EXPERT TEAM ON MARINE CLIMATOLOGY
Second Session

Geneva, Switzerland, 26-27 March 2007

FINAL REPORT

JCOMM Meeting Report No. 50

WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

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NOTE

C O N T E N T S

GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE SESSION

1.1 Opening

1.1.1 The Second Session of the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) Expert Team on Marine Climatology (ETMC) was opened at 0900 hours on Monday, 26 March 2007, at the WMO headquarters by Mr Scott Woodruff, Chairperson of the ETMC. In his opening words, Mr Woodruff welcomed the participants to the Second Session (ETMC-II). Mr Woodruff then introduced Prof Hong Yan, Deputy Secretary General of the World Meteorological Organization (WMO).

1.1.2 On behalf of the Secretary-General of WMO, Mr Michel Jarraud, and the Executive Secretary of the Intergovernmental Oceanographic Commission (IOC), Dr Patricio Bernal, Prof Hong Yan welcomed participants to the session, to Geneva in general and to the WMO in particular. He reported on the activities of the Marine Meteorology and Oceanography Programme (MMOP) as a component of the Applications of Meteorology Programme—these major WMO programmes are committed to support WMO's Members, particularly by strengthening crosscutting connections. The purpose of MMOP is the provision of data, information and services in support of the safety of life and property at sea, operations in the open and coastal ocean areas, the protection and sustainable development of the ocean and marine environment, numerical weather prediction and operational meteorology, the monitoring and prediction of seasonal-to-inter-annual climate variability and climate change, and the efficient management of marine resources, based on the collection and integrated management of marine meteorological and oceanographic data, and the development and enhancement of capacity in all maritime countries.

1.1.3 Prof Hong Yan noted that activities undertaken by the ETMC, including the implementation of the Marine Climatological Summaries Scheme (MCSS) have a long history. He noted that the ETMC workplan had achieved substantial progress since the First Session of the ETMC, and in particular with regard to the adoption by the Second Session of JCOMM (JCOMM-II, Halifax, Canada, 19-28 September 2005) of the revised International Maritime Meteorological Tape (IMMT-III) format as well as of the revised Minimum Quality Control Standards (MQCS-V). He thanked the Global Collecting Centres (GCCs) for making Version 3 of the MQCS software recently available. He also noted that ETMC-II had a heavy 2-day agenda, with discussions of the IMMT format and MQCS, Binary Universal Form for the Representation of Meteorological Data (BUFR) templates for ship data, further development of the new IMMA format, the implications of ship call sign masking schemes now being implemented on a trial basis because of the concerns of ship owners and masters with regard to availability of VOS reports on public websites, the archival of wave and storm surge data, preparations for CLIMAR-III in 2008, as well as many other issues.

1.1.4 Prof Hong Yan recalled the decision by the Second Session of the Data Management Coordination Group (DMCG-II, Geneva, Switzerland, 10-12 October 2006), to establish a Task Team on Delayed-Mode VOS Data Exchange (TT-DMVOS) with membership recommended by the ETMC and tasked amongst other things to manage the GCCs, establish requirements for the IMMT format and the MQCS, reconcile the IMMT and the IMMA formats, revise relevant WMO technical publications as needed, and establish a website to share relevant information. He also recalled the development of the JCOMM Data Management Strategy that was drafted by DMCG and later endorsed by the Nineteenth Session of the International Oceanographic Data and Information Exchange (IODE) Committee (IODE-XIX, Trieste, Italy, 12-16 March 2007). The strategy stressed in particular data interoperability, free and unrestricted exchange, real-time distribution, migration to Table Driven Code Forms (TDCFs), and quality management.

1.1.5 Requirements for platform/instrument metadata are now clearly expressed for a number of oceanographic and meteorological applications both research and operational, including for Marine Climatology. The ETMC was invited to cooperate with the Water Temperature Metadata Pilot Project (META-T) in this regard.

1.1.6 Quality Management is a priority activity of the WMO. Currently, the JCOMM is collaborating with the development of the WMO Quality Management Framework, and is in the process of documenting all of its related publications and ensuring that said documents comply with Quality Management terminology. The WMO is working to enhance its cooperation with the International Standards Organization (ISO) so that some standards might eventually be published jointly with ISO. The DMCG has reviewed and updated the list of JCOMM Publications and is inviting all JCOMM Groups and Expert Teams to update the publications they are responsible for, in such a way that they comply with quality management terminology.

1.1.7 The JCOMM Data Management Strategy also discusses the cooperation with archive centres, and with IODE, in assisting in the development of climatologies. The IODE support of Global Oceanographic Data Archaeology and Rescue (GODAR) is a prime example of this cooperation. The JCOMM Data Management Programme Area (DMPA) has recently been asked to assist in the development of an Extreme Waves Database. In this case, the objective is not to develop a climatology, but rather to identify extreme wave events (e.g., significant wave heights of 14m or greater) and improve access to the data to assist with improving wave models. The ETMC was invited to cooperate with the JCOMM Expert Team on Wind Waves and Storm Surges (ETWS) and the DMCG in this regard.

1.1.8 In his conclusion, Prof Hong Yan assured the ETMC the continued commitment of WMO to support the ETMC and its work. He concluded by wishing all participants a very successful meeting and an enjoyable stay in Geneva.

1.1.9 In addition to the remarks expressed by the Deputy Secretary General, Dr Georgi Kortchev highlighted a few issued related to the activities of the Applications of Meteorology Programme.

1.1.10 A major Data Management activity of the WMO is the development of the WMO Information System (WIS). The WIS is an overarching approach based on widely accepted standards, such as those promoted by the ISO, and intended to meet information exchange requirements of all WMO Programmes. The WIS offers much promise, and will help WMO to avoid data incompatibilities, and problems in sharing of valuable data. It will ensure interoperability of the Information Systems and Programmes both inside and outside of WMO. The ultimate implementation will build upon the most successful components of existing WMO Information Systems. The WIS will continue to rely upon the WMO communication system—initially the Global Telecommunication System (GTS)—to provide highly reliable delivery of time-critical data and products.

1.1.11 WMO hosted the Second Session of the ETWS (ETWS-II) in Geneva, Switzerland, 20-24 March 2007, which, responding to a recommendation adopted during the Second Session of the JCOMM to discuss and review the implementation plan for the preparation of the *Guide to Storm Surge Forecasting*, agreed that the *Guide* should raise attention to the need for addressing the vulnerability of coastal areas exposed to storm surges, and that forecasting should include not only hazards but also risks, which result from a combination of hazard and vulnerability. This will be done in accordance with the increasing practice of National Meteorological and Hydrological Services (NMHSs) to use and deliver warnings and risk hazard maps. The *Guide to Storm Surge Forecasting* will be published by the end of this year as a WMO Guide Series.

1.1.12 Dr Kortchev recalled that the JCOMM Management Committee (MAN) at its Fifth Session (MAN-V, Geneva, Switzerland, 5-7 October 2006) agreed that there was a clear need to better define cross-JCOMM Programme Area issues, and urged the Programme Area coordinators to define a strategic and implementation plan for Programme Area cross-cutting activities and interactions, also addressing WMO cross-cutting programmes and activities, such as the WMO Natural Disaster Prevention and Mitigation Programme (DPM), Least Developed Countries

Programme (LDC), WIS and IOC Programs. In this regard and in light of the new focus on wave climate responsibilities of the ETWS, the ETMC was invited to discuss the future interaction with the ETWS and to develop a proposal for joint work plan, such as collaboration on the enhancement of storm surge statistics.

1.1.13 Dr Kortchev wished all participants a very successful session and an enjoyable stay in Geneva.

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

1.2 Adoption of the agenda

1.2.1 The Team adopted its agenda for the session on the basis of the provisional agenda. The final agenda for the session is given in **Annex II**.

1.3 Working arrangements

1.3.1 Under this agenda item the Team 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. JCOMM ASPECTS

2.1 Report by the ETMC Chairperson

2.1.1 The Chairperson of the ETMC, Mr Scott Woodruff reported on the Expert Team activities since the first ETMC Session. He was expecting this meeting, while brief, to allow the ETMC to finalize the work plan, and establish new directions for the Team.

2.1.2 He recalled that the Marine Climatological Summaries Scheme (MCSS), which was defined in the 1960s and has represented the core of ETMC's work to date, ties together two major important functions (a.) delayed-mode (DM) Voluntary Observing Ship (VOS) data management; and (b.) the production of the MCSS (tabular/graphical) Summaries (MCS). He explained that following JCOMM and DMCG recommendations a review and restructuring of the MCSS was needed. As an initial step, the DMCG-II established a self-funded, cross-cutting Task Team on DMVOS data, comprised of members both from the ETMC and the Ship Observations Team (SOT). An important parallel task, which should be initiated during the two days of the ETMC-II, will be to establish a new direction for the secondary MCSS function—the tabular/graphical MCS. A JCOMM questionnaire in 2005 provided information about the potential customer base and purposes of the MCS products. However, these justifications need to be more broadly agreed upon, to the extent that the MCS products will be managed and officially sanctioned by ETMC, as opposed to produced and offered nationally.

2.1.3 The JCOMM-II also recommended that the ETMC explore how oceanographic and ice climatologies could be coordinated with the marine meteorological data, so that the results could be viewed as an integrated product.

2.1.4 In response, new task interconnections also need to be established between the DMPA/ETMC and the JCOMM Services Programme Area (SPA), including its ETWS and Expert Team on Sea Ice (ETSI); and, as appropriate, to other commissions and organizations including the WMO Commission for Climatology (CCl) and the Joint CCl / Climate Variability and Predictability Experiment (CLIVAR) / JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI). One suggested approach, following along the lines of the TT-DMVOS, may be to establish a parallel self-funded, cross-cutting Task Team on Marine and Oceanographic Climatological Summaries (TT-MOCS).

2.1.5 The Team noted with appreciation the establishment of the TT-DMVOS by DMCG-II.

2.1.6 The Team agreed that there was a need to strengthen the linkages both within JCOMM and with other WMO Technical Commissions such as the CCl and the WMO Commission for Basic Systems (CBS) and groups in the marine and oceanographic communities, and with the Global Climate and Ocean Observing Systems (GCOS and GOOS). This can for example be done through its participation in the ETCCDI. It noted that the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) provided an important linkage with ETMC and JCOMM for example via the International Maritime Meteorological Archive (IMMA) format, which is now being used extensively (e.g. ICOADS already allows limited integration between marine and oceanographic data, and metadata). The Team noted that through cooperation between the ETMC and the SPA we may be able to achieve further the internationalization of some tasks suggested by past marine climatology (CLIMAR/MARCDAT) workshops and ETWS-II.

2.1.7 The Chairperson reported on the following recent ETMC activities:

- JCOMM questionnaire circulated in 2005 concerning the future of the MCS;
- From JCOMM-II, the Chairperson of the Team was rotated from Poland to the USA, and 10 other representatives were selected to complete the Team;
- An ETMC website hosted by NOAA under the ICOADS portal was developed (http://icoads.noaa.gov/etmc/), which provides documents, membership and contact information, plus selected JCOMM and other links. However, appropriate portions of the website are planned for migration in due course to reside under official JCOMM web hosting. The ETMC website also links to another website, hosted under the ICOADS, of interest to the ETMC and the JCOMM, for the “RECovery of Logbooks And International Marine data” (RECLAIM) project;
- Establishment of the GCC, UK website in July 2006 in addition to the existing GCC, Germany one;
- MQCS software Version 3 completed in September 2006;
- Completion in September 2006 of a revised draft, summarizing the results from the 2005 questionnaire concerning the future of the MCS;
- Finalization of the CLIMAR-II special issue of the *International Journal of Climatology* (Gulev 2005) as a “Dynamic Part” of the *Guide to the Applications of Marine Climatology* (WMO-No. 781, 1994);
- Participation (among four JCOMM Representatives) of two ETMC members, Dr Elizabeth Kent and Mr Woodruff, at the ETCCDI Second Session, Niagara-on-the-Lake, Canada, 14-16 November 2006. As an outcome of the meeting, and in cooperation with the SPA, development of a new set of marine climate indices was planned;
- Considerations of enhancing the coordination of both oceanographic climatologies and ice climatologies as recommended by JCOMM-II;
- Planned future international development of the IMMA format, which will require careful review by the ETMC;
- Imaging and digitization of the WMO Publication No. 47 back to 1955;
- Connection with other marine data and metadata archaeology activities, including documenting the history of the marine ship codes, and the broadly based international RECLAIM activities now under development to image and digitize historical ship logbook data and metadata.

2.1.8 Regarding future activities, the Chairperson mentioned the need to explore the possibility of some convergence of the IMMA format with features of TDCFs so that better connections with the WIS are made and invited the Team to consider the issue when discussing agenda item 4.1.

2.1.9 Also, there were recommendations by recent sessions of the JCOMM Data Management and Services Coordination Groups (DMCG-II and SCG-III) for development of the Extreme Waves Database, working together with ETWS and appropriate IODE or meteorological centres where *in situ* extreme wave and meteorological data exist. Possibilities for contributing to, or possibly hosting such a facility, were discussed by the Team under agenda item 4.3.

2.1.10 Possible areas for MQCS augmentation could include the following items: (a.) expansion, where possible nationally or internationally, to include the integration and archival (e.g., in the IMMA format) of quality control (QC) feedback flags supplied by operational weather models and Global Atmospheric and other Reanalyses, and (b.) the convergence of MQCS with QC procedures used for non-VOS marine data and in the oceanographic community. The Team realized that the time was limited to discuss these issues at depth during this meeting but agreed that it should be more involved in the future and recommended that the proposed Marine and Oceanographic Climatological Summaries Task Team (agenda item 6.1) and the TT-DMVOS (agenda item 3.1) coordinate their activities in this regard.

2.1.11 By mid 2006, discussions began regarding the timing, venue, and organizers for a self-funded CLIMAR-III Workshop. CLIMAR-III is currently planned for 6-9 May 2008 in the 3-city complex of Gdansk/Sopot/Gdynia, Poland, following Poland's kind offer made in October 2006 to host the Workshop. Currently, Poland has local arrangements under active consideration, and the scientific organizing committee has been partially formed (discussed by the Team under agenda item 7).

2.2 Report by the Secretariats

2.2.1 The WMO Secretariat's representative reported on actions taken since the First Session of Expert Team on Marine Climatology (ETMC-I, Gdynia, Poland, July 2004).

2.2.2 At its Fifty-eighth Session, the WMO Executive Council (EC-LVIII, Geneva, Switzerland, June 2006) noted the Progress/Activity report on MMOP, including substantive achievements under the JCOMM during the past intersessional period such as the adoption of the JCOMM Strategy document. WMO EC-LVIII reiterated the need for the preparation of an accompanying Implementation Plan for the upcoming intersessional period, which would include a comprehensive set of specific objectives and deliverables, with associated timelines and performance indicators, across all JCOMM Programme Areas, and input to broader WMO Programme monitoring and assessment. WMO EC-LVIII also discussed the ship owners and masters' concerns regarding the availability of ship positions and identification data on public websites (discussed by ETMC under agenda item 3.6).

2.2.3 Action undertaken by the Secretariat in support of the ETMC during the past year include:

i. Preparation of various letters and documentation;
ii. Follow-up on decisions of the ETMC-I and preparation for the upcoming ETMC-II;
iii. Close liaison with the JCOMM, in particular, in the development of coordination and integration procedures;
iv. Provide GCC annual reports to WMO Members;
v. Inform Members about Version 3 of MQCS software provided by the GCCs;
vi. Liaison with CBS on codes and other related matters, with other IOC and WMO technical commissions and regional associations (or equivalent bodies) on relevant issues; and with the CLIVAR, GCOS, GOOS, and SCOR;
vii. Loan 1973-98 editions of WMO Publication No. 47 to the NOAA Climate Database Modernization Program (CDMP) for imaging;
viii. Provide a link on the WMO website to the latest Dynamic Part of the *Guide to the Applications of Marine Climatology* (WMO-No. 781).

2.2.4 The Team was briefed on the new JCOMM Structure decided at JCOMM-II for the next intersessional period. JCOMM-II noted with appreciation the results achieved by ETMC-I, including existing data management systems and resources that had been developed to improve marine climatological data management and services. JCOMM-II took the following actions related to ETMC activities:

(a) Adoption of IMMT-III and MQCS-V to replace the existing versions from 1 January 2007;

(b) Adoption of Version 03 of WMO Publication No. 47, and agreement to use the Extensible Markup Language (XML) for the future exchange of the metadata included in WMO-No. 47;

(c) Requested the CBS to review, and if necessary, revise the BUFR template for ship data, based on the findings of the ETMC on the issue;

(d) Endorsed the proposal from the SOT and ETMC, supported by the JCOMM MAN, that instead of the reduced wind at 10 m, the original wind data should always be reported in ship meteorological reports, including those generated by electronic logbooks.

2.2.5 JCOMM-II noted with satisfaction that the Second JCOMM Workshop on Advances in Marine Climatology (CLIMAR-II) was successfully held in Brussels, November 2003, in conjunction with the celebration of the 150th anniversary of the landmark Brussels Maritime Conference of 1853, under the High Patronage of His Majesty King Albert II. The Commission expressed its sincere appreciation to the organizing committee for CLIMAR-II, especially to Mr Woodruff (USA), Chairperson of that committee, for their excellent organization of the workshop. The Commission agreed that the workshop was valuable, and that similar workshops should continue to be held in the future. Therefore, it agreed to the proposal that a third such self-funded workshop, CLIMAR-III, should take place in the near future. It requested the DMPA Coordinator and the Secretariats to proceed with the organization of the workshop at an appropriate time (see item 7).

2.2.6 The Commission noted that the work carried out by the ETMC was strongly focused on marine meteorology. It urged the ETMC to include in its Work Plan for the intersessional period, an examination of how both oceanographic climatologies and ice climatologies could be coordinated so as to be seen as an integrated product (discussed by the Team under agenda items 2.4.3 and 6.1).

2.2.7 The Team agreed that there was a need to strengthen JCOMM activities and visibility at the national level and recommended establishment of JCOMM National Committees as a practical way to move forward.

2.3 Observations Programme Area

2.3.1 **Ship Observations Team**

2.3.2 The Third Session of the SOT (SOT-III) was held in Brest, France, 7-12 March 2005, at which Prof Miroslaw Mietus (Poland) reported on the ETMC activities. Prof Mietus discussed the new IMMA format, metadata, the history of previous WMO Commission on Marine Meteorology (CMM) decisions concerning VOS and MCSS, bilateral data exchange within GCCs, and development of IMMT-III and MQCS-V, which both help meet the needs of the VOSClim Project. Prof Mietus pointed out at SOT-III that data management, including data quality, is a very important issue for VOS/VOSClim data and the continuation of the MCSS. He also mentioned that cooperation with the JCOMM Expert Team on Data Management Practices (ETDMP) was an important issue for the ETMC.

2.3.3 The SOT-III supported the ETMC recommendations, as well as the proposed role and responsibilities of the GCCs and Responsible Members (RMs), complemented by their responsibility for the revision of the MQCS-software used also by Contributing Members (CMs).

2.3.3.1 The new format of the WMO Publication No. 47, developed in cooperation between the ETMC and the SOT Task Team on Metadata for WMO-No. 47, was approved by the JCOMM-II in September 2005. The SOT-III also considered the recommendation from the Task Team to use XML as a future method of exchanging Pub. 47 metadata, and agreed with the ETMC's recommendation for trial use of XML in the VOSClim project. It was further agreed then that the SOT had the appropriate expertise to make proposals on revisions to Pub. 47, and that the SOT should assume the responsibility for the future revisions. With regard to the need for a dedicated ASAP metadata database, the ETMC had suggested that the SOT would be the more appropriate body to consider this issue, but also agreed to assist, if so requested by the SOT and the ASAP Panel.

2.3.3.2 The SOT-III stressed the need to regularly update the WMO Publication No. 47 metadata—to which timely accessibility is a crucial issue for research and operational purposes—and agreed that the historical editions of Pub. 47 are also an important resource for climate research.

2.3.3.3 Dr Kent recalled the lack of a JCOMM Observations Programme Area (OPA) implementation target for the VOS component of the observing system. The Team recognized that this was a difficult issue but nevertheless recommended that the SOT and the JCOMM Observations Coordination Group (OCG) carefully address it both in terms of requirements and practicality. The Team noted that the implementation target did not have necessarily to be expressed as a number of ships but could be expressed as a number of observations and their completeness. The Team also considered that the issue had to be addressed in the context of the new proposed TT-MOCS and its Terms of Reference defined accordingly, i.e. TT-MOCS should develop a target, and then make specific recommendations to the SOT and the OCG (**action TT-MOCS**). In parallel the SOT and the OCG will be informed of the work by the TT-MOCS (**action, Secretariat**).

2.3.3.4 It was noted that whilst the recent decline in numbers of ship reports may be due, at least in part, to ship security issues, there had also been a longer term decline in numbers due to other reasons; e.g., changing numerical weather prediction (NWP) requirements, reduction in the Port Meteorological Officer (PMO) network and the difficulty of servicing ships which do not regularly return to ports where PMO visits can be arranged.

2.3.4 Data Buoy Cooperation Panel

2.3.4.1 The Twenty-second Session of the DBCP (DBCP-22) was held in La Jolla, California, USA, 16-20 October 2006. The Panel has been in collaboration with the ETMC in the past in defining the Ocean Data Acquisition System (ODAS) metadata catalogue, which is now being used by the JCOMM ODAS Metadata Service operated by the National Marine Data and Information Service (NMDIS), China (http://www.odas.org.cn/). The Panel has developed a buoy metadata collection scheme which has been implemented at the JCOMM *in situ* Observing Platform Support Centre (JCOMMOPS) to collect metadata from the buoy operators and the manufacturers of newly deployed buoys (http://wo.jcommops.org/cgi-bin/WebObjects/meta). The DBCP is also acting as a component of the META-T Pilot Project.

2.3.4.2 The Team noted that buoy data are being routinely archived by the Responsible National Oceanographic Data Centre for Drifting Buoys (RNODC/DB), which is operated by Integrated Science Data Management (ISDM; formerly MEDS), Canada.

2.3.4.3 The DBCP has also started an active dialogue with the ETWS. The Panel recognised the requirement for additional high-quality wave measurements in under-sampled areas of the world oceans in support of the SPA's activities in the area of Maritime Safety Services (MSS), and agreed to: (i.) recommend adding wave measurements to the DBCP Implementation Strategy, (ii.) invite buoy operators and Panel Members to increase wave measurements, particularly from open ocean areas, in the Southern Ocean, and the tropics, (iii.) invite the DBCP Evaluation Group to address wave measurement technology issues and to communicate with the ETWS and Ocean

Observations Panel for Climate (OOPC) on user requirements, and (iv.) make recommendations to the OCG in this regard and to liaise with the ETWS and OOPC on wave data requirement issues. The Panel urged the ETWS to work with the OPA, through its component groups and sub-groups including the DBCP, to put forward a more detailed set of requirements for additional high-quality wave measurements as soon as possible, and to transmit those requirements through the SCG to the OCG for further action.

2.3.4.4 The Chairperson invited the Team to enhance its cooperation with the DBCP in terms of (i.) management of historical drifting and moored buoy data, and (ii.) the collection of buoy instrumental metadata. The Team agreed that strengthening the cooperation would be valuable and to investigate the possibility of having the ETMC represented at the next DBCP meeting (DBCP-23), Jeju, Korea, 15-19 October 2007 **(action, S. Woodruff and Secretariat).**

2.4 Services Programme Area

2.4.1 Results from the Third Session of the SCG

2.4.1.1 The SPA coordinator, Dr Craig Donlon, introduced the work of that program area, noting that four expert teams constitute its core work: the Expert team on Maritime Safety Systems (ETMSS), the Expert Team on Marine Accident and Emergency Support (ETMAES), the ETWS, and the ETSI. A comprehensive workplan has been established for the SPA and is available at http://www.jcomm-services.org/modules/documents/documents/JCOMM-SPA-WP-06-09-v1.6.pdf, which contains a number of Top Level Objectives for the SPA (**Annex XII**). The SPA coordinator encouraged the ETMC to be aware of the cross-cutting tasks between the SPA and the ETMC.

2.4.1.2 Each of these teams develops uses or contributes to systems that require advanced data management. The SPA coordinator highlighted the important underpinning role of databases and cross-cutting nature of data management at the Third Session of the SCG (SCG-III, Exeter, UK, 7-10 November 2006): without proper data management and effective databases and climatologies MetOcean services cannot exist. Furthermore, there is a clear need to address new and emerging requirements for bio-geochemical databases (especially satellite ocean colour data, harmful algal blooms and oil spills), for using non standard observations for defining how linking socio-economic data to physical databases, to provide interfaces to online data sets (e.g., ICOADS should be up-to-date and available on line as a browsable searchable resource) and for the integration of data sets into new standards for electronic chart display and information system (ECDIS) including object catalogues, amongst other things.

2.4.1.3 At the SCG-III several key areas of work were discussed that require the direct involvement of the ETMC, which include:

- Development of the Extreme Waves Database in collaboration with ETWS (discussed further under 2.4.1.8);
- Assistance to define and include wave observations in operational and delayed-mode data sets (including ICOADS) in collaboration with ETWS;
- Help in defining bio-geo-chemical observation reporting templates and codes for use in operational systems;
- Assistance with harmful algal blooms (HAB) and oil spill events databases in collaboration with ETMAES;
- Assistance with marine and sea ice objects catalogues in collaboration with ETSI;
- Participation in the JCOMM Extreme Water Level Pilot Project (JEWL-PP) including construction of climatologies/risk maps and Maximum Envelope of Water (MEOW) with ETWS.

2.4.1.4 These items were then followed up in more detail in presentations made by the Secretariat and the Chairperson of ETSI.

2.4.1.5 The SPA coordinator noted that there is a need to integrate satellite and *in situ* data in common databases, as there are clear synergy benefits for the end user community. For example, the Global High Resolution Sea Surface Temperature Pilot Project (GHRSST-PP) has a need to provide uncertainty estimates for satellite data sets based on statistics generated from near contemporaneous satellite and SST data. In fact at IFREMER, France, a GHRSST-PP match-up database for a large proportion of *in situ* and satellite SST data is being constructed for this purpose based on the CORIOLIS database and the formats defined by the GHRSST-PP. The database considers all ocean SST observations collocated to +/- 25km and within 6 hours and to a depth of 100m. The GHRSST-PP databases are managed and designed by the GHRSST-PP Science Team and as the project moves into operations, it would be extremely useful for the ETMC to review the structure and content of the database prior to operational implementation after which point it may be more difficult to change (**action, SPA Coordinator and TT-DMVOS**).

2.4.1.6 Dr Donlon also noted that work at the Met Office ("*Three-way error analysis between AATSR, AMSR-E and in situ sea surface temperature observations*", by Anne O'Carroll, John Eyre, and Roger Saunders) has shown that in the case of the ENVISAT Advanced Along Track Scanning Radiometer (AATSR), the satellite data are more accurate than buoy observations, and thus can provide a mechanism to monitor and QC individual *in situ* measurements. As the AATSR retrieval algorithms do not use *in situ* data when they are derived such comparisons are valid. The SPA coordinator suggested that ETMC might use this approach, in collaboration with the GHRSST-PP databases: (a.) to monitor buoy and ship SST performance in near real time, (b.) to define SST uncertainty estimates for individual buoys and ships, and (c.) to provide guidance and assistance to the GHRSST-PP teams constructing satellite and *in situ* databases **(Action: SPA Coordinator and ETMC members)**.

2.4.1.7 The Team noted that the issue also related to the discussion under agenda 6.1 and to work undertaken by other groups such as the DBCP and the SOT, regarding real-time QC.

2.4.1.8 SCG-III identified a range of activities under the SPA that could be carried out in close collaboration with the ETMC, to:

(i) Continue to develop the Extreme Waves Database (ETWS - ETMC cooperation). The objective is to develop a database of high-quality measured data (e.g., ship, buoy, and OceanSITES; and possibly also more subjective data such as helicopter pilot observations, as noted by Mr Martin Rutherford, Australia) for significant wave heights (SWH) of 14m or greater. This archive would form an invaluable data set of measurements that could be used to validate wind wave models and also satellite altimeter wave estimates, which have largely unknown characteristics at these heights. It was suggested that a more comprehensive database, including satellite data, be proposed at the JCOMM-III;

(ii) Develop climatologies and statistics for mapping HAB and oil spill events (ETMAES - ETMC cooperation, target JCOMM-III);

(iii) Explore how climatologies of storm surge inundation zones can be constructed (ETWS - ETMC cooperation, target JCOMM-III). This should be considered as a component of the JEWL-PP;

(iv) Convene a sea ice data analysis and assimilation workshop, to support the preparation and assimilation of sea ice and iceberg analysis and climatology products in numerical forecasting and climatic analysis (ETSI - ETMC - GCOS cooperation, target early 2008);

(v) Contribute to the International Maritime MetOcean Services Conference 2008 (IMMSC 2008), which is planned in October 2008, including representation by ETMC on the organizational steering team.

2.4.1.9 The SPA Coordinator stressed that maintaining databases with ocean data of appropriate quality is fundamental for marine services applications. Databases feed from the output of ocean forecast systems, satellite systems, and *in situ* observing systems and provide input in turn to a wide range of applications. He suggested that data management was a cross cutting activity with a scope ranging from the JCOMM Observations to the Services Programme Areas. This approach would be consistent with the WIS concept.

2.4.1.10 The Team recommended that one representative from ETMC attend the IMMSC 2008 conference and sit on the steering team **(action, ETMC Chairperson)**.

2.4.2 Expert Team on Wind Waves and Storm Surges (ETWS)

2.4.2.1 The Team noted with interest the report by the Chairperson of the ETWS, Mr Val Swail, on the existing and proposed interactions between the ETWS and the ETMC. It pointed out major areas for potential collaboration between ETWS and ETMC, such as: (a.) CLIMAR-III; (b.) Extreme Waves Database; (c.) wave climate summaries in ICOADS; (d.) ETCCDI; (e.) storm surge statistics; and (f.) climate change and design.

2.4.2.2 The Team noted that at the Second Session of the ETWS (ETWS-II, Geneva, Switzerland, 20-24 March 2007), the ETWS agreed with developing a definite role at CLIMAR-III, by ensuring that waves and surges would be well represented within the marine climatology envelope. The Team was informed that the ETWS Chairperson is on the Organizing Committee for CLIMAR-III.

2.4.2.3 The Team was presented with the motivation and proposal for developing the JCOMM Extreme Waves Database of high-quality measured data for SWH ≥14m (discussed further in item 4.3). The planned database is intended for use in model validation and validation of remotely sensed waves, where such models and algorithms suffer from lack of sufficient data. The Team agreed on the need for contributions of high quality wave measurements of a complete record of such extreme storm seas events and associated surface winds, with appropriate documentation, ancillary data (e.g., temperatures and winds) and metadata, to the database. The Team noted that at the ETWS-II session concerns were raised about (a.) the need to associate adequate disclaimers with the database, since the extracted *in situ* data would necessarily be very sparse and incomplete; (b.) the likelihood that some complications would also need to be sorted out on open redistribution and other national or organizational data policies. The Team also noted that ETWS-II suggested that altimeter data be included as an integrated component of the system. Mr Rutherford supported this suggestion and emphasized that altimeters are reporting wave measurements of extreme storm seas with SWH much larger than 14m. The Team concurred with the rationale for development of the Database, and recommended to begin ingest of *in situ* and satellite data (with specific actions discussed under item 4.3).

2.4.2.4 The Team noted that a considerable amount of wave data from ships and buoys is already available in ICOADS. Recommendations from the CLIMAR and MARCDAT meetings have supported the development of wave climate statistics and summaries using these data (e.g. see http://www.marineclimatology.net). In this context, the ETWS-II: (a.) agreed to joint work towards the development of wave climate summaries for ICOADS based on the historical *in situ* record; and (b.) stressed the need to support this activity by developing new ICOADS staff at different international institutions coordinated by the ETMC and ETWS Chairpersons. The Team stressed some concerns about the logistics of internationalization of some ICOADS tasks, e.g., considering resource limitations within Members/Member States, but proposed to discuss this broader issue at CLIMAR-III and urged the Organizing Committee to consider this proposal **(Action: CLIMAR-III Organizing Committee)**. Dr Kent expressed interest if resources could be located to work on the calculation of wave summaries in ICOADS probably based on collaboration with Sergey Gulev and involving the ETWS Chairperson (**action, V. Swail**).

2.4.2.5 The Team noted that the ETWS would provide input to the ETCCDI with respect to wind waves and storm surges in cooperation with the ETMC. The Team noted that there is a range of marine datasets, both *in situ* and model-derived, that could be used in the development of indices. Examples include: reanalyzed wind and wave datasets, ICOADS surface marine reports and summaries, sea level from tide gauges and satellites. The Team also noted that the proposed modernization of the MCSS provides an opportunity to develop appropriate wind and wave indices. The Team was informed that the ETWS focal point on ETCCDI matters is the ETWS Chairperson, Mr Swail. ETCCDI issues were further discussed in item 6.2.

2.4.2.6 The Team noted that the MAN-V and the SCG-III agreed that there is a need for enhanced global and regional storm surge statistics. This would involve guidelines for storm surge historical databases and statistical techniques to enable members to carry out statistical analysis in their countries. It was also recommended to explore how risk areas of storm surge inundation zones and MEOW can be identified and mapped. Here there is a clear link with the WMO Tropical Cyclone Programme and DPM. The ETWS-II recommended development of a joint work plan between ETWS and ETMC using the results of the First Scientific and Technical Storm Surge Symposium to be hosted by Republic of Korea, 2-6 October 2007. Mr Rutherford stressed that there is a close link between coastal erosion and extreme events and this should be considered in this joint work plan. In this regard, Mr Rutherford would provide an article on this issue to the Secretariat **(Action: M. Rutherford)**.

2.4.2.7 The Team noted that the International Association of Oil and Gas Producers (OGP) has expressed interest in a joint workshop on the potential impacts of climate change on future design criteria, which relates to the planned ETWS Technical Report *Wave Climate Change Effects and Operations*. The ETWS Chairperson proposed that for this subject the work could be undertaken through the ETCCDI link and urged the Team consider this issue under item 6.2. The Team was also informed that an OGP preparatory meeting for this workshop is taking place in London and Mr Swail and Dr Johannes Guddal are the JCOMM representatives that would establish the necessary link with OGP (**action, V. Swail, J. Guddal**).

2.4.3 Expert Team on Sea Ice

2.4.3.1 JCOMM-II had agreed, as noted by SCG-III, that the ETSI should be the responsible designated body for information and assessment of sea ice as an Essential Climate Variable (ECV). The Group also noted that during the GCOS meetings, it was agreed that the Global Digital Sea Ice Data Bank (GDSIDB) data products, as well as individual data sets, will be widely used for the implementation of the GCOS tasks, including validation and co-analysis with Special Sensor Microwave/Imager (SSM/I) products and provision of sea ice climatology. In this regard, and to support the preparation and assimilation of sea ice and iceberg analysis and climatology products in numerical forecasting and climatic analysis, the Group endorsed the Sea Ice Data Analysis and Assimilation Workshop proposed by the ETSI Chairperson, Dr Vasily Smolianitsky, to be held in the beginning of 2008. Main themes for the workshop will be developed during ETSI-III session.

2.4.3.2 Dr Smolianitsky reported on the agenda for the upcoming ETSI-III and GDSIDB-XI meetings and on some particular agenda items of interest to the ETMC.

2.4.3.3 The Team agreed that it should be increasingly involved in sea-ice matters and climatology and should therefore develop better links with the ETSI. Areas where cooperation is needed include the following:

- Climate requirements for sea ice (Marine services in sea ice regions, NWP, climate monitoring);
- Sea-Ice terminology;
- Convergence of formats and possible conversions (e.g. to NetCDF);
- Provisional of sea ice data to climatic archives.

Dr Smolianitsky presented the scheme of ETSI relationship with other programmes and addressed indices issues. The Team noted that extensive sea-ice climatologies (data and statistics) were developed within the GDSIDB project and include historical material for the Arctic region in the form of ice indexes starting from 1900 to the present, iceberg positions from 1912 to the present, and ice charts from the 1930s. For the Antarctic region, the period of available data is shorter, typically starting in the 1950s.

2.5 Data Management Programme Area

2.5.1 Results from the Second Session of the Data Management Coordination Group

2.5.1.1 The Second Session of the DMCG (DMCG-II) was held in Geneva, Switzerland, from 10 to 12 October 2006. Mr Woodruff represented the ETMC at the meeting, and presented an overview of the accomplishments of the ETMC since JCOMM-II. These accomplishments included: the ETMC and RECLAIM websites hosted by NOAA, results of the JCOMM questionnaire on the future of the MCSS Summaries, the Dynamic Part of the WMO *Guide to the Application of Marine Climatology*, preliminary arrangements for CLIMAR-III in 2008, GCC website and MQCS Version 3 developments, and participation of the ETMC (Dr Kent and Mr Woodruff) at the ETCCDI.

2.5.1.2 At DMCG-II, the ETMC was also requested to consider the possibility of developing, with the ETWS and other appropriate groups, the JCOMM Extreme Waves Database. The Group recommended preparation of a proposal in this regard for submission to the IODE-XIX. Finally, the possibility of broadened connections to other marine (e.g., NWP and oceanographic QC was noted.

2.5.1.3 The DMCG agreed that the management, formatting and QC of delayed-mode VOS data (forming the non-Summaries part of the MCSS) have long represented important tasks of the ETMC. These delayed-mode data remain crucial for climate applications, including because of new security issues developing with the GTS reporting of VOS data, plus other longstanding GTS code limitations.

2.5.1.4 The DMCG-2 agreed that one important task will be to resolve the future of the MCSS Summaries. A related task is the examination, as requested by the JCOMM-II, of how both oceanographic and ice climatologies could be coordinated with the marine meteorological data to be seen as an integrated product; this might naturally be tied into modernization of the MCSS Summaries. The IMMA format, widely used for ICOADS, was suggested for wider review within the ETMC, possibly followed by formal JCOMM publication.

2.5.1.5 The DMCG recommended a broadened discussion of MQCS issues, including the possibility of better integration of the VOS and the Global Ocean Surface Underway Data Pilot Project (GOSUD) within the MQCS. It suggested preparation of a scoping document on common QC issues, including consideration also of the Shipboard Automated Meteorological and Oceanographic System (SAMOS) initiative.

2.5.1.6 The DMCG discussed the role of the ETMC with regard to delayed-mode VOS data, and decided to establish the TT-DMVOS. Terms of Reference (ToR) and Membership for the Task Team are provided in **Annex VI**, and the issue was also discussed under agenda item 3.1.

