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Marine Data and Information Management System for the Indian Ocean

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The User friendly computer system for the management of marine data / information has been developed for processing of physical, chemical, biological, geological and geophysical data sets with a common inventory database. It provides geographical, seasonal and parameterwise catalogue information and retrieval of data using multi-parameter selection criteria. The system incorporates database for temperature, salinity, oxygen, nutrients, primary production, Chlorophyll *a* and zooplankton biomass in the water column and zoobenthic biomass, micro-organism, geochemical parameters, marine magnetics, gravity etc. at the bottom of the ocean.

1. Introduction

The Responsible National Oceanographic Data Centre (RNODC) for the Indian Ocean (INDO) region is a national and international repository for marine and oceanographic data and information. The centre has responsibility to archive entire spectrum of marine and oceanographic data and disseminate it from time to time in suitable format to scientists, research scholars, industries, Government departments and other end users. The centre receives a good number of inquiries from users regarding availability of multi-disciplinary marine data sets.

India has made great strides in oceanographic research in the last three decades and has firmly established itself in the international science. Several agencies in the country have collected large amount of marine and oceanographic data in and around Indian Seas on various parameters.

It is difficult for a data user to know the sources of all the data he may need, and the

individual institutions collecting data may not have the mission or resources to provide services to end users. Hence, computer based data management has become an essential component for modern oceanography. The progress in marine science depends not only on the ability of the oceanographer to collect, process and analyse his own data but also on the extent to which he has access and work with data collected by other scientists in other laboratories both at home and abroad. Therefore, data base management systems has become an essential part to provide the data / information services to its end users.

Advances in oceanographic / marine sciences and technology depend 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 provide the answers to important questions posed by the scientists, research scholars, etc. The

principal purpose of a national centre is to provide on a continuing basis information / data in a suitable form to the so-called "secondary users community". The data centre ensures that the user gets good quality and accurate data which can generate good information.

2. Source of data

RNODC acquired the oceanographic and marine data pertaining to the Arabian Sea, Bay of Bengal, Laccadive Sea, Andaman & Nicobar Sea and the Indian Ocean. The centre is the nucleus of marine and oceanographic data and information in the country. Today the centre holds oceanographic data for about 50,000 stations and geophysical data for 90,000 nautical miles in the Indian Seas collected during International Indian Ocean Expedition (IIOE, 1960-65), by INS Darshak (1973-74), R.V. Gaveshani (1976-93), ORV Sagar Kanya (1983-96), FORV Sagar Sampada (1985-96). Our country has a vast Exclusive Economic Zone (EEZ) measuring about 2.01 million sq.km. along an extensive coastline of nearly 7517 km. including that of Laccadive and Andaman & Nicobar coasts (Bhargava, 1990). It contributes about 46% of total exploitable living resources from the Indian Seas (Sarupria, 1986). The area of the Indian Ocean is 46.98 million square kilometer with a mean depth as 4284m and volume is 349.6 million cubic kilometer. The EEZ area of India alone is about 66% compared to its landmass and 2.4% compared to the Indian Ocean (Sarupria, 1986).

Besides Indian sources, this centre is getting & exchanging data from various international data collecting agencies. This exchange of data / information is under the International Oceanographic Data / Information Exchange System (IODE) of IOC / UNESCO. It consists of 50 National Oceanographic Data Centres (NODCs), 15 Responsible National Oceanographic Data Centres (RNODCs) and three World Data Centres, i.e. WDC-A (Washington, USA); WDC-B (Moscow, Russia); WDC-D (China). World Data

Centres are holding the global oceanographic data (Sarupria, 1989)

3. Organisation of marine and oceanographic data / information

In general, marine and oceanographic data can be classified into three major categories for the management purpose (Bhargava, 1990). These categories are as follows :

3.1 Station data(Ship/Fixed platform)

Physical, Meteorological, Chemical, Biological, Geological and Pollution data sets.

3.2 Time series data(Mooring / Fixed platforms)

Physical, Meteorological and Biological data sets.

3.3 Satellite remote sensing data.

Meteorological, Physical and Biological data sets.

The above three categories of marine data are further classified into three different levels for management purpose. These levels are :

1. Inventory level
2. Documentation level
3. Processed numerical data level.

Further level can be created as temporary levels from the above three levels by merging the two levels of data.

4. Data bases :

The following data bases have been created using this system (Fig. 1):

A. Station data base :

1. Station and parameter inventories
2. Hydrographic data (T,S)
3. Bathythermograph data (T)

4. Surface meteorological data (SST, wind, weather)
5. Chemical data (O₂, NO₂, NO₃, PO₄, pH, SiO₃ etc.)
6. Trace metal data
7. Oil pollution data

B. Time series data base :

1. Time series inventory
2. Wave data (height, direction)
3. Current data (speed, direction)
4. Hydrographic data (T,S)

C. Underway data base :

1. Navigational fixes inventory
2. Bathymetry data
3. Magnetics data
4. Gravity data

5. Retrieval system :

Apart from systematic management of data, the centre is also responsible for supplying marine and oceanographic data / information to users as per their requirements. A command level program in SQL is written to handle the user's request from the integrated inventory level data base. Also, a user friendly module is developed having menu-driven programmes. This module retrieves the data on the following criteria or their combination :

- i. Area in terms of latitude and longitude.
- ii. Year, season, month, day and night time selection.
- iii. Depth range selection.
- iv. Station/platform/particular ship cruise selection.
- v. Subjectwise or parameterwise selection etc.

