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LAND COVER AND CHANGE

Newsletter of the GOFC-GOLD Land Cover Project Office

2016 GFOI Plenary and Open Forum

The GFOI Plenary and Open Forum meetings were held at the European Space Agency's (ESA) Centre for Earth Observations (ESRIN) in Frascati, Italy, from 22 to 25 February 2016. With well over 100 registered participants bringing different backgrounds, expertise and perspectives from all over the world; the meetings were engaging and highly productive.

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Content

Expert Workshop on Using Global Datasets for National REDD+ Measuring and Monitoring

UNFCCC negotiations have identified the need to establish national forest monitoring systems that use an appropriate combination of remote sensing and ground-based forest carbon inventory approaches for estimating anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks to support REDD+ implementation and assessing performance in implementing REDD+ activities.

Efforts to improve country monitoring capacities are ongoing, and a series of global and regional datasets have been produced by the research community. These global and regional products become increasingly relevant, spurred by the REDD+ monitoring requirements, and aided by the communications efforts of initiatives such as Global Forest Watch and recently the Global Observation Forests Initiative (GFOI) has provided a module with initial advice on the possible use of global datasets in the context of national monitoring. Beyond that, there is little additional guidance on their use for national forest monitoring, change estimation, or reporting and over the past 24 months, a number of experiences on the use of global data products have been collected in different country circumstances.

The international community together with experts from countries has been working to provide guidance to countries on how estimate emissions from REDD+ activities through the GOFC-GOLD REDD+ Sourcebook and related training materials, and the GFOI methods and guidance document which links REDD+ operationally to IPCC guidelines.

The workshop aimed to bring together the communities of REDD+ monitoring experts and national practitioners to discuss the current state in using global datasets for national forest monitoring systems, identify gaps and obstacles that hinder progress where the use of global datasets would be advantageous, and to develop a synthesis, additional guidance and an action plan towards improving the underlying science and national forest monitoring in REDD+ countries. More

specifically, the workshop aimed to:

1- **Present** and collect of current experiences on the use of global data products related to national forest monitoring system (NFMS) and those of other stakeholders involved in REDD+ monitoring. These experiences largely relate to the use of remote sensing-based forest cover and change products but also take into account those related to biomass and emission factors for biomass and other pools (i.e. from fire and peatlands)
2- **Identify** gaps, inconsistencies, uncertainties and other obstacles for the useful integration of global monitoring efforts with those of national forest monitoring efforts
3- **Discuss** and **document** the impact of different experiences.

Sponsors of the Expert Workshop were: Norwegian International Climate and Forest Initiative, US Silvacarbon Program, Global Forest Observations Initiative, GOFC-GOLD Land Cover Office, European Space Agency, Wageningen University.
The summary report of the Expert Workshop is available online: http://www.gofcgold.wur.nl/sites/glc4redd-workshop2015.php.

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The focus of the week was squarely on collaborative action to assist emerging countries to develop forest monitoring systems to support their national development priorities such as climate change mitigation and adaptation. Participants discussed how best to leverage the enormous resources of GFOI partners to ensure assistance to countries is targeted, efficient and effective.

The Open Forum gave the floor to countries to report on operational land cover/forest cover monitoring systems and GHG reporting. A demonstration of the GFOI Method and Guidance Document (MGD) Portal was performed in order to demonstrate how countries can use the system to support their monitoring and reporting activities. Other complementary systems (toolbox and processing platforms) such as the Open Foris toolbox and the SEPAL system from the Food and Agriculture Organisation were presented. Other key stakeholders reported on the development of their activities such as the Copernicus Programme, the Global Forest Watch, but also the Silvacarbon Programme from the USGS.

Closed sessions allowed the different components of the GFOI to report on the progress of their activities and how to improve the coordination of activities such as the update of the GFOI MGD (scheduled for June 2016), develop joint training workshops (in partnership with the World Bank FCPF), organise new R&D Expert Workshops, but also facilitate access to Earth Observation data to countries and participating research groups. To this end, the R&D Coordination component of the GFOI agreed on series of actions to be implemented during the next 12 months. For more information please visit the webpage of the R&D Coordination component. Figure 1 on page 3 illustrates the interactions between the different components of the GFOI.

