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The availability of reliable, up-to-date, accessible data and information is an essential basis for integrated coastal area management (ICAM), and sustainable management of coastal and marine resources. Large amounts of data are collected daily from diverse sources such as equipment installed on the shore, moored and drifting buoys, research ships and merchant ships, aircraft, and satellites. The users and uses of these data are also varied and include industries, fishermen, coastal communities, academics, researchers and resource managers. Though the primary user of the data may have no further need for the data after utilizing it for the purpose it was collected, they are often valuable to subsequent users. Data is always unique even if only in the timing of collection, and is therefore irreplaceable. Proper management and archiving of the data is essential to provide access to subsequent users. It enables new studies to compare data with baseline information of the past and integrate data sets from different sources. This facilitates multidisciplinary studies and better knowledge and understanding of the marine environment.

The Intergovernmental Oceanographic Commission of UNESCO established the International Oceanographic Data and Information Exchange (IODE) in 1961 to address the requirements for data and information, and in particular: to enhance marine research, exploitation and development. This would be achieved by facilitating the exchange of oceanographic data and information between participating Member States and by meeting the needs of users for data and information products. The IODE system consists of a network of Designated National Agencies (DNAs), and National Oceanographic Data and Information Centres (NODCs).

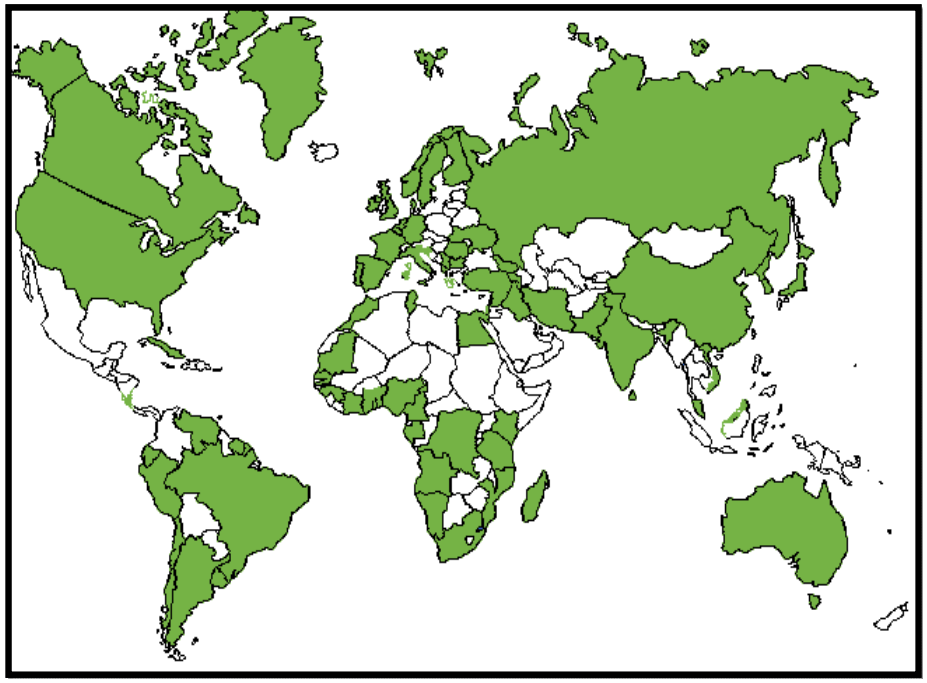

Figure 1. The IODE Network of National Oceanographic Data Centres.

IODE collaborates closely with the International Council for Science's system of World Data Centres that include the four dealing with marine data: Silver Spring, USA, Bremen, Germany, Obinsk, Russian Federation, and Tianjin, China.

The IODE committee structure comprises regional Ocean Data and Information Networks (for Africa, Caribbean and South America, Central Indian Ocean, Western Pacific, Black Sea, and European Countries in Economic Transition), and groups of experts dealing with specific topics such as Biological and Chemical data (GE-BICH), Marine Information Management, and Expert Team on Data Management Practices (ETDMP). IODE also implements special projects that are managed by Steering Groups. These include OceanTeacher, OceanDataPortal, MarineXML, and the Marine Environmental Data Information referral catalogue (MEDI).

