

Intergovernmental
Oceanographic
Commission

1

GUIDE TO IGOSS DATA ARCHIVES AND EXCHANGE (BATHY & TESAC)

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CHAPTER I

1. INTRODUCTION

1.1 PURPOSE

This Guide is intended to document the procedures to be followed in archiving and exchanging BATHY/TESAC/TRACKOB/DRIFTER data¹ within the IGOSS & IODE systems. It describes the arrangements developed between IODE & IGOSS to share data so as to better serve the need of users. It is also intended to provide information on IGOSS data collection, data flow and data archival for scientists and engineers who wish to use the data and who are not familiar with the system.

The Guide deals primarily with oceanographic data collected under IGOSS and reported in codes for oceanographic data [the WMO code forms are: FM 63-IX BATHY (report of bathythermal observation); FM 64-IX TESAC (temperature, salinity & current report from a sea station); FM 62-VIII Ext. TRACKOB (report of marine surface observation [temperature, salinity and/or current] along a ship's track); FM 18-IX Ext. DRIFTER (report of a drifting buoy observation)]. As other types of IGOSS data may flow on the GTS (e.g., various kinds of observations coded along with the IGOSS Flexible Code (IFC) form, including sea-level data) additional mechanisms will have to be developed between IGOSS & IODE.

1.2 GENERAL

The Integrated Global Ocean Services System (IGOSS) is the international operational system for global collection and exchange of oceanic data and the timely preparation and dissemination of oceanographic products and services. The Intergovernmental Oceanographic Commission (IOC) and the World Meteorological Organization (WMO) co-operate in the planning and implementation of IGOSS. The operation of IGOSS is based on national efforts and depends on the full support of all IOC & WMO Member States. The timely dissemination of telecommunicated data and/or products depends mainly on the facilities of the Global Telecommunication System (GTS), of the World Weather Watch (WWW) of the WMO.

IGOSS consists of 3 major elements. These elements are:

- (i) The IGOSS Observing System (IOS) consisting of various facilities and arrangements for obtaining standardized oceanographic information from ships-of-opportunity, research ships, ocean weather stations, fixed and drifting buoys, aircraft and other platforms;
- (ii) The IGOSS Data Processing & Services System (IDPSS) consisting of national, specialized and world oceanographic centres for the timely processing of observational data and the provision of products and services to marine user groups, for short-term data archiving and for the near real-time and delayed mode exchange activities; and

¹ Referred later in the text as "operational oceanographic data".

- (iii) The IGOSS Telecommunication Arrangements (ITA) consisting of telecommunication facilities of the WWW, GTS and other arrangements necessary for the rapid and reliable collection and distribution of the required observational data and processed information.

The International Oceanographic Data & Information Exchange (IODE) is the international system for the archival and non-operational exchange of all types of oceanographic data and for the provision of relevant marine data and information products and services through internationally agreed arrangements.

IODE is developed under the auspices of IOC. It is based on the following major elements:

- (i) National Oceanographic Data Centres (NODC) established by the IOC Member States have facilities for archiving oceanographic data originated from national programmes.
- (ii) Responsible National Oceanographic Data Centres (RNODC) have various specific agreed processing, archival and exchange responsibilities in support of the World Data Centre System. RNODCs are usually NODCs which are well equipped with processing and computer facilities (or have access to such facilities) and thus are in a position to help in the systematic exchange of IGOSS data and in the provision of services to "*secondary*" users, and to enable the international exchange system to cope with the increasing variety and volume of oceanographic data being collected.
- (iii) World Data Centres (WDC) A, B & D for Oceanography in Washington, Moscow, Tianjin have responsibilities for exchange and archival of oceanographic data and selected products on a global basis. WDCs operate under the auspices of the International Council of Scientific Unions (ICSU).

IGOSS & IODE systems are guided by the Joint IOC-WMO Committee for IGOSS and the IOC Committee on IODE, respectively. These committees rely upon members of Task Teams and Groups of Experts to develop the data exchange and data management techniques and mechanisms required.

IGOSS & IODE activities were originally designed to meet the requirements of basically different user communities. The goals of IGOSS & IODE can be summarized as follows:

IGOSS: To provide operational oceanographic data, products (including datasets) and services to users involved in marine activities and the management of international scientific programmes.

IODE: To provide accurate and complete oceanographic databases, synthesized datasets, products and information to users concerned with the advancement of the knowledge and understanding of oceanographic processes and oceanic conditions over time and space.

Practical considerations and the development of recent international scientific programmes have led to the requirement of an integrated IGOSS-IODE data management system to serve a full spectrum of users with an expanding variety of needs.

To this end, in January 1990, a new project was launched, built on the existing oceanographic data management systems, IGOSS & IODE, which is known as the Global Temperature-Salinity Pilot Project (GTSP). Its immediate task is to create a complete data and information base of ocean temperature and salinity data captured both in real-time and submitted in fully processed form weeks to months later (Annex I). Through co-operative IGOSS-IODE programmes, such as the Global Temperature-Salinity Pilot Project, both systems work together to provide users with more data of higher quality in shorter time-periods than in the past.

Consideration of IGOSS & IODE goals leads to a realization of both the similar and different requirements of the two systems.

- (i) IGOSS requirements for operational data override other considerations to a certain extent and there is some sacrifice in the quality of the data and the completeness of the databases.
- (ii) IODE requirements for quality and completeness likewise demand that there is some sacrifice in the timeliness of the databases.

Considerable joint and individual efforts have been and will continue to be expended by IGOSS & IODE to overcome the problems of quality and completeness. IGOSS & IODE are continually improving the quality control techniques in use and are moving in the direction of increased automation. IGOSS is streamlining the submission of data to the WDCs of IODE through the RNODCs (IGOSS) and both systems are expediting the development of more efficient formatting schemes and of improved data centre services to marine users and international scientific programmes.

1.3 DEFINITION OF TERMS

Annex II contains definitions of terms commonly used in IGOSS & IODE literature. They will also be used in this Guide and are defined for the convenience of readers.

1.4 PUBLICATIONS RELEVANT TO IGOSS-IODE DATA MANAGEMENT²

The list of publications relevant to IGOSS & IODE data management activities is presented in Appendix 1 to the *IOC-ICSU Manual on International Oceanographic Data Exchange* (IOC Manuals & Guides No 9, Revised Edition 1991). In addition to the

² IOC & WMO publications referred to above can be acquired from the IOC or WMO Secretariats by submitting a request to one of the following addresses:

Intergovernmental Oceanographic Commission
Attn. Dr. Iouri Oliouline
7, place de Fontenoy
75007 Paris
FRANCE

Tel: (33) (1) 45 68 39 63
Fax: (33) (1) 40 56 93 16
E-mail: IOC.SECRETARIAT

World Meteorological Organization
Attn. Dr. Peter Dexter
41, avenue Giuseppe Motta
CH-1211 Geneva 20
SWITZERLAND

Tel: (41) (22) 730 82 37
Fax: (41) (22) 734 09 54
E-mail: P.DEXTER

publications referred to in this Appendix, WMO published two Guides relevant to the subject of this publication which are given below.

