

GOFC-GOLD



Global Observation of Forest
and Land Cover Dynamics

GOFC-GOLD

Global Observation of Forest Cover and Land Dynamics



Land Cover
Project Office

Annual Report 2016

January 2017

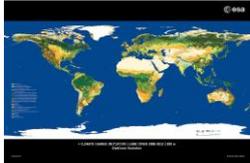
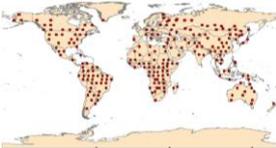


Overview

In its eleventh year of operation, the GOFC-GOLD Land Cover Project Office (LC-PO) successfully fulfilled the requirements and challenges posed by the international community and ESA as contracting agency. Reliable environmental observations are of crucial importance to understand climate change and its impacts, to sustainable development, natural resources management, conservation, biodiversity and understanding of ecosystems and biogeochemical cycling. The project office has further strengthened its position as an established international focal point for global and regional land cover observations, and is a key actor of GOFC-GOLD implementation towards operational land monitoring globally and on the European, regional and national level.

GOFC-GOLD (Global Observation of Forest Cover - Global Observation of Land Dynamics) as technical panel of the Global Terrestrial Observing System (GTOS) provides the platform for international communication and cooperation for actors involved in global Earth Observation including data producers (e.g. space agencies, land cover facilities), the scientific community, and data users (FAO, UNEP, World Bank, global modeling community etc.). These activities improve the value of current and future land cover datasets for a multitude of applications and contribute to the overall goal of operational observations of the land surface.

Contribution to Key International Activities

| | GOFC-GOLD Land Cover Project office involvement | Major achievements in 2016 |
|---|--|---|
|  | <p>United Nations Framework Convention on Climate Change: Organisation of an expert workshop on using global datasets for national REDD+ measuring and monitoring .</p> | <ul style="list-style-type: none"> • Coordination of GOFC-GOLD REDD working group • Development of REDD Sourcebook version COP 22 |
|  | <p>Group on Earth Observation: Contribution to the GEO work plan 2009-2011, coordination and participation in global land cover and forest monitoring tasks.</p> | <ul style="list-style-type: none"> • Participation in GEO SB-02 task on Global Land Cover & Change • Member of Technical Advisory Board for Land Cover for Africa WG • Participation in GFOI activities • Leading development of sourcebook on biodiversity monitoring in tropical forests with GEO BON |
|  | <p>GCOS- Terrestrial Observation Panel for Climate (TOPC) Panel bridging GTOS with GCOS</p> | <ul style="list-style-type: none"> • GOFC-GOLD LC PO represents GOFC-GOLD at TOPC • Participation in design of new GCOS Implementation Plan • Report to ESA on LC data needs for climate change mitigation |
|  | <p>ESA-Land Cover CCI:</p> | <ul style="list-style-type: none"> • Support in design of new high resolution land cover products • Provision of expertise on validation activities • Advertisement of LC-CCI activities |
|  | <p>Global Land Cover Validation: Activities towards synergy and improved usability of land cover products</p> | <ul style="list-style-type: none"> • Addition of datasets to the reference data portal for global land cover mapping • Report on design of operational global land cover validation service • Scientific publications |
|  | <p>Regional networking and capacity building: Organisation and participation in workshop on capacity building involving the GOFC-GOLD regional networks.</p> | <ul style="list-style-type: none"> • REDD+ training workshop organization with the World Bank • Participation in GOFC-GOLD regional network meetings |

European Space Agency Sponsorship



Location of the ESA GOFC-GOLD land cover office at Wageningen University, The Netherlands



With the establishment of a GOFC-GOLD land cover project office at the **Wageningen University**, the European Space Agency has taken responsibility to participate and contribute to the international cooperation and communication to coordinate and improve global observations of land.

