FAORAP Meeting Report

4th UN-REDD Regional Lessons Learned Workshop: National Forest Monitoring Systems for REDD+

Venue: Bangkok, Thailand

Date: 15-17th October 2013

Background:

REDD+ decisions under the UNFCCC request developing countries aiming to implement REDD+ to develop a National Forest Monitoring System (NFMS). An NFMS enables countries to collect information required to provide measurable, reportable and verifiable estimates of emission reductions and/or removals that occur as a result of the implementation of REDD+ activities. Many countries have made significant progress in developing NFMSs, including components on forest inventory and satellite land monitoring systems. However, the range of methods and advantages or disadvantages of various approaches are not always well known or shared among and between countries. Furthermore, within countries the information required to prepare NFMS and National Greenhouse Gas inventories and reports is often fragmented between different agencies. Thus there are opportunities for individuals and countries within the Asia Pacific region to share information and experiences that will assist them in developing effective and efficient national forest monitoring systems.

The 4th UN-REDD Regional Lessons Learned Workshop, on **National Forest Monitoring Systems for REDD+**, responded to these opportunities. This workshop was part of a series of regional events around the world, organized by FAO. The UN-REDD document *"National Forest Monitoring Systems: Monitoring and Measurement, Reporting and Verification (M & MRV) in the context of REDD+ Activities"* was the key reference document for this workshop, and the basis for most of the sessions and presentation material. The workshop was held in partnership with two USAID-funded projects involved in building capacity for NFMS in Asia and the Pacific: the SilvaCarbon program of the United States Forest Service (USFS) and the Lowering Emissions in Asia's Forests (LEAF) project.

Objectives:

The key objectives of the meeting were to:

- Build consistency in understanding of key issues relating to NFMS for REDD+, and in application of this understanding in the context of national REDD+ Readiness activities and REDD+ Strategy development;
- Provide an overview of the purposes, benefits, practices, and costs of monitoring forest carbon for REDD+ and for traditional national forest inventory

- Provide an opportunity for information exchange and joint learning across countries in the Asia-Pacific region on NFMS for REDD+;
- Identify capacity gaps in NFMS development and plan follow-up activities for support at regional and national levels.

Summary of Discussions:

The meeting proceeded as outlined in the agenda provided in Annex 1. The workshop gathered 83 participants from 20 countries, 15 of which are UN-REDD member countries (see participant list in Annex 2). Opening the workshop, Vili Fuavao, Deputy Regional Representative for FAO in Asia and the Pacific, said "NFMS's for REDD+ should include both a 'Monitoring' function and a 'Measuring, Reporting and Verification (MRV)' function as integral parts of REDD+ readiness." See Annex 3 for the full opening address. The participants then had the opportunity to discuss how these two functions complement each other and how the three pillars of MRV - National Forest Inventory, Satellite Land Monitoring System, and Greenhouse Gas Inventory - fit together. Their expectations were collected at the beginning of the workshop so that they could be reviewed at the end of the proceedings.

Many countries are working to improve their NFMSs, according to their own national circumstances. They face many issues and problems in common and by sharing experiences through this workshop, they were able to explore a number of potential avenues for collaboration, enhancing South-South learning.

The workshop included presentations covering all aspects of NFMS (see Annex 4), and group work to discuss some of these topics in greater depth. Resource persons included Ben Vickers and Joel Scriven, regional UN-REDD officers of FAO RAP, Danilo Mollicone of FOM in FAO HQ and Adam Gerrand of NRC in FAO HQ. Kimberley Todd of UNDP/UN-REDD and Lucy Goodman of UNEP/UN-REDD provided expertise from FAO's partner agencies within the UN-REDD programme, with additional facilitation support coming from UNDP and UNEP officers in the UN-REDD Asia-Pacific advisory team. Marija Spirovska-Kono of SilvaCarbon, Geoffrey Blate of USFS and Peter Stephen of LEAF also served as expert resource persons and facilitators throughout the three days of the workshop.

The first technical session, taking up all of day 1 after the opening address, consisted of an introduction to the NFMS for REDD+, as outlined in the key reference document, and to each of the four key components: the 'Monitoring' function, and the three pillars of the 'MRV' function – Satellite Land Monitoring System (SLMS), National Forest Inventory (NFI) and Greenhouse Gas Inventory (GHG-I). Mr Vickers, Dr Scriven, Dr Mollicone and Ms Todd were the presenters. The presentations were followed by group work. Groups of participants were asked to discuss the information presented during the session and identify (a) issues requiring further discussion or where there is potential difference of opinion; (b) questions of clarification and (c) subjects or topics which were omitted but should have been covered. All of these points were recorded but the groups were asked to prioritise two questions only to

take forward to a plenary discussion. Each group then had the opportunity to direct these questions to the panel of the four presenters.

The second technical session covered the first half of day 2 and introduced experiences from the Asia-Pacific region with tools used for NFMS's. Presenters included Ms Goodman, Dr Mollicone and Dr Blate as well as Joe Pokana from the Papua New Guinea Forest Authority (PNGFA) and Nguyen Dinh Hung of Viet Nam's Forest Inventory and Planning Institute (FIPI). These presentations generated discussions on the options available for countries in designing an NFMS for REDD+, and introduced practical examples of work already ongoing.

The third technical session covered three hours of the afternoon of day 2 and consisted of four parallel group discussions related to the four components introduced on day 1. The first group, facilitated by Dr Mollicone, compared national experiences with remote sensing technologies for SLMS. The second group, facilitated by Dr Blate and Ms Spirovska-Kono, examined the current status of NFIs in the region, using Dr Hung's presentation on Viet Nam's NFI as a starting point for identifying country-specific objectives for NFIs. The third group, facilitated by Ms Todd, examined reporting requirements for GHG-I under the UNFCCC, and the needs of countries in the region in order to meet these requirements. The fourth group, facilitated by Ms Goodman, discussed the potential for collection of different types of information through an NFMS, including socio-economic and environmental information relevant for addressing REDD+ safeguards.

The fourth technical session lasted for an hour and a half at the end of day 2, involving presentations by each of the four break-out groups back to the plenary, facilitated by Mr Vickers and Mr Gerrand.

The fifth technical session took up the whole of day 3 and concerned the development of NFMS Action Plans for REDD+. Mr Vickers introduced the concept of these Action Plans, followed by presentations by Mariam Akhter of FAO Bangladesh and Gewa Gamoga of PNGFA to outline the experience of Action Plan development in their respective countries. Participants then divided into their respective country groups to identify those activities ongoing and resources available in their countries which would contribute to NFMS Action Plan development, and thus their respective needs for resources and technical advice. Country groups then met in five sub-regional clusters (South Asia, Greater Mekong, NE Asia, Archipelagic SE Asia, and the Pacific) for moderated discussions on the opportunities for sub-regional collaboration and capacity building. These sub-regional groups then reported back to the plenary.

The workshop concluded with introductions to future plans for NFMS capacity building activities in the region by FAO, LEAF, SilvaCarbon and RECOFTC, and a review of participants' expectations, facilitated by Mr Gerrand.

Summary of Conclusions and Recommendations:

- REDD+ is not simply concerned with measuring the carbon stored in forests. It is also about finding ways to better manage our forests in the interests of all those whose

livelihoods depend on them. A National Forest Monitoring System, in the context of REDD+, must facilitate both of these objectives.

- Future regional capacity building events on NFMS for REDD+ should reprise the collaboration between UN-REDD (FAO), SilvaCarbon and LEAF
- The distinction between MRV and Monitoring functions of an NFMS for REDD+ is crucial to understanding how REDD+ strategies actually contribute to net reductions in GHG emissions, and thus for designing appropriate policies and measures.
- Long-term cost effectiveness and affordability of tools used for SLMS and NFI are key considerations in the design of a nationally-appropriate NFMS, and take precedence over greater accuracy in the majority of cases
- NFMS must be designed to suit the long-term information needs of the country foremost, rather than specifically for REDD+
- Substantial potential for sub-regional capacity building exists, for example from India and Nepal to other South Asian countries.

Annex 1:
Meeting Agenda

4th UN-REDD Regional Lessons Learned Workshop

National Forest Monitoring Systems for REDD+

Bangkok, Thailand, 15-17 October 2013

WORKSHOP AGENDA

Day 1: Tuesday 15th October 2013

Registration and refreshments from 08:00

Time	Topic / activity	Speaker	Facilitator / comments
Introductory session. Moderator Ben Vickers (FAO UN-REDD)			
09.00 – 09.15	Welcome and opening comments	Vili Fuavao, Deputy Regional Representative (FAO RAP) Daniel Whyner (Deputy Director, Regional Environment Office, USAID RDMA)	
09.45 – 10.15	Objectives of workshop Participants discuss expectations in pairs and write up cards	Adam Gerrand, FAO UN-REDD	
10.15 – 10.45	*Tea / Coffee break*		
Technical Session 1	**NFMS in the context of REDD+: The four components of an NFMS** *Moderator: Adam Gerrand (FAO UN-REDD)*		
10.45 – 11.10	Outline of UNFCCC requirements, IPCC guidelines for national reporting. Introduction to the UN-REDD Programme and the approach to NFMS in the context of REDD+	Ben Vickers, FAO UN-REDD	
11.10 – 11.40	Component 1: Satellite Land Monitoring Systems: Getting **Activity data** from remote sensing	Danilo Mollicone, FAO	
11.40 – 12.00	Component 2: National Forest Inventory: Getting **Emission factor** data from National Forest Inventories	Joel Scriven, FAO UN-REDD	
12.00 – 13.00	*Lunch break*		
13.00 – 13.20	Component 3: **Greenhouse Gas Inventory**: Reporting requirements for the forest sector	Kimberly Todd, UNDP UN-REDD	
13.20 – 13.40	Component 4: Forest Monitoring: Going **beyond MRV**	Ben Vickers, FAO UN-REDD	

13.40 – 14.45	**Group work**: Developing questions on the four NFMS components – issues, clarifications, and omissions. Break into small groups, start with pairs to discuss the presentations, aim to develop 2 questions to take to the plenary after tea/coffee break	Facilitators: Geoffrey Blate, Danilo Mollicone, Lucy Goodman, Joel Scriven, Peter Stephen, Kim Todd, Ben Vickers, Celina Yong.	
14.45 – 15.15	*Tea / Coffee break*		
15:15 – 17:00	Moderated Q+A on four NFMS components	Danilo Mollicone, FAO Joel Scriven, FAO UN-REDD Ben Vickers, FAO UN-REDD Kim Todd, UNDP UN-REDD	Adam Gerrand

Day 2: Wednesday 16th October 2013

Start / end time	**Topic / activity**	**Speaker**	**Facilitator / comments**
09.00 – 09.15	Summary and report back from Day 1	Rapporteur to be selected	
Technical session 2	**Regional experiences with NFMS tools** *Moderator: Marija Spirovska- Kono, SilvaCarbon*		
09.15 – 09.45	Spatial analysis for REDD+ activity planning	Lucy Goodman, UNEP-WCMC, UN-REDD	
09.45 - 10.15	Experience from PNG's NFMS preparations	Joe Pokana, PNG OCCD Gewa Gamoga, PNG FA	
10.15 – 10.45	Remote sensing tools for REDD+	Danilo Mollicone, FAO	
10.45 – 11.15	*Tea / Coffee break*		
11:15 – 11:45	How to do an NFI in 20 steps and Introduction to the Design Tool for Inventory and Monitoring	Geoffrey Blate, USFS	
11:45 – 12:15	Designing NFMS for REDD+ in Viet Nam	Nguyen Dinh Hung, FIPI Viet Nam	
12.15 – 13.15	*Lunch break*		

Participants split up into 4 parallel breakout groups to discuss technical topics in more detail, and then report back to main plenary in afternoon session				
Technical Session 3	**Parallel break out groups Technical topics needed to implement a National Forest Monitoring system for REDD+. Sharing new approaches and techniques, challenges and experiences.**			
13.15 - 16.00	**1. Satellite Land Monitoring System for a NFMS and REDD+**	**2. National Forest Inventories**	**3. GHG Inventories and national communications**	**4. Collecting other information** (e.g. socio-economic and biodiversity data)
13.00 - 16.00 (continued)	Comparing remote sensing technologies for Activity Data generation; national experiences Facilitator: Danilo Mollicone, FAO	Current status of NFI's in region – what objectives, do they meet REDD+ needs? Starting points from Viet Nam presentation on NFI for REDD+ Group discussion on broad monitoring objectives, questions to be addressed in NFI Facilitators: Geoff Blate and Marija Spirovska- Kono	Reporting requirements for UNFCCC; national experiences and information needs Facilitator: Kimberly Todd, UNDP UN-REDD	What information can we use from forest and land use monitoring for NFMS and safeguards information system and spatial planning for REDD+ Facilitator: Lucy Goodman, UNEP-WCMC, UN-REDD
16.00 – 16.20	*Tea / Coffee break*			

Technical session 4	**Report back to all from technical breakout groups and discussions**	**Speaker**	**Facilitator / comments**
16.20 – 16.30	1. Satellite Land Monitoring System for a NFMS and REDD+	Working group nominee	Ben Vickers, FAO UN-REDD
16.30 – 16.40	2. National Forest Inventories	Working group nominee	
16.40 - 16.50	3. GHG Inventories and national communications	Working group nominee	
16.50 - 17.00	4. Collecting other information	Working group nominee	
17.00 – 17.30	Bringing it all together – discussion on combining all components into an NFMS	Facilitated group discussion	Adam Gerrand, FAO UN-REDD

Day 3: Thursday 17th October 2013

Technical session 5	Topic	Speaker	Facilitator / comments
9.00 – 9.30	Summary and report back from Day 2	Rapporteur	
9.30 – 9.45	Introduction to the NFMS Action Plan	Ben Vickers, FAO UN-REDD	
9.45 - 10.30	NFMS Action Plans: national experiences	Mariam Akhter, Bangladesh Gewa Gamoga, PNG	
10.30 – 11.00	*Tea / Coffee break*		
11.00 – 12.00	In-country groups: Identify existing resources and on-going activities contributing to NFMS Action Plan, and prioritise resource and advice needs	Introduction by Ben Vickers Multiple facilitators	
12.00 – 13.00	*Lunch break*		
13.00 – 14.00	Sub-regional country groups: 1. South Asia 2. Greater Mekong Sub-region 3. NE Asia 4. Archipelagic SE Asia 5. Pacific Moderated discussion on opportunities for sub-regional collaboration and capacity building events		Ben Vickers Geoffrey Blate Joel Scriven Peter Stephen Adam Gerrand
14.00 – 15.00	Reporting back from sub-regional groups (10 minutes each)		Ben Vickers, FAO UN-REDD
15.00 – 15.30	*Tea / Coffee break*		
15.30 - 16.30	Future plans for regional NFMS capacity building activities	Adam Gerrand, FAO UN-REDD Peter Stephen, LEAF Marija Kono, SilvaCarbon Caroline Liou, RECOFTC	
16:30 – 17:00	Meeting workshop expectations: Review initial days cards and questions	Adam Gerrand, FAO UN-REDD	
17.00 – 17.30	*Workshop closing comments*		

Annex 2:
Participant List

4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring Systems (NFMS) for REDD+"

15-17 October 2013 | Swissotel Nai Lert Park, Bangkok, Thailand

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Annex 3:
Opening Address (FAO)

منظمة الأغذية والزراعة للأمم المتحدة | 联合国粮食及农业组织 | Food and Agriculture Organization of the United Nations | Organisation des Nations Unies pour l'alimentation et l'agriculture | Продовольственная и сельскохозяйственная организация Объединенных Наций | Organización de las Naciones Unidas para la Agricultura y la Alimentación

WELCOME ADDRESS

of

Hiroyuki Konuma
Assistant Director-General and
FAO Regional Representative for Asia and the Pacific

delivered by

Vili Fuavao
Deputy Regional Representative
FAO Regional Office for Asia and the Pacific

at the
4th UN-REDD Regional Lessons Learned Workshop
National Forest Monitoring Systems for REDD+

15 October 2013
Bangkok, Thailand

Mr Daniel Whyner , Deputy Office Chief, Regional Environment Office-USAID

Distinguished Participants, Colleagues, Friends, Ladies and Gentlemen

Good morning! It's a great pleasure for me to be here this morning and to welcome you on behalf of Mr. Hiroyuki Konuma, Assistant Director General and Regional Representative for Asia and the Pacific, and our UN-REDD partners – UNDP and UNEP – to this 4th UN-REDD Regional Lessons Learned Workshop on "National Forest Monitoring Systems for REDD+."

It's great to see such a comprehensive collection of individuals from so many countries, and representing such a wide range of expertise, gathered here for this workshop.

Just a bit of background:
UN-REDD was established in September 2008, as an innovative "One UN" partnership to provide coordinated technical and financial support for the development and implementation of REDD+, utilizing the complementary resources of the three participating UN agencies: FAO, UNDP and UNEP. The Programme is now supporting 49 partner countries, including 15 here in the Asia-Pacific region.

You would ask why are we convening this workshop at this time?

Obviously, the REDD+ concept has greatly increased the recognition given by society to forests, and the importance given to forests for the potential role they can play in reducing greenhouse gas emissions.

But REDD+ is not simply concerned with measuring the carbon stored in forests. It's also about finding ways to better manage our forests in line with the interests of all stakeholders whose livelihoods depend on them and who benefit from them.

A National Forest Monitoring System, for countries which aim to participate in a future international REDD+ mechanism, must facilitate and support both of these objectives.

The workshop agenda is based around the publication that was distributed in your welcome packs: "National Forest Monitoring Systems: Monitoring and

Measurement, Reporting and Verification (MRV) in the context of REDD+." This publication was produced by FAO's UN-REDD team at the request of the UN-REDD Policy Board and released earlier this year. Among the important messages of the publication, and one that I hope you'll all take away from this workshop, is the dual functions of National Forest Monitoring Systems for REDD+. The title of the publication is very long and – I will be the first to admit – rather confusing at first, but for a good reason: it's to highlight that "Monitoring" and "MRV", in the context of REDD+, are two different elements of a National Forest Monitoring System. This workshop will provide an opportunity to delve into the meanings and intricacies of these terms, and to discuss how the three pillars of an MRV system for REDD+: namely National Forest Inventory, Satellite Land Monitoring System, and Greenhouse Gas Inventory, all fit together.

This is only the latest of a series of regional "lessons learned" workshops organized by UN-REDD in Asia and the Pacific. FAO has led in organizing of this particular workshop, owing to our key role within the UN-REDD Programme in supporting country efforts to improve and strengthen forest monitoring.

We know that many countries are working to improve their National Forest Monitoring Systems, according to their own national circumstances. But countries also share many common issues, problems and conditions, so the opportunity to bring experts and stakeholders together from across the region in a workshop like this is very useful – particularly to learn from each other's different approaches, perspectives and experiences.

In reviewing the program, I can see that you have a very interesting 3-day agenda ahead. During the workshop, you'll hear what FAO, UN-REDD,

SilvaCarbon, LEAF and others are doing to support development of National Forest Monitoring Systems in the context of REDD+ Readiness, and in return we will all learn from you how we can more effectively address your needs and priorities.

Before I close my opening remarks, I would like to offer my sincere thanks to our UN agency partners in the UN-REDD programme, UNDP and UNEP, for their substantive contributions to the workshop agenda, and for their positive collaborative work. We're also very grateful to the USAID-funded "LEAF" project and GIZ/SPC for enabling us to bring participants to this workshop from some important countries that are not UN-REDD partners: China, India, Fiji, Korea, Thailand, and Vanuatu. Having these participants here will surely help enrich the discussions and enhance the learning opportunities during the workshop.

Finally, I'd like to highlight that the organization of this workshop has also been very much a collaborative effort between FAO/UN-REDD and the USDA Forest Service-financed "SilvaCarbon" program. I hope that this will be the first of many such collaborations.

I'm confident that you will have a very productive workshop, and I look forward to hearing more about the results from my colleagues after the event is completed.

I wish you all the best in your discussions over the next few days and I hope you have a very pleasant stay here in Bangkok.

Thank you.

Annex 4:
Presentations

4th UN-REDD Regional Lessons Learned Workshop

"National Forest Monitoring System for REDD+"

15th – 17th October 2013
Bangkok, Thailand

UN-REDD PROGRAMME

Introduction and outline of the workshop

Adam Gerrand, adam.gerrand@fao.org

With input from and thanks to:

Ben Vickers

Joel Scriven

and our other partners

Intro to UN-REDD

- Adam to add a few slides on UN-REDD

UN-REDD PROGRAMME

Workshop objectives

1. Build consistency in understanding key issues in NFMS for REDD+ & how this supports national REDD+ Readiness activities
2. Provide an overview of the purposes, benefits, practices, and costs of monitoring forest carbon for REDD+ and for traditional national forest inventory
3. Information exchange & joint learning across countries in the Asia-Pacific region on NFMS for REDD+;
4. Identify capacity gaps in NFMS development and plan follow-up activities for support at regional and national levels.

Outline of the workshop

Day 1: Introductions and presentations on NFMS for REDD+ MRV

Day 2: 3 *[or 4]* sub-groups in parallel sessions:

1) National Forest Inventories
2) Monitoring forests using satellite images
3) Collection of other information in NFI's including socio-economic and biodiversity data, consultation and safeguards
4) Greenhouse Gas Inventory: Reporting requirements for forests

Day 3: NFMS planning and future activities

- Introduction to NFMS Action Plans and national experiences
- Identification of capacity building needs / priorities for NFMS for REDD +
- Future plans for regional NFMS capacity building activities

UN-REDD PROGRAMME

Expected Outcomes from the workshop?

- Outputs
  - A report on the workshop, including notes on issues requiring further work to develop countries NFMS capacity
  - Presentations will be on a website (or copy your USB on Friday)
- Outcomes?
  - Improved knowledge, skills and networks on NFMS for REDD+
  - Aim to help countries UN-REDD and other agencies plan work
  - Help plan next years workshops
- We look forward to your input!

