Global Terrestrial Observing System

Report of the Meeting of Experts on Ecological Networks

(Guernica, Spain, June 17-20, 1997)

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I. Opening of the Session

i. Welcome

The Chairman, Dr Robert Scholes, opened the meeting. On behalf of Josu Montalban Goicoechea, Director of Diputación Foral de Urbanismo, Dr Luis Rodriguez Herrero, Director of the Instituto de Estudios Territoriales de Vizcaya, welcomed the participants of the meeting and stated that the Instituto de Estudios Territoriales de Vizcaya and the Biosphere Reserve of Urdaibai were pleased to host the meeting in Guernica. He emphasised that man must live in harmony with his environment and this presents many challenges. Further, he stated to understand the impact man is having on the environment it is necessary to monitor long-term changes that are occurring in ecosystems. Prof. John Townshend, Chairman of the Joint Scientific and Technical Committee of the Global Climate Observing System thanked Dr Rodriguez Herrero for his remarks, for the local organizational support to the meeting, and for the substantial financial contribution that Diputado Foral de Urbanismo had made towards the meeting.

ii. Purpose of the Meeting

Dr Scholes stated that the purpose of the meeting was to bring together representatives from selected networks to provide the Global Climate Observing System (GCOS) and the Global Terrestrial Observing System (GTOS) steering committees with advice on the best way to proceed in developing a network of ecological sites to meet both GCOS and GTOS objectives. The participants were asked to make a series of recommendations to the GTOS Steering Committee and the JSTC of GCOS that, if accepted, would result in a nucleus for a GTOS network that would not only meet the needs of the Global Observing Systems, but also the needs of individual networks and sites. Specific goals for the meeting were to:

- Establish a consensus for the need for an overarching international framework for ecological networks;
- Establish guiding principles for the development of such a system;
- Agree to an overall architecture for such a system;
- Develop a demonstration project that can be undertaken to show the benefit of working together;
- Develop a series of required steps to establish a GOS-Net;

iii. Approval of the Agenda

The provisional agenda was approved, though later modified as the meeting progressed. The revised agenda is attached (Annex II).

iv. Introductory Comments

International Geosphere-Biosphere Programme (IGBP)

Dr Scholes welcomed the participants on behalf of IGBP. While IGBP is not a monitoring programme a significant amount of data that is directly useful to the Global Observing Systems is being collected. IGBP wants to assist the G3OS's to make many of the current IGBP observations operational. IGBP clearly supports the Global Observing Systems and the need for a set of long-term observations, which will further research efforts in the future.

Global Terrestrial Observing System (GTOS)

Mr Jeff Tschirley, Director of GTOS welcomed the participants and reviewed the structure and main elements of the programme. GTOS was created to provide policy makers, resource managers and researchers with access to the data needed to detect, quantify, locate, understand and warn of changes (especially reductions) in the capacity of terrestrial ecosystems to support sustainable development. The focus is on five key development issues of global or regional concern:

- Changes in land quality;
- Availability of freshwater resources;
- Loss of biodiversity;
- Pollution and toxicity; and
- Climate change.

An important GTOS objective is to link scientific information with policy development. This will be achieved through equitable partnerships between data providers and users. Included in these two groups are governments, national and international scientific programmes, Secretariats of International Conventions related to the environment (e.g. Biodiversity, Climate Change and Desertification), UN agencies, non-governmental organizations and the private sector.

GTOS is sponsored by five organizations - Food and Agriculture Organization of the United Nations (FAO), International Council of Scientific Unions (ICSU), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Environment Programme (UNEP) and World Meteorological Organization (WMO) who make modest annual contributions to the operation of the programme. The secretariat is operated by FAO in Rome.

Following a preparatory stage, GTOS began operation in 1996. It has issued two publications - the Scientific and Technical Planning Group Report[1], and GTOS and the Conventions[2]. The GTOS Steering Committee met in December 1996 in Rome. A coordination and implementation sub-group met in May 1997 to review a draft programme implementation plan which will be completed during 1997.

During the preparatory phase, a terrestrial ecosystem monitoring sites meta-database (TEMS) was established which is an international directory of long-term terrestrial monitoring sites around the world. TEMS presently operates on Oracle software, is web-based, is searchable and contains information on more than 700 sites. It is planned to continue development of this meta-database, including the addition of more sites, improved user interface and a PC-based version.

Mr Tschirley outlined the elements of a GTOS global network demonstration project which would serve to demonstrate the value of linking existing terrestrial monitoring networks by concentrating on a few topics of common interest and that are of global or regional importance. Among the characteristics that would be sought among the participating networks are:

- Common ground with GTOS;
- Technical experience and maturity;
- Active data gathering;
- International context;
- Broad geographic coverage;
- Coverage of data-poor regions;
- Functional complementarity;
- Expectation of continuity.

It is envisioned that a network demonstration project could help to promote the sharing and exchange of terrestrial data, and compare methods used to collect it. Specific studies could be undertaken to document how networks function, their user groups, and different uses of the data such as for modelling. GTOS was prepared to establish a Network panel to advise the GTOS Steering Committee (GTSC) and guide the evolution of a network of networks.

It was hoped that a demonstration project could be discussed during the meeting and participants were asked for their advice on the conceptual approach, priority issues to be addressed, and suggestions on how to proceed.

Global Climate Observing System (GCOS)

Prof. John Townshend presented the background of the GCOS. The GCOS was established after the Second World Climate Conference to ensure the acquisition of the observations required to meet the needs for:

[1] ICSU/UNEP/FAO/UNESCO/WMO, 1995: Global Terrestrial Observing System (GTOS): Turning a sound concept into a practical reality UNEP/EAP. TR/95-08

[2] Gwynne, M.D., 1996: GTOS and the Conventions: The Global Terrestrial Observing System and the Data and Information Needs of some of the Environmental Convention Secretariats UNEP/DEIA/TR.96-3

- Climate system monitoring, climate change detection, and response monitoring, especially in terrestrial ecosystems;
- Data for application to national economic development;
- Research towards improved understanding, modelling, and prediction of the climate system.

To meet these objectives, the GCOS planning took a comprehensive view of the observational requirements for climate information, and addressed the required observations from the atmosphere, ocean, land surface, and cryosphere. It must include surface-based and space-based observations, and a comprehensive data system.

The GCOS is planned as a phased programme, building upon the present observational activities of the operational and research programmes of the participating countries. For the atmosphere, a close coordination with ongoing WMO programmes has begun. The GCOS programme is currently assessing existing operational systems, including the World Weather Watch (WWW), the Global Atmosphere Watch (GAW), and operational hydrology programmes. Based on these assessments, recommendations will be made for enhancements or new observations, which should be done, in concert with existing programmes, to ensure the climate needs are met. In a similar fashion for the ocean, the GCOS programme is cooperating with the Intergovernmental Oceanographic Commission (IOC) in its efforts to establish a Global Ocean Observing System (GOOS). For Terrestrial Systems a joint programme with the GTOS was established.

The detailed scientific plans for GCOS have considered the full scope of issues, including the requirements of users/participants, the contributions of current research and operational programmes and data systems, and the participation of both international and national organizations. The scientific scope includes atmosphere, ocean, land surface, cryosphere, hydrosphere, and ecosystem processes. With the completion of these important plans and documents in 1995, GCOS entered a new phase in 1996, that of implementation. The initial implementation of GCOS has led to improved seasonal to interannual predictions of climate. It is expected that as GCOS continues to be implemented, countries will see benefits not only from improved climate predictions but also in planning for sustainable development and in assessing the impacts of climate change on both agricultural and natural ecosystems.

Prof. Townshend stated it is recognised that operational programmes such as WMO's WWW, GAW and others are well organized and contributing significantly to GCOS. However, there is a clear and defined need for *in situ* observations from the land surface to support GCOS objectives of detecting climate change on a regional basis, assessing seasonal to interannual climate variability, simulating long-term climate change and evaluating the impact of climate change, particularly on terrestrial systems.

He concluded by stating that the GCOS objectives for the meeting were essentially the same as outlined by the Chairman. It is important to gain an agreement from the networks on the way forward and agree on at least the initial steps to forming a network of sites for *in situ* observations

v. Background to the Meeting

There is widespread recognition of the value of and need for systematic collection of ecosystem data to meet requirements of sustainable development, conservation of resources, the needs of the international conventions, and the validation of measurements and information derived from satellite data. While few activities take place at the global level there is an enormous data collection effort at the national or regional levels. The Fontainebleau meeting (1992)[3] laid out a framework for a global system to monitor terrestrial ecosystems. The planning for GTOS began after the Fontainebleau meeting. During the planning phases of GTOS a Global Hierarchical Observing Strategy (GHOST) was defined by the GCOS/GTOS Terrestrial Observation Panel for Climate (TOPC) and the GTOS Scientific and Technical Planning Group. That strategy has had extensive review and it is believed that it can form the basis of networks and sites working together for some common objectives. The strategy has been endorsed by a meeting of hydrology experts held in Geneva in April 1996 and by the G3OS meeting on *In Situ* Observations for the Global Observing Systems[4] held in Geneva in September, 1996. The *In Situ* Observation meeting identified, among others, the need for a mechanism through which existing sites and networks can be coordinated, enhanced and augmented. Finally, space agencies require *in situ* data for the conduct of calibration and validation studies as well as for effective use of routine, long-term satellite observations. A global terrestrial network of ecological sites will be particularly useful for this purpose.