The Land Cover Project Office (PO) helps to strengthen the **GOFC-GOLD framework**, to coordinate, promote and fulfill the GOFC-GOLD Land Cover implementation plan, and to support the European Space Agency and related projects and services. ESA has invested 300 K € over a 3 year period (2014-2016) to support the LC-PO. In conjunction with the advent of the Sentinel constellations, and several regional and global mapping activities (e.g. Land Cover Climate Change Initiative), ESA has strengthened its position in coordination of land observations and extended their activities for an improved match between data products and user needs.

The ESA LC-PO office is led by Prof. Martin Herold, the Co-chair of the GOFC-GOLD Land Cover Implementation Team (LC-IT) jointly with Curtis Woodcock from Boston University. The Project Office is located at the Department of Geo-information at Wageningen University, The Netherlands. Dr. Brice Mora is the Project Officer. The management, coordination and execution of the GOFC-GOLD activities are in close cooperation with the GOFC-GOLD-Chair Anthony Janetos.

Despite fostering the implementation of GOFC-GOLD objectives, a major objective of the PO is to support ESA in the coordination of land cover harmonization and validation activities focused on the development of a user information service for the reporting and exchange of validation results and information relating to the operational activities of satellite platforms and data delivery.

Summary of Activities and Achievements in 2016

- **State of the art in global land cover assessment/validation**
 - Role as International focal point for global and regional land cover observations
 - Strong cooperation with CEOS Cal-Val group on development and promotion of land cover validation standards and implementation procedures (i.e. for ECV monitoring)
 - Improvement of a global land cover reference data portal
 - Each of the six available datasets downloaded 200 times in average
 - Promotion of CCI-LC as contribution to GCOS implementation plan, GEO tasks, and UN Sustainable Development Goals
- **UNFCCC support on Reducing emissions from deforestation:**
 - Coordination of GOFC-GOLD working group to evolve internationally agreed technical protocols for using Earth observation in monitoring emissions from tropical deforestation
 - Participation in methodological expert meetings related to REDD+
 - Coordination the development of the next version of the GOFC-GOLD REDD Sourcebook and present the progress during UNFCCC meetings (COP-22)
 - Sourcebook downloaded 1,824 times this year
 - Update of REDD+ curriculum (lectures and exercises) with the World Bank FCPF
 - Contribution to joint capacity development activities with FAO, World Bank, SylvaCarbon
- **Participation in GEO process as part of the GEO 2014-2016 work plan activities**
 - LC-PO acts as participant of global land cover task (SB-02)
 - Participant in tropical forest monitoring task(GFOI)
 - Member of Technical Advisory Board for Land Cover for Africa WG
 - Joined the GEO BON Task coordinating development of a sourcebook for biodiversity monitoring in tropical forests
- **Land cover map product applications**
 - Participation in the ESA Land Cover Climate Change Initiative (new high resolution product definition, validation, advertisement)
- **Participation in key events to foster international cooperation**
 - GOFC-GOLD science meetings and capacity building events
 - Contacts and communications with GOFC-GOLD regional networks
 - Participation in meetings and workshops on: ESA (CCI), GEO Tasks, scientific conferences (sensors, techniques on land cover and forest monitoring)
- **Documentation, publication, and outreach:**
 - 16 deliverables submitted to ESA
 - Update and maintenance of website, development and distribution of three GOFC-GOLD **newsletters, downloaded more than 650 each, in average.**
 - Promotion of the LC PO activities on social medias: Facebook, Twitter, LinkedIn groups
 - Scientific publications (5 peer-reviewed papers and reports published)
 - Addition of datasets to the reference data portal for global land cover mapping activities