Part of a global series - Latin American NFMS workshop 63 Participants, from 11 countries

Some formal presentations, lots of active working groups:

UN-REDD PROGRAMME

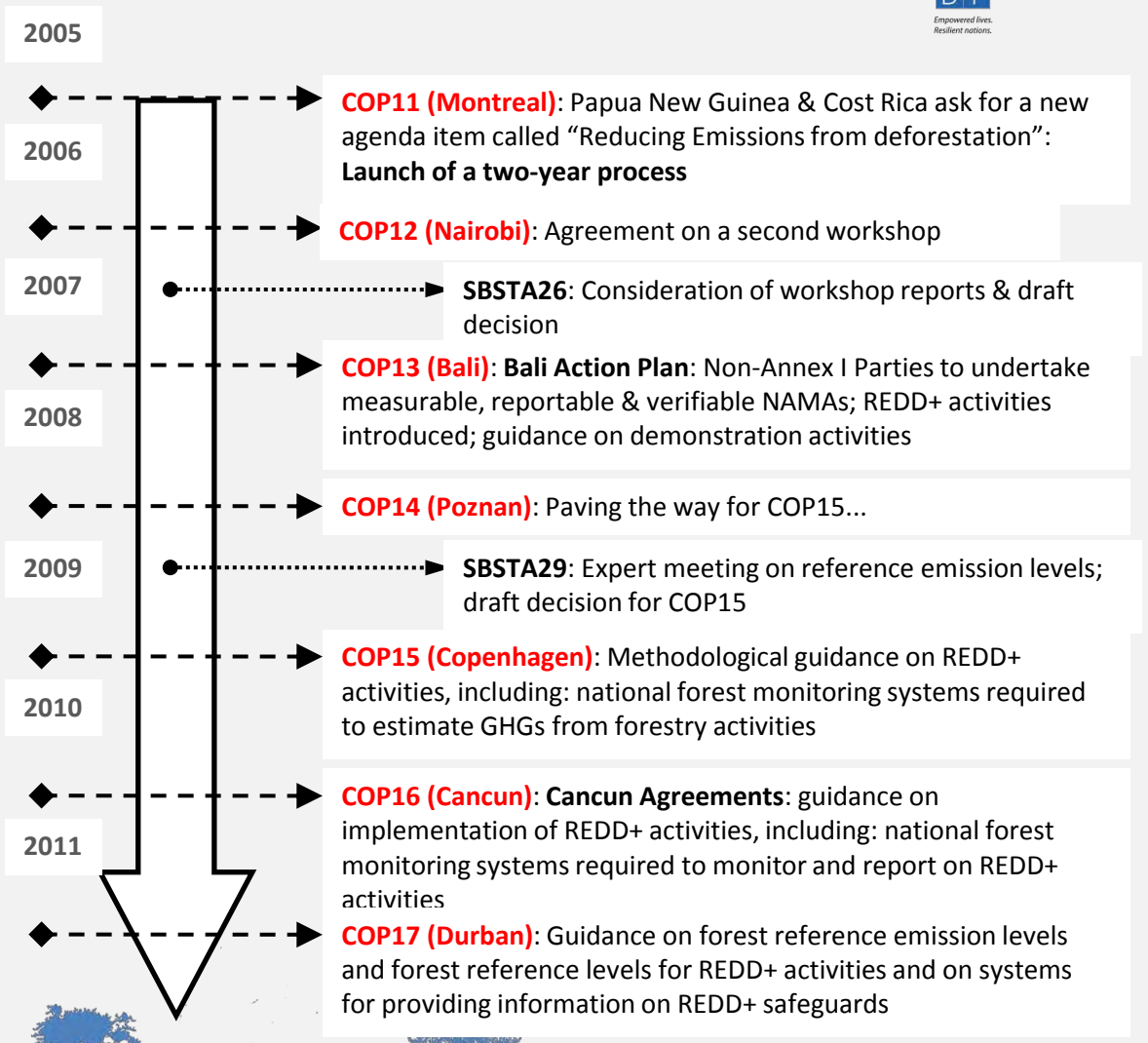
National Forest Monitoring Systems (NFMS) in the context of REDD+

Bangkok

15th October 2013

UN-REDD PROGRAMME

REDD+ discussions under the UNFCCC



UN-REDD PROGRAMME

REDD+ Activities

"Encourages *developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities, as deemed appropriate by each Party and in accordance with their respective capabilities and national circumstances:*

- *Reducing emissions from deforestation;*
- *Reducing emissions from forest degradation;*
- *Conservation of forest carbon stocks;*
- *Sustainable management of forests;*
- *Enhancement of forest carbon stocks."*

REDD+ under the UNFCCC

The Cancun Agreements (Decision 1/CP.16)

Elements requested to be developed

"….requested developing country Parties aiming to undertake the REDD+ activities, in the context of the provision of adequate and predictable support, including financial resources and technical and technological support, in accordance with national circumstances and respective capabilities, to develop:

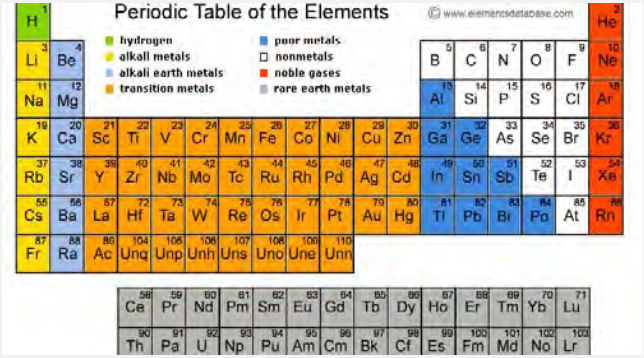
- *A national strategy or action plan*
- *Forest reference emission level and/or forest reference level*
- ***A robust and transparent national forest monitoring system for the monitoring and reporting of REDD+ activities***
- *A system for providing information on how the safeguards are being addressed and respected"*

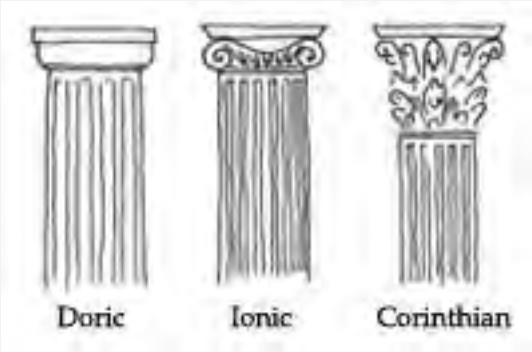
MRV

SIS

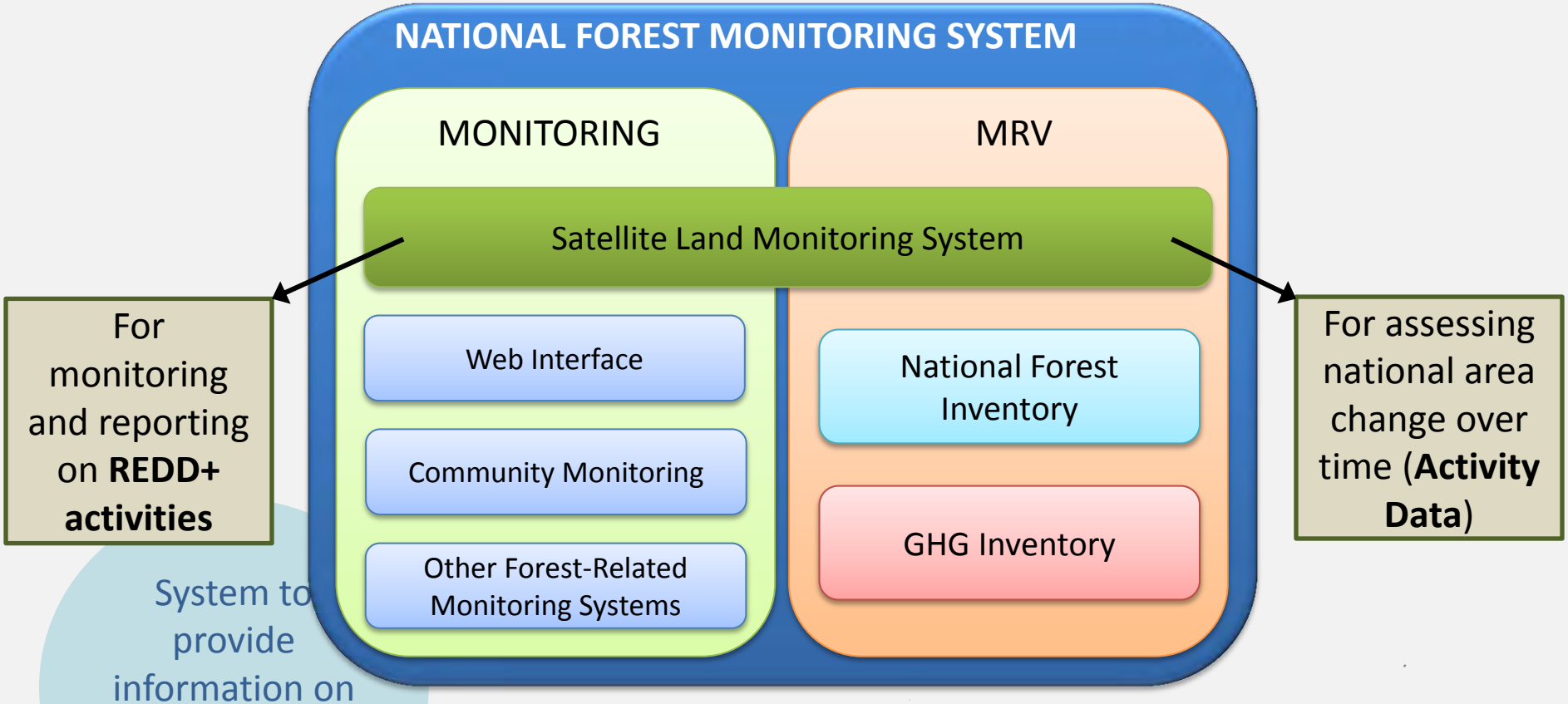
UN-REDD PROGRAMME

Breaking down the NFMS





Functions of the NFMS



UN-REDD PROGRAMME

Why two functions?

- NFMS has two functions in REDD+ context:
  - Monitoring (M) of Policies and Measures (PAMs)
  - Measurement (the M of MRV) of emissions and removals
- Develop the NFMS in a stepwise approach through 3 Phases of REDD+
- Fully operational in Phase 3, to allow for positive incentives under an international mechanism

UN-REDD PROGRAMME

Monitoring function Objectives

- To deliver a comprehensive assessment of the outcome of REDD+ Policies and Measures (PAMs)
- To include carbon stocks plus all other information requirements to assess performance and safeguards under the Cancun Agreements e.g:
  - Forest health and condition, Biodiversity, Socio-economic functions
- To develop efficient, equitable resource allocation mechanisms
- To provide information necessary for non-REDD+ purposes, for wider forestry and land use sector objectives

Monitoring function Practice

- REDD+ policies and measures, implementation and performance
- Direct monitoring of forest carbon stocks, and stock changes, as a result of PAMs
- Indicators to track implementation of a specific policy or measure – proxy indicators for forest carbon e.g.
  - Monitor volume of timber harvested through an SMF measure, as a proxy for impact on carbon
- Primarily a ***domestic*** tool, to allow countries to assess and refine PAMs
- Use existing tools where possible (e.g. network of forest inspectors) and new tools where necessary (e.g. satellite remote sensing system)
- Harmonize existing tools with new tools and with newly required capacities for MRV

UN-REDD PROGRAMME

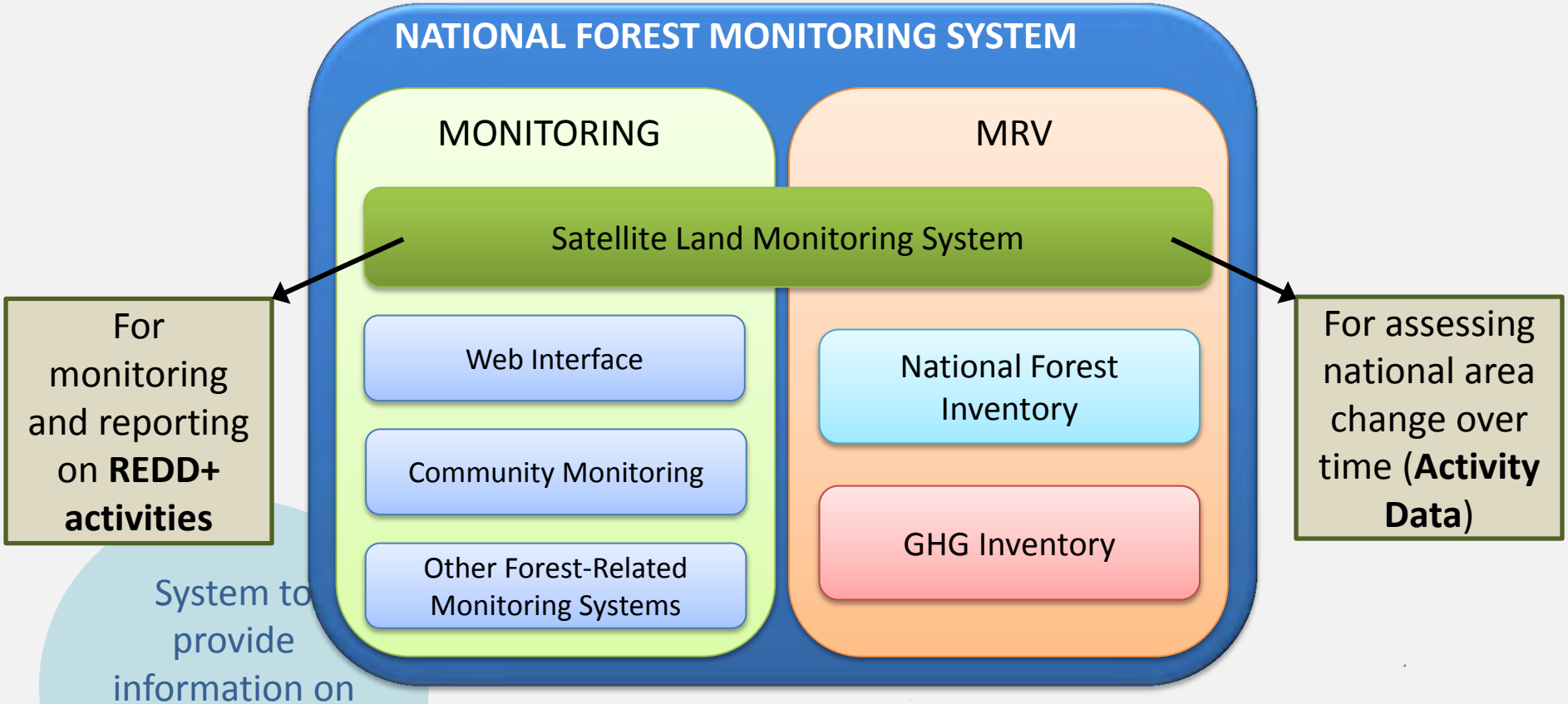
MRV within an NFMS

*"…establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems and, if appropriate, sub-national systems as part of **national forest monitoring systems** that:*

- *Use a combination of remote sensing and ground-based forest carbon inventory approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes;*
- *Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities;*
- *Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties;"*

"Taking note of, if appropriate, the guidance on consistent representation of land in the Intergovernmental Panel on Climate Change Good Practice Guidance for Land Use, Land-Use Change and Forestry."

Functions of the NFMS



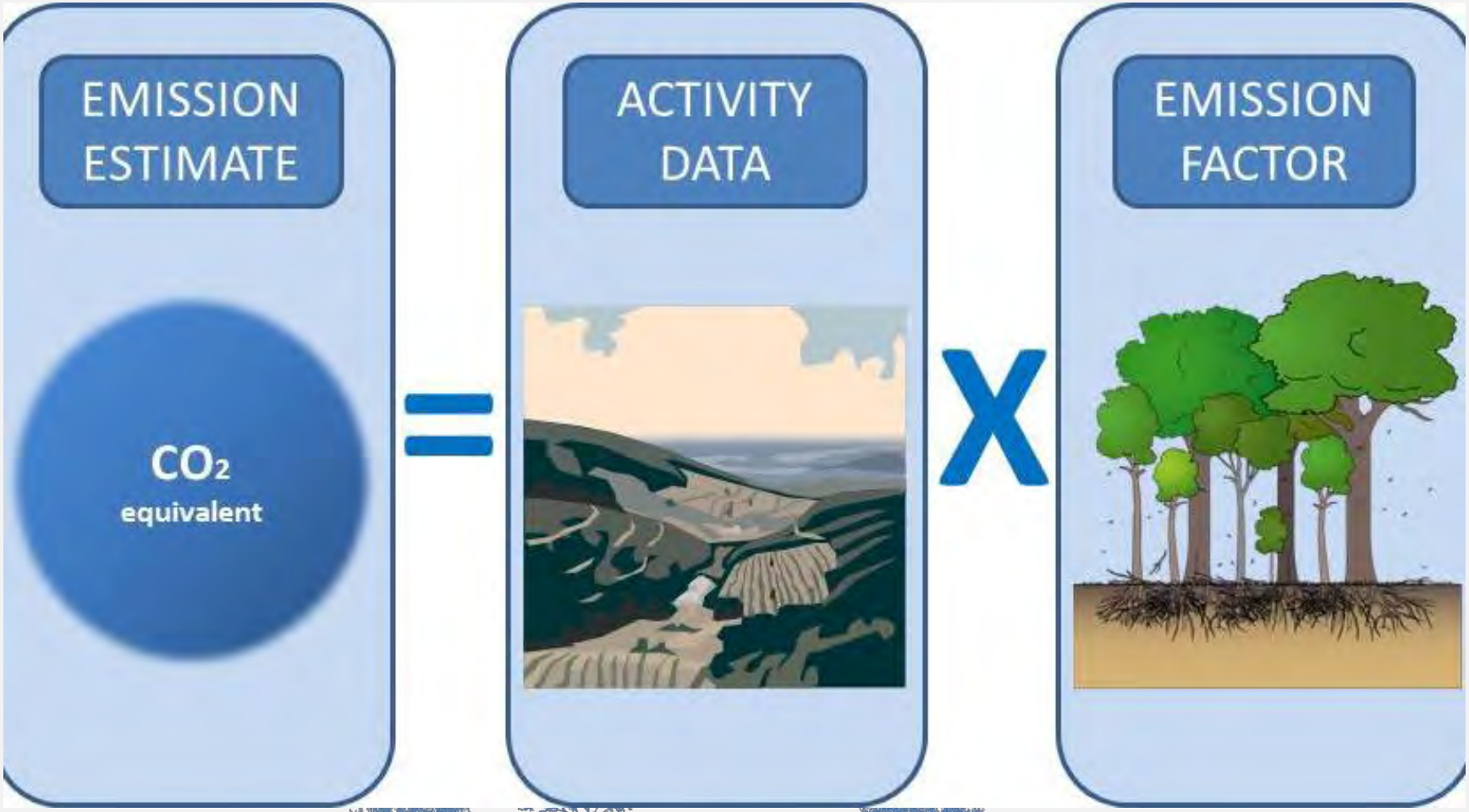
Pillars of MRV

The monitoring function of NFMS can be defined only broadly. Its components will vary depending on national circumstances

The MRV function will always consist of three main components or 'pillars':

- The satellite land monitoring system (SLMS)
  - To collect Activity Data (AD)
- The national forest inventory (NFI)
  - To gather information for obtain emission factors (EFs)
- The national GHG inventory (GHG-I)
  - To provide emissions and removals estimates for a national report

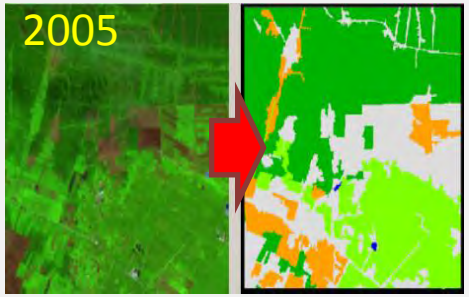
MRV according to IPCC guidance



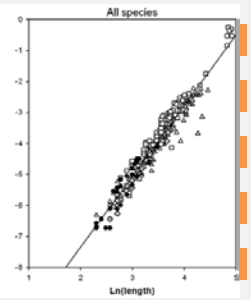
How the pillars combine for MRV

M

ACTIVITY DATA
(SLMS)

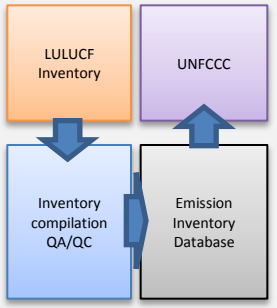


EMISSION FACTORS
(National Forest Invetories)



R

GHGs invetories



V

UNFCCC secretariat
Roster of Experts

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Activity Data

- Data showing the extent and magnitude of a particular human-induced activity e.g.
  - Land area, Management systems, Materials used
- Three approaches to AD collection for land area, recommended by IPCC
  1. Net change in total areas of land categories within a defined spatial unit (e.g. a country)
  2. Tracks land use conversions between categories
  3. Tracks conversion between categories on a spatially-explicit basis

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Emission Factors

- Coefficients that quantify emissions or removals of GHGs per unit of a specific human-induced activity e.g.
  - tCO_2e per ha of forest cleared, per kg of fertiliser used, per household using improved cookstove
- An average value, a proxy for direct measurement, giving an ***estimate***
- IPCC identifies 3 'tiers' of methods to obtain estimates, with increasing accuracy
  1. Use IPCC default EF data (EF database)
  2. Apply country- or region-specific EFs which allow more disaggregated AD
  3. Regular, detailed inventories used to create very specific EFs and models

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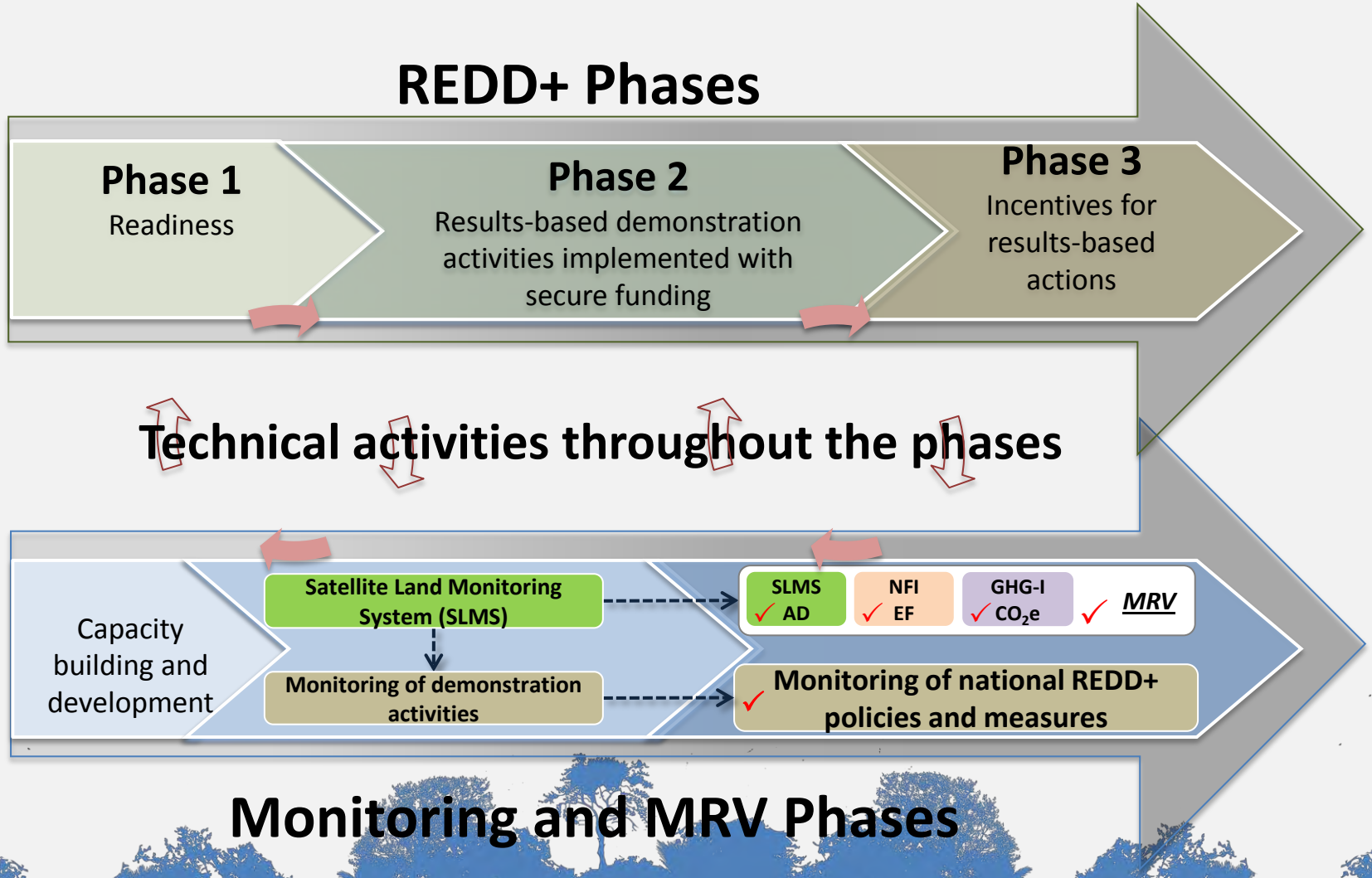
Phased implementation of the NFMS



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Principles for NFMS

- National Ownership
  - Countries must have full control over the NFMS development process, assuming full responsibility for effective operation through to implementation in Phase 3. Partner organisations should be limited to a TA and capacity building role.
- Build on existing systems and capacities:
  - Use, wherever possible, existing programmes, initiatives, institutions and infrastructure
- Consistency with UNFCCC process:
  - Fully integrate REDD+ strategies and NFMS with UNFCCC commitments, including for NAMAs

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Ben Vickers

ben.vickers@fao.org

Thank You

Website: http://www.un-redd.org

Satellite Land Monitoring Systems: Getting activity data from remote sensing

Danilo Mollicone
FAO Forestry Department

Outline

- IPCC framework for consistent land representation
- Annex I countries methodological approaches to report activity data
- Efforts to improve earth observation methodologies
- Methodological solutions for non-Annex I countries

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UNDP Empowered lives. Resilient nations.