Guide to IGOSS Data Processing & Services System (IDPSS), 1983

This Guide was published jointly by IOC & WMO (WMO-Nº. 623) and is intended to be a general guide to IDPSS for the information of countries, organizations or individuals wishing to participate in the system and/or utilize its products. This Guide is being revised and an updated version should be submitted to the Seventh Session of the Joint Committee for IGOSS (1995).

Guide to Data Collection & Location Services Using Service Argos, 1989

This Guide is intended to be a general guide for the utilization of the Service Argos, and a source of reference material for the design and construction of buoy hardware (*WMO, Marine Meteorology & Related Oceanographic Activities, Report N° 10, 1983*).

GTSPP Quarterly Reports

Starting from November 1990, GTSPP monthly and from January 1992 quarterly reports are being issued by the Marine Environmental Data Service, Canada (MEDS) and widely circulated with the assistance of IOC & WMO. These reports provide a variety of information on progress in the implementation and further development of the GTSPP. These reports contain details of the milestones achieved during the month, description of the data management technology being developed and implemented in the GTSPP, availability of associated software or databases, and analysis of various elements of the real-time data flow.

CHAPTER II

2. IGOSS-IODE DATA MANAGEMENT

2.1 PRINCIPLES OF IGOSS-IODE DATA MANAGEMENT

The needs of user communities can be met by a data management system having the capabilities to respond to the following requirements.

The first requirement is for **timeliness of data**. In general, data for short range weather and climate forecasts must be available within a few days. Data concerning inter-annual variability must be available within 30 days. This requirement is met by IGOSS. Data for research on mechanisms of variability over years to decades are required only on a somewhat longer time-scale. In accordance with IODE procedures all data should preferably be made available in the WDCs for Oceanography within one year of collection.

The second requirement is for **operational data**. Historically, only a relatively small amount of oceanographic data are collected and distributed operationally. It is important that an effort be made to exchange observational information operationally for those systems which have become standardized to the extent that they can be assumed

to be utilized by a number of organizations over a number of years. Existing international formats should be utilized where available and developed if not available.

The third requirement is for **quality control** of the data. Users must be able to assign a degree of confidence to data, particularly those data taken by other individuals and organizations. Quality control has two aspects: first, with respect to reliability, and second, with respect to remedying deficiencies in the data which result from handling and transmission between the point of the observation and the ultimate user.

The fourth requirement relates to **products**. Increasingly, the most important material for exchange and archiving is derived from analysis of the data, rather than the data themselves. Close collaboration among data collectors, data centres and data users is essential, in order to specify the types of products wanted.

The final requirement is **completeness**. A primary problem facing users is the inability to gain access to a complete dataset. Data exchange and archiving systems must ensure that potential users are provided with ready access to as complete a dataset as can be made available and in as timely a manner as possible.

2.2 DATA COLLECTION ACTIVITIES

Data collection activities are the responsibility of Member States. The data are collected in support of programmes which are usually of a research, survey or monitoring nature. IGOSS data are collected by a variety of methods. The platform may be a ship, aircraft, ocean weather station, satellite, drifting buoy or moored buoy.

The data may be acquired through ships-of-opportunity programmes arranged by the organization requiring data. Temperature, salinity and current data collected by ships-of-opportunity are exchanged in BATHY/TESAC or TRACKOB formats. Operational procedures for the collection and exchange of IGOSS data are presented in the *IOC Manuals & Guides N° 3* (jointly prepared with WMO).

An important source of reliable sub-surface data for IGOSS is drifting or moored buoys, particularly in areas not adequately covered by ship observations. Data from these buoys are made available internationally in real-time via the GTS. The data are generally available in DRIFTER format but some may be in BATHY format. Principles and procedures for collection, temporary archiving and exchange of the DRIFTER code data are described in the *Guide to Data Collection & Location Services Using Service Argos*.

Data handling on the platforms mentioned above and transmission to the shore-based facility which will insert these data onto the GTS depend on the nature of operations on the platform. The data handling may be manual, semi-automated or totally automated. The platform may be manned or unmanned. In some cases, the data may be abstracted manually from the original record, transcribed by hand to coding forms and radio-transmitted by voice or morse code to the shore-receiving station. On the other hand, the data may be computer abstracted, transmitted automatically via satellite and inserted onto the GTS without any manual intervention.

The method by which the data proceed from the sensor to the GTS is of interest for two reasons. The first is timeliness. In general, the data from automated systems could be expected to reach the GTS, and thus the users, more rapidly than data requiring

substantial manual processing. Secondly, systems involving manual processing can be expected to be more error-prone than automated systems. Automated systems are therefore to be encouraged.

2.3 PRINCIPAL ARCHIVING COMPONENTS

A brief description of the principle activities and components which play a role in the IGOSS data archiving scheme are given in the following paragraphs.

National Meteorological Centres or National Oceanographic Centres (NMCs, NOCs) are agencies of Member States which provide services in response to national priorities. Certain of these agencies receive IGOSS data, in real-time, carry out quality control checks and error correction, prepare the necessary telecommunication bulletins and enter the data onto the GTS for national and international distribution.

Certain NMCs or NOCs act as Specialized Oceanographic Centres (SOCs). They maintain files of IGOSS data and also provide the link to IODE by compiling the IGOSS operational data and supplying it in digital form to a RNODC-IGOSS on a monthly basis.

The Responsible National Oceanographic Data Centres for IGOSS (RNODCs-IGOSS) are National Oceanographic Data Centres (NODCs) which have accepted additional responsibilities for IGOSS data. They provide comprehensive archives of IGOSS data and assume exchange and service obligations for specified regions of the world's oceans on a voluntary basis. The responsibilities of the RNODCs-IGOSS are described in Chapter III.

In terms of IGOSS, World Data Centres A,B, & D for Oceanography are concerned with the maintenance of inventories of data, the provision of data referral services and for a mutual exchange of data which they receive on an annual basis from the RNODCs-IGOSS. The WDCs also participate in monitoring of the non-operational data flow.

