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# The Global Ocean Observing System— One Perspective

**J.R. Wilson**

This document presents a possible organization for a Global Ocean Observing System (GOOS) within the Intergovernmental Oceanographic Commission and the joint ocean programs with the World Meteorological Organization. The document and the organization presented here is not intended to be definitive, complete or the best possible organization for such an observation program. It is presented at this time to demonstrate three points.

- The first point to be made is that an international program office for GOOS along the lines of the WOCE and TOGA IPOs is essential.
- The second point is that national programs will have to continue to collect data at the scale of WOCE plus TOGA and more.
- The third point is that there are many existing groups and committees within the IOC and joint IOC/WMO ocean programs that can contribute essential experience to and form part of the basis of a global ocean observing system.

It is particularly important to learn from what has worked and what has not worked in the past if a successful ocean observing system is to result.

This rationalization is submitted to express one person's opinion as to how some of the IOC and joint IOC/WMO ocean service programs might be restructured to better and more efficiently meet the needs of the next decade or so. This rationalization is also intended to provide a more effective development and management environment for the data service programs.

Figure 1 shows the possible organization from a functional point of view. The boxes are referred to below as entities and represent functionality rather than details of organization. They are not intended to necessarily represent IOC or IOC/WMO committees although some of them might best be implemented in that manner.

## **Research Programs Development Entity**

This entity represents the international science programs such as WOCE and TOGA operating essentially as they operate now. The experiments will change with time, but there will be a requirement for this function continuing on into the indefinite future. The function is to organize and operate the international research programs that are needed to develop understanding of the global processes important to climate and global change.

In examining the goals and results of WOCE and TOGA it is always possible to point a finger and say that this or that did not work properly. In terms of final scientific results the jury will be out for some years to come. However both these programs have set an enviable standard for the development and delivery of global research.

TOGA and WOCE have;

- recruited scientific expertise on a global scale and with this expertise have set the program goals, and designed the necessary experiments and supporting data collection networks.
- systematically developed the required data management plans and recruited the scientific organizations and data centres to implement the data flows.
- with the support of scientists in participating countries persuaded national agencies to support global ocean data collection, global ocean research, and global ocean modelling at an unprecedented level.

In short TOGA and WOCE have delivered total global research programs and in doing so have provided a model for very serious consideration in developing a global ocean observing system.

### **GOOS Program Development Entity**

This represents a new entity responsible for the development of international programs to coordinate the implementation of global and regional descriptive and predictive systems based on the knowledge gained from the research programs. Descriptive systems will describe existing and past conditions based on data and models. Predictive systems will describe future conditions based on models simulating ocean processes and assumptions about inputs including anthropogenic activities. This allows the assessment and prediction of change.

This particular function will require a level of research and applied scientific participation equivalent to WOCE and TOGA. The application of scientific knowledge to describe, compare with an earlier situation, to predict into the future based on assumed scenarios, and to maintain an efficient data collection network that measures where needed, is a highly scientific and technical undertaking.

Data and data management have been described from time to time as the heart of a global ocean observing system. If one were to extend the analogy, then this function is the brain of an ocean observing system. It will have to recruit and draw on a base of international research and applied science expertise in the manner that WOCE and TOGA have drawn on their communities. As a research program achieves its results and begins to wind down, its scientists would ensure the conversion of the appropriate portions of the program to an operational or monitoring phase by participation in the work of this entity.

Other functions of this entity would be to continually monitor the performance of the descriptive and predictive systems to ensure they are producing the necessary quality of results, to conduct reviews of the data collection networks to ensure that they are designed to produce the critical measurements and are neither over or under designed. There would be a requirement to work through national contacts to convince countries of the necessity of supporting additional data collection for the global ocean observing system by clearly demonstrating the needs and that the proposed networks were optimized. There would also be a requirement to assess and implement new technologies to better monitor the ocean and at lower cost. The amount of data collection would have to support present and future research programs plus the ocean observing system. Thus the scale of data collection would exceed WOCE plus TOGA present collection requirements. There would of course be a large overlap in data needs between these programs themselves and between the programs and GOOS.

In terms of the size, diversity, and method of working it seems that an equivalent of a WOCE or TOGA IPO working through ad-hoc committees as does WOCE and TOGA is indicated for a global ocean observing system. The entity would interact with the research programs entity to implement observational programs. It would develop requirements and directions for the four entities below on networks, data management, delivery of services, and joint tariff agreements.