UNEP

IPCC FRAMEWORK FOR CONSISTENT LAND REPRESENTATION

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Systems for land representation should be:

- **adequate**, i.e., capable of representing land-use categories, and conversions between land-use categories, as needed to estimate carbon stock changes and greenhouse gas emissions and removals;
- **consistent**, i.e., capable of representing land-use categories consistently over time, without being unduly affected by artificial discontinuities in time-series data;
- **complete**, which means that all land within a country should be included, with increases in some areas balanced by decreases in others, recognizing the bio-physical stratification of land if needed (and as can be supported by data) for estimating and reporting emissions and removals of greenhouse gases; and
- **transparent**, i.e., data sources, definitions, methodologies and assumptions should be clearly described.

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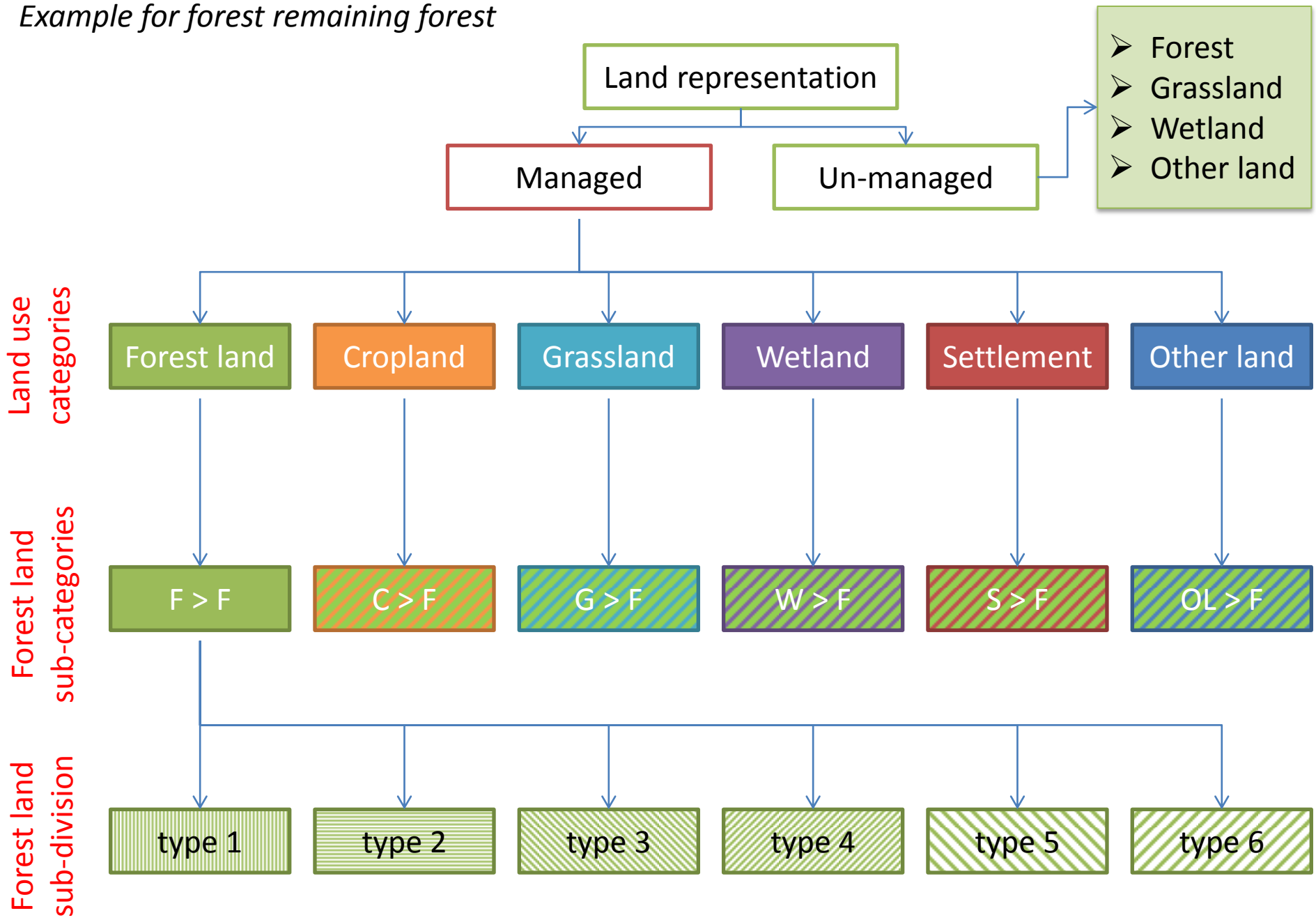
Land representation follow the framework of:

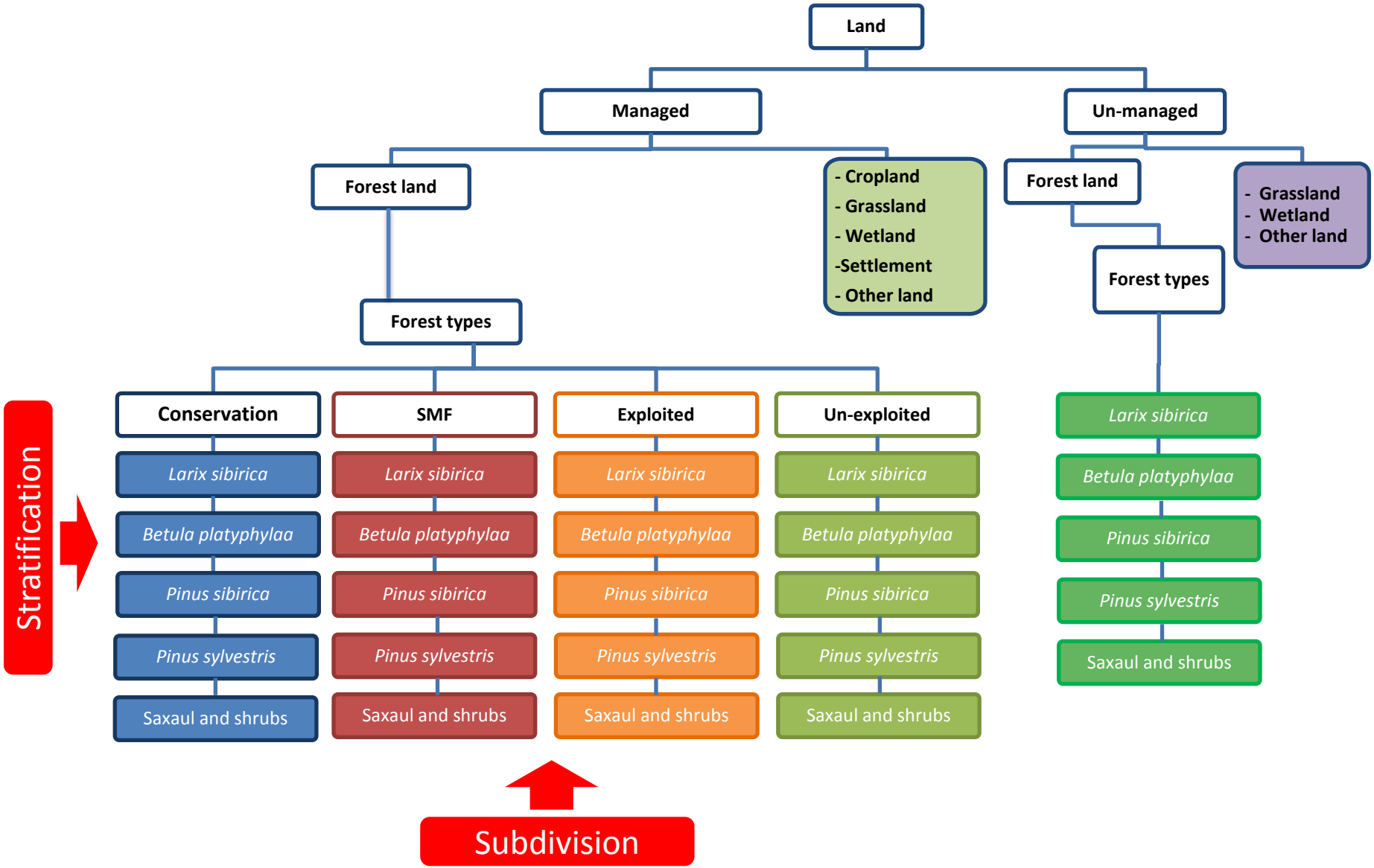
- **Land-use category** - is the broad land use (one of the six land-use categories described below) reported as either land remaining in a land-use category (i.e., remaining in the same use throughout the inventory timeseries) or land converted to a new land-use category (representing a change in land use).
- **Land use sub-category** - refers to special circumstances (e.g., areas of grazing within Forest Land) that are estimated and reported separately but do not duplicate land in the broad land-use category.
- **Land-use sub-division** Land-use categories and sub-categories may be further stratified on the basis of land-use practices and biophysical characteristics in order to create more homogeneous spatial units as may be used for emissions estimation

IPCC Land Representation Framework

Example for forest remaining forest



Potential Mongolia's Forest Land Stratification & GHG Reporting Sub-Divisions for REDD+



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Within the IPCC Land Representation Framework there are three methodological approaches:

- Approach 1: Basic land-use data
- Approach 2: Survey of land use and land-use change
- Approach 3: Geographically explicit land use data

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APPROACH 1: BASIC LAND-USE DATA

Approach 1 uses area datasets likely to have been prepared for other purposes such as forestry or agricultural statistics. The absence of a unified data system can lead to double counting or omission, since the agencies involved may use different definitions of specific land use for assembling their databases. Coverage must obviously be complete enough to include all land areas affected by the activities set out in the *IPCC Guidelines,* but might not extend to categories such as unmanaged ecosystems, wetlands or settlements.

TABLE 3.2
EXAMPLE OF APPROACH 1: AVAILABLE LAND USE DATA WITH COMPLETE NATIONAL COVERAGE

Time 1			Time 2			Net land-use conversion between Time 1 and Time 2		
F	=	18	F	=	19	Forest Land	=	+1
G	=	84	G	=	82	Grassland	=	-2
C	=	31	C	=	29	Cropland	=	-2
W	=	0	W	=	0	Wetlands	=	0
S	=	5	S	=	8	Settlements	=	+3
O	=	2	O	=	2	Other Land	=	0
Sum	=	140	Sum	=	140	Sum	=	0

Note: F = Forest Land, G = Grassland, C = Cropland, W = Wetlands, S = Settlements, O = Other Land. Numbers represent area units (Mha in this example).

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APPROACH 2: SURVEY OF LAND USE AND LAND-USE CHANGE

The essential feature of Approach 2 is that it provides a national or regional-scale assessment of not only the losses or gains in the area of specific land categories but what these changes represent (i.e., changes from and to a category). Tracking land-use changes in this explicit manner will normally require estimation of initial and final land-use categories, as well as of total area of unchanged land by category. The final result of this approach can be presented as a non spatially explicit land-use change matrix.

TABLE 3.6
SIMPLIFIED LAND-USE CONVERSION MATRIX FOR APPROACH 2 EXAMPLE

Net land-use conversion matrix

Final \ Initial	F	G	C	W	S	O	*Final sum*
F	**15**	3	1				*19*
G	2	**80**					*82*
C			**29**				*29*
W				**0**			*0*
S	1	1	1		**5**		*8*
O						**2**	*2*
Initial sum	***18***	***84***	***31***	***0***	***5***	***2***	***140***

Note:
F = Forest Land, G = Grassland, C = Cropland, W = Wetlands,
S = Settlements, O = Other Land

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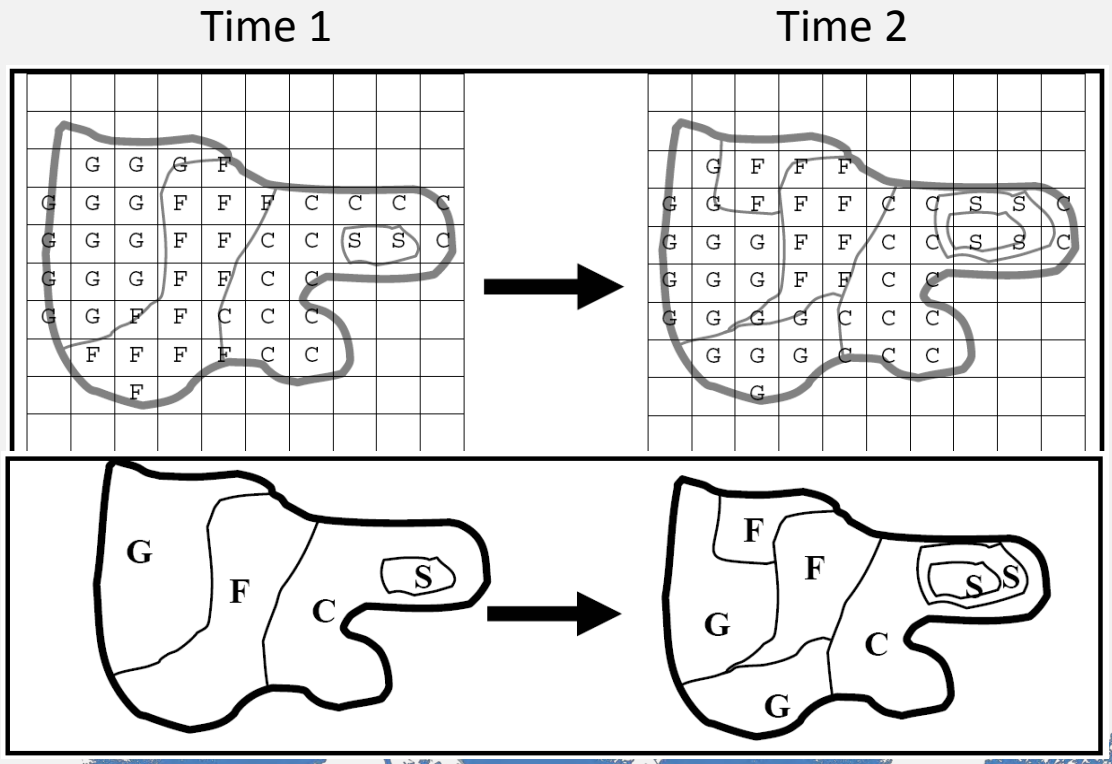
APPROACH 3: GEOGRAPHICALLY EXPLICIT LAND USE DATA

Approach 3 requires spatially explicit observations of land use and land-use change. The data may be obtained either by sampling of geographically located points, a complete tally (wall-to-wall mapping), or a combination of the two. Approach 3 is comprehensive and relatively simple conceptually but data intensive to implement.



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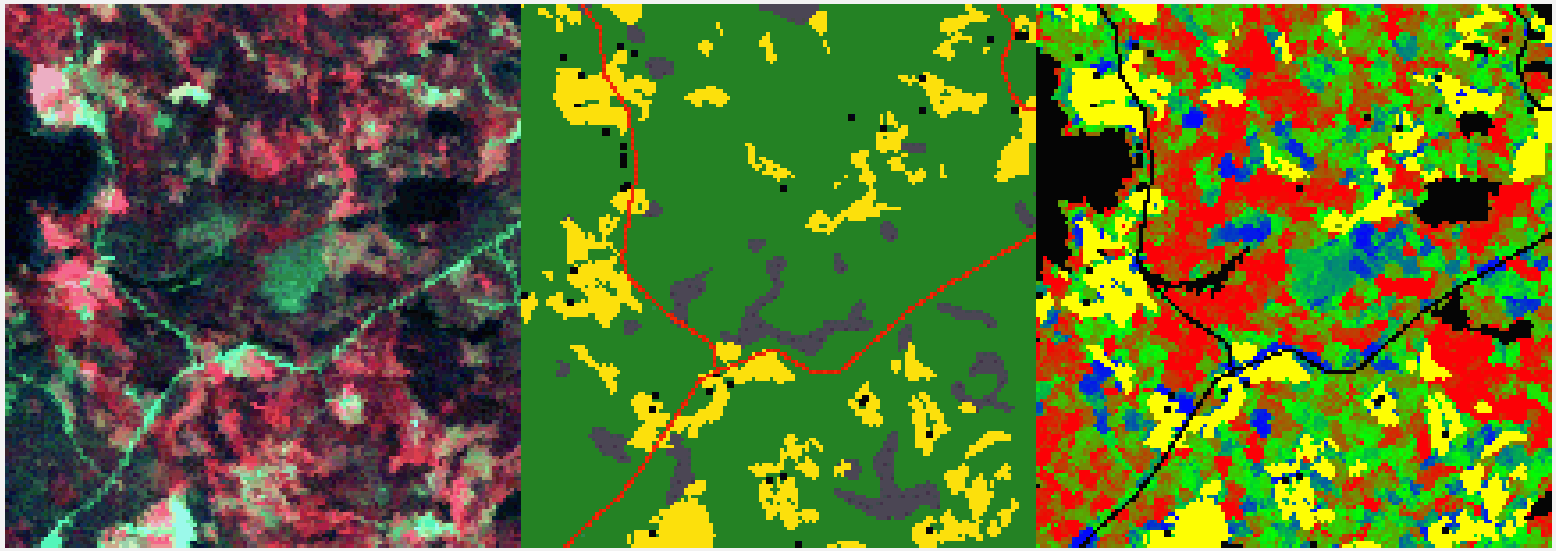
APPROACH 3: GEOGRAPHICALLY EXPLICIT LAND USE DATA

By wall-to-wall mapping



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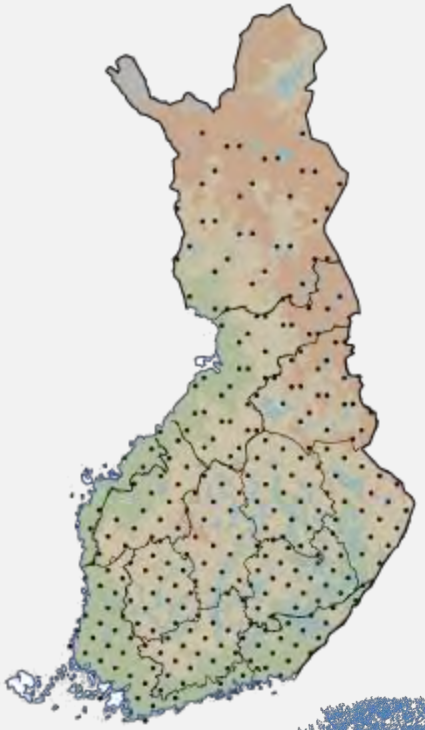
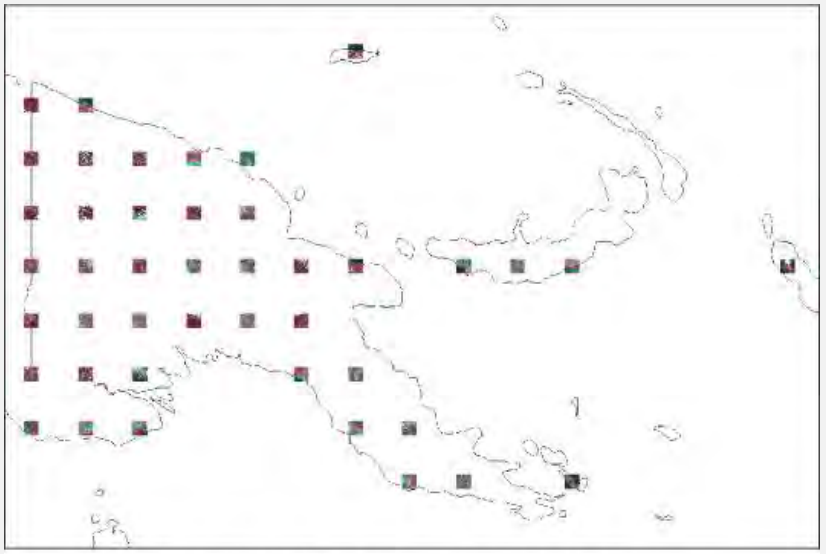
APPROACH 3: GEOGRAPHICALLY EXPLICIT LAND USE DATA

by sampling of geographically

located points or area subsets





Sample frame: geographical grid (a sample at each 1° × 1°)
Sample size: 20 × 20 km^2 (with extracts of Landsat imagery for year 2000)

Activity Data in the GHG Inventory

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TABLE 5.A SECTORAL BACKGROUND DATA FOR LAND USE, LAND

Forest Land

(Sheet 1 of 1)

