Newsletter N° 37| December 2016

LAND COVER AND CHANGE

Newsletter of the GOFC-GOLD Land Cover Project Office

GOFC-GOLD LC / GFOI R&D Science meeting

The GOFC-GOLD Land Cover Office and the R&D Coordination component of the GFOI organised a Science meeting in The Hague, The Netherlands (31st October - 4th November).
The meeting allowed to report scientific progress, and discuss avenues on tropical forest monitoring and global land cover mapping issues. The Plenary was an opportunity for different stakeholders to present and discuss with policy

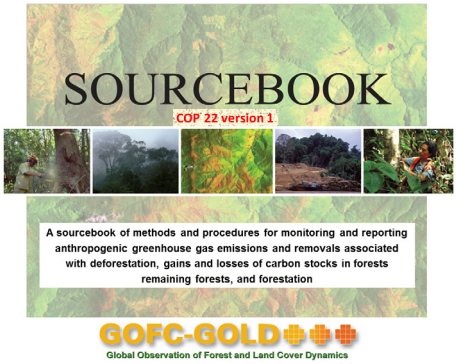
makers what the current key land monitoring needs are. Go to page 2 for more information.

Content

Update of the GOFC-GOLD REDD Sourcebook - COP 22 Version

The REDD sourcebook provides a consensus perspective from the global community of Earth observation and carbon experts on methodological issues relating to quantifying the greenhouse gas (GHG) impacts of implementing activities to reduce emissions from deforestation and degradation in developing countries (REDD+). Based on the current status of negotiations and UNFCCC approved methodologies, this sourcebook aims to provide additional explanation, clarification, and methodologies to support REDD+ early actions and readiness mechanisms for building national REDD+ monitoring systems. It emphasizes the role of satellite remote sensing as an important tool for monitoring changes in forest cover, and provides clarification on applying the IPCC Guidelines for reporting changes in forest carbon stocks at the national level. This sourcebook is a living document and further methods and technical details are specified and added with evolving political negotiations and decisions.

This year information in section 2.9 **guidance on reporting** is updated notably to take into account the Paris Agreement. Section 2.1 on **monitoring changes in forest area** has been updated, with a section on the use of **global products** that refers to the guidance provided by the Global Forest Observations Initiative (GFOI). Section 2.10 on **evolving technologies** now provides updated information on the use of **allometric models** constructed from samples of **biomass measurements**. The sub-section on **LIDAR** has been updated also. The REDD Sourcebook can be downloaded on the GOFC-GOLD Land Cover website: http://www.gofcgold.wur.nl/redd/.



GFOI's Methods and Guidance Document (MGD 2.0) release

We are pleased to announce the publication of the second edition of GFOI's Methods and Guidance Document (MGD 2.0). It is available for download as a pdf and for viewing through its online portal REDDcompass (www.gfoi.org/reddcompass).

In linking UNFCCC reporting requirements with the IPCC's good practice guidance, the MGD provides a systematic workflow approach to guide countries through the complex process of developing forest monitoring and MRV systems for REDD+. MGD 2.0 provides a full update and extension of the first edition and presents improved and extended methods and guidance. It will form a key element of GFOI partners' assistance to developing countries going forward.

The document is currently available in English but French and Spanish translations will also be available within the next few weeks.

The GFOI Office would like to acknowledge the significant contributions from many partners in the development MGD2.0. In particular we would like to acknowledge the late Prof. Jim Penman. Jim was the EU lead in the international climate negotiations and had as expert on LULUCF a major role in establishing and developing REDD+. We hope that Jim is looking down on us and feeling an immense sense of pride and satisfaction. As a mark of respect, MGD 2.0 has been dedicated to Jim in recognition of his long standing contribution and commitment to the MGD and broader GFOI community.

We ask that you please pass this announcement on to your networks and encourage stakeholders to consider applying this systematic guidance to assist in their system design and development.

If you have any questions about the MGD or other GFOI activities, please contact office@gfoi.org.

Figure 1: Prof. James Penman

GOFC-GOLD LC / GFOI R&D Science meeting

The GOFC-GOLD Land Cover Office and the R&D Coordination component of the GFOI organised a Science meeting in The Hague, The Netherlands (31st October - 4th November).

The GOFC-GOLD LC-IT and the GFOI R&D Coordination component co-organized this meeting to review the recent accomplishments in tropical forest monitoring in the arenas of research, and implementation in developing countries. Specific activities from the GOFC-GOLD LC-IT, GFOI R&D research groups and its partners were reported. The Science meeting outlined the specific research, applications and development needs that should be targeted by these stakeholders in the future. The Science meeting was an opportunity for the GOFC-GOLD LC-IT and the GFOI to communicate on its advancements and on its ongoing and potential contributions to a series of international initiatives notably those related to the Sustainable Development Goals (SDGs), and REDD+.

