17}=5$ , otherwise $Q_{17}=4$ $Q_{17}=9$
55	$V_s \neq 0-9, \Delta$ $V_s = \Delta, /$	Correct manually and $Q_{18}=5$ , otherwise $Q_{18}=4$ $Q_{18}=9$
56	$d_{w2}d_{w2} \neq 00-36,99$	Correct manually and $Q_{13}=5$ otherwise $Q_{13}=4$

Element	Error	Action
57	$25 < P_{w2}P_{w2} < 30$ $P_{w2}P_{w2} > 30$ and $\neq 99$	$Q_{13}=3$ $Q_{13}=4$
58	$35 < H_{w2}H_{w2} < 50$ $H_{w2}H_{w2} = > 50$	$Q_{13}=3$ $Q_{13}=4$
59	$c_1 \neq 0-9, \Delta$	Correct manually otherwise $\Delta$
60	$S_1 \neq 0-9, \Delta$	Correct manually otherwise $\Delta$
61	$b_1 \neq 0-9, \Delta$	Correct manually otherwise $\Delta$
62	$D_1 \neq 0-9, \Delta$	Correct manually otherwise $\Delta$
63	$z_1 \neq 0-9, \Delta$	Correct manually otherwise $\Delta$

Specifications for quality-control indicators  $Q_1$  to  $Q_{18}$

- 0 - No quality control (QC) has been performed on this element
- 1 - QC has been performed; element appears to be correct
- 2 - QC has been performed; element appears to be inconsistent with other elements
- 3 - QC has been performed; element appears to be doubtful
- 4 - QC has been performed; element appears to be erroneous
- 5 - The value has been changed as a result of QC
- 6-8 - Reserve
- 9 - The value of the element is missing

Rec. 8 (CMM-X) - SELECTED DEFINITIONS FOR USE WITH THE MARINE CLIMATOLOGICAL SUMMARIES SCHEME

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) The final report of the sixth session of the Advisory Working Group of CMM (Geneva, May 1986);

(2) The final report of the fifth session of the CMM Working Group on Marine Climatology (Geneva, November 1986),

(3) The International Organization for Standardization (ISO) document ISO/TC 37/SC 3, containing selected definitions of computer technology,

## CONSIDERING

(1) The desirability of having a recommended standardized terminology related to the storage of data for use within the Marine Climatological Summaries Scheme,

(2) That the availability of such a standardized terminology would greatly facilitate translation from and into the languages of WMO,

RECOMMENDS That the list of terms for computer technology, as published by the International Organization for Standardization and given in the annex to this recommendation, be included as an annex to Section 2.7 of the Guide to Marine Meteorological Services for use within the Marine Climatological Summaries Scheme,

REQUESTS The Secretary-General to prepare an appropriate amendment to the Guide to incorporate this annex for the consideration of the Executive Council.

## Annex to Recommendation 8 (CMM-X)

SELECTED DEFINITIONS FOR USE WITH THE MARINE CLIMATOLOGICAL SUMMARIES SCHEME

The following is a set of definitions as accepted for use with special reference to the Marine Climatological Summaries Scheme. They do not imply any official status within WMO. The definitions are adapted from those published by the International Organization for Standardization (ISO) in document ISO/TC 37/SC 3:

- Data Base: A data base is a set of structured entries (data) in a store, to and from which data can be read in or called up for processing.
- Data bank: A data bank is a data base administered by a data base management system which can be shared by several user programmes.
- Data collection: (1) The process of capturing raw data for use within a computer system. Also known as data gathering. Related to file creation.
- (2) In modern systems the term is often used to imply the capture of information at the instant a transaction occurs, for example, requiring the use of data transmission equipment to connect distant locations with a computer system where the transactions are recorded and processed.
- Data retrieval: The extraction of data from a file or files by searching for specified keys or labels contained in records stored on the file. Records may be selected according to logical relationships between files and may be processed or summarized to produce the required information.

Data set: Raw or processed assembled data (whether available or not in a data base).

Data storage: The use of any medium for storing data.

Note: If these terms are used in any way which does not conform to the above definitions, this usage should be made clear at the time.

Rec. 9 (CMM-X) - HANDBOOK ON SEA-ICE NAVIGATION IN THE SOUTHERN OCEAN

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) The abridged final report of CMM-X, general summary, paragraph 10.3,

(2) The final report of the fifth session of the CMM Working Group on Sea Ice,

(3) Recommendation X of the XIVth Antarctic Treaty Consultative Meeting,

(4) Resolution 14 (Cg-X) - Marine meteorology and associated oceanographic activities for the period 1988-1991,

(5) The abridged report with resolutions of EC-XL, general summary, paragraphs 9.2.1 and 9.2.3,

(6) Resolution 19 (Cg-X) - Antarctic meteorology,

CONSIDERING:

(1) That the Antarctic Treaty Consultative Parties have invited WMO, SCAR and IOC to advise on ways of improving or developing operational marine meteorological and sea-ice information services for the Treaty area of the Southern Ocean,

(2) That the publication of relevant manuals and guidance material relating to sea ice for the Region is a necessary step in the development of marine meteorological and sea-ice information services;

(3) That maximum acceptance of such guidance material amongst the maritime community may be gained through the participation of the International Maritime Organization (IMO) in its preparation;

RECOMMENDS:

(1) That the preparation of a handbook on sea-ice navigation in the Southern Ocean be undertaken, based on the outline given in the annex to this recommendation;



(2) That the handbook should not duplicate information already contained in Sea-ice Information Services in the World (WMO-No. 574);

(3) That this handbook be published in all four languages of WMO since these are also the official languages of the Antarctic Treaty parties;

REQUESTS the Secretary-General to arrange for the preparation and publication of the handbook in 1991, as resources permit, in consultation with the president of CMM and the Secretary-General of IMO, as appropriate.

Annex to Recommendation 9 (CMM-X)

DRAFT OUTLINE OF A HANDBOOK ON SEA-ICE NAVIGATION IN THE SOUTHERN OCEAN

Preface: Goals and objectives of the publication; the scope of its application

1. Description of navigation conditions in the Southern Ocean
  - 1.1 Physiographic
  - 1.2 Hydrological and meteorological
  - 1.3 Sea ice
  - 1.4 Ship routeing
2. Regular features of spatial and temporal distribution of hydrological, meteorological and sea-ice conditions of ship routeing
  - 2.1 Pressure systems, their trajectories and development, their effects on weather conditions
  - 2.2 Areas of storm waves and other adverse marine meteorological effects on weather conditions
  - 2.3 Characterization of Antarctic sea ice and its spatial and temporal variations
    - 2.3.1 Pack ice
    - 2.3.1 Ice massifs and zones of their divergence
    - 2.3.3 Fast ice
    - 2.3.4 Polynyas
    - 2.3.5 Icebergs
3. Assessment and consideration of marine meteorological and sea-ice conditions in planning and in ship routeing operations
  - 3.1 Marine meteorological conditions
  - 3.2 Sea-ice conditions
    - 3.2.1 Quantitative indicators of sea-ice affects on ship routeing
    - 3.2.2 Types of marine operations and sea-ice classification as navigation medium
    - 3.2.3 Classification of sea-ice conditions of ship routeing
  - 3.3 Location of optimal ship routes and recommended navigation time
  - 3.4 Recommendations for cargo operations at the Antarctic coast
  - 3.5 Techniques of calculation of the loading capacity of sea ice
4. Established international practices of marine meteorological services to ship routeing
  - 4.1 Sources of marine meteorological and sea-ice data
  - 4.2 Volumes and types of information provided to users
  - 4.3 Principles of the usage of real-time and predicted information by users

5. List of recommended reference material for marine meteorological services to ship routing in the Southern Ocean: atlases, handbooks, reference books and similar publications.

Rec. 10 (CMM-X) - HANDBOOK ON THE ANALYSIS AND FORECASTING OF SEA-ICE

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) Resolution 6 (CMM-IX) - Working Group on Sea Ice, by which the Commission decided to re-establish the Working Group on Sea Ice with terms of reference which included, inter alia, the review and promotion of international co-operation in improving methods of predicting sea-ice growth, drift and decay (including the preparation of guidance material on forecasting sea-ice conditions),

(2) The report of the fifth session of the CMM Working Group on Sea Ice,

CONSIDERING:

(1) That a handbook on the analysis and forecasting of sea ice is a means for technology transfer in the field of sea ice to countries which do not have enough experience in the subject, in particular developing countries,

(2) The responsibility of CMM for developing guidelines relating to sea-ice forecasting methods,

(3) The lack of such guidelines for sea-ice forecasting techniques used at present by the leading Members of WMO for providing sea-ice services for various national users,

RECOMMENDS:

(1) That the preparation of a handbook on the analysis and forecasting of sea ice be undertaken, based on the outline given in the annex to this recommendation;

(2) That the handbook be published by WMO;

REQUESTS the Secretary-General, in consultation with the president of CMM, to arrange for the preparation and publication of the handbook, as resources permit.

Annex to Recommendation 10 (CMM-X)

DRAFT OUTLINE OF A HANDBOOK ON THE ANALYSIS AND FORECASTING OF SEA ICE

Contents

Preface

1. Major definitions and descriptions of sea ice
  - 1.1 Terminology and main definitions

- 1.2 Sea-ice formation
  - 1.2.1 Freezing of sea water
  - 1.2.2 Ice crystals: formation and growth
  - 1.2.3 Sea-ice growth
- 1.3 Texture and physical characteristics of sea ice
  - 1.3.1 Sea-ice structure
  - 1.3.2 Sea-ice texture
  - 1.3.3 Sea-ice density and porosity
  - 1.3.4 Sea-ice thermal and physical characteristics
- 1.4 Chemical composition and salinity of sea ice
  - 1.4.1 Sea-ice phase composition
  - 1.4.2 Brine migration
  - 1.4.3 Salt crystallization
  - 1.4.4 Sea-ice salinity
- 1.5 Sea-ice melting and disintegration
  - 1.5.1 Radiational properties of sea ice
  - 1.5.2 Thermal melting of sea ice
  - 1.5.3 Enthalpy of sea ice (sensible heat)
  - 1.5.4 Equilibrium thickness of sea ice
  - 1.5.5 Elastic and plastic properties of sea ice
  - 1.5.6 Sea-ice strength
  - 1.5.7 Disintegration of sea ice
- 2. Main definitions and descriptions of sea-ice physical and geographic features
  - 2.1 Terminology and main concepts
  - 2.2 Sea-ice formation
    - 2.2.1 Sea-surface cooling
    - 2.2.2 Ice freezing
    - 2.2.3 Sea-ice growth and spreading
    - 2.2.4 Snow on ice
    - 2.2.5 Heat flux to the sea-ice bottom
  - 2.3 Pack-ice motion processes
    - 2.3.1 Forms of floating ice
    - 2.3.2 Sea-ice drift
    - 2.3.3 Deformation and hummocking
  - 2.4 Melting and disintegration of sea ice
    - 2.4.1 Melting from the surface, bottom and sides
    - 2.4.2 Formation of thaw holes
    - 2.4.3 Stages of melting and disintegration of sea ice
  - 2.5 Spatial and temporal variability of sea ice
    - 2.5.1 Large-scale variability
    - 2.5.2 Mesoscale variability
    - 2.5.3 Effects of sea-ice inhomogeneities on thermal and dynamic sea/air interaction processes
  - 2.6 Sea-ice remote sensing
    - 2.6.1 Visual and IR emissions of sea ice
    - 2.6.2 Sea-ice (microwave) brightness temperatures
    - 2.6.3 Radar: SAR
      - SLAR
      - Forward-looking radar
      - Coastal radar
      - Other
    - 2.6.4 Upward-looking sonar
    - 2.6.5 Other, including sea-ice albedo

3. Methodological principles of collecting, processing and analysing ice data
  - 3.1 Visual observations
    - 3.1.1 Surface observations
    - 3.1.2 Airborne observations
    - 3.1.3 Shipboard observations
    - 3.1.4 Specialized observations
  - 3.2 Instrumental observations
    - 3.2.1 Contact measurements
    - 3.2.2 Remote sensing
    - 3.2.3 Automatic data buoys
  - 3.3 Ice data collection
    - 3.3.1 International sea-ice formats
    - 3.3.2 Data transmission procedures
    - 3.3.3 Sea-ice composite maps
    - 3.3.4 Centres of data collection
    - 3.3.5 Sea-ice data banks: national and international
  - 3.4 Review of sea-ice data analysis techniques
    - 3.4.1 Review of sea-ice data analysis techniques
    - 3.4.2 Statistical methods of sea-ice data analysis
    - 3.4.3 Joint analysis of the processes in the ocean/atmosphere and sea ice
    - 3.4.4 Climatic regime atlases and reference books
4. Introduction to mathematical modelling of sea ice
  - 4.1 Major concepts
  - 4.2 Interaction processes in the ocean/sea-ice/atmosphere system
  - 4.3 Simulation of sea-ice formation processes
  - 4.4 Simulation of sea-ice dynamics
  - 4.5 Simulation of thermal breaking of sea ice
  - 4.6 Simulation of the annual sea-ice cycle
5. Principles of sea-ice forecasting techniques
  - 5.1 Basic principles of forecasting
  - 5.2 Empiric methods
    - 5.2.1 Generalized characteristics
    - 5.2.2 Time of ice formation
    - 5.2.3 Sea-ice thickness
    - 5.2.4 Time of sea ice melting away
  - 5.3 Statistical methods
    - 5.3.1 Evaluation of sea-ice occurrence probability
    - 5.3.2 Probability evaluation of sea-ice pressure
    - 5.3.3 Forecasts with the due consideration of external forcing
  - 5.4 Dynamic and thermodynamic methods
    - 5.4.1 Ice formation and growth
    - 5.4.2 Pressure and sea-ice redistribution
    - 5.4.3 Melting and ice-free conditions
  - 5.5 Sea-ice forecasts: their validity, skill/score and adequacy
6. Provision of sea-ice information: structure
  - 6.1 Goals and objectives of sea-ice information
  - 6.2 Provision of sea-ice information for long-term planning
  - 6.3 Provision of sea-ice information for annual planning
  - 6.4 Operational sea-ice data
  - 6.5 Typical objectives of sea-ice data provision
    - 6.5.1 Sea-ice information for ship routeing

- 6.5.2 Sea-ice information for construction activity at the coast and offshore
- 6.5.3 Sea-ice data for geological prospecting, exploration, development
- 6.5.4 Sea-ice data for fishing
- 6.5.5 Sea-ice data for operations on pack ice
- 6.5.6 Sea-ice data for operations on fast ice
- 6.5.7 Other uses of sea-ice data

## ANNEXES

- I-1 List of handbooks for sea-ice physics and chemistry
- I-2 Tables of the changes of major physical and chemical characteristics of sea ice
- II-1 Sea-ice publications: bibliography
- II-2 Tables and graphs of major statistical characteristics of the spatial and temporal variability of sea ice
- III Tables of comparison of different ice observing techniques
- IV List of models used in national sea-ice services and their capabilities
- V List of sea-ice forecasting methods used in national sea-ice services and their capabilities
- VI Bibliography on sea-ice information provision to users.

Rec. 11 (CMM-X) - FORMAT FOR THE ARCHIVAL AND EXCHANGE OF SEA-ICE DATA IN DIGITAL FORM (SIGRID)

THE COMMISSION FOR MARINE METEOROLOGY,

## NOTING:

(1) The abridged final report of CMM-IX, general summary, paragraph 8.6,

(2) The final report of the fifth session of the CMM Working Group on Sea Ice,

(3) Resolution 14 (Cg-X) - Marine meteorology and associated oceanographic activities for the period 1988-1991,

(4) The report of the chairman of the Working Group on Sea Ice to CMM-X,

## CONSIDERING:

(1) That the World Climate Programme needs support in the area of sea ice,

(2) That creation of a global sea-ice data bank will facilitate climate research,

(3) That the feasibility of producing a combined sea-ice data set using data from different sources has been established,

(4) That the SIGRID format is now extensively used by many sea-ice services for the archival and exchange of sea-ice data in digital form,

(5) That the SIGRID format has at present no formal status within WMO and that this may create problems for its use as the exchange format for sea-ice data to establish a global sea-ice data bank,

RECOMMENDS:

(1) That the SIGRID format which is detailed in the annex to this recommendation be adopted by WMO as the required digitizing format for the international exchange of sea-ice data;

(2) That the SIGRID format be included as an appendix to Part II of the Manual on Marine Meteorological Services (WMO-No. 558);

REQUESTS the Secretary-General:

(1) To promulgate the agreed version of the format to Members by 1 September 1989;

(2) To prepare an appropriate amendment to the Manual on Marine Meteorological Services, which will include the SIGRID format as an appendix to Part II of the Manual, for the consideration of the forty-second session of the Executive Council.

Annex to Recommendation 11 (CMM-X)

FORMAT FOR THE ARCHIVAL AND EXCHANGE OF SEA-ICE DATA IN DIGITAL FORM (SIGRID)

1. INTRODUCTION

A vast amount of sea-ice information is today available at the various ice services in the world. Almost all of this information is stored in the form of ice charts for operational purposes. For statistical or climatological use the chart format is however not convenient and the information needs to be digitized. This is done by assigning numerical values to the ice variables and reading these values at given grid points on the chart. The values read at each grid point are representative for the ice conditions in a well defined area around the point.

The charts prepared by the various ice services do not all contain the same number of variables. The resolution and accuracy also vary according to the use for which the charts are intended. A large degree of flexibility has therefore to be built into the design of both code format and grid. It should allow digitization of historical ice charts as well as current ones in order to obtain a comprehensive computer-compatible sea-ice data bank which is constantly updated. The SIGRID format is mainly designed to meet larger-scale climate requirements but it may also be used by national services for other purposes.