Inventory 2011

Submission 2013 v1.1

CANADA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		ACTIVITY DATA		CHANGES IN CARBON STOCK					
Land-Use Category	Sub-division[1]	Area[2] (kha)	Area of organic soil (kha)	k change in living biomass[3][4]		Net carbon stock change in dead organic matter[4]	Net carbon stock change in soils[4][6]		Net CO_2 emissions/ removals[8][9]
				Losses	Net change		Mineral soils	Organic soils[7]	
				(Gg C)					(Gg)
A. Total Forest Land		229,346.62	IE,	7	-800,176.11	-2,744.55	17,304.02	7,421.12	IE,NO	-80,595.52
1. Forest Land remaining Forest Land		229,266.44		1	-800,078.62	-2,910.81	17,264.78	7,436.41	IE	-79,898.03
	RZ10 Boreal Plains	36,032.12		4	-138,279.96	-13,325.02	16,302.40	1,030.36	IE	-14,695.08
	RZ11 Subhumid prairies	1,822.59		1	-5,799.63	366.58	48.54	71.99	IE	-1,786.10
	RZ12 Semiarid prairies	18.24		6	-47.90	1.56	0.88	0.57	IE	-11.04
	RZ13 Taiga Plain	20,027.59		1	-42,621.38	6,180.43	2,015.12	615.50	IE	-32,307.18
	RZ14 Montane Cordillera	35,407.71		2	-140,824.00	-9,300.97	-9,613.87	1,947.37	IE	62,214.07
	RZ15 Pacific Maritime	13,204.16		0	-93,856.53	58.77	-2,966.47	298.18	IE	9,568.28
	RZ16 Boreal Cordillera	16,618.57		5	-56,734.56	2,617.79	4,239.63	698.22	IE	-27,703.99
	RZ17 Taiga Cordillera	412.08		5	-1,008.11	163.55	-119.06	15.74	IE	-220.81
	RZ18 Taiga Shield West	1,829.57		4	-4,462.33	-309.79	1,184.54	3.49	IE	-3,220.20
	RZ4 Taiga Shield East	1,102.86		7	-3,442.46	-607.68	120.25	24.72	IE	1,696.63
	RZ5 Boreal Shield East	55,637.29		1	-166,309.17	14,747.54	-5,472.73	1,544.17	IE	-39,669.57
	RZ6 Atlantic Maritime	15,409.20		2	-56,082.22	2,679.10	-1,676.59	254.91	IE	-4,610.56
	RZ7 Mixedwood Plains	2,664.15		0	-10,311.93	2,244.18	-127.33	18.04	IE	-7,827.91
	RZ8 Hudson Plains	302.26		7	-781.59	152.38	-15.79	15.07	IE	-556.10
	RZ9 Boreal Shield West	28,778.05		6	-79,516.86	-8,579.21	13,345.24	898.10	IE	-20,768.46
2. Land converted to Forest Land[10]		80.17	IE,	6	-97.50	166.26	39.25	-15.28	IE,NO	-697.49
2.1 Cropland converted to Forest Land		80.17	IE,	6	-97.50	166.26	39.25	-15.28	IE,NO	-697.49
	RZ10 Boreal Plains	5.92		9	-9.11	14.88	4.50	-1.09	IE	-67.07
	RZ11 Subhumid prairies	0.49		5	-0.87	2.28	0.41	-0.06	IE	-9.65
	RZ12 Semiarid prairies	NO		O	NO	NO	NO	NO	NO	NO
	RZ13 Taiga Plain	NO		O	NO	NO	NO	NO	NO	NO
	RZ14 Montane Cordillera	4.06		3	-1.69	3.04	0.81	-1.06	IE	-10.24
	RZ15 Pacific Maritime	0.80		5	-1.18	2.07	0.48	-0.15	IE	-8.80
	RZ16 Boreal Cordillera	NO		O	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	
Land-Use Category	Sub-division[1]
A. Total Forest Land	
1. Forest Land remaining Forest Land	
	RZ10 Boreal Plains
	RZ11 Subhumid prairies
	RZ12 Semiarid prairies
	RZ13 Taiga Plain
	RZ14 Montane Cordillera
	RZ15 Pacific Maritime
	RZ16 Boreal Cordillera
	RZ17 Taiga Cordillera
	RZ18 Taiga Shield West
	RZ4 Taiga Shield East
	RZ5 Boreal Shield East
	RZ6 Atlantic Maritime
	RZ7 Mixedwood Plains
	RZ8 Hudson Plains
	RZ9 Boreal Shield West
2. Land converted to Forest Land[10]	
2.1 Cropland converted to Forest Land	
	RZ10 Boreal Plains
	RZ11 Subhumid prairies
	RZ12 Semiarid prairies
	RZ13 Taiga Plain
	RZ14 Montane Cordillera
	RZ15 Pacific Maritime
	RZ16 Boreal Cordillera

Activity Data for GHG Inventory

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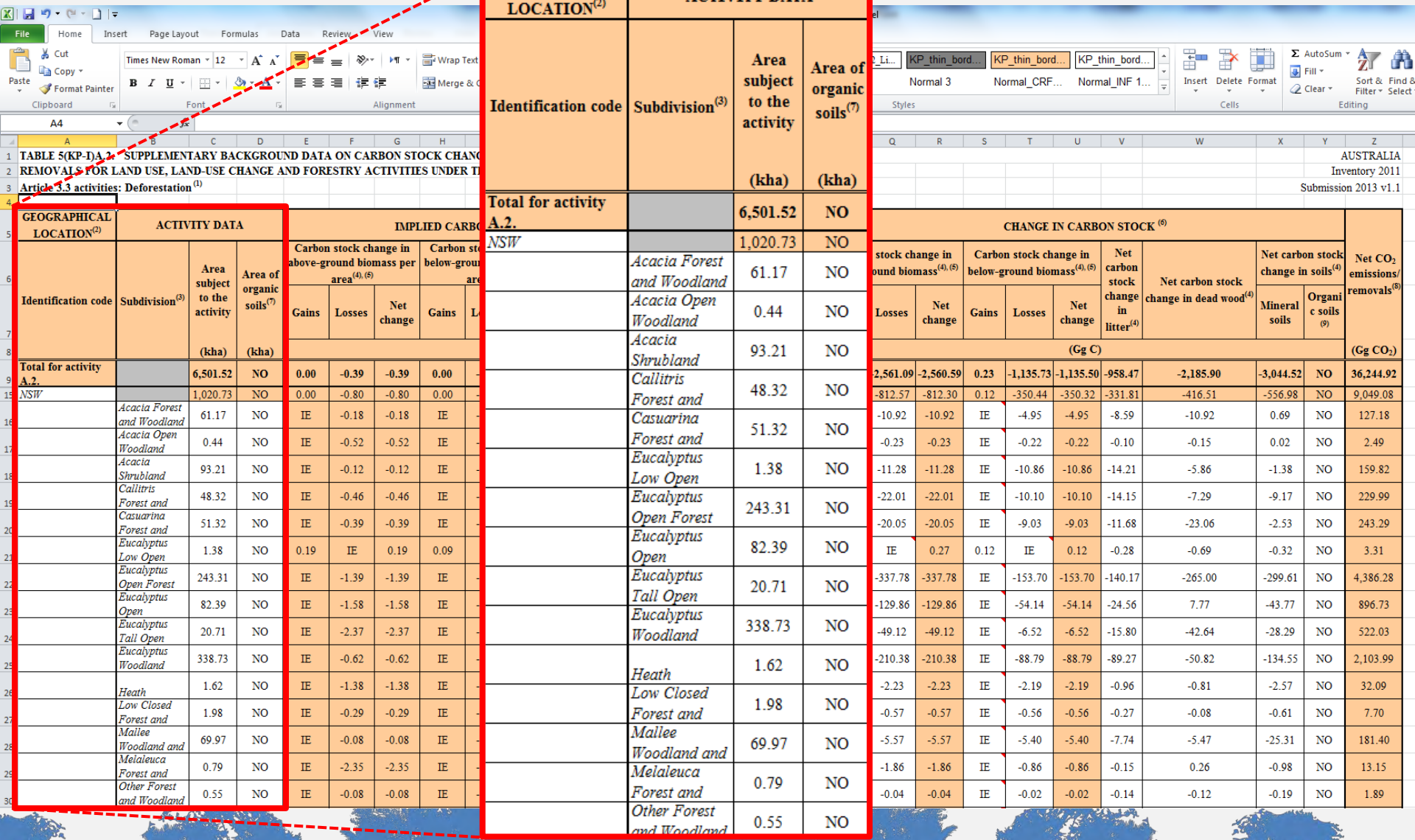


TABLE 5(KP-I)A.2 SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANG
REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER T
Article 3.3 activities: Deforestation (1)

AUSTRALIA
Inventory 2011
Submission 2013 v1.1

GEOGRAPHICAL LOCATION(2)	ACTIVITY DATA			IMPLIED CARBO					CHANGE IN CARBON STOCK (6)									Net CO_2 emissions/ removals(8)
Identification code	Subdivision(3)	Area subject to the activity	Area of organic soils(7)	Carbon stock change in above-ground biomass per area(4), (5)			Carbon st below-grou are		stock change in ound biomass(4), (5)		Carbon stock change in below-ground biomass(4), (5)			Net carbon stock change in litter(4)	Net carbon stock change in dead wood(4)	Net carbon stock change in soils(4)		
				Gains	Losses	Net change	Gains	L	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils (9)	
		(kha)	(kha)															(Gg CO_2)
Total for activity A.2.		**6,501.52**	**NO**	**0.00**	**-0.39**	**-0.39**	**0.00**		**2,561.09**	**-2,560.59**	**0.23**	**-1,135.73**	**-1,135.50**	**-958.47**	**-2,185.90**	**-3,044.52**	**NO**	**36,244.92**
NSW		1,020.73	NO	0.00	-0.80	-0.80	0.00		-812.57	-812.30	0.12	-350.44	-350.32	-331.81	-416.51	-556.98	NO	9,049.08
	Acacia Forest and Woodland	61.17	NO	IE	-0.18	-0.18	IE		-10.92	-10.92	IE	-4.95	-4.95	-8.59	-10.92	0.69	NO	127.18
	Acacia Open Woodland	0.44	NO	IE	-0.52	-0.52	IE		-0.23	-0.23	IE	-0.22	-0.22	-0.10	-0.15	0.02	NO	2.49
	Acacia Shrubland	93.21	NO	IE	-0.12	-0.12	IE		-11.28	-11.28	IE	-10.86	-10.86	-14.21	-5.86	-1.38	NO	159.82
	Callitris Forest and	48.32	NO	IE	-0.46	-0.46	IE		-22.01	-22.01	IE	-10.10	-10.10	-14.15	-7.29	-9.17	NO	229.99
	Casuarina Forest and	51.32	NO	IE	-0.39	-0.39	IE		-20.05	-20.05	IE	-9.03	-9.03	-11.68	-23.06	-2.53	NO	243.29
	Eucalyptus Low Open	1.38	NO	0.19	IE	0.19	0.09		IE	0.27	0.12	IE	0.12	-0.28	-0.69	-0.32	NO	3.31
	Eucalyptus Open Forest	243.31	NO	IE	-1.39	-1.39	IE		-337.78	-337.78	IE	-153.70	-153.70	-140.17	-265.00	-299.61	NO	4,386.28
	Eucalyptus Open	82.39	NO	IE	-1.58	-1.58	IE		-129.86	-129.86	IE	-54.14	-54.14	-24.56	7.77	-43.77	NO	896.73
	Eucalyptus Tall Open	20.71	NO	IE	-2.37	-2.37	IE		-49.12	-49.12	IE	-6.52	-6.52	-15.80	-42.64	-28.29	NO	522.03
	Eucalyptus Woodland	338.73	NO	IE	-0.62	-0.62	IE		-210.38	-210.38	IE	-88.79	-88.79	-89.27	-50.82	-134.55	NO	2,103.99
	Heath	1.62	NO	IE	-1.38	-1.38	IE		-2.23	-2.23	IE	-2.19	-2.19	-0.96	-0.81	-2.57	NO	32.09
	Low Closed Forest and	1.98	NO	IE	-0.29	-0.29	IE		-0.57	-0.57	IE	-0.56	-0.56	-0.27	-0.08	-0.61	NO	7.70
	Mallee Woodland and	69.97	NO	IE	-0.08	-0.08	IE		-5.57	-5.57	IE	-5.40	-5.40	-7.74	-5.47	-25.31	NO	181.40
	Melaleuca Forest and	0.79	NO	IE	-2.35	-2.35	IE		-1.86	-1.86	IE	-0.86	-0.86	-0.15	0.26	-0.98	NO	13.15
	Other Forest and Woodland	0.55	NO	IE	-0.08	-0.08	IE		-0.04	-0.04	IE	-0.02	-0.02	-0.14	-0.12	-0.19	NO	1.89

GEOGRAPHICAL LOCATION(2)	ACTIVITY DATA		
Identification code	Subdivision(3)	Area subject to the activity	Area of organic soils(7)
		(kha)	(kha)
Total for activity A.2.		**6,501.52**	**NO**
NSW		1,020.73	NO
	Acacia Forest and Woodland	61.17	NO
	Acacia Open Woodland	0.44	NO
	Acacia Shrubland	93.21	NO
	Callitris Forest and	48.32	NO
	Casuarina Forest and	51.32	NO
	Eucalyptus Low Open	1.38	NO
	Eucalyptus Open Forest	243.31	NO
	Eucalyptus Open	82.39	NO
	Eucalyptus Tall Open	20.71	NO
	Eucalyptus Woodland	338.73	NO
	Heath	1.62	NO
	Low Closed Forest and	1.98	NO
	Mallee Woodland and	69.97	NO
	Melaleuca Forest and	0.79	NO
	Other Forest and Woodland	0.55	NO

Which approach should be used for non-Annex I :

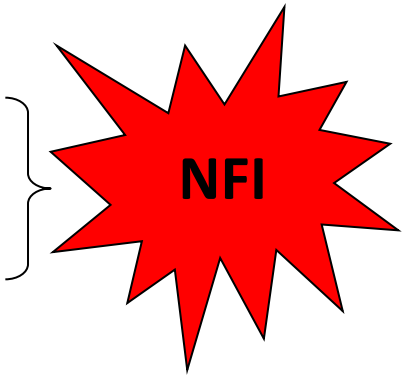
IPCC indication: Countries should characterize and account for all relevant land areas in a country consistently and as transparently as possible. Data should reflect the historical trends in land-use area.

IPCC 2003 LULUCF Guidance suggests three Approaches*:

Approach 1: Basic land-use data

Approach 2: Survey of land use and land-use change

Approach 3: Geographically explicit land use data



In almost all the developing countries there are no NFIs that could be use to assess historical trends in land-use area, the only way to represent land in a consistently and transparently approach with a time frame of 20 years backward is the use of satellite remote sensing data which allows to follow the Approach 3. Thus NFI will not be directly used to assess activity data.

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ANNEX I COUNTRIES METHODOLOGICAL APPROACHES TO REPORT ACTIVITY DATA

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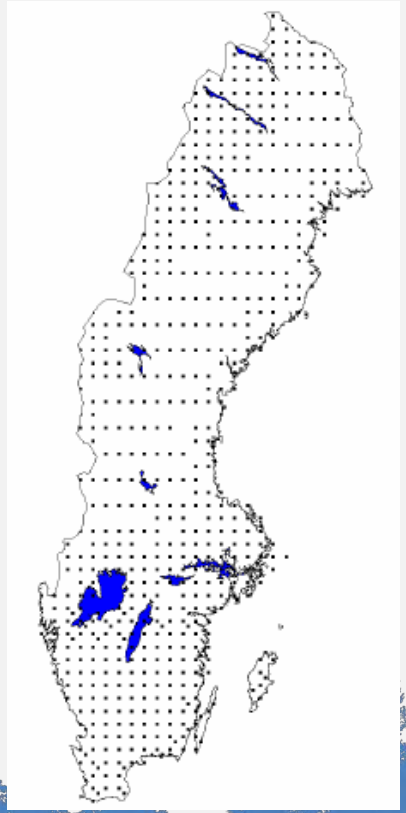
All Annex I countries use IPCC Approach 3 to assess activity data:

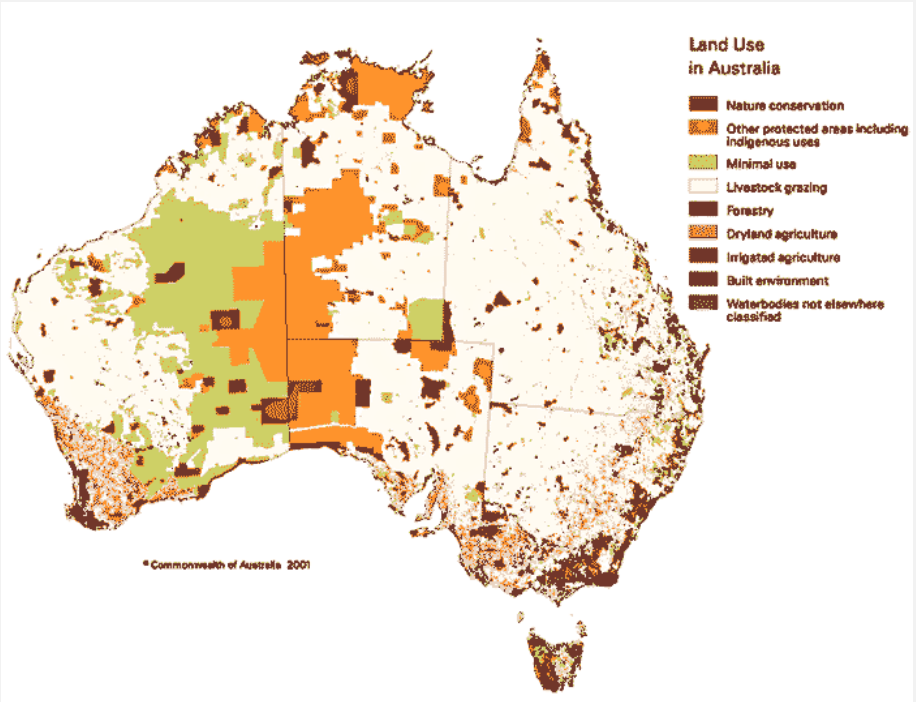
Most countries use sampling approaches

Few countries use wall to wall approaches

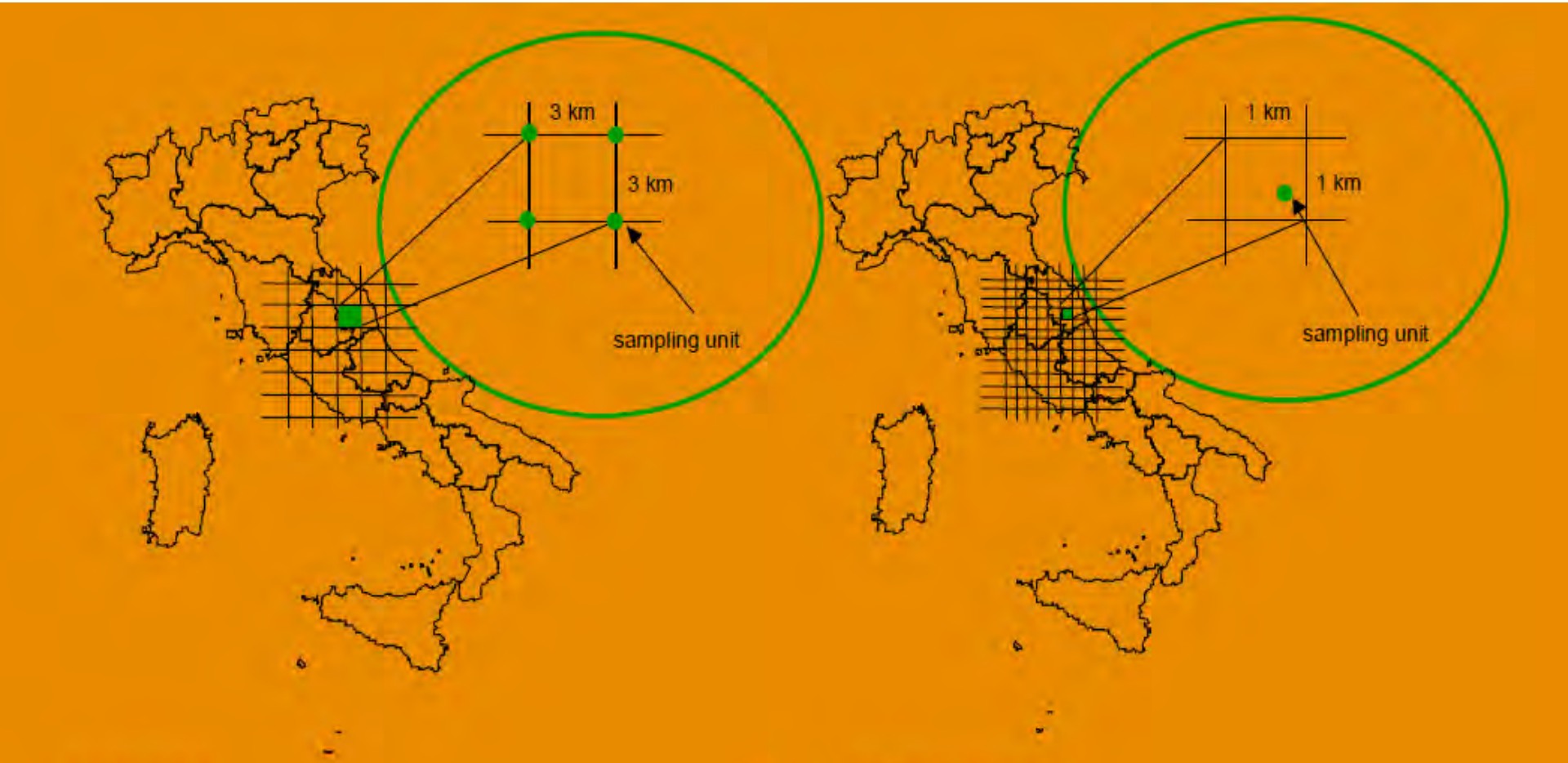
Sweden



Australia



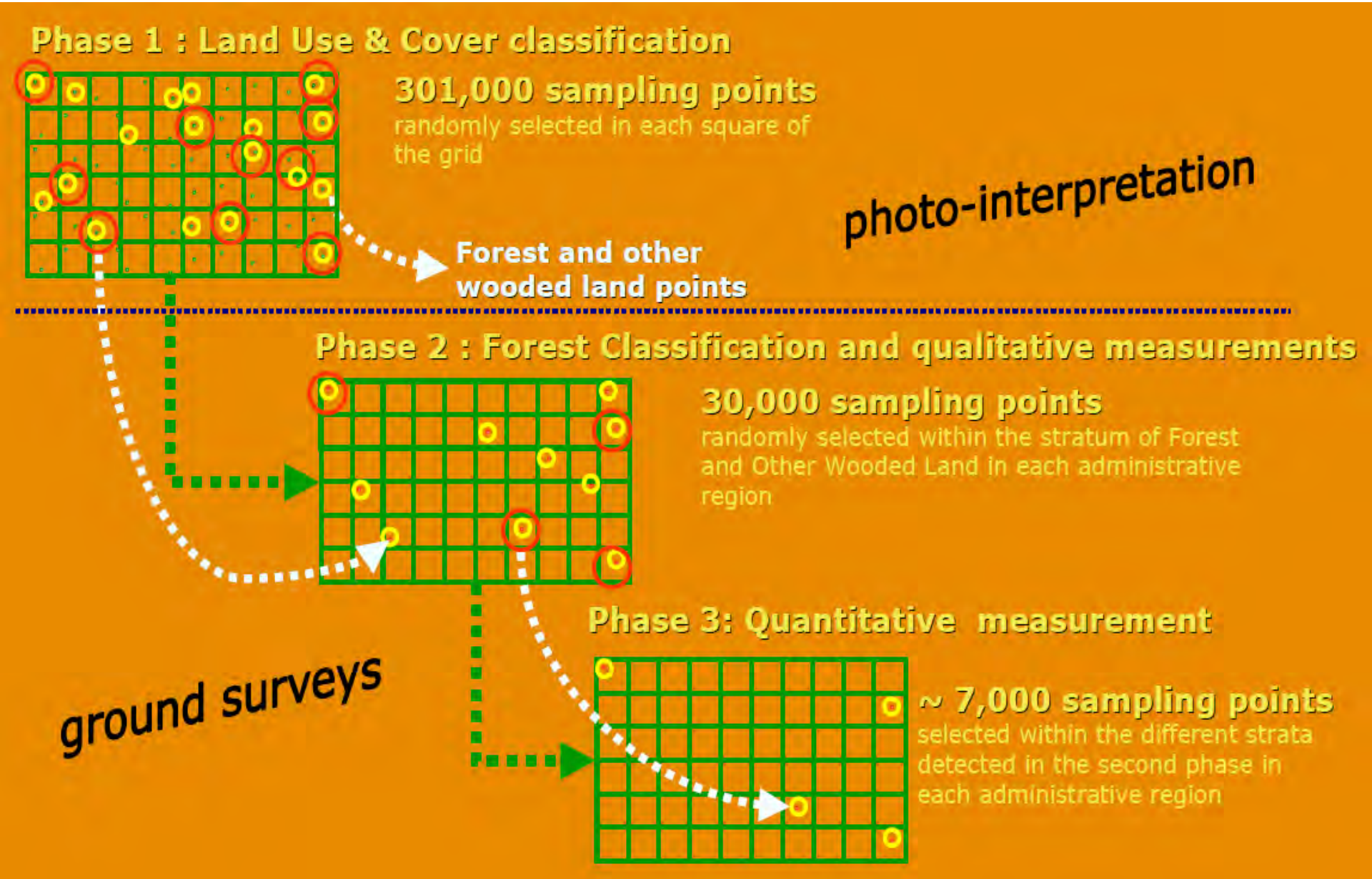
The Italian sampling system (within NFI)



IFNI85
30,000 sampling units
Aligned Systematic Sampling
One-phase Sampling Design

INFC2005
300,000 sampling units
Unaligned Systematic Sampling
Three-phase Sampling Design

The Italian sampling system (within NFI)

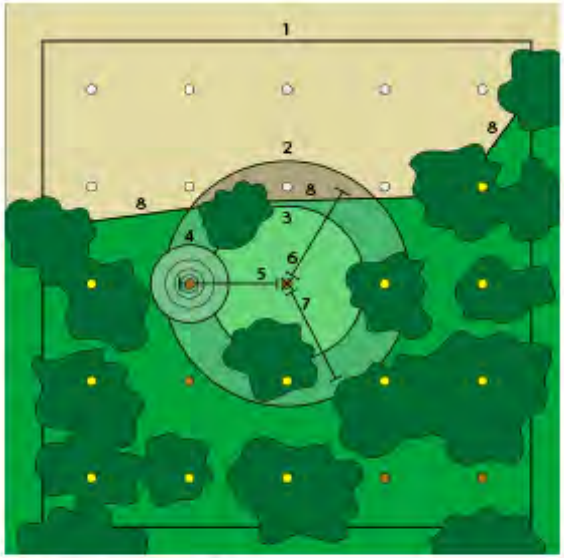


Inventory concept

There are more than 500 million trees in Switzerland - far too many to investigate individually. Random sampling, however, yields adequate information. For that purpose a 1km-grid was mapped over Switzerland in the first NFI. The intersections defined the location of the sample plots in the forest.

