SUBGROUP ON MARINE CLIMATOLOGY

Eighth Session

Asheville, NC, USA, 10 to 14 April 2000

FINAL REPORT

JCOMM Meeting Report No. 2

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE SESSION (agenda item 1)

1.1 Opening (agenda item 1.1)

1.1.1 The eighth session of the Joint WMO/IOC Technical Commission For Oceanography and Marine Meteorology (JCOMM) Subgroup on Marine Climatology (SGMC) was opened at 10.00 hrs on Monday, 10 April 2000, in a conference room of the National Climatic Data Center (NCDC, NOAA, Asheville, NC, USA), under the chairmanship of Mr Joe Elms. Mr Elms welcomed participants to the session and called on the Director of the NCDC, Mr Thomas R. Karl, to address the session.

1.1.2 Mr Karl welcomed participants to the session, to Asheville in general and to the NCDC in particular. He indicated that the NCDC had always provided support both to WMO activities, particularly climate related issues such as climate change and the work of the Intergovernmental Panel on Climate Change (IPCC). He expressed being highly impressed by the work already achieved by the Working Group and by the agenda in front of the session, containing some critical world issues that would be a challenge also to the recently formed JCOMM. He said to be certain that this session would be as successful as the CLIMAR99 workshop had been (Vancouver, Canada, September 1999). He was not able to mention all the important items to be considered, but wanted to underline the importance and absolute need to focus on the metadata issue and on the SHIP code, which if wrong, ruined the observation as a whole, observations which continued to be critical for the functioning of many other programmes. He closed by welcoming the initiative to establish a selected group of Voluntary Observing Ships (VOS) to better handle the aspects of accuracy and precision of marine observations. He reiterated his welcome to all participants wishing them a pleasant stay in Asheville and assured everybody that he and his staff would do everything possible for the session to be a most successful one.

1.1.3 The list of participants in the meeting is given in **Annex I**.

1.2 Adoption of the agenda (agenda item 1.2)

1.2.1 The subgroup adopted its agenda for the session on the basis of the provisional agenda with the addition of **agenda item 6.4: Review of global tropical cyclone data**: This then required the renumbering of agenda items 6.4 and 6.5 as new agenda items 6.5 and 6.6 respectively. The final agenda for the session is given in **Annex II**. A list of acronyms is in **Annex XV**.

1.3 Working arrangements (agenda item 1.3)

1.3.1 Under this agenda item the subgroup agreed its hours of work and other arrangements necessary for the session. The list of session documents was introduced by the Secretariat, as well as a session timetable.

2. REVIEW OF THE DECISIONS OF CMM-XII CONCERNING THE SUBGROUP ON MARINE CLIMATOLOGY (agenda item 2)

2.1 The meeting was informed that the establishment of the JCOMM had been approved by 13th WMO Congress and the 20th Intergovernmental Oceanographic Commission (IOC) Assembly, respectively in May and July 1999. JCOMM replaces the former Commission for Marine Meteorology (CMM) and the Integrated Global Ocean Services System (IGOSS) and becomes the formal reporting and coordinating mechanism for virtually all other operational ocean-related activities of the two sponsoring Organizations (including the Data Buoy Co-operation Panel (DBCP), the ASAP Panel (ASAPP) and the Global Sea-level Observing System (GLOSS)). As such, it is now the parent body, *inter alia*, for the Subgroup on Marine Climatology.

2.2 A first transition planning meeting for JCOMM took place in St Petersburg, Russian Federation, in July 1999. A report on the work of the Subgroup on Marine Climatology was presented to this meeting by the chair of the Working Group on Marine Meteorological Services, Therese Pierce. The meeting put in place a variety of transitional arrangements for JCOMM, which included: interim co-presidents to be the president of the former CMM, Johannes Guddal and chairman of the former IGOSS, Dieter Kohnke; interim management committee to include the chairs of all existing bodies which are now a part of or report to JCOMM; all existing bodies to continue their present work plans and to report on these to JCOMM-I. The meeting also initiated the process to develop detailed proposals for an integrated work plan and sub-structure for JCOMM, as well as a capacity building strategy. Final agreement on these is to be reached at a second transition planning meeting scheduled for Paris in June 2000. The first formal session of JCOMM is scheduled for 19-29 June 2001, in Iceland. A schematic for the draft proposed substructure for JCOMM is given in **Annex III**.

2.3 The meeting noted all these developments with interest. It welcomed the advent of JCOMM as a significant step in the implementation of operational oceanography, in the same sense as operational meteorology. JCOMM would, indeed be the body with prime responsibility for the international coordination, management and regulation of a comprehensive, operational ocean observing, data management and services system, to serve all ocean users, including global climate studies. The meeting therefore pledged its full support to JCOMM. In doing so, it noted with particular interest the proposals concerning the Data Management Programme Area (DMPA). It agreed that this was perhaps the key programme area for JCOMM, in particular in the context of providing a fully integrated stream of oceanographic and marine meteorological data, metadata, products, services and information to users. It was therefore important that questions relating to both the assembly and archival of oceanographic and marine meteorological data and metadata should be treated in an as integrated a way as possible, and the meeting supported the proposed draft structure for this programme area. At the same time, it agreed that there remained issues specific to particular data types, such as ship meteorological reports, which required specialist treatment. It therefore urged that this concern should be taken into account when establishing the draft terms of reference for the Expert Teams within the Data Management Programme Area.

2.4 Further relating to JCOMM, the meeting noted with interest the proposal to form an integrated Ship Observations Group, within the JCOMM Observations Programme Area, through a close association of the existing VOS Subgroup, ASAPP and the Ship of Opportunity Programme (SOOP) Implementation Panel (SOOPIP). It agreed that there were a number of issues, related for example to ship recruitment and servicing, telecommunications, etc., which were common to all three programmes. At the same time, there were considerable potential advantages in having SOOP and the Automated Shipboard Aerological Programme (ASAP) ships providing also high quality meteorological observations. The meeting recognized that there were indeed some potential advantages in this proposal, provided that the many distinct technical differences among the three observational programmes were also recognized and addressed. It therefore welcomed and supported the proposal and recommended its adoption to JCOMM-I.

3. REVIEW OF CONTRIBUTIONS AND REQUIREMENTS OF THE WORLD CLIMATE PROGRAMME AND OTHER WMO PROGRAMMES (agenda item 3)

3.1 The subgroup noted the information that the first session of the CCl/CLIVAR Joint Working Group on Climate Change Detection (Geneva, November 1999) expressed its concern about the archiving and future use of the data from automatic weather stations (AWSs), for climate change detection and climate variability studies on global and regional scales, in view of the inhomogeneities due to the use of automated sensors. The subgroup noted that this was a well-known problem also with marine data particularly with wind data, fortunately somewhat less important than expected with data from marine buoys but also of considerable concern for stations on board ships. For obvious reasons these were more difficult to maintain, with any malfunctions taking a long time to be corrected. The subgroup agreed that this was a situation that should be carefully monitored.

3.2 The subgroup welcomed the information that a pilot project had just been initiated to replace the WMO Internet version of the Climate System Monitoring monthly Bulletin with a more interactive Access to Global CSM Products Web page.

3.3 The subgroup learned with pleasure that considerable progress had been made in implementing the Archival Climate History Survey (ARCHISS) Project, especially during 1996 and 1997 when valuable instrumental climate data were identified in the national archives of Mexico and retrieved in digital form. It noted also with pleasure that a bilateral agreement had been made between the Governments of Germany and the USA to scan and digitize more than 600 journals from the Maury collection.

4. REVIEW OF THE RECOMMENDATIONS OF VOSCLIM-I (agenda item 4)

4.1 The meeting noted with interest that the first session of the JCOMM Subgroup on the VOS (Athens, March 1999) had proposed the development of a project to establish (eventually as an operational programme) a subset of the VOS, to provide high quality data and metadata, to serve as a reference data set for air-sea flux computations, in particular in support of global climate studies. The subset would involve in particular the implementation of the recommendations of the Special VOS Observing Project for the North Atlantic (VSOP-NA) regarding VOS instrumentation, observing practices and metadata.

4.2 A first planning meeting for this project took place in Southampton, U.K., in November 1999, hosted by the Southampton Oceanography Centre. Participants included representatives of all VOS operators which had expressed provisional interest in participating, the chairman of the marine climate subgroup and representatives of the Ocean Observation Panel for Climate (OOPC). This meeting had agreed in principle to the project, as well as several specific details, a draft project document and an initial action plan. Capt. G. Mackie (U.K.) was appointed project leader, and national focal points were identified. A second project planning meeting will take place late 2000 in Asheville, USA, and implementation will begin in late 2000/early 2001. The objectives of VOSClim are given in **Annex IV**.

4.3 The meeting agreed that VOSClim is an important project for global climate studies, whose success will depend on the combined efforts of many people and institutions. These include in particular ships' officers and crew who are motivated, well trained and conscientious. In addition, it recognized that, for many studies, it might be extremely beneficial to be able to associate high quality surface meteorological observations with coincident (in space and time) upper ocean data. For these reasons, it supported the suggestion that existing SOOP ships might also be recruited to participate in this project, and urged both the project management committee and the IGOSS Ship of Opportunity Programme Implementation Panel (SOOPIP) to implement it to the extent possible.

4.4 The meeting noted with satisfaction that project implementation was proceeding according to the schedule given in the action plan in the project document. Specifically, in addition to the finalization of the project document itself, the following actions were completed or underway:

(i) As noted above, the Data Assembly Centre (DAC) and Real Time Monitoring Centre (RTMC) had been identified, as NCDC/NOAA and the UK Met. Office, respectively;

(ii) The proposed SHIP code changes had been submitted to the Commission for Basic Systems (CBS) expert team on codes and data representation, for review at its meeting in Geneva, 10-14 April 2000. This meeting, however, could not support any proposal for further modifications to character codes, including SHIP. Instead, it had recommended that the Character form for the Representation and EXchange of data (CREX) be implemented in the report compilation and transmission software for the project. To this end, it had prepared the necessary modification to CREX to include the additional data required, and also prepared the necessary CREX template, which could be used in developing the new software;

(iii) VOS operators had been invited to formally agree to participate in the project, and several had already done so;

(iv) Work had begun on preparation of the reporting forms and publicity material.

4.5 With regard to the proposal to implement CREX as the real time reporting code for project ships, specifically so that the additional data required could be reported in real time, the meeting noted with concern a number of major practical difficulties associated with its implementation. These included the implementation of CREX encoders in shipboard message compilation software; the difficulties for ships' officers in dealing with CREX; and the problems for many National Meteorological Services (NMSs) in dealing with CREX messages on the Global Telecommunications System (GTS). The meeting expressed a strong preference for the real time messages from project ships to continue to be sent in SHIP code, with the additional information included only in the delayed mode data stream in International Maritime Meteorological Tape (IMMT) format. In this context, it questioned the necessity for the real time message to include the additional data, and requested the project management committee to re-examine this matter, with a view to simplifying report transmission and exchange procedures to the extent possible.

4.6 Finally, the meeting noted that, as detailed in the project document and the action plan, there are two specific action items referred to JCOMM, which in this case means the Subgroup on Marine Climatology. These are:

(i) slightly revise the IMMT format, to include the additional information, required for the project, which is to be transmitted with each observation; details of this information are also given in **Annex IV**;

(ii) work with the DAC and the Secretariat to design a supplement to the existing metadata catalogue (WMO-No. 47), specifically for ships participating in the project.

4.7 The meeting therefore addressed these two action items. Specifically, it requested the small team established to work on revising the IMMT format to also address the VOSClim Project requirements in this work (see report under agenda item 5.2 later). It also designated a small number of subgroup members to work with the project leader, DAC and Secretariat subsequent to the session, to develop the necessary enhancements to the ship catalogue format, to be completed in time for the second project meeting (see also report under agenda item 10). These members were Scott Woodruff and Joe Elms, with Joe Elms being task leader.

5. DATA QUALITY AND EXCHANGE (agenda item 5)

5.1 Review of quality control procedures for marine climatological data (agenda item 5.1)

5.1.1 The subgroup recalled that at CMM-XII (Havana, Cuba, 1997) the Gobal Collecting Centres (GCCs) proposed some revisions and clarifications to the set of minimum quality control standards (MQCS), to be applied by contributing Members prior to data submission, and which were given in the *Manual on Marine Meteorological Services*. Dr V. Wagner (Germany) had now proposed to the subgroup, on behalf of both GCCs, some additional minor revisions to the MQCS. The subgroup thanked Dr V. Wagner, for his revision of the standards and agreed both with the changes presented, mostly of an editorial nature, and with the proposal to put into use this new standard as soon as possible. The modified Annex 3.E to the *Guide to Marine Meteorological Services* is given in **Annex V**, where all corrections and modifications are indicated.

5.1.2 The subgroup also considered that the lack of a version identification for the MQCS, could have a negative effect in the data being archived, as well as in the metadata database and therefore approved the proposal that, as is done with the IMMT code, the MQCS carry an identification number, as indicated in the following table:

MQCS-I	=	Original version
MQCS-II	=	Version 2, May 1996
MQCS-III	=	Version 3, May 2000 (corrected Annex 3.E to the Guide to MMS)

5.2 Review of the IMMT and SHIP code (FM 13 - X) (agenda item 5.2)

5.2.1 The subgroup noted that new sea surface temperature sensors are being adopted for use aboard ships. The present SHIP code (FM13-X) only allows for intake, bucket, hull contact sensor and other to be reported including the positive or negative sign. The subgroup agreed on the need to review the code regarding the possible need for modifications to include other sensors and for better harmonization between the IMMT and the SHIP code.

5.2.2 The subgroup recognized that such a revision was too long a task to be undertaken during the session. It thanked Mr. F. Koek (Netherlands) for his presentation and initial evaluation of the situation. The subgroup decided that this issue should be undertaken by a small Task Group and accepted the offer of Mr V. Wagner, Mr J. Elms and Mr C. Hall with Mr F. Koek as convenor to participate in the group. The task group should also address the requirements of VOSClim, as noted in paragraph 4.7 above. The subgroup recommended to the Task Group that their proposals, to be addressed to JCOMM-I after approval of the Chairman of the SGMC, should contain no proposals for the modification of the SHIP code itself. It was recognized that CBS, particularly in view of the gradual conversion to BUFR and CREX format codes, had made it clear that proposals for changes to the existing character codes were not welcome. However, changes to existing character code tables were still acceptable, and could be implemented quickly.

5.3 Metadata of the marine ship codes (agenda item 5.3)

5.3.1 The subgroup considered the study conducted by Ms T. Manabe (Japan) to verify if all WMO publications documenting the history of the marine ship codes (i.e. SHIP code and IMMT format) are available and the feasibility of making this information available on the web.

5.3.2 Because the SHIP and International Maritime Meteorological Punch-Card (IMMPC)/IMMT codes and formats are approved through resolutions of the WMO Executive Council on the basis of recommendations by CSM/CBS and CMM, an historic table of changes was prepared based on past Executive Council (EC), CSM/CBS and CMM resolutions, recommendations and reports. In order to properly finalize this study, the subgroup agreed that it was required that:

(a) past EC, CSM/CBS and CMM reports, and especially their Recommendations and Resolutions be digitized;
(b) Technical Commissions develop and use systematic methods for naming titles of Recommendations;
(c) attach key word(s) for each Recommendation and Resolution when they are digitized, allowing for the search of related subjects in Recommendations and Resolutions through the key words;
(d) the full text of the revised “codes with notes and regulations” be included in the digitized Recommendations and Resolutions;
(e) pages of amendments to Manual and other WMO publications indicate the date of entry into effect;
(f) a list of the abolished FM numbers, their code, and EC Resolutions related to their amendments be included in the Manual on Codes (WMO-No.306), Section A;
(g) code forms approved by extraordinary session of CBS (normally named FM-IX Ext. only) should also indicate the year of approval (i.e. FM-Ext (1990));
(h) future changes to the BUFR codes be carefully and systematically recorded, so that the history of the changes can be traced;

5.3.3 The subgroup wished to thank Ms Manabe for the thorough study that was presented. It also agreed with her in that, while a substantial advance in this subject had been achieved, there were a number of tasks that remain, as follows:

(a) It is necessary to confirm if Tables 1 and 2 in **Annex VI** are correct. It is also crucial to keep updating those tables.

(b) All the past “code forms with notes and regulations” (extract from Manual on Codes (WMO-No.306), Section A, b. List of code forms with notes and regulations and its forerunners) and “layout for IMMT” (extract from Manual on Marine Meteorological Services (WMO-NO.558) and its forerunners) need to be digitized. Not only all the “code” changes which can be detected by change of a Roman numeral which identify the session of CSM/CBS but also all the changes in “notes” and/or “regulations” which do not affect Roman numerals after FM, need to be digitized.

(c) The history of changes of code tables used in SHIP and IMMPC/IMMT needs to be traced and a table including the dates when the amendments come into effect and their relevant Recommendations and Resolutions;

(d) All the code tables, not only those which are used at present and appear on Manual on Codes, Section C, b. Code tables, but those which were ever used, need to be digitized.

5.3.4 The subgroup requested the chairman to liaise with subgroup members and the Secretariat, with a view to establishing a pilot project along these lines, at least for IMMT. Finally, the subgroup agreed that efforts should continue to digitize previous versions of WMO Pub. 47, and thanked Joe Elms and Scott Woodruff for their agreement to investigate undertaking this work.

5.4 Requirements for and provision of marine climatological data and services (agenda item 5.4)

5.4.1 The subgroup considered the report prepared by Mr W.L. Chang (Hong Kong, China) on the availability and cost of accessing marine data at national web sites. It basically indicated that the "hit" rates of the search engines in locating marine data sites was low, that while on these sites the data were easy to locate, each had a different path, and that there was little, if any, information on the cost of data access.

5.4.2 The subgroup then considered recommendations on how this problem may be redressed. It agreed that the ideal of a uniform path for all sites would be difficult to achieve, but also agreed that the use of clearly identified key words would better direct search engines to marine data sites. The Secretariat representative informed the session that work was being done to update the WMO Marine Programme web page, which would contain direct links to marine sites, including those that had been identified in Mr Chang's report.

5.4.3 The subgroup also recommended that marine web sites should of course use their national language, but should do their utmost to also use English, particularly where the information provided was of international interest and could be picked up by various search engines on the Internet. Finally, the subgroup recognized that the provisions of Resolution 40 (Cg-XII) would apply in all provision of data and services.

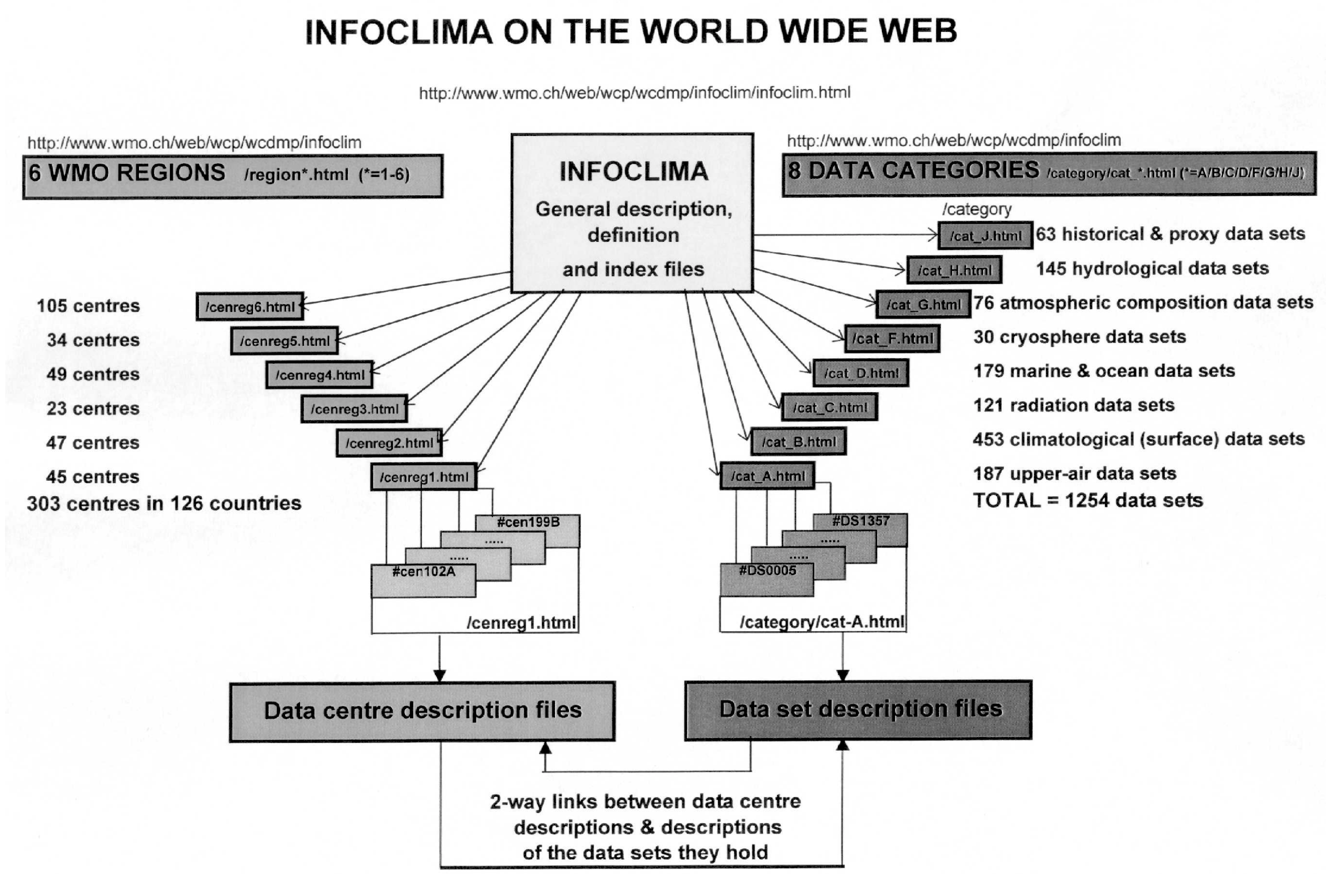
5.5 Review and updating of the INFOCLIMA catalogue (agenda item 5.5)

5.5.1 The subgroup recalled that the purpose of the World Climate Data Programme (WCDP) is to ensure timely access to reliable climate data which are exchangeable in an acceptable format to support climate applications, impact studies and research. The provision of information about the availability of climate data is being pursued under the World Climate Programme (WCP) to meet the vast requirements of that programme. It is in this context that INFOCLIMA – The World Climate Data and Information Referral Service – was conceived as a common service of WMO Member countries, to provide information on data sources in a coordinated way. Information on data sets submitted to the WMO Secretariat by Members, international and national centres is edited and entered into the INFOCLIMA database in a standardized format after verification with centres involved.

