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

Summary Report

Wageningen University, The Netherlands

9-10 November 2015

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GFOI Global Forest Observations Initiative

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

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NORWEGIAN MINISTRY OF CLIMATE AND ENVIRONMENT

Expert workshop on using global datasets for national REDD+ measuring and monitoring, Wageningen University, The Netherlands, 9-10 November 2015

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Contents

1. Background

UNFCCC negotiations have identified the need to establish national forest monitoring systems that use a combination of remote sensing (RS) 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 have become increasingly relevant, spurred by the REDD+ monitoring requirements, and aided by the communications efforts of initiatives such as Global Forest Watch and the Global Forest Observations Initiative (GFOI) that in March 2015 published a module[1] with initial advice on the possible use of global datasets in the context of national monitoring. Otherwise there is little additional guidance on the use of global datasets for national forest monitoring, change estimation, or reporting. Over the past two years, experience has accumulated related to the use of global data products in different country circumstances and it became apparent that additional guidance is required. Therefore, it is timely and relevant for an exchange of these experiences to guide future research, inform guidance documents, and communicate the appropriate use of global data products. Central actors in the field have expressed the value of, and their interest in, such an effort.

2. Workshop objectives

The international community together with experts from countries, has been working to provide guidance to countries on how to estimate emissions from REDD+ activities through the GOFC-GOLD REDD+ Sourcebook (www.gofcgold.wur.nl/redd) and related training materials (http://www.gofcgold.wur.nl/redd/Training_materials.php), and the GFOI methods and guidance document (MGD) (http://www.gfoi.org/methods-guidance/) which links REDD+ operationally to IPCC guidelines.

The "Expert workshop on using global datasets for national REDD+ measuring and monitoring" held in Wageningen on 9-10 November, brought together the communities of REDD+ monitoring experts, producers of relevant global datasets, and national practitioners to discuss the current state of using global datasets for national forest monitoring systems (NFMS), and to identify gaps and obstacles that hinder progress where the use of global datasets would be advantageous. Further, the workshop aimed to develop a synthesis, additional guidance and an action plan towards improving the underlying science and national forest monitoring in REDD+ countries. Specifically, the workshop aimed to:

1) Gather current experience on the use of global data products for REDD+ monitoring and NFMS more generally. These experiences presented largely relate to the use of remote sensing-based forest cover and change products, but will also take into account experiences related to the generation of biomass and emission factors for biomass and other pools (especially fire and peatlands)

[1] The Module is available at http://www.gfoi.org/wp-content/uploads/2015/03/MGDModule2_Use-of-Global-Data-Sets.pdf. Modules are GFOI's mechanism to respond to emerging issues between updates of the main Methods and Guidance Document.

2) Identify gaps, inconsistencies, uncertainties and other obstacles for the useful integration of global monitoring datasets with those of national forest monitoring efforts
3) Discuss and document the impact of these experiences with a view to providing better guidance to countries based on expert consensus and subsequent updates to the GFOI MGD. This includes:
    - Guidance from GFOI (methods and guidance document) and GOFC-GOLD (Sourcebook and training materials)
    - Capacity building efforts for national forest monitoring systems (UN-REDD, WB-FCPF, SilvaCarbon)
    - Communication of global data product analyses and results
    - Research needs and opportunities (links to the GFOI R&D component)

Examples of global datasets discussed in this document include:

1. Activity data and land use change
2. Forest biomass and emission factors
3. Fire and biomass burning
4. Peatlands and related emissions

Annex I includes the workshop agenda and in Annex II the list with workshop participants can be found. Annex III includes some workshop photos.

3. 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

Sessions 2, 3, and 4 of the first day of the workshop focused on presenting country level experiences with using global datasets (See Annex I). Many different topics were presented, ranging from the use of the University of Maryland (UMD) dataset[2] for global forest monitoring, to the future use of Sentinel-2 data for the assessment of degradation in countries, to accuracy assessment issues. Experiences from different countries (Tanzania, Indonesia, Ethiopia, Colombia, Gabon and Central Africa, Guyana, Brazil) and institutes (UN-REDD, WRI/GWF, GIZ, IIASA) were presented on using global datasets for national forest monitoring. All presentations are available on the website of the workshop: http://www.gofcgold.wur.nl/sites/glc4redd-workshop2015.php.

