Intergovernmental Oceanographic Commission

World Meteorological Organization

Manuals and Guides 3

GUIDE TO OPERATIONAL PROCEDURES FOR THE COLLECTION AND EXCHANGE OF JCOMM OCEANOGRAPHIC DATA

THIRD REVISED EDITION

1999 UNESCO

For bibliographic purposes
this document should be cited as follows:

Guide to Operational Procedures for the collection and exchange of JCOMM Oceanographic Data
IOC Manuals and Guides No. 3 (3rd Rev. Ed.).
UNESCO 1999
(Original: English;
also available in French, Spanish & Russian)

Published in 1999
by the United Nations Educational,
Scientific and Cultural Organization

Printed in UNESCO's Workshops

Printed in France

SC-2000/WS/2

TABLE FOR NOTING AMENDMENTS RECEIVED

Amendment No.	Dated	Inserted in the Publication	
		by	date

PREFACE

All nations are profoundly influenced by the world oceans in many ways - some direct and obvious, others indirect and subtler. Even those countries without ocean coastline feel the influence of the ocean, for example, as it affects world-wide weather and climate and in the availability of foreign goods and access to distant markets. Some influences of the ocean are beneficial; others may be detrimental to human activities; most are beyond our ability to control, except in very limited ways. Forewarned with knowledge of the state of the ocean and even a limited prediction of future trends, it may be possible to maximize the beneficial effects and to avoid or guard effectively against those that could be detrimental.

The Integrated Global Ocean Services System (IGOSS) was conceived as a means to collect and exchange oceanic data in such a form that they could be readily interpreted and applied to practical problems. Data in various forms may be gathered from many sources. It is necessary to properly encode and route these data to processing centres using proper quality control procedures. It is possible to prepare products that summarize and/or interpret the data in ways that are meaningful and useful to others. Finally, the products are distributed to users and the data are stored or "archived" for future use. The IGOSS system had been designed to carry out these functions in co-operation with other international agencies.

The Global Ocean Observing System, GOOS, is a new international system for making ocean observations and providing both data and information to clients. It is setting requirements for the type and frequency of sampling, for timely delivery of data to users and establishing the data quality needs. In co-operation with the Global Climate Observing System (GCOS), GOOS has already developed a first action plan for data requirements and exchange entitled: "*Global Physical Ocean Observations for GOOS/GCOS: an Action Plan for Existing Bodies and Mechanisms.* IGOSS was one of the bodies concerned and had an important role to play for GOOS to provide data and information and to respond positively to the requirements expressed.

In the mean time, GOOS, GCOS and the World Climate Research Programme (WCRP) expressed the requirement for a coherent joint IOC-WMO mechanism for the implementation and international co-ordination of operational oceanography. On that ground, as well as from a number of related considerations (e.g. the need for a fully coordinated mechanism for implementing the requirements for ocean and surface marine meteorological data in support of GOOS and GCOS; the expanding requirements of all marine users for a comprehensive range of marine meteorological data and products; etc.), the IOC and WMO governing bodies decided to establish a Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), to replace the existing Joint IOC-WMO IGOSS and the WMO Commission for Marine Meteorology (CMM). JCOMM shall be responsible for: the further development of the observing networks; the implementation of data management systems; the delivery of products and services; the provision of capacity building to Member States; and the assistance in the documentation and management of the data in international systems. The JCOMM terms of reference encompass, *inter alia*, the programme activities previously undertaken within IGOSS.

Within that general framework, this document is intended as a general guide to the operational procedures for the collection, encoding, quality control and exchange of oceanic surface and sub-surface temperature, salinity and current (BATHY, TESAC and TRACKOB) data. It is anticipated that individual nations will issue specific guidelines within the framework of this document. In all cases, it should be recalled that the overall objectives of JCOMM include the timely collection and exchange of oceanographic data and products. Therefore, proper procedures and precautions must be exercised at all times by participants in the programme.

This edition of the Manuals and Guides No. 3 replaces the 1988 edition.

TABLE OF CONTENTS

1. INTRODUCTION

1.1 GENERAL

1.1.1 The Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) is the body responsible for, *inter alia*, the implementation and international co-ordination of operational oceanography. It encompasses the late WMO Commission for Marine Meteorology (CMM) and Joint IOC-WMO Integrated Global Ocean Services System (IGOSS). The latter used to be the international operational oceanic system for: (i) the global collection and exchange of oceanic data; and (ii) the timely preparation and dissemination of oceanic products and services. WMO and IOC co-operate in the planning and implementation of JCOMM. The operation of JCOMM is based on national contributions and depends on the full support of all IOC Member States and WMO Members. The timely dissemination of data and/or products depends on the facilities of the Global Telecommunication System (GTS) of the World Weather Watch (WWW) of WMO.

1.1.2 The programme for the collection and exchange of BATHY and TESAC data was initiated as a pilot project on 15 January 1972 and became fully operational in June 1975 as the BATHY/TESAC Operational Programme. It involves the global collection and exchange of ocean temperature, salinity and current data observed from merchant ships, research vessels, Ocean Weather Stations (OWS), ocean data buoys, offshore platforms, coastal stations and aircraft, and other platforms. The incorporation of new technological developments will enhance the implementation of this programme.

1.1.3 The development of the Global Ocean Observing System, GOOS, relies heavily on the infrastructure developed by JCOMM both for data collection and data exchange. GOOS is conceived as a new, internationally organized system for gathering, coordination, quality control and distribution of many types of marine and oceanographic data and derived products. The climate module of GOOS has as one goal the provision of observations needed for the prediction of climate variability and change. Thus GOOS is setting the requirements for data collection and dissemination to which the JCOMM programme is responding.

1.1.4 This Guide describes the operational procedures for the BATHY/TESAC Operational Programme, which includes the collection and exchange of operational BATHY, TESAC and, since 1 November 1987, TRACKOB data. The instructions and guidelines to be followed are arranged under the following main headings:

- Data Collection
- Data Encoding
- Data Routing
- Error Checking and Quality Control
- Monitoring

1.2 DEFINITION OF TERMS

A number of terms are used in this Guide with a meaning unique to JCOMM (oceanography) and may cause some confusion to meteorologists, oceanographers and data specialists. Working definitions of these terms, taken from the IGOSS Glossary, are given below.

Operational Data

1.2.1 Oceanographic data up to 30 days old from the time of observation. Operational data should be exchanged on the GTS.

Non-Operational Data

1.2.2 Oceanographic data older than 30 days. Non-operational or delayed mode data should not be exchanged on the GTS.

Timely

1.2.3 Within that space of time, since the time of observation, such that the data continue to be representative of the environmental conditions and are of operational use. The duration of the timely period depends on the physical phenomenon under consideration. For JCOMM (oceanography) purposes that duration goes from one or two days up to 30 days.

Oceanographic Product

1.2.4 Any analysis, forecast or summary of oceanographic conditions prepared and disseminated in a format, and according to a schedule, that suits the needs of governmental, commercial, academic or private user groups. JCOMM (oceanography) service products include analyses, forecasts and summaries for such variables as sea surface temperatures, sub-surface temperatures, mixed layer depth, ocean frontal position, current, salinity and their anomalies.

Operational Product

1.2.5 An operational product is prepared to reach the user in a timely fashion and is produced on a regular basis for more than a year. An operational product distributed by means other than through telecommunications channels is referred to as a delayed mode product.

Report

1.2.6 An observation encoded in appropriate code form and transmitted to shore (BATHY reports are in WMO code form FM 63-X Ext., TESAC reports in WMO code form FM 64-IX, and TRACKOB reports in WMO code form FM 62-VIII Ext.). Reports are then forwarded through national channels to a GTS input point where they are gathered into GTS bulletins.

Bulletin

1.2.7 A message transmitted from the platform to shore and containing:

(i) the abbreviation OBS;
(ii) the radio address of a meteorological or oceanographic centre;
(iii) one or more reports;
(iv) any other information prescribed by radio-telecommunication procedures.

2. DATA COLLECTION

2.1 VARIABLES INVOLVED

2.1.1 The primary variables to be observed within the framework of JCOMM (oceanography) are those which are relevant for the physical description of the state of the ocean and which can be measured on a routine basis. Therefore, the Operational Programme deals with temperature, salinity and currents. In addition, other environmental variables may be useful in order to interpret the data.

Temperature

2.1.2 Knowledge of the thermal structure of the upper layers of the ocean is essential in order to understand heat transfer between the atmosphere and the sea, and heat transport in the ocean. In addition, knowledge of the thermal structure is needed for operational applications (e.g. in fisheries) and for climate analysis.

Salinity

2.1.3 Sea surface salinity is important in order to determine water mass movement, circulation and frontal activity. Sub-surface salinity structure together with sub-surface temperature structure is useful for calculating geostrophic currents. It is also pertinent to the behaviour of the mixed layer.

Currents

2.1.4 Currents are the main process through which heat is transferred from one zone of the world to another, and is a critical item in climate studies. Regular current monitoring is also of great value for such practical purposes as ship routing.

2.2 INSTRUMENTATION

The instruments used for measuring temperature, salinity and current are:

2.2.1 For temperature *versus* depth:

- Mechanical Bathythermographs (MBT)
- Expendable Bathythermographs (XBT)
- Airborne Expendable Bathythermographs (AXBT)
- Submarine launched XBTs (SXBT)
- Thermistor Chains
- Reversing Thermometers.

2.2.2 For temperature and salinity *versus* depth:

- Hydrocasts
- Conductivity-Temperature-Depth Instruments (CTD)
- Expendable CTD (XCTD).
- PALACE floats (Profiling Autonomous LAgrangian Circulation Explorer) or profiling floats.

2.2.3 For surface temperature and/or salinity along a ship's track:

- Any of the above
- Different kinds of instruments fixed to the hull of a platform such as thermo-salinographs.

2.2.4 For sea surface current:

- GEK (Geomagnetic Electrokinetograph)
- Acoustic Doppler Devices
- Ship's set and drift
- Drifting buoys.

2.2.5 For current *versus* depth:

- Moored current meters
- Doppler current profiling systems.

