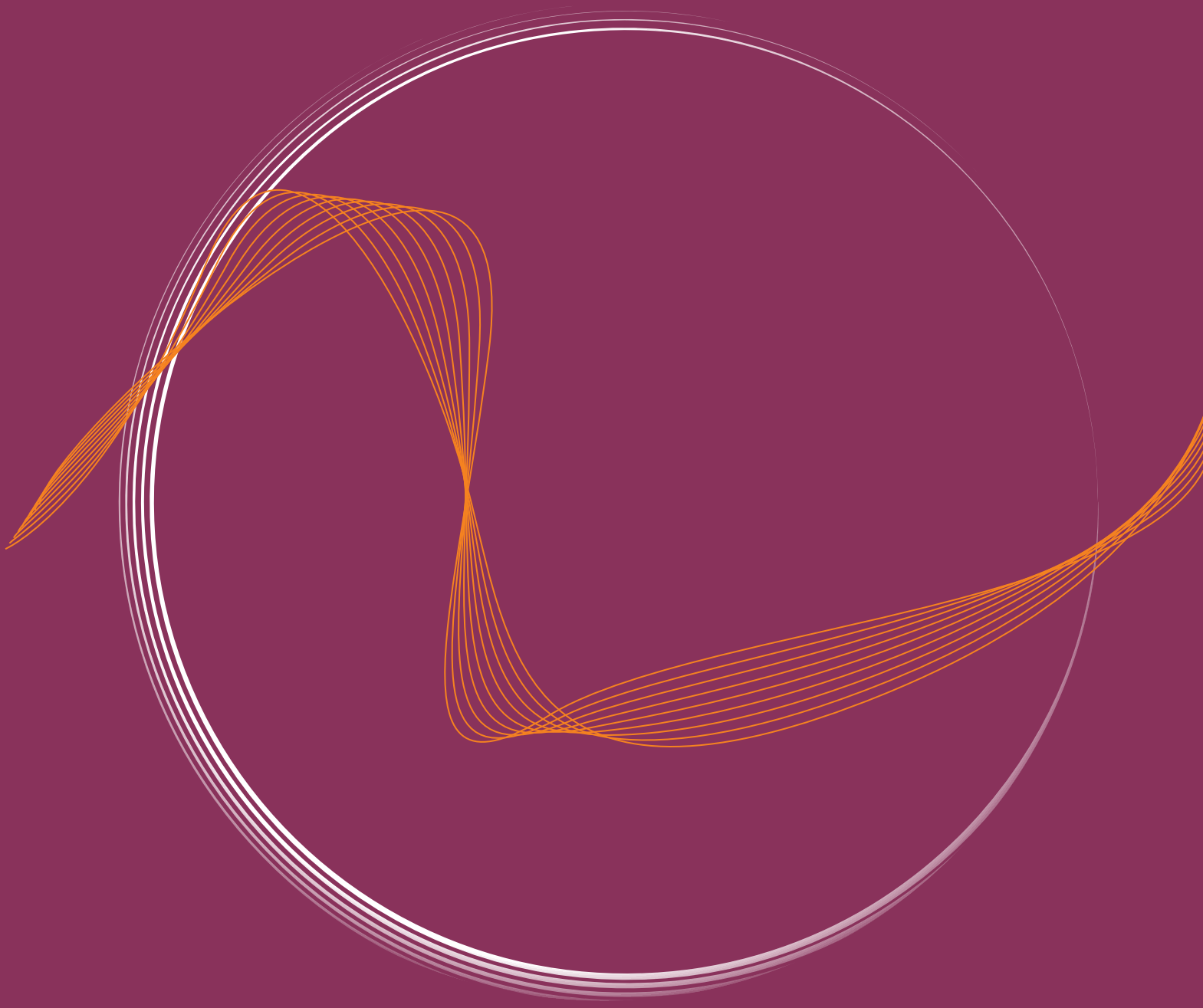
TERRESTRIAL OBSERVATIONS OF OUR PLANET



BIENNIAL REPORT 2008/09

WMO UNEP ICSU FAO GTOS

TERRESTRIAL OBSERVATIONS OF OUR PLANET

[GTOS 73]

Editor Valeria Salvatori

Authors Olivier Arino
Antonio Bombelli
Michel Brady
Paola Cardenas
Roberto Cazzolla
Robert R. Christian
Han Dolman
Claudia Drexler
Adam Gerrand
Gregory B. Greenwood
Matieu Henry
Martin Herold
Thomas Hofer
Anthony Janetos
Vasileios Kalogirou
John S. Latham
Mette Løyche Wilkie
José-Ramos Perez
Stephen Plummer
Robert Scholes
Luigi Simeone
Riccardo Valentini

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, Rome 2008

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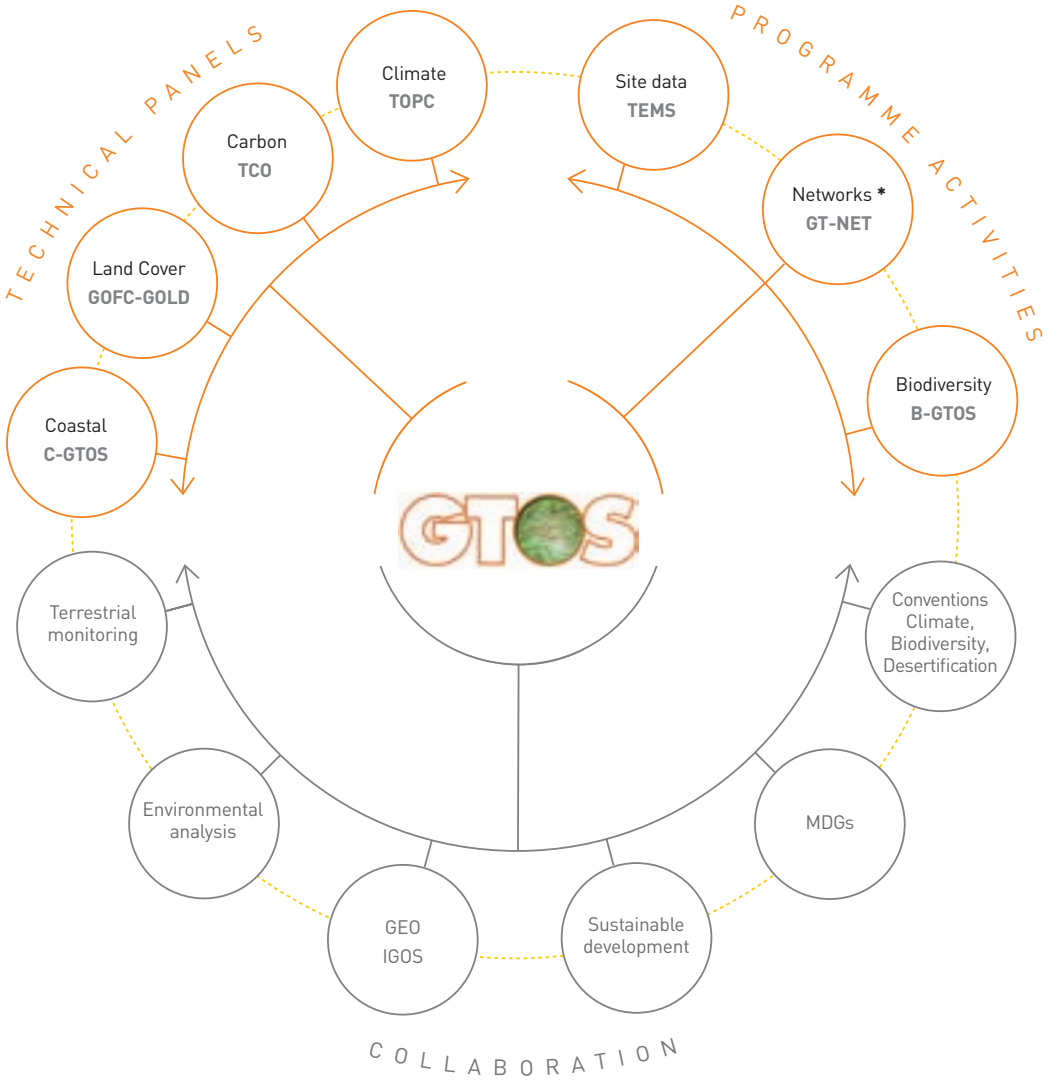
GTOS PROGRAMME STRUCTURE

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

Riccardo Valentini
Department of Forest Science and Environment,
University of Tuscia

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

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

Zhang Wenjian
Director, Observing and Information Systems Department (OBS)
World Meteorological Organization (WMO)

Gisbert Glaser
Senior Advisor
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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Head, Centre for Environment and Development for Arab Region and Europe (CEDARE)

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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 off Biology, East Carolina University

Antony 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 S. Latham, Programme Director
Antonio Bombelli, Programme Officer
Paola Cardenas, Programme Assistant
Roberto Cazzolla, Programme Assistant
Antonio Martucci, Information System Officer
Valeria Salvatori, Communication Assistant

ACKNOWLEDGEMENTS

Contribution to the GTOS Programme
The GTOS Secretariat would like to thank the many individuals who have assisted in the GTOS Programme, including: Renato Cumani, Catherine Gaury, Trina Hershkovitz, Zubair Qamar, Ilaria Rosati, Reuben Sessa, Gabriele Zanolli, Stefano Bravi.

LETTER FROM THE NEW CHAIR

by Riccardo Valentini

The United Nations Climate Change Conference in Copenhagen is fast approaching and we are facing a new challenge toward stabilization of GHG emissions in the atmosphere. We all must take responsibility to achieve this objective, and I sincerely believe that high quality systematic Earth observations are a key tool in understanding the biogeophysical processes leading to global change and to help governments take appropriate policies and measures, contributing to sustainable development.

In the past several years the scientific community has played a vital role by continuous and consistent monitoring of GHG fluxes and other environmental variables. More than fifty years have passed since the first measurements of CO2 concentration in the atmosphere were performed at Mauna Loa Observatory in Hawaii, thanks to the pioneering work of Dr. Charles David Keeling. The Keeling Curve showed for the first time the significant increase of CO2 in the atmosphere. This is one of the most evident examples of the importance and practical usefulness of continuous systematic observations of the biosphere.

Long-term monitoring of our environment is essential to:

i. show trends and their changes of natural and anthropic processes,
ii. discover "surprises" and unknown behaviours of our planet systems,
iii. identify early warning and preparedness of the civil society on emerging critical environmental issues, and
iv. verify the effectiveness of societal responses to global change pressures.

Much work has already been done, however continued efforts in systematic observation of the Earth should be maintained.

During the coming years, systematic observations are essential to improve the understanding of the relationship between the carbon cycle and climate systems, assess the mitigation potential of terrestrial ecosystems and propose adaptation options. Only through systematic observations is it possible to verify the adequacy of the commitments of emission reduction, and to monitor and foresee any possible risks that could be induced by global change.

GTOS should play a leading role in supporting the maintenance and the development of a global observation system, in collaboration with other monitoring programmes such as GCOS, GOOS, and GEO. I am sure that this is possible, but we need to conceive a new effective GTOS strategy for at least the next ten years. Thus, it is a great responsibility and a great challenge to lead this process during the next three years.

The next GTOS strategy should address the concrete integration of space-based and ground observations with renewed emphasis. Remote sensing and *in situ* communities have developed an outstanding wealth of information and data sets in the last 20 years but for several reasons they have remained separated too long. Now there is an urgent need to develop products and models able to combine these two components.

Definition of environmental baselines to be used as a reference for the future observations should be part of the next strategy. GTOS should thus identify a sustainability threshold for ecosystem services based mainly on the projection of historical data.

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

In order to be more effective and gain more visibility , GTOS should be more focused toward the delivery of concrete specific products- to be identified uniquely as GTOS products - such as a global database on terrestrial information, data analysis, data assimilation prototypes, publications and position papers on international peer reviewed journals.
To this end, GTOS should concentrate on a few specific focus areas:

i. climate change,
ii. terrestrial carbon stocks and fluxes,
iii. land degradation, and
iv. loss of biodiversity.

Under these categories, the following cross-cutting topics should be considered: coastal areas, mountains, snow and ice cover, and urban areas.

However, none of the above issues can be realized without securing continuous financial support for the GTOS programme. An important foundation for future strategy will be the adoption of a funding model based on extra-budgetary resources, as GTOS has already demonstrated in these past three years. Furthermore, minimum funding to ensure efficient functioning of the GTOS Secretariat should be guaranteed.

In closing, I would like to thank my predecessor Berrien Moore, for his work as GTOS chair in the period 2004-2009, and the numerous collaborators who contributed to the important progress made by GTOS during the past five years.

I feel very honoured to have been assigned this challenging opportunity and I can only say that I will do my best for the next three years. I am convinced that with everyone's support we can raise the GTOS profile and expand its active role.