II. Reports from the Networks

Included below is a brief statement of the primary goal(s) for each of the networks. A more complete description of the networks can be found in Annex III.

i. UK Environmental Change Network (ECN)

ECN goals are to collect, store, analyse and interpret long-term data based on a set of key variables which drive and respond to environmental change at terrestrial and freshwater sites across the UK. ECN data will be used to distinguish short-term fluctuations from long-term trends associated with man's activities and to predict future changes.

ii. The World Network of Biosphere Reserves

The goals are:

- To explore and demonstrate approaches to *in situ* biodiversity conservation and sustainable use of its components;
- To provide support for demonstration projects, environmental education and training and research and monitoring related to local, regional, national and global issues of conservation and development.

[3] Heal, O.W., Menaut, J.C., Steffen, W.L. (Eds.), 1993: Towards a Global Terrestrial Observing System (GTOS): Detecting and monitoring change in terrestrial ecosystems. MAB Digest 14 and IGBP Global Change Report 26, UNESCO, Paris and IGBP, Stockholm

[4] GCOS-28, 1997: *In Situ* Observations for the Global Observing Systems: Development of an integrated strategy and identification of priorities for implementation, Geneva, Switzerland, WMO/TD No. 793, UNEP/DEIA/MR.97-3

iii. US Long-Term Ecological Research Network (U.S. LTER)

The primary goals of the LTER Network are to facilitate research:

- To understand ecological phenomena that occur over long temporal and broad spatial scales;
- To create a legacy of well-designed and documented, long-term experiments,
- To conduct major syntheses and theoretical efforts; and
- To provide information for the identification and solution of societal problems.

The concepts of the LTER Network are in agreement with those of GTOS, but LTER has a stronger emphasis on research than monitoring.

iv. Chinese Ecosystem Research Network (CERN)

The primary goals of CERN are:

- To monitor environmental change;
- To study the structure, function, dynamics and management of ecosystems;
- To provide the managerial models of sustainable use of ecosystems at the local level;
- To provide the scientific basis for decision-making process at the provincial and national levels.

v. International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP IM)

The primary goals of ICP IM are:

- To monitor the state of ecosystems (catchments/plots) and provide an explanation of changes in terms of causative environmental factors, in order to provide a scientific basis for emission control;
- To develop and validate models for the simulation of ecosystem responses;
- To carry out biomonitoring for detecting natural changes, in particular to assess effects of air pollutants and climate change.

In a more long-term perspective the IM concept is useful among other things in monitoring ecosystem effects of climate change, ozone depletion and changes in biodiversity.

vi. The Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD)

The major goal is to improve the understanding of ecological systems and environmental degradation processes.

vii. Réseau d'observatoires de surveillance Ecologique à Long Terme (ROSELT)

ROSELT is a monitoring system of desertification for African countries with the following major goals:

- To improve the understanding of the mechanisms leading to desertification;

- To establish the indicators related to the causes and the effects of the desertification;
- To propose actions for the optimal management of natural resources;
- To provide assistance in training in relation to environmental issues.

viii. Consultative Group on International Agricultural Research (CGIAR)

The goal of the CGIAR is to contribute, through its research, to promoting sustainable agriculture for food security in the developing countries.

ix. Arctic Monitoring and Assessment Programme (AMAP)

The goals of AMAP are:

- To monitor, assess and report the status of the arctic environment;
- To document levels and trends of pollutants;
- To document and assess the sources and effects of anthropogenic pollutants, including impact of pollutant fluxes from the lower latitudes on the arctic environment;
- To recognise the importance of the use of the arctic flora and fauna by indigenous peoples and to assess their relationship to human health;
- To recommend actions for protecting the arctic environment.

x. Euro Fluxnet

The Euro Fluxnet will address the following specific goals:

- To characterise fluxes and energy exchange at the surface in order to provide useful parameters to global and regional climate modellers and to analyse the variables that determine energy partitioning by forests in different climatic conditions, including extreme events and stress limitations;
- To determine the sink strength of European forests for carbon and analyse the variables that determine the gains and the losses of carbon from forests of differing vegetation composition and in different climate regions;
- To analyse the response of water and carbon fluxes from European forests to climatic factors in order to aid regional scale modelling designed to predict impacts of global environmental change on forest ecosystem function;
- To provide objective data for the validation of forest models, related to growth, partitioning of primary production, water cycling and hydrology;
- To provide information for the development and testing of schemes designed to elaborate forest-atmosphere interactions based on remotely sensed data;
- To recommend management strategies for the conservation of carbon stores in forests.

xi. International Geosphere-Biosphere Programme (IGBP)

The goal of the programme is: To describe and understand the interactive physical, chemical and biological processes that regulate the total earth system, the unique environment that it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human actions.

III. Global Hierarchical Observing Strategy (GHOST)

i. GHOST Strategy

Dr Scholes presented the GHOST that has been developed by the GCOS/GTOS TOPC and the GTOS Scientific and Technical Planning Group. The strategy is based on the principle that it is not possible to measure everything, everywhere, all the time. It is therefore necessary to design an optimal sampling strategy that retains adequate spatial and temporal resolution, but is also affordable and practical. A hierarchical strategy in which at one extreme a few variables are measured regularly in a large number of places, and at the other extreme a large number of variables are measured in a few locations for a limited period, meets these requirements. The hierarchy divides fairly naturally into five tiers, each with more-or-less unique characteristics and roles although existing facilities often straddle more than one tier. The concept is applicable to the three main areas which GHOST is concerned with -- the land surface, freshwater ecosystems and cryospheric surfaces -- each of which would have their own hierarchy, but sharing tier 5. The observing system could be built largely out of existing national and international observation systems, research centres and stations, with modest additions of stations and sites where representation is inadequate.

The proposed hierarchy is incompletely nested. In other words, not all research stations (tier 3) have associated research centres (tier 2) and *vice versa*, sites with stations, and so on; but in most cases there are strong linkages between the tiers. Within the hierarchies for the land, freshwater and cryosphere, there needs to be a balance between different types of systems: for example between natural, agricultural and urban ecosystems on the land; between rivers, lakes, and estuaries in freshwater systems; and between ice sheets, ice caps, glaciers and permafrost in the cryosphere. There is also a geographical balance, which ranges from broad representation at tiers 1 and 2, detailed representation at tier 3, unbiased sampling at tier 4 and complete coverage at tier 5.

ii. GHOST Summary

In summary GHOST is:

- A conceptual framework with 5 nominal levels (tiers);
- Highly integrated, vertically and horizontally;
- Currently climate oriented;
- Statistically efficient.

But should not be considered:

- A rigid blueprint;
- A fully nested hierarchy.

IV. Definition of Requirements

Dr Josef Cihlar presented a list of requirements as defined by the GCOS/GTOS TOPC. The specifics of these requirements are contained in Version 2.0 of the GCOS/GTOS Plan for Terrestrial Climate-related Observations.[5] It is recognised that the climate-related requirements are only a part of the ultimate GTOS needs. He explained that the philosophy used in identifying the key variables was to examine the climate-related objectives of the global observing systems and then identify variables that must be observed to meet these objectives. This was supplemented by assessing the current use of each potential variable (directly, through numerical models, etc.) and also its potential uses in the future. If a variable met one of these needs it was included in the list of key variables. The desired specifications for each variable in terms of accuracy, spatial and temporal resolution were then established. The key variables are described in detail in the above report and are also available on the World Wide Web (http://www.wmo.ch/web/gcos/pub/top_vr_2.html). Following the recent Global Observing Systems Space Panel meeting these specifications are being refined by the TOPC so as to be more meaningful to both satellite and *in situ* observations. It is expected that the revised requirements will be completed by September, 1997

V. Use of Demonstration Projects

The concept of using a demonstration project that all participating networks could find useful and at the same time serve a useful purpose for GCOS and GTOS was introduced by Dr Cihlar. He presented two potential candidates (soil carbon and global forest cover). Dr Cihlar stated in principle a demonstration project should serve several objectives: demonstrate the effectiveness of a Global Observing System Network (GOS-Net) by generating important global data sets which could not be produced otherwise; provide a test bed for the development of mechanisms for the collaboration among networks and sites, including issues of coordination, data sharing and exchange, etc.; and obtain the experience needed for a further development of the global terrestrial network. He noted at the beginning of his presentation that the two particular projects may or may not be appropriate as initial demonstration projects, but was presenting them for two purposes: 1) to give the networks information on other ongoing activities, and 2) to get participants to begin to think about an appropriate project that could be undertaken.

i. Soil Carbon

A project to characterise soil carbon was originally identified as a candidate project at the *In Situ* Observations for the Global Observing Systems meeting held in Geneva in September 1996. The rationale behind the proposal was that soil carbon plays a key role in maintaining soil structure and productivity and is also one of the largest pools in the global carbon cycle. A pre-proposal has been prepared by the TOPC and circulated for comments. The goal of the project would be to produce a global data set for the distribution of the total soil carbon and its associated variables to:

[5] GCOS-32 1997: GCOS/GTOS Plan for Terrestrial Climate-related Observations, WMO/TD-No. 796, UNEP/DEIA/TR.97-7

- Understand and quantify the role of soil carbon in the global carbon cycle and climate change;
- Assess the present state of soil quality and future changes.

The comments received to date are wide-ranging from 'it is too ambitious' to 'this data set is one of the most valuable that could be produced'. Dr Cihlar pointed out that the precise characterisation of carbon in various pools is not feasible at the global scale without much time and financial resources. Hence such a project, while potentially very useful, would be extremely difficult to complete in a relatively short period of time and in a highly accurate manner.

