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THE GLOBAL OBSERVING SYSTEMS

I.1 Global systems for environmental observations began with the World Weather Watch of the World Meteorological Organization (WMO) in 1962. WMO established the Background Air Pollution Monitoring Network (BAPMon) in 1969, which with other systems became the Global Atmosphere Watch (GAW) in 1987. At the time of the United Nations Conference on the Human Environment in Stockholm in 1972, plans were laid in the scientific and international communities for a more comprehensive Global Environment Monitoring System (GEMS). This became one of the responsibilities assigned to the United Nations Environment Programme in its catalytic and coordinating role in the United Nations system. Despite success in particular areas like water pollution (GEMS/Water) and urban air pollution (GEMS/Air), the resources were never available to develop a truly global system for monitoring the environment. However within the last decade, with the rapid evolution of technologies for environmental observations and the political acceptance of the importance of global environmental problems, initiatives have been taken to plan and launch a set of Global Observing Systems. These are the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), and the Global Terrestrial Observing System (GTOS), each focusing on one of the major compartments of the biosphere (see diagram). The origins, approach, objectives and present stage of development of each of these systems are summarized in the Annex.

I.2 GCOS is most advanced system with a plan approved for implementation. GTOS is second with a plan which has just been accepted in principle by the co-sponsors. GOOS has now established and given terms of references to all the bodies which should be involved in preparation of an overall plan.

I.3 As will become clear from the review of the systems in the Annex, the objectives of the above three observation systems are not based on the same fundamental approach and there is a risk of overlapping between the three systems. In several cases the same types of activities are proposed within more than one system, sometimes for different purposes but quite often for similar purposes. Because of the above situation, Mr. C.C. Wallen was requested by the UN System-wide Earthwatch Coordination office, on behalf of UNEP, to prepare a report on the present relationship between the systems and on possibilities for improved coordination, collaboration and mutual support between them. This paper is based on extracts from his report.

II. Common Elements Between the Global Observing Systems

II.1 The three global observing systems, at present being launched, are not completely parallel to each other. Some global systems for the atmosphere (WWW and later GAW) have existed since the early 1960s, while global systems for the oceans (GOOS) and the land (GTOS), which cover the other major environmental compartments or media of the biosphere, are only now being developed. The World Hydrological Cycle Observing System (WHYCOS) is presently being developed in a few regions. The global system for climate (GCOS), the plan for which is ready and approved, is an issue-oriented system that draws from all the three basic systems for atmosphere, ocean and land.

Climate as a common element

II.2 As the overall climate system for the globe involves elements both from the oceans and the land, GCOS must, in addition to a fundamental part based on the existing global system for the atmosphere, obtain contributions from both the global ocean system and the one for the land surface. There has in fact been a continuing interchange between the observing systems, with the GCOS Joint Planning Office represented at all the scientific and technical planning meetings of GOOS and GTOS, and similarly representatives of the other systems attending all GCOS meetings.

The cross-linking elements have been developed by the Ocean Observation Science Development Panel (OOSDP) of GOOS and by the GCOS/GTOS Terrestrial Observations Panel (TOP) and will now go into the implementation phase of GCOS. Climate is an important element which is common to all three of the systems, and GCOS can be perceived as an integrated system of elements from all three of the basic environmental compartments. It should be noted in this context that the Intergovernmental Committee for GOOS (I-GOOS) at its second session in 1995 passed a Resolution that implementation of the GOOS climate element should have high priority and be pursued by the I-GOOS Technical Implementation Panel.

II.3 As GCOS together with the climate elements provided by GOOS and GTOS are now coming into the implementation phase, it is essential that there be increased coordination of these elements with the main GCOS system. GOOS through IOC has in fact provided an expert to the GCOS office in WMO for a year. Reciprocal arrangements from GCOS to the other systems' secretariats will presumably also be needed as they become operational.