Depending upon the number of specification and their combination, request is considered either as one-level (simple) or multi-level (complex) request (Sarupria, 1994). The main menu for the inventory level

data selection will appear. After the selection of the required data criteria, it retrieves the required data from the data base and create a text file in the users area which can be copied through FTP commands on the user's computer system through LAN and WAN for further processing the selected data sets. The above selected data can be further processed, for the presentation of data in the form of graph, 2-D/3-D pictures, plotting the data coverage maps, preparation of catalogues and data summaries etc.

6. Quality control for data

A three level procedure has been developed for checking the quality of temperature data. The criteria used in the procedure are temperature distribution, watermass property and a standard temperature climatology profile derived from historical data. In each level the quality flags are assigned for the inversion station, abnormal intra-cruise variability and climatologically abnormal stations. This procedure has enabled to verify the quality of temperature data (Ghosh, 1992).

7. Conclusion

The present system with indexing key is the best solution for the management of large oceanographic and marine data bases. The microcomputer-based oceanographic station inventory information system if linked with the UNIX based work-station then it becomes a more suitable tool for storage, maintenance and conditional retrieval of oceanographic inventory level and data level information. As Data Centre receives a number of inquiries regarding availability of data. Thus the system is useful to perform such tasks. RNODC-INDO is also planning to keep the inventory level information for the Indian Ocean on home page of NIO, for World-Wide-Web users.

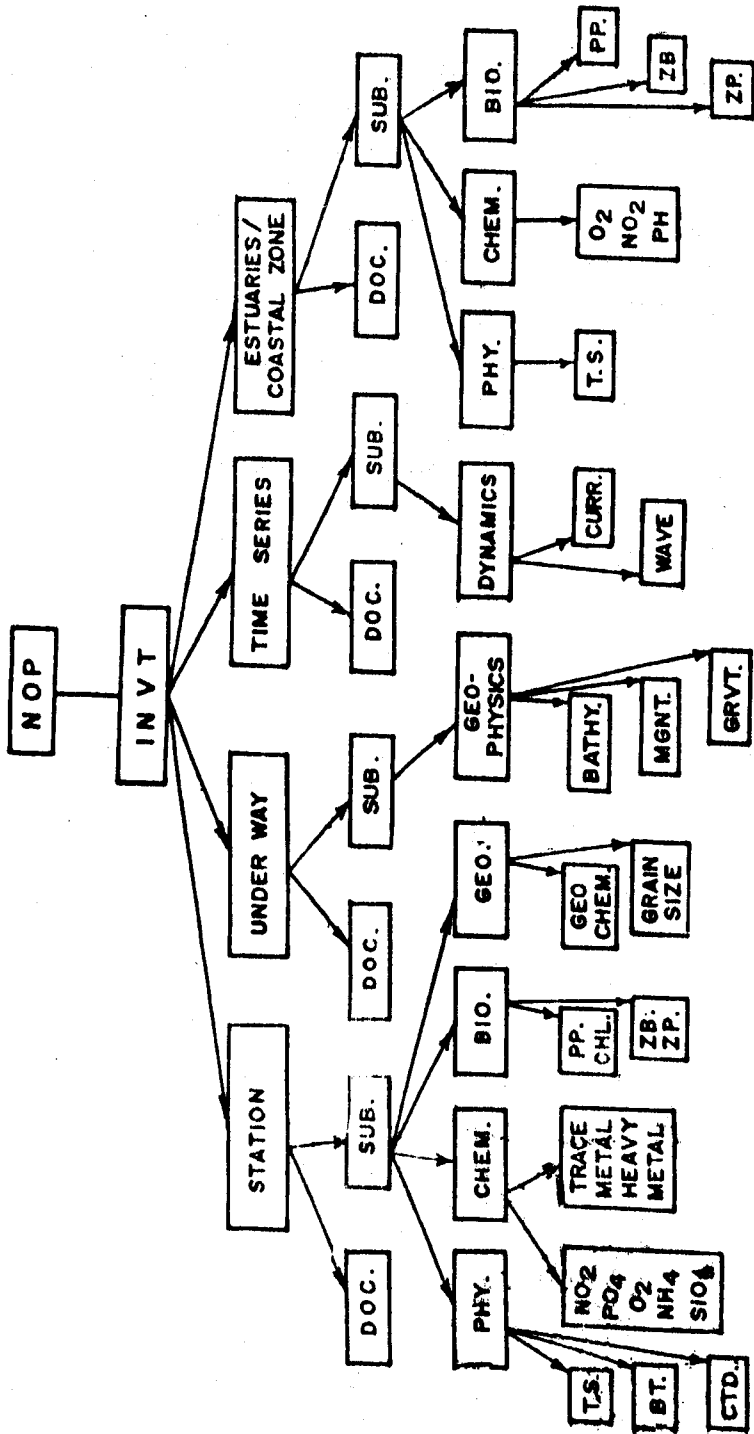
8. Acknowledgment

I express my gratitude to Dr. E. Desa, Director, NIO for his whole hearted

encouragement and providing the required facilities. My sincere thanks are due to Shri R.M.S. Bhargava, Emeritus Scientist and Dr. C.S. Murty, Head, Data and Information Division for suggestions and useful comments. I also thank all my colleagues of Data Division for their help.

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NOP - National Oceanographic Program
 INVT - Inventory
 PHY - Physical Data
 CHEM - Chemical
 BIO - Biological
 GEO - Geological
 DOC - Documentation
 ZB - Zoobenthos
 ZP - Zooplankton
 PP - Primary Productivity
 BT - Bathythermograph

Fig. 1 Structure of INODC Data bank overview