The discussion which followed confirmed that at present such a project was probably not a suitable candidate for an initial collaborative effort and that it should be considered once GTOS is further developed and sources of funding can be found.

ii. Global Forest Cover Database

The Committee on Earth Observation Satellites (CEOS) has proposed several projects to obtain practical experience in implementing global monitoring based on the integration of satellite and *in situ* observations. One proposed project is to develop a database of forest cover. The tentative objectives of this proposal are:

- To provide a database of systematic, complete and reliable earth observation data with ground resolution in the order of tens of meters, from which information about forest cover and its changes can be derived;

- To foster a close collaboration between the data providers and users in order to encourage and facilitate an effective use of the database, including easy and rapid access;

- To provide a repository for forest cover information which can be accessed by a wide spectrum of users.

Dr Cihlar pointed out that this project was under development by CEOS, with a key workshop scheduled for July 1997. Nevertheless, he felt that the project presented an opportunity for the networks to become involved. Many of the networks indicated an interest in staying involved with this project as it was further developed. However, some networks from semi-arid regions were uncertain as to the relevance of the project, pointing out that the extent of geographic coverage and the definition of 'forest' would be important in their potential participation. The project would also be of limited interest to networks concerned with agroecosystems. While it was decided not to pursue this project further at the meeting it was agreed that the project could meet the demonstration project objectives if the focus were on the forest ecosystems and networks. It was also agreed that additional networks should become involved, according to their interests.

iii. Coordinating Land Use and Cover Data and Analyses in Europe

To provide participants with another potential activity on which a demonstration project could be built. Prof. David Norse described the Coordinating Land Use and Cover Data and Analyses in Europe (CLAUDE) project. The overall objective of the project is to develop an internally consistent, Europe-wide plan for land use and land cover monitoring

and research, and to link with other international programmes on this issue. The project will evaluate land use and land cover (LUC) data collection methods and data base structures as currently developed and used in several countries of the European Union (EU) in relation to environmental management and policy formulation needs. This will allow the assessment and monitoring of land use and cover changes, including ecosystem process changes, at different scales as a major input into a future joint approach to LUC in the EU. He felt that the data base structures and metadata that are developed in this project could be very useful to GTOS.

iv. Terrestrial Ecosystem Productivity

It was agreed that the GOS-Net should undertake a project which will demonstrate the potential of an initial network of sites to generate a reliable, useful product with global coverage and regional or local relevance, rapidly and efficiently, by adopting the hierarchical approach and using models to combine *in situ* and remotely sensed data. The participants concluded a set of output products, which have Net Primary Productivity (NPP) as their common foundation would serve this purpose, and is achievable within the desired time frame by collaboration with existing initiatives. The project is designed so that any network or site regardless of its level of sophistication can make a useful contribution.

Net Primary Production (NPP), which is the amount of new plant growth, which occurs within a given area over a specified time period (g m^{-2} y^{-1}) is a key integrator of ecosystem function. It is the mechanistic basis of harvest yield, whether it be of edible plant products, timber or meat. Deviation of NPP from its expected value is an objective indicator of ecosystem degradation, which is of direct use to the Convention on Desertification. Net Ecosystem Production (NEP) is a related variable derived from NPP which is of crucial importance in the global carbon cycle, and thus to the Framework Convention on Climate Change.

The calculation of NPP requires the collection of a set of input data which are valuable long-term observations in their own right: rainfall, temperature, soil water holding capacity and nitrogen content, land cover and Leaf Area Index (LAI). Land cover is of direct relevance to the Biodiversity Convention and Climate Change Convention; water holding capacity and nitrogen content of soils are measures of degradation, and nitrogen content correlates closely with soil carbon, of interest in the global carbon cycle. It was mentioned that a similar project was underway in the United States, and that information on that project was available on the Internet (http://atlantic.evsc.virginia.edu/jhp7e/modlers). The NPP/NEP focus thus meets most of the requirements of a demonstration project. (See Annex IV for a preliminary draft of the proposal.)

VI. Strategy for Forming a Global Network

Following the development of the demonstration project it was decided not to break into working groups but rather jointly define a strategy for forming a global land network. The participants made a number of recommendations to the GTOS Steering Committee that if accepted would result in an initial GOS-Net. (See Section 7.)

i. Rationale

The need for global data falls into two basic categories: 1) requirements for data sets to solve global scale problems, and 2) requirements for local or regional data sets on a world-wide basis. The two environmental themes require global *in situ* data sets if we are to respond to the changes that are occurring. Climate change, its detection, prediction and understanding its impacts clearly requires global data sets. Furthermore, the understanding and management response to desertification and land degradation requires global climate data sets.

Local to regional data sets collected world-wide are needed to address local to regional problems that are so pervasive that they occur around the globe. These include pollution by toxic substances, fresh water resources, and the loss of biodiversity. In these cases comparable data sets help focus attention on these issues and provide information for a global assessment of whether or not improvements are occurring and where further concerted international action may be required.

The participants indicated the interest of their networks was in assisting the Global Observing Systems to obtain required *in situ* data. They also felt that participation in a global network could enhance their effectiveness in a number of ways, including:

- Facilitating access to comparative data from a wider range of sites to improve the interpretation of their own data;
- Making and consolidating contacts between scientists in other parts of the world to improve collaboration in projects designed to attract additional funding for monitoring and research initiatives;
- Promoting increased local awareness of international and global issues;
- Obtaining assistance from GTOS in making global products useful at the regional and local level;
- Acquiring and transferring knowledge regarding new methods to the member sites and scientists;
- Gaining better and easier access to space-based observations;
- Gaining help in developing proposals for capacity building within local networks;
- Increasing the opportunities for student training.

ii. Scope

There was a discussion as to the scope of the network. Initially GOS-Net will be limited to those networks and sites that are making ecologically relevant freshwater or land-based observations. However it was concluded that a global network of existing networks and sites that was to serve all *in situ* GTOS and GCOS observational needs must include coastal zone area, hydrology and the cryosphere. (Because of their interest in coastal zones GOOS should be contacted to determine their interest in participating in such a network.) It was pointed out that there were separate efforts underway to develop a network of glacier and permafrost sites. It was recognised that a network of hydrological sites was also critical. GCOS and GTOS are well aware of significant efforts ongoing in particular the Flow Regimes for Experimental and Network Data Sets (FRIENDS) project, World Hydrological Cycle Observing System (WHYCOS) and the Global Runoff Data Centre (GRDC) which will be used to begin the formation of a hydrological network in the near future.

iii. Data and Methods

There are a number of issues regarding methods, and data and information that need to be addressed by the global observing systems in general and by GTOS in particular. Two of short-term concern are a clearly defined data policy that articulates the Global Observing Systems, view regarding the availability of data and the timeliness with which data should be made available, and development of a set of standards for metadata (information about data sets). Some of the networks do not have metadata standards, but there was concurrence that metadata standards are crucial and those GTOS metadata standards need to be developed. There was insufficient time to fully develop these issues, hence the participants present agreed that they would send their existing data policies to the GTOS Secretariat and recommended that the Joint Data and Information Management Panel (JDIMP) develop a policy as soon as possible.

iv. Definition of Core Variables

For a GOS-Net to respond to the Global Observing Systems' needs, it is necessary for the Global Observing Systems to clearly define the required variables. It was recognised that the climate variables have been well defined by the TOPC. However, the participants urged the GTOS Steering Committee to define the additional variables and requirements for the other priority issues as soon as possible. It was recommended that this be done in a two-step process. First using readily available information, develop a preliminary list of variables. Secondly undertake a more careful detailed examination of each variable to be sure that it is needed on a long-term basis. Information in the Report of the Conventions (See footnote 2, page 2) and from the DIVERSITAS programme
provide excellent starting points for an initial cut at the required core variables. Such an analysis would assist not only the implementation of a GOS-Net, but more importantly it would provide an important input to Version 2.0 of the Global Observing System Space Plan.

v. Internet Access

The participants agreed that as a first step in forming a network that exchanging Internet addresses, so as to be able to refer to each other's pages, was a good idea. The home page addresses of those present at the meeting are available in Annex III.

vi. Organizational Structure

An organizational structure and support for a network of ecological sites are critical. A recommended organizational structure was developed (See Figure 1). While supporting the land-based needs of all G3OS's, organizationally it was felt that a network of ecological sites should be administered by one of the global observing systems. While currently the climate requirements are most clearly defined in the long term it was recommended to the Sponsors of the G3OS that GTOS take the lead in providing secretarial support to the network. It must be recognised that the network must meet the needs of GCOS and GOOS. The proposed diagram reflects this recommendation.

The networks participating in GOS-Net need to have a major say in how the network will be operated, hence the recommendation to have a Network Panel. The Network Panel would initially consist of representatives from all the participating networks plus additional representatives from the GTOS Steering Committee and the JSTC of GCOS.

It was recognised that there is a need to have secretariat support for GOS-Net, and that this will require resources. The participants agreed that the GOS-Net Secretariat need not be physically co-located with the GTOS Secretariat, but the lines of communication should flow both ways through the GTOS Secretariat. Dr Gosz, Director of the U.S. LTER programme and Chairman of the U.S. LTER network felt that U.S. LTER/ILTER might be able to obtain the resources, including necessary computer support, to provide a GOS-Net Secretariat by co-locating it with the LTER/ILTER office in New Mexico. The GOS-Net Secretariat would report directly to the GTOS Secretariat. Since no other similar alternatives have been identified the participants recommended that the GTSC and the JSTC request Dr Gosz to vigorously pursue this possibility.