The code format concentrates on conventional sea-ice variables as this is considered most important in the light of present operational practices and the large amount of historical sea-ice charts that need to be digitized. It is however realized that remote-sensing methods are gradually becoming more and more sophisticated and that automatically interpreted remotely sensed data may supplement some of the conventional sea-ice variables. Provisions have therefore been made to allow for these types of data to be included in the code when required.

## 2. ENCODING OF SEA-ICE INFORMATION

### 2.1 The charts

On sea-ice charts the ice variables are represented by symbols and accompanying numbers giving the actual values of the variables. The various sea-ice services have up to now used their own symbols and one of the problems encountered when designing a coding system for sea-ice information is this lack of uniformity. An international system of sea-ice symbols has, however, been developed and approved by WMO. This symbology forms the basis for the coding system proposed for digitizing sea-ice charts. The symbology covers most variables contained in the various sea-ice charts and, as the variables are basically the same on all charts irrespective of the symbology used, it is possible to digitize charts based on the old as well as the new international sea-ice symbols. The SIGRID format allows for two different digitizing procedures.

### 2.2 GRID-point coding

As the various ice charts do not contain the same number of variables and as these may have different accuracy and resolution, the code has been designed to allow for an arbitrary number of variables to be digitized. Moreover, the grid system can be varied to cover the required resolution. For example, it would be possible to digitize only the total ice concentration with a resolution of 4° longitude x 2° latitude; it would also be possible to digitize 20 variables for each grid point with a resolution of 0°30' longitude by 0°15' latitude. The grid will be geographical, but it can easily be expanded to a Cartesian grid if such a requirement occurs.

### 2.3 Contour coding

Contour coding means that the co-ordinates of the contours of a defined ice area on the chart are read and values for the sea-ice variables inside the contoured area are assigned to that area. It is also possible in this case to digitize an arbitrary number of sea-ice variables. The contours can be digitized by using a digitizing tablet; only the ice variables will have to be read manually. Provided that the accuracy of the contour co-ordinates and the number of co-ordinates along the contour are chosen in correspondence with the scale of the ice chart, it is possible to maintain the resolution of the ice chart at 100 per cent. It is also easy to transfer contour data to grid data with different grid spacing. For example, climate modelling data can be provided in a 20 x 40 grid while fine mesh 1' x 2' data can be produced, e.g. for local ice statistics.

## 2.4 General layout of the tape format

It is assumed that the digitized sea-ice charts will be registered on magnetic tape. As the individual sea-ice services will be responsible for the digitizing and punching procedures, these problems have not been taken up in this study. Control and other procedures will have to be agreed upon; these will be taken up at a later stage.

A magnetic tape containing digitized sea-ice data should include header files and chart data files. The header file should contain information relevant to the whole or major portions of the tape. Each chart data file should contain information relevant to one ice chart and include a header record, grid line records and data groups. See Figure 1.

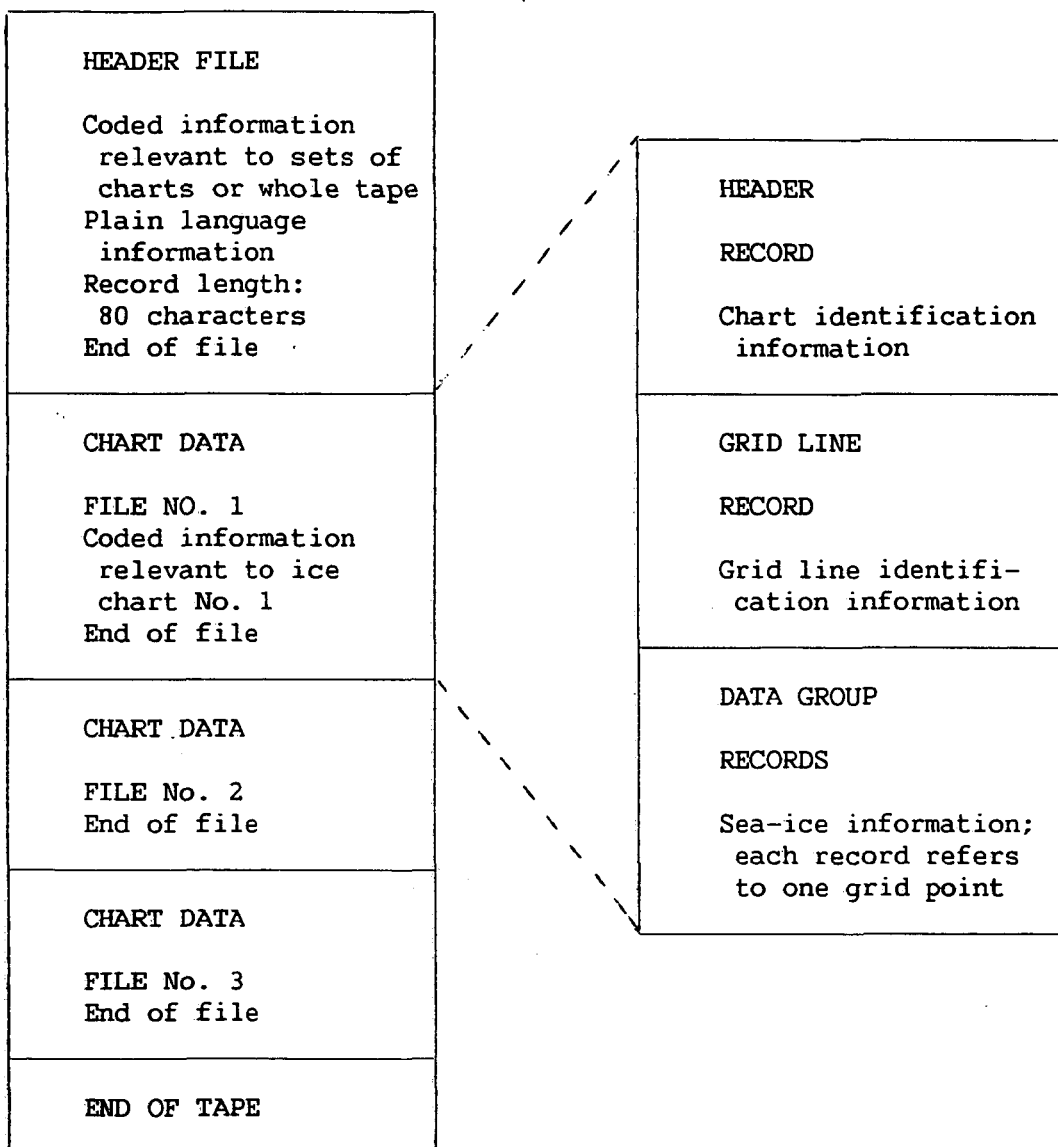


Figure 1 - Organization of digitized sea-ice information on magnetic tape



### 3. HEADER FILE

#### 3.1 Layout

The DS-name of the file should be "SIGRIDINF". The header file should contain all information relevant to a set of uniform ice charts from the same ice service using the same grid. Any changes in grid, grid area or variables should be preceded by a new header file. The header file contains the following information:

- Type of information identifier (SIGRID)
- Originating country
- Originating service
- Type of coding (contour or grid)
- Mesh width of grid
- Starting point of grid
- Size of gridded area
- Total number and types of variables included.

Any other information pertinent to the whole tape should also be included. This may refer to new variables, in which case they should be clearly defined, as well as any other deviation from the coding procedures internationally agreed upon. The header file may also contain information on control procedures used and any other background information facilitating the use of the data. The header file should always include information on the maximum number of grid lines, grid points and variables that can occur in any one chart on the tape. This will allow for the appropriate space to be allocated in the computer. The record length should be 80 characters.

### 4. CHART DATA FILE

#### 4.1 Layout

The DS-name of this file should be "SIGRIDNN", where NN is the sequential number of the file starting from 01. This file contains all information relevant to the individual ice charts and is divided into three records as follows (grid or contour):

Grid coding	Contour coding
- Header record	- Header record
- Grid line record	- Contour co-ordinates record
- Data group records	- Data group records

#### 4.2 Header record

This contains all information required for the identification of the chart:

- Date and time
- Serial number of chart
- Number and types of variables included
- Type of coding (grid or contour).

#### 4.3 Grid or contour line record

This record (there can be more than one) contains information necessary for the identification of the information in grid points lying on the same grid line or for the identification of the co-ordinates of a contour encompassing an ice area whose variables are given in the following data group record:

##### Grid coding

- Start of grid line indicator
- Grid subdivision indicator (if required)
- Indicator for number of following consecutive points for which identical data are repeated (if required)
- Ice variables

##### Contour coding

- Start of contour line indicator
- Ice variables

#### 4.4 Record of data

The record of data will contain the actual ice information for each grid point along a grid line or the ice information for a contoured area:

##### Grid coding

- Start of data group indicator
- Grid subdivision indicator (if required)
- Indicator for number of following consecutive points for which identical data are repeated (if required)
- Ice variables

##### Contour coding

- Start of contour line indicator
- Contour line co-ordinates
- Number of co-ordinates

### 5. CODING PROCEDURES

#### 5.1 General

All information is coded for easy identification of all background information, as well as all data for the digitized ice charts. One possible exception is the inclusion of plain language information on the header file for additional information. This plain language should follow the coded information.

#### 5.2. Header file

SIGRIDINF

:AAF<sub>c</sub>F<sub>c</sub>:NNN

(:AQ<sub>c</sub>L<sub>a</sub>L<sub>a</sub>L<sub>a</sub>L<sub>a</sub>L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>:Bn<sub>1</sub>n<sub>1</sub>n<sub>1</sub>n<sub>p</sub>n<sub>p</sub>n<sub>p</sub>n<sub>p</sub>:Cd<sub>1</sub>d<sub>1</sub>d<sub>1</sub>d<sub>1</sub>)

:DN<sub>t</sub>N<sub>t</sub>P<sub>t</sub>P<sub>t</sub>...P<sub>t</sub>P<sub>t</sub>

- 5.3. Chart data file SIGRIDNN
- Header record :EJJJMMYYGGG<sub>p</sub>G<sub>p</sub>:FN<sub>s</sub>N<sub>s</sub>N<sub>s</sub>
- :GN<sub>p</sub>N<sub>p</sub>P<sub>1</sub>P<sub>1</sub>...P<sub>1</sub>P<sub>1</sub>:HP<sub>x</sub>P<sub>x</sub>N<sub>p</sub>N<sub>n</sub>
- Grid line or contour record =K11:Lmmpppp:MN<sub>p</sub>N<sub>p</sub>N<sub>p</sub>N<sub>p</sub>:XR<sub>n</sub>R<sub>n</sub>
- :PQL<sub>a</sub>L<sub>a</sub>L<sub>a</sub>L<sub>a</sub>OL<sub>o</sub>L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>:QL<sub>a</sub>L<sub>a</sub>L<sub>a</sub>L<sub>a</sub>OL<sub>o</sub>L<sub>o</sub>L<sub>o</sub>L<sub>o</sub>
- Data group (grid) :NG<sub>1</sub>RN<sub>r</sub>N<sub>r</sub>P<sub>1</sub>P<sub>1</sub>...P<sub>1</sub>P<sub>1</sub>
- Data group (contour) :SP<sub>1</sub>P<sub>1</sub>...P<sub>1</sub>P<sub>1</sub>
- 5.4 Specification of symbolic letters\*

The following specifications of identifiers and symbolic letters are given in the order in which they appear in the record:

- SIGRIDINF - Identifier of header file
- :
- Start of a new information group
- AA - Area or country from which the data originate (see Manual on the GTS (WMO-386), Part II, Attachment II-6, Table C1)
- F<sub>c</sub>F<sub>c</sub> - Centre, service or institution from which the data originate (table to be established)
- NNN - Catalogue number giving coding procedure or grid used (see WMO-No. 9, Vol. B). If the grid specification is not included in this publication, the grid can be defined by the following groups identified by the letters A, B and C. Use in this case NNN = 099 for grid coding and NNN = 098 for contour coding (Note: It is very important that this information be given)
- ( ) - If contour coding is used or if the grid is specified by means of a WMO catalogue number, groups within parentheses are omitted
- A B C...R - Indicators

\* In the final version of the Manual on Marine Meteorological Services, the symbolic letters will appear in italics; letters used as indicators on the tape record are printed in normal style.

- $Q_c L_a L_a L_a L_a L_a L_o L_o L_o L_o L_o$  - Latitude and longitude of origo (starting point) of a geographical grid. The grid lines are scanned towards increasing latitudes (south to north in the northern hemisphere and north to south in the southern). The grid points are scanned from west to east along grid lines (applies to the southern as well as the northern hemisphere)
- $n_1 n_1 n_1$  - Maximum number of grid lines (along meridians)
- $n_p n_p n_p n_p$  - Maximum number of grid lines (along parallels)
- $d_1 d_1 d_1 d_1$  - Mesh width of grid (distance between grid lines along meridians) in degrees and minutes
- $N_t N_t$  - Total number of sea-ice variables occurring on the charts
- $P_t P_t \dots P_t P_t$  - Identifiers of all sea-ice variables occurring on the charts
- SIGRIDNN - Identifier of chart data file with sequential number (NN)
- JJJ - Century, decade and year (e.g. 982 = 1982)
- MM - Month of the year; from 01 to 12
- YY - Day of the month; from 01 to 31
- GG - Time of chart in whole hours, UTC
- $G_p G_p$  - Period (+ whole hours) of observations on which chart is based
- $N_s N_s N_s$  - Serial number of chart (determined by national centre)
- $N_p N_p$  - Number of sea-ice variables included in each grid point or each contoured area without being separately identified in these points or area (see Note below)
- $R_n R_n$  - Number of data group records that follows
- $Q_c L_a L_a L_a L_a L_a L_o L_o L_o L_o L_o$  - Co-ordinates of points on a contour
- $P_1 P_1 \dots P_1 P_1$  - Identifiers of sea-ice variables and order in which they are included for each grid point without being separately identified at these points (see Note below)
- $P_x P_x$  - Identifier of sea-ice variables defined individually for actual chart

$N_p$	- Number of variables defined by $P_x P_x$
$N_n$	- Number of digits per variable defined by $P_x P_x$
=	- Sign which identifies the start of grid line or contour line record
ll	- Longitude/latitude mesh-width ratio (example: distance between grid lines (N-S) 2°, distance between grid points (E-W) 4°, ll = 02)
mmmppp	- Co-ordinates of first grid point of a grid line expressed as the number of grid points along the meridian (mmm) and along the parallel (ppp) counted from the origo (the origo has the co-ordinates 001001)
$N_p N_p N_p N_p$	- Number of grid points on a grid line or co-ordinate points on a contour line
:	- Start of data group indicator, used to separate data groups
$G_l$	- Grid sub-division indicator (see code table 14)
$N_r N_r$	- Number of consecutive grid points for which the identical information is repeated. (The $R N_r N_r$ should not occur when the information only refers to one point). When, for example, $R N_r N_r = R 02$ , the actual and the following point contain identical information
$P_i P_i$	- Identifier of sea-ice variable within a data group. The data group may include one or several sea-ice variables, all identified by $P_i P_i$ unless all grid points or contoured areas contain the same variables, in which case the variables are identified in the header record (see Note below)

Note: There will be two ways of identifying the ice variables included in a data group:

- (a) By identifying in the header record the variables which will occur in each data group. In this case space will be reserved for all these variables in each data group and the variables will follow each other without identifiers in the the order given in the header record;
- (b) By using the identifier ( $P_i P_i$ ) within the data group to identify a variable when it is included.

Example:  $X_1 X_2 X_3 P_i P_i X_4 P_i P_i X_5$

The variables  $X_1$  to  $X_3$  will occur in each data group. The variables  $X_4$  and  $X_5$  occur in this particular data group but not necessarily in others and are identified by  $P_i P_i$

## 6. DATA GROUPS

### 6.1 Categories of sea-ice variables

A data group consists of one or several sea-ice variables which correspond to a grid point or a contoured area. In the case of a grid point the variables are actual values from the grid point and not average values for the grid box. The variables are divided into nine main categories which can contain one or several sub-elements.

The sea-ice variables are defined according to the international system of sea-ice symbols. Each variable is identified in the record by two letters, e.g. CT (total concentration of ice). The first letter identifies the category of the variable while the second identifies variables within the category. In the following tables the letters B, C, D, E, L, O, R, S, T and W are used as category indicators. The rest of the alphabet is left for future use.

The letters X, Y and Z are, however, reserved for use by individual national services should they wish to include variables not contained in the internationally agreed list. The X, Y and Z may be used together with any other letter of the alphabet. The use of X, Y and Z should be clearly explained in the tape header file at the beginning of each tape. The number of variables defined in the following tables is 53.

The following categories are for general use:

Category indicator	Elements
C	Concentration, stage of development and form of ice (including strips and patches)
D	Dynamic processes
W	Water openings
R	Topography features
E	Thickness of ice
S	Surface features and melting forms
B	Icebergs or ice of land origin
T	Sea-surface temperature
O	Source of information on which chart is based
L	Land area

### 6.2 Identification of variables within a data group

In order to identify unambiguously a variable within a data group, each variable is defined by an identifier. The identifier can be used in the header record to define the variable or variables and the order in which they appear at each grid point. The identification of variables in the header record shall be used when they occur at all or most of the grid points. Variables not occurring at most of the grid points should be identified at each point or area.

It should be noted that the recording of variables on a tape record is less subject to space restrictions than is their coding for telecommunicated reports or plotting in the form of symbols on a sea-ice chart. For archiving purposes there is a greater freedom of choice of the number of digits to be used to record a variable; this facilitates later processing of the data. Thus, for the recording of, for example, sea-ice concentration, two digits are proposed.

