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An Indian Ocean Observing Strategy

“A Partnership of Agencies and Institutions supporting sustained observations in the Indian Ocean region.”

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Introduction: This paper makes a case for the establishment of an Indian Ocean climate and ocean observing system under the umbrella of the Global Ocean Observing System (GOOS). It begins by identifying the importance of the Indian Ocean and the difficulties, which must be overcome to establish cooperation in the region. Other GOOS regional organizations are identified to provide models for organization and this is followed by a suggestion of one appropriate for the Indian Ocean. Finally, background on the Intergovernmental Oceanographic Commission's (IOC) involvement in Indian Ocean marine science development is given to point out the region's historical association with the IOC and to provide tangible building blocks for further development. The paper will hopefully serve as a catalyst for development without dictating the final preferences of the region or the approach it might decide.

I. Importance of Observing the Indian Ocean

The ocean is of central importance to the life system of the earth. It influences almost every facet of economic and social development and its effect on weather and climate variability has been known for some time. Our ability to forecast weather and effectively exploit marine resources is dependent upon regional co-operation of meteorological and oceanographic institutions. They must provide the scientific and modelling foundation of the observing system. The routine provision of high-quality observations occupies a special place in this process. At the local level the monitoring of marine pollution and the understanding of coastal processes are needed for the protection and management of life, property and ecosystems.

By its very nature, ocean circulation does not recognize any geopolitical boundaries. Climate impacts and pollution, which originate from one area are carried throughout the region by the prevailing winds and currents. This leads to the growing recognition that it is impossible, politically, logistically and in terms of cost, for any one nation to gather all the information it needs for national prosperity and development. On the other hand, a nation would be negligent to ignore the ocean beyond their own waters since proper management and environmental sustainability will always be subject to forces beyond national jurisdiction. It is therefore imperative for nations to seek appropriate regional cooperation in order to ensure that the information they require is gathered and accessible. Hence a regional grouping of countries should establish the

necessary infrastructure and human resources to meet the growing demand for marine data and services from a wide spectrum of users in an efficient and cost-effective fashion. This regional approach reflects a global trend, to share obligations and co-sponsor sophisticated equipment, capacity building and product delivery.

Another important new development is the recognition that the forecasting of weather in particular requires the transmission of critical regional information between adjacent countries in real-time. Thus, it is not only accepted that cooperation is needed but also that it must be virtually instantaneous, reflecting the speed of the phenomena that the data are used to track and forecast.

The Indian Ocean is the third largest ocean in the world, has an average depth of 3890 meters and an area of 68,556,000 square kilometers. It is unique in some ways. It spans 5500 km between Africa and Indonesia at the equator, about half the distance across the Pacific. In the South it opens wide facing Antarctica. It has no connection to the northern polar seas, unlike the Atlantic and Pacific Oceans. These physical characteristics give it unique dynamical qualities. Also, it is the source of most of the weather at intra-seasonal time scales, and modes of inter-annual variability have recently been discovered. All of the time-scales of variability seem to influence the lives and well being of a large fraction of the world's population. The ocean floor is dominated by the Mid-Indian Ocean Ridge and is subdivided by the Southeast Indian Ocean Ridge, Southwest Indian Ocean Ridge, and Ninetyeast Ridge. The Wharton Basin in the east exceeds 6000 meters in depth.

The climate is dominated by the northeast monsoon (December to April), and the southwest monsoon (June to October). Tropical cyclones occur during May/June and October/November in the northern Indian Ocean and during January/February in the southern Indian Ocean. The response to the monsoons is also unique. The ocean surface is dominated by a counter clockwise gyre in the southern Indian Ocean while a unique reversal of surface currents in the northern Indian Ocean is generated by the monsoons. In addition, decadal variation of the Indian Ocean is associated with rain anomalies in Australia and Africa, while the Antarctic circumpolar wave affects the climate of southern Africa and Australia at the southern boundary of the Indian Ocean.