Activities to Support UN Conventions 1/2

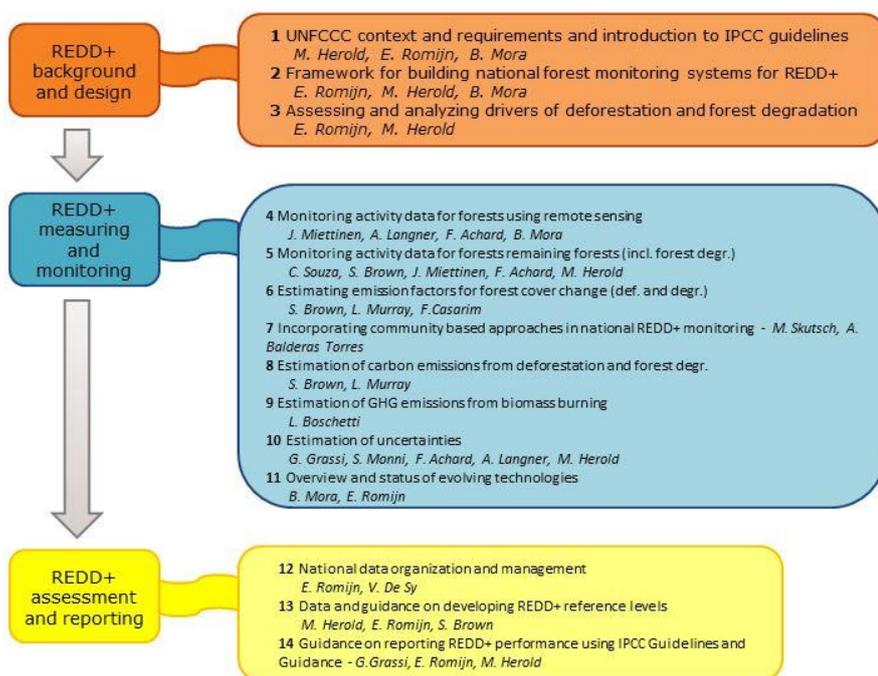
Major activities of the LC-PO in 2016 have been dedicated to the issue of reducing carbon emissions from deforestation and degradation in developing countries (REDD). In 2015 the Paris Agreement gave a new momentum for research targeted to the monitoring of greenhouse gas emission monitoring in tropical forests.

A key issue is the technical feasibility of determining historical deforestation rates and monitoring future land change that would enable tropical countries to obtain carbon credits for reducing deforestation.

The LC PO is working also for the REDD+ co-benefits such as biodiversity and community services, and related issues such as benefit sharing.



Venue of the UNFCCC COP 21 in Paris, France, December 2015



In 2005, the GOFC-GOLD Land Cover IT has established a working group to assess satellite observation capabilities and develop consensus technical guidelines for operational implementation of such policy. A related technical sourcebook has been developed, maintained and presented every year at the UNFCCC Conference of Parties events since 2007. The GOFC-GOLD REDD Sourcebook keeps being updated every year to consider the evolution of the IPCC requirements and the scientific and technological progress made in the field of remote sensing techniques developed for forest monitoring. The **REDD sourcebook** has been **downloaded 1,824 times** this year.



Structure of the REDD+ curriculum

The Sourcebook plays a major role in UNFCCC-related capacity building. For instance the Sourcebook is considered as a key document for the FAO UN-REDD programme.

The LC PO updated the **REDD+ curriculum** developed with the World Bank FCPF. Lectures and exercises are **freely available online** in English, French, and Spanish.