2.3 PLATFORMS

Ships

2.3.1 Ships are a valuable means of oceanographic data gathering. Three types of ships are commonly used for this purpose:

(i) Merchant ships are of major importance for JCOMM and are encouraged to observe oceanic variables by participating in the IOC-WMO Ship-of-Opportunity Programme (SOOP) and in the WMO Voluntary Observing Ships (VOS) scheme;

(ii) Research vessels continue to be a prime element for JCOMM (oceanography) because of the versatility, dependability and accuracy of their observations and despite the fact that their number is relatively small and their operating costs are increasing;

(iii) Ocean Station Vessels (OSV) assigned to the Ocean Weather Stations (OWS) have provided high quality time-series measurements of oceanographic variables at fixed points, and are important for the calibration and verification of satellite and ship data.

Buoys

2.3.2 Both moored and drifting buoys have proved to be useful for oceanic data gathering. Member States should make particular efforts to develop reliable automatic systems capable of producing information on sub-surface variables in the ocean environment.

Aircraft

2.3.3 Aircraft are used for the airborne deployment of such instruments as expendable bathythermographs and for the recording of measurements.

Other Platforms

2.3.4 Coastal stations and offshore platforms should be considered part of JCOMM (oceanography) as far as they provide JCOMM oceanographic data. In particular, countries and/or firms operating offshore platforms are encouraged to carry out regular measurements of oceanic variables in order to provide calibration values and dependable time-series.

2.3.5 Newer platforms, such as Profiling Autonomous Lagrangian Circulation Explorer (PALACE) floats are a technology that shows great promise to make remote observations in ocean regions not easily or regularly visited by other platforms.

2.4 OBSERVATIONAL STRATEGY

Data Requirements

2.4.1 Three scales of interest determine the requirements for observations by JCOMM (oceanography):

(i) The largest of these scales is the ocean basin scale wherein observations are needed to investigate or describe large, planetary-type or climate phenomena or motions occurring in ocean basins;

(ii) Regional requirements are directly linked to more detailed investigation of planetary motions and the preparation of corresponding products. These requirements will arise from cooperative regional programmes by two or more participating Member States;

(iii) Finally, there are requirements on national or local scale that are dictated by the scientific, economic and industrial requirements of the individual state. These requirements will vary greatly from country to country, and will undoubtedly interact with the other 2 categories.

Space/Time Sampling Frequency

2.4.2 The frequency and spacing of observations under JCOMM (oceanography) must be adjusted to suit the physical scales of the oceanographic phenomena to be described. The following classification of scales of oceanographic phenomena are considered under JCOMM:

	Scale	Horizontal	Vertical	Temporal
(a)	Mesoscale	10 - 100 km	1 - 100 m	hours - weeks
(b)	Large scale	100 - 1000 km	100 - 1000 m	weeks - months
(c)	Planetary scale	> 1000 km	total depth	months - years

Although the scales indicate the minimum sampling rates to describe the process, higher sampling rates in space and time may be required to prevent aliasing. In general terms, fixed stations such as weather ships, moored buoys, etc., should take observations at least four times *per* day. It is desirable that mobile ships take BATHY or TESAC measurements at least 4 times *per* day as well, or at approximately 100 km intervals (more closely spaced if crossing major current systems or crossing the continental shelves). TRACKOB observations should be made at shorter intervals, e.g. every one or two hours. The operating agency or institution should determine more precise specification of observational programmes. Apart from the requirement for a world-wide distribution of oceanographic data, there is a strong demand for repeated data from the same area through seasonal or annual cycles. Repeated sections can be achieved, for example, by means of merchant ships on routine tracks.

3. DATA ENCODING

3.1 The encoding instructions are designed to provide a means for formatting the report as a ship-to-shore message. Detailed instructions on how to complete the BATHY, TESAC and TRACKOB code forms are contained in Annex II, III and IV, respectively.

3.2 It has been demonstrated (see Hanawa *et. al.*, UNESCO Technical Papers in Marine Sciences, 67, 1994 or IOC Technical Series, 42, 1994) that expendable instruments such as XBTs do not fall through the water column at the rate specified by the manufacturer. This has an impact on the computed depths of observations. The present real-time BATHY code form has a group, $I_X I_X I_X X_R X_R$, to encode the fall rate equation used when reporting data in real-time. A new TESAC code form will be instituted in year 2000 to contain the same information for XCTDs. It is essential that this information is included in the real-time data.

3.3 More commonly, information to create a BATHY, TESAC or TRACKOB message is stored digitally and prepared in the correct format for transmission *via* satellite to shore. The full resolution profile or higher time resolution surface observations are recorded on magnetic media by a computer. The recorded data are often subsampled to create the BATHY, TESAC or TRACKOB message and these are sent ashore. When the platform returns to port, the magnetic media with the full resolution data should be forwarded to the country's National Oceanographic Data Centre (NODC) or other agency willing to handle the data.

3.4 For some platforms, such as PALACE floats, the full resolution data are sent ashore via satellite. This is because these platforms are expendable. At the shore processing facilities, BATHY or TESAC reports are created from the profiles. The profiles may or may not be subsampled.

3.5 There are two strategies used in subsampling a profile to prepare a BATHY or TESAC report. The first strategy chooses observations at a predetermined set of depths. This is encoded in the BATHY or TESAC as "selected depths". The second strategy chooses observations at inflection points in the profile. This method is better able to represent the shape of the profile and is encoded in the BATHY or TESAC as "significant depths".

3.6 Even though profile data may be recorded digitally, a form that records basic information about each instrument deployment is valuable. The record should include information about the ship, its location and, sometimes, other observations made at the same time. Annex I shows a suggested form for the log. Copies of these forms should be sent along with the delayed mode data to the appropriate processing centre.

4. DATA ROUTING

4.1 GENERAL DATA FLOW

4.1.1 JCOMM oceanographic data that do not need subsequent processing (such as is required to decode a satellite transmission) enter the dissemination system in two ways:

(i) As operational messages received at a National Oceanographic Centre (NOC) or a National Meteorological Centre (NMC) and a Regional Telecommunication Hub (RTH). In the past, these arrived via coastal radio stations, but now more frequently are received via email or ftp (file transfer protocol) using the Internet; and

(ii) As completed reports, or raw data, and log forms via a national oceanographic agency through the normal International Oceanographic Data and Information Exchange (IODE) procedures.

4.1.2 Data that need some subsequent processing, such as data from environmental satellites and satellite-communicated data from moored and drifting buoys, bottom moorings and floats, pass through and are processed by satellite receiving centres. The processed data then enter the system in two ways:

(i) As operational data via a NOC or NMC and a RTH;

(ii) As non-operational data with all available additional information - delivered on computer media - via National Oceanographic Data Centres (NODCs) through the data exchange system of IODE.

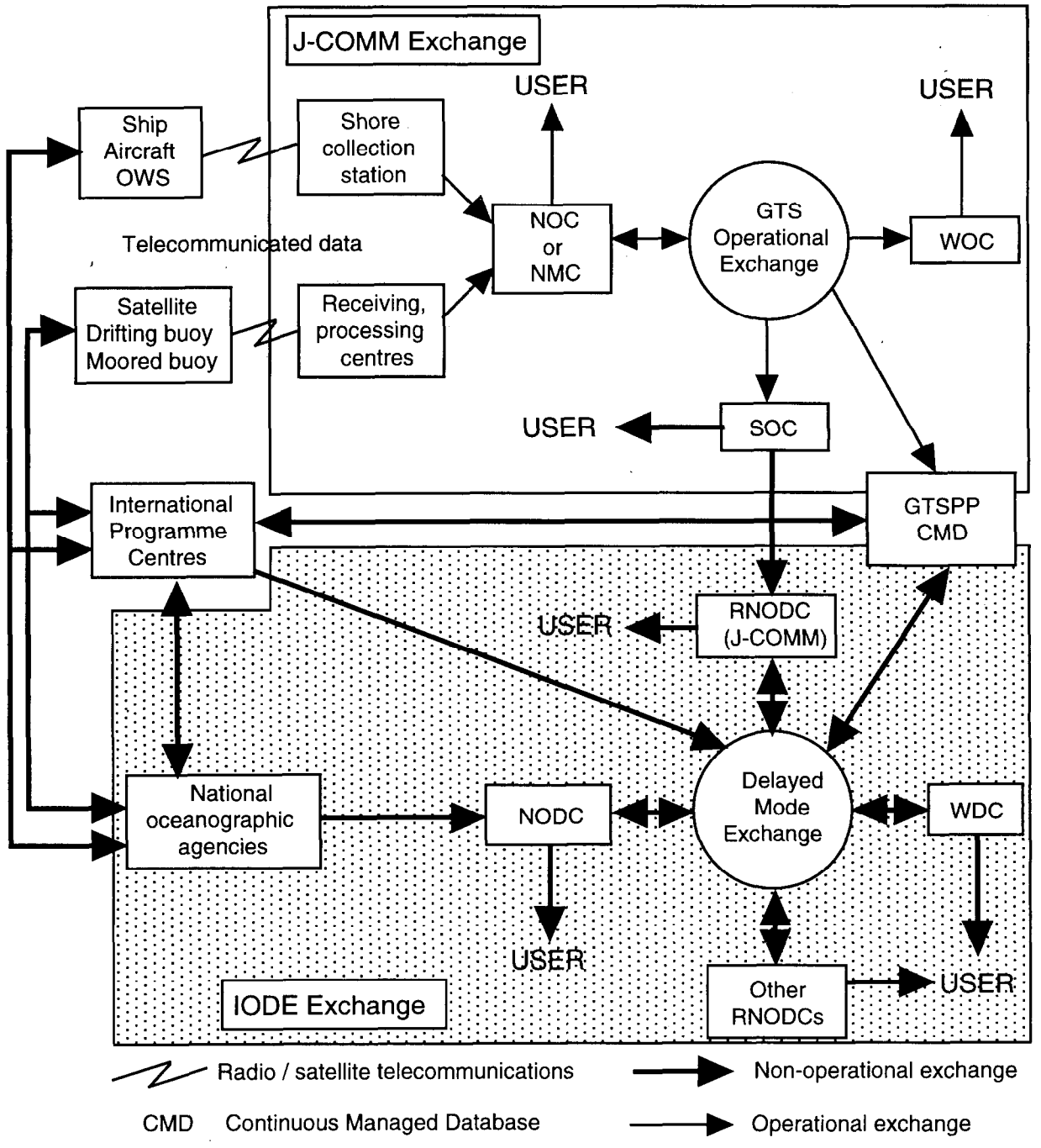
4.1.3 To provide the data to the user within the operational time, as well as to provide long-time archiving, the data flow is separated into two components as the Figure next page shows:

(i) An operational data flow for which JCOMM is responsible. This data flow contains, in general, that information which has been transmitted. The time frame in which the data set is available for JCOMM activities extends from one to thirty days. The quality control procedures applied to these data are described in Section 5. The operational data set is also forwarded to the RNODCs (JCOMM) of IODE which provide long-term storage; and

(ii) A non-operational data flow for which IODE is responsible. This data flow contains detailed identification information and other supporting environmental data as well as the basic oceanographic data.