Since the second NFI, only half of these plots, roughly 6500, have been located in the field. The grid, which originally had a mesh size of 1 km, was extendend to 1.4 km. To compensate for this reduction, the aerial photos were interpreted in a grid of 500 m.

The same methods have been carried out since switching from a periodic to a continuous survey in the fourth NFI, but the sample plots are now located over a period of nine years. Thereby another ninth of the sample plots, which are evenly distributed all over Switzerland, are surveyed every year.



1 NFI3 sample plot
2 circle for survey of trees with a DBH greater than 36 cm.
3 circle for survey of trees with a DBH greater than 12 cm
4, 5 circle for survey of young forest
5, 6, 7 transect for survey of deadwood
X sample plot center

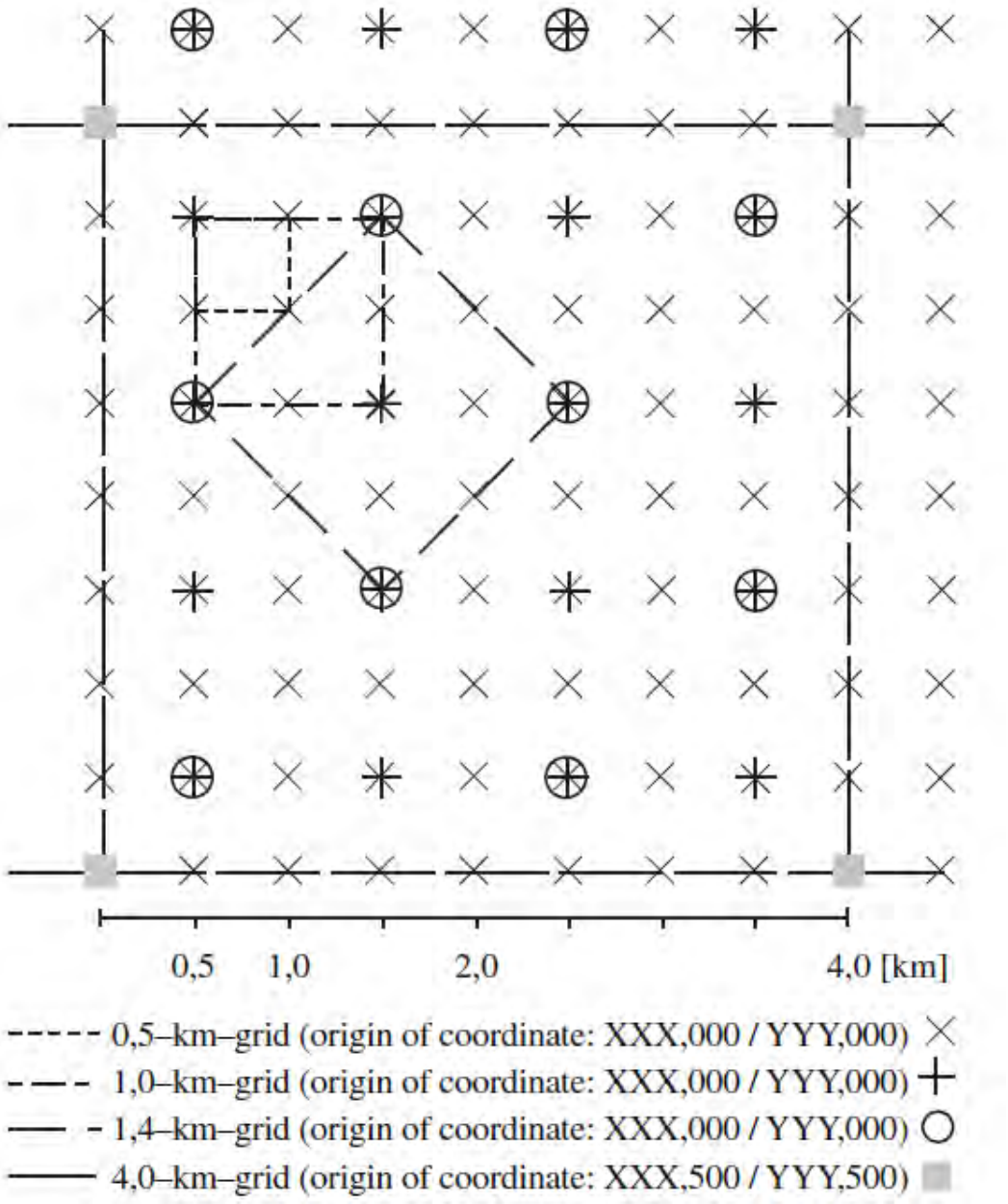
Movie of the first NFI (1983) (in German)

Circles and radii of sample plots

The center of the sample plot is marked by a metal pole in the ground. Roughly 130,000 sample trees were measured in the NFI1 and marked so as they can be found again in later inventories. Thanks to the exact sketches, about 98% of the sample plots could be found directly during the NFI2 without having to search for them. In the NFI4, the position of the centers of the sample plots are located exactly with a GPS.

Within a 200 m^2 circle, every tree which has a diameter larger than 12 cm is recorded, and within a 500 m^2 circle, every tree which has a diameter larger than 36 cm is recorded. These diameters are measured at a height of 1.3 m (diameter at breast height DBH). The radii are 7.98 m (r_1) and 12.62 m (r_2) on level terrain.

Swiss NFI sampling design



For the aerial photo sample plots, a square sample grid with a 0.5 km mesh width (0.5-kmgrid) was chosen. For the terrestrial sample plots a coarser grid with 1.4 km (= √2 km) mesh width (1.4-km-grid) was chosen. The 1.4-km-grid and the 1.0-km-grid of the NFI1 are subsets of the 0.5-km-grid. The second terrestrial grid – a 4.0-km-grid shifted by 0.5 km – was taken as an independent sample in order to verify the representativeness of the NFI2 sample plots.

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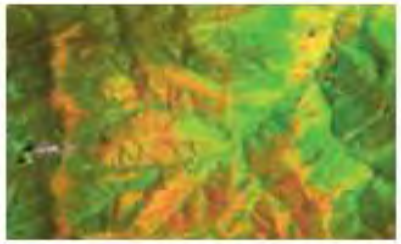
EFFORTS TO IMPROVE EARTH OBSERVATION METHODOLOGIES

http://www.gofc-gold.uni-jena.de/redd/index.php

SOURCEBOOK



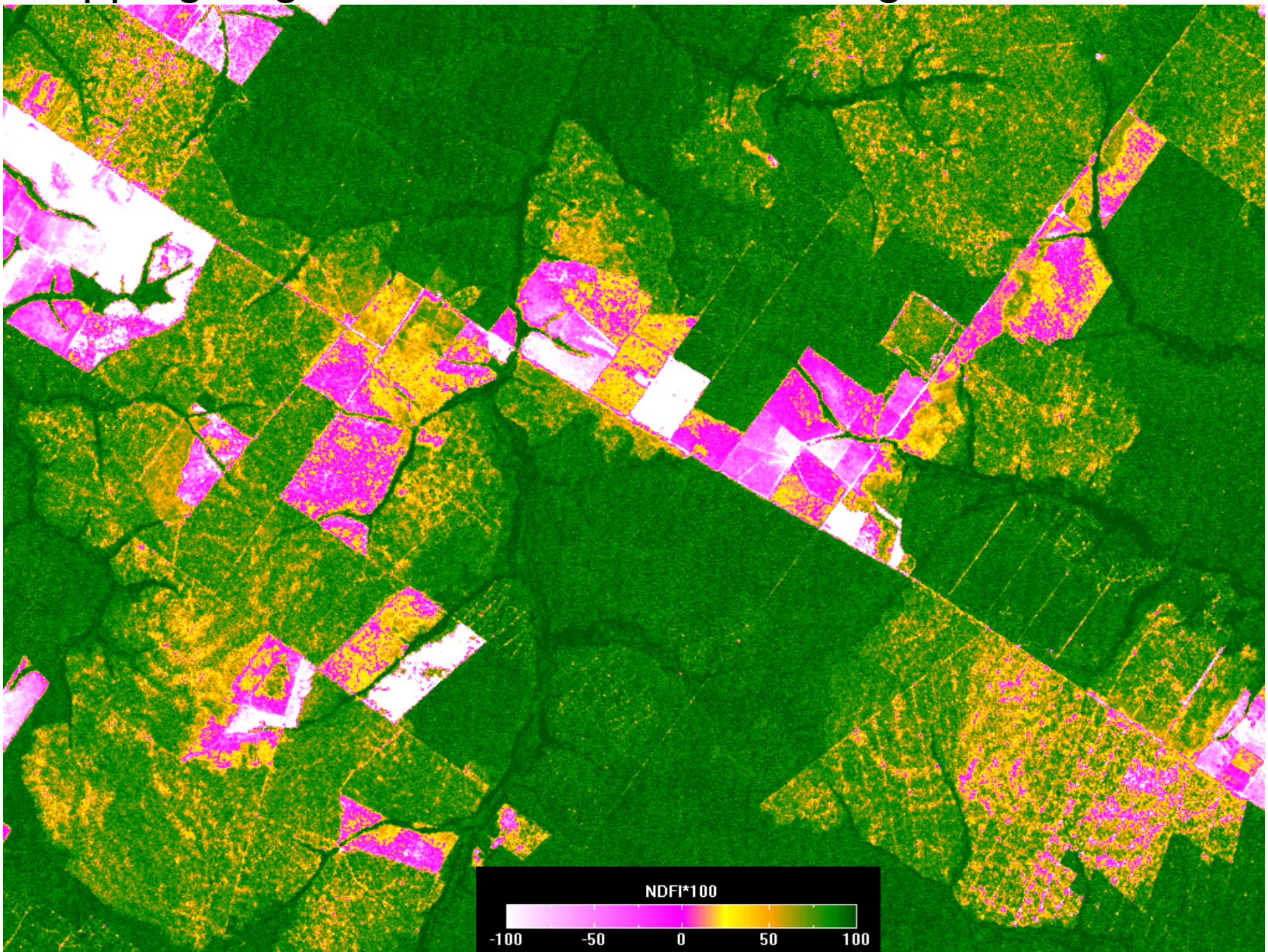


Reducing Greenhouse Gas Emissions from Deforestation and Degradation in Developing Countries: A Sourcebook of Methods and Procedures for Monitoring, Measuring and Reporting

GOFC-GOLD

Changes in forest area

Mapping degradation with Landsat Image (Souza Jr. et al., 2005)



2000

Changes in forest area

Mapping degradation with Landsat Image (Souza Jr. et al., 2005)

2001

Changes in forest area

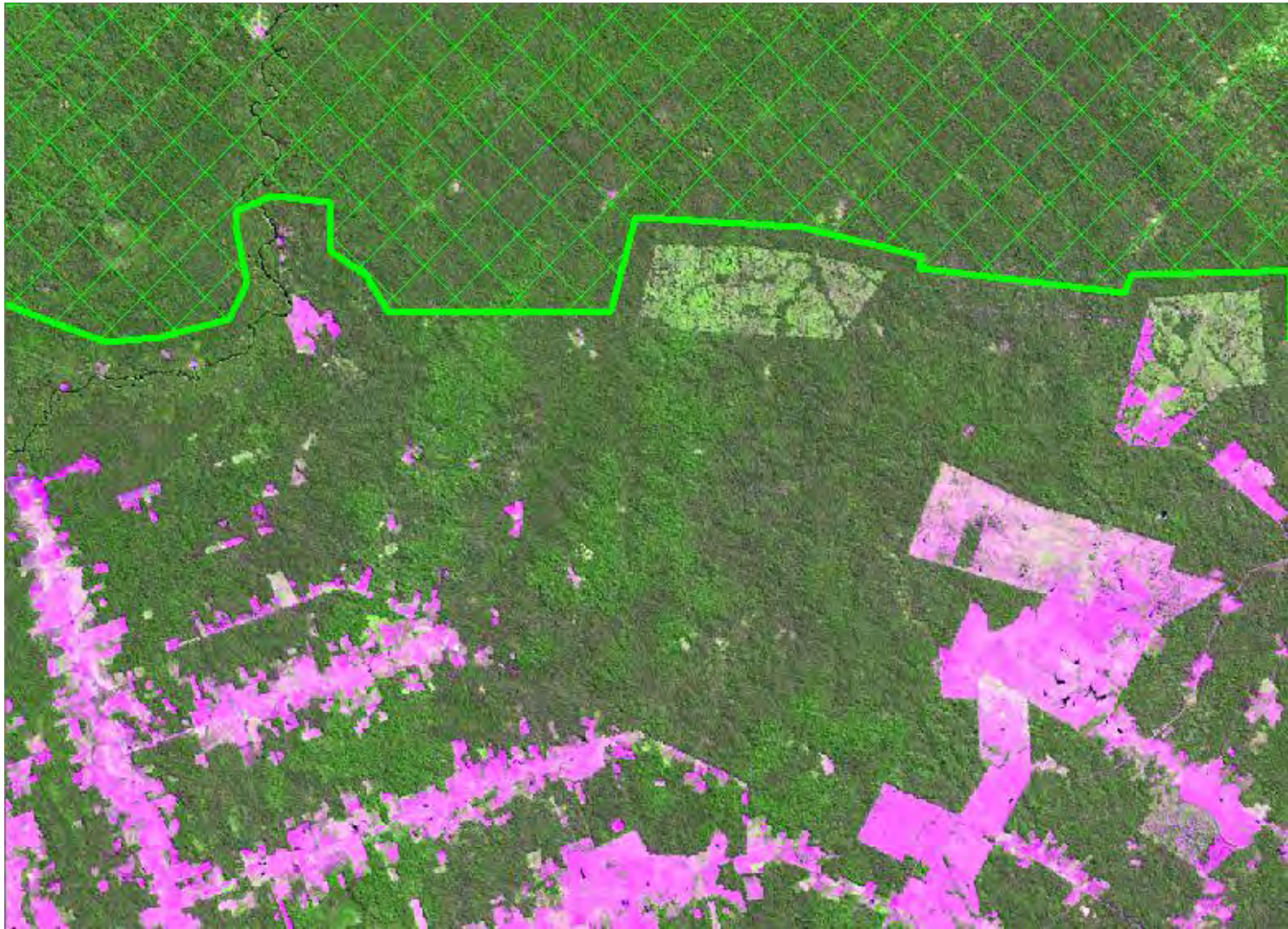
Mapping degradation with Landsat Image (Souza Jr. et al., 2005)

2003

Changes in forest area

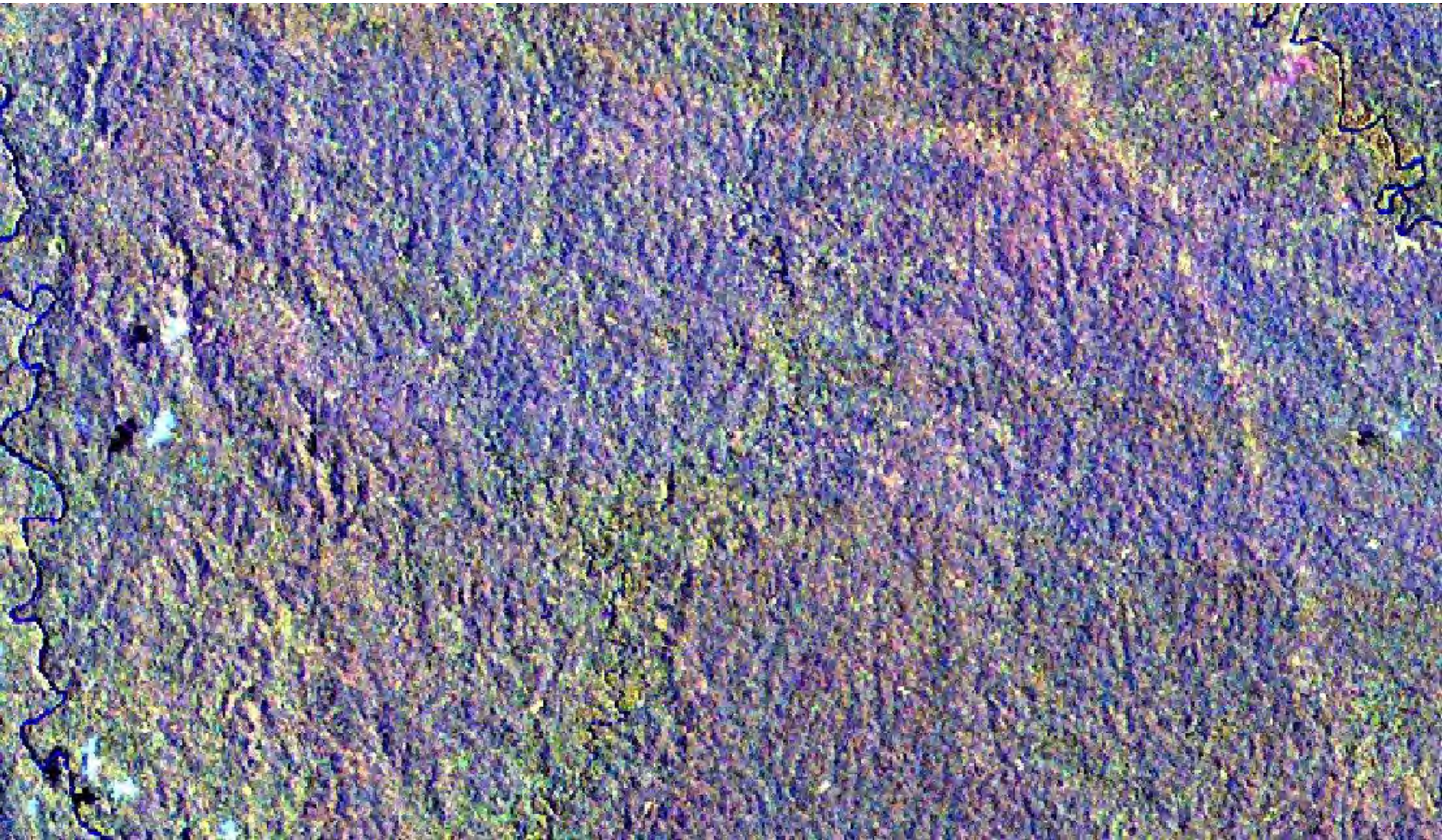
Degradation: to assess as a forest land remaining forest land

Intact
Vs
Non-intact



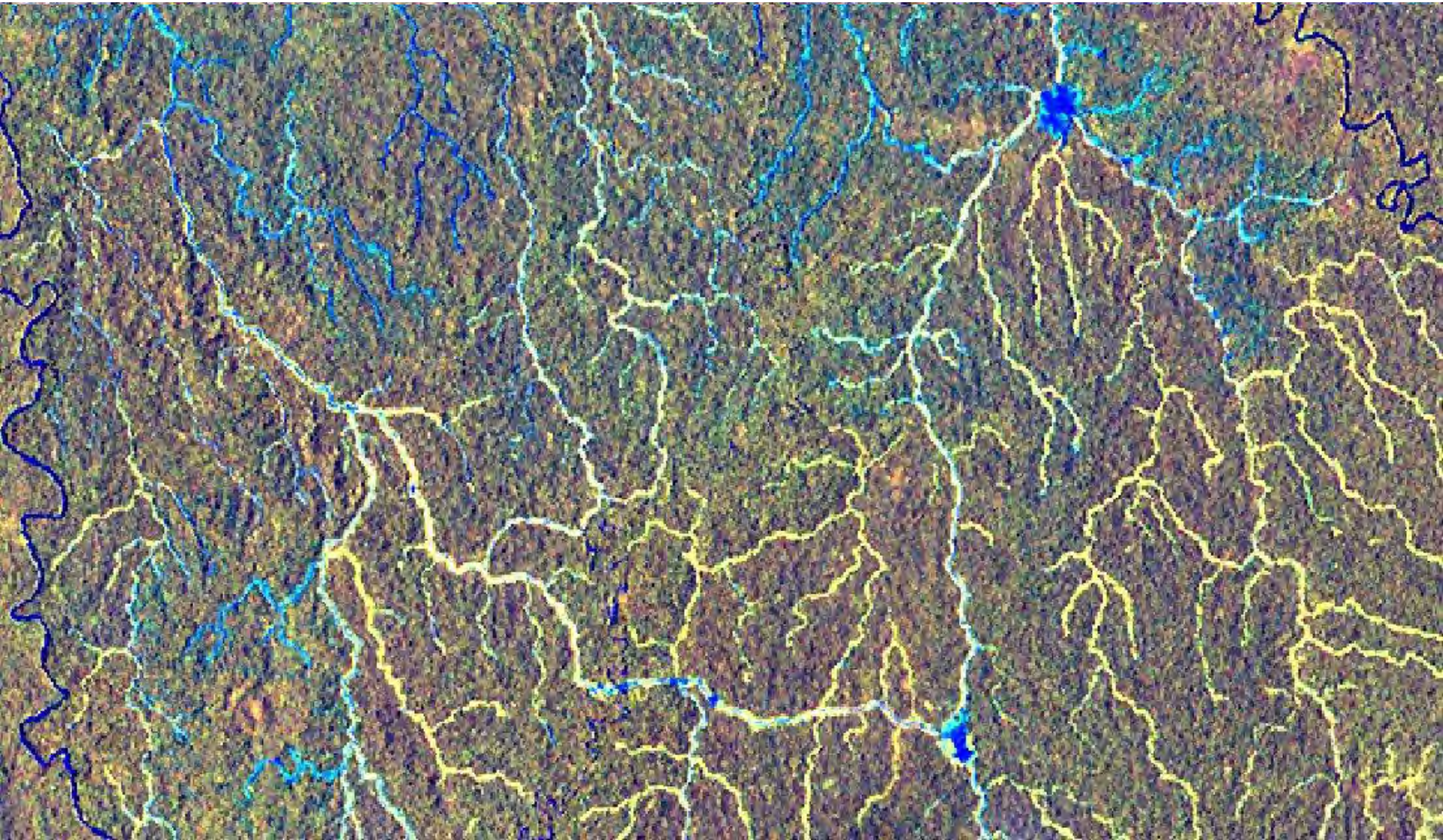
Changes in forest area

Degradation: to assess as a forest land remaining forest land



Changes in forest area

Degradation: to assess as a forest land remaining forest land



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METHODOLOGICAL SOLUTIONS FOR NON-ANNEX I COUNTRIES

Wall to wall mapping approach

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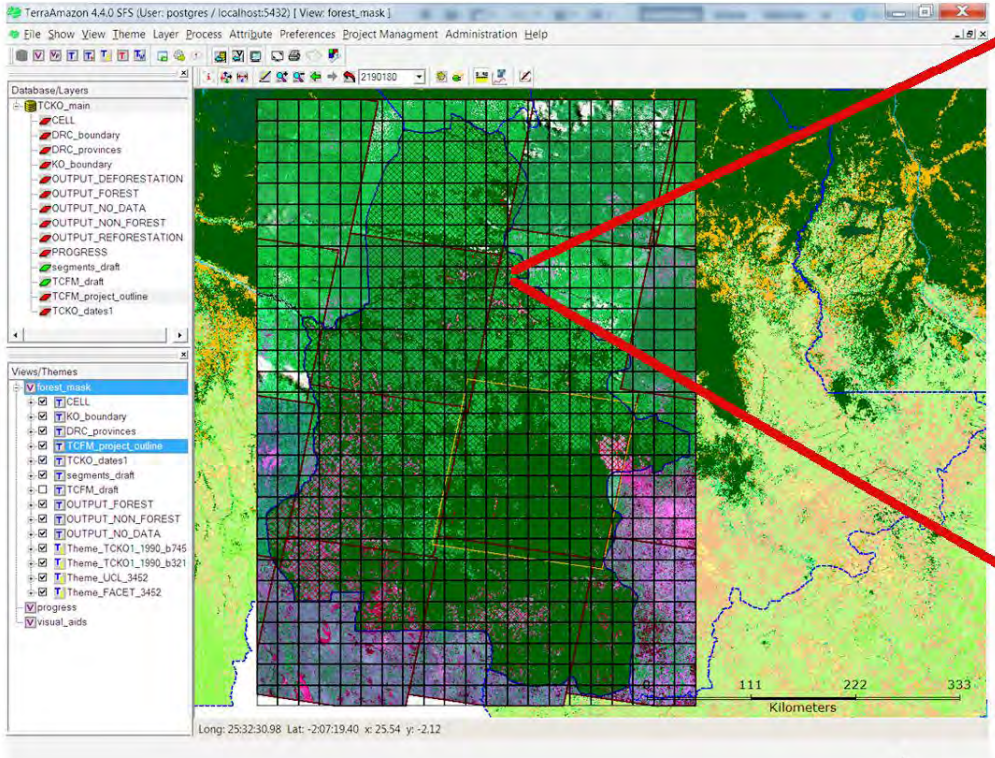
FAO UNDP UNEP

