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LIST OF CONTENTS

Page

EXECUTIVE SUMMARY ..... (ii)

1. THE DEFINITION OF GOOS
1.1 Rationale 1
1.2 The concept of GOOS 1
1.3 The sponsorship and resourcing of GOOS 1
1.4 The Vision, Mission, Goals and Objectives of GOOS 2
1.5 The development of GOOS 2
1.6 The mechanisms for GOOS planning and implementation 3

2. ASSESSMENT OF NEEDS
2.1 A focus on user need 4
2.2 Science as the critical link in GOOS 5
2.3 Estimating the value of GOOS 5

3. THE DESIGN OF GOOS
3.1 Introduction 6
3.2 Approach to the scientific design 6

4. IMPLEMENTATION AND INTEGRATION
4.1 Implementation planning 8
4.2 The GOOS implementation phases 8
4.3 The pace of GOOS implementation 9
4.4 An integration approach to building GOOS 9
4.5 The globalization of GOOS 10
4.6 System compatibility and standards 10
4.7 The role of the GPO in implementation 11

5. GOOS PRODUCTS
5.1 Introduction 11
5.2 Dialogue 11
5.3 Product selection methodology 11
5.4 The GOOS label 11

Page

6. DATA AND INFORMATION MANAGEMENT
6.1 A data and information management system 11
6.2 Existing international data systems 12
6.3 Data and Products distribution 13
6.4 Data policy 13

7. REGIONAL DEVELOPMENT
7.1 Regional integration and common interest 13
7.2 Alignment with GOOS principles 13
7.3 Regional organisation 13

8. TRAINING AND CAPACITY BUILDING
8.1 Introduction 13
8.2 Planning for capacity building through TEMA 14

9. TECHNOLOGY DEVELOPMENT
9.1 Introduction 14
9.2 Numerical models 14
9.3 *In situ* observations 14
9.4 Space-based observations 14

10. RESOURCES
10.1 Introduction 15
10.2 Seeking national commitments 15
10.3 International organisations in support of GOOS 15
10.4 Industrial support 16
10.5 Support from navies 16

11. ENSURING EFFECTIVE COORDINATION
11.1 GOOS sponsoring agencies 16
11.2 External communication 16

ANNEXES

Annex 1: The GOOS Principles explained

Annex 2: List of Acronyms

EXECUTIVE SUMMARY

The Global Ocean Observing System (GOOS) is an ambitious undertaking by the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the World Meteorological Organisation (WMO), and the United Nations Environment Programme (UNEP), together with scientific guidance from the International Council of Scientific Unions (ICSU). It is created as the prime world focus for:

* coordinated, cooperative interaction between nations to create a true 'globally interlinked' system for the gathering, archiving and distribution of all useful kinds of marine and oceanic data on an ongoing (and to all intents, 'permanent') basis;

* the invention and implementation of technology for acquiring and handling these data, and for generating 'products' using these data that can be applied for the benefit of mankind and the safe use and preservation of the marine and oceanic environment; and

* the building of technical and educational capacity in less-developed and smaller countries, to enable them to acquire and use marine and oceanic data and products for their own particular needs.

This Strategic Plan describes the principal elements that will define GOOS. It identifies actions needed and how these might be implemented now and in the near future. For these purposes it outlines: the Vision, Mission, Objectives and Goals of GOOS; the 'Principles' that underlie the design and define the nature of involvement; the defined 'Phases' of planning and implementation; and the roles of the various planning and implementation bodies and the participants at national level.

Behind the rationale for GOOS is the conviction that the benefits of a planned and coordinated system that delivers useable information, understanding and prediction of the marine environment and of its effect on climate will outweigh the costs of its operation by a large factor. GOOS implementation priorities will be set by focussing on what data and data products the 'users' of the world seas and oceans most need to perform their function effectively and responsibly, and on the needs of 'users' on land who are or may be impacted by the ocean or by its effect on climate change. Science is promoted through GOOS as a critical link, being the vehicle by which value is added to data, and as a 'user'.

The prime body overseeing the planning and implementing of GOOS is the jointly-sponsored GOOS Steering Committee (GSC). For convenience GOOS has been divided into five 'Modules', planned by Panels of scientific and technical experts which report to the GSC. Panels are also created as needed to deal with cross-cutting and implementational aspects of GOOS, such as data and information management and capacity-building. Since other global systems for climate and terrestrial observing are also under development, and because of the central importance of space-based observation, many of the GOOS panels are jointly sponsored by or linked with these systems and with the Committee on Earth Observation Satellites (CEOS).

The representation of national interest and the endorsement of GOOS actions on behalf of the member nations by the intergovernmental sponsors (IOC, WMO and UNEP), is conducted through the Intergovernmental Committee for GOOS (I-GOOS).

Administration of GOOS is provided by the GOOS Project Office. Its Director ensures the execution of the decisions of GSC and I-GOOS, and is also the primary external spokesperson for GOOS.

The implementation of GOOS will depend almost entirely upon the cooperative participation of national marine observing and research agencies, industries and non-government organisations. To support this participation and to ensure the resources needed for its success, governments need to become well-informed about GOOS and committed to the concept. For this commitment to be made, GOOS must build upon already functioning systems and elements and must be able, without delay, to demonstrate tangible benefits over these individual efforts.

Already several regional alliances for coordinated marine observation, data sharing and product development have been created with the GOOS concept in mind, and this form may prove to be the most effective means for rapid GOOS implementation. The present GOOS Plan strongly encourages this approach. Nevertheless, for full benefit to be realised, the universal application of GOOS Principles in areas of common relevance such as data standards and exchange is an important goal. In due course, greater coordination of global observing systems under an Integrated Global Observing Strategy appears likely.

Among other things this Plan discusses: GOOS products, GOOS data and information management, regional development, training and capacity building, technology development, the resourcing of GOOS and external interaction and information-sharing.

Some headway has already been made in the planning of GOOS, and implementation has begun. It is in the nature of an undertaking of such complexity, which involves many players and the diverse interests of many countries, that changes will be inevitable as GOOS is implemented. This present Strategic Plan charts a course for the immediate future, and will be regularly updated as implementation proceeds.

1. THE DEFINITION OF GOOS

1.1 RATIONALE

The world ocean plays a major role in a large number of processes occurring at the surface of the earth. It influences the human environment and in turn is impacted by human pressure. However, despite more than a century of detailed scientific study, there exists as yet no internationally coordinated system to observe the ocean continuously and systematically on a global scale, to define the common elements of regional marine environmental problems or to provide data and products on which collective national response can be built, and on which the traditional and new marine-related industries can be advanced responsibly and cost-effectively.

Recognizing these needs the United Nations Conference on Environment and Development (UNCED) called in 1992 for the creation of a global system of ocean observations to enable effective and sustainable management and development of seas and oceans, and prediction of future change. The establishment of such a system was also urged by the Second World Climate Conference in 1990 to provide the oceanographic data needed by the Global Climate Observing System (GCOS). The Global Ocean Observing System (GOOS), formally initiated by the IOC Executive Council in 1992 in cooperation with WMO, UNEP and ICSU, is intended to meet this need. Among other things, access to such a system will enable us to answer one of the fundamental questions of the Intergovernmental Panel for Climate Change (IPCC), namely: what is the precise nature of the ocean's role in controlling climate change?

Inaction on environmental problems has a multiplicative effect, and the ongoing cost of unchecked marine degradation and change is likely to exceed the cost of implementing GOOS by several orders. Public awareness of global environmental decline, development in the technology of low cost observing systems, advances in numerical modelling, including biological processes, and rapid progress in the electronic communication of information are elements contributing to make GOOS feasible now. GOOS is therefore envisaged as an important investment in the future of the planet. What is needed to implement it is political will.

Apart from the "common good" benefits of GOOS, many commercial and industrial activities can gain advantage from access to more comprehensive and reliable "operational" data and information on the marine and coastal environment. The active involvement and support by such non-government interests would both widen the scope of GOOS and strengthen its funding base.

1.2 THE CONCEPT OF GOOS

GOOS is conceived as a new, internationally organised system for the gathering, coordination, quality control and distribution of many types of marine and oceanographic data and derived products of common worldwide importance and utility, as defined by the requirements of the broadest possible spectrum of user groups.

GOOS is envisioned to resemble the global meteorological observation and prediction network, supported by national governments and implemented through the contributions of national agencies, organisations and industries, with the assistance of national and international data management and distribution bodies.

GOOS is an ambitious undertaking which will include diverse marine observations many of which have not been systematically or routinely assembled before. Nevertheless, maximum use will be made of existing systems and organisations, and encouragement will be given for these to modify and enhance their activity to include observations and products contributing to a coordinated GOOS plan.

As with meteorology, the initial impetus for ocean observations has come from operational requirements to meet customer demands, for instance to improve nowcasts and forecasts of ocean conditions, including the information needed to improve weather forecasts. In meteorology however, with the exception of the growing field of atmospheric chemistry, the range of variables requiring observation is smaller, they are generally easier to obtain, and the benefits arising from better description and prediction are more clearly self-evident to the world at large. Most of atmospheric science has developed in response to an already recognised need. In ocean science the needs are not completely articulated and the capacity of an observing system to assist in meeting them is less well developed. Over the last decade scientific technologies such as computing have become capable of combining marine data with numerical models to describe the complexities of the marine environment. The opportunity now exists to provide to users ocean data and products that are as beneficial as those provided by the meteorological networks.

1.3 THE SPONSORSHIP AND RESOURCING OF GOOS

There are many facets to the sponsoring and resourcing of an enterprise as ambitious as GOOS.

Support for planning and international coordination required for the design and implementation of GOOS is apportioned between the GOOS sponsoring organisations, IOC, WMO, ICSU and UNEP; it is supplemented through them by financial, manpower and in-kind contributions from nations with an interest in its success.

The implementation of GOOS will be very largely dependent upon the commitments made by the participating nations to support the observational systems through their national observing agencies, and by providing infrastructural elements such as data centres and distribution networks, scientific and technical research, development and installation. Much of the implementation will be accomplished using regional alliances, but a global approach will be needed to address the ocean's role in the climate system.