It was recognised that not all networks were present at this meeting, and that national networks as well as individual sites are likely to have essential contributions to make to the GOS-Net. The participants felt that while those present at the meeting should be invited initially a provision should be made which will facilitate the incorporation of other networks or individual sites in the network. To this end, a two-stage procedure was suggested. First, a fact sheet should be requested from a prospective new member concerning its site(s), data and practices. Second, a letter of invitation will be sent by the GTOS Steering Committee to join the network after recommendation by the Network Panel. As a minimum the following information should be obtained from each network prior to issuing consideration of an applicant:

Name of the Network or site:

Goals and Objectives:

Scope and Geographic Coverage (including number of sites):

Needs from the GOS-Net:

Ability to Contribute to GOS-Net:

Ability to Contribute to Demonstration Project:

Data Policy:

Training requirements:

URL for Website if available:

Contact Name, Address, Phone, Fax and Email.

The participants also developed a list of tasks and a proposed timetable for the establishment of an initial GOS-Net. (See Table 1.)

Figure 1. Relationship between GCOS and GTOS Panels

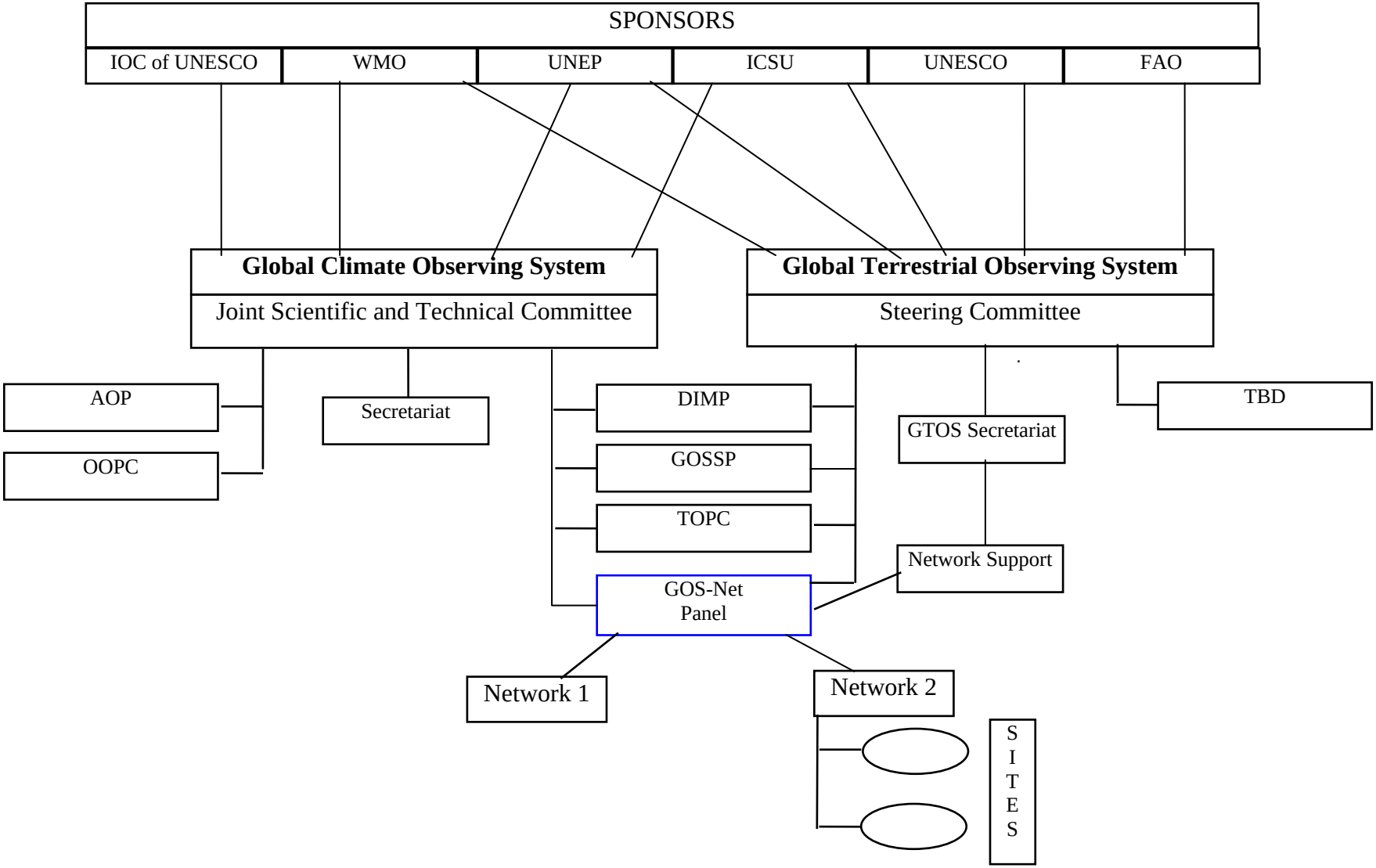

Table 1. Possible Timetable for Implementation of GOS-Net and the Demonstration Project.

	Responsible	1997						1998				1999			
		Month						Quarter				Quarter			
		July	Aug	Sept	Oct	Nov	Dec	1	2	3	4	1	2	3	4
Report of Meeting															
Minutes (July 4)	GCOS/GTOS Secretariat														
Final Report	GCOS/GTOS Secretariat														
Obtain Approval from GTOS SC to Proceed	Glantz														
Formation of GTOS Landnet															
Letters of Invitation to Networks	GTOS Secretariat for Glantz/Townshend														
Draft for Network Consideration	GTOS Secretariat for Glantz/Townshend														
Final	GTOS Secretariat for Glantz/Townshend														
Network Response (Subject to their SC)	Network Representatives														
Draft Terms of Reference for GTOS Landnet Secretariat	GTOS Secretariat														
LTER to Determine Feasibility of Hosting	Gosz														
Implementation of GTOS-Net Secretariat	GTOS Secretariat/Gosz														
Development of Data Policies															
Networks to Send Existing Data Policies to GTOS	Network Representatives														
Meta Data Policies Collected by GTOS	GTOS Secretariat														
GTOS Data Policy Developed with DIMP	GTOS Secretariat														
Methods															
Networks to Send Existing Manuals to GTOS	Network Representatives														
GTOS Secretariat to Publish List of Methods on Web	GTOS Secretariat														
Define Core Variables															
Climate	TOPC	Done													
Land Degradation	GTOS SC	TBD based on priorties of GTOS SC													
Biodiversity	GTOS SC	TBD based on priorties of GTOS SC													
Pollution and Toxicity	GTOS SC	TBD based on priorties of GTOS SC													
Freshwater Resources	GTOS SC	TBD based on priorties of GTOS SC													
Demonstration Project															
Refine Elements and Re-assure Meeting Network Needs	Running/GTOS Secretariat														
Identify Any Additional Critical Networks to Participate	GTOS SC and JSTC for GCOS														
Prepare LAI Methods Description	Cihlar														
Prepare Project Science and Implementation Document	Running/Scholes														
Prepare Funding Proposals as necessary	Running/GTOSnet ?? Secretariat														
MODIS Flies															
Ground Truthing from Networks	Network Representatives														
Products to Networks	Running/GOS-Net Secretariat														

VII. Summary Recommendations

A Global Observing System Network of existing networks and sites that are making *in situ* land and freshwater measurements that are relevant to GTOS and GCOS should be formed. The network should be administered by GTOS but clearly be designed to meet the needs for terrestrial and freshwater observations of all three global observing systems.

i. GTSC Recommendations

The GTSC should:

- Issue a set of formal invitations to those networks at the meeting and any additional ones they deem appropriate to form an initial GOS-Net;
- Provide the necessary leadership for GOS-Net by assuring the GTOS secretariat does the following:
  - (a) Serve as the documentation and information centre for GOS-Net and prepare information or action documents pertaining to GOS-Net, as required by the GTSC;
  - (b) Maintain a meta-database about the networks and sites participating in GOS-Net and make the database available on the web;
  - (c) Provide technical assistance to networks and sites as mutually agreed on a case-by-case basis with the network/site involved and the GTSC;
  - (d) Maintain a library of methods that are used by sites and networks and provide a reference list of these methods on the web;
  - (e) Carry out other selected tasks in support of GTOS as mutually agreed to with the GTSC and/or Director of the GTOS Secretariat;
  - (f) Support the implementation of demonstration projects and other GOS-Net activities;
  - (g) Provide computer support for the assembly and exchange of data to facilitate the work of the GOS-Net, as agreed on a case-by-case basis;

- Establish a GOS-Net Network Panel consisting of representatives of those networks and sites that are participating in the initial GOS-Net and representatives of the GTOS and GCOS Steering Committees;
- Request that the U.S. LTER office in New Mexico provide secretariat support for GOS-Net;
- Endorse the NPP/NEP demonstration project;
- Develop a process to effectively review GTOS including GOS-Net at periodic intervals. The review process is a critical form for keeping the programme at a high quality and ensuring that projects are appropriate;

Recognising the climate requirements are well developed it is recommended that the GTOS steering committee develop specific requirements for other priority issues as soon as possible. The conventions document prepared by Dr Gwynne and the work of the DIVERSITAS programme are excellent starting points.

ii. JSTC Recommendations

The JSTC should:

- Jointly sponsor a GOS-Net Panel consisting of representatives of those networks and sites that are participating in the initial GOS-Net and representatives of the GTOS and GCOS Steering Committees;
- Endorse the NPP/NEP demonstration project;
- Actively participate in the review process of GOS-Net.

VIII. Closure of the Meeting

The meeting was closed at 12:00 noon on the 20 June by the Chairman Dr Robert Scholes.