Hydrology as a common element

II.4 A second element in common for the GCOS, GOOS and GTOS and for which data and information are required by all the three systems is hydrology (fresh water resources). However, the three systems in many cases will need different types of hydrological data and

therefore it is not self-evident that all data can be furnished by one of the systems. Since GTOS explicitly covers surface and sub-surface hydrological information, it would logically be the system that should furnish all three systems with such hydrological information as required. The presently available international data centres for fresh water data: the Global Run-off Data Centre, Koblenz, Global Precipitation Centre, Frankfurt and Global Water Quality Data Centre, Burlington, Canada, should be used as necessary by the three systems. Hydrological data on soil moisture and evapotranspiration cannot at present be obtainedthrough standardized measurements as suitable instrumentation is not available. However, as these data are required both by GTOS and GCOS at a reasonably small scale, they must be calculated by mathematical models or otherwise by using available information. Progress is now being made on providing such calculations, and FAO is working on methodologies for such purposes in Africa which might become available at a later stage. Hydrology is a area where a joint panel or task force for the three observing systems may be required to solve their common needs.

II.5 WHYCOS, the World Hydrological Cycle Observing System being developed by WMO to provide hydrological data, should eventually furnish national data required for various global purpose. At present this system is ongoing in 18 Mediterranean countries as a pilot project funded by the World Bank. It is planned and funded in two other regions of Africa, and in countries around the Aral Sea. Further plans for Latin America are expected to emerge from a meeting in Costa Rica in April 1996. The World Bank and UNDP have expressed interest in this global project. Nevertheless the project will only come into implementation gradually, and will thus take time to be operational for the whole globe.

The Coastal Zone as a Common Element

II.6 The Coastal Zone is clearly a common area for GOOS and GTOS as well as partly also for GCOS. No detailed plans for GOOS and GTOS activities in the coastal zones are so far available. However, it is clear from the terms of reference of GOOS that it is responsible for the marine ecosystems and the marine living resources in the coastal zone.

II.7 The so far fruitful cooperation between UNEP and FAO on the implementation of coastal development projects like urbanization and port building should continue, with funding as far as possible from the World Bank and UNDP. There are in addition to such practical projects a number of ongoing research problems in the coastal zone which, at the moment, are shared by GOOS and GTOS in the sense that experts from both fields are working on them in close cooperation; a useful cooperation that will lead to proposals regarding more operational activities. UNEP has also been charged with secretariat functions under the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, which links terrestrial and ocean problems. Under the Global Atmosphere Watch (GAW), WMO has demonstrated the significance of atmospheric inputs to coastal pollution. All these activities can provide a basis for contributions to the observing systems.

II.8 It will be necessary at some stage to clarify the borderline between the responsibilities of GOOS and GTOS. It seems reasonable that clearly land based projects should be within the GTOS terms of reference while more water related ones dealing with marine ecosystems, water pollution in regional seas, coral reefs, etc., would belong to GOOS. A difficult area, which is shared with GCOS, is the problem of future sea levels which may change due to a climate change. As a sea level rise in itself will have all sorts of repercussions on both land based activities and marine ecosystems, careful consideration about how this problem should be shared is essential. To improve the coordination of the Coastal Zone element, UNEP, with its large experience of environmental problems in the coastal zone, might take a leading role through its oceans, coastal and freshwater programme. A joint task force on this subject with experts from the three systems and with clear terms of reference on the common problems seems necessary.

Data Management as a common element.

II.9 Although, in the original planning of the three systems, it seems to have been taken for granted that separate data management systems should be developed for each, it has become more and more obvious with the development of modern telecommunications that a common data management system or at least a common strategy could be used for them in their operational stage. It seems to be too early to propose how such a common system should be designed, although there are broader on-going efforts to streamline data and meta-data issues for global reporting among the major institutions involved (DPCSD, World Bank, UNEP, UNDP, WRI, etc.). Already both the GCOS and GTOS plans provide clear pictures of the needs for data management of those two systems.

II.10 For regional activities within a data management system, like harmonization of data, it would be preferable to use centres which have been established for other similar purposes and therefore are already furnished with modern telecommunications and computer equipment. There are a number of such systems, for instance GRID within UNEP, IODE in IOC, and WWW in WMO. Further investigations need to be undertaken to find out to what extent existing systems can be used for common data management. However, if data management for the three global systems is to take place at centres already available, each of the systems will have to provide experts to these centres for their special activities. The available staff at these regional centres would not necessarily be sufficiently familiar with the needs of each system to carry out harmonization of data and similar specific activities.