Training and the facilitation of participation by less-developed countries will be a responsibility shared between nations and the sponsors.

Diverse forms of sponsorship will be encouraged to achieve the greatest and most effective participation. Active efforts will be made to recruit the interest and support of non-government corporate sponsors which may benefit from the existence of GOOS, including, among others, selected maritime industries, agribusiness, the World Bank, and the insurance industry.

1.4 THE VISION, MISSION, GOALS AND OBJECTIVES OF GOOS

The Vision: A world where the information needed by governments, industry, science and the general public to deal with marine related issues, including the effects of the ocean upon climate, is supported by a unified global network to systematically acquire, integrate and distribute oceanic observations, and to generate analyses, forecasts and other useful products.

The Mission: To use long-term, multi-disciplinary, operational oceanographic monitoring of seas and oceans as the basis for (i) enabling the use of ocean data in creating and disseminating reliable assessments and predictions of the present and future state of these environments in support of their health and sustainable use and (ii) contributing to prediction of climate change and variability, for the benefit of a wide range of users. This will (iii) guide the directions of scientific and technical research, development and training in the various disciplines of oceanography, that will in turn facilitate the development and management of the system.

The Goals:

(i) To serve the marine data and information needs of humanity for the efficient, safe, rational and responsible use and protection of the marine environment, and for climate prediction and coastal management, especially in matters requiring information beyond that which individual national observation systems can efficiently provide, and which enable smaller and less-developed nations to participate and gain benefit;

(ii) To establish an international system to provide the required coordination and sharing of data and products that otherwise would not be possible.

The Objectives:

(i) To specify in terms of space, time, quality and other relevant factors, the marine observational data needed on a continuing basis to meet the common and identifiable requirements of the world community of users of the oceanic environment and ocean knowledge;

(ii) To develop and implement an internationally coordinated strategy for the gathering or acquisition and the archiving of these data and synthesising them for common use and practical application;

(iii) To facilitate the development of uses and products of these data, and encourage and widen their application in the sustainable use and protection of the marine environment;

(iv) To facilitate means by which less developed nations can increase their capacity to contribute, acquire and use marine data;

(v) To coordinate GOOS activities and ensure their integration with other global observation and environmental management strategies.

1.5 THE DEVELOPMENT OF GOOS

The GOOS Principles: Guiding the development of GOOS are two sets of Principles which together determine the essential and distinguishing characteristics of GOOS design, and of participation in GOOS. The intent of these Principles is to ensure that GOOS is from its inception a system built upon a logical and purpose-oriented design which is universally recognised and accepted by the participants. The Principles have been adopted to guide the design and implementation of GOOS. Nothing within them should be interpreted as contravening or conflicting with the rules and regulations of the sponsoring organisations or the individual rights of Member States. An expanded explanation of these Principles is given in Annex 1.

The Design Principles

D1 GOOS is based on a plan designed to meet defined objectives on the basis of user needs.

D2 The design assumes that contributions to GOOS are long-term and systematic.

D3 The design will be reviewed regularly.

D4 The design allows for flexibility of technique.

D5 GOOS is directed towards global problems and/or those ubiquitous problems benefiting from global observing systems.

D6 The design covers the range from data capture to end products and services.

D7 The management, processing and distribution of data will follow a specified data policy.

D8 The design takes into account the existence of systems outside GOOS that can contribute to and/or benefit from GOOS.

D9 The plan takes into account quality assurance procedures.

Modular Concept: As a basis for organisation and for ease of planning, GOOS has initially been defined in terms of five 'Modules' representing categories of perceived user interest:

(i) Climate monitoring, assessment and prediction (the Climate Module);

(ii) Monitoring and assessment of marine living resources (the Living Marine Resources Module);

(iii) Monitoring and prediction of the coastal marine environment (the Coastal Module);

(iv) Assessment and prediction of the health of the ocean (the Health of the Ocean Module); and

(v) Marine meteorological and oceanographic operational services (the Ocean Services Module).

These Modules are necessarily inter-related and intersecting and will share observations, data networks and facilities, as needed, within one integrated system. Further detail of the design is given in sections 3 and 4.

The Principles of Involvement

P1 To GOOS will be compliant with plans developed and agreed on the basis of the above design Principles.

P2 Contributions will be compliant with a defined GOOS data policy

P3 Contributions should reflect an intent for sustained observations.

P4 Standards of quality will apply to GOOS contributions.

P5 Implementation will be effected using existing national and international systems and organisations where appropriate.

P6 Implementation will be incremental and progressive, whilst bearing in mind the long term goals.

P7 Participation in GOOS implies an undertaking to help less-developed countries to participate and benefit.

P8 Participants will have full autonomy in the management of their contributions to GOOS.

P9 Contributing nations and organisations will reserve the right to determine and limit their contributions to GOOS.

P10 Use of the GOOS 'label' implies conformity with the relevant principles of GOOS.

1.6 THE MECHANISMS FOR GOOS PLANNING AND IMPLEMENTATION

Phases: GOOS will be implemented in five overlapping phases:

(i) planning, including design and technical definition;

(ii) operational demonstrations and pilot experiments;

(iii) incorporation of suitable existing observing and related activities and new activities that can be immediately implemented within the GOOS framework;

(iv) gradual operational implementation of the "permanent" or ongoing Global Ocean Observing System;

(v) continued assessment and improvement in individual aspects and in the entire system.

Further detail of implementation is given in section 4.

There are several necessary process and coordinating elements in the planning and implementation of GOOS. These are:

The GOOS Sponsors Forum: The sponsors of GOOS, namely IOC, WMO, UNEP and ICSU, are responsible for defining the interests of their respective agencies dealing with various aspects of ocean observations, agreeing on responsibilities, and allocating resources as appropriate. The GOOS Sponsors Forum serves this purpose.

The Intergovernmental Process: GOOS has been generated as an intergovernmental enterprise. The sanction, cooperation and active involvement of governments is essential for its sponsorship and implementation, using a variety of mechanisms. From the intergovernmental standpoint it is necessary that there be an oversight body which collectively endorses the plans for GOOS and defines the necessary implementation actions for approval by governments. This function is served by the Intergovernmental Committee for GOOS (I-GOOS) which is jointly sponsored by IOC, WMO and UNEP.

The GOOS Steering Committee (GSC): All stages of the development of GOOS require detailed designs and plans. Scientific and technical expertise is needed in their development. The definition of the planning tasks, and their coordination and evaluation also require expert oversight, and there are myriad issues in the implementation of GOOS that will call for expert advice and judgement. Further, the plans and advice must be communicated to I-GOOS for endorsement, and to facilitate their implementation by national governments. A GOOS Steering Committee (GSC), additionally sponsored by ICSU, assumes all advisory functions on the scientific design and implementation of GOOS, on behalf of I-GOOS, in effect being the executive planning arm of GOOS. Technical tasks may be addressed to expert panels or working groups of the GSC, some of which (such as the Ocean Observing Panel for Climate) are sponsored jointly with other observing systems.

The GOOS Project Office (GPO): The administration of GOOS is provided by the GOOS Project Office (GPO). Its activities include ensuring effective liaison between I-GOOS the GSC and the sponsoring agencies, supporting panels and working groups, preparing documentation and reports, negotiation of resources, and interaction with national and regional groups and activities. Its Director, responsible to the Chairmen of I-GOOS and the GSC, and to the Sponsors, ensures the execution of the decisions of these committees, and serves as a key external spokesman for GOOS.

Integrated Global Observing Strategy (IGOS): GOOS is building an operational program of observations of all aspects of the ocean environment. It is integrated with the other global observing systems for climate (GCOS) and for the terrestrial environment (GTOS) through joint activities and panels, close cooperation between the GOOS, GCOS, and GTOS Secretariats, and joint guidance from the Sponsors' Group for the Global Observing Systems. This complementarity and collaboration in support of a possible integrated global observing strategy will be maintained and enhanced.

Regional Cooperation : GOOS will be implemented in part through initiatives which may be organised or coordinated regionally. Already there are two such regional groupings, NEAR-GOOS and EuroGOOS. Such initiatives will facilitate the establishment of integrated regional networks, improve data communication and processing capabilities, provide mechanisms for local capacity building and facilitate funding of joint participation to large scale elements of GOOS. Further detail is given in sections 4 and 7.

National Organisations: National groupings responsible for the marine environment need to be established or strengthened in some countries. Agreement between national institutions to share responsibilities in GOOS national efforts must be sought in some countries. It is the responsibility of each nation to find the most appropriate national structure for GOOS participation, and an effective organisational interface with the global system. Further detail appears in sections 4, 7 and 10.

Industry: Industry is and will continue to be involved, for instance in making available platforms for observations, in providing and developing observing technologies, in defining and providing products and services, and, potentially, in releasing data.

2. ASSESSMENT OF NEEDS

2.1 A FOCUS ON USER NEEDS

To support a new undertaking of the scale and complexity of GOOS, a clear focus must be placed on what the 'users of the world ocean' (defined as broadly as possible) need by way of marine information, and priorities must be placed upon the data and the products derived from them in terms of what quantifiable benefits can be delivered to these users. GOOS is intended to provide services and benefits in particular to governments, the commercial sector and the public. Applications will extend to fisheries, climate prediction, public health, safety at sea, coastal defences, recreation and tourism, wildlife conservation, weather forecasting, shipping and port operations, agriculture and the management of energy supplies.

International Conventions And Assessments: One clear need for systematic observations is in support of international and regional conventions and action plans. Governments need data on which to meet their obligations under the conventions. The conferences of the parties, the secretariats , and the subsidiary scientific and technical bodies need information on the state of the environment, resources and processes to which the conventions and

actions plans are directed. Only reliable observations over time can demonstrate if the measures taken under the conventions are effective. To ensure GOOS observations serve to meet the needs of such conventions, GOOS will liaise closely with the relevant global and regional convention bodies in the design of observing systems.

There also will be a continuing ocean data requirement in support of assessments of the state of the marine and coastal environment. Assessments in progress include the next GESAMP State of the Marine Environment report in 2002, a prior assessment of land-based activities affecting the marine environment under the Global Plan of Action, and a Global International Waters Assessment planned by the GEF. GOOS should explore with bodies planning these assessments how their data requirements can be supported through GOOS.