2.4 STRUCTURE OF THE IGOSS-IODE DATA MANAGEMENT SYSTEM

The system shown in Figure 1 consists of an IGOSS and an IODE component. The system is complex. Data can enter the system and reach the user by a number of different routes. The route chosen by a particular user will be selected on the basis of a compromise between the urgency of the need and the quality and completeness of data needed to meet the requirement. If the data are required in a few days then only the telecommunicated data of IGOSS will be available and there may not be time to determine and apply the final most accurate instrument calibrations. On the other hand, if the data are not required for a few months or even a year or two, a higher quality and more complete dataset can be compiled.

The IGOSS component is based on an operational data flow using telecommunication facilities. This component contains in general data which have been transmitted via satellites or radio. The time-frame in which data and products are available extends from one day to two months. The operational dataset accumulated by the IGOSS SOCs is forwarded to the RNODCs-IGOSS at the end of each month.

IGOSS-IODE DATA FLOW DIAGRAM

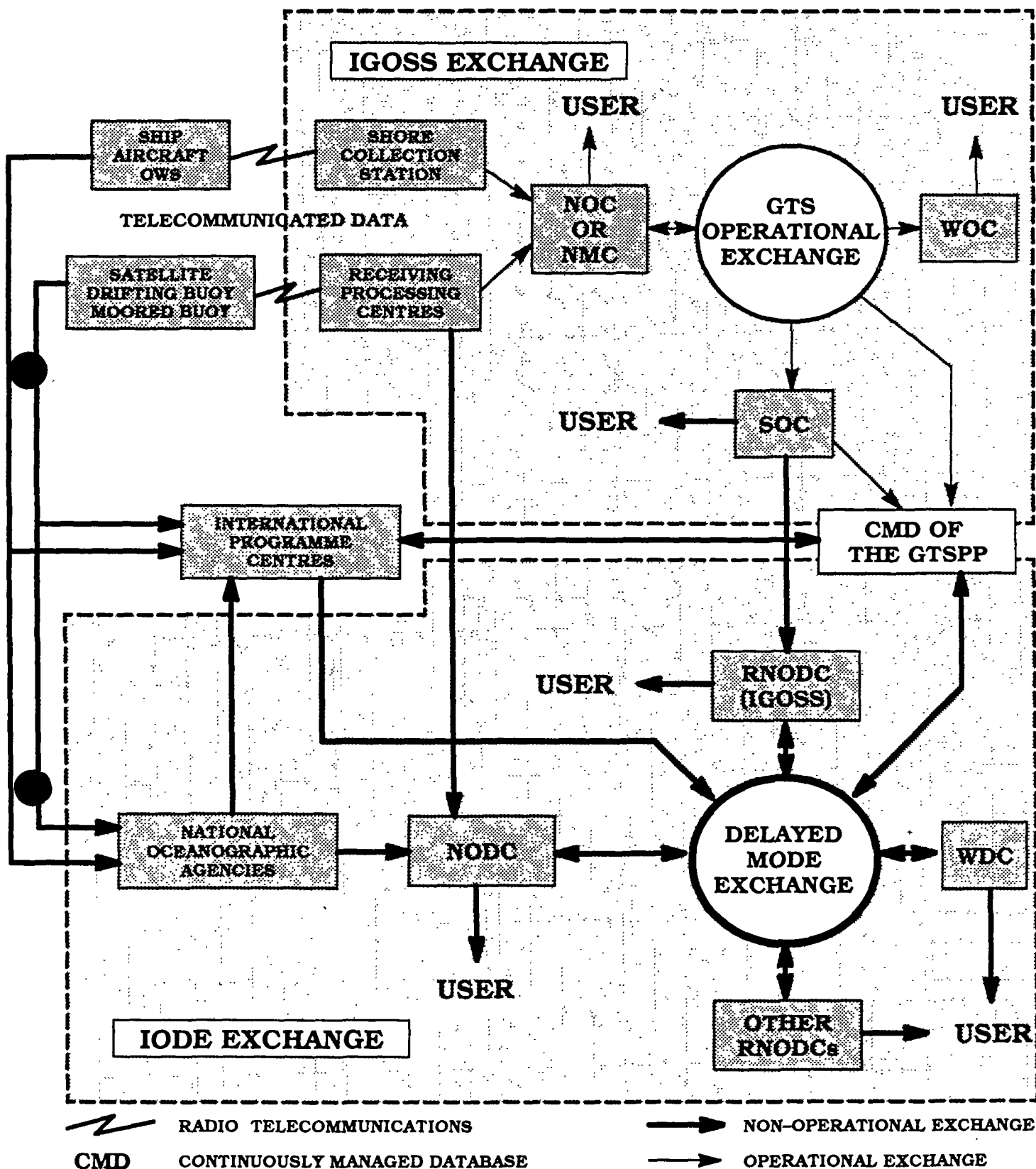


FIGURE 1

The IODE component is based on a non-operational data flow. The IODE system deals with all types of oceanographic data including high resolution datasets from research cruises and monitoring exercises. IGOSS data enter the IODE system via two routes: an operational dataset is forwarded to the RNODCs-IGOSS at the end of each month; the original data accompanied by additional information are forwarded to national oceanographic agencies and then handled by IODE centres. The time-frame in which datasets and products are available from the IODE system ranges from two months, for simple datasets and products, to several months or years for complex integrated multi-disciplinary datasets from long-term variability studies. Further details on IODE mechanisms and procedures can be obtained from the *IOC-ICSU Manual on International Oceanographic Data Exchange, 1991 (IOC Manuals & Guides N° 9)*.

Another component of the IGOSS-IODE data management system is represented by the box "INTERNATIONAL PROGRAMME CENTRES" in Figure 1. This box shows data flows between IGOSS-IODE centres and centres established in other programmes. For example the Tropical Ocean and Global Atmosphere (TOGA) and World Ocean Circulation Experiment (WOCE) programmes established data centres in scientific organizations that perform functions complementary to the data management activities of IGOSS and IODE, particularly in regard to quality control of data. Thus complex systems can be built up that incorporate the strengths of IODE & IGOSS and the strengths of these other programme centres to provide the best possible and most economic data management.

2.5 DATA FLOW WITHIN IGOSS

The flow of operational data within the IGOSS system (presently BATHY, TESAC, TRACKOB messages), the procedures to encode the data and route it to the GTS, as well as samples of BATHY, TESAC & TRACKOB forms, are described in detail in *IOC Manuals & Guides N° 3, Guide to Operational Procedures for the Collection & Exchange of IGOSS Data*. The procedures to encode the data from DRIFTER messages and route it to the GTS are described in the *WMO Manual on Codes, WMO Publication N° 306, 1988*. A short summary is included below to enable the reader to focus on points of importance to the processing and archiving of the data in IODE centres.