There are now three groups involved in aspects of program development related to GOOS. The GLOSS Committee, the IGOSS Group of Experts on Scientific Matters, and the present GOOS Committee are developing elements of the global ocean observing system.

### **Data Collection Networks Entity**

This box represents a service entity that works to implement and manage through international cooperation, the data collection networks necessary to collect the variety of data required by international science and observational programs, ensure the data meet the necessary standards, and that the coverage is adequate. Within the IOC/WMO programs we now have the IGOSS SOOP and DBCP groups doing this function for BATHY/TESAC and drifting buoy data collection programs. SOOP and DBCP are successful. They get their jobs done. They also have contacts and experience that must not be lost to a global ocean observing system. The entity would have to be broadened beyond SOOP and DBCP to deal with a wider range of data types as ocean data collection programs using other sensors were defined. It might also have some responsibilities for instrument testing and certification.

This entity would basically be programmed by the scientific and observational program entities described above who would define the data collection networks. This entity would liaise and cooperate with the data management and communi-

cations entity described below to define the data delivery mechanisms to the data management function.

### **Data Management and Communications Entity**

This box represents a service entity that is not new. It is based on a combination of the IGOSS and IODE committees to handle the real time to delayed mode to historical data exchange/distribution/archival through the existing NODC-RNODC-SOC-WDC structures augmented where appropriate by other centres such as the science portion of the WOCE Data Assembly Centres. The distinction between real time and delayed mode data management systems would gradually disappear. The entity would have additional responsibilities for moving archiving, disseminating satellite data and model data; and for establishing and maintaining an oceans communications network for exchange of various kinds of ocean data not appropriate to the GTS.

Can IGOSS and IODE respond to the development of a global ocean observing system? It seems that it has been demonstrated that they can. Through GTSP and the work of some NODCs and RNODCs IGOSS and IODE have responded to WOCE and TOGA and data is flowing in time frames consistent with data management plans. In the case of IODE there is a need to address more urgently the time frames in which delayed mode data flow through the system. This is being done and in another year it should be apparent whether IODE can deliver. However for the present one has to recognize that these systems have responded.

Some present functions of the two communities could perhaps be moved elsewhere. For example the responsibilities of the IGOSS Group of Experts on Scientific Matters would fit into the international GOOS program development entity. The responsibilities of IGOSS and IODE for delivery of data services to clients, in particular developing countries, could be moved to the scientific data and information services entity proposed below. This new entity might also take on the marine information management responsibilities of the IODE committee.

### **Scientific Data Products and Information Services Entity**

This box represents a new entity to the system. This is suggested as a separate function from the data management function to give it a higher profile and allow the entity to concentrate on delivery of data products and information to clients at all levels from researchers in developed countries to those in developing countries and at time scales from real time to historical. Although both IGOSS and IODE have agenda items at their meetings related to delivery of products and services, this aspect is not well developed. This is due to the fact that the data management problems themselves are complex and demanding and by the time that facet of the business has been dealt with there is generally not much energy or time left for products. On the other hand the Marine Information Management (MIM) group in

IODE tends to concentrate on delivery of information as opposed to data management and is successful in that area. Based on these considerations it seems reasonable to suggest that an entity that is responsible for delivery of data products and information as opposed to data acquisition and management could improve the situation.

### **Joint Tariff Agreements Entity**

This box represents a service entity that is also not quite new. It would be based on the present ARGOS Joint Tariff group but would have additional responsibilities for procuring agreements for the ocean satellites of the 1990s. It could also be responsible for negotiating agreements with common carriers for communications services to meet the needs for an ocean network. This entity is seen as necessary because of the inefficiencies and difficulties now encountered in negotiating with ESA for ERS-1 data on an individual basis. For example WOCE is still uncertain how access to ERS-1 data will be arranged and what it will cost. This is likely to become even more complicated as more satellites with ocean sensors are launched.

In terms of performance, the ARGOS JTA has been successful. It has resulted in reduced costs for users to the ARGOS system, and has benefited ARGOS by reducing the number of groups with which it has to negotiate.

### **Linkages**

The black arrows in figure 1 represent linkages. In the case of the vertical arrows between the research and observational program entities, the linkages are for coordination, advice, and consultation in moving the results of the international experiments from the research to the applications phase. Also some operational and monitoring programs will support further research so that there is a two way flow of support between these entities.