Indicators and indices, such as climate indices, are a form of information increasingly being called for in Agenda 21, by the Commission on Sustainable Development and other fora, to assist decision-makers in identifying problems and trends, measuring progress, and evaluating the effectiveness of management measures. GOOS should contribute to the design of appropriate indicators for the oceans and coastal areas, and should help to provide the regular flow of reliable data from which such indicators and indices can be calculated.

Management As A Key User: In addition to enhancing knowledge and understanding of coastal and oceanic processes and validating and verifying predictive models, coastal and open ocean observations are needed to determine the status of specific coastal and marine areas and resources, to detect changes and trends, to provide early warning of future problems, to provide real-time observations to guide routine and emergency operations, and to evaluate the efficacy of coastal and open ocean management strategies and policies.

Management converts information derived from ocean and coastal observations, into actions. Managers of coastal and marine resources (fish, oil and gas), areas (protected areas), and activities (shipping, waste disposal etc) should be seen as key users of GOOS products and services. Their requirements should be addressed in the design and implementation of GOOS. Both public and private sector management institutions at all levels may also be a source of funds for some GOOS products and services.

2.2 SCIENCE AS THE CRITICAL LINK IN GOOS

Science is the critical link that converts ocean observations into useful information. Science must therefore be treated as a key member of the 'user community' of GOOS. Science also plays a key role in the design of the system and the development of products from it. Fundamental scientific knowledge about our planet will undoubtedly emerge from GOOS observations, but this by itself is not a major justification for GOOS.

To develop operational ocean science effectively, it is vital to gain the respect and willing participation of the basic research community in designing GOOS and developing the roots of its products. GOOS also provides a challenge and an opportunity for graduate students. Their participation can be encouraged through scholarship and training incentives.

2.3 ESTIMATING THE VALUE OF GOOS

The benefits of GOOS occur in different economic and social forms: improved commercial cash profits; reduction of commercial risk and uncertainty, improved management of the environment; reduction in pollution; early warning of developing environmental problems; the assessment of the effectiveness of ameliorative action; public good benefits such as improved health and reduction of natural hazards, and long term benefits such as climate prediction and protection of biodiversity. The economic characteristics of these benefits are not immediately comparable, and some are very difficult to quantify on any scale.

International estimates by IOC, OECD, and EuroGOOS, suggest that the turnover of marine-based industries and services are of the order of 3-5% of GNP in most coastal countries. If it is assumed that these industries and services benefit from GOOS to the extent of 1-2% of their revenue, then the benefit is calculated to be of the order of US$10 bn per year, for the marine sector alone. To this should be added the intangible benefits from environmental protection and amenity, and the terrestrial benefits to agriculture and energy management, as well as the potentially enormous benefit from the reliable prediction of climate variability and climate change.

The El Niño event of 1982-83 is reported to have caused US$13bn worldwide in damages and 2000 deaths. Improvements in El Niño forecasts based on ocean data for US agriculture alone are estimated to be between US$240-323M/yr as reported at a NOAA-IOC Workshop in 1996.

Better estimates of the yield from GOOS are needed at many scales, and should be derived carefully, using standardised methodology, and consistent assumptions.

So far, most estimates of the benefits from GOOS have been focussed on developed technological countries. It is important that this exercise is repeated for a sample of developing countries, to ensure that GOOS is designed to provide the data types and products which they need.

In regions where countries must necessarily collaborate in GOOS, for example, inland seas such as the Mediterranean, or large archipelago regions such as South East Asia and the Caribbean, collective economic and political decisions will need to be taken, based on a common assessment of benefits from GOOS. Regional assessments will provide greater attention to details and geographical differences than is possible on the global scale.

At the national level, some governments and agencies are already carrying out assessments of the demand for operational forecasts and data products. Each industry and service sector has different requirements for specialised data products, and it is important to study at least a representative sample of user groups to find exactly what they need. The results of these studies can be extended by analogy to similar industries, or to other countries with similar environments and economic conditions. Convergence or standardisation of techniques in these studies would make it easier to replicate studies and aggregate national studies into regional and global contexts.

3. THE DESIGN OF GOOS

3.1 INTRODUCTION

GOOS is an evolving, permanent system whose design must be flexible, expandable and adaptable to changing needs, changing technologies and implementation constraints. The design must also be comprehensible and logical at both a technical and non-technical level, and efficient in the use of resources. The scientific design of products and their incorporation into implementation is vital.

GOOS will not be planned and implemented as a single system, but in many separate parts as plans develop, resources are found and technology becomes available. At present, for convenience at the design stage, GOOS is structured by Modules defined according to a broad sectoral need. In practice however, GOOS will be implemented largely as separate observational or functional 'elements' of separate technical type, discipline or mode of implementation, some of which will contribute to more than one Module. Some elements such as data management and space-based observations will 'cross-cut' all Modules. In due course, as GOOS is implemented, the different elements of GOOS will become integrated and the initial modules will lose their emphasis.

3.2 APPROACH TO THE SCIENTIFIC DESIGN

The GSC carries overall responsibility for ensuring that all Modules and elements of GOOS are considered and planned scientifically, in ensuring that the system draws successfully upon existing ocean observational systems and on best available knowledge and technology, that it is technically feasible and efficient, that it is capable of supporting products derived from the observational data and that these products can be applied to the needs and demands of national users and beneficiaries of marine information.

The GSC will ensure that implementation plans for specific modules and components of GOOS are prepared and issued as completed or updated. An overall implementation plan will emerge and be updated regularly. The GOOS 1998 document will contain an initial recipe for the implementation of some elements of GOOS. The GSC also will consider any other scientific issue of GOOS planning or implementation referred to it by associated bodies and kindred observing and data management systems.

In its initial planning stage the scientific and technical design of GOOS is being based for convenience on four primary 'Modules' representing the scientific and technical requirements of definable subsets of users, and a fifth module which is concerned with the development of products and services. Despite this emphasis in the planning phase, it is accepted that the modules overlap one another in terms of observational elements. As GOOS becomes operational it will lose this sectoral appearance and work as an integrated system. Its facilities, observations, networks and products will be shared by all classes of users. Implementation will focus on the stream of data and products tailored to user's needs not necessarily grouped by module. It is accepted that planning for some modules will necessarily advance more rapidly than others, resulting in some parts of the system being implemented before others.

Planning will be carried out largely through Module or specialist Panels and Groups or by individuals with appropriate scientific expertise.

Module Panels are the first scientific planning step. Each Panel will consider an end-to-end process in which the requirements of end-users of marine information generate a demand for services and products to meet these needs. The products in turn define the marine observations and the time-scales and systems necessary for their delivery. The Panels will specify in scientific terms these needs, products and observations as a basis for the Implementation Plan and define tasks requiring further scientific consideration. Panels may also need to consider the design of Pilot or Demonstration Projects that can be used to test the feasibility of systems and the generation of products or to facilitate the recruitment of support for GOOS.

Having addressed and reported on these components, Module panels will be reconvened only occasionally for re-examination of needs. Specialist panels or working groups may also be set up to address specific tasks, taking into consideration the aspects of commonality or complementarity between Modules or elements.

Specialist panels such as the Joint Data and Information Panel and the Global Observing Systems Space Panel have already been established to address specific aspects of GOOS development. Further panels will be established as the need arises. Their responsibilities will be broadly to:

(i) develop detailed specifications of the element(s) under consideration;

(ii) define the scope of scientific studies or designs arising out of such specifications and how they might be addressed;

(iii) following (i) and (ii), develop procedural plans and prioritisation of an integrated set of technical

requirements consistent with the observing system design criteria;

(iv) generate technical reports on the results of these studies, and the content of corresponding entries in the GOOS Handbook (see section 4.1).

The Climate Module: This module is also providing the plan for the ocean component of GCOS. The plan is being developed by the Ocean Observations Panel for Climate (OOPC), using as a foundation a report of the Ocean Observing System Development Panel (OOSDP), published in 1995. Because there is a need to liaise and coordinate between operational ocean observing systems and those of climate research, this panel is jointly sponsored by GOOS, GCOS and the WCRP. Its function is to evaluate, modify and update the design of the climate module of GOOS, the goals of which are:

(i) to monitor, describe, and understand the physical and bio-geochemical processes that determine ocean circulation and its influence on the carbon cycle as well as the effects of the ocean on seasonal to multi-decadal climatic changes.

(ii) to provide the observations needed for the prediction of climate variability and climate change.

Because present systems are generally inadequate for the analysis and prediction of climate change on an operational basis, one initial task will be the development of a Global Ocean Data Assimilation Experiment (GODAE) to improve the way data are assimilated into models.

Health of the Oceans (HOTO) Module: The primary objective of this Module as defined in the HOTO Strategic Plan published in 1996 is to provide information on the nature and extent of adverse effects, including increased risks, on human health, marine resources, natural change and ocean health. Data collection, bio-monitoring, and biological effects assessment will be carried out on both global and regional scales using commonly agreed standards and methodologies, emphasizing initially:

(i) development of a set of reliable, relatively easily applicable biological distress indicators of the health of the environment;

(ii) monitoring concentrations and trends of contaminant loading in coastal regions in relation to ecological responses;

(iii) developing methodologies for evaluating assimilative capacities of coastal regions for contaminant loads;

(iv) accessing available data on contaminant levels and community response at regional and national levels to provide baselines to underpin monitoring.

Living Marine Resources Module: The objective of this module is to develop a system to monitor marine ecosystems and the biological, chemical and physical parameters controlling their variability. The plans will include specifications and a framework for an adequate package of observations and research to understand and forecast major change and variability over time scales of seasons to decades, arising from changes in the carrying capacity and/or health of the ocean.

Planning is at an early stage. The objectives and conceptual design of this module are to be defined and an initial plan prepared based upon customer needs. Anticipated advances in observing and modelling technology will be taken into account. A panel will be established to take the planning forward.