Main objectives of the Science meeting were:

1) Present, discuss, and synthesize the achievements of the GOFC-GOLD LC-IT, GFOI R&D, and partners like Silvacarbon,

2) Discuss the new orientations the forest mapping and the global land cover research communities should take to support some of the UN SDGs (e.g., #13: Climate action, #15: Life on land), the outcomes of the UNFCCC COP-21 (Paris Agreement), and the evolving needs for observing land cover as an essential climate variable (ECV).

3) Review of the internal organization and coordination of the GOFC-GOLD LC-IT, and GFOI R&D Coordination component, but also their respective places and roles in the context of emerging needs related to international policy, on-going and emerging needs of the land and forest cover user communities.

The presentations made during the Science meeting and the summary of discussions (see report) are available on the this page: http://www.gofcgold.wur.nl/sites/gofcgold-gfoi_sciencemeeting2016.php.

Figure 2: Participants of the Plenary Day.

National change website, ~3 decades of labeled change to explore and discover in Canada

Government, university, and industry in Canada have combined to produce a website to explore the history of Canada's forests over a three decadal period. Using Landsat imagery provided freely by the United States Geological Survey, a time series based change detection approach was applied to determine the year of change and to provide additional information to aid in the typing of the detected changes.

The Canadian Forest Service of Natural Resources Canada, partnered with the University of British Columbia, with support from the Canadian Space Agency, has been developing the science and methods to track and characterize the history of Canada's forests. For this research we use Landsat imagery to detect changes, identify the year in which the changes occur, and estimate a change type (such as harvest or wildfire). For information see Hermosilla et al. 2016.

From the time series we can also assess the recovery of forests after disturbances by wildfire and harvest. In this research, partnered with Foundry Spatial, we have developed an explore and discovery tool to portray and communicate forest change over Canada. The map shows points representing locations where forest change has been observed between 1985 and 2011. The source Landsat imagery is a continuous surface of pixels, each representing a 30m x 30m square area. For visualization purposes the change pixels have been converted to points, and generalized at different zoom levels.

The accuracy of the change products was evaluated using independent validation data. Overall, change events were detected with a 90% accuracy. Fires were detected with a user's accuracy of 98%, while harvesting was detected with a user's accuracy of 88%. These results indicate that the automated change detection and attribution algorithms are robust, but errors will exist. Web tools such as this aid in visualizing and sharing results, but they are also designed to enable feedback that can further support refinement of the change detection and attribution algorithms.

Website:
http://forests.foundryspatial.com/

Citation:
Hermosilla, T., Wulder, M.A., White, J.C., Coops, N.C., Hobart, G.W., Campbell, L.B. 2016. Mass data processing of time series Landsat imagery: pixels to data products for forest monitoring. International Journal of Digital Earth. Open Access: http://dx.doi.org/10.1080/17538947.2016.1187673.

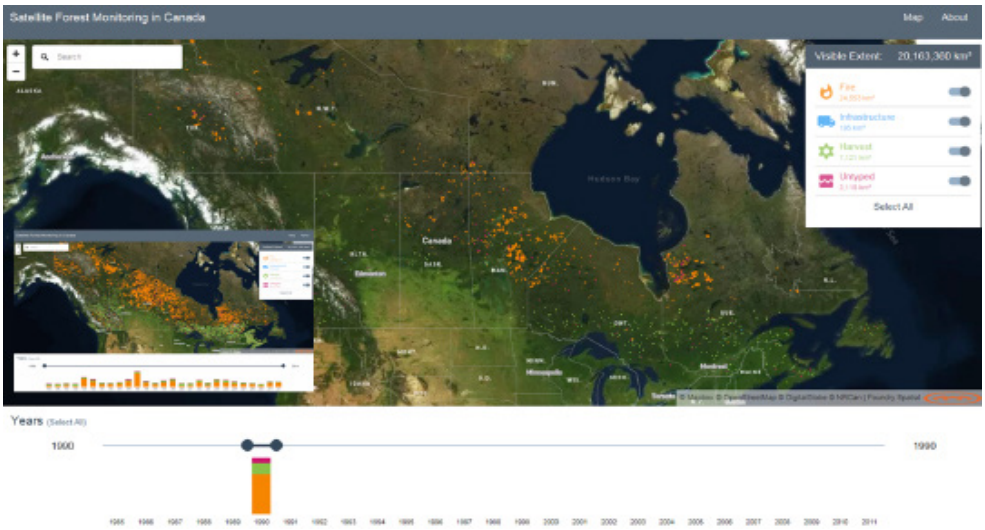


Figure 3: Web interface of the project

A New Path Forward for Generating Land Cover Products by GEO

On 23-24 May, 2016, the Global Land Cover (GLC) Task of the Group on Earth Observations (GEO) organised a workshop in Rotterdam, The Netherlands, to discuss the conception of new approaches to generating LC maps. The presentations made during this workshop are available online along with a summary of the discussions (access webpage).