The Indian Ocean is important from an economic perspective. It provides major sea routes connecting the Middle East, Africa, and East Asia with Europe and the Americas. It carries sea traffic associated with petroleum exploration and petroleum products from the oilfields of the Persian Gulf and Indonesia. An estimated 40% of the world's offshore oil production comes from the Indian Ocean. Large reserves of hydrocarbons are being tapped in the offshore areas of Saudi Arabia, Iran, India, and western Australia. Its living marine resources are of great and growing importance to the bordering countries for domestic consumption and export. Fishing fleets from Russia, Japan, South Korea, and Taiwan also operate in the Indian Ocean, mainly for shrimp and tuna. Beach sands rich in heavy minerals and offshore placer deposits are actively exploited by bordering countries, particularly India, South Africa, Indonesia, Sri Lanka, and Thailand. Tourism is a substantial industry around the margins. All of this economic activity is subject to the tsunamis, monsoons, floods, droughts and cyclones that frequent the region, which are influenced or caused by the ocean and the weather and climate generated by it.

The importance of understanding, monitoring and predicting variations in the Indian Ocean is underscored by the human, environmental and economic factors cited above. Aside from these factors, which are all coastal or open ocean, the ocean's influence on climate is also felt in the hinterland, for example in the supply of fresh water, the productivity of agriculture, and the demand for energy.

Historically, knowledge of the Indian Ocean has been limited relative to the Pacific and Atlantic. Sustained observing and monitoring combined with modelling and analysis will produce marine data and services that people need for decision-making (eg. where to route ships; what crops to plant). Application of the data and provision of information and services to governments and the public will result in improved management, quality of life, and improved access to the resources contained within the Indian Ocean.

II. Regional Issues

Regional Problems

Regional marine science cooperation in the Indian Ocean has been in general difficult to initiate and sustain. There are a number of reasons for this. Many of the countries of the region must struggle to feed their people and provide basic infrastructure. The extra funds required to study and monitor their coastal seas and the adjacent oceans are a lower priority. Another obstacle is the general reluctance to allow others access to information concerning their marine environment. Strategic considerations and national security are often given precedence. Some agencies claim an economic disadvantage will result from making national data available to outsiders. Often too, within individual countries different agencies tend to have different objectives, and priorities and mechanisms are missing that would allow the undertaking of cooperative activities. Also, within the region some individuals believe that there are only a small number of scientific problems to be solved in the ocean and question why scientists from the big countries should be allowed to make all the discoveries and write all the PhD theses. There are historical conflicts and jealousies that have created an environment of distrust. This has resulted in much rhetoric on cooperation at various meetings but little real cooperation.

Under the umbrella of the IOC the countries of the region have established two regional committees for the purpose of organizing themselves in IOC affairs. These are IOCINDIO (central) and IOCINCWIO (north and central western). The regional committees provide a useful mechanism for the region with respect to representation at IOC executive body meetings for purposes of voting and decisions on budget allocations. As mechanisms for cooperation in marine science activities and GOOS they have not been effective largely in part for the reasons cited above. Also, in many of the countries there are no mechanisms in place for sharing what is learned at regional committee meetings or workshops. The result is that the information is used by only a limited few, which dilutes the potential benefit.

Regional Success

The most successful attempts at conducting regional Indian Ocean marine scientific research have been when multi-national efforts were planned with active and full participation of academic institutions from both within and outside the region. The first example is the International Indian Ocean Expedition, which was conducted during 1959-1965. It involved more than forty research vessels belonging to thirteen countries. Data was collected in all marine science disciplines except for fisheries and marine microbiology. Hundreds of papers were printed along with a set of atlases. National and world data centers were established, computers were used for data logging and new oceanographic instruments were introduced. The IIOE was coordinated by the IOC and included most of the Indian Ocean countries.

