

## Oceanographic Data and Information Network in the Indian Ocean

By

**JS Sarupriya and GV Reddy**

Indian Oceanographic Data Centre  
National Institute of Oceanography  
Dona Paula, Goa-403004

e-mail: sarujs@darya.nio.org

**Abstract:** Intergovernmental Oceanographic Commission (IOC) committee on International Oceanographic Data Exchange (IODE) has developed a data center network by establishing 70 National Oceanographic Data centres (NODCs) in 70 IOC member states, 12 Responsible National Oceanographic Data Centres (RNODCs) and 3 World Data Centres (WDCs) for oceanographic data/information management and exchange. Regional data/information network in the Indian Ocean is being managed by 9 NODCs and 2 RNODCs and oceanographic research work is monitored by two IOC committees for the central and western Indian Ocean (IOCINDIO & IOCINCWIO). Enormous amount of oceanographic data/information have been generated by various research, academic, survey, and defense institutes at national level, in order to manage data/information, Department of Ocean Development (DOD) has established 13 National Marine Data Centres (NMDCs), in 1994 and a new autonomous centre called 'Indian National Centre for Ocean Information Services' (INCOIS), in 1999, under Ocean Information Services (OIS). Indian Oceanographic Data Centre (IODC) at NIO is one of them established in 1964 as National facility for oceanographic data & information management. IODC services was further elevated to RNODC for Indian Ocean by IOC/IODE in 1996. IODC holding oceanographic data for more than 70,000 stations collected during various expeditions/projects in the Indian Ocean since 1904. IODC has been developed 45 database tables for managing 36 oceanographic parameters. Historical hydrographic, chemical and Argo float profiles for the Indian ocean are available over the internet for operational research work (URL <http://www.indian-ocean.org/support/main.htm>, <http://www.incois.gov.in/Incois/argo>) IODC also developed value added data products such as Atlases, CDROMs, etc. An attempt is made to assess data/information available in public domain. The result shows that more than 60% of oceanographic data/information is being available in public domain from oceanographic observational programs. The rest is either lost or partially available in publications. The reasons are many for losing data/information, but these are mainly due to: (i) Data management component is missing in project proposal/observational programs, (ii) Observational programs are

not well linked with data management activities, (iii) There are communication gaps between data collectors (Scientists) and data managers and (iv) Funding agencies are not monitoring data flow from data generating agencies to the national data centers / archives. Therefore, the national oceanographic data acquisition network is partially fail to trace/ monitor data flow effectively . To overcome these problems and some suggestions for improvement data /information network are discuss in this communication.

**Key words:** Oceanography, Data Centre, information, Management, Data Network, Indian Ocean.

## 1. Introduction

India has a coast line of about 75000 Km with an exclusive economic zone (EEZ) of 2.02 million sq. Km. About 20% of India's population inhabit in coastal areas. The rapid growth in population particularly, in the coastal states of India has increased the demand for land and ocean resources. Most of the coastal population is far below the living standard in many respect, Their standard of living can be raised when marine activities are increased and the sea is used for revenue. The most important and priority area for study is the near shore water, continental shelf and margin which has highest relevance to the exploitation of the marine food and other resources. To understand the coastal ecosystem, which is a complex process, Since it is most affected by monsoon, river-run-off, pollution, currents, tides and other man made changes.

The computer based data/information management has become an essential component for to understand the coastal processes and marine environment .The progress in marine science depends not only on the ability of the oceanographers to collect, process and analyses his own data but also on the extent to which he has access and work with data collected by others scientists .

Advances in oceanography /marine sciences and technology depends to a significant degree upon the effective flow of information and data from the collectors to various users, Such data have limited usage, until processed and merged with other information to understand the coastal ecosystem and provide the answers to important questions posed by the oceanographic society. The principal purpose of a national centre is to provide on a continuing basis information/data in a suitable form to users community to generate knowledge for benefit of the society.

## 2. Data and Methodology

The oceanographic studies in the Indian waters were conducted very sporadically before early 60's. It was Seymore Sewell who first studied the sea as a naturalist. Many expeditions have been undertaken in the Indian Ocean. These are Challenger(1872-1876), Investigator (1884-1925), Vityaz (1886-1909), Valdivia (1898-1899), Gauss (1901-1903), planet(1906), Dana (1920-1927), Snellius (1929),

Discovery-II (1929-1933), John Murry (1933-1934) and Galathea (1951). These expeditions had their limitations and mostly covered the Indian Ocean, but failed to bring out conclusive results in time and space for all the oceanographic parameters. Later, few universities like Bombay, Madras, Travancore initiated marine biology work in the coastal areas. The real impetus to the Indian Oceanography was given by International Indian Ocean Expedition (1960-65) through which systematic studies were made in all oceanographic disciplines. Based on its work many of research papers, report, and atlases have been published. The active participation of India in IIOE programme resulted in establishment of National Institute of Oceanography and a Indian Oceanographic Data Centre (IODC) in 1966. Later Govt. of India established the Department of Ocean Development (DOD) in 1981 to promote deeper understanding of the seas around India. DOD has further enhance the ocean research and technology by establishing the National Institute of Ocean Technology (NIOT) in Chennai in 1993 and Indian national centre for oceanographic information services in Hyderabad in 1999.

