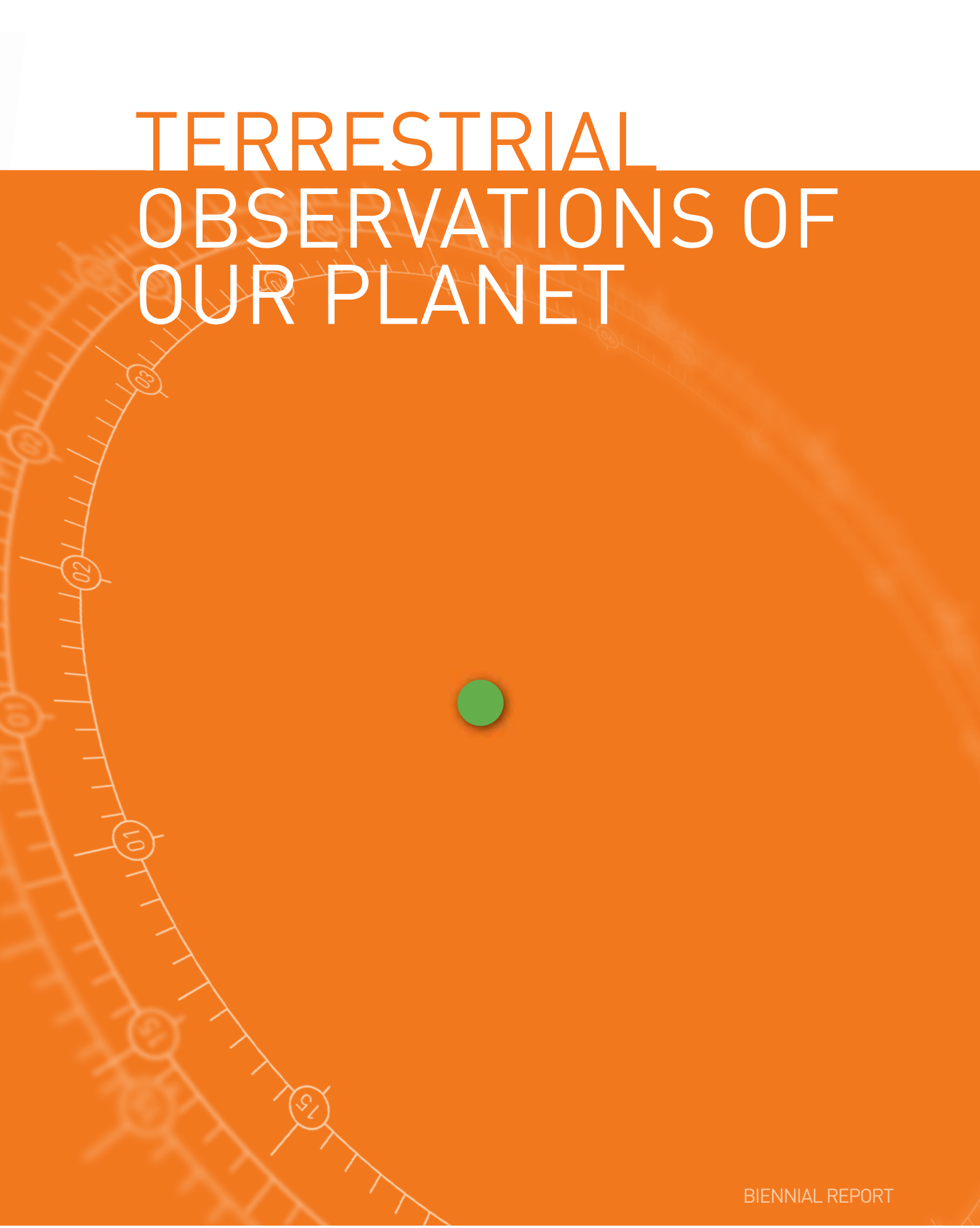
TERRESTRIAL OBSERVATIONS OF OUR PLANET



BIENNIAL REPORT

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TERRESTRIAL OBSERVATIONS OF OUR PLANET

[GTOS 50]

Editor Reuben Sessa

Authors Olivier Arino
Antonio Bombelli
Michael Brady
Robert R. Christian
Renato Cumani
Han Dolman
Claudia Drexler
Alain Giorgio Economides
Gregory B. Greenwood
Martin Herold
Thomas Hofer
Anthony Janetos
Mami Kainuma
John Latham
Mette Løyche Wilkie
Antonio Martucci
Berrien Moore
Francesco Palazzo
Paolo Prosperi
Franck Ranera
Inbal Becker Reshef
Ilaria Rosati
Steven W. Running
Robert Scholes
Reuben Sessa
Lucilla Spini
John Townsend
Jeff Tschirley
Riccardo Valentini
Maosheng Zhao

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, Rome 2008

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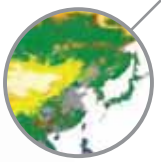
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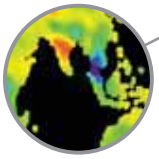
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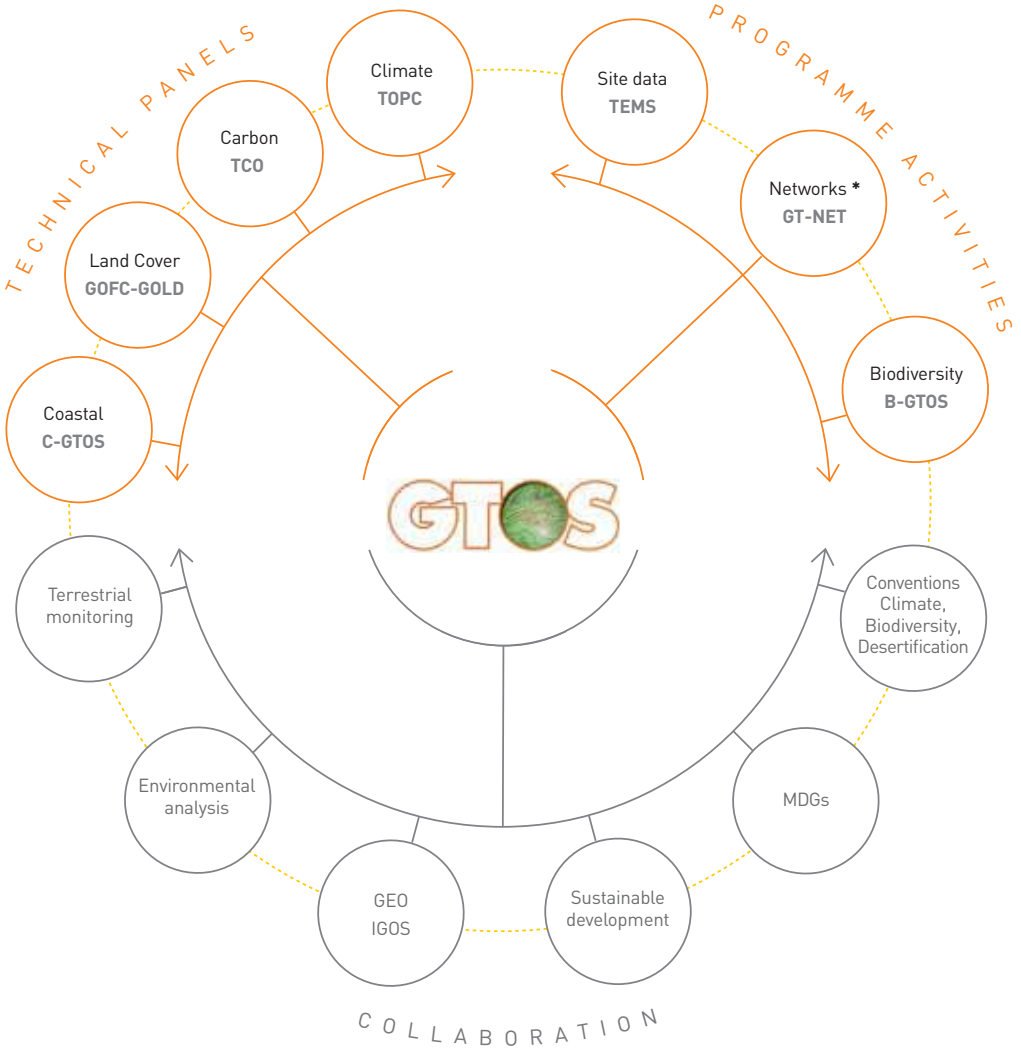


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GTOS PROGRAMME STRUCTURE

GTOS is a global system for observations, modelling and analysis of terrestrial ecosystems to support sustainable development.

Its mission is to facilitate access to reliable information on terrestrial ecosystems so that researchers and policy-makers can detect and manage global and regional environmental change.



* Networks e.g.: Glaciers (GTN-G), Hydrology (GTN-H), Mountains (GTN-M), Permafrost (GTN-P), River Discharge (GTN-R).

CHAIR

Berrien Moore
Institute for the Study of Earth, Oceans and Space
University of New Hampshire

AGENCY REPRESENTATIVES

Mario Hernandez
Division of Ecological Sciences
United Nations Educational, Scientific and Cultural Organization (UNESCO)

Norberto Fernandez
Chief, Early Warning and Observing System Branch
United Nations Environment Programme (UNEP)

Buruhani S. Nyenzi
Director, World Climate Programme
World Meteorological Organization (WMO)

Thomas Rosswall
Executive Director
International Council for Science (ICSU)

Jeff Tschirley
Chief, Environmental Assessment and Management Unit (NRCE)
Food and Agriculture Organization of the United Nations (FAO)

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André Bassolé
Directeur Général du Centre d'Etude, de Recherche et de Production en Information pour l'Environnement et le Développement Durable

Eric Lambin
Professor, Department of Geography, University of Louvain

H.E. Nadia Makram Ebeid
Head, Centre for Environment and Development for Arab Region and Europe (CEDARE)

Jacqueline McGlade
Executive Director, European Environment Agency (EEA)

Diane Wickland
Manager, Terrestrial Ecology Programme – NASA

PANEL CHAIRS

Han Dolman
Terrestrial Observation Panel for Climate (TOPC)
Faculty of Earth and Life Sciences, Vrije Universiteit

Robert R Christian
Coastal GTOS Panel (C-GTOS)
Department of Biology, East Carolina University

Anthony C. Janetos
Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD)
Joint Global Change Research Institute

Riccardo Valentini
Terrestrial Carbon Observation (TCO)
Department of Forest Science and Environment, University of Tuscia

SECRETARIAT

John Latham, Programme Director
Reuben Sessa, Programme Officer
Antonio Martucci, Information Systems Officer
Lucilla Spini, Programme Officer
Paolo Prosperi, TEMS Coordinator
Antonio Bombelli, Carbon Assistant
Simona Castelli, Budget Clerk
Barbara De Filippis, GTOS Clerk
Anne Ricchiuti, GTOS Clerk

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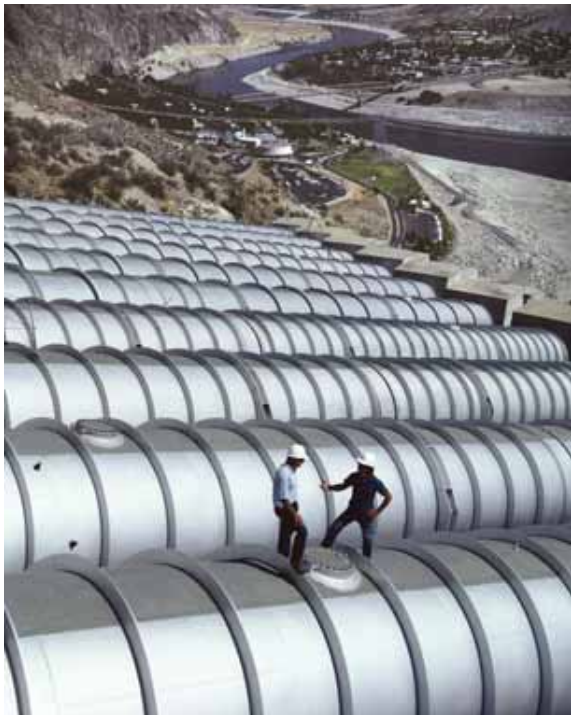


LETTER FROM THE CHAIR

by Berrien Moore

As is now well-known, the increase in atmospheric CO_2 concentrations, as well as other greenhouse gases, due to human activity, has produced concerns regarding the energy balance of the global atmosphere and this shift in balance will cause global patterns of temperature to increase and precipitation to change — the broad outlines are that wet areas will get wetter and dry areas will get drier.

What is less well known is just how daunting the task is of stabilizing climate change. Stabilizing emissions does not stabilize the concentration in the atmosphere, and even after achieving stabilization of CO_2 in the atmosphere, climate will continue to change, with both ocean and land temperatures continuing to rise for decades, and sea levels continuing to rise for centuries. The world has therefore already a future "pre-committed" to warming on account of carbon dioxide that humans have already added to the atmosphere.



Human activities are also significantly influencing Earth's environment in many ways in addition to greenhouse gas emissions and climate change. For many parts of the planet, the challenging environmental concerns are "place-based": shortages of clean and accessible freshwater, health threatening changes in the chemistry of the atmosphere, severe degradation of terrestrial and aquatic ecosystems, increases in soil erosion, loss of biodiversity, alterations of the coastal zone, and declines in fisheries. This direct immediate environmental impact further increases the urgency and the need to take action.

Confronting these concurrent challenges of global climate change and place-based environmental threats requires continuous focused information about the planet. The Global Terrestrial Observing System (GTOS) is committed to advancing, through advocacy and informed planning, the development and maintenance of the required observations of the terrestrial component of the Earth.

This report reviews some of the efforts made by GTOS, its technical Panels and its partners, in meeting the terrestrial observational requirements of stakeholders. For example, considerable support has been given to the realization of the Global Earth Observation System of Systems (GEOSS), which should ensure a coordinated observational mechanism. GTOS is collaborating, and in some cases is leading, the implementation of a number of GEOSS tasks and will continue to work with GEO and other partners to develop a terrestrial observing strategy.

Observations are essential to address the growing concern over the ever-increasing human modification of the global environment and the consequent implications for human wellbeing



GTOS is also committed to continue its support to other initiatives such as the Multilateral Environmental Agreements. In particular, considerable effort has been made in supporting the United Nations Framework Convention on Climate Change (UNFCCC), especially in regards to its systematic observational requirements. Providing technical guidance; developing the harmonization of methodologies; and improving data access and collaboration are just some of the examples of activities being undertaken. In particular, GTOS will continue its assistance to the Global Climate Observing System (GCOS) Implementation Plan, supporting the *in situ* networks in making the required observations and working with CEOS to ensure the continuation of the needed satellite observations. GTOS is also engaging with the international climate change community to raise awareness of the importance of observations for the development and implementation of effective climate change adaptation strategies. GTOS will also continue its role in assisting the timely delivery of the required data and information to stakeholders, especially those in developing countries.









RELATED LINKS:
GTOS: www.fao.org/gtos

BIENNIAL REVIEW FROM THE PROGRAMME DIRECTOR



by John Latham

CONSIDERABLE PROGRESS

The 2006–2007 biennium has been a challenging yet fulfilling period. The programmes that were initiated in the previous 2004–2005 biennium are now operational and new supporting activities are underway. GTOS has successfully reached its objectives of developing stronger links with national and international stakeholders to promote a more coordinated observational approach. For example, through its Secretariat and its technical Panels, GTOS has continued its support, and in some cases has led the implementation of the GEOSS tasks and activities. One of these tasks included the development of an Operational Agricultural Monitoring System, which will be a component of the 10-year Strategy for Agriculture (task AG-06-01).

What is particularly satisfying for me as Programme Director is that GTOS is now operationally involved in the implementation of a number of important observational initiatives. CarboAfrica; the global remote sensing survey of the FAO 2010 Forest Resources Assessment (FRA); the Fire Information for Resource Management System (FIRMS) and the World Atlas on Mangroves are just a few examples of such activities. This is an important step in evolving GTOS into a service provider to its stakeholders. GTOS has also been proactive in achieving the Millennium Development Goals (MDGs) and to participate in activities such as the Global Monitoring for Environmental Security (GMES). In all cases, the priority of GTOS is to assist in ensuring data providers meet the requirements of the numerous users.

PANEL ACTIVITIES

Significantly many of the technical Panels of GTOS are showing maturity and are now often able to create their own mechanisms to generate financial and technical support to implement the priorities outlined in their strategies. Synergy between the panels is also encouraged and cross-representation at Panel meetings is now common. This greatly facilitates the work of the GTOS Secretariat. It is a paradox that it is becoming increasingly difficult to secure donor support for coordination and information flows, an anomaly in an era when the international community is demanding more and more precise and timely information across the range of the GTOS thematic areas.

Under the new Chairman, Anthony Janetos, the Global Observation of Forest and Land Cover Dynamics Panel (GOFC-GOLD) through its land theme is supporting numerous activities, including: IGOL, Globcover, GEOSS, and advocacy is promoting the need for a new set of high resolution imagery for the Mid-decadal Global Land Survey. The GOFC-GOLD fire theme is undertaking and participating in numerous fire monitoring and management products. GOFC-GOLD also coordinates a number of land and fire *in situ* monitoring networks, and has also been investigating the technical aspects of UNFCCC activities on Reducing Emissions from Deforestation in Developing countries (REDD).