Annex I: List of Participants

Prof. Antonio CENDRERO
DCITIMAC
Facultad de Ciencias
Email:cendrera@ccaix3.unican.es
Universidad de Cantabria
Av. de los Castros s/n
39005 SANTANDER, Spain
Tel: +34 42 201503
Fax: +34 42 201402

Dr Josef CIHLAR
Applications Division
Canada Centre for Remote Sensing
588 Booth Street
OTTAWA, Ontario, Canada K1A OY7
Tel: +1 613 9471265
Fax: +1 613 9471406
Email:
josef.cihlar@ccrs.nrcan.gc.ca

Dr Martin FORSIUS
Finnish Environment Institute
ICP IM Programme Centre
P.O. Box 140
FIN-00251 HELSINKI, Finland
Tel: +358 9 40300308
Fax: +358 9 40300390
Email: martin.forsius@vyh.fi

Prof. James GOSZ
Biology Department
University of New Mexico
ALBUQUERQUE, NM 87131, USA
Tel: +1 505 2772265
Fax: +1 505 2775355
Email: jgosz@sevilleta.unm.edu

Dr Michael D. GWYNNE
P.O. Box 24529
NAIROBI, Kenya
Tel: +254 2 882370
Fax: +254 2 882370
Email: -

Mr Qunli HAN
Division of Ecological Sciences
Man and the Biosphere Programme
UNESCO
1, rue Miollis
75015 PARIS, France
Tel: +33 1 45684142
Fax: +33 1 45685804
Email: q.han@unesco.org

Dr Peter JONES
CIAT
AA 67-13
CALI, Colombia
Tel: +57 2 4450000
Fax: +57 2 4450073
Email: P.Jones@cgnet.com

Dr Jean KHOURI
The Arab Centre for the Studies of
Arid Zones and Dry Lands
P.O. Box 2440
DAMASCUS, Syria
Tel: +963 11 5323087
Fax: +963 11 5323063
Email: -

Prof. Vitaly KIMSTACH
AMAP Secretariat
Strømsveien 96
P.O. Box 8100 Dep.
N-0032 OSLO, Norway

Tel: +47 22573634
Fax: +47 22676706
Email: vitaly-a.kimstach@
sftospost.md.dep.telemax.no

Prof. Hamid NARJISSE
Institut Agronomique et Vétérinaire Hassan II
B.P. 6201
RABAT, Morocco

Tel: +212 7 777018
Fax: +212 7 680397
Email: narjisse@mtds.com

Prof. David NORSE
Department of Geography
University College London
26 Bedford Way
LONDON WC1H 0AP, United Kingdom

Tel: +44 171 3877050 (Ext. 5542)
Fax: +44 171 3807565
Email: dnorse@geog.ucl.ac.uk

Dr Terry PARR
Institute of Terrestrial Ecology
Merlewood Research Station
Windemere Road
GRANGE-OVER-SANDS
Cumbria LA11 6JU, United Kingdom

Tel: +44 15395 32264
Fax: +44 15395 34705
Email: t.parr@ite.ac.uk

Dr Steven RUNNING
School of Forestry/NTSG
The University of Montana
MISSOULA, MT 59812, USA

Tel: +1 406 2436311
Fax: +1 406 2434510
Email: swr@ntsg.umt.edu

Dr Robert SCHOLES
Division of Water, Environment and Forest Technology
CSIR
P.O. Box 395
PRETORIA 0001, South Africa

Tel: +27 12 8412045
Fax: +27 12 8412689
Email: bscholes@csir.co.za

Prof. John TOWNSHEND
Department of Geography
University of Maryland
1113 Lefrak Hall
COLLEGE PARK, MD 20742-8225, USA

Tel: +1 301 4054558
Fax: +1 301 3149299
Email: jt59@umail.umd.edu

Dr Riccardo VALENTINI
Department of Forest Science and Resources
University of Tuscia
Via S. Camillo de Lellis
01100 VITERBO, Italy

Tel: +39 761 357394
Fax: +39 761 357389
Email: RIK@unitus.it

Dr F. Javier ZAPATA
O.A. Parques Nacionales
Gran Via de S. Francisco, 4
F-28005 MADRID, Spain

Tel: +34 1 3476174
Fax: +34 1 3476301
Email: zelotes@accessnet.es

Prof. Shidong ZHAO
CERN Secretariat
Commission for Integrated Survey of Natural Resources
Chinese Academy of Sciences
3, Datun Road, P.O. Box 9717
BEIJING 100101, China

Tel: +86 10 64931980
Fax: +86 10 64931970
Email: zhaosd@CERN.ac.cn

SECRETARIAT

Dr Hal KIBBY
Joint Planning Office
Global Climate Observing System
gcosjpo@gateway.wmo.ch
c/o World Meteorolgical Organization
P.O. Box 2300
1211 GENEVA 2, Switzerland

Tel: +41 22 7308259
Fax: +41 22 7401439
Email:

Mr Jeff TSCHIRLEY
SDRN, GTOS
FAO
Via delle Terme di Caracalla
00100 ROME, Italy

Tel: +39 6 52253450
Fax: +39 6 52253369
Email: jeff.tschirley@fao.org

Annex 2: Agenda

1.0 Opening of the Session

- 1.1 Welcome Diputado Foral de Urbanismo
- 1.2 Purpose of the Meeting
- 1.3 Approval of the Agenda
- 1.4 Introductory Comments
- 1.5 Background to Meeting

2.0 Reports from Networks

- 2.1 UK Environmental Change Network (ECN)
- 2.2 The World Network of Biosphere Reserves
- 2.3 US Long-term Ecological Research Network (U.S. LTER)
- 2.4 Chinese Ecosystem Research Network (CERN)
- 2.5 International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems (ICP IM)
- 2.6 The Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD)
- 2.7 Réseau d'observatoires de surveillance Ecologique à Long Terme (ROSELT)
- 2.8 Consultative Group on International Agricultural Research (CGIAR)
- 2.9 Arctic Monitoring and Assessment Programme (AMAP)
- 2.10 Euro Fluxnet
- 2.11 International Geosphere-Biosphere Programme (IGBP)

3.0 Global Hierarchical Observing Strategy (GHOST)

4.0 GCOS/GTOS Requirements

5.0 Use of Demonstration Projects

- 5.1 Soil Carbon
- 5.2 Global Forest Cover Database
- 5.3 Coordinating Land Use and Cover Data and Analyses in Europe

6.0 Discussion Strategy for Forming a Network of Networks and SITES

7.0 Recommendations

8.0 Closure of the Meeting

Annex 3: Description of Participating Networks

Network Name: The Arab Centre for the Studies of Arid Zones and Dry Lands Monitoring Network (ACSAD)

Aims:
To improve the understanding of ecological systems and environmental degradation processes.

Scope and geographical coverage:
Four sites have been established in 1997. The number of sites will increase to seven sites in 1998 and between 12 and 14 sites in 1999. They are located east of the Mediterranean in SW Asia and south of the Mediterranean north of the Sahara (N. Africa).

Needs from a global network:
- Capacity building;
- Equipment mainly meteorological;
- Expertise in remote sensing, information systems, meteorology;
- Financial contributions to workshops.

Ability to contribute to GTOS and the demonstration project:
Could initiate contribution to biodiversity and desertification in 1998 and start its contribution to GTOS and GCOS in 1999.

Training needs:
A fundamental need in instrumentation data collection, processing and management.

Data policy:

URL:

Contact:
Dr Jean Khouri
The Arab Centre for the Studies of
Arid Zones and Dry Lands
PO Box 2440
DAMASCUS, Syria
Tel: +963 11 5323087
Fax: +963 11 5323063

Network Name: Arctic Monitoring and Assessment Programme (AMAP)

Aims:
The objectives of AMAP are:
- To monitor, assess and report the status of Arctic environment;
- To document levels and trends of pollutants;

- To document and assess the sources and effects of anthropogenic pollutants, including impact of pollutant fluxes from the lower latitudes, on the Arctic environment;
- To recognize the importance of the use of the Arctic flora and fauna by indigenous peoples and to assess their relationship to human health;
- To recommend actions for protecting the Arctic environment.

Scope and geographical coverage:
The geographical area covered by AMAP is essentially the circumpolar terrestrial/freshwater and marine areas north of the Arctic Circle, and, as determined by each of the participating countries, further south between the Arctic Circle and 60N.

Needs from a global network:
Data, information and expertise, relevant to the AMAP objectives, from the following global network sub-systems:
- Climate terrestrial observation system;
- Pollution terrestrial observation system.

Ability to contribute to GTOS and the demonstration project:
Terrestrial/freshwater pollution data and other relevant information for the geographical area covered by AMAP.

Data policy:
All data supplied to AMAP TDCs are subject to an AMAP data ownership agreement that guarantees that these data will only be used for AMAP assessment process purposes, unless otherwise directed by data originators. The restrictions on access to the data are applied specifically to ensure that data originators retain first rights to their (unpublished) data.

URL:
http://www.grida.no/amap

Contact:
Prof. Vitaly Kimstach
AMAP Secretariat
Strømsveien 96
PO Box 8100 Dep.
N-0032 OSLO, Norway
Tel: +47 22573634
Fax: +47 22676706
Email: vitaly-a.kimstach@sftospost.md.dep.telemax.no

Network Name: Chinese Ecosystem Research Network (CERN)

Aims:
The primary goals of CERN are:
- To monitor environmental change;
- To study the structure, function, dynamics and management of ecosystems;
- To provide the managerial models of sustainable use of ecosystems at the local level;
- To provide the scientific basis for decision-making process at the provincial and national levels.