The Joint Global Ocean Flux Study (JGOFS) involved Arabian Sea cruises by six countries including Germany, India, Netherlands, Pakistan, UK and USA during 1992-1997. Its operational goal is to assess more accurately, and understand better the processes controlling, regional to global and seasonal to interannual fluxes of carbon between the atmosphere, surface ocean and ocean interior, and their sensitivity to climate changes.

Perhaps the most sustained and comprehensive effort to study and understand the ocean circulation and physical parameters of the region was the World Ocean Circulation Experiment (WOCE). WOCE is a part of the World Climate Research Programme (WCRP) sponsored by IOC, WMO and ICSU. It has used resources from nearly 30 countries to make unprecedented in-situ and satellite observations of the global ocean between 1990 and 1998 and to observe poorly-understood but important physical processes. The Analysis Interpretation Modelling and Synthesis (AIMS) phase will end in 2002.

One might therefore conclude that a successful observing program for the Indian Ocean would include a strong synergy between IOC initiatives for GOOS and the gradual and incremental build-up of sustained observations by international research programs such as CLIVAR.

Other Regions' Approaches to Organizing GOOS

The development of GOOS regionally has varied depending on the interests of the countries/agencies involved, consideration of funding opportunities, pre-existing organizational structures and various geo-political criteria. EuroGOOS is the most advanced of GOOS regional organizations. It is structured on the basis of "agencies" cooperating as opposed to "countries". Sub-regions of EuroGOOS have developed their own pilot projects and observing activities under the umbrella of EuroGOOS, such as the Mediterranean Forecasting Project, and the Baltic Ocean Observing System, while adhering to GOOS principles and guidelines. EuroGOOS has benefited from having an economically viable membership.

NEAR-GOOS (North East Asia Regional GOOS) was formed to facilitate the exchange of data between Japan, the Republic of Korea, the Russian Federation and China, especially in the Sea of Japan. The countries participating are motivated by a common interest in understanding and acquiring data on the physical parameters of the area for practical applications associated with shipping, fishing, etc. Academic institutions are involved along with government agencies. Japan funds a sizeable research programme directed to improving GOOS activities in the region, largely seawards of Japan. The NEAR-GOOS region may expand in this direction.

PacificGOOS is an example of an organization based on cooperation amongst existing regional organizations in the Pacific, coupled with organizations/agencies from outside the region having an interest in the region. This organization is fairly new with a history of two workshops to build capacity within the region and to identify pilot projects. There are other regional GOOS activities in various stages of development throughout the world as mentioned above. There is no consensus of opinion or historical record to suggest what type of organization might work best for a particular region. Purposely, very few constraints have been placed on how regions organize themselves to participate in GOOS. Nevertheless some basic rules have been devised by the GOOS Steering Committee, and a regional policy is expected to be announced by the Intergovernmental Committee for GOOS in 2001.

Duplication of organizations such as EuroGOOS and NEAR-GOOS would be difficult in the Indian Ocean since the region does not contain countries with the economic capacity to fully sustain a regional observing program. Countries instead will have to contribute in whatever way they can and depend on international research and development programs and support from agencies such as the Global Environmental Fund and World Bank.

III. Indian Ocean GOOS Proposal

Introduction

The following proposal identifies an organization for developing an observing system(s) for the Indian Ocean using a basin scale approach involving contributors and participants with common interests. The servicing of the system could be expensive and the costs will be minimized if the system can be operated locally. Agencies and institutions participating in the system will require sufficient basic infrastructure to contribute meaningfully. It does not have to be complex. Data management and communication systems will be required along with laboratories for analysis and modelling. These could be regional as opposed to national. Participating institutions and agencies should have a capacity to provide training and assistance to those requiring it. This assistance would be made available to neighboring countries with the goal of elevating their capacity to participate in GOOS.