The following variable identifiers are defined:

Concentration, stage of development and form of ice

According to the new international system of sea-ice symbols, seven cases need to be distinguished:

- |    |  |
|----|--|
| CT | - Total concentration, CC (code table 1)   |
| CA | - Partial concentration, stage of development* and form of thickest ice<br>C <sub>a</sub> C <sub>a</sub> S <sub>a</sub> S <sub>a</sub> F <sub>a</sub> F <sub>a</sub> (code tables 1, 2 and 3)  |
| CB | - Partial concentration, stage of development* and form of second thickest ice<br>C <sub>b</sub> C <sub>b</sub> S <sub>b</sub> S <sub>b</sub> F <sub>b</sub> F <sub>b</sub> (code tables 1, 2 and 3)   |
| CC | Partial concentration, stage of development* and form of third thickest ice<br>C <sub>c</sub> C <sub>c</sub> S <sub>c</sub> S <sub>c</sub> F <sub>c</sub> F <sub>c</sub> (code tables 1, 2 and 3)  |
| CF | - Predominant F <sub>p</sub> F <sub>p</sub> and secondary F <sub>s</sub> F <sub>s</sub> form of ice (code table 3)   |
| CN | - Stage of development* of ice thicker than reported by S <sub>a</sub> S <sub>a</sub> but with a concentration less than 1/10, S <sub>o</sub> S <sub>o</sub> . (code table 2)  |
| CD | - Stage of development of any remaining class of ice S <sub>d</sub> S <sub>d</sub> not reported under CA, CB or CC (code table 2) (note that no concentration or form of ice is reported for S <sub>o</sub> S <sub>o</sub> and S <sub>d</sub> S <sub>d</sub> ) |

Coding:

CTCC CAC<sub>a</sub>C<sub>a</sub>S<sub>a</sub>S<sub>a</sub>F<sub>a</sub>F<sub>a</sub> CBC<sub>b</sub>C<sub>b</sub>S<sub>b</sub>S<sub>b</sub>F<sub>b</sub>F<sub>b</sub>

CCC<sub>c</sub>C<sub>c</sub>S<sub>c</sub>S<sub>c</sub>F<sub>c</sub>F<sub>c</sub> (CFF<sub>p</sub>F<sub>p</sub>F<sub>s</sub>F<sub>s</sub>) CNS<sub>o</sub>S<sub>o</sub> CDS<sub>d</sub>S<sub>d</sub>

Dynamic processes

- |    |   |
|----|---|
| DP | - Dynamic processes d <sub>p</sub> (code table 4) |
|----|---|

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\* or thickness

- DD - Direction\* of dynamic processes D (code table 5)
- DR - Rate of ice drift in tenths of knots ( $V_1V_1$ )
- DO - Source of information  $O_p$  (code table 14)
- Coding: DPd<sub>p</sub> DDD DRV<sub>1</sub>V<sub>1</sub> DOO<sub>p</sub>

Water openings

- WF - Form of water openings  $W_f$  (code table 6)
- WN - Number of water openings  $N_o$  (code table 7)
- WD - Orientation (direction) of water openings D (code table 5)
- WW - Width of water openings  $W_wW_w$  (in hundreds of metres)
- WO - Source of information  $O_p$  (code table 14)
- Coding: - WFW<sub>f</sub> WDD WWW<sub>w</sub>W<sub>w</sub> WNN<sub>o</sub> WOO<sub>p</sub>

Topography features (ridges and rafting)

- RN - Nature of topography feature  $R_n$  (code table 8)
- RA - Age of topography feature  $R_a$  (code table 9)
- RD - Orientation of topography feature D (code table 5)
- RC - Concentration of topography feature  $C_rC_r$  (code table 1)
- RF - Frequency of topography feature  $R_fR_f$  (number per nautical mile)
- RH - Height (mean) of topography feature  $R_hR_h$  in tenths of metres
- RO - Source of information  $O_p$  (code table 14)
- RX - Maximum height of topography feature  $R_xR_x$  in tenths of metres
- Coding: - RNR<sub>n</sub> RAR<sub>a</sub> RDD RCC<sub>r</sub>C<sub>r</sub> RFR<sub>f</sub>R<sub>f</sub> RHR<sub>h</sub>R<sub>h</sub> RXR<sub>x</sub>R<sub>x</sub> ROO<sub>p</sub>

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\* Drift of iceberg to be reported under "icebergs or ice of land origin"



Thickness of ice

- EM - Mean thickness of level ice in cm  $t_{EtEtE}$   
 EX - Maximum thickness of level ice in cm  $t_{xtxtx}$

To indicate whether the thickness is estimated or measured the following convention may be used:

- Last digit of  $t_{EtEtE}$  or  $t_{xtxtx}$  is 0 or 5: estimated  
 - Last digit is any other number: measured

- EI - Thickness interval  $t_{ntntntxtxtx}$   
 $t_{ntntn}$  = lower limit in centimetres  
 $t_{xtxtx}$  = upper limit in centimetres

Example: 35 - 50 = EI035050 ( $t_{ntntn}$  = 35 cm,  $t_{xtxtx}$  = 50 cm)

- EO - Source of information  $O_p$  (code table 14)

Coding:  $EMt_{EtEtE}$   $EXt_{xtxtx}$   $EIt_{ntntntxtxtx}$   $EOO_p$

Surface features and melting forms

- SC - Concentration of snow (areal coverage) in tenths  $C_sC_s$   
 SN - Snow depth  $s$  (code table 10)  
 SD - Orientation (direction) of sastrugies  $D$  (code table 5)  
 SM - Melting forms  $m_s$  (code table 11)  
 SA - Area coverage of water on ice in tenths  $m_a m_a$   
 SO - Source of information  $O_p$  (code table 14)

Coding:  $SCC_sC_s$   $SNs$   $SDD$   $SMm_s$   $SAm_a m_a$   $SOO_p$

Icebergs or ice of land origin

- BL - Type of iceberg  $B_i B_s$  (code table 12)  
 BD - Direction of drift of iceberg  $D$  (code table 5)  
 BR - Rate of drift in tenths of knots  $V_i V_i$   
 BN - Number of icebergs  $n_B n_B$  (code table 13)  
 BY - Day of month (YY) when iceberg(s) was (were) sighted

BO - Source of information  $O_p$  (code table 14)

Coding: BLB<sub>1</sub>B<sub>s</sub> BDD BRV<sub>1</sub>V<sub>1</sub> BNn<sub>B</sub>n<sub>B</sub> BYYY BOO<sub>p</sub>

Sea-surface temperature

TT - Sea-surface temperature in tenths of degrees  
T<sub>w</sub>T<sub>w</sub>T<sub>w</sub>

TO - Source of information  $O_p$  (code table 14)

Coding: TTT<sub>w</sub>T<sub>w</sub>T<sub>w</sub> TOO<sub>p</sub>

Note: If the temperature is negative, the first digit should be coded by a minus sign

Source of information

OP - Primary source of information on which the chart is based  $O_p$  (code table 14)

OS - Secondary source of information on which the chart is based  $O_s$  (code table 14)

OT - Tertiary source of information on which the chart is based  $O_t$  (code table 14)

Coding: OPO<sub>p</sub> OSO<sub>s</sub> OTO<sub>t</sub>

Land area

LL - Grid point over land

LU - Bogus grid point (e.g. off the chart)

A list of variable identifiers and variables is given in Annex 1 and a list of variables with definitions in Annex 2. Code tables are given in Annex 3.

## 7. THE GRID

### 7.1 General

Provision is made for only one type of grid, the geographical. This is in order to facilitate the compilation of data from different centres which cover overlapping geographical areas.

The following definitions are used in this report:

Grid line: Line connecting all grid points having the same latitude

- Grid point: A point in the middle of a square or rectangle where the dimension corresponds to the mesh width along parallels and meridians. The distance between the grid points corresponds to the above mesh width. The ice information for a grid point is representative for the grid square in which the grid point lies.
- Data group: Group which contains information on one or several ice variables relative to one grid point (or several consecutive grid points with identical information on a grid line)
- Mesh width: The length of the sides of the rectangles in the middle of which the grid point lies. The sides of the rectangle will in most cases have different lengths in a geographical grid (e.g. 2° along parallels and 1° along meridians)
- Scanning mode: The order in which the grid points are scanned. In a geographical grid the grid points are scanned along grid lines from west to east (0°-360°). The grid lines are scanned towards increasing latitudes (south to north in the northern hemisphere and north to south in the southern).

## 7.2 Positioning of the grid

A grid will consist of a number of sequential grid lines along which lie a number of sequential grid points. An example of a geographical grid is given in Figure 3 below. The grid covers an area from 67°N to 83°N and 33°W to 40°E corresponding to the Norwegian ice chart shown in Figure 4 below. The grid squares have a mesh width of 2° longitude x 1° latitude from 67°N to 75°N and 4° longitude x 1° latitude from 76°N to 83°N. The origo is placed in the lower left corner. The grid lines are numbered and scanned from south to north and the grid points from west to east. When digitizing a chart the "co-ordinates" of the first point on each grid line shall be given, e.g. 008007. This would mean that the first point on grid line 008 to be scanned is No. 007. This point is marked with an x in Figure 3.

To identify a grid the following information is needed:

- The co-ordinates of the origo;
- The mesh width (grid distance) along meridians, which is constant for each ice chart;
- The longitude/latitude ratio for each grid line (this will allow the ratio long/lat to be changed when moving along the meridians).

The following ratio (long/lat) is recommended:

Latitude intervals long/lat	Mesh width along parallels if mesh width along meridians is 60 nm (1°lat)
00° - 50°      1	60 nm - 39 nm
50° - 75°      2	77 nm - 31 nm
75° - 80°      4	62 nm - 42 nm
80° - 85°      6	63 nm - 31 nm
85° - 87°     12	63 nm - 38 nm
87° - 89°     20	63 nm - 21 nm
89° - 89.5°   40	42 nm - 21 nm
89.5° - 90°   80	42 nm

### 7.3 Variation of grid resolutions

The information contained in an ice chart will generally not be evenly distributed. Over large areas the conditions may be fairly uniform and a coarse grid may suffice. In other areas more detailed information may be shown, especially along coast lines and along the ice edges. A more detailed recording of information in such limited areas without having to use a fine grid for the entire chart is made by the insertion of local sub-divisions of the grid. The sub-division is then indicated by a "sub-division indicator".

Three levels of sub-division have been provided for, with a view to dividing the original grid square into 4, 9 or 16 areas according to Figure 2. The basic grid may be defined as "first order" and the following finer meshes as second, third and fourth respectively. The number of sub-areas for each of these orders will be  $1^2 = 1$ ,  $2^2 = 4$ ,  $3^2 = 9$  and  $4^2 = 16$ .

Basic Grid (First order)	Second-order subdivision		Third-order subdivision			Fourth-order subdivision			
	3 .	4 .	7 .	8 .	9 .	13 .	14 .	15 .	16 .
			4 .	5 .	6 .	9 .	10 .	11 .	12 .
	1 .	2 .	1 .	2 .	3 .	5 .	6 .	7 .	8 .
			1 .	2 .	3 .	1 .	2 .	3 .	4 .

Figure 2 - Sub-division of a grid square

Example: A geographical grid has a basic mesh width of 1° latitude by 2° longitude; the second order will have four grid squares with a mesh width of 1/2° latitude by 1° longitude, the third order nine grid squares with a mesh width of 1/3° latitude by 2/3° longitude and the fourth order 16 grid squares with a mesh width of 1/4° latitude by 1/2° longitude. Expressed in degrees and minutes, this would be 1° x 2°, 30° x 1°, 20° x 40° and 15° x 30°. The grid sub-division is indicated by a sub-division indicator which for the basic grid is set to 1, second order to 2, third order to 3, and fourth order to 4.

## 8. CONTOUR CODING

The principles for contour coding are very simple. The ice charts that are to be digitized are all drawn so that the various, more or less homogeneous, ice areas are enclosed by lines following the boundaries of the areas. The types of ice that occur inside the boundaries are defined by the international system of sea-ice symbols which is a combination of figures inside an oval (the egg) and/or symbols drawn on the map. An ice chart is digitized by reading successive co-ordinates along each boundary line and storing the appropriate ice variables together with these co-ordinates. In open water or ice-free areas the temperature can be digitized by reading the successive co-ordinates of each temperature isoline and storing the corresponding temperature values with them.

The only definitions needed in connection with contour coding are:

Contour co-ordinates:	Co-ordinates defining successive points along a contour line (Note: The first and the last point should have identical co-ordinates)
Data group:	Group which contains information on one or several ice variables relative to an area enclosed by a contour line

## 9. EXAMPLES

To give an example of digitizing, the Norwegian ice chart from 1 February 1979 has been gridded and contour coded. The mesh width of the grid is constant 1° along the meridians and 2° along the parallels south of 75°N and 4° north of 75°N. The origo of the grid lies at 67°N, 33°W. The grid is shown in Figure 3. The sea-ice information has only been digitized for two grid lines, 009 and 010. In Example 1 each variable is identified at each grid point, while in Example 2 the variable CT (total concentration of ice) is defined in the header record and identified at each grid point by its position. The coding is given in Example 3. Only the area marked A has been digitized and the total concentration is defined in the header record (only two points along contour line are given).

Example 1 - Grid digitized Norwegian ice chart of 1 February 1979

```
SIGRIDINF
:NOMI:099:A7670003300:BO18036:C0100:D05CTCAWFWDTT
SIGRID01
:E97902011200:F009
=K02:L009007:M0032
:RO2CT92CA929908:RO3CT90:RO7CT80:N2CT80:CT40WF6WD3
:CT00:CT60WF6WD7:CT00:TT000:TT010:TT015:N2CT10:TT000:TT005
:CT40WF6WD7:CT50WF6WD7:RO3CT80:N2CT40:CT20WF6WD5:CT80:CT70
:CT30WF6WD1:RO2 CT20WF6WD2:CT60WF6WD3:CT70:RO2CT90:RO2CT80
=K04:L010004:M016
:CT92CA929908:RO2CT90:CT90:CT80:CT60WF6WD3:CT00TT005
:CT01TT005:N2CT01TT005:CT40WF6WD4:CT60WF6WD7:CT00
:CT70WF6WD3:RO2CT80:CT90:RO4CT90
=K04:L011004:M016
:99:99:99
```

Example 2 - Grid digitized Norwegian ice chart of 1 February 1979

```
SIGRIDINF
:NOMI:099:A7670003300:BO18036:C0100:D05CTCAWFWDTT
SIGRID01
:E97902011200:F009:G01CT
=K02:L009007:M0032
:RO292CA929908:RO390:RO780:N280:40WF6WD3:00:60WF6WD7:00
:00TT000:00TT010:00TT015:N210:00TT000:00TT005:40WF6WD7
:50WF6WD7:RO380:N240:20WF6WD5:80:70:30WF6WD1:RO220WF6WD2
:60WF6WD2:70:RO290:RO280
=K04:L010004:M016
:92CA929908:RO290:90:80:60WF6WD3:00TT005:01TT005:N201TT005
:40WF6WD4:60WF6WD7:00:70WF6WD3:RO280:90:RO490
=K04:L011004:M016
:99:99:99
```

Example 3 - Contour coded Norwegian ice chart of 1 February 1979

```
SIGRIDINF
:NOMI:098:D01CT
SIGRID01
:E97902011200:F009:G01CT
=M0049
:P7700001400:P7701500800:7710000500:7721000230
:7700001400:S89
=Mxxxx
:P7 .....
:99:99:99
```

## Explanation of the code figures

NO	= Norway
MI	= Meteorological Institute
099	= Geographical grid with definitions
098	= Contour coding with definitions
A7670003300	= Co-ordinates of origo (67°00'N, 33°00'W), scanning direction south to north
B0018036	= Maximum number of grid lines (18) and maximum number of grid points along grid line (36)
C0100	= Grid mesh (one degree along meridians)
D05CTCAWFWDTT	= Total number of variables digitized (5) and identifiers of these variables
E97902011200	= Date of chart (1 February 1979 12 UTC, no information on period of observations)
F009	= Serial number of chart (No. 9/1979)
G01CT (Example 2)	= Number of variables (1) and variable not identified at each grid point
=	= Start of grid or contour line
K02	= Ratio between longitude and latitude (2° long/1° lat)
L009007	= Co-ordinates of starting point of grid line
M0032	= Number of grid points along grid line
M0049	= Number of points along contour line
:	= Start of first data group
R02	= Number of grid points for which the same data apply (two grid points)
CT92 (Example 1)	= Total concentration = 10/10
92 (Example 2)	= Total concentration = 10/10
CA92	= Partial concentration of thickest ice = 10/10
99	= Stage of development of ice unknown
08	= Form of ice = fast ice
:	= Start of second data group (applies to third grid point)
R03	= Number of grid points for which the same data apply (three grid points)
CT90 (Example 1)	= Total concentration = 9/10
90 (Example 2)	= Total concentration = 9/10
P7700001400	= Co-ordinates of contour line point
S89	= Total ice concentration in ice area inside contour line
:	= Start of third data group (sixth grid point)
R07	= Seven consecutive grid points are identical
CT80 (Example 1)	= Total concentration = 8/10
80 (Example 2)	= Total concentration = 8/10
:	= Start of fourth data group (thirteenth grid point)
N2	= Grid square subdivided into four sub-squares
CT80 (Example 1)	= Total concentration in first sub-square = 8/10
80 (Example 2)	= Total concentration in first sub-square = 8/10
:	= Start of fifth data group (sub-square 2)
CT40 (Example 1)	= Total concentration = 4/10
40 (Example 2)	= Total concentration = 4/10
WF6	= Form of water opening = ice edge (6)
WD3	= Orientation of ice edge = SE - NE (3)
:	= Start of sixth data group (sub-square 4)

CT00 (Example 1)	=	Open water
00 (Example 2)	=	Open water
:	=	Start of seventh data group (sub-square 4)
CT60 (Example 1)	=	Total concentration = 6/10
60 (Example 2)	=	Total concentration = 6/10
WF6	=	Form of water opening = ice edge (6)
WD7	=	Orientation of ice edge = NW - SE (7)
:	=	Start of eighth data group (fourteenth grid point)
CT00 (Example 1)	=	Open water
00 (Example 2)	=	Open water
:	=	Start of ninth data group (fifteenth grid point)
00 (Example 2)	=	Open water
TT000	=	Sea-surface temperature = 00.0°C
.		
.		
.		