Following up on this meeting, the participants developed further the concept and presented the progress during the GOFC-GOLD LC / GFOI R&D meeting in the Hague (see main article in this newsletter), and a side-event at the last GEO Plenary held on 7-10 November in Saint-Petersburg, Fed. of Russia.

GEO GROUP ON EARTH OBSERVATIONS

The rationale of this initiative is underpinned by the need for land cover and land cover change information to help guide and assess progress towards policy outcomes such as the Sustainable Development Goals (SDGs), the Convention on Biological Diversity (CBD) Aichi Targets, the Ramsar convention on wetlands, the Framework Convention on Climate Change (UNFCCC), and the UN Convention to Combat Desertification (UNCCD), among others.

The availability of consistent global observations from land monitoring satellites has enabled a variety of global GLC products differing in terms of spatial resolution (1,000 m to 30 m), thematic classes, year, and accuracy.
Although there are more global products available now than ever before they do not align with all user needs. Additionally, because accuracy varies spatially and in unspecified ways their usefulness for national or subnational applications can be limited, and inconsistencies in how these products were generated make it difficult to assess change over time. National LC datasets can have similar limitations, albeit at a different scale.
A new approach to generating and providing LC and LCC products is needed to meet these varied user requirements and still be operationally practical and sustainable. Fortunately, science, technology, and data availability have all advanced to the point where new approaches are possible—in fact, some of these are already being implemented.

Ongoing discussions converge towards the development of a system that is scalable to meet national and global-scale needs, flexible enough to be updated to consider future needs (e.g., algorithms, data types, thematic classes). The system should be developed following stepwise approach providing a few processing chains towards the production of land cover products requested for specific needs. A datacube approach that would allow notably the calculation of change maps over large spatial extents, has been identified as a core system the platform should be built on. Coordination with successful international initiatives should be sought for the validation phase associated to every map production. Participants of the meetings identified potential issues linked to country sovereignty, data ownership that will be have to be taken into consideration from the early stages of the development of such a system. Participants also emphasized such a system relies on the sustained and continuous provision of Earth observation data, recalling the need for a continuous dialogue between Space Agencies and users. Figure 3 summarises the generalized architectural concept of the platform.

Follow up discussions on this project will take place during the 37th International Symposium on Remote Sensing of the Environment (ISRSE-37), in Tshwane (Pretoria), South Africa, on 8-12 May 2017. Look for the invited session *Towards a new philosophy for generating land cover products*. organised by the GEO Secretariat. The objectives of the session are:
• Discuss current LC generation approaches and challenges,
• Present a new approach,
• Explore and discuss pros, cons, and elements of a path forward.

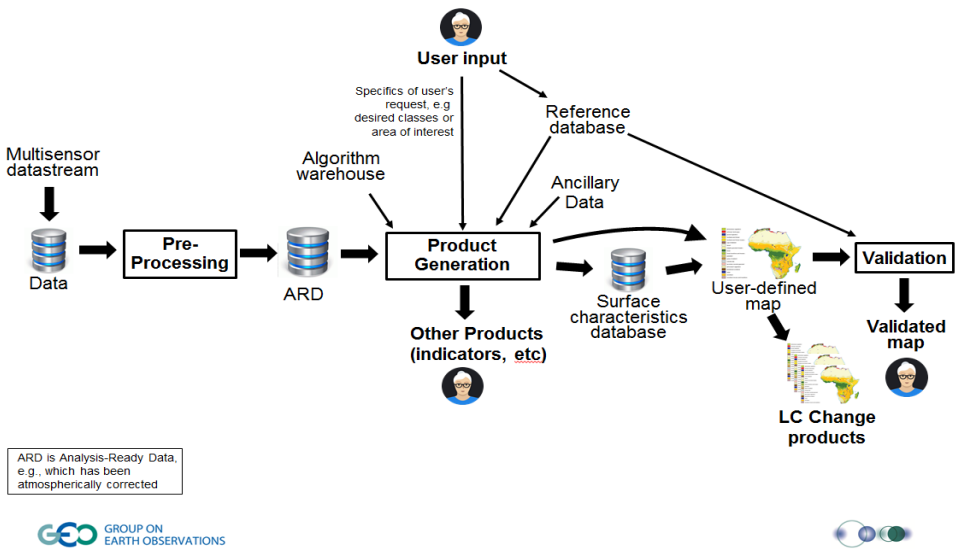


Figure 4: Conceptual model of the land cover mapping portal. Credits: GEO Secretariat