Indian Ocean GOOS (IOGOOS)

The most unique aspect of IOGOOS (which will be used until the organization selects a name) is that it will be open to members from both inside and outside the region. Thus, there will be “Regional” members and “Global” members. There will also be “Government” members and “Nongovernmental” members. For practical purposes all participants will be referred to as “Members”. The members may include representatives from national agencies, academic institutions, data centers, scientific institutions, intergovernmental committees and user groups. The common denominator will be an interest and ability to contribute to Indian Ocean monitoring, assessment, modelling, product development and use.

It is envisioned that a core group of interested potential members will begin discussing the general guidelines for IOGOOS development in early 2001. The meeting will be hosted by one of the institutions in the region, and will work to an agenda reflecting the issues identified through prior canvassing. This meeting will examine the proposal contained herein and decide how it wishes to proceed. The process will likely take a few years and can occur in parallel with incremental development of an Indian Ocean observation system by national and international projects. Nothing will be decided until the group meets and decides its own future. This proposal is merely a suggestion for how an organization might function in the region. Global members sponsoring GOOS activities and committees should be invited to participate on an equal basis.

The IOGOOS goal will be to coordinate the various elements of an observing system for the whole Indian ocean, and to develop and implement pilot projects that may be basin scale or more regional in scope. Some of these projects will have sponsorship by UN agencies such as IOC, WMO, FAO, UNEP and others. The planning of the projects would normally occur within scientific and technical committees established for this purpose by the Indian Ocean body in cooperation with other bodies as appropriate eg. the global science project committees such as CLIVAR, WOCE, GLOBEC, HAB, OOPC etc. Personnel from potential IOGOOS institutions are often members of such committees. In any case a relationship with such projects will be of mutual benefit to all.

The IOGOOS design should reflect the interests of its individual members but be focused to serve the common good. It should not be a mechanism used by entities outside the region seeking entry to the region by token involvement of regional scientists. IOGOOS should develop projects that are of interest to research and/or pre-operational services in countries from within the region. All the projects should reflect the principles associated with GOOS and have regional and global application. These may or may not be related to UN sponsored projects and some may be more coastal or practical than others. By linking into GOOS they will benefit from the experience of other regional GOOS organizations and, also, acquire access to the data and products available in the GOOS system. Regional members may want to organize projects that are solely regional in nature, for example the Mediterranean Forecasting Project within EuroGOOS. The membership of such sub-regional groups will be appropriate to the task.

Sector Responsibility Approach

It is envisioned that certain IOGOOS institutions will take ownership of various sectors of observing systems. For example the National Institute of Oceanography in Goa may decide to maintain an observing system in the Bay of Bengal on behalf of IOGOOS. If this occurs it should reflect the interests of an individual institution's mandate and charter. The infrastructure of the institution should be sufficiently developed to enable it to provide the support required for sustained measurements and observations. In taking on sector responsibility the institution assumes a responsibility to the other participants in providing them the data and in cooperating with them to the maximum extent. A lead institution could be located outside the Indian Ocean.

The sector approach should enhance the ability of an IOGOOS institution to call on other institutions in the sector to join in the project. The institution should seek to enlist the support of navies, fishing fleets, merchant vessels, various users of products, weather bureaus, and other scientists involved and interested in using ocean data. This local connection should result in cost-savings in the deployment and servicing of instruments and buoys, calibration of equipment, data management and distribution, communications and so on.

By managing a sector an IOGOOS institution may be better suited to apply the data and information to their region. Having responsibility for the sector and being located in the sector will enable them to tailor the design to meet local needs. This approach may also facilitate increased local support and funding for the activity as it becomes more relevant to the needs of the local area. National agencies will be better able to justify their contribution to the project by showing how it meets their own objectives and needs. In taking responsibility for a sector the IOGOOS institution becomes responsible to the other participants in IOGOOS and also to the global GOOS community.

As IOGOOS develops it will solicit support for projects from outside donors. It first must present a serious planning effort and interest in delivering data, information and services so as to attract donor support.