4.1.4 Bridging these two systems is the Global Temperature Salinity Profile Programme, GTSPP. This programme was started in order to improve the performance of both (then) IGOSS and IODE in making data or higher quality more quickly available to users. GTSPP handles temperature and salinity profile data as well as other types of profiles collected at the same time. The real-time (JCOMM) data are gathered from the GTS and pass through well-documented quality control and duplicates checking procedures. The data then pass to a Continuously Managed Database, CMD, from which users have access to the most up-to-date and highest quality data available at any time. As delayed mode data arrive at the CMD they replace the lower resolution real-time data. On a regular basis, the available data are passed to Science Centres who subject the data to higher data quality assessment and return them to the CMD.

Figure 1: JCOMM / IODE Data Flow Diagram



4.1.5 There are three Science Centres that participate in the GTSPP. They are at Scripps Institution of Oceanography in San Diego, the Atlantic Oceanographic and Meteorological Laboratory in Miami, and CSIRO in Hobart. They use custom software to examine the data and assess their scientific quality. Flags are assigned that provide reasons for judging the data to be of lower quality. Data are processed yearly with as much delayed mode data as possible replacing the real-time data. The resulting files are then passed back to the CMD, for archiving.

4.1.6 The collection and exchange of operational JCOMM oceanographic data involves the following four stages:

- Platform to Shore Transmission;
- National Routing Arrangements;
- International Routing Arrangements;
- Operational Data Dissemination.

4.2 PLATFORM TO SHORE TRANSMISSION

General

4.2.1 The platform to shore transmission concerns the forwarding of data from the platform to a National Oceanographic Centre (NOC) or a National Meteorological Centre (NMC) *via* a shore-collecting centre. At the present time, this transmission is largely based on satellite data collection systems although some data may still be collected through the International Maritime Mobile Service (IMMS).

Completion of Radio Messages

4.2.2 The report consists of the completed BATHY, TESAC or TRACKOB code form. In most cases, these reports are prepared by computer software from the digitally stored data. After checking, the data are sent ashore through satellite communications services.

Time and Delay of Transmission

4.2.3 The reports should be transmitted as soon as possible after the time of observation. However, the reports may be transmitted up to 48 hours after the time of observation, in case operational difficulties preclude their earlier transmission. Nevertheless, in order not to interfere with the transmission of meteorological reports, it is recommended to avoid, as far as possible, the following regularly scheduled meteorological transmission periods:

23.30 UTC - 02.00 UTC
05.30 UTC - 08.00 UTC
11.30 UTC - 14.00 UTC
18.30 UTC - 20.00 UTC

Use of Satellite Telecommunication Capabilities

4.2.5 The use of semi-automated or automated transmission devices onboard platforms is common. These include those employed in the International Maritime Satellite (INMARSAT) system, environmental satellite DCPs and the Argos System. Specific procedures for data transmission are determined by the particular system in use. In all cases, the objective remains to transfer observational data from the platform to the appropriate NMC or NOC for insertion onto the GTS as rapidly and as error-free as possible.

4.3 NATIONAL ROUTING ARRANGEMENTS

4.3.1 The national arrangements for the routing of JCOMM oceanographic observations fall under the responsibility of the country in which the shore-collecting station is located. In principle, this part of the routing can be envisioned as follows.

4.3.2 The messages sent from platform to shore contain the address of the NMC or NOC to which they are to be forwarded from the shore collecting station. If the NOC and the NMC are not co-located, the NOC should ensure the relay of reports to the NMC.

4.3.3 The NMC is usually responsible for the collection of oceanographic reports received by centres located in its area of responsibility and for their transmission to the associated RTH of the GTS. The NMC is also responsible for checking and correcting reports to ensure that standard telecommunication procedures are applied. The NMC acts therefore as the GTS centre responsible for compiling individual reports into bulletins. It is recommended that bulletins be compiled at least every 12 hours or as they become available. They may contain reports from several ships and various observation times. BATHY, TESAC and TRACKOB observations should be compiled in separate bulletins.

4.3.4 WMO Members operating those GTS centres which insert oceanographic reports onto the GTS should provide the WMO Secretariat with the transmission schedules, TTA_1A_2ii and CCCC groups.

4.4 INTERNATIONAL ROUTING ARRANGEMENTS

4.4.1 The exchange programme of JCOMM oceanographic observations over the GTS is based on the decision of the WMO Executive Council and Commission for Basic Systems (CBS) that the WMO Regional Associations make suitable arrangements for the exchange of these data in their regions. It has, however, become necessary to widen the scope to include inter-regional and global exchanges, taking into account the increasing requirements for the exchange of oceanographic data.

4.4.2 On the basis of requirements expressed by Members, the WMO Secretariat has prepared a plan for the routing of the JCOMM oceanographic messages. The basic principles followed in establishing this plan were:

(i) These messages are exchanged globally on the Main Telecommunication Network (MTN) and its branches. Since the MTN and its branches are fully operational, all WMCs and RTHs located on the MTN and its branches receive and transmit messages in accordance with stated requirements;

(ii) The WMO standard telecommunication procedures specified in the Manual on the Global Telecommunication System (WMO No. 386) apply to JCOMM oceanographic messages;

(iii) The national meteorological services operating NMCs as GTS centres are the responsible parties for the international exchange of the messages.

4.4.3 Only messages formatted in accordance with the rules enacted in the Manual on the GTS may be routed on the GTS:

(i) Each message is composed of a starting signal <SOH>, one bulletin and an end-of-message signal, <ETX>;

(ii) A bulletin is composed of an abbreviated heading followed by a set of reports in one code form only, each separated by a report separation signal;

(iii) The reports have already been defined (see para. 1.2.6).

Annex V shows the layout of a JCOMM oceanographic message as it must be compiled for exchange through the GTS. Annex VI gives an example of such a message and explains how to decode it.

4.5 OPERATIONAL DATA DISSEMINATION

4.5.1 The NMC which is the terminal point of the GTS for the receipt of data disseminated over the GTS is responsible for receiving the oceanographic reports and forwarding them to oceanographic and meteorological centres involved in the preparation of products. The routing arrangements in this phase should be established on a national basis.

4.5.2 Requirements for the operational receipt of oceanographic data should be directed to and consolidated by the National Meteorological Service which operates the NMC as a GTS centre. These requirements are to be further submitted to the WMO Secretariat to ensure the co-ordination of routing arrangements, in consultation with appropriate WMO bodies, for the implementation by Members concerned.

4.6 NON-OPERATIONAL ROUTING ARRANGEMENTS

4.6.1 The international data exchange and archiving of JCOMM oceanographic data in non-real-time falls under the responsibility of the International Oceanographic Data and Information Exchange (IODE) system of IOC. The *Guide to IGOSS Data Archiving and Exchange* (IOC Manuals and Guides No. 1, UNESCO 1974) stipulates the procedures to be followed. As the original data records and the log forms are to be submitted, observers should strive to label records correctly.

4.6.2 After return to port, the completed log forms and data logged on magnetic media will be forwarded to the national oceanographic agency in charge of collecting these data. The actual channels through which the data are routed before entering the IODE system vary from country to country.

5. ERROR CHECKING AND QUALITY CONTROL

5.1 INTRODUCTION

5.1.1 The value of JCOMM oceanographic data for a user depends essentially upon the quality of the data. In this context, quality is meant in terms of accuracy and reliability which concerns the physical content of a measurement as well as in terms of correct encoding of the value measured.

5.1.2 Several studies have shown that a significant percentage of the reports still contain errors that can be easily corrected. These errors are the ones that are possible to detect by examination of a telecommunicated data set without the benefit of the original data. Thus, such subtle errors as those arising from minor instrument malfunctions or miscalibration, poor choices of inflection points by the observer, or inaccurate reading techniques are not considered in this classification. The following are definitions of different types of errors, taken from the IGOSS Glossary, which will be used in this text.

Message Format Error

5.1.3 An error which concerns the starting line of a message, the abbreviated heading of a bulletin or end-of-message signals.

Coding Error

5.1.4 An error which is assumed to have occurred if the report received does not conform with the internationally agreed code forms FM 63-X Ext. BATHY, FM 64-IX TESAC or FM 62-VIII Ext. TRACKOB. This can be an error in the position or content of those fields or characters which are used to indicate the type, origin and content of the report.

Physical Error

5.1.5 An error in the reported value of any observation, e.g., date/time of observation, position, depth, temperature, salinity, current and wind speed and direction, air temperature and pressure.

5.1.6 At any stage within the data exchange scheme, errors may creep into a report, therefore quality control procedures should be applied to the JCOMM oceanographic data at the following three stages:

- Onboard ship;
- At a NMC (or NOC) before insertion onto the GTS;
- At a SOC (or NOC) after reception from the GTS.

5.2 STEPS TO IMPROVE THE DATA QUALITY AT ITS ORIGIN

5.2.1 Errors begin with the instrumentation. The accuracy of the instrument, its calibration and the operational limitations, e.g. depth or the speed of the ship, have to be considered. In this context, reference is made to the *Guide to Oceanographic and Marine Meteorological instruments and Observing Practices* (IOC Manuals and Guides Series No. 4, UNESCO 1975).