Recordings of the sessions can be found here, minutes and presentations can be found here and here, respectively.

To register your interest or become a GFOI Associate, please contact the GFOI Office (office@gfoi.org). To stay up to date with all GFOI activities and events, please follow our social media accounts: Facebook and Twitter.

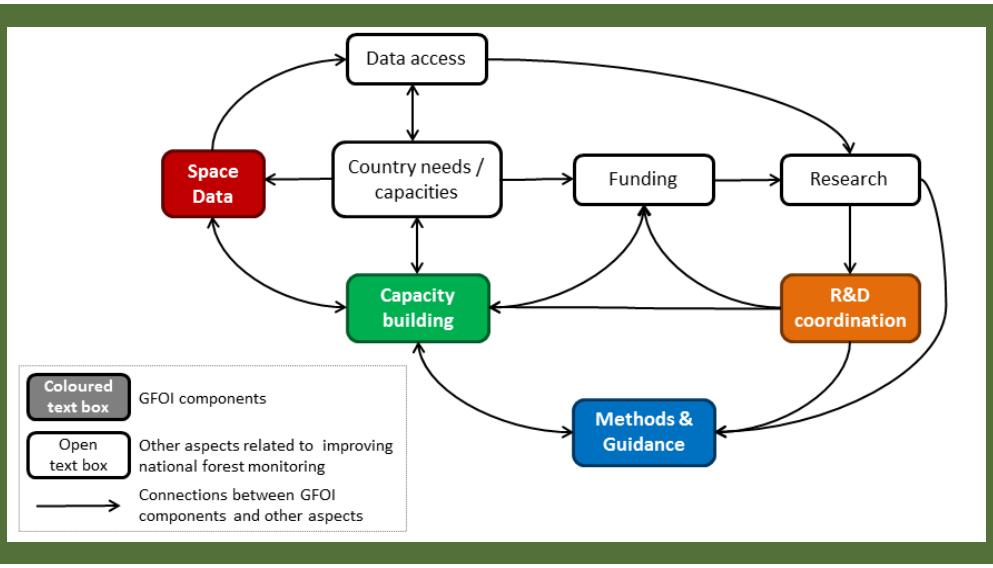


Figure 1: Interactions between the different comonents of the GFOI.

Spatial Accuracy Assessment and Integration of Global Land Cover Datasets

Currently, GLC map production is progressing towards higher resolution maps, namely the Land Cover-CCI (LC-CCI) maps at 300 m resolution and the Fine Resolution Observation and Monitoring (FROM-GLC) and Globeland30 maps at 30 m resolution (Chen et al. 2015; Mora et al. 2014). Along with the creation of new maps, current efforts for improving global land cover (GLC) maps focus on integrating maps by accounting for their relative merits, e.g., agreement amongst maps or map accuracy. Such integration efforts may benefit from the use of multiple GLC reference datasets that are available via the reference data portal of the GOFC-GOLD LC project office and Geo-Wiki platform. The availability of such datasets opens also a possibility of assessing the spatial accuracy of GLC maps thus providing information about where the current maps are accurate and where not.

Using available reference datasets via the GOFC-GOLD reference data portal and Geo-Wiki platform, the researchers of Wageningen University and IIASA assessed spatial accuracy of recent GLC maps and compared several methods for creating an improved land cover map. Spatial correspondence with reference dataset was modelled for Globcover-2009, Land Cover-CCI-2010, MODIS-2010 and Globeland30 maps for Africa. Using different scenarios concerning the used input data, five integration methods for an improved LC map were tested and cross-validated. The study used a geostatistical approach to assess and model the spatial dependence of map accuracy and class probabilities. In addition, methods based on a conventional voting approach (Iwao et al. 2011), i.e., without using reference data, and a geostatistical method that relies only on the reference data, i.e., without using the GLC maps, were also compared.

Comparison of the spatial correspondences showed that the preferences for GLC maps varied spatially. Integration methods using both the GLC maps and reference data at their locations resulted in 4.5%–13% higher correspondence with the reference LC than any of the input GLC maps. An integrated LC map and LC class probability maps were computed using regression kriging, which produced the highest correspondence (76%). This study demonstrates the added value of using reference datasets and geostatistics for improving GLC maps. This approach is useful as more GLC reference datasets are becoming publicly available and their reuse is being encouraged.