Project Selection

Projects will be selected after full review by all IOGOOS members and formally designated as IOGOOS projects or activities. The decision can be made through a meeting or email but it must reflect a consensus. All IOGOOS projects will have to provide regional benefit. There may be a case where an individual institution undertakes an activity that meets all GOOS criteria yet the institution does not want it to be part of IOGOOS. In such a case it might still be designated as part of GOOS.

Although it will be useful to develop projects in full concert with IOGOOS, this will not be mandatory. Occasionally projects will be developed elsewhere and may be transported into the region. This will be acceptable if deemed by IOGOOS as being beneficial to the region and is eventually approved and endorsed by IOGOOS. For example, a European country could independently develop a moored ocean array and seek IOGOOS endorsement. The region would benefit from its access to the data.

Projects will meet all the criteria required by GOOS as determined by policies established by GOOS executive bodies.

Projects may address coastal or ocean GOOS and GOOS capacity building requirements. Particularly in the area of capacity building, projects may be conducted within one country but may have long-term benefit for the entire region. Maximum effort should be made to provide access for the widest group of participants in such activities. This point should be demonstrated to the IOGOOS membership when seeking IOGOOS designation for a project.

Project management and execution is at the discretion of the initiators but should be as open as possible to other interested parties.

Funding

The members will be required to provide the funding needed to sustain IOGOOS projects. For that reason, it will be desirable to engage entities that already have or can help with the funding required. A successful initiation of activities might result in additional supplemental resources from funding agencies chartered to assist in areas of climate change, disaster mitigation, environmental stewardship, etc.

Most Indian Ocean research institutes derive their funding from national agencies. In some cases certain national agencies may have responsibility for carrying out certain types of ocean monitoring, observing and data management. These are sometimes related to military, meteorological services, sea-rescue, fisheries management or other activities. It would therefore be highly beneficial for these institutions and agencies to be part of the IOGOOS founding members.

There will be no financial obligation to maintain a secretariat or staff to manage the organization. Members will fund their own costs of attending meetings and contribute in-kind to support meetings. The organization will operate through a rotating secretariat supported by a host agency. Rotation will occur when the members decide it is appropriate and when a new host agency volunteers the support required. Most communications will be by email.

Membership

The organization will address all aspects of GOOS and membership would therefore include institutes and agencies from both inside and outside the region having a shared interest in participating in sustained ocean and coastal observing of the Indian Ocean. Essentially the price of membership is some real contribution to the system. It could be in any area of the end-to-end system, from instrument deployment to product development. Countries and agencies are free to contribute or withhold any observations they chose; however, withheld observations would not be considered part of IOGOOS or GOOS as per IOC and WMO data policies.

A unique aspect of IOGOOS is that it will invite and include as members of the organization, the chair or representative of the major science planning committees

involved in the Indian Ocean. These would include WOCE, OOPC, CLIVAR, GLOBEC, WCRP, GCRMN, and others. The important factor is that these committees cooperate and support GOOS, and the science community operating under these committees has been the most successful in planning sustained observations in the Indian Ocean over its history. Their inclusion would allow for optimum planning and execution of expanded and continued activities in the region.

Each institution or committee will designate one official contact, who will be responsible for coordinating IOGOOS activities. Countries with more than one interested institution are encouraged to establish a national coordinating mechanism for IOGOOS following the guidelines on the IOC's GOOS web page. At some time in the future the organization may decide a different approach is needed for organization management.

National Sovereignty

There is no aspect of IOGOOS that minimizes or exempts any member from requirements stated in the Convention on the Law of the Sea. All rights and protections afforded by the Convention are maintained by all members and all obligations imposed by the Convention must be adhered to. IOGOOS activities must conform with the Convention on the Law of the Sea and, when necessary, be approved by national governments.

Decisions

Decisions will be by consensus.