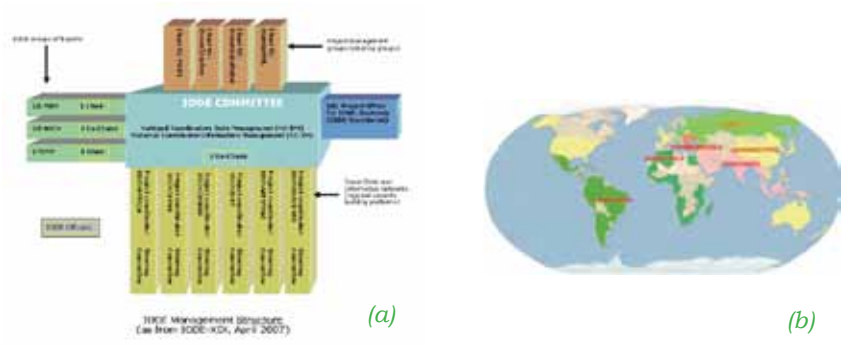

Figure 2. (a) IODE Management Structure (as from IODE-XIX, April 2007), and (b) IODE Regional Ocean Data and Information Networks.

Marine Data Sources for Africa

Most African countries gained independence between the late 1950s and mid 1960s. After independence the countries started building local capacities in all frontiers including coastal and marine sciences. However, it was in the mid 1980s when the results of these efforts with respect to coastal and marine sciences started to be of real benefit to the countries. Because of the existence of some local capacity there was a rapid increase of local marine and coastal research initiatives and projects. These generated large amounts of data and information. The coastal African states started to experience another burden of how to make efficient use of the data and information being generated by the ongoing as well as completed projects. It was realized that capacity available for ocean data and information management was insufficient in most of the African states and this needed to be addressed urgently. This includes the capacity for collection, analysis and distribution of data and information. African states through their various meetings of regional bodies, such as the Pan African Conference on Sustainable Coastal Management – PACSICOM (18 – 25 July 1998, Maputo, Mozambique), the IOC Regional Committees the Western Indian Ocean (IOCWIO), and the Central and Eastern Atlantic (IOCEA) requested assistance. In response the IOC of UNESCO, in collaboration with marine related institutions from African member states, developed a proposal for the Ocean Data and Information Network for Africa (ODINAFRICA).

Training of staff of NODCs

The initial focus of ODINAFRICA was on enabling member states from Africa to get access to data available in other data centres, develop skills for manipulation and processing of data, and develop infrastructure for archiving, analysis and dissemination of the data and products. Training was provided on data and information management. The aim was for the data centres to prepare databases, and data and information products for integrated management of the coastal environments and resources. These would enable the Member States to address the key issues such as: (i) coastal erosion, (ii) management of key ecosystems and habitats, (iii) pollution, (iv) sustainable use of living resources, and (v) tourism.

Figure 3. Experts from ODINAFRICA institutions at a data management training course at the IODE Project Office, Ostende, Belgium.

Ocean Data View (ODV) was one of the basic training tools for ODINAFRICA data managers and has been incorporated in Ocean Teacher (www.oceanteacher.org) which is the IODE training package. It is a software package for the interactive exploration, analysis and visualization of oceanographic and other geo-referenced profile or sequence data. ODV is supported by, and supports several oceanographic databases such as the World Ocean Database which are regularly updated. The software as well as the several databases are available freely for download from the home page of ODV at the URL: http://odv.awi.de. The databases comprise of a broad range of the basic oceanographic data such as salinity, oxygen, depth, and others. Additionally, the ODV software supports many useful functions such as plotting of oceanographic data. The ODINAFRICA Data Centres built their initial national archives starting with ODV data and have developed many products from these archives. Furthermore, many Data Centres import locally collected data into the ODV system for processing because the system is user friendly.

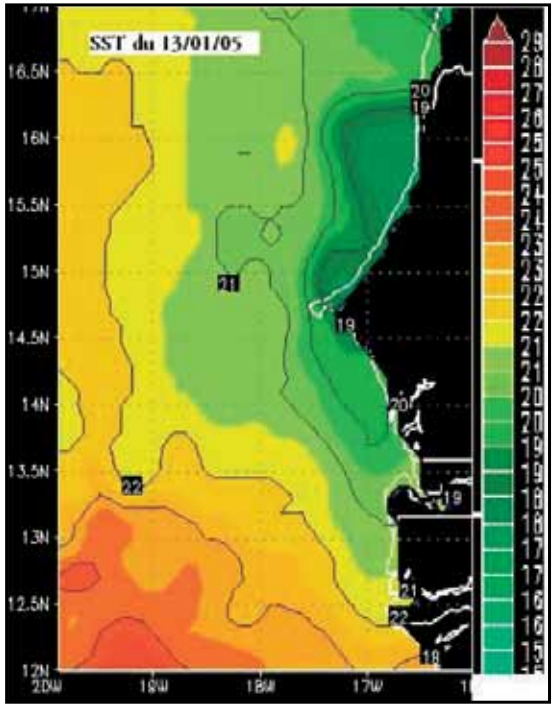

Figure 4. Sea surface temperature of Senegal on 13th January 2005 as plotted from the ODV system (NODC, Senegal).