The paper can be found in http://www.mdpi.com/2072-4292/7/12/15804. The integrated land cover map of Africa is available upon request.

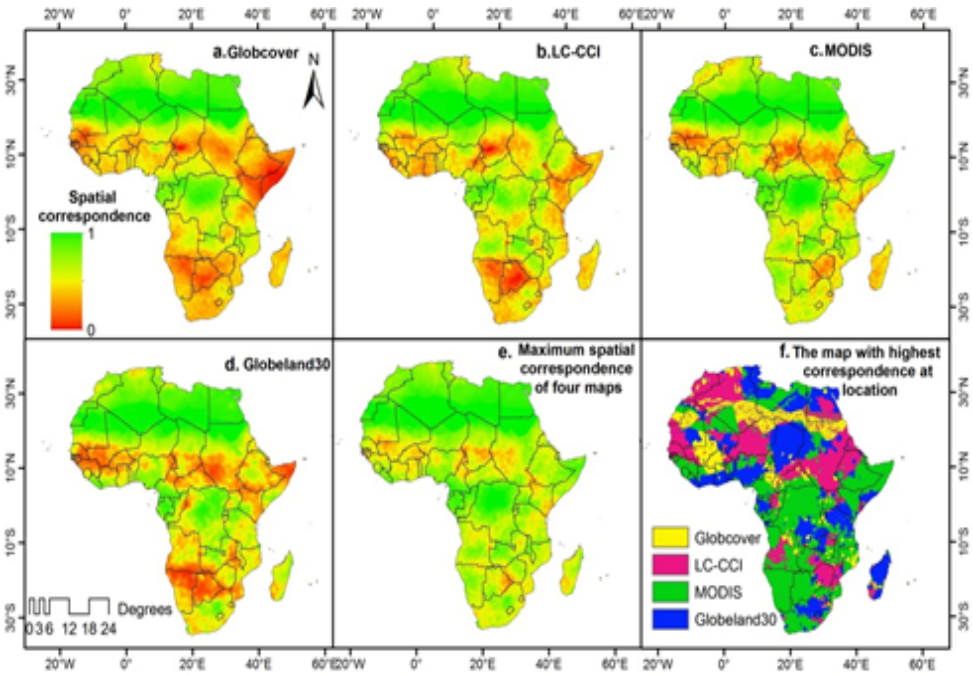


Figure 2: Spatial correspondence of the GLC maps (a–d), maximum correspondence (e) and the map with highest correspondence (f).

Remote Sensing and GIS for Ecologists – Using Open Source Software

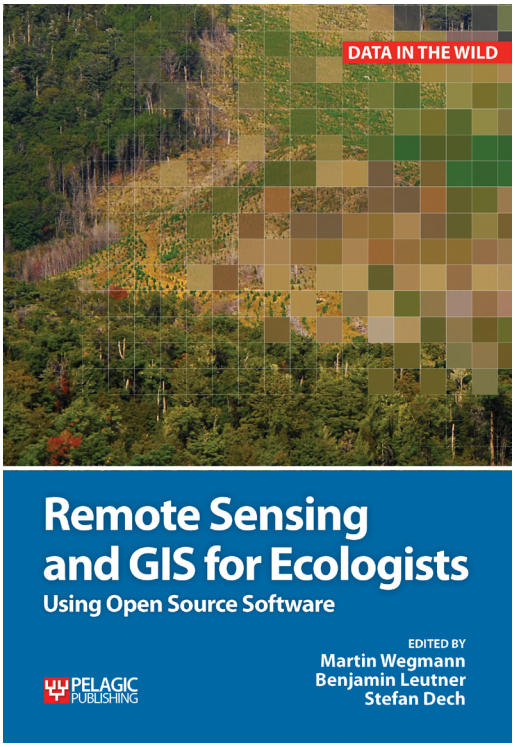
The book “Remote Sensing and GIS for Ecologists – Using Open Source software” is now available.