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

BIENNIAL REVIEW FROM THE PROGRAMME DIRECTOR

by John S. Latham

GLOBAL ENGAGEMENT

The 2008–2009 biennium has seen a major elevation in the profile of GTOS within the International community. There has been a significant increase in the engagement with and reporting to the International community by the GTOS Panels. The relevancy and need for an improvement in the quality and quantity of observations has never been greater, in the lead up to the negotiation of a new climate agreement in Copenhagen. The increase in number and intensity of natural disasters, as well as the rise in reporting on the evidence and effects of climate change on local, regional and global systems, are cause for concern, motivating policy-makers to intensify national and international efforts to understand, prevent and adapt to climate change. Clearly, climate change is a real threat to development and puts additional pressure on already limited resources. To respond to these requirements GTOS is fully engaged in advocating for the improvement of the global quality and coverage of systematic Earth observations, both ground and space based, in the terrestrial domain.

GEO/GEOSS

The Group on Earth Observations (GEO) has become the focal point and guidance for all institutions, initiatives and individuals involved in environmental observations, and its Global Earth Observation System of Systems (GEOSS) should ensure the needed political support. What is now required are the financial resources to develop a coordinated infrastructure for collecting and distributing the observations needed by the broad user community. GTOS and its Panels have actively supported the process and have contributed to the development of the nine societal benefit areas (SBAs) and the ten-year implementation plan. GTOS remains committed to the process as an active participating agency implementing a number of critical tasks of the GEO 2009-11 workplan. GTOS is currently engaged in 16 tasks/subtasks and leads 4 of these, addressing four SBAs: Disasters, Climate, Ecosystems and Biodiversity. With 4 tasks/subtasks, the climate SBA has the largest number of tasks addressed by GTOS.

GTOS DELIVERING AS ONE

GTOS panels have succeeded in raising the profile through a set of integrated actions and a set of strategic documents developed across several areas. A few key examples include:

- The new REDD sourcebook of GOFC-GOLD, is a baseline reference for countries seeking strategic advice on how best to approach methodologies for carbon stock assessment.
- The Global Fire Information Management System (GFIMS) of University of Maryland, under the financial support of NASA, is an operational email alert system of daily active fire that will be fully ported to the Food and Agricultural Organization of the United Nations (FAO) for distribution to the global community of users.
- TCO continues to provide support to the terrestrial carbon assessment with a focus on Africa. TCO further supported the development of capacities through three milestone workshops on carbon fluxes estimation, approaches to biomass assessment and fire monitoring by remote sensing, convened in South Africa, Congo and UK, respectively. TCO is also directly involved in the writing and editing of the GEO carbon strategy.
- TOPC is supporting the development of the adequacy reports and the preparation of the Implementation Plan for the Global Observing

System for Climate (GCOS) for UNFCCC. The GTOS Secretariat has also been active in support of the convention, in particular for issues related to terrestrial Essential Climate Variables (ECVs).

- The GTOS Coastal initiative is now seeing the realization of its Implementation Plan. A new global mangrove atlas in partnership with the International Society for Mangrove Ecosystems (ISME) and the International Tropical Timber Organization (ITTO) has been developed by FAO. A new initiave supported by FAO and UNEP is assisting C-GTOS to build up a profile of the dynamics of coastal deltaic ecosystems through the mapping of changes in land cover in the world's main deltas.

INTERNATIONAL CONVENTIONS

GTOS was conceived at the time of UNCED and Agenda 21 in support of the international environmental conventions. A primary GTOS objective is to support climate-related international priorities and initiatives. GTOS has continued to raise the profile and importance of terrestrial observations and panels have re-energized their efforts to increase delivery at this critical time. It is not coincidental that during the biennium the greatest increase in all observation, as identified in the GCOS Implementation Plan, has occurred in the terrestrial domain. Most of the terrestrial actions (56%) were associated with a moderate to good delivery rating. Not withstanding this, it is evident that *in situ* observations are still underrepresented and that significant and sustained actions by governments are needed to increase the number of long-term and high-quality standardized *in situ* measurements, covering the main representative land cover and ecosystem types. The significant progress made by GTOS in improving the terrestrial observing systems for climate was recognised by UNFCCC/SBSTA at its 30th session which also saw the endorsement of the approval of the UN/ISO framework for the development of standards for variables in the terrestrial domain that affect climate.

Through the promotion of harmonized collection, analysis and exchange of relevant information related to land degradation, its contribution to the UN-REDD initiatives, and its involvement in wetlands and biodiversity issues, GTOS continues its contribution also to the other main environmental conventions, such as UNCCD, CBD and Ramsar.

MAINTAINING THE LEADERSHIP

Maintaining GTOS at the forefront of terrestrial observation requires that the programme is dynamic and responsive to new challenges. In this regard the forthcoming Steering Committee of GTOS will deliberate the new strategy for GTOS. Focus is proposed to be orientated towards:

- climate change
- terrestrial carbon stocks and fluxes
- land degradation
- loss of biodiversity.

The Key issue will be the integration of space and ground observations to support the assessment of global change impacts on terrestrial ecosystem services.

Equally important is the development of new Essential Climate Variables (ECVs), following new technological developments and stakeholder requirements. As the diversity of ECVs is expanding, increasing attention will be focused on reviewing the applicability of the ECVs as the basis for supporting climate services in the field of land degradation and biodiversity and in this regard strengthening links with UNFCCC, as well as broadened collaboration with UNCCD and CBD is being pursued.

Finally, I would like to thank the many individuals who have been involved in GTOS activities, especially the members of the panels, tireless dedication of the chair and the secretariat for their tremendous effort and long hours and hard work. Gratitude also goes to our many supporters and sponsors, for their financial contribution to GTOS.

I also take this opportunity to thank the outgoing GTOS Chair, Berrien Moore, for his efforts, and warmly welcome the new GTOS Chair, Riccardo Valentini, with whom I look forward to work in the coming years.

RELATED LINKS:

GTOS: www.fao.org/gtos | **GTOS and the Conventions:** www.fao.org/gtos/Conventions.html

01 GTOS AND GEO

by Antonio Bombelli, Michael Brady and John Latham

GEO

The Group on Earth Observations (GEO) is a global initiative to coordinate national and international efforts in environmental monitoring. GEO is a voluntary partnership of governments and international organizations and provides a framework within which its partners can develop new projects and coordinate their strategies and investments. As of September 2009, GEO Members include 80 Governments and the European Commission. In addition, 56 intergovernmental, international and regional organizations with a mandate in Earth observation or related issues have been recognized as Participating Organizations. GEO recognizes that international collaboration is essential for exploiting the growing potential of Earth observations to support decision making in an increasingly complex and environmentally stressed world.

The GEO implementation plan is conceived to build a Global Earth Observation System of Systems (GEOSS) by contributing to the nine GEO Societal Benefit Areas (SBAs): Disasters, Health, Energy, Climate, Water, Weather, Ecosystems, Agriculture and Biodiversity.

GTOS AND GEO

GTOS is involved in sixteen tasks/subtasks of the last GEO 2009-2011 WorkPlan. GTOS addresses four out of the nine GEO SBAs: Disasters, Climate, Ecosystems and Biodiversity. With 4 tasks/subtasks, the climate SBA is the most intensively addressed by GTOS.

POC = Point of Contact

Task/Subtask	Title	Level of involvement	GTOS and relevant panels involved
AR-09-03a	Global Terrestrial Observations	Leader & POC	GTOS Secretariat, TCO and TOPC
DA-09-03a	Global Land Cover	Leader & POC	GOFC-GOLD and GTOS Secretariat
CL-09-03b	Forest Carbon Tracking	Leader	GTOS Secretariat and TCO
DI-09-03b	Implementation of a Fire Warning System at Global Level	Leader	GOFC-GOLD and GTOS Secretariat
EC-09-01c	Regional Networks for Ecosystems	Leader	GOFC-GOLD and GTOS Secretariat
US-09-03b	Forest Mapping and Change Monitoring	Leader	GOFC-GOLD, TCO and GTOS Secretariat
AR-09-01a	Enabling Deployment of a GEOSS Architecture	Contributor	GTOS Secretariat
AR-09-01c	GEOSS Best Practices Registry	Contributor	GTOS Secretariat
AR-09-02a	Virtual Constellations	Contributor	GOFC-GOLD
BI-07-01a	Biodiversity Observation Network	Contributor	B-GTOS
CB-09-03a	Building National and Regional Capacity	Contributor	GOFC-GOLD
AR-09-03c	Global Ocean Observation System	Contributor	C-GTOS
CL-09-03a	Integrated Global Carbon Observation (IGCO)	Contributor	TCO
DA-09-01b	Data, Metadata and Products Harmonisation	Contributor	GTOS Secretariat
DI-06-09	Use of Satellites for Risk Management	Contributor	GOFC-GOLD and GTOS Secretariat
EC-09-01a	Ecosystem Classification and Mapping	Contributor	GTOS Secretariat

List of all the GEO tasks GTOS is contributing to.

AN OVERVIEW ON THE GTOS ROLE IN SOME GEO TASKS

Task AR-09-03a: Global Terrestrial Observations

This task aims at developing intergovernmental mechanisms to coordinate terrestrial observations needed for climate studies and forecasting. Reports on 13 Essential Climate Variables (ECVs) in the terrestrial domain were published and submitted by GTOS to the 30th Session of UNFCCC/SBSTA, in Bonn, June 2009. SBSTA encouraged GTOS to implement a joint framework mechanism between relevant UN agencies and ISO for the preparation of guidance materials, standards and reporting guidelines on terrestrial observing systems for climate and the related ECVs. The current GTOS proposal will be recommended for adoption by the COP 15 in Copenhagen.

Task AR-09-03c: Global Ocean Observation System

This task aims at enhancing and improving the coordination of coastal/open-ocean observations and modelling initiatives, in support of a global ocean observation system. C-GTOS is part of the steering committee of the GEO Coastal Zone Community of Practice, designed to bridge observations of the land and sea components of the coast. An international workshop was organized in Athens (Greece) on 9-13 June 2008 to promote coastal observations in the Mediterranean region.

Task DA-09-03a: Global Land Cover

The task is providing a suite of global land cover datasets, initially based on improved and validated moderate resolution land cover maps and eventually including land-cover change at high resolution. The product is based on the FAO/UNEP Land Cover Classification System LCCS). GOFC-GOLD, a panel of GTOS, contributed a technical sourcebook on and procedures for monitoring, measuring and reporting on reducing GHG emissions from deforestation and degradation in developing countries (REDD) in support of the UNFCCC process.

Task CL-09-03a: Integrated Global Carbon Observation (IGCO)

This task supports the development of an integrated global carbon observation system, including improved global observing networks. GTOS contributed to the initiation of the GEO Carbon Community of Practice. GTOS members are part of the group of experts in the field of carbon (from space to ground, across ocean, land and atmospheric domains) that is preparing the GEO Carbon Report for an integrated global carbon observations strategy.

Task CL-09-03b: Forest Carbon Tracking

This task aims at facilitating access to long-term continuity of satellite, airborne and *in situ* data, providing the associated analyses and prediction tools, and creating the appropriate framework and technical standards for a global network of national forest carbon tracking systems. This task is instrumental for the post-Kyoto climate-change mitigation agreements. A particular focus of GOFC-GOLD in the task is to formulate validation procedures and accuracy assessment for the remote sensing of forest area and carbon stock estimates.

Task DI-09-03b: Implementation of a Fire Warning System at Global Level

GTOS supports the FAO co-led initiative on Global Fire Information Management System (GFIMS) to disseminate updated active fire and burned area information products to a broader community. GOFC-GOLD co-leads the development of a system for global early warning of wildland fire disaster. The system is currently being re-designed with new components, algorithms, and products to better meet operational requirements at global, regional and national levels. An African prototype system is a priority focus of the task.

Task US-09-03b: Forest Mapping and Change Monitoring

This task is integrating international efforts on assessment and monitoring of forests and forest changes using a combination of ground and satellite information and internationally agreed standards. The task leaders at FAO and in the various partner organizations, including GOFC-GOLD, are developing new techniques for forest monitoring using remote sensing data at a high scientific level. A particular focus in the task has been the evaluation of methods and validation, including new uses of SAR for forest monitoring.

RELATED LINKS:

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

02 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 and forest 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 guided by the Executive Committee, with support and coordination from two project offices.