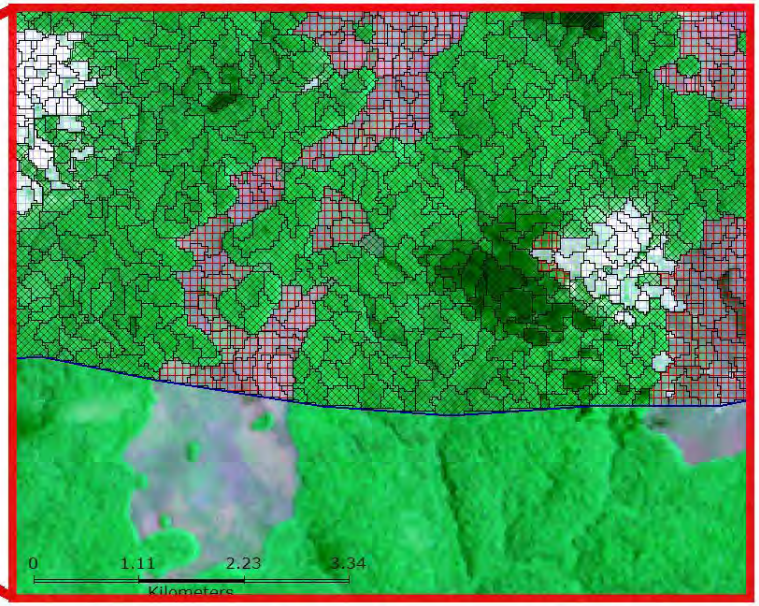
TERRA AMAZON

Satellite data, maps, algorithms, expertise

Basic image interpretation
Database
Storage
Review / Revision
Validation

TerrAmazon Projects





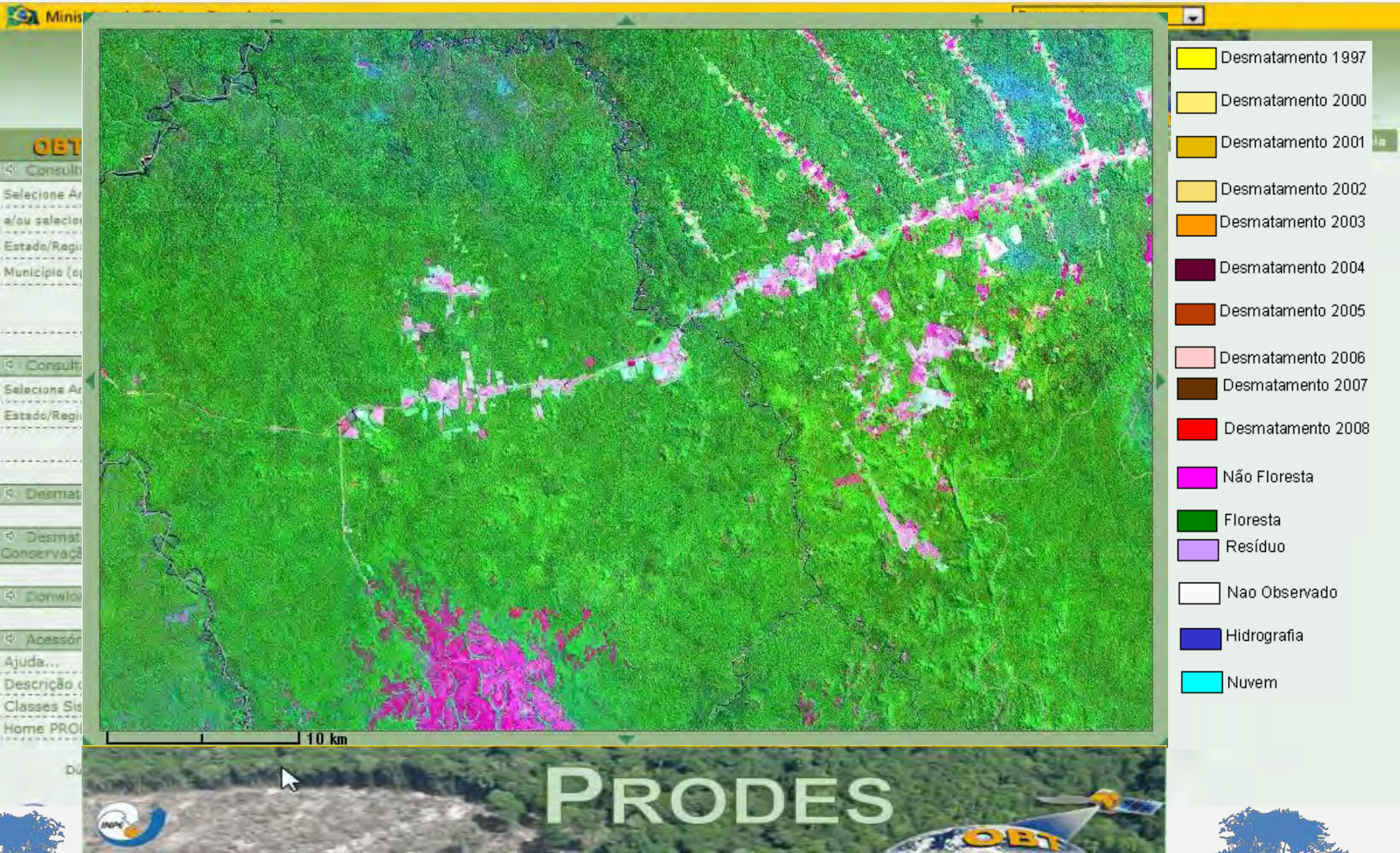
pre-classified segments within the project area

Brazil's PRODES System

Mapping deforestation & distributing data transparently online

Brazil's PRODES System

Mapping deforestation & distributing data transparently online

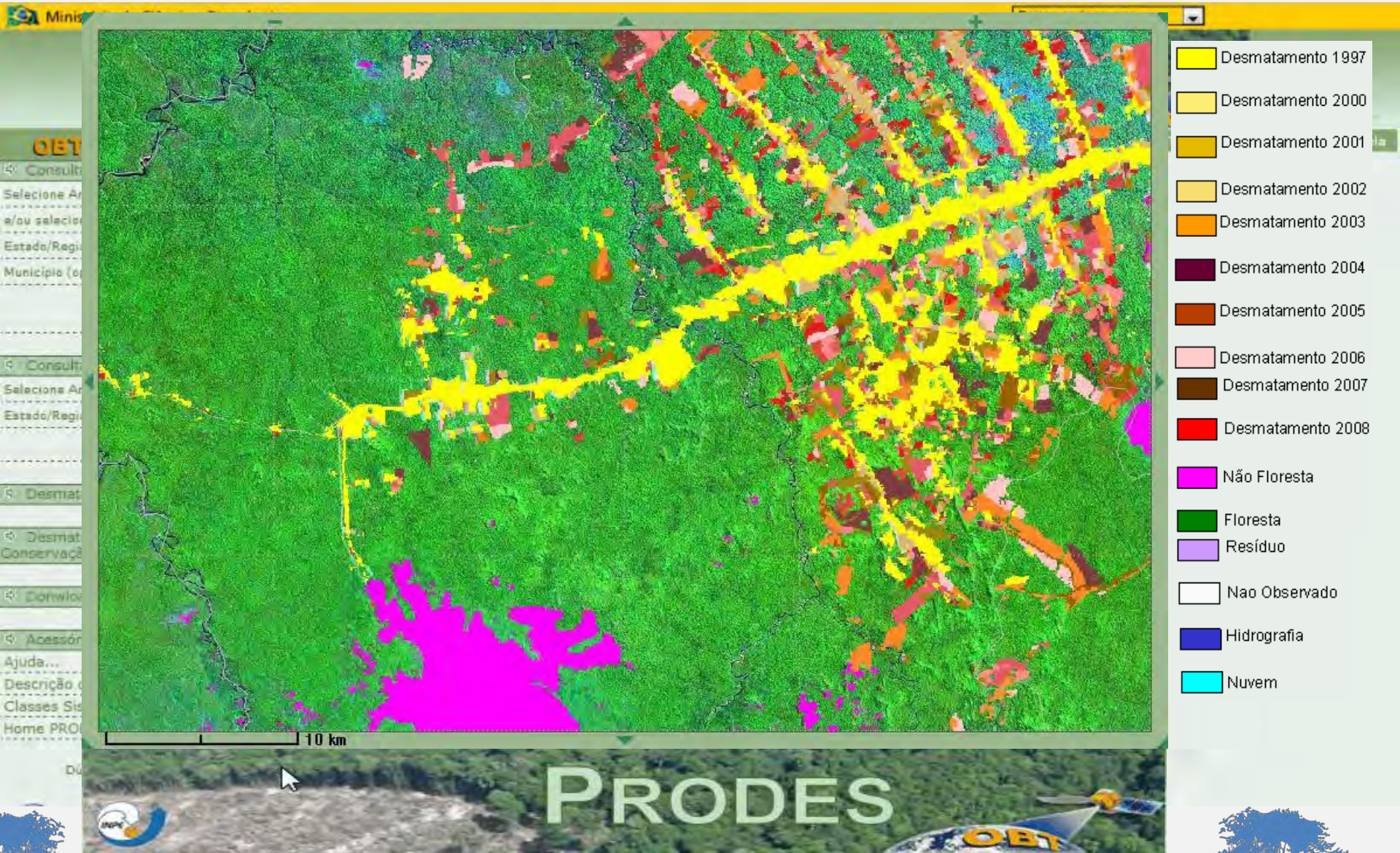


Brazil's PRODES System

Mapping deforestation & distributing data transparently online

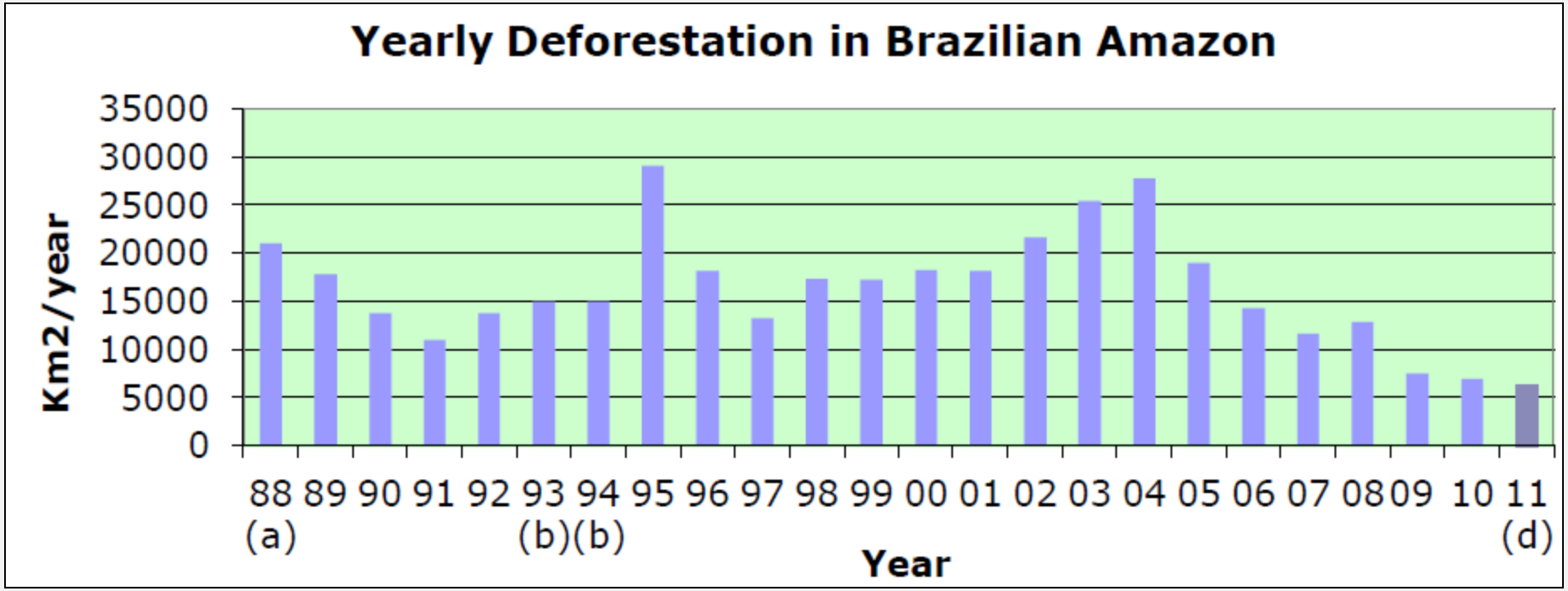
Brazil's PRODES System

Mapping deforestation & distributing data transparently online

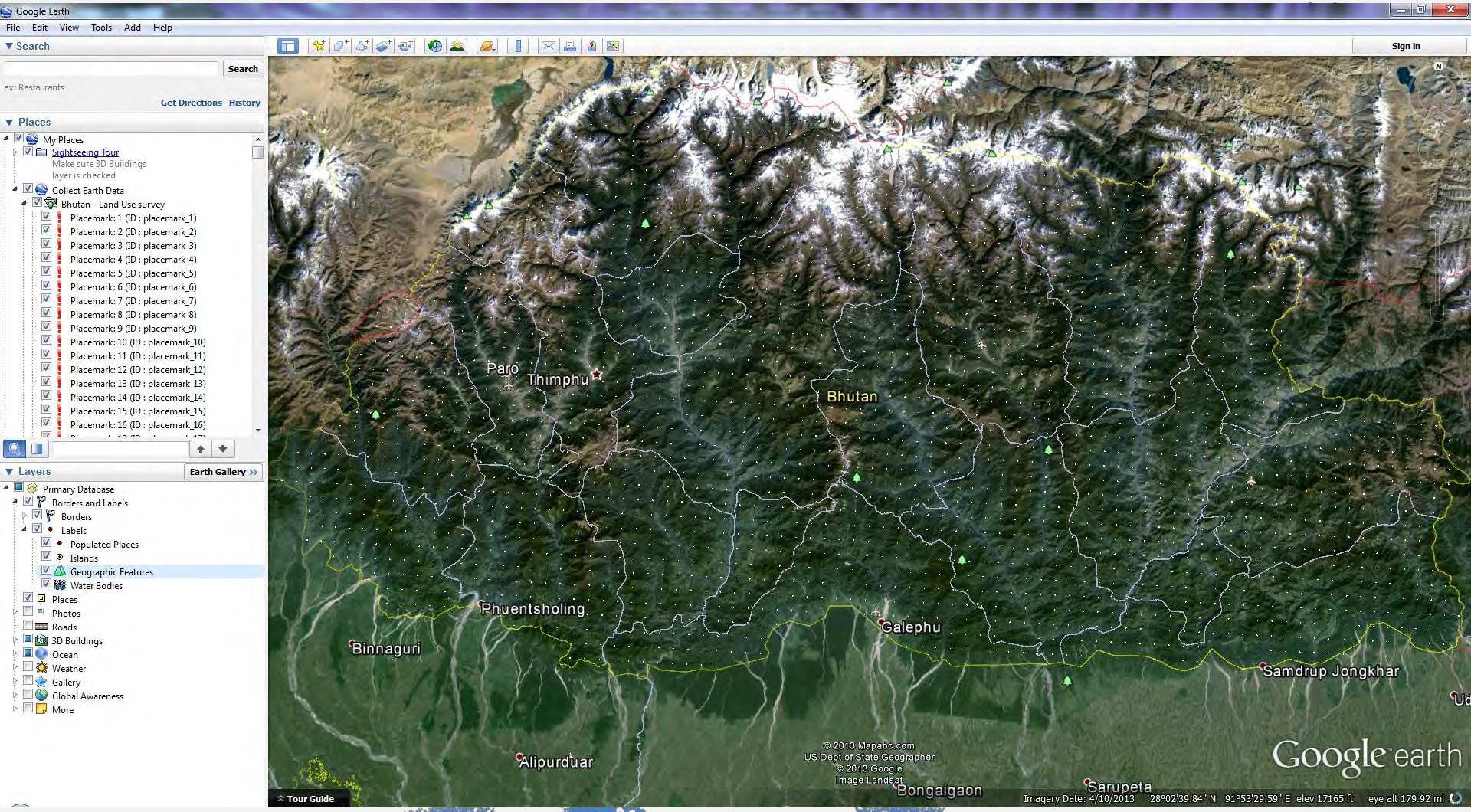


Brazil

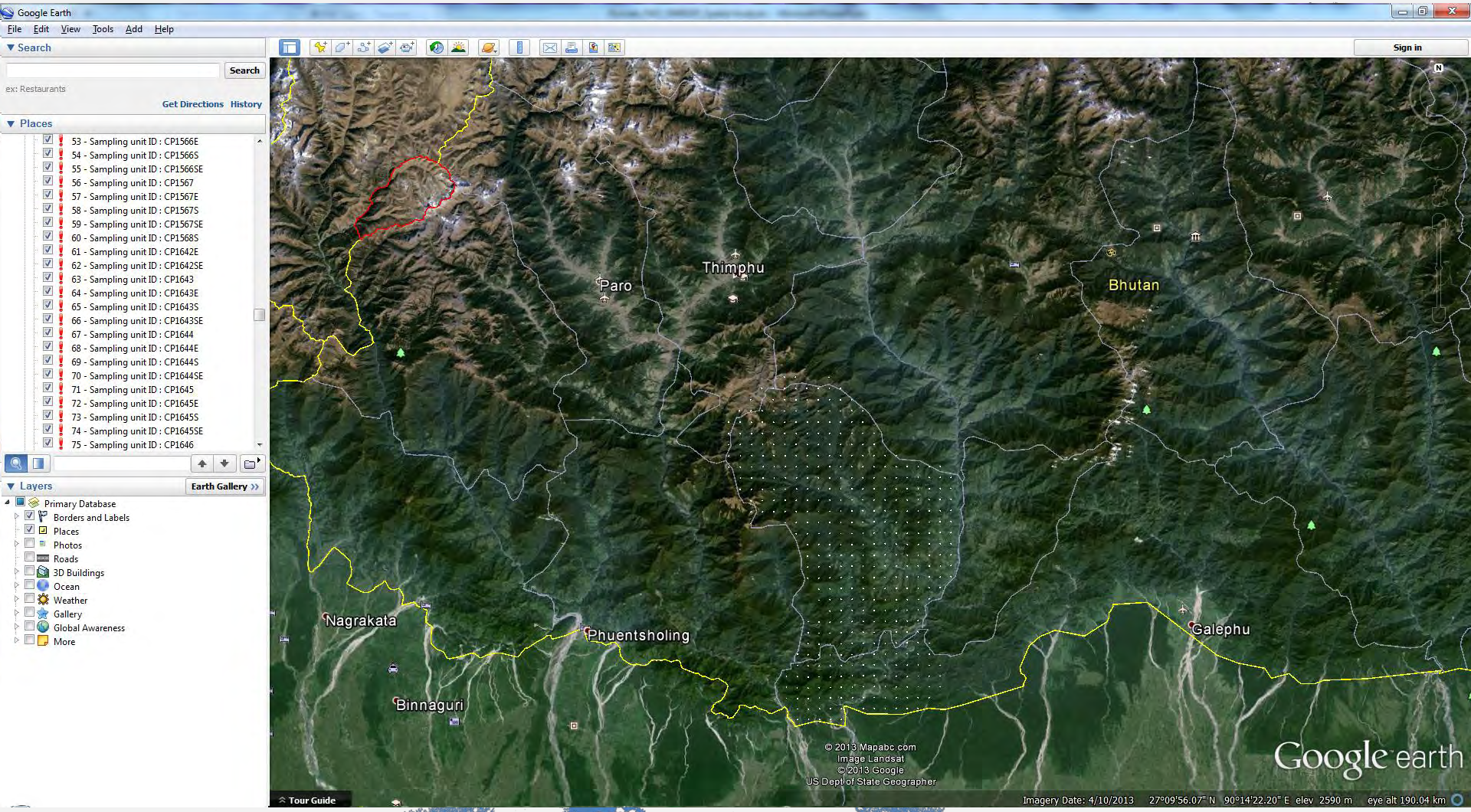
Amazonian deforestation rates 1988-2011



Sampling approach:
Open Foris Collect Earth – Bhutan



Sampling approach:
Open Foris Collect Earth – Bhutan



Sampling approach:
Open Foris Collect Earth – Bhutan

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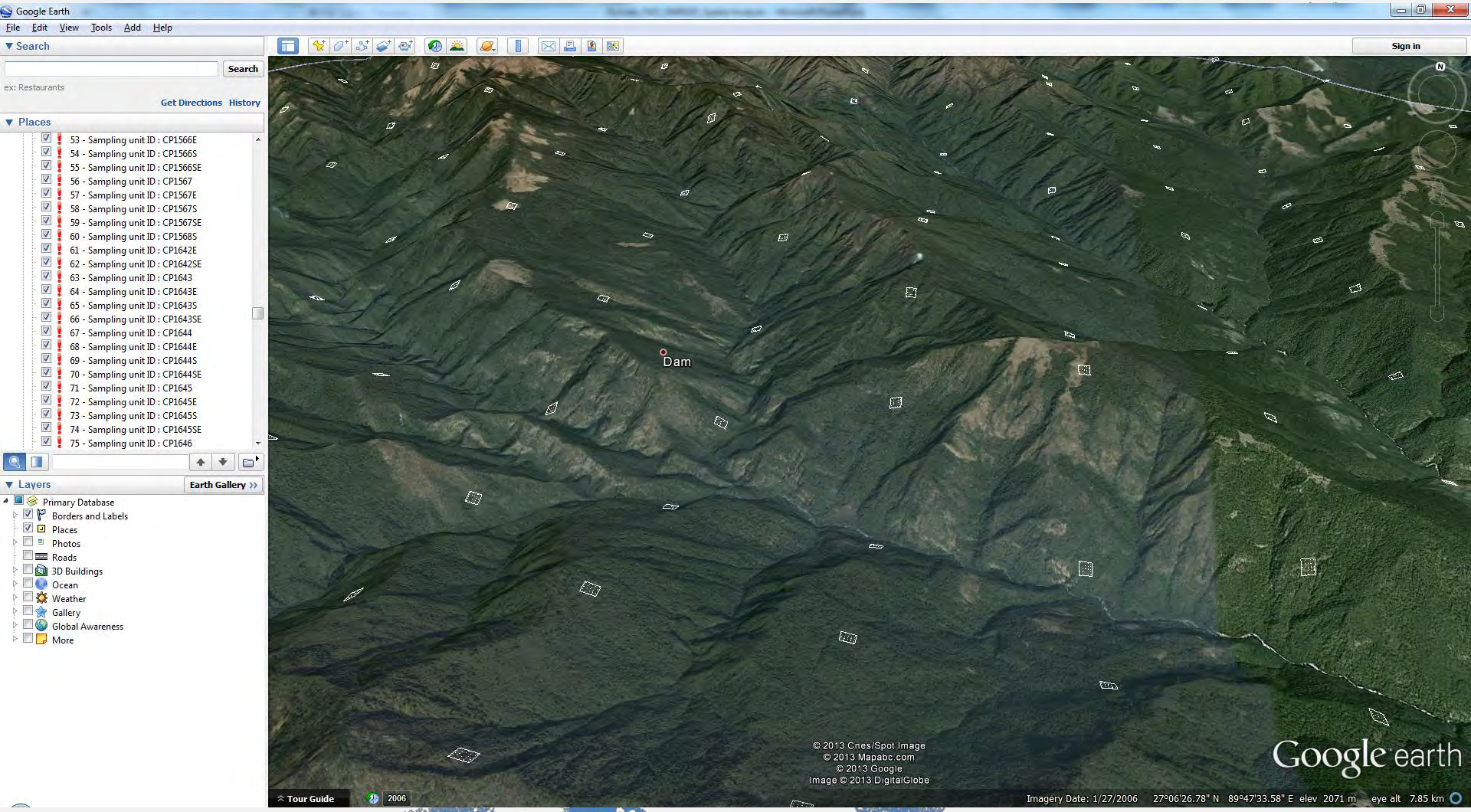