Space-based observations as a common element

II.11 In Version 1 of the GCOS plan for space-based observations, an excellent overview is presented not only of the GCOS needs for space-based observations of the atmosphere and the land surface but also for GCOS needs for the oceanic climate element. However similar information is lacking on the requirements of GOOS and GTOS for space-observations of the oceans and land surface for other purposes than climate. A Space Observation Panel has

recently been proposed for GOOS.

II.12 It is obvious, however, that the space observations which are available or will be developed for the climate purpose will go a long way to meet other requirements under both GOOS and GTOS, so further coordination in this area is required. Experts on space-observations from GOOS and GTOS should study what space observations are available or will be developed for GCOS in the climate area and identify gaps that need to be filled for the special requirements of GOOS and GTOS. These experts could become adopted members of the GCOS panel on space-based observations. The combined needs of the three systems can then be fed into CEOS, where the partner organizations are all associates.

III. Characteristics of Each of the Global Systems

III.1 It is more realistic to aim for a common strategy for the three observing systems rather than integrating them into one single system. The basic reason is that each of the systems, although linked in various ways with the others, has its own characteristics which make it fundamentally different from the others, as follows:

GOOS

III.2 To start with GOOS as the first system launched, the idea of developing an observation system for the oceans, which has been considered for about 100 years is, at this stage, mainly driven by practical needs and political considerations. While scientific issues have a role to play, the main problems for implementing a system today are related to the disparate views of governments on how to achieve what they feel essential for their needs.

III.3 Hence, GOOS is being established primarily for other purposes than those related to climate and GCOS. Continuous observations are needed of fish and other marine living resources and for environmental requirements such as the state of coral reefs and mangroves. GOOS should become the ocean observation system that would meet reporting requirements arising from the implementation of the Law of the Sea Convention for which a Secretariat has been established. The system is likely to become crucial for applications to the fishing industry and also to the possible future exploitation of the sea bed. The integration of GOOS with the other two systems is thus not feasible.

GTOS

III.4 GTOS, as with GOOS for the oceans, is basically conceived as an independent observation system for the land surface, where most activities are of direct benefit to or linked to applications both at the national level and within international organizations (FAO, UNEP, UNESCO). There are many reasons to establish GTOS independent of its climate linkages with GCOS. The GTOS plan shows that the basic need for GTOS is to monitor changes in terrestrial ecosystems caused by anthropogenic or natural impacts, including changes in the

local status and micro-climates of ecosystems. Providing information on the feedback of such changes to the overall climate system observed in GCOS is not the fundamental purpose for the establishment of GTOS. The practical usefulness of both GOOS and GTOS lies in their provision of data and information for direct applications concerning changes in both managed and natural ecosystems. These are needed not only for decision making at the national level but also for FAO for agriculture and forestry, UNEP on biodiversity, WMO on hydrology, and UNESCO which coordinates the MAB programme with its Biosphere reserves. With particular regard to the Biosphere Reserves, the UNESCO General Conference recently adopted standard regulations for Biosphere Reserves making them more useful for becoming involved with GTOS. Other activities under GTOS related directly to applications include i.a. observations of global forest cover, land degradation, soil cover and hydrological variables such as soil moisture and evapotranspiration.

GCOS

III.5 GCOS is the one system that is oriented more towards an environmental and scientific issue, that of climate change, rather than an environmental compartment of the biosphere. Its basic aim is the generation of data to improve understanding of the complex climate system and its variability required by governments and users for three basic applications:

(1) Developing methods for and use in prediction of climate around the globe on a seasonal basis;

(2) Early detection of climate change;

(3) Securing data from all parts of the globe necessary for predicting the impact of climate, climate variability and change on national and regional socio-economic systems.

For the above purposes GCOS is closely linked to GOOS and GTOS, being dependent upon data both from the oceans and land, as well as atmospheric data from WWW and GAW. Therefore GCOS is the only system based on a real integration of the three environmental media, while in both GOOS and GTOS there are considerable data activities which are not related to the climate elements integrated in GCOS.

IV. A Common Strategy and Basic Aims of the Three Systems

IV.1 In order to coordinate the activities of the three global observing systems with the above particular characteristics, the approach to the three systems needs to be harmonized. At present, the special objectives of the three systems dominate their approaches, they were launched at different times and are in many ways independent of each other.