5.2.2 Crude or subtle errors introduced by such factors as malfunctioning temperature thermistors, recorder response and uncalibrated thermometers are very often difficult to detect from isolated stations. Also, the spike induced by insulation punctures along the launcher probe connecting wire sometimes looks real. The recording of additional information, such as sea surface temperature, from other sensors can help significantly to identify such problems (See Annex I).

5.2.3 The proper training in the use and maintenance of ocean instrumentation, particularly the instrumentation used onboard ships-of-opportunity, is an important factor in the improvement of data quality.

5.2.4 Direct discussion of the programme between the ship's crew and a national authority will lead to closer identification with the value and importance of the JCOMM programme. Feedback of results and expressions of appreciation are some of the best means of ensuring high-quality reports from the observing ship.

5.2.5 Several types of automated systems have been developed. These systems automatically format and transmit data through highly reliable satellite systems. Therefore, they are undoubtedly the best way to minimize data quality problems arising from manual interpretation, coding and transmission.

5.2.6 One such system, the Shipboard Environmental Data Acquisition System (SEAS) was developed in the USA to deliver data from ships to shore. Data entered into the SEAS units are automatically transmitted through the GOES or INMARSAT-C satellite systems or by email. As the data pass to US processing facilities, they are also made available to authorized users who have a terminal with a phone modem. Only seconds elapse between the time of shipboard transmission and the arrival of the data to users. The SEAS equipment is totally portable, can be set up in a few hours and occupies a space of about 0.3 m^3. Currently, it is possible to enter, code and transmit standard shipboard meteorological observations

(winds, temperature, pressure, waves/swell and ice) and Expendable Bathythermograph (XBT) observations *via* SEAS.

5.2.7 Another automated system was developed by Collecte Localisation Satellite (CLS) Service Argos at the request of the Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER) to gather, record, process and transmit BATHY data to the GTS via the Argos system. The hardware is made up of a launcher, an electronics unit and a microcomputer (which can be used for other shipboard applications when not required for soundings). The electronics unit is portable, and occupies less than 0.1 m^3. The location of the observation is computed at the Argos processing centres in Toulouse, France, or Landover, USA, which also forward the reports to the RTHs of Paris or Washington, respectively, for insertion onto the GTS.

5.3 QUALITY CONTROL PROCEDURES BEFORE INSERTION ONTO THE GTS

5.3.1 JCOMM oceanographic reports are inserted onto the GTS by NMCs or, as an exception, by NOCs which have access to the GTS *via* an NMC. The data arriving at NMCs contain various errors, some of which are easily detected and identified and, therefore, can be corrected, such as, for example, primarily coding errors. The data reside at NMCs for only a short time, so that correction procedures are best carried out operationally on a computer. However, limited manual corrections can be carried out where data quantity is not large. It is therefore recommended that the minimum set of correction procedures intended for this purpose (see Annex VII) be applied to the reports at an NMC (or at an NOC on behalf of an NMC) before the data are inserted onto the GTS.

5.3.2 When compiling bulletins and preparing messages, special attention should be given to the following message format errors which are frequently observed (see Annex V):

(i) TT must be SO. If it is not, most centres cannot retrieve the bulletin and it will be lost.

(ii) A_1A_2 are incorrect. ("Country codes" (WMO No. 386, Vol. I, Part II, Attachment II-6, table C1)) should not be used; table C2 (same reference) should be followed). The position of the observation is not within the region designated by A_2; whenever practicable, X should not be used for A_2;

(iii) ii conflicts with C in catalogue number. For JCOMM oceanographic data bulletins, ii should be in the range 01-19 inclusive for global distribution according to the Manual on GTS (WMO No. 386, Vol. I, Part II, para. 2.3.2.2);

(iv) YYGGgg is incorrect. This should be the time (day, hour, minute in UTC) that the bulletin is compiled at the GTS centre for exchange;

(v) BBB used incorrectly. The use of RTD is reserved for delayed information but has been used for overflow bulletins at the same time as the normal bulletin.

5.4 QUALITY CONTROL PROCEDURES AFTER RECEPTION FROM GTS

5.4.1 The further quality control of JCOMM oceanographic data is necessary after reception of the message from the GTS to ensure the accuracy of operational products and to provide archive centres with uniform quality-controlled data sets.

5.4.2 Quality control procedures at this point in the system should include checks for message format, coding and physical errors. Data which are found to be erroneous or highly suspect should be flagged as

such. Changes are permissible only when they can be made with a high degree of confidence and if the original value is stored in the data record. No data should be removed from the record. Flags are to be provided for all reported physical variables including position, date, time and depth. The flags are considered necessary to provide users with information and results of quality control operations and to document any changes made to physical variables.

5.4.3 The GTSPP has published a well-documented set of quality control procedures in IOC Manuals and Guides No. 22, UNESCO 1990. This has been further enhanced by procedures published by the participating Science Centres in GTSPP. These latter are available from the separate centres (CSIRO, Australia, AOML and Scripps in the U.S.A.) or through data centres participating in the GTSPP. It is recommended that these procedures be used.

6. MONITORING

6.1 GENERAL

The exchange of JCOMM oceanographic reports is monitored in four ways. Exchange of national data is monitored at the national level. International exchange is monitored on a broad statistical basis through examination of monthly input/output figures submitted by Members. Finally, detailed examination of the GTS exchange is periodically carried out in conjunction with other GTS monitoring within the World Weather Watch of WMO. Finally, there have been extensive monitoring procedures established by the GTSPP.

6.2 NATIONAL MONITORING

Since reports come from a variety of platforms without fixed positions or observation times, it is important that a close watch be maintained on the entire process of exchange to avoid interruptions in data flow due to errors in formatting or routing. It is a national responsibility to assure that all observations destined for international exchange are collected, correctly formatted and exchanged *via* the GTS in a timely manner. This can only be accomplished through an adequate national monitoring programme. In particular, it is important that the national monitoring programme know how many messages are sent from their ships and to check that all of these appeared on the GTS.

6.3 MONTHLY EXCHANGE

The monthly summaries of the number of JCOMM oceanographic reports inserted onto the GTS (INPUT) and extracted from the GTS (OUTPUT) are submitted by national meteorological or oceanographic centres to the SOOP Technical Coordinator. An example of the monthly statistical summary with an explanation for completion is given in Annex VIII. These summaries are analyzed to identify data exchange problems, particularly inconsistencies among centres. The centre where the apparent problem occurs is then alerted to the nature of the problem and a solution is sought.

6.4 PERIODIC GTS MONITORING

The periodic GTS monitoring is used to determine the efficiency of the exchange of the JCOMM oceanographic data and to identify discrepancies observed at different centres. The actual message transcripts at several centres are compared. One of the major causes of data loss is errors in formatting the GTS messages.

6.5 GTSPP MONITORING

6.5.1 A number of reports are generated from the GTSPP to monitor data flow and quality. The real-time data are accumulated on a monthly basis from four different centres connecting to the GTS (Canada, U.S.A., Japan and Germany). These are examined to determine how many reports were received at each centre, and where and if data were not received. A report is issued each month.

6.5.2 In recent years the JJYY form of BATHY code (the form described in this document) is being used. Each month a report is compiled documenting the progress in switching from the older code form (JJXX form) to the newer one.

6.5.3 On a monthly basis, a data quality report is assembled that shows which platforms have had higher rates of problems in their data collections. Ship's operators are notified so that they can take actions to correct these noted problems.

6.5.4 A display of where profiles were collected is made both on a monthly basis and in the previous 12 months. This is used to monitor the global sampling and where possible adjust the sampling to provide a more uniform coverage of the oceans.

ANNEX I

SUGGESTED LOG FORM

Introduction

A handwritten record of the deployment of instruments can be very useful in recording information that later helps interpret the data collected. In addition, some measurements that are made at the same time, but that do not or cannot be sent with the BATHY, TESAC or TRACKOB reports, can be recorded here. Finally, comments about any problems encountered can help to correct mistakes.

A log form should contain the following information once only.

- Platform name
- Cruise identifier
- Project

A log form should contain the following information for each deployment of an instrument.

- Station identifier
- Instrument type
- Instrument identifier
- Instrument serial number if an expendable instrument
- Date (UTC)
- Latitude
- Longitude
- Comments

A log form may also provide additional fields for other measurements that accompany the deployment.

Some examples are as follows:

- Sea surface temperature
- Wind speed
- Wind direction
- Air temperature

ANNEX II

INSTRUCTIONS FOR PREPARING THE "BATHY" REPORT

Introduction

The BATHY report, as provided therein, should be used for recording temperature observations *versus* depth taken with instruments which provide the temperature with a resolution of 0.1 degrees Celsius or less, such as mechanical or expendable Bathythermographs, thermistor chains or others. The TESAC report should be used for temperature values with a higher resolution and/or when salinity or current *versus* depth are reported (see Annex III). In addition to the temperature information, the BATHY report makes provision for encoding sea-surface current measurements and depth to the bottom, as well as other environmental information.

Report information is designed according to the reporting code FM 63-X Ext. BATHY published in the Manual on Codes, Vol. I (WMO No. 306) and is for the transmission as a BATHY report. The BATHY message, accompanied by the original data and any station log should be forwarded to the national agency which delivers the JCOMM oceanographic data to the IODE system. An explanation of this code form can be found at http://www.meds-sdmm.dfo-mpo.gc.ca. Follow the links to National and International Programmes, and SOOPIP.

BATHY Report Information

*Note that in the explanations below, a * preceding a variable name indicates the group is optional.*

REPORT IDENTIFIER

All BATHY reports must contain the 4-character identifier JJYY to distinguish them from other oceanographic/meteorological reports. Each subsequent individual BATHY report (i.e. each coded temperature-depth profile) shall begin with the JJYY identifier.