5.5.2. For practical purposes, climate system data have been divided into a number of categories. Cross-references are inserted where data sets could be included under more than one category. There are currently eight categories, and the fourth, Category D has been assigned for marine and ocean data sets. Category D, which contains 179 Marine and Ocean data sets and the 72 centres, that hold them, can be found via the WMO web page

http://www.wmo.ch/web/wcp/wcdmp/infoclim/category/cat_D.html

5.5.3 The following figure represents a schematic description of INFOCLIMA:



5.5.4 The subgroup noted the a proposal is being presented to the next WMO Executive Council, to establish closer collaboration among the World Climate Data and Monitoring Programme, World Weather Watch (WWW) and Global Climate Observing System (GCOS), with a view to providing interactive Internet access to an enlarged database listing of climate data sets that encompass the full range of climate system parameters. This would be based on the principle that *INFOCLIMA has been developed to provide information on climate data sets which are available in various services and institutions as well as in National Climate Centres and that one of the objectives of the Global Observing System Information Center (GOSIC) is to provide a registry of data sets and data products that are part of the G3OS (GOOS, GCOS and GTOS).*

5.5.5 The subgroup supported the above proposal, particularly because this opened INFOCLIMA to effect an integration with the oceanographic community, which is one of the objectives of JCOMM. In view of the subgroup's ongoing responsibility to review and, as necessary, update relevant parts of the INFOCLIMA catalogue on behalf of JCOMM, it also recommended the following actions to further activate and increase the number of data sets available in INFOCLIMA:

(i) to place a hit counter in the web pages that give access to the catalogue in order to monitor its use and accessibility;
(ii) To request Members to establish hyperlinks from their web pages to the INFOCLIMA pages;
(iii) The Secretariat to inform each Member of their current individual entries for their possible updating. If available, the date of the last update should also be included.

5.6 Review of the operations of the Global Collecting Centres (agenda item 5.6)

5.6.1 The subgroup recalled that the modified Marine Climatological Summaries Scheme (MCSS) has been in operation since January 1994 (see **Annex VII**). GCC representatives provided a summary of the data received at the GCCs since then and indicated several of the reasons for a general decrease in the amount of data received.

5.6.2 Several actions in order to improve the present situation were discussed by the subgroup, which decided to recommend the following actions:

(i) To urge all Members who provide data for later processing by the Responsible Members and the GCCs (i.e. all recruiting countries listed in WMO Pub. 47) to submit their data holdings to the MCSS;
(ii) That in doing so, Members should provide all the elements allowed in the IMMT-I format;
(iii) To request Members that during the implementation of the initial QC procedures, to do their utmost to correct the data rather than simply flagging it. In particular, it is very important to correct data such as call sign, date/time of the observation and the ship's position.

5.6.3 The issue of duplicate data was also discussed in detail by the subgroup. It was determined that the main reasons for such duplications were:

(i) Logbooks (and/or copies) from one ship are given to two services;
(ii) Incorrect use of the country code which identifies the country recruiting the ship;
(iii) Extraction of ship observations from the GTS by one country where the same observations are extracted from logbooks by another country;
(iv) Competition between countries to recruit the same ship.

5.6.4 To reduce the number of duplicate ship observations submitted to the GCCs, the subgroup made the following recommendations:

(a) Contributing Members (CMs) should only provide data from their own recruited ships;
(b) WMO should extract from WMO Pub 47 a list of all ships (by call sign) and their recruiting countries. By using this list, CMs are requested to ensure that data from any one ship are returned to only one country; and
(c) Members should update WMO Pub 47 as frequently as possible and include all ships recruited by them, independently of the flag the ship navigates under.

5.7 Review of wind speeds reporting methods (agenda item 5.7)

5.7.1 The subgroup recalled the recent requirements made by Regional Association VI that all wind speeds be reported in meters per second. It agreed that this practice may introduce a bias into the wind speed climatological record and could also affect other RAs who are using Turbo 1 / Turbo Win or similar software.

5.7.2 In addition to the above, the subgroup agreed that the coding and recording of wind speed in m/s may cause:

- Disarray in the everyday recording and coding of meteorological observations on board of the ships, especially at the beginning of the implementation phase;
- Errors in the recording of the observation that may be difficult to correct (i.e. if no other ships are reporting in the vicinity);
- Systematic errors in archived climatological wind speed data due to the use of simplified methods of unit conversion and overestimation of values due to rounding procedures. Such practices might affect the results of climatic studies, i.e. on climate variability and climate change;
- Loss of data resolution by using m/s instead of knots, which is particularly important for operational forecasting models as well as for climate studies.

5.7.3 The subgroup also recognized that there exists a long tradition in the marine community for using non-metric units when making meteorological observations, like knots and the Beaufort wind force scale, both in observing and forecasting procedures.

5.7.4 The subgroup agreed that a solid list of arguments for the continuation in the use of knots as unit for wind speed in reporting from ships should be prepared for presentation to JCOMM-I. It accepted the kind offer of Dr. M. Mietus (Poland) to prepare such arguments.

6. DATA ARCHIVAL (agenda item 6)

6.1 Development of a comprehensive metadata database for ODAS (agenda item 6.1)

6.1.1 The subgroup recalled that it had been requested by CMM-XII (Havana, March 1997) to consider the development of a comprehensive metadata-base for Ocean Data Acquisition System (ODAS), including moored and drifting buoys, offshore platforms, etc. The Commission had requested that the Subgroup undertake a feasibility study for the project and, if that proved satisfactory, to proceed to implement it, in cooperation with the Secretariat, the DBCP, the IOC and interested Members.

6.1.2 The subgroup reviewed for content and structure a draft format (fourth version, **Annex VIII**) presented by Mr J. Elms (USA). After making some suggestions and minor modifications the subgroup recommended that this amended fourth version be circulated to members of the DBCP as well as to other national buoy centres and interested Members for additional comments.

6.1.3 The need for such metadata database received strong support from the subgroup, which expressed the hope that the project should be operational as soon as possible. It also recognized that, once all interested participants, institutions and organizations agreed with the final content and format, it will be necessary to find an appropriate centre to host the database. The administrators of such a centre would also have to agree to maintain and update the database.

6.2 Archival of WAVEOB data (agenda item 6.2)

6.2.1 The subgroup noted that there is already a significant amount of observed wave spectral data in circulation on the GTS in the FM 65-IX WAVEOB code and that this amount is likely to increase substantially in the future, not only with moored buoys as the main source but also from remote platforms such as aircraft or satellites. It was further noted that although a number of national agencies maintain archives of such data in a higher resolution format, no internationally agreed procedures and/or centres exist to undertake such archival on a global or regional basis, or to make the data available to users in accepted ways.

6.2.2 In view of the above, the subgroup considered that a pilot project should be undertaken in order to find out in a realistic manner the number of countries reporting such data via the GTS as well as its volume. Based on the results of the project, which should last for approximately one year, the subgroup would then re-examine this question with a view to determine if the users should contact individual providers to obtain the higher resolution information or if the data should be archived in a central place. The group also requested the Secretariat to circulate a questionnaire to all members of JCOMM to enquire whether the need existed for archiving WAVEOB reports extracted from the GTS in a central location.

6.2.3 The subgroup kindly accepted the offer of Mr J. Elms (USA) to undertake the preparation of the questionnaire to be circulated by the Secretariat as soon as it is available, and for the extraction from the GTS of WAVEOB reports headed MMXX, for the period of one year. The subgroup also agreed that if sufficient information was available, a preliminary report should be prepared for consideration by JCOMM-I.

6.3 Archival of data other than in IMMT format (agenda item 6.3)

6.3.1 The subgroup was informed that, with increasing recognition of the importance of upgrading and maximizing the data available for analyses of the climate record, efforts have intensified to digitize additional historical ship data (and metadata) that exist in many national logbook collections. They are particularly focused on data during major gaps in the existing record, such as the two world wars, and adding 19th century and earlier data. At present, however, there is no effective, internationally agreed format for exchange of keyed historical data. The format needs flexibility to preserve crucial original data elements and metadata. This would help facilitate analyses of data biases and discontinuities arising from changes in instrumentation and observing practices. Moreover, the format should be expandable, to meet new requirements that are not presently anticipated, but also simple enough that it is practical to implement by Member countries.

6.3.2 The subgroup therefore considered a proposed International Maritime Meteorological Archive (IMMA) format meeting those requirements, and thanked Scott Woodruff for his work in preparing the proposal. The resulting format also has the potential flexibility to store modern marine data, and data from special projects (e.g. VOSClim). It was recalled that the IMMT-1 format was created to store contemporary marine data. As a result it lacks space for original data fields, e.g., fields whose conversion into modern units may be questionable. Other formats that were surveyed were also judged not suitable for technical or archival reasons.

6.3.3 A set of proposed "sub-record" types was outlined for the IMMA format, consisting of a "location" and "core" section, and a selection of "attachments." Each "record" consisted of the location and core sections of the format (including major climate elements common over the full period-of-record) followed optionally by one or more attachments. The historical attachment is only partly defined, but contains elements such as Beaufort wind codes and original cloud elements, and includes space for supplemental data fields (to be defined by Members). This approach was chosen since it would be impossible to predict in advance all the characteristics of early historical data. Some additional technical considerations were discussed, including the recommendation for a fixed-field rather than delimited format, and the use of blank as the uniform designation for missing data. Another important technical consideration i.e. for research applications, is the conversion of historical data elements into modern units, but needs to be accomplished by reliable and standardized methods.

6.3.4 The group agreed that, as suggested and with the input from Members, the development of a preliminary version of the IMMA format would require approximately one year. It was also agreed that it could be named, to mark its first version, IMMA-2001. The subgroup also noted that as the IMMA format is in ASCII, it may offer a solution and standardization for the Comprehensive Ocean-Atmosphere Data Set (COADS), and its blend with the UK Marine Data Bank (MDB), including improved near-real-time products.

6.3.5 Finally on this item the subgroup agreed that an updated IMMA be circulated to the eight Responsible Members for comments, a consultation process that should be ready in February 2001 for submission to JCOMM-1 (June, 2001) and possible insertion in the next version of the *Guide to MMS.*

6.4 Review of global tropical cyclone data (agenda item 6.4)

6.4.1 The subgroup was informed that the third Tropical Cyclone (TC) Regional Specialized Meteorological Centres (RSMCs) Technical Coordination Meeting, which was held at the RSMC La Réunion – Tropical Cyclone Centre from 5 to 11 November 1999, had considered a recommendation made by CMM-XI (Lisbon, April 1993) regarding possible improvements to the report format of the "Global tropical cyclone track and intensity data set". These included the inclusion of radius of tropical cyclone core and radius of maximum wind gust. It noted that the Coordination Meeting had also taken into account proposals made by the tropical cyclone research community through the International Workshop on Tropical Cyclones (IWTC)-IV (Haikou, China, April 1998). As a result, the subgroup was presented with an updated report format, which contained the following changes:

- (i) expansion and amendment of positions 1 – 10 to become 1 – 19 on cyclone identification code and name;
- (ii) positions old 39 – 41/new 48 – 50 : editorial change;
- (iii) position old 42/new 51 : provision for additional units;
- (iv) positions old 43 – 44/new 52 – 53 : editorial change;
- (v) positions new 54 – 58 and 63 – 108 : expansion (for data related to intensity, size, type);
- (vi) positions old 45 – 46/new 109 – 110 : correction (type 04);
- (vii) positions old 51 – 52/new 111 – 112 : updating and editorial changes;
- (viii) consequential changes to other position numbers, “Headings” and deletion of “expansion” positions (old 53 – 80) and foot “Note”.

6.4.2 The subgroup reviewed and agreed with the updated “Report Format” which is given in **Annex IX** to this report. As proposed by the Tropical Cyclone Programme, it recommended that the appropriate mechanisms be used to obtain an early adoption of the format for possible application as from the year 2000. The subgroup also agreed that the “first level” information on tropical cyclones (i.e. information covering the tropical cyclone’s present and forecast position, movement and intensity) should be provided to all users having a requirement for such information.

6.5 Review of the status of the catalogue of storm surge data holdings (agenda item 6.5)

6.5.1 The subgroup recalled that its seventh session (Geneva, April 1996) considered the preliminary results of a survey on this subject prepared by Dr E. Zaharchenko (Latvia). The results of the survey indicated that:

- there were substantial amounts of storm surge data archived in a number of countries;
- there was some interest in having a global catalogue of data holdings; and
- there was also interest in the eventual international exchange of these data, at least regionally.

6.5.2. At the same time the group had agreed to adopt the definition for "storm surge" as it appears in the International Meteorological Vocabulary (WMO No. 182) which has also been adopted by the five WMO regional tropical cyclone bodies and their members. The subgroup then adopted a draft catalogue outline, recognizing that both the structure and details of the catalogue needed to be further developed. It also considered that it would be both logical and practical if the catalogue could be incorporated or associated in some way to the INFOCLIMA catalogue.

6.5.3 The twelfth session of CMM (Havana, March 1997) supported this project and urged Members to contribute whenever possible, and accepted with appreciation the offer made by the Russian Federation for assistance of the World Data Centre-B in that work.

6.5.4 The subgroup now reconfirmed the findings produced by the survey and decided that in order to advance the project, the Chairman would write to Dr Zaharchenko and ask him for an update of the status of the catalogue. The information would also be made available to Dr Somova (Russian Federation) so that an early coordination could be made for the preparation and implementation of the catalogue, particularly if the offer for assistance made by the Russian Federation delegate at CMM-XII, namely to receive the help of the Global Data Centre-B, was to be taken up.

6.6 Results of the questionnaire on satellite-based ocean wave database (agenda item 6.6)

6.6.1 In view of the potential value of wave data holdings to global climate studies as well as to the provision of various marine services, the seventh session of the subgroup (Geneva, April-May, 1996), considered that it would be very useful if a catalogue of national, satellite-derived ocean wave databases was prepared. As a consequence a questionnaire prepared by Mr Val Swail (Canada) was circulated to CMM/JCOMM members.

6.6.2 The subgroup was informed that the response to the questionnaire was rather disappointing, but not unexpected. A total of 35 were received, of which 30 indicated that no such databases were in use by that Member. The five answers left, contained information which varied widely in level of detail and degree of coverage. The details of the databases reported, and access to them, is summarized and given in **Annex X**.

6.6.3 The subgroup agreed that even if the total information was limited it was valuable, and requested the Secretariat that those Members having answered the questionnaire be invited to provide their information to INFOCLIMA by completing and submitting the appropriate form.

7. ARCHIVAL OF OCEAN CURRENT DATA (agenda item 7)

7.1 The subgroup recognized that ocean currents may be measured by moored current meters, from the drift of ships or buoys, by acoustic doppler current profilers and, indirectly from satellite altimeter measurements. WMO codes FM 18-X (BUOY) and FM 64-IX (TESAC) allow for the reporting of currents at various depths while FM 63-IX (BATHY) and FM 62-VIII (TRACKOB) allow for the reporting of surface current. In practice few observations of ocean current are exchanged on the GTS in these codes formats at the present time. Almost all ocean current data are only available in non-real time.

7.2 The subgroup also recalled that the earliest regular observations of ocean currents were made by the measurement of a ship's set and drift, whereby the current is assumed to be equal to the vector difference between the dead reckoning position of the ship, taking due account of the wind on the ship's course, and an absolute measurement of the ship's position. Recognizing the importance of these measurements, internationally agreed procedures for the exchange and archiving of the data were proposed by the CMM Working Group on Marine Climatology in November 1977 and approved by CMM under Recommendation 20 (CMM-VII). It was also agreed that the UK Met. Office should act as the International Surface Current Data Centre (ISCDC) having responsibility for the collection, quality control, archiving and exchange of ship set and drift data provided by member countries.

7.3 In the years following CMM-VII the role of the ISCDC proved successful with many national centres contributing to the exchange of data. Today, the archive of data maintained at Bracknell consists of some 5m observations. However, changes have taken place in observing practices amongst the world's VOS, either as a result of manning reductions or automation of the methods of ship's navigation, which have led to a steep decline in the number of observations of ocean current by the set and drift method. In the case of the UK, VOS observations have fallen to no more than a few hundred per year having been in excess of 10,000 per year in the 1980s. At the same time the data received from other national centres has dried up completely. No ocean current data have been sent to Bracknell as the ISCDC for about 10 years and no requests for archived data have been received for a similar period of time.

7.4 The subgroup, considering the complete decline in the role of the ISCDC, recommended that the procedures set up in Rec. 20 (CMM-VII) be discontinued and that, following consideration by JCOMM-I, the Manual and the Guide on MMS be modified accordingly. The subgroup also agreed with the proposal that the present archive of surface current data held by the UK Met. Office be copied to the World Data Centres for Oceanography to ensure completeness of their data holdings.

7.5 The Chairman, on behalf of the subgroup, of the former CMM (now JCOMM), its members and the marine meteorology community, expressed his thanks and appreciation for the considerable effort made by the staff of the UK Met. Office during more than twenty years, to create and maintain this database.

8. GUIDES AND GUIDANCE (agenda item 8)

8.1 Guide to the Applications of Marine Climatology: Results of CLIMAR99 (agenda item 8.1)

8.1.1 The subgroup recalled that, at the Twelfth Session of the CMM (Havana, Cuba, 10-20 March 1997), approval was given for WMO to organize a self-funding workshop, to serve primarily as a means for generating appropriate input to the dynamic part of the *Guide to the Applications of Marine Climatology* (WMO No. 781). Subsequently, the Government of Canada kindly offered to host the workshop, and named Mr. Val Swail to take the lead in its organization.

8.1.2 A Workshop Organizing Committee (WOC), consisting of Mr. Val Swail (Canada; Chair), Mr. Joe Elms (USA), Dr. Henry Diaz (USA) and Mr. Fernando Guzman (WMO Secretariat) was established to organize the workshop, which was named CLIMAR99 – WMO International Workshop on Advances in Marine Climatology. As a first step the Committee agreed that the workshop be scheduled to take place from 8 to 15 September 1999, in Vancouver, British Columbia, Canada.

8.1.3 The workshop was organized in conjunction with a workshop on the NOAA COADS Project. Sponsorship was obtained from WMO, NOAA’s Office of Global Programs (OGP), the National Weather Service, NOAA, USA and the Meteorological Service of Canada.

8.1.4 The objectives of the workshop were defined as:

- To receive appropriate input for the dynamic part of the new version of *the WMO Guide to the Applications of Marine Climatology*, with particular emphasis on new technologies;
- To review the requirements of users for new marine climate products and enhanced climate information;
- To provide guidance and technical support for those National Meteorological Services with responsibilities under the Marine Climatological Summaries Scheme (MCSS); and
- To make a further contribution to the data and metadata of COADS.

8.1.5 A “Call for Papers” was distributed to WMO Members, and to the general marine climate community. The format of the Workshop called for selected invited presentations from experts in the respective fields. Shorter, relevant contributions were also accepted from the general scientific community. This resulted in more than 70 abstracts being submitted by experts from every Regional Association of WMO for consideration by the WOC. The final program was developed from these abstracts. The Workshop itself was a huge success, with more than 80 participants from 30 countries from all WMO Regional Associations, and generated a great deal of interest in holding future meetings of this type. The subgroup welcomed the initiative of the Secretariat to publish the final version of all the papers both in the new JCOMM technical report series as well as in the new web page of the Marine Programme.

8.1.6 The subgroup was further informed that a subset of the papers which addressed the primary objectives of the workshop has now been identified; that these papers will be subjected to peer review, and will subsequently be published as the dynamic part of the *WMO Guide to the Applications of Marine Climatology*, hopefully before the end of the year 2000. A list of those papers is given in **Annex XI**.

8.1.7 Based on the success of CLIMAR99, the subgroup proposed that a second workshop, CLIMARxx, be held in the period prior to JCOMM-II, which is likely to take place during 2005. As for CLIMAR99, sponsors should be sought as early as possible. In the spirit of JCOMM, serious consideration should also be given to integrate the oceanographic community's interests in CLIMARxx. The subgroup also considered that a joint event with an initiative such as a future OceanObs should also be investigated.

8.2 Review of the Guide to Marine Meteorological Services in view of JCOMM
(agenda item 8.2)

8.2.1 The subgroup considered the new Unedited Version of the Guide to Marine Meteorological Services on the basis of the recent establishment of JCOMM to replace CMM (see item 2 above). The subgroup carefully considered if any changes, and in particular those related to marine climatology (chapter 3), should be made to the Guide, and determined that suggested changes belonged to two categories: those of an editorial nature that could be implemented immediately so as not to delay the publishing of this version of the Guide, and those that required formal approval by JCOMM-I, as follows:

<u>Editorial changes:</u>

- Review the names of countries used in the text, maps and figures which may have changed since the preparation of this version of the Guide (i.e. USSR and Hong Kong);
- Change all references to CMM by JCOMM;
- Where references are made to particular magnetic media such as CD-ROMs, disks, magnetic tape, etc, to change then, in view of rapid technological advances, to a more generic term such as "computer readable media";
- Normalize the name of the Guide throughout the publication. Currently two different titles are used: "Guide to Applications…" and "Guide to the Applications….".
- To invert the order of the last two paragraphs under 3.2.4 and then move them to follow the paragraph under 3.2.3;
- 1st para. of 3.2.7: Delete: "If exchanged in magnetic tape… …blocking factor 10";
- Under (a) of 3.2.9.1: replace "an automatic sensor" by "a sensor";
- 2nd para. of 3.3.3: delete the words "ground based";
- To improve the quality of Annex 3.B;
- Add a footnote to Annex 3.C that reads: "Blanks entered in a record represent missing data";
- 2nd para. under 2. of Annex 6.D replace: "The *sea of currents*…" by "The *set of currents*…."
- In Annex 6.H delete Monthly Bulletin, North Sea and add "Der Wetterlotse", 6, Germany, German.
- 3rd para. of 3.3.3: change "temperature at a depth of hundreds of centimetres" by "temperature from a few centimetres down to several metres";
- 2nd para of 3.4.3: replace: "Compact disk… …CD-ROM) technology" by "modern computer technology".

Changes requiring approval by JCOMM-I

- Modify the last sentences of the first paragraph of 3.2.9.2 to indicate that while flagging data as doubtful was an accepted procedure, all efforts should be made first to correct those data;
- To delete all under 3.3.2 (see item 7 of this report). However, Annex 6.D also associated to this paragraph of the Guide, should be kept as metadata of the procedures;
- Under element 64 of Annex 3.C to add: 9 = FM 13-XI.