[2] M C Hansen et al, *High-resolution global maps 21st-century forest cover change*, Science, **342** Nov. 15, 2013. The data are also available via the World Resources Institute Global Forest Watch web-site, at http://www.wri.org/our-work/project/global-forest-watch

4. Synthesis of group discussion outcomes on the use of global data products for national forest monitoring

4.1 Introduction to the use of global datasets

National datasets provide countries with the most reliable and accurate estimates. However, if countries lack proper national datasets, they could use available global datasets instead, including as a bridge to establishing national capacity. It is up to the countries whether they want to use global datasets and if they choose to do so, it is useful to have guidance on how to do this, because use global data off-the-shelf is not appropriate in most circumstances. Quality and accuracy of global products vary regionally and so some country circumstances are more conducive than others to the use of global datasets. Relevant factors include:

- Bioclimatic variation (differential sensitivity at biome and eco-regional scales)
- Scale of change dynamic (smallholder to industrial scale)
- Data richness (more observations are better)

Guidance is needed on how to use these global datasets, in terms of calibrating for national circumstances. Knowledge already exists on how to collect reference data for calibration.

IPCC already refers to the use of global datasets (international land use and land cover datasets) in developing estimates in GPG2003 and the 2006GL. Large global datasets that are useful for REDD+ measurement and reporting are available. The UMD dataset referred to above produces tree cover maps, and annual cumulative tree cover gains and annual losses, which may be useful for estimating activity data in the context of generating emissions and removals estimates for REDD+ reporting.

However, while countries may expect to derive annual land cover information with temporal consistency and uncertainty estimates highlighted, confusion exists regarding how to most appropriately utilize global datasets. Consistent guidance is needed on how to use UMD data in various ways. Countries can then build on this experience in how to use other global datasets.

Comparison of national and global datasets can lead to a constructive discussion and result in mutual improvement in forest monitoring. Moreover, global products can contribute to more than just REDD+ reporting.

4.2 Motivations for a country to use global datasets

Country cases presented during the workshop provided useful examples on how to use global datasets for national forest monitoring purposes. Motivations for a country to use global datasets are listed below:

1. Lack of reliable or official national map
2. As a cross-check of national forest cover and forest change data with global data for consistency/inconsistency or potential errors (Brazil / Colombia – case study)

3. To conduct an assessment to identify possible use and limitations of national data (Indonesia – case study)
4. For stratification for obtaining training data of land use change– (Ethiopia – case study)
5. For integration in national monitoring and estimation to increase precision and/or reduce costs (Gabon/Guyana/Ecuador – case study)

Decisions on possible use of available global datasets to generate national level estimates of forest area and change are related to[3]:

- whether national mapping capacity already exists
- accuracy achieved by global datasets
- cost relativities (e.g. the cost of collecting more reference observations versus establishing a national mapping capability, and costs of establishing the relationship between global maps and national forest definitions)
- specific national needs for a land cover map (e.g. related to forest definition and land cover classifications, for integration with domestic planning)
- preferences for national ownership of the process, to respond to technical developments
- possible use as an interim step to establishing national mapping capacity.

4.3 Implications of national forest definitions for the use of global datasets

Mapping of forest cover is based on a minimum mapping unit (MMU) and definitions of forest. Usually, definitions used with global and national products differ. This presents a key issue when integrating these two types of data. An interesting, exploratory task could be to investigate the implications of using different forest definitions with global and national data for reporting results. Some considerations when using global datasets to map forest cover at the national level include:

- National sovereignty: countries decide on their own definition.
- Forest definitions should be used consistently.
- Monitoring which utilizes the UMD data generates estimates of land cover and land cover change estimates. However, IPCC methodologies require estimation and reporting of emissions and removals related to land use change. There is a difference between land cover change and land use change. For example, for a certain area, the land cover detected by the global forest product may be trees, but the land use, based on a country's forest definition may classify this area as agriculture[4]. Using the global tree cover product, this area would be detected as deforestation if trees were removed below the canopy cover threshold being used, but at a country level the land use does not change (i.e. it was agriculture prior and post tree removal therefore the associated emissions are related to the agriculture sector and outside the scope of REDD+ reporting) because it is still designated as agricultural land. For comparisons to be meaningful, these differences need to be taken into account.

[3] Extracted from Presentation of Penman "Current GFOI modules on using global datasets"

[4] Bearing in mind the FAO definition of forest as *Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopycover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use*.

- To consider the role of plantations, natural and managed/degraded forests within the national forest definition. In the REDD+ context this may be linked to implementation of the safeguard, that REDD+ actions should not lead to the conversion of natural forest.
- Crown cover (CC) threshold: if a country uses a forest definition that includes a CC>30%, then, if degradation is an active process, significant carbon emissions may go unreported unless degradation from higher crown cover to 30% is also estimated.
- MMU and plot size vs pixel size: For example the MMU is 1 ha. This size is related to the minimum area which is needed to call it a forest. This implies the need to aggregate Landsat pixels or polygons to come to the MMU.