IV.2 Obviously there is no reason to abolish or change the particular objectives which were the basis for launching each of the systems, but better coordination requires at least the

development of an overall "raison d'être" for their common function.

IV.3 A basic problem with the existing objectives is that they reflect the main considerations for their launching: GCOS, although established also for practical needs, is basically driven by scientific requirements; GOOS has practical objectives and also involves political considerations; GTOS, as an observation system for the land surface, is much more directly related to human needs, although through IGBP, science has an important place.

IV.4 In finding common goals and aims, and ultimately a common strategy, for the three systems, it is necessary to review the needs of governments, policy makers and users in practical life for the data and information that the systems together will generate in their monitoring of global environmental changes over time. Only through demonstrating how important these needs are to the future of the world's governments and users can funding be obtained to implement the systems. GCOS has already established a Socio-economic Working Group to address this. The three systems should together develop a clear picture of how governments and user groups would be able to apply their data and information in decision making, for instance in the calculation of indicators for sustainable development as called for by the Commission on Sustainable Development. The proposed implementation of pilot projects to demonstrate the feasibility of GTOS, GCOS and GOOS can be useful in the development of a common strategy.

IV.5 To respond to the above concerns, the co-sponsors are considering the establishment of an umbrella group for the three systems to ensure continuing close synergy and a common broad strategy for the global observation systems and their applications. This group is expected to meet in June 1996.

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ANNEX

Origins, Approach, Objectives, and Present Stage of Development of the Global Observation Systems

1. The Atmosphere

1.1 The first serious attempt to establish a global observation system was launched for the atmosphere by WMO in 1962 and was endorsed by the UN General Assembly the same year. It was given the name World Weather Watch (WWW), and was intended as a basis for weather forecasting around the world. The observations to be taken were of the physical parameters within the atmosphere relevant to the processes causing the variability of weather. The observation system is completed by a telecommunication system (GTS) which ensures a real time distribution of the ground observations around the world. Satellite observations, which had started to become available at about the same time, are gathered in World Meteorological Centres from where they are distributed worldwide.

In 1969 WMO launched a first attempt to observe changes in the chemical composition of the atmosphere through the establishment of a world wide system called the Background Air Pollution Monitoring Network (BAPMoN) where measurements of the carbon dioxide content of the atmosphere are made at 10-15 base line stations and precipitation chemistry is observed at about 150 regional stations. In 1987 this observing system was joined with other existing systems for studies of chemicals in the atmosphere to create what is called GAW, the Global Atmosphere Watch.

1.2 In view of the growing importance of the world's climate and its possible change due to anthropogenic impact, and as a consequence of the Second World Climate Conference in 1990, WMO together with FAO, IOC, ICSU, UNEP and UNESCO decided to launch a global observation system for climate called GCOS. This observation system, planned to be based upon existing observation activities in the atmosphere, oceans and on land like WWW, GAW, IGOSS, SST, GIPME, MAB, GEMS/WATER, etc., is now coming into its implementation stage.

1.3 **Approach to GCOS**. The Global Climate Observing System (GCOS) was launched in 1992, in order to define and specify an operational climate observing system for the next century. For this purpose the deficiencies in existing observation systems need to be identified, research stimulated and development enhanced. The needs for and benefits of a GCOS became even more clear after the UN Conference on Environment and Development in Rio in 1992 when the Framework Convention on Climate Change was launched and Agenda 21 was presented as a basis for global sustainable development in the next century. A Secretariat for GCOS was set up in WMO in 1992 to develop an operational plan for implementation, and a GCOS Joint Scientific and Technical Committee (JSTC) was established. The GCOS Plan, the Plan for Data and Information Management, and the Plan for Space-based Observations were all agreed at JSTC-IV in 1994 and published in 1995. The TOP Plan for Terrestrial Observations was agreed by the fifth session of the JSTC in October 1995.

1.4 **Objectives of GCOS** (as included in the above plan)

Systematic global observations of key variables within the global climate system should be made available to nations to enable them to:

- Detect and quantify climate change at the earliest possible time;

- Document natural climate variability and extreme climate events;

- Model, understand and predict climate variability and change;

- Assess the potential impact of climate and its variability on ecosystems and socio-

economics;

- Develop strategies to diminish potentially harmful effects or amplify beneficial ones;

- Provide services and applications to national climate - sensitive sectors;

- Support sustainable development.