8.2.2 The subgroup recalled that under agenda item 5.1 it had made a review of the minimum quality control procedures currently in use. That review produced an amended Annex 3.E of the Guide (see **Annex V**). The subgroup also considered Chapter 3 as a whole, and found that many of the corrections were of an editorial nature but this was not the case for all of them. It recognized however, that all members of the group, including those with GCC responsibilities, had agreed with the proposed changes and with the requirement for their earliest possible implementation. The subgroup requested the Secretariat to find an accelerated and appropriate mechanism to include the required changes to Chapter 3 in the present edition of the Guide and which are given in **Annex XII** to this report.

8.2.3 The subgroup also noted that some examples, for Annexes 4.C, 4.D, 4.E, 4.J, 4.M, 5.A and 6.H of the Guide were missing. Several members of the subgroup offered to provide as soon as possible, relevant examples to complete the Guide.

8.3 Guide to Climatological Practices (agenda item 8.3)

8.3.1 The subgroup was provided with the status report of the revision presently being undertaken by the WMO Commission for Climatology (CCl) to produce the Third Edition of the Guide to Climatological Practices. An accelerated plan has been established to complete the Guide, and the Thirteenth WMO Congress noted the progress and urged CCl to complete the work in the near future.

8.3.2 The plan includes a series of Individual sections being drafted by a set of Lead Authors, each section being placed onto the CCl Internet Web site as soon it has been edited and approved. Comments and additional contributions on completed sections are welcome. A web-accessible facility called a "shared room" was established at an independent Internet Web site, which is being used to advance the assembly of the Guide from authors' drafts. The "shared room" is like a shared file cabinet, and is accessible only to authors and reviewers through ID and password control. At all times, authors and reviewers have access to the most current versions of the Guide chapters.

8.3.3 Following a review of the planned content of the Guide by the members of the subgroup, suggestions were made for the consideration of the CCl Guide Editorial Board (GEB). The subgroup proposed that in Part II of the Guide, and under 2.4, Statistical techniques, new sections should be established and devoted to the topics of:

(i) "Spatial Statistical Techniques". This type of analysis is becoming more important as gridded data-bases are produced and the computer power increases. Often, these spatial statistics are those most easily related to large-scale circulation indices such as "El Niño Southern Oscillation" (ENSO), the Arctic Oscillation (AO), the North Atlantic Oscillation (NAO) and the Pacific Decadal Oscillation (PDO). The level of detail in the Guide should probably consist of a description of the various methodologies, their importance, examples of their application, and reference to detailed discussions in recent books and journal papers, e.g. Zwiers and von Storch (1999). Techniques which should be addressed include empirical orthogonal functions (EOF), canonical correlation analysis (CCA), redundancy analysis (RA) and reduced space optimal interpolation (RSOI); and

(ii) "Statistical or Diagnostic Techniques" for studying the impact of short- and long-term climate changes. This should be a short section comprising a brief description of what the techniques (such as singular value decomposition (SVD) and singular spectral analysis (SSA)) set out to achieve; it should also indicate where the related software may be obtained as well as pertinent references.

8.3.4 The subgroup appreciated the offer made by Scott Woodruff (USA) to consult with his colleagues at the Climate Diagnostic Centre (CDC) regarding the possibility to help with topic (ii) above.

8.3.5 The subgroup also expressed its wish to be assured that in Part I of the layout of this Guide, section 1.5.1 includes marine data, section 2.4.5 includes marine metadata and that section 3.3.2 includes marine activities.

9. DEVELOPMENTS ON THE BEAUFORT EQUIVALENT SCALE (agenda item 9)

9.1 The subgroup noted with interest and appreciation a presentation by the JCOMM (formerly CMM) Rapporteur on Beaufort Equivalent Scales, Dr R. Lindau (Germany). Dr Lindau stressed that, to assess the quality of Beaufort equivalent scales, the applied driving technique is of fundamental importance. Most historical scales are based on one-sided regressions where one parameter, the Beaufort estimate or the measured wind speed, is regarded as independent. Such one-sided regressions are only suited to predict individual values. However, especially for climate study purposes, it is essential that the characteristics of entire data sets are conserved when Beaufort estimates are converted into metric wind speed. Since both parameters are subject to errors, a correct equivalent scale lies between the one-sided regressions. The scale derived by Lindau (1995) takes into account both the different error variances and the effects of the natural variability. This procedure guarantees a correct determination of the common relationship between Beaufort force and wind speed. For that reason, this scale was recommended by Dr Lindau to be used in the future for scientific purposes.

9.2 The subgroup agreed with this recommendation, at the same time emphasising that there should be no change to the scale presently recommended by WMO to be used for observations and in the archival records. In addition, the subgroup considered that the written report by Dr Lindau was a significant contribution, which would be of value to everyone concerned with global climate studies and the applications of marine climatology. It therefore agreed that the report should be published in the new Part 2 to the *Guide to the Applications of Marine Climatology*, along with the papers selected for inclusion from those presented at CLIMAR99.

10. REVIEW OF PUBLICATION WMO-No. 47 (agenda item 10)

10.1 Proposed revised specifications for database fields

10.1.1 The subgroup noted with interest a report on the status of implementation by the WMO Secretariat of the agreed new format and specifications for the ship metadata catalogue (WMO-No. 47). It welcomed the news that the fully updated catalogue, in the new format, would be online through the WMO web page in a very short time, hopefully before the end of May. It also expressed appreciation for the fact that the catalogue would include a full search facility, which would allow the rapid extraction of information on individual ships and their instrumentation. This would include a capability to extract, for example, a list of the ships equipped with specific instruments, such as hull contact sensors for SST. The meeting considered that this facility would be enhanced if this capability were extended to include combinations of instruments. The combination recommended as being of most potential value included instruments for measuring the significant variables for air-sea flux computations: wind speed, air temperature, humidity and SST. In addition, the subgroup recommended that the search engine should be able to easily identify duplicates in the catalogue; i.e. the same ship recruited by more than one country (see 5.6.4 (c)). It also strongly supported the use of the IMO ship number as a unique ship identifier.

10.1.2 The subgroup recalled the requirement from the VOSClim project for a special ship catalogue supplement to be developed, to include the additional metadata required by this project (see agenda item 4). It reiterated its agreement to support the project by working with the DAC and WMO Secretariat to design the supplement format, and requested the task team leader to ensure that this work was completed before the second project meeting in late 2000.

10.2 Requirements for vessel digital image data

10.2.1 The subgroup noted with interest a report on this topic by Dr Lothar Kaufeld (Germany). It agreed with Dr Kaufeld that the inclusion of such data in the ship catalogue would be very useful, in particular for those involved in climate studies. It noted that such imagery was certainly to be included in the ship catalogue supplement being prepared for the VOSClim project, and agreed that this would provide a valuable pilot study and introduction to the eventual inclusion of such imagery for the whole VOS. The subgroup therefore recommended:

(i) that the WMO Secretariat prepare the necessary format and entries for inclusion of vessel digital imagery in No. 47, on the basis of recommendations regarding the catalogue supplement for VOSClim;
(ii) that a ship side view was the preferred image, showing deck line, deck cargo and superstructure; however, several different images could be included if these were available;
(iii) that photographic images should be obtained where possible; PMOs submitting such images should use digital cameras; if this was not possible, other images sources could be used, such as scanning of ship photographs or construction plans in shipping company catalogues or files;
(iv) that, while VOS operators should be able to submit their imagery (for example by email) to the Secretariat in any common digital image format (e.g. .gif, .tif, .jpeg), the catalogue product should be in a single standard format, with an associated reader if appropriate.

10.2.2 The Secretariat was requested to make a formal call to VOS operators for the submission of imagery once all the necessary formats and catalogue entries had been established.

11. FUTURE ACTIVITIES (agenda item 11)

11.1 The subgroup recalled its agreement to the proposal that, in the new JCOMM substructure, its work should be integrated with oceanographic data management activities under the Expert Team on Data Assembly, within the Data Management Programme Area (see agenda item 2). In this context, it requested its chairman and the Secretariat to ensure that the existing subgroup terms of reference (see **Annex XIII**) should be incorporated into the terms of reference for the expert team as follows:

- a, b, c, e, f, and h to be included within generic terms for the expert team;
- d and g to be included specifically.

In addition, the subgroup requested that the following items also be included as activities for the new expert team:

(i) Keep under review and encourage the use of advanced information technology in marine data management;
(ii) Encourage and assist countries to identify, digitise and archive historical marine meteorological and oceanographic data.

11.2 The subgroup recalled that, as a result of its deliberations during the present meeting, formal recommendations were required to be prepared for adoption by JCOMM-I on the following topics:

(a) modifications to the recommended minimum QC procedures;
(b) modifications to the IMMT format, in particular for VOSClim;
(c) revisions to the *Guide to the Applications of Marine Climatology*, to include selected CLIMAR99 papers as Part 2;
(d) the ODAS metadata format;
(e) a format for historical data exchange and archival;
(f) some further substantive (non-editorial) modifications to the *Guide to Marine Meteorological Services*.

The subgroup requested the chairman to liaise with group members and the Secretariat to ensure that the work to prepare the necessary information to be included in these recommendations was completed by the end of 2000 at the latest, for submission to the Secretariat for the preparation of JCOMM-I documentation.

11.3 The subgroup recalled that, in addition to these draft JCOMM recommendations, it had identified during the session a number of other actions, for subgroup members and the Secretariats, to be completed by JCOMM-I. These are listed for convenience in **Annex XIV**. In addition, it considered that an internet mailing list of subgroup members would be a valuable tool for the distribution of information and exchange of ideas and suggestions within the group. It therefore requested the Secretariat to implement such a list on the WMO server and to inform subgroup members accordingly.

12. CLOSURE OF THE SESSION (agenda item 12)

12.1 In closing the session, the chairman Joe Elms thanked all participants for their contributions to what had been a very successful meeting, both before and during the session. He noted that the subgroup had already accomplished a large part of its work plan since CMM-XII, and that it would have substantial recommendations to make to the forthcoming JCOMM-I. He recognized that the work of the subgroup would continue in the future within the new JCOMM structure, assuming even greater significance as JCOMM moved towards a fully integrated marine data management system. He concluded by wishing all participants success in the future and a safe trip home.

12.2 Speaking on behalf of all participants, the WMO Secretariat representative expressed his thanks once more to NCDC, its Director Mr T. Karl and to Joe Elms, for hosting the meeting and for providing such impressive facilities, support and hospitality. He also expressed his appreciation to the chairman for his excellent chairing of the session and for his substantial support for and work on behalf of the subgroup over many years, and expressed the hope that he would continue to support JCOMM in the future.

12.3 The eighth session of the JCOMM Subgroup on Marine Climatology closed at 1130 hours on Friday, 14 April 2000.

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Annex II

AGENDA

1. ORGANIZATION OF THE SESSION

1.1 Opening
1.2 Adoption of the agenda
1.3 Working arrangements

2. REVIEW OF THE DECISIONS OF CMM-XII CONCERNING THE SUBGROUP ON MARINE CLIMATOLOGY

3. REVIEW OF CONTRIBUTIONS AND REQUIREMENTS OF THE WORLD CLIMATE PROGRAMME AND OTHER WMO PROGRAMMES

4. REVIEW OF THE RECOMMENDATIONS OF VOSCLIM-I

5. DATA QUALITY AND EXCHANGE

5.1 Review of quality control procedures for marine climatological data
5.2 Review of the IMMT and SHIP code (FM 13 - X)
5.3 Metadata of the marine ship codes
5.4 Requirements for and provision of marine climatological data and services
5.5 Review and updating of the INFOCLIMA catalogue
5.6 Review of the operations of the Global Collecting Centres
5.7 Review of wind speeds reporting methods

6. DATA ARCHIVAL

6.1 Development of a comprehensive metadata database for ODAS
6.2 Archival of WAVEOB data
6.3 Archival of data other than in IMMT format
6.4 Review of global tropical cyclone data
6.5 Review of the status of the catalogue of storm surge data holdings
6.6 Results of the questionnaire on satellite-based ocean wave databases

7. ARCHIVAL OF OCEAN CURRENT DATA

8. GUIDES AND GUIDANCE

8.1 Guide to the Applications of Marine Climatology: Results of CLIMAR99
8.2 Review of the Guide to Marine Meteorological Services in view of JCOMM
8.3 Guide to Climatological Practices

9. DEVELOPMENTS ON THE BEAUFORT EQUIVALENT SCALE

10. REVIEW OF PUBLICATION WMO-No. 47

10.1 Proposed revised specifications for database fields
10.2 Requirements for vessel digital image data

11. FUTURE ACTIVITIES

12. CLOSURE OF THE SESSION

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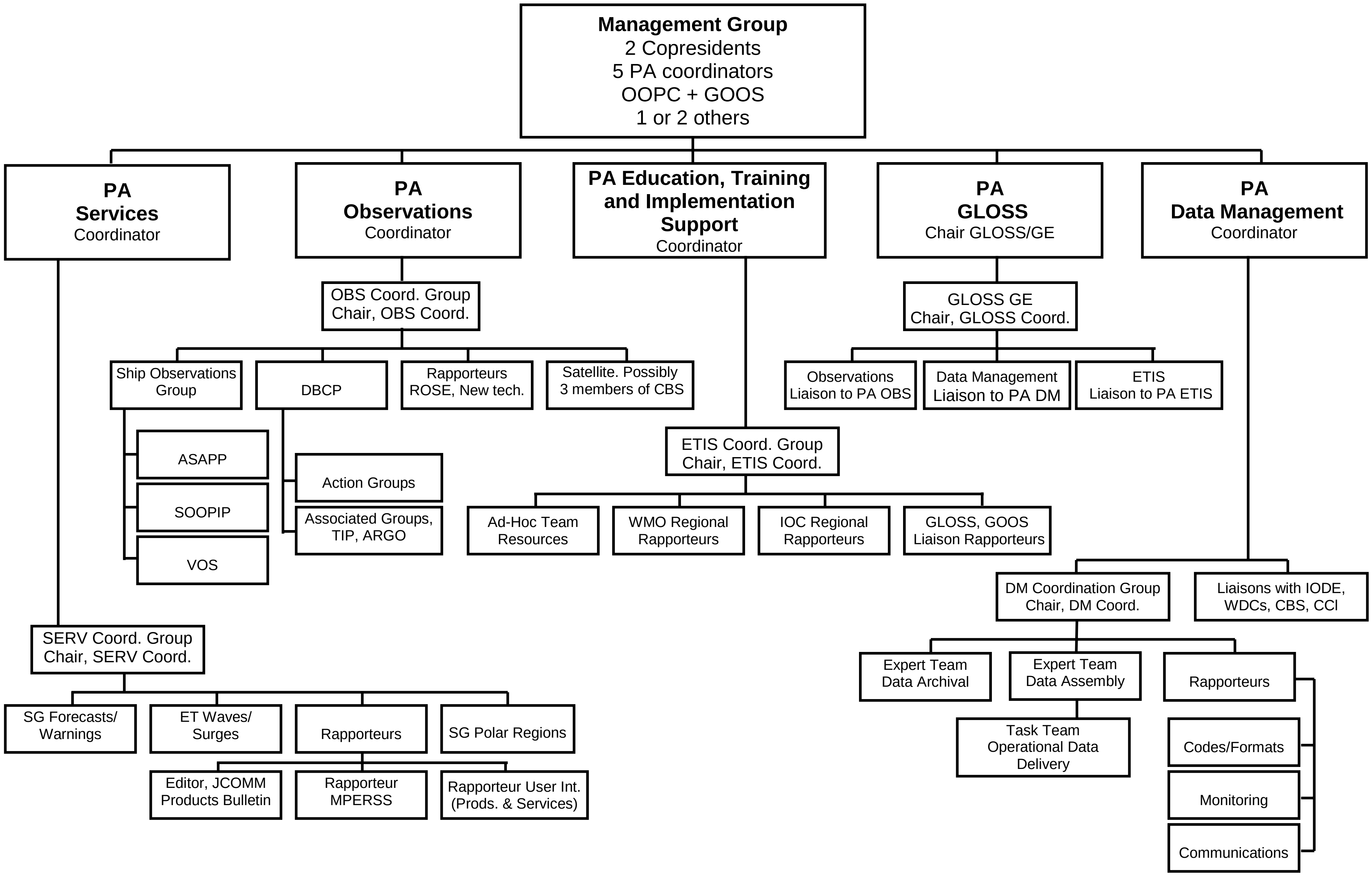
ANNEX III

JCOMM STRUCTURE



Annex IV

VOLUNTARY OBSERVING SHIPS (VOS) CLIMATE SUBSET PROJECT (VOSClim)

Objectives

The primary objective of the project is to provide a high-quality subset of marine meteorological data, with extensive associated metadata, to be available in both real time and delayed mode. Eventually, it is expected that the project will transform into a long-term, operational programme. Specifically, the project gives priority to the following parameters: wind direction and speed, sea level pressure, sea surface temperature, air temperature and humidity. Data from the project will be used: to input directly into air-sea flux computations, as part of coupled atmosphere-ocean climate models; to provide ground truth for calibrating satellite observations; and to provide a high-quality reference data set for possible re-calibration of observations from the entire VOS fleet. Requirements, rationale and scientific justification for the project are detailed below.

The VSOP-NA demonstrated clearly that the quality of measurements depends significantly on the types of instruments used, their exposures and the observing practices of shipboard personnel. It made a number of substantive recommendations in these areas which, if systematically implemented, would be expected to result in VOS observations of a quality appropriate to global climate studies. For logistic reasons, it is not realistic to expect full implementation to the entire global VOS. However, it is undoubtedly feasible for a limited subset of the VOS, and the primary goal of this project is therefore to effect such a limited implementation.

Scientific requirements and justification

1. The evolving requirements for Voluntary Observing Ship data

1.1 Introduction

For well over 100 years, the weather observations from merchant ships have been used to define our knowledge of the marine climate. This function continues within the Voluntary Observing Ships (VOS) programme as the Marine Climatological Summaries Scheme. However the main emphasis of the VOS programme has traditionally been the provision of data required for atmospheric weather forecasting. Today, the initialisation of numerical weather prediction models remains an important use of weather reports from the VOS. However recent trends, such as the increasing availability of data from satellite sensors, and the increased concern with regard to climate analysis and prediction, are making further requirements for data from the VOS.

That there is a growing need for higher quality data from a sub-set of the VOS has been identified by, *inter alia*, the Ocean Observing System Development Panel (OOSDP, 1995), the Ocean Observations Panel for Climate (OOPC, 1998), and the JSC/SCOR Working Group on Air Sea Fluxes (WGASF, 2000). The justification for improved surface meteorological data was also discussed in detail at the recent Conference on the Ocean Observing System for Climate (see paper by Taylor et al. 1999). Here we shall give examples of the requirements, the present state of the art and the potential improvements.

1.2 Examples of evolving requirements for VOS data

A. Satellite data verification

Satellite borne sensors are now used routinely for, for example, determining sea surface temperature (SST), sea waves, and surface wind velocity. Compared to *in situ* measurements, these remotely sensed data provide better spatial coverage of the global oceans. However the data are derived from empirical algorithms and a very limited number of individual sensors. In this respect, an important role for VOS data is the detection of biases in the remote sensed data due to instrument calibration changes or changing atmospheric transmission conditions. For example, the SST analyses produced by the US National Centers for Environmental Prediction (NCEP) are used at a number of operational weather forecasting centres including the ECMWF. The NCEP analyses (Reynolds and Smith, 1994) use SST data from satellite sensors that have been initially calibrated against drifting buoy data. VOS and buoy data are used to detect and correct biases in the satellite data caused, for example, by varying atmospheric aerosol loading due to volcanic eruptions. Without these real time bias corrections, errors of several tenths K or more can occur in satellite derived SST values (Reynolds, 1999). For satellite verification purposes the need is for a dataset of accurate data with known error characteristics.

B. Climate Change Studies

The VOS data are being increasingly used for climate change studies. Assembled into large data bases (such as the Comprehensive Ocean Atmosphere Data Set, COADS, Woodruff et al., 1993) the observations have been used, for example, to quantify global changes of sea and marine air temperature (Folland and Parker, 1995). Based on such studies, the recommendations of the Intergovernmental Panel on Climate Change (Houghton et al., 1990) have led to politically important international agreements such as the UN Framework Convention on Climate Change. However the detection of climate trends in the VOS data has only been possible following the careful correction, as far as is possible, of varying observational bias due to the changing methods of observation. For example sea temperature data have different bias errors depending on whether they were obtained using wooden buckets from sailing ships, canvas buckets from small steam ships, or engine room intake thermometers on large container ships. For the present, and for the future, it is important that we better document the observing practices that are used.

C. Climate Research and Climate Prediction

Coupled numerical models of the atmosphere and ocean are increasingly being used for climate research and climate change prediction. Because the time and space scales for circulation features in the atmosphere and the ocean are very different, the ocean surface is an important interface for model verification. The simulated air-sea fluxes of heat, water and momentum must be shown to be realistic if there is to be confidence in the model predictions. At present the uncertainty in our knowledge of these surface fluxes is of a similar order to the spread in the model predictions (WGASF, 2000). Partly this is due to the limitations of the parameterisation formulae used to calculate the fluxes. Verification of the model predictions of near surface meteorological variables (air temperature, humidity, SST etc.) against high quality *in situ* observations from moored "flux" buoys and specially selected VOS is required (e.g. Send et al. 1999, Taylor et al. 1999a).

2. The State-of-the-Art for VOS observations

2.1 What is needed?

These relatively new applications for VOS data imply a need to minimise the errors present in the observations. For example, 10 Wm^{-2} is often quoted as a target accuracy for determining the heat fluxes; it is about 10% of the typical interannual variability of the wintertime turbulent heat fluxes in mid to high latitudes. To achieve such accuracy implies that the basic meteorological fields are known to about ±0.2°C for the SST, dry and wet bulb temperatures (or about 0.3 g/kg for specific humidity) and that the winds be estimated to ±10% or better, say about 0.5 m/s. These are stringent requirements which we do not expect to be met by an individual VOS observation. Enough observations must be averaged to reduce the errors to the required level. The more accurate the individual VOS observations, the less averaging will be needed. Nor is averaging alone enough; corrections must also be applied for the systematic errors in the data set.