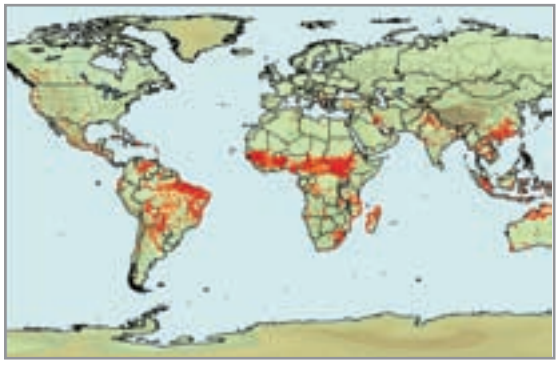
FIRE MAPPING AND MONITORING

Fire Mapping and Monitoring theme is aimed at providing the necessary international coordination to improve fire data availability, 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 global 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 Committee on Earth Observing Satellites (CEOS) Land Product Validation (LPV) Working Group and EARSeL. The GOFC-GOLD Fire programme continued several GEOSS activities, including the ongoing development of the Global Wildland Fire Early Warning System, a Global Geostationary Network for fire monitoring, and improved use of satellite-based fire information for disaster monitoring and management. Emphasis over the past reporting period has been given to developing a Global Fire Assessment, development and implementation of an international Burned Area Validation Protocol, and a number of international collaboration initiatives on active fire characterization. Notable achievements include the setting up of the International Land Direct Readout Coordination Committee (ILDRCC), transitioning an Active Fire Monitoring system to operate at the UN FAO and promoting and securing fire monitoring capabilities for the next generation of planned polar-orbiting and geostationary satellites (e.g. NPOESS VIIRS, GOES R, Sentinel-3). A number of workshops were held on fire monitoring, including those organized in West Africa (WARN), Latin America (REDLATIF), Southeast Asia (SEARIN), Eurasia (NERIN), Southern Africa (SAFNET), and the newly formed Central Asia network (CARIN).

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, achieved significant progress, examples of which are given below.



Active Fire Monitoring system in operation at the UN FAO.

Building nation forest carbon monitoring capabilities using the GOFC REDD Sourcebook

The Third Land Cover Symposium was held at Jena, Germany in 2008. The Symposium addressed several related topics including boreal and temperate forest monitoring, GOFC-GOLD Land Cover Implementation Team planning, monitoring tropical deforestation and degradation (REDD), land cover change accuracy assessment, coordination among the GOFC-GOLD Regional Networks, and a GOFC-GOLD strategy review.

The GOFC-GOLD REDD working group, which was formed in 2006 to address key technical issues (i.e. degradation, accuracy assessment), updated and expanded the "Sourcebook" that summarizes the technical consensus on current and future earth observation capabilities for monitoring deforestation and its emissions.

A GOFC-GOLD working Group on Biomass was initiated in 2009 at the 4th Global Vegetation Workshop. The group was established in response to the need for international coordination and a communication platform to enhance biomass monitoring using a combination of remote sensing and in-situ observations. The working group supports international initiatives to specify the observation requirements for monitoring biomass as an Essential Climate Variable (ECV). It is also working on the Group on Earth Observation (GEO) tasks for forest carbon tracking. The working group supports space agencies and their efforts for improved biomass monitoring, including the development of dedicated space-borne missions.

The Land Cover Implementation Team continues to be the focal point for the Land Cover and Biomass ECVs, and has provided a considerable contribution to the development of the ECVs reports.

ENGAGING USERS IN THE REGIONS

During the biennium the GOFC-GOLD Regional Networks held their fifth pan network meeting, involving members from Southeast Asia, Central, Southern, and Western Africa, Northern Eurasia, Latin America and East Asia.

GOFC-GOLD collaborated with the US Geological Survey to implement a Regional Network Data Initiative. The goals were to help disseminate US Earth observation data in regions where available distribution methods are not effective, compile regional and country data sets relevant to land cover and fire observations and make them freely available, and engage regional expertise in global data set development, evaluation and validation. An Africa Pilot was successfully held at the EROS Data Centre in April 2009, involving data specialists from the four networks in Africa. Plans are underway for another data initiative in spring 2010 and will include members from the networks in Asia.

Regional Network participation included the FRA 2010; land cover product validation; planning and coordination of optical and radar data acquisition for tropical countries involved in GEO forest carbon tracking; and the Global Fire Assessment 2010. Future collaboration with GOFC-GOLD will focus on validation and calibration activities, best practices formulation, training and capacity building, global fire assessment, and facilitating the distribution of data, materials and documents.

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

03 CLIMATE OBSERVATIONS

by Han Dolman

INTRODUCTION

The terrestrial part of the climate system provides human beings with important resources such as food, fibre, forest and water. At the same time, variability and change in fundamental properties of the hydrological and biogeochemical cycles are coupled with the climate system and affect the livelihood of millions of people. The primary way in which the terrestrial domain features in climate variability and change is through changes in water storage, carbon storage and changes in land cover, such as deforestation. Precipitation, evapotranspiration, groundwater, soil moisture, lake levels, glaciers and river discharge constitute critical components of the hydrological cycle, with often direct impact on water availability and, for instance, droughts and floods.

Land is often covered by vegetation; importantly, by now, almost 40% of the Earth surface has been under some form of management. Land use changes the characteristics of the land surface and thus can induce important local climate effects, especially through changes in albedo, roughness, soil moisture and evapotranspiration. When large areas are concerned (tropical deforestation) regional and even global climate may be affected. Land is covered by snow and ice on a seasonal basis, and it features glaciers, ice sheets, permafrost, and frozen lakes. Snow and ice-albedo play an important role in the feedback to climate. Further, as land-based ice, such as a glacier, melts, it affects rivers and contributes directly to sea-level rise. Disturbances to land cover (vegetation change, fire, diseases and pests) have the capacity to alter climate and the ground (e.g., permafrost) but also respond to climate in a complex manner through changes in biogeochemical and physical properties. Precise quantification of the rate of change is important to determine whether feedback or amplification mechanisms through terrestrial processes are operating within the climate system. There is thus increasing significance being placed on terrestrial data for both fundamental climate understanding as well as impact and mitigation assessment.

The recognition of this has led to substantial progress in a number of areas in the terrestrial domain. TOPC has been actively contributing to the GCOS Progress report in assessing the success of the terrestrial action in the implementation plan. Fifty-six percent of terrestrial domain actions show progress in the range from moderate to good, although advances are still limited or absent in others.

Summary of progress in the terrestrial domain:

- There has been significant progress in defining internationally accepted standards for the terrestrial ECVs. The GTOS Secretariat has been reporting regularly to SBSTA on collaboration with the International Organization for Standardization (ISO) and the evolution of a joint UN-ISO framework.
- Progress in establishing institutional support for *in situ* networks has been slow, leading to networks that are still poorly coordinated and harmonized, despite considerable effort of the research community to keep them running.
- The objective of creating a comprehensive and well coordinated reference network for *in situ* observations of the fullest possible range of terrestrial ECVs is continuing. Such a network would provide the observational data and associated details relevant to their application in model validation, process studies, and the validation of observations derived from Earth observation satellites.
- The establishment of several Global Terrestrial Networks (GTNs) in a number of areas (e.g. Hydrology, Glaciers, Permafrost), where data

Assessment Categories	No or Low Progress	Moderate to Low Progress	Moderate Progress	Good to Moderate Progress	Good Progress
Number of Actions	8	8	4	5	12
Percent of Actions	22%	22%	11%	13%	32%

Assessment of Progress on the 37 Terrestrial Domain Actions in the GCOS IP-04

collection takes place largely through *in situ* measurements has significantly improved the coordination and global coverage of these observations.

- Observations made for purposes other than climate, but with climate relevance, are often not made available, sometimes due to their economic or national strategic value. This has for instance, led to a declining number of reports of river discharge. However some networks, such as for glaciers (GTN-G), have shown remarkable resilience and now operate very effectively. Similar progress has been made in the production of fire-related global datasets.
- Good progress has been made in guaranteeing short-term continuity in the availability of high-resolution optical observations from satellites, a gap highlighted in previous GCOS reports. Long-term commitment to continuity of this class of missions, though crucial to successful maintenance of the observation records, has yet to be secured.
- The increasing commitment of space agencies to produce fundamental climate data records from existing systems has led to improved availability of global datasets, such as burned area and land cover. The community now increasingly uses these datasets. Substantial gaps remain in quality control, which need to be addressed through intercomparison and validation.
- The analysis of historical records, both *in situ* and satellite based, has been progressing slowly and needs the urgent consideration of space agencies together with the potential users.

Thirty-seven Terrestrial Domain actions were identified within GCOS and, with the contribution of TOPC, progress was made in most of them (Table 2).

One of the key conclusions of the GCOS progress report is that although there has been marked improvement, the setting up of reference sites for validation of satellite observations and algorithms is not sufficiently developed.

THE DEVELOPMENT OF STANDARDS FOR ECVs

With GTOS secretariat, the status of the development of standards for each of the essential climate variables in the terrestrial domain was assessed.

The report can be accessed at http://www.fao.org/gtos/Pubs.html. TOPC members have been involved in writing and reviewing of these documents.

CARBON OBSERVATION NETWORK

There has been considerable activity around the Geo carbon tasks, in particular CL-09-03a, the Integrated Carbon Observing System. TOPC's chair is one of the co-leads of this task and is involved in writing a new GEO-report on carbon observations. In practice the development of an integrated network is progressing slowly. The failure of the launch of OCO was a considerable setback, although GOSAT is now producing data. A presentation on this task was given at the GEO plenary in Washington. The updated GEO Carbon report will be presented in Copenhagen at the UNFCCC COP15. TOPC is working with GTOS TCO panel to improve carbon observations by defining new possible carbon ECVs.

NEW ECVs

TOPC has been contributing to the definition of new ECVs for Ice Sheets, Soil Moisture and redefinition of several existing ones. The new ECVs will be presented in the new GCOS Implementation plan.

RELATED LINKS:
www.fao.org/gtos/topc.html

04 TERRESTRIAL CARBON OBSERVATION (TCO)

by Antonio Bombelli, Matieu Henry and Riccardo Valentini

INTRODUCTION

TCO is a coordinated initiative in support of the global network of terrestrial carbon observations for better understanding the terrestrial carbon budget and for supporting decision makers in adopting mitigation and adaptation strategies. TCO's overarching goals are to better identify the potential end users and their requirements; organize and coordinate reliable data and information on carbon; and link science and policy. Main cross-cutting issues to TCO are climate change, land cover and land use changes, fires, biomass and net primary productivity. The TCO importance is increasingly in response to the improved awareness of the linkages between the carbon cycle and climate change. In the last two years TCO contributed to a number of international initiatives and programmes, some of which are highlighted below.

AFRICA, CARBON AND CLIMATE

Africa plays a key role in the global carbon cycle and is one of the most vulnerable continents to global change. The current African monitoring network is inadequate, and TCO has been contributing to fill this major gap through its involvement, under the frame of the GTOS programme, in relevant international initiatives, such as CarboAfrica and ClimAfrica. CarboAfrica (www.carboafrica.net) is coordinating an expanded network of continued and enhanced observations of carbon stocks, fluxes, atmospheric concentrations and ecological processes in Sub-Saharan Africa. TCO is mainly involved in specific studies on deforestation and forest degradation, the assessment of the potential for carbon sequestration, and training activities. ClimAfrica is a European project that is going to be funded under the FP7, with the main objective of developing improved climate change predictions in Sub-Saharan Africa. ClimAfrica will also consider: (i) the quantification of impacts to key sectors, such as water resources and agriculture; (ii) the vulnerability of both ecosystems and civil population; and (iii) assessment of adequate adaptation measures, suited for local needs.

Biomass sampling in Ghana Asante Winston

BIOMASS AND SOIL INVENTORIES

TCO is supporting specific activities for assessing vegetation biomass and soil organic carbon, and monitoring land cover and land use change in Sub-Saharan Africa (SSA). A first data set of available and harmonized allometric equations and the first biomass metadatabase for SSA were built. Various biomass conversion factors were derived to allow data standardization. These data were used to support the FAO-WISDOM (Woodfuel Integrated Supply/Demand Overview Mapping) products which provide data and information on the supply and the demand of firewood. Available soil data were collected and harmonized to produce soil organic carbon maps. New carbon emission factors from forest degradation were calculated for tropical

humid forests and a biomass map of Ghana was produced. These activities are supporting the UN-REDD activities, by the development of methods that integrate local scale carbon measurements with national and global products. These products are useful for monitoring forest changes and observing carbon stock changes.

ESSENTIAL CLIMATE VARIABLES (ECVs)

TCO has contributed to the development of the standard reports for the terrestrial ECVs (Essential Climate Variables). In particular TCO coordinated more than 20 international experts, both from *in situ* and space based perspective, to produce the ECV report on biomass (ECV-T12, Biomass: http://www.fao.org/gtos/ecv-t12.html). Biomass is a crucial ecological variable linking the carbon cycle to the climate system. A global assessment of its stocks and dynamics is an essential input to climate change forecasting models and mitigation and adaptation strategies. The final version of the ECVs reports will be presented at the next United Nations Framework Conference on Climate Change (COP 15) in Copenhagen (December 2009).

GROUP ON EARTH OBSERVATION

TCO has been actively contributing to the Group on Earth Observation (GEO) and its Global Earth Observation System of Systems (GEOSS). Inputs were given to the development and update of the GEO 2009-11 Work Plan, and TCO members participated in relevant GEO meetings. TCO is particularly involved in GEO task CL-09-03: Global Carbon Observation and Analysis System. The production of a new GEO document for an integrated global carbon observation strategy is ongoing.