Coastal Module: The Coastal module is of high priority to many coastal nations. The design of an observing system for this environment presents a complex challenge, since it must take into account and integrate the plans and recommendations of the climate, HOTO and LMR panels. It must take into account the needs of a wider range of users, for instance the communities involved in coastal management, environmental protection, ports and shipping, Monitoring, documenting and forecasting change in this environment will require integration of physical, chemical, biological and geological observations, and consideration of socio-economic requirements. Ideally the coastal module will provide the necessary guidance to enable the provision of services and products to a wide range of users.

The GOOS concept provides nations with the goal of creating a unified framework within which such operations can take place to high standards and in a coordinated way so as to be mutually supporting, thereby adding value to the data in a national sense as well as contributing to an overarching international goal. While not all coastal seas observations will be part of GOOS, many will contribute to GOOS, especially those addressing change and its detection. Of particular interest would be those ubiquitous problems which would benefit from a global observing system. These include, for example, observations on non-point source pollution from agricultural runoff, an issue which has local impacts but is a global problem; assessing its global magnitude and rate of change, and finding and sharing common concerns and solutions, is a potential major activity within the coastal module.

It is internationally acknowledged that because coastal seas have no natural boundaries there are advantages to adjacent member states in taking the GOOS approach and sharing data, models and forecasts with their neighbours bilaterally or in regional groups to improve their individual understanding of how their coastal seas work. Several member states are already taking this approach, for instance regionally in the north-east Asian regional consortium (NEAR-GOOS), in the European consortium (EuroGOOS), and on a bilateral basis between the USA and Canada.

Services Module: The aim of GOOS is to capture and process information about the ocean and convert it into products required by a wide range of end users (Sections 5

& 6). To some extent this activity is already being carried out by national agencies and private companies who between them provide a large range of marine meteorological and oceanographic services around the world in support of shipping, fisheries, coastal zone management, tourism and recreation, and improving the safety of life at sea.

The purpose of the Services module is to assist the other Module panels in establishing services and products and ways in which the provision of existing services and products can be improved.

The intention is to increase the number and value of services and products available to end-users. For developing countries in particular this may involve training programmes for assistance in establishing operational services and in the use of products.

4. IMPLEMENTATION AND INTEGRATION

4.1 IMPLEMENTATION PLANNING

GOOS implementation plans will be produced by the GSC and its panels and working groups. They will cover the technical issues of implementation and will detail the interrelationship of GOOS with the scientific plans of other observing systems. However, while the plans will go as far as possible in addressing the technical requirements they will not be able to stipulate how nations and organisations will implement their participation in GOOS.

A guiding principle of the design is that it will follow the 'end-to-end concept', meaning that there will be a known or definable pathway of connection between each initial measurement and the end uses to which it (or information derived from it) is applied.

GOOS will be initially implemented as an assembly of the contributions of data, resources, effort and products of existing and proposed national and international observing systems and (in some cases) experiments and satellite missions. Only parts of these systems will contribute to GOOS. However, for those parts the design must encourage participation, the selective enhancement and refinement of observations and the alignment of their quality and relevance to follow an accepted GOOS philosophy and design, and to comply with defined GOOS criteria. To facilitate this requires that:

(i) Implementation Plans and detailed specifications of the Modules and Elements be available in a form and detail from which adaptations and enhancements to these systems can be readily defined;

(ii) Systems be adapted or created to enable the contribution of data to the GOOS network, and to access and use GOOS data and products;

(iii) Wherever possible, GOOS will make best use of present or new systems which give scope for cooperative management;

(iv) The downstream 'user community' for GOOS products be encouraged to participate in, and to sponsor GOOS design and implementation at national level;

(v) systems for crosscutting elements such as data management and distribution take full account of the GOOS requirements.

A prime source of collated information for participants in GOOS will be the GOOS Handbook. This will contain such information as:

- Organisational structure;
- Key personnel and addresses, including Web addresses;
- National contact addresses, as submitted;
- Relevant definitions and terms of reference of GOOS bodies;
- Plans and other important documentation (such as policy statements and principles) or source references;
- Regional program information;
- Implementation and operational advice when formulated;
- Timetables and schedules (eg. meetings, satellite missions).

This Handbook will be accessible primarily through the Internet, but also in hard-copy versions wherever needed. It will be regularly revised and added to (in loose-leaf style) by the GPO as planning documents and information become available.

4.2 THE GOOS IMPLEMENTATION PHASES

For reference, progress in implementation will be defined in phases. This document mainly concerns the first three phases, as follows:

Phase 1: Planning, Design And Technical Definition: As a basic principle (Principle D1, Section 1.5 above), GOOS is a planned system, intended to accord with designs developed by the GSC and its specialist panels and subcommittees (and their predecessors). So far, planning has not been uniform, largely due to the difficulty in specifying what users will require in end-products from the observable non-physical variables. Significant progress has been made on the Climate and Health of the Ocean modules. The priority task is to refine the specifications and define from them the needed observations. Inputs from the planning modules and elements can then be progressively combined to achieve coherent and comprehensive implementation plans.

Phase 2: Operational Demonstrations And Pilot Projects: Pilot projects and demonstrations are an important developmental stage:

(i) to test how GOOS will work as a comprehensive and integrated system of data collection and exchange through to modelling and product delivery, and

(ii) to provide an impetus to key technology areas such as instrumentation, sensors, or communication, model development or data assimilation. Pilot projects are essential to convince operational agencies that GOOS is an achievable mission and a worthwhile investment.

Some pilot projects will be designed as 'proto-GOOS' systems from their inception, others may focus initially on one particular aspect of the eventual GOOS, for example, on data exchange, later expanding to build upon that foundation, in order to develop the end-to-end data-to-product system, involving modelling and forecasting, delivering to a broad range of ultimate users.

Phase 3: Immediate Implementation Using Existing Systems: Many activities capable of becoming part of GOOS are already operational at present through national observing systems, international organisations and bodies or through large scale scientific programs. These components need to be effectively used to implement GOOS. This requires the following actions within a systematic process:

(i) Combine and enhance observations already being made routinely, such as sea level, sea surface temperature, wave climatology, upper ocean temperature, surface meteorology and nutrients, and cooperatively address their incorporation within a common plan;

(ii) Identify existing ocean observing activities relevant to GOOS that are or will be of limited duration and/or geographical extent (satellite missions, surveys, experiments) and develop and promote strategies and sponsorship to encourage their continuation;

(iii) Establish or accredit data centres to receive the data and apply appropriate GOOS standards and the management of implementation according to GOOS plans;

(iv) Secure appropriate GOOS-identified infrastructure for data distribution and delivery;

(iv) In parallel, devote effort to the generation of computational and interpretation tools, the implementation of appropriate training, the provision of basic infrastructure (PCs, application software, web access, models) to broaden the hands-on usage of GOOS data. All these contribute to the building of a scientifically competent user community;

(v) Encourage the production of GOOS 'demonstration' end-products (models and case studies) that have relevance to identified target user communities (eg, shipping, oil production, fishing, coastal protection);

(vi) Build demand; introduce a program of active promotion of GOOS, using these products and successes in implementation as a focus.

It will be desirable to direct attention in early stages upon observations that can be quickly and readily implemented, can gain the participation of many countries and can be converted into products of immediate application.

4.3 THE PACE OF GOOS IMPLEMENTATION

From the outset, the implementation of GOOS must be recognised as a long-term undertaking. While some parts can be activated immediately, others may take decades. Nevertheless valuable outcomes should be clearly evident within ten years. Some ocean observations such as Pacific Ocean observations for El Niño forecasting are already partly in place and proving their value.

Modules will not be implemented uniformly or in parallel, and implementation will depend to a great extent on needs as they become identified, not necessarily according to module. For example the physical data associated with coastal observation may well become linked with physical observations within the Climate module. Implementation is an evolutionary process; as greater understanding and technological capability is achieved, this knowledge will be applied to continuously redefine the path of implementation.

4.4 AN INTEGRATIVE APPROACH TO BUILDING GOOS

GOOS will be built from the efforts and contributions of many national and international organisations, including private industry and non-governmental organisations. In what follows we focus on existing national and international systems, but the rules apply for any potential contributor. Because GOOS is a planned system, participation does not involve only the assigning of marine data to a common organisational framework but also the integration or combination of national effort to a significant degree. This will be achieved in several ways.

Using the plans of the modules, elements and pilot projects as they become available, the managers of existing systems will be encouraged at national level and through international and intergovernmental fora to review their existing observing activity with a view to the allocation or modification of effort to align their activity with these plans. Such alignment might include not only the observations themselves but the adoption of data and metadata frameworks, communication and infrastructure.

National systems will be encouraged to invest resources in enhancements consistent with GOOS plans. Such resources may well arise through the rationalisation of existing marine observing activity into larger national and regional units, and could also include the recruitment of industrial and other non-government effort in areas of perceived economic benefit. At the same time, the GOOS sponsors will be encouraged to address the organisation of the observing and management frameworks they administer toward efficient systems that are best able to meet GOOS requirements.

The implementation strategy must ensure that at the earliest stage:

(i) Nations and observing agencies are made fully aware of the benefits that can be gained from GOOS in general and their participation in particular;

(ii) Nations are informed in a continuously improving and readily accessible way how they can use GOOS data and products for their own benefit;

(iii) National governments, agencies and organisations are encouraged and motivated to participate in GOOS and to facilitate and sponsor its activity;

(iv) National governments, agencies and organisations are fully aware of how they can participate in GOOS and what they can do to make a worthwhile contribution.

These requirements imply the following planning elements:

(a) Benefits of the GOOS organisational framework, GOOS data and GOOS products are documented as quickly as possible in terms suitable for diverse readership and are updated frequently;

(b) GOOS Plans and other useful documentation are prepared and available without delay;

(c) Strong communication and working arrangements are established between the GPO, national corresponding bodies or "points of contact" and with the executives of related international programs, planning bodies and agencies;

(d) A pro-active external communication and 'marketing' strategy for GOOS is developed.