The 4th Mission - the need for a global plot-based biomass reference

Forest monitoring is high on the scientific and political agenda. Global measurements of forest height, biomass and how they change with time are urgently needed as essential climate and ecosystem variables. Three spaceborne missions to measure forest structure are going to be launched in the coming years, namely ESA BIOMASS, NASA GEDI and NISAR. How to make the best use of these missions? Will users trust the derived products? To address these questions, we need to launch the "4th mission" – to collect high quality ground data for calibration and validation.

The Forest Observation System – FOS (http://forest-observation-system.net/) is an international cooperation to establish a global in-situ forest biomass database to support environmental monitoring, earth observation and to encourage long-term investment in relevant field-based observations and science. FOS aims to link the Remote Sensing (RS) community with ecologists who measure forest biomass in the field for a common benefit. The added value of FOS for the RS community is the partnering of the most established teams and networks that manage permanent forest plots globally; to overcome data sharing issues and introduce a standard biomass data flow from tree level measurement to the plot level aggregation served in the most suitable form for the RS community. Ecologists benefit from the FOS with improved access to global biomass information, data standards, gap identification and potential improved funding opportunities to address the known gaps and deficiencies in the data.

FOS, currently in the proof-of-concept phase includes such networks as: the Center for Tropical Forest Science – Forest Global Earth Observatory (CTFS-ForestGEO), the ForestPlots.net (incl. RAINFOR, AfriTRON and T-FORCES) and the IIASA network in Northern Eurasia. FOS is an open initiative with other networks and teams most welcome to join.

The online database (http://forest-observation-system.net/) provides open access for both metadata (e.g. who conducted the measurements, where and which parameters) and actual data for a subset of plots where the authors have granted access. A minimum set of database values include: principal investigator and institution, plot coordinates, number of trees, forest type and tree species composition, wood density, canopy height and above ground biomass of trees. Plot size is 1 ha (preferably) or at least 0.25 ha.

The database will be essential for validating and calibrating satellite observations and various models, but also has immense ecological value itself for both science and policy. The focus is to provide ground support for the future ESA Earth Explorer BIOMASS mission. We are currently exploring synergies with other ongoing projects like the GlobBiomass project as a pilot user, NASA GEDI, NISAR, but also JAXA ALOS, and ESA SAOCOM-CS.