2.5.1.7 In other actions, The DMCG expressed appreciation to the NOAA/CDMP for the work done on the imaging and digitization of WMO Publication No. 47, recommended continuing the organization of CLIMAR-III, and establishment of new connections between the ETSI and the ETMC. The ETMC-related action items from the DMCG-2 meeting are provided in **Annex XI**.

2.5.2 Expert Team on Data Management Practices

2.5.2.1 Since the ETMC-I, the ETDMP has concentrated efforts on developing and testing End-To-End Data Management (E2EDM) technology. The goals of this technology are to: (i.) integrate the non-homogenous real-time and delayed-mode local data systems into a unified distributed marine data system that will provide transparent exchange between the local data systems, and (ii.) provide end-user access to any data or information generated by the systems. The E2EDM technology is now a WIS prototype component constituting a WIS Data Collection and Production Centre (DCPC) is based at the Russian National Oceanographic Data Centre (NODC) in Obninsk.

2.5.2.2 There are a number of initiatives such as the Ocean Biogeographical Information System (OBIS), the WIS, Pan-European infrastructure for Ocean and Marine Data Management (SeaDataNet) with very similar objectives using various technical solutions and standards. Therefore, the DMCG-2 stressed the importance of providing a common (or compatible) system vision and basic technical metadata/data standards for system interoperability. Taking this into consideration, the DMCG established a Task Team that will focus on E2EDM technology.

2.5.2.3 Considering that the ETDMP has been focusing on the E2EDM and WIS, the DMCG agreed to broaden the scope of the Team, particularly to assist in helping the diverse data systems in place in JCOMM to converge. The Chairpersons of the DMCG and ETDMP resolved to develop a workplan that reflected broader interests, and requested the Secretariats to prepare invitations for membership for the ETDMP.

2.5.2.4 The DMCG stressed the importance of starting work on the JCOMM/IODE Ocean Data Portal that will be based on E2EDM technology. The DMCG requested the ETDMP Chairperson, in consultation with the DMCG Chairperson to prepare a checklist of technical requirements for participation in the Ocean Data Portal, for consideration by the IODE-XIX.

2.5.2.5 The Team noted that the DMCG-II had established a Task Team on Table Driven Codes and encouraged its Members to contribute to the work of the Team through the provision of marine climatology requirements. Dr Donlon explained that quality of marine services relied on the standardization of codes. The Team stressed that it was important for marine climatology to retain access to the original data, including the data transmitted directly from the deck of the ship. The Team noted that VOS data in IMMT format were recorded on-board many of the ships but that some of those data might ultimately not be received by the GCCs. In those cases users would rely only on the real-time data flow, which therefore also needs to be preserved.

2.5.2.6 The Team considered the distribution of VOS data in BUFR format and delayed the discussion until agenda item 3.3.

2.5.2.7 The Team agreed that it had to eventually comply with the E2EDM, WIS, and Ocean Data Portal requirements in terms of interoperability and data discovery, so as to ensure access to high-quality data and metadata for marine climatology.

2.5.2.8 The Team agreed therefore that it will be helpful to populate the ETMC website with appropriate documents regarding interoperability and the JCOMM Data Management strategy document (**action, Secretariat**).

3. DATA QUALITY AND EXCHANGE

3.1 New Task Team on Delayed-Mode VOS data (TT-DMVOS)

3.1.1 DMCG-II agreed that maintaining the delayed-mode VOS data flow utilizing the IMMT format was important, but also that management of the MCSS—including the two separate functions of VOS data handling and MCSS Summaries—needed to be modernized. As an initial step it recommended establishment of the new self funded TT-DMVOS, to focus exclusively on the first function, which would be tasked amongst other things to manage the GCCs, establish requirements for the IMMT format and the MQCS, reconcile the IMMT and the IMMA formats, revise relevant WMO technical publications as needed, and establish a website to share relevant information (the Climatological Summaries function under MCSS was discussed separately, under Agenda item 6).

3.1.2 The Team agreed with the proposed reporting mechanisms i.e. (i.) producing a project plan to guide operations for the next three years (the plan should explain the linkages to other components of the JCOMM, including the SOT and other pertinent programs), (ii.) establishing an annual reporting mechanism to the ETMC and the SOT, and (iii.) reporting to the ETMC and the SOT at their regular meetings.

3.1.3 The Team agreed that the project plan would be produced by the Chairpersons of the TT-DMVOS by August 2007 **(action, TT-DMVOS Chairpersons)**.

3.1.4 The Team considered the Terms of Reference and Membership. The Team agreed on a few changes with regard to the ToR that will have to be submitted to the SOT and then the DMCG (**action, Secretariat**). These included the following:

- Replacing the word “convergence” by “commonality” in item (ii) of the ToR, because converging data management of the delayed-mode data with real-time VOS data might be a limiting factor of what the ETMC is seeking to achieve.
- Delete specific references to WDC and NCDC and replace them by more general terminology referring to “appropriate archives, including ICOADS.”

3.1.5 The new proposed ToR are given in **Annex VI**.

3.1.6 The Team agreed that the following issues will have to be considered by the TT-DMVOS once established (**action, TT-DMVOS**):

- Investigating the implementation of a unique report identifier, possibly using BUFR, in order to compare the same observation coming from different data streams.
- Enhancing QC at the GCCs, data archival exchange between GCCs, and data provision to the ICOADS project.
- Establishing the future role of ICOADS with respect to TT-DMVOS in terms of providing archive capabilities and climatological products.

3.1.7 The Team agreed with the Membership that was proposed by DMCG-II and noted that the US/NOAA/NCDC Member had not been identified yet (**action, S. Woodruff**).

3.1.8 The Team noted that the data inserted on GTS and the data received by operational centres do not always match, in part because of decisions made at the operational centres before storing or archiving the data (reports deleted or changed; data excluded). The Team suggested that in order to validate the data collection process, a detailed intercomparison survey should be conducted between FM 13 (GTS SHIP code) sample (e.g. one month) data sets received at key operational centre (**action, E. Kent**). FM 18 (GTS BUOY code) data should also be collected and will be considered later for another survey. The Team asked the WMO Secretariat to contact key operational centres by the way of letter to WMO PRs (e.g. ECMWF, UK Met Office, NOAA/NCEP, Japan Meteorological Agency) in order to seek the delivery of sample data to the UK National Oceanography Centre, Southampton (NOCS) (**action, Secretariat**). The Team tasked Mr Takashi Yoshida to investigate whether similar studies had already been made and to provide any useful information to the Chairperson of the ETMC for inclusion on the ETMC website (**action, T. Yoshida**).

3.2 Review of the IMMT and MQCS

3.2.1 The Team reviewed the current IMMT-III format and the MQCS-V, including their implementation status (to be implemented generally for all data collected as from 1 January 2007), and discussed the need for further revisions or action, at this time, to be passed to the TT-DMVOS.

3.2.2 The Team reviewed the following proposed changes presented by the GCCs for a version IV of the IMMT format (see also **Annex VIII**):

1. The case of the code for element 13, true wind direction, would be corrected to lower case (“dd”).
2. The coding procedure for element 40, source of observation would be refined so “4”

specifically refers to using an electronic logbook (e.g., the TurboWin, SEAS, or OBSJMA software).

3. The version of the IMMT code (element 65) would be updated to introduce IMMT-IV in line with the above changes.
4. The version of the MQCS (element 86) would also be updated to introduce MQCS-VI (see section 3.2.6 for details).
5. Changes were also proposed to the numbering of a few VOSClim elements, to separate the departure of the reference level from actual sea level, from its preceding sign field (element 91 onwards).
6. Due to the renumbering of VOSClim elements, some QC flags would also need to be renumbered. No other sign was given a flag, so the flag on the sign of the departure of reference level from actual sea level would be removed accordingly. Leaving a blank at character 156 should minimize changes to any IMMT processing software, since the result would be the same total numbers of characters and elements as for IMMT-III.

3.2.3 In addition, the Team also discussed the benefits of some further desirable changes to the format (listed below), which should however be considered jointly with the proposed convergence with the new IMMA format (discussed further under agenda item 4.1). The Team asked the TT-DMVOS to consider revising the IMMT-IV proposal for JCOMM-III accordingly.

1. Fractional hour
2. Wind speed: increase resolution
3. Unique report identifier (re. item 3.1.6)
4. Dew point: computational metadata (ref. item 3.2.8)
5. Depth of SST
6. Expand the indicator for SST measurement (element 30), e.g. add infrared, micro-wave, or indicate the wavelength (however, the Team noted that this might instead be appropriate for Pub. 47; moreover, for a radiation thermometer, it is the height that needs to be considered).
7. Latitude/longitude (elements 7 and 8): increase resolution
8. Observational platform (element 41); add identification for VOSClim ship

3.2.4 The Team noted that GHRSST requirements needed to be considered and included in the META-T Pilot Project categorization of instrumental metadata. META-T also was requested to provide input for possible changes to the IMMT format (**action, META-T**).

3.2.5 The Team agreed that the SOT should be informed of the IMMT developments (**action, Secretariat**).

3.2.6 The Team also reviewed the following proposed changes presented by the GCCs for a version VI of the MQCS (see also **Annex IX**):

1. Check for validity of character for element 9 (indicator for cloud height and visibility) added.
2. Check for validity of character for element 64 (version of FM 13 code) added.
3. Check for validity of character for element 65 (version for IMMT format) added.
4. The version of the MQCS (element 86) would be updated to introduce MQCS-VI.
5. The limit of the maximum height in meters of deck cargo above Summer maximum load line (element 90) would be increased to 35 metres to allow for the larger cargo vessels being built.
6. The flags set by checks on element 91 would be updated to reflect the separation of the sign, from the value, of the departure of the reference level from actual sea level, and subsequent re-numbering of elements within VOSClim and their flags.

3.2.7 The Team agreed in principle with the proposed MQCS-VI changes, but noted that they must be linked to the proposed IMMT-IV changes, which in turn relate to possible convergences with the IMMA format that should be also considered by TT-DMVOS. Within this broader context, IMMT-IV and MQCS-VI will be considered by the TT-DMVOS (**action, TT-**

DMVOS) and proposed to JCOMM-III for adoption and inclusion in the *Manual on* and the *Guide to Marine Meteorological Services* **(action, ETMC, Secretariat, SOT, JCOMM-III)** after concurrence by all. Current draft versions of the IMMT-IV format and MQCS-VI are provided in **Annex VIII** and **Annex IX** respectively.

3.2.8 The Team agreed that the methods of calculation of dew point and other humidity variables should be documented and that software should be made freely available with the goal of eventually achieving standardization for marine climatology. The Team agreed to approach the WMO Commission on Instruments and Methods of Observation (CIMO) in this regard (**action, Secretariat**). It recommended to publicise available software via the ETMC website (**action, Chairperson ETMC**). It noted that a method was described in the *Guide to Observational Practices and Methods of Observation* (WMO-No. 8), which the Royal Netherlands Meteorological Institute (KNMI) was using. The Team recommended that an intercomparison study be initiated between the different electronic logbooks leading to the production of a report documenting current procedures and any differences (**action, SOT-IV**). The Team recalled that WMO Pub. 47 now contained information on the type of electronic logbook, which thus would more readily enable recalculations as needed to obtain better consistency in the calculated humidity variables or make possible corrections in formulae.

3.3 Review of BUFR template for ship data

3.3.1 The Team discussed BUFR encoding requirements for ship data and other marine data. It was recalled that DMCG-II had established a new Task Team on TDCFs (TT-TDCF) and that any changes to existing BUFR templates will have to be passed to that Task Team after consultation with the SOT codes group. In addition, the Team noted that considerable effort was presently being made within the SOT to consider a large range of requirements, including for marine climatology, but also for GHRSST-PP, VOSClim, the META-T Pilot Project, XBTs and XCTDs, ADCPs, and high-resolution upper air soundings (ASAP). The SOT was also seeking consistency between the different ship templates and with other observing systems providing profile data, and well as requirements for the SeaKeepers Society.

3.3.2 The Team reviewed the current situation regarding ocean-related BUFR templates, taking requirements for marine climatology into account.

3.3.3 The Team recalled that ETMC-I made a limited review of marine BUFR data (http://icoads.noaa.gov/etmc/etmc1/doc3.2.pdf), based on comparisons of BUFR data from NOAA's National Centers for Environmental Prediction (NCEP) with originally reported ship (FM 13) and buoy (FM 18) data. A number of those findings and recommendations are still outstanding, e.g.:

- Retention by the NCEP of the original GTS message strings was felt to be critical, and was recommended for consideration for inclusion in the BUFR template, because it permits effective, automated verifications of the translations made into BUFR by the National Meteorological Services (NMSs) from the original data;

- Even if the BUFR template was able to prescribe a complete set of field-by-field mappings of the FM 13 and FM 18 into BUFR (which it does not appear to have achieved yet), differences likely would arise between versions of BUFR produced at different NMSs due to differences (or inadvertent errors), in the event that the handling of a given field is not 100% specified (as for instance in the case of variable wind direction).

3.3.4 The Team discussed whether BUFR or other TDCFs (e.g., CREX) should eventually be suitable for the archiving of marine data. The Team agreed that this was not the case at present. The Team recommended that work should be undertaken to carefully validate TDCFs in such a way as to ensure that all the originally reported data are completely and accurately preserved, and recommended that CBS investigate feasibility and make appropriate recommendations (**action, CBS**).

3.3.5 In addition, the Team considered more recent results comparing NCEP BUFR with FM 13 GTS messages and agreed that there were still a number of outstanding issues to be considered (e.g. iced bulb temperature sign errors, small wind speed biases). The Team asked the SOT-IV and the TT-TDCF to look into these issues and into the automated validation and preservation of the originally reported data, tasking Mr Woodruff to liaise with the TT-TDCF in this regard **(action, S. Woodruff)**. Mr Woodruff also agreed to present the issues at the upcoming SOT-IV meeting **(action, S. Woodruff)**.

3.3.6 In addition to a possible participation of the ETMC in the development and continuing review of the VOS (and possibly other marine and oceanographic template(s)), the ETMC agreed to investigate further development of the following BUFR templates:

- B/C35 – Reporting CLIMAT TEMP and CLIMAT TEMP SHIP and data in TDCFs;
- B/C32 – Reporting CLIMAT SHIP data in TDCFs;
- B/C10 – Reporting SHIP data (VOS) in TDCFs.

3.3.7 The team agreed that it was premature at this point to make any recommendation regarding the B/C35 and B/C32 templates to the next meeting of the CBS Expert Team on Data Representation and Codes (ET/DRC), Darmstadt, Germany, 23-27 April 2007. However, the Team tasked Mr Frits Koek to investigate possible changes that might be recommended to the ET/DRC in about 12 months from now **(action, F. Koek)**. B/C10 will be a matter of discussion for the SOT Task Team on codes.

3.3.8 Mr Koek reported on marine climatology requirements for TDCFs and listed a number of applications and programmes where the Team should be involved. These included the SOT, VOSClim, Argo, DBCP, GHRSST-PP, META-T, GTSPP, GOSUD, etc.

3.3.9 The ETMC strongly recommended that the following important general requirements be kept under consideration:

- Need for certified decoders and encoders (e.g. portable software for validating BUFR reports) (**action, CBS**);
- Archives should ensure permanent access to the originally reported data, e.g. attaching the original data format to the BUFR reports following the NCEP practice;
- Unique identifier of the original report;
- Consideration of meteorological and oceanographic variables in both Master Table 10 (MT10) and Master Table 0 (MT0);
- Consistency with climatological practices, e.g. use of non-SI units is required for marine climatology, because unit transformations or conversions of data frequently lead to some loss of information;
- BUFR reports need to be carefully validated for marine climatology requirements; experience shows that operational BUFR reports did not always comply with such requirements (any conversion between formats must be rigorously tested).

3.3.10 Whilst BUFR/CREX formats are mandated for future real-time GTS exchange of data, the Team recognized that TDCFs are not necessarily the best choice for all types of data storage and exchange. More compact formats e.g. ASCII or compressed ASCII are suitable for expensive platform-to-shore transmission; and simple, comprehensive formats are suitable for data exchange in delayed-mode and archival.

3.4 Review on electronic logbooks

3.4.1 Members operating the VOS have been encouraged to use electronic logbooks (e-logbooks) such as TurboWin. It is essential that amendments on codes and formats be carefully coordinated and accommodated in timely fashion in the electronic logbooks. Frits Koek presented the processes currently used to modify some e-logbooks and summarized the status of the Japanese OBSJMA and the Dutch TurboWin software.

3.4.2 The Team agreed that important issues for the e-logbooks that will become necessary to consider in the near future include (i.) the reduction of the transmission costs, (ii.) migration to BUFR, (iii.) encoding the ship's call sign into a VOS ID, and (iv.) metadata collection.

3.4.3 Regarding transmission costs, the Team noted that the latest TurboWin version is capable of compiling half-compressed messages, which reduces the transmission costs. The use of broadband Internet is relatively new, and in use by only a few—mainly passenger—ship companies. The possibility of sending observations by e-mail has already been implemented in TurboWin. Web-based online entry of observations may be the next step. However, because the transmission costs are still very high, this option will probably not be developed actively for a few years. The Team recognized that much discussion was also planned on the subject during SOT-IV and agreed that there was no need to discuss the issue further.

3.4.4 Some aspects of the BUFR migration were discussed under agenda item 3.3 above. However, the Team noted that experimenting with these developments has already begun. For instance, TurboWin 4.0 is already capable of compiling BUFR messages. Nevertheless, guidance is needed from the SOT to indicate: (i.) whether BUFR is going to be assembled on board or at the local receiving NMSs before being inserted into the GTS, and (ii.) if on board, which BUFR template should be used. The Team recommended that the SOT address these issues **(action, SOT)**.

3.4.5 Regarding encoding the ship's call sign, in response to security and commercial concerns, TurboWin 4.0 has implemented an option to use a proposed "VOS ID." Nevertheless, uniform guidance has not yet been provided (these issues are discussed in more detail under agenda item 3.6).

3.4.6 Metadata collection (WMO Pub. 47) from e-logbooks was noted as another emerging issue (discussed further below and under agenda item 5.1).

3.4.7 The Japan Meteorological Agency (JMA) has distributed a software package named "OBSJMA for WIN" to facilitate the use of e-logbooks for VOS. The most current version was released in 2004, and provided to 305 vessels by the end of 2006. A revised version of the manual for OBSJMA was published in December 2005, to facilitate use of the software. A total of 795 revised manuals were distributed to VOS by the end of 2006. Over the last three years, 40-55 ships have used OBSJMA, compared to around 11000 total e-logbooks at sea (internationally, e-logbooks made up about 28% of all logbooks in the last two years). The JMA currently has no plan to modify the OBSJMA package. Starting in September 2005, some VOS started to use the dummy call sign "SHIP" for delayed-mode logs, in addition to real-time transmission. The Team agreed that marine data masked with a dummy call sign are less useful for marine climatological purposes. However, for the time being, the JMA has been unable to associate those data with real ship identification information in the data being sent to the GCCs (of which masked data represented about half of the total e-logbook data in 2006).

3.4.8 In the early 1990's, the KNMI introduced a software package (Turbo1) to be used on board the VOS by the observers, to help entering the observations in the correct format. Over the years, this software has been adapted to new operating systems and other requirements, and has recently (January 2007) been upgraded to TurboWin Version 4.0.

3.4.9 TurboWin was developed at KNMI, with contributions from several NMSs, and endorsed by the WMO and the European Surface Marine Programme (E-SURFMAR). One aim in developing the software has been to optimize data quality, before real-time transmission, by having the observers perform the QC shipboard (when observations are subject to errors in keying, coding, calculations, etc.). TurboWin is a user-friendly system with over 250 built-in quality checks performed on several levels, including (i.) Level-1: input form checks (errors/not possible to insert), (ii.) Level-1b: mandatory parameters/groups (errors), (iii.) Level-2: consistency all inserted parameters (errors), and (iv.) Level-3: warnings. It contains checking routines, which are applied to the observations before they are transmitted. It allows the automated compilation of observations on board ships and fixed sea stations, their downloading to disk and their subsequent transmission ashore and thence to an NMS, by using Inmarsat, e-mail or other specific communication facilities. The program assists the observer with many menus, pictures, photos, forms, help pages, output options, automated calculations, etc.

3.4.10 The latest version of TurboWin can be downloaded from the following website: http://www.knmi.nl/turbowin and includes a number of innovative features such as a new method for computing the height of the barometer above sea level, an option to compile the observations into a semi-compressed message, copyright assignment for phenomena and meteorological observations, more combination checks on ship maintenance data, IMMT-3 storage, an option to zip and attach log files, logs automatically backed up after download, etc.

3.4.11 Due to several constraints, the promised manual on the installation and use of TurboWin has not yet been published. As soon as this becomes available, it will be announced through several mailing lists, and will be available for download from the web.

3.4.12 To provide enhanced services to mariners, TurboWin incorporates, in conjunction with the data entry module, a variety of other modules. Add-ons like MeteoClassify give the observer the possibility to increase their knowledge in the field of cloud and sea-ice determination, as well as learning the various sea states and their accompanying wind forces. The add-on “MetPub47” is used to collect metadata from the ship and to store that in the correct format. The PMO, when visiting the ship, can collect the metadata. Further, wave and climatic atlases are appended, as well as pilot charts for several oceans.

3.4.13 The Team also noted that there was a number of other e-logbooks and logging software being developed or maintained by the Members. These included for example the SEAS, AVOS, and BATOS. In addition, Mr Rutherford advised the meeting on the development of the e-logbook RAIDEN for use by the Royal Australian Navy. The Team agreed that improved coordination was also required among all the electronic systems and asked the TT-DMVOS to initiate liaison with the SOT in this regard and to keep the ETMC informed on resulting actions **(action, TT-DMVOS)**.

3.4.14 The Team noted that there was a good potential for progress on achieving better cooperation between the different groups involved following on from recent initiatives such as the establishment of the new DMCG TT-TDCF and the existing SOT Task Teams on WMO Publication 47, on satellite data telecommunication, and on instrument standards and practices.

3.4.15 The Team also agreed that intercomparison surveys of e-logbooks should be conducted. It suggested the establishment by the SOT of a Task Team on e-logbooks to include membership from the ETMC (**action, Secretariat, SOT**). It recommended the inclusion of Messrs. Yoshida, Rutherford, and Koek in the TT Membership and invited Mr Woodruff to propose someone from AMVER/SEAS (**action, S. Woodruff**).

3.4.16 The Team encouraged the groups and programmes above to provide feedback on the use and possible improvements of e-logbooks to the developers. The Team recognized that training workshops could be a mechanism to obtain such feedback. ETMC agreed that versions of the e-logbooks should be made available in selected foreign languages (e.g. English, Spanish, Russian, French) and recommended that developers start implementing such requirements (**action, proposed SOT TT on e-logbooks**).

3.4.17 The Team noted that some ship owners were reluctant to install e-logbook software and suggested that the proposed SOT TT on e-logbooks address the issue.

3.4.18 The Team noted with concern the extent to which ship call sign masking had been occurring in collected delayed-mode data (as noted in 3.4.7) and that the number of such data was increasing. The Team also noted that a recent High-level WMO-International Maritime Organization (IMO) Consultative Meeting (as discussed further under item 3.6) had not made any specific recommendation to mask delayed-mode data and recommended that the SOT take action in order to resolve this issue (**action, SOT**).

3.5 Review of the operations of the Global Collecting Centres and the Responsible Members

3.5.1 The Team reviewed the operation/activities of the GCCs and Responsible Members (RMs). The GCCs were established by Recommendation 11 (CMM-XI) (Lisbon, April 1993), and have been operated by Germany and the UK. The 2006 GCC annual report marks the 13th year of GCC operation. It was an average year, with just less than 1 million observations received and with contributions coming from sixteen members.

3.5.2 Problems with duplicate data and on-land positions have been decreasing with only 282 and 194 such observations, respectively, received in 2006 (making up a very small percentage of 958 thousand observations). The majority of data was also from the recent past, such that 55% of the observations received in 2006 from 2005 and 2006 though data were received from as far back as 1993.

3.5.3 Although initially VOSClim data were slow to reach the GCCs, observations from the VOSClim project have been increasing over the past three years and nine CMs now have recruited ships. In 2006 the GCCs received around 84 thousand observations from VOSClim recruited ships, this made up 9% of the total number of observations received (2005: 4%, 2004: 4%, 2003: 1%). However, not all observations from VOSClim recruited ships are being submitted with the extra VOSClim elements and conversely some VOSClim data elements are being received from ships not registered with the VOSClim project. Most observations are now received in IMMT-3 format (64% of observations in 2006), and VOSClim observations have proved to be of better quality with significantly less duplicated observations and all observations received with flags attached.

3.5.4 The Team noted the following highlights and issues:

- Both GCCs now exchange data quarterly with the RMs via FTP—rather than sending large files over e-mail, or more slowly via CD-ROM.
- The IMMT-III format and MQCS-V were ratified at JCOMM-II (in September 2005) for implementation in January 2007.
- The software package created by the GCCs to help contributing members (now called "MQCforCM") was revised during 2006, and distributed to all members who had requested a copy of previous versions of the software. Version 3 allows the IMMT-III format to be used, and checks data using MQCS-V. It also includes the option to separate duplicate observations into a separate dataset if required.
- During ETMC-I the use of the MCS charts was discussed, leading to the questionnaire produced by the GCCs and Prof Mietus, which was distributed by the WMO Secretariat in September 2005. Prof Mietus collated the replies and provided a summary of these to the current ETMC Chairperson, Mr Woodruff, in September 2006.
- One problem that is becoming a significant concern for the GCCs and RMs is the use of masked call signs (discussed further under item 3.6).
- The German GCC website has been updated, and its new URL is http://www.dwd.de/gcc
- The UK GCC has created a GCC website at http://www.metoffice.gov.uk/research/interproj/gcc/index.html

3.5.5 The GCCs believe there should be a review of the roles and responsibilities of the GCCs and eight RMs. Each quarter every RM now receives the global data set, not just the data within their area of responsibility, so there may be eight different versions of the same observation (due to individual RM quality control) that a CM could request. Additionally not all areas/RMs produce and publish the optional MCS charts, as documented in the *Manual on* and *Guide to Marine Meteorological Services* (WMO-Nos. 558 and 471). Also, due to the distributed nature of the data storage there needs to be one common source established, or a technical solution (e.g., website) to provide a single source of data to the user. The end-to-end data management should be more streamlined, with less duplication of data and effort. The JCOMM VOS data flow needs to be more joined up, with different members in specific roles to create an overall service.

3.5.6 The Team discussed the responsibilities and activities of GCCs and RMs. The following points were agreed upon:

- Increase the autonomy of the GCCs so not only do they receive and process observations, but also they can actively help CMs to enable them to submit their data. This will be done through the TT-DMVOS **(action TT-DMVOS)**.
- The GCCs will make available every quarterly exchange via FTP so any CM can download the global data received within the last three months. However, the GCCs will also continue to separate out the VOSClim data to send to the VOSClim DAC **(action GCCs).**
- In addition to the MQCS the marine meteorological community should work toward an internationally agreed Higher-level of Quality Control (HQC). This should be addressed by the new TT-DMVOS and the new proposed TT- MOCS (agenda item 6.1).
- Consider the benefits of not only processing and storing ship meteorological data, but also other forms of marine and oceanographic measurements. The Team noted that ICOADS was already providing such data to some extent. The Team agreed that an end-to-end data management system storing all these data streams together should begin to be developed (**action ETDMP, TT-DMVOS**).
- Considering formalizing the role of ICOADS (with the GCCs) in the context of modernizing the delayed-mode data flow including possible convergences of the IMMT and IMMA formats (at minimum requiring software to convert from one format to the other). The TT-DMVOS was tasked to address these issues, including the possible inclusion of other types of marine and oceanographic data. The Team suggested that the TT-DMVOS draft a proposal intended for JCOMM-III that would be circulated through the Team for agreement by CLIMAR-III **(action, TT-DMVOS)**.
- The definition of the role and functions of RMs, as well as their number, concerning (i.) archival and distribution of marine meteorological data and (ii.) generation of marine climatological products will be discussed in the context of the TT-DMVOS and the proposed TT-MOCS (agenda item 6.1).

3.5.7 The Team noted with concern that the increasing use of automated systems has led to a substantial decrease in the number of visually observed variables being reported by ships with automatic systems. These visual observations are of vital importance for marine climatology. It asked the SOT to consider these requirements and to suggest solutions to maintain the reporting of the visual observations (**action, SOT**). CCI had noticed a similar problem regarding land-based observations. The CCI Representative, Mr. William Wright, will provide information on the issue to the ETMC Chairperson (**action, W. Wright**).

3.5.8 Current responsibilities and recent activities of the GCCs and Responsible Members are provided in **Annex IV**.

3.5.9 Reports from the following Responsible Members were presented to the Team:

- Germany
- Hong Kong, China
- India
- Japan
- Netherlands
- UK

- USA

3.5.10 Reports are provided in **Annex III**.

3.6 Ship call sign masking

3.6.1 Ships participating in the VOS Scheme do so on the understanding that the meteorological data they transmit are exchanged between NMSs for real-time meteorological forecasting activities and for climatological research. In recent years however there has been a proliferation of publicly accessible websites displaying these data. This has raised questions about how these data were obtained, but of greater concern are (i.) the identification of ships by their name or callsign on these websites, and (ii.) the mapping of ships from the positional data in their BBXX reports. These situations expose ships to increased security risks and may also have commercial implications. Some ship owners have already withdrawn ships from national VOS programmes, whilst other companies have threatened to withdraw ships from national VOS programmes if the display of these data on the web continues. Following SOT-III and the third International PMO workshop, recommendations were made to the WMO Executive Council for its Fifty-eighth Session, June 2006.

3.6.2 The WMO EC-LVIII recognized the seriousness of the situation, which if not addressed, could ultimately lead to the disappearance of the majority of VOS reports available on the GTS, and agreed that there were many implications and associated issues to address at the international and national levels. It adopted Resolution 7 (EC-LVIII) authorizing Members which, in consultation with ship owners, wish to protect the identity of the VOS to implement ship call sign masking, for a trial period of one year, a process which would facilitate open distribution of masked data on the GTS. All respective Members implementing such a process should provide for the secure exchange of ship call signs and reports affected by the masking process, so as to assist in resolving real-time monitoring and climate analysis problems. The Council also requested the Secretary-General, as a high priority issue, to establish a high level dialogue, involving affected Members, the IMO, the International Chamber of Shipping (ICS), shipping companies, and other relevant organizations and technical commissions (e.g., JCOMM and CBS), in order to determine if there is a link between VOS data availability on external websites and piracy and other ship security issues, to review the implementation and impact of masking, and to propose a general and universally acceptable solution to the issue that would address ship owners and masters' concerns as well as the data monitoring and quality information feedback requirements, for consideration to the Fifty-ninth Session of the Executive Council in 2007 (EC-LIX).

3.6.3 Therefore, a High-level WMO-IMO Consultative Meeting was held at the WMO Headquarters in Geneva, Switzerland, from 12 to 13 February 2007 with representatives from WMO Members, WMO Technical Commissions (CBS, JCOMM, and CCl) as well as the IMO, ICS, INTERCARGO, and INTERTANKO (the latter three organizations representing the shipping industry). From the discussions, the following appeared: (i.) there are not only security concerns for the shipping industry but also commercial activities concerns, and (ii.) there are different approaches and concerns within the WMO Members (e.g., Japan is concerned about piracy, the USA is concerned about protecting its partnership with the private sector). The Meeting discussed the requirements for VOS observations for operational applications (NWP, marine safety) and for climate applications. After the discussions, a number of principles could be agreed upon, and the Meeting agreed on a number of actions for the coming months. It was particularly recommended that the SOT, in liaison with the WMO Secretariat, drafts a report to the upcoming Executive Council (EC-LIX) proposing to maintain Resolution 7 (EC-LVIII) in force and to continue the ship's call sign masking trials for an additional year, on the basis of the recommendations from the SOT regarding a unified approach to call sign masking.

3.6.4 The Team reviewed the recommendations from the high level WMO-IMO Consultative Meeting and agreed that any required action should be undertaken under the SOT, bearing in mind the need for unique identification for a variety of purposes, including so that linkage with the WMO Publication No. 47 and the IMMT data can be ensured.

3.6.5 The Team agreed on the following recommendations that should be conveyed to the SOT (**action; Secretariat**):

- ETMC is concerned about the increasing number of masked data that appear in e-logbook data.
- The call sign should not be masked in the delayed-mode data flow and in the e-logbooks.
- A unique report identifier is required for all VOS including VOSClim.
- Information about the issue, its solutions and technical implications should be made available via the ETMC website, as appropriate.

4. DATA ARCHIVAL

4.1 Development of the International Marine Meteorological Archive (IMMA) format

4.1.1 The Team reviewed the development and status of the International Maritime Meteorological Archive (IMMA) format, which has been under consideration by ETMC and its predecessor Sub-group under CMM for several years. The provisional version of the IMMA format is already widely used for the ICOADS. It is also in use for VOSClim data at that project's Data Assembly Centre (DAC), based at the NCDC. In addition, a variety of contemporary and historical data collections have been converted into the IMMA format, generally including the standard ICOADS QC flags, which are offered as datasets "Auxiliary" to the ICOADS—thus making all these data readily accessible to users via web-based subsetting software (available through the project web portal: http://icoads.noaa.gov). Background information about the IMMA format is provided in **Annex VII**.

4.1.2 For the ETMC (and TT-DMVOS), the maintenance and evolution of the IMMA format in relationship to that of IMMT, plus possible convergence of the two formats, could be an important area of consideration. At present, for example the IMMA format has not been updated to incorporate changes made effective 1 January 2007 for the IMMT-III. Similarly, no plans been made yet to accommodate changes newly proposed for the IMMT-IV. Moreover, ICOADS is a large and complex archive, which, in addition to reports from VOS, includes many from buoys and other automated ODAS. Therefore, any proposals for the IMMA format changes or for possible convergence with the IMMT would need to be thoroughly coordinated and implemented with due consideration of cost and transition issues.

4.1.3 Under the WIS, the requirement has been expressed to move all observational GTS traffic (and possibly some other data exchanges) to use TDCFs such as BUFR or CREX. However, the TDCFs are optimized for contemporary and operational data requirements, and the need to store all possible forms of meteorological data leads to a high degree of complexity (and the suitability of TDCFs for permanent archival is undemonstrated). Therefore, considering the success of the IMMA format in the research community and features that appear to make it very attractive for permanent archival, a possible future direction for the JCOMM and the ETMC might be to explore some limited convergence of the IMMA with appropriate features of TDCFs (e.g., establish cross-references between the IMMA field names and BUFR/CREX table numbers, and demonstrated record export capability from BUFR/CREX so that modern records can be merged with historical records in ICOADS, thus helping to ensure the continued homogeneity of long-term climate evaluations) (**action, TT-DMVOS**).

4.1.4 The Team discussed potential linkages and convergence issues between the IMMA and IMMT formats, and recognized that these were part of the TT-DMVOS Terms of reference.

4.1.5 The Team considered possible future plans for the ETMC regarding this issue, including possible recommendations to the JCOMM and other appropriate WMO/IOC bodies, aimed to foster utilization and future development of the format—these actions could potentially extend to a JCOMM publication, or consideration of the feasibility of more formalized adoption.

4.1.6 The Team agreed that a proposal by the TT-DMVOS for utilization and further development of IMMA should be finalized by CLIMAR-III and then circulated through the ETMC for formal agreement. The format will then be either proposed to JCOMM-III for adoption and inclusion in the *Manual on* and the *Guide to Marine Meteorological Services* or published as a JCOMM Technical Report. The DMCG will be invited to provide guidance in this regard **(action, TT-DMVOS, Secretariat)**.

4.1.7 Considering discussions under agenda item 3.2 regarding the IMMT format, the Team emphasized that both IMMT and IMMA format issues should be considered at the same time by TT-DMVOS.

4.1.8 The Team discussed whether IMMA was exclusively an archive format, or also could be an exchange format (e.g. potentially used by the GCCs to provide data in IMMA format to the ICOADS or archiving centres). It was noted for example that KNMI had submitted Climatological Database for the World's Ocean 1750-1850 (CLIWOC) data to the ICOADS in IMMA format. However, a long transition period was foreseen for all Members to be ready. The Team agreed that in order to facilitate this process, software was needed to convert between the IMMT and IMMA formats. As an initial step, the Team noted that the existing IMMA read software was FORTRAN77 based and needed to be updated to FORTRAN90/95 (**action, S. Woodruff**). The Team asked the new TT-DMVOS to look into the broader issues of exchanging and archiving the data, such as a possible transition from the IMMT format to the IMMA format, as well as considering possible conversion issues concerning netCDF (**action, TT-DMVOS**).

4.2 History of the marine ship code

4.2.1 The CMM Subgroup on Marine Climatology (SGMC) and its successor ETMC has placed much effort into verifying the availability of documentation relating to the history of WMO's alphanumeric marine ship code (presently FM 13–XII Ext. SHIP), since approximately the mid-20th century.

4.2.2 In addition to FM 13, these efforts traced the evolution of the International Maritime Meteorological Punch-Card and Tape (IMMPC and IMMT) formats, with the goal to make all this documentation available on the web. Substantial progress was made and some results were presented at the Eighth Session of the SGMC (SGMC-VII, Asheville, North Carolina, USA, 10-14 April 2000) and ETMC-I, including a website hosted at JMA (http://goos.kishou.go.jp/ws/ETMC/code_task) on which the results of this study on the history of codes and format changes are being made available.

4.2.3 The Team agreed that this documentation was extremely valuable in particular to help enable the correct interpretation of observational data contained in the archives, which are clearly sensitive to the codes and formats used for their exchange.

4.2.4 ETMC-I also agreed on a precise work plan to make all final reports of CMM and Commission for Synoptic Meteorology (CSM)/CBS sessions available on the website, to update the website, to look for past editions and supplements to the *Manual on Codes* (WMO-No. 306) and making them available on the website, and to expand this task to other marine codes such as FM 18 DRIFTER/BUOY, FM 62 TRACKOB, FM 63 BATHY, FM 64 TESAC and FM 65 WAVEOB.

4.2.5 Since ETMC-I, CDMP has also partnered to some extent on this work, including archiving copies of the resultant imaged publications. A progress report was presented by Mr Takashi Yoshida, and provided in **Annex V**. Amongst the achievements since ETMC-I, the following were highlights:

- Making all final editions of the CMM/JCOMM and CSM/CBS sessions available via the website;
- Agreement in 2005 from the WMO Publications Board that permission should be granted for public availability from the CDMP image archive system of these and similar imaged

technical WMO documents (e.g., older editions of WMO-No. 47), provided a copyright notice was added as a "cover page."