Activities to Support UN Conventions 2/2

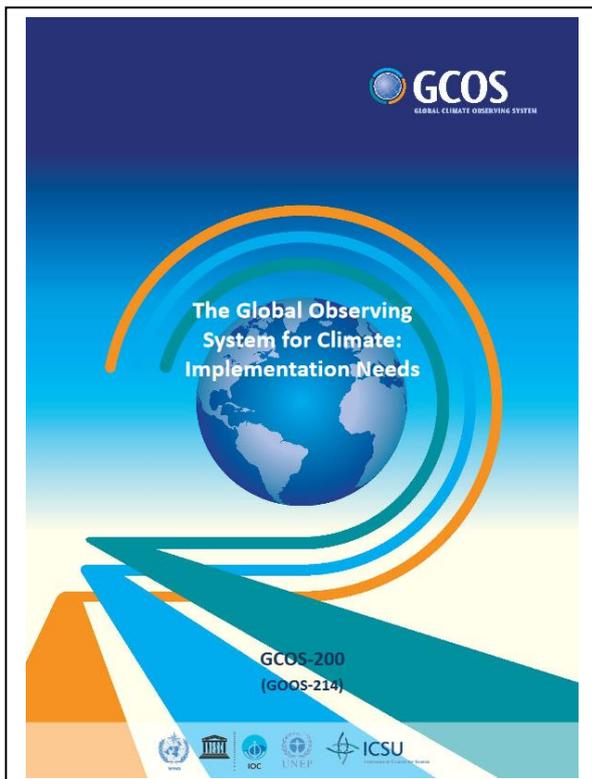
GCOS/TOPC activities

The 2016 annual TOPC meeting was held in Boulder, CO (25-27 April). The meeting focused on the development of the new GCOS Implementation Plan that will guide the development of global climate observations over the next 5-10 years.

The GOFC-GOLD LC-PO reported on the new Land Cover ECV requirements and contributed to the writing of the new Implementation Plan.

The Implementation Plan can be accessed here:

http://unfccc.int/science/workstreams/systematic_observation/items/3462.php.



Development of a GOFC-GOLD / GEO BON sourcebook

Following up on an inception workshop held in May 2014, the development of a sourcebook of methods and procedures for monitoring biodiversity in tropical forests has been developed. This joint initiative with the GEO BON was motivated by the necessity to:

- increase visibility and recognition of the issue of biodiversity loss,
- promote use of remote sensing data associated with field information for biodiversity monitoring in tropical forests,
- support capacity development initiatives and awareness on use of RS-based technologies,
- provide up-to-date scientific and technical guidance on how to use RS-based technologies for biodiversity monitoring,
- address the need for a living document that is a reference manual (regularly updated),
- promote standardized and harmonized monitoring methods to facilitate inter-comparisons between projects
- demonstrate to policy-makers that RS-based technologies can help meet the requirements from international initiatives on biodiversity monitoring such as CBD, or IPBES, and
- foster long-term synergies between the remote sensing and biodiversity/conservation communities.

This joint effort coordinated by the LC-PO gathers **contributions from more than fifty international experts**. The last sections of the sourcebook are being reviewed before the official release during the first quarter of 2017. The sourcebook will be **accessible for free** on the LC-PO and GEO BON websites.

Societal Benefits from Land Cover Observations

Land Cover information is relevant for all areas of societal benefits as addressed by the Group on Earth Observation (GEO)



GOFC-GOLD Contribution to GEO

- GOFC-GOLD provides an operational framework for land observations within GTOS.
- The land domain is least advanced compared to other fields of observation (ocean, atmosphere).
- GOFC-GOLD provides a communication and cooperation platform between data producers, data users, and the science community to cooperatively improve observation, data products definition, assimilation, and dissemination.
- Implementation builds upon and enhances established partnerships and observing systems, and stable funding and staffing is essential for a comprehensive GEOSS implementation.
- Potential of international capacity building (linkage to GOFC-GOLD regional networks).

The LC-IT leads and/or contributed to a series of tasks from the GEO work plan 2014-2016:

- SB-02: participation in the **Global Land Cover and Change task**
- Land Cover for Africa WG: member of the Technical Advisory Group
- **Global Forest Observation Initiative task (GFOI):**
 - . co-organizing and participating in expert workshops (capacity development, forest degradation)
 - . participating in the R&D plan
- **GEO Biodiversity Observation Network (BON):** leading the development of a sourcebook for biodiversity monitoring in tropical forests
- **UN Sustainable Development Goals (SDGs):** analysing adequacy of existing global land cover products to the monitoring the SDGs.

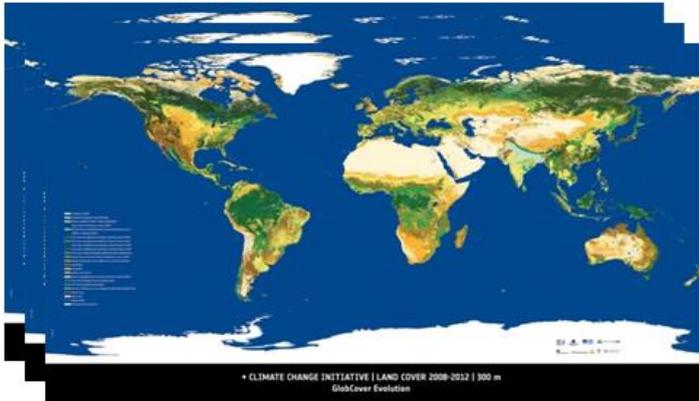
The PO co-leads the GEO task SB-02 Global Land Cover and Land Cover Change.