Sampling approach:
Open Foris Collect Earth – Bhutan

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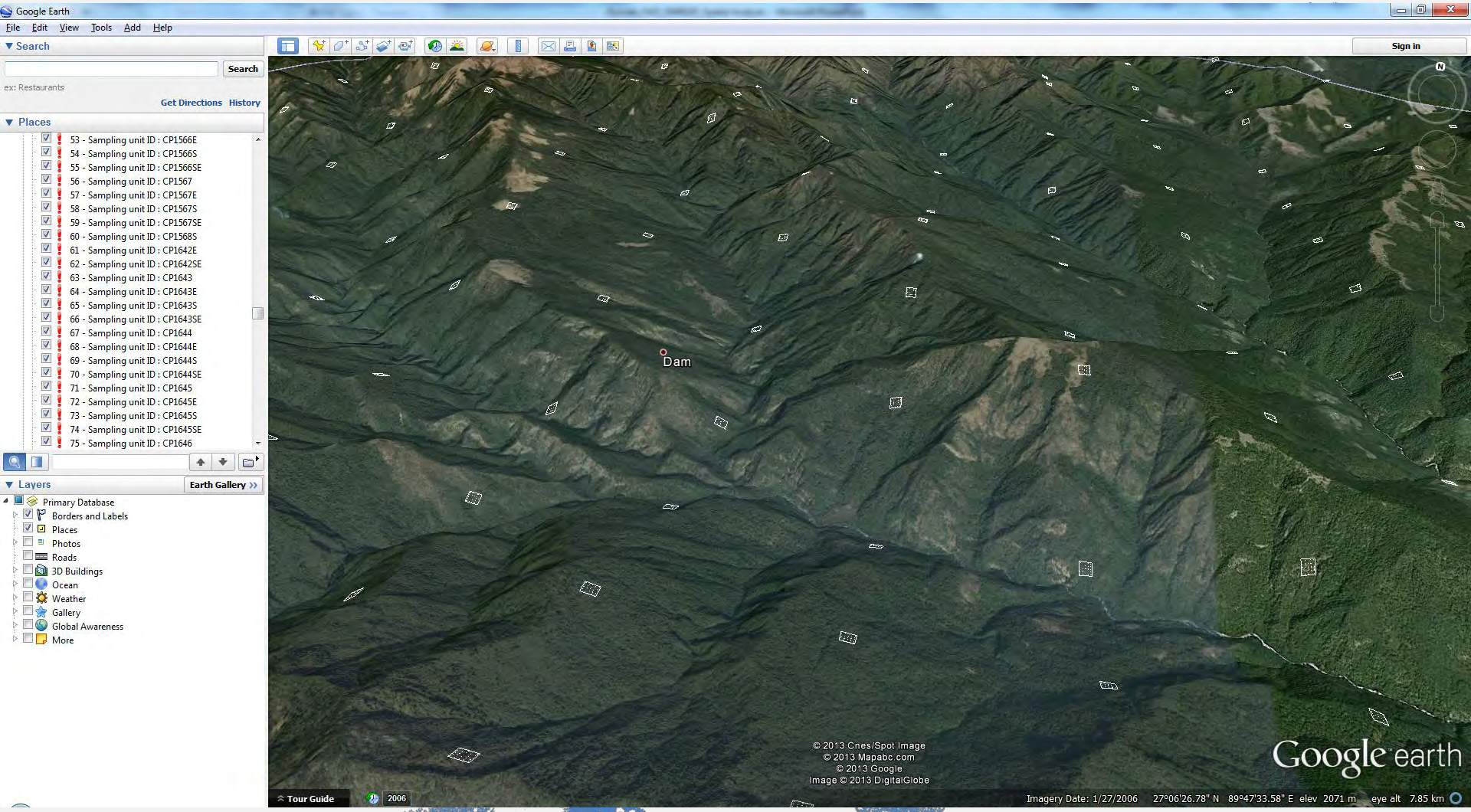

Open Foris Collect Earth – Bhutan

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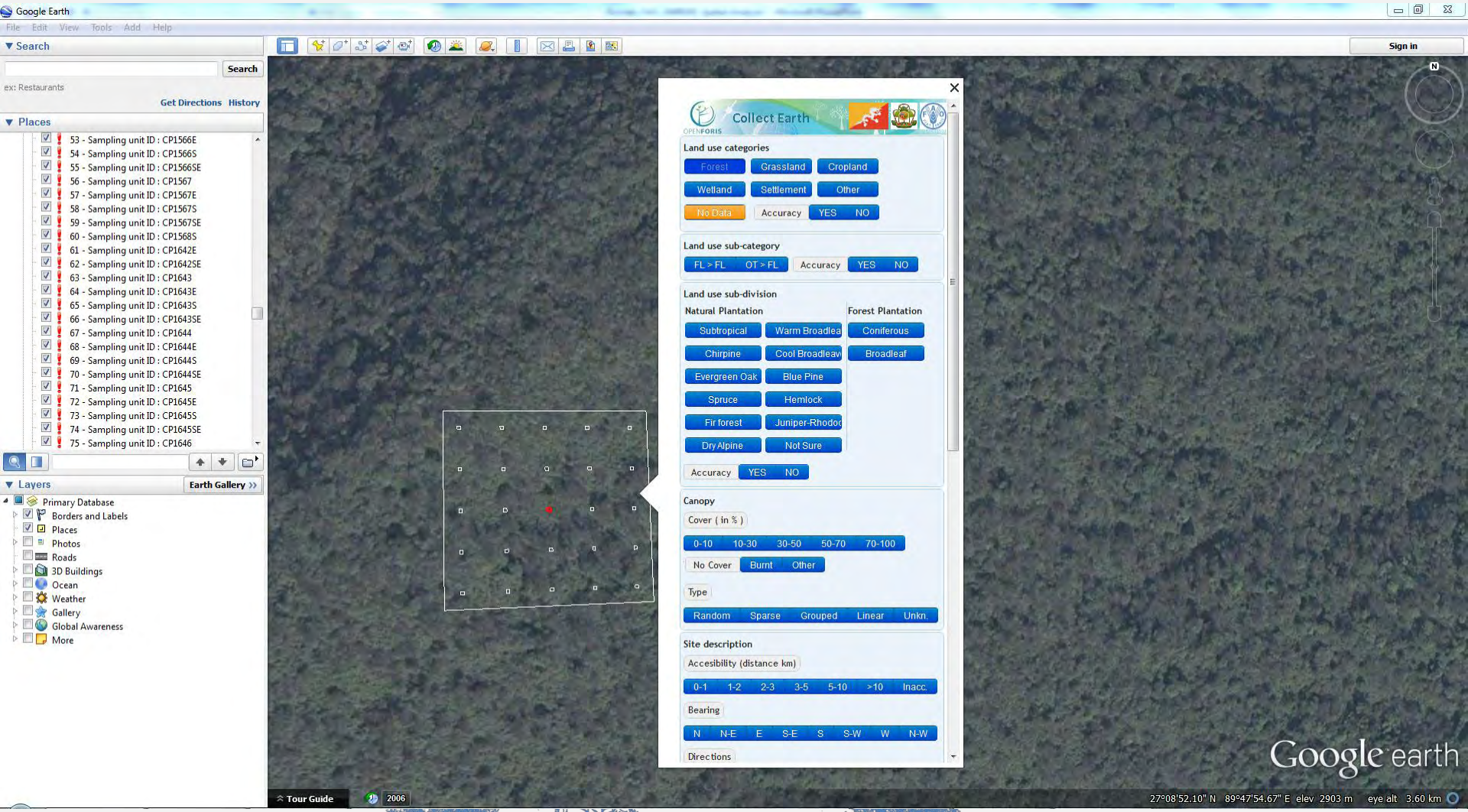
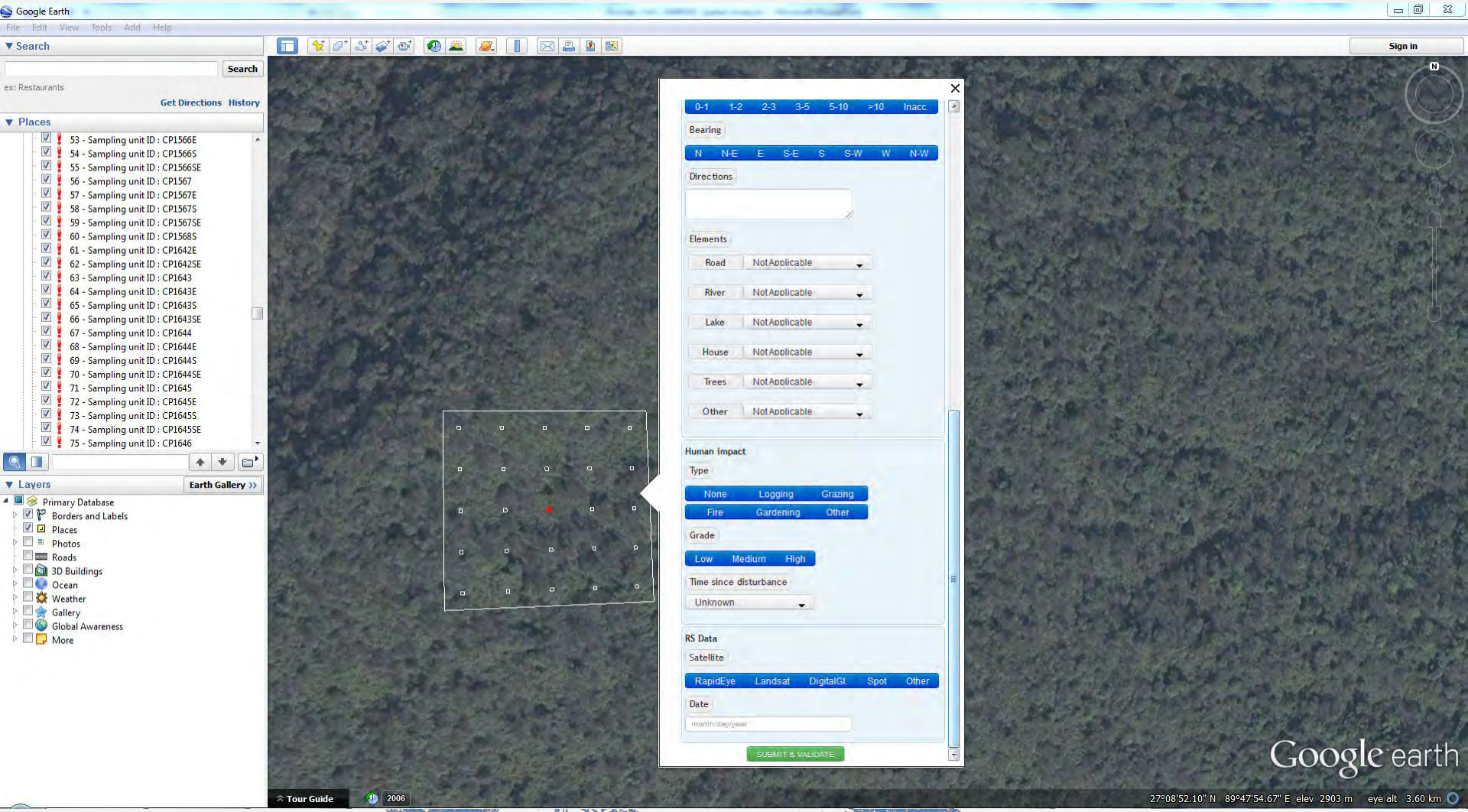


Open Foris Collect Earth – Bhutan




Thank you for your attention

UN-REDD PROGRAMME

NATIONAL FOREST MONITORING SYSTEMS FOR REDD+

National Forest Inventories

Joel Scriven

UN-REDD Programme, FAO Bangkok

UN-REDD PROGRAMME

FAO UNDP UNEP

Assessing Emission Factors

INTERNATIONAL REQUIREMENTS

Copenhagen REDD+ Decision (4/CP.15)

No global agreement, but…

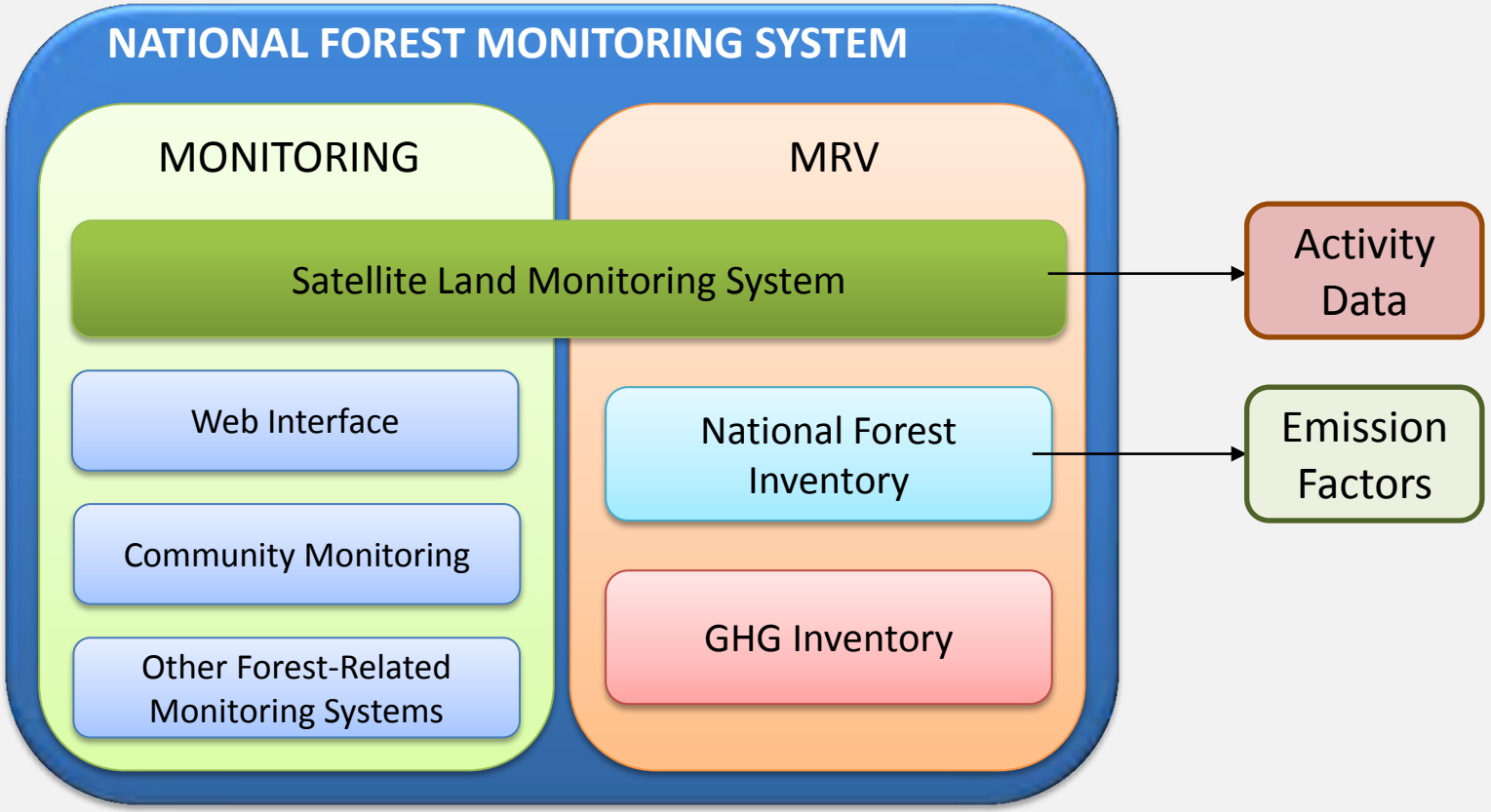
- Methodological guidance on REDD+

- Requests developing country Parties on issues relating to measurement and reporting:

- (c) To use the most recent **IPCC guidance and guidelines** … as a basis for estimating anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes

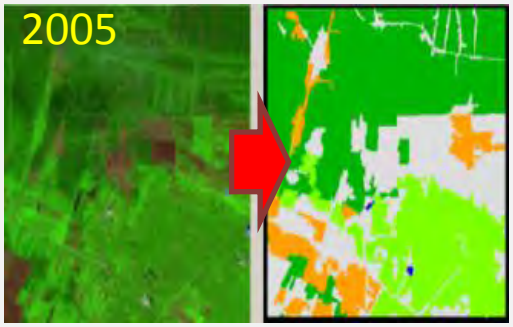
- To establish … national forest monitoring systems … that:
  - Use a combination of remote sensing and **ground-based forest carbon inventory** approaches for estimating, as appropriate, anthropogenic forest-related greenhouse gas emissions by sources and removals by sinks, forest carbon stocks and forest area changes

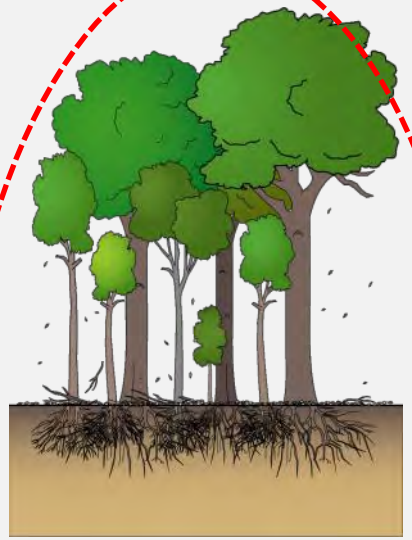
National Forest Monitoring Systems for REDD+



Measuring & Reporting Carbon Emissions and Removals related to Forestry

UN-REDD PROGRAMME





CO_2

	FL Wet evergreen	FL Moist evergreen	FL Moist semi-deciduous	FL South-east subtype	FL North-west subtype	FL North-west subtype	FL Dry semi-deciduous	Agricultural land	Savanna	Shrub Ticket	Settlements	Wetland	Other land	Unclassified	Final Area
FL Wet evergreen	51														51
FL Moist evergreen		42													42
FL Moist semi-deciduous			60												60
FL South-east subtype				52											52
FL North-west subtype					12										12
FL North-west subtype						2									2
FL Dry semi-deciduous							25		2						27
Agricultural land	5	2				2	3	1							13
Savanna			1			3	1		20						25
Shrub Ticket					1					12					13
Settlements						1		10			25				36
Wetland									0			2			2
Other land								5					25		30
Unclassified								9						10	19
Initial Area	56	44	61	52	13	8	29	25	22	12	25	17	25	10	
Net change (Δ = T0-T1)	-5	-2	-1	0	-1	-6	-2	-12	3	1	11	-15	5	9	0

Area change data from satellite remote sensing

Forest carbon stock change data from a national forest inventory

Inventory of greenhouse gas **emissions** from the forest sector

ACTIVITY DATA × **EMISSION FACTOR** = **EMISSIONS ESTIMATE**

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tC/ha ?


