

National Oceanographic Information System

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Ocean study is inherently interdisciplinary and therefore calls for a controlled and integrated approach for information generation, processing and decision making. In this context, Indian National Oceanographic Data Centre (INODC) of NIO has been recognized as a national facility to acquire, process, store and disseminate the oceanographic data pertaining to Arabian Sea, Bay of Bengal, Laccadive sea, Andaman & Nicobar sea and the Indian Ocean. At INODC, a National Information system for oceanographic studies is under development. Bibliographic information forms an integral part of oceanographic system as it is an essential component for data analysis and interpretation. Hence two major systems are considered under National Oceanographic Information System viz. 1. Data and Information system 2. Library and documentation system. The present status, organization and structure, role and functions of the above mentioned systems impact of information technology and outlook for the future are described.

1 INTRODUCTION

Exciting challenges lie ahead not only for the marine scientists but also for those involved in the management, banking and dissemination of data collected at sea. Progress in marine science depends not only on the ability of the oceanographer to collect, process and analyze his own data, but also to the extent to which he has access to data collected by other scientists in other laboratories both at home and abroad. And so computer based data management has become an essential component of modern oceanography.

Ocean study is inherently interdisciplinary and therefore calls for a controlled and integrated approach for information generation, processing and decision making. In this context, Indian National Oceanographic Data Centre (INODC) of the National Institute of Oceanography (NIO) has been recognized as a national facility to acquire, process, store and disseminate the oceanographic data pertaining to Arabian Sea, Bay of Bengal, Laccadive Sea, Andaman & Nicobar Sea and the Indian Ocean.

Expenditure on oceanographic research is very high. Despite the large amount of money and efforts in such data collection, the density in time and space of the available data from the oceans in general remains low. Data are valuable not only to the primary users, responsible for its original collection but

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also to a wide range of secondary users. Thus a centralized management of oceanographic data not only improves the availability of data to end-users but also ensures that the data are preserved for long-term use.

A feature of marine information which often makes it difficult to handle different types of data in a consistent fashion is the number of dimensions they occupy. For example, bathymetry can be considered as static and two-dimensional, whereas temperature and salinity are spatial and temporal (although the latter variation is reasonably periodic). Sampling distribution, resolution and frequency which in principle should be matched to the phenomena being investigated, also present problems in terms of data storage, manipulation and presentation. And hence processing, cataloguing and dissemination of spatial data is a major undertaking.

The complimentary constituent of the information system is library and documentation system which primarily includes bibliographic information by different modes. Since it is difficult for anybody to keep abreast with latest work, the bibliographic system comes to aid in providing the necessary reference materials easily, quickly and at a very low cost.

2 DATA AND INFORMATION SYSTEM

21 Objective

The main objective of the INODC, is to acquire, store, and disseminate entire spectrum of oceanographic data for meeting the needs of marine scientists and user communities. The data centre ensures that the user gets good quality and accurate data which can generate useful information.

22 Major Functions

The following functions are defined;

i. Acquisition of data & Information: INODC acquires data and information from 1) NIO scientists & Scientists from other national organizations 2) Government departments and 3) Data centres of other countries.

ii. Processing (coding & quality checking): The data and information acquired is reformatted, checked for its quality and accuracy wherever possible and compressed to suit computer aided storage system. This centre sorts out inventory level information and assigns INODC numbers to each station and cruise and does the computations for derived parameters wherever necessary.

iii. Storage (Database Management): The Centre stores inventory level information in Station Inventory Information System and actual data in Integrated File System for efficient data management.

iv. Preparation of data products: Inventories, atlases, charts, data reports, directories etc. are various data products that the INODC publishes.

v. Dissemination of Data: as per users demand, processed archived data is made available to end-users in suitable formats on magnetic media and paper prints.

23 Quantum of Data Holding

The INODC holds the data collected by NIO and other marine data generating organizations and also holds data collected during the International Indian Ocean Expedition. In addition, data from Institutes and DAta Centres of other countries are acquired. The following is the quantum and type of data available at the INODC.