CAPACITY DEVELOPMENT

Through the above mentioned CarboAfrica project, TCO supported three different training activities in Africa, aimed at developing the capacities of African people to better manage carbon related issues and benefit from the relevant economic opportunities. More than 100 African students and experts from 17 African countries (Botswana, Burkina Faso, Congo, Cameroon, Ghana, Kenya, Lesotho, Mozambique, Nigeria, Rwanda, Senegal, South Africa, Sudan, Togo, Uganda, Zambia and Zimbabwe) participated in the following training events:

1. Training Course on Ecosystem Functioning, Biomass and Carbon Markets, Brazzaville (Congo), 10-14 December 2007. Main topics: biomass assessments in natural ecosystems by theoretical and practical sessions. Organizers: CIRAD, UR2PI, University of Brazzaville, and FAO.
2. Field Training Workshop on Carbon Cycle Measurements, Phalaborwa (South Africa), 10-15 March 2008. Main topics: ecophysiology and eddy covariance fluxes (measurements and analysis) by theoretical and practical lessons. Organizers: CSIR, MPI, and FAO.
3. Training Course on Remote Sensing of Fire for National Greenhouse Gas Accounting, Leicester (UK), 7-8 September 2009. Main topics: accounting for GHGs emissions from fires for reporting to the UNFCCC using satellite data. Organizers: University of Leicester and FAO.

MANUAL FOR VEGETATION SAMPLING AND DATA SUBMISSION

TCO promoted the publication of a manual on "Terrestrial Carbon Observations: Protocols for Vegetation Sampling and Data Submission" by B.E. Law and collaborators (http://www.fao.org/gtos/doc/pub55.pdf). This is a useful manual (i) for making biological measurements in forests (biomass, primary and net production, ecosystem processes, etc.) and in other vegetation types (such as crops) and (ii) for submission of biological data to a database. This is an effort toward the standardization of methods for measurements of variables associated with the carbon cycle and data submission.

Students at the training course in Congo Werner Kutsch

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

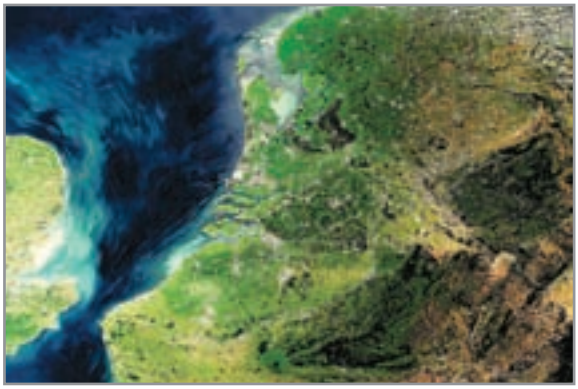
05 COASTAL GTOS

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 their functioning is of particular importance in guiding wise national and international policy decisions. 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. Also, coastal wetlands and transitional waters are considered within the purview of C-GTOS, as they are often not included within coastal ocean observations. C-GTOS has been designed to interface with coastal ocean observing systems and provides support for GEOSS, especially through the Coastal Zone Community of Practice (CZCP).

After the completion of the C-GTOS Strategic Design and Phase 1 Implementation Plan, members of the original panel of experts, the GTOS Secretariat and other partners have worked towards the development of initial coastal products. One significant contribution has been a formal discussion and publication of the definition of the coast and recognition that the definition is issue dependent and contextual.



DELTA VULNERABILITY ASSESSMENT

C-GTOS participated in the development of the World Deltas Network. The work being done by C-GTOS aims at providing a comprehensive, high quality base of information on physical, environmental, ecological and sociological threats to deltaic ecosystems as an aid to integration of science and management. A linked development has been the creation of a time series of images of the Nile Delta to evaluate land-use changes over multiple decades and initiation of similar efforts on five other deltas. Work is ongoing on the deltas of Mekong, Shatt-al-Arab, Senegal, Tana and Irrawaddy rivers.

The deltas are being chosen to aid management of these important regions of developing countries. This is done in collaboration with the Global Land Cover Network (GLCN) and will foster collaboration with the Delta Research and Global Observation Network (DRAGON). Also, related is the recent mangrove atlas that provides important information about the distribution and status of mangroves around the world. This product is discussed elsewhere in the report.

CULTURAL SITES MANAGEMENT

C-GTOS has continued playing a role in the cooperative agreement (Memorandum of Cooperation) with the Ramsar Convention on Wetlands. This has led to C-GTOS developing the "sentinel ecosystem" approach for observations in support of coordinated management of conservation and cultural sites. This approach explicitly uses managed sites from international

programs as the basis for establishing *in situ* stations for global observations. The focus of efforts has been largely on wetlands of the Mediterranean region with MedWet.

MEDITERRANEAN LAGOONS

The University of Parma (Italy) has contributed in leading 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. The network links C-GTOS and the programme Land-Ocean Interactions in the Coastal Zone (LOICZ).

GEO COASTAL ZONE COMMUNITY OF PRACTICE (CZCP)

C-GTOS is a member of the GEO CZCP. The CZCP works to coordinate coastal programmes and promote coordinated coastal observations. The CZCP follows from the IGOS- Coastal Theme. It importantly provides a forum for the interaction of representatives of C-GTOS, Coastal – GOOS and LOICZ. Emphasis is on managing and mitigating the impacts of human activities and coastal inundation. Recently representatives of the CZCP provided a white paper on the decision support for coastal management in response to local sea level changes for the conference OceanObs2009. Regional coastal observing systems are being fostered with the intent of them coalescing into a global programme. The CZCP conducted a regional workshop on this topic for the Mediterranean region and is working toward other regional workshops in the future. Most immediately regional workshops in northern Africa and western Africa are being organized. Workshops in the Americas and Indo-Pacific are planned.

PANEL STATUS

Currently, no formal panel for C-GTOS exists. 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 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.

RELATED LINKS:

C-GTOS: www.fao.org/gtos/C-GTOS.html | **C-GTOS Phase 1 Implementation Plan:**www.fao.org/gtos/gtospub/pub36.html | **DRAGON:** http://deltas.usgs.gov
GEO CZCP: http://www.czcp.org | **Lagunet:** www.lagunet.it | **LOICZ:** www.loicz.org | **MedWet:** http://www.medwet.org/medwetnew/en/index.asp
WDN: http://cires.colorado.edu/science/groups/wessman/projects/wdn

06 TERRESTRIAL ESSENTIAL CLIMATE VARIABLES (ECVs)

by Antonio Bombelli, Paola Cardenas, John S. Latham, Valeria Salvatori

WHAT ARE ECVs

The Essential Climate Variables (ECVs) in the terrestrial domain have been identified and endorsed by the international community as the core set of observations required to allow the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC) and other end users to achieve their objectives and mandates. ECVs fall under the atmospheric, oceanic or terrestrial domains and have been selected on the basis of their urgent need and of the technical and economical feasibility to systematically observe them. Current and historical data and information on these variables are of fundamental importance for the assessment of and adaptation to impacts of climatic changes, and for related issues such as characterizing the state of the climate system, predicting future climate changes, and enabling the assessment of vulnerability and risk to them. The ECVs identified to date are listed below:

- T1 River Discharge
- T2 Water Use
- T3 Ground Water
- T4 Water Level
- T5 Snow Cover
- T6 Glaciers and Ice Caps
- T7 Permafrost
- T8 Albedo
- T9 Land Cover (including vegetation type)
- T10 Fraction of Absorbed Photosynthetically Active Radiation (FAPAR)
- T11 Leaf Area Index (LAI)
- T12 Above-ground biomass
- T13 Fire Disturbance
- T14 Soil Moisture

The 2009 edition of the Global Climate Observing System (GCOS) Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (IP-09) updated the list of ECVs and proposed addition of three new ECVs: Ice Sheets, Soil Carbon, and Terrestrial Biodiversity and Habitat Properties. It is expected that this addition to the terrestrial ECVs will be approved, completed and peer-reviewed in the near future.

GTOS CONTRIBUTION

GTOS has played an important role in assessing the availability of standards for the terrestrial 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 Subsidiary Body for Scientific and Technological Advice (SBSTA) of the UNFCCC through its resolution SBSTA 23 requested the GTOS Secretariat: "to develop a framework for the preparation of guidance materials, standards and reporting guidelines for terrestrial observing systems for climate." and "to assess the status of the development of standards for each of the essential climate variables in the terrestrial domain.". The guidance provided by SBSTA 27 in reaction to previous progress reports allowed GTOS to develop an implementation proposal based on a joint effort of the UN organizations (which are also GTOS Sponsors) and the International Organization for Standardization (ISO).

Since report to SBSTA 27 (prepared for 14 terrestrial ECVs), detailed reports on the status of individual ECVs have been completed, peer- reviewed, and published (http://www.

fao.org/gtos/Pubs.html). These reports are dynamic and constantly updated when required to reflect new technological developments and stakeholder needs. The last review of the status of each terrestrial ECV will be presented at COP 15 in Copenhagen (December 2009). In addition, a special report was completed on the status of standardization for the terrestrial ECVs, taking into consideration observation standards, guidelines and guides within ISO, other international organizations, scientific programmes or projects, and in some cases by national entities. Of interest is a conclusion that the UN-ISO standardization framework should initially focus on *in situ* methodologies, while the satellite-based methodologies continue to be developed through product validation and intercomparisons – both underpinned by *in situ* data.

The last GTOS report submitted to SBSTA 30 (Bonn, Germany, June 2009), included existing 14 ECVs completed in 2009 and peer-reviewed, dealing with *in situ* measurements only (refer to Part D of report to SBSTA). The status of revision and documentation shows that *in situ* observations are ready for standardization while satellite methodologies are still under development in most cases.

Considering the need and 'readiness' for developing an international standard for *in situ* observations, variables such as biomass, glaciers, land cover, permafrost, and soil moisture were ranked as high priority.

Regarding ECVs relying primarily or equally on satellite data, the development of standards for *in situ* measurement is currently at various stages. Particularly:

- for fire disturbance further methodological research and development is needed;
- for biomass, glaciers and ice caps, LAI, FAPAR, and soil moisture standards are to be developed;
- for albedo, land cover, lake levels and reservoir storage, and snow cover existing documents are satisfactory for the present, or work is in progress, thus development is 'in good shape'.

SBSTA 30 recognised the significant progress made in improving the observing systems for climate relevant to UNFCCC and encouraged GTOS to implement the proposed joint framework mechanism. This decision was recommended for adoption by the COP 15 in Copenhagen (December 2009). SBSTA invited the GTOS secretariat and sponsoring agencies (FAO, UNEP, WMO, UNESCO, ICSU) to elaborate a work plan for developing observational standards and protocols for the ECVs assessed. The results of the review of the ECVs provide a basis for defining the initial workplan to be followed once the framework for standardization is established. Finally, SBSTA requested the GTOS secretariat to report on the results of the framework implementation and work plan elaboration at SBSTA 33 (November 2010).

RELATED LINKS:
www.fao.org/gtos/pubs.html | **UNFCCC Framework and ECVs:** www.fao.org/gtos/news56.html

07

BIODIVERSITY IN GTOS

by Robert Scholes

APPROACHING THE 2010 TARGET

The nations of the world committed themselves in 2002 to 'reducing the rate of loss of biodiversity by 2010'. Next year that promise comes due. In anticipation, 2010 has been declared 'International Year of Biodiversity'. While it is widely recognised that the target will not be met in many respects, it has had the enormous benefit of mobilising a large community of interested parties around the issue of biodiversity conservation. They all agree that one of the critical deficiencies is the inadequacy of biodiversity information, in terms of spatial coverage, topical coverage and availability. Since this is a mandate of GTOS, the political arena is favourable for more support to biodiversity observation systems, if a realistic plan can be presented.

THE EMERGENCE OF GEO BON

The big advance during the past year has been the creation of the Group on Earth Observation Biodiversity Observation Network (GEO BON). This is the result of a multi-year planning and advocacy process, in which GTOS has been a partner, along with the biodiversity network DIVERSITAS, the space agency NASA, and a number of other leading biodiversity institutions. The Group on Earth Observation arose from the 2002 World Summit on Sustainable Development. It is a voluntary grouping of around 80 countries and 120 participating organizations dedicated to making information essential for the cooperative management of the global environment freely and openly available. Its mode of operation is called the Global Earth Observation System of Systems (GEOSS). GEOSS identifies nine 'societal benefit areas' (SBAs) where coordinated observations are immediately needed. One of these is biodiversity. Topics related to the GTOS concept of biodiversity are also to be found in other SBAs, such as ecosystems. The activities within the SBA are intended to result from largely self-organizing communities of practice, or networks.

An interim committee, on which GTOS was represented, formed to envision and design a biodiversity observation network. After several committee meetings and two highly-inclusive stakeholder meetings, a GEO BON Concept Document and a GEO BON Implementation Plan were approved, and tabled at the GEO plenary. The next step was to form a steering committee, which was achieved in June 2009. The first chair is Dr Bob Scholes, a former chair of GTOS and leader of its B-GTOS activity.