\*

\*

\*



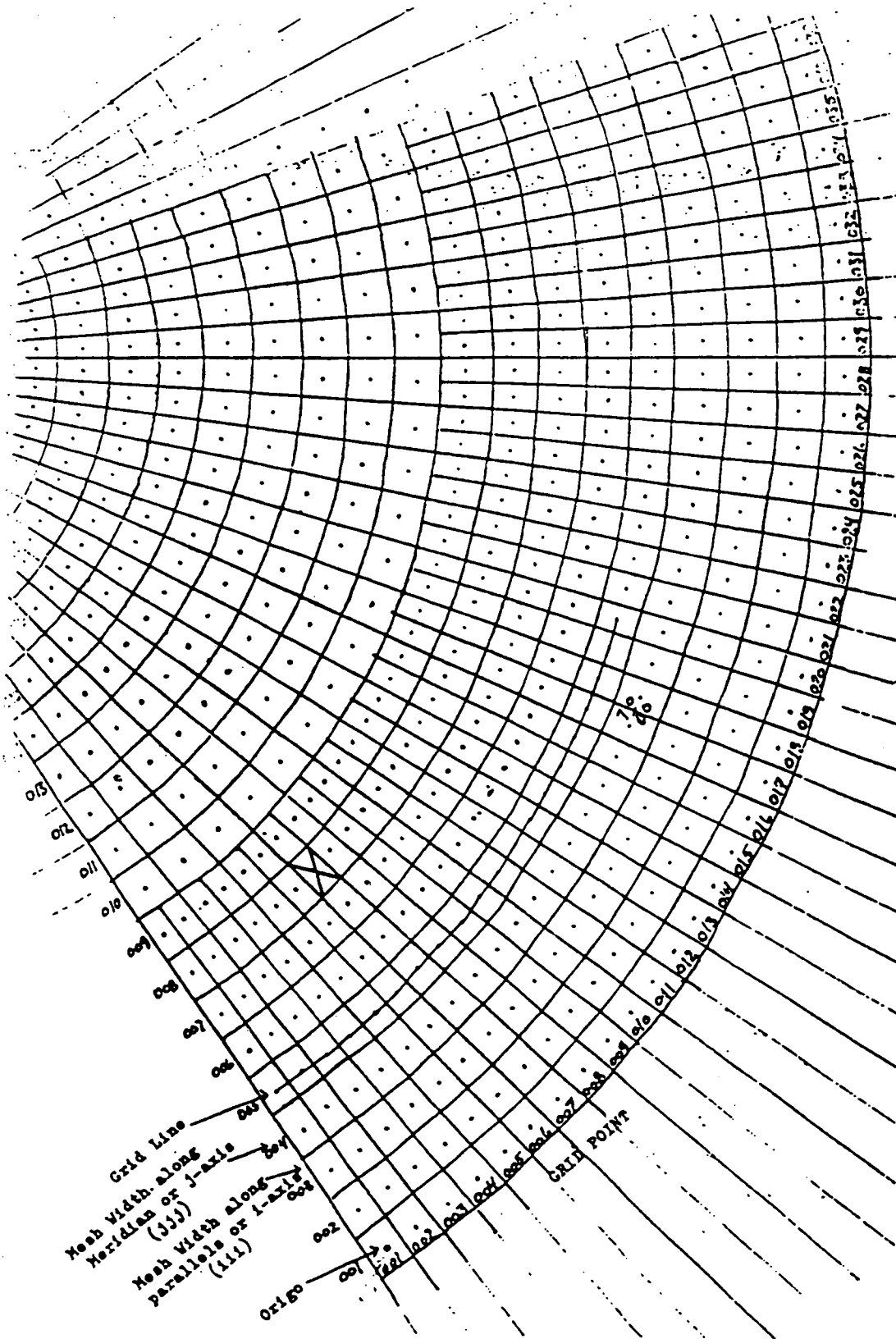


Figure 3 - Example of geographical grid

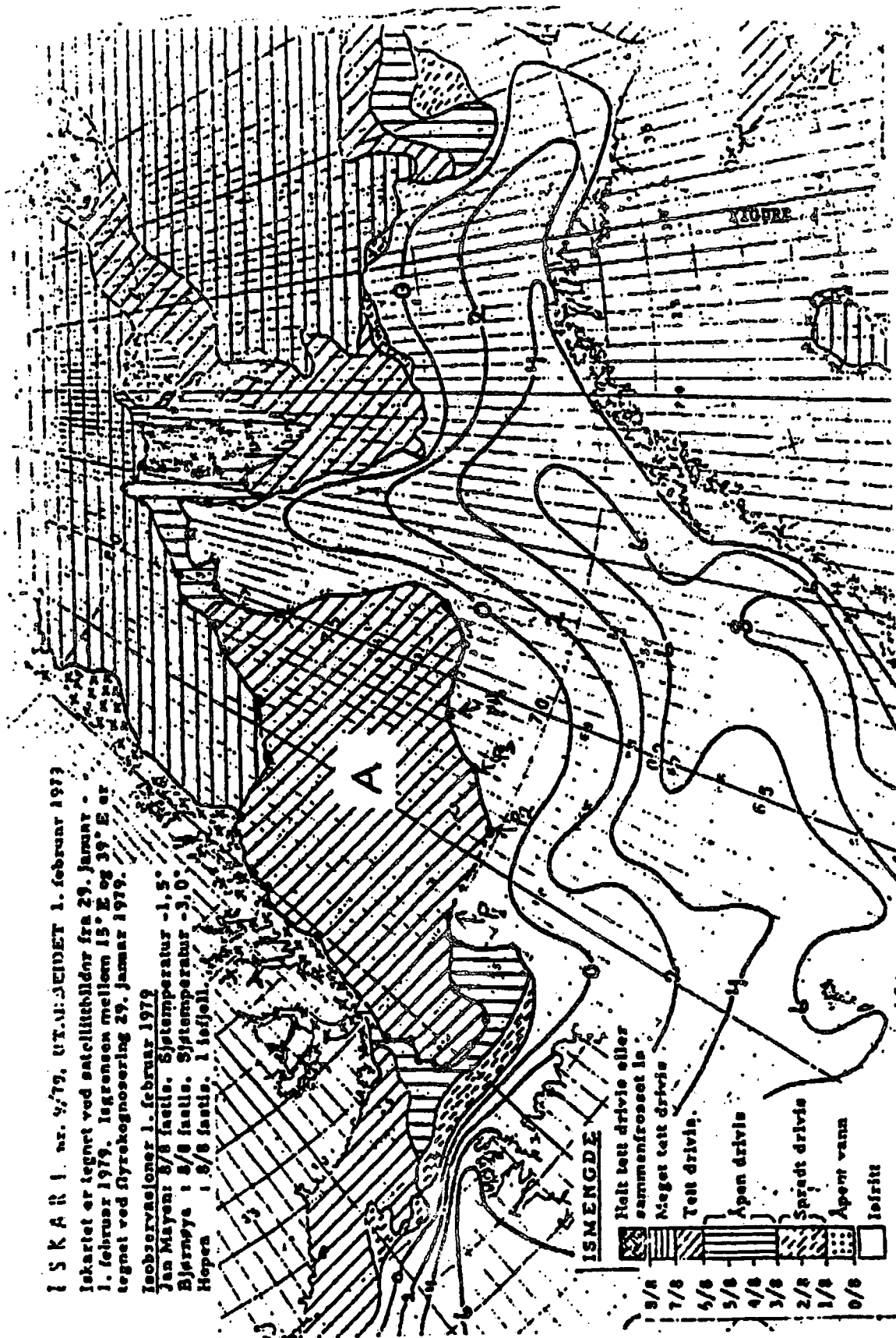


Figure 4 - Example of ice chart (Norway)

## ANNEX I

## LIST OF VARIABLE IDENTIFIERS AND VARIABLES

Variable identifier	Variable(s)	Number of variables	Digits per variable	Total number of digits
CT	CC	1	2	2
CA	C <sub>a</sub> C <sub>a</sub> S <sub>a</sub> S <sub>a</sub> F <sub>a</sub> F <sub>a</sub>	3	2	6
CB	C <sub>b</sub> C <sub>b</sub> S <sub>b</sub> S <sub>b</sub> F <sub>b</sub> F <sub>b</sub>	3	2	6
CC	C <sub>c</sub> C <sub>c</sub> S <sub>c</sub> S <sub>c</sub> F <sub>c</sub> F <sub>c</sub>	3	2	6
CF	F <sub>p</sub> F <sub>p</sub> F <sub>s</sub> F <sub>s</sub>	2	2	4
CN	S <sub>o</sub> S <sub>o</sub>	1	2	2
CD	S <sub>d</sub> S <sub>d</sub>	1	2	2
DP	d <sub>p</sub>	1	1	1
DD	D	1	1	1
DR	V <sub>i</sub> V <sub>i</sub>	1	2	2
DO	O <sub>p</sub>	1	1	1
WF	W <sub>f</sub>	1	1	1
WN	N <sub>o</sub>	1	1	1
WD	D	1	1	1
WW	W <sub>w</sub> W <sub>w</sub>	1	2	2
WO	O <sub>p</sub>	1	1	1
RN	R <sub>n</sub>	1	1	1
RA	R <sub>a</sub>	1	1	1
RD	D	1	1	1
RC	C <sub>r</sub> C <sub>r</sub>	1	2	2
RF	R <sub>f</sub> R <sub>f</sub>	1	2	2
RH	R <sub>h</sub> R <sub>h</sub>	1	2	2
RO	O <sub>p</sub>	1	1	1
RX	R <sub>x</sub> R <sub>x</sub>	1	2	2
EM	t <sub>ε</sub> t <sub>ε</sub> t <sub>ε</sub>	1	3	3
EX	t <sub>x</sub> t <sub>x</sub> t <sub>x</sub>	1	3	3
EI	t <sub>n</sub> t <sub>n</sub> t <sub>n</sub> t <sub>x</sub> t <sub>x</sub> t <sub>x</sub>	2	3	6
EO	O <sub>p</sub>	1	1	1
SC	C <sub>s</sub> C <sub>s</sub>	1	2	2
SN	s	1	1	1
SD	D	1	1	1
SM	m <sub>s</sub>	1	1	1
SA	m <sub>a</sub> m <sub>a</sub>	1	1	1
SO	O <sub>p</sub>	1	1	1
BL	B <sub>i</sub> B <sub>s</sub>	1	2	2
BD	D	1	1	1
BR	V <sub>i</sub> V <sub>i</sub>	1	2	2
BN	n <sub>B</sub> n <sub>B</sub>	1	2	2
BY	YY	1	2	2
BO	O <sub>p</sub>	1	1	1
TT	T <sub>w</sub> T <sub>w</sub> T <sub>w</sub>	1	3	3

Variable identifier	Variable(s)	Number of variables	Digits per variable	Total number of digits
TO	O <sub>p</sub>	1	1	1
OP	O <sub>p</sub>	1	1	1
OS	O <sub>s</sub>	1	1	1
OT	O <sub>t</sub>	1	1	1
LL	Not in use at this time	0	-	0
<b>Total</b>	<b>46</b>	<b>53</b>		<b>88</b>

\*

## ANNEX II

## LIST OF SEA-ICE VARIABLES

$B_i B_s$	- Type and size of iceberg (code table 12)
CC	- Total concentration of all ice in the area, reported in tenths (code table 1)
$C_a C_a$ ) $C_b C_b$ ) $C_c C_c$ )	- Partial concentration of respectively thickest, second thickest and third thickest ice reported in tenths (code table 1)
$C_r C_r$	- Concentration of topography feature in tenths (code table 1)
$C_s C_s$	- Concentration of snow coverage in tenths (code table 1)
D	- 1) Direction of dynamic processes (code table 5) 2) Orientation of water openings (code table 5) 3) Orientation of sastrugies (code table 5) 4) Orientation of topography feature (code table 5) Note: Compacting of ice in, for instance, a NE-SW direction is recorded either as 1 or as 5
$d_p$	- Dynamic processes (code table 4)
$F_a F_a$ ) $F_b F_b$ ) $F_c F_c$ )	- Form of ice corresponding to $S_a S_a$ , $S_b S_b$ and $S_c S_c$ respectively (code table 3)
$F_p F_p$ ) $F_s F_s$ )	- Predominant ( $F_p F_p$ ) and secondary ( $F_s F_s$ ) form of ice (code table 3)
$m_a m_a$	- Area coverage of melt water in tenths
$m_s$	- Melting forms (code table 11)
$N_o$	- Number of water openings (code table 7)
$n_B n_B$	- Number of icebergs (code table 13, WMO code table 2877)
$O_p$	- Observational method for individual variables (code table 14)
$O_p$ ) $O_s$ ) $O_t$ )	- Primary ( $O_p$ ), secondary ( $O_s$ ) and tertiary ( $O_t$ ) source of observation on which the ice chart is based (code table 14)
$R_a$	- Age of topography feature (code table 9)
$R_f R_f$	- Frequency of topography feature in number per nautical mile
$R_h R_h$	- Mean height of topography feature in tenths of metres
$R_x R_x$	- Maximum height of topography feature in tenths of metres

- $R_n$  - Nature of topography feature (code table 8)
- $S_a S_a$  )  
 $S_b S_b$  )  
 $S_c S_c$  ) - Stage of development of respectively thickest, second thickest and third thickest ice of which the concentration is reported by  $C_a C_a$ ,  $C_b C_b$  and  $C_c C_c$  respectively (code table 2)
- $S_d S_d$  - Stage of development of any remaining class of ice not reported by  $S_a S_a$ ,  $S_b S_b$ ,  $S_c S_c$  or  $S_o S_o$  (code table 2)
- $S_o S_o$  - Stage of development of ice thicker than  $S_a S_a$  but with a concentration less than 1/10 (code table 2)
- $s$  - Snow depth (code table 10, WMO code table 3870)
- $T_w T_w T_w$  - Sea-surface temperature in tenths of degrees
- $t_e t_e t_e$  - Mean thickness of ice in centimetres
- $t_n t_n t_n$  - Minimum thickness in thickness interval
- $t_x t_x t_x$  - Maximum thickness of ice in centimetres
- $V_i V_i$  - Rate of ice drift in tenths of knots
- $W_f$  - Form of water openings (code table 6)
- $W_w W_w$  - Width of water openings in hundreds of metres
- $YY$  - Day of month when icebergs were sighted

## ANNEX III

## CODE TABLES

Code table 1 Concentration ( $C_C, C_aC_a, C_bC_b, C_cC_c, C_rC_r, C_sC_s$ )

	Code figure
Ice free	00
Less than 1/10 (open water)	01
Bergy water	02
1/10	10
2/10	20
.	.
.	.
.	.
9/10	90
More than 9/10 less than 10/10 (9+)	91
10/10	92
Concentration intervals	$C_1C_h$
( $C_1$ = lowest concentration in interval)	
( $C_h$ = highest concentration in interval)	
Examples:	
1/10 - 3/10	13
4/10 - 6/10	46
7/10 - 9/10	79
7/10 - 10/10	71
Unknown	99

Code table 2 Thickness of ice or stage of development  
( $S_aS_a, S_bS_b, S_cS_c, S_dS_d, S_oS_o$ )

	Code figure
Ice free	00
Ice thickness in cm	01
	.
	.
	.
	50
----- 55 cm	51
60 cm	52
65 cm	53
70 cm	54
Thickness 75 cm	55
interval 80 cm	56
5 cm 85 cm	57
90 cm	58
95 cm	59

Code table 2 (contd.)