4.4 The use of reference data with global datasets

It is said that *maps are not the truth*. Therefore, the errors in maps need to be reduced and the estimates based on the maps need to be adjusted to compensate for the errors. To do this you need reference data of greater quality (See also GFOI MGD Module 2). Thereby, it is important to distinguish between calibration data and validation data.

An estimate of forest area, or area change has to comply with the IPCC good practice guidelines and guidance. It needs to be neither over- nor underestimated (relates to issue of bias) and the uncertainties need to be reduced as far as practicable (relates to issue of precision).

The purpose of reference data is to:

- Estimate and adjust for bias in map estimation
- Estimate uncertainties, particularly the precision of the bias-corrected estimate
- Estimate map accuracies (overall accuracy, producer's accuracy, user's accuracy)

Reference data has greater quality than map data (assumption). **Three types of reference data can be gathered:**

- Ground data are regarded as most certain. However, obtaining ground data can be expensive, especially in remote or otherwise less accessible areas. Ground data should also be consistent with the national definition of forest regarding the minimum criteria. This includes temporarily unstocked land. Ground crews need to be aware of the criteria, via the NFMS.
- Finer resolution RS data (IKONOS, RapidEye) can be used to obtain reference data. Here there can be an issue with the acquisition date, which should be the same, or as close as possible to, the date of the map data. Expertise in accurately interpreting the finer resolution RS data is required. Tree height can be difficult to estimate for non-stereoscopic datasets.
- Landsat data can be used to obtain reference data, even if the map was created from Landsat data. In this case, the reference data need to be independently classified and may incorporate auxiliary data to reduce uncertainties. Visual interpretation is considered 'superior' to automatic classification and, therefore, suitable for obtaining reference data.

Collection of reference data

- Reference data should be collected using a probability sampling design so that the sample is representative for the whole area. Several sampling designs exist:
    - Simple random sampling design (problem: you might miss certain important areas, because of randomness; for maximum efficiency plots should be more apart than the range of spatial correlation)
    - Systematic sampling design (helps overcome the problem with simple random sampling, but has two problems: 1. It may be necessary to go to plots in less accessible areas, increasing costs 2. If the grid is relatively coarse it may still miss small features)
    - Cluster sampling (may reduce costs relative to simple random and systematic designs but subject to the problems identified, especially spatial correlation)
    - Stratified sampling: this varies sampling intensity with by strata for forest type and to capture areas subject to change or where no change is likely. It is likely to be the most efficient approach but requires a basis for stratification, e.g. auxiliary data on the extent of ecosystem types, management regimes and socioeconomic pressures.
- It may be useful to use a decision tree on how to select the sampling design
- Estimators must match sampling design
    - So using, e.g. a cluster sampling design, you have to use a cluster sampling estimator as well, etc.

Issues for the use of reference data

- Lessons from other countries can be very informative. So, tests of validation of global products can be used to inform other countries.
- It is important to understand that there are different uncertainties in different biomes etc. Biomass estimates need to correspond to strata where stratified sampling is used. This has implications for sampling (or drawing data from global maps).
- Increasing the time interval between map data, increases reliance on reference data to achieve result corrected for estimated bias, and may reduce precision.
- A reference data analysis needs to be done with the same frequency as the estimation.

4.5 Joint use of maps and reference data; relative efficiency

Reference data can be used to make estimates but in most circumstances joint use of maps and reference data will reduce costs. In this case the process is:

1) decide on precision required (possibly depending on the use that will be made of the data – e.g. any requirements linked to results-based payments)
2) obtain initial reference dataset
3) estimate the amount of additional reference data needed
4) gather additional reference data to obtain the target precision required.

Relative efficiency is a measure of the improvement in variance obtainable by using a map

and reference data in conjunction rather than just the reference data. National and global maps both have usually both have relative efficiencies greater than 1. The gain is likely to be greater with a well-produced national map, where available, because national circumstances are easier to take into account.

A country with a national map will probably want to use this map. A country without a national map may wish to work at first with a global dataset. A decision tree and/or matrix on the use of national vs global datasets, thereby showing trade-offs between the precision and accuracy required would be useful.

It is not easy to generalize the results on relative efficiency to produce rules of thumb, although case studies are emerging and it may be possible to use these to provide very general advice. An idea is to simply have a summary table of results so far and let readers draw own conclusions.

