

# 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 2015

January 2016

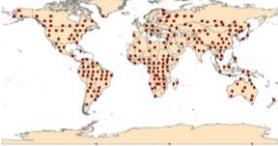


## Overview

In its tenth 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 2015
	<p><b>United Nations Framework Convention on Climate Change:</b> Organisation of an expert workshop on using global datasets for national REDD+ measuring and monitoring .</p>	<ul style="list-style-type: none"> <li>• Coordination of GOFC-GOLD REDD working group</li> <li>• Development of REDD Sourcebook version COP 21</li> </ul>
	<p><b>Group on Earth Observation:</b> 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"> <li>• Lead of GEO SB-02 task on Global Land Cover</li> <li>• Member of Technical Advisory Board for Land Cover for Africa WG</li> <li>• Organization and participation in GFOI meetings</li> <li>• Leading project for development of sourcebook on biodiversity monitoring in tropical forests</li> </ul>
	<p><b>GCOS- Terrestrial Observation Panel for Climate (TOPC)</b> Panel bridging GTOS with GCOS</p>	<ul style="list-style-type: none"> <li>• GOFC-GOLD LC PO represents GOFC-GOLD at TOPC</li> <li>• Workshop and reports on Observations for Climate Change Mitigation</li> <li>• Report to ESA on LC data needs for climate change mitigation</li> </ul>
	<p><b>ESA-Land Cover CCI:</b></p>	<ul style="list-style-type: none"> <li>• Key User Survey and User Requirement Document V.2.0</li> <li>• ESA-CCI LC website User Survey</li> <li>• Pan-tropical forest cover loss maps for the 1980s and 1990s</li> </ul>
	<p><b>Global Land Cover Validation:</b> Activities towards synergy and improved usability of land cover products</p>	<ul style="list-style-type: none"> <li>• Improvement of the reference data web portal for global land cover mapping</li> <li>• Scientific publications</li> </ul>
	<p><b>Regional networking and capacity building:</b> Organisation and participation in workshop on capacity building involving the GOFC-GOLD regional networks.</p>	<ul style="list-style-type: none"> <li>• Development and release of REDD+ curriculum with the World Bank</li> <li>• Participation in GOFC-GOLD Regional Network meetings</li> </ul>

## 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 is investing 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 2015

- **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)
  - Development of reference data portal
  - Comparative assessment of GLC maps for specific applications
  - Each of the six available datasets downloaded 40 times in average
  - Promotion of CCI-LC as contribution to GCOS implementation plan and GEO tasks
- **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-21)
  - Sourcebook downloaded 2,365 times this year( > year 2014)
  - Release 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 2012-2015 work plan activities**
  - LC-PO acts as leader for global land cover task (SB-02)
  - Active participant in forest monitoring (GFOI) task
  - Member of Technical Advisory Board for Land Cover for Africa WG
  - Joined the GEO BON Task coordinating development of a sourcebook on biodiversity monitoring in tropical forests
- **Land cover map product applications**
  - Participation in the ESA Land Cover Climate Change Initiative (validation, cross-comparison)
  - Pan-tropical forest cover loss maps for the 1980s and 1990s
- **Participation in key events to foster international cooperation**
  - GOFC-GOLD science meetings and capacity building
  - 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:**
  - 13 deliverables submitted to ESA
  - Update and maintenance of website, development and distribution of three GOFC-GOLD newsletters, downloaded 600 each, in average.
  - Promotion of the LC PO activities on social medias: Facebook, Twitter, LinkedIn groups
  - Scientific publications (6 peer-reviewed papers and reports published)
  - Improvement of the reference data portal for global land cover mapping activities
  - Keynote presentations in international conferences (ISPRS/Future Earth, and UNESCO)