Some nations need to become technically equipped to derive maximum strategic benefit from GOOS, and to play an effective part in its implementation. The GOOS structure includes specialist panels to address these issues. Actions should include:

(i) ensuring that technical advice and training is made available via identified programs, teams and courses to assist countries in the development or adaptation of national observing systems and to equip them to participate in GOOS and to make effective use of its products;

(ii) assistance to find resources and sponsorship for both training and equipment for example through national agencies and bilateral projects;

(iii) dedicated effort through the main research agencies of the world to generate products for the use of GOOS data in practical applications such as coastal modelling and environmental management.

Experience in the creation of EuroGOOS and NEAR-GOOS provides evidence that regional GOOS integrations are an effective means for expanding operational observation beyond national boundaries to deliver common utility while protecting national interests. At this stage no particular model for regional development is advocated, provided that the GOOS Principles and Strategy are adhered to.

Regional integration may well begin with bilateral projects which derive benefit from cooperative international behaviour and observing practice beyond the traditional scientist-to-scientist model. Such projects provide the foundation on which broader GOOS alliances can be built. Further advice on regional development appears in section 7.

4.5 THE GLOBALIZATION OF GOOS

Some elements of GOOS, the Ship Of Opportunity Programme (SOOP) network and some elements of the Climate Module for instance, will have a 'global' structure from the start. Much will however depend on the merging of regional GOOS programs into a larger framework of integration. Special attention will need to be directed to the 'more difficult' areas for global cooperation which nevertheless relate to the fundamental well-being of the oceanic environment, such as marine living resources, pollution and oceanic health.

Some products and demonstrations of the feasibility of GOOS will focus on their global benefit. Climate prediction is an obvious candidate. Other examples of products of global integration will also be needed to justify the effort committed by the international and intergovernmental sponsors, and the nations that support them.

4.6 SYSTEM COMPATIBILITY AND STANDARDS

Speedy development of GOOS requires settling quickly upon common practices and standards without which integration cannot occur. Thus the voluntary adoption of a common data and management framework is essential, preferably embracing as many of the global observing systems as possible, at least for those parts of the

national observing networks that could serve as contributions to GOOS.

It will be prudent not to prescribe systems and methods too closely, because the rapid development of electronic communication presents dangers in the adoption of a single rigid system. The needs of global communication will drive the evolution of such systems more strongly than any element, and the essence should be redundancy and flexibility to guarantee access to GOOS data and products to the widest range of potential users, by ensuring that sufficient infrastructure is available to all.

4.7 THE ROLE OF THE GPO IN IMPLEMENTATION

The GOOS Project Office has a key role to fill in creating and maintaining the links between the central GOOS organisation and diverse national and regional initiatives. It will need to maintain contact with nominated individuals and organisations associated with these initiatives and will seek to ensure interest in, comprehension of and commitment to the GOOS strategy and planning at national and agency level. Potential participating countries are therefore strongly encouraged to establish national and regional coordinating bodies, and to identify contact persons who can be relied upon by the GPO for communication and promotion.

5. GOOS PRODUCTS

5.1 INTRODUCTION

Operational oceanographic services already exist in many forms in several countries, but taken together do not form a complete or coherent global service. They operate to different levels of performance, lack common standards and lack the international infrastructure of operational meteorology. Most focus on physical observation, and are locally or regionally oriented.

An objective of GOOS is to provide a coherent user-oriented set of beneficial services and products. There are opportunities for the provision of a new range of services and products, for example:

(i) in the more effective and sustainable management of regional seas;

(ii) to support the more effective design of coastal defences in an era of changing climate.

Prototype GOOS products are already being derived from presently existing precursors to GOOS, like TAO, IGOSS, IODE, DBCP, GTSPP, GLOSS, CMM and so on, and it is anticipated that success will breed success, as new players seek to benefit from what the pioneers have demonstrated.

Inevitably some operational oceanographic systems will be more marketable than others, and it is therefore likely that governments will always be involved in providing a range of 'public good' services (eg, ENSO forecasts), while industry will often run specific sectoral services, for instance in support of vessel routing and traffic control. GOOS will develop a strategy for dealing with this mix of public and commercial data sources and services.

5.2 DIALOGUE

To determine what is wanted, and what is possible, dialogue is essential between service users and providers and the scientific community which is developing the modelling and other technologies and networks. This dialogue is in aimed at the developing projects that will produce products to meet a particular need or provide a particular service.

5.3 PRODUCT SELECTION METHODOLOGY

GOOS will facilitate the evaluation and distribution of, and access to a range of products. A survey may help to identify potential users and their needs, an approach successfully pioneered by EuroGOOS. Inevitably, a need for as yet unused products, which may have to be developed through experimentation, will arise from this analysis. If a product seems to be feasible and deliverable but has not yet been addressed, GOOS will look for short term commitment by consortia of data centres and institutes to support product development.

5.4 THE GOOS LABEL

There is an obvious need for a mechanism that would allow GOOS 'certification' or 'labelling' of ocean data and products. Criteria concerning documentation, reproducibility, skill and standardisation should be considered as elements in such a mechanism.

6. DATA AND INFORMATION MANAGEMENT

6.1 A DATA AND INFORMATION MANAGEMENT SYSTEM

Access to data and information and products is the lifeblood of GOOS. Although the mechanisms for managing GOOS data and information have yet to be agreed in detail, it has been accepted that GOOS, GCOS and GTOS will develop a common approach to data and information management through the activities of a Joint Data and Information Panel (J-DIMP) which will produce a GOOS Data and Information Management Plan. GOOS data and information management will follow the Principles set out above in section 1.5 and expanded upon in Annex I.

Implementing the GOOS Data and Information Management Plan is likely to require:

(i) A distributed network of national, regional, and world databases;

(ii) Technical Advisory Groups (TAGs) to set detailed guidelines, standards and protocols;

(iii) A Data and Information Centre;

(iv) A Data and Information Management Service including such functions as system coordinator, and assessment of the status of GOOS operational programmes relative to user requirements; and

(v) Capacity building.

Distributed Network: The GOOS data and information system will make best use of all existing facilities, which will be linked through a network of local, regional and world data centres including those in the IODE system.

The primary source of most GOOS data will be the national organisations that have agreed to commit a part of their data gathering and data-related activity to the GOOS framework. Designated 'Local Data Centres' will be expected to make their short-term archives and products of relevant data accessible to GOOS, both directly and by submission to World Data Centres.

As several (though by no means all) of the required activities are already the responsibility of existing research or operational centres, the initial emphasis of GOOS will be on coordination, integration and stimulation of these activities, the encouragement of expansion or enhancements and compliance with GOOS designs and standards of timeliness and quality as defined in GOOS documents. Timely data distribution is an important prerequisite for real-time operational oceanography.

The system recognises that not all ocean data will be GOOS data. Data will be acceptable for GOOS if they adhere to the GOOS data policy and standards, are long-term, systematic, and relevant to the overall objectives. Much of the data collected for local, national or regional interests will not form part of GOOS. Exclusion of data from the GOOS network remains at the discretion of the nations concerned.

In many cases GOOS will be implemented through regional alliances that may apply their own coordination and distribution frameworks to GOOS data, concentrated upon regional centres. Such alliances should also be a major means of facilitating participation of smaller countries and agencies that would have difficulty in implementing their own distribution infrastructure.

World data and processing centres will be responsible for the receipt of data submitted by the Local and Regional Centres, the application of further quality control (eg international comparisons and bias adjustment), and for the operational production of integrated data sets, analyses and products. World Data Centres already exist for some types of marine data, but as yet there are no organisations for the production of interdisciplinary data-sets and analyses or special GOOS products.

Wherever possible, and with the assistance of the GOOS framework of implementation, existing centres will be encouraged to assume the necessary additional responsibilities as the needs become defined.

Technical Advisory Groups (TAGs): GOOS will put in place informal groupings TAGs of data-gathering experts from the participating agencies, convened on an as-needed basis, in order to reach consensus in:

(i) defining the detailed guidelines for data and meta-data of various types in terms of format and protocol, standards, distribution, etc;

(ii) addressing technical questions concerning data gathering and distribution methodology;

(iii) providing a conduit of feedback to the GOOS design and implementation process on the above matters.

Data and Information Management Centre: The J-DIMP has proposed that a prototype Data and Information Management Centre be established for the three global observing systems, GCOS, GTOS, and GOOS. The Centre will provide a single window through which the various data sets of the three observing systems can be accessed. Initially the Centre will address the needs of GCOS including the Climate Module of GOOS. In due course, if that experiment proves successful it may be expanded to include other GOOS Modules.

Data and Information Management Service (DIMS): A coordination service is envisaged as an integral and necessary part of the infrastructure of a distributed GOOS Data and Information Management System.

Capacity Building: There is a need to assist developing Member States to find out what data are available to them, and to access and convert different data sets into valuable products.

6.2 EXISTING INTERNATIONAL DATA SYSTEMS

GOOS will be built upon the existing and planned national and international information management infrastructure. This includes IGOSS and IODE, which have already begun adapting their data and information strategies to align themselves with the growing requirement of GOOS. Dialogue between GOOS, GLOSS, DBCP, IGOSS and IODE and others (like CMM) must be sustained to ensure that the present systems evolve in the most appropriate way and at the most appropriate rate.

6.3 DATA AND PRODUCT DISTRIBUTION

The GOOS distribution system will be designed to meet the needs of users to the best degree possible. This might include: dedicated communication lines, INTERNET servers, CD ROMS and traditional printed reports. Several products of different kinds may be distributed using a dedicated single server, such as the IGOSS electronic products bulletin. This will facilitate comparison and overlay of products. The WMO's Global Telecommunications System (GTS) will facilitate the exchange of data.

GOOS product distribution systems will be evaluated before implementation. Their operational performance will then be continuously evaluated through feedback from users, as will the quality and character of the products and services themselves.

6.4 DATA POLICY

The GOOS Principles indicate that GOOS will develop according to a defined data policy based on the published data policies of the GOOS sponsoring organisations. It is recognised that agreement on details of the GOOS data policy may take some time to negotiate. As a practical basis for progress, participants will be encouraged to regard GOOS as a global system for their collective benefit, and to allow their data to be exchanged freely to the greatest degree possible. By this fundamental approach donors and their countries stand to gain more use and practical advantage through access to the total volume of data available than they risk losing by making their data commonly accessible.