The Terrestrial Observation Panel for Climate (TOPC) has also a new Chairman, Professor Han Dolman, and a new team of experts. The Panel will have the important task of supporting GCOS in the review of current stakeholder requirements and the preparation of a new adequacy report. It will also assist GTOS in its activities related to the terrestrial Essential Climatic Variables (ECVs), including the development of methodological standards. Another important role of TOPC will be to also support the terrestrial *in situ* networks undertaking the observations and interacting with CEOS and individual satellite agencies to ensure adequate and continued remote observations. In this regard, the

Continued long-term observation of the terrestrial environment faces considerable technical and organizational challenges for successful implementation



emergence of new platforms from countries (such as Brazil, China and India, and the new emerging Sentinel systems of ESA) are welcome, especially when under a coordinated system such as the CEOS Land Surface Imaging Constellation.

The Terrestrial Carbon Observation (TCO) Panel of GTOS has the mandate to identify end users, organize and coordinate reliable data and information on terrestial carbon, and link the science community with potential users. Current activities include support to the Fluxnet network, implementation of Carboafrica and the participation in the EC-funded Intergrated Carbon Observation System (ICOS) initiative. TCO will also implement capacity building activities, such as training and study programmes and the development of field manuals.

C-GTOS has matured from an activity to a full GTOS Panel and is undertaking the phase 1 implementation plan, which includes: assessment of vulnerability of delta ecosystem services; operational observation networks, and coordinated management for the conservation of cultural sites.

CLIMATE CHANGE

Climate change and climate variability in local, regional and global systems are a cause for concern and have generated considerable political attention and stakeholder engagement. Clearly, climate change is a real threat to development and puts additional pressure on already limited resources. What is most disconcerting is that these phenomena are most likely to affect developing countries, which have the least capacity to adapt and meet these new challenges.

GTOS is supporting the terrestrial data and observational requirements of UNFCCC to assist it to reach its objectives. It is developing options for an intergovernmental framework mechanisms for the preparation of guidance materials, standards, and reporting guidelines for climate and associated data, metadata and products. GTOS is also undertaking the review of available standards and methodologies for the terrestrial ECVs. In addition GTOS is also collaborating in the UNFCCC Nairobi work programme on adaptation. These activities are reviewed in the special terrestrial ECV supplement that has been prepared with this biennial report.

FINANCIAL UNCERTAINTY

The considerable financial support that has been received by GTOS from the Government of Italy has been fundamental in attaining the achievements of this biennium. It is regrettable that we now come to the end of the agreed funding period, but are extremely grateful to the Government of Italy for the support they have provided. Coordination mechanisms are fundamental for reaching national and international observational objectives, but, regrettably, financial support for such activities are difficult to secure.

An essential priority for the new biennium will be to identify a new donor base that will allow GTOS to continue the coordination and implementation of activities. It is hoped that the Group on Earth Observations (GEO) and other international bodies will ensure the needed institutional support and generate the required financial mechanisms to continue the development of a coordinated infrastructure for collecting and distributing the terrestrial observations needed by the broad user community.

RELATED LINKS:
GTOS: www.fao.org/gtos

ITALIAN DEVELOPMENT COOPERATION AND THE GLOBAL ENVIRONMENT



by Alain Giorgio Economides

COOPERAZIONE ITALIANA

DEVELOPMENT COOPERATION AND ENVIRONMENTAL PROTECTION

Half-way to the year 2015, the Italian Development Cooperation is increasingly focusing on the attainment of the Millennium Development Goals (MDGs), by recognizing the interlinkages among the priority areas highlighted in the goals. In particular, the pivotal role of MDG No. 7 ("Ensure environmental sustainability") is recognized in the achievement of other MDGs, and especially MDG No. 1 ("Eradicate extreme poverty and hunger"). In this framework, among the key thematic priorities of the Italian Development Cooperation, there is the environment, with particular focus on rural development, organic and conventional agriculture, water management, climate change and renewable and alternative energies. This focus is exemplified by activities undertaken through bilateral, multilateral and decentralized cooperation aimed at the protection and sustainable use of natural resources – our common goods. For example, the projects "Integrated Development Project in Battambang Province (Kingdom of Cambodia)" and "Sustainable Development and Biodiversity Conservation for the People of Socotra Island (Yemen)" exhibit the interlinkages between environment and development by reconciling environmental protection with long-term economic growth, through the sustainable use of natural resources.

SCIENTIFIC DATA AND INFORMATION IN A CHANGING ENVIRONMENT

The effectiveness of these and other projects and related policy for the wise use of natural resources require accurate and reliable scientific data and information at local, national and international levels. The Government of Italy has a long tradition of mainstreaming technical and scientific components into development cooperation, as exemplified by the mandate and work of the Istituto Agronomico per l'Oltremare (IAO), the technical and scientific branch of the Italian Ministry of Foreign Affairs, and by the support to the UN-driven initiatives concerning environment and sustainable development.

SUPPORT TO THE GLOBAL TERRESTRIAL OBSERVING SYSTEM

The effective applications of scientific data and information towards project implementation and policy development has to be facilitated by



FAO/22406/R. Faidutti

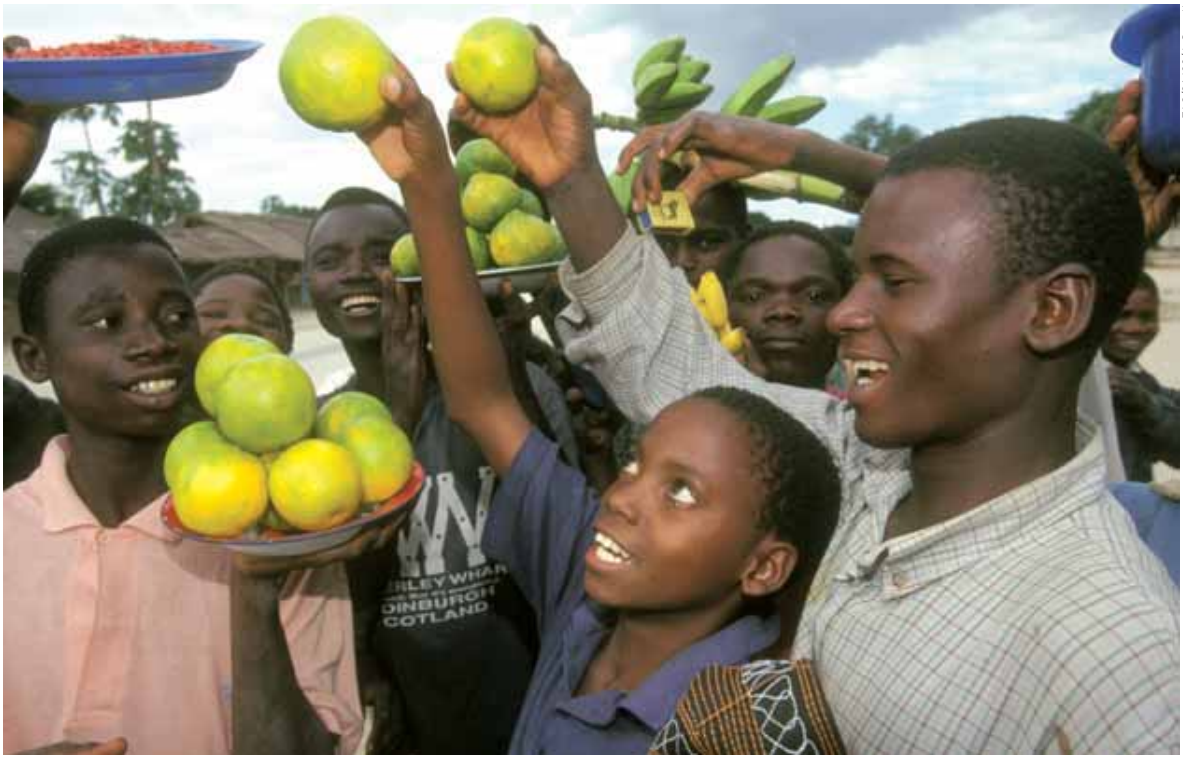


FAO/10085/J. Van Acker



FAO/21736/A. Proto

Supporting GTOS in a changing environment


FAO/21409/J. Spaull

standardization of methodologies and accessibility. The Italian Development Cooperation, through support to the interagency Global Terrestrial Observing System (GTOS) programme, promotes the accessibility of data and information on terrestrial ecosystems so that researchers and policy-makers can detect and manage global and regional environmental change. In particular, support has been targeted towards the strengthening of GTOS' capacity to assist international environmental conventions and to develop GTOS initiatives on land cover, terrestrial monitoring, terrestrial carbon, climate change, biodiversity and coastal ecosystems.

These GTOS activities reflect the extent of the challenge in addressing global environment change and environmental protection within development cooperation. At the same time, they illustrate the importance of working in synergies and partnerships in order to ensure environmental sustainability towards 2015 and beyond.


FAO/19710/G. Bizzarri


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RELATED LINKS:

Italian Development: www.cooperazioneallosviluppo.esteri.it/pdgcs/inglese/intro.html | **Ministry of Foreign Affairs:** www.esteri.it/MAE/EN/Home.htm

01 COORDINATED EARTH OBSERVATIONS

by Reuben Sessa, Antonio Bombelli, Michael Brady, Martin Herold, John Latham, Jeff Tschirley



GEO CREATION

Observations of the Earth system are critical in supporting policy and decision-making, and contribute to realizing the goals of the World Summit on Sustainable Development (WSSD), the Millennium Development Goals (MDGs), international conventions and other national and international efforts.

To reach the required level of coordinated, comprehensive and sustained Earth observations and information, the Group on Earth Observations (GEO) has initiated a 10-year implementation plan towards the Global Earth Observation System of Systems (GEOSS). The overall objectives of GEOSS are to enhance human health, safety and welfare; alleviate human suffering, including poverty; protect the global environment; reduce disaster losses, and achieve sustainable development.

IMPLEMENTATION PROCESS

In 2006, GEO began implementation of the GEOSS 10-Year Implementation Plan. Activities cover all nine societal benefit areas (see box) and five transverse areas, namely: user engagement; architecture; data management; capacity building; and outreach. The tasks identified will be implemented by GEO members at local, national, regional and global levels.



GEO will work with, and build upon, existing national, regional and international systems, addressing critical gaps, supporting their interoperability, sharing information, reaching a common understanding of user requirements, and improving delivery of information to users.

GTOS CONTRIBUTION

From the beginning, GTOS has welcomed the GEOSS process as it has the political endorsement and support to carry out the important role of coordinating the large number of national and international activities in the development of the products and data required by end users.

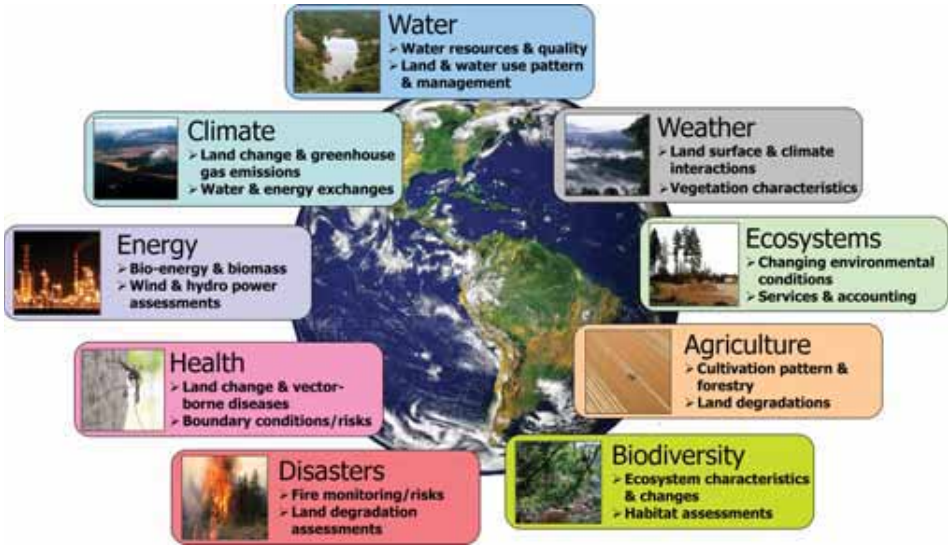
GTOS and its Panels have been active in assisting in the development of the Societal Benefit Areas, the 10-year implementation plan, and the execution of numerous tasks (see box). In addition, GTOS is ensuring that its activities comply with and are relevant to GEO objectives and requirements, as well as assisting in the creation of the required networks and infrastructure.

MINISTERIAL SUMMIT

The next GEO Ministerial Summit on Earth Observation for Sustainable Growth and Development will be held on 30 November 2007 in Cape Town, South Africa. It will be an important opportunity to report to ministers on the early progress made on developing GEOSS, highlight emerging priorities, and ensure continued engagement and support to the GEOSS process.

Of particular note at the Summit are two GEO tasks led by the GTOS GOFC-GOLD Panel that address global land cover and fire observations. These tasks have been recognized by GEO as "early success stories" and described in the ministerial Summit publication "The Full Picture".

Worldwide effort to build a Global Earth Observation System of Systems over the next 10 years



GEO observation needs emphasize the multitude of benefits from continuous and consistent global land cover observations (*Source*: M.Herold, GOFC-GOLD)

GTOS-RELEVANT GEOSS TASKS AND ACTIVITIES

[In Italic when a task leader]

- AG-06-04 Forest Mapping and Change Monitoring (*GOFC-GOLD*, GTOS Sec., TCO)
- AR-07-01 Enabling Deployment of a GEOSS Architecture (GTOS Sec.)
- BI-06-02 Biodiversity Requirements in Earth Observation (B-GTOS)
- BI-07-01 Biodiversity Observation and Monitoring Network (B-GTOS)
- CL-06-03 Key Terrestrial Observations for Climate (*GTOS Sec.*, TOPC, TCO)
- CL-06-06 Global Ocean Observation System (C-GTOS)
- DA-06-04 Data, Metadata and Products Harmonisation (GTOS Sec)
- DA-07-02 Global Land Cover (*GOFC-GOLD*, GTOS Sec.)
- DA-07-03 Virtual Constellations (GOFC-GOLD)
- DI-06-09 Use of Satellites for Risk Management (GTOS Sec., GOFC-GOLD)
- DI-06-13 Implementation of a Fire Warning System at Global Level (*GTOS Sec.*, GOFC-GOLD)
- EC-06-01 Integrated Global Carbon Observation - IGCO (TCO, GTOS Sec.)
- EC-06-02 Ecosystem Classification (GTOS Sec.)
- EC-06-07 Regional Networks for Ecosystems (*GOFC-GOLD*, GTOS)
- EC-07-01 Global Ecosystem Observation and Monitoring Network (GTOS Sec., TCO, C-GTOS)
- US-06-01 Identify Priorities and Synergies between SBAs (GTOS Sec.)
- US-06-02 Communities of Practice (GTOS Sec., Forests: GOFC-GOLD, Coastal zone: C-GTOS)

GEO SOCIETAL BENEFIT AREAS (SBAS)

DISASTERS – Reducing loss of life and property from natural and human-induced disasters
HEALTH – Understanding environmental factors affecting human health and well-being
ENERGY – Improving management of energy resources
CLIMATE – Understanding, assessing, predicting, mitigating and adapting to climate variability and change
WATER – Improving water-resource management through better understanding of the water cycle
WEATHER – Improving weather information, forecasting and warning
ECOSYSTEMS – Improving the management and protection of terrestrial, coastal and marine resources
AGRICULTURE – Supporting sustainable agriculture and combating desertification
BIODIVERSITY – Understanding, monitoring and conserving biodiversity

GEO MEMBERS

- 71 nations
- the European Commission
- 46 international organizations

RELATED LINKS:
GEO: http://earthobservations.org | **GTOS related activities:** www.fao.org/gtos/GEOSS.html

02 LAND OBSERVATIONS

by John Townsend, John Latham, Reuben Sessa, Inbal Becker Reshef and Chris Justice



Reliable observations of the terrestrial environment play a crucial role for sustainable economic development and for natural resources management, as well as for the development, implementation and monitoring of a number of multilateral environmental agreements.

Vast quantities of observations of land are collected, but, compared with the atmosphere and oceans, there has been much less international coordination and standardization of observations, making country-by-country and region-by-region comparisons difficult, and thus hindering understanding of land processes at a global scale.

THE IGOS PARTNERSHIP

The Integrated Global Observing Strategy (IGOS) Partnership is a strategic planning process, involving a number of partners, that links research, long-term monitoring and operational programmes, data producers and data users in a structure that helps determine observation gaps and identify the resources to fill observation needs.

LAND THEME

In 2004, the IGOS Partnership endorsed the development of the Integrated Global Observations for Land (IGOL) theme.

An international team has undertaken the complex task of preparing the theme report, which has been achieved through a series of workshops and numerous consultations with experts and other stakeholders.

It is proposed that IGOL will build on current initiatives and existing monitoring programmes linked to relevant research programmes to ensure that the best possible products are obtained, and that these products are made available to a wide range of users at the national and international levels.