All IGOSS data originate at a sensor in a data collection instrument associated with a ship, satellite or buoy. The variables measured can include meteorological variables such as wind speed and direction and air pressure, and ocean variables such as temperature, salinity and currents as a function of depth. In order for the data to reach the operational centres of IGOSS, observations must be encoded either manually or automatically into the appropriate reporting code (report) and transmitted within a message via satellite or radio telecommunication facilities to national agencies.

IGOSS data can enter the operational dissemination system as radio messages to a coastal radio station, transmitted by morse code or voice. It can also enter the system by other telecommunication facilities including satellite re-transmission. The coastal radio station or other shore facility routes the radio messages to an NMC or NOC that has accepted the responsibility to compile various reports into a bulletin which is entered in a BATHY, TESAC, TRACKOB or DRIFTER message on the GTS.

The NOC or NMC is the first point of quality control for IGOSS data. The quality assessment and error correction is carried out prior to insertion of the data on the GTS. Regardless of the route by which the data have reached this point, it is mandatory that a minimum set of internationally agreed quality control checks be applied and error correction be carried out, should the circumstances warrant. The quality control checks to be performed at this point are given in the *IOC Manuals & Guides N° 3, Annex VI*.

Once the data are transmitted on the GTS they are available simultaneously to all NOCs/NMCs, SOC & WOCs. Within the IGOSS centres datasets are continuously being compiled. Each receiving centre performs additional quality control and then uses the data to prepare products and/or operational datasets for distribution to its community of users. The centre can, for example, examine series of reports from one ship or buoy, or compare physical values from nearby observations. The internationally agreed minimum set of quality control checks to be applied at this point is given in the *IOC Manuals & Guides N° 3, Annex VII*. The checks and error corrections are to be carried out prior to the preparation of data products or of datasets for the delivery of operational data. This is the second point of improved quality control checking for IGOSS data.

The operational datasets prepared in IGOSS SOC will generally be the only form in which the data will be available for the first two months after its collection. Users requiring the data in this time-frame have to contact the appropriate SOC. After two months, datasets containing the telecommunicated data and additional data from other sources will be available from the RNODCs-IGOSS.

To telecommunicate IGOSS data, messages should be encoded as shown in Part II of the BATHY, TESAC & TRACKOB coding forms. Data encoded in Parts I, III & IV are beneficial to the management of IODE to increase the value of the data to secondary users and therefore should be forwarded to the NODC of a Member State along with the original record. The NODC is responsible for forwarding the full information to the appropriate IODE centres as required by the international agreements described in the *IOC Manual & Guides N° 9 IOC-ICSU Guide to International Oceanographic Data Exchange, 1991*.

Data from automated recording systems are usually transmitted to a receiving centre via satellites. The data are processed, encoded in the BATHY, TESAC or TRACKOB reporting code and entered on the GTS, usually through special national arrangements.

There are 3 types of errors which can occur in the messages. Message format errors are those errors which concern the abbreviated heading of a bulletin and the end of a message signal. Coding errors are errors which concern the code forms for BATHY, TESAC, TRACKOB or DRIFTER reports. Physical errors concern the measured or observed values such as date/time of the observation, position, depth, temperature, salinity, current, wind speed, wind direction or air temperature.

Several studies have shown that a significant percentage of BATHY, TESAC, TRACKOB & DRIFTER reports contain errors that can easily be corrected. Error correction should only be performed at the point when there is considerable confidence that the proposed change is valid. The quality control applied at this point can only be based on the content of the single BATHY, TESAC or TRACKOB bulletin being prepared.

The procedures described above is in general used in most Member States. This does not preclude other national arrangements, should circumstances demand. However, any alternative arrangements must provide for timely transmission of the data on the GTS in either the BATHY, TESAC, TRACKOB or DRIFTER approved code. If it is not possible to accomplish the entry within a few hours or very few days, the data are still useful. Data can and should be transmitted on the GTS up to 30 days after the time of the observation.

2.6 DATA FLOW WITHIN IODE

Data flow in the IODE system is generally based on computer magnetic tapes or diskettes exchanged between IODE centres by mail or courier, although the use of telecommunication facilities for data exchange is increasing. In some cases, the national agency will be participating in an international programme and additional arrangements for data flow other than those described below may be negotiated.

The traditional route for IODE flow begins with the national oceanographic agencies. The data from observing platforms are processed and assessed by subject specialists. Instrumental performance is evaluated; final calibration corrections and necessary quality control procedures are determined and applied. After this, the data are ready to be forwarded to the National Oceanographic Data Centre or Designated National Agency for international exchange, as appropriate.

It is important to recognize that some portion of the data discussed above have been telecommunicated earlier in less complete form through the IGOSS system. These telecommunicated data reach the IODE system via the transfer of operational data from SOC's of IGOSS to RNODCs-IGOSS of IODE. IODE centres must replace duplicate data arriving through IGOSS & IODE by higher quality and more complete delayed-mode records. Procedures for identification of duplicate observations are described in the GTSP Monthly Report for December 1990.

The time-frame within which oceanographic data are processed by the national oceanographic agencies and submitted to the NODCs is quite variable. Member States are urged to adhere to the time-frame for non-operational data submission identified in the *IOC-ICSU Manual & Guides N° 9 on IODE, 1991*.

Once the data have reached NODCs, international exchange can proceed according to the arrangements outlined in the *IOC-ICSU Manual & Guides N° 9 on IODE, 1991*. There may be, however, *ad hoc* arrangements developed in the framework of data management plans to meet the needs of particular international programmes. Therefore, the NODC may be required to place data and/or inventory information in a specified format and supply it to a World Data Centre and to one or more RNODCs. Upon the completion of the tasks assigned to an RNODC, this centre will send data to WDCs Oceanography for final archiving.

The IGOSS operational datasets are forwarded by the IGOSS SOC's to the RNODCs-IGOSS in digital form on a monthly basis. It is the responsibility of the RNODCs-IGOSS to process the data and be prepared to make the data and data inventories available to users on request within one month following receipt of an operational dataset. This ensures that the data are available from the IODE system two months after the observation date.

The IGOSS operational data are also forwarded by the IGOSS-SOCs to the Real-time Assembly and QC centre of the GTSP (Annex I), to create a timely, high-quality and complete data and information base from both operational and non-real-time ocean temperature and salinity data.

The GF3 format is available to be used for the delivery of IGOSS data from SOC to RNODCs-IGOSS. The *IOC Manual on the IOC General Formatting System for Geo-Referenced Data, 1992, Volume 5* (IOC Manuals & Guides N° 17), contains in its specifications for the GF3 subset designed for this purpose. This does not preclude other mutually agreed arrangements between two specific centres, providing the format includes all data fields and quality flags carried in the GF3 format.