DATE (YYMMJ)

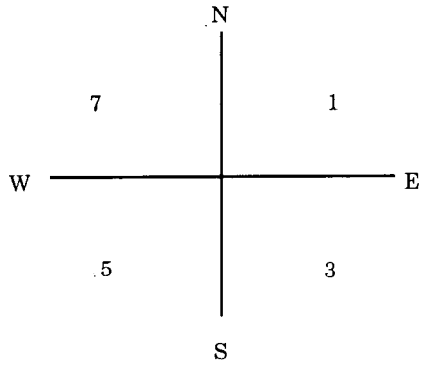
DAY (YY):	Enter the day of the month in UTC by using numerals 01 to 31.
MONTH (MM):	Enter the month of the year in UTC by using numerals 01 to 12.
YEAR (J):	Enter the last digit of the year in UTC.

TIME (GGgg/)

HOUR (GG):	Enter the time of observation in UTC in hours.
MIN (gg):	Enter the minutes of the time of the observation in UTC. Include the solidus (/) at the end as part of the transmitted group.

LATITUDE ($Q_cL_aL_aL_aL_a$)

QUAD (Q_c): Enter the quadrant of the globe according to the following table (where N or S is measured with respect to the equator and E or W is measured with respect to Greenwich):



Code Figure	Latitude	Longitude
1	north	east
3	south	east
5	south	west
7	north	west

DEG (L_aL_a): Enter the latitude of the observation in degrees
MIN (L_aL_a) and minutes.

LONGITUDE ($L_oL_oL_oL_oL_o$):.

DEG ($L_oL_oL_o$): Enter the longitude of the observation in degrees
MIN (L_oL_o) and minutes.

****WIND*** (i_uddff)

(i_u): Wind speed units indicator. Enter the code figure according to the following table:

Code Figure	Units used	Instruments (certified or otherwise)
0	metres / second	Land stations and ships with certified instruments
1	Knots	
2	metres / second	Ships with uncertified instruments
3	Knots	

DIR (dd): True wind direction - Enter the wind direction, in tenths of degrees, from which the wind is blowing. Enter "00" for calm and "36" for a wind direction of 355 degrees to 4 degrees (e.g. 01 = 10 degrees east of north).

SPEED (ff): True wind speed - Enter true wind speed in metres *per* second or knots (as described by i_u). Prefix zeros to fill the field. Enter "00" for calm.

****AIR TEMPERATURE DRY*** ($4s_nTTT$)

IN: Indicator for the air temperature group, enter 4.

+/- (s_n): Air temperature sign indicator - Enter "0" for temperature positive or zero and "1" for temperature negative.

TEMP DRY (TTT): Air temperature - Enter the air temperature to tenths of a degree Celsius. Prefix zeros to fill the field.

INDICATOR GROUP (k_1)

Enter 8888k_1 before recording depth-temperature values at "significant" or "selected depths".

(k_1): Indicator for digitization:

- Enter $k_1 = 7$ for values at selected depths (data points fixed by the instrument or selected by any other method).
- Enter $k_1 = 8$ for values at significant depths (data points taken from traces at significant depths).

INSTRUMENT INFORMATION ($I_XI_XI_XX_RX_R$)

PROBE TYPE ($I_XI_XI_X$): Enter the type of instrument used to make the temperature profile observation using WMO code table 1770.

RECORDER TYPE (X_RX_R): Enter the recorder that was used to log the observations using WMO code table 4770.

DEPTH/TEMPERATURE (zzTTT)

DEPTH (z_0z_0): Always include temperature at the sea surface or use the first readable

TEMP ($T_0T_0T_0$): temperature in the upper 10 metres for this purpose. Prefix zeros to fill the field.

DEPTH (z_nz_n): Enter depth (metres, last two figures) and temperature (tenths of a degree

TEMP ($T_nT_nT_n$): Celsius) at "significant" or "selected" points.

The following procedures should be used when encoding the depth - temperature measurements:

(a) The temperature to be encoded should be taken to the nearest tenth of a degree Celsius. The depth is to be taken to whole metres; Prefix zeros to fill the field.

(b) In case of a continuous recording, it is recommended that "significant" depths be reported ($k_1 = 8$):

(i) Select sufficient "significant" depths to describe the basic features of the temperature profile;
(ii) Include the depth and temperature of the top and bottom of isothermal layers;

(c) Do not adjust the trace to agree with the reference temperature or interpret the trace at convenient depth increments (5 m, 20 m, etc.) unless flexure points actually exist at these depths.

(d) If the instruments used strikes the sea bottom, enter 5 zeros (00000) after the last depth-temperature entry.

(e) Use $k_1 = 7$ for temperature values taken from ocean data buoys and other instruments yielding fixed depth values.

(f) To indicate a negative temperature, add 50.0 to the absolute value of the temperature and drop the negative sign.

(g) As there are only 2 digits to indicate the depth, each increase in 100 m intervals has to be indicated. Therefore, the code 999zz has to precede the first depth-temperature value in each 100 m interval containing a significant or selected depth. zz is coded as follows:

99901	for the interval	100 to 199 metres
99902	for the interval	200 to 299 metres
.....		
99910	for the interval	1000 to 1099 metres
99911	for the interval	1100 to 1199 metres
.....		
99920	for the interval	2000 to 2099 metres

The tens and unit digits of depths are then entered with the corresponding temperatures. For example:

	zzTTT	zzTTT	zzTTT
	99901	50128	75053
This represents:	≥ 100 m	150 m, 12.8 °C	175 m, 5.3 °C

(h) The temperature at the lowest depth of the sounding shall be reported in the last temperature group.

INDICATOR GROUP:

Insert 66666 if the "TOTAL WATER DEPTH" and/or the "SEA SURFACE CURRENT" are included in the BATHY report.

TOTAL WATER DEPTH ($1Z_dZ_dZ_dZ_d$)

IN: Enter "1" (indicator for the TOTAL WATER DEPTH group).

($Z_dZ_dZ_dZ_d$) Enter the sounding depth to the nearest metre for the station.
Note: Group ($1Z_dZ_dZ_dZ_d$) *shall be omitted when group* 00000 *(instrument hits the bottom) is used.*

SS-CURRENT (Sea surface current) ($k_5D_cD_cV_cV_c$)

(k_5) Indicator for measuring method:

- Enter k_5 = 2: GEK (Geomagnetic Electrokinetograph)
- Enter k_5 = 3: Ship's set and drift determined by fixe more than 6 hours but less than 12 hours apart.

DIR (D_cD_c): Surface current direction: Enter direction in tens of degrees towards which sea current is moving.

SPEED (V_cV_c): Enter surface current speed in 0.1 knots.

PLATFORM CALL SIGN:

If the platform is a ship, enter the ship's call sign or the letters "SHIP". If the platform is a float, enter 99999 $A_nb_Wn_bn_bn_b$ where $A_nb_Wn_bn_bn_b$ is the WMO identifier given to the float.

Note: The radio call sign, which also acts as a radio message terminator, should terminate each report.

ANNEX III

INSTRUCTIONS FOR PREPARING THE "TESAC" REPORT

Introduction

The TESAC report should be used if one or all of the following data sets are available:

- Temperature *versus* depth with a resolution of 0.01 degrees Celsius.
- Temperature and salinity *versus* depth.
- Current *versus* depth.

Report information is designed according to the reporting code FM 64-IX TESAC published in the Manual on Codes, Vol. I (WMO No. 306) and is for transmission as a TESAC report. The TESAC report accompanied by the original data and any handwritten station log should be forwarded to the national agency which delivers the JCOMM oceanographic data to the IODE system. An explanation of this code form can be found at http://www.meds-sdmm.dfo-mpo.gc.ca. Follow the links to National and International Programmes, and SOOPIP.

TESAC Report Information

*Note that in the explanations below, a * preceding a variable name indicates the group is optional.*

REPORT IDENTIFIER

All TESAC reports must contain the 4-character identifier KKXX to distinguish them from other oceanographic/meteorological reports. Each subsequent individual TESAC report (i.e. each coded temperature-salinity-current depth profile) shall begin with the KKXX identifier.

DATE (YYMMJ)

DAY (YY): Enter the day of the month in UTC by using numerals 01 to 31.

MONTH (MM): Enter the month of the year in UTC by using numerals 01 to 12.

YEAR (J): Enter the last digit of the year in UTC.

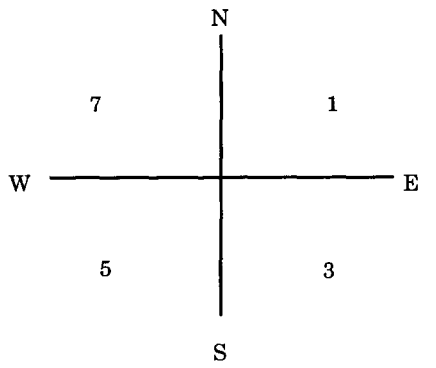
TIME (GGgg/)

HOUR (GG): Enter the time of observation in UTC in hours.

MIN (gg): Enter the minutes of the time of the observation in UTC. Include the solidus (/) at the end as part of the transmitted group.

LATITUDE ($Q_cL_aL_aL_aL_a$)

QUAD (Q_c): Enter the quadrant of the globe according to the following table (where N or S is measured with respect to the equator and E or W is measured with respect to Greenwich):



Code Figure	Latitude	Longitude
1	north	east
3	south	east
5	south	west
7	north	west

DEG (L_aL_a): Enter the latitude of the observation in degrees
MIN (L_aL_a) and minutes.

LONGITUDE ($L_oL_oL_oL_oL_o$):.

DEG ($L_oL_oL_o$): Enter the longitude of the observation in degrees
MIN (L_oL_o) and minutes.

**WIND* ($i_u$ddff)

(i_u): Wind speed units indicator. Enter the code figure according to the following table:

Code Figure	Units used	Instruments (certified or otherwise)
0	metres / second	Land stations and ships with certified instruments
1	Knots	
2	metres / second	Ships with uncertified instruments
3	Knots	

DIR (dd): True wind direction - Enter the wind direction, in tenths of degrees, from which the wind is blowing. Enter "00" for calm and "36" for a wind direction of 355 degrees to 4 degrees (e.g. 01 = 10 degrees east of north).

SPEED (ff): True wind speed - Enter true wind speed in metres *per* second or knots (as described by i_u). Prefix zeros to fill the field. Enter "00" for calm.

**AIR TEMPERATURE DRY* (4s_nTTT)

IN: Indicator for the air temperature group, enter 4.