CONTRIBUTION TO GEOSS

The IGOL theme report has been developed to support the 10-year implementation plan of the Global Earth Observation System of Systems (GEOSS). The report identified the critical observations, coordination mechanisms, relevant institutions and gaps that need to be filled, to ensure the delivery of the requisite information products in a timely fashion. For this to be achieved, information products at national to global scales, deriving from a combination of sources — satellite, *in situ* observation, socio-economic data — need to be designed to meet current and future societal requirements. Many of the recommendations from the theme report are already being undertaken in GEO tasks and activities.

AGRICULTURAL MONITORING

An example of support to GEO has been the formulation of the strategy for Task AG-07-03 (Development of an Operational Agricultural Monitoring System), which contributes to Task AG-06-01 (Development of a 10-year Strategy for Agriculture). An IGOL/GEOSS Agriculture Community of Practice, representing 25 national and international organizations, was established in order to support and implement the task. Through workshops, this community has reviewed the current state of agricultural monitoring and identified the priorities

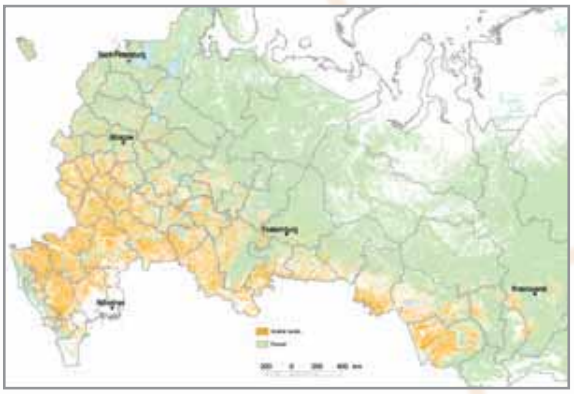




Identify the key land cover observations and data products needed by decision-makers



and requirements for: early warning, food security, national- and subnational-level agricultural monitoring (both statistical and satellite based) and information capacity building needs of developing countries. The strategy and actions required for implementing a global agriculture monitoring system are currently being formulated, and are detailed in a separate GEOSS/IGOL report from the *Workshop on Developing a Strategy for Global Agricultural Monitoring* held in July 2007 at FAO headquarters in Rome, Italy.



A preliminary map of arable lands for Russia generated from MODIS data (*Source*: Bartalev et al)

FUTURE OF IGOL

IGOS and its themes are undergoing transition to GEO, and discussions are underway to establish the most suitable position of IGOL within the GEO mechanism.

THEME TEAM MEMBERS

- John Townshend and John Latham (IGOL co-chairs)
- Olivier Arino, Roberta Balstad, Alan Belward, Richard Conant, Dris El Hadani, Chris Elvidge, Jay Feuquay, Angas Hopkins, Tony Janetos, Chris Justice, Jiyuan Liu, Mengxue Li, Tom Loveland, Doug Muchoney, Dennis Ojima, Christiana Schmullius, Reuben Sessa, Ashbindu Singh, Jeff Tschirley and Kirokazu Yamamoto.

MAIN IGOL MEETINGS

- 1st IGOL Theme Team meeting, September 2004, Rome, Italy
- 2nd IGOL meeting, July 2005, Reston, Virginia, USA
- Biodiversity meeting, November 2005, Washington DC, USA
- 3rd IGOL meeting, February 2006, Beijing, China.
- Agricultural Monitoring Workshop, March 2006, Rome, Italy
- GEO Global Agricultural Monitoring workshop, July 2007, Rome, Italy

RELATED LINKS:
www.fao.org/gtos/igol/index_en.asp | www.igospartners.org

03 LAND COVER DYNAMICS

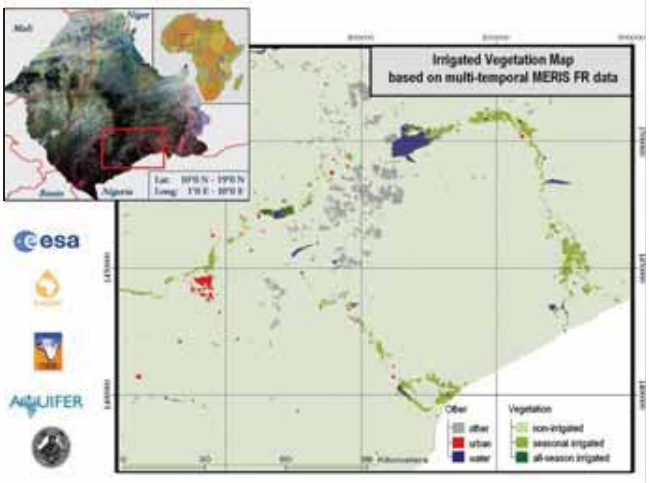
by Anthony Janetos and Michael Brady



INTRODUCTION

The GTOS Panel on Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) is a coordinated international effort to ensure a systematic long-term programme of space-based and *in situ* observations of land cover and forest change, including the role of fire. Over the biennium period, GOFC-GOLD has worked with the international land cover community and the Group on Earth Observations (GEO) to build the foundations for land cover observations as an integral part of a Global Earth Observation System of Systems (GEOSS).

Through implementation teams and regional networks, GOFC-GOLD develops contributory products at regional and global scales in two thematic areas: Land Cover Characteristics and Change, and Fire Monitoring and Mapping. GOFC-GOLD activities are coordinated by the project office and members of the Executive Committee. After six years of dedicated service and leadership as GOFC-GOLD Chair, John Townshend stepped down in 2007, but continues as a member of the Land Cover Implementation Team. In June 2007, Anthony Janetos, of the Joint Global Change Research Institute at the University of Maryland (USA), was appointed as the new GOFC-GOLD Chair.



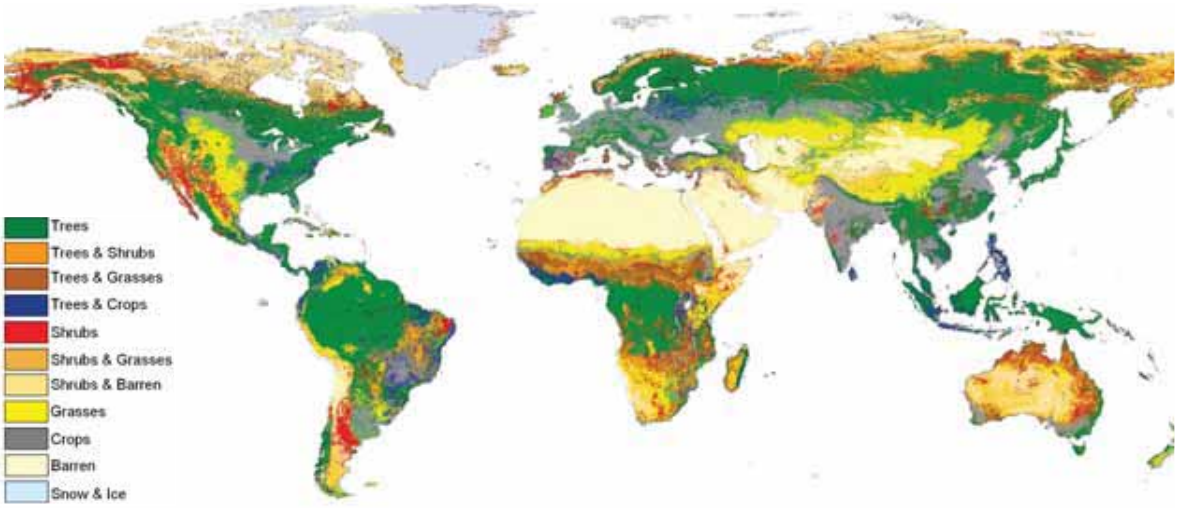
FIRE MAPPING AND MONITORING

The GOFC-GOLD Fire Mapping and Monitoring theme is aimed at providing the necessary coordination to improve fire data access and use, and to secure long-term fire observing systems. The GOFC-GOLD-Fire implementation areas address the needs of resource managers, policy-makers and the scientific community, covering such topics as fire danger rating, fire detection and characterization, fire affected area mapping, post-fire recovery, and fire emissions.

During the biennium, GOFC-GOLD operated in partnership with a number of related international organizations, including the Global Wildland Fire Network and the Wildland Fire Advisory Group under the United Nations International Strategy for Disaster Reduction (UNISDR). The fire programme also contributed to several GEOSS activities through the development of a Global Wildland Fire Early Warning System; a global geostationary fire monitoring network; and use of satellite-based fire information for disaster monitoring and management. The inclusion of satellite observations in fire early warning systems is helping to improve the spatial resolution of systems currently driven by weather data.

GOFC-GOLD is facilitating a global geostationary network of satellites monitoring the diurnal cycle of fire activity, using the next generation of weather satellites. Development of small-satellite technologies and constellation systems for fire monitoring will lead to considerable improvements in fire monitoring.

Recent progress in observing global land cover and forest change



SYNMAP - a global synthesis product of existing global land cover maps for carbon cycle modelling (*Source*: M. Jung, MPI-BGC, Jena)

LAND COVER CHARACTERISTICS AND CHANGE

The Land Cover Characteristics and Change theme promotes the use and refinement of land cover data and information products for resource managers, policy-makers and scientists studying the global carbon cycle and biodiversity loss. During the biennium, the global land cover observation community, with GOFC-GOLD leadership and involvement, was able to achieve significant progress, examples of which are given below.

The new IGOS partnership theme for Integrated Global Observations of the Land (IGOL) defines detailed observation requirements for different areas including land cover and fire.

The new ESA-funded GLOBCOVER product provides the highest resolution (300 m) consistent global land cover map fully compliant with international standards for land cover characterization (FAO/UNEP Land Cover Classification System) and validation (CEOS best practices).

GOFC-GOLD is collaborating with NASA and the U.S. Geological Survey to plan and acquire high resolution imagery for the Mid-decadal Global Land Survey, which is intended to provide a consistent, pre-processed, global, free-of charge Landsat data set for 2005 that extends the existing 1990 and 2000 Geocover Landsat global datasets.

Countries participating in the UNFCCC began addressing the issue of Reducing Emissions from Deforestation in Developing Countries (REDD) as a globally important source of greenhouse gas emissions. The GOFC-GOLD REDD working group was formed in 2006 to address key technical issues (i.e. degradation, accuracy assessment) and is preparing a "sourcebook" that will summarize the technical consensus on current and future earth observation capabilities for monitoring deforestation and its emissions.

ENGAGING USERS IN THE REGIONS

During the biennium, the GOFC-GOLD Regional Networks held their fourth pan-network meeting, involving members from Southeast Asia, Central and Southern Africa, Northern Eurasia, Latin America and East Asia. Common issues among the networks include the need to establish calibration/validation test sites in the regional locations; increase participation in the GEOSS 10-year plan; promote network activities that support national priorities and requirements such as international convention monitoring and reporting; and finally the development of common strategies and resource pools to enhance network sustainability and capacity building. Future collaboration with GOFC-GOLD will focus on validation and calibration activities, and facilitating the distribution of data, materials, and documents through electronic portals.

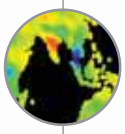
RELATED LINKS:

Project Office: www.fao.org/gtos/gofc-gold | **Fire Implementation Team:** http://gofc-fi re.umd.edu

Land Cover Implementation Team: www.gofc-gold.uni-jena.de

04 CLIMATE OBSERVATIONS

by Han Dolman



ROLE AND IMPORTANCE

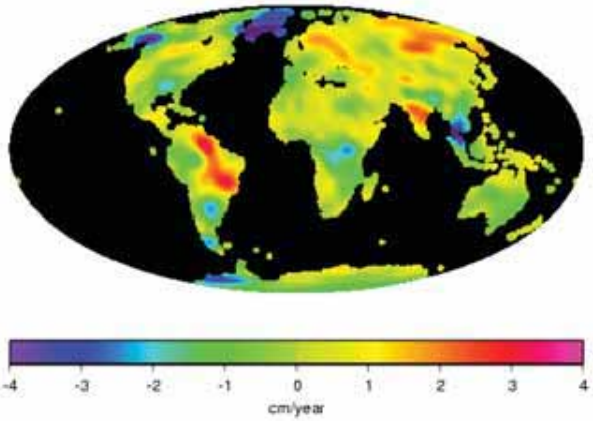
The Terrestrial Observing Panel for Climate (TOPC) is a joint Panel of GTOS and the Global Climate Observing System (GCOS). TOPC liaises with relevant research and operational communities to identify measurable terrestrial properties and attributes that control the physical, biological and chemical processes affecting climate, are themselves affected by climate change, or serve as indicators of climate change.

Although climate change is now firmly established, there remains considerable uncertainty about the rate of change and its regional variability. *Precise quantification of the rate of change remains important to determine whether feedback or amplification mechanisms are operating within the climate system.* Unfortunately, the climate observing system in the terrestrial domain still remains the least well developed component, whilst at the same time there is increasing significance being placed on terrestrial data both for climate understanding and for impact and mitigation assessment.

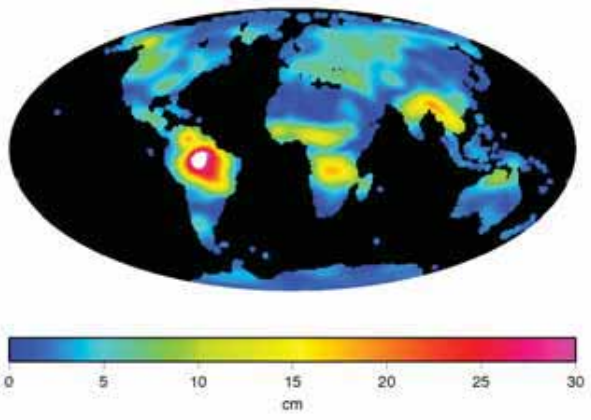
Foundations exist for both the *in situ* observation networks and the space-based observing components of the terrestrial domain. Space agencies and other organizations are generating new products, the Global Terrestrial Networks (GTNs) are being established and growing in effectiveness, and their associated international data centres are beginning to be populated with data.

IMPLEMENTATION PROGRESS

TOPC has played an important role in assessing the availability of standards for the terrestrial Essential Climate Variables (ECVs) within its overall mandate of improving the understanding of the terrestrial components of the climate system, the causes of change to this system and consequences in terms of impact and adaptation. The TOPC Panel composition has been revised and a new Chair was appointed in March 2007. The Panel is strengthened in the key areas of groundwater and permafrost monitoring, and land surface modelling.



Emerging, short-term trends in total water storage (cm/yr), which reflect both natural variations and human management of the water cycle
Courtesy of Jay Famiglietti and Don Chambers



Annual amplitude of variations in total water storage (cm) from the Gravity Recovery and Climate Experiment (GRACE), from 2002 to present. Total water storage includes all snow, surface water, soil moisture and groundwater
Courtesy of Jay Famiglietti and Don Chambers

Working with *in situ* monitoring services and satellite agencies to ensure that the gaps identified are filled



A new joint working group between TOPC and the Atmospheric Observation Panel for Climate (AOPC) on Land-Surface/Atmosphere Issues (WG-LSA) has been created. It will address the scientific issues arising from the need to ensure the physical consistency of atmospheric and land surface ECVs derived from operational Earth Observation measurements (both *in situ* and from remote sensing techniques) and will investigate some of the key implications of potential incoherencies or discrepancies.

FUTURE ORIENTATIONS

Changes in the context of both the status of ECVs and the need for new ones required for impact and mitigation studies require some re-establishment of the focus of TOPC. TOPC will continue to work with space agencies to help ensure that optimum use is made of earth observing satellite data for monitoring the terrestrial component of our climate system. Work will continue with *in situ* monitoring services to ensure, for example, that gaps identified in the global glacier and permafrost monitoring networks are filled, and TOPC will continue to work with the GTOS and GCOS sponsors (especially FAO and WMO) on the establishment of a formal process for issuing technical guidelines for terrestrial observations. The process is underway to establish the World Climate Research Programme (WCRP) as a co-sponsor of TOPC, which will ensure increased international coordination for terrestrial climate observations.

NEW TOPC PANEL CONFIRMED MEMBERSHIP

- Han Dolman (Chair)
- Jay Famiglietti
- Wilfried Haeberli
- Ulrich Looser
- Jan Polcher
- Shaun Quegan
- Michel Verstraete
- Valery Vuglinsky

RELATED LINKS:

GRACE: www.csr.utexas.edu/grace | **TOPC:** www.wmo.int/web/gcos/topc.htm | **TOPC:** www.fao.org/gtos/TOPC.html

05 TERRESTRIAL CARBON OBSERVATION (TCO)

by Riccardo Valentini and Antonio Bombelli



INTRODUCTION

The Terrestrial Carbon Observation (TCO) Panel of GTOS supports the coordination of a global carbon observation system and its database. This includes the relevant methodological development to allow the global standardization and synthesis of data and for its improved use in validation and modelling applications. TCO is dedicated to improving the access of data and information to stakeholders. This includes the identification of potential end users (such as scientific bodies, policy-makers and international conventions) and their data requirements. Capacity buiding is also an important component of TCO activities.