7. REGIONAL DEVELOPMENT

7.1 REGIONAL INTEGRATION AND COMMON INTEREST

For participation in GOOS, nations are encouraged to adopt whatever organisational framework that is most acceptable to them. In some cases a regional approach of some kind may be preferred. Regional development involves nations or agencies joining together and combining resources to focus on a specific set of objectives for collective benefit. By contributing to a global data and information management system each participating region also plays an integral role in establishing the global network.

7.2 ALIGNMENT WITH GOOS PRINCIPLES

Nations engaging in regional development of GOOS are encouraged to develop their systems in conformance with the GOOS Principles. Similarly, adherence to certain standards, methodology, data and information management specifications, established by the GOOS planning bodies is essential if GOOS participants are to receive the benefits of contributing to the global programme. Such adherence will be equally important in ensuring future consistency and compatibility between regional and global GOOS.

7.3 REGIONAL ORGANISATION

Regional alliances can be very useful for GOOS implementation, though not necessarily for all types of observations and products. Since IOC and the other GOOS sponsors do not have the resources for operational programs, regions will be relied upon to take the initiative and organise resources if a GOOS activity is to gain a high regional profile.

For the initiation of the development of a GOOS regional program, a first step may be the agreement between Agencies or Institutes from neighbouring countries on regional contributions to GOOS, with the objective of getting commitments from Member States. The importance of adhering to the principles of GOOS out-weighs aspects of organisation when deciding what is and what is not part of GOOS.

Regional subsidiary bodies of the IOC (such as WESTPAC) have a part to play in facilitating GOOS, and could embrace regional GOOS activities within their purview in coordination with global GOOS (as WESTPAC has done with NEAR-GOOS). In general, use could be made of the managerial, financial and administrative support services available at the IOC regional secretariat. However, until GOOS is more fully developed flexibility is encouraged. In this context consideration should also be given to the regional subsidiary bodies of UNEP and the other sponsors of GOOS.

Examples of national grouping may include, for instance, a group of nations cooperating under the umbrella of an international organisation that acts on their behalf as a member of the GOOS community. The South Pacific Applied Geosciences Commission (SOPAC) is an example. SOPAC is an organisation of Member States in the South Pacific, which can act as a 'technical agency' for an entire region, conducting observational and monitoring programs and acting essentially as a single entity for the regional community.

8. TRAINING AND CAPACITY BUILDING

8.1 INTRODUCTION

A primary goal of GOOS is to ensure that smaller and less-developed countries can gain benefit from participation. To lift the capacity of developing states requires assistance in creating appropriate institutional arrangements, in acquiring appropriate equipment and physical infrastructure, in training for their effective use and in raising the awareness of decision makers and the public. Regional GOOS projects are of particular importance in recruiting the participation of smaller countries because they are best able to reflect local needs and to implement regional training and infrastructure.

8.2 PLANNING FOR CAPACITY BUILDING THROUGH TEMA

To enable developing countries to form GOOS national and regional projects a GOOS Plan for capacity building has been developed in the form of a new TEMA Framework Planning Process which was approved by the IOC's TEMA Group of Experts at its meeting in Bremen in May 1997.

The GOOS capacity building plan will be based on an assessment by IOC Regional Subsidiary Bodies of the needs and priorities of the regions. This Plan will then be reviewed by the IOC's TEMA Group of Experts in association with the GOOS Project Office and a GOOS Capacity Building Panel, and sent back to the Regional Bodies to be finalised for eventual approval at the following Executive Council or Assembly.

Once the Plan is approved, implementation will be overseen by a GOOS Capacity Building Panel This Panel will serve as an advisory, planning, implementing, facilitating and advocacy group for the GOOS programme, and is intended to provide a planned, efficient and effective approach to GOOS Capacity Building. The Panel and the GOOS Project Office will work together and with regional bodies to help them develop TEMA Plans related to GOOS, and advise the TEMA Unit on the development and advancement of those plans. The Panel will carry out Capacity Building Workshops to increase awareness and identify needs.

Once plans have been outlined, decisions can be made about possible sources of funding to enable Capacity Building to proceed. The GOOS Project Office and Capacity Building Panel will provide advice on possible funding sources, and assist in the preparation of funding proposals. One possible source of funds is the World Bank's Global Environmental Facility.

9. TECHNOLOGY DEVELOPMENT

9.1 INTRODUCTION

GOOS will not reach its potential without significant improvements in technology. GOOS will rely heavily on satellite-borne sensors to monitor the ocean's surface. It will require surface measurements *in situ* to calibrate and validate satellite observations. It will also involve extensive suites of measurements from the subsurface, made by fixed and drifting buoys, and other advanced technologies under development, such as autonomous underwater vehicles and acoustic thermometry. Advances in technology will be required, for instance in communication from instruments by telemetry or satellite, and in anti-fouling techniques to keep sensors working for long periods unattended.

To ensure the right technologies are in the right place at the right time surveys are now needed in given regions to assess what is currently available and what is needed, as the basis for justifying the appropriate expenditure on technology acquisition or development for GOOS.

9.2 NUMERICAL MODELS

Recognising the inevitable sparseness of data in relation to the scales of ocean processes, much of our understanding of ocean behaviour and our ability to forecast events, will come from numerical simulation in advanced ocean models nested at different levels from global to local. These models are themselves a technology in need of development; their power in turn depends on advances in the power of computing systems. Meteorological forcing is required for operational ocean models; a key source is and will be operational weather prediction models assimilating atmospheric and surface marine data. Research is needed in the development of the global scale models needed to provide boundary conditions for prediction at the local level. Also identified is the need for research into the assimilation of data into models to enable accurate forecasts to be made. Expertise should be assembled in a few specialist centres to process data in the most appropriate way through advanced numerical modelling for the production of forecasts of ocean conditions. A model for such a centre might be the ECMWF. To disperse skills internationally, such centres can be staffed by representatives of different contributing nations.

9.3 *IN SITU* OBSERVATIONS

Full use needs to be made of automated sensors and instrument packages on floats, and moorings, and on platforms of opportunity, such as ships and fixed platforms or autonomous vehicles, to obtain routine data which can provide a high density of coverage at little cost. Maximum advantage also needs to be taken of subsurface acoustic methods for remotely sensing changes in ocean temperature. The need for robust and durable instrumentation is highlighted by the demands of an operational system. Marine instrumentation industries should be encouraged to recognise the commercial opportunities of GOOS arising from a steadily increasing demand for such instruments as profiling drifters, autonomous vehicles, expendable multi-function probes, autonomous chemical analysis equipment and a host of other high-technology devices.

9.4 SPACE-BASED OBSERVATIONS

The GOOS community must work with the space community through organisations like CEOS, to ensure that the most appropriate sensors are developed and that there will be a continuous long-term coverage of critical ocean parameters in support of GOOS. Space-based observations are essential to any global ocean observing system, as is demonstrated by the wealth of data flowing from the TOPEX/POSEIDON mission, many of the benefits of which were not foreseen.

It is estimated that over the next decade at least $1 Billion will be spent on satellite missions which provide ocean data. Satellite data is essential to effective GOOS implementation, and in turn global observing systems provide a justification for continuing space missions. GOOS must therefore influence and capitalise upon the development of remote observations from space. To this end, GOOS, GCOS and GTOS are working together through the Global Observing Systems Space Panel (GOSSP) where advantage is gained from the prior development of the GCOS Space Plan.

Recognition of GOOS requirements by the space agencies is likely to proceed rapidly because the space agencies themselves have seen the relevance of the global observing systems to the continuation of space programs. Through the Committee on Earth Observation Satellites (CEOS), space agencies are pressing for development of an Integrated Global Observing Strategy (IGOS). This development should be exploited in GOOS planning.

Space missions designed to provide data suitable for studies of climate change (and to meet the needs of other GOOS modules) are already largely fixed through to 2005. Influencing what happens after that will depend on development and delivery of forceful arguments for ocean-specific observation. One particular development that appears reasonably feasible is a space-based measurement of sea-surface salinity.

How space-based data are made available to GOOS participants is equally important, especially in the context of making a direct practical contribution to Capacity Building. Through the Data and Information Management Service proposed above the GPO will work with Member States to facilitate reception of remotely sensed data and their integration with *in situ* data to develop products useful to local decision makers.

10. RESOURCES

10.1 INTRODUCTION

The design, implementation and management of GOOS will require the long-term commitment of substantial resources. Existing international, regional and national agency mechanisms will be used to the extent possible; ultimately GOOS will be carried out and funded by nations. The application of resources to GOOS will arise in several ways.

10.2 SEEKING NATIONAL COMMITMENTS

National commitments to GOOS are needed at two levels. Firstly, there is the commitment to create national data gathering and management systems that are compliant with GOOS principles and contributing the data from those systems to GOOS. Secondly, there will be the need for nations to specifically support those observations of GOOS that are truly global in nature.

Even though commitments will always be made for programs that are primarily in the national interest, they can be fully accepted as contributing to GOOS provided that the data are made available and the measurements accord with the Principles, guidelines and standards established by GOOS. The benefit will arise from the reciprocal access to global information which may be applied to the solution of local problems.

To generate funding commitments and to prioritise activities within GOOS, meetings and fora bringing together interested national bodies are needed to establish GOOS as a globally mandated program with support from nations both large and small. Even though ultimately all interested nations will develop their own GOOS participation, from the start developed nations have the ability to support initiatives from less developed countries through capacity building and transfer of know-how.

Resources are needed for the operation of an effective GOOS Project Office operating within the IOC. The secondment by nations of expert personnel for GOOS is an effective method of providing such support. Activities will not be confined to IOC headquarters. Personnel will be required at other agencies, regional secretariats and elsewhere to operate the GOOS Programme. Such positions need to be anticipated, planned for and recruited in a timely way to coincide with development activities.

Identification of national resources for GOOS activities and infrastructure is critical. At present the demand identified by I-GOOS and the GSC on behalf of member States for activities needed for planning, implementation and capacity building far exceeds the ability of IOC to pay for them, meaning that GOOS will not progress without additional funding for specified activities from external sources.