Scope and geographical coverage:
CERN is a national scale network dealing with the key ecosystems located in different eco-regions. It consists of 29 ecosystems, research stations (16 agricultural, 7 forest, 2 grassland, 2 lake and 2 estuaries), five disciplinary data centres (water, soils, atmosphere, biology, and aquatic ecosystems) and a synthesis research centre. About 900 scientists and graduate students are involved.

Needs from a global network:
- Sharing data;
- Joining international research projects;
- Learning from foreign scientists and improving our work on observations, research and network management;
- Getting funds from international funding agencies and support for our activities.

Ability to contribute to GTOS and the demonstration project:
- Data on ecosystems, environment and some socio-economics of China;
- Human resources, including scientists and technicians working in different fields at various levels;
- Facilities including field stations, labs, computers and equipment. They could be used for joint projects under agreements. Some could be used for training.

Training needs:
- General training on data management and network management;
- Specific training on remote sensing, modelling under the framework of the demo project;
- Could also provide trainers in some fields.

Data policy:
Data produced in three tiers of CERN, field stations, subcentres and synthesis centre, must be entered into the data network according to CERN's principles and policies of data management. CERN field stations, subcentres, and the synthesis centre have specific responsibilities for collecting observational data and for providing those data to all other entities in CERN. In exchange, each member of CERN has the right to access data generated in the network. The Data Management Committee will have authority in determining specific responsibilities and rights. CERN data will be shared among three tiers of CERN and relevant home institutes. CERN will also promote data exchange with other institutions and data centres at home and abroad concerned with eco-environment research and will create operational mechanisms and a research environment favorable to data sharing and data exchange. CERN is a non-profit, open network and its data are available within CERN, to other CAS institutions, and to non-CAS institutions domestically and internationally. CERN will charge recovery costs for producing data. Access to data may also be subject to the terms of data sharing protocols for recipients, not members of CERN.

A copy of the complete data policy is available from the GTOS secretariat.

URL:

Contact:

Prof. Shidong Zhao
CERN Secretariat
Commission for Integrated Survey of Natural Resources
Chinese Academy of Sciences
3, Datun Road, PO Box 9717
BEIJING 100101, China

Tel: +86 10 64931980
Fax: +86 10 64931970
Email: zhaosd@CERN.ac.cn

Network Name: Consultative Group on International Agriculture Research (CGIAR) and the International Centre for Tropical Agriculture (CIAT)

Aims:

- Research on sustainable agricultural development;
- Research Themes - Germplasm development, Natural Resource Management, Biodiversity Protection, Farmer Participatory Research.

Scope and geographical coverage:
CGIAR globally, over 80 permanent experimental sites, many are research stations, some are farm research networks. Natural resource management study areas are large sites with multiple land use, typically up to 200,000 hectres.

CIAT has 6 experimental stations in a range of agroecosystems in Colombia, 6 reserve management study areas in acid hillsides, savannas and forest margins in Honduras, Colombia, Brazil and Peru.

Needs from a global network:

- Assistance with the ability to use GIS facilities to monitor agricultural and environment for problem identification, research planning and extrapolation from our study areas;
- Risk analysis, land use modelling and policy analysis.

Ability to contribute to GTOS and the demonstration project:

- Detailed land use characterization from resource management sites;
- General GIS coverages of land use, crop distribution, soil degradation and interpolated climate surfaces. Daily climate data from research stations;
- Land cover/land use data from resource management sites are available for use by the demonstration project;
- Metadata, yield data from selected farming systems are available;
- Currently not taken but might be available LAI, phenology and primary productivity estimates in pastures and forest margin ecosystems.

Training needs:
None immediately

Data policy:

URL: CGIAR http://www.worldbank.org/html/cgiar/HomePage.html
CIAT http://www.ciat.cgiar.org

Contact:
Dr Peter Jones
CIAT
AA 67-13
CALI, Colombia
Tel: +57 2 4450000
Fax: +57 2 4450073
Email: P.Jones@cgnet.com

Network name: FLUXNET

Aims:
The FLUXNET will address the following specific goals:

- To characterize fluxes and energy exchange at the surface in order to provide useful parameters to global and regional climate modellers and to analyze the variables that determine energy partitioning by ecosystems in different climatic conditions, including extreme events and stress limitations;
- To determine the sink strength of forests for carbon and analyze the variables that determine the gains and the losses of carbon from forests of differing vegetation composition and in different climate regions;
- To analyze the response of water and carbon fluxes from ecosystems to climatic factors in order to aid regional scale modelling designed to predict impacts of global environmental change on forest ecosystem function;
- To provide objective data for the validation of models, related to growth, partitioning of primary production, water cycling and hydrology;
- To provide information for the development and testing of schemes designed to elaborate forest-atmosphere interactions based on remotely sensed data;
- To recommend management strategies for the conservation of carbon stores in different ecosystems.

Scope and geographical coverage:
These are the major networks linked within FLUXNET:

- EUROFLUX : 17 stations encompassing various countries in Europe, mainly focussed on forests, ongoing
- AMERIFLUX : 13 stations in North America, including grasslands and rangelands, ongoing
- LBA : 5 stations operating from 1998 in Amazonia
- MEDEFLU : 5 stations operating from 1998 in Mediterranean region
- GAME : 2 stations operating in Siberia (tundra and taiga) from 1998
- OZFLUX : 5 stations operating in Australia from 1998
- OTHERS : 5 stations in various countries in South-East Asia

Needs from a global network:

- Access to comparative data from a wider range of sites to improve the interpretation of flux data and to broaden relevance;

- Development of contacts between scientists to improve the use and interpretation of data;
- To implement new sites in cooperation with existing programmes.

Ability to contribute to GTOS and the demonstration project:
- Interannual variability of carbon uptakes and release;
- Global terrestrial carbon budget data;
- Improvement of management for carbon storage in disturbed ecosystems.

Training needs:
The FLUXNET programme can contribute in the following ways:
- General training on data management and network management;
- Specific training on remote sensing, modelling under the framework of the demo project;
- Could also provide trainers in some fields.

Data policy:
Fluxnet database will be organized in Oak Ridge CDC and available to external community trough Internet.

URL:
http://www.unitus.it/eflux/euro.html

Contact:
Dr Riccardo Valentini
Department of Forest Science and Resources
University of Tuscia
Via S. Camillo de Lellis
01100 VITERBO, Italy
Tel: +39 761 357394
Fax: +39 761 357389
Email: RIK@unitus.it

or

Dr Steven Running
School of Forestry/NTSG
The University of Montana
MISSOULA, MT 59812, USA
Tel: +1 406 2436311
Fax: +1 406 2434510
E-mail: swr@ntsg.umt.edu

Network name: International Cooperative Programme on Integrated Monitoring of Air Pollution Effects on Ecosystems

Aims:
- To monitor the state of ecosystems (catchments/plots) and provide an explanation of changes in terms of causative environmental factors, in order to provide a scientific basis for emission control;
- To develop and validate models for the simulation of ecosystem responses;

- To carry out biomonitoring for detecting natural changes, in particular to assess effects of air pollutants and climate change;
- In a more long-term perspective the IM concept is useful among other things in monitoring ecosystem effects of climate change, ozone depletion and changes in biodiversity.

Scope and geographical coverage:
The multidisciplinary Integrated Monitoring Programme is part of the effects monitoring strategy of the UN/ECE (United Nation's Economic Commission for Europe) Convention on Long-Range Transboundary Air Pollution (LRTAP). The IM sites (mostly catchments) are reference sites, located in undisturbed areas. Monitoring is divided into a number of compartmental subprogrammes carried out at the sites. The IM database presently contains data from 59 sites in 23 countries in the ECE region. The international programme centre is at the Finnish Environment Institute. Monitoring is funded by national agencies and organisations.

Needs from a global network:
- Participation in GTOS would extend the present use of the IM data towards other issues of regional/global concern. This would facilitate the long-term national funding of the monitoring and research activities carried out at the sites. Moreover, participation would enhance the transfer of knowledge on new methods and data to the participating institutes and scientists;
- Some of the countries in the eastern parts of Europe are running their IM sites under a very difficult financial situation. Capacity building in these countries would facilitate the implementation and further development of the programme.

Ability to contribute to GTOS and the demonstration project:
Several of the priority tasks of GTOS (pollution and toxicity, climate change, biodiversity) are included in the ICP IM programme aims (see above). ICP IM can provide time series of many of the priority variables included in the GHOST strategy (vegetation, soil properties, hydrology, element pools and fluxes, etc.) from sites throughout the ECE region. These reference sites have been set up with the specific task of providing long-term data. The data have already been used for site-specific modelling and assessment of the effects of air pollutants and climate change. The data are being used in the effects assessment work under the framework of the UN/ECE LRTAP convention.

Some of the IM sites could contribute to the planned demonstration project by providing data on land cover, meteorology, soil properties and biomass increment. LAI and NPP measurements would require implementation of new techniques.

Training needs:
The inclusion of new measurements related to the modelling and assessment of carbon fluxes (LAI, NPP, etc.) would require training of the responsible scientists in many of the participating countries.

Data policy:
The use of the data stored in the international database is restricted for work under the LRTAP convention. However, permission to use the data for other purposes can be given by the Programme Task Force or the National Focal Point concerned. Since the GTOS aims and

organizational structure are closely linked to those of the ICP IM, it is most likely that such permission would be given regarding the GTOS needs.

URL:
http://www.vyh.fi/fei/organiz/ird/im.htm

Contact:
Dr Martin Forsius (Programme Manager, ICP IM)
Finnish Environment Institute
P.O. Box 140
FIN-00251 HELSINKI
Finland
Phone: +358 9 40 300 308
Fax: +358 9 40 300 390
Email: martin.forsius@vyh.fi

Network Name: Organismo Autónomo Parques Nacionales (OAPN)

Aims:
- Representation of the main ecosystems and regions;
- Protection of areas with singular scientific, cultural, educational, aesthetic, landscape and recreational interest;
- Contribution to endangered communities or species survival, by habitats conservation and species restoration plans;
- Collaboration on international programmes of wilderness and wildlife conservation.