Readers will learn how to apply remote sensing within ecological research projects, how to approach spatial data sampling and how to interpret remote sensing derived products. The authors discuss a wide range of statistical analyses with regard to satellite data as well as specialised topics such as time-series analysis. Extended scripts on how to create professional looking maps and graphics are also provided.

This book is a valuable resource for students and scientists in the fields of conservation and ecology interested in learning how to get started in applying remote sensing in ecological research and conservation planning.

All practical examples in this book rely on open source software and freely available data sets. Quantum GIS (QGIS) is introduced for basic GIS data handling, and in-depth spatial analytics and statistics are conducted with the software package R. Readers will learn how to apply remote sensing within ecological research projects, how to approach spatial data sampling and how to interpret remote sensing derived products. We discuss a wide range of statistical analyses with regard to satellite data as well as specialised topics such as time-series analysis. Extended scripts on how to create professional looking maps and graphics are also provided.

See more at:
http://book.ecosens.org

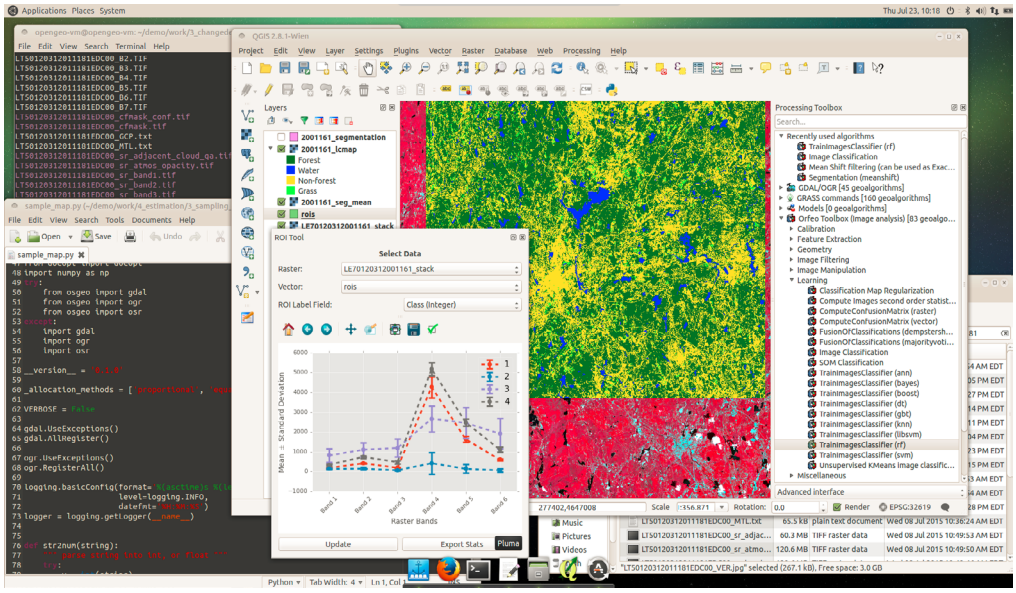


BEEODA Suite for Remote Sensing Analyses

The Boston Education on Earth Observation Data Analysis, or BEEODA in short, is a fully open-source suite of educational material and software tools for processing Earth observation data. It is developed by a team of researchers at Boston University and allows practitioners to employ recent advancements in remote sensing analyses without spending large amounts of money on proprietary software. BEEODA supports a wide range of remote sensing analyses and processing tasks including time series analysis, object-based image analysis, and accuracy assessment and area estimation, and has been used successfully in GOFC-GOLD capacity building workshops. The suite is based on a virtual machine that contains various open-source software like QGIS, GDAL and Orfeo Toolbox to which the development team has added implementations and functions for seamless workflows. For more information, visit http://beeoda.org, https://github.com/beeoda and https://github.com/ceholden, or email Pontus Olofsson at olofsson@bu.edu.

The virtual machine runs in Oracle VM VirtualBox and can be downloaded from here: http://earth.bu.edu/public/ceholden/VM/.

Figure 3: Screen capture of the BEEODA suite.