The horizontal arrows represent the flow of requirements from the developmental aspects of the global research and global ocean observing system elements to the data services entities. In the reverse direction the arrows represent the flow of data services, data flow and data monitoring information, and advice from the data services entities back to the developmental entities.

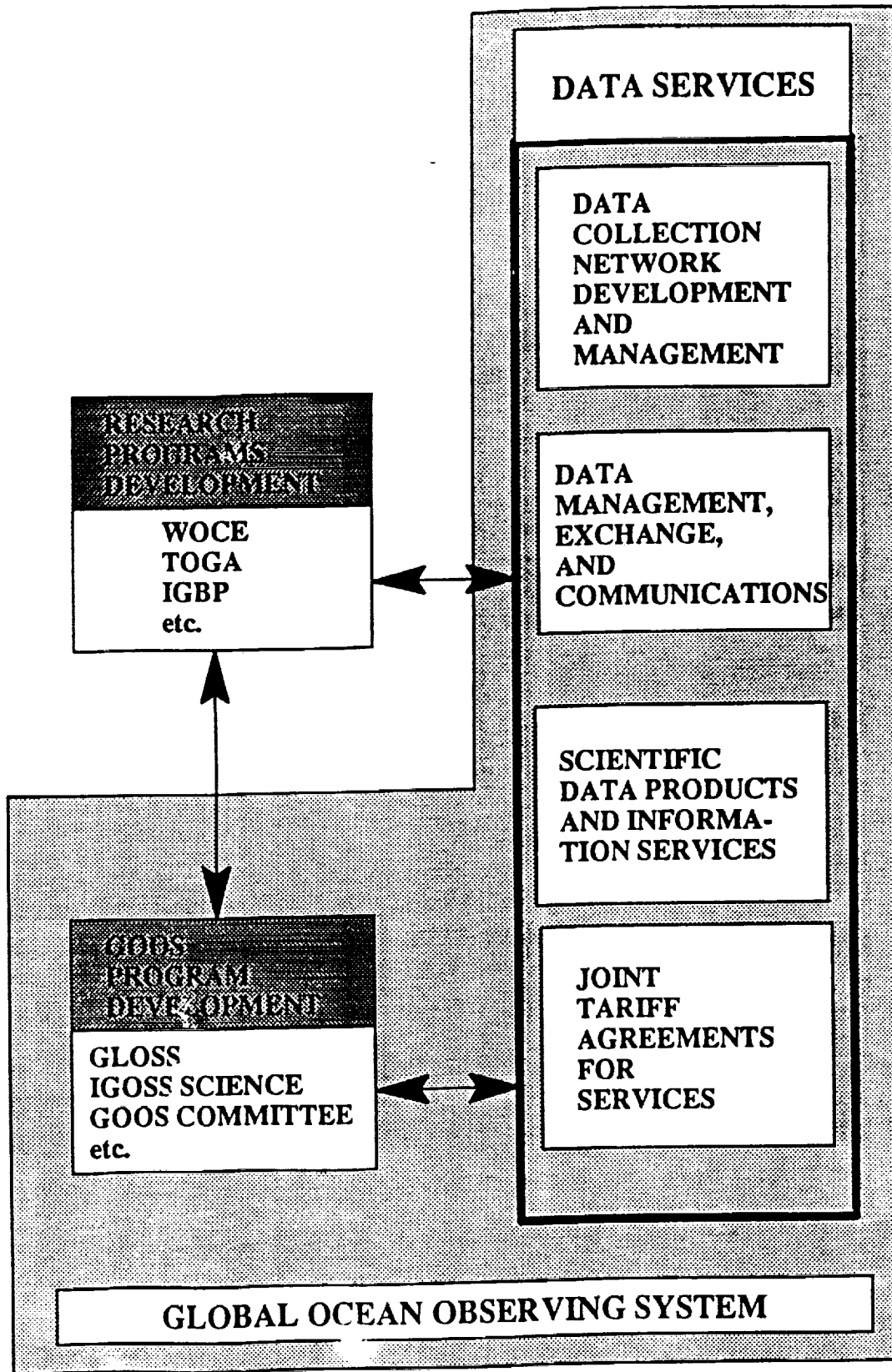


Figure 1. One concept for a rationalization of IOC and Joint IOC/WMO ocean programs in the context of the GOOS.