Scope and geographical coverage:
- The main natural systems of Spain, and the 10 National Parks declared there, are:
- Eurosiberian region: Ordesa y Monte Perdido N.P., Picos de Europa N.P.
- Mediterranean region : Tablas de Daimiel N.P., Cabañeros N.P., Doñana N.P., Cabrera Maritime-Terrestrial N.P.
- Macaronesian region: Teide N.P., Caldera de Taburiente N.P., Garajonay N.P., and Timanfaya N.P.

Also, at the moment, 6 more sites are managed:
- Chafarinas Islands (Mediterranean sea, north coast of Morocco);
- Almoraima (in the main *Quercus suber* forest of Europe);
- Quintos de Mora (Mediterranean scrub formation);
- Valsaín;
- Lugar Nuevo (Mediterranean scrub formation);
- Santoña (intertidal marshes and northern *Quercus ilex* formations).

Needs from a global network:
- Sharing and exchange data and information to compare similar sites on issues of common interest. Predictions on conservation status and trends;
- Encourage broader use of OAPN data and make a visible input into international issues as a means of consolidating support for OAPN at the national level;
- Expertise in remote sensing, information systems;
- Learning and improving our work on observations and network management;

- Capacity building in the implementation and further development by the network demo project;
- Improved accessibility to data sources, especially space-bound data; access to the analyses done for the entire GTOS;
- Increased opportunities for training in other networks.

Training needs:
- Training on new measurements related to demo project;
- Workshop and training course on processing and management data technology, use of new satellite data;
- On line version of training package;
- Support by Email after training.

Ability to contribute to GTOS and the demonstration project:
Since the eighties, Spanish National Parks have developed an important number of research works, inventories, etc. to support skilful management of natural resources. Much of the data that has been collected may be used by the demonstration project. By 1998, we will be in a reasonable position to participate in the demonstration project and in GTOS –Net.

Data Policy:

URL:

Contact:
Dr F. Javier Zapata
Organismo Autónomo Parques Nacionales
Gran Vía de San Francisco, 4, 2ª planta
E-28005 MADRID (Spain)

Phone +34 1 3476174
Fax +34 1 3476301
E-mail: zelotes@accessnet.es

Network Name: The World Network of Biosphere Reserves

Aims:
- To explore and demonstrate approaches to *in situ* biodiversity conservation and sustainable use of its components;
- To provide support for demonstration projects, environmental education and training and research and monitoring related to local, regional, national and global issues of conservation and development.

Scope and geographical coverage:
As of April 1996 there were 337 reserves in 85 countries representing all major biomes. There are approximately 160 biosphere reserves in developing countries.

Needs from a global network:

- Initiatives for international scientific cooperation, collaborative studies, coordinated monitoring activities;
- Scientific advice, updated methodologies;
- Improved accessibility to data sources, especially space-bound data.

Ability to contribute to GTOS and the demonstration project:

- An intergovernmental mechanism to facilitate development of GTOS/GCOS dedicated activities;
- A large group of sites where scientific and facilities do exist focusing on biodiversity and ecosystem research;
- Long-term records and data collection in many related disciplines. (See ACCESS 96 as an example.)

A short list of sites may be identified to participate in the demonstration project especially in Europe, Latin America and Asia.

Training needs:

- Workshop and training course on modelling and use of new satellite data;
- An on-line version of training package;
- Support by Email after training.

URL:
http://www.unesco.org/mab

Contacts:
Dr Paul Lasserre, Director
Division of Ecological Sciences
Man and the Biosphere Programme
UNESCO
1, rue Miollis
75015 PARIS, France
Tel: +33 1 45684142
Fax: +33 1 45685804
Email: p.lasserre@unesco.org

or

Mr Qunli Han
Division of Ecological Sciences
Man and the Biosphere Programme
UNESCO
1, rue Miollis
75015 PARIS, France
Tel: +33 1 45684142
Fax: +33 1 45685804
Email: q.han@unesco.org

Network Name: Réseau d'Observatoires de Surveillance Ecologique à Long Terme (ROSELT)

Aims:

- To promote the operation of a regional network of sites performing ecological monitoring activities;
- To enhance capacity building of member sites;
- To promote development of products useful to decision-makers;
- To facilitate the formation of national monitoring networks;
- To stimulate regional and international cooperation on ecological monitoring activities;
- To facilitate integration of local population into development processes.

Scope and geographical coverage:
25 sites located in East Africa, West Africa, and North Africa were already accredited by the ROSELT network. Among these 25 sites, 12 were selected as pilot sites to test the ROSELT concept.

Needs from a global network:

- Interaction with scientists sharing common interest;
- Exchange of data and information on issues of common interest;
- Harmonization of methods and coordination of efforts whenever feasible;
- Joint effort for funding mobilization;
- Capacity building;
- Training on modelling and translation of NPP to harvest yield.

Ability to contribute to GTOS and the demonstration project:
ROSELT can contribute Multi-disciplinary (soil, vegetation, water resources, biodiversity, climate, and socio-economic) data collected in a wide range of ecosystems, land uses, and geographical coverage. ROSELT can also contribute to a better understanding of causes and effects of land degradation in arid and semi-arid Africa through:

- Assessing climate change impacts;
- Assessing human activities impacts;
- Documenting interaction between ecological and social systems;
- Developing local environmental information systems to be integrated into national and international systems.

Data policy:
On-going assessment of data policy, to be finalised by October, 1997.

URL: http://www.rio.net/oss/roselt.htm

Contact:
Prof. Hamid Narjisse
Institut Agronomique et Vétérinaire Hassan II
B.P. 6201
RABAT, Morocco
Tel: +212 7 777018
Fax: +212 7 680397
Email: narjisse@mtds.com

Network Name: UK Environmental Change Network (ECN)

Aim:
ECN aims to collect store, analyse and interpret long-term data based on a set of key variables which drive and respond to environmental change at terrestrial and freshwater sites across the UK. ECN data will be used to distinguish short-term fluctuations from long-term trends associated with man's activities and to predict future changes.

Scope and geographical coverage:
ECN has 11 terrestrial and 38 freshwater sites across the UK.

Needs from a global network:
- Access to comparative data from a wider range of sites to improve the interpretation of ECN data and to broaden relevance;
- To encourage broader use of ECN data and make a visible input into international issues as a means of consolidating support for ECN at the national level;
- Development of contacts between scientists involved in ECN and scientists in the international community to improve the use and interpretation of ECN data;
- To make and consolidate scientific contacts as source of potential partners in collaborative projects designed to attract additional funding for monitoring and research initiatives related to environmental change;
- To promote increased awareness within the ECN community of international global change issues, particularly in relation to the needs of user communities in science and policy;
- Capacity building - identification of improvements to existing range of methods made by ECN which would lead to a broader relevance to global environmental issues.

Ability to contribute to GTOS and the demonstration project:
- ECN strongly supports the objectives of GTOS and will aim to contribute to its success in so far as limited resources allow;
- In the UK National Strategy for Global Environmental Research published by the Inter-Agency Committee on Global Change, ECN is supported as the natural contact point for GTOS;
- ECN has had an ongoing data collection programme since 1993, plus historical data for some variables at sites;
- ECN is involved in a new EC Preparatory Action on Networking of Long-term Integrated Monitoring in Terrestrial System (NoLIMITS), with partners from the Finnish IMP and the Hungarian Academy of Sciences. The work is designed to prepare the way for the development of a European Network of sites and will use the European Environment Agency, the Centre for Earth Observation and the GTOS to provide links and ensure relevance to European scale user requirements;
- ECN sites can contribute data on most of the climate-related variables included under Soil Properties, Hydrology, Biogeochemistry and Land Cover sections of the TOPC Plan;
- ECN is closely linked to other UK programmes that can provide data and information relevant to tiers 4 and 5;
- ECN should be able to contribute to the demonstration project by providing meteorological data, land cover data, and soil data from most of the terrestrial sites. LAI data will involve new data collection which is only likely to be done if some benefit to

sites can be clearly demonstrated (e.g., provision of locally calibrated 1 km data set on a regular basis).

Training needs:

Can assist through cooperative programmes in modelling and database technology.

Data policy:

ECN has a data policy which allows direct access to summary database and licensed access to raw data for environmental change research. Summary data are available directly over the World Wide Web.

URL:
http://www.nmw.ac.uk/ecn

Contact:

Dr Terry Parr
Institute of Terrestrial Ecology
Merlewood Research Station
Windemere Road
GRANGE-OVER-SANDS
Cumbria LA11 6JU, United Kingdom
Tel: +44 15395 32264
Fax: +44 15395 34705
Email: t.parr@ite.ac.uk

Network Name: U.S. Long-Term Ecological Research Network (U.S. LTER)

Aims:

The primary goals of the LTER Network are to facilitate research that:

- Understands ecological phenomena that occur over long temporal and broad spatial scales;
- Creates a legacy of well-designed and documented, long-term experiments;
- Conducts major syntheses and theoretical efforts; and
- Provides information for the identification and solution of societal problems.

The concepts of the LTER Network are in agreement with those of GTOS but LTER has a stronger emphasis on research than on monitoring.

Scope and geographical coverage:

18 sites currently, expanding to 22 by the end of 1997.