Code figure

-----	100 cm	60
	110 cm	61
	120 cm	62
	130 cm	63
Thickness	140 cm	64
interval	150 cm	65
10 cm	160 cm	66
	170 cm	67
	180 cm	68
	190 cm	69
-----	200 cm	70
Thickness	250 cm	71
interval	300 cm	72
50 cm	350 cm	73
-----	400 cm	74
Thickness	500 cm	75
interval	600 cm	76
100 cm	700 cm	77
	800 cm	78
	≥ 900 cm	79
No stage of development		80
New ice		81
Nilas, ice rind	< 10 cm	82
Young ice	10 - 30 cm	83
Grey ice	10 - 15 cm	84
Grey-white ice	15 - 30 cm	85
First year ice	30 - 200 cm	86
Thin first year ice	30 - 70 cm	87
Thin first year stage 1	30 - 50 cm	88
Thin first year stage 2	50 - 70 cm	89
For later use		90
Medium first year ice	70 - 120 cm	91
For later use		92
Thick first year ice	> 120 cm	93
For later use		94
Old ice		95
Second year ice		96
Multi-year ice		97
Glacier ice		98
Undetermined/unknown		99

Code table 3 Form of ice (F<sub>a</sub>F<sub>a</sub>, F<sub>b</sub>F<sub>b</sub>, F<sub>c</sub>F<sub>c</sub>, F<sub>p</sub>F<sub>p</sub>, F<sub>s</sub>F<sub>s</sub>)

Code figure

Pancake ice	30 cm - 3 m	00
Shuga/small ice cake, brash ice	< 2 m across	01
Ice cake	< 20 m across	02
Small floe	20 m - 100 m across	03
Medium floe	100 m - 500 m across	04
Big floe	500 m - 2 km across	05
Vast floe	2 km - 10 km across	06
Giant floe	> 10 km across	07



## Code table 3 (contd.)

## Code figure

Fast ice		08
Growlers, floebergs or floebits		09
Icebergs		10
Strips and patches	concentration 1/10	11
"	" 2/10	12
"	" 3/10	13
"	" 4/10	14
"	" 5/10	15
"	" 6/10	16
"	" 7/10	17
"	" 8/10	18
"	" 9/10	19
"	" 10/10	20
Level ice		21
Undetermined or unknown		99

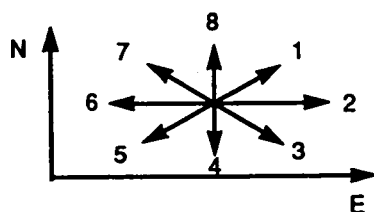
Code table 4 Dynamic processes ( $d_p$ )

## Code figure

Compacting ice, no intensity given	0
Compacting ice, slight	1
Compacting ice, considerable	2
Compacting ice, strong	3
Diverging ice	4
Shearing ice	5
Ice drift, rate 0.1 - 0.9 knots	6
Ice drift, rate 1.0 - 1.9 knots	7
Ice drift, rate 2.0 - 2.9 knots	8
Ice drift, rate 3.0 knots or more	9

Note: When actual rates of ice drift ( $V_1V_1$ ) are given, the code figure  $V_1V_1 = 99$  is used for rate unknown.

## Code table 5 Direction indicator (D) (see WMO code table 0700)



The direction is identified in relation to the grid. In a geographical grid, 1 would indicate north-east, 2 east, 3 south-east, etc.

Code table 6 Form of water opening ( $W_f$ )

## Code figure

Cracks	1
Crack at specific location	2
Lead	3
Frozen lead	4
Polynia	5
Ice edge	6

Code table 7 Number of water openings (N<sub>o</sub>)

	Code figure
1	1
2	2
3-5	3
4-10	4
> 10	5

Code table 8 Nature of topography feature (deformation) (R<sub>n</sub>)

	Code figure
Rafting	1
Hummocks	2
Ridges	3
Jammed brash barrier	4

Code table 9 Age of topography feature (R<sub>a</sub>)

	Code figure
New	1
Weathered	2
Very weathered	3
Aged	4
Consolidated	5

Code table 10 Snow depth (s) (see WMO code table 3870)Code table 11 Melting forms (m<sub>s</sub>)

	Code figure
No melt	0
Few puddles	1
Many puddles	2
Flooded ice	3
Few thaw holes	4
Many thaw holes	5
Dried ice	6
Rotten ice	7
Few frozen puddles	8
All frozen puddles	9

Code table 12 Ice of land origin (B<sub>i</sub>B<sub>s</sub>)

Type (B <sub>i</sub> )	Code figure
Growler and/or bergy bit	1
Iceberg unspecified	2
Iceberg glacier berg	3
Iceberg dome	4
Iceberg pinnacled	5
Iceberg tabular	6
Ice island	7
Floeberg	8
Radar target (suspected iceberg)	9

Size ( $B_s$ )	Code figure
Unspecified	0
Small	1
Medium	2
Large	3
Very large	4

Code table 13 Number of icebergs ( $n_{BNB}$ ) (see WMO code table 2877)

	Code figure
<u>Code table 14</u> Observational methods ( $O_p, O_s, O_t$ )	
Visual surface observation	1
Visual aircraft observation	2
Visual and infra-red satellite observation	3
Passive microwave satellite observation	4
Radar surface or airborne observation	5
Radar satellite observation (SAR)	6
Laser/scatterometer/sonar	7
Data buoys	8
Estimated (temporal and/or spatial)	9
Unknown	0

	Code figure
<u>Code table 15</u> Grid subdivision indicator ( $G_1$ )	
Second order subdivision (four squares)	2
Third order subdivision (nine squares)	3
Fourth order subdivision (16 squares)	4

Rec. 12 (CMM-X) - REVISION OF THE MANUAL ON MARINE METEOROLOGICAL SERVICES,  
VOLUME I, PART II

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) Recommendation 6 (CMM-VIII) - Marine Climatological Summaries Scheme (MCSS),

(2) Recommendation 8 (CMM-VIII) - International Maritime Meteorological Punch Card (IMMPC)/International Maritime Meteorological Tape (IMMT),

(3) The final report of CMM-IX, general summary, paragraph 7.2,

(4) The final report of the fifth session of the Working Group on Marine Climatology (Geneva, November 1986),

CONSIDERING:

(1) That the WMO Marine Climatological Summaries Scheme (MCSS) has proved to be a unique and valuable system for the collection, archival and processing of marine climatological data,

(2) That the requirements of all users for marine climatological information continue to expand,

RECOMMENDS that the revised text for the WMO Manual on Marine Meteorological Services, Volume I, Part II, Section 5, as contained in the annex to this recommendation, be introduced.

#### Annex to Recommendation 12 (CMM-X)

### 5. MARINE CLIMATOLOGICAL SUMMARIES SCHEME

Note: The international arrangements regarding the Marine Climatological Summaries Scheme are based on Resolution 35 (Cg-IV), Recommendation 36 (68-CMM), Recommendation 6 (CMM-VI), Recommendation 15 (CMM-VII), Recommendation 35 (79-CMM), Recommendation 6 (CMM-VIII), Recommendation 8 (CMM-VIII) and Recommendation 12 (CMM-X).

#### 5.1 Principles

The principles of the Marine Climatological Summaries Scheme are as follows:

##### Principle 1

The oceans and seas are divided into eight areas of responsibility for the purpose of preparing the marine climatological summaries and with a view to continued international co-operation regarding the collection, archiving and exchange of marine data.

##### Principle 2

Members having assumed responsibility for the respective areas as shown in Appendix II.4 - hereinafter called responsible Members - prepare climatological summaries for their area of responsibility. The preferred method of producing summaries is the chart form. However, Members may prepare, without cost to the World Meteorological Organization, climatological summaries in tabular form for selected representative areas. The tabular form of the summaries is to be used for fixed ship stations. The procedures are specified in paragraph 5.3.

##### Principle 3

Members operating fixed ship stations or selected, supplementary and auxiliary ship stations make available all surface observations from these stations to the appropriate responsible Members in accordance with the procedures specified in the agreed plan. The cost of this work shall be borne by the Member operating the ship stations.

##### Principle 4

Responsible Members make available, on request, copies of marine climatological data on magnetic tape in the agreed international exchange format (IMMPC or IMMT). The Member making the request may be asked to bear

the cost of copying the data. Other formats may be agreed between the requesting Member and the responsible Member provided that the requesting Member undertakes to bear the additional expenditure involved.

## 5.2 Areas of responsibility

Each responsible Member shall prepare climatological summaries of observations made after 1960 in accordance with the agreed plan (Appendix II.6), in chart form for its area of responsibility, in tabular form for a number of selected representative areas in its area of responsibility, or in tabular form for a number of fixed ship stations within its area and for fixed ship stations operated solely by the responsible Member in the area of another responsible Member.

### 5.2.1 Boundaries of areas of responsibility

5.2.1.1 The areas of responsibility shall be as given in Appendix II.4.

5.2.1.2 Examination of the boundaries of areas of responsibility with a view to making recommendations for adjustment shall be the responsibility of the Commission for Marine Meteorology (CMM). Such adjustments may become necessary if other Members wish to become responsible Members. Alternatively, existing responsible Members may find that it is necessary to adjust boundaries.

5.2.1.3 Adjustments of boundaries of areas of responsibility should be kept to a minimum.

### 5.2.2 Polar and extra-polar regions

For the purpose of marine climatological summaries, polar regions are defined as extending poleward from latitudes 60°N and 50°S respectively.

### 5.2.3 Selected representative areas

Note: This section applies only if the tabular form of summaries is produced.

5.2.3.1 Each responsible Member shall propose a number of selected representative areas from within its assigned area of responsibility. These areas should be chosen to achieve a good density of data or because of other requirements, such as climatic gradients and related factors.

5.2.3.2 Responsible Members shall submit the list of areas selected to the president of CMM who will ensure that the final choice of the selected representative areas, proposed by the responsible Members, provides a reasonable distribution throughout all areas of responsibility.

5.2.3.3 The indices system, which is given in Appendix II.5, shall be used to code the extent and location of the selected representative areas.

5.2.3.4 The selected representative areas shall remain fixed in their size, shape and position for as many years as possible.

Note: The recommended maximum size of a selected area in polar regions is 50 one-degree squares.

5.2.3.5 A map (or maps) showing the distribution of the selected representative areas in each area of responsibility shall be included in the summaries for that area.

#### 5.2.4 Fixed ship station area/ocean island stations

5.2.4.1 The "on station" area should be defined for each fixed station. This area should consist of the smallest number of adjacent one-degree squares, centred on the nominal fixed position, which contain at least 95 per cent of the observations from the fixed station.

5.2.4.2 It should be left to the discretion of the responsible Members to publish data from ocean island stations located in data-sparse areas as supplements to the marine climatological summaries. The island data summaries should not be combined with summaries of ocean data and a warning to this effect must be included in the supplements. Data from ocean island stations should be published in the same form as for fixed ship stations.

### 5.3 Procedures for preparing marine climatological summaries

#### 5.3.1 General plan

The plan for the production of marine climatological summaries is shown in Appendix II.6.

#### 5.3.2 Layout of marine climatological summaries

##### 5.3.2.1 Chart form

The layout of the marine climatological summary in chart form is given in Appendix II.7.

##### 5.3.2.2 Tabular form

The parameters to be included in the tabular form of marine climatological summaries are given in Appendices II.8, II.9 and II.10.

#### 5.3.3 Period of marine climatological summaries

##### Q 5.3.3.1 Annual summaries

The routine publication of annual summaries ceased in 1981 (Recommendation 6 (CMM-VIII)). However, annual climatological summaries may be published by the responsible Members on an optional basis, preferably in chart form. The processing of data shall be continued so that the original observations will be readily available upon request.

##### Q 5.3.3.2 Decadal summaries

Decadal climatological summaries shall be prepared for the periods 1961-70, 1971-80, 1981-90.

5.4. Minimum number of observations for the preparation of the marine climatological summaries

5.4.1 General

All available data shall be used in the preparation of annual and decadal summaries.

5.4.2 Annual summaries

5.4.2.1 The annual mean for any unit area or selected representative area should not be calculated if there are less than ten observations from the area in any individual month.

5.4.2.2 Statistics for chart areas and frequency tables should not be prepared if there are less than ten observations from a unit area of a chart or selected representative area or tabulation in any individual month.

5.4.2.3 For tabular summaries, the data should be LISTED if there are less than 40 observations from a selected representative area in any individual month and those observations have been made on less than ten different days of the month.

5.4.2.4 For tabular summaries, the data should be SUMMARIZED if there are less than 40 observations from a selected representative area in any individual month and those observations have been made on ten or more different days of the month.

5.4.2.5 The data should be SUMMARIZED in charts or tabulations if there are more than 40 observations from a selected representative area in any individual month.

5.4.3 Decadal summaries

5.4.3.1 Summaries are prepared for decadal periods and not for individual years if there are less than 40 observations from a selected representative area in any individual month.

5.4.3.2 In preparing a climatological summary for a decade or longer period, the summary for each month should be prepared by combining all available observations from months of that name during the period of the summary.

5.4.3.3 It must be clearly stated in the text of the summary when data are summarized which are known to be irregularly distributed over the ten-year period.

5.5 Parameters to be included in and form of the marine climatological summaries

5.5.1 Fixed ship stations

Annual and decadal summaries for fixed ship stations shall be produced in tabular form and shall contain the parameters listed in Appendix II.8.

## 5.5.2 Polar and extra-polar regions

### 5.5.2.1 Annual summaries -----

Data for annual summaries shall be prepared either in a format suitable for publication of charts or alternatively in a format suitable for publication of tables. The type of output required in any individual year is specified in Appendix II.6.

### 5.5.2.2 Decadal summaries -----

Decadal summaries shall be published either in chart form (preferred) or in tabular form as also indicated in Appendix II.6.

### 5.5.2.3 Chart form -----

Parameters which are to be included in the summaries which are produced in chart form are listed in Appendix II.7.

### 5.5.2.4 Tabular form -----

Parameters which are to be included in the tabular summaries are listed in Appendices II.8, II.9 and II.10.

## 5.5.3 Inventory of marine climatological summaries

During the first quarter of each year, responsible Members shall send a list of marine climatological summaries which have been produced during the previous year to the Secretary-General.

## 5.6 Marine climatological data

### 5.6.1 Collection and exchange of data

5.6.1.1 Members operating fixed ship stations or selected and supplementary ship stations should transfer all surface observations from these stations onto magnetic tape (or punched cards). It is recommended that the data be arranged in the agreed format of the International Maritime Meteorological Tape (IMMT) as described in Appendix II.11 (or in the format of the International Maritime Meteorological Punch Card (IMMPC) as described in Appendix II.12). The data should be dispatched to the appropriate responsible Member at half-yearly intervals.

5.6.1.2 The Member originating the data should notify the responsible Member of the dispatch of the half-yearly collection of data. The notification should contain details of the order in which the records are sorted.

5.6.1.3 Members may use the alternative format for maritime meteorological tapes which is given in Appendix II.13. Any alternative format must only be used by mutual agreement between the two Members which are exchanging data.

5.6.1.4 Members should ensure that magnetic tapes are 9-track and written at a density of 1600 or 6250 bpi. The tapes should be unlabelled and written in EBCDIC or ASCII with blocking factor 10.



5.6.1.5 Members may dispatch data from auxiliary ships to responsible Members using a mutually agreed format. These data should be specifically mentioned in the notice of dispatch which is sent to the responsible Member.

5.6.1.6 The responsible Member should indicate clearly, in the summary, the extent to which auxiliary ship data have been used.

#### 5.6.2 Inventory of marine climatological data

Responsible Members shall keep an inventory of all marine climatological data received from Members. During the first quarter of each year the responsible Member shall forward a list of Members which have contributed data to the Secretary-General.

#### 5.6.3 Quality control of data

5.6.3.1 All Members should make every effort to check the positions and call signs of ships and the date and hour of observations before dispatching the data to the responsible Members. It is much more effective for the Member to make this check because it has the original manuscript containing the data.

5.6.3.2 Quality control of marine data by Members and responsible Members should be continued and improved. Details of national quality-control schemes should be made available to responsible Members.

5.6.3.3 If the facilities exist, at least the minimum quality-control procedures established by the CMM Working Group on Marine Climatology (Appendix II.14) are recommended for use by Members.

#### 5.6.4 Period before 1961

5.6.4.1 The Historical Sea Surface Temperature Data (HSSTD) project provides for the collection and summarizing of marine climatological data for the period 1861 to 1960. The participants in the HSSTD project have agreed to exchange any additional digitized historical data as they become available.

5.6.4.2 Members having historical data which are not yet included in the HSSTD project should send those data to the appropriate participating Member. The data should be converted into the agreed exchange format of the HSSTD project or, if mutually agreeable, in the international exchange format (IMMT or IMMPC) before dispatch to the participating Member. The cost of conversion should be borne by the Member supplying the data.

5.6.4.3 The exchange format for historical data should be that agreed between the participating Members and is shown in Appendix II.15.