Sr.No.	Discipline	Parameters	No.of stations for which data is available
1.	Physical Oceanography	(Nansen cast) Temp, Salinity STD/CTD, MBT, XBT, DBT wave, currents, and surface meteorological data.	24116
2.	Chemical Oceanography	O ₂ PO ₄ , NO ₃ , NO ₂ , SiO ₃ , pH, NH ₄ , major chemical elements, trace metals and toxic elements.	23286
3.	Biology	Chlorophyll, productivity rate, Zooplankton and Benthos.	3640
4.	Geology	Grain size, sediment composition, sediment load, foraminifera and geochemistry.	2120
5.	Geophysical	Bathymetry, Gravity, Magnetics and Seismics.	125113(line Kms)

INODC's major area of interest is Indian Ocean in general and its two arms viz. the Bay of Bengal and the Arabian of the Exclusive Economic Zone of India which covers about 2.01 million km along India's coastline of 7517 km including that of Laccadive and Andaman & Nicobar coasts. The above mentioned stations are therefore spread over in these areas of the Indian Ocean.

3 OCEANOGRAPHIC DATA ORGANIZATION

INODC has designed, discipline-wise and parameter-wise data formats for systematic acquisition and dissemination of data. The Centre prefers to receive data in fully processed form, on magnetic media and in prescribed formats. However, Data received in raw form are converted to digital form before further processing.

For the purpose of management, oceanographic data is classified as,

1. Station data :From a stationary research ship/platform
2. Underway data :From a moving ship (geographical data)
3. Time Series data :From moorings & drifting buoys
4. Satellite data :Remote Sensing data

31 Data Treatment

The data submitted to INODC is reviewed to ensure that it is accurately described to characterize the data type and to determine if it is suitable for processing. Conversion into INODC formats is required if it is in raw form. Analog charts are screened for obvious errors or omissions and then digitized for computer storage.

The Data Centre, at present, does not have an absolute check on the accuracy. However, certain methods are employed to point out the coding errors and the suspected data. Quality control programs check for completion of mandatory fields, expected ranges for fields and similar items. The suspected or erroneous data are flagged and some data are even omitted if necessary. The data sets are assigned INODC reference numbers that are recorded in inventory data base. INODC identifies oceanographic information at four levels,

1. Inventory level information
2. Parameter level information
3. Documentation information
4. Actual numerical data

Inventory level information includes geographic location of the stations, cruise details and INODC number as reference key field. Parameter level information includes various parameters observed at each station along with their respective Report On Samples Observations Collected during Oceanographic Programs (ROSCOP) codes which are accepted Internationally. Data level information includes processed numerical data and INODC number as reference key field.

The inventory and parameter information is stored in Station Inventory Information System (SIIS) developed using "dBASE III PLUS" database package

available on PS/386 micro computer working under MS-DOS environment. Numerical data is stored in NORISK DATA (ND) 570 computer system adopting Integrated File System (IFS).

32 Database Management Systems

The Data centre has developed the following systems and subsystems for the management of various types of data

- 1) Station Inventory Information System (SIIS)
- 2) Integrated File System (IFS) for numerical data storage
- 3) Geophysical Data management system (GPDMS)

321 On-Line Oceanographic Station Inventory Information System (OSIIS)

Oceanographic inventory information of the data collected during RV Gaveshani and ORV Sagar Kanya cruises have been organized and structured using popular dBASE III PLUS data base package available on DCM PS/386 microcomputer and working under MS-DOS environment. Using dBASE command level programming language, software modules are developed additionally, to support build-in- capabilities of dBASE III, for developing a very user friendly online system.

The system developed, is capable of carrying out major functions such as

- 1) Systematic storage and management of data,
- 2) selection of inventory information as per user's demand, and
- 3) Preparation of catalogues and reports.

322 Integrated File System (IFS)

An Integrated File System (IFS) is designed for management of Oceanographic Data and Information. This system has three hierarchical level. The system basically provides the storage facility for all categories of oceanographic data. Each category has four levels. Levels 1 and 2 are assigned for inventory and documentation information which actual digital data is stored in 3rd level. Level 4 contains additional information related to some special types of data.