Data from IODE network of data centres

The growing pool of local coastal and marine scientists needed more types of ocean data than they were able to collect nationally. This includes satellite data and data from global ocean programmes. These data sources were made available through other international centres and programmes.

Within the framework of ODINAFRICA all marine data sources for Africa were explored in order to ensure that African states have access to all useful and relevant available data, and that it is accessible to decision-makers.

ODINAFRICA enabled the newly established data centres in Africa to join the IODE network of data centres. These data centres archive marine data from all over the world. By joining the IODE system ODINAFRICA Data Centres gained access to virtually all available unrestricted data in the network. The IODE identified various data sets that were collected from African oceans and these were repatriated to the respective countries through the national ODINAFRICA Data Centres. These are available on CD/DVD ROMS, as well as in the form of digital atlases. They included geophysical, oceanographic, biological, chemical, as well as satellite and remotely sensed data. Data managers were acquainted with the skills to handle the various data types through the data management training organized by ODINAFRICA. Data repatriation exercise brought a lot of data into ODINAFRICA Data Centres.

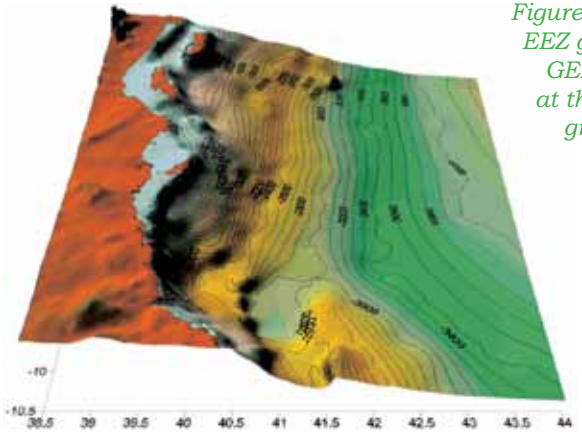

Figure 5. A 3D map of the Tanzania EEZ generated from the Centenary GEBCO Atlas datasets extracted at the Tanzania National Oceanographic Data Centre (TzNODC).

Local research project and programmes

Increased local research capacity brought about an increase in the coastal and marine research projects implemented in most coastal African states. These projects generate a substantial amount of data, which is critical for the development of the respective states. They range from small initiatives within creeks, lagoons and coastal waters, to work undertaken in deeper waters. Resulting data sets are critical because most projects address current issues or concerns. When the projects end, the data sets should be archived at the NODC. Locally collected data come from many different players including the faculty and students from teaching and research institutions, non-governmental organizations, and many others. It is important for the NODC to forge good partnerships and working relations with the local players and stakeholders to ensure that finally these data are archived at the NODC. Data managers were trained on how to positively engage local players on the importance of ocean data management.

Figure 6 (a).

Figure 6 (b).

Figure 6. Sampling for marine micro algae (photos by Ndirangu, Kenya Marine & Fisheries Research Institute).

Regional and International research projects and programmes

Global or regional issues such as climate change, coral reefs degradation and the need to conserve an ecosystem or species such as the fossil fish (Coelacanth) usually trigger International or regional research need to conserve an ecosystem or species such as the fossil fish. Several of these projects are implemented in the African oceans and coastal waters and include the Large Marine Ecosystem projects in the Agulhas, Somali, Benguela, Guinea and Canary current regions, as well as the World Ocean Circulation experiment. These projects generate substantial amounts of data, which should be accessible to local researchers.

Figure 7. Scientist from Madagascar prepares sampling bottles for launch from a research vessel.

It is critical for the Data Centre to be recognized locally to be able to engage international and regional projects on data management issues. Several ODINAFRICA Data Centres are actively involved in regional and international research projects in which they archive all data collected. An example is the Tanzania National Oceanographic Data Centre (TzNODC) which is involved in the efforts to conserve the coelacanth in Tanzania and in the region. The TzNODC is actively collaborating with the African Coelacanth Ecosystem Programme (ACEP) in the conservation efforts of the fossil fish in Tanzania. All data collected in Tanzanian waters and coastal environments have been archived at the TzNODC. Through this collaboration the TzNODC has received hundreds of gigabytes of data. Another example is the collaboration and participation of the NODCs in the Western Indian Ocean (WIO) region in the UNEP project on "Addressing Land Based Sources of Marine pollution (WIO Lab). All data collected within the framework of the WIO Lab project are archived at the NODC in the respective country.

On the other hand, some of ODINAFRICA Data Centres (e.g. those in Benin, Madagascar, Nigeria and Tanzania) in collaboration with respective local institutions and authorities are now accessing data collected in their respective ocean waters by Ships of Opportunity.