Chairperson

A chairperson will be designated to serve a term of three years. He will preside over organizational meetings and most technical meetings. Technical meetings of IOGOOS may designate a meeting chairperson in special cases based on prior consultations with the chairperson. In the event the chairperson cannot attend a meeting a new chairperson will be determined for only that meeting by consensus of all the members. If a chairperson resigns for whatever reason a new chairperson will be determined by consensus of all the members.

Potential Members

- Mauritius Oceanography Institute,
- Zanzibar Marine Institute,
- Kenya Marine Fisheries Service (Mombassa),
- Institute for Meteorological Training and Research (Nairobi)
- Madagascar Oceanographic Inst. (Nosy Be and Toliara),

- University of Cape Town Oceanography Dept,
- Oceanographic Research Institute (Durban),
- National Institute of Oceanography (Goa),
- Department of Ocean Development (New Delhi),
- CSIRO Marine Research (Hobart),
- Bureau of Meteorology (Melbourne),
- Intergovernmental Committees (WOCE, CLIVAR, GLOBEC, etc.)
- Etc.

Conclusion

Organizational development of an Indian Ocean observing system should be driven by the science and operational requirements. We are at the early stage of developing an organization because the needs for the Indian Ocean are still being defined. A "bottom up" approach is considered to have higher potential for generating cooperation in the Indian Ocean region. It is recommended that early in 2001, as the process of observing system planning continues, that various fora include sessions on organizational development. The IOC Perth Regional Programme Office is prepared to assist in this process, which should include all the potential members identified in the above section.

IV. IOC's Involvement

The IOC was created in 1960 to help nations cooperate in understanding the oceans and forecasting their behaviour. One of its first missions was the now historic International Indian Ocean Expedition, which the IOC facilitated, and which was completed three decades ago. IOC has supported a wide range of projects and activities in the region over the years, for example through the World Ocean Circulation Experiment (WOCE), JGOFS (Joint Global Ocean Flux Study), IODE (International Oceanographic Data and Information Exchange program), ICAM (Integrated Coastal Area Management), GCRMN (Global Coral Reef Monitoring Network), and others. The IOC is informed about the needs of many of the countries surrounding the Indian Ocean for projects or for capacity building through two regional bodies, the IOC regional committee for the Central Indian Ocean (IOCINDIO) and the IOC regional committee for the north and central Western Indian Ocean (IOCINCWIO). These bodies meet about every 4 years.

In recent years the IOC has been working with countries of the Indian Ocean region in the development of the Global Ocean Observing System GOOS, and through that contributing to the Global Climate Observing System (GCOS) of which GOOS forms the ocean component. In 1997, a GOOS Capacity Building workshop was convened in Goa, India with the objective of explaining how GOOS operates and to identify potential pilot projects. Although the workshop was well attended and several project ideas were tabled, direct follow-up was lacking. Nevertheless, IOC has been working with WMO and other partners to develop a proposal for a storm surge warning system

for the Bay of Bengal, which is a contribution to coastal GOOS. In addition, IOC and WMO hosted the first implementation-planning meeting for the Western Indian Ocean Marine Applications Project (WIOMAP) in Mauritius in May 1997. WIOMAP is a GOOS pilot project, and a proposal to fund it has now been finalised (see details below). More recently in March 2000, at the IOCINDIO meeting in Teheran GOOS was discussed and plans were made to develop capacity building in the region. As yet there has been no follow-up GOOS activity apart from continued development of the storm surge proposal. The project calls for instrumentation and monitoring of the Bay of Bengal to provide storm surge warnings to the local populations with potential application to GOOS. World Bank support is being sought and IOC is attempting to support the initiative.