+/- (s_n): Air temperature sign indicator - Enter "0" for temperature positive or zero and "1" for temperature negative.

TEMP DRY (TTT): Air temperature - Enter the air temperature to tenths of a degree Celsius. Prefix zeros to fill the field.

INDICATOR GROUP (k_1k_2)

Enter 888k_1k_2 before recording depth-temperature-salinity values at "significant" or "selected depths".

(k_1): Indicator for digitization:

- Enter k_1 = 7 for values at selected depths (data points fixed by the instrument or selected by any other method).
- Enter k_1 = 8 for values at significant depths (data points taken from traces at significant depths).

(k_2): Method of salinity/depth measurement:

- Enter k_2 = 0 No salinity measured. (Omit the salinity groups)
- Enter k_2 = 1 *In situ* sensor, accuracy better than 0.02 PSU.
- Enter k_2 = 2 *In situ* sensor, accuracy less than 0.02 PSU.
- Enter k_2 = 3 Sample analysis.

DEPTH ($2z_0z_0z_0z_0$)

IN: Indicator for depth. Enter 2.

($z_0z_0z_0z_0$): Enter depth to the nearest metre of the uppermost measurement.

TEMP ($3T_0T_0T_0T_0$)

IN: Indicator for temperature. Enter 3.

($T_0T_0T_0T_0$): Enter temperature in hundredth of a degree Celsius of the uppermost measurement.

SALINITY ($4S_0S_0S_0S_0$)

IN: Indicator for salinity. Enter 4.

($S_0S_0S_0S_0$): Enter salinity in hundredth of the salinity unit of the uppermost measurement.

DEPTH ($2z_nz_nz_nz_n$)

IN: Indicator for depth. Enter 2.

($z_nz_nz_nz_n$): Enter depth at "significant" or "selected" points.

TEMP ($3T_nT_nT_nT_n$)

IN: Indicator for temperature. Enter 3.

($T_nT_nT_nT_n$): Enter temperature at "significant" or "selected" points. In case temperature is not measured at all omit this group.

SALINITY ($4S_nS_nS_nS_n$)

IN: Indicator for salinity. Enter 4.

($S_nS_nS_nS_n$): Enter salinity at "significant" or "selected" points. In case salinity is not measured at all omit this group.

The following procedures should be used when encoding the depth- temperature-salinity measurement:

(a) The temperature to be encoded should be taken to the nearest hundredth of a degree Celsius. The salinity to be encoded should be taken to the nearest hundredth of the salinity unit. The depth is to be taken to whole metres. Prefix zeros to fill the field.

(b) In case of a continuous recording, it is recommended that "significant" depths be reported ($k_1 = 8$):

(i) Select sufficient "significant" depths to describe the basic features of the temperature and salinity profiles;

(ii) Include the depth, temperature and salinity of the top and bottom of isothermal and isohaline layers;

(iii) At each significant depth (whether required because of a feature in the temperature or salinity profile) include both the temperature and salinity observations.

(c) Do not adjust the trace to agree with the reference temperature/salinity or interpret the trace at convenient depth increments (5 m, 20 m, etc.) unless flexure points actually exist at these depths.

(d) If the instrument used strikes the sea bottom, enter 5 zeros (00000) after the last depth-temperature-salinity entry.

(e) Use $k_1 = 7$ for temperature/salinity values taken from ocean data buoys and other instruments yielding fixed depth values.

(f) To indicate a negative temperature, add 50.0 to the absolute value of the temperature and drop the negative sign.
(g)

(g) The temperature/salinity at the lowest depth of the soundings shall be reported in the last temperature/salinity group.

****CURRENT INDICATOR GROUP*** ($66k_6k_4k_3$)

Insert $66k_6k_4k_3$ if the sea surface current or current *versus* depth are included in the TESAC report.

(k_6): Method of removing ship velocity and motion from current measurements (Doppler current profiling method), according to Table 2267 of Manual on Codes (WMO No. 306).

(k_4): Period of current measurement (drift method) according to Table 2265 of Manual on Codes (WMO No. 306).

(k_3): Duration and time of current measurements according to Table 2264 of Manual on Codes (WMO No. 306).

DEPTH ($2z_0z_0z_0z_0$)

IN: Indicator for depth. Enter 2.
($z_0z_0z_0z_0$): Enter depth to the nearest metre of the uppermost measurement.

DIR/SPEED ($d_0d_0\ c_0c_0c_0$)

DIR (d_0d_0): Enter the direction in tenths of degrees towards which the current of the uppermost measurement is moving.

SPEED ($c_0c_0c_0$): Enter the speed of the current of the uppermost measurement, in centimetres *per* second.

DEPTH ($2z_nz_nz_nz_n$)

IN: Indicator for depth. Enter 2.

($z_nz_nz_nz_n$): Enter depth to the nearest metre of the selected depth.

DIR/SPEED ($d_nd_n\ c_nc_nc_n$)

DIR (d_nd_n): Enter the direction of the current at the selected depth.

SPEED ($c_nc_nc_n$) Enter the speed of the current at the selected depth.

****INDICATOR GROUP***: Insert 55555 if the "TOTAL WATER DEPTH" is included in the TESAC report.

****TOTAL WATER DEPTH*** ($1Z_dZ_dZ_dZ_d$)

IN: Enter "1" (Indicator for the **TOTAL WATER DEPTH** group).

($Z_dZ_dZ_dZ_d$) Enter the sounding depth to the nearest metre for the station.
Note: group ($1Z_dZ_dZ_dZ_d$) *shall be omitted when group* 00000 *(instruments hits the bottom) is used.*

PLATFORM CALL SIGN:

If the platform is a ship, enter the ship's call sign or the letters "SHIP". If the platform is a float, enter 99999 $A_nb_wn_bn_bn_b$ where $A_nb_wn_bn_bn_b$ is the WMO identifier given to the float.
Note: The radio call sign, which also acts as a radio message terminator, should terminate each report.

ANNEX IV

INSTRUCTIONS FOR PREPARING THE "TRACKOB" REPORT

Introduction

The TRACKOB report should be used for recording of conventional oceanographic observations at the sea surface taken along a ship's track.

The report form permits the collection and transmission of one or more parameters such as:

- water temperature and/or
- salinity and/or
- ocean currents in terms of direction and speed

It is designed to report spot values as well as averaged data over a selected time period. The instruments used should provide the temperature with a resolution of 0.1 degrees Celsius or less, the salinity in 0.01 of practical salinity units, the current speed with a resolution of 0.1 metres/second or 0.1 knots, and the current direction to at least 10°.

Report information is designed according to the reporting code FM 62-VIII Ext. TRACKOB published in the Manual on Codes, Vol. I (WMO No. 306) and is for the transmission as a TRACKOB report. A report contains a whole series of observations, provided that all the observations took place during one UTC day. The log form accompanied by the original data, should be forwarded to the national agency which delivers the JCOMM oceanographic data to the IODE system. An explanation of this code form can be found at http://www.meds-sdmm.dfo-mpo.gc.ca. Follow the links to National and International Programmes, and SOOPIP.

TRACKOB Report Information

REPORT IDENTIFIER:

All TRACKOB reports must contain the 4-character identifier NNXX to distinguish them from other oceanographic/meteorological reports.

DATE (YYMMJ)

DAY (YY): Enter the day of the month in UTC by using numerals 01 to 31.

MONTH (MM): Enter the month of the year in UTC by using numerals 01 to 12.

YEAR (J): Enter the last digit of the year in UTC.

Beginning of the section to be repeated for each observation made at different times and locations within a given UTC day.

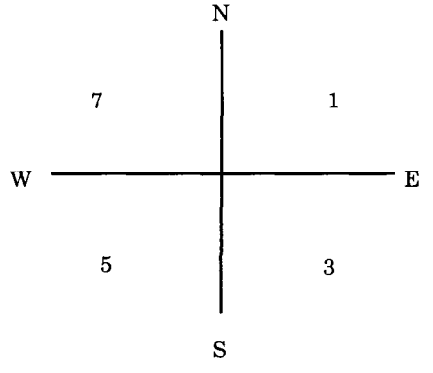
TIME (GGgg/)

HOUR (GG): Enter the time of observation in UTC in hours.

MIN (gg): Enter the minutes of the time of the observation in UTC. Include the solidus (/) at the end as part of the transmitted group.

LATITUDE ($Q_cL_aL_aL_aL_a$)

QUAD (Q_c): Enter the quadrant of the globe according to the following table (where N or S is measured with respect to the equator and E or W is measured with respect to Greenwich):



Code Figure	Latitude	Longitude
1	north	east
3	south	east
5	south	west
7	north	west

DEG (L_aL_a): Enter the latitude of the observation in degrees
MIN (L_aL_a) and minutes.

LONGITUDE ($L_oL_oL_oL_oL_o$):.

DEG ($L_oL_oL_o$): Enter the longitude of the observation in degrees
MIN (L_oL_o) and minutes.

The following group is mandatory for the first observation and any subsequent change in the averaging procedures; otherwise it is optional.

INDICATOR GROUP ($4m_Tm_Sm_ci_c$)

IN: Indicator for INDICATOR GROUP: Enter 4.

($m_Tm_Sm_c$): Averaging periods for temperature, salinity and current measurements respectively:

- Enter m_T, m_S, m_c = 0 for spot values
- Enter m_T, m_S, m_c = 1 for averaging period <15 minutes
- Enter m_T, m_S, m_c = 2 for averaging period 15-45 minutes
- Enter m_T, m_S, m_c = 3 for averaging period > 45 minutes
- Enter m_T, m_S, m_c = 9: no measurement of the variable

(i_c): Indicator of the units of current speed

- Enter i_c = 0 for current speed in m/s

- Enter i_c = 1 for current speed in knots
- Enter i_c = 9 no measurement of current

TEMP ($6s_nT_wT_wT_w$)

IN: Indicator for temperature. Enter 6.

(s_n): Sign of sea surface temperature

- Enter s_n = 0 for pos. temperature
- Enter s_n = 1 for neg. temperature

($T_wT_wT_w$): Enter temperature (spot or averaged value) in tenth of degree Celsius. Prefix zeros to fill the field.