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## APPENDICES

APPENDIX II.4	Areas of responsibility and responsible Members for marine climatological summaries	Existing manual
APPENDIX II.5	Area indices system for marine climatological summaries	Existing manual with inclusion of paragraph 5.2.2.4
APPENDIX II.6	Plan for the production of marine climatological summaries over the period 1961-1990	CMM-VIII
APPENDIX II.7	Layout for marine climatological summary charts for representative areas	CMM-VIII
APPENDIX II.8	Parameters to be included in marine climatological summaries for fixed ship stations	Existing manual
APPENDIX II.9	Parameters to be included in marine climatological summaries for selected representative areas in extra-polar regions	Existing manual
APPENDIX II.10	Parameters to be included in marine climatological summaries for selected representative areas in polar regions	Existing manual
APPENDIX II.11	Layout for the International Maritime Meteorological Tape (IMMT)	CMM-VIII
APPENDIX II.12	Layout for the International Maritime Meteorological Punch Card (IMMPC)	CMM-VIII
APPENDIX II.13	Layout for a maritime meteorological tape for possible use in national and bilateral data exchange	CMM-VIII
APPENDIX II.14	Minimum quality-control standards	Considered under agenda item 8.3
APPENDIX II.15	Historical sea-surface temperature data exchange format	New and included here

APPENDIX II.15  
(see paragraph 5.6.4.3)

## HSST COMPACT FORMAT

CD	MSQ	Q	LAT	LON	YR	MO	DA	HR	WIND DIRECT	WIND SPD	AIR TEMP	SEA TEMP	AREA
XXX	XXX	X	XXX	XXXX	XXX	XX	XX	XX	iXX	iXXX	XXX	XXX	XXXX

Field	Col.	Element*
001	1-3	Card deck number in TDF-11
002	4-6	Marsden 10° square
003	7	Quadrant
004	8-10	Latitude
005	11-14	Longitude
006	15-17	Year (last 3 digits, i.e. 927 = 1927)
007	18-19	Month
008	20-21	Day
009	22-23	Hour-GMT
010	24-26	Wind direction and indicator
011	27-30	Wind speed and indicator
012	31-33	Air temperature
013	34-36	Sea-surface temperature
014	37-40	Area

\* TDF-11 describes elements

Logical rec. = 40  
Blocking factor = 100

\*

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\*

## RECOMMENDATION 12

HSST DATA SET - EXTENDED FORMAT FOR ATLANTIC AND INDIAN OCEANS  
AND MEDITERRANEAN DATA

Character UK/US	Notation NL/DL	Record Identifier	
1		H	
2		M	Historical Marine Data
3		D	
4		Identifies the of origin of the tape	
5			
6	1	Octant	
7	2		
8	3	Square number	
9	4		
10	5	Month	
11	6		
12	7	Year	
13	8		
14	9		
15	10		Latitude
16	11	Position	
17	12	Unit and tenths	Longitude
18	13		
19	14		
20	15	Day of month	
21	16		
22	17	Hour of day (00-23 GMT)	
23	18	+, -	
24	19		
25	20	Sea temperature (tenths of °C)	
26	21		
27	22	+, -	
28	23		
29	24	Air temperature (tenths of °C)	
30	25		
31	26	+, -, e	e = Ice
32	27		
33	28	Wet bulb temperature (tenths of °C)	
34	29		
35	30		000 = calm
36	31	Wind direction (whole degrees)	990 = variable
37	32		999 = missing
38	33		
39	34	Wind speed (tenths of m/s)	
40	35		
41	36		
42	37		
43	38	Barometric pressure (tenths of hPa)	
44	39		
45	40		
46	41	Total cloud amount (oktas)	
47	42	Flags for sea temperature	
48	43	Flags for air temperature	
49	44	Flags for wind	
50	45	F sus 1	
51	46	F sus 2	Flags for suspect values

## CODES FOR FLAG CHARACTERS

Flags for sea temperatures and state of wet bulbF sea

- 0 Sea temperature measured to 0.1°F accuracy
- 1 Sea temperature measured to 0.1°C accuracy
- 2 Sea temperature measured to 0.5°F accuracy
- 3 Sea temperature measured to 0.5°C accuracy
- 4 Sea temperature measured to 1°F or 1°C accuracy
- 5)
- 6) As for codes 0-4, but also the wet bulb is not frozen,
- 7) even when showing temperature below freezing point
- 8)
- 9)

Flags for dry bulb and wet bulb temperaturesF air

- 0 Air temperatures measured to 0.1°F accuracy
- 1 Air temperatures measured to 0.1°C accuracy
- 2 Air temperatures measured to 0.5°F accuracy
- 3 Air temperatures measured to 0.5°C accuracy
- 4 Air temperatures measured to 1°F or 1°C accuracy
- 5)
- 6) As for codes 0-3, but temperatures were measured by an
- 7) aspirated or whirling psychrometer
- 8)
- 9) Original units of temperature or accuracy unknown

Flags for wind observations

- 0 360 point compass )
- 1 36 point compass )
- 2 32 point compass ) Wind speed measured
- 3 16 point compass )
- 4 8 point compass )
- 5)
- 6) As for codes 0-4, but wind speed estimated or converted
- 7) from Beaufort force, or method of observation unknown
- 8)
- 9)

Flags for suspect values of sea temperature, air temperature and windF sus 1

- 0 No suspect element
- +1 Sea temperatures >97°F (36.1°C)
- +2 Dry bulb or wet bulb not in range -5°F to 99.9°F (-20.5°C to 37.7°C) or wet bulb > dry bulb
- +4 Wind direction 990 (variable) and wind speed >5 kt

Flags for suspect values of pressure and cloud amountF sus 2

0	No suspect pressure or cloud amount
+1	Pressure <940 or >1050 (pressures <800 or >1080 have been rejected)
+2	Cloud amount not reported
+4	Additional observation at the same time in the same 1° square, though not identical

The values of F sus 1 and F sus 2 may also be 3, 5, 6 or 7. This means that more than one value is suspect, and the code figures have been added together for the suspect values.

Rec. 13 (CMM-X) - SPECIALIZED LONG-TERM EDUCATION AND TRAINING IN MARINE METEOROLOGY AND PHYSICAL OCEANOGRAPHY

THE COMMISSION FOR MARINE METEOROLOGY:

NOTING:

(1) The high priority given by Tenth Congress to marine meteorological services and to improved specialized education and training in marine meteorology and physical oceanography,

(2) The report of the Rapporteur on Education and Training to CMM-X,

(3) Recommendation 11. (JWC-IGOSS-V) - Specialized long-term education and training related to IGOS,.

BEING AWARE that, with the notable exception of RMTC Manila, there is presently a lack of long-term specialized training courses in marine meteorology and physical oceanography at Regional Meteorological Training Centres,

CONSIDERING:

(1) That properly trained personnel are essential to the further development, implementation and operation of marine meteorological services, and that training should extend also to the users of marine meteorological services, where this does not already occur,

(2) That the expanded involvement of developing countries in programmes such as the Integrated Global Ocean Services System and the World Climate Research Programme is also dependent on the availability of specialized personnel in the field of marine meteorology and physical oceanography,

RECOGNIZING that long-term specialized training courses in marine meteorology and physical oceanography are essential for the provision of suitably trained personnel for these purposes,

## RECOMMENDS:

(1) That high priority within WMO should be given to the development of long-term specialized training courses in RMTCs in the field of marine meteorology and physical oceanography;

(2) That in particular every effort should be made to establish a six-month course on marine meteorology and physical oceanography at RMTC Nairobi as a matter of some urgency;

(3) That, whenever possible, these courses should be developed and operated in close collaboration with IOC and the oceanographic community;

(4) That following the successful establishment of a course in Nairobi, consideration should then be given to the establishment of similar courses in RMTCs Oran and Buenos Aires;

## REQUESTS the Secretary-General:

(1) To approach funding sources, including UNDP, with a view to establishing appropriate long-term funding support for such courses;

(2) In consultation with the president of CMM, the Secretary IOC and the Directors of the RMTCs concerned, to develop as soon as possible curricula for these courses, for the consideration of the EC Panel of Experts on Education and Training.

Rec. 14 (CMM-X) - REVIEW OF RESOLUTIONS OF THE EXECUTIVE COUNCIL BASED ON PREVIOUS RECOMMENDATIONS OF THE COMMISSION FOR MARINE METEOROLOGY

## THE COMMISSION FOR MARINE METEOROLOGY,

NOTING with satisfaction the action taken by the Executive Council on the previous recommendations of the Commission for Marine Meteorology,

CONSIDERING that many of these recommendations have become redundant in the meantime,

## RECOMMENDS:

(1) That Resolutions 8 and 9 (EC-XXXVII) no longer be considered necessary;

(2) That Resolutions 15 (EC-XXI), 12 (EC-XXV) and 10 (EC-XXXVII) be kept in force.

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A N N E X I

LIST OF PERSONS ATTENDING THE SESSION

1. Officers of the session

F. Gérard	president
R. J. Shearman	vice-president

2. Representatives of Members of WMO

F. Ounnar	principal delegate	Algeria
A. Guersi	delegate	
S. Herda	delegate	
M. O. Yermèche	delegate	
A. Zehar	delegate	
M. A. Rebolledo	principal delegate	Argentina
R. E. Poy	delegate	
D. Linforth	principal delegate	Australia
J. B. R. Alvarenga	principal delegate	Brazil
D. O'Neill	principal delegate	Canada
M. Macleod	alternate	
B. Byron	delegate	
J. R. Keeley	delegate	
D. Da Graça	principal delegate	Cape Verde
Wu Xianwei	principal delegate	China
Lu Jialian (Ms)	delegate	
Qian Zhicun	delegate	
Yang Huating	delegate	
N. Martin-Leyes (Ms)	principal delegate	Colombia
B. Rasmussen	principal delegate	Denmark
M.-L. Komulainen (Ms)	principal delegate	Finland
H. Grönvall	delegate	
C. Billard	principal delegate	France
F. Gérard	delegate	
M. Kerdoncuff (Ms)	delegate	
D. Lambergeon	delegate	
A. Lebeau	delegate	
G. Le Goff	delegate	
H. H. Lejeune	delegate	
L. Lesnevan	delegate	
J. Manach	delegate	
J. O. Holz	principal delegate (13-17.2)	German Democratic
G. Schmager	principal delegate (6-12.2)	Republic
	delegate (13-17.2)	



2. Representatives of Members of WMO (contd.)

A. Kresling	principal delegate	Germany, Federal
G. Olbrück	delegate	Republic of
K. Wurodu	principal delegate	Ghana
S. K. Xatse	delegate	
G. Kassimidis	principal delegate	Greece
H. K. Lam	principal delegate	Hong Kong
M. Moeini Najafabadi	principal delegate	Iran, Islamic
G. K. Atigh	delegate	Republic of
J. Nouri	delegate	
M. Yoosefi	delegate	
L. Burke	principal delegate	Ireland
A. Teitelman	principal delegate	Israel
L. Casarsa	principal delegate	Italy
M. Capaldo	delegate	
G. C. Ruggeri	delegate	
K. Yamamoto	principal delegate	Japan
J. W. Muhoro	principal delegate	Kenya
J. T. Lim	principal delegate	Malaysia
Lemrabott Ould Abdy	principal delegate	Mauritania
S. Ragoonaden	principal delegate	Mauritius
H. Villanueva	principal delegate	Mexico
C. G. Korevaar	principal delegate	Netherlands
L. J. Mahieu	delegate	
A. K. Laing	principal delegate	New Zealand
Y. Salahu	principal delegate	Nigeria
J. Guddal	principal delegate	Norway
Jong-Hon Bong	principal delegate	Republic of Korea
A. M. Ly	principal delegate	Senegal

2. Representatives of Members of WMO (contd.)

A. Jansá	principal delegate	Spain
J. L. Sanchez Aylo	delegate	
T. Thompson	principal delegate	Sweden
S. Andersson	delegate	
T. Jedidi	principal delegate	Tunisia
M. Senhan	principal delegate	Turkey
A. Chilingarov	principal delegate	Union of Soviet
S. S. Lappo	alternate	Socialist Republics
B. Bakoumov	delegate	
I. E. Frolov	delegate	
V. Krasiuk	delegate	
F. Terziev	delegate	
G. V. Mackie	principal delegate	United Kingdom of
R. J. Shearman	alternate	Great Britain and
J. Hopkins	delegate	Northern Ireland
A. M. Morrice	delegate	
U. M. Lifiga	principal delegate	United Republic of
D. N. Wambura	delegate	Tanzania
R. Landis	principal delegate	United States of
D. Barnett	delegate	America
J. Elms	delegate	
G. Hamilton	delegate	
D. B. Rao	delegate	
J. B. Tupaz	delegate	
A. Morán	principal delegate	Uruguay
A. Piñero Díaz	principal delegate	Venezuela
Nguyen Ngoc Thuy	principal delegate	Viet Nam
Ali Abdulbari Ahmed	principal delegate	Yemen Arab Republic

3. Invited experts

C. Billard  
Y. Tourre

4. Representatives of international organizations

U. Mawisa	Organization of African Unity (OAU)
G. Kullenberg	United Nations Educational, Scientific and
D. Krause	Cultural Organization (Unesco)

4. Representatives of international organizations (contd.)

G. Soares R. Godin A. Tolkachev	Intergovernmental Oceanographic Commission (IOC)
J. L. Thompson	International Maritime Organization (IMO)
M. Taillade L. Mesnier	CLS/Service Argos
A. B. Alexiou	Committee for Climate Changes and the Ocean (CCCO)
G. Bridge	European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
M. Van Ommen	International Federation of Shipmasters' Associations (IFSMA)
A. C. Fuller A. Civetta	International Hydrographic Organization (IHO)
J. L. Fear	International Maritime Satellite Organization (INMARSAT)

5. WMO Secretariat

T. D. Potter	Director, World Weather Watch Department; representative of the Secretary-General
P. E. Dexter	Chief, Ocean Affairs Division, World Weather Watch Department
Y. Tréglos	WMO Scientific Officer posted to IOC
F. Guzman	Ocean Affairs Division, World Weather Watch Department
E. Dar-Ziv (Ms)	Conference Officer

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A N N E X II

AGENDA

Agenda item	Res./Rec. adopted
1. OPENING OF THE SESSION	
2. ORGANIZATION OF THE SESSION	
2.1 Consideration of the report on credentials	
2.2 Adoption of the agenda	
2.3 Establishment of committees	
2.4 Other organizational matters	
3. REPORT BY THE PRESIDENT OF THE COMMISSION	
4. REPORTS BY THE CHAIRMEN OF WORKING GROUPS AND BY RAPPORTEURS	
5. MARINE METEOROLOGICAL SERVICES	1, 2
6. MARINE TELECOMMUNICATIONS	
6.1 Marine telecommunication arrangements for data collection and transmission	
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7. SYSTEMS AND TECHNIQUES FOR MARINE OBSERVATION AND DATA COLLECTION	
7.1 Marine observing methods and instrumentation	4, 5
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7.3 WMO Wave Programme	
7.4 Observational data requirements	
8. MARINE CLIMATOLOGY	
8.1 Contribution of CMM to the WCP	
8.2 Marine Climatological Summaries scheme	

Agenda item	Res./Rec. adopted
8.3 Marine climatological data banks	7, 8
8.4 Other matters related to marine climatology	
9. SEA ICE	9, 10 11
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11. GUIDES AND OTHER TECHNICAL PUBLICATIONS	
12. EDUCATION AND TRAINING, TECHNOLOGY TRANSFER AND IMPLEMENTATION SUPPORT ACTIVITIES IN THE FIELD OF CMM	
12.1 Specialized education and training activities	13
12.2 Technology transfer and implementation support activities	
13. RELATIONSHIP WITH OTHER WMO PROGRAMMES AND THOSE OF OTHER ORGANIZATIONS AND BODIES	
14. WMO LONG-TERM PLAN	
15. ESTABLISHMENT OF WORKING GROUPS AND NOMINATION OF RAPPORTEURS	1, 2, 3, 4, 5
16. REVIEW OF PREVIOUS RESOLUTIONS AND RECOMMENDATIONS OF THE COMMISSION AND OF RELEVANT RESOLUTIONS OF THE EXECUTIVE COUNCIL	6 14
17. ELECTION OF OFFICERS	
18. DATE AND PLACE OF THE ELEVENTH SESSION	
19. CLOSURE OF THE SESSION	

WORK PROGRAMME OF CMM FOR THE PERIOD 1989-1993

Major project	Task	Execution	Target date
1. Marine Meteorological Services	(a) Monitoring of marine user requirements and making recommendations for relevant MMS including updating the <u>Guide to</u> and <u>Manual on MMS</u> ;	WG on B/MMS with the assistance of the secretariat	Continuous
	(b) Co-ordination of MMS with related service organizations such as IMO, IHO, IOC and with user organizations (E&P Forum, ICS, FAO, etc.);	WG on B/MMS and Secretariat	Continuous
	(c) Revision and updating of "Marine Services Programme to the Year 2000";	WG on B/MMS	1993
	(d) Development, in co-ordination with IMO, IHO and INMARSAT, of a revised and updated system for the provision of MMS to shipping, compatible with the requirements of the GMDSS;	WG on B/MMS and Secretariat	1991
	(e) Development, in conjunction with IMO and UNEP, of a co-ordinated system for meteorological support for marine pollution emergency operations;	WG on B/MMS and Secretariat	1993
	(f) Monitoring and preparation of guidance material on the application of remote-sensing techniques to the provision of MMS, including the preparation of appropriate amendments to the <u>Manual on</u> and <u>Guide to MMS</u> ;	WG on S/MMS, WG on TP	Continuous
	(g) Review of developments in requirements for and provision of specialized MMS, including the preparation of guidance material on: (i) services for ports and harbour areas, (ii) services for fisheries, (iii) weather routing of ships, (iv) coastal marine services, (v) MMS in sea-ice areas, including sea-ice services;	WG on S/MMS, WG on SI WG on TP and Secretariat	1993
	(h) Development of procedures and guidance in the provision of sea-ice data for operational services.	WG on SI	Continuous

Annex to paragraph 3.10 of the general summary

A N N E X  
I I I

## Annex III (contd)

Major project	Task	Execution	Target date
2. Marine climatology	(a) Co-ordination of marine climatological requirements (including for sea-ice data) with WCP and provision of technical advice on exchange and archival of such data;	WG on S/MMS, WG on SI	Continuous
	(b) Continued review and revision as appropriate of MCSS;	WG on S/MMS	Continuous
	(c) Further study of operationally and scientifically useful marine data from remote sensing and numerical modelling, with a view to archival and exchange;	WG on S/MMS, WG on SI	1993
	(d) Evaluation and development of marine climatological data exchange for special projects;	WG on S/MMS	Continuous
	(e) Review and revision of relevant sections of the <u>Guide to</u> and <u>Manual on MMS</u> ;	WG on S/MMS, WG on SI with Secretariat	Continuous
	(f) Finalization and publication of <u>Guide to Applications of Marine Climatology</u> ;	WG on S/MMS with Secretariat	1991
	(g) Continuing review of quality-control procedures for marine climatological data;	WG on S/MMS	Continuous
	(h) Establishment of a global digital sea-ice data bank;	WG on SI	1993
	(i) Promote co-operation in improving the methodology for the acquisition, exchange, processing, storage and dissemination of sea-ice data (including remotely sensed data).	WG on SI	Continuous