- The web pages regarding the history of IMMT and MQCS were updated with the latest modifications to IMMT and MQCS. The web page of the final reports of the CMM/JCOMM and CSM/CBS was updated with the links to the reports of the recent sessions such as JCOMM-II (2005) and CBS-XIII (2005).
- Efforts were made to create a list of the past editions of and supplements to the *Manual on Codes*.
- Expanding the study to other marine codes (i.e., FM 14 DRIBU, FM 18 DRIFTER/BUOY, FM 62 TRACKOB, FM 63 BATHY, FM 64 TESAC and FM 65 WAVEOB).
- Connections with historical data and metadata archaeology. Similar to the work that identified past editions of WMO-No. 306, lists of a number of historical (largely national) publications on earlier marine codes and observing instructions have also been created.

4.2.6 The Team recognized that efforts have not yet been considered to identify past editions and supplements of the additional Parts B (Binary codes) and C (Common features to binary and alphanumeric codes) of Volume I (including information about the TDCFs BUFR and CREX), or of Volume II (Regional codes and national coding practices) of the WMO *Manual on Codes*. The Team therefore recommended development of a plan to scan all the past editions that can be located of WMO-No. 306 and its supplements, possibly in collaboration with CDMP and the RECLAIM project (see agenda item 4.4).

4.2.7 The Team agreed that the next step required was to attempt to locate copies of seven known previous editions (from 1949-1974) in WMO and international libraries, of the three Parts (A-C) and their supplements, as listed above. Information on the supplements to the seven editions could be obtained from the existing version of those publications. The Team strongly recommended that consideration be given to the feasibility to image the entire publication, which includes large amounts of non-marine codes, for efficiency and to cover currently unforeseen requirements. Also, the latest edition of WMO-No. 306 is available electronically from the above-mentioned WWW website, so another part of the task will be to determine the extent of WMO holdings of electronic copies of any other recent editions (**Action, T. Yoshida, and S. Woodruff in liaison with CDMP**).

4.2.8 The Team considered copyright and related WMO issues and recommended that any imaged WMO document should be created to include a standard WMO copyright statement, or alternatively copyright statements might be embedded on webpages. It invited the Secretariat to investigate the best ways for progressing on this issue (**action, Secretariat**).

4.2.9 The Team agreed that there was a need for a JCOMM publication documenting the SHIP code evolution. Takashi Yoshida offered to draft an outline of such a publication and to seek input from Mr Woodruff, Dr Kent and other ETMC members and to report at the next ETMC Session **(action, T. Yoshida)**. The Team recognized that some work on tracing the IMMPC and IMMT formats had already been done in the context of developing the IMMA format (see Supplement B of Appendix A of **Annex VII**). The Team recommended that this earlier work be taken into account in drafting the proposed SHIP code history publication (**action, T. Yoshida**).

4.2.10 Finally, the Team agreed to eventually, migrate the JMA website contents, especially including the electronic versions of final session reports and other complete WMO publications, to a website hosted by WMO or JCOMM (**action, Secretariat and T. Yoshida**).

4.3 Archival of wave and storm surge data, extreme wave archive

4.3.1 ETMC-I had agreed that ETWS would take responsibility for the development of global wave metadata archives, and noted with appreciation that ETWS was involved in the preparation of a variety of such products (e.g., catalogues of wave and storm surge data and modeling).

4.3.2 More recently, however, DMCG-II requested the ETMC to consider the possibility of developing, with the ETWS and other appropriate groups, the JCOMM Extreme Waves Database. The Team indeed agreed that the possible deficiencies in the models, especially at extreme wave heights, could have a major impact on present wave climatologies (such as the ERA40 and MSC50), and resulting impacts on the computed design criteria for offshore structures. The Team agreed that if observed data from such events were assembled—e.g. recent hurricane events (Ivan and Katrina) in the Gulf of Mexico, the January 2006 storm off Norway, and historical events such as the Draper 1972 storm—this would form the beginnings of an invaluable data set of high quality measurements that could be used (together with other environmental observations collected *in situ* in the storm period and area) to validate wind wave models and also satellite altimeter wave estimates which have largely unknown characteristics at these heights.

4.3.3 A proposal has therefore been developed among the ETWS, ETMC, and DMCG for the establishment of the JCOMM Extreme Waves Database for use in model validation and validation of remotely sensed waves, where such models and algorithms suffer from lack of sufficient data. This Database would be populated with measured wave data where the significant wave height exceeds 14 metres, with appropriate accompanying metadata. Mr Robert Keeley and Mr Woodruff have run initial searches on selected archived wave databases and were able to identify a number of data meeting these requirements. Description of the JCOMM Extreme Waves Database is provided in **Annex X**.

4.3.4 The Ninth International Workshop on Wave Hindcasting and Forecasting, Victoria, Canada, 24-29 September 2006, expressed a strong interest in expanding the scope of the Extreme Waves Database, to include satellite estimates as well as data from wave radars such as the WaMoS or MIROS.

4.3.5 The rationale for the proposed Database is to have a relatively small and manageable set of extreme storm sea states for comparison with wave forecast and hindcast products, model development and evaluation and satellite sensor calibration and validation. The Database should carry a WMO-IOC JCOMM label, and be referenced from various locations in the JCOMM web pages, including the Dynamic Part of the *Guide to Wave Analysis and Forecasting* presently under development. Development of the Database should be undertaken jointly by the ETWS, ETMC and others, including possibly the IODE, SOT and DBCP.

4.3.6 It has been further suggested that an archive of storm surge events for similar purposes should also be considered.

4.3.7 At its Second Session, Geneva, 20-24 March 2007, the ETWS raised concerns about the need to associate adequate disclaimers with the planned Database, since the extracted *in situ* data will necessarily be very sparse and incomplete. It was also suggested that altimeter data be included from the outset. The ETWS-II agreed to contribute to the establishment of the Database, through the solicitation of additional contributions of *in situ* data (e.g., beyond the Canadian and US data that have been scanned in preliminary fashion), with the likelihood that some complications would also need to be sorted out on open redistribution and other national or organizational data policies; and with Dr Hendrik Tolman kindly agreeing to arrange for the provision of a selection of appropriate altimeter data, and Dr Jean Bidlot of a selection of GTS data from the ECMWF.

4.3.8 The ETMC agreed with the development of the Database and recommendations by the ETWS-II (ref. ETWS-II Final Report) and reviewed the draft proposal. The Team invited its Members to seek National contributions to the database once established (**action, ETMC members**), and asked the Secretariat to draft a recommendation for JCOMM-III in this regard (**action, Secretariat**).

4.3.9 The Team agreed that it should be responsible for the coordination of the development and standardization for the Database in terms of format, quality control, and delivery of the data while the Database itself will be managed and implemented by Members/Member states (**action ETMC**).

4.3.10 ETWS-II also considered the need for wind wave and storm surge climatologies and suggested continuation of ongoing work including in the areas of completing analyses of existing questionnaires, and updating inventories of climatological products. Products from the US Corps of Engineers in this area were emphasized as an important potential resource.

4.3.11 The Database will be relatively small but plans to eventually also incorporate selected nearby and contemporaneous additional data are also part of the Database proposal. As noted by ETSW-II, data policy/availability issues will have to be investigated (**action, ETWS**). In addition to specific contributions that have been identified for the Database (e.g. satellite data, ECMWF *in situ* data, NOAA National Data Buoy Center (NDBC) archive, and ISDM), work is needed to solicit additional contributions. It was anticipated that this would primarily be accomplished through ETWS (**action, ETWS**); but that ETMC can help as well, (e.g. Ms Elanor Gowland has checked a UK Met Office database). For example, Ocean Weather Station databases will need to be explored, which could be a helpful ETMC contribution. Jason/Topex/ERS1/ERS2/ENVISAT databases may also contain useful records and Space Agencies will have to be approached (**action, ETWS**). Industry data (e.g. from rigs and platforms) should be sought as well **(action, V. Swail**). ETMC members were also invited to seek additional records (**action, ETMC members, W. Wright**).

4.3.12 Management and hosting of the database still needs to be investigated; possible solutions could be at the US National Center for Atmospheric Research (NCAR) or ISDM. It was suggested that NDBC data could be initially included as a seed for the database, translated into IMMA format. However, this might require the development of a new IMMA attachment to hold additional variables (e.g., elevation). The Team invited an *ad hoc* Task Team consisting of ETMC members M. Rutherford, E. Kent, and S. Woodruff, together with V. Swail, R. Keeley, and C. Donlon to coordinate the ingest of the data from the ETWS and ETMC, as well as to move forward on format issues (e.g., possible utilization of the IMMA format) (**action, *ad hoc* TT**).

4.4 Logbook and international marine data recovery (e.g. RECLAIM)

4.4.1 The Team recalled that European, US, and other National archives still contained many thousands of, as yet, unexamined ships' logbooks. In hopes of improving efforts to detect climate change signals, and benefit other research reliant on the historical *in situ* marine records, efforts have accelerated in recent years to locate and digitize more meteorological observations from ships' logbooks.

4.4.2 Most instrumental shipboard marine meteorological observations were recorded after the 1853 Brussels Maritime Conference. That landmark Conference provided the initial international framework for reporting ships' observations, which has evolved into the JCOMM's contemporary VOS program. However, the European Union-funded CLIWOC project also succeeded in digitizing and interpreting approximately 300K wind and other (mostly pre-instrumental textual) observations from the period 1750-1850, from British, Dutch, French, and Spanish logbooks.

4.4.3 As a consequence of these various activities, many new international datasets are in preparation for, or already await blending into, historical marine archives, most prominently the ICOADS.

4.4.4 Mr Woodruff reported on the RECovery of Logbooks And International Marine data (RECLAIM) project, which is closely connected with CDMP. The Team noted for example that CDMP has an extensive image archive containing many recently recovered logbook images. The Team agreed that there was a need to further promote and enhance such activities both nationally and internationally, and discussed ways to help quantify the added scientific value, and to help determine the prioritization, of ongoing and future digitization efforts, including possible new priorities outside of the World War II period for future UK digitization.

4.4.5 The Team noted that among the main users of early marine data was the climate research community, including long-term climate assessments such as the 4th assessment report of the Intergovernmental Panel on Climate Change (IPCC). Such applications have strong interests in extending the marine record back in time, and in identifying what newly available data records might best fill in temporal and spatial data gaps.

4.4.6 The Team noted that dataset quality assessments are needed, in conjunction with the identification of data sparse regions, so as to determine priorities for digitization; e.g., it may be important to know what variables are available in a given candidate dataset. This information may be helpful to justify the (often large) costs of future digitization efforts. Conversion to IMMA format is needed to blend the data into ICOADS, which generally represents another costly step. The Team agreed to eventually seek connection to the WIS and to document availability of digitized data through metadata profiles in order to provide visibility to these datasets even though the data might not be readily available yet.

4.4.7 The Team noted that inventory information from the UK was still being developed and that Germany was starting to document information. Reinhard Zoellner described the HISTOR project operating at the German Weather Service (DWD). Digitization at DWD first began in the 1940s and will be continued in the framework of the HISTOR project. The Team endorsed investigations of the feasibility of making the DWD historical marine archive available for merger with ICOADS, in accordance with a recommendation from the GCOS AOPC/OOPC Surface Pressure Working Group (**action, R. Zoellner).**

4.4.8 The Team agreed that CCI can help identify marine data that have not been digitized and that can be useful for marine climatology. The CCI Representative therefore agreed to raise this issue with the CCI Expert Team on the Rescue, Preservation and Digitization of Climate Records (**action, W. Wright**), with the outcome to be reported back to ETMC **(action, ETMC Chairperson**). Depending on the results of the CCI/ETMC discussions, a short manageable questionnaire to the WMO Members could eventually be prepared by the Secretariat to identify additional information (**action, ETMC Chairperson and Secretariat**).

5. PLATFORM METADATA ARCHIVAL

5.1 Current status of WMO Ship Catalogue (WMO-No. 47)

5.1.1 The Team reviewed the status of the WMO *International List of Selected, Supplementary and Auxiliary Ships* (WMO Pub. No. 47) and its future plans. It was recalled that the Publication contained details of the names, call signs, layouts, types of instrumentation and methods of observation used on VOS. The publication relies on the regular submission of metadata from respective NMSs operating VOS programmes, nominally on a quarterly basis.

5.1.2 The timely availability of the current ship metadata is of particular concern to the VOS operators. However, there is also a need to maintain a digital archive of the historical metadata for use with climate datasets, to allow the identification and correction of spurious climate signals that may result from changes in VOS instrumentation. In addition, accurate details about the method of observation and instrument type, instrument exposure, instrument calibration dates and ship layout, are vital to meet the objectives and the desired accuracies of the VOSClim.

5.1.3 The current version of the WMO Pub. No. 47 (hereafter Pub. 47) has been adopted by the JCOMM-II through its Recommendation II following recommendations by SOT-III and ETMC-I, which had cooperated to develop the proposal. The JCOMM-II agreed to initiate the preparation, by the SOT, of an XML version for the future exchange of the metadata for said publication, and approved the adoption by the SOT of a semi-colon delimited format for the immediate current exchange of the metadata. Per the agreement of the ETMC-I, the JCOMM-II agreed that the SOT should be the subsidiary body of the JCOMM responsible for the future maintenance of Pub. 47, in consultation, as appropriate, with the ETMC and other relevant bodies, including user groups. At its Third Session, the SOT decided to re-establish its Task Team on Metadata for Pub. 47. The SOT-

III recognized the importance of the historical editions of Pub. 47 as a resource for climate research. The accessibility of the up-to-date metadata is an important issue for research and operational purposes. The current format of the Publication is detailed at the following web page:

http://www.wmo.int/pages/prog/www/ois/pub47/pub47-home.htm

5.1.4 The Team noted that SOT-IV will address the requirements for Pub. 47, and suggest new changes for a future version. The Team reviewed the current format (Version 03), and agreed that the present version of Pub. 47 continued to meet ETMC requirements, including with regard to the VOSClim project. The Team, while sharing the concerns expressed at SOT-III, agreed that the SOT-IV should continue to address the issue of the management of Pub. 47.

5.1.5 The Team stressed again that access to the call sign was needed in the delayed-mode data in order to link these observations with the appropriate Pub. 47 records. Pub. 47 should also contain information about the call sign and the ship name in order to ensure access to required information about any individual ship (not necessarily via Pub. 47). The Team agreed that Pub. 47 could be secured, for example on a password protected website, if needed.

5.2 Old versions of WMO Ship Catalogue (WMO-No. 47)

5.2.1 The Team recalled that Pub. 47 has been issued since 1955. It has long been recognized that the metadata on ships and their instrumentation contained within Pub. 47 are important for the quantification and correction of bias in VOS observations. Bias adjustment is an essential step in the process of generating climate-quality datasets from the VOS.

5.2.2 Given its importance for climate research, the Team was presented with information on the progress of tasks designed to make information more accessible from historical editions of Pub. 47. Firstly, CDMP imaged and digitized Pub. 47 editions for the period 1955-72, because machine-readable Pub. 47 metadata became available from WMO only starting in 1973. These imaged editions have been made available in PDF format from the ICOADS website. Secondly, since post-1972 metadata were already available in machine-readable form from WMO, CDMP imaged the paper editions, which are now available on the CDMP Web Search Store Retrieve Display (WSSRD) website (accessible after registration with CDMP). Digital metadata have been combined into a database at NOCS and preliminary tests have corrected some misreported codes and heights in non-standard units.

5.2.3 Because Pub. 47 was designed as an operational resource, its changing contents have never been comprehensively documented by the WMO. Therefore, a journal paper was published in February 2007, which documents the variables contained within Pub. 47 since 1955 (Kent, E.C., S.D. Woodruff and D.I. Berry, 2007: WMO Publication No. 47 Metadata and an Assessment of Voluntary Observing Ships Observation Heights in ICOADS, *Journal of Atmospheric and Oceanic Technology*, 24(2), 214–234, DOI: 10.1175/JTECH1949.1). The paper also describes links of those metadata variables to the observations made by ships archived in the ICOADS for the period after 1972.

5.2.4 An IMMA metadata attachment for ICOADS has been developed at NOCS for the period 1972-2005 and will shortly be updated to 2006. The metadata will therefore be automatically available for this period if ICOADS is downloaded from NCAR in IMMA format. Extension of the IMMA attachment prior to 1973 is hindered by the lack of callsign information in ICOADS as ships in this period are usually identified with a national ship number or other identifier.

5.2.5 Comments were invited from the Team on the accessibility of the metadata, which welcomed the construction and availability of the IMMA attachment. The possibility of developing the metadatabase from the NOCS into a searchable database was suggested, which will be investigated at NOCS (**action, E. Kent**).

5.2.6 The Team agreed that the priority for future work would be to populate the ICOADS website with imaged editions of Pub. 47 for 1973 to 1998 and other metadata information. Other tasks, for example improving matching rates of metadata to ICOADS reports or investigating non-Pub. 47 sources of additional metadata, would be attempted on a best-effort or ongoing basis.

High priority:

- Populating the ICOADS website with additional metadata and documentation **(action: S. Woodruff)**;

Best-effort or ongoing basis:

- Incorporating into the dedicated NOCS metadatabase (including merger with the 1966 Edition metadata) the October 1967 supplement;
- Updating the ICOADS IMMA metadata Pub. 47 attachment to take advantage of improved Pub. 47 database for the period of 1955-2006;
- Investigating the feasibility of improving metadata matching rates in the ICOADS, using either GTS/logbook comparisons or ship name information;
- WMO to explore making the scanned publications available in electronic form via the WMO web pages;
- WMO to explore making the keyed digital metadata from Pub. 47 presently available at NOCS, and in selected form from ICOADS, also available through the WMO website;
- Investigating non-Pub. 47 sources of ship metadata and other information (e.g. questionnaire, observing instructions, contemporary accounts). This would include investigation of access to information from Lloyd's Register of Shipping (digital records exist since 1970; non-digital since 1764).

5.3 Ocean Data Acquisition System (ODAS) Metadata

5.3.1 Following a catalog originally proposed by the former SGMC and adopted at JCOMM-I, a database of ODAS (e.g., moored and drifting buoys, and mobile and fixed ocean platforms) metadata has been under development by JCOMM, and graciously hosted by China. The Team was briefed about the status of this database, plus about efforts across JCOMM to gather current and historical ODAS metadata for ingest into this or other databases (e.g. WMO-No. 47 or JCOMMOPS). For example, ETMC-I had agreed that, on a temporary basis, mobile offshore platforms should be a subject to WMO-No. 47 metadata requirements, whilst fixed platforms should be the subject of ODAS metadata requirements.

5.3.2 The Team recognized the need for metadata for a number of applications, including marine climatology in particular, and recalled that in those terms metadata such as instrument siting, ship or ODAS platform characteristics, and instrument performances are critical for climate variability studies (e.g., wind measurement heights are be used to adjust velocity to a common reference in the boundary layer).

5.3.3 As discussed under agenda item 5.2, ICOADS has recently associated the Pub. 47 metadata with individual VOS observations for the periods of 1973-2005, with plans for its extension through 2006. Similarly, it would be beneficial to associate ODAS metadata with ICOADS buoy and other ODAS observations, but this is not yet generally practical (particularly for historical metadata).

5.3.4 While any real-time metadata available are useful, the primary ICOADS requirement presently is for authoritative delayed-mode and historical metadatabases (e.g., Pub. 47 and for ODAS).

5.3.5 The JCOMM ODAS Metadata Service (ODASMS) is hosted at the World Data Centre for Oceanography (Tianjin, China) and operated by NMDIS. The website for the ODASMS was released in August 2004 and the Centre has developed an ODAS metadata management scheme, conducted comparative study on eleven marine metadata formats, and designed the ODAS metadatabase structures. An ODAS metadatabase has now been developed and web-based operating tools provided, together with a users' guide for the collection and inputting of the ODAS metadata (http://www.odas.org.cn/).

5.3.6 To date, the ODASMS has mainly collected metadata for selected international observing platforms. In the past two years, the ODASMS has focused on the automatic collection and transformation into the ODAS metadata catalogue, of metadata from the DBCP via JCOMMOPS and from Argo via the China Argo Data Centre (CADC). Collected metadata are made available via the website. An ODAS metadatabase format was released, and online tools have been developed for metadata submission and metadatabase querying. The NMDIS recommended expanding the ODAS metadata standard to make it complementary to META-T. The ODASMS is now seeking collection of metadata from other types of ODAS.

5.3.7 The DMCG-2 recommended that ODAS China, in consultation with ETMC, document the existing XML format for ODAS metadata and recommend it (to ETMC and JCOMM-III) for adoption as a standard.

5.3.8 Moreover the DMCG-2 agreed that the "On-line Information Service Bulletin on non-drifting ODAS" operated by ISDM (Canada), under a separate IOC ODAS metadata scheme, should be superseded by equivalent tools provided by the ODASMS. The IOC will continue to collect ODAS metadata on a yearly basis from the IOC Member States, and will submit the information to the ODASMS, instead of to ISDM. Practical arrangements need to be discussed between the IOC Secretariat and the ODASMS. In addition, ISDM will need to provide its historical ODAS metadata to the ODASMS.

5.3.9 Currently, the relevant marine ODAS types are regarded as lighthouses and light vessels, observing towers and platforms, oil rigs, land-based automatic stations which have been allocated international ocean data buoy identifier numbers (or national identification numbers, as is the case with Coastal-Marine Automated Network [C-MAN] reports from NDBC), ice drift buoys, and buoys mounted on ships. All of these are suitably instrumented for marine meteorological and oceanographic observation and transmission of data. Metadata from some of these stations are therefore being made available to WMO for inclusion in Pub. 47 by a few WMO Members, e.g., the UK is routinely submitting metadata to WMO for the instrumented oil rigs that they operate.

5.3.10 The Team noted that the *Manual on Codes* (WMO-No. 306) indicates that rig and platform data transmitted in FM 13 can use either a real callsign or a "buoy" identification number (based on deployment area). Offshore platforms can be fixed or mobile. This, coupled with the current lack of centralized metadata linking both forms of identification, results in a situation where the rig and platform data may be difficult or impossible to identify in GTS data (and thus in climate databases such as ICOADS). It should be noted that whilst platforms can use a buoy identification number, they do not come under the jurisdiction of the DBCP. They are more akin to the VOS; however, it was a recommendation from the SOT Task Team on Pub. 47, and temporarily endorsed by ETMC-I, that Pub. 47 should be restricted to essentially mobile platforms, that mobile offshore units should be reported under the Pub. 47, and that rigs should be reported under the IOC ODAS metadata scheme. The Team agreed that the IOC ODAS metadata scheme was not anymore the most appropriate place to maintain information about rigs and platforms and suggested that the ODASMS was better qualified to do this. It therefore recommended that the META-T and the ODASMS investigate the possibility of archiving such metadata and to report to the ETMC Chairperson **(action, ODASMS and Elanor Gowland)**.

5.3.11 The Team agreed that it should work closely with the META-T Pilot Project to ensure adequate consideration of marine climatology requirements. The Team noted with appreciation the offer made by the NMDIS to host metadata servers for the Pilot Project. NDBC also expressed its interest to participate in this project by hosting a mirror server, and is investigating the feasibility. The Team agreed to liaise with the ODASMS in order to design and adopt an electronic format for the ODAS, based on the JCOMM-recommended ODAS metadata catalogue. The format should thus be compliant with META-T requirements. The Team invited Ms Gowland to contact ODASMS and to seek agreement on the format (including exploring XML) so that a proposal could be presented to the Team before CLIMAR-III, and proposed for endorsement by JCOMM-III **(action E. Gowland, ODASMS, Secretariat)**.

5.3.12 The Team also recognized that the current ODAS metadata catalogue that was adopted at JCOMM-I might no longer meet the current requirements in terms of content and suggested that the ODASMS provides guidance in this regard **(action, E. Gowland, ODASMS).** At the same time, the Team agreed that guidance from the DBCP might again be required and suggested that DBCP-23 address the issue **(action, DBCP, Secretariat).**

5.3.13 The Team agreed to propose the following recommendation for adoption by JCOMM-III: For rigs and platforms, manual observing-systems should be treated as a “ship” and their metadata included in the Pub. 47; automated systems onboard rigs and platforms should be treated as a “buoy” and their metadata included in the ODASMS (**action, Secretariat**). The eventual decision should be left to the operator of the instrument, with the important requirement however that all these ODAS stations end up in one metadatabase or the other.

5.3.14 The Team agreed that access to metadata of coastal ODAS (e.g., C-MAN stations) and coastal moorings was also needed. It suggested that the DBCP could eventually be involved with coastal moorings but noted that that would involve changing its Terms of Reference. The Team asked the WMO Secretariat to investigate this possibility (**action, Secretariat**).

5.3.15 Work is needed with the ODASMS in order to agree on a metadata submission format. The ODASMS was invited to make a proposal for a submission format, preferably in XML, and to submit the proposal to the META-T and the ETMC for review and agreement (**action, ODASMS, META-T, ETMC**).

5.3.16 The Team noted with concern that the present metadata collection systems were not entirely satisfactory or effective. The Team stressed that access to ODAS metadata was essential for marine climatology and stressed that the implementation panels under JCOMM or its associated programmes as well as WMO and IOC Members/Member States should augment their contributions to have the required metadata, both historical and operational, submitted through the existing systems, or should assist in the development of new systems. The Team agreed to propose a recommendation for adoption by JCOMM-III in this regard (**action, Secretariat**).

6. REVIEW OF CONTRIBUTIONS AND REQUIREMENTS OF THE WORLD CLIMATE PROGRAMME AND OTHER CLIMATE RELATED PROGRAMMES

6.1 Requirements for and provision of marine climatological data and services

6.1.1 The Team discussed the requirements for marine climatological data and services. It recalled that an original objective of the MCSS was to establish a joint effort of all maritime nations in the preparation and publication of climatological statistics and charts for the ocean. Accordingly, the current versions of the *Guide to* and *Manual on Marine Meteorological Services* (WMO-Nos. 471 and 558) include guidance for the MCSS Summaries (MCS).

6.1.2 DMCG-II agreed on the need for modernization of the management of the two separate functions of the MCSS: delayed-mode VOS data handling and the preparation of the MCS (modernization of the VOS data handling function through creation of the TT-DMVOS was discussed under agenda item 3.1). Ms Gowland presented the results of a questionnaire concerning the MCS (circulated by WMO in 2005), which considered the applications and benefits of the MCS, and included suggestions for modifications to the scheme.

6.1.3 The Team also discussed how both oceanographic and ice climatologies could be coordinated, as requested by JCOMM-I, with the marine meteorological data to be seen as an integrated product.

6.1.4 To address these issues, the Team agreed that it would be useful to eventually establish a new Task Team on Marine and Oceanographic Climatological Summaries (TT-MOCS). The Team will be tasked amongst other things to eventually propose changes to the *Manual on* and the *Guide to Marine Meteorological Services* to reflect the proposed changes in the MCSS. The future TT-MOCS will also consider the interaction with other JCOMM groups and the integration of meteorological, oceanographic and ice climatologies.

6.1.5 The Team recalled its agreement under agenda item 3.5 that in addition to the Minimum Quality Control Standards (MQCS) the marine meteorological community should work toward an internationally agreed Higher-level of Quality Control (HQC). It tasked the future TT-MOCS to look into this **(action, future TT-MOCS)**.

6.1.6 Also, the Team agreed that the definition of the role and functions of RMs, as well as their number, concerning (i.) archival and distribution of marine meteorological data, and (ii.) generation of marine climatological products, should be discussed both in the context of the TT-DMVOS and the proposed TT-MOCS (**action, TT-DMVOS, future TT-MOCS**).

6.1.7 The Team furthermore agreed that metrics were needed for the marine climatology system, and suggested that this could be a logical area for involvement of the proposed TT-MOCS. For example, quality control of climatological summaries (including MCS) needs to be well documented and standardized, and better information is needed on who is using the data and products to compile appropriate information on user requirements.

6.1.8 Climate change detection, monitoring and indices products might be another area for the new TT-MOCS to explore, to look at climate trends on a decadal scale, etc. (discussed further under item 6.2).

6.1.9 However, the question remains to be resolved of what role ETMC should have to promote products and services—including through the future TT-MOCS—as opposed to providing data.

6.1.10 In light of these and other questions, the Team agreed that it was premature to agree on the Terms of Reference for the proposed TT-MOCS at this meeting. The Team therefore decided to establish an *ad hoc* cross-cutting Task Team with Membership from ETMC, ETSI, ETWS, CCI, and ETCCDI to set up the Terms of Reference for the proposed TT-MOCS: M. Rutherford (Chairperson), W. Wright or a representative from CCI Open Program Area Group (OPAG) 2, E. Kent, V. Smolianistsky, R. Zoellner, V. Swail or someone from the ETWS, E. Gowland, and C. Donlon. It was anticipated that the TT would work by e-mail and August 2007 was agreed as the deadline for the proposed ToR (**action, *ad hoc* cross-cutting TT**).

6.2 Climate change detection, monitoring and indices

6.2.1 Elizabeth Kent reported on the outcome of the second meeting of the Joint CCI/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI, Niagara-on-the-Lake, Canada, 14-16 November 2006).

6.2.2 ETCCDI is currently co-sponsored by the CCl, the WCRP CLIVAR program and JCOMM. JCOMM was added to the list of sponsoring organizations in 2005 as it was felt that the oceans were under-represented on the Expert Team, and that JCOMM, with primary responsibility for marine climate within WMO, should be represented organizationally.

6.2.3 JCOMM and ETMC were therefore represented at the second meeting of the ETCCDI in Niagara-on-the-Lake, Canada, 14-16 November 2006, by Prof Chris Folland (UK Met Office), Dr Kent (ETMC member); Mr Swail (ETWS Chairperson) and Mr Woodruff (ETMC Chairperson).

6.2.4 A range of marine datasets, both *in situ* and model-derived, could be used in the development of indices. Examples include reanalysed wind and wave datasets, ICOADS surface marine reports and summaries, sea ice extent and thickness, sea level from tide gauges and satellites, and the World Ocean Database of sub-surface parameters. Data products such as the UK Met Office Hadley Centre Sea Surface Temperature datasets (http://www.hadobs.org) are already used in the calculation of indices such as annual mean global surface temperature. Some of these data sets include satellite data, which are likely to make an increasing contribution in the future to marine indices of various kinds.

6.2.5 The priority variables for JCOMM might include: winds, waves, sea surface temperature, air temperature, humidity, sea level, ice parameters and a range of subsurface variables including temperature, salinity and ocean heat content. Further investigation is required to identify other impact-relevant marine variables, for example variables that might indicate favourable conditions for Harmful Algal Blooms. Homogenization techniques are well advanced for land station data and it was thought important to try to construct daily timeseries from ICOADS data and to apply these techniques to the marine data.

6.2.6 The Team considered whether the ETMC has a role to play in the development of marine indices. The Team agreed to continue to investigate the development of marine indices in cooperation with the JCOMM Services Programme Area and its Expert Teams, initially through the proposed TT-MOCS, with the aim of promoting some of the indices at the forthcoming CLIMAR-III meeting (**action, ETMC, future TT-MOCS**).

6.2.7 At ETWS-II, the ETWS Chairperson (M Swail) reported on those aspects pertaining to potential marine indices. This was set as a less immediate priority for the ETWS, in view of the absence of any lengthy *in situ* records from buoys (earliest starting around the 1970s), and questions about the homogeneity and usability for this purpose of VOS reports (e.g., since the mid 20th century). However, again the ETWS Chairperson was felt to be in a better position than other ETWS members present at that meeting to carry this area forward.

6.2.8 At ETMC-II, Mr Swail (via teleconference) suggested that wind waves was an area to explore, and he had been tasked by ETWS to work on this. The wave climate community outside of the ETs must be involved; this can be achieved via workshops. Moreover, the MCSS restructuring could aim to become more compatible with marine indices. These issues will have to be considered by the cross-cutting team that will be defining the ToR of the proposed new TT-MOCS (**action, *ad hoc* cross cutting TT**).

6.2.9 The ETSI Chairperson (Dr Smolyanitsky) suggested that the sea ice indices to be considered should include: global scale ice extent; regional ice extents for shelf seas (which are more variable than basin-scale ice extents); trends and differences for sea ice total concentration (e.g. differences between the last decade and the last 50 years); ice thickness and stages of development; distribution of old ice for the Arctic region; and iceberg propagation. Most of these indices are already under development and several are already available. It was planned to discuss this subject during the upcoming ETSI-III (**action, ETSI**).

6.2.10 The strength of the overturning thermohaline circulation is another index of interest, and is currently monitored with an array at 26.5˚N in the Atlantic. Greater integration of indices should be explored including developing linkages between marine and coastal land based systems. (**action ETCCDI, future TT-MOCS**).

6.2.11 Improved co-ordination of effort is required on homogeneity and for developing combined indices; for example JCOMM should work with ETCCDI on the homogeneity of the marine and coastal components. In this context, the Team therefore recognized the need to maintain links also with ETSI, ETWS, and CCI (**action, V. Swail**)

6.3 Report from the Commission on Climatology

6.3.1 Dr W. Wright, Team Leader of the CCI Expert Team on Observing Requirements and Standards for Climate (OPAG1), provided an overview of the scope of CCI's work, and in more detail, of the specific tasks that are being undertaken by his expert team. Briefly, CCI has four Open Programme Area Groups (OPAG), and two of them–OPAG1 for Climate Data and Data Management, and OPAG2 for Monitoring and Analysis of Climate Change—are most relevant to the ETMC. The major items of CCI's work that might have synergies with, or otherwise be of relevance to, the activities of JCOMM/ETMC are:

- Provide guidance on the implementation of new Climate Data Management Systems (CDMSs) to ensure better data management, including incorporation of new types of data and improved quality management
- Establish standards for the exchange of metadata and the needs for WIS
- Provide guidance on the choice of instruments and sensors, and basic characteristics of Climate observing networks
- Provide guidance on best practices to ensure long term homogenity of climate data
- Development of procedures for improved data exchange to meet GCOS requirements and principles
- Identify specific needs to rescue data at risk of lost and/or degradation, and prepare project proposals for data rescue and digitization
- Capacity building: i.e., support training in the implementation of, e.g., CDMSs
- Provide a mechanism for international collaboration on climate change detection
- Develop and make use of indices of climate variability and change
- Explore joint activities with relevant programs, projects and technical commissions to identify observation needs for climate change detection
- Contribute to generation of optimized integrated satellite and *in situ* datasets in support of climate monitoring
- Identify needs in reanalysis data for monitoring climate variability and change
- Coordinate global extreme data records

6.3.2 In the current intersessional period, Dr Wright's Expert Team will be addressing the following specific tasks:

Task 1. Develop an updated list of standards for Automated Weather Systems (AWS) for climate purposes. This will include recommendations on sensor precision, network spacing and design, provision for non-instrumental observations, backup systems, etc.

Task 2. Develop a Guidelines document for improving climate observational standards in developing countries (noting the special problems in these countries of sustainability and limited resources for maintenance), and provide advice relevant to the Global Earth Observation System of Systems (GEOSS).

Task 3. Complete a "Guidelines on Quality Assurance/Quality Control of surface meteorological data document.

6.3.3 Finally, Dr Wright also outlined some current activities being undertaken or planned within the Australian Bureau of Meteorology's (BOM) Climate Section, which might be of relevance/interest to JCOMM ETMC. These included:

- Digitization of historical ship's logs from the Australian region.
- Digitization of data, including marine data, from Australian coastal sites.
- Digitization of historical sea-level and tidal data.
- Establish stronger links with overseas counterparts (e.g., UK Met Office).
- Consider ingest of sea-level and tsunami data into the climate database (BOM is Australian location of a Tsunami warning system).
- Work towards integrated systems for access to Australian marine data holdings, via interoperable data portals.

6.3.4 The Team agreed that the CCI should play a role in the proposed future TT-MOCS and invited the CCI representative to propose a participant **(action, CCI).**

6.3.5 The Team noted substantial overlap between the CCI activities in the marine area and the ETMC with many common issues of interest. Synergies are clearly possible on historical ship and buoy data, as well as possibly with sub-surface data and Tsunami data.

6.3.6 More broadly, the Team also noted that work is needed in terms of instrument standards and best practices to have the different perspectives integrated between CCI, CIMO, and JCOMM (**action, OCG**).

7. MARINE DATA AND CLIMATOLOGY WORKSHOPS, AND RECOMMENDATIONS

7.1.1 Dr Kent informed the ETMC about the outcome of the Second JCOMM Workshop on Advances in Marine Climatology (CLIMAR-II), which took place in Brussels, November 2003. This was followed by the Second International Workshop on Advances in the Use of Historical Marine Climate Data (MARCDAT-II), Exeter, UK, October 2005, thus continuing the alternating sequence (with approximately 2-year intervals) of these successful, and closely related, workshops.

7.1.2 Dr Kent recalled the recommendations from CLIMAR-II to hold a CLIMAR-III in 2007, which was then endorsed by MARCDAT-II and JCOMM-II. DMCG-II was tasked to proceed with the organization of the workshop. The Team was informed about the status of the planning, based on an offer by Poland to host the workshop in May 2008. The Team agreed that the Organizing Committee (OC) should be tasked to advise on possible meeting structure, content and planning, and include at least the following individuals: Mr Etienne Charpentier (WMO Secretariat), Dr D.E. Harrison (NOAA), Mr Keeley, Dr Kent, Prof Mietus, Mr Woodruff and Mr Swail with potentially one or two additional members **(action, OC).**

7.1.3 Issues concerning the proposed structure, content and planning of CLIMAR-III that will need to be discussed by the OC and others include:

- Sessions on wave and storm surges should be considered
- The promotion of indices
- The length of the CLIMAR-III meeting
- Informal meetings of the task teams and of the ETMC should be organized in conjunction with CLIMAR-III. Other JCOMM teams and Programme Areas, e.g., SCG and OCG could thus be invited to attend any informal meetings.
- SOT invited to discuss the possibility of having SOT Members attending CLIMAR-III (**action, SOT-IV**)
- The possibility of a side meeting during SOT-IV to discuss organization of CLIMAR-III should be investigated, perhaps including a teleconference with those key members of the organizing committee unable to attend (**action, OC**).

7.1.4 The outcomes from the past workshops have been disseminated in a variety of ways, sometimes involving significant delay. It was felt that the publication of the special issue in the *International Journal of Climatology* following CLIMAR-II had been particularly effective, which was discussed further under agenda item 8.1.

7.1.5 The Team was informed about a new “Wiki” (http://www.marineclimatology.net), which has been introduced to allow the marine climatology community to track recommendations from MARCDAT-II (as well as from the earlier CLIMAR and MARCDAT workshops, as appropriate). The Team welcomed these developments and suggested that links should be inserted in the JCOMM, and appropriate WMO and IOC web pages **(action, Secretariat)**. The Team invited its members and others interested within the marine climatology community to provide input and feedback to the Wiki **(action, ETMC)** and noted that informal discussion items can be added to the Wiki.