SAL ($8S_0S_0S_0S_0$)

IN: Indicator for salinity. Enter 8.

($S_0S_0S_0S_0$): Enter salinity (spot or averaged value) in hundredth of salinity units (practical salinity).

CURRENT ($9d_0d_0c_0c_0$)

IN: Indicator for current. Enter 9.

(d_0d_0): Enter the direction of the current to the nearest 10°.

(c_0c_0): Enter the speed of the current in 0.1 of metres/seconds or 0.1 of knots according to i_c. If the current is less than 0.05 metres/seconds or 0.05 knots enter 0000 for $d_0d_0c_0c_0$.

End of the section to be repeated for each observation made at different times and locations within a given UTC day.

PLATFORM CALL SIGN:

Enter the ship's call sign or the letters "SHIP".
Note: The radio call sign, which also acts as a radio message terminator, should terminate each report.

ANNEX V

SIMPLIFIED LAY-OUT OF A BATHY, TESAC OR TRACKOB MESSAGE EXCHANGED OVER THE GTS

Message

Starting line: <SOH> nnn

<SOH> (hexadecimal) = Start of heading

nnn (number) = Transmission sequence number (000 to 999)

Bulletin

Abbreviated Heading: TTA_1A_2 ii CCCC YYGGgg (BBB)

TT (letters): Data descriptor for alphanumeric information. For BATHY, TESAC and TRACKOB use TT = SO.

A_1A_2 (letters): Geographical designators: For BATHY, TESAC and TRACKOB reports
A_1 = W for ocean weather stations
= V for mobile ships and other marine stations
A_2 denotes the regions (of WMO) from which the report originates.

ii (figures): Indicator of the distribution of the bulletin (global, regional, national). For BATHY, TESAC or TRACKOB reports, ii should be set to 01 to 19 inclusively to denote a global distribution.

CCCC (letters): Indicator of the station originating or compiling the bulletin.

YYGGgg (figures): International date-time group. For BATHY, TESAC and TRACKOB this is the time of compiling the bulletin for insertion onto the GTS and does not refer to observation times.
YY: day of month.
GGgg: hour and minutes in UTC.

BBB (letters): Indicator to be used for an addition or a correction to a previous bulletin defined by GTS abbreviated heading.

Report

Text: a set of reports in one code form only (BATHY, TESAC or TRACKOB) separated by the symbol =.

End of message: <ETX> (hexadecimal) = End of text

ANNEX VI

EXAMPLE OF A BATHY MESSAGE EXCHANGED OVER THE GTS

[*Note: Indicator of the station and ship's call signs are hypothetical*]

A message may appear as follows:

```
<SOH>  004
SOVD02 LOVE          071943
JJYY   07129         0000/     73456     12802     88888
05205  00170         33171     39180     51183     89157
99901  04157         20141     28147     60110     80100
99902  19092         65080     99904     50057     99999
16573=
JJYY   07129         0000/     75348     15841     10535
41075  88888         05205     00054     05054     25061
35058  70058         75042     90039     99901     30039
60040  65039         85040     99902     30040     35039
99904  05039         10038     50038     ZULU=
JJYY   07129         0204/     73531     13944     01106
40242  88888         ///99     00180     78180     99901
00160  50143         80125     99902     00180     50098
99903  00091         50084     99904     00075     50067
66666  15850         32604     TGIF=
<ETX>
```

It is read as follows:

Message Level

<SOH>: is the hexadecimal symbol for start of heading
004: is nnn, the transmission sequence number

Bulletin Level

SOVD02: is TTA$_1$A$_2$ii, data designator, geographical designator, and distribution designator.

- TT = SO: oceanographic data.
- A$_1$A$_2$ = VD: reports originated from mobile ships or other marine stations except ocean weather stations (A$_1$ = V) and from WMO Region IV (A$_2$ = D).
- ii = 02: bulletin for global distribution.
- LOVE = CCCC: indicator of the GTS centre compiling the bulletin.
- 071943 is YYGGgg: international date-time group indicating when the bulletin was compiled, meaning here: the 7th. of the month, 19h 43 UTC.

Report Level
First Report

JJYY = $M_iM_iM_jM_j$: identification group meaning here: report of temperature observation.
07129 = YYMMJ: day (07) of the month (02), units of the digit of the year (9 meaning 1999).
0000/ is GGgg/: observation time UTC (time of start of collection of the profile) meaning here 00h 00 UTC.
73456 = $Q_cL_aL_aL_aL_a$: quadrant of the globe (7), latitude in degrees and minutes, meaning here 34 degrees 56 minutes, N latitude.
12802 = $L_oL_oL_oL_oL_o$: longitude in degrees and minutes, meaning here: 128 degrees 2 minutes W longitude (in combination with $Q_c = 7$).
88888 = 8888k_1: a symbolic figure group meaning that data on temperatures *versus* depths follow. $k_1 = 8$ means that temperature at significant depths follow.
05205 = $I_XI_XI_XX_RX_R$: selection from code tables 1770 and 4770 giving the type of probe used in making a temperature profile and what unit was used for recording the information (here Sippican Deep Blue probe, MK12 recorder).
00170 = $z_0z_0T_0T_0T_0$: significant depth in metres, temperature in tenths of a degree Celsius at that specified depth, meaning here: 17.0°C at the surface.
33171 = $z_1z_1T_1T_1T_1$: 17.1°C at 33 m depth.
39180 = $z_2z_2T_2T_2T_2$: 18.0°C at 39 m depth.
51183 = $z_3z_3T_3T_3T_3$: 18.3°C at 51 m depth.
89157 = $z_4z_4T_4T_4T_4$: 15.7°C at 89 m depth.
99901 = 999zz: 999 is a symbolic figure group meaning that data on hundreds of metres of depth (zz) follow; since z_iz_i indicates depth from 00-99 metres the 999zz is a code flag indicating that the following depths are equal to or greater than zz hundred metres. i.e. zz = 01: all depths following should be read $1z_iz_i$ metres; zz = 12: $12z_iz_i$ metres.
04157 = $z_iz_iT_iT_iT_i$ (see above): 15.7°C at 104 m of depth, etc. The remaining reads: 14.1°C at 120 m; 14.7°C at 128 m; 11.0°C at 160 m; 10.0°C at 180 m; 9.2°C at 219 m; 8.0°C at 265 m; 5.7°C at 450 m.
99999 16523: 99999 plus the float's WMO number.

Bulletin level

= is the symbol separating 2 reports within the bulletin.

Reports level
Second report: (see above for explanation).

A BATHY observation has been made on 7 December 1999 at 00h 00 UTC, at 53°48'N and 158°41'W.

10535 = $i_u$ddff: (optional group): wind and instrument indicator, true direction in tenths of degrees from which wind is blowing, wind speed in units indicated by i_u meaning here: wind speed measured in knots with certified instruments, blowing from 050° at 35 knots.
41075 = 4s_nTTT: (optional group): symbolic figure meaning that data on air temperature follow, sign of temperature, air temperature in tenths of a degree Celsius, meaning here: air temperature is 7.5°C.

Sea temperatures have been recorded at the following significant depths: 5.4°C at the surface; 5.4°C at 5 m depth; 6.1°C at 25 m; 5.8°C at 35 m; 5.8°C at 70 m; 4.2°C at 75 m; 3.9°C at 90 m; 3.9°C at 130 m; 4.0°C at 160 m; 3.9°C at 165 m; 4.0°C at 185 m; 4.0°C at 230 m; 3.9°C at 235 m; 3.9°C at 405 m; 3.8°C at 410 m; 3.8°C at 450 m.

Ship's call sign is ZULU

Bulletin level: (see above).

Reports level
Third report: (see above for explanation).

A BATHY observation has been made on 7 December 1999 at 02h 04 UTC, at 35°31'N and 139°44'W. The wind was blowing from 110° at 6 metres *per* second (measured with a certified instrument). The air temperature was +24.2°C.

The probe type and recorder information is missing from this report and so $I_X I_X X_R X_R X_R$ is set to ///99. Sea temperatures have been recorded at the following significant depths: 18.0°C at the surface; 18.0°C at 78 m of depth; 16.0°C at 100 m; 14.3°C at 150 m; 12.5°C at 180 m; 18.0°C at 200 m (this value is obviously erroneous and comes most likely from an encoding or a transmission error); 9.8°C at 250 m; 9.1°C at 300 m; 8.4°C at 350 m; 7.5°C at 400 m; 6.7°C at 450 m.

66666: (optional group): a symbolic figure group meaning that data on total water depth and/or sea surface current follow.
15850 = $1Z_dZ_dZ_dZ_d$: (optional group): symbolic figure meaning that data on total water depth follow, total water depth in metres, here 5850 m.
32604 = $k_5D_cD_cV_cV_c$: (optional group): symbolic figure meaning that data on ship's set and drift determined by fixes 3-6 hours apart follow, direction in tenths of degrees towards which sea current is moving, sea current speed in tenths of a knot meaning here: sea surface current moving towards 260° at 0.4 knots.

Ship's call sign is TGIF.

Bulletin level: (see above).

Message level

<ETX> is the hexadecimal symbol indicating end of text.

ANNEX VII

MINIMUM QUALITY CONTROL PROCEDURES FOR JCOMM OCEANOGRAPHIC DATA TO BE TRANSMITTED OVER THE GTS

It is recommended that minimum quality control procedures as described in the *SOOP Best Practices Guide* be followed to ensure the data to be transmitted are of high quality.

It is recommended that the following checks of report and message encoding as well as simple range checks be made prior to insertion of JCOMM oceanographic data onto the GTS. They are intended to be carried out on a computer using interactive editing procedures. However, if the amount of data is low, the procedures can be carried out manually.

1. Check if a set of reports can be separated into individual reports.

2. If there are combined reports (two or more strung together) determine if each report contains:

    a) The proper prefix; if not, insert JJYY, KKXX or NNXX.
    b) A call sign; if not (and call sign is known) insert it. If not known, insert "SHIP" or "99999" and the WMO buoy identifier.
    c) A report separation signal; if not insert "=" at the end.

3. If there are individual reports, check if the report separation signal "=" appears at the end of every individual report; if not insert "=".