Nations have been encouraged to establish GOOS coordinating mechanisms. National operational activities require support such as personnel, equipment and management structures. The international GOOS infrastructure can assist by sharing models, information and techniques to approach this difficult problem. The international community can also assist in training of personnel and capacity building, to yield benefit for the programme overall.

10.3 INTERNATIONAL ORGANISATIONS IN SUPPORT OF GOOS

The implementation of GOOS will depend on the use of existing organisations such as IODE, IGOSS, GLOSS and the DBPC, which are supported by nations through their contributions to the IOC and WMO, as well as by the secondment of personnel and the use of national facilities to carry out parts of the programme. Strengthening of the needed parts of these mechanisms and the development of others will be needed to effectively implement and manage the full breadth of GOOS. Negotiation is required with the

managers of these other observing organisations to develop the relationships between them that are necessary to create a truly global ocean observing system. Within IOC and WMO attention needs to be given to the way their programmes relate to one another in the GOOS context.

10.4 INDUSTRIAL SUPPORT

Industry in many forms (agribusiness, energy, insurance, fisheries, construction, telecommunications and so on), could be not only a user of GOOS products and services but also a provider of GOOS data, information, products, and services. The international GOOS community must welcome their involvement and give attention to their advice and requirements.

Realistically, direct industrial support for GOOS in the form of cash is likely to take very considerable effort unless particular GOOS products and services are seen to have industrial relevance. Efforts to build links to industry should be very carefully targeted on selected companies who are major users of marine information in the main sectors: oil and gas; shipping; fisheries; construction; telecommunications; and insurance.

It needs to be borne in mind that most major companies are not themselves direct users of marine information. They buy what they need from the oceanographic and meteorological service industry. This is a highly dispersed sector comprising numerous small to medium sized enterprises which might best be approached initially through national or regional trade associations. A primary goal should be to persuade such companies to contribute their extensive holdings of often highly localised data to national or international GOOS data centres. The advantage to companies in doing so is that it provides them with a means of archiving at no cost data which otherwise might be discarded as of no short term commercial value, yet which might be valuable to them in the long term. In accepting such data GOOS centres would have to ensure that the data were provided along with appropriate metadata (information regarding the collection of the data), appropriate quality assurance, and freedom of distribution.

A further advantage to the service industry and their users in supporting GOOS is that it will provide the basis for the creation of advanced commercial services and products that are beyond the present capabilities of the industry.

Already commercial shipping and fishing operations provide access to ships for the collection of marine information through the IGOSS Ship of Opportunity Programme (SOOP) and the WMO Voluntary Observing Ship (VOS) programme. Efforts should be made by IOC and WMO to expand such operations for data capture by industry, and by national and regional GOOS offices to expand the instrumentation of ferries in coastal seas.

10.5 SUPPORT FROM NAVIES

Among the major generators of *in situ* oceanographic, bathymetric and marine meteorological information are the world's navies. Extensive efforts should be made nationally and internationally to get as much as possible of these environmental data into national and international GOOS archives either in real time or delayed mode. Given the sensitivity of navies to the potential military value of environmental information and the secrecy surrounding certain naval missions, it must be recognised that much data will not be immediately available for transfer. Indeed, some may never be. However, navies agree that there is a tendency to classify as confidential far more data than necessary. In some instances, navies can be persuaded to make data available provided that the recipients are prepared to accept them in binned or gridded form rather than in original form. This may be found to apply especially to data of recent vintage. Older data are usually less sensitive in military terms and therefore may be available in original form. Negotiations with navies by national GOOS offices should be considered, to establish the conditions needed to effect data transfer. GOOS constitutes an advantage to navies in providing much improved environmental data bases on which to draw; therefore it is in their interest to ensure that the data bases are as complete as possible.

11. ENSURING EFFECTIVE COORDINATION

11.1 GOOS SPONSORING AGENCIES

The Director of the GPO should keep the GOOS sponsoring agencies continuously aware of overall GOOS progress, especially regarding issues where intergovernmental or international action could facilitate GOOS development. In addition to formal reports at the General and Executive Sessions of these agencies the GPO must maintain working relations with the appropriate Secretariat members to keep informed of relevant developments, avoid information gaps and misunderstandings and to become aware of opportunities.

11.2 EXTERNAL COMMUNICATION

The development of GOOS is vitally dependent upon the initiatives and cooperation of other global observing systems presently under development, regional GOOS-related programs, inter-governmental marine data management systems, international research programs, multilateral observation initiatives and national programs. It is essential that information, and in particular details of desired actions tasks and responsibilities, must flow both ways between the coordinators of these activities and those of GOOS.

This could be facilitated by the maintenance of a common electronic register of cooperative actions as determined by these coordinators. Such a register might also be entered in the GOOS Handbook.

National Organisations: GOOS will be implemented almost entirely through the voluntary participation of national marine observing organisations, science agencies and data management bodies. These require an exchange of detailed advice and information, covering the 'end-to-end' spectrum from observation to product, to guide their involvement on the one hand and to guide the design of GOOS itself on the other. While GOOS documents and national reports will be important, direct informal interaction between the GPO and identified national 'contact points' will greatly aid this process.

User Community: It is through the interest of the user community in the products and analyses of GOOS that its national support will ultimately depend. Scientists are only one part of that community whose support is so far 'enlisted'; it is by their efforts that the benefits of GOOS must be demonstrated initially, yet scientific resources are unsuitable and inadequate for a continuing, 'operational' observing system. Since much of the remaining community of users remains to be convinced of the benefits of GOOS participation, incentives must be found for the sponsorship of scientific case-studies and demonstrator projects, by those who will ultimately benefit. This requires 'marketing' the GOOS concept to governments, commerce and international sponsoring authorities.

General Public: There exists a vast worldwide resource of public goodwill toward enterprises which work towards the protection and preservation of the global environment. To bring GOOS to the attention of the public the communication strategy should include 'image building' products which might involve the enlistment of the media and popular 'environmental' publications. Here also, demonstrator products may be valuable, and expert communication advice will be needed.

ANNEX I

THE PRINCIPLES FOR A GLOBAL OCEAN OBSERVING SYSTEM (GOOS)

1. INTRODUCTION

It has been recognized for some time that a set of GOOS principles concerning the design and implementation of GOOS could provide coherence to the program, a set of basic rules for the design of the system itself and a clear statement to engage the interest and commitment of agencies and governments while spelling out the expected 'terms' of their involvement in this ambitious undertaking.

The Principles are designed as a set of relatively concise statements that could be understood without great elaboration. The SSC of I-GOOS requested that explanations of the principles be prepared in time for distribution to J-GOOS in April 1997 and I-GOOS in June 1997. Explanations of the intent of the principles are given below, incorporating modifications by J-GOOS.

Two sets of Principles are defined. The first (Design Principles) define the overall principles that determine the design of the system and provide a guide for what the design should include and exclude. The second is a guide to the conditions that should determine participation in the system, and the elements that determine those conditions.

These Principles have been adopted to guide the design and implementation of GOOS. Nothing within them should be interpreted as contravening or conflicting with the rules and regulations of the sponsoring organizations or the individual rights of Member States.

2. EXPLANATIONS OF THE GOOS DESIGN PRINCIPLES

Principle D1. GOOS is based on a plan designed to meet defined objectives on the basis of user needs.

This principle states foremost that GOOS from its conception, is a planned system for the acquisition and value-added application of a specific subset of observations gathered according to a designed strategy. It is not an opportunistic assembly of whatever ocean observations are offered for contribution by participating countries. The plan will therefore state (or at least outline) the observations that are required for each particular objective, and should where possible define how they would be applied to the needs of users. Applications should include the 'public good' where there is a defined socio-economic basis. Observations that qualify for inclusion as contributions to GOOS will, by definition, be of a kind and quality applicable to the defined objectives and end-use.

Principle D2. The design assumes that contributions to GOOS are long term.

GOOS is founded on the concept of an observing system that is ongoing or of an indefinite lifetime, in the same sense as the system of global meteorological observations. Although it will inevitably include observations gathered and sponsored for a limited duration and for differing purposes, the design will assume that such observations will be selected and contributed as part of a continuum that assembles to create a long-term, systematically structured and quality-controlled dataset.

Principle D3. The design will be reviewed regularly.

GOOS will evolve as plans consolidate, alliances form, commitments are made, needs become better defined and prioritised and technology improves. In addition, an essential element of the observing system must be the continual evaluation of the system design through the analysis of its products. Thus, to ensure that implementation proceeds continuously and effectively, the system design will require frequent review and adaptation.

Principle D4. The design allows for flexibility of technique.

GOOS is aimed at the assembly of a data set of specific oceanic variables. Depending on the capability of the participating observing agencies and the advance of technology, the method of observation of these variables will differ. The design should not unnecessarily restrict the technique used for observation provided its standard is adequate for the purpose.

Principle D5. GOOS is directed towards global problems and/or those ubiquitous problems benefiting from global observing systems.

Among the range of needs for systematic observation of the marine environment on all scales, thereis a subset of needs that can be most effectively addressed through cooperation within GOOS. Some depend on a scheme of related observations; such as those required for the changing climate of the large-scale ocean or for a pollutant stressing the capacity of large parts of the ocean. Others are generic, common or dependent and can be facilitated and in some cases only made possible by a globally coordinated or globally designed and facilitated system of observations. Even needs that are dependent only on local observations, as is the case for many coastal applications, may benefit greatly from data products that are generated as part of a globally coordinated system. The thrust of the GOOS design should be to service this subset of needs without prejudice to existing systems operating outside of the GOOS framework.

Principle D6. The design covers the range from data capture to end products and services.

The end-to-end concept implies a known or definable pathway of connections between a basic observational element and the end use or purpose to which the observation (or information derived from it) is applied. Typically, each type of ocean observation has a range of potential applications, and most applications have the need for more than one observation type. In designing a system to serve a given range of end-uses, it is important to know how the observation would be used, processed and combined with other observations to deliver an observational 'product' of value to the end user. The GOOS design must therefore be concerned not only with how observations should be made but the steps and operational and scientific products (eg technology and models) required for their end use..