323 Geophysical Database Management System (GPDMS)

GPDMS is designed for the computerized storage and retrieval of marine geophysical data and information, GPDMS is subdivided into various databases depending upon disciplines such as navigation, bathymetry, magnetics and gravity.

Navigation database which contains Inventory level information along with assimilation and search modules exists on microcomputer (DCM PS/386 system) whereas the geophysical database resides on NORISK DATA 570 computer system.

GPDMS is a user friendly computer software system that a) processes underway marine geophysical data into a database with a common structured format b) provides inventory and data retrieval capabilities, and c) presents information in graphic form.

33 Databanks

Data available with INODC is checked for quality, sorted, indexed and preserved in flat file form in various data banks. The following data banks are currently available at the centre.

Sl.No.	Data Banks	Imp. Parameters	Records
1.	MBT	Temp., Bathy. (Mechanical)	1398
2.	XBT	Temp., Bathy.	931
3.	Nansen Cast	Depth, Temp., Salinity	1000
4.	Surface Meteorology	Temp., Wind speed, direction Pressure, cloud, sea state	2037
5.	Time Series Invt.	Current, Waves	
6.	Primary productivity	Pigments, Chlorophyll	316
7.	Zooplankton	Zooplankton	1642
8.	Zoobenthos	Zoobenthos	1500
9.	Nutrient & Oxygen	Nitrate, Nitrite, pH, Ammonia, Phosphate, Silicate	
10.	Geological (19 sub data banks)	Grain Size analysis, Coarse fraction, Petrography, water sample analysis etc.	

34 Data Dissemination

For dissemination purpose the data is divided into the following three categories:

1. **Open data:** Data collected from international waters i.e. beyond Exclusive Economic Zone.
2. **Restricted data:** Data collected within the Exclusive Economic Zone.
3. **Classified data:** Certain types of data depending upon the nature may be classified as sensitive and such data would not be available for exchange or dissemination purpose.

Open data and to some extent Restricted data are made available to users according to guide lines.

35 User Inquiries Handling

On-line Station Inventory Information System also provides an easy and user-friendly access for selecting inventory information as per users demand. Query handling system of OSIIS searches and sorts the required information depending upon users specification (geographic area, depth, season etc.) and stores it in a new data base. Selected inventory level information is correlated with corresponding data sets with the aid of unique INODC numbers and required data is retrieved.

The data is disseminated in the form of hard copies (Printout) or magnetic media (tapes and floppies). The data can also be supplied/exchanged in internationally accepted General format (GF- 3), if user requires.

The INODC/NIO provides the guidelines for dissemination of oceanographic data through a booklet "Guidelines for the Distribution and Exchange of Samples and Data", which also contains a specimen of the request form. In spite of the charges mentioned in the guidelines, the INODC/NIO is taking a liberal view. The centre, nevertheless, prefers to exchange data.

36 Oceanographic Data Products

The following products have so far been brought out.

1. **Inventory reports (total 10 nos):** Stations and cruises inventories have been published in nine reports. These reports contain the inventory information of R.V. Gaveshani (1976 - 88), ORV Sagar Kanya (1983 - 88), Sagar Sampada (1985 - 86) and R.V. Samudra Manthan 1983 -86). One inventory report pertains to 13 geophysical cruises and 6480 fixes of R.V. Gaveshani for the year 1983 to 1988.
2. **Data reports:** Following data reports have been prepared from data collected onboard RV Gaveshani, ORV Sagar Kanya.

Data Reports:

- a) Mechanical Bathythermograph Data Reports.
- b) Surface Meteorological Data Reports.
- c) Nansen Case Data Reports
- d) Chemical Data Reports
- e) Zooplankton Biomass Data Reports.

37 OCEANOGRAPHIC ATLAS:

Three oceanographic atlases have been prepared. Oceanographic atlas of EEZ of India incorporates physical, chemical and biological data collected during 1976-80 and shows the general annual distribution at different depths. the atlas of mechanical Bathythermograph data gives composite plots of seasonal variation of temperature profiles drawn against depth, in each square degree grid. The Geophysical Atlas of Eastern Arabian Sea displays Bathymetry, Magnetics and Gravity data as contour maps, anomaly maps, profiles and 3-d sea bottom topography plots.