In terms of the longer term ocean heat balance even an accuracy of 10 Wm^{-2} is not adequate. A flux of 10 Wm^{-2} over one year would, if stored in the top 500m of the ocean, heat that entire layer by about 0.15°C. Temperature changes on a decadal timescale are at most a few tenths of a degree (e.g. Parilla et al., 1994) so the global mean heat budget must balance to better than a few Wm^{-2}. It is unlikely that such accuracy will ever be achieved using VOS data either alone, or combined with other data sources. Thus the calculated flux fields must be adjusted, using "inverse analysis", to satisfy various integral constraints. Inverse analysis techniques rely on detailed knowledge of the error characteristics of the data; information which is poorly known at present for the VOS data set. Thus there is an urgent need to better define the accuracy of VOS data.

2.2 What is presently achieved?

To attempt to quantify the random error in VOS observations, Kent et al. (1999) determined the root-mean-square (rms) error for VOS reports of the basic meteorological variables. Table 1 shows the minimum, maximum and mean error values for individual ship observations calculated for 30° x 30° areas of the global ocean. It is obvious that individual ship observations can not achieve the desired accuracy and that the average of many observations is needed. For example, to reduce a typical temperature error of 1.4C to the desired 0.2C requires some 50 independent observations; more when natural variability is taken into account. Sufficient observations are obtained for adequate monthly mean values in well-sampled regions like the North Atlantic but in data sparse regions acceptable accuracy cannot be achieved.

The Voluntary Observing Ship Special Observing Programme - North Atlantic project, VSOP-NA (Kent et al., 1993a), was an attempt to determine the systematic errors in VOS data. For a subset of 46 VOS, the instrumentation used was documented (Kent & Taylor, 1991), and extra information included with each report. The output from an atmospheric forecast model was used as a common standard for comparison. The results were analysed according to instrument type and exposure, ship size and nationality and other factors, and relative biases were determined. For example it was found that SST values from engine intake thermometers were biased warm compared to other methods (Kent et al. 1993a), and that daytime air temperatures were too warm due to solar heating (Kent et al. 1993b). It could be shown that the dew point temperature was not biased by the latter error (Kent and Taylor, 1996) but, compared to aspirated psychrometer readings, the dew point was biased high when obtained from fixed thermometer screens.

Table 1 - RMS Error Estimates: The uncertainty quoted in the mean error is derived from the weighted sum of the error variances (from Kent et al. 1999)

Observed Field	RMS Error:		
	Min.	Max.	Mean
Surface Wind Speed (m/s)	1.3	2.8	2.1 ± 0.2
Pressure (mb)	1.2	7.1	2.3 ± 0.2
Air Temperature (°C)	0.8	3.3	1.4 ± 0.1
Sea Surface Temperature (°C)	0.4	2.8	1.5 ± 0.1
Specific Humidity (g/kg)	0.6	1.8	1.1 ± 0.2

Some of the VOS in the VSOP-NA project reported anemometer estimated, relative wind speed in addition to the calculated true wind speed. Kent et al. (1991) showed that a major cause of error was the calculation of the true wind speed. Only 50% of the reported winds were within 1 m/s of the correct value, 30% of the reports were more than 2.5 m/s incorrect. For wind direction, only 70% were within ±10° of the correct direction and 13% were outside ±50°. These were large, needless errors which significantly degraded the quality of the anemometer winds. A similar conclusion was reached by Gulev (1999). Preliminary results from a questionnaire distributed to 300 ships' officers showed that only 27% of them used the correct method to compute true wind. The problem is not confined to VOS observations. A majority of the wind data sets obtained from research ships during the World Ocean Circulation Experiment showed errors in obtaining true wind values (Smith et al., 1999).

2.3 How can the situation be improved?

Consider as an example, wind velocity. The typical rms error for a wind speed observation shown in Table 1 (about 2.1 m/s) was achieved after instrumental observations had been corrected for the height of the anemometer above the sea surface (using data from the List of Selected Ships, "WMO47") and the visual observations corrected using the Lindau (1995) version of the Beaufort scale. For the observations as reported, the errors were nearly 20% greater - about 2.5 m/s. Alone, this change in mean accuracy decreases the number of observations required to obtain a reliable mean by a factor of 2/3rds. The quality of the anemometer winds can be further improved by using an automated method of true wind calculation such as the TurboWin system developed at KNMI. The effect on the anemometer measurements of the air-flow disturbance around the ships' hull and superstructure can be investigated using computational fluid dynamics (CFD) modelling of the airflow (Yelland et al., 1998). While it would be impracticable to model all the VOS, it is believed that typical values for the resulting error can be estimated given knowledge of the anemometer position and the overall geometry of the ship (Taylor et al. 1999b).

Similarly for the other observed variables correction schemes can be devised. For example, air temperature errors due to daytime heating of the ship depend on the solar radiation and the relative wind speed (Kent et al. 1993b). Josey et al., (1999) found that correcting the various known biases changed the climatological monthly mean heat flux by around ±15 Wm^{-2} varying with area and season. For climate studies these represent significant changes.

3. Conclusions

Most of the potential improvements discussed above require detailed, accurate documentation on the methods of observation. Some of this information is available in the List of Selected Ships (WMO47) which should be augmented with information similar to that collected for the ships which participated in the VSOP-NA. Improved meta-data with regard to the ship and observing practices, and improved quality control of the observations, are the initial priorities for the VOS Climate project. Other desirable enhancements to the VOS system include increased use of automatic coding, and improved instrumentation. These are being introduced on an increasing number of VOS, and future implementation on the ships participating in the VOS climate subset should be anticipated.

The successful implementation of the VOS Climate project will represent an important contribution to the Ocean Observing System for Climate as defined by the OOSDP (1995) and the OOPC (1998).

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EXTRA INFORMATION WITH EACH OBSERVATION

Ship parameters

Code 1	ss	Instantaneous ship's speed in knots at time of observation
Code 2	DD	Ship's heading in tens of degrees true
Code 3	LL	Maximum height in metres of deck cargo above summer maximum load line
Code 4	hh	Departure of summer maximum load line from actual sea level (m)

Wind

Code 5	ff	Relative speed in knots or m/s (in conformity with wind code indicator)
Code 6	DD	Relative wind direction in tens of degrees (00 to 36) off the bow.

This information will be included in Section 2 of the SHIP code, in optional groups to be introduced after the ICE groups. The groups will be prefixed by CLIM, and will be of the form 1ssDD 2LLhh 3ffDD, to be extended as required.

Annex V

MINIMUM QUALITY CONTROL STANDARDS

MQCS - III (Version 3, May 2000)

NOTE See specification for quality control Indicators Q_1 to Q_{20} at the end of this appendix
Δ = space (ASCII 32)

Element	Error	Action
1	$i_T \neq$ 3-5	Correct manually, otherwise Δ
2	AAAA $\neq$ 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	G $\neq$ 00 - 23	Correct manually otherwise reject
6	Q $\neq$ 1, 3, 5, 7	Correct manually and Q_{20} = 5, otherwise Q_{20} = 4
	Q = Δ	Q_{20} = 2
7	$L_aL_aL_a \neq$ 000-900	Correct manually and Q_{20} = 5, otherwise Q_{20} = 4
	$L_aL_aL_a$ = $\Delta\Delta\Delta$	Q_{20} = 2
8	$L_oL_oL_oL_o \neq$ 0000-1800	Correct manually and Q_{20} = 5, otherwise Q_{20} = 4
	$L_oL_oL_oL_o$ = $\Delta\Delta\Delta\Delta$	Q_{20} = 2
But	$L_aL_aL_a$ = $L_oL_oL_oL_o$ = $\Delta\Delta\Delta(\Delta)$	Correct manually otherwise reject

Time sequence checks

Element	Error	Action
	Change in latitude > 0.7^o /hr	Correct manually otherwise Q_{20} = 3
	Change in longitude > 0.7^o /hr when lat. 00-39.9	Correct manually otherwise Q_{20} = 3
	Change in longitude > 1.0^o /hr when lat. 40-49.9	Correct manually otherwise Q_{20} = 3
	Change in longitude > 1.4^o /hr when lat. 50-59.9	Correct manually otherwise Q_{20} = 3
	Change in longitude > 2.0^o /hr when lat. 60-69.9	Correct manually otherwise Q_{20} = 3
	Change in longitude > 2.7^o /hr when lat. 70-79.9	Correct manually otherwise Q_{20} = 3
9		No checking
10	h $\neq$ 0-9, Δ	Correct manually and Q_1 = 5, otherwise Q_1 = 4
	h = Δ	Q_1 = 9
11	VV $\neq$ 90-99, $\Delta\Delta$	Correct manually and Q_2 = 5, otherwise Q_2 = 4
	VV = $\Delta\Delta$	Q_2 = 9
12	N $\neq$ 0-9, Δ, /	Correct manually and Q_3 = 5, otherwise Q_3 = 4
	N < Nh	Correct manually and Q_3 = 5, otherwise Q_3 = 2
13	dd $\neq$ 00-36, 99, $\Delta\Delta$	Correct manually and Q_4 = 5, otherwise Q_4 =4
	dd = $\Delta\Delta$, //	Q_4 = 9
	<u>dd versus ff</u>	
	dd = 00, ff 00	Correct manually and Q_4 or Q_5 = 5 otherwise Q_4 = Q_5 = 2
	dd $\neq$ 00, ff = 00	Correct manually and Q_4 or Q_5 = 5 otherwise Q_4 = Q_5 = 2
14	$i_w \neq$ 0, 1, 3, 4	Correct manually, otherwise Q_5 = 4
15	ff > 80 knots	Correct manually and Q_5 = 5, otherwise Q_5 = 3
	ff = $\Delta\Delta$, //	Q_5 = 9
16	$s_n \neq$ 0, 1	Correct manually, otherwise Q_6 = 4
17	TTT = $\Delta\Delta\Delta$, ///	Q_6 = 9
	If **-**25 > TTT >40 then	
	when Lat. < 45.0	
	TTT < **-**25	Q_6 = 4
	TTT > 40	Q_6 = 3
	when Lat. >= 45.0	
	TTT < **-**25	Q_6 = 3
	TTT > 40	Q_6 = 4
Element	**Error**	**Action**

TTT versus humidity parameters

	TTT < WB (wet bulb)	Correct manually and $Q_6 = 5$, otherwise $Q_6 = Q_{19} = 2$
	TTT < DP (dew point)	Correct manually and $Q_6 = Q_7 = 5$, otherwise $Q_6 = Q_7 = 2$
18	$s_t \neq 0, 1, 2, 5, 6, 7$	Correct manually, otherwise $Q_7 = 4$
19	DP > WB	Correct manually and $Q_7 = 5$, otherwise $Q_7 = Q_{19} = 2$
	DP > TTT	Correct manually and $Q_7 = 5$, otherwise $Q_7 = Q_6 = 2$
	WB = DP = ΔΔΔ	$Q_7 = 9$
20	930 > PPPP > 1050 hPa	Correct manually and $Q_8 = 5$, otherwise $Q_8 = 3$
	870 > PPPP > 1070 hPa	Correct manually and $Q_8 = 5$, otherwise $Q_8 = 4$
	PPPP = ΔΔΔΔ	$Q_8 = 9$
21	ww = 22-24, 26, 36-39, 48, 49, 56, 57, 66-79, 83-88, 93, 94 and latitude <20^o	Correct manually and $Q_9 = 5$, otherwise $Q_9 = 4$
	ww = ΔΔ, //	$Q_9 = 9$
22, 23	$W_1 = W_2 = 7$ and latitude <20^o	Correct manually and $Q_9 = 5$, otherwise $Q_9 = 4$
	$W_1 < W_2$	Correct manually and $Q_9 = 5$, otherwise $Q_9 = 4$
	$W_1 = W_2 = Δ$, /	$Q_9 = 9$
24,25, 26,27	N = 0, Δ, 9 and $N_hC_LC_MC_H \neq Δ$	Correct manually and $Q_3 = 5$, otherwise $Q_3 = 4$
28	$s_s \neq 0, 1$	Correct manually otherwise $Q_{10} = 4$
29	$T_wT_wT_w$ = ΔΔΔ, ///	$Q_{10} = 9$
	if $-2.0 > T_wT_wT_w > 37.0$ then	
	when Lat. < 45.0	
	$T_wT_wT_w < -2.0$	Control manually and $Q_{10} = 5$, otherwise $Q_{10} = 4$
	$T_wT_wT_w > 37.0$	Control manually and $Q_{10} = 5$, otherwise $Q_{10} = 3$
	when Lat. >= 45.0	
	$T_wT_wT_w < -2.0$	Control manually and $Q_{10} = 5$, otherwise $Q_{10} = 3$
	$T_wT_wT_w > 37.0$	Control manually and $Q_{10} = 5$, otherwise $Q_{10} = 4$
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	$20 < P_wP_w < 30$	$Q_{11} = 3$
	$P_wP_w \geq 30$ and ≠ 99	$Q_{11} = 4$
	P_wP_w = ΔΔ, //	$Q_{11} = 9$
33	$35 < H_wH_w < 50$	$Q_{12} = 3$
	H_wH_w > = 50	$Q_{12} = 4$
	H_wH_w = ΔΔ, //	$Q_{12} = 9$
34	$d_{w1}\, d_{w1} \neq$ 00-36, 99, ΔΔ	Correct manually and $Q_{13} = 5$, otherwise $Q_{13} = 4$
	$swell_1 = swell_2 = Δ$	$Q_{13} = 9$
35	$25 < P_{w1}P_{w1} < 30$	$Q_{13} = 3$
	$P_{w1}P_{w1} \geq 30$ and ≠ 99	$Q_{13} = 4$
36	$35 < H_{w1}H_{w1} < 50$	$Q_{13} = 3$
	$H_{w1}H_{w1}$->= 50	$Q_{13} = 4$
37	$I_s \neq$ 1-5, Δ	Correct manually, otherwise Δ
38	$E_sE_s \neq$ 00-99, ΔΔ	Correct manually, otherwise ΔΔ
39	$R_s \neq$ 0-4, Δ	Correct manually, otherwise Δ
40	Source ≠ 0-6	Correct manually, otherwise Δ
41	Platform ≠ 0-9	Correct manually, otherwise Δ
42	No call sign	Insert manually, otherwise reject
43	No country code	Insert manually
44		No Quality Control
45	Q ≠ 0-6, 9	Correct manually, otherwise Δ
46	$i_x \neq$ 1-7	Correct manually, otherwise Δ
47	i_R = 0-2 and RRR = 000, ///, ΔΔΔ	Correct manually, otherwise $Q_{14} = 4$
	i_R = 3 and RRR ≠ 000, ///, ΔΔΔ	Correct manually, otherwise $Q_{14} = 2$
	i_R =4 and RRR ≠ ///, ΔΔΔ	Correct manually, otherwise $Q_{14} = 2$
	$i_R \neq$ 0 - 4	Correct manually, ortherwise $Q_{14} = 4$
Element	**Error**	**Action**

48	RRR $\neq$ 001 - 999 and i_R = 1, 2	Correct manually and Q_{14} = 5, otherwise Q_{14} = 2
49	t_R 0-9	Correct manually and Q_{14} = 5, otherwise Q_{14} = 4
50	$s_w \neq$ 0, 1, 2, 5, 6, 7, 9	Correct manually, otherwise Q_{19} = 4
51	WB < DP	Correct manually and Q_{19} = 5, otherwise Q_{19} = Q_7 = 2
	WB = ///, ΔΔΔ	Q_{19} = 9
	WB > TTT	Correct manually and Q_{19} = 5, otherwise Q_{19} = Q_6 = 2
52	a $\neq$ 0-8, Δ	Correct manually and Q_{15} = 5, otherwise Q_{15} = 4
	a = 4 and ppp $\neq$ 000	Correct manually and Q_{15} = 5, otherwise Q_{15} = Q_{16} = 2
	a = Δ	Q_{15} = 9
53	150 < ppp $\leq$ 250	Correct manually and Q_{16} = 5 otherwise Q_{16} = 3
	ppp > 250	Correct manually and Q_{16} = 5 otherwise Q_{16} = 4
	ppp = ΔΔΔ	Q_{16} = 9
54	$D_s \neq$ 0-9, Δ	Correct manually and Q_{17} = 5, otherwise Q_{17} = 4
	D_s = Δ, /	Q_{17} = 9
55	$V_s \neq$ 0-9, Δ	Correct manually and Q_{18} = 5, otherwise Q_{18} = 4
	V_s = Δ, /	Q_{18} = 9
56	$d_{w2}d_{w2} \neq$ 00-36, 99	Correct manually and Q_{13} = 5, otherwise Q_{13} = 4
57	25 < $P_{w2}P_{w2}$ < 30	Q_{13} = 3
	$P_{w2}P_{w2} \geq$ 30 and $\neq$ 99	Q_{13} = 4
58	35 < $H_{w2}H_{w2}$ < 50	Q_{13} = 3
	$H_{w2}H_{w2}$ >= 50	Q_{13} = 4
59	$c_i \neq$ 0-9, Δ	Correct manually, otherwise Δ
60	$s_i \neq$ 0-9, Δ	Correct manually, otherwise Δ
61	$b_i \neq$ 0-9, Δ	Correct manually, otherwise Δ
62	$D_i \neq$ 0-9, Δ	Correct manually, otherwise Δ
63	$z_i \neq$ 0-9, Δ	Correct manually, otherwise Δ

Specifications for quality control Indicators Q_1 to Q_{20}

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, 7	Reserved for GCCs
8Reserve	
9	The value of the element is missing

Use of flag 6:

The GCCs wil set the flag to 6 if the flag has been set to 1 by the Contributing member and the GCCs find it not in accordance with the MQCS

Use of flag 7:

The GCCs wil set the flag to 7 if the flag had been set to 5 by the Contributing member andnthe GCCs find it no in accordance with the MQCS

---oooOooo---

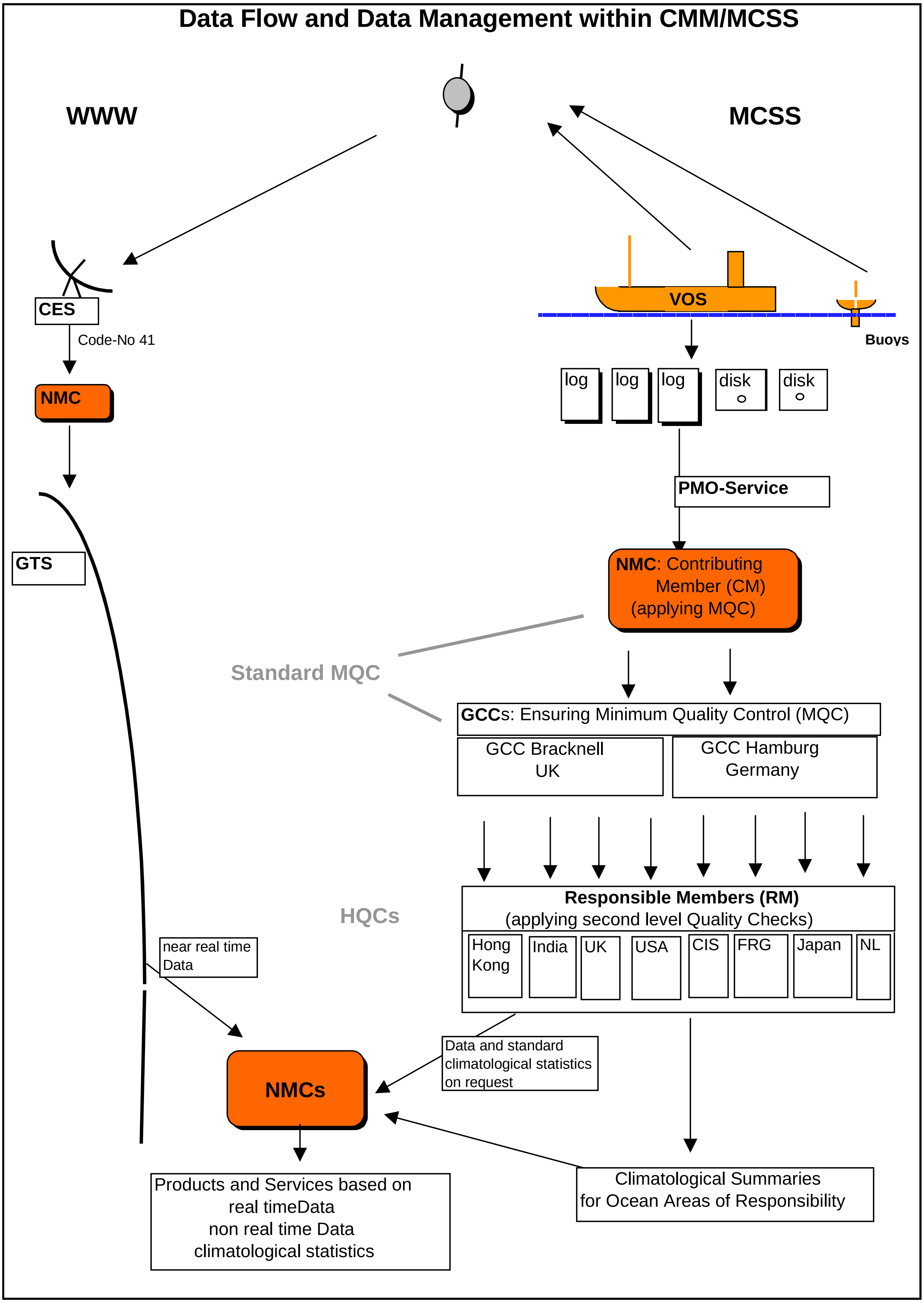
Table 1
History of FM13 SHIP, FM21 SHIP, FM22 SHIP, FM23 SHRED, FM24 SHIP