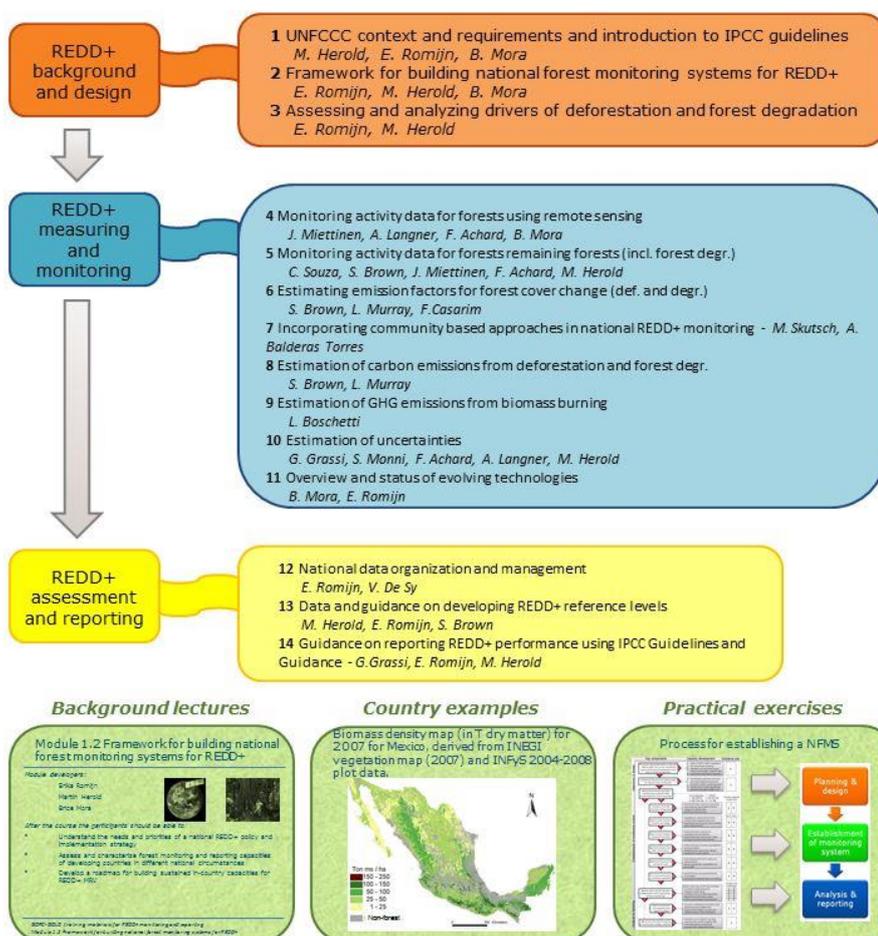
## Activities to Support UN Conventions 1/2

Major activities of the LC-PO in 2015 have been dedicated to the issue of reducing carbon emissions from deforestation and degradation in developing countries (REDD). International negotiations are underway within the UNFCCC to include incentives for developing countries to avoid deforestation in a post Kyoto agreement. 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



Structure of the REDD+ curriculum

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 2,365 times** this year.

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 finalised a **REDD+ curriculum** with the World Bank FCPF. Lectures and exercises were **released online** in English (June), then in French and Spanish (November) 2015.

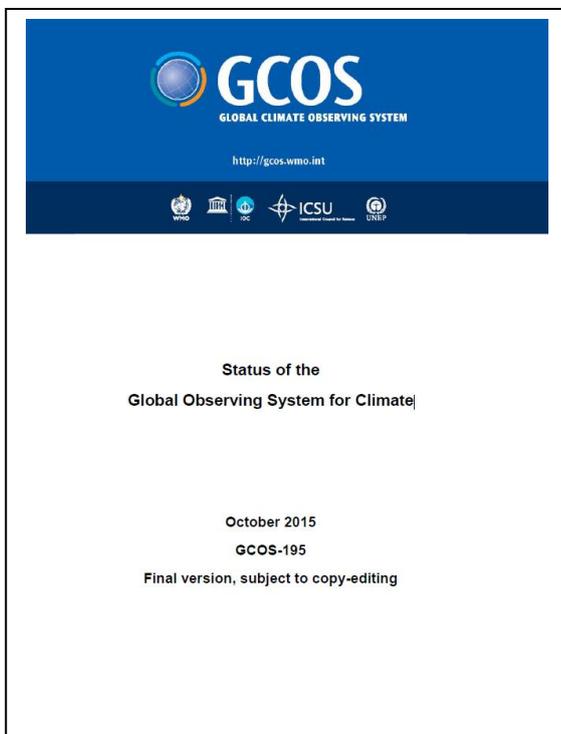
## Activities to Support UN Conventions 2/2

### GCOS Workshop on Observations for Climate Change Mitigation

Following up on the Global Climate Observing System (GCOS) and GOFC-GOLD LC Office joint workshop on Observations for Climate Change Mitigation held in Geneva, Switzerland, on 5-7 May 2014, the LC Office participated in:

- the 17<sup>th</sup> session of the GCOS/GTOS/WCRP Terrestrial Observation Panel for Climate (TOPC-17),
- the development of the report: Status of the Global Observing System for Climate (GCOS-195). The report can be accessed here:

[http://www.wmo.int/pages/prog/gcos/Publications/GCOS-195\\_en.pdf](http://www.wmo.int/pages/prog/gcos/Publications/GCOS-195_en.pdf).