Sites range from the Arctic tundra in Alaska to Puerto Rico plus 2 sites in Antarctica. Types of sites range from pristine to intensive agriculture and urban.

Needs from a global network:

Connectivity with other networks, ability to exchange data and information, opportunities to develop collaborative research between scientists in the U.S. and those of other networks, increased opportunities for student training in other networks, access to the analyses done from data for the entire GTOS.

Ability to contribute to GTOS and the demonstration project:
The U.S. LTER Network was initiated in 1980 building from an initial 6 sites to the current level of 18 sites. This history provides a wealth of experience and lessons on site establishment, network development, connectivity within the network and among networks, and developing international interactions among long-term research efforts. Data management and accessibility are primary emphases in the LTER Network and applications of modern technologies to ecological research questions are actively pursued. These characteristics allow many opportunities for sharing expertise and training for GTOS sites that may wish to take advantage of them. The Network Office of the LTER programme can acquire funds from the U.S. for training in data management and exchanges of scientists and students. The Network Office can also provide access to other countries involved in the International LTER Network such as those in Latin America and South-East Asia.

With regard to the pilot project, there is a current project (MODLTER) that has experience in making field measurements of the necessary variables and training would be possible to be used on other GTOS sites. A suggestion would be for interested sites to have individuals participate in the acquisition of field data on these variables at sites in the U.S. Also, the Network Office will be responsible for an automated procedure for downloading the satellite NPP imagery for the U.S. sites that also can be provided to interested GTOS sites.

The majority of GHOST data requirements are currently being met by LTER sites for the variables appropriate to that site's environment. Many can be accessed directly from the web pages, others may require the contact of the principle investigator at a site. The major need will be the harmonization of efforts.

Data policy:
The policy in the LTER Network is for open access to the data via the web pages for each site. Most LTER core data sets can be obtained directly from the home pages of each site. These can be accessed through http://LTERnet.edu. The Network data access policy is also available at that web site. More specialised data sets are also available; however, many sites request that the principle investigator be contacted. The data policy is that data are to be made available within 2 years.

A copy of the complete data policy is available from the U.S. LTER homepage, or from the GTOS secretariat.

URL:
http://LTERnet.edu

Contact:
Prof. James R. Gosz, Chairman, U.S. LTER Network
Biology Department
University of New Mexico
ALBUQUERQUE, NM 87131, USA
Tel: +1 505 2772265
Fax: +1 505 2775355
Email: jgosz@sevilleta.unm.edu

Annex 4: Demonstration Project - Terrestrial Ecosystem Productivity

1. Rationale

The GTOS Land Network needs to undertake a project which will demonstrate the potential of a relatively sparse network of sites to generate a reliable, useful product with global coverage and local relevance, rapidly and efficiently, by adopting a hierarchical approach and using models to combine *in situ* and remotely sensed data. The project is designed so that any network or site regardless of its level of sophistication can make a useful contribution to the project.

A set of output products which have Net Primary Productivity (NPP) as their common foundation would serve this purpose, and is achievable within the desired time frame by collaboration with existing initiatives. NPP, which is the amount of new plant growth which occurs within a given area over a specified time period (g m^{-2} y^{-1}), is a key integrator of ecosystem function. It is the mechanistic basis of harvest yield, whether it be of edible plant products, timber or meat. Deviation of NPP from its expected value is an objective indicator of degradation, which is of direct use to the Convention on Desertification. Net Ecosystem Production (NEP) is a related variable derived from NPP which is of crucial importance in the global carbon cycle, and thus to the Framework Convention on Climate Change.

The calculation of NPP requires the collection of a set of input data which are valuable long-term observations in their own right: rainfall, temperature, soil water holding capacity and nitrogen content, land cover and Leaf Area Index (LAI). Land cover is of direct relevance to the Biodiversity Convention and Climate Change Convention; water holding capacity and nitrogen content of soils are measures of degradation, and nitrogen content correlates closely with soil carbon, of interest in the global carbon cycle.

2. Objectives

The GTOS-NPP project has two primary goals, first to distribute a global standard NPP product to regional networks for evaluation, and translation of this standard product to regionally specific crop, range and forest yield maps for land management applications. Second, this project will use the FLUXNET global network of eddy covariance flux towers to translate the EOS NPP product into NEP, or total net ecosystem CO_2 flux, for use in global climate and carbon cycle models.

In this context, the GTOS-NPP project will inaugurate a globally distributed tracking of NPP and NEP critical to global change monitoring. As the network achieves global distribution, it will quantify any trends in biospheric productivity of significance, including NPP responses to desertification and land degradation trends, interannual climate variability, CO_2 fertilisation, pollution effects, etc. This plan also incorporates the principles of GHOST, the global hierarchical observing strategy, in that the regional NPP drivers will be done as a Tier 4 activity, regional NPP validation a Tier 3 activity, and the FLUXNET towers function as Tier 2 intensive continuous NEP study sites. Finally, the plan offers two end products, one of high practical utility at the local level, the other of high global significance at the scientific level.

3. Procedure

Satellite measurements

The project will extract the global weekly NPP product from the US NASA Earth Observing System Data Information System for dissemination to participating GTOS-NPP networks. Specifically, EOS is computing a NPP product at 1 km for the entire global vegetated land surface every 8 days from the MODIS sensor and ancillary data. This EOS product will commence shortly after the June 1998 launch of the AM-1 satellite, probably around September 1998. The EOS NPP algorithm is based on an extensive development of logic relating time integrated absorbed PAR to NPP.

In situ measurements

Each participating site should aim to collect the following input variables. Failure to collect the full set does not render the site useless, since the data, that are available, can be used for independent validation of the default global data sets. The data must be collected to be representative of a 3 km x 3 km square. This is because the calculated NPP product will initially have a resolution of 1 km by 1 km, with a positional error of up to 1 km. Future products could have a 250 m x 250 m resolution. The stratification and sub-sampling procedure necessary to ensure this will depend on the location and homogeneity of the particular site.

Daily precipitation
Daily maximum temperature
Daily minimum temperature
Once-daily absolute humidity (i.e. dewpoint temperature, or wet and dry bulb temp)
Daily wind run
24 hour total incoming radiation

Soil Total Nitrogen 0-30 cm
Soil clay and sand content, 0-30 cm
Soil Profile Water Holding Capacity, 0-30 and 30-bottom of rooting zone[6], which consists of:
Porosity (calculated from bulk density and stone content)
In situ drained limit (>field capacity)
*In s*itu wilting point (about -1.5 MPa)
Air dry water content (about 9 MPa)

Only for sites where phosphorus may be limiting, for the rooting zone
Total P
Organic P
Extractable P
Only for sites where soil acidity may be limiting,
pH
Only for sites where salinity may be limiting,
soil paste conductivity

Land cover, in the IGBP broad land cover classes

[6]Depth which includes 90% of the roots

Seasonal maximum and minimum LAI[7], more frequently if possible.
Sites should aim to collect at least one of the following sets of output variables:
NEP + soil respiration + harvest yield (Tier 2)
Above-ground NPP + soil respiration + harvest yield (Tier 3)
Harvest yield (Tier 4)

Failure to be able to collect any of the desired information does not limit the utility of other data that are collected. Hence if a site can collect any of the desired variables it will make a useful contribution to the project.

Sites collecting NEP will do so using an eddy covariance system located in the dominant cover type. Soil respiration must be integrated for the year and cover type, which means that it must be collected at a statistically valid number of locations, at least monthly, and be accompanied by the 0-30 cm water content and temperature at the time of measurement. Above-ground NPP would be collected by a method appropriate to the biome, for instance tree wood increment plus litterfall in forests, and sequential harvesting in grasslands.

4. Products

A central GTOS-NPP project office will extract the NPP data stream every 8 days for each participating GTOS network region from the 1.5 x 10{8} global cells. Additionally, the MODIS derived land cover and 8 day LAI/FPAR will also be downloaded from the global data set for each regional network. After development, this should be an automated extraction procedure.

Harvest yield is that fraction of the NPP which is extracted for human use; for instance, the grain yield in cereal crops, timber yield in forests, or forage in range lands. The harvest algorithm is a relationship between NPP and the harvest yield. It is a function of the product type, the site water and nutrient stress, and the age of the plant. It will be determined regionally by combining data from the literature with data emerging from those sites which have both NPP (or NEP) and harvest yield.

5. Roles and responsibilities

In situ site operators
- site-integral data provision to the coordinator within 6 months of collection;
- data quality control and adherence to metadata protocols

Regional networks
- development of transfer functions to convert NPP to an issue-based indicator (e.g. yield);
- identification of capacity-building needs.

GOS-Net Secretariat
- collation of data sets for provision to modelling team within 1 month of receipt;

[7]Defined as the daily integral fraction of PAR intercepted by photosynthetic tissue

- coordination of proposals for technical assistance agencies for capacity building;
- collation of methods;
- provision of NPP and LAI fields to network sites in accessible form.

NPP modelling team

- calculation of global NPP fields;
- provision of NPP models to the network in site-unable form.

6. Schedule

Jul 1997-Sept 1998	Planning, methods validation, capacity building, DIS design and implementation, soil and cover data collection
Oct 1998	Southern Hemisphere sites begin to collect data
Mar 1999	Northern Hemisphere sites begin to collect data
Dec 1999	First NPP surface validation
Jan 2000-Mar 2000	Recalibration of models, generation of first pass regional issue-based data sets
Dec 2000	Validation of second generation surfaces, second pass regional data sets.

Figure 1. Relationship between *in situ* measurements, satellite measurements and modelled outputs for deriving regional and local Net Primary Production, Net Ecosystem Production and Yield Estimates.