### **3. Results and Discussion**

#### **3.1 IODE Data Centres Network**

International Oceanographic Data/Information Exchange committee was established in 1961 at UNESCO/IOC, Paris, to enhance marine research, exploitation and development by facilitating the exchange of oceanographic data and information between participation Member States and by meeting the needs of users for data and information products. Today IODE developed network of more than 70 data centers in the IOC Members States, which includes three World Data Centres (WDC), sixty four National Oceanographic Data Centres (NODC), and Responsible National Oceanographic Data Centres (RNODC)

#### **3.2 Regional Network in Indian Ocean**

The main objective for establishing of regional network in the Indian Ocean is to enhance the regional co-operation in marine science, to develop the scientific program and to strengthen the data/information management system for the benefit of the member states bordering Indian ocean, these are Australia, Bangladesh, India, Indonesia, Iran, Kuwait, Malatsia, Maldives, Myanmar, Oman, Pakistan, Qatar, Saudi Arabia, Sri Lanka, Thailand, United Arab Emirates etc. The data centers network is consisting of nine NODCs and two RNODCs in the region. The regional marine research and data/information management works are monitors by the IOC regional committee for the Central Indian Ocean (IOCINDIO). The committee is to play a regional role for improving the marine science, information management and infra structure facility. The committee also provided the support for the development of new research project and observational programmes.

#### **3.3 RNODC-INDO**

One of the active centre in the region is RNODC-INDO. The Centre was established by IOC/IODE in January 1996 (Ref. Resolution IODE-XV.I) at the

National Institute of Oceanography (NIO), Goa, India. Since then the centre is working actively to enhance the oceanographic data / information management activities in the region. The center is also actively disseminating the oceanographic data / information through the IOC/IODE regional network. The center is also helping IOC member states by providing training to the data personnel on oceanographic data / information management in the IOCINDIO region. The center is working to enhance IOC regional capabilities to interpret and to use results from field experiments through participation in the IOC regional programs. The center hold the oceanographic data sets for more than 70,000 stations collected from the Indian Ocean since 1900.

The other active centre is the Indian National Center for Ocean Information Services (INCOIS) an autonomous body under Dept. of Ocean Development (DOD) was established in February, 1999 with a mandate to synthesizes, ocean observations, satellite oceanography, ocean information and advisory services. The center is managing the projects on ocean modeling, coastal research and Argo floats deployment etc.

### 3.4 Data products for Indian Ocean

#### 3.4.1 Data visualization S/W

A window based system has been developed for selection, retrieval and visualisation of biological data archived in the Indian Oceanographic Data Centre (IODC) data bank. The system is developed in Visual Basic (VB) and it has three modules namely selection, visualization and retrieval of biological data sets. The first module for data selection operates on input information namely, (i) area (range of lat. and long. or clicking the four coordinates from the map), (ii) cruise / station references, (iii) period (year / months) selection. The selected data profiles can be plotted by visualization module. The module also plots average profile of the variable considering all the stations of the cruise and overlay a profile of the station. Thus the module can check the variation in the station profile over the average cruise profile. The system has been developed, interfaced and tested with forty five years historical biological data sets.

#### 3.4.2 NIO-BIO-CD

NIO-BIO-CD was developed by IODC, contains 3956 historical biological profiles collected in 1951 to 1996 on primary productivity, Chlorophyll-a, zooplankton biomass, zoo-benthos biomass & density and microbiological bacterial analysis in the Indian Ocean. A part of the data of 1194 profiles were collected by the institute on board the research vessels INS Darshak, R.V. Gaveshani and ORV Sagar Kanya during 1974 to 1996 and 2762 profiles were taken from the IOC data report (Published in 1974) having the biological data sets collected by many countries in Indian Ocean since 1951.