Through its international Panel of experts, TCO contributes to a number of international initiatives and programmes, some of which are highlighted below.

CARBOAFRICA

CarboAfrica is a project funded by the European Commission under the 6th Framework Programme. The overarching goal is to coordinate a greenhouse gases (GHGs) monitoring network for Africa, in order to better quantify, understand and predict Africa's role in the global change process. FAO and GTOS (through TCO) are full partners of the project, and during the first year of the project have implemented the communication and capacity building components, involving the project Web page, the list server, newsletters, brochures and support to African students.

FLUXNET-TCO WORKSHOP

TCO provided financial, technical and logistical support for the FLUXNET–TCO Synthesis Workshop (18–22 February 2007, LaThuile, Italy). The workshop was attended by approximately 60 scientists. The objectives were to: discuss the scientific potential of a new global dataset; propose new synthesis activities; and start first data analyses based on the global database. The main results included: the production of a standardized database of carbon, water and energy fluxes, consisting of about 620 years of data from 180 eddy covariance sites; the definition of a common policy for data distribution to the wider scientific community, and proposals for more than 50 papers. Most importantly, the foundations for the harmonization of the different eddy covariance networks have been established.



Photo: Luca Belelli Marchesini

Despite the low amount of aboveground biomass, steppe can contain high carbon stocks in soil



Photo: Luca Belelli Marchesini

An example of anthropic disturbance to the carbon cycle: flame weeding of a mountain grazing area in the Ukraine

Monitoring the carbon cycle to improve our understanding of terrestrial ecosystems and climate change



Photo: Luca Belelli Marchesini

Forest after a wind storm in Slovakia. Selecting the best forest management option after a natural disturbance is important for carbon cycle optimization

ESSENTIAL CLIMATE VARIABLES (ECVS)

TCO has contributed to the development of the standard reports for the ECVs (see climate change supplement). In particular, TCO has supported the development of the ECV on biomass, which is a key variable to understand the global carbon cycle and climate change issues. Estimates of biomass change provide a direct measurement of carbon sequestration or loss, and can help to validate carbon-cycle models.

DEVELOPMENT OF PROJECTS

TCO, together with the GTOS Secretariat, has participated in the development of the COCOS project (Coordination of Carbon Observing Systems) that is currently under negotiation with the European Community. The main aim of COCOS is to create a coordinated system of integrated global carbon cycle observations (ocean, land and atmosphere), including *in situ* and remote observations.

GTOS and TCO are full partners, with the main task of the development of contacts and synergies with all global projects and initiatives related to the carbon cycle. TCO has also contributed to the successful submission of the project ICOS (Integrated Carbon Observation System), and should now be involved in its implementation.



Photo: Justice Mensah

The construction of the first flux tower in an African tropical forest in Ghana, by University of Tuscia, Italy

THE FUTURE

TCO will continue to assist in the coordination of global monitoring of terrestrial carbon. Our understanding of ecosystem processes and the factors driving climate change are strongly linked to the future improvements in studies of the carbon cycle and its terrestrial component. There are still many knowledge gaps that need to be filled, and TCO, through its work at scientific and political level, can contribute towards filling these gaps.

The future activities of TCO are also dependent on the availability of funds. It is for this reason that TCO has adopted the strategy of securing funds through its participation in projects and consortiums. This should ensure the continuation of the needed activities required by stakeholders.

RELATED LINKS:

TCO: www.fao.org/gtos/tco.html | **CarboAfrica:** www.carboafrica.net | **IGCO:** http://ioc.unesco.org/igospartners/Carbon.htm | **GCP:** www.globalcarbonproject.org

06 COASTAL GTOS

by Robert R. Christian



SCOPE AND IMPLEMENTATION

As coastal areas have intensive human activity and are rich and diverse in natural resources, an understanding of coastal areas is of particular importance in guiding wise national and international policy decisions. Therefore Coastal GTOS (C-GTOS) was established to aid in the detection, assessment and prediction of global and large-scale regional changes associated with land-based and freshwater ecosystems along coasts.

After the completion of the Coastal GTOS Strategic Design and Phase 1 Implementation Plan, the members of the original panel of experts, the GTOS Secretariat and other partners have worked towards the development of the initial coastal products.

DELTA VULNERABILITY ASSESSMENT

C-GTOS participated in the development of the World Deltas Network. This effort is in support of the assessment of vulnerability of delta ecosystem services and was led by John Kineman. A linked development was the creation of a time series of images of the Nile Delta to evaluate land-use changes over multiple decades. This has been done in collaboration with the Global Land Cover Network (GLCN).

CULTURAL SITES MANAGEMENT

C-GTOS played a leading role in the establishment of a cooperative agreement (Memorandum of Cooperation) with the Ramsar Convention on Wetlands.

This has led to C-GTOS supporting coordinated management of conservation and cultural sites, with a focus on wetlands. The agreement also includes the development and launch of the Partnership on Wetlands Mapping and Inventory, in cooperation with the International Water Management Institute (IWMI).

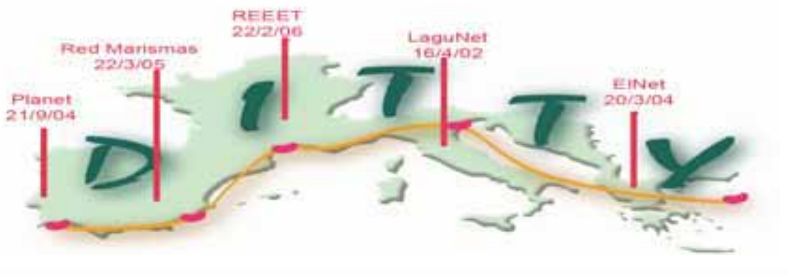
MEDITERRANEAN LAGOONS

Pierluigi Viaroli, of the University of Parma (Italy), is helping to lead the development of a network of programmes studying coastal lagoons within the Mediterranean region.

The objective is to establish a network for inventory and coordination purposes, and to undertake sustainable observations related to delivery of materials to coastal waters. It is hoped that the network will serve as a regional alliance for sustained coastal observations.



Geographical distribution of the 20 LaguNet sites



Development of National Networks with the support of the DITTY project

C-GTOS activities address the interaction of humans with coastal ecosystems and their many important services



Photo by G. Giordani

Off shore fishfarm under a windstorm , Manfredonia, Italy

NEW TEMS COASTAL MODULE

Great efforts have been made to increase the number of coastal monitoring sites in the TEMS database, which now also includes four new C-GTOS related networks (PLaNet, RedMarismas, Elnet and LaguNet). Approximately 80 new variables have also been added to allow the data monitoring from LaguNet to be included in the system. These activities have been achieved with the support and collaboration of the University of Parma, Italy.



Photo by G. Giordani

Automatic monitoring station in the Sacca di Goro, Italy



Photo by G. Giordani

Special vessel for macroalgal harvesting, Sacca di Goro, Italy

PANEL FORMATION

At the GTOS Steering Committee Meeting (January 2006), agreement was reached to convert C-GTOS from a GTOS activity to a full C-GTOS Panel. In addition, both GTOS and the Global Ocean Observing System (GOOS) agreed that C-GTOS should act as the coordination mechanism with the coastal module of GOOS.

A Joint Panel for Integrated Coastal Observations (JPICO) was proposed in the IGOS–Coastal Theme proposal and is under consideration by the relevant parties. The formation of a C-GTOS Panel has therefore been deferred in the hope that it will be established within the context of JPICO.

Robert Christian, who chaired the initial group of experts to write the *C-GTOS Strategic Design and Phase 1 Implementation Plan*, has continued to represent C-GTOS. He served on the Panel that wrote the IGOS–Coastal Theme plan that formally coordinated GOOS and GTOS coastal activities in conjunction with the IGOS Coral Reef Sub-Theme, LOICZ and other coastal programmes. He currently represents C-GTOS on the Steering Committee of the GEO Coastal Zone Community of Practice, which is the entrée of GTOS into the GEO process for coastal issues.

RELATED LINKS:

C-GTOS: www.fao.org/gtos/C-GTOS.html | **C-GTOS Phase 1 Implementation Plan:** www.fao.org/gtos/gtospub/pub36.html

TEMS Coastal module: www.fao.org/gtos/tems/mod_coa.jsp

07 TERRESTRIAL ECOSYSTEM MONITORING SITES (TEMS)

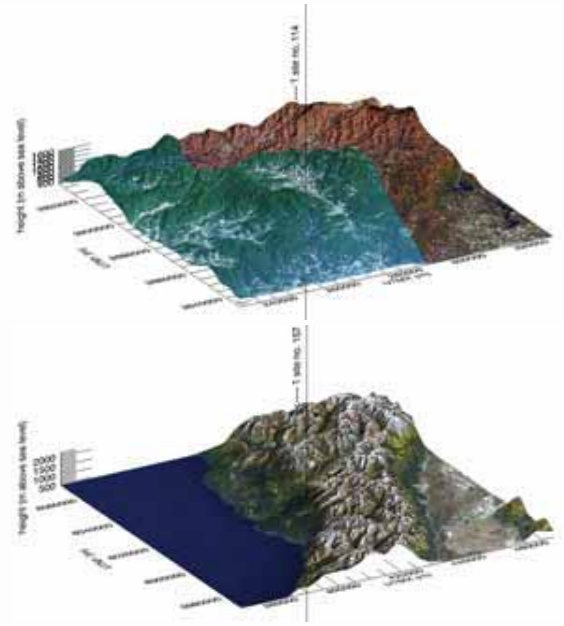
by Paolo Prosperi



TEMS is a Web-based directory of international stations and networks that carry out long-term, terrestrial monitoring and research activities. The database offers easy access to information on "who is monitoring what (variable) and where" that can be useful to both the scientific community and to policy-makers, as well as to other stakeholders.

DATABASE IMPROVEMENTS

Following the request of site managers, the GTOS Secretariat has implemented a number of new features and services to improve the database. For example, a Web-based Digital Elevation Model (DEM) has been developed for each registered site. The final products are three-dimensional models of a 100×100 km square buffered area, with superimposed Landsat ETM+, TM and MSS imagery (land cover vector layers will follow). This represents a significant enrichment of the information offered by TEMS.



3D view of TEMS sites, 100km x100km using SRTM digital elevation model with superimposed Landsat imagery

For each site, if available, the model is offered as a static 3-D image, but future improvements will include a virtual 3-D image that can be freely rotated or zoomed in or out using Web browsers, provided that a special plug-in is installed.

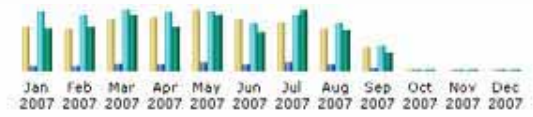
NEW CONVENTIONS MODULE

A new module on the UNFCCC and other international conventions has been designed and is being published on the TEMS Web site. It will contain an introductory section on the conventions and the linkages with GTOS and TEMS services.

The module will also include other sections such as a glossary of terms and a list of the variables of interest to the conventions.

NEW NETWORKS AND SITES

Since 2006, TEMS has continued to grow in number of sites, networks (e.g. CarboAfrica, PLaNet, RedMarismas, Elnet, LaguNet) and information available. In collaboration with the GTOS Coastal



Month	Number of visits	Pages	Hits	Bandwidth
Jan 2007	3232	7343	91263	340.83 MB
Feb 2007	3113	7067	85722	347.32 MB
Mar 2007	3708	10155	93045	455.55 MB
Apr 2007	3948	7757	89493	346.28 MB
May 2007	4501	12888	92603	452.45 MB
Jun 2007	3775	7037	71741	309.13 MB
Jul 2007	3581	12058	85919	486.53 MB
Aug 2007	3119	8020	72075	332.23 MB
Sep 2007	1700	3457	37705	151.02 MB
Oct 2007	0	0	0	0
Nov 2007	0	0	0	0
Dec 2007	0	0	0	0
Total	30837	76582	719566	3.15 GB

TEMS Monthly Web history (taken in mid September 2007)



The "who, what and where" of *in situ* terrestrial monitoring



Photo by P. Stefani

An eddy covariance station measuring carbon fluxes in Italian Alps

Panel and the University of Parma (Italy), approximately 80 new variables have been added to the system to allow data monitoring of the LaguNet network to be included in the system. TEMS now features 2059 T.sites and 183 variables.

INTEGRATION WITH OTHER PROGRAMMES

GTOS and the Global Observing Systems Information Center (GOSIC) have worked towards strengthening the collaboration between the two portals. Cooperation includes promoting the registration of T.site datasets onto the Global Change Master Directory (GCMD). Another potential area of collaboration is the implementation of an automated update mechanism for the GTOS/TEMS data Matrix. The matrix links *in situ* observations (at monitoring sites registered in TEMS) to the data already available and referenced in the GCMD.

ECOPORT

The prototype integration of TEMS into EcoPort has been successfully developed and deployed. Detailed guidelines have been published on the TEMS Web site to allow users to explore the TEMS/EcoPort test system. Further integration and improvements will depend on the responses from the user community.

OTHER IMPROVEMENTS AND COLLABORATION

With the kind support of GOSIC, a significant effort has been made to update T.site contact information and profiles. A new anti-spam script has been put in place on the feedback form of the Web site and a new privacy policy section has been added that includes information on how to credit TEMS.

FUTURE OF TEMS

Activities are being planned for the future to make TEMS more efficient in serving the end-user community.

The mountain, biodiversity and hydrology modules in TEMS will be improved and a Web-based user forum for discussion of relevant issues, exchange of data or suggestions will be implemented.

Collaboration will be strengthened with the FAO GeoNetwork initiative.

TEMS FEATURES

- 2 060 monitoring sites
- 44 networks
- 1 200 contact persons
- 180+ environmental variables and 55 socio-economic indicators (with description sheets)
- Thematic modules on hydrology, biodiversity, coastal zone and mountain issues.
- On-line registration and update of T.sites data and information
- Video and audio tutorials
- Feedback form

MONITORING SITES INFORMATION

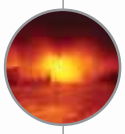
- Location
- Research objective(s)
- Variables measured
- Contact person(s)
- Network(s)
- Data policy
- Local climate estimates
- Geology
- Pedology
- Hydrology
- Reference area
- Basic land cover information
- Variables monitored
- 3-D model of the surrounding area

RELATED LINKS:

TEMS: www.fao.org/gtos/tems | **GOSIC:** www.gosic.org | **TEMS GCMD Matrix:** www.gosic.org/ios/gTOs_observing_system.asp

08 GTOS AND THE CONVENTIONS

by Lucilla Spini and Reuben Sessa



The global community is working cohesively towards the attainment of environmental and development goals within international conventions and Multilateral Environmental Agreements, by stressing the importance of science-based terrestrial observations in monitoring and assessing environmental change. In this context, GTOS provides an important platform to facilitate access to terrestrial observations to allow the detection of climate change, biodiversity loss and land degradation.

Upon assessing the needs and requirements of the Rio and the Biodiversity-Related Conventions, GTOS has been working with the Secretariats of the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands, the Convention on the Conservation of Migratory Species of Wild Animals (CMS) and the United Nations Framework Convention on Climate Change (UNFCCC) to develop joint initiatives linking science and policy with respect to observations of terrestrial ecosystems.

CLIMATE CHANGE

The GTOS Secretariat, in collaboration with its technical Panels and other partners, is supporting the UNFCCC and its Parties in meeting their terrestrial observational requirements needed to implement their activities and achieve their objectives.

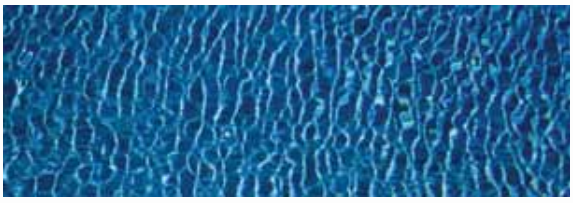
In particular, GTOS has undertaken the review of the available standards, guidelines, measurements and processing protocols already being used for the 13 terrestrial essential climate variables (ECVs) by national institutions and international organizations and initiatives. In addition, it has developed various proposals for a framework mechanism for the preparation of guidance materials, standards and reporting guidelines for terrestrial observing systems for climate, and associated data and products. GTOS also continues to support the networks and initiatives that are undertaking these measurements.

FIGHTING BIODIVERSITY LOSS: SYNERGY TO ACHIEVE THE BIODIVERSITY 2010 TARGET

Given the approach of the year 2010, GTOS has continued to work in synergy with the CBD Secretariat through meetings and consultations on many issues, such as Target 2010 indicators, drylands, climate change and protected areas. At the Fourth Meeting of the Ad Hoc Technical Expert Group on the Review of Implementation of the Programme of Work on Forest Biological Diversity (28 May–1 June 2007), GTOS illustrated how geo-spatial information management, in the context of vegetation monitoring, could be relevant to the review of the Programme of Work on Forest Biological Diversity.

Discussions have also taken place with the CMS Secretariat towards the delineation of cooperation on *in situ* and remote-sensing observations, with particular attention to CMS mapping requirements, within the framework of GTOS and related initiatives such as GLCN and GeoNetwork.