with effect from	Description of change	Resolution (EC)	Recommendation (CBS, CSM)	
5 Nov. 1997	A new regulation 12.4.7.1.3 (notes on code) is added .	Res. 4 (EC-XLIX) - Report of the Eleventh Session of the Commission for Basic Systems (June 1997)	Rec. 7 (CBS-XI) - Amendments to the Manual on Codes, Volume I.1, alphanumeric codes and Volume I.2, binary codes and common tables (Oct. 1996)	
2 Nov. 1994	FM13-X SHIP is modified. (Amendments to FM 13-IX Ext, SHIP) -add wet-bulb temp, -systematically report present past weather, temp cloids and wave, -indicate type of sst measurement	Res. 4 (EC-XLV) - Report of the Tenth Session of the Commission for Basic Systems (June 1993)	Rec. 9 (CBS-X) - Amendments to FM13-IX Ext. SHIP (Sept. 1992)	Annex I.1
3 Nov. 1993	FM 13-X SHIP is made. (Amendments to FM 13-IX Ext, SHIP) -add net short wave and direct solar radiation	Res. 4 (EC-XLV) - Report of the Tenth Session of the Commission for Basic Systems (June 1993)	Rec. 8 (CBS-X) - Amendments to FM12-IX Ext. SYNOP and FM13-IX Ext.SHIP (Sept. 1992)	
1 Nov. 1991	FM13-IX Ext .SHIP is made (Modification to FM-13 IX SHIP) -pressure tendency algorithms -total amount of precipitation -actual time of observation	Res. 8 (EC-XLIII) - Report of the Extraordinary Session (1990) of the Commission for Basic Systems (May 1991)	Rec. 13 (CBS-(IX.)Ext.(90)) - Proposed modifications to regulations of FM12-IX SYNOP and FM13 IX SHIP and minor modification... Sept.1990	Annex I.2
1 Nov. 1989	FM13-IX SHIP is made (Modification to FM-13 VIII Ext. SHIP) -snow-depth data -precipitation data daily amount of evaporation, net-radiation ad duration of sunshine data	Res. 1 (EC-XL) - Report of the Ninth Session of the Commission for Basic Systems (June 1988)	Rec. 12 (CBS-IX) - Proposed modifications to regulations of FM12-VIII Ext. SYNOP and FM13-VIII Ext. SHIP to meet additional data requirements (Jan. 1988)	
1 Nov. 1987	FM13-VIII Ext. SHIP is made. (Amendments to FM 13-IX Ext, SHIP) -broaden the use of N=/	Res. 4 (EC-XXXVIII) - Report of the Extraordinary Session of the Commission for Basic Systems (June 1986)	Rec. 5 (CBS-(VIII.)Ext.(85)) - Amendments to FM12-VII SYNOP and FM13-VII SHIP (Oct.1985)	
1 Jan.1982	FM13-VII SHIP was introduced (deletion of FM 21-V SHIP, FM22-V SHIP, FM23-V SHRED, and FM 24-V SHIP)	Res. 5 (EC-XXXI) - Common code for reporting surface observations from different types of surface stations (May 1979)	Rec. 14 (CBS-VII) - Common code for reporting surface observations from different types of surface stations (Nov.1978)	Annex I.3
1 Jan 1979	Amendments to FM 21-V SHIP, FM22-V SHIP and FM23-V SHRED (FM-VI Ext was not adopted as code name) -revision of ice group	Res. 3 (EC-XXIX) - Report of the Extraordinary Session (1976) of the Commission for Basic Systems (May 1977)	Rec. 9 (CBS-Ext.(76)) - Amendments to marine codes (Nov.1976)	
1 Jan.1978	revision of the notes on code FM24-V	Res. 3 (EC-XXIX) - Report of the Extraordinary Session (1976) of the Commission for Basic Systems (May 1977)	Rec. 12 (CBS-Ext.(76)) - Revision of the noted on Codes FM11-V, FM14V, and FM24V (Nov. 1976)	
1 Jan. 1972	FM21.E,FM22.E,FM23E are made -introduction of MiMiMjMj	Res. 15 (EC-XXII) - Modifications to the International Meteorological Codes (Oct. 1970)	Rec. 8 (CSM-V) - Time and Type of Message Indicator Group (June 1970)	Annex I.4
1 Jan. 1972	FM24.E is introduced	Res. 15 (EC-XXII) - Modifications to the International Meteorological Codes (Oct. 1970)	Rec. 22 (CSM-V) - Code Form for Synoptic Surface Observations Rec. 23 (CSM-V) Code Form for Exchange of Synoptic Surface Observations Originating from Automatic Weather Stations (June 1970)	

with effect from	Description of change	Resolution (EC)	Recommendation (CBS, CSM)	
1 Jan. 1968	FM21.D,FM22.D,FM23D are made -99LaLaLa QcLoLoLoLo are introduced	Res. 13 (EC-XVIII) - Modification of the International Meteorological Codes, Specifications and Descriptive terms and Instructions concerning Methods of Coding (May 1966)	Rec. 24 (CSM-IV) - Reporting of Ship's Position Rec. 25 (CSM-IV) - Identification of Ship Report and Position (Mar. 1966)	
1 Jan 1964	FM21.C,FM22.C,FM23C are made -2IsEsEsRs is introduced	Res. 34 (EC-XIV) - Modification of the International Meteorological Codes, Specifications and Descriptive terms and Instructions concerning Methods of Coding (May 1962)	Rec. 27 (CSM-III) - Coding Reports of Ice Accretion on Ships (Mar. 1962)	Annex I.5
1 Jan. 1960	FM23B is made Amendment to FM23A. (simplified code to be used after IGY)	Res. 22 (EC-X) - Modification of the International Meteorological Codes, Specifications and Descriptive terms and Instructions concerning Methods of Coding (May 1958)	Rec. 1 (CSM-II) - Simplified Code Forms for Ships in area where observations are sparse (Jan. 1958)	
	FM26B is made Amendment to FM26A (more frequent reports from the sea)		Rec. 2 (CSM-II) - Code form special reports from ships (Jan.1958)	
1 Jan. 1955	FM21.A,FM22.A,FM23A. is made -DsVsXXX is added to FM22-A SHIP ,FM 23-SHIP -note (6) under FM21 is added	Res. 21 (EC-IV) - Meteorological Codes and Forms of Messages (Oct.1953)	Rec. 18 (CSM-I) - Introduction of the code group DsVsXXX (Apr. 1953)	Annex I.6
	SHIP is introduced. -FM is not used here	Res. 161 (CD, Washington 1947) Standard Formats of Messages for Reports of Surface Observations (Sept. 1947)	Rec. XVI (CSWI Toronto 1947) - Standard Formats of Messages for Reports of Surface Observations	Annex I.7

Table 2
History of IMMPC/IMMT and Minimum Quality Control Standards

with effect from	Description of change	Resolution (EC)	Recommendation (CMM)	
1 Jan. 1998	ISO Alpha-2 country code be used as the country codes in the IMMT format.	Res. 8 (EC-XLIX) - Report of the Twelfth Session of the Commission for Marine Meteorology (June 1997)	Rec. 8 (CMM-XII) - Harmonized Country Codes in the IMMT format and the International List of Selected, Supplementary and Auxiliary Ships (WMO-No.47)	
not fixed	Inclusion of the revised MQC standards in the Manual on MMS (No. 558)	Res. 8 (EC-XLIX) - Report of the Twelfth Session of the Commission for Marine Meteorology (June 1997)	Rec. 7 (CMM-XII) - Revised minimum quality control standards	
2 Nov. 1994	Modified IMMT format (IMMT-1) is introduced. The implementation date is the same as that for SHIP	Res. 10 (EC-XLV) - Report of the Eleventh Session of the Commission for Marine Meteorology (June 1993)	Rec. 13 (CMM-XI) - Modification to the International Maritime Meteorological Tape (IMMT) Format for the Exchange of Marine Climatological Data	Annex II.1
1 Mar. 1985	Inclusion of weather indicator (ix) is the IMMPC/IMMT format for all the data	Res. 8 (EC-XXXVII) - Report of the Ninth Session of the Commission for Marine Meteorology (June 1985)	Rec. 5 (CMM-IX) - International Maritime Meteorological Punch Card (IMMPC)/International Maritime Meteorological Tape (IMMT)	Annex II.2
1 Jan. 1982	Revision of IMMPC in accordance with the new common surface code FM13-VII, and introduction of IMMT	Res. 9 (EC-XXXIV) - Report on the Eight Session of the Commission for Marine Meteorology (June 1982)	Rec. 8 (CMM-VIII) - International Maritime Meteorological Punch Card (IMMPC)/International Maritime Meteorological Tape (IMMT)	Annex II.3 (IMMPC) Annex II.4 (IMMT)
1 Jan 1966	Visibility, Height of clouds, etc. are modified. Amendments of Technical Regulations Appendix F (note) Rec23,24(CMM-III) are no longer be kept in force	Res. 14 (EC-XVII) - Report on the Forth Session of the Commission for Marine Meteorology (May 1965)	Rec. 28 (CMM-IV) - Amendments to the International Maritime Meteorological Punch-Card	Annex II.5
1 Jan 1962	Amendments of Technical Regulations, Appendix F Modified IMMPC format is introduced in accordance with commencement of MCSS.	Res. 20 (EC-XIII) - International Marine Meteorological Punch-Card (May 1961)	Rec. 23 (CMM-III) - International Maritime Meteorological Punch Card	Annex II.6
1 Jan 1962	Future changes in units and codes affecting the data to be entered on IMMPC always become effective on 1 Jan.	Res. 18 (EC-XIII) - Report on the Third Session of the Commission for Marine Meteorology (May 1961)	Rec. 25 (CMM-III) - Future Code Changes Affecting the International Maritime Meteorological Punch-Card	
1 Jan 1962	Country of Origin is identified by a number consisting two figures	Res. 18 (EC-XIII) - Report on the Third Session of the Commission for Marine Meteorology (May 1961)	Rec. 24 (CMM-III) - WMO System for the “Country of Origin” on the International Maritime Meteorological Punch Card	
not fixed	Amendments of Technical Regulations The international maritime punch card given in annex VI should be used for permanent records of synoptic surface observations made at sea stations.	Res. 33 (EC-IX) - Report on the Second Session of the Commission for Marine Meteorology (Sept. 1957)	Rec. 30 (CMM-II) - Proposed Amendments to the Technical Regulations Relating to Marine Meteorology	Annex II.7
not clear (Mar. 1951?)	The international code form for punching cards from ships' observations was adopted	Res. 23 (CD 1951) - International Punch card for ships' observations.		Annex II.8



Data Flow and Data Management within CMM/MCSS
WWW
MCSS
CES
Code-No 41
NMC
VOS
Buoys
log
log
log
disk
disk
PMO-Service
GTS
NMC: Contributing Member (CM) (applying MQC)
Standard MQC
GCCs: Ensuring Minimum Quality Control (MQC)
GCC Bracknell UK
GCC Hamburg Germany
HQCs
Responsible Members (RM) (applying second level Quality Checks)
Hong Kong
India
UK
USA
CIS
FRG
Japan
NL
near real time Data
Data and standard climatological statistics on request
NMCs
Products and Services based on real timeData non real time Data climatological statistics
Climatological Summaries for Ocean Areas of Responsibility

Annex VIII

Proposed Ingest Format

The two basic metadata record types (header and data) are listed. Within the data record type, there are different subsidiary record types defined for the different sensor types that are presently defined (the data record list could be expanded in the future). The descriptions of the fields that make up each record type are listed in Table 1.

1. Header Record (HR is the identifier for the metadata header record)

HR; ts; WMOn; stn; Ain; ind; oed; cnty; ragy; Idum; DA; Lat; Lon; WC; lngth; brth; diam; hult; huln; mtyp; cmsy; Stt; foo; dfmt; wdpth; plt; DI; WebA; footnote # 1; footnote # 2; footnote # 3; footnote # 4; footnote # 5

2. Data Records (DR is the identifier for the sensor information record, thus designated data record) the first six elements will link the data record to the header record. A data records will only exist when there is an actual sensor on the platform and it can be repeated for every sensor of a given type.

"Sno" in the eighth element represents the sequence number of sensors located on the platform e.g. if two anemometer sensors were on the platform there would be two data records for anemometers indicated in elements 7 and 8 as AN;1 and AN;2".

The "ind" field is a critical part in linking records in the case where a platform was moved or totally re-equipped or redesigned, this will allow the correct data records to be linked to the proper header record especially in cases where the same identifier was reissued at a later date.

AN metadata record: **Anemometer** sensor (**AN** in 7th element)

DR; ts; WMOn; stn; AIn; ind; AN; Sno; anmI; aMS; anmL; anDB; anDC; hwl; ouAN; sfWD; sfWS; apWD; apWS; amWS; cmpT; apWG; amWG; amScd; amID; amSD; footnote # 1

AT metadata record: **Air temperature** sensor (AT in 7th element)..

DR; ts; WMOn; stn; AIn; ind; AT; Sno; ats; atsMS; atsL; atsDB; atsC; atswl; ouAT; sfAT; apAT; atScd; atID; atSD; footnote # 1; footnote # 2

WT metadata record: **Water temperature** sensor (WT in 7th element).

DR; ts; WMOn; stn; AIn; ind; WT; Sno; wts; wtsMS; wtsL; wtsDB; wtsC; dws; ouWT; sfWT; apWT; wtScd; wtID; wtSD; footnote # 1

SA metadata record: **Salinity** sensor (SA in 7th element).

DR; ts; WMOn; stn; AIn; ind; SA; Sno; Sstp, Ssm; SsL; SsDB; SsC; dss; ouSs; sfSs; apSs; mSs; SsScd; SsID; SsSD; footnote # 1

BP metadata record: **Barometric Pressure** (BP in 7th element).

DR; ts; WMOn; stn; AIn; ind; BP; Sno; bps; bpsMS; bpsL; bpsDB; bpsC; bpswl; ouBP; sfBP; apBP; bpScd; bpsID; bpsSD

RH metadata record: **Relative Humidity** (wet bulb/dew point) sensor (RH in 7^{th} element)

DR; ts; WMOn; stn; AIn; ind; RH; Sno; hs; hsMS; hsL; hsDB; hsC; hswl; ouHS; sfHS; apHS; hsScd; hsID; hsSD

PG metadata record: **Precipitation** gauge (PG in 7^{th} element).

DR; ts; WMOn; stn; AIn; ind; PG; Sno; pg; pgMS; pgL; pgDB; pgC; pgwl; pupg; sfPG; apPG; pgScd; pgID; pgSD

RD metadata record: **Radiation** sensor (RD in 7^{th} element).

DR; ts; WMOn; stn; AIn; ind; RD; Sno; srs; rMS; rsL; rsDB; rsC; srwl; ours; sfSR; apSR; srScd; rsID; rsSD

CR metadata record: **Ocean Current** sensor (CR in 7^{th} element).

DR; ts; WMOn; stn; AIn; ind; CR; Sno; OC; Tsmoc; dmOC; ouOC; sfOC; apOC; ocScd; ocID; ocSD

WS metadata record: **Wave Spectra** (WS in 7^{th} element).

DR; ts; WMOn; stn; AIn; ind; WS; Sno; wasp; Digf; Nblks; Npts; spAT; sfWAS, apWAS

HV metadata record: **Horizontal Visibility** (HV in 7^{th} element).

DR; ts; WMOn; stn; AIn; ind; HV; Sno; hvm; hvit; hvl; hvDB; hvC; hvwl; hvou; hvsf; hvap; hvScd; hvID; hvSD

Table 1
ODAS Metadata-base Contents

Record type and sequence #		Field Abbre-viation	Input codes	Description of fields
Header Record (HR)				
HR	1	ts	 MB DB ID FP IS AL CM PF OT	Type of station - Moored Buoy Drifting buoy Ice Drifter Fixed Platform (oil Rig, etc.) Island Station Automatic Light Station Coastal Marine Automated Station Profiling floats (e.g. ARGO - a global array of profiling floats) Other (specify in footnote # 1 Header Record)
	2	WMOn		WMO Number - 5 digit identifier
	3	stn		Unique call sign if available; otherwise, station name (C-MAN, Platforms, etc.)
	4	AIn		Additional Identifier Number ; define in footnote # 2 (e.g. ARGOS = up to 7 digits, GOES No., others)
	5	ind		Period of validity / beginning of historical record (initiation date - year, month, day e.g. 19950321) date of mooring, launching, or platform instrumentation (date the platform began collecting weather observations under its current ID and location). If the platform is moved or assigned a new ID then a new period of validity should be initiated.
	6	oed		Operational end date of platform operations (year, month, day e.g. 20000127). This item is associated with the entry above which shows the beginning date and this item the ending date when a platform closed operations. If for example a moored buoy was placed in the Great Lakes each Spring and withdrawn each Winter the beginning date would not change unless the identifier, ownership, or location changed at some point. When one of these change a new beginning date should be entered ind above and a operational end date entered in this field.
	7	cnty	see list	Country of ownership - International Organization for Standardization (ISO) country code (Alpha-2; two character alpha code)
	8	ragy		Responsible agency/organization within a country responsible for the platform s operations, launch, and metadata [e.g. in the USA it could be National Ocean Service (NOS) NOAA , National Data Buoy Center (NDBC) NOAA, Woods Hole Institute, etc.] List the full name of the organization or agency responsible. There should be a link between the responsible agency/organization and web address listed in item 114.
	9	ldmu		Last date metadata updated (year, month, day e.g. 20000527 representing 27 May 2000)
	10	DA	 1 2 3 4 5	Degree of Automation Fully automated Always supplemented with manual input Occasionally supplemented with manual input Fully manual (no automation) Unknown
	11	Lat		latitude - degrees, up to three decimal places if available (e.g. 50. 985 N/S)
	12	Lon		Longitude - degrees, up to three decimal places if available (e.g. 124.976 E/W)
	13	WC		Watch Circle - nearest whole meter (e.g. 346.5 = 347 meters) . The maximum distance a moored buoy can be located from its central position related to the length and type of mooring. Outside the watch circle and the moored buoy is likely adrift.
	14	lngth		Length - the length of the platform (if rectangular or boat shape hull). See code diam below if the platform is a discus. Meters to tenths (e.g. 26. 9 meters)
	15	brth		Breath - the breath (width) of the platform (if rectangular or boat shaped hull). Meters to tenths (e.g. 12.6 m)
	16	diam		Diameter - platform dimension for discus type hulls. Diameter in meters to tenths (e.g. 6.0 m)

Record type and sequence #		Field Abbre-viation	Input codes	Description of fields
	17	hult		Hull type
			DS	Discus (Cylinders)
			BS	Boat shaped hull
			RS	Rectangular shape
			SP	Spars
			OD	ODAS 30 series
			NM	NOMAD
			TR	Torus
			CN	Conic
			OR	Omnidirectional wave-rider
			DR	Directional wave-rider
			OT	Other (specify in footnote # 3 Header Record)
	18	huln		Hull or platform number - enter as assigned (a combination of numeric and alpha characters if required)
	19	mtyp		Mooring type - Mooring type if a moored buoy or drouge type if drifting buoy.
			AC	All Chain (shallow depths generally up to 90 meters)
			ST	Semitaut (intermediated depths generally 60 to 600 meters-generally nylon cable)
			FC	Float Inverse Catenary (deep ocean generally 600 to 6000 m-generally nylon with glass floats)
			PC	Poly-nylon Inverse Catenary (deep ocean generally 1200 to 6000 m)
				Drouge Type
			HS	Holey sock drogue
			TS	Tristar
			WS	Window shade
			PA	Parachute
			NL	Non-Lagrangian sea anchor
				Use for either mooring or drouge as needed
			OT	Other (specify in footnote # 4 Header Record)
	20	cmsy		Satellite Data Collection System - system used to transmit the observations
			GO	GOES DCP
			AR	ARGOS PTT
			GA	GOES primary ARGOS backup
			RF	RF
			OT	Other (specify in footnote # 5 Header Record)
	21	Stt		Satellite transmission time - time slot assigned for observation transmission. Hours and minutes UTC (e.g. 1230) or for example, on the hour, on the half hour, two orbits per day, etc.
	22	foo		Frequency of observations - hours and minutes (e.g. every hour = 1.0, every 6 hours = 6.0, or every half hour 0.5, etc., I = irregular)
	23	dfmt		Data format - data format (WMO codes; Pub 306) the observations was transmitted or digitized (i.e. observational form). Buoy code -FM 18-X Ship code - FM 13-X TESAC - FM 64-IX WAVEOB - FM 65-IX BUFR - FM 94-XI Other WMO codes added as needed Note: use actual WMO Code designator as the abbreviation (e.g. FM 18-X)
	24	wdpth		Water Depth (nearest whole meter)
	25	plt		Payload Type (e.g. DACT, VEEP, GSBP, ZENO, ODAS33, etc.) Details should be provided regarding each type of payload (payload description)
	26	DI		Digital image - a phtograph or schematic of the platform and equipment
			AV	Available in digital file
			NA	Not available
	27	WebA		Web Address (URL) where additional information can be obtained

Record type and sequence #		Field Abbre-viation	Input codes	Description of fields
ANEMOMETER (AN)				
DR	1	anmI	 P TC FC S WT OT	Anemometer instrument type propeller/vane three cup four cup sonic WOTAN (wind observation through ambient noise) other (define in footnote)
	2	aMS		Anemometer - model (manufacturer/series no.)
	3	anmL	 FM AM CM RY LY OT	Anemometer - location foremast aftmast centermast (mainmast) right yardarm left yardarm other (define in footnote)
	4	anDB		Anemometer - distance from the bow or front of platform (meters to tenths)
	5	anDC		Anemometer - distance from center line or from center of discus (meters to tenths)
	6	hwl		Anemometer- height above water line (meters to tenths). Value can be negative for WOTAN
	7	ouAN		Anemometer - operational range and units of measurement (e.g. 0 to 60 m/s ; 000 to 360 degrees)
	8	sfWD		Sampling frequency (Hz) - wind direction (e.g. 1.28 Hz)
	9	sfWS		Sampling frequency (Hz) - wind speed (e.g. 1.28 Hz)
	10	apWD		Averaging period (minutes to tenths) - wind direction (e.g. 8.0 minutes)
	11	apWS		Averaging period (minutes to tenths) - wind speed (e.g. 8.0 minutes)
	12	amWS	 S V	Averaging method - wind speed Scalar Vector
	13	cmpT		Compass type/model No. - anemometer
	14	apWG		Averaging period (seconds) - wind gust (e.g. 5 seconds)
	15	amWG	 S V	Averaging method - wind gust Scalar Vector
	16	amScd		Calibration date- Anemometer sensor No. Date sensor was last calibrated (year, month, day e.g. 20000723)
	17	amID		Anemometer sensor installation date (year, month, day e.g. 19950228). If the direction sensor and speed sensor are separate instruments then use footnote # 1 in the Anemometer data record to enter the dates for speed sensor and this position for direction sensor.
	18	amSD		Anemometer out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known these dates should be entered anytime either the direction , speed, or both is unavailable due to equipment outage (non-reporting or invalid reports)
AIR TEMPERATURE (AT)				
DR	1	ats	ER M MS A AS OT	Air temperature sensor- instrument type electrical resistance thermometer mercury-in-glass thermometer screen shelter - mercury thermometer alcohol-in-glass thermometer screen shelter - alcohol thermometer other (specify in footnote # 1 in the air temperature data record)