The task aims to:

- Provide a suite of global land-cover and land-cover change datasets, based on improved and validated moderate resolution land-cover maps.
- Develop <50m global land-cover and land-cover change data sets, based on international community consensus and including a robust accuracy assessment.
- Improve the use of time-series products to characterize the nature and extent of land-cover change and dynamics.
- Advocates for the development of a web-based platform for land cover mapping activities.

Various activities of the Land Cover IT contribute to the progress of this task (see summary of activities and achievements above).

Global Land Cover Observation and Assessments



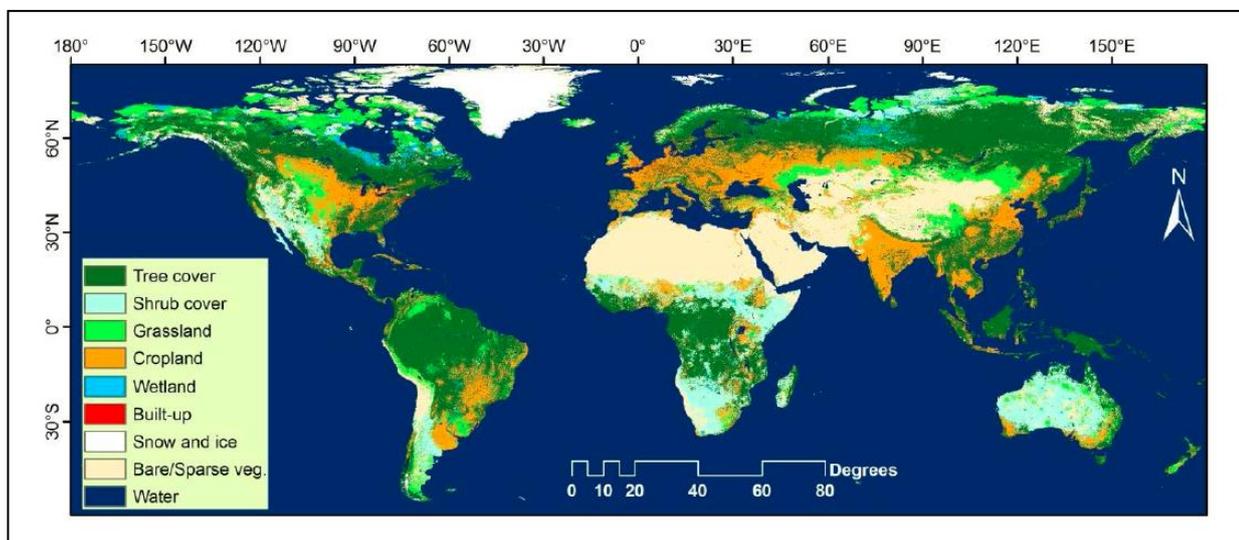
ESA LC- CCI land cover 3-epoch state map products

The Challenge

There is a need for detailed and accurate information about land cover and land cover change on all geographic scales from different communities (e.g. climate modellers, biodiversity community). Monitoring capabilities for land cover needs to move from research to operational monitoring. Furthermore, operational data and products need to be better defined, flexible, and openly available.

GOFC-GOLD activities:

- Support of coordination mechanisms for land surface observations
- Work towards continuity and consistency of land cover observations
- Support to share data, information and knowledge
- Support improved match between observations, data products and user needs
- Establish international standards and protocols especially with respect to harmonization and accuracy assessment
- Synthesize progress and synergise GLC mapping efforts. See this special issue: http://www.mdpi.com/journal/remotesensing/special_issues/lulc
- Maintain GOFC-GOLD regional networks
- Development of new high resolution land cover map products as part of the LC-CCI
- Development of land cover map products and reference datasets as part of Copernicus Global Land Service
- Consolidation of GlobCover 2005 reference dataset
- Development of a reference data web portal for global land cover mapping initiatives
- Participation in the production of reference data for global land cover mapping using optical very high spatial resolution satellite images



Integrated Global Land Cover map in Tsendbazar et al. (2016).