4. Check if a BATHY, TESAC or TRACKOB report contains non-5 digit groups exclusive of the report identifier (JJYY, KKXX, or NNXX) and call sign. If so, correct them.

5. Check if the 5th character of the time group is a "/":

    a) If it is a "9", the report is in an older form where temperatures were reported in degrees Fahrenheit and depths were in feet. Either make the conversion to degrees C and metres (and replace the "9" by "/") or do not transmit.
    b) If it is a numeral other than "9", replace by "/".
    c) If it is blank, insert "/".

Note:
Current BATHY and TESAC formats do not recognize characters other than the solidus, "/" in the 5th. place of the time group. In cases where a national practice has been adopted to use this place to indicate a change such as English units, the GTS insertion centre should strive to correct the format for international exchange, i.e. to insert the solidus and assure temperatures are in degrees Celsius and depths in metres.

6. Check if there are characters other than numbers between the report identifier (JJYY, KKXX, or NNXX) and the call sign, except for "/" in the time group (or other locations used to indicate missing values), either correct it manually, or delete the group.

7. Check if the groups 8888k_1 (in JJYY) and 888k_1k_2 (in KKXX) are present but have missing, incorrect, or additional characters. Replace with the correct 8888k_1/888k_1k_2 group.

8. Check that the probe type and recorder type information has been filled in and that values correspond to correct table entries.

9. Check if the optional group 66k6k4k3 (in KKXX) is present but has missing, incorrect, or additional characters. Replace with the correct 66k6k4k3 group.

10. Check if the 999xx group in JJYY is followed by a duplicate 999xx group; correct or delete one of the groups.

11. Check if the depth is increasing with each observation.

12. Check if the order of sequence in KKXX is 2, 3, 4.

13. Check if the year indicator is different from the current year. Change year indicator to current year. Use caution at the beginning of the year not to change December reports.

14. Check if the report or set of reports contains excess blanks or non-essential characters; if it does delete excess blanks and non-essential characters to compress the report or bulletin.

15. Check if the current report is an exact duplicate of a previously transmitted report. If it is, do not transmit.

16. Check if a duplicate report appears in preparation. If it does, transmit only the one received last.

17. Check the following limits of parameters to exclude likely impossible values (tighter ranges may be applied as appropriate for the area of ocean being reported in the message):

    a) $1 \leq$ day ≤ 31 (or appropriate last day for the month)
    b) $1 \leq$ month ≤ 12
    c) $0 \leq$ hour ≤ 23
    d) $0 \leq$ minute ≤ 59
    e) Quadrant is 1, 3, 5, or 7
    f) $0 \leq$ latitude degree ≤ 90
    g) $0 \leq$ latitude minute ≤ 59
    h) $0 \leq$ longitude degree ≤ 180
    i) $0 \leq$ longitude minute ≤ 59
    j) $0 \leq$ wind direction/ocean current direction ≤ 36
    k) $0 \leq$ wind speed ≤ 50 (If wind speed unit indicator $i_u = 1$ or $i_u = 3$)
    l) $0 \leq$ wind speed ≤ 25 (If wind speed unit indicator $i_u = 0$ or $i_u = 2$)
    m) If wind direction/ocean current direction = 0 then wind speed/ocean current speed = 0.
    n) $0 \leq$ ocean current speed ≤ 500
    o) $-40.0°C \leq$ air temperature $\leq 40.0°C$
    p) $-2.0°C \leq$ water temperature $\leq 35.0°C$
    q) $0 \leq$ salinity ≤ 40.0 (only in KKXX)
    r) deepest observation depth $\leq$ total water depth

ANNEX VIII

GUIDELINES FOR REPORTING MONTHLY JCOMM OCEANOGRAPHIC DATA STATISTICS

Introduction

JCOMM oceanographic data statistics are to be reported using the JCOMM Oceanographic Data Statistical Evaluation Sheet (see below).

A nationally designed reporting form containing at least the information as the JCOMM sheet is acceptable.

The exchange statistics report should be submitted as soon, after the end of each month, as possible (within 2 weeks) to assure rapid feedback of information, Statistics are based upon individual reports of observations encoded in the appropriate code form (BATHY reports are in WMO code form FM 63-IX Ext. TESAC reports in WMO code form FM 64-IX and TRACKOB reports in WMO code form FM 62-VIII Ext.).

Note that each BATHY, TESAC or TRACKOB bulletin (which is usually identified by SO in the TTA1A2ii group of the abbreviated heading, see Annex IV) may contain more than one report. Any additional information which would be useful in evaluating exchange, such as the number of garbled messages or problems in the exchange process, should be included with the monthly report.

GUIDELINES

NATIONAL CENTRE and COUNTRY:	Enter the name of the meteorological or oceanographic centre providing JCOMM oceanographic data statistics on the number of BATHY TESAC and TRACKOB reports INPUT and OUTPUT onto the GTS. Each country should submit only one Evaluation sheet.
MONTH and YEAR:	Enter the calendar month and year for which statistics are provided. Statistics should be compiled by counting those reports whose bulletins date/time group fall within the given month, i.e. the date/time group of the bulletin should be between 0000 on the first of the month and 2359 on the last day of the month.
INPUT:	Indicate separately the total number of BATHY, TESAC and TRACKOB reports entered into the GTS by the country submitting the evaluation sheet. All reports input should be counted on the evaluation sheet regardless of the country of registry of the originating ship. If quality control procedures are performed on reports prior to input, only those reports that are actually input onto the GTS should be counted. When it is discovered that two or more countries are entering the same reports, arrangements should be made so that the reports are entered only once.
OUTPUT:	Indicate separately the total number of BATHY, TESAC and TRACKOB reports received from the GTS by the country submitting the report evaluation sheet. The number of reports should be indicated individually by originating GTS centre. Reports from repeated bulletins (those arriving at a centre more than once or via different routes) should not be counted. If any duplicates are discovered within the output, they should be listed within parenthesis next to the output as well as included in the output. All output reports should be counted even if they are not utilized by the receiving centre.

The following is an example of a completed JCOMM Oceanographic Data Statistical Evaluation Sheet:

JCOMM OCEANOGRAPHIC DATA STATISTICAL EVALUATION SHEET

NATIONAL CENTRE: Waltonville MONTH: April

COUNTRY: Republic of Gondwana YEAR: 1999

INPUT

Data input consists of all data collected from coastal radio stations and entered onto the GTS

GTS centre	BATHY	TESAC	TRACKOB
CSPU	427	386	15

OUTPUT

Data output consists of all data received by the telecommunications centre from other GTS centres.

GTS centre	BATHY	TESAC	TRACKOB
AMMC	77 (6)	84 (4)	100 (2)
CWHF	55 (7)	23 (0)	20 (1)
EDZW	462 (12)	315 (20)	310 (1)
EGRR	200 (15)	45 (10)	55 (3)
ESWI	45 (2)	15 (10)	70 (1)
KWBC	1100 (20)	24 (2)	160 (2)
BFPW	42 (2)	16 (1)	20 (1)
RJTD	216 (10)	35 (0)	33 (2)
RUHB	475 (26)	300 (12)	120 (3)
RUMS	400 (20)	750 (6)	200 (4)
RUML	275 (6)	300 (40)	50 (1)
SABM	25 (0)	10 (0)	10 (0)
TOTAL OUTPUT	3372 (126)	1918 (105)	1148 (21)

Note: The number in parenthesis indicates the number of duplicates within the total from that GTS centre. Repeated bulletins are not counted.

ANNEX IX

LIST OF ACRONYMS

AOML	Atlantic Oceanographic and Meteorological Laboratory (Miami, U.S.A.)
AXBT	Airborne Expendable Bathythermograph
BATHY	Code for reporting temperature profile observations
CBS	Commission for Basic Systems (WMO)
CLS	Collecte - Localisation - Satellite
CMD	Continuously Managed Database
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CTD	Conductivity - Temperature - Depth instrument
DCP	Data Collecting Platform
GCOS	Global Climate Observing System
GEK	Geomagnetic Electrokinetograph
GOES	Geostationary Operational Environmental Satellite (USA)
GOOS	Global Ocean Observing System
GTS	Global Telecommunication System (WWW)
GTSPP	Global Temperature Salinity Profile Programme
IDPSS	IGOSS Data Processing and Services System
IFREMER	Institut Français de Recherche pour l'Exploitation de la Mer (France)
IGOSS	Integrated Global Ocean Services System (IOC-WMO)
IMMS	International Maritime Mobile Service
INMARSAT-C	International Marine Satellite service C
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODE	International Oceanographic Data and information Exchange (IOC)
JCOMM	Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology
MBT	Mechanical Bathythermograph
MTN	Main Telecommunication Network (GTS)
NOAA	National Oceanographic and Atmospheric Administration (USA)
NOC	National Oceanographic Centre (IGOSS)
NODC	National Oceanographic Data Centre (IODE)
NMC	National Meteorological Centre (WWW)
OBS	Indicator for paid service (in BATHY, TESAC and TRACKOB radio messages)
OSV	Ocean Station Vessel
OWS	Ocean Weather Station (WWW)
PALACE	Profiling Autonomous LAgrangian Circulation Explorer
PSU	Practical Salinity Units
RNODC (JCOMM)	Responsible National Oceanographic Data Centre (for JCOMM) (IODE)
RTH	Regional Telecommunication Hub (GTS)
SEAS	Shipboard Environmental Data Acquisition System
SOC	Specialized Oceanographic Centre (IDPSS)
SOOP	Ship-of-Opportunity Programme
SXBT	Submarine launched XBT
TESAC	Code for reporting observations of temperature, salinity and current from a sea station
TRACKOB	Code for reporting marine surface observations taken along a ship's track
UTC	Universal Time Coordinate
VOS	Voluntary Observing Ships (WMO)

WCRP	World Climate Research Programme
WDC	World Data Centre
WMC	World Meteorological Centre (GDPS)
WMO	World Meteorological Organization
WOC	World Oceanographic Centre (IDPSS)
WWW	World Weather Watch (WMO)
XBT	Expendable Bathythermograph
XCTD	Expendable Conductivity - Temperature - Depth instrument