### 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 progressed. This joint initiative with the GEO BON is 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.

A **progress meeting** was organised in **May 2015** (ISRSE Conference, Berlin, Germany). The first release of the sourcebook is scheduled for the UNCBD COP-13 (fall 2016).

## 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)**



The LC-IT leads and/or contributes to a series of tasks from the GEO work plan 2012-2015:

- SB-02: leading the Global Land Cover and Land Cover Change task
- Land Cover for Africa WG: member of the Technical Advisory Group
- Forest Carbon tracking – Global Forest Observation Initiative task (GFOI):
  - . co-organizing and participating in expert workshops (capacity development, forest degradation)
  - . participating in the R&D plan
- GEO BON: leading the development of a sourcebook for biodiversity monitoring in tropical forests.

### **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).

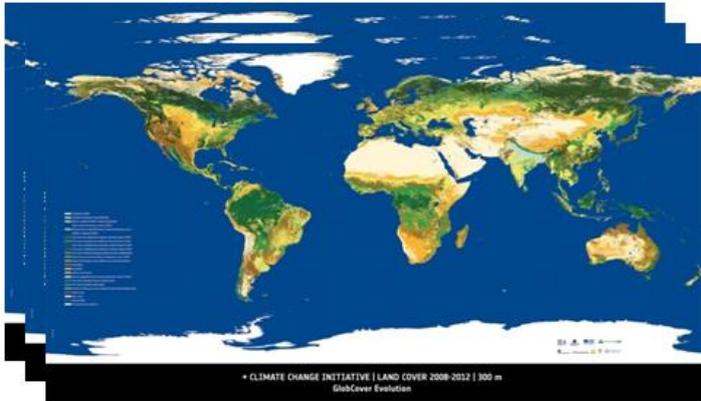
The PO leads the **GEO task SB-02 Global Land Cover and Land Cover Change**.

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.

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



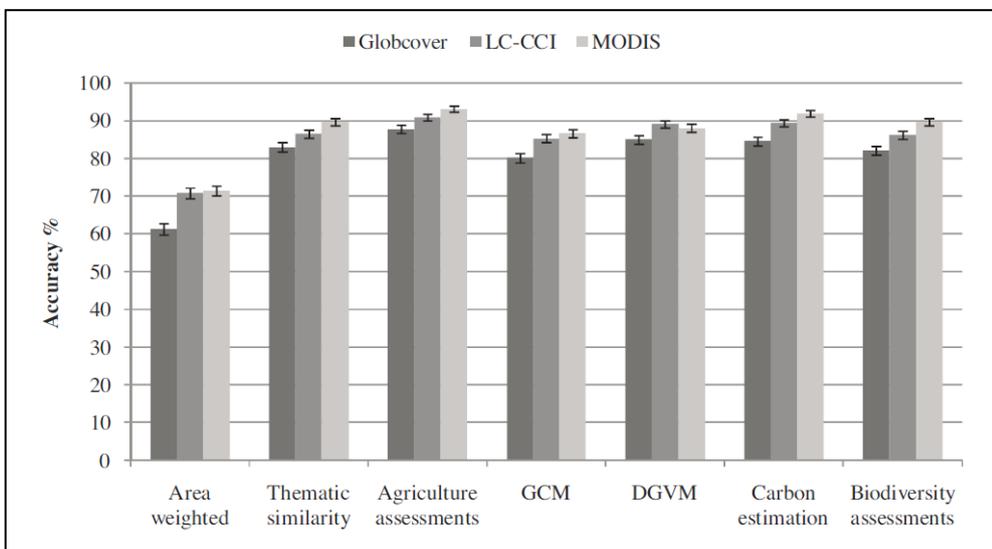
ESA LC- CCI land cover 3-epoch state map products