Harmonization and Validation Activities

Joint GOFC-GOLD and CEOS WGCV initiative

The GOFC-GOLD land cover implementation team and the CEOS land validation working group have been working on developing and implementing a land cover harmonization and validation framework.

As part of the Copernicus Global Land Service, the GOFC-GOLD LC-PO contributes to the development of new reference datasets for global land cover mapping activities.



A GOFC-GOLD reference data portal for global land cover mapping

The GOFC-GOLD LC PO has worked on the development of a reference data portal. Some datasets are available already: GLC2000, GlobCover 2005, STEP, VIIRS, GLCNMO 2008, Urban dataset. We expect more datasets to be made available in a near future, notably: FROM dataset (Tsinghua U., China), GOFC-GOLD/Boston VHSR dataset.

The GOFC-GOLD LC PO has worked on the improvement of the data portal using up-to-date web-GIS technologies to better display the spatial datasets, and provide these in different formats for download.

Objectives of the portal

- Provide most appropriate databases based on internal quality criteria and a consolidation
- Allow open and easy access to available datasets
- Foster use of recommended practices for land cover validation in the GLC mapping community
- Each dataset provided along with detailed information and recommendations for an appropriate use
- Direct users to most appropriate dataset(s) according to specific needs



Main page of the LC PO Validation data portal

Presentation, Publications and Outreach

GOFC-GOLD LC PO Newsletter and social medias



The LC-PO is continuously producing documentations and outreach materials. Several **reports, newsletters, and scientific papers** have been produced, edited, released and circulated.

The quarterly newsletter is distributed to a comprehensive list of actors (3,500+) involved in land cover monitoring. The **newsletters** released this year were **downloaded more than 650 times** in average. **Social medias** (Facebook, Twitter, LinkedIn groups) are used to advertise our activities, progress and achievements as well.

The GOFC-GOLD LC-PO **website keeps being updated** and contains a variety of services to users including documentation on access to global and regional land cover map

Land Cover PO website



Reports and deliverables have been submitted to ESA. They include status reports and results from prototype studies. The LC-PO has contributed to the GOFC-GOLD report series. Further input and documentation was provided to UNFCCC COP 22, GEO tasks, including GFOI. The LC-PO has completed several scientific publications in the peer-reviewed literature.

Scientific Peer-reviewed Literature

<http://gofcgold.wur.nl>

International Reports



remote sensing

Article

Evaluating the Potential of PROBA-V Satellite Image Time Series for Improving LC Classification in Semi-Arid African Landscapes

Johannes Eberenz ^{1,*}, Jan Verbesselt ^{1,*}, Martin Herold ¹, Nandin-Erdene Tsendbazar ¹, Giovanni Sabatino ^{2,3} and Giancarlo Rivalola ^{2,3}

opinion & comment

NATURE CLIMATE CHANGE | VOL 6 | FEBRUARY 2016

COMMENTARY:

Combining satellite data for better tropical forest monitoring

Johannes Reiche, Richard Lucas, Anthea L. Mitchell, Jan Verbesselt, Dirk H. Hoekman, Jörg Haarpaintner, Josef M. Kellndorfer, Ake Rosenqvist, Eric A. Lehmann, Curtis E. Woodcock, Frank Martin Seifert and Martin Herold

Workshops and Travels

The LC PO Director and Project Officer have organized, contributed and participated in several workshops and meetings to foster international cooperation and communication and for outreach and capacity building purposes.

Most prominently in this fifth year of operation in Wageningen, the LC-PO has organized a Science meeting jointly with GFOI, in The Hague.

Significant steps toward the integration of capacity development activities for REDD+ were made this year with the organisation of joint meetings with the World Bank, the FAO UN-REDD Programme and the USGS SilvaCarbon Programme.