## Annex III (contd)

Major project	Task	Execution	Target date
3. Marine observations and data collection	(a) Improvement of the Vos scheme: (i) improved data quality, (ii) automation of observations, (iii) directed ship recruitment in data-sparse areas;	WG on B/MMS, WG on S/MMS with Secretariat and VSOP-NA	Continuous
	(b) Improvement of real-time data collection procedures through: (i) enhanced use of INMARSAT, (ii) improvements in coastal radio station network, (iii) increased automation, (iv) increased use of other satellite-based systems such as Argos and the geostationary satellites;	WG on B/MMS with Secretariat	Continuous
	(c) Investigation of use of small craft for ocean weather data;	WG on B/MMS, WG on TP with Secretariat	1993
	(d) Marine data density studies;	WG on TP with WCRP, CBS WG on GOS and Secretariat	1993
	(e) Preparation for the collection, processing and application of satellite ocean data (including priorities and procedures);	Ad hoc group on remote sensing WG on SI	1993
	(f) Provision of guidance on the application of satellite ocean data;	Ad hoc group on remote sensing	1993
	(g) Co-ordination with IOC in development of composite ocean observing systems;	AMG	Continuous
	(h) Specification of requirements of MMS for ocean data	WG on B/MMS, WG on TP, AMG	1991



## Annex III (contd)

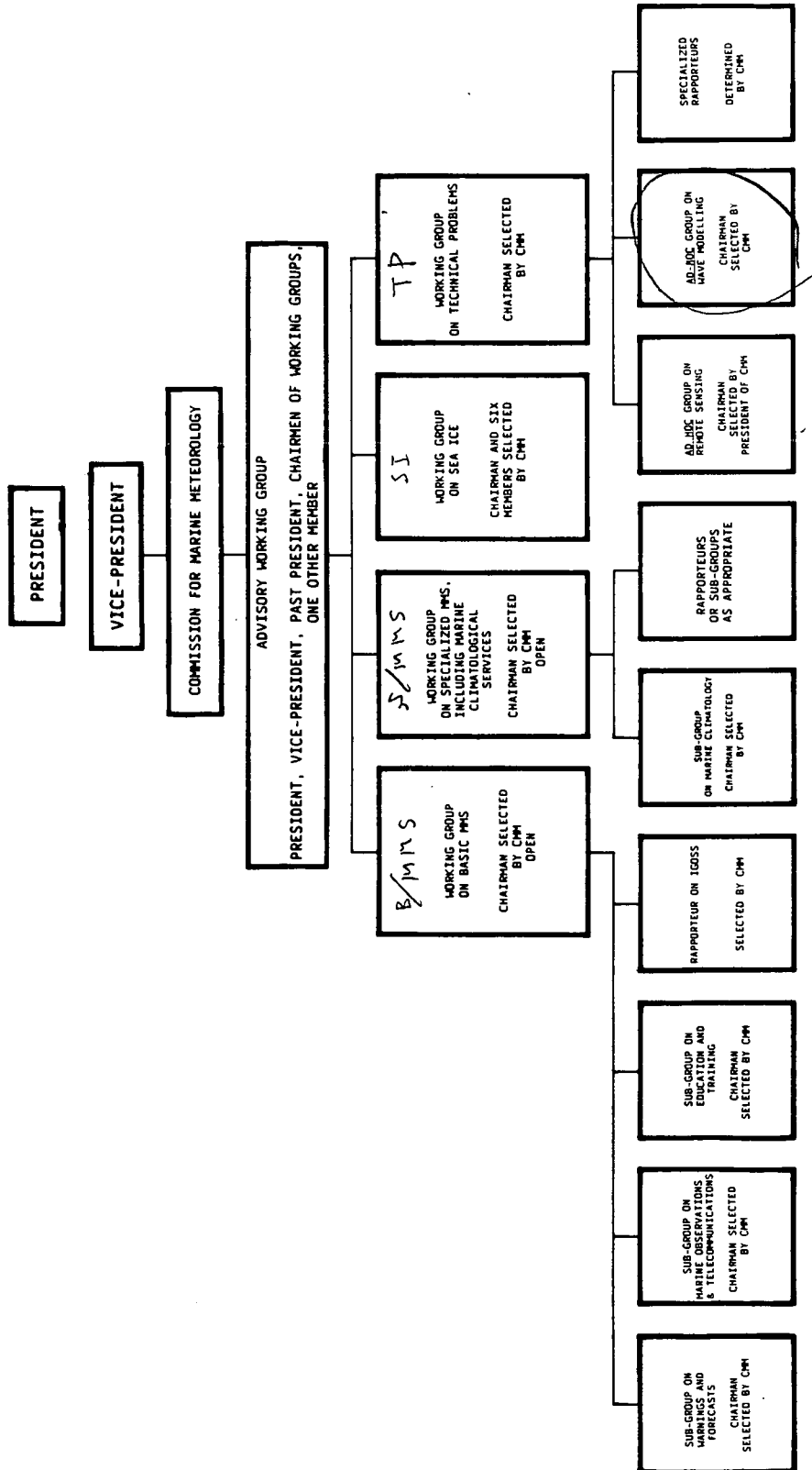
Major project	Task	Execution	Target date
4. Information exchange	(a) Preparation and publication of guidance material on: (i) use of satellite data for MMS, (ii) analysis and forecasting of sea ice (iii) application to offshore areas and high seas of subjective and numerical forecasting techniques and objective techniques such as model output statistics,	WG on TP, WG on SI	1993
	(iv) use of coastal Doppler radar and profiling radiometers in analysing and forecasting nearshore wind fields;	WG on TP	1993
	(b) Review and updating, as appropriate, of: (i) <u>CIMO Guide to Meteorological Instruments and Methods of Observation</u> , (ii) <u>Guide to Wave Analysis and Forecasting</u> , (iii) technical report on processing of marine data; (iv) <u>Sea-ice Information Services in the World</u> ;	WG on TP, WG on SI	1993
	(c) Review and updating of INFOCLIMA catalogue relevant to CMM;	WG on S/MMS, WG on SI	Continuous
(d) Review and updating, as appropriate, of <u>Guide to and Manual on MMS</u> and other WMO regulatory and guidance material.	ALL WGs with Secretariat	Continuous	

Major project	Task	Execution	Target date
5. Techniques development	(a) Promote and publicize developments in numerical wave forecast techniques;	<u>Ad hoc</u> group on wave modelling	Continuous
	(b) Advise and assist in the implementation of new wave forecasts models;	<u>Ad hoc</u> group on wave modelling with Secretariat	Continuous
	(c) Monitoring of requirements for specialized marine forecasts and preparation of guidance material;	WG on TP, WG on S/MMS with	Continuous
	(d) Monitoring and publicizing improved techniques for <u>in situ</u> measurements: (i) for ocean waves, (ii) for winds and precipitation from VOS, (iii) from moored and drifting buoys;	WG on TP, WG on B/MMS, WG on S/MMS with DBCP and Secretariat	Continuous
	(e) Review and preparation of guidance material, as appropriate, on remote-sensing techniques for ocean variables: (i) satellite-based (active and passive), (ii) ground-based radars, (iii) aircraft-based.	<u>Ad hoc</u> group on remote sensing	1993
6. Implementation support	(a) Identification of experts to advise on requirements for support by Members and regional projects;	All WGs with Secretariat	Continuous
	(b) Formulation of suggestions on activities and areas suitable for regional co-operation	All WGs with Secretariat and RAs	1991
7. Specialized education and training	(a) Development of curriculum for specialized long-term training courses at RMTCs;	Sub-group on E & T with IGOSS, EC WG on E & T and Secretariat	1990
	(b) Provision of specialized input and identification of expert lecturers for training seminars;	All WGs with sub-group on E & T and Secretariat	Continuous
	(c) Identification and preparation of appropriate specialized training material for use by Members and RMTCs;	Sub-group on E & T, all WGs with Secretariat	Continuous
	(d) Provision of guidance material for user education;	All WGs with sub-group on E & T	1992
	(e) Preparation of a bibliography on available publications in marine meteorology and physical oceanography.	Sub-group on E & T	1993

A N N E X I V

Annex to paragraph 15.4 of the general summary

OUTLINE OF WORKING GROUPS AND RAPPORTEURS - STRUCTURE OF CMM



ANNEX V

LIST OF DOCUMENTS

A. "DOC" series

Doc. No.	Title	Agenda item	Submitted by
1	Provisional agenda	2.2	
2	Explanatory memorandum relating to the provisional agenda  REV. 1	2.2	
3	Requirements for reporting codes	6.3	Secretary-General
4	Guides and other technical publications	11	Secretary-General
5	Technology transfer and information support activities	12.2	Secretary-General
6	Marine telecommunication arrangements for data collection and transmission	6.1	Secretary-General
7	Marine telecommunication arrangements for product dissemination	6.2	Secretary-General
8	Marine telecommunication arrangements for data collection and transmission  Collection of ships' weather reports through INMARSAT	6.2	Secretary-General
9	Marine Climatological Summaries Scheme	8.2	Secretary-General

Doc. No.	Title	Agenda item	Submitted by
10	Establishment of working groups and nomination of rapporteurs  Working groups and rapporteurs' structure	15	Secretary-General
11	WMO Wave Programme	7.3	Secretary-General
12	Review of Technical Regulations of interest to CMM	10	Secretary-General
13	Reports by the chairmen of working groups and by rapporteurs  Report by the Rapporteur on Education and Training	4	Rapporteur
14	Other matters related to marine climatology	8.4	Secretary-General
15	Relationship with other WMO programmes and those of other organizations and bodies  ADD. 1	13	Secretary-General
16	WMO Long-term Plan	14	Secretary-General
17	Reports by the chairmen of working groups and by rapporteurs  Report by the chairman of the Working Group on Sea Ice	4	Chairman of the working group
18	Reports by the chairmen of working groups and by rapporteurs  Report by the chairman of the Working Group on Marine Climatology	4	Chairman of the working group

Doc. No.	Title	Agenda item	Submitted by
19	Contribution of CMM to the World Climate Programme	8.1	Secretary-General
20	Report by the president of the Commission	3	President of CMM
21	Marine meteorological services	5	Secretary-General
22	Marine observing methods and instrumentation	7.1	Secretary-General
23	Marine climatological data banks REV. 1	8.3	Secretary-General
24	Reports by the chairmen of working groups and by rapporteurs  Report by the chairman of the Working Group on Marine Meteorological Services	4	Chairman of the working group
25	The WMO Voluntary Observing Ships' scheme  ADD. 1	7.2	Secretary-General
26	Review of previous resolutions and recommendations of the Commission and of relevant Executive Council resolutions	16	Secretary-General
27	Sea ice	9	Chairman of the Working Group on Sea Ice
28	Observational data requirements	7.4	Secretary-General

Doc. No.	Title	Agenda item	Submitted by
29	Reports by the chairmen of working groups and by rapporteurs  Report by the chairman of the Working Group on Technical Problems	4	Chairman of the working group
30	Specialized education and training activities	12.1	Secretary-General
31	Marine meteorological services  Reports by the regional rapporteurs on marine meteorological services  ADD. 1	5	Rapporteurs
32	Marine meteorological services  Marine services programmes to the year 2000	5	Secretary-General
33	Marine meteorological services  MMS provided to Soviet ships during their voyage	5	USSR
34	Marine meteorological services  Marine meteorological services in the Antarctic  ADD. 1	5	Rapporteur

B. "PINK" series

Doc. No.	Title	Agenda item	Submitted by
1	Opening of the session Organization of the session Report by the president of the Commission Reports by the chairmen of working groups and by rapporteurs	1, 2, 3 4	President of CMM
2	Marine meteorological services	5	Chairman, Committee A
3	Contribution of CMM to the WCP marine climatological data banks Other matters related to marine climatology	8.1, 8.3 8.4	Chairman, Committee B
4	Marine teleCommunications	6.1, 6.2	Chairman, Committee A
5	The WMO Voluntary Observing Ships (VOS) scheme	7.2, 7.3	Chairman, Committee B
6	Education and training, technology transfer and implementation support activities in the field of CMM	12	President of CMM
7	Relationship with other WMO programmes and those of other organizations and bodies	13	President of CMM
8	Marine Climatological Summaries Scheme	8.2	Chairman, Committee B
9	Marine observing methods and instrumentation	7.1	Chairman, Committee B
10	Requirements for reporting codes	6.3	Chairman, Committee A
11	Observational data requirements	7.4	Chairman, Committee A
12	Sea ice	9	Chairman, Committee B



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Doc. No.	Title	Agenda item	Submitted by
13	Establishment of working groups and nomination of rapporteurs	15	President of CMM
14	Review of technical regulations of interest to CMM Guides and other technical publications	10, 11	President of CMM
15	Review of previous resolutions and recommendations of the Commission and of relevant resolutions of the Executive Council Election of officers Data and place of the eleventh session Closure of the session	16, 17, 18, 19	President of CMM
16	WMO Long-term Plan	14	President of CMM

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RECOMMENDATIONS OF THE COMMISSION FOR MARINE METEOROLOGY  
ADOPTED PRIOR TO ITS TENTH SESSION AND MAINTAINED IN FORCE

Rec. 1 (CMM-VIII) - MARINE METEOROLOGICAL SERVICES MONITORING PROGRAMME

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

- (1) Recommendation 6 (CMM-VII) - Monitoring of marine meteorological services,
- (2) Manual on Marine Meteorological Services, Part II, paragraph 2.1, Principle 5,
- (3) The report of the chairman of the Working Group on Marine Meteorological Services,

CONSIDERING:

- (1) The need for routine and continuous monitoring of marine meteorological services to maintain the highest possible standards,
- (2) That assistance should be given to Members in the implementation of their obligations in compliance with the Manual on Marine Meteorological Services,
- (3) The importance of keeping up-to-date information on the requirements of marine users,

RECOGNIZING the current activities for the monitoring of marine meteorological services effected by Members,

RECOMMENDS:

- (1) That a marine meteorological services monitoring programme be instituted;
- (2) That the Secretariat in consultation with the president of CMM and the chairman of the Working Group on Marine Meteorological Services, as necessary, assist in the execution of the programme;

REQUESTS the president of CMM to arrange for the Working Group on Marine Meteorological Services to devise an appropriate method for the implementation of the marine meteorological services monitoring programme taking into account the following guidelines:

- (a) The monitoring activities should be supported by Members;
- (b) The monitoring may be extended and also include the performance of coastal radio stations;

- (c) The method of evaluation should be flexible enough to allow Members to adjust it to their specific needs; the questionnaire to be distributed should have a standard section for entering answers in a simple manner.

Rec. 2 (CMM-VIII) - MEASUREMENT OF SEA-SURFACE AND SEA SUB-SURFACE LAYER TEMPERATURES

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) Annex to Resolution 12 (Cg-VIII): Policy statement on the WMO Programme on Marine Meteorological and Related Oceanographic Activities in 1980-1983, paragraph 12,

(2) Abridged report of the thirty-second session of the Executive Committee, general summary, paragraph 6.4.2,

(3) Marine Meteorology and Related Oceanographic Activities, Report No. 2 - Investigation of Contemporary Methods of Measuring Sea-Surface and Sub-surface Layer Temperature,

CONSIDERING:

(1) The need for determination of international principles and procedures for sea-surface and sea sub-surface layer temperatures,

(2) That the comparability of measurements taken needs to be improved, particularly to support meteorological research, including climatological study programmes,

RECOMMENDS the establishment of a study programme which includes:

(a) The formulation of an agreed terminology and definitions of sea-surface temperature data obtained through direct observation and remote-sensing techniques;

(b) The possibility of accepting a single sub-surface layer to which all temperatures are reduced for international use;

REQUESTS the Secretary-General, in consultation with the president of CMM, JSC, IOC and SCOR:

(1) To formulate a detailed study programme;

(2) To invite Members, JSC, IOC and SCOR to participate in the study by providing expert services;

(3) To submit a progress report on this study to Members of CMM before 1 July 1983.

Rec. 2 (CMM-IX) - WMO WAVE PROGRAMME

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) The abridged final report of CMM-VIII, paragraph 6.1.7 of the general summary,

(2) The final report of the Meeting of Experts on the WMO Wave Programme,

(3) The activities of IOC relating to the collection and archiving of measured sea waves, particularly through its Responsible National Oceanographic Data Centre (Waves),

CONSIDERING:

(1) That Members are increasingly being required to provide sea-wave analysis and forecast services as part of general marine meteorological services,

(2) That the Marine Meteorology Programme of WMO is required to assist Members in implementing such services,

(3) That the observation, analysis and forecasting of sea waves is a rapidly evolving field, and requires continuing attention by the Commission and Members,

RECOGNIZING that activities currently undertaken by Members in all aspects of sea waves need to be further strengthened and streamlined,

RECOMMENDS that the WMO Wave Programme consisting of elements and a plan of implementation, as detailed in the annex to this recommendation, be implemented;

URGES Members to contribute, wherever possible, to the WMO Wave Programme;

REQUESTS the Secretary-General, in consultation with the president of CMM and in co-operation with IOC and relevant user groups, where appropriate, to assist in the implementation of the programme according to the timetable and priorities indicated in the WMO Wave Programme.

Annex to Recommendation 2

WMO WAVE PROGRAMME - MAJOR ELEMENTS AND PLAN OF IMPLEMENTATION

1. DEVELOPMENT OF CODES FOR REAL-TIME EXCHANGE AND REPORTING OF MARINE SURFACE DATA, INCLUDING DIRECTIONAL WAVE SPECTRA

Recommendations and implementation

1.1 The characteristics of all the possible data sources should be examined, the work done so far should be assessed and the requirements should be developed for new codes for the real-time reporting of surface wind, sea-

surface temperature, sea-level data (i.e. including tides and storm surge), sea-state and spectral wave data. One or more experts should be engaged for this purpose. The manner of condensing spectral data should receive special attention - with the co-operation of an expert on wave data - in order to make real-time exchange feasible. The development of the requirements should be completed by 1985.

1.2 This element of the Wave Programme is seen as being of the highest priority since the exploitation of existing (e.g. buoy and ship-borne wave-recorder) and imminent (e.g. satellites and surface-based radio and microwave systems) sources of much useful data depends on the ability to report and exchange different kinds of such data in real-time. If possible, codes for data from conventional sources should be given immediate attention. Full participation of CBS and the Joint IOC/WMO Working Committee for IGOSS is essential throughout the implementation of this element.