Working together to fight climate change, biodiversity loss and land degradation



FOCUSING ON FRAGILE ECOSYSTEMS: COOPERATION FOR THE WISE USE OF WETLANDS

Further to the Millennium Ecosystem Assessment highlighting that "the degradation and loss of wetlands is more rapid than that of other ecosystems", GTOS has been working with the Ramsar Convention, under a Memorandum of Cooperation signed on 13 June 2006, to assist Parties in facilitating the detection, assessment and prediction of global and large-scale change associated with wetlands. This has provided a framework for GTOS inputs within the Scientific and Technical Review Panel (STRP) of the Convention where FAO, through the GTOS Coastal Panel (C-GTOS), in cooperation with the International Water Management Institute (IWMI), called for a Type II Partnership on Wetland Mapping and Inventory to promote and improve wetland mapping inventories for monitoring and assessment at multiple scales in support of the Ramsar Convention and other Biodiversity-Related Conventions.



OUTREACH

To raise awareness and to illustrate the activities of GTOS in support to the conventions, a number of Web sites have been created; these include a new TEMS Module on Biodiversity-Related conventions and Web pages for the activities on the UNFCCC ECVs and terrestrial framework (see links below).

MAIN MEETINGS FOR 2008

- **14th meeting of the Scientific and Technical Review Panel (STRP-14) of the Ramsar Convention, Gland, Switzerland, 28 January–1 February 2008**
- **13th meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-13) of the CBD, Rome, Italy, 18–22 February 2008**
- **36th meeting of the Ramsar Standing Committee, Gland, Switzerland, 25–29 February 2008**
- **4th meeting of the Conference of the Parties serving as the Meeting of the Parties to the Cartagena Protocol on Biosafety (COP/MOP-4), Bonn, Germany, 12–16 May 2008**
- **9th meeting of the Conference of the Parties to the CBD (COP-9), Bonn, Germany, 19–30 May 2008**
- **28th session of UNFCCC Subsidiary Bodies (SBSTA and SBI), Bonn (tbc), 2–13 June 2008**
- **9th Meeting of the CMS Conference of Parties, Rome, Italy, 30 November–5 December 2008 (tbc)**
- **UNFCCC COP 14 / CMP 4, 29th session of the subsidiary bodies, 1–12 December 2008, venue to be determined**

RELATED LINKS:

GTOS and the Conventions: www.fao.org/gtos/Conventions.html | **UNFCCC Framework and ECVs:** www.fao.org/gtos/news56.html
TEMS Conventions module: www.fao.org/gtos/tems | **GTOS/Ramsar Memorandum of Cooperation:** www.ramsar.org/moc/key_gtos_moc.htm
Partnership on Wetland Mapping and Inventory: http://csi.cgiar.org/wetland_partner/index.asp

09

BIODIVERSITY ACTIVITY IN GTOS

by Robert Scholes

UNPRECEDENTED BIODIVERSITY LOSS

The crisis of global biodiversity loss is becoming more apparent with each successive assessment. In 2005, the Millennium Ecosystem Assessment showed that the current rate of species loss is about 100-fold higher than the average rate in the fossil record, and the rate is accelerating.

The recently released Fourth Global Environment Outlook (GEO-4) report confirms that the "sixth extinction" is imminent. All of these studies note the difficulty in assembling reliable and comprehensive data on the status of biodiversity globally.

INTERNATIONAL ACTION FOR EFFECTIVE MONITORING

There is movement internationally in the area of biodiversity observation systems, on several fronts. The UN Convention on Biological Diversity, by setting (in 2002) a target of reducing the rate of biodiversity by the year 2010, has triggered a process of identifying key indicators of biodiversity loss. The Government of France has undertaken a consultative process examining the feasibility of an International Mechanism on Scientific Expertise on Biodiversity (IMoSEB). Biodiversity is one of the nine "societal benefit areas" being addressed by the Global Earth Observation System of Systems (GEOSS).

The international research coordinating body Diversitas is developing a core programme called 'bioDiscovery' whose aim is to improve our understanding of current and future biodiversity trends. The Global Biodiversity Information Facility (GBIF) places millions of museum and herbarium collection records in the digital public domain each year. There are also several other biodiversity information initiatives taking place within national governments and international non-governmental organizations.

THE NICHE FOR B-GTOS

What role might GTOS play within this unfolding scheme? That is the question that the GTOS Steering Committee asked a small team of experts to address. From the outset, GTOS has had biodiversity on its list of five mandated focus areas, but other strategic priorities and resource constraints have prevented the elaboration of an active programme until now. GTOS has been represented in virtually all of the activities noted above. The outlines of the potential role that GTOS can play are becoming apparent. Clearly, it is not an exclusive, or even leading role, given the strength and momentum of activities already underway. But there are important contributory elements that GTOS is well-positioned to deliver.

LAND COVER MONITORING

The central one is GTOS' strength in the area of land cover monitoring, through its GOFC/GOLD team. Its mandate, which has already expanded from the original "global observations of forest cover" (itself a key biodiversity indicator) to the more-inclusive "global







How can GTOS contribute to the international effort to monitor and stem the global loss of biological diversity?



observations of land dynamics", would need to expand somewhat in depth as well, to be able to link to the kinds of functional indicators within land cover type that are needed for a useful operational biodiversity observation system.The close links between GTOS and the Global Land Cover Network (GLCN) and the good working relationships with Space Agencies are also elements of comparative advantage.

OBSERVATIONS BY MEMBERS OF THE PUBLIC

The second key opportunity relates to one of the unusual features of the biodiversity observation domain, which is the enormous public interest and commitment that it stimulates. For the foreseeable future, critical elements of biodiversity will not be able to be observed using instruments, either on the land surface or in space. They will require informed human observers—but how to achieve this, given the vast taxonomic array and global coverage required? Perhaps the emerging model of "bottom-up" collective knowledge generation, epitomized by internet-based "wikis", offers the answer. There are already large and active networks of amateur and professional observers in the fields of birds, mammals, reptiles, amphibian, fish and some invertebrates. If properly organized to allow for traceability, peer-review and the inclusion of digital images, and when synergistically linked to the power of more formal observation and modelling systems, concerns regarding the reliability of such data sources are likely to be unfounded. Apart from geographically and temporally-explicit presence/absence and abundance data for individual species, a volunteer observation network can help to fill in the biggest current gap in biodiversity observation systems: observations about species interactions. This includes information such as tropic links (host plants, predator/prey relations), vector information (victims or carriers of diseases), and mutualisms (pollinators, dispersal agents).

NEXT STEPS

The GTOS biodiversity investigative task will deliver a report to the GTOS Steering Committee in 2008, and a decision on GTOS commitments to this area is expected then.

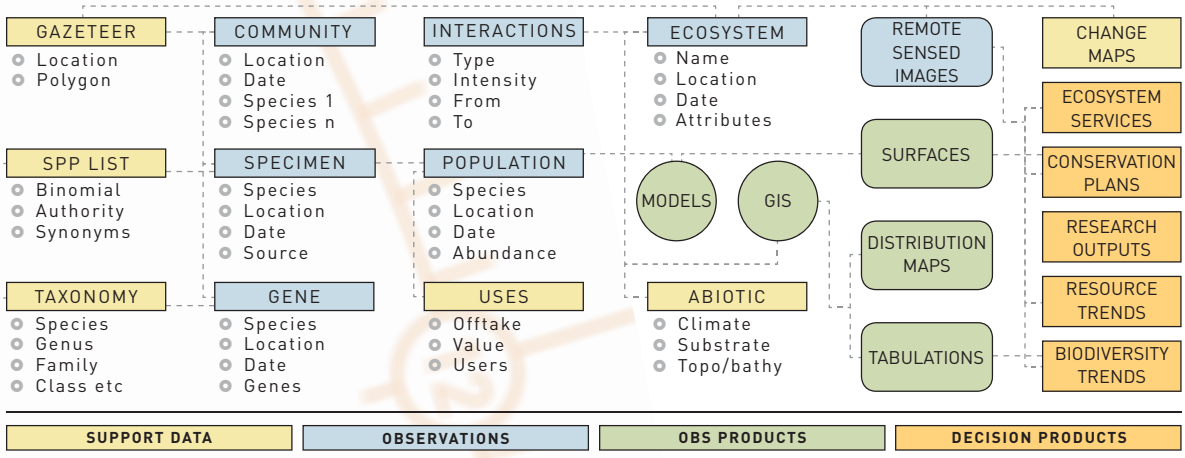


Diagram of a biodiversity observing system: the contribution of GTOS is likely to be at the ecosystem level

RELATED LINKS:

B-GTOS: www.fao.org/gtos/B-GTOS.html | **TEMS module:** www.fao.org/gtos/tems/mod_div.jsp

10

WORLD ATLAS OF MANGROVES

by Ilaria Rosati, Paolo Prosperi, John Latham and Mami Kainuma



WHAT ARE MANGROVES?

Mangroves are plants of more than 110 different species, including trees, shrubs, palms and ferns. They grow in the tropics and subtropics in saline inter-tidal coastal habitats, such as estuaries and shorelines. These species are physiologically adapted to overcome the problems of anoxia, high salinity and frequent tidal inundation.

WHY ARE THEY IMPORTANT?

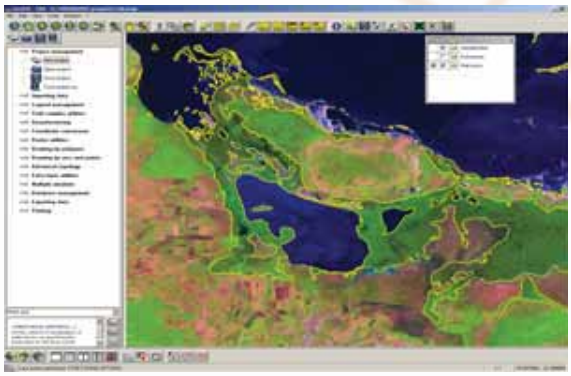
Mangrove ecosystems are unique, highly productive areas, which are important from social, economic and biological points of view. Tens of millions of people in the tropics and subtropics depend on mangrove forests, which provide a variety of wood and non-wood forest products, as well as other resources such as dyes, medicines, livestock feed and honey.

Mangroves host a wide variety of organisms, including a number of endangered species. They serve as a valuable nursery to many shrimps, crustaceans and molluscs, and act as a breeding and feeding ground for many commercially important fish species.

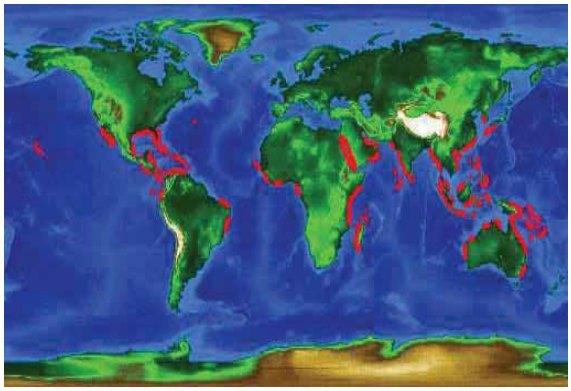
Mangroves maintain water quality and clarity, filtering pollutants (including heavy metals) and trapping sediments. Mangroves also help prevent erosion by stabilizing sediments and protecting the coast, especially during surge storms, hurricanes and tsunamis. These ecosystems are, however, fragile and it is estimated that over half the world's mangroves have been lost in recent times.

WORLD ATLAS ON MANGROVES

The International Society for Mangrove Ecosystems (ISME) and its partners (see below) are publishing a new version of the World Atlas of Mangroves, with funding primarily from the International Tropical Timber Organization (ITTO). The new World Atlas of Mangroves will provide GIS-based distribution maps



Geographical Vector Interpretation System



Global distribution of mangroves

and describe the recent status of mangrove forests around the world, with detailed estimates of changes in mangrove forests at the regional and national levels.

Inventorying the world's mangrove stands is an important step in preserving these ecosystems. The Atlas aims to contribute towards the effective management of mangrove forests for sustainable production of timber, fisheries and other products without compromising their environmental, ecological and socio-economic value.

The Food and Agriculture Organization of the United Nations (FAO) Forestry Department has

FAO ISME ITTO UNESCO MAB UNEP WCMC UNITED NATIONS UNIVERSITY UNU-INWEH

Mangrove ecosystems are important from a social, economic and biological point of view



undertaken a global assessment of mangroves in support of the Atlas, and the Environment, Climate Change and Bioenergy Division (NRC) is using its considerable experience in remote sensing and mapping and the support of the Global Land Cover Network (GLCN) and Global Terrestrial Observing System (GTOS) to contribute to this initiative through the preparation of digital maps for more than 40 countries.

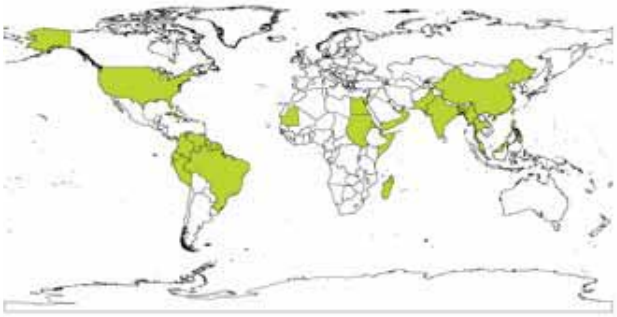
MAPPING PROCESS

Almost 400 Landsat ETM+ scenes were photo-interpreted at a scale equivalent to 1:250 000, achieving a much greater precision than in the previous atlas, published in 1997. Band composites 432 and 543 were utilized to perform the initial visual interpretation, using the GeoVIS software, and a network of partners has been established to allow the necessary field-level validation.

Partners and field experts are being provided with the images, interpretation shape files, coastline data and other relevant information, including the interpretation doubts and uncertain boundaries. All the information is packaged using the Dynamic Atlas software in order to allow non-mapping experts the capability to view the data and provide guidance on the mapping polygons produced. Considering that a full field validation has not been undertaken, the above process will minimize mapping errors.

ATLAS AVAILABILITY

The expected publication date of the Atlas is mid-2008. It will include country profiles, maps, colour plates, case studies and descriptive information from the lead author/editor, Dr Mark Spalding (TNC). For additional details or queries please see the link below or contact the Atlas coordinator, Dr Mami Kainuma, (Mami.Kainuma@mangrove.or.jp).



Countries mapped by FAO - GTOS

Bahamas	Madagascar	S. Lucia
Bangladesh	Malaysia	Seychelles
Brazil	Martinique	Singapore
China	Mauritania	Solomon Islands
Colombia	Mayotte	Somalia
Cuba	Micronesia	Sudan
Ecuador	Myanmar	Suriname
Egypt	Oman	Thailand
Eritrea	Pakistan	UAE
French Guiana	Palau	USA
Guadeloupe	Peru	Vanuatu
Guam	Philippines	Venezuela
Guyana	Qatar	Yemen
India	S. Kitts and Nevis	

RELATED LINKS:

ISME: www.mangrove.or.jp | **FAO NRCE:** http://dwms.fao.org/mangroves/index_en.asp | **FAO mangroves site:** www.fao.org/forestry/site/mangrove/en

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THE GLOBAL FOREST RESOURCES ASSESSMENT 2010

by Mette Løyche Wilkie, Renato Cumani, Antonio Martucci and John Latham



FAO has carried out global forest resources assessments at 5- to 10-year intervals since 1946. The latest assessment (FRA 2005) covered 229 countries and territories and involved more than 800 people, including officially nominated national correspondents and their teams in 172 countries.

FRA DATA RELEVANCE

The FRA reports are the main authoritative source of global data on forest resources, and are widely used by countries and international processes for policy development and implementation.

In particular, FRA data are used for monitoring progress towards the Millennium Development Goals, by the international environmental conventions (UNFCCC, UNCCD and CBD), the United Nations Forum on Forests (UNFF) and the International Tropical Timber Organization (ITTO).

The next assessment (FRA 2010) is specifically designed to cover the forest-related information needs for monitoring progress towards the 2010 Biodiversity Target, the Global Objectives on Forests of the UNFF and the Millennium Development Goals.

REMOTE SENSING SURVEY

As part of the Global Forest Resources Assessment 2010, FAO, its member countries and partners will undertake a global remote sensing survey of forests. This survey is aimed at substantially improving the knowledge on land use change dynamics over time, including deforestation, afforestation and natural expansion of forests. This effort constitutes the core framework for the implementation of the GEOSS global forest monitoring task (AG-06-04).

The survey will be based primarily on the use of available Landsat imagery, but will incorporate auxiliary information, including other remote sensing images and the results from existing and past field inventories. A systematic sampling design will be used based on each longitude and latitude intersect, with a reduced intensity above 60° N due to the curvature of the Earth.

The assessment will cover the whole land surface of the Earth and will consist of approximately 13 500 samples, of which about 9 000 samples are outside deserts and areas with permanent ice. The area covered at each sample site is 10 km × 10 km (with a 5-km buffer zone), providing a sampling intensity of about one percent of the global land surface.