#### 3.4.3 NIO-HYDRO-CD

NIO-Hydro-Cd developed by IODC, contains 2591 historical hydrographic profiles collected during 1906 to 1996 on Temperature, salinity, dissolved oxygen,

nitrate, nitrite, phosphate, ammonia, silicate, pH and alkalinity in the Indian Ocean. A part of the data 9270 profiles were collected by the NIO on board the research vessels R.V. Gaveshani and ORV Sagar Kanya during 1976 to 1996 and 16021 profiles were taken from World Data Centre CD collected during 1906-1996. Software for data selection, visualization, and retrieval of data was interfaced with the database on the CD.

### 3.5 Bio Data Quality Control S/W and Results

A quality control system has been developed and performed the quality control (qc) checking on the primary production (pp) and chlorophyll-a (chl<sub>a</sub>) profiles in the Northern Indian ocean collected from 1976 to 1997 by R.V.Gaveshani cruises (1976-94) and ORV Sagar Kanya cruises (1985-1997). These quality checks are based on the Meta data inventory, duplicate, range, maximum value of specific production, tail end increase and statistical. Preliminary quality check is performed by visual inspection of the vertical profiles of pp and chl<sub>a</sub> along with temperature. Individual station profiles of the parameters were selected and plotted in the same plane so as to compare the nature of the profile easily. Other quality check on pp was done by computing the chl<sub>a</sub> specific pp, i.e. mgc ( $\text{mg chl}_a^{-1} \text{d}^{-1}$ ) and verify whether the ratio falls below or above the theoretical possible maximum value. This ratio is maximum at light saturation and known as specific production or Assimilation No.(AN). Here AN was fixed as 250 and we found that about 5% of the data are doubtful. Another qc, called tail end increase, was performed on pp. This test is based on the limit of the euphotic zone. It has been noticed that about 11% of pp values from 1% light depth is more than the value at the depth immediately above the euphotic depth. Statistical checks were carried out by grouped the data in  $1^\circ \times 1^\circ$  or  $2^\circ \times 2^\circ$  latitude-longitude square depending on the number of data sets available. Mean and standard deviation(SD) for the values from every observed depth were computed. Maximum and minimum value of each depth were fixed as mean  $\pm 5\text{SD}$  when land area contained in the square. In other case the maximum and minimum value were fixed as mean  $\pm 3\text{SD}$  in the square. For PP values below 50m depth, the criteria was that the values should be between mean  $\pm 3\text{SD}$ . All the values of pp and chl<sub>a</sub> passed this test.

### 3.6 On Line Hydrographic Data Service

The on line hydrographic data service has been developed with user friendly data selection and retrieval interface software. The hydrographic data profile on temperature, salinity, oxygen, nitrate, nitrite, phosphate, ammonia, silicate, Ph and alkalinity collected during 1906 to 1996 are available on the Indian-ocean web server of the institute for on line dissemination (URL <http://www.indian-ocean.org/support/main.htm>)

## 4. Conclusion

Project Data and Information Management (mostly, to ensure the rapid dissemination of data and its long-term preservation and accessibility) could be summarised as follows: Establish a coherent, credible, semi-distributed and scalable, end-to-end Data & Information Management (D&IM) plan with clear D&IM

objectives, activities and timeline; a policy (e.g., delivery and exchange standards), widely agreed by the scientists and sponsors, and supported by funding agencies to insure compliance; a clearly identified core project science and associated core parameters, to be revised regularly; an International Project Data Centre designed to establish guidelines, provide advice, and facilitate exchange of knowledge and expertise; several experienced, full-time national data managers / coordinators; an increase of the overall value of scientific research and derived outputs.

An ideal D&IM system is also proposed as the support for a possible vision or a feasible set-up for the future D&IM for marine projects.

It includes a range of services and products, taking full advantage of best practices, standards or innovative approaches; several pro-active, "bottom-up" strategies addressing all needs and requirements; the establishment & support of experienced, full-time national or regional data managers, through existing infrastructures, capacity building, new international synergies; a fair "top-down" strategies to insure compliance, better integration; a policy fully agreed upon and widely disseminated at the (inter)-national levels, for delivery, quality-control, referencing, exchange, integration, dissemination, preservation, to facilitate interoperability; project knowledge resource centre, a Data Management Committee (DMC, with data managers, project leaders and modellers) and a set of Data Evaluation Units (DEUs), where needed.

Within the schematic diagram representing the interactions between the project partners and collaborative bodies, and the main fluxes of data & information, each element represents a function rather than an office. In addition it is reminded that several useful marine data policies are already available (especially online). The overall idea that the highest quality in D&IM should help and support the Project Investigators (PIs), project sponsors, funding agencies and end-users, to achieve and/or benefit from the best science, today and tomorrow.

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