Record type and sequence #		Field Abbre-viation	Input codes	Description of fields
	2	atsMS		Air temperature sensor - model (manufacturer/series no.)
	3	atsL	 FM AM CM RY LY OT	Air temperature sensor - location foremast aftmast centermast (mainmast) right yardarm left yardarm other (specify in footnote # 2 in the air temperature data record)
	4	atsDB		Air temperature sensor - distance (meters to tenths) from bow or front of platform note: leave this field blank if platform is a discus
	5	atsC		Air temperature sensor - distance (meters to tenths) from center line or center of discus
	6	atswl		Air temperature sensor - height (meters to tenths) above water line
	7	ouAT		Air temperature sensor - Operational range and units of measurement (e.g. - 40C to + 50C)
	8	sfAT		Sampling frequency (Hz) - air temperature sensor (e.g. 1.28 Hz)
	9	apAT		Averaging period (minutes to tenths) - air temperature sensor (e.g. 8.0 minutes)
	10	atScd		Calibration date- Air temperature sensor No. Date sensor was last calibrated (year, month, day e.g. 20000723)
	11	atID		Air temperature sensor installation date (year, month, day e.g. 19950228).
	12	atSD		Air temperature sensor out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known these dates should be entered anytime the air temperature is unavailable due to equipment outage (non-reporting or invalid reports)
WATER TEMPERATURE (WT)				
DR	1	wts	 HC HT RT ER TT BU CTD STD RM XC NS AL XBT OT	Water temperature sensor - instrument type Hull contact sensor "Through hull" sensor Radiation thermometer Electrical resistance thermometer Trailing thermistor Bucket thermometer CTD (conductivity-temperature-depth) STD (salinity-temperature-depth) refractometer XCTD (expendable CTD probe) Nansen cast ALACE (autonomus Lagrangian Circulation Explorer) Expendable Bathythermograph Other (specify in footnote # 1 in the water temperature data record)
	2	wtsMS		Water (sea) temperature sensor - model (manufacturer/series no.)
	3	wtsL		Water temperature sensor - location (e.g. port bow, bottom of discus, etc.)
	4	wtsDB		Water temperature sensor - distance (meters to tenths) from the bow or front of platform Note: left blank for discus hulls and subsurface temperatures
	5	wtsC		Water temperature sensor- distance (meters to tenths) from center line or center of discus
	6	dws		Depth of water temperature sensor; tenths of meters (e.g. 10.3 meters) below the water line.
	7	ouWT		Operational range and units of measurement-water temperature sensor (e.g. range - 4 C to + 40 C)
	8	sfWT		Sample frequency (Hz) - Water temperature sensor (e.g. 1.28 Hz)
	9	apWT		Averaging period (minutes to tenths) - Water temperature sensor (e.g. 8.0 minutes)

Record type and sequence #		Field Abbre-viation	Input codes	Description of fields
	10	wtScd		Calibration date- Water temperature sensor No. Date sensor was last calibrated (year, month, day e.g. 20000723)
	11	wtID		Water temperature sensor installation date (year, month, day e.g. 19950228).
	12	wtSD		Water temperature sensor out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known these dates should be entered anytime the water temperature is unavailable due to equipment outage (non-reporting or invalid reports)
SALINITY (SA)				
DR	1	Sstp		Salinity - sensor type
			CTD	CTD (conductivity-temperature-depth)
			STD	STD (salinity-temperature-depth)
			RM	refractometer
			XC	XCTD (expendable CTD probe)
			NS	Nansen cast
			AL	ALACE (autonomus Lagrangian Circulation Explorer)
			OT	Other (specify in footnote # 1 in the salinity data record)
	2	Ssm		Salinity sensor (model/manufacturer/series no.)
	3	SsL		Salinity sensor No. - Location (note: to be used only for those sensors attached to a platform)
	4	SsDB		Salinity sensor No. - distance from bow or front of platform Note: to be used only when sensor is attached to a platform (same as location above)
	5	SsC		Salinity sensor No. - distance from center line or center of discus
	6	dss		Depth of salinity sensor No. - meters to tenths (e.g. 10.7 m) of salinity sensor below the water line (surface of the water)
	7	ouSs		Salinity sensor - operational range and units of measurement (e.g. 25 to 45 parts per thousand. Salinity is calculated based on the measurement of chlorinity)
	8	sfSs		Sample frequency - available only for automated digital sensors
	9	apSs		Averaging period - available only for automated digital sensors
	10	mSs		Method used to compute the salinity (e.g. chlorinity, electrical conductivity, refractive index, etc.)
	11	SsScd		Calibration date - salinity sensor No. Date the sensor was last calibrated (year, month, day e.g. 20000207)
	12	SsID		salinity sensor installation date (year, month, day e.g. 19950228).
	13	SsSD		Salinity sensor out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known these dates should be entered anytime the salinity is unavailable due to equipment outage (non-reporting or invalid reports)
BAROMETRIC PRESSURE (BP)				
DR	1	bps		Barometric pressure sensor - instrument type
	2	bpsMS		Barometric pressure sensor - model (manufacturer/series no.)
	3	bpsL		Barometric pressure sensor - location (e.g. centermast)
	4	bpsDB		Barometric pressure sensor - distance (meters to tenths) from the bow or front of platform Note: leave this field blank if platform is a discus
	5	bpsC		Barometric pressure sensor - distance (meters to tenths) from center line or center of discus
	6	bpswl		Barometric pressure sensor - height (meters to tenths) above water line
	7	ouBP		Barometric pressure sensor - Operational range and units of measurement (e.g. 900-1100 hPa)
	8	sfBP		Sampling frequency (Hz) - Barometric pressure sensor (e.g. 1.28 Hz)
	9	apBP		Averaging period (minutes to tenths) - Barometric pressure sensor (e.g. 8.0 minutes)

Record type and sequence #		Field Abbre-viation	Input codes	Description of fields
	10	bpScd		calibration date - barometric pressure sensor No. Latest date of calibration (year, month, day e.g. 20000207)
	11	bpsID		Barometric pressure sensor installation date (year, month, day e.g. 19950228).
	12	bpsSD		Barometric pressure sensor out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known these dates should be entered anytime the barometric pressure is unavailable due to equipment outage (non-reporting or invalid reports)
RELATIVE HUMIDITY (RH)				
DR	1	hs		Relative Humidity (wet bulb/dew point) sensor -instrument type
	2	hsMS		Relative Humidity (wet bulb/dew point) sensor -model (manufacturer/series no.)
	3	hsL		Relative Humidity (wet bulb/dew point) sensor -location (left yardarm mast)
	4	hsDB		Relative Humidity sensor - distance (meters to tenths) from the bow or front of platform Note: leave this field blank if platform is a discus
	5	hsC		Relative Humidity sensor - distance (meters to tenths) from center line or center of discus
	6	hswl		Relative Humidity sensor - height (meters to tenths) above water line
	7	ouhs		Relative Humidity (wet bulb/dew point) sensor - Operational range and units of measurement (e.g. range 0-100 %)
	8	sfhs		Sampling frequency (Hz)-Relative Humidity (wet bulb/dew point) sensor (e.g. 1 Hz)
	9	aphs		Averaging period (minutes)-Relative Humidity (wet bulb/dew point) sensor (e.g.1 min.)
	10	hsScd		Calibration date - Relative Humidity (wet bulb/dew point) sensor No. Latest date the sensor was calibrated (year, month, day e.g. 20000207)
	11	hsID		Relative Humidity (wet bulb/dew point) sensor installation date (year, month, day e.g. 19950228).
	12	hsSD		Relative Humidity (wet bulb/dew point) sensor out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known, these dates should be entered anytime the Relative Humidity (wet bulb/dew point) is unavailable due to equipment outage (non-reporting or invalid reports)
PRECIPITATION (PG)				
DR	1	pg		Precipitation gauge -instrument type (e. g. weighing bucket, tipping bucket, etc.)
	2	pgMS		Precipitation gauge - model (manufacturer/series no.)
	3	pgL		Precipitation gauge -location
	4	pgDB		Precipitation gauge - distance (meters to tenths) from the bow or front of platform
	5	pgC		Precipitation gauge - distance (meters to tenths) from center line or off center of a discus
	6	pgwl		Precipitation gauge- height (meters to tenths) above water line
	7	oupg		Precipitation gauge - Operational range and units of measurement (e.g. 0 to 25 cm per hour)
	8	sfPG		Sampling frequency - Precipitation gauge (e.g. continuous)
	9	apPG		Averaging period-Precipitation gauge (e.g. 6 hours; then reset)
	10	pgScd		Calibration date -Precipitation gauge No. Latest date sensor/gauge was calibrated (year, month, day e.g. 20000207)
	11	pgID		Precipitation gauge installation date (year, month, day e.g. 19950228).
	12	pgSD		Precipitation gauge out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known, these dates should be entered anytime the precipitation measurement is unavailable due to equipment outage (non-reporting or invalid reports)

Record type and sequence #		Field Abbre-viation	Input codes	Description of fields
RADIATION (RD)				
DR	1	srs		Solar radiation sensor -instrument type
	2	rMS		Radiation sensor - model (manufacturer/series no.)
	3	rsL		Radiation sensor -location (e.g. foremast)
	4	rsDB		Radiation sensor - distance (meters to tenths) from the bow or front of platform Note: leave this field blank if platform is a discus
	5	rsC		Radiation sensor - distance (meters to tenths) from center line or center of discus
	6	srwl		Solar radiation sensor- height (meters to tenths) above water line
	7	ours		Radiation sensor - Operational range and units of measurement (e.g. 0.07-1.65 cal. cm^{-2} min^{-1})
	8	sfSR		Sampling frequency (Hz)-Solar radiation sensor (e.g. 1 Hz)
	9	apSR		Averaging period (minutes to tenths) - Solar radiation sensor (e.g. 8.0 minutes)
	10	srScd		Calibration date - Solar radiation sensor No. Latest date the sensor was calibrated (year, month, day e.g. 20000207)
	11	rsID		Radiation sensor installation date (year, month, day e.g. 19950228).
	12	rsSD		Radiation sensor out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known, these dates should be entered anytime the radiation measurement is unavailable due to equipment outage (non-reporting or invalid reports)
OCEAN CURRENTS (CR)				
DR	1	OC	 C M E	Ocean current speed reported calculated measured estimated
	2	TSmoc		Type sensor measuring ocean currents (type/model/manufacturer)
	3	dmOC		Depth of measurement (in meters, e.g. 10 m) of the ocean current
	4	ouOC		Ocean currents - Operational range and units of measurement (range e.g.-10 m/s to +10m/s)
	5	sfOC		Sampling frequency (Hz) -Ocean currents (e.g.0.667 Hz)
	6	apOC		Averaging period (minutes to tenths) - Ocean currents (e.g. 20.0 minutes)
	7	ocScd		Calibration date - Ocean current sensor (year, month, day e.g. 20000208)
	8	ocID		Ocean current sensor installation date (year, month, day e.g. 19950228).
	9	ocSD		Ocean current sensor out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known, these dates should be entered anytime the ocean current measurement is unavailable due to equipment outage (non-reporting or invalid reports)
WAVE SPECTRA (WS)				
DR	1	wasp		Wave spectra - type of surface elevation sensor (From which wave spectra is derived)
	2	Digf		Digital filter used - wave spectra
	3	Nblks		Number of blocks used for averaging - wave spectra
	4	Npts		Number of points in each block - wave spectra
	5	spAT		Spectral analysis technique (e.g. FFT, MEM, etc.)
	6	sfWAS		Sampling frequency -Wave spectra (e.g. 2.56 Hz)
	7	apWAS		Averaging period- length of record for averaging period -Wave spectra (e.g. 20 minutes)

Record type and sequence #		Field Abbre-viation	Input codes	Description of fields
HORIZONTAL VISIBILITY (HV)				
DR	1	hvm	 MAN ATM	Horizontal visibility manual automated
	2	hvit		Instrument type (automated sensor) - model/manufacturer/series no.
	3	hvl		Location - Horizontal visibility sensor No.
	4	hvDB		Horizontal visibility sensor - distance (meters to tenths) from the bow or front of platform Note: leave this field blank if platform is a discus
	5	hvC		Horizontal visibility sensor - distance (meters to tenths) from center line or center of discus
	6	hvwl		Horizontal visibility sensor- height (meters to tenths) above water line
	7	hvou		Horizontal visibility sensor - Operational range and units of measurement (e.g. 0000 to 9999 meters or < 0.1km -10km)
	8	hvsf		Sampling frequency - Horizontal visibility sensor No.
	9	hvap		Averaging period - Horizontal visibility sensor No.
	10	hvScd		Calibration date- Horizontal visibility sensor No. Latest date sensor was calibrated (year, month, day e.g. 20000208)
	11	hvID		Horizontal visibility sensor installation date (year, month, day e.g. 19950228).
	12	hvSD		Horizontal visibility sensor out of service dates (beginning and ending dates; year, month, day e.g. 19960123-19960212). If known, these dates should be entered anytime the visibility measurement is unavailable due to equipment outage (non-reporting or invalid reports)

Annex IX

GLOBAL TROPICAL CYCLONE TRACK AND INTENSITY DATA SET - REPORT FORMAT

Position	Content
1- 9	Cyclone identification code composed by 2 digit numbers in order within the cyclone season, area code and year code. 01SWI2000 shows the 1st system observed in South-West Indian Ocean basin during the 2000/2001 season. Area codes are as follows: ARB = Arabian Sea; ATL = Atlantic Ocean; AUB = Australian Region (Brisbane); AUD = Australian Region (Darwin); AUP = Australian Region (Perth); BOB = Bay of Bengal; CNP = Central North Pacific Ocean; ENP = Eastern North Pacific Ocean; ZEA = New Zealand Region; SWI = South-West Indian Ocean; SWP = South-West Pacific Ocean; WNP = Western North Pacific Ocean and South China Sea
10-19	Storm Name
20-23	Year
24-25	Month (01-12)
26-27	Day (01-31)
28-29	Hour- universal time (at least every 6 hourly position -00Z,06Z,12Z and 18Z)
30	Latitude indicator: 1=North latitude; 2=South latitude
31-33	Latitude (degrees and tenths)
34-35	Check sum (sum of all digits in the latitude)
36	Longitude indicator: 1=West longitude; 2=East longitude
37-40	Longitude (degrees and tenths)
41-42	Check sum (sum of all digits in the longitude)
43	position confidence*: 1 = good (<30nm; <55km); 2 = fair (30-60nm; 55-110 km); 3 = poor (>60nm; >110km); 9 = unknown

Note* Confidence in the center position: Degree of confidence in the center position of a tropical cyclone expressed as the radius of the smallest circle within which the center may be located by the analysis. **"position good"** implies a radius of less than 30 nm, 55 km; "position fair", a radius of 30 to 60 nm, 55 to 110km; and "position poor", radius of greater than 60 nm, 110km

Position	Content
44-45	Dvorak T-number (99 for no report)
46-47	Dvorak CI-number (99 for no report)
48-50	Maximum average wind speed (whole values) (999 for no report).
51	Units 1=kt, 2=m/s, 3=km per hour.
52-53	Time interval for averaging wind speed (minutes for measured or derived wind speed, 99 if unknown or estimated).
54-56	Maximum Wind Gust (999 for no report)
57	Gust Period (seconds, 9 for unknown)
58	Quality code for wind reports: 1=Aircraft or Dropsonde observation; 2=Over water observation (e.g. buoy); 3=Over land observation; 4=Dvorak estimate; 5=Other
59-62	Central pressure (nearest hectopascal) (9999 if unknown or unavailable)
63	Quality code for pressure report (same code as for winds)
64	Units of length: 1=nm, 2=km
65-67	Radius of maximum winds (999 for no report)
68	Quality code for RMW: 1=Aircraft observation; 2=Radar with well-defined eye; 3=Satellite with well-defined eye; 4=Radar or satellite, poorly-defined eye; 5=Other estimate
69-71	Threshold value for wind speed (gale force preferred, 999 for no report)
72-75	Radius in Sector 1: 315°-45°
76-79	Radius in Sector 2: 45°-135°
80-83	Radius in Sector 3: 135°-225°
84-87	Radius in Sector 4: 225°-315°
88	Quality code for wind threshold: 1=Aircraft observations; 2=Surface observations; 3=Estimate from outer closed isobar; 4=Other estimate
89-91	Second threshold value for wind speed (999 for no report)
92-95	Radius in Sector 1: 315°-45°
96-99	Radius in Sector 2: 45°-135°
100-103	Radius in Sector 3: 135°-225°
104-107	Radius in Sector 4: 225°-315°
108	Quality code for wind threshold (code as for row 88)
109-110	Cyclone type: 01= tropics; disturbance (no closed isobars); 02= <34 knot winds, <17m/s winds and at least one closed isobar; 03= 34-63 knots, 17-32m/s; 04= >63 knots, >32m/s; 05= extratropical; 06= dissipating; 07= subtropical cyclone (nonfrontal, low pressure system that comprises initially baroclinic circulation developing over subtropical water); 08= overland; 09= unknown

Position	Content
111-112	Source code (2 - digit code to represent the country or organization that provided the data to NCDC USA. WMO Secretariat is authorized to assign number to additional participating centers, organizations) 01 RSMC Miami-Hurricane Center 02 RSMC Tokyo-Typhoon Center 03 RSMC-tropical cyclones New Delhi 04 RSMC La Reunion-Tropical Cyclone Centre 05 Australian Bureau of Meteorology 06 Meteorological Service of New Zealand Ltd. 07 RSMC Nadi-Tropical Cyclone Centre 08* * Joint Typhoon Warning Center, Honolulu 09* * Madagascar Meteorological Service 10* * Mauritius Meteorological Service 11* * Meteorological Service, New Caledonia 12 Central Pacific Hurricane Center, Honolulu
Note* *	no longer used
Headings	1-19 Cyclone identification code and name; 20-29 Date time group; 30-43 Best track positions; 44-110 Intensity, Size and Type; 111-112 Source code.

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Annex X

SATELLITE-BASED OCEAN WAVE DATA BASES
PART I : SUMMARY

COUNTRY	SATELLITE	INSTRUMENT	AREA COVERED	TIME SPANNED	PARAMETERS AVAILABLE	RELATED INFORMATION	ADDRESS
GERMANY	ERS 1/2	Scatterometer Altimeter Synthetic Aperture Radar	30°N - 90°N 90°W – 90°E	ERS-1 1991-1996 ERS-2 1996 on Irregular intervals.	Wave height Wind speed, direction 2-D wave spectra Raw data: no Statistics: no	Low-rate fast-delivery data via GTS QC: no Publications: no	Eberhard Muller Business Area Research and Development Deutscher Wetterdienst Postfach 10 04 65 63004 Offenbach Germany Ph: +49 69 8062 0 Fax: +49 69 8062 2880
JAPAN	ERS 1/2	Scatterometer Altimeter Synthetic Aperture Radar	Global	March 1996 on	Wave height Wind speed, direction 2-D wave spectra Raw data: no Statistics: no	Algorithm: CMOD4, CMOD5 QC: no Publications: no	Marine Meteorological Division Climate and Marine Department Japan Meteorological Agency 1-3-4, Otemachi Chiyoda-ku Tokyo 100 Japan Ph: 81-3-3212-8341 Fax: 81-3-3211-6908
	TOPEX/ Poseidon	Altimeter	Western North Pacific	March 1996 on	Wave height Raw data: no Statistics: no	Algorithm: CMOD4, CMOD5 QC: no Publications: no	As above
SINGAPORE	ERS 1/2	Synthetic Aperture Radar	Within 3000 km radius of Singapore	September 1995 on, on days when passes are allocated	SAR images: single look and geo-referenced detected images Statistics: no	Algorithm: N/A QC: no Publications: no	Prof. Lim Hock Centre for Remote Imaging, Sensing and Processing National University of Singapore, Kent Ridge, Singapore 119260 Republic of Singapore Ph: (65) 772 3220 Fax: (65) 775 7717 crisp@leonis.nus.sg
	RADARSAT	Synthetic Aperture Radar	Within 3000 km radius of Singapore	January 1997 on, on days when passes are allocated	SAR images: single look and geo-referenced detected images Statistics: no	Algorithm: N/A QC: no Publications: no	Prof. Lim Hock Centre for Remote Imaging, Sensing and Processing National University of Singapore Kent Ridge, Singapore 119260 Republic of Singapore Ph: (65) 772 3220 Fax: (65) 775 7717 crisp@leonis.nus.sg

UNITED KINGDOM	ERS 1/2	Scatterometer	Global	ERS-1 1991-1996 ERS-2 1996 on	ESA derived scatterometer winds (level 2 data) UK derived scatterometer winds (level 2 data) Raw data (level 1.5)	Algorithm: CMOD4 QC: "distance to cone"; gross error checks; "buddy checks" Publications: no	Mr. D. Offiler Meteorological Office London Road Bracknell Berkshire RG12 2SZ United Kingdom Ph: +44 (0)1344 854698 Fax: +44(0)1344 854026 Doffiler@meto.gov.uk
	ERS 1/2	Altimeter	Global (no thinning)	ERS-1 1991-1996 ERS-2 1996 on	ESA derived wave height ESA derived wind speed ESA derived sea surface height Raw data: no	Algorithm : ESA QC: no Publications: no	Dr. M Holt Meteorological Office (as above) Ph: +44 (0)1344 856512 Fax: +44(0)1344 854026 mjholt@meto.gov.uk
	ERS 1	ATSR Radiometer	Global	1991-1996 (with gaps)	0.5° by 0.5° degree average sea surface temperature Raw data: no (RAL product only	Algorithm : SADIST-1 QC: no Publications: no	Mr. D. Offiler Meteorological Office (as above) Ph: +44 (0)1344 854698 Fax: +44(0)1344 854026 Doffiler@meto.gov.uk
	ERS 1/2	Synthetic Aperture Radar	Global	ERS-1 1991-1996 ERS-2 1996 on	ESA derived 2-D wave spectra Raw data: no (ESA product only)	Algorithm : ESA QC: no Publications: no	Mr. D. Offiler Meteorological Office (as above) Ph: +44 (0)1344 854698 Fax: +44(0)1344 854026 Doffiler@meto.gov.uk
UNITED STATES	GEOSAT	Altimeter	Global	March 1985 – September 1986	Significant wave height Wind speed (two values, generated by separate algorithms) Raw data: geophysical backscatter Statistics: no	Algorithm: -wave heights: Brown model (shape of radar return) -wind speed: Chelton-Wentz - wind speed: smoothed Brown algorithm QC: some; see data CD-ROM Publications: Ref. 1,2,3,4	Donald W. Collins NOAA National Oceanographic Data Center SSMC-3, Fourth Floor 1315 East-West Highway Silver Spring, MD USA 20910-3282 Ph: (301) 713-3277 Fax: (301) 713-3302 service@nodc.noaa.gov