7.1.6 The Team thanked Poland and Prof Mietus for organizing CLIMAR-III in Poland.

8. MANUALS, GUIDES, AND OTHER TECHNICAL PUBLICATIONS

8.1 Guide to the Applications of Marine Climatology

8.1.1 The recalled that presentations at CLIMAR-II were incorporated into a JCOMM Technical Report (JCOMM TR No. 22, 2004), and a selection of papers was published in a special issue of the *International Journal of Climatology* (Royal Meteorological Society, UK; Gulev 2005). This formed an update to the Dynamic Part (WMO/TD-No. 1081, 2003) of the *Guide to the Applications of Marine Climatology*, which was originated at the first CLIMAR workshop (CLIMAR99) held in Vancouver, September 1999. The Team agreed that this was a very effective and useful way to deliver updates to the Dynamic Part of the *Guide*—which also helps researchers justify making substantial contributions to it—and suggested that this approach be considered as an outcome from CLIMAR-III (**action, OC and CLIMAR-III**).

8.1.2 The Team reviewed the status and availability of the current Dynamic Part of the *Guide*, which includes the possibility of WMO hosting PDF files of articles from Gulev (2005) on its website starting around June 2007, and a recommended plan for its next update. The Team agreed that WMO could host that Dynamic Part of the guide in PDF format on the WMO website as of July 2007 provided that the Wiley copyright of the papers is credited, and that promotional copy from Wiley may be hosted on the WMO website **(action, WMO).**

8.1.3 The Team suggested exploring the possibility to scan the Static Part of the *Guide* (WMO-No. 781 (1994)) and to make it available electronically via the WMO website. Mr Woodruff offered to investigate feasibility with CDMP **(action, S. Woodruff)**. WMO was asked to investigate whether it would be acceptable to make the publication available online **(action, WMO)**.

8.1.4 The Team also discussed the possibility that the Dynamic Part of the Guide could in the future consist of a web portal linking to many documents and publications (e.g. Pub. 47, ICOADS documentation, QC information, Wiki).

8.2 Review of the *Manual on Marine Meteorological Services* (WMO-No. 558) and the *Guide to Marine Meteorological Services* (WMO-No. 471)

8.2.1 The Team reviewed the status of the *Manual on* and the *Guide to Marine Meteorological Services* (WMO-Nos. 558 and 471).

8.2.2 The Team noted that a few outstanding changes in the *Manual* should be made, including those that were proposed by ETMC-I, but inadvertently not brought forward to JCOMM-II.

8.2.3 The Team noted that additional changes would be proposed by the TT-DMVOS and the future TT-MOCS by CLIMAR-III, and that all required changes should eventually be compiled in a consolidated proposal to be endorsed by the ETMC, and eventually submitted to JCOMM-III for approval **(action, Secretariat)**.

8.2.4 The ETMC also requested that the WMO investigate the possible release of electronic versions of WMO-Nos. 558 and 471 (**action, Secretariat**).

8.3 Guide to Climatological Practices

8.3.1 Mr Woodruff informed the Team about ETMC's past involvement with the Commission for Climatology (CCl) on revisions of the *Guide to Climatological Practices* (WMO-No. 100), which has been underway for many years (additional status information can be obtained from websites http://www.wmo.int/pages/prog/wcp/ccl/opags/index_en.html and http://www.wmo.int/pages/prog/wcp/ccl/guide/guide.3e_en.html). Mr Woodruff recalled that JCOMM-I agreed with a recommendation from the former SGMC, that the JCOMM should contribute, as required, to the revision being undertaken by the CCl of that *Guide*. Later, ETMC-I was informed regarding the status of the preparation of said revision, which was envisioned at that time by the CCI in the form of two parts—subsequently unified by the CCI-XIV (1985) into a planned single volume.

8.3.2 In consideration of the related contributions the ETMC was already making on the general topic through updates to the Dynamic Part of the *Guide to the Applications of Marine Climatology* and through organizing workshops (see items 7 and 8.1), the ETMC-I had proposed only a review of what then formed Section 2.7 of WMO-No. 100, "Climatological Summaries", which was deemed likely to be highly relevant to the MCSS. Prof Mietus was tasked by the ETMC-I to review this Section, if the text could be made available. At the time of ETMC-II, the status of that review was unavailable.

8.3.3 The Team therefore asked its Chairperson to coordinate with Prof Mietus in order to progress on the issue and to report informally to the ETMC by CLIMAR-III (**action, ETMC Chairperson**). The CCI Representative was also asked to provide feedback to the ETMC Chairperson in terms of recent CCI progress on WMO-No. 100 (**action, W. Wright**).

9. ORGANIZATIONAL MATTERS

9.1 Terms of reference (ToR) of ETMC

9.1.1 The Team noted that it would be essential to re-establish this Team at JCOMM-III especially for the purpose of the implementation of the MCSS or its replacement to be proposed by the newly established TT-DMVOS and the future TT-MOCS. The Team reviewed the current ToR of the Team. It agreed substantial revisions could eventually be proposed, especially in light of those new Task Teams. The Team once again stressed that the GCCs (Ms Gowland and Mr Zoellner) and at least some of Responsible Members should be represented on the Team. ETMC members were invited to provide comments about the ToR to its Chairperson, who was tasked in liaison with the Secretariat and the TT Chairpersons to draft revised ToR for the ETMC **(Action: Secretariat, ETMC Chairperson, TT-DMVOS Chairpersons and future TT-MOCS Chairperson, by CLIMAR-III**).

9.1.2 Proposed change in Membership, Hong Kong China, Mr Mok to replace WT Wong.

10. REVIEW OF ETMC-II SESSION REPORT AND ACTION ITEMS

10.1.1 The meeting made a preliminary review of action items, and this final report was subsequently reviewed and adopted shortly following closure of the meeting. The listed of action items arising from this meeting is provided in **Annex XIII**.

11. Closure of the session

11.1 In closing the meeting, the Chairperson, Mr Woodruff, thanked all participants for their participation and cooperation. He wished all participants an enjoyable stay and a safe return journey.

11.2 On behalf of all participants, the Secretariat representative expressed his appreciation to the Chairperson for his excellent chairing of the session and for his substantial support and work.

11.3 The second session of the JCOMM Expert Team on Marine Climatology closed at 1800 hours on Tuesday 27 March 2007.

Annex I

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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. JCOMM ASPECTS

2.1 Report by the ETMC Chairman
2.2 Report by the Secretariats
2.3 Observations Programme Area
2.3.1 Ship Observations Team
2.3.2 Data Buoy Cooperation Panel
2.4 Services Programme Area
2.4.1 Results from the third meeting of the SCG
2.4.2 Expert Team on Wind Waves and Storm Surges (ETWS)
2.4.3 Expert Team on Sea Ice (ETSI)
2.5 Data Management Programme Area
2.5.1 Results from the second Data Management Coordination Group
2.5.2 Expert Team on Data Management Practices

3. DATA QUALITY AND EXCHANGE

3.1 New Task Team on Delayed-Mode VOS data (TT-DMVOS)
3.2 Review of the IMMT and MQCS
3.3 Review of BUFR template for ship data
3.4 Review on electronic logbooks
3.5 Review of the operations of the Global Collecting Centres
3.5.1 Report of the Global Collecting Centres
3.5.2 Report of Responsible Members
3.6 Ship call sign masking

4. DATA ARCHIVAL

4.1 Development of International Marine Meterological Archive (IMMA) format
4.2 History of the marine ship code
4.3 Archival of wave and storm surge data, extreme wave archive
4.4 Logbook and international marine data recovery (e.g. RECLAIM)

5. PLATFORM METADATA CATALOGUE

5.1 Current status of WMO Ship Catalogue (WMO-No. 47)
5.2 Old versions of WMO Ship Catalogue (WMO-No. 47)
5.3 Ocean Data Acquisition System (ODAS) Metadata

6. REVIEW OF CONTRIBUTIONS AND REQUIREMENTS OF THE WORLD CLIMATE PROGRAMME AND OTHER CLIMATE RELATED PROGRAMMES

6.1 Requirements for and provision of marine climatological data and services
6.2 Climate change detection monitoring and indices

7. MARINE DATA AND CLIMATOLOGY WORKSHOPS, AND RECOMMENDATIONS

8. MANUALS, GUIDES AND OTHER TECHNICAL PUBLICATIONS

8.1 Guide to the Applications of Marine Climatology
8.2 Review of the Guide to Marine Meteorological Services
8.3 Guide to Climatological Practice

9. ORGANIZATIONAL MATTERS

9.1 Terms of reference of ETMC

10. REVIEW OF ACTION ITEMS

11. CLOSURE OF THE SESSION

Annex III

REPORT BY THE RESPONSIBLE MEMBERS

(GERMANY; HONG KONG, CHINA; INDIA; JAPAN; NETHERLANDS; RUSSIAN FEDERATION; UNITED KINGDOM; USA)

REPORT OF RESPONSIBLE MEMBER - GERMANY

1. Data management

- The German Meteorological Service, DWD, hosts one of the two Global Collecting Centres (GCCs) within the Marine Climatological Summaries Scheme, MCSS, and at the same time acts as Responsible Member for the South Atlantic Area.

- After MQC check and exchange of the globally collected ship observations between the two GCCs the completed data sets are forwarded to the Responsible Members on a quarterly basis. Detailed information on these activities is contained in the “Annual Report for 2006 of the Global Collecting Centres (GCCs)”.

- New versions of MQCS and IMMT have been elaborated by the GCC UK in co-operation with the GCC Germany and will be submitted for discussion at ETMC-II.

- Reports from ships of the German VOS fleet and fixed stations in 2006:

418	Selected Ships	-	121,716	Obs.
2	Supplementary Ships	-	282	Obs.
25	Auxiliary Ships	-	18,492	Obs.
7	Automated Stations	-	25,909	Obs.
18	Fixed Sea Stations	-	95,315	Obs.
	Total	-	**261,714**	**Obs**.

- The total number of data sets received from the Area of Responsibility of RM Germany in the year 2006 amounts to about 110,000. There are also older reports contained in this number which were generated in the years before but delivered to the GCCs in 2006. Fig.1 gives an overview of the distribution.

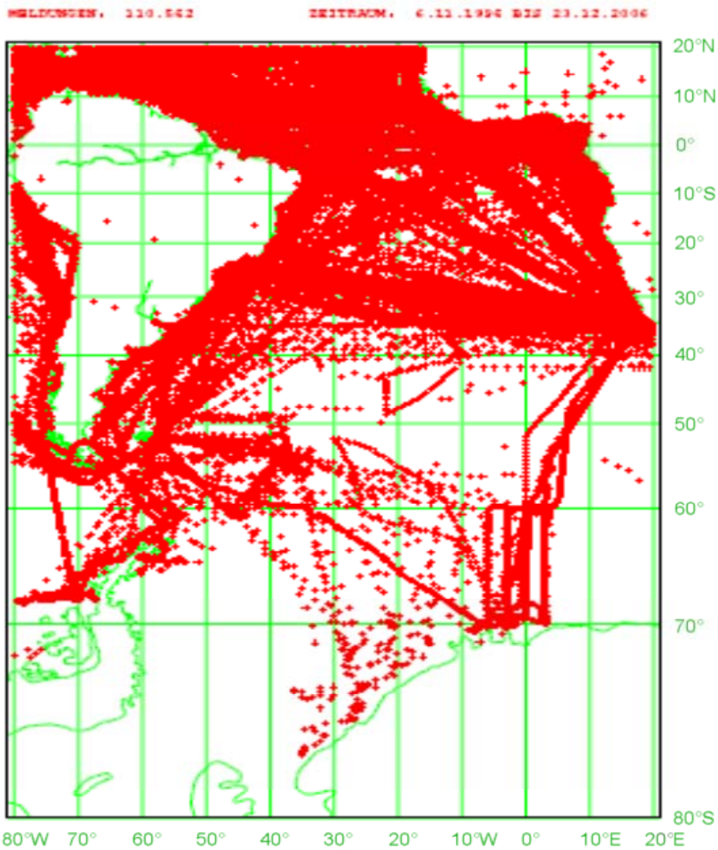

Fig.1 Distribution of observations received by RM Germany from the area South Atlantic during 2006 - Period 06 November 1996 – 23 December 2006

- In 2006 the German VOSClim ships contributed 9552 observations, 8771 of them with VOSClim-Elements.

2. Preparation of Summaries

- DWD as Responsible Member for the South Atlantic Area has put its Marine Climatological Summaries for the 10 year period 1991 – 2000 on CD-ROM, keeping in mind that the use of these climatological statistics is far more efficient if they are available on electronic media.

  Because a significant amount of the delayed-mode data used for the Summaries is available only some years after the end of the period under consideration, the calculations of the climatologies were carried out using such data as well. Thus after quality checks about 700,000 observations were available for the preparation of the Summaries.

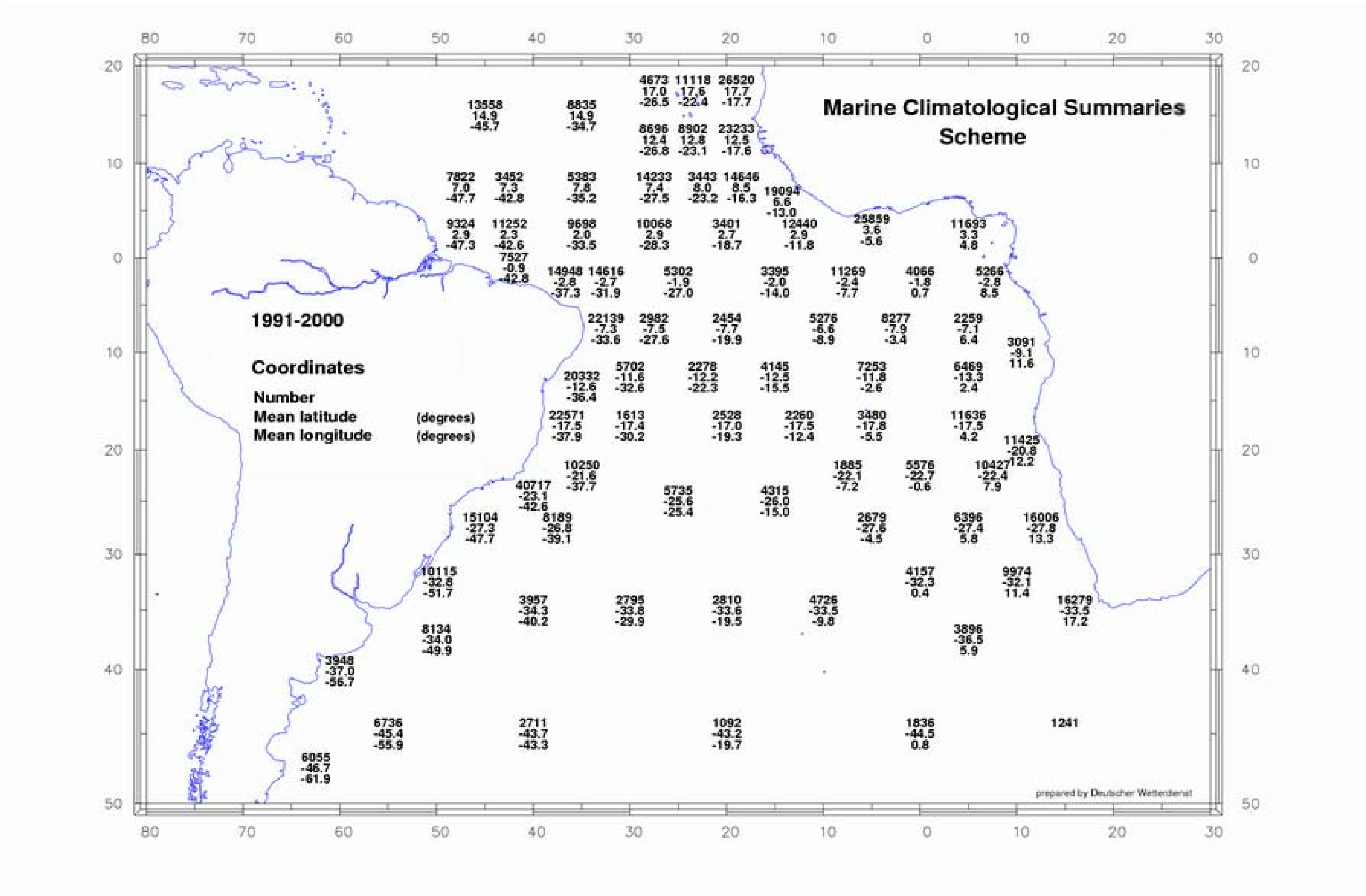

Fig. 2 Number and distribution of observations used for the preparation of the decadal Summaries 1991 – 2000 South Atlantic

3. Development of the Marine Climatological Summaries Scheme

In order to facilitate information exchange on requirements and needs concerning marine climatological data and products and the possibilities to cope with them in the framework of the existing or an extended MCSS it was decided at ETMC-I to make an inquiry. Germany took part in the development of the questionnaire.

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REPORT OF RESPONSIBLE MEMBER - HONG KONG, CHINA
FEBRUARY 2007

Area of Responsibility

1. Under the Marine Climatolgoical Summaries Scheme of WMO, the Hong Kong Observatory (HKO) is responsible for collecting marine meteorological data for the area bounded by the Equator and latitude 30°N, and longitudes 100°E and 120°E.

Marine Climatological Summaries

2. Annual marine climatological summaries for HKO's area of responsibility have been compiled and published for 1961 to 1990. Decadal marine climatological summaries have been compiled and published for 1961-70, 1971-80, and 1981-90.

Data Exchange with Global Collection Centres

3. Delay mode data sent to Global Collection Centres (GCC) by HKO in the past three years:

Number of data sent in 2004:

Year of observation					Total
≤ 2000	2001	2002	2003	2004	
233	1825	2497	1510	Nil	6065

Number of data sent in 2005:

Year of observation					Total
≤ 2001	2002	2003	2004	2005	
138	725	850	2376	2788	6877

Number of data sent in 2006:

Year of observation					Total
≤ 2002	2003	2004	2005	2006	
Nil	Nil	417	1577	695	2689

4. For the delayed mode data observed within Hong Kong's Area of Responbility, the numbers of observation reports taken in the past five years that have been digitized in the GCC archive are:

2002	2003	2004	2005	2006	Total
16980	24661	18431	16341	20586	96999

5. Data exchange frequency and data management details:

Frequency of data exchange with GCC	Quarterly
Data format	International Maritime Meteorological Tape-3 (IMMT-3) (effective 1 January 2007)
Quality control	GCC minimum quality control software MQC version 5 (effective 1 January 2007)
Frequency of submitting metadata to WMO	Quarterly
Metadata format	WMO Pub 47 version 02, to be changed to

	version 03 starting 1 July 2007

Challenges

6. Most shipping companies are reluctant to have third party software installed on the ship computer. Only 2 out of 36 ships in the Hong Kong VOS fleet have installed electronic logbook “Turbowin”.

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REPORT OF RESPONSIBLE MEMBER - INDIA

Introduction

India is one among the 8 responsible members of the Marine Climatological Summaries Scheme (MCSS) with the responsibility of the Indian Ocean Area north of 15^{o}S bounded by the longitudes of 20^{o}E and 100^{o}E. India Meteorological Department carries out the responsibility.

Voluntary Observing Ships & Data Processing

As on Dec 2006, the status of the Voluntary Observing Ships fleet of India is as given below:

Category	**No. of ships as on 31 Dec 2006**
Selected	11
Supplementary	133
Auxiliary	41
Other (specify)	Nil
Total National VOS fleet	185
Number of VOS vessels recruited in 2006	2
Number of VOS vessels de-recruited in 2006	Nil
Number of VOSClim vessels at 31 December 2006	21
Number of VOSClim vessels recruited in 2006	Nil
Number of VOSClim de-recruitments in 2006	Nil
Number of VOSClim recruitments planned for 2006	3
Target number of ships to participate in VOSClim	3

Marine weather observations from the meteorological log books of the VOS were scrutinized to eliminate instrumental, positional and coding errors and were digitized using The International Maritime Meteorological Tape-2 (IMMT-2) format. These data together with those received from other WMO Members were checked by an in-house quality control software application. The Minimum quality control software MQC version 4 obtained from GCC was also used for quality control. All flagged data were reviewed and corrected as far as possible, and the corrected data were then sent to GCC. A total of 8548 marine records were sent to GCC during 2006.

Marine Climatological Summaries

Annual Marine Climatological Summaries for seventeen selected areas of the Indian Area of responsibility were compiled and published for the period 1961 to 1970. Following the recommendation of the WMO Commission for Marine Meteorology at its eighth session held in 1981, chart form of the decadal summary for the decade 1971-80 was published. As the use of electronic version of the climatological statistics is far more efficient, recently Surface Marine Climatological Atlas 1961-90 was published along with electronic form on CD-ROM. At present preparation of marine decadal summary for 1991-2000 is in progress. About 6 lakhs marine observations from the area of responsibility of RM India are available for this purpose.

Marine Data Archival

At present over 4 million marine weather observations made within the area of responsibility of RM India are in the archive of National Data Center, India Meteorological Department, Pune, India. Annual distribution of these observations for the period 1961-2006 is given in the following figure:

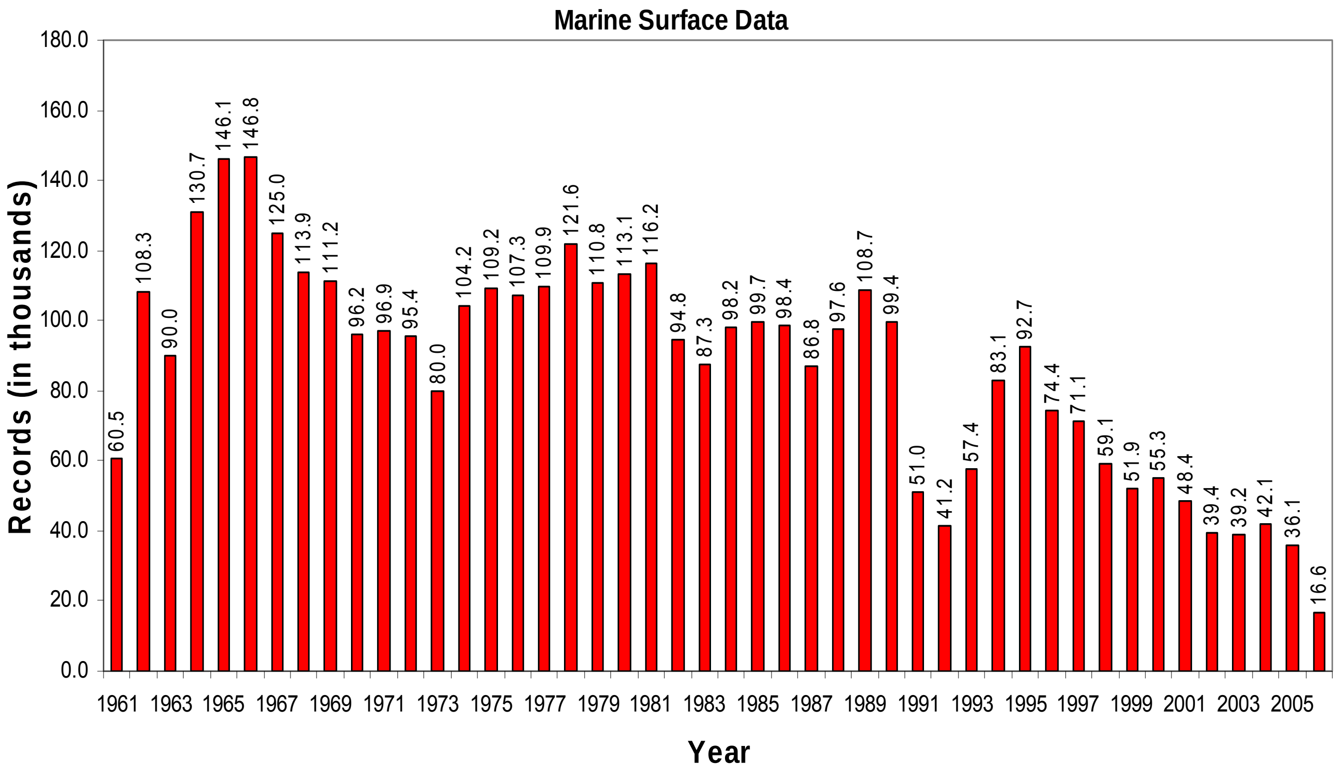

Fig1 : Marine Surface Data available in the archives of National Data Center, India Meteorological Department, Pune for the Indian area of responsibility.

Difficulties in the analysis of old Ship Weather Observation

RM India is planning to prepare Marine Climatological Atlas 1951-2000 for Indian area of responsibility. But face some difficulties as the marine surface data prior to 1961 are in various formats and its metadata are not fully available. These data are in unprocessed stage and still not integrated with the archives. World over Historical Marine Surface data have been rescued and digitized by various meteorological centers/agencies like NOAA/NCAR, Japan Meteorological Agency, Meteorological Office, U. K.. It will be of great help if these historical marine data sets are converted to a uniform format (e.g. IMMT-2) and redistributed among responsible member countries for their climatological/research work. Therefore, it is suggested that ETMC may discuss this point and an effort may be made to convert all the data in a uniform format (IMMT-2). For this any one of the GCC can take up initiative and after reformatting sent the data to respective RMs. If accepted, India is ready to participate in this effort.

REPORT OF RESPONSIBLE MEMBER - JAPAN

1. Japan is one of the eight Responsible Members for Marine Climatological Summary Scheme (MCSS), whose responsible area is the western North Pacific and its marginal seas. The Japan Meteorological Agency (JMA) has taken charge of it since the beginning of MCSS. JMA's activities for MCSS in the last three years are presented in this report.

Collection, archiving and exchange of marine data

2. JMA accepts marine meteorological log book in both paper and electronic forms from Japanese VOSs. In the last three years (2004-2006), 101946 observations were processed and submitted to the Global Collecting Centres (GCCs) on a quarterly basis. Electronic logs accounts for about 30% of the total number of the logs. IMMT-3 will be introduced in 2007 for the data observed by VOSClim vessels, all of which are JMA's research vessels. JMA continue to use IMMT-1 for non-VOSClim observations to make sure that these data don't meet the VOSClim requirement. MQCS-4 is applied to the IMMT-1 data.

3. Some VOSs started to use a dummy call sign "SHIP" not only for the real time transmission but also for the delayed mode logs in September 2005. From the viewpoint that the marine data with a dummy call sign are less useful for marine climatological purpose, JMA has been keeping those data, including ship name information, not to be sent to GCCs for the time being. Number of those data reached 8000 by the end of 2006.

The marine climatological summaries

4. Marine climatological summaries have not been updated since JMA published the 30-year summary for 1971-2000 in 2003. Discussion has been made on how to improve the summaries, but we have not reached conclusion.

REPORT OF RESPONSIBLE MEMBER – THE NETHERLANDS

Since the first meeting of the ETMC in Gdynia/Poland - 2004, KNMI has continued to submit IMMT reports to the GCC.

Table I. Submitted by the Netherlands

Date	**Number of submitted observations**
December 2004	17,415
March 2005	24,626
April 2005	16,502
September 2005	16,510
January 2006	14,792
April 2006	11,875
September 2006	16,505
January 2007	14,365
TOTAL	**132,590**

In the MCSS, the Netherlands are Responsible Member for the Mediterranean, Southern Indian Ocean and the Australian Waters. However, we collect IMMT data for the whole globe and therefore receive the files with global observations from the GCCs every quarter. There are no further activities in the field of the MCSS.

With respect to the MQC: all observations we receive from our VOS fleet are made with TurboWin. This implies that the Minimum Quality Control has been done adequately.

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REPORT OF RESPONSIBLE MEMBER – RUSSIAN FEDERATION

No report has been provided by the Russian Federation for this ETMC Session.

REPORT OF RESPONSIBLE MEMBER – UNITED KINGDOM

The UK Met Office maintains three roles within the Marine Climatological Summaries Scheme (MCSS). Its acts as a contributing member for UK data, is one of eight responsible members (taking responsibility for data within the North Atlantic Ocean) and is also one of two Global Collecting Centres (GCC) for global marine meteorological data. The activities of the GCCs are detailed annually with the most recent 'GCC 2006 Annual Report' in the process of being published by the WMO.

1. Contributing Member

The UK Voluntary Observing Fleet as at end 2006 is displayed in fig. 1.

Fig. 1: UK VOF end 2006

Category	***Number as at end 2006***
Selected Ships	378
Active Rigs	30
Ships/Rigs with TurboWin	277
VOSClim Ships	60

The UK endeavour to submit their quality controlled to the GCCs on a quarterly basis. The numbers of observations submitted to the GCCs during 2004 to 2006 are shown in fig.2, including a breakdown of the contributions from VOSClim ships.

Fig. 2: Contributions to the GCCs

Year	***Total Obs***	***VOSClim Obs***	***VOSClim with extra elements***
2004	65,280	0	0
2005	0	0	0
2006	345,443	51,204	42,779

During 2004 & 2005 the UK experienced some technical/software difficulties in storing and exchanging their data, in particular for the new VOSClim additional elements. These problems were eventually overcome in 2006 which allowed the UK to submit a backlog of data to the GCCs and now continue to contribute each quarter.

2. Responsible Member

As a responsible member country the UK receive the global dataset from the GCCs at the end of each quarter.

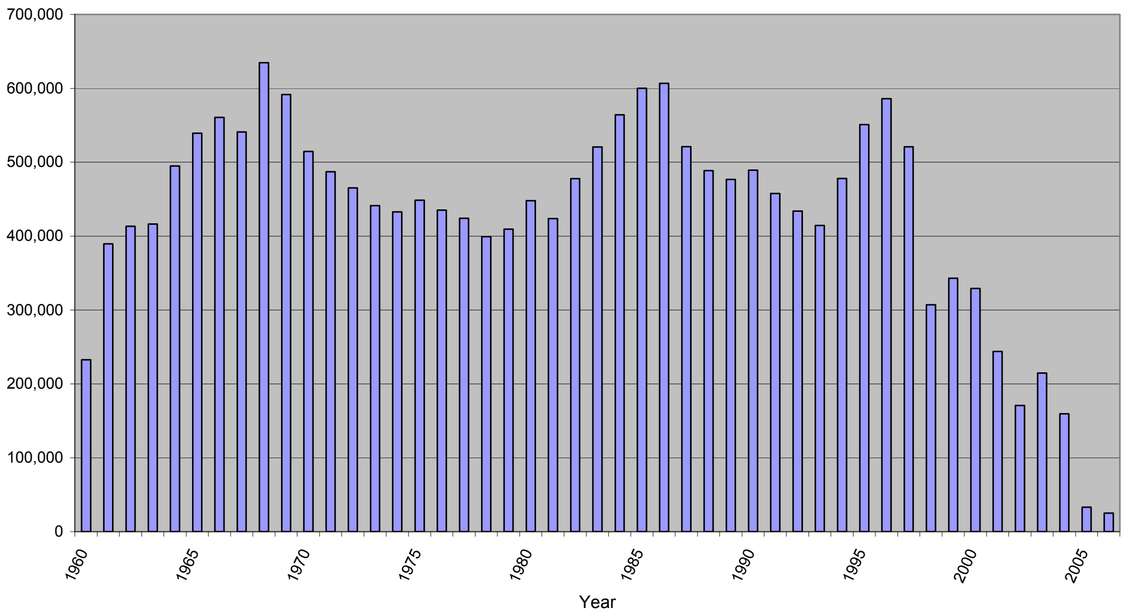
2.1 Data Processing: The UK stores the global marine datasets in the Met Office relational (Oracle) database. During storage if an observation matches the date/time/position/id as a GTS observation already stored, this process overwrites this record with the delayed-mode observation. Unfortunately due to a shortage of staff resources, only UK Ships observations have been stored since April 2005.

Within 24 hours of storage quality control software checks the data and sets quality flags (currently GCC flags are not passed to the database). Both automatic and manual quality control is performed and if any changes are made to data two versions will be stored in the database – 1 original & 1 quality controlled.

2.2 Climatological Summaries: During 2004 to 2006 there were no summary requests and as a consequence no charts were produced.

2.3 ***Data Requests*:** During 2006 the UK has received several data requests under the MCSS with requests originating from contributing members to research students. Fig. 3 shows the volumes of delayed-mode data stored in the database for the UK's area of responsibility.

Fig. 3: Obs by Year for UK Area



REPORT OF RESPONSIBLE MEMBER - USA

The Expert Team on Marine Climatology (ETMC) is invited to review the activities of NOAA's National Climatic Data Center (NCDC).

In recent years the NCDC has not provided any delayed-mode input to the Global Collecting Centers (GCC). This is largely due to a lack of resources and a shift in focus of the marine program.

The NCDC is attempting to rectify this deficiency by providing additional human resources to support the marine program to fulfill the responsibilities to the GCCs and as the Data Assembly Center for the VOSClim program. The new resource will be tasked with the oversight of the marine program with special emphasis on delayed-mode data and the recovery of historical logbook data.

A meeting comprising representatives of the NCDC (Mr Alan Hall), the United Kingdom's Global Collecting Center (GCC), and the United Kingdom Met Office was held in October of 2006 to discuss the issues. The meeting was able to identify the specific responsibilities of the NCDC and efforts have been underway to meet those responsibilities. A conversion process has been developed to convert IMMA format (NCDC archive format) to the latest IMMT-3 format. This new process will be used to convert all delayed-mode data to IMMT-3 and then passed said data on to the respective GCCs. The timeframe for this to take effect should be in the second quarter of 2007.

A new process will be developed to convert historical logbook data and Buoy data to the IMMA. At that point, these data can be converted to IMMT-3 and made available to the GCCs, if recommended.

Respectfully submitted:

NOAA's National Climatic Data Center
Alan D. Hall

Annex IV

RESPONSIBILITIES/ACTIVITIES OF GLOBAL COLLECTING CENTRES AND RESPONSIBLE MEMBERS

<u>GCC</u>

Act as a focal point between Contributing and Responsible Members – purely a point of dataset exchange, with no responsibility for archival of data.

Receive delayed-mode data from CMs electronically (e.g., by email, FTP, CD-ROM or floppy disk), in IMMT format.

Ensure current MQCS on delayed-mode data, received from CMs.

Keep inventory of datasets received from CMs (minimum: CM, date received, number of observations).

Bilateral exchange of dataset details with other GCC (i.e. CM, number of observations, years of observations, callsign list, any problems).

Feedback any problems to CMs, and agree any amendments to the dataset submitted.

Distribute quarterly data updates to RMs, in agreed format, for responsible area (or globally as agreed).

Prepare annual report to be distributed through the Secretariat to Members operating VOS and other relevant bodies.

<u>RM</u>

Archive data received from GCCs (at least for their responsible area). If possible, it is recommended that RM should also archive the SHIP GTS data, either as a separate dataset, or to be replaced by logbook data, received in delayed-mode from the GCCs.

Produce marine climatological summaries as appropriate.

Distribute observational data (in IMMT format) to Members on request – charge to be borne by RM, unless another exchange format agreed.

Report to the ETMC.

Annex V

PROGRESS REPORT REGARDING THE HISTORY OF MARINE SHIP CODES

1. Introduction

The Commission for Marine Meteorology (CMM) Subgroup on Marine Climatology (SGMC) and its successor, the JCOMM Expert Team on Marine Climatology (ETMC), has placed much effort into verifying the availability of documentation relating to the history of WMO's alphanumeric marine ship code (presently FM 13–XII Ext. SHIP), since approximately the mid-20th century[1].

In addition to FM 13, these efforts traced the evolution of the International Maritime Meteorological Punched Card and Tape (IMMPC and IMMT) formats, with the goal to make all this documentation available on the web. Substantial progress was made and some results were presented at the Eighth Session of the SGMC (SGMC-VII, Asheville, North Carolina, USA, 10-14 April 2000) and the First session of ETMC (Gdynia, Poland, 7-10 July 2004), including a website hosted at the Japan Meteorological Agency (JMA) (http://goos.kishou.go.jp/ws/ETMC/code_task) on which the results of this study on the history of codes and format changes are being made available.

During its First Session, the Expert Team on Marine Climatology (ETMC-I) agreed the Work Plan to continue the following tasks:

a.) Making all final reports of the CMM and CSM/CBS sessions available on the website;
b.) Updating the website;
c.) Looking for past editions and supplements to the *Manual on Codes* (WMO-No. 306), and making them available on the website; and
d.) Expanding the study to other marine and oceanographic codes such as the FM 14 DRIBU, FM 18 DRIFTER/BUOY, FM 62 TRACKOB, FM 63 BATHY, FM 64 TESAC and FM 65 WAVEOB.

The progress of the tasks during the intersessional period since the ETMC-I, are presented in this report.

2. Progress on the task during the intersessional period

2.1 Making all final editions of the CMM/JCOMM and CSM/CBS sessions available via the web

All reports regarding the CMM[2], Commission for Synoptic Meteorology (CSM)[3], and Commission for Basic Systems (CBS) were scanned. The documents were made available as PDF files on the JMA website (as mentioned above), in December 2004. All the scanned image files were converted into searchable PDF files under the NOAA Climate Database Modernization Program (CDMP), and the searchable files replaced the scanned image files in June 2005. Additionally, the CDMP archived copies of all the files. The abridged Final Reports from JCOMM-I and –II (as already published in electronic format by WMO), have also been made available on the website.

2.2 Copyright and other WMO publications issues

In 2005 the WMO Publications Board agreed that permission would be granted for public availability from the CDMP image archive system (which provides restricted access, generally for research) of these and similar imaged technical WMO documents (e.g., older editions of WMO-No. 47; Ref. ETCM-II/Doc. 5.2), provided a copyright notice was added as a "cover page." Similarly, a

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[1] The WMO came into existence around 1950 as the successor organization to the International Meteorological Organization (IMO).
[2] Together with the IOC Intergovernmental Global Ocean Services System (IGOSS), the CMM was a predecessor organization to JCOMM.
[3] The CSM was a predecessor organization to CBS.

general copyright notice is posted on the JMA website to cover this same requirement. Inconveniently, in some respects, it was noted that the available JCOMM-I final abridged report was a secure (encrypted) PDF document, which thus could not be printed, accessed by external search engines, etc. In contrast, the JCOMM-II report was not created with these restrictions.

2.3 Updating the website

- The web pages regarding the history of IMMT and MQCS were updated with the latest modifications to IMMT and MQCS, which were recommended at JCOMM-II (Halifax, Nova Scotia, Canada, 2005), adopted at Fifty eighth WMO Executive Council EC-LVIII (2006), and came into effect on 1 January 2007.
- The web page of the final reports of the CMM/JCOMM and CSM/CBS was updated with the links to the reports of the recent sessions such as JCOMM-II (2005) and CBS-XIII (2005).