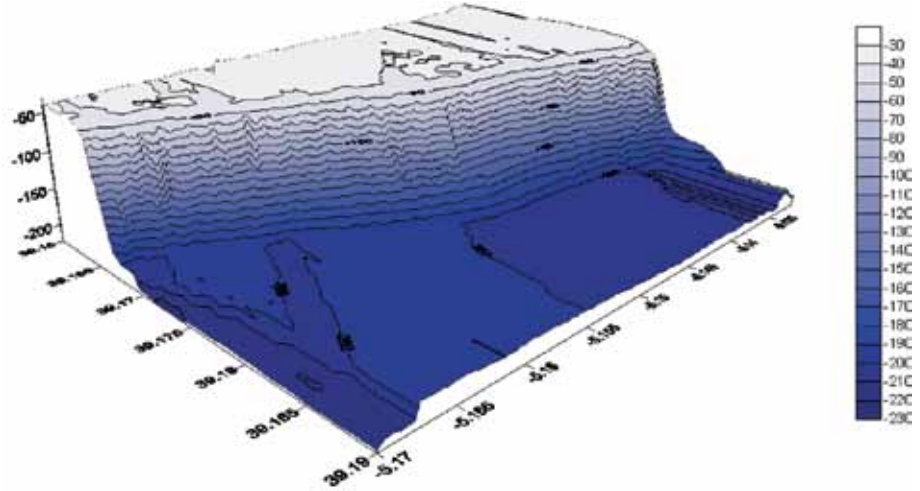

Figure 8. Three dimensional bathymetric map of Mwarongo, Tanga (Tanzania) as mapped by ACEP in collaboration with the TzNODC and other local institutions.

Accessing the data

The ODINAFRICA data centres have prepared catalogues of data sets in their collection, and others that are in possession of institutions in the respective countries. These catalogues have been incorporated in the Marine Environmental Data Inventory (MEDI), a global inventory of information about marine related datasets developed within the framework of the IOC's International Oceanographic Data and Information Exchange (IODE) system. The MEDI directory has been developed to provide a reference point for locating marine and coastal datasets and will be populated with metadata descriptions of marine datasets from IOC member states. The African component of MEDI comprises metadata descriptions of the data available in ODINAFRICA countries. MEDI Africa database is updated regularly and can be accessed at http://ioc.unesco.org/medi/.

Figure 9. The MEDI home page.

The data centres established within the framework of ODINAFRICA have developed websites through which they advertise their services and products. The information on available data sets and how to retrieve them can also be accessed through these websites. The URLs for the national websites are of the format www.nodc-countryname.org (e.g. www.nodc-kenya.org).

Figure 10. The homepage for the Kenya National Oceanographic Data and Information Centre – KeNODC (www.nodc-kenya.org).

The ODINAFRICA website (www.odinafrica.org) and the websites for key products also provide access to a wide range of data and information. These include:

- The African Marine Atlas (www.africanmarineatlas.net)
- The African Register of Marine Species
- The African Sea level Network (www.iode.org/glossafrica)

FUTURE FOCUS OF ODINAFRICA

Availability of coastal and ocean data and information has and continues to be a major constraint to sustainable development in coastal and marine areas in Africa. Although ODINAFRICA has significantly improved access to data and information, the data from many regional and global marine related projects and programmes that have been implemented in Africa over the years, remain virtually inaccessible to marine scientists and resource managers. This is due to the combined effect of several factors, including: complex data use agreements, reluctance to share data without financial compensation, scattered data repositories in various institutions, the fact that many datasets are not digitized, and the wide variety of data formats and metadata formats that are prevalent. In some cases, projects and programmes that generated valuable data sets did not have a good institutional home, leading to data being lost once programmes cease to be funded.

The next phase of ODINAFRICA will address this by collaborating with other projects to develop data products and to ensure that the data and products are widely accessible to users. In particular the focus will be on:

- Expanding and strengthening the network of marine scientists and institutions in the region to foster the sharing of data and information. Whereas previous phases mainly involved the institution hosting the National Oceanographic Data Centres and Marine Institution Libraries, the next phase will require a multi-sectoral approach that involves other stakeholders.
- Developing high quality products and tools to support decision making, management and conservation of the marine and coastal environment. This includes atlases, forecasts, predictions, models, and scenario development. The following priority areas will be addressed: shoreline changes, marine related hazards and disasters, management of key ecosystems, and sustainable use of resources. The African Marine Atlas will be further developed, and higher resolution national marine atlases created.
- Promoting the use of data, as well as products and services developed by the project, to all stakeholders. Improved mechanisms will be developed for the dissemination and application of data, information and products. This includes standards based catalogues of data and metadata, and integrated web based portals connected to the IODE Ocean Data Portal.