GEO BON is organized as a series of focussed, limited-duration working groups on particular topics. The first meeting of these working groups will take place simultaneously, in the first quarter of 2010.

BIG INITIATIVES IN BIODIVERSITY MONITORING

Over the past decade a number of large biodiversity observation initiatives have emerged. GTOS recognizes their existence, help to promote their activities, partner with them as necessary, and adjust its own role and strategy accordingly. Some of the most important ones are:

- An explosion of gene-level biodiversity data and the emergence of a very sophisticated field of information technology called 'bioinformatics'. One of the key institutions in this field is GenBank, a vast open-access database into which genetic sequencing information is deposited, as a prerequisite for publication of research results in the peer-reviewed literature. GenBank is supported by the US National Centre for Biological Information, and is strongly driven by researchers in the health sector.
- A somewhat-related, but different, initiative is the 'Barcode of Life', which uses a small subset of the total genetic code as a relatively quick and cheap


Photo by R. Cazzolla


Photo by R. Cazzolla


Photo by R. Cazzolla

way of identifying species. It is particularly useful for identifying incomplete material, such as a piece of fish in a restaurant, or a larval stage of a pest. It is a global activity funded by the Sloan Foundation, with a secretariat at the Smithsonian Natural History Museum in Washington DC.

- The Global Biodiversity Information Facility (GBIF) is a multi-national activity with a secretariat in Copenhagen and participating 'nodes' in many countries, including some in key high-biodiversity tropical countries. It strives to make species-level observation data, particularly that in museum and herbarium collections, digitally visible and shared. It has made great advances in developing the IT architecture to do such a large task. One key contribution made by GBIF and partners is a unified and tidied up list of all known species (about 1.9 million). This is an essential and long-awaited step towards linking various biodiversity databases.
- The World Conservation Monitoring Centre of UNEP, based in Cambridge, UK, has compiled a global database of protected areas.
- Various non-governmental organisations, including Conservation International, the World Wide Fund for Nature (WWF) and IUCN have developed key databases on species abundance trends and species richness patterns at regional-to-global scale.
- The example of a successful citizen-based observation system pioneered by birdwatchers (organized by Birdlife International) is now expanding to other groups, such as reptiles and amphibians.

GTOS UNIQUE ROLE: LAND COVER MONITORING

The Global Observations of Forest Cover-Global Observations of Land Dynamics (GOFC-GOLD) activity of GTOS is widely acknowledged as the key mechanism by which land cover and land cover change activities worldwide are coordinated. The actual mapping is carried out by numerous agencies, at global, continental and national scales. This multiplicity of efforts raises two critical issues: how can the methods and legends be harmonised so that the products are comparable; and how can the effort be coordinated so that all parts of the world are covered with and accuracy and periodicity that is adequate for various purposes, including monitoring the habitat for biodiversity. The role of the FAO Land Cover Classification System (LCCS) and its new iterations and data model encompassed in LCCS -3 and the meta language of LCML is central in the former challenge, and the forum provided by GOFC-GOLD is crucial for the second. The UN GLCN (FAO/UNEP) provides capacity development and interactive tools to support national and regional implementation. An emerging challenge will be the integration of the new global ecosystem map under development as a task of GEO into the land cover mapping framework.

OBSERVATIONS BY MEMBERS OF THE PUBLIC

The 2010 'Year of Biodiversity' outreach campaign presents an excellent opportunity for GTOS to engage in a citizen science activity. The key opportunity is probably in relation to the creation and promotion of an 'interactions database', which is an element of the global biodiversity observation landscape that is currently completely missing, but needed if the knock-on impact of biodiversity changes are to be tracked. This is an arena that lends itself to public participation. A typical entry in this database would have the form: 'species A has the following relationship to species B', where 'relationship' is a defined set of interactions including, for instance, 'is a predator of', 'pollinates', 'is the dispersal agent for' etc. The record would be accompanied by quality control information, such as who the observer was, and when and where the observation was made.

RELATED LINKS:
www.gbif.org | www.earthobservations.org/geobon.shtml | www.diversitas-international.org

08

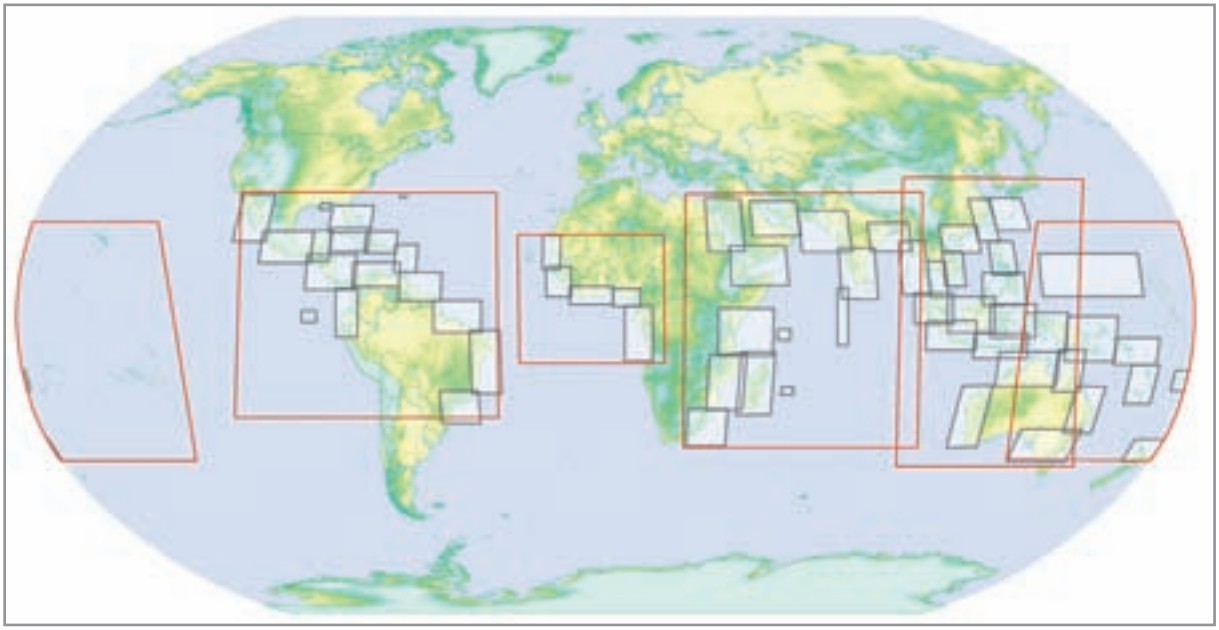
THE NEW REVISED WORLD MANGROVE ATLAS

by Luigi Simeone

Mangroves include 110 different species of trees, shrubs, palms and ferns. They grow in the tropics and subtropics in saline inter-tidal coastal habitats, such as estuaries and shorelines. They are physiologically adapted to overcome the problems of anoxia, high salinity and frequent tidal inundation. Mangrove ecosystems are unique and highly productive, and they host a wide variety of organisms, including a number of endangered species and offers hutching sites for commercial species. In addition to this, they also maintain water quality and clarity, filtering pollutants (including heavy metals) and trapping sediments. Their role in preventing erosion by stabilizing sediments and protecting the coast, especially during surge storms, hurricanes and tsunamis is vital, particularly in areas affected by climatic changes. These ecosystems are fragile, however, and it is estimated that over half the world's mangroves have been lost in recent times due to an increase in pollutants generated by a general increase in population, waterfront development, agriculture, boating, recreational and related activities.

WORLD ATLAS ON MANGROVES

In recent years FAO-NRCE, within the framework of the GTOS Programme and the Global Land Cover Network (GLCN), has conducted a global assessment of mangrove distribution. The mapping of mangrove regions have been achieved by the employment of the latest remote sensing techniques, including satellite image processing, photo-interpretation and field validation.



Key to Map Plates

The International Society for Mangrove Ecosystems (ISME) and its partners took the decision to produce an updated version of the World Atlas of Mangrove after the first issue of the Atlas in 1997. Within the vision and framework of the C-GTOS implementation plan, FAO has undertaken the task to update the database of mangrove areas and to produce new maps. As reported in the previous Biennial report, almost 400 ETM+ Landsat images were used to conduct analyses. The new Revised World Atlas of Mangrove, containing all updated maps produced through the latest analyses, is expected to be published by Earthscan in UK by December 2009.

Following the image interpretation process, the cartographic project was implemented in 2008-2009, following the cartographic standards agreed by FAO – NRCE, the partners (ISME, ITTO, WCMC) and the lead author, Dr. Mark Spalding (TNC), who was also the Project coordinator responsible for definition of cartographic standards (number of maps, scale and size of maps, cartographic projection, graphical styles, etc.).

The project work was implemented in different phases, illustrated by the following points:

- Collection of information and analysis of different database made available by the WCMC, ISME and the Lead Author (global best mangrove sites database);
- Definition and implementation of GIS filtering procedures regarding the best mangrove sites database and the Protected Areas database, aimed at the detection of spatial proximities between the two;
- Selection of the background info, or geo-features, accompanying the mangrove layer (topography, populated places, river and lakes, geographical sites);
- Definition and creation of the geodatabase structure, the platform from which the map layout is built;
- Definition of criteria for the choice of the geographical features to be included in the maps (geographical locations and populated places);
- Population of the geodatabase (geographical names).

A total of 55 detailed maps have been compiled, with some 25 inset maps, where areas of particular interest or importance are shown at finer resolution. In addition, four regional maps, showing the general distribution of mangrove at continental scale were produced.

Map Plate showing Mangrove distributon in Northern Thailand

RELATED LINKS:

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

THE GLOBCOVER PROJECT

by Olivier Arino, Vasileios Kalogirou and José-Ramos Perez

WHY GLOBAL LANDCOVER MAPS?

Global models, assessments of climate impact and ongoing research on sustainability rely on up-to-date information about global parameters. Global landcover products are one such parameter, representing basic input for the understanding of land-cover and land-use dynamics. The need to improve global landcover products comes from numerous international programs and initiatives, as landcover is an important input to a large variety of applications and, therefore, essential for scientists, land managers, conservationists, government bodies, organizations and many others.

WHAT IS GLOBCOVER?

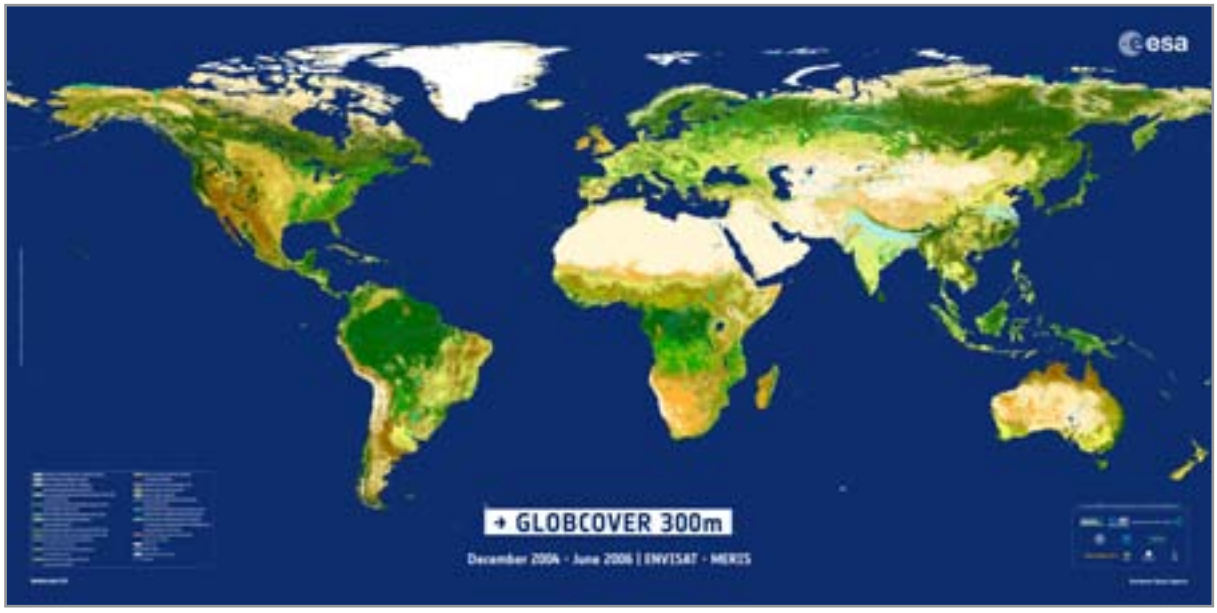
GlobCover represents a significant step forward in our capacity to automatically produce new global land cover products with finer resolution and a more detailed thematic content than ever achieved in the past. The GlobCover Project was launched in 2005 in the framework of the European Space Agency (ESA) Data User Element, with the objective of updating and complementing existing global products with comparable recent and finer resolution information (300 m). The project was carried out by a consortium of selected institutions in partnership with a number of end-user organizations. In October 2008 ESA delivered and made freely-available a harmonized, detailed, flexible and validated global landcover map of 2005–2006 at fine resolution, with a thematic legend compatible with the UN – FAO /UNEP Land Cover Classification System (LCCS). Nevertheless, GlobCover is not just a map. It is a system that implements an automatic processing chain for a global land cover service. Under this perspective, it is an important step not only for ESA and its partners but also for the almost 8200 scientists, officers, students, conservationists and other users. Responding to the continuous need of this user community, ESA is currently working on the production of the new GlobCover 2009 map.