Financial overview

The GOFC-GOLD LC-PO is operated through ESA's Technical Officers Frank Martin Seifert and Olivier Arino under ESA ESRIN contract. All expenses have been documented in Quarterly Status Reports submitted to the ESA technical officer.

| Financial summary 2016 | |
|--|--------------|
| Revenues | K € |
| ESA sponsorship | 100,0 |
| Additional funding | 8,0 |
| WU Chair group (33.7K) | |
| World Bank project (317.4K) | |
| TOTAL | 459.1 |
| Expenses | |
| Personnel costs: | |
| - PO executive officer | 123,5 |
| - World Bank project assistants and sub-partners | 167,9 |
| Travel & subsistence | |
| - PO director & officer | 17,8 |
| - World Bank project | 149,5 |
| Consumables | |
| - operating & communication costs | 0,4 |
| - Publications/Brochures/other | 0 |
| - Workshop subsistence | 0 |
| - World Bank project | 0 |
| TOTAL | 459,1 |

| Workshops (co-)organized by the GOFC-GOLD LC PO | | |
|--|--------------------------|--|
| Date | Venue | Workshop |
| May | Berlin, Germany | GFOI R&D session at GEO GEPW-10 meeting |
| July | Zvolen, SK | GOFC-GOLD regional workshop meeting |
| November | The Hague, Netherlands | Science meeting |
| November | Saint Petersburg, Russia | Global LC mapping side-event at GEO XIII Plenary |
| Participation in international meetings | | |
| Date | Venue | Workshop |
| January | Yangon, Myanmar | NASA LCLUC Science meeting and training |
| February | Frascati, Italy | GFOI Plenary |
| April | Boulder, CO | TOPC meeting |
| May | Prague, CZ | ESA LPS |
| June | Mexico, MX | GFOI Regional R&D Expert workshop |
| September | London, UK | GFOI policy forum |
| December | Berkeley, CA | GEOSS SDG meeting |

Additional funds were obtained from the World Bank (REDD+ curriculum), and via the financial overhead from the institution (WU) hosting the GOFC-GOLD LC-PO.

Activities and Objectives for 2017

The three-year cycle of activities of the GOFC-GOLD LC-PO stopped at the end of 2016. However members of the GOFC-GOLD LC Implementation Team will keep being active in the research field, and participating in international conferences, such as those organized by ESA (see next page).

Participation of the GOFC-GOLD LC PO in Upcoming Events

| Date | Location | Purpose and objective |
|---------------|-------------------|--------------------------------------|
| January, 2017 | Otaniemi, Finland | 2nd GlobBiomass Public User Workshop |
| March, 2017 | Frascati, Italy | WorldCover2017 Conference |

More Information and Contact

Information and documentation about GOFC-GOLD, GTOS, and the LC-PO activities can be found on the following web pages:

| | |
|---|---|
| ESA | http://www.esa.int/ |
| ESA Data User Element | http://dup.esrin.esa.it/ |
| GTOS | http://www.fao.org/gtos/ |
| GOFC-GOLD | http://www.fao.org/gtos/gofc-gold/ |
| GOFC-GOLD LC Project Office | http://www.gofcgold.wur.nl/ |
| GOFC-GOLD report series | http://www.fao.org/gtos/gofc-gold/series.html |
| LC-IT Newsletter | http://www.gofcgold.wur.nl/sites/letter.html |
| CEOS group on calibration and validation for land | http://landval.gsfc.nasa.gov/LPVS/ |

Prepared and published by the international GOFC-GOLD Land Cover Project Office

Dr. Brice Mora, Prof. Dr. Martin Herold
Land Cover Project Office
Wageningen UR
Centre for Geo-Information
P.O. Box 47
6700 AA Wageningen (The Netherlands)

Phone: +31 (0) 3.17.48.38.89
Fax: +31 (0) 3.17.41.90.00
E-mail: brice.mora@wur.nl, martin.herold@wur.nl

<http://www.gofcgold.wur.nl/>