The Western Indian Ocean Marine Applications Project (WIOMAP) will contribute to enhanced food security, the sustainable development of marine resources, the protection of the marine environment, and better long term planning and management of the impacts of climate change and climate variability (e.g. sea level rise, tropical cyclone intensity, etc). This will be achieved through improved weather, climate and marine resource predictions, based on the provision of additional monitoring, analysis and prediction efforts directed at the tropical western Indian Ocean and its monsoon circulation system. The project will act to strengthen marine meteorological and oceanographic activities of relevant institutions in western Indian Ocean countries. WIOMAP includes the establishment of a moored array in the tropics to describe Indian Ocean response to the El Nino – Southern Oscillation (ENSO). A moored array and associated communication technology and ship support activities would complement Japan's TRITON buoys in the eastern Indian Ocean. WIOMAP would ensure that the observations in support of GOOS and GCOS are sustained and utilized in ocean data assimilation and modelling activities and well coordinated through existing application centers located in the western Indian Ocean. The implementing agencies are selected universities, national meteorological services, and oceanographic institutions from: Comoros, Kenya, Madagascar, Mauritius, Mozambique, Reunion, Seychelles, Somalia, South Africa and Tanzania.

The needs of the African coastal countries for integrated coastal area management (ICAM) were addressed by the IOC through the Pan-African Conference on Integrated Coastal Management (PASICOM) at Maputo in July 1998. It identified the need for extensive capacity building, and also for the development of GOOS in support of ICAM. As a consequence the attendees at the meeting agreed to form GOOS-Africa, a committee to stimulate and coordinate GOOS developments continent-wide. They identified four main priorities for the immediate future: (i) building an Africa-wide network of tide gauges and training people to use them; (ii) providing access to and training in the use and application of remotely sensed data from satellites; (iii) building an Africa-wide network of national oceanographic data centres, and training people to work them; and (iv) providing an adequate electronic communications infrastructure, to facilitate data exchange. The last two are being implemented through ODINAFRICA (see below). Proposals for the first two are in preparation.

The IOC sponsors or co-sponsors several other ongoing cooperative activities that contribute to the development of GOOS in the region:

- IOC Global Sea-Level Observing System (GLOSS) -Monitoring sea-level variation and rise. Thirteen GLOSS stations have been established within the framework of the WMO / IOC Tropical Ocean and Global Atmosphere (TOGA) programme of the World Climate Research Programme (WCRP) since 1996.
- WMO/IOC Ship Of Opportunity Programme (SOOP) – Monitoring of the upper ocean temperature along specified routes at pre-determined sampling intervals. A few lines as recommended by the World Ocean Circulation Experiment (WOCE) are being implemented with participation of countries in the WIO.
- WMO/IOC Data Buoy Cooperation Panel (DBCP) – This panel coordinates the deployments of drifting buoys collecting surface ocean and marine meteorological data. Its Indian Ocean action group is the International Buoy Programme for the Indian Ocean (IBPIO), which held its first meeting in La Reunion in September 1996.
- WMO Voluntary Observing Ship Network - Collects marine meteorological data from commercial ships along trade routes.
- IOC Regional Co-operation in Scientific Information Exchange in the Western Indian Ocean (RECOSCIX) – Assistance from the Belgian and Flanders governments to establish a marine scientific information exchange network in the WIO region with a Regional Despatch Centre (RDC) in Mombassa as its central node.
- IOC Oceanographic Data and Information Network in East Africa (ODINEA) – To encourage the use of standard methods for data collection and storage in the region and develop capacity for the preparation of data products for scientists and policy-makers. The initial thrust is to establish National Oceanographic Data Centres (NODC). ODINEA is now part of an Africa-wide initiative-ODINAFRICA.
- Global Oceanographic Data and Archaeology and Rescue (GODAR) Project - IOC'S International Oceanographic Data and Information Exchange (IODE) Programme has taken steps to help the countries of the region rescue marine data trapped in various archives. A GODAR meeting was held in Goa in December 1994.

In addition, some national activities provide in situ information about the Indian Ocean. Mention has been made above of Japan's TRITON buoys. Also, India has emplaced some met-ocean buoys in the equatorial region and is prepared to make the meteorological data from them generally available. The ocean is over-flown by satellites from several countries, including India, and the ocean data from many of these are available.

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