The quality control procedures applied to IGOSS data by RNODCs-IGOSS can be more stringent than either of the previous two checks described in page 9 (first 2 paras). RNODCs have available more extensive data holdings and can, for example, compare the new data to historical data for the area and time-span to assist in detecting errors. **Each RNODC should be prepared to provide information on their quality control procedures to users of the data.** IGOSS data are also quality controlled in near real-time in the Global Temperature Salinity Pilot Project. Those quality control procedures are well documented in the series of the *IOC Manuals & Guides N° 22 GTSP Real-time Quality Control Manual* published by the IOC, 1990.

2.7 IODE ARCHIVAL & DISSEMINATION OF IGOSS DATA

When the quality control procedures have been completed, RNODCs maintain complete archives of all IGOSS data received for their respective geographical area of responsibility. It will therefore be necessary that regular exchange occur between the RNODCs to acquire data for all geographical areas in order to have a global coverage.

The internal format in which IGOSS data is archived in RNODCs is not of concern either to IODE or to IGOSS. However, **the archival files must accommodate all necessary fields and quality control flags contained in the GF3 format.** These flags are also to be used to provide information on updates applied by RNODCs to the quality control.

The responsibility of the World Data Centres, Oceanography for the international exchange of IGOSS data includes the archival of the IGOSS data on global scale, the provision of inventory information on their data holdings and those of the RNODCs-IGOSS and assistance to Member States requesting data. Data will be provided to Member States on magnetic tape or diskettes in the GF3 format. In order that the WDCs have on hand the necessary information to meet these responsibilities, **the RNODCs-IGOSS are to prepare and submit copies of their IGOSS data and inventories of their holdings to the WDCs on an annual basis.** The RNODCs are also to be prepared to provide inventories and data to other users on request.

As part of their responsibilities, the RNODCs are required to prepare integrated datasets of IGOSS data. However, it is clear that there is a need for integrated datasets of subsurface temperature, salinity and current data from other sources in the development of knowledge of the ocean and climatological processes and in developing histories of the behaviour of oceanic variables. NODCs in Member States requiring such integrated datasets can, and should, request IGOSS data from the RNODCs and

integrate it with other data holdings. The GTSP Continuous Managed Database (CMD) provides a constantly integrated dataset of temperature and salinity data from BATHY, TESAC, and delayed mode data streams (Annex I).

If the integrated dataset is required by an international programme two possible methods are available. The programme may be supported by a specialized data centre, such as an *ad hoc* RNODC, established to provide data management services. In this case, the specialized centre can obtain IGOSS data from the RNODCs-IGOSS and integrate it with the data it holds from other sources in the programme. If such a centre does not exist, the programme may, by special arrangement, seek the service from one of the existing RNODCs-IGOSS.

In addition to providing inventory information and data on request, **the RNODCs are required to archive selected data products produced by the SOC and prepare products as appropriate.** Information on the types of products and their availability can be obtained from the RNODCs.

2.8 MONITORING OF IGOSS-IODE DATA FLOW

A description of procedures for monitoring the flow of data in the IGOSS & IODE systems is presented in the *IOC-WMO Guide N°. 3, Operational Procedures for the Collection & Exchange of IGOSS Data, 1988*, and in the *IOC-ICSU Manual N°. 9 on IODE, 1991*.

CHAPTER III

3. IGOSS DATA DEPOSITORIES

3.1 GENERAL

This Chapter is intended to furnish the most current information on the identity of individual activities and centres concerned with archiving and exchange of IGOSS data and to briefly describe the specific tasks and functions each centre is presently performing or plans to perform.

Functions of existing RNODCs-IGOSS and those of the RNODC for Drifting Buoys Data (operated by MEDS, Canada) are presented in the *IOC-ICSU Manual N°. 9 on IODE, 1991*. Operational and non-operational functions of NOCs, SOC and WOCs are described in the *IOC-WMO Guide to the IGOSS Data Processing and Services System, 1983*.

It is anticipated that with the continued development and broadening scope of the IGOSS programme, additional facilities will participate in the IGOSS data archiving and exchange scheme, and additional tasks, functions and responsibilities will be assumed by these facilities. Amendments to, and revisions of, the material in this chapter must therefore be expected.

"Area of Responsibility" in the framework of IGOSS is defined as the geographic area for which an RNODC assumes the obligation to compile, maintain and render exchange services from complete IGOSS databases. It should be noted that for the

present there is some deliberate overlap between the areas of responsibility of the various RNODCs.

"*Area of Interest*" includes both the area of responsibility of the RNODC and any additional areas from which it wishes, for national or regional purposes, to receive and archive IGOSS data.

For this edition of the Guide it is convenient to arrange the material in a summary form according to the type of archiving activity as given in the following sections.

3.2 RESPONSIBLE NATIONAL OCEANOGRAPHIC DATA CENTRES FOR IGOSS (Operated by NODCs of Japan, Russian Federation & the USA)

3.2.1 Japan Oceanographic Data Centre

3.2.1.1 Responsibilities include both RNODC functions and Japanese national data functions.

3.2.1.2 Area of Responsibility. Pacific Ocean.

3.2.1.3 Area of Interest. Pacific and Indian Oceans.

3.2.1.4 Data to be received:

From Japan SOC (JMA, Tokyo):

- (a) BATHY & TESAC data for area of responsibility.
- (b) IGOSS data products.

From other SOC's by request:

- (a) BATHY & TESAC data from GTS for Pacific Ocean.
- (b) IGOSS data products for Pacific Ocean.

From NODCs, DNAs & RNODCs by request:

- (a) BATHY & TESAC Data for Pacific Ocean.

From Japanese national activities:

- (a) BATHY & TESAC logs.
- (b) IGOSS data products.

3.2.2 National Oceanographic Data Centre of the Russian Federation

Responsibilities include both RNODC data functions and the Russian Federation national data functions.

Area of Responsibility. North Pacific west of 180 degrees, Baltic Sea and North Sea, Indian Ocean, Mediterranean Sea, North Atlantic Ocean.

Area of Interest. All ocean areas.

Data to be received:

From the Russian Federation SOC (WMC, Moscow):

- (a) BATHY, TESAC & DRIFTER data for area of responsibility;
- (b) Selected data products (by arrangements).

From NODCs & DNAs:

- (a) IGOSS related data inventories upon request.
- (b) IGOSS data for area of responsibility (by arrangements).

From other RNODCs - IGOSS:

- (a) BATHY & TESAC reports as required.