4.6 Auxiliary data for use with global dataset

Global maps are better used with supplementary data, if available. This helps take account of national forest definitions, for example. Using supplementary data will also give higher relative efficiency and therefore reduce costs to deliver the given precision.

The list below indicates what sorts of data can usefully complement global data.

- Forest concessions data
- Mining concessions
- Forest land use
- Forest type (plantation, oil palm, protection forest, production forest)
- Peatland map
- Soil type
- Management type
- Expert knowledge

5. Scope of Guidance on the use of global datasets

The following guidance can be provided to countries with regards to using global datasets for national forest monitoring:

- Global datasets can complement appropriate reference data
- Differences between national and global datasets are expected, for reasons including:
  - Forest Definitions (MMU/thresholds/land use vs land cover)
  - Uncertainties
  - Different data sources
  - Collated on different temporal basis
  - Types of changes included
  - Natural disturbances which are beyond emissions reporting

All these aspects related to using global datasets for national forest monitoring, as discussed in the previous sections, are expected to be covered in the MGD Edition 2.0. Documented

case studies from countries using UMD datasets will be added, with specific guidance on relevant approaches used within these country cases.

There is general agreement on how to calculate relative efficiency and its use in estimating reference data requirements. A coordinated effort will produce guidance on this, which will be incorporated in the MGD Edition 2.0.

6. Research needs and opportunities (links to GFOI R&D component)

The outcomes of the workshop indicate the following areas where research is needed:

- Improving accuracy and precision of global data products
- Fine-tuning global data products for use on regional / national scales
- How to use the national forest definition with the global data product, for national monitoring and reporting purposes
- Which sampling design to use to collect reference data under specific national circumstances

Annex I Workshop Agenda

Day 1

GFOI/GOFC-GOLD expert meeting Wageningen University campus: building Atlas, room Atlas 1 and 2		
Monday, 9 November 2015		
SESSION 1: Introduction and workshop objectives (Chair: Herold)		
09.00-09.15 09.15-09.30 09.30-09.45 09.45-10.00	Opening and welcome Workshop framing: perspectives from NICFI Workshop background and objectives Current GFOI module on using global datasets	Seifert/Herold Hertzberg Herold Penman/Green
10.00-10.30 Break		
SESSION 2: Country level experiences with using global datasets 1 (Chair: Achard)		
10:30-10:50 10:50-11:10 11:10-11:30 11:30-11.50 11.50-12:00	Accuracy assessment issues and examples Examples and experiences from various countries Use of Hansen et al data examples WRI/GFW examples GiZ experiences	Olofsson McRoberts Hansen/Popatov Harris Kallweit
12.00-13.00 Lunch		
SESSION 3: Country level experiences with using global datasets 2 (Chair: McRoberts)		
13.00-13.20 13.20-13.40 14.00-14.20 14.20-14.40 14.40-15.00	Perspectives of using Sentinel-2 data for the assessment of forest degradation in countries Country experiences from UN-REDD Tanzania Indonesia Ethiopia	Achard Jonckheere/Lindquist Naesset Morgono/Sugardiman Melakeneh
15.00-15.30 Break		
SESSION 4: Country level experiences with using global datasets 3 (Chair: Seifert)		
15.30-15.50 15.50-16.10 16.10-16.30 16.30-16.50 16.50-17.10 17.10-17.30 17.30-17.45	Colombia Gabon and Central Africa Guyana Brazil IIASA experiences Role and use of global biomass (Oslo w/s outcomes) Open discussions	Galindo Sannier Donoghue Camara Schepaschenko/Lesiv McRoberts/Olofsson all
17.45 Closing of first day		
No-host Dinner (Restaurant/Pizzeria Sa Lolla, Wageningen)		

Day 2

GFOI/GOFC-GOLD expert meeting Wageningen University campus: building Atlas, room Atlas 1 and 2		
Tuesday, 10 Nov. 2015		
SESSION 5: Synthesizing approaches and experiences: group discussions		
09.00-09.30 09.30-11.00	Reflections/discussions from day one and breakout groups Group discussions	Herold all
11.00-11.30 Break		
SESSION 6: Group discussions		
11.30-12.30	Group discussions	all
12.30-13.30 Lunch		
SESSION 7: Presentation of breakout group outcomes		
13.00-14.30	Group presentations and discussions	Group rapporteurs
14.30-15.00 Break		
SESSION 8: Next steps and update of guidance materials		
15.00-17.00 17.00-17.30	Plenary discussions or breaking in smaller groups Closing discussion and next steps	all
17.30 Closing of the meeting		

Annex II List of participants

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Annex III Workshop photos