GLOBCOVER PRODUCTS

So far the GlobCover project delivered three groups of products, generated in the period between Dec. 2004 and June 2006, 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 for 2005, 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 applying LCCS-2.

Global landcover maps at 300 m resolution



PRODUCTION PROCESS

ENVISAT MERIS 300 m Full Resolution Full Swath (FRS) images are the only data source of the project. ESA has made a large effort to ensure all the needed acquisitions were made and provided more than 20 terabytes of data. 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 and absolute accuracy much better than the 150 m requested in the product specifications. Last but not least, the final product has been validated using a global network of approximately 4300 points, the majority of which (→90%) has been collected by landcover experts. The validation results are distributed with the product and the overall accuracy of the six main land cover types was estimated to be ~72%.

The GlobCover system has been installed in ESA's European Space Research Institute (ESRIN) and the new production process is underway to provide GlobCover 2009 products.

PRODUCT AVAILABILITY

All GlobCover reflectance products (two-monthly and annual composites) have been made available to the public by the European Space Agency through the GCAT tool (see Web link). The global landcover map product and the validation report are freely-available through an open-access URL. Products may be used for educational or scientific purposes, without any fee, on the condition that ESA and the ESA GlobCover Project are credited as the source. More information on the terms of use is available online (see Ionia website).

RELATED LINKS:

GlobCover on DUE: http://dup.esrin.esa.it/projects/summaryp68.asp | **GlobCover products (Ionia):** http://ionia1.esrin.esa.int/index.asp

10

THE GLOBAL FOREST RESOURCES ASSESSMENT 2010

by Mette Løyche Wilkie and Adam Gerrand

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 2010 will be even more comprehensive and will include a new remote sensing survey.

FRA DATA - RELEVANT TO GLOBAL REPORTING AND INFORMATION NEEDS

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 of UNFCCC, UNCCD and towards the 2010 Biodiversity Target of the CBD, by the United Nations Forum on Forests (UNFF) and the International Tropical Timber Organization (ITTO).

WHY WE ARE DOING A REMOTE SENSING SURVEY OF THE WORLD'S FORESTS

The increasing importance of climate change is increasing the demand for better information because forest and land cover changes are estimated to be responsible for approximately 17% of human induced carbon emissions. Forests store more carbon per unit area of land than most other land covers, this means that changes in forest area are some of the most important information needed for climate change reporting. Remote sensing enables consistent data to be collected and analysed globally and can be done in the same way for different time periods to get better estimates of change. Remote sensing does not replace the need for good field data, but combining the two provides better results than either methods alone.

KEY OUTCOMES OF THE FRA 2010 REMOTE SENSING SURVEY WILL BE:

- Improved knowledge on global forest and land use changes, especially patterns and processes of deforestation, afforestation and natural expansion of forests;
- Baseline information at the global, biome and regional level on trends in the rate of deforestation over the past 15 to 30 years;
- A global framework and methodology for monitoring forest change, which can be expanded to generate estimates at country level;
- An internet-based data portal providing easy access to remote sensing imagery, which can also be used for other studies and monitoring purposes;
- Enhanced capacity in many countries for monitoring, assessing and reporting on forest extent and on land use changes affecting forests.

A SCIENTIFIC SAMPLING DESIGN

The FRA 2010 Remote Sensing Survey (RSS) will take samples across the whole land surface of the Earth using a sampling grid design with imagery taken at each longitude and latitude intersection (approximately 100 kilometres apart, see Figure 1). There are almost 14,000 samples, of which about 9,000 are outside deserts and areas with permanent ice (Antarctica is excluded). The area covered at each sample site is 10 km x 10 km, providing a sampling intensity of about one percent of the global land surface. This grid of sample plots is the same as used for the national forest assessments supported by FAO and by many national forest inventory programmes.

The survey is primarily based on the use of available Landsat imagery, but also incorporates auxiliary information including Vegetation Cover data from MODIS processed with partners at the South Dakota State University and radar images from Terra-SAR X processed by partners at Jena University.

IMPROVED GLOBALLY CONSISTENT ESTIMATES OF FOREST EXTENT AND CHANGE OVER TIME

For each sample plot, at least three Landsat images - dating

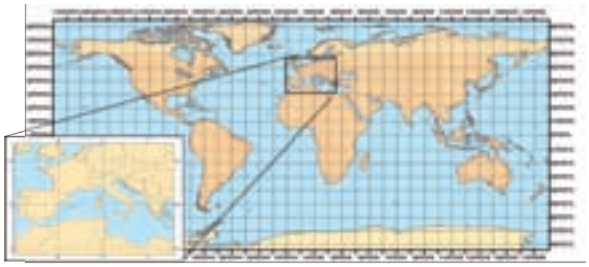


FIGURE 1. The FRA 2010 RSS systematic sampling grid overlaid on land. The 10km x 10km plots are located at each latitude and longitude intersection except Antarctica and reduced above 60 degrees north.

from around 1990, 2000 and 2005 - will be interpreted and classified in terms of tree cover using an image segmentation approach. Changes in land cover over time are captured in the segmentation polygons and reflected in changes in land cover labels assigned during the classification process (Figure 2). National experts will be involved in interpreting the forest land use and deriving statistical estimates of land-cover and land-use changes.

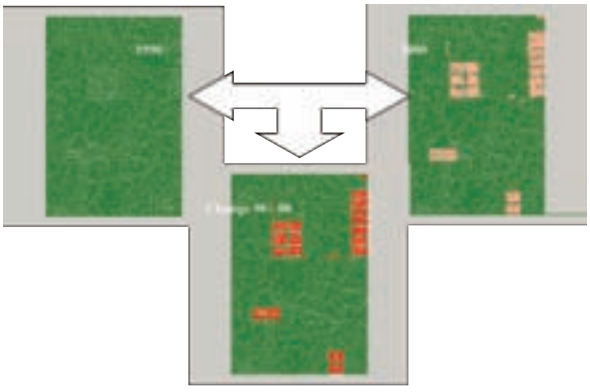


FIGURE 2. A sample site showing the draft pre-labeled polygons resulting from multi-date segmentation classified by land cover for 1990 (left) and 2000 (right).

Areas showing a change in land cover between the two time periods are shown in red (left). In this example, green represents tree cover and brown represents herbaceous cover. Changed polygons will receive land use labels for both time periods.

MAKING SATELLITE IMAGERY SAMPLES EASILY AVAILABLE

FAO and its partner organizations have made rectified and pre-processed imagery for the sample areas easily available through an on-line information gateway (Figure 3). http://geonetwork4.fao.org/geonetwork/srv/en/fra.home

The interpretation of the imagery and the development of the change matrices are undertaken with national experts, thus making the best use of local knowledge and existing information. The access to free remote sensing data and software will particularly benefit developing countries with limited forest monitoring data or capacity. This initiative was tested with 22 pilot countries in 2009 and the operational process has already begun for Central and Eastern Africa with two workshops in October 2009 where national experts from over 15 countries came together to assess the land cover and land use classification for their countries.

FIGURE 3. The new portal to data for the Global Forest Remote Sensing Survey allows access to data for all 13,689 sample areas.

STRONG TECHNICAL PARTNERSHIPS

The project brings together strong partnerships between some of the leading agencies in forest and remote sensing analysis. The project combines the technical forest and land cover expertise in FAO with external agencies as partners through funding support from the European Commission and technical expertise of the Joint Research Centre. Additional studies will be done by the South Dakota State University to generate a new global tree cover map using medium resolution (250m) data which will improve on the previous 1km maps from FRA 2000. Scientists at Friedrich-Schiller University in Jena are testing radar data to "see" through clouds and develop techniques to overcome some gaps in optical satellite data.

An informal implementation partnership has been established with FAO (the Forestry Department and the Natural Resources Department, which includes the Secretariat of the Global Terrestrial Observing System GTOS). Other partners include NASA and USGS who have been instrumental in providing the majority of the satellite imagery forming the core datasets for the work. GOFC-GOLD will be involved in providing technical expertise to assist the land cover validation and statistical analysis.

The Global Forest Resources Assessment Remote Sensing Survey plans to complete the final analysis and report in late 2011.

RELATED LINKS:
www.fao.org/forestry/fra2010-remotesensing

FOR FURTHER INFORMATION:
adam.gerrand@fao.org, or fra@fao.org

11 THE GLOBCARBON PROJECT

by Olivier Arino, Stephen Plummer, Vasileios Kalogirou

WHY CARBON?

The concentration of 'greenhouse gases', especially carbon dioxide, in the atmosphere is intimately connected to climate change. The big challenge for the scientific community is to understand and model the spatial and temporal patterns of carbon fluxes on land, ocean and in the atmosphere, in order to predict future global climate responses. Understanding and modelling carbon fluxes will be the main 'pillars' that will enable us to manage future changes and decide on possible actions and effective policy measures. Observations of terrestrial carbon-cycle dynamics are a fundamental component of attempts to understand the carbon cycle.

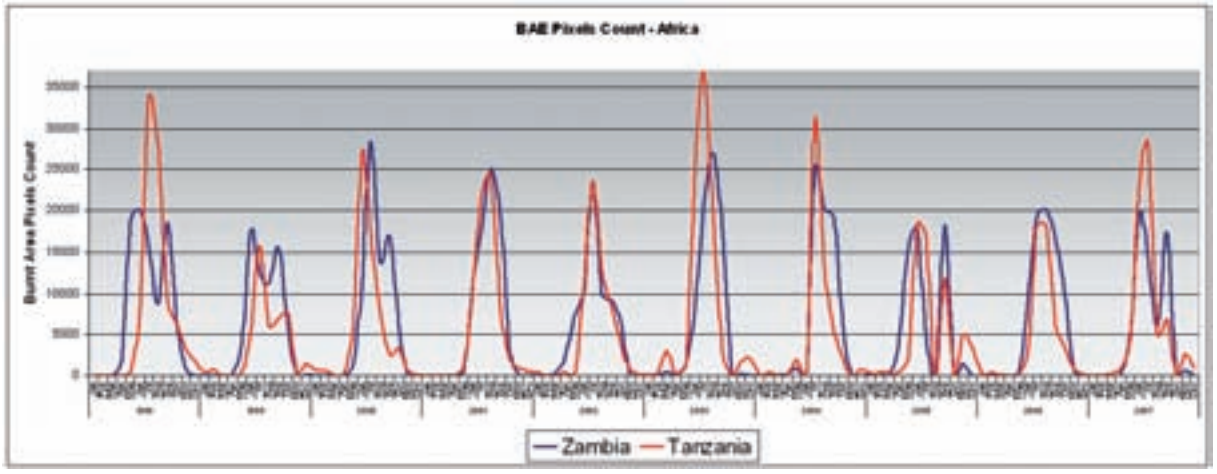
WHAT IS GLOBCARBON?

The European Space Agency (ESA) initiated the GlobCarbon project in order to deliver global land products for use within several global initiatives that aim to determine the spatial and temporal distribution of global terrestrial carbon. GlobCarbon project has developed a service to generate fully calibrated estimates of land products, quasi-independent of the original Earth Observation source. The project has been carried out by a consortium of selected institutions in partnership with a number of end-user organizations. The system's baseline inputs (approximately 50Tb) is satellite data from the ATSR-2, AATSR and MERIS sensors aboard ESA's ERS-2 and ENVISAT satellites and from the VEGETATION sensor aboard Système Pour l'Observation de la Terre (SPOT) satellite. Ten years of Earth Observation data have been processed by the GlobCarbon system to produce a consistent and validated set of products from 1998 to 2007.

GLOBCARBON PRODUCTS

GlobCarbon has delivered a large variety of science products, which can be grouped in two large categories:

- GLOBAL BIOPHYSICAL PARAMETERS PRODUCTS
  - ◊ **Leaf Area Index (LAI)** is an important structural property of plant canopies. LAI product is monthly in different resolutions (1km, 10km, 0.25 and 0.5 degree).
  - ◊ **Fraction of Absorbed Photosynthetically Active Radiation (fAPAR)** helps to determine the canopy photosynthesis potential. GlobCarbon delivered daily estimates of fAPAR in different resolution.
  - ◊ **Vegetation Growth Cycle (VGC)** Product. Useful to evaluate the growth season of vegetation, which also serves as input for carbon cycle models. It is delivered in different resolutions.
- BURNT AREA ESTIMATE PRODUCTS
  - ◊ **Burnt Area Estimate (BAE)** products are representing the new burnt areas detected every month. The product provides pixel location and timing of areas that were detected as 'burnt', in different resolutions. Burnt Area Estimates per country during the period 1998-2007 have been extracted as well.