From the Russian Federation national activities:

- (a) BATHY & TESAC logs.
- (b) ROSCOP reports.
- (c) Inventories of IGOSS-related databases.

From RNODC-Drifting Buoys:

- (a) Delayed mode buoy data.

3.2.3 U.S. National Oceanographic Data Center

Responsibilities include both RNODC data functions and U.S. national data functions.

Area of Responsibility. Eastern North Pacific, South Pacific Ocean, Atlantic Ocean and Arctic Ocean.

Area of Interest. All ocean areas.

Data to be received:

From U.S. SOC, WOC, Ocean Products Center, NOS/NWS Washington:

- (a) BATHY, TESAC & TRACKOB data from SOC respective area of responsibility;
- (b) IGOSS data products from SOC's respective area of responsibility.

From NODCs, DNAs & RNODCs:

- (a) BATHY, TESAC & TRACKOB data as may be arranged.

From U.S. national activities:

- (a) BATHY, TESAC & TRACKOB logs and analog records.
- (b) IGOSS data products.

ANNEX I

GLOBAL TEMPERATURE-SALINITY PILOT PROJECT (GTSP)

1. INTRODUCTION

The Global Temperature-Salinity Pilot Project (GTSP) is designed to create a complete data and information base of ocean temperature and salinity data which are captured in real-time or submitted in fully processed form weeks to months later. It is intended as a trial system that will provide the model for a global marine science data exchange system to serve the needs of present and future international scientific programmes. GTSP data are intended to support the World Climate Research Programme (WCRP), its associated programmes and all types of national requirements, from fisheries operations to fundamental research.

1.1 RATIONALE

Oceanographic data have been available internationally for many years through IGOSS in a real-time mode and through the IODE in a delayed mode. Although there has been considerable co-operation between agencies in those two systems, it is only recently that data from the two systems have been systematically integrated, in the TOGA project, to support scientific research. GTSP builds on that TOGA experience in order to build a global temperature and salinity data resource. The TOGA experience produced two benefits:

- (i) Analysis of data by ocean researchers steadily improved the quality and usefulness of data which were available to others, and
- (ii) A number of useful data products became accessible to others.

In following that model, GTSP is expanding to include both temperature and salinity data from all over the globe.

1.2 SCIENTIFIC & OTHER USER REQUIREMENTS

The scientific community, in general, and the World Climate Research Programme (WCRP) in particular, require high quality, timely and complete global ocean temperature and salinity datasets. It is the intention of GTSP to provide these datasets.

To meet user needs, GTSP data adhere to standards which are agreed to by the scientific community. Furthermore, scientists are fully involved in the project, particularly in the quality assurance aspects. GTSP data which are provided to users have been passed through several quality control checks, which are documented in the GTSP Quality Control Manual. In addition, users are able to ascertain which tests were made and which tests failed. This reduces the need for users to undertake their own quality control checks. GTSP retains data of all levels of reliability, including real-time data, for which preparation and quality control are minimal, and fully processed data which become available months later. For example, a fully processed and scientifically quality

controlled CTD observation replaces a lower quality TESAC message in the GTSPP database.

1.3 BACKGROUND OF THE GTSPP PROJECT

At the **Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow**, January 1988, a proposal was drafted for a project to develop a very high quality, scientifically acceptable global ocean thermal dataset. In February 1988, the **Group of Experts on RNODCs and Climate Data Services** recommended "*...that a pilot project (global thermal database) be started to prove the value of the concept...*". At the **Fifth Session of the Joint IOC-WMO Working Committee for IGOSS**, November 1988, a proposed pilot project on global temperature and salinity data management was enthusiastically endorsed in Recommendation IV.

The **First *Ad hoc* Consultative Meeting on the GTSPP**, January 1989, was the first opportunity to discuss the project in detail and examine technical areas of concern. A set of goals was developed and major elements of the project were defined. The **Second *Ad hoc* Consultative Meeting on the GTSPP**, July 1989, included participants of existing programmes (TOGA, WOCE) to gain their experience and tie GTSPP into those programmes.

At a **Workshop on the GTSPP**, which was held prior to IODE-XIII, January 1990, elements of the project were clarified, and the terms of reference and composition of the Steering Committee on the GTSPP were defined.

Steering Committee meetings have since been held in ORSTOM, Brest (France), 17-19 September 1990, and in Obninsk (Russia) 15-20 July 1991. These meetings further developed the concepts of the GTSPP and guided its implementation as an operational project.

2. OBJECTIVES OF THE GTSPP

- (i) To create a timely and complete data and information base of ocean temperature and salinity data of known quality in support of the World Climate Research Programme (WCRP) and of national requirements.
- (ii) To improve the performance of the Intergovernmental Oceanographic Commission (IOC) IODE and the World Meteorological Organization (WMO)-IOC IGOSS data exchange systems by actively pursuing data sources, exercising the data inventory, data management and data exchange mechanisms as they are intended to work, and recommending changes where necessary to meet national and international requirements.
- (iii) To disseminate, through a widely distributed monitoring report produced on a regular basis, information on the performance of the IODE & IGOSS systems.
- (iv) To improve the state of historical databases of oceanographic temperature and salinity data by developing and applying improved quality control systems to these databases.

- (v) To improve the completeness of these historical databases by the digitization of historical data presently in analogue or manuscript form and by including digital data not presently available at a World Data Centre (WDC).
- (vi) To distribute copies of portions of the database and selected analyses to interested users and researchers.

3. BENEFITS OF GTSP FOR MEMBER STATES

- (i) Increased quantities of temperature and salinity data becoming available.
- (ii) Improved timeliness of the data and in distributing it to the user community.
- (iii) The global standardization of the quality control procedures and the production of regional and global data products.
- (iv) Standardization of data formats and processing methodologies.
- (v) The introduction of new state-of-the-art methods and technology in communications, artificial intelligence, quality control and data management, and its progressive transfer to Member States.

4. GTSP INTERFACE WITH EXISTING PROGRAMMES

GTSP works within existing programmes, such as IGOSS & IODE, to complement rather than replace their capabilities. It also works closely with TOGA & WOCE projects to provide data management support to researchers. The TOGA-WOCE Subsurface Data Centre in Brest, France, continues to receive global datasets through GTSP. The WOCE Upper Ocean Thermal Centres play a key role in GTSP by scientifically quality controlling the data.

5. PROJECT ELEMENTS

The GTSP includes 8 elements which are essential to proper functioning:

- (i) Near Real-Time Data Acquisition;
- (ii) Delayed Mode Data Acquisition;
- (iii) Communication Infrastructure;
- (iv) Quality Control Procedures;
- (v) Continuously Managed Database;
- (vi) GTSP Data & Information Products;
- (vii) Data Flow Monitoring;
- (viii) Historical Data Acquisition & Processing.