For each sample plot, four Landsat images —



Land cover change analysis will be undertaken on 13 500 sample blocks of 10km x 10km. 239 subsets have been identified by the FRA 2010-Remote Sensing Survey project to test alternative methodologies of forest classification and change analysis (example from Bazil is shown above)

FAO and partner organizations are leading an ambitious global remote sensing survey of forests in collaboration with countries



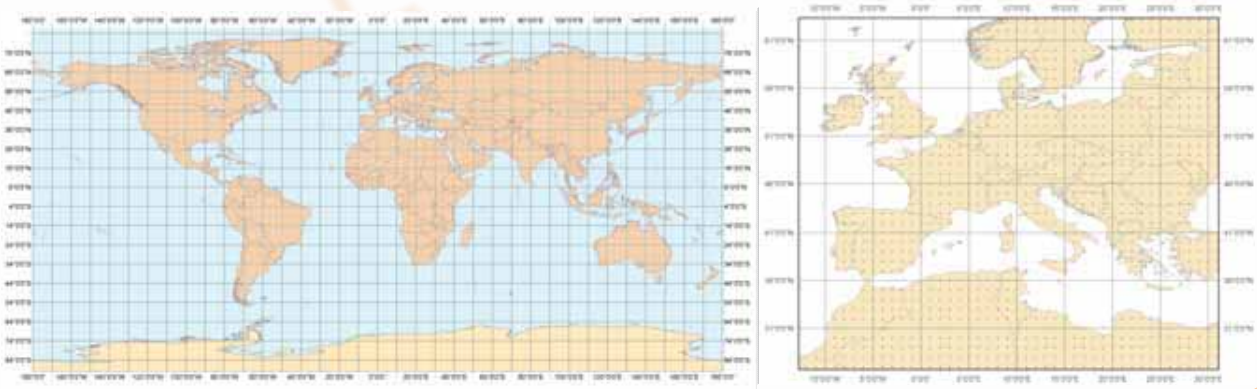
dating from around 1975, 1990, 2000 and 2005 — will be interpreted and classified, and a change matrix prepared providing quantitative information on the magnitude of different land use change processes.

DATA VALIDATION AND CAPACITY BUILDING

FAO and its partner organizations will make rectified and pre-processed imagery available through an online information gateway, and will develop the necessary training material and a suite of tools to aid the interpretation process. The interpretation of the imagery and the development of the change matrices will be undertaken by national teams, thus making the best use of local knowledge and existing information while facilitating transfer of technology and capacity building in forest monitoring where needed. This initiative is expected to form a pilot project for the establishment or strengthening of national land cover and land use monitoring systems in many developing countries.

IMPLEMENTATION PARTNERSHIP

An informal implementation partnership has been established with FAO (the Forestry Department and the Environmental Assessment and Management Unit, which includes GTOS), the EU Joint Research Centre (the TREES 3 programme and FOREST Europe) and South Dakota State University (USA) as the lead organizations. Other key partners include NASA, US Forest Service (USFS), USGS, GLCN, GOFC-GOLD and Jena University (Germany). Additional partners are welcome.



The sampling design of the FRA 2010 Remote Sensing Survey

RELATED LINKS:
FAO FRA 2010: www.fao.org/forestry/fra

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THE GLOBCOVER PROJECT

by Olivier Arino, Francesco Palazzo and Franck Ranera



WHY GLOBAL LANDCOVER MAPS?

Global models, assessments of climate impact and ongoing research on sustainability rely on up-to-date information on global parameters. Global landcover products are one such parameter, representing a basic input for the understanding of land-cover and land-use dynamics. As the products currently available have coarse resolution and were produced long ago, numerous international programmes and initiatives have called for improved global landcover products.

WHAT IS GLOBCOVER?

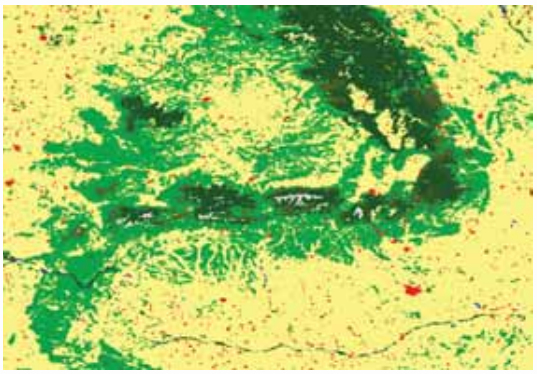
The GlobCover Project was launched in 2005 in the framework of the European Space Agency (ESA) Data User Element, with the objective of updating and complementing existing global products with comparable recent and finer resolution information (300 m). ESA is undertaking the GlobCover initiative in partnership with a number of end-user institutions, and the project is being carried out by a consortium of selected institutions. The challenge is to deliver global land products, including a harmonized, detailed, flexible and validated global map of 2005–2006 at fine resolution, with a thematic legend compatible with the UN Land Cover Classification System (LCCS).

GLOBCOVER PRODUCTS

The GlobCover project delivers three groups of products, generated in the period between May 2005 and April 2006, and all at 300 m resolution.

- GlobCover Bimonthly MERIS FR Composites: six products per year, computed every two months and providing, for each spectral band, the average surface reflectance calculated from all valid observations during each two-month period.
- GlobCover Annual MERIS FR Composite, computed by advance averaging of the surface reflectance values of the two-monthly products generated over one year.
- GlobCover Land Cover derived by an automatic and regionally-tuned classification of a time series of MERIS FR Composites. Its 22 land cover classes are defined using LCCS.

GLC2000

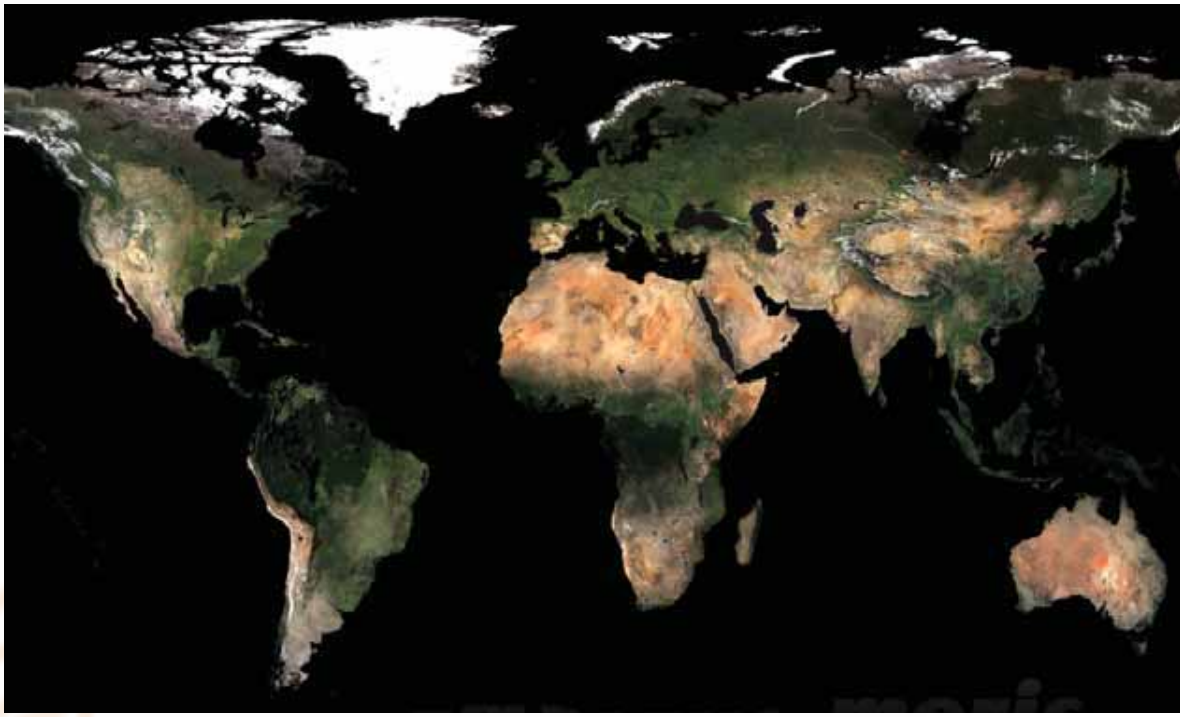


GLOBCOVER LC (preliminary)



Preliminary GLOBCOVER classification results of selected land cover classes show greater geometric detail in comparison with similar global land cover products. The final GLOBCOVER LC map will also include classes for Artificial Surfaces (red in the GLC2000 image), water bodies and permanent snow and ice cover, which are not yet considered in the preliminary version.The GLOBCOVER LC Map is derived by an automatic and regionally-tuned classification of a time series of the MERIS FR Global Mosaics. The 22 land cover classes are defined with the UN Land Cover Classification System (LCCS)

Development of global landcover maps at 300 m resolution



Two-monthly GlobCover composite (May/June 2005)

PRODUCTION PROCESS

ENVISAT MERIS 300 m Full Resolution Full Swath (FRS) images are the only data source of the project. ESA made a large effort to ensure all the needed acquisitions were made and provided more than 20 terabytes of data to the consortium.

Cloud detection, atmospheric correction, geolocalization, re-mapping and classification are the key milestones of the production process. In particular, as a geometrically stable source product is needed for mean compositing and land cover classification, an *ad hoc* geolocation processing chain was developed, resulting in a relative accuracy of 51.6 m and an absolute accuracy of 77.1 m. This is more accurate than the 150 m requested in the product specifications.

An intensive validation campaign led by a network of worldwide experts is planned for late 2007 for the landcover product. Globcover products will be further refined with additional MERIS data from 2004 and 2006.

PRODUCT AVAILABILITY

All GlobCover reflectance products (two-monthly and annual composites) have been made available to the public by the European Space Agency (see Web link). The Landcover product, jointly with the validation report, will also be made available at the same URL. Products may be used for educational or scientific purposes, without any fee, on the condition that ESA and the ESA GlobCover Project, led by MEDIAS-France, are credited as the source. More information on the terms of use is available online.

GLOBCOVER CONSORTIUM

- **POSTEL/Médias-France (France)**
- **Brockmann Consult (Germany)**
- **Magellium (France)**
- **Microsoft (the Netherlands)**
- **Noveltis (France)**
- **Spacebel (Belgium)**
- **UCL MILA (Belgium)**

RELATED LINKS:

GlobCover (French): http://postel.mediasfrance.org/en/PROJECTS/Preoperational-GMES/GLOBCOVER

GlobCover on DUE (English): http://dup.esrin.esa.it/projects/summaryp68.asp | **GlobCover Products:** http://www.esa.int/due/ionia/globcover

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MOUNTAIN RESEARCH INITIATIVE (MRI)

by Gregory B. Greenwood and Claudia Drexler



The Mountain Research Initiative (MRI) is a multidisciplinary organization that supports research on global change in mountain regions around the world. MRI is funded by the Swiss National Science Foundation (SNSF) and the Swiss Federal Institute of Technology (ETH Zürich) and is endorsed by the International Geosphere Biosphere Programme, the International Human Dimensions Programme, GTOS and UNESCO's Man and the Biosphere Programme (MAB).



MRI has initiated a consortium of ten African and international organizations for the workshop on "A Global Change Research Network in African Mountains", held in Kampala, Uganda, in July 2007

GLOCHAMORE: from the global template...

The GLOCHAMORE Research Strategy was the final product of the Global Change and Mountain Regions Project (Specific Support Action under the EU 6th Framework Programme) which MRI and the University of Vienna (Austria) coordinated in 2004 and 2005. The Research Strategy laid out a global template for global change research in mountain regions (see link below).

...to its implementation through Regional Global Change Research Networks (GCR Networks)

In 2006, the MRI broadened its focus from strategy development on a global level to include the initiation and support of regional networks of global change researchers. It is through these regional networks that the strategy is being implemented. During 2006, MRI allocated substantial funds to the GCR networks and launched efforts in the Americas and Europe, while establishing partnerships with other entities in Monsoon Asia (see networks box).

AMERICAN CORDILLERA ACTIVITIES

Immediately after the "Climate Change: Organizing the Science for the American Cordillera" (CONCORD) conference, MRI and UNESCO MAB chaired a workshop on the creation of an American Cordillera Transect (ACT), a network of sites along the American Cordillera where research could be pursued within the context of the GLOCHAMORE strategy. During the ACT workshop, six work groups were established (see link below for details).

Of the six work groups, the Cordillera Forest Dynamics Network (CORFOR) is an exemplary project. This international group of collaborators maintains hundreds of long-term forest monitoring plots along the American Cordillera, from Alaska to Tierra del Fuego. No other forest network spans such a wide range of environmental gradients:

- a latitudinal gradient from 60°N to 50°S,
- elevational gradients spanning thousands of metres,
- west to east precipitation gradients crossing the Cordillera,
- broad gradients of topography and soils, and
- broad gradients of land use and disturbance history.

These gradients offer unique opportunities to understand consequences of forest management and the environmental controls of forest structure, composition, biodiversity and dynamics.

GCRN EM

GCRN AFRICAN MOUNTAINS

The American Cordillera Transect

The implementation of the global research strategy through regional networks



Photo by C. Drexler

FUTURE STEPS

To achieve the full objectives of the initiative, MRI will continue and amplify support to regional networks for global change research in mountains. The goal is to initiate and facilitate the development of research proposals whose results will be meaningful at the policy level. MRI's role is to integrate existing and new programmes into a coherent framework (Research Network Programme), while the actual monitoring or modelling activities take place in individual programmes with their own funding.

THE NETWORKS INITIATED AND SUPPORTED BY MRI INCLUDE:

- **The American Cordillera Transect for Global Change Research**
  http://mri.scnatweb.ch/content/category/3/45/67
- **Global Change Research Network in European Mountains (GCRN_EM)**
  http://mri.scnatweb.ch/content/category/3/47/68
- **Global Change Research Network in African Mountains (GCRN_AM)**
  http://mri.scnatweb.ch/content/category/3/61/80
- **Mountain Component to Monsoon Asia Integrated Regional Study (MAIRS)**
  http://mri.scnatweb.ch/content/category/3/53/71



Developing a global change research network: going beyond FP7, Zürich, Switzerland, 1-2 February 2007

RELATED LINKS:

GLOCHAMORE: http://mri.scnatweb.ch/content/view/74/31 | **American Cordillera Transect (ACT):** http://mri.scnatweb.ch/content/category/3/45/67
CORFOR: www.corfor.com

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FAO FOCUS ON MOUNTAINS

by Jane Ross and Thomas Hofer



IMPORTANCE OF MOUNTAINS

Mountains are essential to our health and well-being. They provide most of the world's freshwater, harbour an extraordinary variety of plants and animals, and are precious reservoirs of biological diversity for food, medicine, timber and recreation. Mountains are also home to at least one in ten people, with diverse cultures that are rich in traditions, knowledge and languages.

Yet, mountain ecosystems are more fragile than lowlands. The growing demand for water, the consequences of global climate change, the growth in tourism, the effects of armed conflict and the pressures of industry, mining and agriculture threaten the extraordinary web of life that mountains support. These threats are causing rapid, and in cases irreversible, changes to mountain environments and to mountain people, already amongst the world's poorest and hungriest.

FAO ACTIVITIES

The Food and Agriculture Organization of the United Nations (FAO) is pooling its collective expertise, experience and skills to address mountain-specific problems and strengthen cooperation to find solutions for poverty, hunger and environmental degradation in mountain areas, in line with the Millennium Development Goals (MDGs).

Activities to promote sustainable mountain development around the world involve four main areas of focus: normative work; field programme; contribution to global partnerships, processes and initiatives, and communications and advocacy.

This work benefits from, and is complemented by, strong in-house collaboration at headquarters, the regional offices, as well as many country offices. It is also enhanced by strong cooperation maintained with a large partnership, including sister UN agencies, non-governmental organizations (NGOs), universities and research institutions.

NORMATIVE WORK

Normative work covers such topics as Sustainable Agriculture and Rural Development in Mountains (SARD-M), watershed management, policy and law, and mountain products, and focuses on information generation and dissemination, the development of methods, approaches and guidelines, networking and capacity building.

FIELD PROGRAMME

FAO's field programme support to countries is typically through capacity-building, institutional strengthening and pilot field activities, as well as assistance with project identification, formulation and technical backstopping. Projects are currently underway in Cuba, Kyrgyzstan, Pakistan, Poland and Tajikistan. Projects were recently completed in Armenia and North Korea. Projects are also to be initiated in the Fouta Djallon Highlands of West Africa and in Turkey.



Photo by T. Hofer, FAO



Photo by A. Mihich, FAO

The Mountain Partnership continues to be supported by the Swiss and Italian Cooperation

Improving lives and environments in mountains around the world



Photo by T. Hofer, FAO

GLOBAL PARTNERSHIPS

FAO's contribution to such global partnerships, processes and initiatives as the Convention on Biological Diversity (CBD), the Millennium Ecosystem Assessment (MEA), the International Consortium on Landslides and the Mountain Research Initiative (MRI) is helping increase knowledge and facilitate action for sustainable mountain development around the world. In addition, FAO brings its wide range of expertise to the Mountain Partnership — a global alliance of countries, intergovernmental organizations, civil society, non-governmental organizations and the private sector in five regions. FAO is a founding member of the Mountain Partnership and hosts the Secretariat to support it.