2.4 Locating past editions/supplements to the Manual on Codes (WMO-No. 306)

Efforts were made to create a list of the past editions of and supplements to the *Manual on Codes* (WMO-No. 306). At least in recent years, WMO-No. 306, Volume I, Part A (Alphanumeric codes) has contained information regarding FM 13 and the other traditional alphanumeric codes.

The ETMC efforts have not yet been considered to identify past editions and supplements of the additional Parts B (Binary codes) and C (Common features to binary and alphanumeric codes) of Volume I (including information about the table driven codes, BUFR and CREX), or of Volume II (Regional codes and national coding practices).

Based on the available documents and information provided by contributors, it appears that approximately seven editions of the WMO-No. 30 (for the following years: 1949, 1955, 1960, 1964, 1968, 1971 and 1974) were likely published before 1984. It should also be noted that the Volume and Part structure of the publication may have changed significantly from the earliest edition thus far identified, from 1949.

From 1984, three editions of WMO-No. 306 were published (1984, 1988 and 1995), of which copies of “table for noting supplements received” were provided by the WMO (through the WMO Secretariat’s former Scientific Officer, Teruko Manabe). Based on the information from the tables and the latest version of the *Manual on the World Weather Watch* (WWW) website: http://www.wmo.ch/web/www/WMOCodes.html, supplements to the three editions were listed as follows:

Edition	Supplement	Date of issue
1984 Basic edition	1984	
No. 1		December 1985
No. 2		January 1986
No. 3		April 1987
1988 Basic edition	1988	
No. 1		September 1989
No. 2		July 1991
No. 3		August 1991
No. 4		March 1993
No. 5		July 1993
(No. 6B concerns part B, May 1994)		
No. 7A		July 1994
1995 Basic edition	1995	
No. 1		July 1997
No. 2		March 2000

No. 3	August 2001
No. 4	August 2003
No. 5	August 2005

The next step planned will be to attempt to locate copies of seven previous editions (from 1949-1974), in the WMO, international libraries, and the three editions and their supplements listed above. Information on the supplements to the seven editions could be obtained from the existing version of those publications. It is felt that consideration should definitely be given to the feasibility to image the entire publication, which includes large amounts of non-marine codes, for efficiency and to cover currently unforeseen requirements. Also, the latest edition of WMO-No. 306 is available electronically from the above-mentioned WWW website, so another part of the task should be to determine if the WMO already possesses electronic copies of any other the other recent editions.

2.5 Expanding the study to other marine codes

Additional work was completed in tracing the history of other marine and oceanographic codes (i.e., FM 14 DRIBU, FM 18 DRIFTER/BUOY, FM 62 TRACKOB, FM 63 BATHY, FM 64 TESAC and FM 65 WAVEOB). These results will be placed on the JMA website in the similar form to the studies of the history of SHIP code and IMMPC/IMMT.

2.6 Connections with historical data and metadata archeology

Similar to the work that identified past editions of WMO-No. 306, lists of a number of historical (largely national) publications on earlier marine codes and observing instructions have also been created. Those early historical publications are not a direct target of this WMO-focused task, but they are certainly useful marine metadata, and some of them have already or may in the future be targeted by the CDMP for imaging. This related task for historical metadata falls under the RECovery of Logbooks And International Marine data (RECLAIM) project (see ETMC-II/Doc. 4.4).

Annex VI

PROPOSED TERMS OF REFERENCE (TOR) OF THE JCOMM DMPA TASK TEAM ON DELAYED-MODE VOLUNTARY OBSERVING SHIP DATA (TT-DMVOS)

(as revised by ETMC-II)

Background: The Marine Climatological Summaries Scheme (MCSS), established in 1963 (Resolution 35, Cg-IV), has as its primary objective the international exchange, quality control and archival of delayed-mode marine climatological data, in support of global climate studies and the provision of a range of marine climatological services. Eight countries (Germany, Hong Kong, China, India, Japan, Netherlands, Russian Federation; United Kingdom and USA) were designated as Responsible Members (RMs) to gather and process the data, including also data from other Contributing Members (CMs) worldwide; and to regularly publish Marine Climatological Summaries (MCS) for representative areas, in chart and/or tabular forms. Two Global Data Collecting Centres (GCCs) were established in 1993 in Germany and the United Kingdom to facilitate and enhance the flow and quality control of the data. Eventually all data are to be archived in the appropriate archives, including ICOADS.

Scope: In practice, the delayed-mode marine climatological data, handled under the MCSS, and published in the MCS, have generally been limited to Voluntary Observing Ship (VOS) data (i.e., excluding buoy or other non-ship data), in accordance with the original intent of the MCSS. The Task Team will focus primarily on modernizing the management and quality control of the delayed-mode VOS data, while at the same time exploring possible connections with the management of real-time VOS and other ship-based data (e.g., Shipboard Automated Meteorological and Oceanographic System (SAMOS) and GOSUD). So as to develop a clearer separation between data processing, and the preparation of climatological summaries, the team’s scope will be limited to data management. Because the RMs and the GCCs have primary involvement in the data processing, they will be invited to contribute to the work. The review and modernization of the MCS is clearly also an important task, which will be considered separately by the ET-MC, and to which the RMs will also be invited to contribute. In addition, as part of the collective modernization of the data management and the MCS, it is anticipated, in due course, that the “MCSS” terminology will be replaced by a new and more up-to-date terminology reflecting a separation between the two functions.

The self-funded Task Team will primarily work via email and shall:

(i.) Examine current delayed-mode VOS data management practices, including those of the GCCs, and streamline them as possible to reduce redundancies (if any), standardize operations, and exploit appropriate modern technologies;
(ii.) Examine possibilities for commonality of the data management of the delayed-mode data, with real-time VOS data;
(iii.) Keep under review the International Maritime Meteorological Tape (IMMT) format, and suggest changes if necessary;
(iv.) Keep under review the Minimum Quality Control Standards (MQCS), and suggest changes if necessary;
(v.) Submit proposals to the JCOMM via the ET-MC for revising technical publications, in particular the WMO *Manual* (No. 558) and *Guide* (No. 471) *on Marine Meteorological Services*, to incorporate possible changes in the IMMT and the MQCS, and to reinvent the MCSS terminology;
(vi.) Review the International Maritime Meteorological Archive (IMMA) format, and suggest ways to reconcile the IMMT and IMMA formats;
(vii.) Establish and maintain a website to share relevant information;
(viii.) Collaborate and liaise with other groups (e.g., SAMOS and GOSUD), as needed, both to ensure access to expertise and appropriate coordination.

Tentative Membership (from ET-MC; including both GCCs as Co-Chairpersons, and all RMs presently represented on the ET-MC) include: Elanor Gowland (Co-Chairperson), Elizabeth C.

Kent, Frits B. Koek, Alexander Vorontsov, Wing-tak Wong, Takashi Yoshida, Scott D. Woodruff, and Reinhard Zöllner (Co-Chairperson).

Proposed additional members (not on the ET-MC) include: A representative from US/NOAA/NCDC, Graeme Ball (Chairperson of the OPA/SOT) and Julie Fletcher (Chairperson of the OPA/SOT/VOS Panel).

Reporting mechanisms*:*

(a.) The Team will produce a project plan to guide operations for the next three years. The plan should explain the linkages to other components of the JCOMM, including the SOT and other pertinent programs.
(b.) The Team will establish an annual reporting mechanism to the ET-MC and the SOT.
(c.) The Team will report to the ET-MC and the SOT at their regular meetings.

Annex VII

BACKGROUND INFORMATION AND PROPOSED IMMA FORMAT

(Submitted by Mr Scott Woodruff[1], Ms Sandy Lubker[1], Mr Steve Worley[2], Mr Zaihua Ji[2]
(1) NOAA Earth System Research Laboratory (ESRL), USA
(2) National Center for Atmospheric Research (NCAR), USA)

1. Background

The International Maritime Meteorological Archive (IMMA) format has been under consideration by ETMC, and its predecessor Subgroup under the Commission for Marine Meteorology (CMM), for several years (JCOMM 2000, 2004). The Data Management plan from the first session of JCOMM (WMO 2001) tasked ETMC to finalize the format with a view to eventual submission to the Commission for formal adoption, and the possibility of its publication through a JCOMM Technical Report has been suggested, most recently by the Second Session of the JCOMM Data Management Coordination Group (JCOMM 2007).

Furthermore, the Second JCOMM Workshop on Advances in Marine Climatology (CLIMAR-II) (Parker et al. 2004), and the First and Second Workshops on Advances in the Use of Historical Marine Climate Data (MARCDAT) (Diaz et al. 2002, Kent et al. 2007b), have all suggested continued usage and expansion of the format (recent recommendations from these workshops relating to IMMA are discussed in sec. 5).

Following its introduction at JCOMM (2000), the IMMA format and documentation underwent a number of updates and revisions, and a provisional version of the format became fully operational for the International Comprehensive Ocean-Atmosphere Data Set (ICOADS; Worley et al. 2005). This discussion, which updates the corresponding document presented at ETMC-I (JCOMM 2004), provides a brief overview of the format, and of its status and current utilization for ICOADS, and for other projects such as the Climatological Database for the World's Oceans 1750-1850 (CLIWOC) (García-Herrera et al. 2005) and the Voluntary Observing Ship (VOS) Climate (VOSClim) project.

Appendix A to this Annex provides additional background and a detailed description of the format.

2. Format overview

IMMA is a flexible and extensible ASCII format designed for archival and exchange—of both historical and contemporary marine data—plus convenient data access by users. The convention adopted for standardized representation of data within the format uses a "fixed-field" approach (in contrast to a delimited format, or a binary format such as BUFR) similar to IMMT. In addition, blanks fully occupying any field width, define the universal representation for missing data.

The fields presently composing IMMA have been organized into two different types of format components: the "core"—containing the most universal and commonly used marine data elements (e.g., reported time and location, temperatures, wind, pressure, cloudiness, and sea state)—and "attachments" (attm), which contain additional, less universal data elements. The core forms the common front-end for all IMMA data, and by itself forms a relatively concise "record type" that can satisfy many end-user requirements. Additional record types are constructed by appending to the core one or more attms (Table 1).

Table 1. Size (bytes) and status of IMMA format components: the core and presently defined or proposed attachments (attm).

Abbrev.	Name	Size (B)	Cumulative size (B)	Status
C0	Core	108	108	operational
C1	ICOADS attm	65	173	"
C2	IMMT/FM 13 attm	76	249	"
C3	Model quality control (QC) attm	66	315	"
C4	Ship metadata attm	57	372	"
C5	Historical attm	(TBD)	(n/a)	under development
C6	Supplemental data attm	(variable)	(n/a)	operational

Following is a further description of the attachments listed in Table 1:

- C1 (ICOADS): used to store data and metadata fields (e.g., QC flags) specific to ICOADS.
- C2 (IMMT-2/FM 13): stores fields, in addition to those included in the core, from contemporary (e.g., IMMT and FM 13 GTS) ship or other (e.g., drifting and moored buoy) marine data. Note: this attm has not been updated for IMMT-3.
- C3 (Model QC): designed specifically for VOSClim to store co-located numerical weather prediction feedbacks from the UK Met Office.
- C4 (Ship metadata): stores selected platform and instrumental metadata from WMO (1955–) Publication No. 47 (Kent et al. 2007a).
- C5 (Historical; still under development): intended for storage of fields from older ship data that are no longer part of the current ship code (e.g., Beaufort force numbers; Woodruff et al. 2005).
- C6 (Supplementary data): used to store supplementary (or original input) data of indeterminate type, and of fixed or variable length (e.g., FM 13 strings).

The format has been designed with the flexibility to define new attms, as required, to satisfy emerging or unanticipated data and metadata requirements. For example, a new attm designed to store additional buoy data elements from the GTS FM 18 BUOY format, or buoy metadata, might prove useful in the future.

3. Status and utilization

The provisional version of the IMMA format is already widely used for ICOADS, and also in use for VOSClim data at that project's Data Assembly Center (DAC) based at the NOAA National Climatic Data Center. In addition, a variety of contemporary and historical data collections have been converted into the IMMA format, generally including the standard ICOADS QC flags, which are offered as datasets "Auxiliary" to ICOADS (Table 2).

Storing the QC'd Auxiliary data in IMMA format—alongside the regular ICOADS data—makes all these data readily accessible to users via web-based subsetting software (available through the project web portal icoads.noaa.gov). Temporal, spatial, and IMMA content (i.e., individual fields) can be selected through this processing for output into simple ASCII and spreadsheet-compatible formats.

Table 2. ICOADS or Auxiliary datasets currently available in IMMA format. The Auxiliary datasets are divided into two types: "new" sources generally are unique observations not found in ICOADS, whereas "replacement" sources are represented in ICOADS either by an earlier version or another source that is very similar. These data cannot be added to ICOADS without careful consideration of the impact of duplicate and near-duplicate records. Total numbers of reports in 10^6 (M) or 10^3 (K) are listed, and sizes (uncompressed) in megabytes or gigabytes.

	Type	*Date Range*	*Description*	*No. reports*	*Size*
ICOADS	—	1784-2005	ICOADS Release 2.3[1]	213 M	49.0 GB
Auxiliary	New	1750-1855	CLIWOC[2]	280 K	148 MB
Auxiliary	New	1936-2000	Russian research vessel obs.	2.03 M	664 MB
Auxiliary	New	1946-84	Japanese Whaling Ship Data	20.6 K	5.72 MB
Auxiliary	Repl.	1990-97	PMEL/JAMSTEC buoy data	21.4 M	6.19 GB
Auxiliary	New	1990-98	COAPS research vessel obs.	57.7 K	28.0 MB
Auxiliary	New	1878-94	US Marine Met. Journals	1.8 M	888 MB

1. Release 2.4, which will extend ICOADS through 2006, is planned for completion by mid-2007.
2. Addition of ICOADS QC flags is planned, as well as creation of an abbreviated version to resolve technical issues associated with very long supplementary data (C6) lengths.

Table 3 provides examples of the record types currently utilized for data products in terms of the attachment structure. Storage volume can be minimized in IMMA by omission of attachments that contain only missing data or are not relevant to a given product. For example, the model quality control (C3) information presently is available only for the limited set of VOSClim ships, thus it is unnecessary to include C3 with other products. Similarly, the ship metadata attm (C4) contains metadata selected from WMO–No.47 (1955-) by the Southampton Oceanography Centre (Kent et al. 2007a), which currently have been blended only for 1973-2005.

Table 3. Examples of IMMA record types currently in use. The notation •/∂ indicates a statically/dynamically included IMMA format component (i.e., the dynamic components are only included if they contain extant data, whereas the static components are always included). For example buoy records included in ICOADS will never have C4. All these records types may be variable, so the average record sizes are listed (bytes).

Record type utilization	C0 core	C1 icoads	C2 immt2	C3 model	C4 meta	C5 hist	C6 suppl	Average Rec. size (B)
ICOADS 1998-2005[1]	•	•	∂		∂		•	327
ICOADS 1973-97[1]	•	•	∂		∂			213
ICOADS 1784-1972[1]	•	•	∂					170
VOSClim[2]	•	•	•	•			•	(N/A)
CLIWOC[3]	•						•	528
US Marine Met. Journals[1]	•	•					•	503

1. Data availability: icoads.noaa.gov
2. Data availability: www.ncdc.noaa.gov/vosclim.html
3. Data availability: www.ucm.es/info/cliwoc/ or icoads.noaa.gov

4. Software and documentation

Fortran software (“rdimma0”) to read IMMA is available within this website directory:

icoads.noaa.gov/software/

This software is widely portable, and reads IMMA record types with any legal attachment layout (including core-only records) into a convenient data structure. With minor modifications, the software can also be adjusted to write out IMMA records, once the input data are transformed and loaded into that same data structure—which has proven to be relatively straightforward for many marine data. This self-contained software (which requires only a Fortran compiler) contrasts with BUFR or other Table-Driven Codes (TDCs), which may also require large subroutine libraries for encoding/decoding.

Within the documentation, each IMMA field has a simple alphanumeric identifier (e.g., SST for sea surface temperature, and LAT for latitude). These identifiers, as well as legal ranges for each field and other constraints, are built into the software for ease of use.

The latest version of the attached (Appendix A to this Annex) IMMA documentation (imma.pdf) is available within this website directory:

icoads.noaa.gov/e-doc/imma/

Also stored in the directory are an abridged version of the report (imma_short.pdf), which omits the lengthy background material and provides only the format details contained in supplements C and D of the report, and a technical document (Pub47_IMMA.pdf) providing additional technical details on the blending of the VOS metadata (Kent et al. 2007a).

5. Future plans

For ETMC (and TT-DMVOS), the maintenance and evolution of the IMMA format in relationship to that of IMMT, plus possible convergence of the two formats, could be an important area of consideration. At present, for example (as noted above) attm C2 (IMMT-2/FM 13) has not been updated (nor a new attm defined) to incorporate changes made effective 1 January 2007 for IMMT-3. Similarly no plans been made yet to accommodate changes newly proposed for IMMT-4 (ETMC-II/Doc. 3.2). Moreover, COADS is a large and complex archive, which, in addition to reports from VOS, includes many from buoys and other automated Ocean Data Acquisition System (ODAS). Therefore, any proposals for IMMA format changes or for possible convergence with IMMT, would need to be thoroughly coordinated, and implemented with due consideration of cost and transition issues.

Under the new WMO Information System (WIS) the requirement has been expressed to move all observational GTS traffic (and possibly some other data exchanges) to use TDCs such as BUFR or CREX (ETMC-II/Doc. 3.3, WMO 1995). However, the TDCs are optimized for contemporary and operational data requirements, and the need to store all possible forms of meteorological data leads to a high degree of complexity—and the suitability of TDCs for permanent archival is undemonstrated.

Therefore, considering the success of the IMMA format in the research community and features that appear to make it very attractive for permanent archival, a possible future direction for JCOMM and ETMC might be to explore some limited convergence of IMMA with appropriate features of TDCs (e.g., establish cross-references between IMMA field names and BUFR/CREX table numbers; and demonstrated record export capability from BUFR/CREX so that modern records can be merged with historical records in ICOADS, thus helping to ensure the continued homogeneity of long-term climate evaluations).

Finalization of the historical attm (C5) is another important unresolved area. Careful planning will be needed to develop generalized C5 fields to store a selection of data commonly reported from early ships. This will be beneficial in making original data forms (e.g., Beaufort force numbers, tenths of sky clear or cloudy, and magnetic wind directions) readily available to researchers or to help facilitate readjustments into standardized units (e.g., a uniform retranslation of wind forces to m s^{-1} according to a scale other than WMO 1100).

Table 5 outlines some additional areas for future work, based on recommendations from the most recent MARCDAT and earlier workshops.

Table 5. Recommendations relating specifically to the IMMA format from MARCDAT-II (Kent et al. 2007b), which are tracked at: www.marineclimatology.net.[1]

Recommendations	*Individual observations*
21	Integrate datasets to ICOADS using IMMA attachments: The integration of appropriate datasets into ICOADS should be accomplished using IMMA attachments to provide ancillary information. Priorities for integration should include: information for the interpretation of cloud information including the solar elevation and the relative lunar illuminance from the Extended Edited Cloud Reports Archive (EECRA); and meteorological reports from research vessels.
33	Expand use of IMMA attachments for ICOADS: The role of IMMA attachments for incorporating quality control, bias, metadata and other non-standard information into ICOADS should be expanded. Tools and documentation should be developed to guide users in the conversion of datasets into IMMA format. GHRSST may be considered as a model for this.
35	User feedback: Need both user survey, and methods to capture the feedbacks and bias assessments (e.g., IMMA attachments) that can be provided by users and applications such as reanalyses.
Recommendations	*Gridded datasets*
71	ICOADS QC: The existing ICOADS QC should be kept intact. Collect alternative QC information and make available with IMMA attachments.

1. Another important technical issue for ICOADS is that currently available IMMA data prior to 1998 were implemented using the ICOADS end-user "LMRF" format as input, which contains fewer fields than IMMA, and lacks supplementary (original input) data (ref. Table 3). For ICOADS, a more inclusive conversion to IMMA, using the full-length production "LMR" format, is needed when resources become available. The LMR format contains important supplementary data, which should be tapped for fields not defined in LMRF but now available in IMMA (e.g., sea ice fields), or for fields planned for availability in IMMA when the historical attm is finalized (e.g., Beaufort wind force numbers).

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Appendix A to Annex VII

ARCHIVAL OF DATA OTHER THAN IN IMMT FORMAT:
The International Maritime Meteorological Archive (IMMA) Format

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Updated Report (14 March 2007)

Update of JCOMM-SGMC-VIII/Doc.17 submitted to:
Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM)
Working Group on MMS, Subgroup on Marine Climatology (SGMC)
Eighth Session, Asheville, NC, USA (10-14 April 2000)

Update of ETMC-I/Doc. 4.1, Appendix submitted to:
JCOMM Expert Team on Marine Climatology (ETMC)
First Session, Gdynia, Poland (7-10 July 2004)

Appendix of ETMC-II/Doc. 4.1 submitted to:
JCOMM Expert Team on Marine Climatology (ETMC)
Second Session, Geneva, Switzerland (26-27 March 2007)

Contents

Introduction

1. With increasing recognition of the importance of upgrading and maximizing the data available for analyses of the climate record (Barnett et al. 1999), efforts have intensified to digitize additional historical ship data (and metadata) that exist in many national logbook collections (Diaz and Woodruff 1999, Woodruff et al. 2004). Current efforts are focused on data during major gaps in the existing record, such as the two world wars, and adding 19th century and earlier data (e.g., Elms et al. 1993, Manabe 1999, García-Herrera et al. 2005, Woodruff et al. 2005).

2. 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 will 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.

3. This document describes an International Maritime Meteorological Archive (IMMA) format meeting these requirements, which is proposed for wider adoption by JCOMM. In addition to the exchange of newly digitized data, the format should also be useful for reformatting and more effective exchange (and archival) of existing national digital archives, including contemporary marine data. The format is already in use for the International Comprehensive Ocean-Atmosphere Data Set (ICOADS), for the Climatological Database for the World’s Ocean (CLIWOC) project

(García-Herrera et al. 2005), and helping to meet requirements of the Voluntary Observing Ship (VOS) Climate (VOSClim) project.

4. Following its introduction to the Subgroup on Marine Climatology (JCOMM 2000), the JCOMM-I (WMO 2001) Data Management plan tasked the Expert Team on Marine Climatology (ETMC) to finalize the format, with a view to eventual submission to the Commission for formal adoption (JCOMM 2004a). Publication of the format through a JCOMM Technical Report also has been suggested, most recently by the Second Session of the JCOMM Data Management Coordination Group (JCOMM 2007). Furthermore, the Second JCOMM Workshop on Advances in Marine Climatology (CLIMAR-II) (Parker et al. 2004), and the First and Second Workshops on Advances in the Use of Historical Marine Climate Data (MARCDAT) (Diaz et al. 2002, Kent et al. 2007b) have recommended continued usage and expansion of the format.

5. The Background section of this document (together with Supps. A-B) describes the evolution of meteorological codes, and a variety of existing formats used for exchange and archival of marine data. This material also discusses strengths and weaknesses in these formats that helped define the requirements for the new IMMA format. The existing Format Structure and alternative technical options for Format Implementation are discussed in the following sections.

Background

6. International agreement to systematically record weather observations in ships' logbooks was reached at the 1853 Maritime Conference held at Brussels (Maury 1854, JCOMM 2004b), but large quantities of earlier ship logbook records (largely pre-instrumental) are available extending back to about 1600 (Diaz and Woodruff 1999, García-Herrera et al. 2005). WMO introduced an International Maritime Meteorological (IMM) punched card format around 1951 (Yoshida 2004), and the international exchange of digitized logbook data in IMM formats was formalized by WMO (1963) Resolution 35 (Cg-IV). However, maritime nations had earlier programs to digitize historical ship logbook data, and copies of many of the available digital collections of historical logbook data were exchanged (e.g., on punched cards in unique national formats) through bilateral agreements. Many of these historical (plus real-time) data sources have been compiled into global collections such as the Comprehensive Ocean-Atmosphere Data Set (COADS; Woodruff et al. 1987, Woodruff et al. 1998), thus making marine data, presently covering more than 200 years, widely available to the climate research community. In recognition of its broad multinational basis, COADS was renamed the *International* COADS (ICOADS; Diaz et al. 2002, Parker et al. 2004, Worley et al. 2005).

7. By the 1920s ships started to transmit meteorological reports by wireless telegraph, and the Global Telecommunication System (GTS) was completed near the end of 1972. Telecommunicated data apparently were preserved (or survive) in digital form only starting about 1966, but since then GTS data from ships (and buoys) have evolved to form an increasingly important portion of the data mixture. It is important to note, however, that earlier changes in the telecommunication codes also heavily influenced the form of data as recorded in ships' logbooks. Major changes included the "Copenhagen Code" established by the International Meteorological Organization (IMO) in 1929 (WMO, 1994), and an international code effective starting in 1949 (MetO, 1948). Vestiges of the codes dating back to 1929, and of even earlier (primarily land-based) codes (NCDC 1960), persist in the SHIP (now FM 13) code used over GTS.

8. Manabe (2000) surveyed the documentation for changes in the SHIP code (and IMM formats) since about 1949 (see Annex VI in JCOMM 2000). This work has been updated and expanded, with the results now available in digital form for Web access (Yoshida 2004, 2007). In addition, it would be highly desirable to locate documentation for earlier codes and observing practices, and make it digitally available. Reports from WMO predecessor organizations such as IMO may provide information on the Copenhagen and earlier codes. National instructions for marine observers (Elms et al. 1993, Folland and Parker 1995) will also form crucial metadata, which appear increasingly important to describe the practices of earlier years (e.g., prior to the 1949 code change). For example, 19th century observing practices appear to have been based generally on

the 1853 Brussels Maritime Conference (JCOMM 2004b), but with some major national variations (see Supp. A).

9. Supplements A-B discusses a variety of internationally recognized or widely used formats for marine data, and compares these with the requirements for IMMA. Although valuable concepts and features can be derived from many of these formats, none provided a satisfactory solution.

10. This conclusion extended to more recently defined Table-Driven Codes (TDCs): the Binary Universal Form for the Representation of meteorological data (BUFR) and the Character form for the Representation and EXchange of data (CREX) (WMO 1995). Under the new WMO Information System (WIS) the requirement has been expressed to move all observational GTS traffic (and possibly some other data exchanges) to use TDCs. However, TDCs are optimized for contemporary and operational data requirements, and the need to store all possible forms of meteorological data leads to a high degree of complexity—moreover the suitability of TDCs for permanent archival is undemonstrated. Therefore, over the longer term, it may be useful to explore some limited convergence between IMMA and appropriate features of TDCs (e.g., establish cross-references with IMMA field names; and ensure standardized record export capabilities, so that data from TDCs can be merged with historical records in ICOADS).

Format Structure

11. A new format is needed to help facilitate data entry, provide for the more effective exchange of existing national archives, and ensure that the data and metadata are preserved as accurately and completely as possible. Drawing on features from the existing formats discussed in Supps. A-B, the IMMA format seeks to provide a flexible solution to the problem of storing both contemporary and historical marine data. Following are additional goals, which the proposed design attempts to balance in terms of costs and benefits:

(a) The format should be practical for Member countries to implement, and end-users to read and manipulate, using a variety of computer technology. This includes making computer input and output of fields more straightforward by elimination, where practical, of complex data encoding and mixtures of character and numeric data.
(b) The fields within the format should be organized into logical groupings to bring related data and metadata together. A field layout that will facilitate sorting records, e.g., into synoptic order is also a consideration.
(c) It is impractical to anticipate in advance all the storage requirements for older historical data, much less for future observing systems and reporting practices. Therefore, the format should be flexible in providing space for supplemental data (to be defined by Member countries). A related issue (not addressed in detail in this report) is the need for a system by which Members would provide documentation (preferably in electronic form) for the origin and configuration of the supplementary data.
(d) The format should also be expandable in more general terms to meet future or modern data requirements. Careful version control will therefore be required.
(e) Many end-user requirements can be satisfied from a small number of fields, thus an abbreviated, fixed-length record type is attractive as one option. On the other hand, archival requirements include the retention of all useful fields, and may best be satisfied in some cases by variable-length records.
(f) Progress has been made in linking ship metadata (WMO 1955–) to individual marine reports (e.g., Josey et al. 1998, Kent et al. 2007a), and the format should allow for anticipated metadata requirements (e.g., anemometer heights).
(g) Important additional considerations are storage efficiency, and format documentation logistics.

12. The design of the format proceeded as follows: A wide range of fields was considered for IMMA based on comparisons of existing codes and formats (e.g., Supps. A-B). Fields suggested for international standardization, plus those already controlled by WMO, are described in Supp. D. Selected fields were assembled as described in Supp. C into an IMMA "core," which provides the common front-end for all IMMA record types. The core was divided into two sections:

- "location" section: for report time/space location and identification elements, and other key metadata
- "regular" section: for standardized data elements and types of data that are frequently used for climate and other research

13. Supp. C further describes "attachments" (attm) that may follow the core to produce different IMMA record types. One attm, for example, can be used to store supplementary data of indeterminate type, and of fixed- or variable-length. In addition to the abbreviated record formed by the core itself, two additional record types are outlined in Supp. C:

- VOSClim record
- historical record (proposed)

(Variations on these record types are currently being constructed by attaching different mixtures of the defined attachments to the core).

Format Implementation

14. Some of the field configurations, field assignments, and record designs are already in use—others are preliminary. Additional fields not listed in Supps. C-D, particularly for older historical data (e.g., Tables A1-A2 in Supp. A), may also be desirable after further planning and research. The entire plan should benefit from discussion and feedback from Member nations. However, even if a revised approach is chosen, the existing design should still provide a starting point for defining the overall data and metadata content that is needed to address both historical and contemporary requirements, with appropriate consideration of data continuity issues of key importance to climate and global change research.

15. The unification of major data elements into modern units is crucial to make data easily usable for research applications. However, questions arise about how to standardize conversions and ensure that they are correctly implemented. In some cases it may be preferable for Member nations to provide only the old codes (e.g., as supplementary data), and leave the regular data elements missing awaiting a uniform conversion through WMO Members or at a World Data Center. A complementary approach may be to make standardized units conversion software more widely available (e.g., a Fortran software library for this purpose, which is under development as part of the ICOADS project for data adjustments and time conversions, is available at this website: icoads.noaa.gov/software/lmrlib).

16. For some major data types the IMMA field structure proposes separate fields in the historical attm for older codes (e.g., cloud amount in tenths), as well as including space in the regular data section for the data element converted to modern codes (oktas). In other cases, only modern codes are, thus far, provided, e.g., time converted from historical Local Standard Time (LST) to UTC. Potentially, however, some indicators could be expanded to indicate the presence of pre-standardized data. For example, the configuration of the time indicator (*TI*) could possibly be expanded to include a new value indicating that *YR*, *MO*, *DY*, and *HR* are LST. Alternatively, the LST values could be stored as supplementary data.

17. Currently IMMA has been defined (Supp. C) using a fixed-field format, similarly to WMO's existing IMM formats. Another possibility under consideration was a delimited (by spaces, commas, quotes, tabs, etc.) format, which might integrate more easily with PC-based database and spreadsheet applications (e.g., for digitization of new data). However, the delimited approach does not set limits on the sizes of fields, and thus is susceptible to errors in those sizes and other problems. In the longer-term, emerging technologies such as the Extensible Markup Language (XML) might also become relevant (XML may begin to supersede HTML for the next generation Web; and it offers a defined syntax, parsing software, and powerful self-descriptive capabilities).

18. The IMMA format is proposed for long-term archival and wide exchange of data, therefore, stability, ease of documentation, and wide machine-portability all need to be important considerations. A fixed-field approach, using blank as the universal representation for missing data (for technical reasons discussed in Supp. D), is suggested as the most efficient and robust solution

available at this time. Conversion of data in other forms to a uniform IMMA format is recommended prior to data exchanges, but it is possible that generalized software could be developed for this purpose to facilitate translations by Member countries of delimited data, for example, to a fixed-field format.

19. We are using VOSClim data requirements as one initial test-bed for prototyping IMMA. VOSClim is utilizing GTS and IMMT reports, plus comparisons (output in BUFR) of the reported GTS data against a UK numerical weather prediction (NWP) model. The VOSClim record type includes all the data fields anticipated necessary for VOSClim (315 characters), plus the complete original input format data string in the supplemental attm of each report (total record-length depending on data source). This supplementary approach provides a reliable mechanism for data recovery in the event of conversion errors, and storage for any data elements not carried across into other IMMA fields. The full IMMA records including the attached original supplemental data are planned for permanent archival.

20. For the GTS message strings we are using a variable-length supplemental attm, terminated by a line feed (Unix-style line termination). However, variable-length records need not necessarily be provided to users; instead, for example, a fixed-length record type can be created from the variable-length records.

21. Storage in IMMA of binary (e.g., BUFR) data may require a scheme like “base64” encoding (Borenstein and Freed 1993) to obtain well-behaved, printable ASCII data. Base64 encoding, however, has the disadvantage of increasing data volume by about 33%. Simple “base36” alphanumeric (0-Z) encoding is being used to reduce the storage requirements for some record control or secondary data elements (Table 1).

Table 1. Base36 encoding. Decimal numbers and base36 equivalents. The complete set of 1-character encodings (0-35) is listed on the left, and examples of 2-character encodings (0-1295) are given on the right. Note that the subset 0-F of base36 is the same as hexadecimal.

1-character encoding:								E.g. 2-character encoding:	
dec.	base36	dec.	base36	dec.	base36	dec.	base36	dec.	base36
0	0	10	A	20	K	30	U	0	0
1	1	11	B	21	L	31	V	1	1
2	2	12	C	22	M	32	W	2	2
3	3	13	D	23	N	33	X	.	.
4	4	14	E	24	O	34	Y	.	.
5	5	15	F	25	P	35	Z	.	.
6	6	16	G	26	Q			1293	ZX
7	7	17	H	27	R			1294	ZY
8	8	18	I	28	S			1295	ZZ
9	9	19	J	29	T				

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Supplement A: Existing Formats and Codes

The following sections describe major existing formats and codes used for: (a) early historical ship logbook data, including the first internationally agreed logbook design (see Maury 1854); (b) digitization and exchange of logbook data; (c) GTS transmission; and (d) storage and archival of contemporary and historical marine data. The existing formats are contrasted with the requirements for IMMA. Additional archival formats with similar characteristics have been defined nationally, but are not discussed in further detail (e.g., the German Seewetteramt archive, the Russian Marine Meteorological “MARMET” archive, and the UK Main Marine Data Bank).

Early historical logbook formats

Table A1 provides examples of the data and metadata elements that were specified in the “Abstract Log” defined in Maury (1854), or were available in ship logbook examples from different collections. In addition to the listed elements, 19th century and some earlier logbooks generally had latitude/longitude observed (or by dead reckoning) once a day (at local noon), and were laid out for meteorological observations at regular intervals (see also García-Herrera et al. 2005, Woodruff et al. 2005). Many early logbooks (including 18th century examples in Table A1) contained columns labelled “H, K, F”, where H=hour, K=knots, and F=fathoms (knots and its subunit fathoms measured the amount of line run out with the log to determine the ship’s speed).

Table A1. Data and metadata elements present (“•”) in early ship logbook data. An example logbook was examined from each of five different collections, plus published “Abstract Log” specifications from the 1853 Brussels meeting. The columns are labelled as follows including the year of the example logbook (or of the Maury, 1854 publication):

WWI: US Merchant 1912-46 Collection (US Form No. 1201-Marine, 1910).
MMJ: US Marine Met. Journals (1878-94) (Woodruff et al. 1987, Fig. 1).
Nor.: Norwegian Logbooks (1867-99) (Diaz and Woodruff 1999, pp. 100/102).
M(2): Maury (1854) Abstract Log specifications.
M(1): Maury Collection (Diaz and Woodruff 1999, title page).
EIC: British East India Company (EIC) logbook (ibid. p. 70).

Note that some additional elements are not listed, and logbook forms and contents varied widely in some of the collections. The two 18th-century examples had textual remarks about wind and weather (García-Herrera et al. 2005), and ship name was assumed available from other metadata. Weather entries with 18 or more symbols are variants of the Beaufort weather system (e.g., WMO 1994, p. III-1).

	WWI	MMJ	Nor.	M(2)	M(1)	EIC
Data elements:	1918	1887	1873	1854	1797	1734
observations per day (maximum)	1	12	6	14	24	24
ship’s speed and courses		•			•	•
wind direction (M=magnetic; T=true)	T	M	T (?)	M	M	M
wind force (code range or text)	0-12	0-12	0-6	0-11	text	text
weather (number of symbols or text)	>18	18	5	4	text	text
remarks	•	•	•	•	•	•
current direction/rate (daily in MMJ)		•		•		
barometer and attached thermometer	•	•	•	•		
sea surface and air (dry bulb) temperature	•	•	•	•		
wet bulb temperature	•	•		•		
form/direction of clouds	•	•		•		
tenths of sky clear (X) or cloudy (C)	C	X	C	X		
sea state (number of symbols or numeric code)		9	0-9	(?)		
Metadata elements:						
ship name	•	•	•	•	•	•
type of vessel (e.g., sailing, steamer, bark)	•	•	•			
instrumental characteristics	•	•	•	•		

WMO International Maritime Meteorological (IMM) formats

The International Maritime Meteorological Punched Card (IMMPC) format was introduced around 1951 (Yoshida 2004). With advances in computer technology beyond 80-character Hollerith punched cards, an expanded International Maritime Meteorological Tape (IMMT) format was initiated starting in 1982, as an alternative to IMMPC. These two formats (referred to collectively as "IMM") were designed with the primary purpose of the exchange of keyed logbook ship data starting around 1963 for implementation of the Marine Climatological Summaries Scheme (MCSS) under WMO (1963) Resolution 35 (Cg-IV).

The IMM formats have been modified a number of times to keep pace with changes in the SHIP (presently FM 13-XI) code (Yoshida 2004, Supp. B). Changes effective 2 November 1994, for example, brought IMMT-1 (as the 2 November 1994 version is termed) into close, but not identical, agreement in content with the SHIP code. More recently (WMO 2001, JCOMM 2005), changes were made (IMMT-2 and IMMT-3) mainly in response to the VOSClim project (e.g., to retain relative wind data and other new elements, so that true wind speed and direction could be revalidated in delayed mode). Currently, further proposed revisions to the format (IMMT-4) are under discussion.

Supplementary punching procedures (see Supp. B) were also devised with the view towards exchange of "deviating codes or additional data" including some earlier historical codes (e.g., Appendix F, Part B of WMO 1959). But it is not clear whether the supplementary procedures were widely used, and they fail to adequately address present-day requirements for retention of the original form of data and more complete metadata.