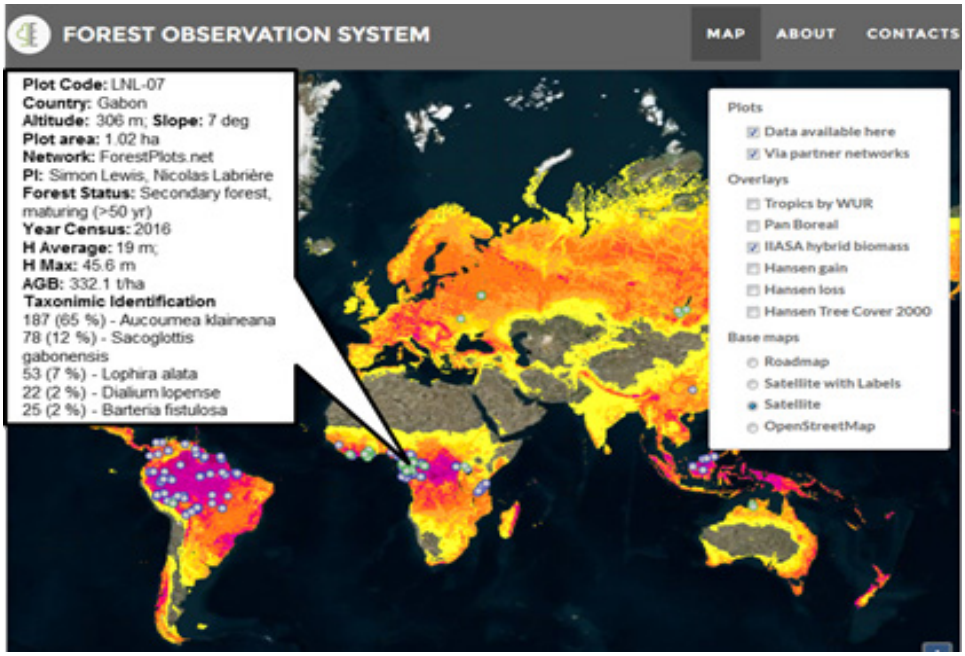


Figure 5: Web interface of the initiative

Authors and contact points:
Jérôme Chave (CNRS, France, jerome.chave@univ-tlse3.fr), Klaus Scipal (ESA, Netherlands), Dmitry Schepaschenko (IIASA, Austria, schepd@iiasa.ac.at), Oliver Phillips (University of Leeds, UK), Stuart J. Davies (STRI, USA), Simon Lewis (UCL, UK), Christoph Perger (IIASA), Christopher Dresel (IIASA), Ian McCallum (IIASA), Steffen Fritz (IIASA).

FROM Global Land Cover Mapping Portal demonstrated during GEO XIII Plenary

China's FROM-GLC data sample allows the use of Landsat Thematic Mapper data in mapping anywhere in the world. It enables an online on-the-fly dynamic mapping capability for researchers and practitioners worldwide.
Land cover mapping reference sites could be easily shared, accessed and inter-compared on this portal. Research groups in need of land cover maps for a specific area can either use samples in FROM-GLC or use their own sample data. The portal enables the researchers to do sampling in the system for training and validation purposes. Samples collected by the research group in the portal can be downloaded to and archived in local computing environments.
The portal also supplies pre-loaded land cover mapping algorithms such as the conventional maximum likelihood classifier and Random Forest for use. Given the satellite data available in the portal, algorithms developed by any research group can also be uploaded in the portal for land cover map development. Mapping results developed by other researchers are accessible online as well. This will make it easy for researchers to inter-compare individual mapping results with different methods.
Researchers from the Center for Earth System Science (CESS) at Tsinghua University was pleased to release the phase one of the mapping portal and it was exhibited during the GEO XIII Plenary in St. Petersburg during 7-10 November 2016.

You can access the portal here: http://www.fromlc.net/.
For more information please contact: Prof.Peng Gong (penggong@mail.tsinghua.edu.cn), and Dr. Yuqi Bai (yuqibai@mail.tsinghua.edu.cn).

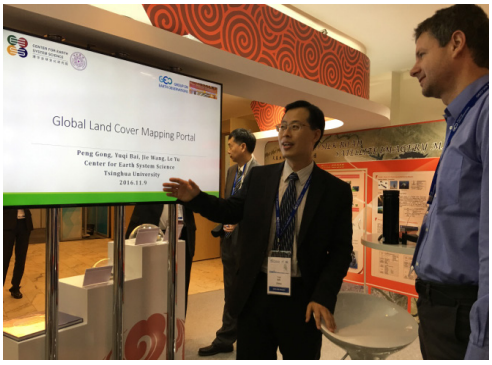


Figure 6: Presentation of the portal at the GEO XIII Plenary in Saint Petersburg (November 2016)

Calendar of Upcoming Events

Event	Date	Venue	Information
Remote Sensing of Fluorescence, Photosynthesis, and Vegetation Status	17-19 January, 2017	Frascati, Italy	http://www.flex2017.org/
WorldCover 2017 Conference	14-16 March, 2017	Frascati, Italy	worldcover2017.esa.int
GFOI Plenary 2017	11-12 April, 2017	Ho Chi Minh City, Vietnam	office@gfoi.org
ISRSE37	8-12 May, 2017	Tshwane, South Africa	conference site
MultiTemp 2017	27-29 June, 2017	Bruges, Belgium	

Table 1: Upcoming events

Acknowledgements

We thank Dmitry Schepaschenko from IIASA for providing information on the Forest Observation System initiative, Gary Geller and Andre Obregon from the GEO Secretariat for providing materials on the on-demand Land cover mapping project, Mike Wulder from the Canadian Forest Service for providing information on the forest change monitoring portal, Tom Harvey and Carly Green for providing information on the release of the V2 of the GFOI Method & Guidance Document, and Dr. Yuqi Bai for providing information on the FROM LC portal..

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http://www.gofcgold.wur.nl/sites/letter.php

If you have any suggestions or recommendations for future contributions to this newsletter please feel free to contact us.

GOFC-GOLD
Global Observation of Forest Cover and Land Dynamics
Land Cover Project Office

Prepared by
B. Mora & M. Herold
Tel: +31 (0) 3.17.48.38.89
Fax: +31 (0) 3.17.41.90.00
brice.mora@wur.nl
http://www.gofcgold.wur.nl

GOFC-GOLD
Land Cover Project Office
Wageningen UR
Centre for Geo-Information
P.O. Box 47
6700 AA Wageningen (Netherlands)