Number of burnt area pixels detected by at least 2 of the 3 GlobCarbon algorithms. Seasonal variations of burnt areas (example: Zambia and Tanzania) can be clearly seen and analysed.

PRODUCTION & VALIDATION PROCESS

The processing system offers a flexible service that can be retrospectively applied to existing archives and used with future satellite systems. Particular attention was given to detect and remove non-valid pixels, especially those affected by cloud, cloud shadow and snow. Numerous processing chains and algorithms were utilized for the large variety of products (for details see the documentation in Geosuccess website). Finally, independent validation of the products took place by analytical comparison with reference data taken from global test sites. The Burnt Area product has been validated, using 72 pairs of Landsat imagery above various land cover types, while for the LAI product the large validation exercise was based on a network of 22 FLUXNET sites. The outputs of the LAI processing chain have been also inter-compared with similar global LAI products and the results were distributed to the users (see Geosuccess website). The validation of the phenology product (VGC) was based on several sources of reference data available from the GLOBE network, Plantwatch and Metla databases.

PRODUCT AVAILABILITY

GlobCarbon Products (in zip format) are available from the Geosuccess web site, where a simple registration is needed. Demonstration products can be found on Ionia Website (see Web link below).

GTOS AND GLOBCARBON

GlobCarbon products, such as LAI, FAPAR, and BAE, are also part of the GTOS framework, in particular of the GTOS led initiative on Terrestrial ECVs (Essential Climate Variables). Strong linkages are foreseen between GTOS and GlobCarbon: GTOS will contribute through its coordinating work on *in situ* and satellite observations, and will benefit, in turn, from the GlobCarbon products.

RELATED LINKS:

GlobCarbon on DUE: http://dup.esrin.esa.it/projects/summaryp43.asp | **GlobCarbon products (Ionia):** http://dup.esrin.esa.int/ionia/globcarbon/products.asp
Geosuccess website: http://geofront.vgt.vito.be/geosuccess

12 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), hosted by the University of Bern, and endorsed by the International Geosphere Biosphere Programme, the International Human Dimensions Programme, GTOS and UNESCO's Man and the Biosphere Programme (MAB).

MRI supported the definition of the GLOCHAMORE Research Strategy that laid out a global template for global change research in mountain regions in its early years from 2003 to 2005 and is now working on the implementation of the global template through regional Global Change Research Networks (GCRN). It is within these networks that the leading scientists meet to exchange knowledge, discuss methods or develop peer-reviewed papers.

RESEARCH NETWORKS IN EASTERN EUROPE

In the reporting period 2008-2009 MRI's GCRN for the Carpathians found much more solid institutional footing. The second Science for the Carpathians (S4C) planning meeting on 10 June 2009, Slovak Academy of Sciences, Bratislava, Slovakia aimed at securing long-term funding for an S4C coordination office within the Carpathian region, establishing an official S4C Steering Committee, and planning the first Forum Carpaticum scheduled for 15-17 September 2010 in Krakow, Poland. An Interim Scientific Steering Committee was nominated for the period from June 2009 until September 2010.

CLIMATE CHANGE AND WATER RESOURCES MANAGEMENT IN MOUNTAINS

In conjunction with Dr. Daniel Viviroli of the University of Bern, MRI brought together water resource experts working in the Pacific North West, the Tropical Andes, Mediterranean and Alpine Europe, the Middle East, South Africa, Pakistan, China and New Zealand in Göschenen on 16-19 September 2009 to assess the current scientific and managerial capacities in their regions for responding to climate change and to explore how results of climate change research can be made more useful to water resource

Photos by MRI and Lubos Halada

Photos by MRI and Lubos Halada

At the workshop "Securing the Sustainable Provision of Ecosystem Services in the Alps and the Carpathians" the MRI and its regional partners supported the definition of urgent research question and the development of research proposals.

managers. The conference will result in a special issue of Hydrology and Earth System Science.

TOWARDS FINE RESOLUTION HYDRO-ECOLOGICAL OBSERVATORIES IN SOUTHERN AFRICAN MOUNTAINS

In conjunction with Institute for Snow and Avalanche Research SLF and the University of Pretoria, MRI brokered the submission in November 2008 to SNF's bilateral program with South Africa of a proposal for a joint Swiss-South African scientific conference, Toward Sustainable Fine Resolution Hydro-Ecological Observatories in Southern African Mountains. Switzerland and South Africa subsequently approved the project and the conference will occur in November 2009.

MOUNTAIN.TRIP

In January 2009 a consortium of 6 partners including MRI submitted the Mountain Sustainable Development. Transforming Research Into Practice (Mountain.TRIP) proposal to the 2009 EU FP7 call. Mountain.TRIP will render EU-funded mountain relevant research results available to practitioners in forms that they can easily access and use. Mountain.TRIP was approved for funding in June 2009 and will start on 1 November 2009.

TALK ABOUT WHAT YOU DO!

The MRI launched its own newsletter, MRI News, in September 2008 containing news from MRI's regional networks, scientific articles from the MRI community, meeting reports, and introductions of the people shaping MRI.

Photo by Blase Reardon

Winter weather station maintenance, Snowslip Wheater Station, Glacier National Park, USA

RELATED LINKS:

MRI workshops: http://mri.scnatweb.ch/events/mri-events | **MountainTRIP project description:** http://mri.scnatweb.ch/projects/mountain.trip
Science for the Carpathians: http://mri.scnatweb.ch/networks/mri-carpathians | **MRI Newsletter:** http://mri.scnatweb.ch/index.php? option=com_docman&task=cat_view&gid=111&Itemid=43

13

FAO FOCUS ON MOUNTAINS

by 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, mountain products and disaster risk management, 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 Pakistan, Tajikistan, Turkey, Ecuador, Nepal and the Fouta Djallon Highlands in West Africa. Projects are also to be initiated in the Altai Republic of Russia, Morocco, Mauritania and Syria.

INTERNATIONAL PROCESSES AND PARTNERSHIPS

FAO's contribution to such global partnerships, processes and initiatives as the Convention on Biological Diversity (CBD), 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, inter-governmental organizations, civil society, non-governmental organizations

Photo by T. Hofer, FAO

and the private sector in five regions. FAO is a founding member of the Mountain Partnership and hosts the Secretariat to support it. FAO is in the process of developing a more strategic collaboration with the Kathmandu-based International Centre for Integrated Mountain Development (ICIMOD). Finally, at the World Water Forum in March 2009 and the World Forestry Congress in October 2009, FAO organised special Side Events to raise awareness about the particular opportunities, challenges and needs of mountain regions with particular reference to the management of water and forests.

COMMUNICATION AND OUTREACH

FAO's role in communications and advocacy for mountains has included its lead role in the implementation of 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. There is evidence that natural hazards are increasing in mountain areas: the growing risks of glacial lake outburst floods in the Himalayas and rockfalls in the Alps which result from the upward movement of permafrost and which threaten strategic roads and railway lines, are just two examples. 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.

MOUNTAIN DAY 2009

The theme "Disaster Risk Management" has been chosen for International Mountain Day in 2009. This special day provides an opportunity to raise awareness amongst a wide audience—governments, intergovernmental organizations, civil society, media and general public about the increased incidence of disasters in mountain areas and about their implications for vulnerable communities —and to promote support and partnerships for advocacy, research, education and action on the ground.

REGIONAL HARMONIZATION PROGRAMME IN THE HIMALAYA

The land cover database of the Himalaya Regional Harmonization Programme (RHAP) was finalized at the GLCN Topic Centre hosted by the Istituto Agronomico per l'Oltremare (IAO) in Florence. The database is now under the final revision process which should be completed by the end of 2009. For the same area a land cover change assessment was carried out comparing three sets of images (1970-80, 1990 and 2000). A report automatically produced, defines the changes both at national and sub-national level.

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
RHAP HIMALAYA: www.glcn.org/activities/himalaya_en.jsp

PUBLICATIONS

GTOS 72 - Report on the 11th session of the TOPC, 29-30 Oct 2008.

GTOS 71 - GTOS submission to UNFCCC SBSTA 30, June 2009: Terrestrial framework mechanisms and assessment of available standards and guides to terrestrial ECVs.

GTOS 70 - GCOS/GOOS/GTOS Progress Report on GCOS IP.

GTOS 69 - GTOS submission to UNFCCC SBSTA 29, December 2008: Terrestrial framework mechanisms and assessment of available standards and guides to terrestrial ECVs.

GTOS 68 - ECV 13: Fire Disturbance: assessment report on available methodological standards and guides, 2009.

GTOS 67 - ECV 12: Biomass: assessment report on available methodological standards and guides.

GTOS 66 - ECV 11: LAI: assessment report on available methodological standards and guides, 2009.

GTOS 65 - ECV 10: FAPAR: assessment report on available methodological standards and guides, 2009.

GTOS 64 - ECV 09: Land cover: assessment report on available methodological standards and guides, 2009.

GTOS 63 - ECV 08: Albedo: assessment report on available methodological standards and guides, 2009.

GTOS 62 - ECV 07: Permafrost: assessment report on available methodological standards and guides, 2009.

GTOS 61 - ECV 06: Glaciers and Ice Caps: assessment report on available methodological standards and guides, 2009.

GTOS 60 - ECV 05: Snow Cover: assessment report on available methodological standards and guides, 2009.

GTOS 59 - ECV 04: Lakes and Reservoirs: assessment report on available methodological standards and guides, 2009.

GTOS 58 - ECV 03: Groundwater: assessment report on available methodological standards and guides, 2009.

GTOS 57 - ECV 02: Water Use: assessment report on available methodological standards and guides, 2009.

GTOS 56 - ECV 01: River Discharge: assessment report on available methodological standards and guides, 2009.

GTOS 55 - Terrestrial Carbon Observations: Protocols for Forest Sampling and Data Submission, 31 July 2008.

GTOS 54 - Integrated Global Observations of the Land: an IGOS-P Theme. IGOL Report, No. 8, May 2008.

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

GTOS 50 - GTOS Biennial report 2006-2007 - January 2008.

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.

2010

November - UNFCCC SBSTA 33. To be decided

November - RedLatif and Serena general meeting. To be decided

July - COCOS workshop on Examination of existing approached for construction of regional carbon budgets for both land and ocean areas. Rome, Italy

17-19 March - CarboAfrica Conference: Toward a biophysical carbon accounting in Africa. Pointe-Noire, Congo

15-16 March - Final Project Meeting. Pointe-Noire, Congo

March - GOFC-GOLD Fire Implementation Team meeting. Frascati, Italy

March - 12th TOPC Panel Meeting. Rome, Italy

January - OSFAC Regional Network Workshop. Kinshasa, Congo

January - Regional CARBON REDD meeting. To be decided

2009

7-18 December - UNFCCC 15th Conference of the Parties. Copenhagen, Denmark

30 November-2 December - GTOS Steering Committee. Paris, France

20 November - GOFC-GOLD Executive Committee meeting, Washington D.C, USA

17-18 November - Group on Earth Observations Sixth Plenary Session GEO-VI. Washington, DC, USA

16-18 November - ICOS Stakeholders Conference. Rome, Italy

7-12 November - LCCS Workshop. Damascus, Syria

2-4 November - International GEO Workshop on Synthetic Aperture Radar (SAR) to Support Agricultural Monitoring. Kananaskis, Canada

27-30 October - GCOS Steering Committee, XVIIth session. Paris, France

26-28 October - Asia Pacific Forest Monitoring Network meeting. Wuhan, China

19-22 October - GEO Forest Carbon Tracking Task meetings with PRP and Google. London, UK

6-9 October - Mexico REDD and GEO Forest Carbon Tracking task meeting. Ensenada, Mexico

15-20 September - NERIN non-boreal workshop, LCLUC, and MAIRS meetings. Almaty, Kazakstan

1-3 July - 2nd GEO Forest Monitoring Symposium, Chiang Rai, Thailand

16-18 June - Global Vegetation Workshop 2009.

15 June - Biomass Working Group initiation meeting. Missoula, USA

10-12 June - GLCN National Workshop. Dakar, Senegal

1-12 June - UNFCCC SBSTA 30. Bonn Germany

20-21 May - GEO Carbon Workshop. Canberra, Australia

19 May - ICOS 2nd Annual Meeting. Paris, France

14 May - COCOS 2nd Annual Meeting. Paris, France

10-13 May - Africa Regional Network meetings. Washington, DC, USA

4-15 May - GLCN National training workshop. Montevideo, Uruguay

4-8 May - 33rd International Symposium on Remote Sensing of Environment: Sustaining the Millenium Development Goals. Stresa, Lago Maggiore, Italy.