1.5 A new important support for GCOS and its objectives has recently been developed as a result of the WMO Intergovernmental Meeting on the World Climate Programme in 1993. In the document requested by that meeting: "The Climate Agenda", a proposal for an Integrated Framework prepared by FAO, ICSU, UNEP, UNESCO and its IOC, and WMO, dedicated observations of the global climate system is one of the four main thrusts.

1.6 Details outside the 1995 plan have been described in various GCOS publications issued over the last three years. According to the plan, GCOS is expected to provide the following deliverables:

(1) High quality, well-calibrated, long-term observations needed for

- seasonal to interannual climate projection

- early detection of climate trends due to human activities

- reduction of major uncertainties in long-term climate projection

- observational requirements of the UN Framework Convention on Climate Change;

(2) Information to assist national economic and sustainable development;

(3) Increased capacity and involvement of developing countries to enable them to participate in both observational and analytic activities to better address national issues;

(4) Improved data and information services in support of climate research, climate services and climate impact assessments as foreseen in the "Climate Agenda".

1.7 Present State of Development of GCOS

The GCOS plan consists of four parts:

(1) A brief review of the climate issues which motivated the establishment of GCOS;

(2) The strategy for the development of the system;

(3) The scientific and technical issues associated with the development and initial implementation of the system;

(4) Management issues.

1.8 **GCOS activities during the next step in the planning process are to** :

(1) Design an effective, operational climate observing system;

(2) Establish, coordinate and manage an Initial Operational System by integrating and enhancing existing components;

(3) Develop new components to provide a comprehensive and responsive system to meet existing and future needs.

1.9 The following and final step is implementation, which is expected to take place in phases and require the participation of nations with both activities and funding. Selected implementation activities are:

(1) Select sites for inclusion in networks;

(2) Improve data access especially in developing countries, filling gaps;

(3) Integrate climate issues across disciplines;

(4) Promote international climate discussions.

2. The Oceans

2.1 Close relations between WWW and GAW on one side and oceanic observing systems on the other have existed since the early 1960s and earlier, as weather forecasting for many years has required observations from the oceans, like from the joint WMO/IOC IGOSS system. A system for monitoring the health of the oceans was launched in 1978 when GIPME was established by IOC. In 1989 IOC decided to launch the idea of a global observing system for the oceans and the marine ecosystem called GOOS, which is now in the planning stage.

2.2 **Approach** to GOOS

In 1990 the Second World Climate Conference reiterated the need for GOOS as providing a major element to the Global Climate Observing System. In 1992 IOC called for its Member

States to support, in collaboration with WMO and UNEP, the development of GOOS as an important contribution to Agenda 21 from UNCED. In 1993 the Seventeenth Session of the IOC Assembly endorsed "The Approach to GOOS", a document that gives the broad lines for the planning and development of GOOS. The first session of the Intergovernmental Committee for GOOS (I-GOOS) was held in 1993 and a number of special Panels for GOOS Modules were agreed to be gradually established : Ocean Observing System Panel, Health of the Ocean Panel, Marine Living Resources Panel, Marine Services Panel, etc. These were later established by the Joint Scientific and Technical Committee for GOOS (J-GOOS). The first meeting of that body was held in 1994. A second session of J-GOOS was held in April 1995 and a second session of I-GOOS in June 1995.

2.3 GOOS will be developed in a phased approach as follows:

(1) Planning phase, design and definitions;

(2) Operational demonstrations; pilot phase;

(3) Implementation of permanent operations;

(4) Continued assessments by the use of data

2.4 **Objectives** (according to "The approach to GOOS")

"GOOS is a major endeavour of the ocean megascience activities for the next century to address issues such as global environmental and climate change as well as aspects of sustainable development in relation to rational use of ocean resources and integrated coastal zone management."

"GOOS is a multi-disciplinary approach to systematic long-term observations of the World Oceans and requires close collaboration of various national agencies and institutions dealing with scientific research, operational services, technology development as well as explorationand exploitation of marine resources". The major activity elements of GOOS are:

(1) Operational, oceanographic and marine resource observations and analysis;

(2) Timely distribution of data and products;

(3) Data assimilation into numerical models for prediction;

(4) Capacity building within Member States.