COMMUNICATION AND OUTREACH

FAO's role in communications and advocacy for mountains has included its lead role in the implementation of the International Year of Mountains (2002), which was dedicated to protecting mountain ecosystems and improving the well-being of mountain people. During the Year, FAO prepared and implemented a global communications campaign and supported the development of 78 national committees to promote country-level action. Many of these mechanisms continue today. Since 2003, FAO has also acted as lead coordinating agency for UN International Mountain Day, which is celebrated on 11 December every year to highlight the global importance of mountain ecosystems and promote ongoing attention to the unique needs of mountain communities.

CLIMATE CHANGE

Mountains are barometers of climate change. As the world heats up, mountain glaciers — the source of water for many of the world's river systems and people — are melting at unprecedented rates, while rare plants and animals struggle to survive over ever diminishing areas. Mountain people, already among the world's most disadvantaged, face greater hardships. Understanding how climate change affects mountains, and learning how to manage and mitigate any negative effects, is vital for all of us, wherever we live.

INTERNATIONAL MOUNTAIN DAY 2007

The theme "Facing Change: Climate Change in Mountain Areas" has been chosen for International Mountain Day in 2007. This special day provides an opportunity to highlight the incidence and implications of climate change in mountains amongst a wide audience — governments, intergovernmental organizations, civil society, media and the general public —and to promote support and partnerships for advocacy, research, education and action on the ground.



Photo by A. Mihich, FAO

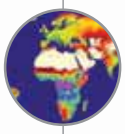
RELATED LINKS:

FAO Sustainable Mountain Development: www.fao.org/mnts/index_en.asp | **Mountain Partnership:** www.mountainpartnership.org
FAO Forests and Water Programme: www.fao.org/forestry/site/forestsandwater/en | **International Mountain Day:** www.fao.org/mnts/intl_mountain_day_en.asp

15

GLOBAL PRIMARY PRODUCTION AND EVAPOTRANSPIRATION

by Steven W. Running and Maosheng Zhao



DATA PRODUCTS

Terrestrial primary production provides the energy to maintain the structure and functions of ecosystems, and supplies goods (e.g. food, fuel, wood and fibre) for human society. Gross primary production (GPP) is the amount of carbon fixed by photosynthesis, and net primary production (NPP) is the amount of carbon converted into biomass after subtracting the cost of plant respiration. The water loss through exchange of trace gas CO_2 by leaf stomata during photosynthesis plus evaporation from soil and plants is evapotranspiration (ET). ET computes the water lost by a land surface, so it is consequently a component of the water balance in a region, and is therefore relevant for drought monitoring and water management, providing an assessment of the water potentially available for human society. Under current, unprecedented, global environmental change, monitoring variations in GPP, NPP and ET is significant in tracking degradation in ecosystem services. Based on observations from the NASA Moderate Resolution Imaging Spectroradiometer (MODIS) sensor, these variables are calculated every eight days in near real time at 1 km resolution. MODIS GPP, NPP and ET data are available at the EOS data gateway (see link below).

To correct for contamination in the global reflectance data due to severe cloudiness or aerosols in the near real time products, these datasets are reprocessed at the end of each year to build more stable, permanent datasets. These end-of-year versions of MODIS GPP, NPP and ET are available at NTSG, University of Montana (see link below).

RESULTS FOR 2000–2006

Figure 1 shows the seven-year average MODIS NPP for vegetated land on earth at 1 km spatial resolution. Forests, especially tropical forests, have high NPP values, while savannahs, shrubs and grasses have low NPP due to the limitations of water availability or short growing season in high latitude or altitude areas. These remotely sensed NPP data

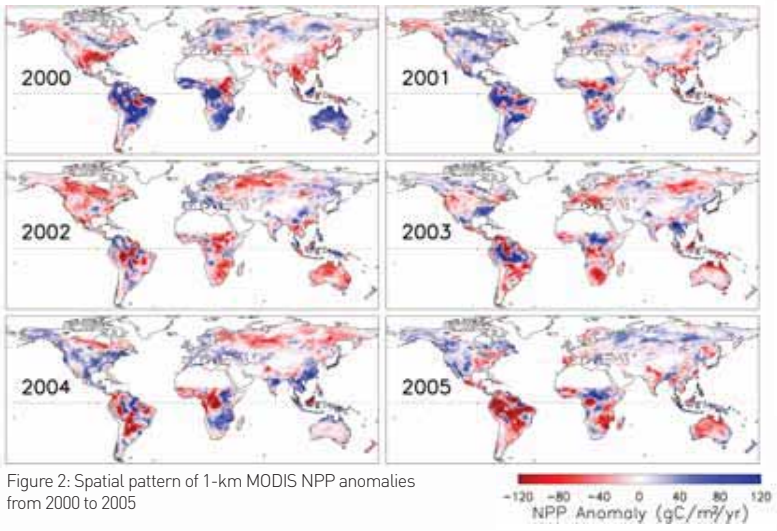


Figure 2: Spatial pattern of 1-km MODIS NPP anomalies from 2000 to 2005

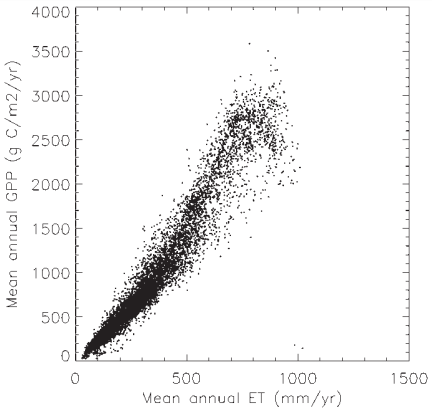


Figure 3: Relationship of annual total GPP versus annual total ET in 2001

Issues for maintaining global continuity of terrestrial primary production and evapotranspiration

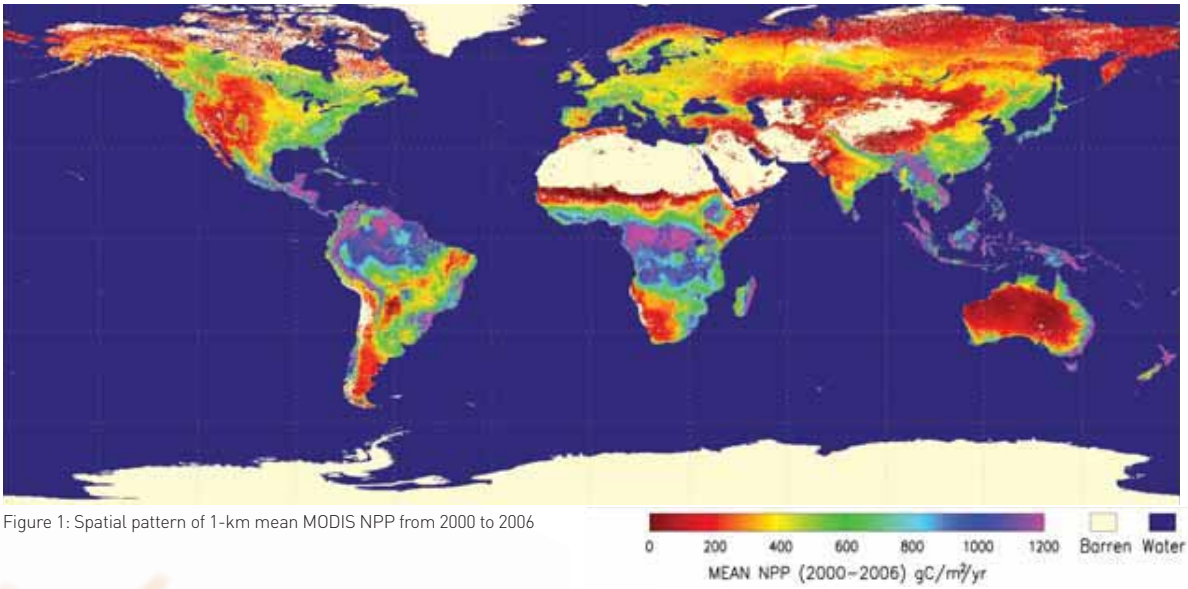


Figure 1: Spatial pattern of 1-km mean MODIS NPP from 2000 to 2006

provide information on the geographic variability of agricultural crops and renewable natural resources. However, our food availability is largely influenced by the year-to-year variations and long-term trend (decrease or increase) in NPP. Climatic fluctuations and land cover change (fire, deforestation, urbanization, etc.) are responsible for the changes in NPP. Figure 2 shows the anomalies of MODIS NPP from 2000 to 2006. In most cases, the regional scale reductions in NPP are caused by severe droughts. In 2000, drought occurred in China and the southern USA. In 2002, severe drought occurred in Australia and over a large part of the USA. In 2003, the heat wave in Europe led to drought, and lower than average NPP. In 2005, the Amazon experienced the worst drought in 100 years, making water availability the leading limiting factor for plant growth instead of solar radiation.

RELATIONSHIP OF PRIMARY PRODUCTION AND EVAPOTRANSPIRATION

Plant transpiration and photosynthesis are strongly coupled because stomata are the pathway for absorbing CO_2 and releasing water vapour by transpiration. MODIS ET is calculated based on a mechanistic model, the Penman-Monteith equation, combined with remotely sensed surface albedo, vegetation cover and canopy leaf area, coupled with meteorological conditions. Figure 3 illustrates this strong relationship between MODIS GPP and ET. Generally, high GPP corresponds with high ET, and vice versa, although exact correspondence is not expected because climate variables drive these processes in somewhat different ways. This correlation can also give some information on water use efficiency (WUE), i.e. the ratio of GPP to ET, which is about 3.2 g C/mm H_2O. Both daily GPP and ET from MODIS are validated and refined with the measurements from FluxNet, a global network of nearly 300 eddy flux towers, located in different continents and climatic zones, and continuing to expand.

CONTINUITY OF THE DATA

These data may be a critical component of future terrestrial carbon credit calculations, and particularly provide an independent measure of carbon sinks at national levels. The next-generation Kyoto agreement may rely on these types of information to verify claimed carbon credits. However, the current satellite source of this data, the NASA Earth Observing System, is nearing the end of its lifetime, and the replacement U.S. National Polar Orbiting Environmental Satellite System (NPOESS) has been delayed. A more international basis for generating this information therefore needs to be devised.

RELATED LINKS:

EOS data gateway: http://edcimswww.cr.usgs.gov/pub/imswelcome | **NTSG - University of Montana:** www.ntsg.umt.edu

PUBLICATIONS

GTOS 52 — Terrestrial Essential Climate Variables for Climate Change Assessment, Mitigation and Adaptation, January 2008.

GTOS 51 — Global Terrestrial Network - Hydrology (GTN-H). Report of the 3rd GTN-H Coordination Panel Meeting, Koblenz, Germany, 17–19 September 2007. Also published as GCOS-116 and as WMO/TD 1415.

GTOS 50 — GTOS Biennial report 2006–2007: Terrestrial Observations of our Planet, January 2008.

GTOS 49 — Assessing the Status of the Development of Standards for the ECVs in the Terrestrial Domain. GTOS Progress Report to the 26th Meeting of the UNFCCC SBSTA, March 2007.

GTOS 48 — A Framework for Terrestrial Climate-Related Observations: Implementation Options. GTOS Progress Report to the 26th Meeting of the UNFCCC SBSTA, March 2007.

GTOS 47 — 2nd GTOS Panel Chairs Meeting. ICSU headquarters, Paris, France, 28–29 June 2006.

GTOS 46 — Reducing Greenhouse Gas Emissions from Deforestation in Developing Countries: Considerations for Monitoring and Measuring. August 2006. Also published as GOFC-GOLD 26.

GTOS 45 — New TCO strategy document. July 2006.

GTOS 44 — TCO Panel Meeting report. 26–27 June 2006.

GTOS 43 — Report on the 9th Session of the TOPC, 28–29 March 2006.

GTOS 42 — A Revised Strategy for GOFC-GOLD. Prepared by J.R. Townshend and M.A. Brady, January 2006. Also published as GOFC-24.

GTOS 41 — Report on the GTOS Steering Committee Meeting, 25–27 January 2006.

GTOS 40 — GTOS Biennial Report 2004–2005.

GTOS 39 — Report of the 3rd Meeting of the GOFC-GOLD Science and Technology Board. Beijing, China, 19–22 April 2005. Also published as GOFC-GOLD 21.

GTOS 38 — GTOS Sponsors Meeting. Rome, Italy, 12–13 April 2005.

GTOS 37 — Report of the 2nd Meeting of the GTN-H Coordination Panel. Koblenz, Germany, 4–5 July 2005.

GTOS 36 — Coastal GTOS Phase 1 Implementation Plan.

GTOS 35 — GTOS/GCOS 8th Session of the Terrestrial Observation Panel for Climate. Summary Report. Also published as GCOS 93.

GTOS 34 — GTOS Biennial Report 2002–2003.

GTOS 33 — GTN-H Coordination Panel Meeting report. Toronto, Canada, 21–22 November 2002. Also published as GCOS 85.

GTOS 32 — HWRP/GCOS/GTOS Expert Meeting on Hydrological Data for Global Studies report. Toronto, Canada, 18–20 November 2002. Also published as GCOS 84.

GTOS 31 — TCO: The Frascati Report on *in situ* carbon data and information. November 2002.

GTOS 30 — GTOS Biennial Report 2000–2001.

GTOS 29 — GCOS/GTOS/HWRP Expert Meeting on the Implementation of a Global Terrestrial Network – Hydrology (GTN-H). Koblenz, Germany, June 2001. Also published as GCOS 71.

GTOS 28 — Global Change and Mountain Regions. IGBP Mountain Research Initiative and IHDP. Also published as IGBP 49. 13 January 2001.

GTOS 27 — Terrestrial Data Management and Accessibility Workshop in Central and Eastern Europe. Vàcràtòt, Hungary, 30 October–4 November 2000.

GTOS 26 — GCOS/GTOS/HWRP Establishment of a Global Hydrological Observation Network for Climate. Geisenheim, Germany, 26–30 June 2000.

GTOS 25 — IGOS-P Carbon Cycle Observation Theme: Terrestrial and Atmospheric Components. October 2000 (revised February 2001).

GTOS 24 — GTOS Biennial Report 1998–1999.

GTOS 23 — Terrestrial Carbon Observation Synthesis Workshop. Ottawa, Canada, 8–11 February 2000.

GTOS 22 — GTOS/GCOS Terrestrial Observation Panel for Climate, 5th Session. Birmingham, UK, 27–30 July 1999.

GTOS 21 — GTOS Regional Implementation Plan for Southern Africa. February 2001.

GTOS 20 — Regional Implementation Plan for Central and Eastern Europe (CEE). February 2000.

GTOS 19 — GTOS Steering Committee, 2nd Session. Santander, Spain, 15–19 June 1998.

GTOS 18 — GTOS Data and Information Management Plan. October 1998.

GTOS 17 — GTOS Implementation Plan. December 1998.

GTOS 16 — Report of the G3OS Joint Data and Information Management Panel, 4th Session. Honolulu, United States of America, 28 May–1 April 1998.

GTOS 15 — GTOS/GCOS Terrestrial Observation Panel for Climate, 4th Session. Corvallis, United States of America, 26–29 May 1998.

GTOS 14 — GTOS Annual Report 1997. December 1997.

GTOS 13 — GHOST – Global Hierarchical Observing Strategy. June 1997.

GTOS 12 — GCOS/GTOS Plan for Terrestrial Climate-related Observations, version 2.0. June 1997.

GTOS 11 — GCOS/GOOS/GTOS Joint Data and Information Management Panel (JDIMP), 3rd Session. Tokyo, Japan, 15–18 July 1997.

GTOS 10 — Meeting of Experts on Ecological Networks. Guernica, Spain, 17–20 June 1997.

GTOS 9 — Global Observing Systems Space Panel (GOSSP), 3rd Session. Paris, France, 27–30 May 1997.

GTOS 8 — GTOS Coordination and Implementation meeting. Rome, Italy, 12–15 May 1997.

GTOS 7 — GTOS and the Conventions. October 1996 (Updated April 1997).

GTOS 6 — First meeting of the GTOS Steering Committee, final session. Rome, Italy, 2–5 December 1996.

GTOS 5 — Global Observing Systems Space Panel, 2nd Session. Geneva, Switzerland, 16–18 October 1996.

GTOS 4 — *In Situ* Observations for the Global Observing Systems. Geneva, Switzerland, 10–13 September 1996.

GTOS 3 — Planning Group Report GTOS: Turning a sound concept into a practical reality. June 1996.

GTOS 2 — Expert Meeting on Hydrological Data for Global Observing Systems. Geneva, Switzerland, 29 April–1 May 1996.

GTOS 1 — GCOS/GTOS Terrestrial Observation Panel for Climate, 3rd Session. Cape Town, South Africa, 19–22 March 1996.

MEETINGS

For information on upcoming meetings, workshops and conferences, please consult the GTOS Web site: www.fao.org/gtos/meet.html or the GOFC-GOLD Web site: www.fao.org/gtos/gofc-gold/2008_e.html.

2008

29 September — Australian and Southeast Asia MODIS validation workshop at the 14th Australasian Remote Sensing and Photogrammetry Conference, Darwin, Australia.