Additional historical (1889-1940) data from Japan's Kobe Collection were recently digitized (Manabe 1999, JWA and JMA 2003). Owing to the lack of an international historical format for data exchange, IMMT-1 format was used. Table A2 provides examples of the types of historical Kobe information that it was not possible to store in IMMT-1, but that IMMA should seek to retain.

Table A2. Examples of elements that were omitted, or subject to conversion to modern codes, in the 1998 edition of Kobe Collection data (Manabe 1999). Original information generally was recorded in an "interim" format, and Manabe (1999) documented the conversion of elements. The final JWA and JMA (2003) edition stored similar information in a separate "metadata" format.

Elements omitted	Elements subject to conversion/adjustment
temperature of barometer's attached thermometer	Fahrenheit temperatures
barometer height (meters above sea level)	barometric pressure
type of barometer	Beaufort wind force
specific gravity of sea surface water	32-point wind directions
direction and speed of sea surface current	early wave/swell codes
weather and visibility	cloud amount in tenths

Omission of important data and metadata elements that do not fit into the current SHIP code and IMM format is undesirable in case the elements are ever needed. For example, an indicator for the type of barometer would permit stratification of data from mercurial and aneroid barometers. Some conversions to modern codes (e.g., of temperatures from Fahrenheit or Réaumur to Celsius) are relatively straightforward and computationally reversible (if properly implemented). In such cases the complexity of IMMA can be reduced by converting and storing the temperature elements in Celsius, but also including indicators to preserve information about the original units and form (e.g., whole degrees) of the data (plus possible reference to conversion algorithms used on the data).

In contrast, the conversion of cloud amounts from tenths to lower-resolution oktas is not fully reversible (WMO 1994 discusses this and other conversion biases), and the original tenths values should therefore be retained. Inadvertent conversion (software) errors should be noted as another potential source of data biases and irreversible conversions. Preserving original data is particularly important for complex conversions, in case better algorithms are developed in the future. Two examples: (a) Mapping of Beaufort wind force numbers, and estimated wind speeds in knots or meters per second (not necessarily following recognized midpoints of the Beaufort equivalence scale), to a new equivalence scale. (b) Recalculation of complex mercurial barometer adjustments (instrument error, temperature, gravity, and height if available).

Alphanumeric telecommunication codes

Marine reports (and many other meteorological data) are still transmitted over GTS in alphanumeric formats, with roots in early synoptic telecommunication codes (NCDC 1960). The form and content of ship logbook data is also closely related to the telecommunication codes, so documentation of their evolution (e.g., since MetO 1948) represents key metadata to seek to ensure data continuity. Only recently, however, have efforts begun to locate and assess the documentation for these code changes (Yoshida 2004, 2007).

Individual weather elements, each described by one or more symbolic letters, are assembled into "code groups," each generally five digits in length. For example, s_S and $T_WT_WT_W$ are the symbolic letters for the sign and type of measurement of sea surface temperature, and the SST measurement proper. When replaced by actual numeric data, and prefixed by an identifying zero, these are assembled into the 5-digit code group $0s_ST_WT_WT_W$. Note that the symbolic letters serve an important role in providing a precise mechanism for communication among people about the data, although subscripts for many of the symbolic letters render them more difficult to employ, e.g., for labelling a computer printout.

A specified (WMO 1995) sequence of code groups then composes an individual report in a given "code form," such as FM 13. Lastly, collectives of reports are assembled into larger "bulletins" for transmission, adding information such as the UTC day and time of bulletin preparation in an overlying message envelope. Note that FM 13 reports include only the day of the month and UTC hour; year and month are not defined in the FM 13 message and must be derived by the GTS receiving center. These and other technical features served to optimize the format for GTS transmission, e.g., by minimizing data volume. Perhaps as a consequence, however, few raw GTS messages have been archived. Instead data have been decoded into subsidiary archive formats. For example, NOAA's National Centers for Environmental Prediction (NCEP) for many years translated marine GTS data into a format known as Office Note 124 (ON124). The downside of this approach is that any errors made, or data omitted, in the process of such a conversion may be unrecoverable unless the raw data are permanently archived.

WMO Table-Driven Codes (BUFR/CREX)

The Binary Universal Form for the Representation of meteorological data (BUFR) and the Character form for the Representation and EXchange of data (CREX) are Table-Driven Codes (TDCs; WMO 1995) proposed eventually to replace the earlier alphanumeric codes, including FM 13. BUFR is a binary code generally limited to storage of data in SI units (e.g., temperatures are stored in Kelvins). In contrast, CREX is an alphanumeric code that allows more flexibility on data units. Reports encoded into these formats are self-descriptive in that a hierarchy of tables is referenced to indicate which data elements are included, and their exact form. This introduces some volume overhead into each message, but provides flexibility in the data structure, and the master table definitions can be modified and tracked in the WMO (1995) *Manual on Codes*.

In CREX, for example, table references "B 11 011" and "B 11 012" specify wind speed and direction. In FM 13, in contrast, these elements are abbreviated by symbolic letters "dd" and "ff" (dd was in use since at least 1913 in the International Synoptic Code; NCDC 1960). As noted above, the existing symbolic letters can provide an important communication mechanism among producers and users of the data. A similar user-friendly mechanism, and linkage with the historical synoptic codes, does not yet appear to exist in TDCs. Moreover, the complexity of TDCs appears to require large computer programs for data encoding and decoding in full generality. The need to rewrite complex software at multiple sites to interface with local requirements (e.g., countries digitizing data) would raise software reliability questions and potentially lead to data continuity problems.

Data continuity is of critical importance for climate research. Plans under the new WMO Information System (WIS) to transition from alphanumeric formats such as FM 13 to TDCs should anticipate a long period of overlap and careful cross-validation to ensure that no data resolution, elements, or configurations are lost. The experience of NCEP in transitioning to BUFR in 1997 is instructive. Initially for marine data in NCEP's version of BUFR, some data elements were omitted, and some data resolution was lost, e.g., in temperatures (Table A3). Several known problems have now been addressed (Woodruff 2004), but additional thorough checks still appear needed to ensure that all elements of FM 13 (and FM 18 BUOY) are adequately retained in BUFR. Fortunately, NCEP included the input raw GTS report as part of the resultant BUFR message, thus providing a means for recovery of any missing or inaccurately converted data.

Table A3. Examples of initial data continuity problems in NCEP's version of BUFR marine GTS data, based on comparisons for March 1997 data.*

Temperature biases (0.1°C)	Usage of the standard factor 273.15 for conversion of Celsius temperatures, and rounding to tenths Kelvin precision (which until approximately 17 Feb. 1999 was the maximum precision available), lead to some unrecoverable temperature errors of 0.1°C.
Wind speed indic. (measured/est.)	Indicator omitted until approximately 21 October 1997.
Wind codes	Incomplete conventions to store originally reported FM 13 code combinations for calm and variable winds.
Cloud amounts	Oktas converted to percent, such that BUFR did not preserve the distinction between code figures 9 (sky obscured by fog, snow, or other meteorological phenomena), "/" (cloud cover indiscernible for reasons other than code figure 9, or observation is not made), and a missing code figure.

* Starting in March 1997, data are available processed by NCEP into BUFR. In addition, overlapping data were processed into NCEP's previous ON124 format until 19 April 1997. Limited comparisons were made between the overlapping BUFR and ON124 data, and also against BUFR data encoded by the US Navy (icoads.noaa.gov/real-time.html). Some of the data continuity problems were later alleviated, as noted. Woodruff (2004) provided a set of updated comparisons.

Historical Sea Surface Temperature (HSST) Data Project formats

The Historical Sea Surface Temperature (HSST) Data Project, begun in 1964 (WMO 1985), designated a highly abbreviated “Exchange” format (see supplement I in Slutz et al. 1985) for “collection and summarizing of marine climatological data for the period 1861 to 1960” (WMO 1990). The project was focused on SST and a few other key variables. That focus plus technical limitations at the time of format design lead to the omission of important data and metadata elements (e.g., weather, cloud types, waves, and ship identification). Some data may have been digitized especially for the HSST project, and large amounts of data in the HSST format were included, e.g., in ICOADS. To some extent, therefore, national archives may still contain more complete marine reports than are presently available internationally. Efforts to exchange such data in the future may be warranted to extend and complete portions of the archive, and the design of the IMMA format should keep that possibility in mind.

Dual-record digitization formats

Recent Norwegian, UK, and US digitization projects have used a “dual-record” approach for keying historical records (e.g., Elms et al. 1993). This is as opposed to a “single-record” approach, in which one physical record is created for each marine “report” (i.e., the collective of observations reported by a ship at one time and place). The single-record approach is followed in the IMM formats, and IMMA. In contrast, the dual-record approach closely follows the organization of paper logbook (or log sheet) records, which frequently are organized into metadata that describes the ship or voyage(s), and then meteorological records taken one or more times a day. Each record of the first type, referred to as a “header” record, is then linked to multiple “observational” records via a “control number.” Although it is not always feasible to key all entries in the logbooks (e.g., free-form Remarks), as many elements as possible have been included because of the difficulty and expense of handling paper (or microfilm) records, including the possibility that they will no longer be accessible (e.g., in the event of media degradation).

An important feature of the dual-record efforts has been the inclusion of reports without latitude and longitude, which typically were recorded only at local noon in early records due to navigational constraints. During conversion into a single-record format, interpolation is performed and a flag set to distinguish interpolated from originally reported (or port) positions. For instance, in the US 1878-94 Marine Meteorological Journal Collection, digitized by China, meteorological observations were entered at local 2-hourly intervals (2, 4, 6, 8, 10, 12 a.m., and p.m.), thus omission of the intervening observations would yield only 1/12 of the recorded data. The frequency of observations should make this Collection attractive for studies of diurnal variations.

The dual-record approach has advantages of reducing keying and data volume, and also organizes a given voyage or stream of data into a sequence for “track” checking and other quality controls. However, the requirement for two types of records can lead to problems if not carefully implemented, which are probably best resolved by the digitizing country (e.g., if an error occurs in assigning control numbers, this represents a single point of failure that could lead to the non-usability of an entire voyage). Therefore, we recommend the dual-record format approach to countries for possible initial preparation and quality control of digitized historical ship data, but feel that a more easily standardized single-record approach should be used in IMMA for the exchange of quality controlled data. The transformations from dual-record formats to a single-record format are conveniently handled and cross-checked with computer software programs.

ICOADS Long Marine Report (LMR) formats

For past ICOADS "delayed-mode" production processing, input individual marine reports in a variety of formats have all been converted to the Long Marine Report (LMR, currently version 6; LMR6) format. This is a variable-length packed-binary format, containing a fixed-length portion, followed by a variable-length portion. The fixed-length portion contains commonly used marine data elements (from both ships and buoys), and is divided into a "location" and "regular" section. The location section contains elements such as time/space location and source identification of the report. The regular section contains the observational data (e.g., sea surface and air temperatures, humidity, wind, air pressure, cloudiness, and waves). (A fixed-length version of LMR, LMRF, is distributed for research applications.)

The variable-length portion of LMR contains a series of "attachments" (e.g., containing detailed quality control information). Two of these, the supplemental and error attachment, vary in size. The supplemental attachment is used to store elements from the original (input) format (character or binary data) that will not fit into the location or regular sections, or whose conversion is questionable. The error attachment stores fields from the original format that contained errors (e.g., illegal characters or values out of range) when an attempt was made to convert them into regular LMR fields. The attachment feature of the LMR format was designed to be extensible, in that new attachments can be added as needed.

Supp. B compares fields from the LMR regular and location sections, with fields available in the IMM formats. Some fields or expanded field configurations defined for LMR appeared desirable to carry forward into IMMA. In addition, the LMR attachment feature provided a valuable model for flexible retention of data that is utilized in a somewhat different form for IMMA.

Note: LMR documentation is referred to in the following Supps. Current documentation (at this writing dated 18 July 2006) can be reviewed at website:

icoads.noaa.gov/e-doc/lmr

US National Climatic Data Center (NCDC) TD-11 formats

Much of the data included in COADS Release 1 (Slutz et al. 1985) prior to 1970 were obtained from NCDC in Tape Data Family-11 (TDF-11) format (NCDC 1968). This ASCII format had a fixed record-length of 140 characters. Positions 64-140 within the 140-character record-length were set aside for supplementary data fields. The supplementary fields varied in content and length (with trailing blanks as needed to extend through 140 characters) according to source "deck" (originally named for punched card decks). By this method, data elements that were unique to a given deck, or whose conversion might be questionable, could be preserved for future reference. This feature served as a useful model in development of the LMR supplementary attachment. COADS Release 1 (1854-1979) data were made available at NCDC in similar formats (NCDC 1989a, NCDC 1989b).

Supplement B: Comparison of WMO IMM and ICOADS LMR Formats

Table B1 compares two of JCOMM's more recent IMMT formats (IMMT-2 and IMMT-1) with selected past IMMT and IMMPC formats, thus illustrating the evolution of the (collectively) "IMM" formats since their wide adoption around 1963 (prior to 1982 there were only the 80-character punched card formats; in 1982 the tape format was added as an alternative). Some portions of the code were relatively stable over the time period since 1963 (e.g., clouds and temperatures), whereas others were subject to significant change (e.g., wave fields). Table B1 also indicates fields that were present in the ship code at least since the 1940s (MetO 1948). Fields from the ICOADS LMR formats also are compared in Table B1. Table B2 lists the quality control flags available in IMMT-2 and IMMT-1.

IMM formats such as those surveyed in Table B1 were primarily defined for exchange of then contemporary data under WMO's (1963; Cg-IV) Resolution 35. In addition, supplementary punching procedures were defined for "exchange of cards with deviating codes or additional data." Table B3 provides examples of the earlier codes and other information that could be represented by using the 1963 version of the supplementary procedures.

Table B1. The IMMT-2 format (WMO 2001) comprises the 93 elements (151-character record-length) listed in this table. The IMMT-1 format, which became effective 2 November 1994, is a subset of IMMT-2 consisting of its first 85 elements (131-character record length). The columns in this table contain the following information:

1-4: Field number (No), field width (Chars.), code (symbolic letters, or "•" for a field without assigned symbolic letters), and element description (blank indicates missing).

5: Corresponding LMR6 field abbreviation, if any (indirectly related fields are listed in parentheses). Field names followed by "Δ" include additional resolution or information in comparison to IMM.

6-8: These columns contain "•" if the specified earlier IMM format contained approximately the same information. Different symbolic letters are listed in the event of changes, or "Δ" marks some significant field changes that are known to exist. An arrow ("→") in the 1963 column indicates that approximately the same information was defined in the "full message" as reported from Selected Ships (MetO 1948).

Selected fields unique to the LMR formats, or to the IMMPC formats, are interleaved for reference (alternative and additional fields were available under supplementary IMMPC procedures; see Table B3). Temperature sign positions and other information in IMMPC formats were specified using card over-punches, as indicated by "op." Wind speeds were earlier represented only as whole knots (kts), and more recently either as whole kts or whole ms^{-1}. Additional IMMPC formats were defined as far back as 1951 (Yoshida 2004), and there were also intermediate format changes not shown, such as effective 1 March 1985 (adding i_X, which had been added to the GTS code in 1982).

No	Chars	Code	Element description	LMR	IMMT 1982	IMMPC 1968	IMMPC 1963
1	1	i_T	format/temp. indic.	*T1 Δ*	•	Δ	•
2	2-5	AAAA	year UTC	*YR*	AA	•	•
3	6-7	MM	month UTC	*MO*	•	•	•
4	8-9	YY	day UTC	*DY*	•	•	• →
5	10-11	GG	time of obs. UTC	*HR Δ*	•	•	• →
			time indicator	*TI*			
6	12	Q_c (Q*)	quadrant (octant)		Q	•	• →
			10° box	*B10*			
7	13-15	$L_aL_aL_a$	latitude	*LAT Δ*	•	•	•
8	16-19	$L_oL_oL_oL_o$	longitude	*LON Δ*	$L_oL_oL_o$	•	•
			latitude/long. indic.	*LI*			
9	20	•	h and VV indic.	*HI + VI*	•	op**	•
10	21	h	height of clouds	*H*	•	•	•
11	22-23	VV	visibility	*VV*	•	•	• →
12	24	N	cloud amount	*N*	•	•	• →
			wind direction indic.	*DI*			
13	25-26	dd	wind direction (true)	*D*	•	•	• →
14	27	i_W	wind speed indicator	*WI Δ*	•	Δ***	Δ***
15	28-29	ff	wind speed (kts/m s^{-1})	*W*	•	Δ (kts)	• →
			Beaufort wind force			•	•
16	30	s_n	sign of TTT	*(AT)*	•	op	•
17	31-33	TTT	air temperature	*AT*	•	•	• →
18	34	s_t	sign of $T_dT_dT_d$	*(DPT)+ T2*	•	op	•
19	35-37	$T_dT_dT_d$	dew-point temp.	*DPT*	•	•	• →
20	38-41	PPPP	air pressure	*SLP*	•	•	• →
21	42-43	ww	present weather	*WW*	•	•	• →
22	44	W_1	past weather	*W1*	•	W	• →
23	45	W_2	past weather	*W2*	•		
24	46	N_h	amt. of lowest clouds	*NH*	•	•	• →
25	47	C_L	genus of C_L clouds	*CL*	•	•	• →
26	48	C_M	genus of C_M clouds	*CM*	•	•	• →
27	49	C_H	genus of C_H clouds	*CH*	•	•	• →
28	50	s_n	sign of SST	*(SST)*	•	op	•
29	51-53	$T_wT_wT_w$	sea surface temp.	*SST*	•	•	•
			air-sea temp. diff			•	• →
30	54	•	indic. for SST meas.	*SI Δ*	•	op	

No	Chars	Code	Element description	LMR	IMMT 1982	IMMPC 1968	IMMPC 1963
31	55	•	indic. for wave meas.		•		
			wave period indicator	*WX*			
			wave direction	*WD*		•****	# →
32	56-67	P_WP_W	per. wind waves/meas.	*WP*	•	•	P_W →
33	58-59	H_WH_W	ht. wind waves/meas.	*WH*	•	•	• →
			swell period indicator	*SX*			
34	60-61	$d_{W1}d_{W1}$	dir. of predom. swell	*SD*	•	d_Wd_W	#
35	62-63	$P_{W1}P_{W1}$	per. of predom. swell	*SP*	•	P_W	•
36	64-65	$H_{W1}H_{W1}$	ht. of predom. swell	*SH*	•	•	•
37	66	I_s	ice accretion on ship	*IS*	•		
38	67-68	E_sE_s	thickness of I_s	*ES*	•		
39	69	R_s	rate of I_s	*RS*	•		
40	70	•	observation source	*OS*	•		
41	71	•	observation platform	*OP*	•		
			deck	*DCK*			
			source ID	*SID*			
			platform type	*PT*			
			ID indicator	*II*			
42	72-78	•	ship identifier	*ID* Δ	•	##	##
43	79-80	•	country recruited ship###	*C1*	•	•####	•
			2nd country code	*C2*			
44	81	•	(national use)		•		
45	82	•	quality control indic.		•		
46	83	i_X	station/weather indic.	*IX*			
47	84	i_R	indic. for precip. data		•		
48	85-87	RRR	amount of precip.		•		
49	88	t_R	duration of per. RRR		•		
50	89	s_w	sign of $T_bT_bT_b$	*(WBT)+ T2*	•	op	op
51	90-92	$T_bT_bT_b$	wet-bulb temperature	*WBT*	•	•	•
52	93	a	characteristic of PPP	*A*	•		→
53	94-96	ppp	amt. pressure tend.	*PPP*	•		→
54	97	D_s	true direction of ship	*SC*	•		→
55	98	v_s	ship's average speed	*SS*	•		→
56	99-00	$d_{W2}d_{W2}$	dir. of second. swell		•		
57	101-2	$P_{W2}P_{W2}$	per. of second. swell		•		
58	103-4	$H_{W2}H_{W2}$	ht. of second. swell		•		
59	105	c_i	concentration of sea ice		•		
60	106	S_i	stage of development		•		
61	107	b_i	ice of land origin		•		
62	108	D_i	true bearing ice edge		•		
63	109	z_i	ice situation/trend		•		
64	110	•	FM 13 code version			&	&
65	111	•	IMMT version				
66-86	112-132	Q_1-Q_{21}	QC indicators (see Table B2)		•		
87	133-5	HDG	ship's heading				
88	136-8	COG	course over ground				
89	139-40	SOG	speed over ground				
90	141-2	SLL	max.ht.>sum load ln.				

No	Chars	Code	Element description	LMR	IMMT 1982	IMMPC 1968	IMMPC 1963
91	143-5	$s_L$hh	dep. load ln.: sea lev.				
92	146-8	RWD	relative wind direction				
93	149-51	RWS	relative wind speed				

* Initially available IMMT-1 format documentation inadvertently listed octant instead of quadrant, and some data were exchanged using octant until Member countries were informed via correspondence.
** Overpunches on h and VV for measured data; an additional overpunch on VV for fog present but VV not reported.
*** In the 1968 version, a separate field indicated estimated or measured (36-point compass) wind data. In the 1963 version, an overpunch on wind direction indicated measured data.
**** Field allotted but: "Not reported. Not to be punched."
# WMO Code 0885 with symbolic letters $d_W d_W$ is listed for 1963 (documentation has not yet been located for this code). WMO Code 0877 with the same symbolic letters is listed for the 1968 version forward (only to be used for swell direction), but the symbolic letters changed to $d_{W1} d_{W1}$ in 1982.
In the 1968 version, there was an optional field for ship or log number. In the 1963 version, ship or log number could be entered according to supplementary punching procedures (Part B).
Change from numeric to alphabetic ISO codes effective 1 January 1998.
Overpunch for auxiliary ships (not part of the 1963 format).
& A "Card indicator" field: punched according to the WMO Codes effective in year AA, or according to supplementary procedures (Part B).

Table B2. QC indicators included in IMMT-2. All except number 86 were also included in IMMT-1. Detailed QC information is also available in the LMR formats.

No	Chars.	Code	Applicable elements (from Table B1)
66	112	Q_1	h
67	113	Q_2	VV
68	114	Q_3	clouds (12, 24-27)
69	115	Q_4	dd
70	116	Q_5	ff
71	117	Q_6	TTT
72	118	Q_7	$T_dT_dT_d$
73	119	Q_8	PPPP
74	120	Q_9	weather (21-23)
75	121	Q_{10}	$T_wT_wT_w$
76	122	Q_{11}	P_wP_w
77	123	Q_{12}	H_wH_w
78	124	Q_{13}	swell (34-36, 56-58)
79	125	Q_{14}	i_RRRRt_R
80	126	Q_{15}	a
81	127	Q_{16}	PPP
82	128	Q_{17}	D_s
83	129	Q_{18}	v_s
84	130	Q_{19}	$T_bT_bT_b$
85	131	Q_{20}	ship's position
86	132	Q_{21}	minimum QC standards (MQCS) version identification

Table B3. Examples of additional and alternative fields defined under supplementary punching procedures (Part B) in the 1963 version of the IMMPC format. If indicator fields were set, portions of the regular 80-character punched card held different forms of information such as listed. The documentation regarding Part B seemed to discourage use of the supplementary procedures in stating: “data for former years which have not yet been punched should wherever possible be put in the international maritime meteorological punched card (Part A).”

Field	Code punching alternatives
location	Marsden Square, 1°, and 1/10° or 1/6° units of latitude/longitude
	Ocean station vessel location
visibility	90-99 or 00-89 (WMO Code 4377, 1955)
sea and/or swell	WMO Code 75 (1954)
	Douglas or Copenhagen 1929 scales
	Paris 1919 scale
	Berlin 1939 scale
	WMO Code 1555; 50 added to d_Wd_W to indicate H_W > 9 half-meters
ice data	c_2, K, D_i, r, and e (WMO Codes 0663, 2100, 0739, 3600, and 1000)
Beaufort weather	German and British systems
ship course/speed	D_s , v_s (WMO Codes 0700 and 4451)
pressure tendency	a (WMO Code 0200) and pp
precipitation data	RR, t_Rt_R (WMO Codes 3577 and 4080)
cloud data	N_S, C, h_Sh_S (WMO Codes 2700, 0500, and 1577)
special phenomena	regional WMO Codes

Supplement C. Record Types (revised 14 March 2007)

The IMMA core (Table C0) forms the common front-end for all record types. By itself, the core, which is divided into location and regular sections, forms a useful abbreviated record type incorporating many of the most commonly used data elements in standardized form (drawn from the fields to be agreed internationally, listed in Supp. D). Concatenating one or more "attachments" (attm) after the core creates additional record types. So far, the following attms have been defined or proposed:

Table C1: ICOADS attm
Table C2: IMMT-2/FM 13 attm
Table C3: Model quality control attm
Table C4: Ship metadata attm
Table C5: Historical attm (proposed)
Table C6: Supplemental data attm

The following are examples of the record types that can be constructed from the core plus these attachments (Table numbers are used to indicate the corresponding attm):

- core record:
  core (C0) (108 characters)
- VOSClim record:
  core + C1 + C2 + C3 + C6 (315 characters, before C6)
- historical record:
  core + C5 + C6 (proposed)

Inclusion of the attm count (*ATTC*) field in the core, and of the attm ID (*ATTI*) and attm data length (*ATTL*) fields at the beginning of each attm, enable computer parsing of the records. Thus additional variations on these basic record types are implemented by inclusion or omission of attms, and new attms can be defined in the future as needed for new data or metadata requirements.

Table C0. IMMA core. The columns in this table contain the following information:

1: "D" is listed if the field configuration is discussed in Supp. D (proposed for international agreement); "C" if the field configuration is defined for ICOADS (e.g., in LMR documentation); "UK" if the field is defined by the UK; or blank (fields to be described nationally). "D = C" is listed if the ICOADS configuration is adopted provisionally, pending international standardization.
2: The projected length (Len.) in characters (i.e., bytes).
3-4: Proposed abbreviation (Abbr.) for each field, and a brief element description.
5-6: For fields with a tentative numeric range, the minimum (Min.) and maximum (Max.) are indicated. In other cases the range and configuration are listed as: "a" for alphabetic (A-Z), "b" for alphanumeric (strictly 0-Z), "c" for alphanumeric plus other characters, or "u" for undecided form (only for fields that are currently unused).
7: Units of data and related WMO codes. Information in parentheses usually relates the proposed field to a field from Supp. B, Table B1 (if applicable): WMO Code symbolic letters are listed, or "•" followed by a field number from Table B1 in the absence of symbolic letters. This information is prefixed by "Δ" if the field is proposed for extension in range or modification in form from the presently defined WMO representation.

Location section (45 characters) :

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	4	*YR*	year UTC	1600	2024	(AAAA)
D	2	*MO*	month UTC	1	12	(MM)
D	2	*DY*	day UTC	1	31	(YY)
D = C	4	*HR*	hour UTC	0	23.99	0.01 hour (Δ GG)
D = C	5	*LAT*	latitude	–90.00	90.00	0.01°N (Δ $L_aL_aL_a$)
D = C	6	*LON*	longitude	–179.99	359.99	0.01°E (Δ $L_oL_oL_oL_o$)
				0.00	359.99	(ICOADS convention)
				–179.99	180.00	(NCDC convention)
D	2	*IM*	IMMA version	0	99	(Δ •65)
D	1	*ATTC*	attm count	0	9	
D = C	1	*TI*	time indicator	0	3	
D = C	1	*LI*	latitude/long. indic.	0	6	

Location section (45 characters) :

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	1	*DS*	ship course	0	9	(D_s)
D	1	*VS*	ship speed	0	9	(Δ v_s)
D	2	*NID*	national source indic.	0	99	
D = C	2	*II*	*ID* indicator	0	10	
D	9	*ID*	identification/call sign	c	c	(Δ •42)
D	2	*C1*	country code	b	b	(Δ •43)

Regular section (63 characters):

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D = C	1	*DI*	wind direction indic.	0	6	
D = C	3	*D*	wind direction (true)	1	362	°, 361-2 (Δ dd)
D = C	1	*WI*	wind speed indicator	0	8	(Δ i_W)
D = C	3	*W*	wind speed	0	99.9	0.1 m s^{-1} (Δ ff)
D = C	1	*VI*	*VV* indic.	0	2	(Δ •9)
D	2	*VV*	visibility	90	99	(VV)
D	2	*WW*	present weather	0	99	(ww)
D	1	*W1*	past weather	0	9	(W_1)
D = C	5	*SLP*	sea level pressure	870.0	1074.6	0.1 hPa (Δ PPPP)
D	1	*A*	characteristic of *PPP*	0	8	(a)
D	3	*PPP*	amt. pressure tend.	0	51.0	0.1 hPa (ppp)
D = C	1	*IT*	indic. for temperatures	0	9	(Δ i_T)
D	4	*AT*	air temperature	–99.9	99.9	0.1°C (Δ s_n, TTT)
D	1	*WBTI*	indic. for WBT	0	3	(Δ s_w)
D	4	*WBT*	wet-bulb temperature	–99.9	99.9	0.1°C (Δ s_w, $T_bT_bT_b$)
D	1	*DPTI*	*DPT* indic.	0	3	(Δ s_t)
D	4	*DPT*	dew-point temp.	–99.9	99.9	0.1°C (Δ s_t, $T_dT_dT_d$)
D = C	2	*SI*	*SST* meas. method	0	12	(Δ •30)
D	4	*SST*	sea surface temp.	–99.9	99.9	0.1°C (Δ s_n, $T_wT_wT_w$)
D	1	*N*	total cloud amount	0	9	(N)
D	1	*NH*	lower cloud amount	0	9	(N_h)
D	1	*CL*	low cloud type	0	9, "A"	(Δ C_L)
D = C	1	*HI*	*H* indic.	0	1	(Δ •9)
D	1	*H*	cloud height	0	9, "A"	(Δ h)
D	1	*CM*	middle cloud type	0	9, "A"	(Δ C_M)
D	1	*CH*	high cloud type	0	9, "A"	(Δ C_H)
D	2	*WD*	wave direction	0	38	
D	2	*WP*	wave period	0	30, 99	seconds (P_WP_W)
D	2	*WH*	wave height	0	99	(H_WH_W)
D	2	*SD*	swell direction	0	38	($d_{W1}d_{W1}$)
D	2	*SP*	swell period	0	30, 99	seconds ($P_{W1}P_{W1}$)
D	2	*SH*	swell height	0	99	($H_{W1}H_{W1}$)

Table C1. ICOADS attm (column descriptions as for Table C0). 10° and 1° box numbers are available for sorting. The box system indicator is currently unused, but provides flexibility in case other box requirements arise (i.e., future extant values of *BSI* could indicate different contents in *B10* and *B1*). Other fields in this attm are carried forward from LMR to ensure that all required LMR information maps into IMMA; LMR fields *IRD* and *A6* are obsolete and have been omitted from IMMA.

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	2	*ATTI*	attm ID			Note: set *ATTI*=1
D	2	*ATTL*	attm length			Note: set *ATTL*=65
Box elements (6 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
C	1	*BSI*	box system indicator	u	u	(currently set to missing)
C	3	*B10*	10° box number	1	648	(ICOADS BOX10 system)
C	2	*B1*	1° box number	0	99	
ICOADS processing elements (17 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
C	3	*DCK*	deck	0	999	
C	3	*SID*	source ID	0	999	
C	2	*PT*	platform type	0	15	
C	2	*DUPS*	dup status	0	14	
C	1	*DUPC*	dup check	0	2	
C	1	*TC*	track check	0	1	
C	1	*PB*	pressure bias	0	2	
C	1	*WX*	wave period indicator	1	1	
C	1	*SX*	swell period indicator	1	1	
C	2	*C2*	2nd country code	0	40	
ICOADS QC elements (38 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
C	12	*	adaptive QC flags	1**	35**	6var×2flag×1char.(base36)
C	1	*ND*	night/day flag	1	2	
C	6	*	trimming flags	1	15	base36
C	14	*	NCDC-QC flags	1	10	base36
C	2	*QCE*†	external (e.g., MEDS)	0	63	6 flags encoded in 2 char.
C	1	*LZ*	landlocked flag	1	1	
C	2	*QCZ*†	source exclusion flags	0	31	5 flags encoded in 2 char.

* The first letter of each QC flag indicates the applicable fields(s) (or if the QC applies to an entire report), according to the following general scheme (referring to field abbreviations from Table C1): *A*=*AT*, *B*=*VV*, *C*=clouds, *D*=*DPT*, *E*=wave, *F*=swell, *G*=*WBT*, *P*=*SLP*, *R*=relative humidity (or possibly other humidity variables for *RE*†), *S*=*SST*, *T*=*A* and *PPP*, *U* or *V*=wind U- or V-component, *W*=wind, *X*=*WX*, *Y*=*W1*, Z=entire report. The lists of flag abbreviations are then:

- Adaptive QC flags: *SQZ*, *SQA*, *AQZ*, *AQA*, *UQZ*, *UQA*, *VQZ*, *VQA*, *PQZ*, *PQA*, *DQZ*, *DQA*.
- Trimming flags: *SF*, *AF*, *UF*, *VF*, *PF*, *RF*.
- NCDC-QC flags: *ZNC*, *WNC*, *BNC*, *XNC*, *YNC*, *PNC*, *ANC*, *GNC*, *DNC*, *SNC*, *CNC*, *ENC*, *FNC*, *TNC*.

** Table C7 provides further information about the adaptive QC flags.

† Using the 1st-letter naming scheme described in the first footnote, the abbreviations for the flags decoded from *QCE* are: *ZE*, *SE*, *AE*, *WE*, *PE*, *RE*; and those from *QCZ* are: *SZ*, *AZ*, *WZ*, *PZ*, *RZ*. Flag *RE*, presently unused, has been set aside for possible future use.

Table C2. IMMT-2/FM 13 attm (column descriptions as for Table C0).

Doc.	Len.	Abbr.	Element description			
D	2	*ATTI*	attm ID			Note: set *ATTI*=2
D	2	*ATTL*	attm length			Note: set *ATTL*=76

Common for IMMT-2/-1 (52 characters):

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	1	*OS*	observation source	0	6	(•40)
D	1	*OP*	observation platform	0	9	(•41)
D	2	*FM*	FM code version	0	8	(∆ •64)
D	1	*IX*	station/weather indic.	1	7	(i_X)
D	1	*W2*	2nd past weather	0	9	(W_2)
D	1	*SGN*	sig. cloud amount	0	9	ref. *N*
D	1	*SGT*	sig. cloud type	0	9, "A"	
D	2	*SGH*	significant cloud ht.	0	99	(0-50, 56-99)
D	1	*WMI*	indic. for wave meas.	0	9	(•31)
D	2	*SD2*	dir. of second. swell	0	38	($d_{W2}d_{W2}$)
D	2	*SP2*	per. of second. swell	0	30, 99	($P_{W2}P_{W2}$)
D	2	*SH2*	ht. of second. swell	0	99	($H_{W2}H_{W2}$)
D	1	*IS*	ice accretion on ship	1	5	(I_s)
D	2	*ES*	thickness of I_s	0	99	cm (E_sE_s)
D	1	*RS*	rate of I_s	0	4	(R_s)
D	1	*IC1*	concentration of sea ice	0	9, "A"	(∆ c_i)
D	1	*IC2*	stage of development	0	9, "A"	(∆ S_i)
D	1	*IC3*	ice of land origin	0	9, "A"	(∆ b_i)
D	1	*IC4*	true bearing ice edge	0	9, "A"	(∆ D_i)
D	1	*IC5*	ice situation/trend	0	9, "A"	(∆ z_i)
D	1	*IR*	indic. for precip. data	0	4	(i_R)
D	3	*RRR*	amount of precip.	0	999	(RRR)
D	1	*TR*	duration of per. *RRR*	1	9	(t_R)
D	1	*QCI*	quality control indic.	0	9	(•45)
D	1×20	*QI1-20*	QC indic. for fields	0	9	(Q_1-Q_{20})

New for IMMT-2 (20 characters):

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	1	*QI21*	MQCS version	0	9	(Q_{21})
D	3	*HDG*	ship's heading	0	360	° (HDG)
D	3	*COG*	course over ground	0	360	° (COG)
D	2	*SOG*	speed over ground	0	99	kt (SOG)
D	2	*SLL*	max.ht.>sum load ln.	0	99	m (SLL)
D	3	*SLHH*	dep. load ln.: sea lev.	-99	99	m ($s_L$hh)
D = C	3	*RWD*	relative wind dir.	1	362	°, 361-2 (ref. *D*)
D = C	3	*RWS*	relative wind speed	0	99.9	0.1 m s^{-1} (ref. *W*)

Table C3. Model quality control attm (column descriptions as for Table C0).

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	2	*ATTI*	attm ID			Note: set *ATTI*=3
D	2	*ATTL*	attm length			Note: set *ATTL*=66
GTS bulletin header fields (10 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
UK	4	*CCCC*	collecting centre	a	a	
UK	6	*BUID*	bulletin ID	b	b	
UK model comparison elements (52 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
UK	5	*BMP*	background (bckd.) *SLP*	870.0	1074.6	0.1 hPa
UK	4	**BSWU**	bckd. wind U comp.	−99.9	99.9	0.1 m s^{-1}
UK	4	*SWU*	derived wind U comp.	−99.9	99.9	0.1 m s^{-1}
UK	4	*BSWV*	bckd. wind V comp.	−99.9	99.9	0.1 m s^{-1}
UK	4	*SWV*	derived wind V comp.	−99.9	99.9	0.1 m s^{-1}
UK	4	*BSAT*	bckd. air temperature	−99.9	99.9	0.1°C
UK	3	*BSRH*	bckd. relative humidity	0	100	%
UK	3	*SRH*	derived relative humidity	0	100	%
UK	1	*SIX*	derived stn./wea. indic.	2	3	(subset of i_X)
UK	4	*BSST*	bckd. *SST*	−99.9	99.9	0.1°C
UK	1	*MST*	model surface type	0	9	(UK 008204)
UK	3	*MSH*	model height of land sfc.	0	999	m
UK	4	*BY*	bckd. year	0	9999	year
UK	2	*BM*	bckd. month	1	12	month
UK	2	*BD*	bckd. day	1	31	day
UK	2	*BH*	bckd. hour	0	23	hour
UK	2	*BFL*	bckd. forecast length	0	99	hours

Table C4. Ship metadata attm (column descriptions as for Table C0).