2.5 **User Interest of GOOS**

GOOS will be divided in five interrelated modules which represent user interests:

(1) Monitoring of the Coastal Zone Environment and its changes;

(2) Climate Monitoring, Assessment and Prediction (a module in cooperation with GCOS);

(3) Marine Meteorological and Oceanographic Services;

(4) Assessment and Prediction of the Health of the Ocean;

(5) Monitoring and Assessment of Marine Living resources.

2.6 Present Stage of Development of GOOS

The first planning meeting of the IOC/WMO/UNEP Intergovernmental Committee on GOOS (I-GOOS) in 1993 was attended by 26 IOC-Member States. It recommended the establishment of:

(1) A Strategy Sub-Committee to advise I-GOOS on policy, marketing and fund related issues;

(2) An I-GOOS Panel on Technical Implementation to advise I-GOOS on implementation of an integrated ocean observation network to meet GOOS scientific and operational requirements;

(3) I-GOOS Panel on Products and Distribution to advise I-GOOS on products to meet user needs.

The twenty-seventh session of the IOC Executive Council in July 1994 approved the above recommendations and the above bodies were hence established.

The Planning Session also proposed the following list of priority actions for 1994-95:

(i) formulation of a general GOOS strategy;

(ii) development of a special coastal zone strategy for GOOS;

(iii) scientific design of GOOS;

(iv) support to the implementation of the post-TOGA Observing System;

(v) support to GOOS-related aspects of existing operational ocean observing and data management systems;

(vi) establishment of further I-GOOS panels as required.

The above scheme has on the whole been followed.

2.7 The first session of the IOC/WMO/ICSU Joint Scientific and Technical Committee for GOOS, the so-called J-GOOS, was held in May 1994. The first assigned task under this Committee, to formulate the conceptual scientific and technical design of an ocean climate observing system, as a basis for the climate module of GOOS and the ocean component of GCOS, was completed in December 1994.

Two other modules of GOOS under the J-GOOS are being designed at present by ad hoc panels on Living Marine Resources and on the Health of the Ocean Module under GIPME.

2.8 The main decisions from the second session of the IOC/WMO/UNEPIntergovernmental Committee for GOOS (I-GOOS) in June 1995 were as follows:

(1) A Resolution on the Implementation Responsibility of the common GCOS/GOOS Climate Module which referred the implementation to the I-GOOS Technical Implementation Panel for action with high priority;

(2) Six recommendations request

(i) I-GOOS Strategy Subcommittee to urgently submit a strategic plan for GOOS including basic policy for internal and external coordination. The Strategic Subcommittee was established and given terms of reference;

(ii) Establishment of I-GOOS Panel on Technical Implementation with terms of reference;

(iii) Establishment of I-GOOS Panel on Products and distribution with terms of reference;

(iv) That J-GOOS and its technical and scientific subgroup be invited to review the pilot activities related to the coastal zone environment and to give advice on their implementation. For further action support should be negotiated with UNEP and WMO.

(v) That IOC Assembly recognize the priority for GOOS development.

2.9 The second session of the J-GOOS which was held in April 1995 provided the following main results. The session dealt i.a. with the relationship between GOOS and GCOS, a subject of particular importance for the present report. J-GOOS agreed that there was much

in common between the data management system outlined by GCOS and the one needed for GOOS. It was agreed that GOOS should be represented in the planning process of the data management system of GCOS. For the purpose of Space-based Observations for GOOS a Space Observation Panel was proposed. Its relation with GCOS activities in the same area is not yet clear.

The meeting supported the establishment of OOPC to follow upon the completion of the report of OOSDP. This was agreed by the JSTC for GCOS later in 1995 (see below).

The meeting also reviewed the status of the GOOS panels on Health of the Ocean, Living Marine Resources, Coastal Module and the Ocean and Marine Meteorological Service Module.