9–13 June — GEOSS Support for Decision-Making in the Coastal Zone: Managing and Mitigating the Impacts of Human Activities and Natural Hazards in the Coastal Zone, Herakleion, Crete.

June — Workshop on fire early warning systems, Edmonton, Canada.

May — High-latitude land cover mapping workshop. Venue to be announced.

19–23 May — Effects of climate change on the world's Oceans, sponsored by North Pacific Marine Science Organization. Gijon, Spain.

Late 2008 — GTOS Steering Committee meeting, Rome, Italy.

2007

10–13 December — NEESPI Session at American Geophysical Union (AGU) Fall Meeting, San Francisco, USA.

3–14 December — UNFCCC 13th Conference of the Parties, Bali, Indonesia.

28–30 November — GEO Ministerial Meeting and Plenary, Cape Town, South Africa.

26–30 November — GLCN Central Asia Workshop, Ankara, Turkey.

15–16 November — TOPC Panel Meeting 10th Session, Rome, Italy.

12–19 November — West Africa Regional Network Meeting and Fire Danger Requirements Workshop, Accra, Ghana.

4–9 November — Estuarine Research Federation, Providence, RI, USA.

23–25 October — GOFC-GOLD Land Cover Implementation Team meeting, Boston, USA.

18–19 October — Global Monitoring of Groundwater Resources, Utrecht, The Netherlands.

11–12 October — 2nd GlobCarbon User Consultation Meeting, Boston, USA.

16–20 September — NERIN Dryland Workshop at NASA LCLUC Science Team Meeting, Urumqi, China.

22 September — GOFC-GOLD South America Network (REDLATIF) Regional Fire Meeting, Argentina.

17–19 September — 3rd session of the GTN-H Panel, Koblenz, Germany.

12–13 September — GLOBMODEL Workshop, Frascati, Italy.

25–26 August — CarboAfrica First Annual Meeting, Kruger National Park, South Africa.

1–3 August — GEO User Interface Committee meeting, Washington D.C., USA.

16–18 July — GEO Global Agricultural Monitoring workshop, Rome, Italy.

25–29 June — ISRSE Meeting with Fire Implementation Team and Conabio Fire Session, San Jose, Costa Rica.

20 June — First GlobCover User Consultation Meeting, Ispra, Italy.

27 May–1 June — ISO/TC 211 24th Plenary meeting, Rome, Italy.

30 May — 14th Meeting of the IGOS Partnership, Paris, France.

7–18 May — UNFCCC SBSTA 26, Bonn, Germany.

13–17 May — 4th International Wildland Conference, Fire Implementation Team Meeting and Regional Network Meeting, Seville, Spain.

12–13 April — CarboAfrica modelling workshop, Jena, Germany.

17–19 April — GOFC-GOLD workshop on Reducing Emissions from Deforestation (RED) in developing countries, Santa Cruz, Bolivia.

3–6 April — GEO Global Land Cover task meeting, Washington, DC, USA.

2–3 April — GEO User Interface Committee and Forest Community of Practice meetings, Geneva, Switzerland.

7–9 March — UNFCCC Workshop on Reducing Emissions from Deforestation in Developing Countries, Cairns, Australia.

18–22 February — FLUXNET – TCO Synthesis Workshop, LaThuile, Italy.

5–7 February — GEO User Interface Committee and FCP meetings, Geneva, Switzerland.

2006

5–7 December — GEO AG-06-03 workshop, Copenhagen, Denmark.

4–8 December — GLCN Workshop on Harmonization of Forest and Land Cover Classification using LCCS for Asia Pacific Region, Dehradun, India.

4–6 December — GOFC - GOLD Fire Monitoring and Mapping Implementation Team 2nd Workshop on Geostationary Fire Monitoring and Applications, Darmstadt, Germany.

28–29 November — GEO III Plenary and UIC event, Bonn, Germany.

22–25 November — GTOS-GEOSS-GBIF-DIVERSITAS Workshop on Biodiversity, Geneva, Switzerland.

13–17 November — NERIN workshop, Moscow, Russia.

9–12 November — DIVERSITAS/GOFC-GOLD session at ESSP, Beijing, Paris.

9–12 November — An Earth System Science Partnership (ESSP) Global Environmental Change Open Science Conference, Beijing, China.

6–10 November — 9th GSDI Conference, Santiago de Chile.

6–17 November — UNFCCC COP 12 and SBSTA 25, Nairobi, Kenya.

2–3 November — 1st National GEOSS Conference, Bonn, Germany.

23–25 October — CARBOAFRICA Kick-Off meeting, Pieve Tesino, Italy.

19–20 October — ESA and Ramsar GlobWetland Symposium – Looking on wetlands from space, Frascati, Italy.

18–19 October — FRA 2010 workshop, Washington, DC, USA.

2–6 October — SAFNet meeting, Maputo, Mozambique.

5–8 September — GEO User Interface Committee (UIC) Meeting, Ottawa, Canada.

30 August–1 September — UNFCCC Workshop on Reducing Emissions from Deforestation in Developing Countries, Rome, Italy.

8–10 August — CEOS LPV meeting, Missoula, USA.

31 July–04 August — IEEE International Geoscience and Remote Sensing Symposium, Colorado, USA.

26 July — GlobCover progress meeting, Toulouse, France.

20–21 July — GEO ADC meeting, Seattle, USA.

28–29 June — GTOS Panel Chairs meeting Paris, France.

26–27 June — TCO Panel meeting, Rome, Italy.

8 July — GOFC-GOLD NERIN NELDA Workshop, Tomsk, Russia.

8–9 June — 2nd International Conference on Land cover/ Land use study using Remote Sensing and Geographic Information System, Ulaanbaatar, Mongolia.

29 May–02 June — 26th EARSeL Symposium 'New Developments & Challenges in Remote Sensing', Workshop on Geohazards, Warsaw, Poland.

10–12 May — Reducing Emissions from Deforestation in Developing Countries, Bad Blumau, Austria.

28–29 March — 9th TOPC Panel Meeting, Ispra, Italy.

20–31 March — GTOS side event at 8th CoP of CBD, Curitiba, Brazil.

21–25 March — GOFC-GOLD Symposium on Forest and Land Cover Observations, Jena, Germany.

8–10 March — IGOL Agriculture Meeting, Rome, Italy.

27 February–1 March — 3rd IGOL land theme development workshop, Beijing, China.

22–24 February — NEESPI science meeting, Vienna, Austria.

16–17 February — EROS/GLCN land cover collaboration, Bamako, Mali.

13–14 February — Global Land Project meeting, Rome, Italy.

8–10 February — Land use workshop, Rome, Italy.

25–27 January — GTOS SC meeting, Rome, Italy.

24 January — GTOS Panel Chairs Meeting, Rome, Italy.

ACRONYMS

Unfortunately in Earth Observations you cannot avoid them so a summary list of those used in this document are provided below.

ACT American Cordillera Transect

AOPC Atmospheric Observation Panel for Climate

CALM Circumpolar Active Layer Monitoring

CBD Convention on Biological Diversity

CEOS Committee on Earth Observing Satellites

C-GTOS GTOS Coastal Panel

CMS Convention on the Conservation of Migratory Species of Wild Animals

COCOS Coordination of Carbon Observing Systems

CORFOR Cordillera Forest Dynamics Network

DEM Digital Elevation Model

ECV Essential Climate Variables

ENVISAT advanced polar-orbiting Earth observation satellite of ESA

EOS Earth Observing System (NASA)

ESA European Space Agency

ET evapotranspiration

ETH Zürich Swiss Federal Institute of Technology

FAO Food and Agriculture Organization of the United Nations

FIRMS Fire Information for Resource Management System

FRA Global Forest Resources Assessment (FAO)

FRS Full Resolution Swath

GBIF Global Biodiversity Information Facility

GCMD Global Change Master Directory

GCOS Global Climate Observing System

GCR Networks Global Change Research Networks

GEO Group on Earth Observations

GEOSS Global Earth Observation System of Systems

GHG greenhouse gas

GLCN Global Land Cover Network

GMES Global Monitoring for Environment and Security

GOFC-GOLD Global Observation of Forest and Land Cover Dynamics Panel

GOOS Global Ocean Observing System

GOSIC Global Observing Systems Information Center

GPP gross primary production

GRACE Gravity Recovery and Climate Experiment

GTN Global Terrestrial Network

GTN-P Global Terrestrial Network for Permafrost

GTOS Global Terrestrial Observing System

IAO Istituto Agronomico per l'Oltremare (Italy)

ICOS Integrated Carbon Observation System

ICSU International Council for Science

IGOL Integrated Global Observations of the Land

IGOS Integrated Global Observing Strategy

IMoSEB Partnership International Mechanism on Scientific Expertise on Biodiversity

IPA International Permafrost Association

IPY International Polar Year

ISME International Society for Mangrove Ecosystems

ITTO International Tropical Timber Organization

IWMI International Water Management Institute

JPICO Joint Panel for Integrated Coastal Observations

LCCS Land Cover Classification System

MAB Man and the Biosphere Programme of UNESCO

MDG Millennium Development Goals

MERIS Medium Resolution Imaging Spectrometer

MODIS Moderate Resolution Imaging Spectroradiometer (NASA)

MRI Mountain Research Initiative

NASA National Aeronautics and Space Administration

NGO non-governmental organization

NICOP Ninth International Conference on Permafrost (June 2008)

NPOESS National Polar Orbiting Environmental Satellite System (USA)

NPP net primary production

NRC Environment, Climate Change and Bioenergy Division (FAO)

NRCE Environmental Assessment and Management Unit (FAO)

NSIDC National Snow and Ice Data Center

NTSG Numerical Terradynamic Simulation Group, University of Montana

PACE Permafrost and Climate in Europe

REDD Reducing Emissions from Deforestation in Developing countries (UNFCCC)

SARD-M Sustainable Agriculture and Rural Development in Mountains

SNSF Swiss National Science Foundation

STRP Scientific and Technical Review Panel [of the Ramsar Convention]

TCO Terrestrial Carbon Observation Panel of GTOS

TEMS Terrestrial Ecosystem Monitoring Sites database

TNC The Nature Conservancy

TOPC Terrestrial Observation Panel for Climate

TSP Thermal State of Permafrost

UNCCD United Nations Convention to Combat Desertification

UNEP United Nations Environment Programme

UNESCO United Nations Educational, Scientific and Cultural Organization

UNFCCC United Nations Framework Convention on Climate Change

UNFF United Nations Forum on Forests

UNISDR United Nations International Strategy for Disaster Reduction

UNU-INWEH United Nations University International Network on Water, Environment and Health

USGS United States Geological Survey

WCMC World Climate Monitoring Centre (UNEP)

WG-LSA Working Group on Land-Surface/Atmosphere Issues

WMO World Meteorological Organization

WSSD World Summit on Sustainable Development

WUE water use efficiency

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During the last biennium, the activities of GTOS Secretariat and its Panels have been supported by the following institutions:

Canadian Space Agency and Natural Resources Canada, Canadian Forest Service
www.space.gc.ca/asc/eng/default.asp and www.nrcan.gc.ca/cfs-scf/index_e.html

Committee on Earth Observation Satellites, Land Product Validation Subgroup of the Working Group on Calibration and Validation
http://lpvs.gsfc.nasa.gov

East Carolina University, Greenville, North Carolina, USA
www.ecu.edu

European Commission Joint Research Centre (JRC)
www.jrc.cec.eu.int

European Space Agency (ESA)
www.esa.int

Food and Agriculture Organization of the United Nations (FAO)
www.fao.org

Friedrich-Schiller University, Jena, Germany
www.uni-jena.de

Global Fire Monitoring Center (GFMC)
www.fire.uni-freiburg.de

Government of Italy – Italian Development Cooperation
www.esteri.it/ita/2_10_128.asp

International Strategy for Disaster Reduction (ISDR)
www.unisdr.org

National Aeronautics and Space Administration (NASA)
www.nasa.gov/home

SysTem for Analysis, Research and Training (START)
www.start.org

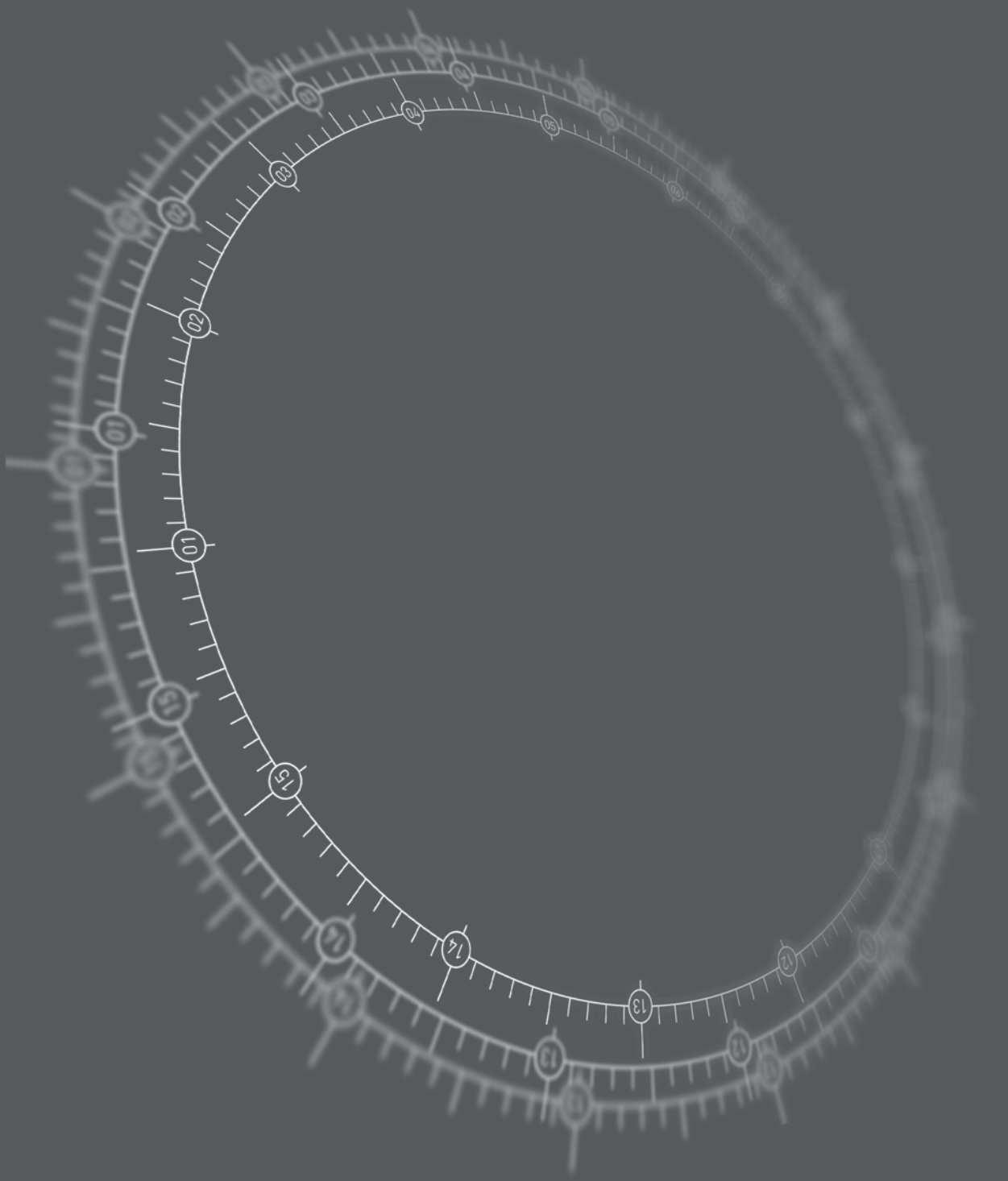
University of Maryland, United States of America
www.umd.edu

University of Parma, Italy
www.unipr.it

University of Tuscia, Italy
www.unitus.it, http://gaia.agraria.unitus.it

United Nations Environment Programme (UNEP)
www.unep.org

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www.wmo.ch



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THE GLOBAL TERRESTRIAL OBSERVING SYSTEM

The Global Terrestrial Observing System (GTOS) was established in January 1996 by its five co-sponsoring organizations in response to international calls for a deeper understanding of global change in the Earth System.

The central mission of GTOS is to provide policy-makers, resource managers and researchers with access to the data they need to detect, quantify, locate, understand and warn of change (especially reduction) in the capacity of terrestrial ecosystems to support sustainable development. Since its establishment, GTOS has been working to improve the quality, the coverage and accessibility of terrestrial ecosystem data.

GTOS is developing activities that focus on five issues of global concern:
1. Change in land quality
2. Availability of freshwater resources
3. Loss of biodiversity
4. Climate change
5. Pollution and toxicity

GTOS promotes: integration of biophysical and socio-economic georeferenced data; interaction between monitoring networks, research programmes and policy-makers; data exchange and application; quality assurance and harmonization of measurement methods; and collaboration to develop regional and global datasets.

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www.fao.org

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GTOS Secretariat
c/o Environment, Climate Change and Bioenergy Division (NRC)
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla 00153 Rome, Italy
E-mail: GTOS@fao.org | Tel: (+39) 06 57056804 | Fax: (+39) 06 57053369 | www.fao.org/gtos