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	2	*ATTI*	attm ID			Note: set *ATTI*=4
D	2	*ATTL*	attm length			Note: set *ATTL=57*
Ship metadata elements (>14 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	2	*C1M*	recruiting country	a	a	(Δ •43)
D	2	*OPM*	type of ship (programme)	0	99	(code unlike *OP)*
D	2	*KOV*	kind of vessel	c	c	
D	2	*COR*	country of registry	a	a	(Δ •43)
D	3	*TOB*	type of barometer	c	c	
D	3	*TOT*	type of thermometer	c	c	
D	2	*EOT*	exposure of thermometer	c	c	
D	2	*LOT*	screen location	c	c	
D	1	*TOH*	type of hygrometer	c	c	
D	2	*EOH*	exposure of hygrometer	c	c	
D	3	*SIM*	*SST* meas. method	c	c	(code unlike *SI)*
D	3	*LOV*	length of vessel	0	999	m
D	2	*DOS*	depth of *SST* meas.	0	99	m
D	3	*HOP*	height of visual observation platform	0	999	m
D	3	*HOT*	height of *AT* sensor	0	999	m
D	3	*HOB*	height of barometer	0	999	m
D	3	*HOA*	height of anemometer	0	999	m
D	5	*SMF*	source metadata file	0	99999	e.g. “19991” 1st Q 1991
D	5	*SME*	source meta. element	0	99999	line number in file
D	2	*SMV*	source format version	0	99	to be defined

Table C5. Historical attm (proposed; column descriptions as for Table C0). *ATTI* is assigned, and *ATTL* to be decided (*tbd*).

Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	2	*ATTI*	attm ID			Note: set *ATTI*=5
D	2	*ATTL*	attm length			Note: set *ATTL=tbd*
Historical data elements (> 19 characters):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
D	1	*WFI*	*WF* indic.	u	u	
D	2	*WF*	wind force	0	12	
D	1	*XWI*	*XW* indic.	u	u	
D	3	*XW*	wind speed (ext. *W*)	0	99.9	0.1 m s^{-1}
D	1	*XDI*	*XD* indic.	u	u	
D	2	*XD*	wind dir. (ext. *D*)	u	u	
D	1	*SLPI*	*SLP* indic.	u	u	
D	1	*TAI*	*TA* indic.	u	u	
D	4	*TA*	*SLP* att. thermometer	–99.9	99.9	ref. *AT*
D	1	*XNI*	*XN* indic.	u	u	
D	2	*XN*	cloud amt. (ext. *N*)	u	u	
(plus additional elements to be decided)						

Table C6. Supplemental data attm (column descriptions as for Table C0). If *ATTL*=0 (unspecified length), this attm must appear at the end of the record, and the record terminate with a line feed. For the VOSClim record type, this attm stores the original input data string in Ascii with *ATTL*=0 and *ATTE*=missing. (Note: if future requirements arise within the VOSClim record type, or for other record types, *ATTL* and *ATTE* can be adjusted accordingly.)

Doc.	Len.	Abbr.	Element description			
D	2	*ATTI*	attm ID			Note: set *ATTI*=99
D	2	*ATTL*	attm length			Note: set *ATTL*=0
D	1	*ATTE*	attm encoding			Note: set *ATTE*=missing
Supplemental data (format determined nationally, or by data source):						
Doc.	Len.	Abbr.	Element description	Min.	Max.	Units (Code)
	*	*SUPD*	supplemental data	c	c	

* The length of the supplemental data is *ATTL* – 5 if *ATTL* > 0, or it may be variable if *ATTL* = 0.

Table C7. A pair of adaptive QC flags is provided for each variable, ending in *Z* and *A* (e.g., *SQZ* and *SQA* for *SST*). These refer to the z* and alpha** values resulting from the comparison of the observation to the adaptive QC limits. If an observation is missing, or exceeds physical limits (e.g., for *SST*: outside the range –5.0°C to 40°C), the flags are set to missing. The technical details of the flag encoding/decoding (handled by the data access software) are described by this table.†

Value (flag 3rd letter):	True value: Min.	Max.	Units	Base	Coded: Min.	Max.
z (*Z*)	–8.5σ	8.5σ	0.5	-18	1	35
alpha (*A*)	0.0	1.0	0.05	-1	1	21

* z: indicates the relationship of an individual observation to the adaptive standard deviation (σ) limits in 0.5σ steps. The extremes are open-ended in that any values < –8.5σ or > 8.5σ are mapped to ±8.5σ. Other σ values represent intervals of approximately ±0.25σ around the reported values because of rounding to the nearest 0.5σ. E.g., –3.5σ represents the approximate interval –3.75σ to –3.25σ.
** alpha: provides a measure of the reliability of the QC: it has a roughly inverse relationship with the number of observations available nearby (smaller alpha values indicate more data).
† A 2-stage encoding is applied: 1) The floating-point true value is divided by the "units" (the smallest increment of the data being encoded). Then the base is subtracted to produce, after rounding, a coded positive integer. 2) The integer is transformed into a base36 character. Decoding reverses this process by transforming the base36 value back into the coded value, and then the true value is reconstructed by:

true value = (coded + base) * units

Supplement D. Field Configurations

IMMA fields proposed for, or already subject to, international standardization are described here. These are ordered according to their appearance in Supp. C. Note: Supp. C also lists additional (ICOADS- or nationally-defined) fields, which are not described here.

The suggested field abbreviations are simple alphabetic strings (plus in some cases numeric suffixes), based generally on GTS symbolic letters (if defined) but without subscripts. These are listed in *UPPER-CASE*, for broad computer portability. As discussed in Supp. A, symbolic abbreviations already provide an important means of communication about the fields and data among Member countries and end-users. However, a transition away from subscripts is recommended to facilitate computerized implementation (e.g., headings for listings of the data).

The configurations of numeric fields were developed on the basis of representations that are readily input and output by computer software. Fields are right-justified within the specified field-widths (Supp. C), and to reduce data-volume decimal points are implicit (e.g., –99.9 is represented as –999). For signed numeric data, the plus sign ("+") is omitted, and the minus sign ("–") immediately prefixes the numeric portion (i.e., blank left-fill). These conventions have the advantage that numeric data can be readily input without separate steps to handle IMM sign positions (0=positive, 1=negative), and without parsing to ensure that a field does not contain non-numeric characters (e.g. "/").

In a delimited format, a universal missing value (e.g., -9999.99) could be selected outside the range of all data (except possibly for alphanumeric fields). In contrast, the fixed-field format contains different field-widths so a single numeric value is unworkable. A convention such as all nines filling each indicated field width doesn't work either, e.g., because many of the 1-character fields have extant numeric values covering the range 0-9.

Therefore, blanks are used as the universal representation for missing data. However, it is important to note that Fortran (by default) considers blanks to be equivalent to zero, thus to ensure correctness the processing must first parse a field as characters to ensure that it is not entirely blank. Machine-portable Fortran software to help read (and optionally write) the IMMA data ("rdimma0") is available (icoads.noaa.gov/software/).

Some field configurations (e.g., for the historical attm) are undecided, and will benefit from future feedback and discussion (including possible additional options that are noted for some fields). In other cases existing LMR configurations are proposed. These provisional configurations may warrant modification or expansion after international consideration.

Location section

YR year UTC
MO month UTC
DY day UTC
HR hour UTC
As for IMMT-1, except *HR* (range: 00.00 to 23.99 UTC). Ship data typically are reported to whole hour, but the extended resolution is needed, e.g., for storage of drifting buoy data.

LAT latitude
LON longitude
Reversed in order from LMR. Position to hundredths of a degree +N or –S (measured north or south of the equator) and +E or –W (measured east or west of the Greenwich Meridian). Extended resolutions are needed, e.g., for storage of drifting buoy data. The longitude range (–179.99° to 359.99°) specified in Supp. C encompasses two distinct longitude conventions (0° to 359.99° and –179.99° to 180.00°), which are desirable for different applications and archival requirements (0° to 359.99° is strongly recommended for use, because it is the simplest formulation and thus helps to reduce the likelihood of location errors). Disallowing 360.00 and –180.00° ensures that meridians

are uniquely represented within the convention range (i.e., avoiding: 0°/360.00°; 180.00°/–180.00°). However, even when IMMA records are stored in mixed conventions, all longitude values can be accurately interpreted because the overall range for longitude reserves negative for the western hemisphere. Note: organizing *YR*, *MO*, *DY*, *HR*, *LAT*, *LON* in sequence can facilitate synoptic sort operations.

Options: Characters (N, S, E, W) could be used in place of sign for both latitude and longitude, but this complicates computer I/O and is therefore not recommended. Usage of quadrant or octant numbers also is not recommended, because a strictly numeric system is much more straightforward.

IM IMMA version
ATTC attm count

These fields are positioned near the front of the record to allow computerized input and interpretation (e.g., of different IMMA versions), but after *LON* so as not to interfere with sort operations. The proposed configuration is similar to "IMMT version":

0 = provisional version
1 = first internationally agreed version
2 = second internationally agreed version
etc.

ATTC provides the attm count:

0 = abbreviated record (no attm)
1 = one attm
2 = two attms
etc.

TI time indicator
LI latitude/longitude indicator

TI preserves the incoming precision of time fields:

0 = nearest whole hour
1 = hour to tenths
2 = hour plus minutes
3 = high resolution (e.g., hour to hundredths)

LI preserves the precision at which *LAT* and *LON* were recorded or translated from, or if they were derived later by interpolation between known positions:

0 = degrees and tenths
1 = whole degrees
2 = mixed precision
3 = interpolated
4 = degrees and minutes
5 = high resolution data (e.g., degrees to seconds)
6 = other

[Note: This is a direct mapping from the LMR configuration, except that *LI*=2 is described there as "non random tenths" (a type of mixed precision; see p. F4 of Slutz et al., 1985).]

DS ship course
VS ship speed

WMO Codes 0700 and 4451 for contemporary data. A different code for *VS*, also with range 0-9, applied to data prior to 1 January 1968 (MetO, 1948):

0 = 0 knots	5 = 13-15 knots
1 = 1-3 knots	6 = 16-18 knots
2 = 4-6 knots	7 = 19-21 knots
3 = 7-9 knots	8 = 22-24 knots
4 = 10-12 knots	9 = over 24 knots

Beginning 1 January 1968 (Code 4451):

0 = 0 knots	5 = 21-25 knots
1 = 1-5 knots	6 = 26-30 knots

2 = 6-10 knots 7 = 31-35 knots
3 = 11-15 knots 8 = 36-40 knots
4 = 16-20 knots 9 = over 40 knots

As in LMR, both the old and new *VS* codes are stored in the same field, to be differentiated by date (*DS* and *VS* are named *SC* and *SS* in LMR). Note: In IMMPC format documentation, Code 4451 may have been used to refer to both the old and new *VS* codes. Further research is needed to clarify the timing and details of this code change.

NID national source indicator

A field for national use in identifying data subsets.

[Note: For the VOSClim record type in the provisional format, this is set to 1 for ships that can be identified as part of the VOSClim Project, or missing otherwise.]

II *ID* indicator

ID identification/call sign

ID is extended to nine characters (versus seven in IMMT-2). In LMR, *II* indicates whether a call sign or some other sort of recognizable identification is contained in the *ID* field:

0 = ID present, but unknown type
1 = ship, Ocean Station Vessel (OSV), or ice station call sign
2 = generic ID (e.g., SHIP, BUOY, RIGG, PLAT)
3 = WMO 5-digit buoy number
4 = other buoy number (e.g., Argos or national buoy number)
5 = Coastal-Marine Automated Network (C-MAN) ID (US NDBC operated)
6 = station name or number
7 = oceanographic platform/cruise number
8 = fishing vessel psuedo-ID
9 = national ship number
10 = composite information from early ship data

C1 country code

The country that recruited a ship, which may differ from the country of immediate receipt (field *C2* in Supp. C) and may also differ from the ship's registry. Numeric code values 00-40 were documented by WMO, which transitioned to 2-character ISO alphabetic codes effective 1 January 1998. We envision storage of the numeric codes for historical data, or of the alphabetic codes for recent data, in this field (since, e.g., the old numeric codes include the USSR and other countries no longer named as such by ISO).

Regular section

DI wind direction indicator

D wind direction

DI gives the compass (and approximate precision) used for reporting the wind direction (in LMR, directions are mapped to degrees according to Table 8 of the LMR documentation):

0 = 36-point compass
1 = 32-point compass
2 = 16 of 36-point compass
3 = 16 of 32-point compass
4 = 8-point compass
5 = 360-point compass
6 = high resolution data (e.g., tenths of degrees)

D is the direction (true) from which wind is blowing, stored in whole degrees (i.e., 360-point compass; range: 1-360°), or special codes:

361 = calm
362 = variable

Options: Alternatively, 0 could be used for calm (00 is used in IMMT-2). Similarly, a value such as 999 could be used for variable (99 is used in IMMT-2, but 99 indicates 99° here). However, an unambiguous and numerically closed range (1-

362, rather than 0-360, 999) is also advantageous for computational reasons (e.g., range checking).

WI wind speed indicator
W wind speed
Wind speed is stored in tenths of a meter per second (to retain adequate precision for winds converted from knots, or high-resolution data). *WI* shows the units in which and/or the method by which *W* was originally recorded (0, 1, 3, 4 follow WMO code 1855):

0 = meter per second, estimated
1 = meter per second, measured
2 = estimated (original units unknown)
3 = knot, estimated
4 = knot, measured
5 = Beaufort force (based on documentation)
6 = estimated (original units unknown)/unknown method
7 = measured (original units unknown)
8 = high-resolution measurement (e.g., hundredths of a meter per second)

For reports derived from, e.g., TDF-11 format, the meaning of *WI*=6 is either "estimated (units unknown)," or "both method and units unknown" (i.e., the indicator was missing). This unfortunate ambiguity derives from the dual meaning present in some original archive formats, including IMMPC (ref. Supp. B).

VI visibility indicator
VV visibility
The "Cloud height and visibility measuring indicator" from IMMT-2 is separated into independent indicators *H* and *VV*. *VI* shows whether *VV* was:

0 = estimated (or unknown method of observation)
1 = measured
2 = fog present

The "fog present" value is not defined in IMMT-2, but stems from early IMMPC definitions (see Supp. B).

WW present weather
W1 past weather
WMO Codes 4677 and 4561. For use of weather data after 1982, refer to *IX*.

SLP sea level pressure
A barometric tendency
PPP amount of SLP change
SLP and *PPP* in tenths of hPa (i.e., millibars), and *A* according to WMO Code 0200. IMMT-2 contains a 4-character (PPPP) representation of *SLP* in IMMT-2 (dropping the leading digit).

IT indicator for temperatures
AT air temperature (i.e., dry bulb)
WBTI *WBT* indicator
WBT wet bulb temperature
DPTI *DPT* indicator
DPT dew point temperature
SI *SST* method indicator
SST sea surface temperature
Temperatures are stored in tenths of a degree Celsius. *IT* provides information about the precision and/or units that the temperature elements were translated from (0-2 match i_T=3-5 in IMMT-2; the full configuration matches *T1* in LMR):

0 = tenths °C
1 = half °C
2 = whole °C
3 = whole or tenths °C (mixed precision among temperature fields)

4 = tenths °F
5 = half °F
6 = whole °F
7 = whole or tenths °F (mixed precision among temperature fields)
8 = high resolution data (e.g., hundredths °C)
9 = other

[Note: Early historical temperatures were also reported in degrees Réaumur, or mixed units. Additional fields may be desirable in the historical attm to record these details.]

WBTI and *DPTI* indicate which of *WBT* or *DPT* was measured or computed, and ice bulb conditions (derived from sign positions s_t and s_w in IMMT-2):

0 = measured
1 = computed
2 = iced measured
3 = iced computed

[Note: For data translated e.g. from IMMT-2 format, *T2* from LMR provides a subset of information derived from s_t and s_w, plus information about whether *DPT* was computed during ICOADS processing (such that for data translated from LMR to IMMA, we set *DPTI*=1 or 3). Future work should seek to recover more complete information from original formats, and consider new configurations to separately document ICOADS processing.]

SI shows the method by which *SST* was taken (0-7 follows the IMMT-2 code):

0 = bucket
1 = condenser inlet (intake)
2 = trailing thermistor
3 = hull contact sensor
4 = through hull sensor
5 = radiation thermometer
6 = bait tanks thermometer
7 = others
9 = unknown or non-bucket
10 = "implied" bucket [Note: applicable to early ICOADS data.]
11 = reversing thermometer or mechanical sensor
12 = electronic sensor

[Note: Except for omitting *SI*=8 ("unknown"), an unintended setting applicable only to decks 705-705), this is a direct mapping from the LMR configuration. In translation from LMR, *SI*=8 is made missing.]

N total cloud amount
NH lower cloud amount
CL low cloud type
HI cloud height indicator
H cloud height
CM middle cloud type
CH high cloud type

Configurations as in IMMT-2, except for use of "A" (10 in base36) in place of "/" (LMR uses 10 in place of "/"), with ordering of *N*,…,*CH* as in LMR. The "Cloud height and visibility measuring indicator" from IMMT-2 is separated into independent indicators *H* and *VV. HI* (not presently part of the GTS SHIP code) shows if cloud height *H* was:

0 = estimated
1 = measured

WD wave direction
WP wave period
WH wave height

Historically, the (wind) wave and swell fields have been subject to complicated code changes. Both the wave and swell fields were reported in descriptive terms according to the SHIP code, and thus are expected to be missing, prior to 1949 (and the swell fields are expected to be missing prior to 1 July 1963, as discussed below). *WD* codes 00 to 36 (WMO Code 0877) show the direction (if any) from which (wind) waves come, in tens of degrees (e.g., 00 = calm, 01 = 005°-014°,…, 36 = 355°-004°). Codes 37-38 (99 in WMO Code 0877) show "waves confused, direction indeterminate" under *WH* conditions explained in the LMR documentation. Starting in 1968, *WD* was no longer reported and *WP* was reported in seconds. Prior to 1968, period was reported as a code, which was converted into whole seconds per Table 10 of the LMR documentation, with *WX* (ref. Table C1) set accordingly. *WH* is wave height in 1/2 meter increments, i.e., 1=0.5 m, 2=1 m, etc.

[Note: *WP*=99, indicating a confused sea, is not presently defined in LMR. Future work should seek to recover this information from original formats.]

SD swell direction
SP swell period
SH swell height
Configurations similar to the corresponding wave fields *WD*, *WP*, and *WH*. Beginning 1 July 1963 both sea (i.e., wind wave) and swell were reported. Prior to that date only the higher of sea and swell was reported. Starting in 1982, *SP* was reported in seconds. Prior to 1968 (1982), *SP* was reported as a code, which was converted into whole seconds per Table 10 (Table 11) of the LMR documentation, with *SX* (ref. Table C1) set accordingly.

Attm control

ATTI attm ID
ATTL attm length
ATTE attm data encoding
Each attm begins with *ATTI* and *ATTL*. *ATTI* identifies the attm contents, and *ATTL* provides the total length of the attm (including *ATTI* and *ATTL*) in bytes, or zero for length unspecified (record terminated by a line feed; line feed not counted as part of *ATTL*). The supplementary data attm (ref. Table C6) also includes *ATTE*, which indicates whether the supplementary data that follow are in ASCII or encoded:

missing = Ascii
0 = base64 encoding

The "rdimma0" software IMMA tests to determine if each individual IMMA record is properly configured, including checking *ATTC* (ref. Table C0) against the number of attachments present. It requires that duplicate attms (i.e., two attms with the same *ATTI*) not appear in a record. The software does not require that attachments appear in any particular order by *ATTI*, with one exception: the supplementary data attm must be the final attm within the record if *ATTL*=0.

IMMT-2/FM 13 attm

OS observation source
OP observation platform
As defined in IMMT-2.

FM FM code version
For *FM*, the corresponding field in IMMT-2 ranges from 0-8, but is extended here to two characters to allow room for expansion.

IX station/weather indicator
W2 second past weather
IX (WMO Code 1860) indicates both whether the station is manned or automatic, and the status of present and past weather data. *IX* is vital for proper interpretation of weather data starting in 1982; see LMR documentation for a detailed discussion, including unforeseen complications that attended its introduction (with *W2*; WMO Code 4561) in 1982 (e.g., *IX* was not included in IMMT until March 1985).

SGN significant cloud amount
SGT significant cloud type
SGH significant cloud height

Use of “A” (10 in base36) in place of “/.” The significant cloud fields are listed in MetO (1948), but they were omitted from the IMM formats. Space is allocated for these, but it is not clear how widely available they would be in logbook data or existing digital archives.

WMI indicator for wave measurement
WMI is the IMMT-2 “indicator for wave measurement” (shipborne wave recorder, buoy, or other measurement systems).

SD2 swell direction (2nd)
SP2 swell period (2nd)
SH2 swell height (2nd)
As defined for IMMT-2 (configurations as for *SD*, *SP*, and *SH*).

IS ice accretion
ES ice thickness
RS ice accretion rate
Fields for ice accretion on the ship, as defined for IMMT-2.

IC1 concentration of sea ice
IC2 stage of development
IC3 ice of land origin
IC4 true bearing ice edge
IC5 ice situation/trend
Configurations as in IMMT-2, except for use of “A” (10 in base36) in place of “/.” These are not presently included among LMR regular fields. The fields changed dramatically in 1982 (field descriptions reflect the 1982 Codes):

pre-1982	starting 1 Jan. 1982
description of ice type	concentration of ice (WMO Code 0639)
effect of ice on navigation	stage of ice development (WMO Code 3739)
bearing of principal ice edge	ice of land origin (WMO Code 0439)
distance to ice edge	true bearing principal ice edge (WMO Code 0739)
orientation of ice edge	ice situation/trend (WMO Code 5239)

Like TD-1129, IMMA simply stores the old/new information as listed above in the same field, thus making it critical that users be aware of the code change.

> Options: Separate fields (or an indicator field) could be considered. Earlier historical ice codes might also need to be researched for possible consideration. MetO (1948) lists an Ice Group (c_2KD_ire) that may be similar or identical to the above pre-1982 code (see also Table B3 of Supp. B).

IR indicator for precipitation data
RRR amount of precipitation
TR duration of period of reference for amount of precipitation
As defined for IMMT-2. The precipitation fields are not presently included among regular LMR fields.

QCI quality control (QC) indicator
QI1-21 QC indicators for fields
Field *QCI* provides general information about the level of manual or automated QC that has been applied to the data. Twenty *QI* indicators for individual fields or field groups are included in IMMT-2 and IMMT-1 (see Table B2 of Supp. B), whereas 18 were included in the 1982 IMMT format, and none were available in IMMPC. IMMT-2 adds a 21st element to document the QC version.

HDG ship’s (bow) heading in degrees (referenced to true North)
COG course over ground (reference to true North)
SOG speed over ground (the speed at which the vessel moves over the fixed earth)
SLL max. height (m) of deck cargo above summer max. load line
SLHH departure of summer max. load line from actual sea level

Fields added to IMMT-2 for VOSClim.

RWD relative wind direction
RWS relative wind speed
Fields added to IMMT-2 for VOSClim.

Ship metadata attm

C1M recruiting country
OPM type of ship (programme)
KOV kind of vessel
COR country of registry
TOB type of barometer
TOT type of thermometer
EOT exposure of thermometer
LOT screen location
TOH type of hygrometer
EOH exposure of hygrometer
SIM SST measurement method
LOV length of vessel
DOS depth of SST measurement
HOP height of visual observation platform
HOT height of air temperature sensor
HOB height of barometer
HOA height of anemometer
SMF source metadata file
SME source metadata element
SMV source format version
Metadata selected from WMO–No. 47 (1955–) by the UK National Oceanography Centre, Southampton (Kent et al. 2007a; additional technical documentation is available at this website: icoads.noaa.gov/e-doc/imma/Pub47_IMMA.pdf). The codes defined in WMO–No. 47, and used in IMMA, for *OPM* and *SIM* differ from the codes used for the similar IMMT-based fields *OP* and *SI*. Prior to 1995 a 3-digit numeric code was defined in WMO–No. 47 for *C1M*; starting in 1995, WMO–No. 47 adopted the 2-character ISO alphabetic code, which was in 1998 also adopted for IMMT. For *C1M*, the earlier 3-digit numeric codes were transformed by SOC into the 2-character alphabetic codes.

> Options: A possible expansion for LOT would add extra codes for paired screens in unknown locations, etc.

Historical attm (proposed)

WFI wind force indicator
WF wind force
XWI *XW* indicator
XW wind speed (extension field for *W*)
XDI *XD* indicator
XD wind direction code (extension field for *D*)
WFI and *WF* are proposed primarily for 0-12 Beaufort wind force codes, but potentially could be extended to other 2- or 1-digit codes, with *WFI* indicating the type of information, e.g.: 0-6 (half Beaufort code in 19th century Norwegian logbooks), Ben Nevis Observatory code. *XWI* and *XW* are proposed for equivalent wind speed, with *XWI* indicating the scale used to convert from *WF* (e.g., the existing WMO Code 1100 scale or newer alternatives). Similarly, fields *XDI* and *XD* are proposed for older 2- or 1-digit wind direction codes, with *XDI* indicating the type of information, e.g.: 32-, 16-, or 8-point compasses.

SLPI *SLP* indicator
TAI *TA* indicator

TA *SLP* attached thermometer

SLPI is proposed for historical data to indicate the barometer type (e.g., mercurial, aneroid, or metal). *TAI* (configuration undecided, but probably similar to some of the other temperature indicators) and *TA* are proposed for older mercurial barometer data, in which the attached thermometer is critical for data adjustments.

XNI *XN* indicator

XN cloud amount (extended field for *N*)

XN is proposed for historical cloud amount data (e.g., in tenths), with *XNI* indicating the units (e.g., tenths).

Document Revision Information

Previous document version: 26 May 2005. No substantive format changes were made as part of this revision. Most of the changes involved updating references, website addresses, and organizational information. Note that this version of the document has been reformatted for WMO publication as part of this report, and differs slightly in appearance from the present on-line version (http://icoads.noaa.gov/e-doc/imma/imma.pdf); the References section has been slightly updated to reflect actual availability of Kent et al. 2007b.

Annex VIII

DRAFT LAYOUT FOR THE INTERNATIONAL MARITIME METEOROLOGICAL TAPE (IMMT) (REVISED;MARCH 2007) [VERSION IMMT-IV]

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	Quadrant 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 meters per second, hundreds omitted; values in excess of 99 knots are to be indicated in units of meters per second and i_w encoded accordingly; the method of estimation or measurement and the units used (knots or meters 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
19	35-37	$T_dT_dT_d$	Dew-point temperature	Tenths of degrees Celsius
20	38-41	PPPP	Air pressure	Tenths of hectopascals

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
21	42-43	ww	Present weather	WMO code table 4677 or 4680
22	44	W_1	Past weather	WMO code table 4561 or 4531
23	45	W_2	Past weather	WMO code table 4561 or 4531
24	46	N_h	Amount of lowest clouds	As reported for C_L or, if no C_L cloud is present, for C_M, in oktas; WMO code table 2700
25	47	C_L	Genus of C_L clouds	WMO code table 0513
26	48	C_M	Genus of C_M clouds	WMO code table 0515
27	49	C_H	Genus of C_H clouds	WMO code table 0509
28	50	s_n	Sign of sea-surface temperature	WMO code table 3845
29	51-53	$T_wT_wT_w$	Sea surface temperature	Tenth of degrees Celsius
30	54		Indicator for sea-surface temperature measurement	0 - Bucket thermometer 1 - Condenser inlet 2 - Trailing thermistor 3 - Hull contact sensor 4 - "Through hull" sensor 5 - Radiation thermometer 6 - Bait tanks thermometer 7 - Others
31	55		Indicator for wave measurement	Shipborne wave recorder: 0 - Wind sea and swell estimated 1 - Wind sea and swell measured 2 - Mixed wave measured, swell estimated 3 - Other combinations measured and estimated Buoy: 4 - Wind sea and swell measured 5 - Mixed wave measured, swell estimated 6 - Other combinations measured and estimated Other measurement system: 7 - Wind sea and swell measured 8 - Mixed wave measured, swell estimated 9 - Other combinations measured and estimated
32	56-57	P_wP_w	Period of wind waves or of measured waves	Whole seconds; show 99 where applicable in accordance with Note (3) under specification of P_wP_w in the Manual on Codes
33	58-59	H_wH_w	Height of wind waves or of measured waves	Half-meter values. Examples: Calm or less than ¼m to be encoded 00; 3½m to be encoded 07; 7m to be encoded 14; 11½m to be encoded 23
34	60-61	$d_{w1}d_{w1}$	Direction of predominant swell waves	Tens of degrees, WMO code table 0877; encoded 00 or 99 where applicable. Blanks = No observation of waves attempted
35	62-63	$P_{w1}P_{w1}$	Period of predominant swell waves	Whole seconds; encoded 99 where applicable (see under element 32)
36	64-65	$H_{w1}H_{w1}$	Height of predominant swell waves	Half-meter values (see under element 33)
37	66	I_s	Ice accretion on ships	WMO code table 1751
38	67-68	E_sE_s	Thickness of ice accretion	In centimeters
39	69	R_s	Rate of ice accretion	WMO code table 3551
40	70		Source of observation	National: 0 - Unknown 1 - Logbook 2 - Telecommunication channels 3 - Publications International data exchange: 4 - Logbook (electronic) 5 - Telecommunication channels 6 – Publications

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
41	71		Observation platform	0 - unknown 1 - Selected ship 2 - Supplementary ship 3 - Auxiliary ship 4 - Automated station/data buoy 5 - Fixed sea station 6 - Coastal station 7 - Aircraft 8 - Satellite 9 - Others ....
42	72-78		Ship identifier	Ship's call sign or other identifier encoded as follows: 7 characters call sign Columns 72–78 6 characters call sign Columns 72–77 5 characters call sign Columns 72–76 4 characters call sign Columns 72–75 3 characters call sign Columns 72–74
43	79-80		Country which has recruited the ship	According to the two-character alphabetical codes assigned by the International Organization for Standardization (ISO)
44	81		National use	
45	82		Quality control indicator	0 - No quality control (QC) 1 - Manual QC only 2 - Automated QC only /MQC (no time-sequence checks) 3 - Automated QC only (inc. time sequence checks) 4 - Manual and automated QC (superficial; no automated time-sequence checks) 5 - Manual and automated QC (superficial; including time-sequence checks) 6 - Manual and automated QC (intensive, including automated time-sequence checks) 7 & 8 - Not used 9 - National system of QC (information to be furnished to WMO)
46	83	i_x	Weather data indicator	1 - Manual 4 - Automatic If present and past weather data included Code tables 4677 and 4561 used 7 - Automatic If present and past weather data included Code tables 4680 and 4531 used
47	84	i_R	Indicator for inclusion or omission of precipitation data	WMO code table 1819
48	85-87	RRR	Amount of precipitation which has fallen during the period preceding the time of observation, as indicated by t_R	WMO code table 3590
49	88	t_R	Duration of period of reference for amount of precipitation, ending at the time of the report	WMO code table 4019
50	89	s_w	Sign of wet-bulb temperature	0 - positive or zero measured wet-bulb temperature 1 - negative measured wet-bulb temperature 2 - iced measured wet-bulb temperature 5 - positive or zero computed wet-bulb temperature 6 - negative computed wet-bulb temperature 7 - iced computed wet-bulb temperature
51	90-92	$T_bT_bT_b$	Wet-bulb temperature	In tenths of degree Celsius, sign given by element 50
52	93	a	Characteristic of pressure tendency during the three hours preceding the time of observation	WMO code table 0200

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
53	94-96	ppp	Amount of pressure tendency at station level during the three hours preceding the time of observation	In tenths of hectopascal
54	97	D_s	True direction of resultant displacement of the ship during the three hours preceding the time of observation	WMO code table 0700
55	98	v_s	Ship's average speed made good during the three hours preceding the time of observation	WMO code table 4451
56	99-100	$d_{w2}d_{w2}$	Direction of secondary swell waves	Tens of degrees, WMO code table 0877; encoded 00 or 99 where applicable. Blanks = No observation of waves attempted
57	101-102	$P_{w2}P_{w2}$	Period of secondary swell waves	Whole seconds; encoded 99 where applicable (see under element 32)
58	103-104	$H_{w2}H_{w2}$	Height of secondary swell waves	Half-meter values (see under element 33)
59	105	c_i	Concentration or arrangement of sea ice	WMO code table 0639
60	106	S_i	Stage of development	WMO code table 3739
61	107	b_i	Ice of land origin	WMO code table 0439
62	108	D_i	True bearing of principal ice edge	WMO code table 0739
63	109	z_i	Present ice situation and trend of conditions over the preceding three hours	WMO code table 5239
64	110		FM 13 code version	0 = previous to FM 24-V 1 = FM 24-V 2 = FM 24-VI Ext. 3 = FM 13-VII 4 = FM 13-VIII 5 = FM 13-VIII Ext. 6 = FM 13-IX 7 = FM 13-IX Ext. 8 = FM 13-X, etc.
65	111		IMMT version	0 = IMMT version just prior to version number being included 1 = IMMT-1 (in effect from Nov. 1994) 2 = IMMT-2 (in effect from Jan. 2003) 3 = IMMT-3 (in effect from Jan. 2006) 4 = IMMT-4 (this version) etc.
66	112	Q_1	Quality control indicator for (h)	0 - no quality control (QC) has been performed in 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 - GCC use. Original flag = 1, but element failed MQCS 7 - GCC use. Original flag = 5, but element failed MQCS 8 – Not used 9 - The value of the element missing
67	113	Q_2	QC indicator for (VV)	- idem -
68	114	Q_3	QC indicator for (clouds: elements 12, 24–27)	- idem -
69	115	Q_4	QC indicator for (dd)	- idem -
70	116	Q_5	QC indicator for (ff)	- idem -

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
71	117	Q_6	QC indicator for (TTT)	- idem -
72	118	Q_7	QC indicator for ($T_dT_dT_d$)	- idem -
73	119	Q_8	QC indicator for (PPPP)	- idem -
74	120	Q_9	QC indicator for (weather: elements 21–23)	- idem -
75	121	Q_{10}	QC indicator for ($T_wT_wT_w$)	- idem -
76	122	Q_{11}	QC indicator for (P_wP_w)	- idem -
77	123	Q_{12}	QC indicator for (H_wH_w)	- idem -
78	124	Q_{13}	QC indicator for (swell: elements 34–36, 56–58)	- idem -
79	125	Q_{14}	QC indicator for (i_RRRRt_R)	- idem -
80	126	Q_{15}	QC indicator for (a)	- idem -
81	127	Q_{16}	QC indicator for (ppp)	- idem -
82	128	Q_{17}	QC indicator for (D_s)	- idem -
83	129	Q_{18}	QC indicator for (v_s)	- idem -
84	130	Q_{19}	QC indicator for ($T_bT_bT_b$)	- idem -
85	131	Q_{20}	QC indicator for ships' position	- idem -
86	132	Q_{21}	Minimum quality control standards (MQCS) version identification	1 = MQCS- I (Original version, Feb. 1989) CMM-X 2 = MQCS-II (Version 2, March 1997) CMM-X11 3 = MQCS-III (Version 3, April 2000) SGMC-VIII 4 = MQCS-IV (Version 4, June 2001) JCOMM-I 5 = MQCS-V (Version 5, July 2004) ETMC-I 6 = MQCS-VI (this version, to be agreed) etc.

Additional Requirements for the VOSCLIM Project

87	133-135	HDG	Ship's heading; the direction to which the bow is pointing, referenced to true North.	(000-360); e.g. 360 = North 000 = No Movement 090 = East
88	136-138	COG	Ship's ground course; the direction the vessel actually moves over the fixed earth and referenced to True North	(000-360); e.g. 360 = North 000 = No Movement 090 = East
89	139-140	SOG	Ship's ground speed; the speed the vessel actually moves over the fixed earth.	(00-99); Round to nearest whole knot
90	141-142	SLL	Maximum height in meters of deck cargo above Summer maximum load line.	(00-99); report to nearest whole meter

Element Number	*Character Number*	*Code*	*Element*	*Coding procedure*
91	143	s_L	Sign of departure of reference level	0 = positive or zero, 1 = negative
92	144-145	hh	Departure of reference level (Summer maximum load line) from actual sea level.	(00-99) is the difference to the nearest whole meter between the Summer maximum load line and the sea level. Consider the difference positive when the Summer maximum load line is above the level of the sea and negative if below the water line.
93	146-148	RWD	Relative wind direction in degrees off the bow	Relative wind direction; e.g. 000 = no apparent relative wind speed (calm conditions on deck). Reported direction for relative wind = 001-360 degrees in a clockwise direction off the bow of the ship. When directly on the bow, RWD = 360.
94	149-151	RWS	Relative wind speed reported in units indicated by i_W (knots or m/s)	Reported in either whole knots or whole meters per second (e.g. 010 knots or 005 m/s). Units established by i_W as indicated in Character Number 27.

Note: Since the relative wind speed can be greater than the true wind speed e.g., i_W indicates knots and ff = 98, the relative wind speed may be 101 knots; therefore, three positions must be allocated since i_W cannot be adjusted and the relative wind speed converted to meters per second as is done in element 15.

95	152	Q_{22}	Quality control indicator for (HDG)	0 - no quality control (QC) has been performed in this element 1 - QC has been performed; element appears to be correct 2 - QC has been performed; element appears to be inconsistent with other elements 3 - QC has been performed; element appears to be doubtful 4 - QC has been performed; element appears to be erroneous 5 - The value has been changed as a result of QC 6 – 8 - Reserved for GCC use 9 - The value of the element missing
96	153	Q_{23}	QC indicator for (COG)	- idem –
97	154	Q_{24}	QC indicator for (SOG)	- idem –
98	155	Q_{25}	QC indicator for (SLL)	- idem –
	156		blank	
99	157	Q_{27}	QC indicator for (hh)	- idem –
100	158	Q_{28}	QC indicator for (RWD)	- idem –
101	159	Q_{29}	QC indicator for (RWS)	- idem -

Note: Most of the codes (groups of letters) in the IMMT format with the exception of those added for the VOSCLIM project are defined in the Manual on Codes (WMO Pub.No. 306) as they basically mirror the code groups used in FM 13-X Ship code. Because CBS was not persuaded to expand the FM 13-X Ship code for the VOSCLIM project the additional observed elements (selected codes) will not appear in WMO Manual on Codes (Pub. 306). Therefore an effort was made to select unique codes (groups of letters) not defined in WMO Pub. 306 for the elements added to the IMMT-2 format version modified for the VOSCLIM project. This was deliberately done to try and prevent a difference in meaning for a given code group (identical symbolic letters) in Pub. 306 versus that in IMMT. Presumably none of the Character Code formats will be altered in the future by CBS.