4 LIBRARY AND DOCUMENTATION SYSTEM

literature on one hand establishes the credibility of the scientific results and is considered to be most powerful media of communication among the scientists and on other hand, it is extensively referred during data analysis and interpretation.

41 Present status

With increasing oceanographic research activity enormous primary literature like books, periodicals, theses, research reports, conference proceedings, patents and standards etc, are being published in variety of forms making an individual unable to keep track of all relevant information. The secondary literature in the form of bibliography, abstracting and indexing services, current awareness services, etc. comes to rescue as they are designed to direct the potential readers to the items of their interest.

Primary and Secondary literature available in N.I.O. library is as follows,

Book including back volumes of journals over	20,000
Technical reports	5,600
Journals currently subscribed Including	
20 (Indian journals)	148
Other collection	
Patents over	300

Microfilms	500
Films (16 mm)	40
Loose reprints/photocopies	several thousands

42 Role and functions of bibliographic information system

1. Acquisition of published literature through document procurements, document exchanges etc.
2. Provide on demand or in anticipation information to the users about the publication, especially microdocuments in their field of specialization through reference services, referral services, current awareness, retrospective literature searches etc.
3. Supporting activity including infrastructure, software developments, surveys and studies and documents delivery.
4. Organization and Structure of data bases.

With the advancement and introduction of computer technology into this field, secondary literature is stored in data bases which are now accessible on-line. The latest trend in the advances in computer technology could be seen in the introduction of the Compact Disk - Read Only Memory (CD - ROM) for creating data base. Two major bibliographic databases are being used at NIO library.

43 Local Data base OCEANLINE

Local data base called 'Oceanline', using Computerized Documentation Service/Integrated Set of Information Systems (CDS/ISIS) software, a popular relational bibliographic data base has been established. This Local data base aimed mainly to store catalogue of books available at NIO library and marine science literature published in India, which is eventually passed on to load on ASFA. More than 400 references are added to the Oceanline every fortnight. Presently over 8000 records have been added and the work is being continued. Data base is equipped with necessary software for searching bibliographic information through selected key-word.

44 Computerized information retrieval services using ASFA CD-ROM data base:

Aquatic Sciences and Fisheries Abstracts (ASFA) is an abstracting and indexing service covering the world's literature on the science, technology and management of marine and freshwater resources and environments. As NIO is acting as national ASFA partner, the ASFA data base, available on compact disk for the period from 1982 till data, is procured and installed in NIO library in collaboration with UNESCO. The compact disk named Compact Cambridge ASFA, contains bibliographic information about relevant papers from over 5000 core and non-core serial publications, forms the major part of data base, apart

from books, reports, conference proceedings etc. Roughly 37,000 articles are notified every year and now data base has more than 1,60,000 records with abstracts, pooled from various input centres the world over.

The record contains various searchable fields such as author, author affiliation, corporate author, title, source, text and abstract language, subject, classification number, environmental regime, conference title, other identification numbers and classification index. A common facility to display/print/download the search results exists. With these facilities the required information is being retrieved within shortest possible time. Being national ASFA partner, NIO has added over 800 bibliographic references to the ASFA data base during 1990 (input of the first year). Quarterly updates of ASFA CD-ROM data base are available in the library.

In addition to above two data bases, bibliographic on-line search facility on international data base through DIALOG is arranged at the Institute as and when required. Day to day library functions such as 1. Document ordering, 2. Circulation control, 3. Library catalogue, 4. Accessioning, 5. Book card printing, and 6. New arrivals of bulletins are also computerized for easy and smooth functioning of library.

5 FUTURE PLANS

In years to come, it is proposed to take up the following activities in a comprehensive manner.

1. Development of menu driven on-line facility for oceanographic data retrievals.
2. Development and implementation of Marine Remote Sensing Information System (MARSIS)
3. Development of Marine Information System.
4. Preparation of Comprehensive Ocean atlas for Indian Sea.
5. Existing databases are to be linked with NICNET or SCIENCE NET for on-line data/information access.