	SEASAT	Scatterometer Altimeter Synthetic Aperture Radar Radiometer	Global	July 1978 – October 1978	Wind direction and speed (SASS) Wind speed and wave height (ALT) Wave spectra (1-D, 2-D) (SAR) Wind speed (SMMR) Raw data: digital and hard copy imagery from SAR Statistics: no	Algorithm: NASA JPL algorithms: sea height: AL.IG.G-01 nadir wind speed: AL.IG.G-18 QC: Scatterometer: land/water flagging; atmospheric attenuation correction Radiometer: radiometric calibration; antenna pattern correction Altimeter and SAR: N/A Raw data: blunder-point editing, timing corrections, track mode corrections, attitude and significant wave height corrections Publications: Ref. 5,6,7,8,9,10,11	NCDC Customer Service NOAA/NCDC 151 Patton Avenue Asheville, NC USA 28801-5001 Ph: (704) 271-4800 opt 5 Fax: (704) 271-4876 dross@ncdc.noaa.gov
	DMSP (Defence Meteorological Satellite Program)	SSM/I (special sensor microwave imager) - passive	Global	June 1987 on	Wind speed statistics Raw data: digital level 1B data (85 GHz channel N/A June 1990 – Dec. 1991) Statistics: monthly mean	Algorithm: Goodberlet et al., 1991 QC: N/A Publication: 15,16,17,18	NCDC Climate Services NOAA/NCDC 151 Patton Avenue Asheville, NC USA 28801-5001 Ph: (704) 271-4800 opt 5 Fax: (704) 271-4876 satorder@ncdc.noaa.gov

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6. SEASAT SAR User's Guide to Data and Products, 1984, NOAA, National Climatic Data Center.
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PART II: ACCESS

COUNTRY	INVENTORY	METADATA	COST	MEDIA; DATA VOLUME	ARRANGEMENT OF DATA	RELATED INFORMATION	ADDRESS
GERMANY	No	No	N/A	CD-ROM	N/A	Data archived at Federal Maritime and Hydrographic Institute in Hamburg.	Eberhard Muller Business Area Research and Development Deutscher Wetterdienst Postfach 10 04 65 63004 Offenbach Germany Ph: +49 69 8062 0 Fax: +49 69 8062 2880
JAPAN	No	No	Marginal	400 disks of MO	By synoptic time	Satellite wave data not stored in data base, but is stored on disk with other wave observations, model output and analyses	Marine Meteorological Division Climate and Marine Department Japan Meteorological Agency 1-3-4, Otemachi Chiyoda-ku Tokyo 100 Japan Ph: 81-3-3212-8341 Fax: 81-3-3211-6908
SINGAPORE	Yes: www.crisp.nus.sg	Yes: www.crisp.nus.sg	See Footnote1	CCT, exabyte, CD-ROM; quick-look images on WWW About 7100 scenes as of Dec. 9, 1996	In time order Supplied to users in individual scenes.	Copyright protected; no further distribution by customer.	Prof. Lim Hock Centre for Remote Imaging, Sensing and Processing National University of Singapore, Kent Ridge, Singapore 119260 Republic of Singapore Ph: (65) 772 3220 Fax: (65) 775 7717 crisp@leonis.nus.sg
UNITED KINGDOM	No	No	N/A	N/A	N/A	UK products for internal use only2	Mr. D. Offiler Meteorological Office London Road Bracknell Berkshire RG12 2SZ United Kingdom Ph: +44 (0)1344 854698 Fax: +44(0)1344 854026 Doffiler@meto.gov.uk

1 According to the prevailing international price list of authorized distributors for various regions.
2 Contact Mr. Alan Terry (on +44 (0) 1344 854678) for more information

COUNTRY	INVENTORY	METADATA	COST	MEDIA; DATA VOLUME	ARRANGEMENT OF DATA	RELATED INFORMATION	ADDRESS
UNITED STATES	No.	Yes. http://www.nodc.noaa.gov/General/NODC-cdrom.html#geosatj3 http://www.nodc.noaa.gov/General/CDR-detdesc/geosatww.html	Various3	CD-ROM Wind speed and wave height: 616 MB Binary geophysical data records: 4 CD-ROMs Raw data: 10 CD-ROMs	By synoptic time	GEOSAT. Non-US requests for these data must be forwarded to NOAA/NODC via the requestors embassy located in the U.S.	Donald W. Collins NOAA National Oceanographic Data Center SSMC-3, Fourth Floor 1315 East-West Highway Silver Spring, MD USA 20910-3282 Ph: (301) 713-3277 Fax: (301) 713-3302 service@nodc.noaa.gov
	General inventory of locations and times for which data are available. Reference 6.	Yes. References 12,13,14.	$ 100 per cartridge (currently under review).	Cartridges 27 GB	By orbit	SEASAT No restrictions on data use, further distribution.	NCDC Customer Service NOAA/NCDC 151 Patton Avenue Asheville, NC USA 28801-5001 Ph: (704) 271-4800 opt 5 Fax: (704) 271-4876 dross@ncdc.noaa.gov

3 (1) wind speed and wave height (1 CD-ROM): $130; (2) 6 CD-ROM set of ERM GDR (Exact Repeat Mission Geophysical Data Record) data $28/CD-ROM or $168/set; (3) 4 CD-ROM set of GM (Geodetic Mission) GDR data $38/CD-ROM or $152/set; (4) 8 CD-ROM set of Crossover Differences data $22/CD-ROM or $176/set; (5) 10 CD-ROM set of reprocessed GM+ERM GDR data – price not yet established.

COUNTRY	INVENTORY	METADATA	COST	MEDIA; DATA VOLUME	ARRANGEMENT OF DATA	RELATED INFORMATION	ADDRESS
	Yes. www.saa.noaa.gov	Yes. www.saa.noaa.gov	Various4	Level 1B on IBM standard 3480 Output on 8mm, 4mm or 3480 12,000 tapes Online via ftp	By orbit	DMSP No restrictions.	NCDC Climate Services NOAA/NCDC 151 Patton Avenue Asheville, NC USA 28801-5001 Ph: (704) 271-4800 opt 5 Fax: (704) 271-4876 satorder@ncdc.noaa.gov

4 Free if downloaded from Web: www.ncdc.noaa.gov/ssmi/html/ssmi.html or www.saa.noaa.gov; $86 per output tape copy (does not include data selection). Also: www.ngdc.noaa.gov/dmsp/dmsp.html

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Annex XI

PAPERS TO BE INCLUDED IN THE DYNAMIC PART OF THE GUIDE TO THE APPLICATIONS OF MARINE CLIMATOLOGY

1.3 **COADS Updates and the Blend with the UK Meteorological Office Marine Data Bank**
S.D. Woodruff, H.F. Diaz, S.J. Lubker, NOAA/ERL Climate Diagnostics Center, Boulder, CO, USA; S.J. Worley, National Center for Atmospheric Research, Boulder, CO, USA; J.A. Arnott, M. Jackson, D.E. Parker, Hadley Centre, Met. Office, Bracknell, UK; J.D. Elms, NOAA/NCDC, Asheville,NC, USA

1.4 **The Kobe Collection (newly digitized Japanese historical surface marine meteorological observations)**; Teruko Manabe, Maritime Meteorological Division, Japan Meteorological Agency, Tokyo, Japan

1.5 **An Archive of Underway Surface Meteorology Data From WOCE**;
David M. Legler, Shawn R. Smith, James J. O'Brien, Center for Ocean Atmospheric Prediction Studies (COAPS), Florida State University, Tallahassee, FL, USA

2.1 **The Accuracy of Marine Surface Winds From Ships and Buoys;** Peter K. Taylor, Elizabeth C. Kent, Margaret J. Yelland, Ben I. Moat, Southampton Oceanography Centre, Southampton, UK

2.2 **The Storm Wind Studies (SWS)**; S.G.P Skey, Kent Berger-North, Axys Environmental Systems, Sidney, BC, Canada; V.R. Swail, Environment Canada, Toronto, ON, Canada; A. Cornett, Canadian Hydraulics Centre, Ottawa, ON, Canada

3.1 **An Intercomparison of In Situ, Voluntary Observing, Satellite Data, and Modelling Wind and Wave Climatologies**;
P. David Cotton, Satellite Observing Systems, Godalming, Surrey, UK; Peter G. Challenor, Lisa Redbourn-Marsh, Southampton Oceanography Centre, Southampton, UK; Sergey K. Gulev, P. Shirshov Institute of Oceanology, Moscow, Russia; Andreas Sterl, Royal Netherlands Meteorological Institute, De Bilt, The Netherlands; Roman S. Bortkovskii, Main Geophysical Observatory, St. Petersburg, Russia

3.2 **The Joint Calibration of Altimeter and In Situ Wave Heights**; P.G. Challenor, Southampton Oceanography Centre, Southampton, UK; P.D. Cotton, Satellite Observing Systems Ltd., Surrey, UK

3.3 **On the Use of In Situ and Satellite Wave Measurements for Evaluation of Wave Hindcasts**;
Andrew T. Cox, Vincent J. Cardone, Oceanweather Inc. - Cos Cob, CT, USA; Val R. Swail, Environment Canada, Toronto, ON, Canada

3.4 **Scatterometry Data Sets: High Quality Winds Over Water**; Mark A. Bourassa, David M. Legler, James J. O'Brien, Center for Ocean-Atmospheric Prediction Studies (COAPS), Florida State University, FL, USA

4.1 **Evaluation of Ocean Wind and Wind Wave Fields From COADS**; Sergey Gulev, Institut fur Meereskunde, Dusternbrooker Weg, Kiel, Germany; Konstantin Selemenov, P.P. Shirshov Institute of Oceanology, RAS, Moscow, Russia

4.5 **Development of the Hadley Centre Sea Ice and Sea Surface Temperature Data Sets (HadISST)**; D.E. Parker, N.A. Rayner, E.B. Horton, C.K. Folland, Hadley Centre, Met. Office, Bracknell, UK

5.1 **Evaluation of NCEP Reanlysis Surface Marine Wind Fields for Ocean Wave Hindcasts**;
Vincent J. Cardone, Andrew T. Cox, Oceanweather Inc., Cos Cob, CT, USA; Val R. Swail, Environment Canada, Toronto, ON, Canada

6.4 **Analysis of Wave Climate Trends and Variability**; Val R. Swail, Environment Canada, Toronto, ON, Canada; Andrew T. Cox, Vincent J. Cardone, Oceanweather Inc., Cos Cob, CT, USA

7.1 **Outlier Detection in Gridded Ship's Datasets**; Pascal Terray, Laboratoire d'Océanographie Dynamique et de Climatologie, Université Paris 7, Paris, France

7.2 **A Methodology for Integrating Wave Data From Different Sources Permitting a Multiscale Description of Wave Climate Variability**; G.A. Athanassoulis, Ch.N. Stefanakos, National Technical University of Athens, Dept. of Naval Architecture & Marine Engineering, Athens, Greece; S.F. Barstow, OCEANOR, Oceanographic Company of Norway, Trondheim, Norway

7.3 **Reduced Space Approach to the Optimal Analysis of Historical Marine Observations: Accomplishments, Difficulties, and Prospects**; A. Kaplan, M.A. Cane, Y. Kushnir, Lamont Doherty Earth Observatory of Columbia University, Palisades, New York, USA

8.1 **Improving Global Flux Climatology: The Role of Metadata**; Elizabeth C. Kent, Peter K. Taylor, Simon A. Josey, Southampton Oceanography Centre, Southhampton, UK

8.2 **Establishing More Truth in True Winds**; Shawn R. Smith, Mark A. Bourassa, Ryan J. Sharp, Center for Ocean-Atmospheric Prediction Studies, The Florida State University, Tallahassee, FL, USA

8.3 **In-Situ Marine Observations Available Within Operational Time Frames**; Jean Gagnon, Paul-André Bolduc, Department of Fisheries and Oceans, Marine Environmental Data Service Branch, Ottawa, ON, Canada

9.1 **Offshore Industry Requirements and Recent Metocean Technology Developments**; C.J. Shaw, Chairman OGP Metocean Committee, and Shell EP Technology, Netherlands

9.2 **Specific Contributions to the Observing System: Sea Surface Temperatures**; Richard W. Reynolds, National Climate Data Center, NESDIS, Camp Springs, Maryland, USA

10.1 **Importance of Marine Data to Seasonal Forecasting in Australia**; Scott Power, Australia's National Climate Centre, Melbourne, Australia

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Annex XII

EDITORIAL AMENDMENTS TO CHAPTER 3 OF THE GUIDE TO MARINE METEOROLOGICAL SERVICES

CHAPTER 3

MARINE CLIMATOLOGY

3.1 Introduction

Preparation of climatological charts and atlases for oceans became possible in the second half of the nineteenth century when ships' observations, recorded in special meteorological logbooks, started to become available in rapidly increasing numbers. For over 100 years these charts and atlases were prepared nationally, mainly for use by shipping; for this purpose countries used to ask for observations stored in other countries to supplement their own data sets.

The proposal for international exchange of marine data and for the preparation of marine climatological summaries originated at the third session of JCOMM in 1960 and was finally adopted by Fourth Congress of WMO in 1963. The object of the system was to establish a joint effort of all maritime nations in the preparation and publication of climatological statistics and charts for the oceans. The underlying idea was that all observations collected from ships of whatever nationality should be included. Eight countries, each with a specific ocean area of responsibility, were designated who were willing to process the data in prescribed forms and regularly publish the climatological summaries.

To improve the flow of the observational data, JCOMM at its eleventh session in 1993 decided on the establishment of two global data collecting centres and this decision was ratified by Executive Council at its 45th Session in 1993.

Marine climatology today supports transportation, engineering and the basic and applied sciences with data and information about the environment from a few tens of metres below the sea surface to a few tens of metres above. The interest in climate change and studies of air-sea interaction have increased the demand for marine climatological data. A comprehensive account of the uses of marine climatology can be found in the Guide to the Applications of Marine Climatology (WMO-No 781).

The basic sources of data are ships, buoys, satellite, aircraft and a few other specialised sensing systems such as land-based radar. New technology is having a significant impact on the traditional methods in marine climatology. Telecommunications advances have led to an increase in the amount of data captured automatically and a decrease in manual key entry requirements. High density computer readable media for use on large computers is now the standard method of data exchange. Computers allow for automated quality control and data validation. Automation in analysis and mapping allows derived quantities such as heat, heat flux, wind stress and atmospheric refractivity to be computed from operationally available data. Data can be used in computer models to generate fields of sea surface temperature, pressure and wind. As well as provision on paper-based media, data can also be provided on computer readable media for analysis on personal computers. Compact Disc — Read Only Memory (CD-ROM) technology allows a vast amount of data to be provided on one disc and the data can be displayed in chart, map or graphical form.

3.2 Marine climatological summaries

3.2.1 *General*

The establishment of the international exchange and processing arrangements described above for the "Marine Climatological Summaries Scheme", as it is called, required the cooperation of all maritime countries participating in the WMO Voluntary Observing Ships' Scheme, i.e. those which have recruited selected, supplementary or auxiliary ships. (See Chapter 6 of this Guide.)

In this system the oceans and seas are divided into areas of responsibility and eight Members (called "responsible Members") have assumed responsibility to prepare marine climatological summaries without cost to WMO. Data from fixed ship stations within the area are also included. For this purpose, the responsible Members receive, through the global collecting centres, surface observations from all Members operating voluntary observing ships and/or fixed ship stations, in their respective areas of responsibility in an internationally accepted format.

The international procedures governing the Marine Climatological Summaries Scheme have the status of Technical Regulations within WMO and are included in the Manual on MMS, Volume I, Part I, Section 5.

3.2.2 *Members responsible for the preparation of summaries*

The responsible Members and the areas allotted to them are shown in Annex 3.A to this Chapter. The boundaries of the areas of responsibility are kept under review by JCOMM. Adjustments, however, should be kept to a minimum.

Climatological summaries are prepared for a number of small areas, called "representative areas" and for fixed ship stations within the assigned area of responsibility. The representative areas were selected on the basis of the density of available data, climatic gradients and factors such as the position of fixed ship stations and island stations. There is a reasonable distribution of representative areas throughout all areas of responsibility. An example of the representative areas in one area of responsibility is shown at Annex 3.B to this Chapter. The Area Indices System is explained in Part (b) of this Annex.

All responsible Members are represented on the JCOMM Working Group on Marine Climatology, which keeps the Marine Climatological Summaries Scheme under review, particularly with regard to the rapidly changing technology in the processing, storage and supply of large volumes of data.

3.2.3 *Global Collecting Centres*

Two responsible Members (Germany and the United Kingdom) operate Global Collecting Centres, which receive ships' observations from all Members. These centres then supply the data to the responsible Members. Two centres are maintained so that a data set will still be available in the event of some catastrophe happening at one Centre.

The global collecting centres ensure that minimum quality control has been applied to the data, and then supply, every three months, data to the responsible Members relevant to each one's area of responsibility. The global collecting centres will provide a global data set to those responsible Members who wish to receive it.

The data are then sent to both global collecting centres, i.e. two copies of each data set are required, one for each centre. The data should be dispatched at three-monthly intervals. The Member sending the data should notify the global collecting centres of the dispatch of the data, and advise details of the order in which the data are sorted.

3.2.4 *The flow of observational data to responsible Members*

Marine meteorological observations are recorded on board most ships in special meteorological logbooks provided by national Meteorological Services. Members operating voluntary observing ships and/or fixed ship stations should arrange for the provision of a suitable form of meteorological logbook. Details of the layout of the logbook are to be found in Chapter 6, paragraph 6.8.1 of this Guide.

The observations are transferred from the log-books to a computer-compatible medium, in a standard internationally agreed format. Every effort should be made to apply minimum quality control to the data. Details of this transfer and associated quality control are to be found in paragraphs 3.2.8 and 3.2.9 below.

An increasing number of ships are being equipped with a personal computer and a program which stores the observations on diskette in the internationally agreed format. This avoids manual data transfer from logbook to the computer-compatible medium and a source of possible errors.

3.2.5 *Preparation of marine climatological summaries*

The detailed procedures for the preparation of marine climatological summaries are described in the Manual on MMS, Volume I, Part I, Section 5.3. Summaries are prepared in both tabular and chart form, and normally include air and sea surface temperature, dew-point temperature, visibility, weather, wind direction and speed, atmospheric pressure, clouds and waves. A necessary minimum number of observations is specified before a mean can be calculated for a given area. Routine publication of annual summaries ceased in 1981, although they are available on request and responsible Members may still publish them if they wish. Decadal climatological summaries are prepared for each decade 1961–70, 1971–80, 1981–90. In view of the importance ascribed to this work by JCOMM, Members are encouraged to continue their publication.

3.2.6 *Availability of summaries and observational data*

Responsible Members keep the Secretariat informed of the availability of their marine climatological data and published summaries so that an inventory can be compiled annually and circulated to Members for information.

Responsible Members will make available, on request, copies of the data at the cost of copying. The data will be on computer readable media in the international exchange format, unless another format has been agreed between the requesting and responsible Members.

Orders for marine climatological summaries, or for observational data, should be addressed directly to the responsible Member concerned and not to the Secretariat.

3.2.7 *Data exchange formats*

It is essential to use standard data formats to facilitate international exchange of data for climatological purposes, particularly when so much of the processing is automated. The standard format for provision of data to responsible Members is the International Maritime Meteorological Tape (IMMT) format. Other forms of data exchange may be used, such as diskettes, provided the format of the data complies with the details as set out in Annex 3.C to this Chapter. The technology for data transfer is changing rapidly, and it will be necessary for the means of data exchange to keep up with the current technology.

A second format, which may be used for national and bilateral exchange of data, is set out in Annex 3.D. Any alternative format must only be used by mutual agreement between the two Members which are exchanging data.

Members wishing to exchange their observational data on media other than magnetic tape, e.g. print-outs in the case of very small numbers of observations, or diskette, or tape cartridge, should arrange for their exchange on a bilateral basis.

3.2.8 *The historical sea surface temperature data project*

Because of the importance of the sea temperature in climatic change, the Historical Sea Surface Temperature Data Project has compiled a comprehensive, homogeneous set of sea surface temperature data for the period from 1861 to 1960 (i.e. for the century preceding the beginning of the Marine Climatological Summaries Scheme). A User's Guide to the Data and Summaries of the Project has been published as Marine Meteorology and Related Oceanographic Activities Report No. 13 (WMO/TD-No. 36).

Members having historical data which have not been included in the Project should send those data to the global collecting centres in the IMMT format. The data should be accompanied by documentation describing the source of the data, the precision of the original observations and conversion algorithms. For example, if the original observations recorded the visibility in terms of poor, moderate, good etc. an explanation is needed of how these terms have been converted into distances in kilometres.

3.2.9 *Quality control*

3.2.9.1 General

The accuracy of data is of primary importance to climatological computations and scientific investigations. It is essential that marine data are quality controlled before exchange. Quality control means the checking of the content, including identification groups, of observational data to ensure its accuracy. Quality control procedures for climatological data in general are described in the Guide to Climatological Practices (WMO-No. 100). Quality control has been incorporated in WMO's CLICOM (CLImate COMputing) programme, and can be used for small marine data sets. A discussion of quality control of marine data can be found in Chapter 3 of Guide to the Applications of Marine Climatology (WMO-No 781).

Errors can arise:

(a) On board ship by misreading an instrument, malfunction of a sensor, or in entering the observation in the logbook;

(b) In transcribing the data on to computer readable media.

In the case where the data are taken from SHIP reports on the GTS, errors can arise in transmission.

3.2.9.2 Minimum quality control

The primary responsibility for the quality control of data rests with the national Meteorological Service from which the data originated. All Members should make every effort to apply the minimum quality control procedures described in Annex 3.E before dispatching the data to the global collecting centres. This quality control includes checks that the observation of each element is within the possible range, that the change in position between observations is within reasonable limits, that call sign and country code have been included. There is space in the IMMT format for 20 quality control flags. These indicators show whether the element has been flagged as doubtful or whether it has been corrected. A problem which often arises is deciding whether an observation is an error or an actual extreme value. Generally care should be exercised in correcting doubtful values; suspect observations may be real extremes of special meteorological interest.

Meteorological logbooks can be scrutinised manually before data transfer to eliminate obvious observational and recording errors. However the minimum quality control should be carried out after transfer to computer readable media to allow for transcription errors. The quality control is best carried out automatically by computer and programmes are available for this purpose.

It is of the utmost importance that Members should make adequate provision for quality control of data to ensure that they are as free from error as possible. The global collecting centres ensure that this minimum quality control has been carried out, and further quality control may be applied to the data by the responsible Members.