## 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
- Support improved match between observations, data products and user needs
- Establish international standards and protocols especially with respect to harmonization and validation
- Improve adequacy and advocacy of land cover products based on user requirements
- Maintain GOFC-GOLD regional networks
- Work towards continuity and consistency of land cover observations
- Support to share data, information and knowledge
- Develops a reference data web portal for global land cover mapping initiatives
- Consolidation of GlobCover 2005 reference dataset
- Participation in the production of reference data for global land cover mapping using optical very high spatial resolution satellite images
- Implement coordinated research, demonstration and operational projects



Weighted accuracies of GLC maps for different applications Tsendbazar et al. (2015).

## Harmonization and Validation Activities

### Joint GOFC-GOLD and CEOS WGCV initiative

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

The GOFC-GOLD LC PO contributes to the progress made on the development of a new reference dataset for global land cover mapping activities. A set of 500 optical very high spatial resolution satellite images (<1 m) has been acquired over the locations of the sample plots. The analysis of the sample plots will be made available eventually on a web portal hosted on the GOFC-GOLD LC PO website.



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

The GOFC-GOLD LC PO has been working on the development of a reference data portal. Some datasets are available already: GLC2000, GlobCover 2005, STEP, VIIRS, GLCNMO 2008, Urban dataset. Some more will be made available in a near future, notably: Chinese validation dataset, GOFC-GOLD/Boston VHSR dataset.

The GOFC-GOLD LC PO has been working 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 600 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 products and in-situ observations.

## 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 21, GEO tasks, including GFOI. The LC-PO has completed several scientific publications in the peer-reviewed literature.

## Scientific Peer-reviewed Literature

Contents lists available at ScienceDirect

**Biological Conservation**

journal homepage: [www.elsevier.com/locate/biocon](http://www.elsevier.com/locate/biocon)

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Perspective

Free and open-access satellite data are key to biodiversity conservation

W. Turner<sup>a,\*</sup>, C. Rondinini<sup>b</sup>, N. Pettorelli<sup>c</sup>, B. Mora<sup>d</sup>, A.K. Leidner<sup>a,e</sup>, Z. Szantoi<sup>f</sup>, G. Buchanan<sup>g</sup>, S. Dech<sup>h</sup>, J. Dwyer<sup>i</sup>, M. Herold<sup>d</sup>, L.P. Koh<sup>j</sup>, P. Leimgruber<sup>k</sup>, H. Taubenboeck<sup>h</sup>, M. Wegmann<sup>l</sup>, M. Wikelski<sup>m</sup>, C. Woodcock<sup>n</sup>

Contents lists available at ScienceDirect

**International Journal of Applied Earth Observation and Geoinformation**

journal homepage: [www.elsevier.com/locate/jag](http://www.elsevier.com/locate/jag)

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Comparative assessment of thematic accuracy of GLC maps for specific applications using existing reference data

N.E. Tsendbazar<sup>a,\*</sup>, S. de Bruin<sup>a</sup>, B. Mora<sup>a,b</sup>, L. Schouten<sup>c</sup>, M. Herold<sup>a</sup>

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<sup>c</sup> Rijkswaterstaat, Ministry of Infrastructure and the Environment, Utrecht, 3500 CE, The Netherlands

<http://gofcgold.wur.nl>

## International Reports

**GCOS**  
GLOBAL CLIMATE OBSERVING SYSTEM

<http://gcos.wmo.int>

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Status of the  
Global Observing System for Climate

October 2015  
GCOS-195

Final version, subject to copy-editing

## 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 fourth year of operation in Wageningen, the LC-IT PO has organized an Expert Workshop on Global Land Cover products for National Forest Monitoring Systems.

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.

A joint workshop with GFOI on forest biomass estimation was held in Brisbane.