A New, Integrated Pan-tropical Biomass Map using Multiple Reference Datasets

Aboveground forest biomass is a key parameter for estimating carbon emissions due to land-use change and related impacts on climate, especially in the tropics where uncertainties are higher. A new study lead by Wageningen University (Avitabile et al., 2015) combined the two main pan-tropical biomass datasets (Saatchi et al., 2011; Baccini et al., 2012) into a new biomass map at 1-km resolution using 14,477 independent observations and a data fusion approach based on bias removal and weighted linear averaging. The fused map incorporated and spatialized the biomass patterns indicated by the reference data and found that tropical forest biomass stock for the tropics (23.4 N – 23.4 S) is 375 Pg dry mass, 9% - 18% lower than previous estimates from Saatchi et al. (2011) and Baccini et al. (2012). Moreover, the new map presents differing spatial patterns: compared to the input maps, higher biomass density were found in the humid forests of the Congo basin, Eastern Amazon and South-East Asia, and lower values in most dry vegetation areas of Africa and Central America. The validation, based on 2,118 independent reference values, indicated that the fused map had almost unbiased estimates at continental scale (mean bias 5 Mg ha-1 vs. 21 and 28 Mg ha-1 for the input maps) and lower errors (RMSE 15 – 21% lower than that of the input maps). Beyond this application for the pan-tropics, the fusion method can be applied at any scale including the policy-relevant national level, providing improved biomass estimates by integrating existing regional/global biomass maps using additional, country-specific reference datasets. The new biomass map for the pan-tropics, as well as the related uncertainty layer and reference data, can be freely downloaded from www.wageningenur.nl/grsbiomass.

Reference: Avitabile V, Herold M, Heuvelink G, Lewis SL, Phillips OL, Asner GP et al. (2016). An integrated pan-tropical biomass maps using multiple reference datasets. Global Change Biology, 22:4, 1406–1420 pp. doi:10.1111/gcb.13139

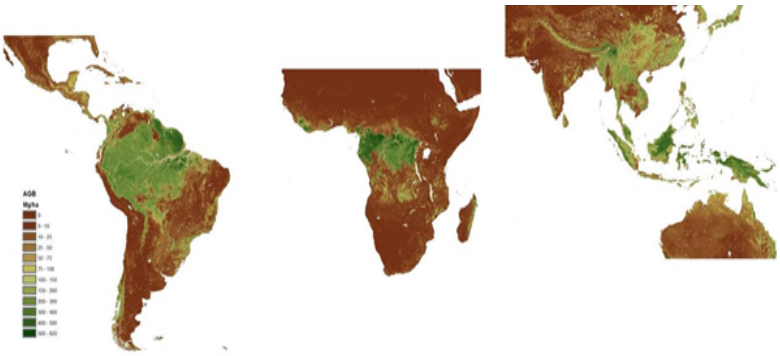


Figure 4: Illustration of the new biomass map (available for download).

Calendar of Upcoming Events

Event	Date	Venue	Information
2nd EARSeL LULC/ NASA LCLUC Workshop	May 6-7 2016	Prague, Czech Republic	http://www.earsel.org/workshops/2016-SIG-LULC-Prague/
ESA Living Planet Symposium	May 9-13 2016	Prague, Czech Republic	http://lps16.esa.int/
2016 GEO BON Open Science Conference	July 4-9 2016	Leipzig, Germany	http:http://conf2016.geobon.org/
5th International ecoSummit	Aug. 29 - Sept. 1 2016	Montpellier, France	http://www.ecosummit2016.org/
Global Land Project 3rd Open Science Meeting	October, 24-27 2016	Beijing, China	http://www.globallandproject.org/glp_events/open_science_meeting.php/
UNFCCC COP-22	November, 7-18 2016	Marrakech, Morocco	http://unfccc.int/

Table 1: Upcoming events

Acknowledgements

We thank Nandin-Erdene Tsendbazar for providing information on her new GLC map product, Pontus Olofsson on the BEEO-DA suite, Valerio Avitabile for providing material on his new global-scale biomass map, and Martin Wegmann for providing information on the new book on remote sensing and GIS for Ecologists. We thank also the GFOI Office for the material provided to report on the Pleanry and Open Forum.

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

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