Annex IX

DRAFT MINIMUM QUALITY CONTROL STANDARDS (MQCS)

(MQCS-VI Version, March 2007)

NOTE See specification for quality control Indicators Q_1 to Q_{29} at the end of this appendix
Δ = space (ASCII 32)

Element	Error	Action
1	$i_T \neq 3 - 5$, Δ	Correct manually otherwise Δ
2	AAAA ≠ valid year	Correct manually otherwise reject
3	MM ≠ 01 - 12	Correct manually otherwise reject
4	YY ≠ valid day of month	Correct manually otherwise reject
5	GG ≠ 00 - 23	Correct manually otherwise reject
6	$Q_c \neq 1, 3, 5, 7$	Correct manually and $Q_{20} = 5$, otherwise $Q_{20} = 4$
	Q_c = Δ	$Q_{20} = 2$
7	$L_aL_aL_a \neq 000\text{-}900$	Correct manually and $Q_{20} = 5$, otherwise $Q_{20} = 4$
	$L_aL_aL_a$ = ΔΔΔ	$Q_{20} = 2$
8	$L_oL_oL_oL_o \neq 0000\text{-}1800$	Correct manually and $Q_{20} = 5$, otherwise $Q_{20} = 4$
	$L_oL_oL_oL_o$ = ΔΔΔΔ	$Q_{20} = 2$
	$L_aL_aL_a = L_oL_oL_oL_o$ = ΔΔΔ(Δ)	Correct manually otherwise reject
Time sequence checks		
	Change in latitude > 0.7°/hr	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 0.7 °/hr when lat. 00-39.9	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 1.0 °/hr when lat. 40-49.9	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 1.4 °/hr when lat. 50-59.9	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 2.0 °/hr when lat. 60-69.9	Correct manually otherwise $Q_{20} = 3$
	Change in longitude > 2.7 °/hr when lat. 70-79.9	Correct manually otherwise $Q_{20} = 3$
9	Indicator ≠ 0-3, Δ	Correct manually, otherwise Δ
10	h ≠ 0-9	Correct manually and $Q_1 = 5$, otherwise $Q_1 = 4$
	h = Δ	$Q_1 = 9$
11	VV ≠ 90-99	Correct manually and $Q_2 = 5$, otherwise $Q_2 = 4$
	VV = ΔΔ	$Q_2 = 9$
12	N ≠ 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 ≠ 00-36, 99	Correct manually and $Q_4 = 5$, otherwise $Q_4 = 4$
	dd = ΔΔ	$Q_4 = 9$
	<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 ≠ 00, ff = 00	Correct manually and Q_4 or $Q_5 = 5$ otherwise $Q_4 = Q_5 = 2$

Element	Error	Action
14	$i_W \neq 0, 1, 3, 4$	Correct manually, otherwise $Q_5 = Q_{29} = 4$
15	ff > 80 knots	Correct manually and $Q_5 = 5$, otherwise $Q_5 = 3$
	ff = ΔΔ	$Q_5 = 9$
16	$s_n \neq 0, 1$	Correct manually, otherwise $Q_6 = 4$
17	TTT = ΔΔΔ	$Q_6 = 9$

	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	$Q_6 = 4$
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	$Q_7 = Q_{19} = 9$
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	Correct manually and $Q_9 = 5$, otherwise $Q_9= 4$
	93-94	Correct manually and $Q_9 = 5$, otherwise $Q_9 = 3$
	and latitude <20^o	
	if $i_x = 7$:	
	w_aw_a = 24 - 25, 35, 47-48, 54-56, 64-68, 70-78, 85-87	Correct manually and $Q_9 = 5$, otherwise $Q_9= 4$
	and latitude <20^o	
22, 23	W_1 or 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 $Q_9 = 2$
	$W_1 = W_2$ = ww = ΔΔΔΔ	$Q_9 = 9$
24-27	N = 0, and $N_hC_LC_MC_H \neq 0000$	Correct manually and $Q_3 = 5$, otherwise $Q_3 = 2$
	N = Δ, and $N_hC_LC_MC_H \neq$ ΔΔΔΔ	Correct manually and $Q_3 = 5$, otherwise $Q_3 = 2$
	N = 9, and not (N_h =9 and $C_LC_MC_H \neq$ ΔΔΔ	Correct manually and $Q_3 = 5$, otherwise $Q_3 = 2$
	N=Δ, and $N_hC_LC_MC_H$=ΔΔΔΔ	$Q_3 = 9$
28	$s_n \neq 0, 1$	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 $Q_{10} = 4$

Element	Error	Action
30	Indicator ≠ 0-7, Δ	Correct manually, otherwise Δ
31	Indicator ≠ 0-9, Δ	Correct manually, otherwise Δ
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	$35 < H_WH_W < 50$	$Q_{12} = 3$
	$H_WH_W \geq 50$	$Q_{12} = 4$
	H_WH_W = ΔΔ	$Q_{12} = 9$
34	$d_{W1}\, d_{W1} \neq$ 00-36, 99	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 $\neq 99$	$Q_{13} = 4$
36	$35 < H_{W1}H_{W1} < 50$	$Q_{13} = 3$
	$H_{W1}H_{W1} \geq 50$	$Q_{13} = 4$
37	$I_S \neq$ 1-5, Δ	Correct manually, otherwise Δ
38	$E_S E_S \neq$ 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, mandatory entry
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 ≠ 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, otherwise $Q_{14} = 4$
48	RRR ≠ 001-999 and i_R = 1, 2	Correct manually and $Q_{14} = 5$, otherwise $Q_{14} = 2$
49	$t_R \neq$ 0-9, Δ	Correct manually and $Q_{14} = 5$, otherwise $Q_{14} = 4$
50	$s_W \neq$ 0, 1, 2, 5, 6, 7	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 ≠ 0-8	Correct manually and $Q_{15} = 5$, otherwise $Q_{15} = 4$
	a = 4 and ppp ≠ 000	Correct manually and Q_{15} or $Q_{16} = 5$, otherwise $Q_{15}=Q_{16}=2$
	a =1,2,3,6,7,8 and ppp=000	Correct manually and Q_{15} or $Q_{16} = 5$, otherwise $Q_{15}=Q_{16} = 2$
	a = Δ	$Q_{15} = 9$
53	250 ≥ ppp > 150	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	Correct manually and $Q_{17} = 5$, otherwise $Q_{17} = 4$
	D_s = Δ	$Q_{17} = 9$
55	$v_s \neq$ 0-9	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, ΔΔ	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	$35 < H_{W2}H_{W2} < 50$	$Q_{13} = 3$
	$H_{W2}H_{W2} \geq 50$	$Q_{13} = 4$
59	$c_i \neq$ 0-9, Δ	Correct manually, otherwise Δ
60	$S_i \neq$ 0-9, Δ	Correct manually, otherwise Δ
Element	Error	Action
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
64	version ≠ 0-8, Δ	Correct manually, otherwise Δ
65	version ≠ 0-4, Δ	Correct manually, otherwise Δ
86	Minimum Quality Control Standards (MQCS) version identification	1= MQCS-I (Original version, Feb. 1989) CMM-X 2= MQCS-II (Version 2, March 1997) CMM-XII 3= MQCS-III (Version 3, April 2000) SGMC-VIII 4= MQCS-IV (Version 4, June 2001) JCOMM-I 5= MQCS-V (Version 5, July 2004) ETMC-I 6 = MQCS-VI (this version, to be agreed)

87	HDG ≠ 000-360	Correct manually and Q_{22} = 5, otherwise Q_{22} = 4
	HDG = ΔΔΔ	Q_{22} = 9
88	COG ≠ 000-360	Correct manually and Q_{23} = 5, otherwise Q_{23} = 4
	COG = ΔΔΔ	Q_{23} = 9
89	SOG ≠ 00 - 99	Correct manually and Q_{24} = 5, otherwise Q_{24} = 4
	SOG = ΔΔ	Q_{24} = 9
	SOG > 33	Correct manually and Q_{24} = 5, otherwise Q_{24} = 3
90	SLL ≠ 00-99	Correct manually and Q_{25} = 5, otherwise Q_{25} = 4
	SLL = ΔΔ	Q_{25} = 9
	SLL > 35	Correct manually and Q_{25} = 5, otherwise Q_{25} = 3
91	s_L ≠ 0,1	Correct manually and Q_{27} = 5, otherwise Q_{27} = 4
92	hh ≠ 00 – 99	Correct manually and Q_{27} = 5, otherwise Q_{27} = 4
	hh = ΔΔ	Q_{27} = 9
	hh >= 13	Correct manually and Q_{27} = 5, otherwise Q_{27} = 3
	hh < -01	Correct manually and Q_{27} = 5, otherwise Q_{27} = 4
93	RWD ≠ 000 - 360, 999	Correct manually and Q_{28} = 5, otherwise Q_{28} = 4
	RWD = ΔΔΔ	Q_{28} = 9
94	RWS ≠ 000 - 999	Correct manually and Q_{29} = 5, otherwise Q_{29} = 4
	RWS = ΔΔΔ	Q_{28} = 9
	RWS > 110 kts	Correct manually and Q_{29} = 5, otherwise Q_{29} = 3
	<u>RWD versus RWS</u>	
	RWD = 000, RWS ≠ 000	Correct manually and Q_{28} or Q_{29} = 5, otherwise Q_{28} = Q_{29} = 2
	RWD ≠ 000, RWS = 000	Correct manually and Q_{28} or Q_{29} = 5, otherwise Q_{28} = Q_{29} = 2

Specifications for quality control Indicators Q_1 to Q_{29}

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	reserved for GCC; original flag = 1, but failed MQCS check
7	reserved for GCC; original flag = 5, but failed MQCS check
8	Reserve
9	The value of the element is missing

Annex X

JCOMM EXTREME WAVES DATA BASE

Purpose:

Phase 1: To provide a source of instrumented wave observations of extreme wave events for model development, forecast verification and satellite validation.

Phase 2: To provide a comprehensive source of all instrumented wave measurements (*in-situ*, remote-sensing) for known extreme wave events, both recent historical events and ongoing.

Data qualification:

- Data will be captured for those storms in which a SWH ≥ 14m;
- Storms will be defined as commencing when the SWH first exceeds 5 m and ending when the SWH first falls below 5m;
- Area of interest will include all wave observations within a 500 km radius of the buoy (or other platforms) registering the extreme event;
- Appropriate information about the type of instrument, sampling characteristics, data processing carried out, etc., will be held with the data;
- Appropriate attribution of contributors will be maintained.

Phase 1:

- The data base will hold all instrumented observations that are available from the storm period and area including:
- *In-situ* surface elevation time series;
- *In-situ* wave spectra from surface-following instruments (e.g., wave buoys, Tucker);
- Other environmental observations collected *in situ* in the storm period and area will also be included.

Phase 2:

- The data base will hold all instrumented observations that are available from the storm period and area including:
- *In-situ* surface elevation time series;
- *In-situ* wave spectra from surface-following instruments (e.g., wave buoys, Tucker);
- *In-situ* wave spectra from surface radars (e.g., MIROS);
- Satellite derived wind fields;
- Satellite derived wave estimates.

Data Assembly and Delivery Services:

- Contributors will be organized under the auspices of the ETWS
- Administration of the assembly and maintenance of the database (db) will be under the Chairperson of the ETMC

The archive centre will provide services that include:

- Receive data from contributors;
- Ensure data pass agreed QC before inclusion;
- Load data into the db;
- Provide the database in a convenient format mutually agreed between the ETWS and the ETMC;

- Provide a convenient download service for the database contents.

Yet to clarify:

- Exactly what data and metadata fields to include (Phase 1 then Phase 2);
- Is the definition of a storm and area adequate?
- How we will solicit an archive?
  - NCAR might be interested;
  - Proposal will be presented to IODE.
- Who will run the data base?
- What is the "agreed" QC and delivery formats?
  - We will need to be flexible in accepting different data formats. On output, we could build something in netCDF or use the IMMA format. We probably should consider a few output formats.

Are the services enough?

Annex XI

EXCERPT FROM THE DMCG-2 ACTION LIST (ETMC RELATED ACTIONS)

2.3 ETMC					
a. Establish a new JCOMM Task Team on Delayed-Mode Voluntary Observing Ship data *(JCOMM-II: Recommendation 9 (JCOMM-II): Implement the new version of the International Maritime Meteorological Tape format for all data collected as of 1 January 2007)*	Membership List and Work Plan to the DMPA Chairperson	Chairperson ETMC	January 2006	0	0
b. Explore the connection between the ETSI and ETMC (GDSIDB)	Report to chair DMCG	Chairperson ETMC	April 2007	0	0
c. Develop a proposal for an Extreme Wave Event Archive	Project proposal presented to the IODE-XIX	Chairperson DMCG (lead) Chairperson ETWS Chairperson ETMC	March 2007 (IODE-XIX)	0	0
d. Prepare a document on common issues of quality control of surface marine variables	Document to the DMCG	Chairperson ETMC (lead) Chairperson SAMOS Chairperson GOSUD Chairperson DMCG	May 2007	0	0
e. Determine interest of GODAR in Historical Ship Data Rescue activity	results to the DMCG	Chairperson ETMC	End of 2006	0	0
f. Organization for the upcoming CLIMAR-III *(responds to JCOMM-II : Paragraph 7.1.17 : Organize a Third JCOMM Workshop on Advances in Marine Climatology to be held in 2007)*	Event	Chairperson ETMC	May 2008	0	0
g. WMO to issue Circular Letter if deadline to meet minimum QC standards have been met (MQCS and IMMT)	Circular Letter	WMO	January 2007	0	0
JCOMM-II: Recommendation 9 (JCOMM-II): Implement the new version of the Minimum Quality Control Standards for all data collected of 1 January 2007	*report on progress of implementation from Chairperson of the ETMC to the Chairperson of the DMPA*	*Members / Member States and ET on MC*	*JCOMM-III*		
JCOMM-II: Recommendation 9 (JCOMM-II): Review the implementation and value of the revised format and quality control standards	*report from Chairperson of the ETMC to Chairperson of the DMPA*	*ET on MC*	*JCOMM-III*		

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Annex XII

THE JCOMM SPA TOP LEVEL OBJECTIVES (TLO)

The JCOMM SPA Top Level Objectives (TLO), embodied within the SPA terms of reference, are:

- **TLO-1: To provide support to maritime safety, hazard warning and disaster mitigation systems.** The objective is to monitor and develop modifications to maritime safety, hazard warning and disaster mitigation systems and to provide assistance to Members/Member States as required. Systems include: the WMO marine broadcast system for the GMDSS, as well as MPERSS; storm surges; tropical cyclones; Tsunami; search and rescue; marine pollution; ice and iceberg warnings; rogue waves and dangerous sea state.
- **TLO-2: To develop, maintain and monitor international MetOcean product and service standards.** The Objective is to ensure that the JCOMM SPA acts as a flexible, streamlined organisation capable of coordinating international maritime services;
- **TLO-3: To implement a User Focussed Program.** The Objective is to understand and respond to present and future needs of the maritime service industry and ensure that the services provided to users meet these requirements, including content, delivery timeliness and quality. A key priority for the JCOMM SPA is to provide mechanisms and services that engage the user community in JCOMM discussions, plans and activities and to manage user feedback on all aspects of JCOMM.
- **TLO-4: To working effectively with Members/Member States.** The Objective is to keep under review and to respond to the requirements of Members/Member States for guidance in the implementation of their duties and obligations with regard to marine services, in particular those specified in the WMO *Manual on Marine Meteorological Services* (WMO-No. 558);
- **TLO-5: To encourage the pull-through scientific and technical expertise to operational systems.** The Objective is to build on international scientific and technical excellence to better meet the needs of the international maritime service industry by developing the preparation and dissemination of ocean products and services;
- **TLO-6: To develop and maintain communications across JCOMM and 'join up' the SPA.** The Objective is to integrate the internal cross-program area activities of JCOMM, with international regional/global efforts and with that of others to increase efficiency and capability including the relevant programmes of WMO and IOC (e.g., DPM, WWW, WCP, GOOS, GCOS), as well as with other organizations such as IMO, IHO, IMSO and ICS in the provision of marine services and information;
- **TLO-7: To build appropriate capacity within JCOMM.** The Objective is to build appropriate capacity within JCOMM to make the most of international collaboration to share marine meteorological and oceanographic knowledge, infrastructure and services for the benefit of the Maritime community.

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Annex XIII

LIST OF ACTION ITEMS (ETMC-II)

Ref	Item	Action by	Deadline
2.3.3.3	to propose implementation target of the VOS to the SOT and OCG	TT-MOCS	Early 2008
2.3.3.3	to inform the SOT and the OCG about the work of the TT-MOCS regarding the proposed implementation target for the VOS	Secretariat	Early 2008
2.3.4.4	to investigate having the ETMC represented at DBCP-23	S. Woodruff and Secretariat	Oct 2007
2.4.1.5	to review the structure and content of the GHRSST-PP database prior to operational implementation	SPA Coordinator and TT-DMVOS	End 2007
2.4.1.6	to use the GHRSST-PP quality monitoring approach in collaboration with the GHRSST-PP databases	SPA Coordinator and ETMC members	End 2007
2.4.1.10	to seek one representative from ETMC to attend the IMMSC 2008 conference and sit on the steering team	ETMC Chairperson	Oct 2008
2.4.2.4	to discuss the further internationalization of appropriate ICOADS tasks at the CLIMAR-III workshop	CLIMAR-III Organizing Committee	May 2008
2.4.2.4	to locate resources to work on the calculation of wave summaries in ICOADS	V. Swail	Early 2008
2.4.2.6	to provide an article regarding the link between coastal erosion and extreme events	M. Rutherford	Mid 2007
2.4.2.7	to establish the link with OGP regarding preparatory meeting for a joint workshop on the potential impacts of climate change on future design criteria	V. Swail, J. Guddal	May 2007
2.5.2.8	to populate the ETMC website with appropriate documents regarding interoperability and the JCOMM Data Management strategy document	Secretariat	Mid 2007
3.1.3	to produce a TT-DMVOS project plan to guide operations for the next three years	TT-DMVOS Chairpersons	August 2007
3.1.4	to submit proposed revisions of the Terms of Reference of the TT-DMVOS to the SOT and the DMCG	Secretariat	April 2007
3.1.6	to consider issues proposed by the ETMC-II	TT-DMVOS	ASAP
3.1.7	to identify US/NOAA/NCDC Member in the TT-DMVOS	S. Woodruff	ASAP
3.1.8	to conduct a detailed intercomparison between FM 13 (GTS SHIP code) sample (e.g. a month of data) data sets received at key operational centres	E. Kent	May 2008
3.1.8	to contact key operational centres by the way of letter to WMO PRs in order to seek the delivery of sample FM 13 and FM 18 data to the UK National Oceanography Centre, Southampton	Secretariat	End 2007
3.1.8	to investigate whether similar studies had already been made and to provide any useful information to the ETMC Chairperson for inclusion on the ETMC website	T. Yoshida	Mid 2007
3.2.4	to include GHRSST requirements in the META-T Pilot Project categorization of instrumental metadata, and provide input for possible changes to the IMMT format	META-T	ASAP
3.2.5	to inform the SOT of the IMMT developments	Secretariat	April 2007
3.2.7	to propose to the ETMC changes to the IMMT format and the MQCS, after considering possible convergences with the IMMA format	TT-DMVOS	Sept 2008
3.2.7	to submit the IMMT format and MQCS changes proposed by the TT-DMVOS for adoption by JCOMM-III	Secretariat, SOT, ETMC	Jan 2009
3.2.8	to approach CIMO regarding documenting methods of calculation of dew point and other humidity variables as well as making software freely available	Secretariat	ASAP
3.2.8	to publicize available software (dew point calculation methods) via the ETMC website	ETMC Chairperson	ASAP

3.2.8	to initiate an intercomparison study between the different electronic logbooks leading to the production of a report documenting current procedures and any differences	SOT-IV	April 2007
3.3.4	to investigate feasibility and make recommendations for carefully validating TDCFs so as to ensure that all the originally reported data are completely and accurately preserved	CBS	May 2008
3.3.5	to consider outstanding issues regarding results of NCEP comparisons of FM 13 with BUFR, and liaise with TT-TDCF	S. Woodruff	Late 2007
3.3.5	to present to SOT-IV the outstanding issues regarding results of NCEP comparisons of FM 13 with BUFR	S. Woodruff	April 2007
3.3.7	to investigate possible changes that might be recommended to the ET/DRC regarding the B/C35 and B/C32 templates	F. Koek	Feb 2008
3.3.9	to consider the need for certified BUFR decoders and encoders	CBS	May 2008
3.4.4	to provide guidance regarding (i.) whether BUFR is going to be assembled on board or at the local receiving NMSs before being inserted into the GTS, and (ii.) if on board, which BUFR template should be used	SOT	End 2007
3.4.13	to initiate continuing coordination with the SOT regarding electronic logbooks and logging software being developed or maintained by the Members	TT-DMVOS	End 2007
3.4.15	to establish a Task Team on electronic logbooks	Secretariat, SOT	April 2007
3.4.15	to propose someone from AMVER/SEAS for participating in the task team on electronic logbooks	S. Woodruff	April 2007
3.4.16	to encourage developers to start making electronic logbooks available in selected foreign languages	proposed SOT TT on e-logbooks	May 2008
3.4.18	to take action in order to resolve the problem of masked delayed-mode data	SOT	ASAP
3.5.6	to increase the autonomy of the GCCs so not only do they receive and process observations, but also they can actively help CMs to enable them to submit their data	TT-DMVOS	ASAP
3.5.6	to make available every quarterly exchange via FTP; to continue to separate out the VOSClim data to send to the VOSClim DAC	GCCs	Mid 2007
3.5.6	to begin development of an end-to-end data management system storing all the data streams together	ETDMP, TT-DMVOS	May 2008
3.5.6	to draft a proposal that would be circulated through the Team for agreement around CLIMAR-III, regarding a proposed formalization of the role of ICOADS in the context of modernizing the delayed-mode data flow, and related issues, with the aim to develop a recommendation for JCOMM-III	TT-DMVOS	May 2008
3.5.7	to consider requirements for visual observations and to suggest solutions for maintaining them	SOT	Ongoing
3.5.7	to provide information to the ETMC Chairperson regarding requirements for visual observations and solutions proposed as far as land-based systems	W. Wright	Mid 2007
3.6.5	to convey ETMC recommendations regarding ship masking to the SOT	Secretariat	April 2007
4.1.3	to explore some limited convergence of the IMMA format with appropriate features of TDCFs	TT-DMVOS	May 2008
4.1.6	to finalize the proposal for utilization and further development of IMMA by CLIMAR-III and to circulate it through the ETMC for formal agreement, aiming for suitable publication and a recommendation for JCOMM-III	TT-DMVOS, Secretariat	May 2008
4.1.8	to update the existing IMMA read software to FORTRAN/90/95	S. Woodruff	May 2007
4.1.8	to look into the broader issues of exchanging and archiving the data, including possible transition to the IMMA format, as well as considering possible conversion issues concerning netCDF	TT-DMVOS	May 2008
4.2.7	to locate copies of known previous editions (1949-74) of WMO-No. 306 (Parts A-C) in WMO and international libraries, and determine the extent of WMO holdings of electronic copies of recent editions	T. Yoshida, and S. Woodruff in liaison with CDMP	End 2007
4.2.8	to investigate the best ways for progressing on copyright and	Secretariat	End 2007

	related WMO issues		
4.2.9	to draft an outline of a JCOMM publication documenting the SHIP code evolution and to seek input from Mr Woodruff, Dr Kent and other ETMC members	T. Yoshida	ETMC-III
4.2.9	to take the earlier work (Supp. B of Appendix A of Annex VII) on tracing the IMMPC and IMMT formats into account in drafting the proposed SHIP code history publication	T. Yoshida	ETMC-III
4.2.10	to eventually migrate the JMA website contents, especially including the electronic versions of final session reports and other complete WMO publications, to a website hosted by WMO or JCOMM	Secretariat and T. Yoshida	Early 2008
4.3.8	to seek National contributions to the wave and storm surge database once established	ETMC members	Early 2008
4.3.8	to draft a recommendation for JCOMM-III regarding seeking National contributions to the wave and storm surge database	Secretariat	Jan 2009
4.3.9	to coordinate the development and standardization of the Extreme Waves Database, while the Database itself will be managed and implemented by Members/Member state	ETMC	Ongoing
4.3.11	to investigate data policy and availability issues regarding the Database	ETWS	Early 2008
4.3.11	to get additional contributions for the Database through ETWS	ETWS	Early 2008
4.3.11	to approach space agencies regarding the Database	ETWS	Early 2008
4.3.11	to seek industry data for the Database	V. Swail	Early 2008
4.3.11	to seek additional records for the Database	ETMC members, W. Wright	Ongoing
4.3.12	to coordinate the ingest of the data from the ETWS and ETMC, as well as to move forward on format issues regarding the Database	*ad hoc* TT	Early 2008
4.4.7	to investigate the feasibility of making the DWD historical marine archive available for merger with ICOADS	R. Zoellner	Mid 2007
4.4.8	to raise the issue of marine data that have not been digitized and that can be useful for marine climatology with the CCI Expert Team on the Rescue**,** Preservation and Digitization of Climate Records (OPAG1, ET1.3)	CCI (W. Wright)	May 2008
4.4.8	to coordinate with ETMC about marine data identified by CCI (OPAG1, ET1.3) that have not been digitized and that can be useful for marine climatology	ETMC Chairperson	May 2008
4.4.8	to prepare a short manageable questionnaire to the WMO Members to identify additional information regarding marine data that have not been digitized and that can be useful for marine climatology	ETMC Chairperson and Secretariat	End 2008, if required
5.2.5	to investigate the possibility of developing the Pub. 47 metadatabase at NOCS into a searchable database	E. Kent	End 2007
5.2.6	to populate the ICOADS website with additional metadata and documentation	S. Woodruff	Sept 2007
5.3.10	to investigate the possibility of archiving rig and platform metadata at the ODASMS and to report to the ETMC Chairperson	ODASMS and E. Gowland	Oct 2007
5.3.11	to seek agreement on the ODAS metadata electronic format (including exploring XML) so that a proposal could be presented to the Team before CLIMAR-III and be proposed for endorsement by JCOMM-III	E. Gowland, ODASMS, Secretariat	Oct 2007
5.3.12	to provide guidance regarding the current ODAS metadata catalogue for meeting the requirements in terms of content	E. Gowland, ODASMS	Oct 2007
5.3.12	to address the issue of ODAS metadata at DBCP-23	DBCP, Secretariat	Oct 2007
5.3.13	to propose the following recommendation for adoption by JCOMM-III: For rigs and platforms, manual observing-systems should be treated as a “ship” and their metadata included in the	Secretariat	Jan 2009

	Pub. 47; automated systems onboard rigs and platforms should be treated as a “buoy” and their metadata included in the ODASMS		
5.3.14	to investigate the possibility of the DBCP being involved with coastal moorings	Secretariat	Jan 2009
5.3.15	to make a proposal for an ODAS metadata submission format, preferably in XML, and to submit the proposal to the META-T and the ETMC for review and agreement	ODASMS, META-T, ETMC	Oct 2007
5.3.16	to propose a recommendation for adoption by JCOMM-III regarding the submission and collection of ODAS metadata	Secretariat	Jan 2009
6.1.5	to work towards an internationally agreed Higher-level of Quality Control (HQC)	future TT-MOCS	May 2008
6.1.6	to discuss the definition of the role and functions of RMs, as well as their number, concerning (i.) archival and distribution of marine meteorological data, and (ii.) generation of marine climatological products	TT-DMVOS, future TT-MOCS	May 2008
6.1.10	to set up the Terms of Reference for the proposed TT-MOCS	*ad hoc* cross-cutting TT	August 2007
6.2.6	to continue to investigate the development of marine indices in cooperation with the JCOMM Services Programme Area and its Expert Teams, initially through the proposed TT-MOCS, with the aim of promoting some of the indices at the forthcoming CLIMAR-III meeting	ETMC, future TT-MOCS	May 2008
6.2.8	to consider wind wave issues (workshops, MCSS becoming more compatible with marine indices, etc.)	*ad hoc* cross cutting TT	Aug 2007
6.2.9	to discuss sea ice indices during the upcoming ETSI-III	ETSI	ETSI-III
6.2.10	to explore greater integration of indices, including developing linkages between marine and coastal land based systems	ETCCDI, future TT-MOCS	May 2008
6.2.11	to work with ETCCDI on the homogeneity of the marine and coastal components; to maintain links with ETSI, ETWS, CCl	V. Swail	May 2008
6.3.4	to play a role in the proposed future TT-MOCS and to propose a CCl participant	CCl	May 2008
6.3.6	to work at instrument standards and best practices to have the different perspectives integrated between CCl, CIMO, and JCOMM	OCG	Jan 2009
7.1.2	to advise on possible meeting structure, content and planning for CLIMAR-III	OC	May 2008
7.1.3	to discuss the possibility of having SOT Members attending CLIMAR-III	SOT-IV	May 2008
7.1.3	to investigate the possibility of a side meeting during SOT-IV to discuss organization of CLIMAR-III	OC	April 2007
7.1.5	to insert links of the new “Wiki” (www.marineclimatology.net) in the JCOMM and appropriate WMO and IOC web pages	Secretariat	Mid 2007
7.1.5	to provide input and feedback to the Wiki	ETMC	Mid 2007
8.1.1	to consider for CLIMAR-III, a similar approach as for CLIMAR-II regarding an update to the Dynamic Part of the *Guide*	OC and CLIMAR-III	May 2008
8.1.2	to host the Dynamic Part of the *Guide* in the PDF form on the WMO website as of July 2007 provided that the Wiley copyright of the papers is credited, and that promotional copy from Wiley may be hosted on the WMO website	WMO	July 2007
8.1.3	to investigate feasibility with CDMP for scanning the Static Part of the *Guide to the Applications of Marine Climatology* (WMO-No. 781 (1994)) and for making it available electronically via the WMO website	S. Woodruff	End 2007
8.1.3	to investigate whether it would be acceptable to make the Static Part of the *Guide* available online (scanned version)	WMO	End 2007
8.2.3	to compile WMO-Nos. 558 and 471 changes proposed by the TT-DMVOS and the future TT-MOCS in a consolidated proposal to be endorsed by ETMC, and eventually submitted to JCOMM-III for approval	Secretariat	May 2008
8.2.4	to investigate the release of electronic versions of WMO-Nos. 558 and 471	Secretariat	May 2007

8.3.3	to coordinate with Prof Mietus regarding the *Guide to Climatological Practices* (WMO-No. 100) in order to progress on the issue and to report informally to the ETMC by CLIMAR-III	ETMC Chairperson	May 2008
8.3.3	to provide feedback to the ETMC Chairperson in terms of recent CCI progress regarding the *Guide to Climatological Practices* (WMO-No. 100)	W. Wright	May 2008
9.1.1	to draft revised Terms of References for the ETMC	Secretariat, ETMC Chairperson, TT-DMVOS co-Chairpersons & future TT-MOCS Chairperson	May 2008

Annex XIV

LIST OF ACRONYMS

AMVER	Automated Mutual assistance Vessel Rescue system
AOPC	Atmosphere Observation Panel for Climate (of GCOS, WCRP)
ASAP	Automated Shipboard Aerological Programme
ASAPP	ASAP Panel (of SOT)
AVOS	Automatic Voluntary Observing Ships System
AWS	Automated Weather System
BATHY	Report of bathythermal observation
BATOS	Automatic shipboard data acquisition and transmission system (Météo France)
BOM	Bureau of Meteorology, Australia
BUOY	Report of a buoy observation
BUFR	Binary Universal Form for the Representation of meteorological data
CADC	China Argo Data Centre
CBS	Commission for Basic Systems
CCl	Commission for Climatology (of WMO)
CBS	Commission for Basic Systems (of WMO)
CDC	Climate Diagnostic Centre
CDMP	Climate Database Modernization Program, NOAA
CDMSs	Climate Data Management Systems
CIMO	Commission on Instruments and Methods of Observations (of WMO)
CLIMAR	JCOMM Workshops on Advances in Marine Climatology
CLIVAR	Climate Variability Programme
CLIWOC	Climatological Database for the World's Ocean 1750-1854
CMs	Contributing Members (of the MCSS)
CMM	Commission for Marine Meteorology (formerly of WMO)
C-MAN	Coastal-Marine Automated Network (of NDBC)
COOP	Coastal Ocean Observations Panel (of GOOS)
CORIOLIS	*In situ* component of the French Operational Oceanography System
CREX	Character form for the Representation and Exchange of data
CSM	Commission for Synoptic Meteorology (now CBS)
DAC	Data Assembly Centre
DBCP	Data Buoy Cooperation Panel
DCPC	Data Collection and Production Centre (of WIS)
DMCG	Data Management Coordination Group (of JCOMM)
DMPA	Data Management Programme Area (of JCOMM)
DPM	Natural Disaster Prevention and Mitigation Programme (of WMO)
DWD	German Weather Service
E2EDM	End-to-end Data Management
EC	Executive Council
ECDIS	electronic chart display and information system
ECMWF	European Centre for Medium Range Weather Forecasts
EOF	empirical orthogonal functions
ERA40	ECMWF 40-Year Re-analysis
E-SURFMAR	European Surface Marine Programme
ETCCMDI	CCl/CLIVAR Expert Team on Climate Change Monitoring Detection and Indices
ETCCDI	CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices
ETDMP	Expert Team on Data Management Practices (of JCOMM/DMPA and IODE)
ETMC	Expert Team on Marine Climatology (of JCOMM/DMPA)
ET/DRC	Expert Team on Data Representation and Codes (of CBS)
ETMAES	Expert team on Marine Accident and Emergency Support (of JCOMM/SPA)
ETMSS	Expert team on Maritime Safety systems (of JCOMM/SPA)
ETSI	Expert Team on Sea Ice (of JCOMM/SPA)
ETWS	Expert Team on Wind Waves and Storm Surges (of JCOMM/SPA)

FWIS	Future WMO Information System
GCCs	Global Collecting Centres (of the MCSS)
GCOS	Global Climate Observing System
GDSIDB	Global Digital Sea Ice Data Bank
GEOSS	Global Earth Observation System of Systems
GHRSST-PP	Global High Resolution Sea Surface Temperature Pilot Project
GODAR	Global Oceanographic Data Archaeology and Rescue
GOOS	Global Ocean Observing System
GOSUD	Global Surface Underway Data
GTS	Global Telecommunications System
HAB	Harmful Algal Blooms
ICOADS	International COADS (Comprehensive Ocean-Atmosphere Data Set)
ICS	International Chamber of Shipping
IFREMER	Research Institute for the Exploitation of the Sea, France
IMMA	International Maritime Meteorological Archive
IMMPC	International Maritime Meteorological Punch-Card
IMMT	International Maritime Meteorological Tape
IMO	International Maritime Organization
IMWM	Institute of Meteorology and Water Management, Poland
INTERCARGO	International Association of Dry Cargo Shipowners
INTERTANKO	International Association of Independent Tanker Owners
IOC	Intergovernmental Oceanographic Commission (of Unesco)
IODE	International Oceanographic Data and Information Exchange (IOC)
IPCC	Intergovernmental Panel on Climate Change
ISDM	Integrated Science Data Management (formerly MEDS) of Canada
ISO	International Standards Organization
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS	JCOMM *in situ* Observing Platform Support Centre
JEWL-PP	JCOMM Extreme Water Level Pilot Project
JMA	Japan Meteorological Agency
KNMI	Royal Netherlands Meteorological Institute
LDC	Least Developed Countries Programme (of WMO)
MAN	Management Committee (of JCOMM)
MARCDAT	Workshops on Advances in the Use of Historical Marine Climate Data
MEDS	Marine Environmental Data Service (now ISDM), Canada
MEOW	Maximum Envelope of Water
MCSS	Marine Climatological Summaries Scheme
MDB	Marine Data Bank, UK
MIROS	Microwave Radar Observing System
MMOP	Marine Meteorology and Oceanography Programme (of WMO)
MMS	Marine meteorological services
MQCS	minimum quality control standards
MSC50	Environment Canada’s Second generation engineering-quality 50-year wind and wave hindcast produced for the entire North Atlantic Ocean
NCAR	National Center for Atmospheric Research, USA
NCDC	National Climatic Data Center, NOAA
NCEP	National Centers for Environmental Prediction, NOAA
NMDIS	National Marine Data and Information Service, China
NMHSs	National Meteorological and Hydrological Services
NMSs	National Meteorological Services
NOAA	National Oceanic and Atmospheric Administration, USA
NOCS	National Oceanography Centre, Southampton, UK
NODC	National Oceanographic Data Centre
NWP	numerical weather prediction
OBIS	Ocean Biogeographical Information System
OBSJMA	Software package for the use of electronic observational logbooks (developed by the JMA)

OC	Organizing Committee (i.e. of CLIMAR-III in the context of this report)
OCG	Observations Coordination Group (of JCOMM)
ODAS	Ocean Data Acquisition System
ODASMS	ODAS Metadata Service (Operated by China for JCOMM)
OGP	International Association of Oil and Gas Producers
OOPC	Ocean Observations Panel for Climate (of GOOS, GCOS, WCRP)
OPA	Observations Programme Area (of JCOMM)
OPAG	Open Area Programme Group (of CCl)
PMO	Port Meteorological Officer
QC	Quality control
RA	Regional Association
RECLAIM	RECovery of Logbooks And International Marine data project
RM	Responsible Members (of the MCSS)
RNODC/DB	Responsible NODC for Drifting Buoys
RSMCs	Regional Specialized Meteorological Centres
RTMC	Real Time Monitoring Centre
SAMOS	Shipboard Automated Meteorological and Oceanographic System
SEAS	Shipboard Environmental (data) Acquisition System (electronic logbook of NOAA)
SCG	Services Coordination Group (of JCOMM)
SGMC	Subgroup on Marine Climatology (formerly of CMM and JCOMM)
SOC	Southampton Oceanography Centre, UK
SOT	Ship Observation Team (of JCOMM/OPA)
SPA	Services Programme Area (of JCOMM)
SSM/I	Special Sensor Microwave/Imager
SST	sea surface temperature
TDCF	Table Driven Code Forms
TESAC	Temperature, salinity and current observation from a sea station
TRACKOB	Report of a marine surface observation along a ship's track
TT	Task Team
TT-DMVOS	TT on Delayed-Mode Voluntary Observing Ship data (of DMPA)
TT-MOCS	TT on Marine and Oceanographic Climatological Summaries (of ETMC)
TT-TDCF	TT on Table Driven Code Forms (of DMPA)
VOS	Voluntary Observing Ships
VOSClim	VOS Climate Project
VOSP	VOS Panel (of SOT)
WaMoS	Wave and Surface Current Monitoring System
VSOP-NA	Special VOS Observing Project for the North Atlantic
WCRP	World Climate Research Programme
WMO	World Meteorological Organization
WSSRD	Web Search Store Retrieve Display (of CDMP)
WWW	World Weather Watch
XML	Extensible Markup Language