## 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.

<b>Financial summary 2015</b>	
<b>Revenues</b>	K €
ESA sponsorship	100,0
Additional funding	57,3
WU Chair group (34.3K)	
World Bank project (23K)	
<b>TOTAL</b>	<b>157,3</b>
<b>Expenses</b>	
Personnel costs:	
- PO executive officer	121,1
- World Bank project assistants and sub-partners	22,3
Travel & subsistence	
- PO director & officer	12,5
- World Bank project	0,4
Consumables	
- operating & communication costs	0,7
- Publications/Brochures/other	0
- Workshop subsistence	0
- World Bank project	0,3
<b>TOTAL</b>	<b>157,3</b>

<b>Workshops (co-)organized by the GOFC-GOLD LC PO</b>		
Date	Venue	Workshop
February	Brisbane, Australia	GOFC-GOLD Biomass WG / GFOI Expert meeting
May	Rome, Italy	GFOI Capacity Development meeting
July	Paris, France	UNESCO Climate Conference
July	Brasov, Romania	GOFC-GOLD SCERIN-3 Capacity Building Workshop
November	Wageningen, The Netherlands	GFOI GOFC-GOLD Workshop on GLC products for NFMS
<b>Participation in international meetings</b>		
Date	Venue	Workshop
March	Zurich, Switzerland	GCOS/TOPC meeting
May	Berlin, Germany	36th International Symposium on Remote Sensing of Environment (ISRSE)
June	Beijing, China	ISPRS / Future Earth Conference
October	Bonn, Germany	GFOI SDCG-8 meeting
December	Paris, France	UNFCCC COP-21

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 2016

Building upon the ten successful years of LC-PO operation, the PO will continue to act as focal point for global and regional land cover observations, and as such provide an international interface assisting data producers and land cover mapping programs, and user organizations. The arena of land cover observations remains heterogeneous despite the advent of new synergies fostered by international initiatives (e.g. GEO Tasks). One of the key general roles of the LC-PO is to coordinate and moderate among the different land cover observation actors. Key activities to achieve progress for **international coordination and cooperation** in particular to evolve common ground for land cover monitoring are:

- Ensure implementation of agreed validation protocols (GEO and CEOS)
- Production of validation data for global land cover mapping derived from optical very spatial resolution satellite images
- Facilitate access to consolidated reference datasets for global land cover mapping
- Capacity building in particular for developing countries (REDD+)
- Encourage free and open data assimilation and dissemination mechanisms for satellite and in-situ data, and land cover mapping products (i.e. for global land cover validation data)

Over the last years GOFC-GOLD has been working on defined objectives and priorities from several international institutions (political and strategic level) involved in land cover and forest monitoring activities. In this context, the LC-PO work plan for the next year includes the organization of a GOFC-GOLD Land Cover conference aimed to present progress made by the different IT members and discuss with main sponsors and collaborators what future activities of GOFC-GOLD should be focusing on. The work plan includes also the support of the **UNFCCC REDD activities** (focus on technical guidance, the development of the sourcebook and capacity building), **GCOS implementation plan** for observing essential climate variables in the terrestrial domain (focus on land cover and biomass), continue to contribute to the **GEO process** concerning forest, land cover, and biodiversity observations via the coordination of the Global Land Cover and Land Cover change task, the participation in the development of training tools around the Method and Guidance Document and R&D from the GFOI, the participation in the GEO BON activities in support of the **UN Convention on Biological Diversity** with a leading role in the development of a sourcebook on biodiversity monitoring in tropical forests.

The LC-PO will further contribute to several on-going land cover mapping projects. Most prominently, the LC PO will further assist ESA in the validation of the **LC-CCI** products and participate in the **GlobBiomass** project. The joint activities with the **CEOS** land validation working group will foster the leading role of the PO in global land cover validation procedures and implementation activities (i.e. access to reference data and harmonization). All these activities will be in accordance with on-going international developments on the strategic level including cooperation with GTOS and GCOS.

A series of key international workshops and a symposium will be organized and attended from LC-PO members (see table below). All progress and developments will be documented and communicated through presentations and reports to ESA, GOFC-GOLD and the public through the LC-PO Newsletter, reports, and social medias (Facebook, Twitter, LinkedIn groups).

## Participation of the GOFC-GOLD LC PO in Upcoming Events

Date	Location	Purpose and objective
February, 2016	Frascati, Italy	GFOI Plenary and Open Forum
March, 2016	Amsterdam, Netherlands	Global Climate Observation: the Road to the Future
May, 2016	Prague, Czech Republic	ESA Living Planet Symposium
July, 2016	Leipzig, Germany	GEO BON Open Science Conference
November, 2016	Marrakech, Morocco	UNFCCC COP 22

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

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