## 2. IMPROVEMENT OF THE STANDARD OF VISUAL WAVE OBSERVATION

### Recommendation and implementation

2.1 It is recommended that there should be a general improvement in the standard of visual wave estimation. This can best be carried out in terms of education and an emphasis on the importance of such observations in terms of the resultant quality of wave analysis and forecast products.

2.2 The training of ships' observers should be intensified and modern visual aids should be made available for such a purpose. Existing training methods rely heavily on written material such as the Guide to Meteorological Instruments and Methods of Observation. This training may be enhanced through the expanded use of visual aids including video tapes and films. It is therefore desirable for WMO, through its Voluntary Co-operation Programme, to obtain or produce a brief correspondence course on wave observation. Such a course could be prepared on video tape and might enjoy wide use aboard voluntary observing ships as well as in training establishments for ships' officers. A suggested completion date for the course is 1986.

2.3 National Meteorological Services, through their Port Meteorological Officers, should stress that accurate wave observations will improve the quality of wave forecasts and thereby benefit marine users.

## 3. REAL-TIME WAVE ANALYSIS AND FORECASTING

### Recommendations and implementation

3.1 Arrangements should be made for the compilation of a catalogue of numerical, deterministic and statistical wave models covering existing operational models for all oceans and seas. In making these arrangements appropriate reference should be made to the catalogue of wave models compiled by the RNODC (Waves) of IOC. The WMO catalogue should be included in the proposed Guide to Wave Analysis and Forecasting and updated regularly. The first catalogue should be completed by the end of 1985.

3.2 Workshops or seminars should be organised on all aspects of operational wave analysis and forecasting techniques with special emphasis on numerical methods. These meetings should deal with wind analyses, boundary-

layer formulation, wave generation, propagation and dissipation and shallow water effects, such as refraction, reflection and shoaling. Discussion of model-performance verification, products and the use of measured wave data should be included. It is expected that each workshop/seminar would be attended by experts from Member countries and that participants would represent a cross-section of both forecasters and modelers. Alternatively, this topic might be included in the lecture programme of seminars on marine meteorological services. It would also be useful to arrange for occasional experts' missions. The establishment of real-time wave-analysis and forecasting services should be encouraged in those countries where such services are needed and the expertise is not directly available. The implementation of this element is continuous.

3.3 The possibility of amending the WMO GRID code (FM 47-V) to accommodate analysed and forecast wave data with spectral and directional components should be examined. Further, national focal points for the WMO Wave Programme, with the assistance of the members of the CMM Working Group on Marine Meteorological Services as appropriate, should have discussions with major user groups of wave data to determine the preferred formats for chart and gridpoint data from numerical wave models. This subject should be reviewed at an appropriate future meeting for possible standardization.

3.4 WMO should work closely with IOC/IODE on the matter of standards and formats for archived wave data. It is expected that IOC will continue as the lead agency regarding archives for measured wave data.

#### 4. GUIDANCE MATERIAL AND ASSISTANCE FOR CO-OPERATIVE WAVE PROGRAMMES

##### Recommendations

4.1 Guide to Wave Analysis and Forecasting, based largely on the present Handbook on Wave Analysis and Forecasting, should be prepared and published.

4.2 A section on wave-measuring instruments should be added to the Guide to Meteorological Instruments and Methods of Observation.

4.3 Guidance material on wave hindcast techniques and models, and their application to a variety of marine problems should be prepared and distributed.

##### Implementation

4.4 The following action will be necessary for the implementation of the recommendation:

(a) A meeting of experts should be convened by 1986 to prepare the Guide to Wave Analysis and Forecasting. The final editing should be done by an expert from this group;

(b) The following additional material should be incorporated in the handbook:

(i) Wind-forcing function;

(ii) A summary of the proposed sections of the Guide to Meteorological Instruments and Methods of Observation that deal with wave-measuring instruments (see subparagraph (d) below);

- (iii) A listing of operational wave-analysis and prediction methods (models);
- (iv) A bibliography of calibration methods for wave-measuring instruments and quality-control techniques for wind and wave data;
- (v) A review of archived marine climatological data, wave-model hindcast data, and wave-hindcast models and techniques;
- (vi) A review of wave statistics, design statistics, e.g. extreme-value estimations;
- (vii) Wave propagation across continental shelves and numerical ray-propagation models;
- (viii) Wave-shoaling effects;
- (c) Assistance in the creation of new national wave programmes may be provided through expert missions if needed.
- (d) Preparation of a new section of the Guide to Meteorological Instruments and Methods of Observation that will deal with wavemeasuring instruments should be undertaken by an expert.

## 5. CONSIDERATION OF DEVELOPING TECHNIQUES FOR MEASUREMENT OF WAVES AND SURFACE WIND

### Recommendations and implementation

5.1 Implementation of this area of the Wave Programme should contain the following elements:

- (a) WMO and the national focal points should co-ordinate with, and give encouragement to, international and national research projects concerned with new measurement techniques, in order to ensure that the resulting data are both operationally usable and valuable;
- (b) National reviews of known work should be compiled regularly by focal points, perhaps on a yearly basis, giving information on national research projects, their progress and potential; national programmes directed at the exploitation of such new data should also be mentioned; the first review should be completed by 1985;
- (c) Reviews should be made of the national reports, again on a yearly basis, so as to inform all participants of the Wave Programme of the progress in this important area; the first review should be completed by 1986;
- (d) An expert should be engaged to assess the likely impact of data obtained from new techniques, its modes of use (e.g. geographical extent, synoptic and asynoptic timing, fixed and transient location), calibration, and assimilation into the GTS, GDPS, etc.

Implementation of this element ((d)) of the WMO Wave Programme should be carried out in order that Members are adequately prepared for the introduction of new kinds of data when the relevant systems reach an operational basis.

#### 6. EXPLOITATION OF EXISTING TECHNIQUES AND SOURCES OF MEASURED WAVE AND SURFACE-WIND DATA

##### Recommendation

6.1 There is by now a wealth of practical experience in using automatic wave- and wind-measurement systems in marine environments and also in the associated problems of real-time data relay. These experiences have clearly demonstrated that automatic measuring and real-time relay systems are viable for marine surface data and it is recommended that such systems should be fully exploited.

##### Implementation

6.2 Efforts should be made to identify governmental and private organizations that deploy instruments to measure surface wind and waves. Data from such sources, if assessed as satisfactory, should be sought and made available to national Meteorological Services for distribution over the GTS. Assistance should be given for the calibration of instruments and quality control of data.

6.3 Oceanographic institutions should be approached through the Permanent Representatives of WMO Members and through relevant IOC channels as appropriate, with a view to their participation in a real-time wave-measuring and -reporting programme.

6.4 The realization of improved networks for surface-wind and wave data using conventional instrumentation is mainly a matter for national implementation. WMO's involvement should, however, include:

- (a) Requesting Members of WMO to submit to the Secretary-General the location of identified wave-recording installations. A summary of this information should subsequently be forwarded to the Responsible National Oceanographic Data Centre for Waves (RNODC(Waves)) of the Intergovernmental Oceanographic Commission, which has the responsibility of identifying all sources of good-quality measured wave data and from time to time publishing catalogues listing the locations. The first summary of information should be available in 1985. A brief form devised by RNODC (Waves) for this purpose should be made available to Members of WMO;
- (b) National implementation which should consist of:
  - (i) Vigorous attempts to gain access to as much data as possible from private, institutional and governmental sources, including help towards the provision of resources for real-time data reporting;



- (ii) Participation in co-ordinated national, regional or international programmes for the installation of conventional surface-wind and wave measuring equipment on suitable marine platforms, using direct or satellite relay communications;
- (iii) Research into the problems of interpretation of surfacewind measurements made on board ships, drilling and production platforms, etc., where height and exposure are non-standard.

## 7. OBSERVING NETWORK SYSTEM EXPERIMENTS

### Recommendations

7.1 It is recommended that the national reviews of known work compiled by national focal points contain a section devoted to experiments on instrumental and model intercomparisons and verifications, a bibliography of published results and a review, if possible, of results not to be published.

7.2 This section of the report should also be forward-looking in announcing planned experiments so that other nations with an interest could pursue participation through bilateral negotiation. The focal points should, in addition, make known nationally the WMO requirements for network experiments so that adjustments could be made to national experiments where economically feasible.

7.3 It is further recommended that the review of the national reports be expanded to include large-scale international experiments which have elements of interest to the WMO Wave Programme. The national focal points could then inform their national agencies participating in the experiments of the sort of assistance they might, if practicable, provide to the WMO Wave Programme.

### Implementation

7.4 Implementation of this item in the WMO Wave Programme will coincide with the implementation of the national reviews of known work.

## Rec. 3 (CMM-IX) - EXPANSION OF MARINE CLIMATOLOGICAL SERVICES

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) The final report of CMM-VIII, general summary, paragraph 7.1 - Contribution of CMM to the World Climate Programme,

(2) Resolution 5 (CMM-VIII) - Terms of reference of the Working Group on Marine Climatology,

(3) The types of action required to achieve World Climate Data Programme objectives as established by Resolution 17 (Cg-IX),

(4) The existence of potentially useful oceanic data products originating from remote-sensing and numerical analysis activities,

(5) Technological advances in mass storage and information and microcomputer technology,

CONSIDERING:

(1) The responsibility of CMM for developing guidelines relating to data management and archives,

(2) The lack of such guidelines for marine data from remote-sensing and numerical analysis activities,

(3) The existence of software in certain Member countries which is useful for providing data services and derived data products for climate research and applications,

(4) The potential usefulness of microcomputer technology and other advances for the development of efficient and inexpensive marine climate data services,

RECOMMENDS:

(1) That a list of marine climate parameters available from remote-sensing and numerical analysis activities be developed with a view to the future archival and exchange of related data for both operational and research purposes;

(2) That guidelines be prepared for the archival and exchange of such data;

(3) That the use of microcomputers and associated software for production and exchange of marine data products be encouraged and advances in emerging information storage technologies be kept under review;

INVITES Members to participate in these activities;

REQUESTS the Secretary-General, in consultation with the presidents of CMM, CBS and CCl, as necessary, to provide support for the promotion of these activities.

Rec. 4 (CMM-IX) - PREPARATION OF A GUIDE TO APPLICATIONS OF MARINE CLIMATOLOGY

THE COMMISSION FOR MARINE METEOROLOGY,

NOTING:

(1) The abridged final report of Cg-IV, general summary, paragraph 3.1.6.5,

(2) Resolution 35 (Cg-IV) - International arrangements for marine climatological summaries and data collection for the marine section of a World Climatic Atlas,

(3) The report of the president of the CMM,

(4) The report of the chairman of the Working Group on Marine Climatology,

## CONSIDERING:

(1) That many Members now have both extensive marine data holdings and developed expertise for presenting these data in ways which are useful for marine data applications,

(2) The need for a publication describing the knowledge and techniques used presently by these Members in providing services for marine climate applications to assist other Members in developing their own programmes,

## RECOMMENDS:

(1) That the preparation of a Guide to Applications of Marine Climatology be undertaken;

(2) That the Guide be complementary to and not duplicate the Guide to Climatological Practices but that it should refer to the material available in that Guide and other WMO publications;

(3) That this Guide be published by WMO;

REQUESTS the Secretary General, in consultation with the president of CMM and the president of CCI, as appropriate, to arrange for the preparation of the Guide, in co-ordination with WCAP.

Rec. 7 (CMM-IX) - GLOBAL SEA-ICE DATA BANK

## THE COMMISSION FOR MARINE METEOROLOGY,

## NOTING:

(1) Resolution 6 (CMM-VIII) - Working Group on Sea Ice,

(2) The report of the chairman of the Working Group on Sea Ice to CMM-IX;

## CONSIDERING:

(1) The need for a global sea-ice data bank in climate research,

(2) The existence of a proposed digitizing format (SIGRID),

(3) The expressed willingness of sea-ice services to participate in digitizing sea-ice charts,

## RECOMMENDS:

(1) That the work towards the establishment of a global sea-ice data bank be started as soon as possible in close co-operation with the World Climate Programme,

(2) That in the preparations for establishing the data bank, the principles given in the annex to this recommendation be followed;

REQUESTS the Secretary-General, in consultation with the president of CMM and the chairman of the Working Group on Sea Ice, to arrange for the commencement of this work and for the evaluation of the test material when available.

Annex to Recommendation 7 (CMM-IX)

GLOBAL SEA-ICE DATA BANK

Principles to be used in the preparations for the establishment of a global sea ice data bank

1. The format to be used for the collection, storage and retrieval should be the proposed SIGRID format;
2. The input data should be provided by national sea-ice services and the main source of information will be operational sea-ice charts and satellite data in processed forms.
3. Digitization will be the responsibility of national sea-ice centres. They should, as far as possible, incorporate any additional information received after the operational use of the ice charts. These centres will also be responsible for the quality control of their own data.
4. Geographical coverage: should be global and in the first stage concentrate on the northern hemisphere. All areas where sea ice occurs for any significant period every year should be included. The data set from each individual ice chart is to be regarded as an independent element.
5. Test year: data from the ice season beginning in the year 1982 should be the test material for the digitizing of sea-ice charts as this was the first year the international system of sea-ice symbols was used by most sea-ice services. The test material provided by the national sea-ice services should be evaluated by a group of experts before the project is continued and the proposed SIGRID format amended as necessary.
6. Years to be covered: following the test year 1982, the digitizing should continue with 1979 - the FGGE year during which a very comprehensive meteorological and oceanographic global data set was compiled. After the digitization and evaluation of the years 1982 and 1979, work should continue with the aim of obtaining a representative climatological period.
7. The global sea-ice data bank After the experience with sea-ice data archiving and merging of data from different sources, the establishment of a global sea-ice data bank should be considered, provided that the necessary resources can be made available. The World Data Centres A and B for Sea Ice and Glaciology should be the location of a sea-ice data bank from which users could retrieve data.

## LIST OF ABBREVIATIONS AND ACRONYMS

ASAP	Automated Shipboard Aerological Programme
ASDAR	Aircraft-to-satellite data relay
BATHY	Bathythermographic report
✓BUFR	Binary universal form for records
CBS	Commission for Basic Systems
CCCCO	Committee on Climate Changes and the Ocean
CCITT	Comité consultatif international télégraphique et téléphonique (of ITU)
CCl	Commission for Climatology
CES	Coast Earth Station
CLICOM	Climate Data Management System
CLS	Collection, location, satellites
CPPS	Permanent Commission for the South Pacific
CSM	Climate System Monitoring project
DBCP	Drifting Buoy Co-operation Panel
DCP	Data collection platform
EGC	Enhanced Group Call system (of INMARSAT)
E and P Forum	International Exploration and Production Forum (oil industry)
EPOCS	Equatorial Pacific Ocean Climate Studies
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
FAO	Food and Agriculture Organization of the United Nations
FGGE	First GARP Global Experiment
GARP	Global Atmospheric Research Project
GDPS	Global Data-processing System
GMDSS	Global maritime distress and safety system (of IMO)
GOS	Global Observing System
GTS	Global Telecommunication System
ICS	International Chamber of Shipping
ICSPRO	Inter-Secretariat Committee on Scientific Programmes Related to Oceanography
ICSU	International Council of Scientific Unions
IDCS	International Data Collection System
IDPSS	IGOSS Data Processing and Services System
IFSMA	International Federation of Shipmasters' Associations
IGOSS	Integrated Global Ocean Services System
IHO	International Hydrographic Organization
IMMPC	International Maritime Meteorological Punch Card
IMMT	International Maritime Meteorological Tape
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite Organization
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data and Information Exchange (IOC)
IOS	IGOSS Observing System
ISLP	IGOSS Sea Level Project
ITU	International Telecommunication Union
JSC	Joint Scientific Committee (for WCRP)
JWC	Joint IOC/WMO Working Committee (for IGOSS)
LEPOR	Long-term and Expanded Programme of Ocean Exploration and Research
LTP	Long-term Plan
LUT	Local User Terminal

MCSS	Marine Climatological Summaries Scheme
MMS	Marine meteorological services
NAOS	North Atlantic Ocean Stations
NMC	National Meteorological Centre
ODAS	Ocean Data Acquisition System
OWSE-NA	Operational WWW Systems Evaluation-North Atlantic
PMO	Port meteorological officer
RMC	Regional Meteorological Centre
RMMP	Regional Marine Meteorological Programme
RMTC	Regional Meteorological Training Centre
RNODC	Responsible National Oceanographic Data Centre (of IODE)
RTH	Regional Telecommunication Hub
SCAR	Scientific Committee on Antarctic Research (Of ICSU)
SCOR	Scientific Committee on Ocean Research (of ICSU)
SES	Ship Earth Station
SIGRID	Format for the archival of sea-ice data in digital form
SOC	Specialized Oceanographic Centre (of IGOSS)
SOLAS	International Convention for the Safety of Life at Sea
TEMA	Training, education and mutual assistance in the marine sciences (IOC)
TESAC	Temperature, salinity, current message
TOGA	Tropical Ocean Global Atmosphere (of WCRP)
UNEP	United Nations Environment Programme
VCP	Voluntary Co-operation Programme
VOS	Voluntary Observing Ships
VOSP-NA	VOS Special Observing Project-North Atlantic
WARC	World Administrative Radio Conference
WCDP	World Climate Data Programme
WCIP	World Climate Impact Studies Programme
WCP	World Climate Programme
WCRP	World Climate Research Programme
WMC	World Meteorological Centre
WOCE	World Ocean Circulation Experiment (of WCRP)
WWNWS	World Wide Navigational Warning System (of IMO and IHO)
WWW	World Weather Watch