5.1 NEAR REAL-TIME DATA ACQUISITION

Near real-time data acquisition depends primarily on the Global Telecommunication System of the World Weather Watch of WMO, and IGOSS

telecommunication arrangements for BATHY, TESAC & TRACKOB data. In addition, other real-time datasets are acquired as they become available from other sources to ensure that the most complete real-time dataset is captured. In particular, the RNODCs-IGOSS assist the GTSP by providing copies of the data for the area of interest for integration into the global real-time database.

The "*Real-time Assembly & QC Centre*" in MEDS (Canada) acquires data from its GTS node, from RNODCs-IGOSS, and from other participating Member States which agree to contribute data. MEDS quality controls these real-time data according to the GTSP Real-time Quality Control Manual and forward the data to the US NODC, which adds the data to the Continuously Managed Database. GTSP works through national and international programmes, such as WOCE, to increase the amount of data, especially salinity, submitted in real-time.

5.2 DELAYED MODE DATA ACQUISITION

GTSP utilizes, as much as possible, the existing IODE data network and processing system to acquire delayed mode data. These data flow into the Continuously Managed Database (CMD) at the US NODC through a Delayed Mode QC process. As delayed mode data are acquired, duplicate real-time observations in the CMD are replaced by higher quality, more complete delayed mode records. These first two elements ensure that the CMD is as timely and complete as possible.

5.3 COMMUNICATIONS INFRASTRUCTURE

The initial operations of GTSP involve a range of data communication mechanisms which include:

- (i) Satellite ship-to-shore (international);
- (ii) HF radio ship-to-shore;
- (iii) High speed network, data centre to data centre;
- (iv) Magnetic tape, data centre to data centre or National Meteorological Centre (NMC) to data centre;
- (v) GTS NMC to NMC.

Over time, the objective is to reduce the range of communication methods and focus on more recent and effective carriers. Some products have near real-time applications if they are made available in a timely fashion. Electronic mail systems are being explored for disseminating GTSP information and products.

5.4 QUALITY CONTROL PROCEDURES

All data in the Continuously Managed Database (CMD) conform to published quality standards. The philosophy is to create a timely and complete database by including all data which come up to a certain level of quality. The GTSP Quality Control Manual specifies what that level is and provides detailed specifications of QC tests to be applied to data.

One new feature of GTSP is the high degree of involvement of the science community in quality control processes. They participated in the design of near real-time QC tests, and the WOCE Upper Ocean Thermal Data Assembly Centres scientifically quality control GTSP data as they analyze the data and create products.

Another unique feature of GTSP is that information about quality control performed on each station is maintained with the data. Records are kept of the tests performed, the institutions which performed them, which tests failed, quality flags produced during QC and original values of any changed fields.

5.5 CONTINUOUSLY MANAGED DATABASE

All activities of GTSP, including data acquisition, communications, quality control, scientific analysis and product generation, result in the creation of the global temperature and salinity dataset. To manage this dataset, a Continuously Managed Database (CMD) is maintained.

As data is acquired in either near real-time or delayed mode, they are added to the database. Delayed mode data calibrated and quality controlled by the originator, replaces data obtained in near real-time. By "*replace*" we mean that the data are flagged as having been replaced by data of higher quality. Once entered into the CMD, the data are never physically removed. The CMD therefore, holds the most current and highest quality data; it is continuously refined as additional quality checks are undertaken.

5.6 GTSP DATA & INFORMATION PRODUCTS

Many products result from the normal processes of data management and quality control within GTSP. In addition, the database itself and subsets thereof, are available as "*data products*". It is intended that GTSP products will be issued on both a monthly and annual basis by research organizations, as well as by GTSP data management groups. The following types of products are either in production or anticipated in the future:

- (i) Spatial distribution of data used in analysis fields;
- (ii) Sea surface temperature & salinity;
- (iii) Mixed layer depth;
- (iv) Vertically integrated upper ocean heat content;
- (v) Dynamic height;
- (vi) 300 meter temperature/salinity;
- (vii) Anomalies of the above fields.

Three objectives for issuing these products are:

- (i) To provide a detailed inventory of data acquired by GTSP;
- (ii) To provide useful products for researchers;
- (iii) To promote and advertise GTSP.

5.7 DATA FLOW MONITORING

The monitoring programme assists all GTSP participants, including data contributors and users, to measure the effectiveness of the project and to make changes

where needed. It also provides an index of performance for future development and improvements. In particular, GTSPP exercises the monitoring procedures developed in IGOSS & IODE and assists with their further development and improvement.

GTSPP data flow monitoring aims for these objectives:

- (i) Provide information on the flow of near real-time and delayed mode data;
- (ii) Identify problem areas and bottlenecks in data and information flow;
- (iii) Provide statistics to promote the GTSPP;
- (iv) Provide feedback to data contributors, data centres and scientific data analysis centres.

5.8 HISTORICAL DATA & LONG-TERM TIME SERIES

An important component of non real-time data acquisition is the potentially large set of original data which have not been made available through IODE. GTSPP works with Member States to actively pursue these historical datasets and submit them via IODE channels.

The objectives of this element is to make available a global historical dataset for climate research purposes. The global dataset is built with the help of the World Data Centres, IGOSS & IODE Centres and other institutions. The resulting database will be available to the scientific community as quickly as possible. The work is being co-ordinated by the Steering Group through SCOR, the CCCO and commitments from individual countries.

6. PROJECT MANAGEMENT

6.1 PARENT BODIES

GTSPP is a co-operative IODE-IGOSS Project and therefore, has a relationship with the technical committees of both programmes. Consequently, the parent bodies for GTSPP are the Intergovernmental Oceanographic Commission and the World Meteorological Organization.

6.2 STEERING COMMITTEE

Both the Terms of Reference and the composition of a Joint IOC-WMO Steering Committee on the GTSPP were accepted as Recommendation IODE-XIII.4 at the meeting of the IOC Technical Committee on IODE in January 1990.

The Steering Group is responsible for co-ordinating GTSPP implementation and its continuing development and operation. The Steering Group continuously reviews the Project and actively promotes and encourages participation in GTSPP. Scientific guidance is provided through the Steering Group, which includes membership from the scientific community. It is the responsibility of the Steering Group to prepare, maintain and distribute relevant documentation and to report to IODE & IGOSS contacts, representatives of scientific programmes and appropriate Committees (IGOSS & IODE).

ANNEX II

DEFINITION OF SELECTED TERMS COMMON TO IGOSS & IODE

GENERAL TERMS

Area of Interest

It includes both the area of responsibility of the data centre and any additional areas for which it wishes, for national or regional purposes, to receive and archive IGOSS data.