3.3 Special marine climatological information

In addition to the elements in the IMMT format, which are used in the production of standard marine climatological summaries, there are other observations of interest to many marine interests. Two specific observation systems which have been instituted relate to freak waves and to sea-surface current data.

3.3.1 *Reports of freak waves*

The occurrence of unusual waves, and occasional distress to vessels as a result, has been noted at times over many years, but accurate observations are rare. A freak wave may be defined as a wave of very considerable height ahead of which there is a deep trough. It is the unusual steepness of the wave which is its outstanding feature and which makes it dangerous to shipping. All marine observers, at fixed or mobile stations, are encouraged to observe and report any such occurrences.

Guidelines for reporting freak waves can be found at Chapter 6, Annex 6.C of this Guide. Procedures for the dealing with reports of freak waves are given in the Manual on MMS, Volume I, Part I, Section 6.2.1

3.3.2 *Exchange of sea-surface current data obtained from ships' set and drift*

To increase our knowledge and prepare climatic charts of the general surface circulation of the oceans, more information is required on sea-surface currents. The current can be derived from the ship's set and drift, and this does not require special instrumentation; any ship willing to participate can contribute to the data base. Guidelines for giving instructions to vessels for the collection of these data are included in Chapter 6, Annex 6.D of this Guide.

The International Surface Current Data Centre (ISCDC) is located in the United Kingdom. The ISCDC receives data on computer readable media and completes quality control after receipt. National

Meteorological Services may wish to check observations before passing to the ISCDC. The procedures covering the collection and exchange of these data, and the functions of the ISCDC are given in the Manual on MMS, Volume I, Part I, Section 6.2.2.

The ISCDC provides each year a copy of the stored data to the World Data Centres for Oceanography, and will provide copies of the stored data on request for the usual charges for data retrieval.

3.3.3 *Special techniques for other parameters*

Requirements arise for information on other parameters, or for more detailed analyses of some parameters included above. Waves are among the most complex and important elements at the surface of the sea. In addition to visual observations from ships, they can be measured by wave recorders on fixed platforms. Wave climatologies are often derived by means of hindcasts, whereby all available historical data (predominantly wind data) is re-analysed for input into suitable wind and wave computer models for calculation of the wave characteristics. More information on these techniques can be found in the Guide to Wave Analysis and Forecasting (WMO-No. 702) and in the Guide to the Applications of Marine Climatology (WMO-No. 781).

The extreme value of elements such as wind, wind gusts and waves is of great interest for coastal engineering and there are statistical means of estimating the extreme value from a set of observations. However the problem is that in an extreme weather event, sensors are often destroyed or damaged, while the feedback signal to a satellite is so attenuated that it is impossible to determine a reliable extreme value. Thus a set of observations may not indicate the true extremes which have been experienced.

Sea-surface temperature, radiant flux, cloud and some wind data can be extracted from special satellite data sets. A far greater coverage of sea surface temperature data can be obtained by satellite than from ships which mostly travel regular shipping lanes. However, observations from ship and from satellite are not directly compatible. The satellite measures the temperature of the very top of the sea, the ship measures the temperature from a few centimetres down to several metres. The two measurements can be very different, particularly in calm weather. Special techniques have been developed to homogenize the two types of observation.

The requirement for a climatology of some elements, required more for global climate studies than marine purposes alone, is not yet able to be satisfied, e.g. for precipitation over the ocean.

3.4 Presentation of climatological data

3.4.1 *General*

Climatological data can be presented in many different forms. They can be shown as long-term averages or as mean values for particular months. They usually include frequencies of occurrence of extremes or other values which are thought to be critical with respect to particular operations. Analyses can disclose statistical relationships between parameters such as wind speed and direction, wave height and period, fog and air/sea temperature difference, etc. Optimum time and space scales are often dictated by the necessary statistical tests for homogeneity of data applied with a realistic understanding of the requirements. Even so, the factor of data availability often forces compromise. Automated treatment of marine data allows the objective production of analysed charts and gridded data fields. This allows easier compilation of climatological summaries over greater time spans. A comprehensive treatment of the analysis, presentation and interpretation of marine climatological data can be found in the Guide to the Applications of Marine Climatology (WMO-No. 781).

Marine data comes from many varied sources and periods from varied instruments. Care needs to be taken in the combination of data from varied sources, and prime attention must be given to consistency and continuity, and to scrutiny of historical data, especially when long periods are being considered. Care must be taken with the combination of standard and non-standard period statistics, and with the use of satellite, buoy and ocean weather station data as reference levels or with extrapolation into data-sparse regions.

3.4.2 *Climatological charts*

The layout for marine climatological summary charts for representative areas is shown in the Manual on MMS, Volume I, Part I, Appendix I.9. There are many other ways of displaying the data in chart form, and several national Meteorological Services have published marine climatological charts and atlases based on data observed in periods since 1860. These charts were prepared primarily to serve marine navigation, but contain useful information for fisheries and other marine operations. Data are usually presented for individual months as an average over the entire period for which data were available. The Mercator projection has usually been used, but others may be employed for special requirements, and charts may also include numerical data, graphs, isopleths and other additional data presentation.

Elements covered by these charts may include:

(a) Surface wind: Frequency distribution of wind speeds in 8 points of the compass (wind rose); wind directions, mean vector of wind speed and prevailing wind direction; frequencies of light winds, gales and storms; bivariate normal statistics;

(b) Surface currents: The same presentation as for wind, including frequencies of currents exceeding certain speeds;

(c) Waves (sea and swell): Wave charts of frequencies of total wave height, usually the higher or a combination of sea and swell. Swell charts depict frequencies of short, medium and long swell in 4 or 8 directions (compass points). Wave charts based on data observed since 1949 (when a new code allowed more detail to be given in ships' observations of waves) give frequencies of waves exceeding given height limits in various directions and sometimes also indications of wave periods.

(d) Visibility: Frequencies of visibility of less than 1 km (fog) and other ranges;

(e) Precipitation and cloud cover: Precipitation given as frequencies or percentages of the number of hours during which precipitation was observed. Frequencies of various degrees of cloud cover (total and low) and heights;

(f) Temperatures, air and sea surface: Isotherms at regular intervals, mean values and standard deviations of the frequency distribution for small areas; percentage occurrence of critical threshold values;

(g) Humidity: Mean values of dew-point temperature; various statistics involving relative humidity, wet bulb and dew point;

(h) Air pressure; pressure systems: Isobars and, on some atlases, frequencies of deep extratropical cyclones with depiction of storm tracks;

(i) Tropical cyclones: Frequencies of occurrence, tracks of individual cyclones, distribution for the months of the year, intensities and intensity changes during the life history of a cyclone etc.;

(j) Sea ice and icebergs: The geographical distribution of different types of sea ice and of icebergs for each month, charts of probability of various positions of ice edge and boundaries of ice patterns with different ice compactness, ice convergence and divergence zones etc.;

(k) Derived quantities: Heat flux, transport data, refractivity, superstructure icing potential, atmospheric stability etc.

3.4.3 *Atlases and CD-ROMs*

The Executive Council at its 38th session in 1986 approved a recommendation of CCl (which had the agreement of JCOMM) that the marine section of the World Climatic Atlas was no longer required. This decision was taken in view of the existence of a number of other global and regional marine climatic atlases. Individual Members are encouraged to prepare such atlases.

Modern computer technology allows a vast amount of data to be provided on one disc and the data can be displayed in chart,map or graphical form. CD-ROMs are becoming available which display marine climatological data in at least some of the ways described in paragraph 3.4.2 above.

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ANNEX 3.C

LAYOUT FOR THE INTERNATIONAL MARITIME METEOROLOGICAL TAPE (IMMT) [VERSION IMMT-1]

(See paragraph 3.2.7)

NOTE: Blanks entered in a record represent missing data

Element Number	Character Number	Code	Element	Coding procedure
1	1	i_T	Format/temperature indicator	3=IMMT format with temperatures in tenths of °C 4=IMMT format with temperatures in halves of °C 5=IMMT format with temperatures in whole °C
2	2–5	AAAA	Year UTC	Four digits
3	6–7	MM	Month UTC	01 - 12 January to December
4	8–9	YY	Day UTC	01 - 31
5	10–11	GG	Time of observation	Nearest whole hour UTC, WMO specifications
6	12	Q_c	Ouadrant of the globe	WMO code table 3333
7	13–15	$L_aL_aL_a$	Latitude	Tenths of degrees, WMO specifications
8	16–19	$L_oL_oL_oL_o$	Longitude	Tenths of degrees
9	20		Cloud height (h) and visibility (VV) measuring indicator	0 - h and VV estimated 1 - h measured, VV estimated 2 - h and VV measured 3 - h estimated, VV measured
10	21	h	Height of clouds	WMO code table 1600
11	22–23	VV	Visibility	WMO code table 4377
12	24	N	Cloud amount	Oktas, WMO code table 2700; show 9 where applicable
13	25–26	dd	True wind direction	Tens of degrees, WMO code table 0877; show 00 or 99 where applicable
14	27	i_w	Indicator for wind speed	WMO code table 1855
15	28–29	ff	Wind speed	Tens and units of knots or metres per second, hundreds omitted; values in excess of 99 knots are to be indicated in units of metres per second and I_w encoded accordingly; the method of estimation or measurement and the units used (knots or metres per second) are indicated in element 14
16	30	s_n	Sign of temperature	WMO code table 3845
17	31–33	TTT	Air temperature	Tenths of degrees Celsius
18	34	s_t	Sign of dew-point temperature	0 - positive or zero measured dew-point temperature 1 - negative measured dew-point temperature 2 - iced measured dew-point temperature 5 - positive or zero computed dew-point temperature 6 - negative computed dew-point temperature 7 - iced computed dew-point temperature

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ANNEX 6.D

GUIDELINES FOR THE OBSERVATION AND RECORDING OF SEA CURRENT DATA ON BOARD SHIP, AND AN EXAMPLE OF A SPECIAL LOG SHEET

(Reference paragraph 6.4.5)

(i) Guidelines

1. *Introduction*

The knowledge which we now posses regarding surface currents in the world seas is, for the most part, based on information from current observations taken on board ships.

The systematic collection of surface current information had already begun in the middle of the nineteenth century. The famous Lieutenant Matthew F. Maury, of the U.S. Navy, was one of the first who saw the importance of gathering wind and current data from ship logbooks. In 1845, he published the first of a series of “Wind and current charts”.

For constructing current charts, as many observations as possible are required, covering many years. As the variability of local currents can be examined only on the basis of a large number of observations, and as the number needed has not been reached for any place at sea, there is still a great need of current observations, especially from areas less frequented by ships outside the major shipping lanes. More observations are also needed to establish, year to year, variations in currents, as some of these are of great significance for marine science, e.g., the El Niño. The only way of obtaining enough observations is by the cooperation of voluntary observers.

By making and reporting observations of currents experienced, the seaman not only gains practical knowledge himself, but benefits shipping generally by adding to our statistical knowledge, so that up-to-date information can be published.

2. *Methods of ocean-current observations and some definitions*

The method of making current observations is to calculate the difference between the dead reckoning (DR) position of the ship after making due allowance for leeway, and the position by a reliable astronomical, land, radio, radar, electronic or satellite fix. The result is the set and drift over the ocean floor experienced by the ship during the interval since the previous reliable fix was obtained, and applies to a mean depth of about half the ship’s draught.

The *set of current* is the direction in which it acts; that is the direction toward which it flows. So, the current set is from the DR position to the fix.

The *drift of a current* is the distance measured in nautical miles from the DR position to the fix.

The *leeway* is the angular difference between the ship’s cource and the ship’s direction of movement through the water (i.e., the direction shown by the wake). Leeway occurs when a ship is subjected by the wind to a pressure from a beam. The angle is rarely more than a few degrees, but there is a considerable loss of accuracy in the observation of current if a realistic allowance is not made for leeway.

The *“FROM”* position is the true position at the beginning of the stretch over which the current is calculated.

The *“TO”* position is the true position at the end of the stretch over which the current is calculated.

The dead reckoning (DR) position is the position of the ship determined by applying to the last well determined position (the “FROM” position), the run that has since been made, using only the true courses steered (corrected for leeway, if necessary) and the distance run, as determined by log or engine revolutions, without considering current. It is important that the true course is corrected for the influence of the wind, so that the difference between the DR position and the true fix is caused only by the current.

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ANNEX 6.H

MARITIME METEOROLOGICAL PUBLICATIONS PRODUCED BY NATIONAL SERVICES AND INTERNATIONAL ORGANIZATIONS OF INTEREST TO SEAFARERS AND MARINE OBSERVERS

(Reference: paragraph 6.11)

Title of Publication	**Editions per year**	**Country of origin**	**Language**
Boletín Climático Marino	3	Cuba	Sp.
Met Mar	4	France	F
Guide de l'Observateur Meteorologiste en Mer	1	France	F
Der Wetterlotse	6	Germany	German
Newsletter for Hong Kong V.O.S.	2	Hong Kong	E
Ship and Maritime Meteorology (Fune to Kaijou Kishou)	3	Japan	Japanese
Schip en Werf de Zee	11	Netherlands	Dutch
Meteorologisch Informatie Bulletin Maritiem	4	Netherlands	Dutch
Monthly Weather Summary	12	Qatar	E
Marine Observer	4	United Kingdom	E
IMO News	4	United Kingdom	E
Mariners Weather Log	4	United States	E
Storm Data	12	United States	E
WMO Bulletin	4	Switzerland	E, F, R, Sp.

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Annex XIII

TERMS OF REFERENCE OF SUB-GROUPS AND AD HOC GROUP OF THE WORKING GROUP ON MARINE METEOROLOGICAL SERVICES

(as approved by Resolution 2 (CMM-XII))

Terms of reference of the Sub-group on Marine Climatology

(a) To continue liaison with, and support for, the WCP and the Commission for Climatology;

(b) To maintain and update the *Guide to the Applications of Marine Climatology* (WMO-No. 781), and to prepare and convene a Workshop on Advances in Marine Climatology;

(c) To review and advise on requirements for the exchange of different types of marine climatological data;

(d) To review the operations of the marine climatological summaries scheme, including the work of the Global Collecting Centres, and to make recommendations for improvements, as necessary;

(e) To review and recommend on formats and quality control procedures for marine climatological data and data exchange;

(f) To review and recommend on, as necessary, the format and contents of the *International List Of Selected, Supplementary and Auxiliary Ships* (WMO-No. 47);

(g) To keep under review developments with Beaufort equivalent scales;

(h) To take actions to encourage enhanced contributions to the marine climatological summaries scheme.

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ACTION ITEMS ARISING FROM THE WORK OF THE SESSION

Chairman of the Subgroup

Para. 5.3.4	To liaise with subgroup members and the Secretariat to properly finalize the study on the metadata of the marine ship codes (**Action** with Scott Woodruff).
Para. 6.1.2	To circulate amended fourth version of the ODAS metadata database to the DBCP, buoy centres and Members for comments (**Action:** with the Secretariat)
Para 6.1.3	To find an appropriate centre to host the metadata database (**Action:** with Secretariat).
Para 6.2.2	Prepare and circulate a questionnaire to all members of JCOMM to enquire whether the need existed for archiving WAVEOB reports extracted from the GTS (**Action:** Secretariat to circulate).
Para 6.2.3	Undertake pilot project to extract from the GTS, WAVEOB reports headed MMXX, for the period of one year, with a preliminary report on results for JCOMM-I.
Para 6.5.4	To write to Dr Zaharchenko and ask him for an update of the status of the catalogue of storm surge data holdings.

Prepare proposals for JCOMM-I on:

Para 7.4	the up-dating of the Guide to MMS related to the archival of ocean current data;
Para. 8.1.7	CLIMARxx to be held some time between JCOMM-I and JCOMM-II.
Para. 11.1	Terms of reference for the JCOMM expert team (with Secretariat)

Members of the Subgroup

Paras. 4.6, 4.7 and 10.1.2	Revise the IMMT format to address the VOSClim Project requirements and to develop the necessary enhancements to the ship catalogue format (**Action: Joe Elms*** and Scott Woodruff, DAC and Secretariat).
Para 5.2.1 & 5.2.2	to review the SHIP code regarding the possible need for table modifications to include other sensors and for better harmonization between the IMMT and the SHIP code (**Action:** Joe Elms, Chris Hall, **Fritz Koek*** and Volker Wagner)
Para. 5.7.4	To prepare a solid list of arguments for the continuation of the use of knots as unit for wind speed in reporting from ships (**Action:** Miroslaw Mietus)
Para. 6.5.5	To circulate to the eight Responsible Members an updated IMMA for comments and to prepare a report to JCOMM-I,
Para. 7.4	To copy the archive of surface current data held at the UK Met. Office to the World Data Centres for Oceanography (**Action:** Chris Hall)
Para 8.2.2 and 8.2.3	Provide material to the Secretariat for missing Annexes of the new version of the Guide to MMS for an accelerated publication (**Action**: W.L. Chang, Joe Elms, Chris Hall, Fritz Koek, Teruko Manabe, Val Swail, Volker Wagner and the Secretariat)

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* Leader of the team in **bold** characters

Para 8.3.4 Investigate possibility of help with the topic of "Statistical or Diagnostic Techniques" (**Action**: Scott Woodruff)

WMO Secretariat

Para. 5.1.1 Edit Annex 3.e of the Guide to Marine meteorological Services to include an identification number, i.e. MQCS-III.

Para 5.5.5 Actions to further activate and increase the number of data sets available in INFOCLIMA:
- (i) to place a hit counter in the web pages that give access to the catalogue in order to monitor its use and accessibility;
- (ii) To request Members to establish hyperlinks from their web pages to the INFOCLIMA pages;
- (iii) to inform each Member of their current individual entries for their possible updating. If available, the date of the last update should also be included;

Para. 5.6.2 In order to improve the amount of data received at the GCCs:
- (i) To urge all Members who provide data for later processing by the Responsible Members and the GCCs to submit their data holdings to the MCSS;
- (ii) That Members should provide all the elements allowed in the IMMT-I format;
- (iii) To request Members that during the implementation of the initial QC procedures, they do their utmost to correct the data rather than simply flagging it.

Para. 5.6.4 In order to reduce the number of duplicate ship observations submitted to the GCCs:
- (a) to request Contributing Members (CMs) to provide data from their own recruited ships only;
- (b) WMO Secretariat to extract from WMO Pub 47 a list of all ships and their recruiting countries and to request CMs to ensure that data from any one ship are returned to only one country; and
- (c) to request Members to update WMO Pub 47 as frequently as possible and include all ships recruited by them, independently of the flag the ship navigates under.

Para 6.4.2 To find an appropriate mechanism to obtain an early adoption of the report format of the "Global tropical cyclone track and intensity data set" for possible application as from the year 2000.

Para. 6.6.3 To invite Members having answered the questionnaire on satellite-based ocean wave database to provide their information to INFOCLIMA by completing and submitting the appropriate form.

Para 8.3.3 Bring to the attention of the WCP Department proposals for the inclusion of marine climatology related topics on the Guide to Climatological Practices.

Para 10.2.1 Prepare format and entries for inclusion of vessel digital imagery in WMO No. 47

Para 10.2.2 to make a formal call to VOS operators for the submission of imagery for inclusion in WMO No. 47

Para11.3 To prepare an internet mailing list of subgroup members

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Annex XV

LIST OF ACCRONYMS

AO	Arctic Oscillation
ARCHISS	Archival Climate History Survey
ASAP	Automated Shipboard Aerological Programme
ASAPP	ASAP Panel
AWSs	automatic weather stations
BATHY	Report of bathythermal observation
BUOY	Report of a buoy observation
CBS	Commission for Basic Systems
CCA	canonical correlation analysis
CCl	Commission for Climatology (of WMO)
CDC	Climate Diagnostic Centre
CLIMAR99	International Workshop on Advances in Marine Climatology
CLIVAR	Climate Variability Programme
CMs	Contributing Members
CMM	Commission for Marine Meteorology
COADS	Comprehensive Ocean-Atmosphere Data Set
CREX	Character form for the Representation and Exchange of data
CSM	Commission for Synoptic Meteorology (now CBS)
CSM	Climate System Monitoring
DAC	Data Assembly Centre
DBCP	Data Buoy Cooperation Panel
DMPA	Data Management Programme Area (of JCOMM)
EC	Executive Council
ENSO	"El Niño" Southern Oscillation
EOF	empirical orthogonal functions
G3OS	GOOS, GCOS and GTOS
GCCs	Gobal Collecting Centres
GCOS	Global Climate Observing System
GEB	Guide Editorial Board (of CCl)
GLOSS	Global Sea-level Observing system
GOOS	Global Ocean Observing System
GOSIC	Global Observing System Information Center
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunications System
IGOSS	Integrated Global Ocean Services System
IMMA	International Maritime Meteorological Archive
IMMPC	International Maritime Meteorological Punch-Card
IMMT	International Maritime Meteorological Tape
INFOCLIMA	World Climate Data and Information Referral Service
IOC	Intergovernmental Oceanographic Commission (of Unesco)
IPCC	Intergovernmental Panel on Climate Change
ISCDC	International Surface Current Data Centre
IWTC	International Workshop on Tropical Cyclones
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
MCSS	Marine Climatological Summaries Scheme
MDB	Marine Data Bank
MMS	Marine meteorological services
MQCS	minimum quality control standards
NAO	North Atlantic Oscillation
NMSs	National Meteorological Services
NCDC	National Climatic Data Center, NOAA
NOAA	National Oceanic and Atmospheric Administration
ODAS	Ocean Data Acquisition System
OGP	Office of Global Programs, NOAA
OOPC	Ocean Observations Panel for Climate (GOOS, GCOS, WCRP)

PDO	Pacific Decadal Oscillation (PDO)
QC	Quality control
RA	redundancy analysis I
RM	Responsible Members (of the MCSS)
RSOI	reduced space optimal interpolation
RSMCs	Regional Specialized Meteorological Centres
RTMC	Real Time Monitoring Centre
SGMC	Subgroup on Marine Climatology (of JCOMM)
SOOP	Ship of Opportunity Programme
SOOPIP	SOOP Implementation Panel
SSA	singular spectral analysis
SVD	singular value decomposition
TC	Tropical Cyclone
TESAC	Temperature, salinity and current observation from a sea station
TRACKOB	Report of a marine surface observation along a ship's track
VOS	Voluntary Observing Ships
VOSClim	VOS Climate Project
VSOP-NA	Special VOS Observing Project for the North Atlantic
WCDP	World Climate Data Programme
WCP	World Climate Programme
WMO	World Meteorological Organization
WOC	Workshop Organizing Committee
WWW	World Weather Watch