2.10 In view of the close relations between GCOS and GOOS, in particular regarding the climate element of GOOS, the further plans of GOOS, OOSDP and OOPC were thoroughly discussed in the JSTC meeting of GCOS in October 1995. Some of the recommendations important for further planning of GOOS were as follows:

- OOPC, which will supersede OOSDP, should assign priorities to the observational elements based on user needs and is encouraged to examine the importance of carbon flux to the ocean from rivers and estuaries. It will be jointly sponsored by GCOS, GOOS and WCRP.

- OOPC should consider the WOCE data quality assessment procedures for applicability to GCOS ocean data for climate.

- For implementation of the ocean climate component of GCOS the needs for continuing interaction between the GCOS Joint Planning Office and the GOOS Support Office were stressed.

An important outstanding question regarding the further planning and implementation of the climate element of GOOS is to which extent it should be funded by GOOS or GCOS. JSTC agreed to remind the IOC of their commitment to provide a significant financial contribution to GCOS for this purpose.

3. **The Land**

3.1 For the purpose of finding out long-term changes in terrestrial ecosystems no special system has existed until recently. Various activities have nevertheless been going on for several decades, such as observations of local and micro-climates for agricultural purposes by FAO/WMO, monitoring of the world's forests by FAO/UNEP and of desertification by UNESCO/UNEP, as well as various hydrological activities at the national level coordinated by FAO, WMO, UNESCO and WHO. UNEP, being concerned particularly with possible anthropogenic impacts on terrestrial ecosystem, studied for some years in the early 1990s the

need for an observing system for the land surfaces and proposed in 1992, together with IGBP which was interested in a similar system from the scientific point of view, a planning group to be established for the purpose of developing a plan for a Global Terrestrial Observing System, GTOS. Such a planning group co-sponsored by FAO, ICSU, UNEP, UNESCO and WMO was established in 1993. A plan for GTOS was submitted to the co-sponsors at the end of 1995, and a support office for GTOS is now being established at FAO, with a Steering Committee to be named during 1966.

3.2 **GTOS** approach

UNEP had a mandate from its creation to coordinate and initiate global environment monitoring systems (GEMS), has over the years acquired considerable experience of such issues. In the 1980s, in cooperation with UNESCO and WMO, GEMS started a pilot project to develop methods for integrated monitoring of pollutants in various media at land stations. When around 1990 the question arose whether a global system was needed to monitor global changes of the terrestrial ecosystems, the above experience caused UNEP to call a series of meetings, which resulted in the establishment of a Scientific Advisory Committee on Terrestrial Ecosystem Monitoring and Assessment (SACTEMA). As the IGBP programme had developed a subprogramme on Global Change in Terrestrial Ecosystems, IGBP in 1992 called a more scientifically oriented expert meeting on the same subject. These two approaches together led to the establishment in late 1993 of a joint committee, by co-sponsors FAO, ICSU, UNEP, UNESCO and WMO, to further study the question. This in turn resulted in the setting up of a planning group for a Global Terrestrial Observing System (GTOS). The planning group reported in early 1995 to the co-sponsors and its final report to them is expected at the end of this year.

3.3 **GTOS objectives** reflect the basic fact that there exist at the same time a clear interest of governments, policy makers and other users in obtaining continuous data on the impact of anthropogenic effects on terrestrial ecosystems, and a strong requirement from various groups of scientists involved in ecosystem research for a global observing system. According to the plan of 1995 the central mission and objectives are presented as follows:

3.4 The **central mission** of GTOS is to provide the data needed to detect, quantify, locate and give early warning of changes (especially reductions) in the national or global capacity of terrestrial ecosystems to support sustainable development and improvements in human welfare, and to help advance our understanding of such changes. To accomplish this, anintegrated and equitable partnership that meets both the immediate needs of national governments and the longer term needs of the global change research community will be developed.

The major objectives to be enabled by GTOS are:

(1) To identify and quantify the natural and anthropogenic factors that affect terrestrial

ecosystem function and structure;

(2) To determine the relative importance of these factors at the national, regional or global level and their interactions;

(3) To distinguish short-term natural variations or perturbations from long-term

changes of anthropogenic origin;

(4) To assist modelling and multidisciplinary dynamic analysis of possible future changes in terrestrial ecosystems and their implications for sustainable development.