Principle D7. The management, processing and distribution of data will follow a specified data policy.

In concert with the policies of IODE, IGOSS and GCOS, and following the data management plan for the World Weather Watch of the WMO, commitment is required by GOOS participants to establishing, maintaining, validating, making accessible, and distributing high quality, long term data meeting internationally agreed standards. Preservation of GOOS data is required in suitable archives following appropriate procedures and criteria for data acquisition and retention, and should include information about data holdings. Data should be processed to a level which is generally suitable for the generation of operational products and for research, and described in internationally accessible on-line computerised directories that can also be made available by other means. GOOS contributors are responsible for full, open and timely sharing and exchange of GOOS-relevant data and products for non-commercial activities. Exchange implies that donation by individual nations gains access to data from others as well as to products derived using all available data, such that the benefit of cooperation exceeds the cost.

Principle D8. The design takes into account the existence of systems outside GOOS that can contribute to and/or benefit from GOOS.

A cornerstone of GOOS development is that it will be built to the greatest extent upon existing systems of observation and data management, national, regional and global This requirement is vitally important for the most effective use of global resources. By the same token, these systems have their own defined purposes and goals outside GOOS and these goals cannot necessarily be deflected to the delivery of GOOS. GOOS must therefore be designed to 'co-exist' and interact cooperatively and to mutual benefit with the other systems. As a particular example, to the present time, most interior ocean physical observations have been made through individual research projects or in connection with global research programs like TOGA and WOCE. These provide valuable data sets to GOOS and could in turn benefit from GOOS observations, although in many respects they are inappropriate for incorporation into a GOOS implementation framework. Systems like IGOSS, GLOSS and IODE are presently structured as central points for the management of specific data types collected by national agencies for reasons that will often be outside the scope of GOOS. Their operations could be adapted and/or expanded to the management of a subset of data that contributes to GOOS.

Principle D9. The design takes into account quality assurance procedures.

The incorporation of quality assurance (qa) procedures as an integral part of the GOOS plan represents a departure from the practice of existing observing systems, which in some cases apply qa processes but not as part of the observation design and acceptance strategy. Without quality assurance procedures, the great promise of global data sets to address specified problems will certainly not be met. Several of the principles stated above, for example D2, D3 and D4, address the need for strong oversight of the observing system and its continued review with an eye to assessing and improving its effectiveness. Quality assurance is a fundamental part of that effort.

3. EXPLANATIONS OF THE GOOS PRINCIPLES OF INVOLVEMENT

In order to assist nations and national agencies to decide whether they are willing and able to participate in the implementation of GOOS, there needs to be a set of principles that define the nature of participation, in terms of the 'requirements' of GOOS as conceived and consistent with the foregoing Design Principles.

Principle P1. Contributions to GOOS will be compliant with plans developed and agreed on the basis of the above design principles.

Consistent with Principle D1, GOOS is designed and implemented according to a plan or series of plans. There will be a great deal of latitude in the way nations participate in GOOS. However, it is very important for the coherence and orderly development of GOOS as well as the optimisation of cooperation between countries and the delivery of benefits, that all contributions are made with the clear intent to comply as closely as possible with these plans.

Principle P2. Contributions will be compliant with a defined GOOS data policy.

Principle D7 indicates that data policies will be defined for GOOS. The success of GOOS depends critically upon the implementation of these policies. It is therefore necessary that compliance with these policies is a prerequisite to effective participation, recognising that the benefits of GOOS will flow primarily from the reciprocal exchange of data and products between countries.

Principle P3. Contributions should reflect an intent for sustained observations.

Nations contributing to GOOS will be understandably reluctant to make an open-ended commitment to GOOS. However, it needs to be recognised that the benefits of GOOS, and indeed the whole concept, depend upon the collation of data sets that are continuous and sustained. Thus, this principle requires affirmation of an intention that, subject to changing circumstances, observations submitted as part of GOOS will be sustained.

Principle P4. Standards of quality will apply to GOOS contributions.

Participants should be aware that GOOS will not be a repository of any data that might be contributed to it. GOOS data will be subject to quality testing to ensure its capacity to meet GOOS requirements. Contributors will be encouraged to apply the agreed quality assurance procedures.

Principle P5. Implementation will be effected using existing national and international systems and organisations where appropriate.

There are a number of international organizations and agencies responsible for the coordination of ocean data collection and its storage. It has been accepted from the start of GOOS that for reasons of efficiency, bodies such as IGOSS, DBCP, GLOSS and the IODE, will be used whenever possible to implement GOOS. At the same time it is recognised that these bodies exist to serve purposes outside of GOOS. Therefore GOOS will not substitute for them or subsume their function. The principle implies the effective use of existing systems, and that the proliferation of new systems and organisations to serve GOOS alone will not be encouraged. At the national level observation systems exist primarily to serve defined national objectives. In many cases these systems could be expanded or adapted to meet GOOS requirements. The principle therefore encourages nations and agencies to facilitate their participation in GOOS through these systems, rather than requiring the creation of new systems.

Principle P6. Implementation will be incremental and progressive, whilst bearing in mind the long term goals.

The implementation of GOOS will occur gradually as nations and agencies decide to submit part of their existing ocean observing effort and put in place new systems as contributions to GOOS networks. It will take time for regional alliances to take shape and new resources to be committed for GOOS as the benefits become apparent. Also, GOOS will evolve as techniques and technologies change and its scope extends, and it is realistic to expect that full implementation will take many years. This principle makes it clear that participation should not be inhibited by the lack of implementation of the complete observing system, and that incremental contributions are effective additions to the whole.

Principle P7. Participation in GOOS implies an undertaking to help less-developed countries to participate and benefit.

Consistent with the global nature of GOOS and its purpose to serve all humankind there is an obligation to enable all nations to participate in and benefit from GOOS. Without external assistance and cooperation, few countries would be well-equipped to establish observing systems to meet the requirements of GOOS or to derive full benefit from the enhanced knowledge and the management tools that GOOS will create. Therefore the undertaking to assist these countries where possible to become capable and effective partners in GOOS is incorporated as a core principle of GOOS participation.

Principle P8. Participants will have full autonomy in the management of their contributions to GOOS.

GOOS will be implemented be nations and their agencies. While GOOS is planned and coordinated internationally, it is recognised that the way in which observations are gathered, resourced and managed differs widely between nations and agencies. This principle is an assurance that GOOS has no role in these internal processes, and its influence will be confined to the encouragement of adherence to the quality assurance protocols, data exchange policy, and Principles of GOOS.

Principle P9. Contributing nations and organisations will reserve the right to determine and limit their contributions to GOOS.

As a corollary to Principles P6 and P8, this principle affirms that, although the success of GOOS will depend on long-term and indefinitely sustained observations, nations must always retain full control of the resources and contributions they make to GOOS.

Principle P10: Use of the GOOS 'label' implies conformity with the relevant principles of GOOS.

The GOOS acronym is already in widespread use and, in the absence of overarching GOOS plans and principles, has become associated with a variety of national and international activities. Some of these lack any effective association with the intended global system. This principle indicates the intention to ensure the quality and dependability of GOOS programs and the consistency and coherence of GOOS development by requiring all activities using the GOOS 'label' to comply with the fore-stated GOOS Principles.

ANNEX II

LIST OF ACRONYMS

CD-ROM	Compact disc Read-only Memory
CEOS	Committee on Earth Observation Satellites
CMM	Commission for Marine Meteorology (WMO)
DBCP	Data Buoy Co-operation Panel (WMO-IOC)
DIMS	Data and Information Management Service
ECMWF	European Centre for Medium-Range Weather Forecasts
ENSO	El-Niño - Southern Oscillation
EuroGOOS	European GOOS
GCOS	Global Climate Observing System
GEF	Global Environment Facility (World Bank-UNEP-UNDP)
GESAMP	Group of Experts on the Scientific Aspects of Marine Environment Protection (IMO-FAO-UNESCO/IOC-WMO-WHO-IAEA-UN-UNEP)
GLOSS	Global Sea-level Observing System
GODAE	Global Ocean Data Assimilation Experiment (GOOS)
GNP	Gross National Product
GOOS	Global Ocean Observing System
GOSSP	Global Observing Systems Space Panel (G3OS)
GPO	GOOS Project Office (formerly GSO)
GSC	GOOS Steering Committee
GTOS	Global Terrestrial Observing System
GTS	Global Telecommunication System (WWW)
GTSP	Global Temperature-Salinity Profile Programme
HOTO	Health of the Oceans (module of GOOS)
I-GOOS	Intergovernmental Committee for GOOS
ICSU	International Council of Scientific Unions
IGOS	Integrated Global Observing Strategy
IGOSS	Integrated Global Ocean Services System
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IODE	International Oceanographic Data and Information Exchange (IOC)
IPCC	Intergovernmental Panel on Climate Change (WMO-UNEP)
J-DIMP	Joint Data and Information Management Panel
J-GOOS	Joint Scientific and Technical Committee for GOOS
LMR	Living Marine Resources (module of GOOS)
NEAR-GOOS	North-East Asian Regional GOOS
NOAA	National Oceanic and Atmospheric Administration (USA)
OECD	Organisation for Economic Co-operation and Development
OOPC	Ocean Observations Panel for Climate
OOSDP	Ocean Observing System Development Panel (old)
PC	Personal Computer
SOOP	Ship-of-Opportunity Programme
SOPAC	South Pacific Applied Geoscience Commission
SSC	Strategy Sub-Committee (of I-GOOS)
TAG	Technical Advisory Group
TAO	Tropical Atmosphere Ocean Array
TEMA	Training, Education and Mutual Assistance (IOC)
TOGA	Tropical Ocean and Global Atmosphere (WCRP)
UNCED	United Nations Conference on Environment and Development (Brazil, 1992)
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
VOS	Voluntary Observing Ship (WMO)
WCRP	World Climate Research Programme
WESTPAC	IOC Sub-commission for the Western Pacific
WMO	World Meteorological Organization (UN)
WOCE	World Ocean Circulation Experiment