23 April-9 May - GOFC-GOLD Data Initiative (Africa Pilot), South Dakota

30 March-3April - FAO FRA 2010 Remote sensing survey meeting. Rome, Italy

3-5 March - CEOS SIT meeting, Land Surface Imaging task meeting. Coco Beach, Florida, USA

25 February - 6th Meeting of the Canadian Land Cover Community of Practice. Ottawa, Canada

13-28 February - Redlatif (CONABIO-INTA) training session. Buenos Aires, Argentina

11-13 February - GEO Agricultural Monitoring workshop. Beijing, China

4-6 February - REDD capacity building event. Sao Jose dos Campos, Brazil

23 January- Asia Pacific Forest Monitoring Network meeting. Beijing, China

12-17 January - SEARRIN-LCLUC-MAIRS meeting. Khonkaen, Thailand

2008

3 December - UNFCCC COP 14, Side Event GTOS: Enhancing country preparedness for post-Kyoto monitoring and assessment (with GTOS partners). Poznan, Poland

3 December - UNFCCC COP 14, Side event for GOFC-GOLD sourcebook. Poznan, Poland

1-12 December - UNFCCC 15th Conference of the Parties. Poznan, Poland.

1-5 December - International Conference on Water Scarcity, Global Changes and Groundwater Management Responses. Irvine, California, USA

25-27 November - Open Science conference on "Africa and Carbon Cycle: the CarboAfrica project", Accra, Ghana

24 November - CarboAfrica project meeting. Accra, Ghana

17 - 21 November - GEO V Plenary. Bucharest, Romania

3-7 November - GEO Forest Observation Symposium. Iguaçu, Brazil

13-17 October - 3rd GOFC-GOLD land cover symposium and STB meeting. Jena, Germany

29-30 October - 11th TOPC Panel Meeting. Rome, Italy

23-24 October - Redlatif and Serena general meeting. Buenos Aires, Argentina

13-14 October - First Regional Workshop on Development and Harmonization of Land Cover Classification in the Hindu Kush-Himalayas (HKH) region. Kathmandu, Nepal

30 September-03 October - GEOSS in the Americas meeting. Panama City, Panama.

29 September-03 October - Australian and Southeast Asia MODIS validation workshop at the 14th Australasian Remote Sensing and Photogrammetry Conference. Darwin, Australia.

22-26 September - GEO UIC & ADC meetings. Boulder, Colorado, USA

22-26 September - 7th SAFNet meeting. Caprivi, Namibia

25 August-12 September - Training on: Land Cover Mapping for the Area Frame Statistical Analysis, Case study of West Showa (Ethiopia). Addis Ababa, Ethiopia

23-27 August - NEESPI Regional European meeting. Odessa, Ukraine

14-18 July - Fire danger rating workshop & WMO meeting. Edmonton, Canada

9-11 July - NERIN High-latitude land cover mapping workshop. Syktyvkar, Russia

4-6 July - Wildland fire network meeting, with EWS team. Freiburg, Germany

25-27 June - UNFCCC SBTSA REDD technical workshop. Tokyo, Japan

16 June - GEO Forest Carbon Monitoring task meeting. Geneva, Switzerland.

11-12 June - Symposium on Asia Pacific Regional Forest Monitoring. Beijing, China

10 -11 June - 2nd Mediterranean workshop. Rome, Italy

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

5 June - GOFC-GOLD sourcebook as technical guidance for REDD implementation: update and prospects, side event at UNFCCC. Bonn, Germany

4-13 June - UNFCCC SBSTA 28 meeting, REDD side event. Bonn, Germany

26 May - ESA side event at UNCBD COP. Geneva, Switzerland.

22-23 May - Global land use dataset workshop. Vienna, Austria

21 May - COCOS Kick-off meeting. Paris, France

19-20 May - ICOS first Stakeholders Conference. Amsterdam, The Netherlands

06-08 May - GEO User Interface Meeting. Toronto, Canada

28 April-02 May - Carbon and Ecosystems joint workshop & LCLUC ST meeting. University of Maryland, USA

22-23 April - Coalition of Rainforest Nation REDD meeting. Panama City, Panama

21-24 April - ESA Dragon Programme Final Meeting. Beijing, China

14-16 April - Second GEOSS Asia-Pacific Symposium - Mapping Forests and Tracking Carbon. Tokyo, Japan

13-18 April - European Geosciences Union (EGU) Fire Sessions. Vienna, Austria

31 March-4 April - EOS/NPP Land Direct Broadcast Workshop. Bangkok, Thailand

28-29 March - SEARRIN Project Office meeting. Kuala Lumpur, Malaysia

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

10 March - GLOBCOVER 2nd User Consult. meeting. Rome, Italy

3-7 March – FAO FRA 2010 Kick-off. Rome, Italy

25-29 February - GEO CEOS Land surface imaging constellation task meeting. Hainan, China

19-21 February - ESA Permafrost User Consultation Workshop. Potsdam, Germany

ACRONYMS

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

BAE	Burnt Area Estimate
BON	Biodiversity Observation Network
CBD	Convention on Biological Diversity
CEDARE	Centre for Environment and Development for Arab Region and Europe
CEOS	Committee on Earth Observing Satellites
C-GTOS	GTOS Coastal Panel
CIRAD	Centre coopération Internationale en Recherche Agronomique pour le Développement
COP15	Conference of Parties 15
CSIR	Council of Scientific and Industrial Research
CZCP	Coastal Zone Community of Practice
DRAGON	Delta Research and Global Observation Network
EARSeL	European Association of Remote Sensing Laboratories
ECV	Essential Climate Variable
EEA	European Environment Agency
ESRIN	European Space Research Institute
FAO	Food and Agriculture Organization of the United Nations
FRA	Global Forest Resources Assessment (FAO)
FRS	Full Resolution Swath
GBIF	Global Biodiversity Information Facility
GCOS	Global Climate Observing System
GCRN	Global Change Research Networks
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GFIMS	Global Fire Information Management System
GHG	GreenHouse Gas
GLCN	Global Land Cover Network
GLOCHAMORE	GLObal CHAnge in MOuntain REgions
GOES R	Geostationary Operational Environmental Satellite R-series
GOFC-GOLD	Global Observation of Forest and Land Cover Dynamics Panel
GOOS	Global Ocean Observing System
GTN	Global Terrestrial Network
GTN-G	Global terrestrial Network - Glaciers
GTOS	Global Terrestrial Observing System
IAO	Istituto Agronomico per l'Oltremare (Italy)
ICIMOD	International Centre for Integrated Mountain Development
ICSU	International Council for Science
IGCO	Integrated Global Carbon Observation

IGOS	Integrated Global Observing Strategy
ILDRCC	International Land Direct Readout Coordination Committee
IP	Implementation Plan
IPCC	Intergovernmental Panel on Climate Change
ISME	International Society for Mangrove Ecosystems
ISO	International Standard Organization
ITTO	International Tropical Timber Organization
IUCN	International Union for Nature Conservation
LAI	Leaf Area Index
LCCS	Land Cover Classification System
LCML	Land Cover Change Language
LOICZ	Land-Ocean Interactions in the Coastal Zone
LPV	Land Product Validation
MAB	Man and the Biosphere Programme of UNESCO
MDG	Millennium Development Goals
MPI	
MRI	Mountain Research Initiative
NASA	National Aeronautics and Space Administration
NGO	Non-Governmental Organization
NPOESS VIIRS	National Polar Orbiting Operational Environmental Satellite System Visible/Infrared Imager/ Radiometer Suit
NRCE	Environmental Assessment and Management Unit (FAO)
REDD	Reducing Emissions from Deforestation in Developing countries
RHAP	Regional Harmonization Programme
RSS	Remote Sensing Survey
SAR	Synthetic Aperture Radar
SBA	Societal Benefit Area
SBSTA	Subsidiary Body for Scientific and Technological Advice
SSA	Sub Saharan Africa
TCO	Terrestrial Carbon Observation Panel of GTOS
TNC	The Nature Conservancy
TOPC	Terrestrial Observation Panel for Climate
TRIP	Transforming Research Into Practice
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
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
UR2PI	Unité de Récherche sur la Productivité des Plantations Industrielles
USGS	United States Geological Survey
VGC	Vegetation Growth Cycle
WCMC	World Climate Monitoring Centre (UNEP)
WISDOM	Woodfuel Integrated Supply/Demand Overview Mapping
WMO	World Meteorological Organization
WWF	World Wildlife Fund for Nature Conservation

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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

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

International Society for Mangrove Ecosystems (ISME)
www.mangrove.or.jp

International Tropical Timber Organizatio (ITTO)
www.itto.int

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

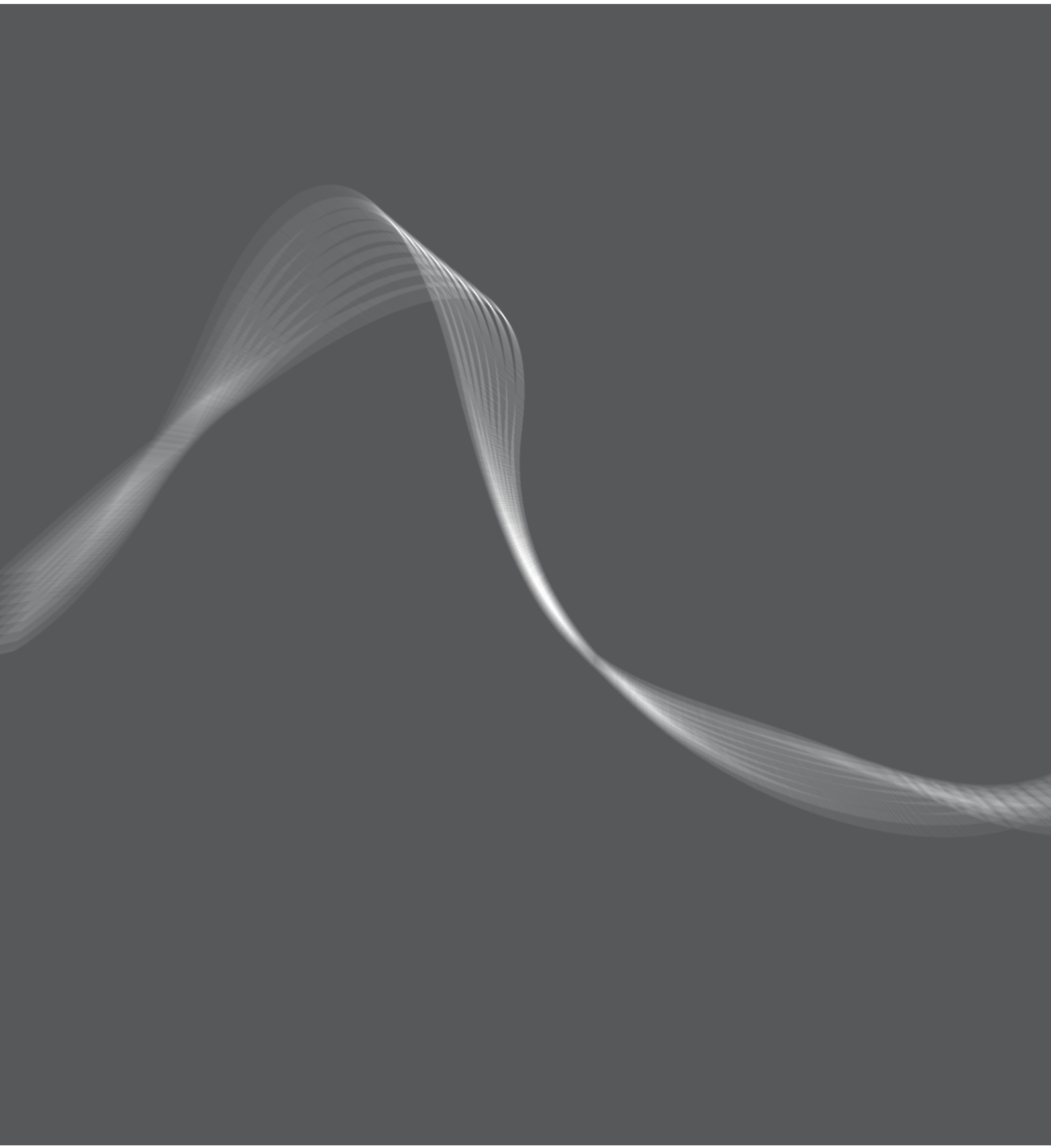
University of Parma, Italy
www.unipr.it

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

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

World Climate Research Programme (WCRP)
http://wcrp.wmo.int

World Meteorological Organization (WMO)
www.wmo.ch



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.

GTOS PARTNERS

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

International Council for Science (ICSU)
www.icsu.org

United Nations Environment Programme (UNEP)
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United Nations Educational, Scientific and Cultural Organization (UNESCO)
www.unesco.org

World Meteorological Organization (WMO)
www.wmo.ch

GTOS Secretariat
NRL, Food and Agriculture Organization of the United Nations (FAO)
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla 00153 Rome, Italy
E-mail: GTOS@fao.org | Tel: (+39) 06 57054026 | Fax: (+39) 06 57053369 | www.fao.org/gtos