In order to accomplish these objectives GTOS will:

(1) Utilize data from the existing monitoring networks and bring them together into a global network to increase their utility;

(2) Support the upgrading of site instrumentation and management where appropriate, and establish additional monitoring sites to ensure adequate representation of the dominant or most sensitive managed agro-ecosystems, biomes, and ecotones;

(3) Develop a hierarchial system of sites, remote sensing imagery, and variables that can provide the data essential for the clarification of key questions and uncertainties on the vulnerability of terrestrial ecosystems to anthropogenic forces;

(4) Collect and assemble data through an international partnership between generators and users;

(5) Work to gain international acceptance for a common data management framework with internationally accepted protocols and procedures for the collection, harmonization and free exchange of compatible data;

(6) Support national monitoring systems in training, project preparation and the sourcing of external financial help.

3.5 **Present stage of development of GTOS**

The overall plan for a global terrestrial observation system (GTOS) was accepted in principle by the co-sponsors of GTOS in January 1996. In addition to this plan and as mentioned under GCOS, the GCOS/GTOS Terrestrial Observation Panel (TOP) has developed version 1.0 of a plan for the terrestrial requirements of GCOS and the climate observations of GTOS. This plan addresses three key areas: the biosphere, the hydrosphere and the cryosphere. The

JSTC has requested a paragraph on socio-economic benefits to be added to the present plan. Particularly useful information in this document is the list of variables in GTOS observations that would be useful or needed for GCOS purposes such as for modelling the general circulation of the atmosphere.

3.6 The GTOS draft plan consists of two parts. The first contains an overall review of the proposed plan. The second gives details of user needs, products and services, the observation system proposed, data management requirements, support to national needs, and the coordination framework. Annexes give details on i.a. potential variables and prospective sites to be included in the observing system.

3.7 The GTOS plan was accepted in principle by the co-sponsors in a meeting on 7-8 January 1996 as a partnership of partnerships bringing together various existing observation networks, sites and research centres. A Steering Committee is being established to oversee the activities of GTOS. FAO will take on the day to day responsibilities for the implementation of the plan, with other agencies taking responsibilities for particular activities e.g. WMO for hydrology and UNESCO for use of biosphere reserves. Scientific and technical advisory groups to support the steering committee are also envisaged eventually. The plan finally foresees the need for some type of regional system of national bodies and contact points.

TABLE OF ACRONYMS

AGMET Agricultural Meteorology

BAPMoN Background Air Pollution Monitoring Network

DBCP Data Buoy Co-operation Panel

FAO Food and Agriculture Organization of the United Nations

GAOS Global Atmosphere Observing System

GAW Global Atmosphere Watch

GCOS Global Climate Observing System

GEMS/WATER Global Environment Monitoring System/Water

GIPME Global Investigations of Pollution in the Marine Environment

GOOS Global Ocean Observing System

GOS Global Observing Systems

GRID Global Resource Information Database

GSO GOOS Support Office

GTOS Global Terrestrial Observing System

GTS Global Telecommunication System

HYDR Hydrology

ICSU International Council of Scientific Unions

I-GOSS Intergovernmental Committee for GOOS

IGBP International Geosphere-Biosphere Programme

IOC Intergovernmental Oceanographic Commission

JPO Joint Planning Office

J-GOOS Joint Scientific and Technical Committee for GOOS

JSTC Joint Scientific and Technical Committee

MAB Man and the Biosphere Programme

MARPOLMON Marine Pollution Monitoring

OCA/PAC Ocean and Coastal Areas Programme Activity Centre

OOPC Ocean Observing Panel for Climate

OOSDP Ocean Observing System Development Panel

SACTEMA Scientific Advisory Committee for Terrestrial Ecosystems Monitoring and Assessment

SST Sea Surface Temperature

TAO Tropical Atmosphere Ocean

TOP Terrestrial Observations Panel

UN United Nations

UNCED United Nations Conference on Environment and Development

UNDP United Nations Development Programme

UNEP United Nations Environment Programme

UNESCO United Nations Educational, Scientific and Cultural Organization

WCIRP World Climate Impact and Response Strategies Programme

WCRP World Climate Research Programme

WCDP World Climate Development Programme

WHO World Health Organization

WHYCOS World Hydrological Cycle Observing System

WMO World Meteorological Organization

WOCE World Ocean Circulation Experiment (WCRP)

WWW World Weather Watch

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