Area of Responsibility

The geographic area for which a data centre assumes the obligation to compile and maintain oceanographic data and to render services from complete IGOSS databases.

Oceanographic Products

Any analysis, forecast or summary of oceanographic conditions prepared and disseminated to meet the needs of user groups. The variables presented may include sea-surface temperature, sub-surface temperature, mixed layer depth, ocean frontal positions, currents, salinity, sea-level, waves, ice conditions and anomalies of these variables.

Secondary User

Any user of data other than those for whom data were originally collected.

IGOSS TERMS

Bulletin

A compilation of several reports of the same type (BATHY, TESAC or TRACKOB) carried out by a GTS insertion point. A bulletin is entered within a GTS message onto the GTS according to the regulations described in the Manual on the GTS (WMO N°. 386).

GTS: Global Telecommunication System

A globally integrated and increasingly automated network of point-to-point telecommunication circuits and associated telecommunication centres dedicated to the rapid exchange of meteorological, oceanographic and other related geophysical data and information.

GTS Message

The message compiled by a NMC or NOC containing the bulletin header information, the bulletin and an end of message information.

NMC or NOC: National Meteorological Centre or National Oceanographic Centre

An NMC or NOC is an operational centre which compiles oceanographic data, quality controls the data, inserts data onto the GTS and produces various kinds of oceanographic products and information for meeting national needs of the Member States. Its functions are solely the responsibility of the Member States. NOCs of Member States are an element of IGOSS Data Processing and Services System (IDPSS). NOCs functions are frequently performed by National Meteorological Centres (NMC).

NTL: National Telecommunication Link

An NTL is a telecommunication facility used to transmit meteorological and oceanographic data between national centres, and to and from the GTS.

Operational Data

Data within 30 days from the time of observation. Operational data are to be exchanged by the GTS and by other rapid means of communication.

Operational Products

Products prepared to reach the user in a timely fashion and produced on a regular basis. In IGOSS, these products are produced through the IGOSS Data Processing and Services System (IDPSS).

IGOSS Message

The message transmitted via satellites or by radio from the platform to a shore-receiving station and containing the respective address of a meteorological or oceanographic centre.

Report

An oceanographic observation coded in an appropriate reporting code and transmitted to shore stations. Reports are then forwarded through national channels to a GTS insertion point where they are gathered into bulletins.

RTH: Regional Telecommunications Hub

RTHs are centres in the Main Telecommunications Network (MTN) of the GTS which have (among others) the responsibility to collect observational data from their zone of responsibility and to transmit such data on the MTN, and to relay the meteorological information from the MTN to the centres not situated on the MTN Circuit.

SOC: Specialized Oceanographic Centre

SOCs are operational centres which produce various kinds of oceanographic products (including datasets) and information for certain regions or for international scientific programmes and projects. Such data centres are established in the frame of the IDPSS on request of interested Member States; their location, services and functions are

determined by an agreement between interested Member States and are subject to confirmation by the governing bodies of the IOC & WMO.

WOC: World Oceanographic Centre

World Oceanographic Centres are specialized oceanographic centres on the global scale. The WOCs have highly automated facilities and can deal with large volumes of data and use numerical techniques efficiently for the analysis and forecast of large and planetary-scale phenomena. Their IGOSS products are usually available to other centres via the GTS in the form of guidance material to be used for the production of specialized products.

IODE TERMS

DNA: Designated National Agency

The National Agency officially charged with the responsibility of the international exchange of oceanographic data in non-operational mode.

Non-Operational Data

Data older than 30 days. Non-operational data are not exchanged on the GTS.

Non-Operational Exchange of Oceanographic Data

The exchange of oceanographic data accompanied by detailed identification information and other supporting environmental data. Non-operational exchange usually occurs months to years after the time of observation and the data frequently undergoes strict quality control. IODE programmes are based on non-operational data exchange.

NODC: National Oceanographic Data Centre

An NODC is the sole responsibility of a Member State. Such a data centre generally serves as a focus for the IODE related activities within the Member State, and provides information and data to the World Data Centre system.

RNODC: Responsible National Oceanographic Data Centre

An RNODC is a National Oceanographic Data Centre that has been established on behalf of the IOC to provide, in addition to its national obligations, a specific set of services to assist with the international exchange of oceanographic data or to meet the needs of international science programmes. An RNODC may exist on a permanent basis or only for the duration of a project.

WDC: World Data Centre

A World Data Centre is a centre established under the auspices of the International Council of Scientific Unions (ICSU). The World Data Centres for Oceanography are the focus for international oceanographic data exchange within the IOC-IODE system.

ANNEX III

LIST OF ACRONYMS

BATHY	Bathythermograph
CCCCO	SCOR-IOC Committee on Climatic Changes & the Ocean
CMD	Continuously Managed Database
CTD	Conductivity, Temperature, Depth
DNA	Designated National Agency
DRIFTER	Drifting Buoy Observation
GF3	General Format 3
GTS	Global Telecommunication System (WMO)
GTSP	Global Temperature-Salinity Project
HF	High Frequency
ICSU	International Council of Scientific Unions
IDPSS	IGOSS Data Processing & Services System
IFC	IGOSS Flexible Code
IGOSS	Integrated Global Ocean Services System
IOC	Intergovernmental Oceanographic Commission
IODE	International Oceanographic Data & Information Exchange
IOS	IGOSS Observing System
ITA	IGOSS Telecommunications Arrangements
JMA	Japan Meteorological Agency
MEDS	Marine Environmental Data Service
MTN	Main Telecommunications Network
NMC	National Meteorological Centre
NOC	National Oceanographic Centre
NODC	National Oceanographic Data Centre
NTL	National Telecommunication Link
NWS	National Weather Service (USA)
ORSTOM	Office de la recherche scientifique et technique outre mer
QC	Quality Control
RNODC	Responsible National Oceanographic Data Centre

ROSCOP	Report on Observations/Samples Collected by Oceanographic Programmes
RTH	Regional Telecommunications Hub
SCOR	Scientific Committee on Oceanic Research
SOC	Specialized Oceanographic Centre
TESAC	Temperature, Salinity, Currents
TOGA	Tropical Ocean and Global Atmosphere
TRACKOB	Track Observation
UNESCO	United Nations Educational, Scientific & Cultural Organization
WCRP	World Climate Research Programme
WDC	World Data Centre
WMC	World Meteorological Centre
WMO	World Meteorological Organization
WOC	World Oceanographic Centre
WOCE	World Ocean Circulation Experiment
WWW	World Weather Watch