Min of Agriculture, Peru


Google Earth

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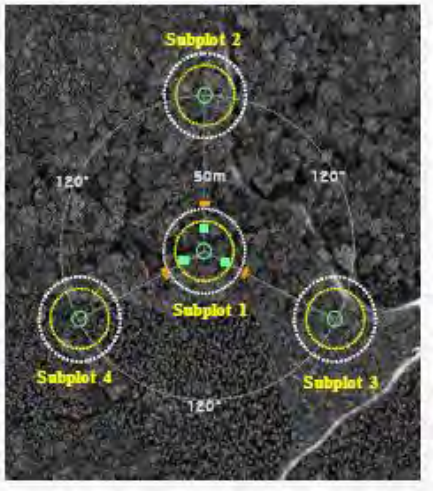
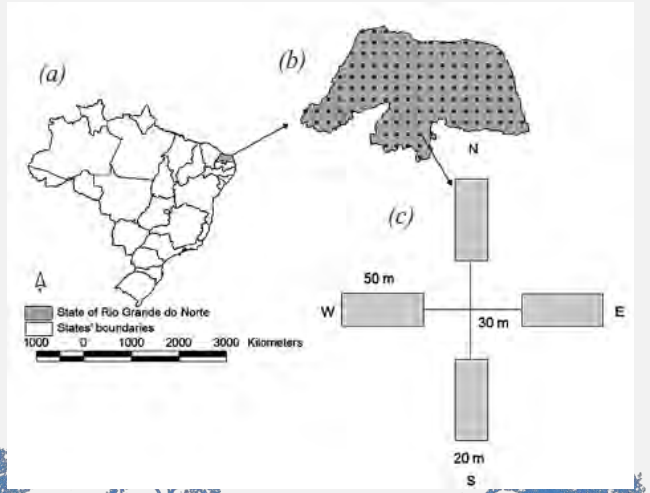
Assessing Emission Factors

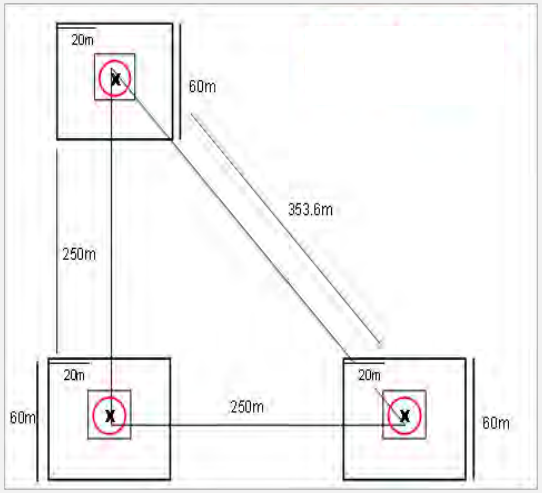
NATIONAL FOREST INVENTORIES

National Forest Inventories (NFIs)

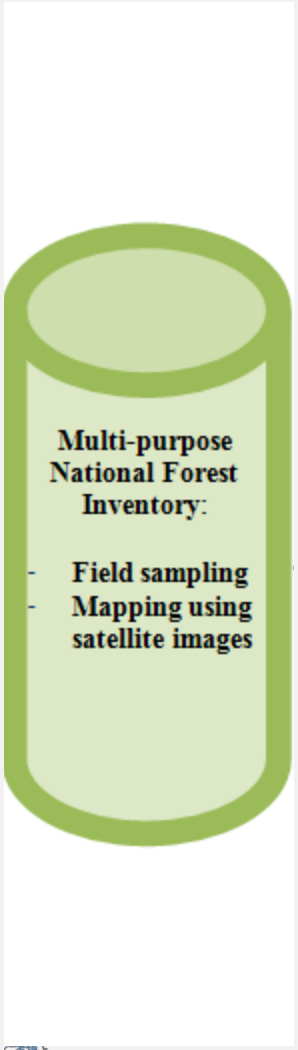
- The goal of a NFI is to generate information for:
  - Decision making (national / sub-national)
  - Monitoring in forestry + related sectors
- 41 out of 42 Annex 1 countries use NFIs as a data source to compile their national GHG inventory
  - Fulfills IPCC requirement of 'completeness'
- Diverse approaches around the world







Multipurpose NFIs



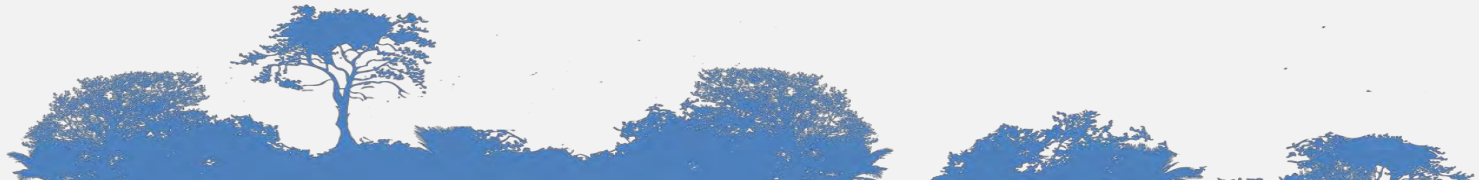
REDD+ Reporting

Carbon Inventories in the Land Use Sector

- Estimation must be made:
  - For carbon stock **CHANGES**! (= EFs)
  - For diverse ecological conditions
  - Under diverse management regimes
  - Emissions and removals due to **human activity**
  - For changes in all carbon pools

- IPCC requirements for NFIs
  - Estimations of Emission Factors made to Tier 2 or Tier 3 level – this requires:
    - Country-specific estimates of emission factors
    - Multi-temporal inventory data
    - Uncertainty analysis and Quality Assurance / Quality Control (QA/QC)

Multi-Data Change without uncertainty	EF Tier 1
Multi-temporal Change with uncertainty	EF Tier 2
Multi-temporal Trend with uncertainty	EF Tier 3



Need to Report on Changes in the Five Forest Carbon Pools

- Above-ground biomass
- Below-ground biomass

} biomass

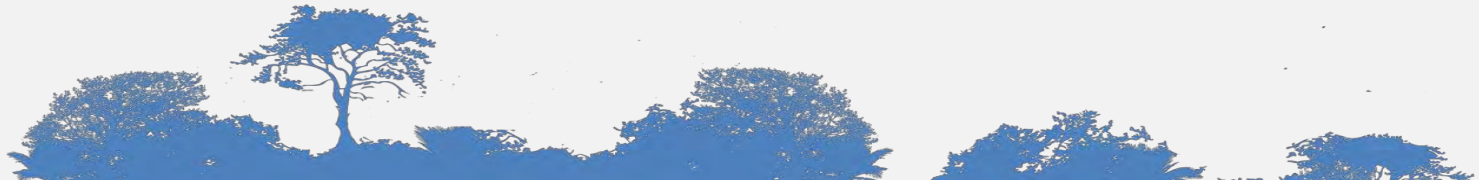
- Deadwood
- Litter

} dead organic matter

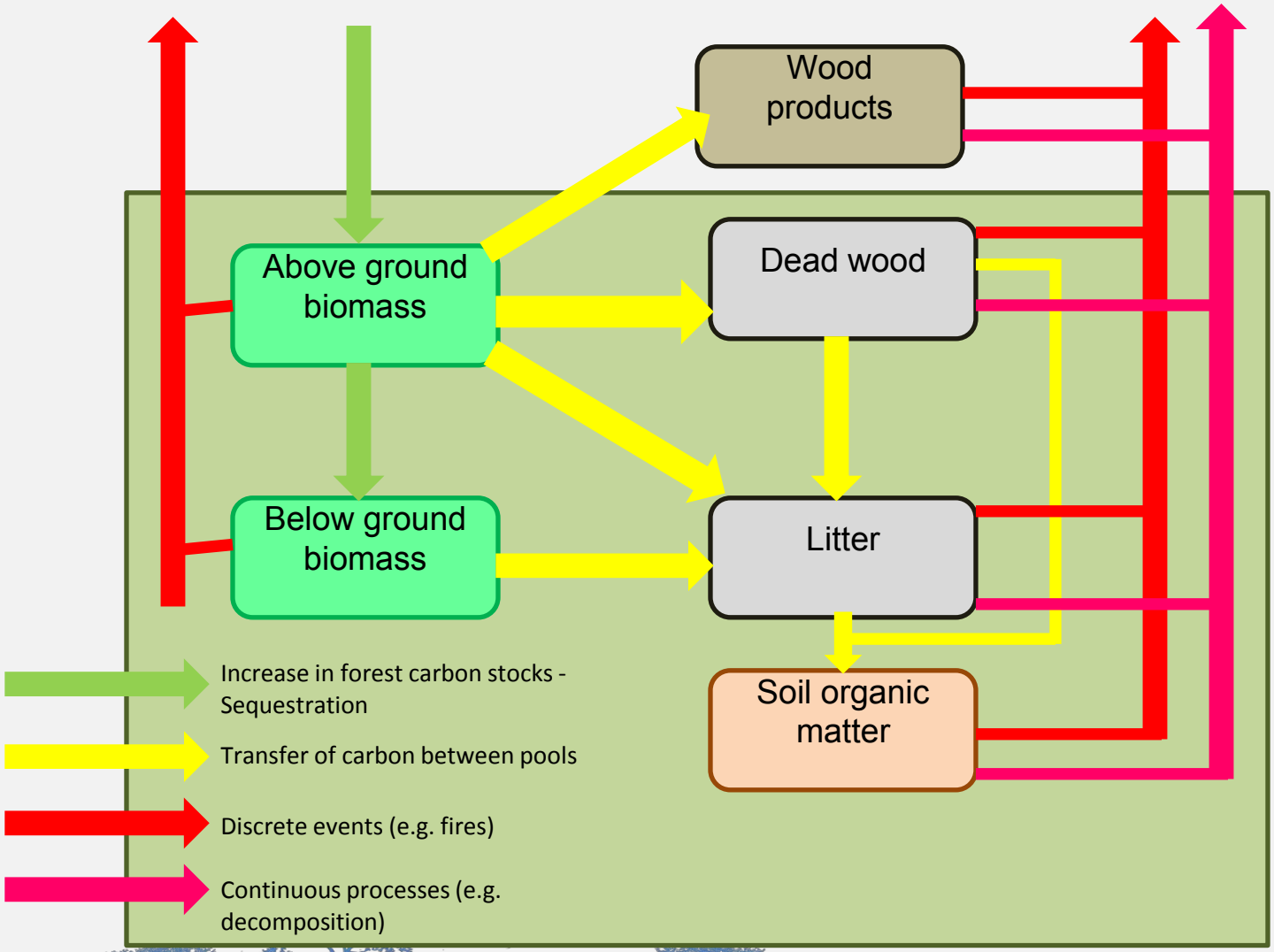
- Soil

{ - mineral
- organic

$$\Delta C = \Delta C_{AB} + \Delta C_{BB} + \Delta C_{DW} + \Delta C_{LI} + \Delta C_{SO}$$



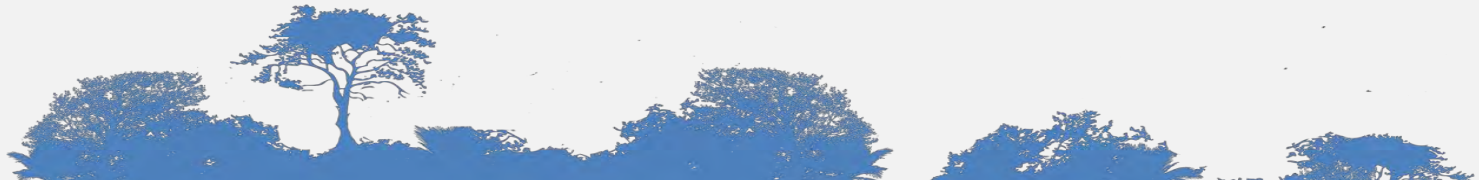
Changes in Forest Carbon Pools



How NFIs are used to generate EFs

- Tier 2 or Tier 3 (Tier 1: Default values: no NFI)
  - **Tier 2**: IPCC default assumptions + default methodology + country specific data
  - **Tier 3**: Country specific assumptions + methodology + data (to be internationally reviewed)

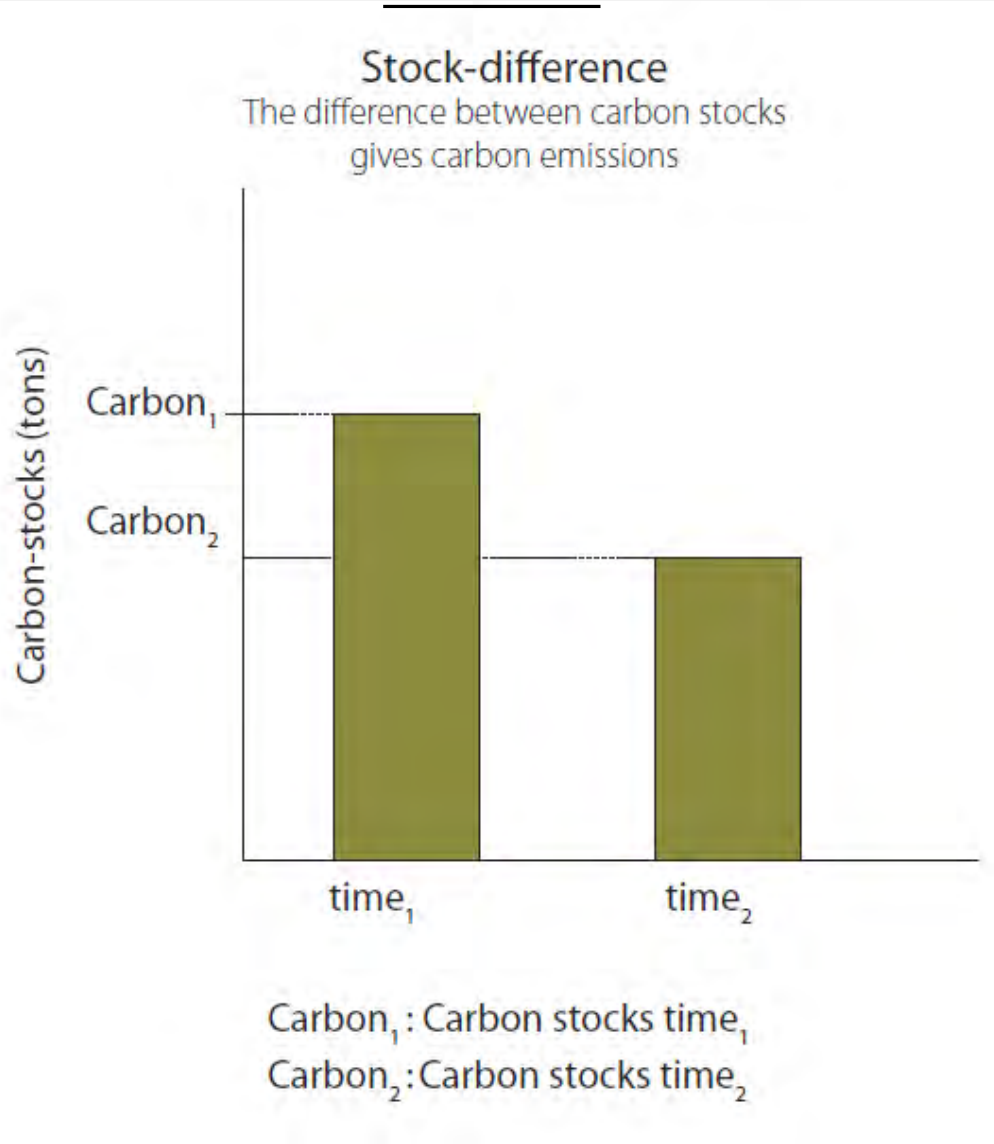
- NFI strategies/methodological approaches for assessing C pool changes:
  1. **Direct measurement of changes**: Gain-Loss ('default') or Stock-Difference methods applied in permanent sample plots (Tier 2 or Tier 3)
  2. **Empirical modelling of changes**: NFI data used for reconstruction of e.g. a forest age class distribution or of an activity chronosequence (Tier 2 or Tier 3)
  3. **Carbon budget modelling**: NFI data inserted into a model with other data, e.g. climatological, biogeographical (e.g. Canada's Carbon Budget Model, CBM-CFS3) (Tier 3)



Direct Measurement of Changes

Stock-Difference and Gain-Loss

METHOD 1



Emission Factors in the GHG Inventory

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TABLE 5(KP-I)A.2. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO PROTOCOL

Article 3.3 activities: Deforestation [1]

AUSTRALIA
Inventory 2011
Submission 2013 v1.1

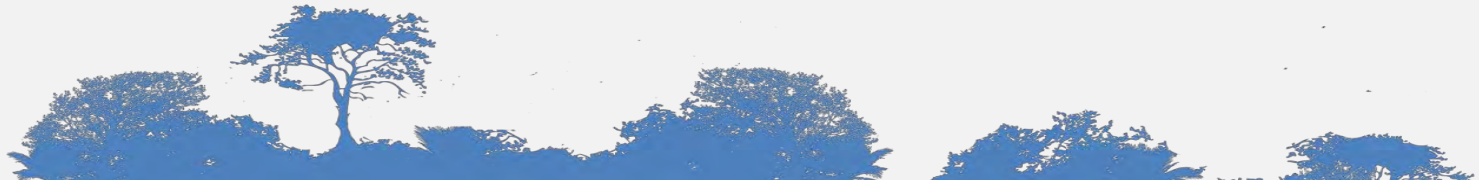
GEOGRAPHICAL LOCATION [2]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FACTORS [5]										Implied emission / removal factor per area [11]	CHANGE IN CARBON STOCK [5]										Net CO_2 emissions/ removals [11]
				Carbon stock change in above-ground biomass per			Carbon stock change in below-ground biomass per			Net carbon stock change in litter per	Net carbon stock change in dead wood	Net carbon stock change in soils per			Carbon stock change in above-ground biomass [4], [5]			Carbon stock change in below-ground biomass [4], [5]			Net carbon stock change in litter [4]	Net carbon stock change in dead wood [4]	Net carbon stock change in soils [4]		
Identification code	Subdivision [3]	Area subject to the activity	Area of organic soils [7]	Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils		Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils [9]	
		(kha)	(kha)	(Mg C/ha)										Mg CO_2/ha	(Gg C)										(Gg CO_2)
Total for activity A.2.		6,501.52	NO	0.00	-0.39	-0.39	0.00	-0.17	-0.17	-0.15	-0.34	-0.47	NO	5.57	0.50	-2,561.09	-2,560.59	0.23	-1,135.73	-1,135.50	-958.47	-2,185.90	-3,044.52	NO	36,244.92
NSW		1,320.73	NO	0.00	-0.80	-0.80	0.00	-0.34	-0.34	-0.33	-0.41	-0.55	NO	8.87	0.27	-812.57	-812.30	0.12	-350.44	-350.32	-331.81	-416.51	-556.98	NO	9,049.08
	Acacia Forest and Woodland	61.17	NO	IE	-0.18	-0.18	IE	-0.08	-0.08	-0.14	-0.18	0.01	NO	2.08	IE	-10.92	-10.92	IE	-4.95	-4.95	-8.59	-10.92	0.69	NO	127.18
	Acacia Open Woodland	0.44	NO	IE	-0.52	-0.52	IE	-0.50	-0.50	-0.22	-0.33	0.04	NO	5.61	IE	-0.23	-0.23	IE	-0.22	-0.22	-0.10	-0.15	0.02	NO	2.49
	Acacia Shrubland	93.21	NO	IE	-0.12	-0.12	IE	-0.12	-0.12	-0.15	-0.06	-0.01	NO	1.71	IE	-11.28	-11.28	IE	-10.86	-10.86	-14.21	-5.86	-1.38	NO	159.82
	Callitris Forest and Woodland	48.32	NO	IE	-0.46	-0.46	IE	-0.21	-0.21	-0.29	-0.15	-0.19	NO	4.76	IE	-22.01	-22.01	IE	-10.10	-10.10	-14.15	-7.29	-9.17	NO	229.99
	Casuarina Forest and	51.32	NO	IE	-0.39	-0.39	IE	-0.18	-0.18	-0.23	-0.45	-0.05	NO	4.74	IE	-20.05	-20.05	IE	-9.03	-9.03	-11.68	-23.06	-2.53	NO	243.29
	Eucalyptus Low Open	1.38	NO	0.19	IE	0.19	0.09	IE	0.09	-0.20	-0.50	-0.23	NO	2.40	0.27	IE	0.27	0.12	IE	0.12	-0.28	-0.69	-0.92	NO	3.31
	Eucalyptus Open																								4,386.28
	Euc																								896.73
	Euc																								522.03
	Euc																								2,103.99
	He																								32.09
	Low																								7.70
	Ma																								181.40
	Ma																								13.15

IMPLIED CARBON STOCK CHANGE FACTORS [5]

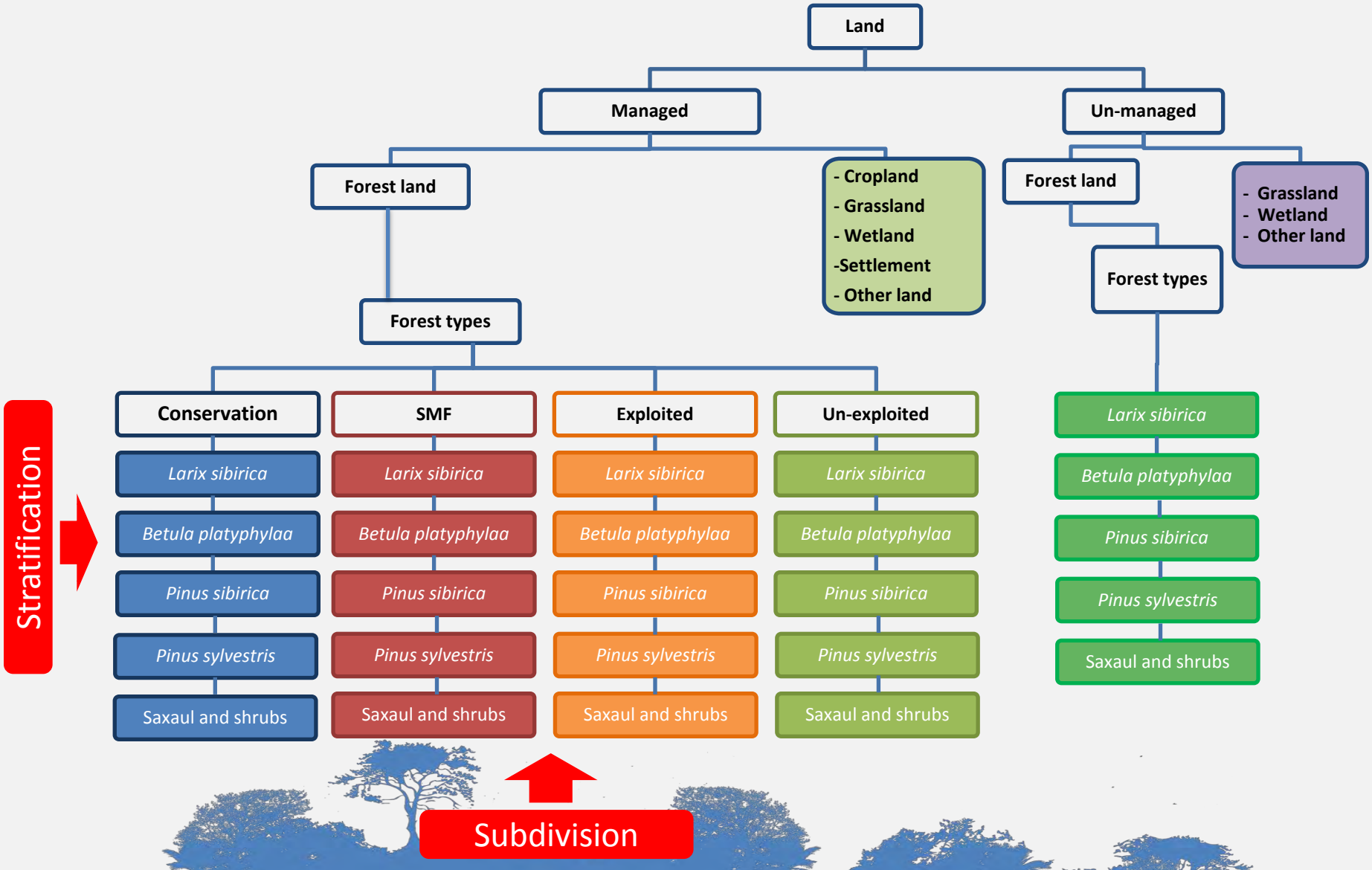
Carbon stock change in above-ground biomass per			Carbon stock change in below-ground biomass per			Net carbon stock change in litter per	Net carbon stock change in dead wood	Net carbon stock change in soils per		Implied emission / removal factor per area [11]
Gains	Losses	Net change	Gains	Losses	Net change			Mineral soils	Organic soils	
(Mg C/ha)										Mg CO_2/ha

Forest Stratification for NFI

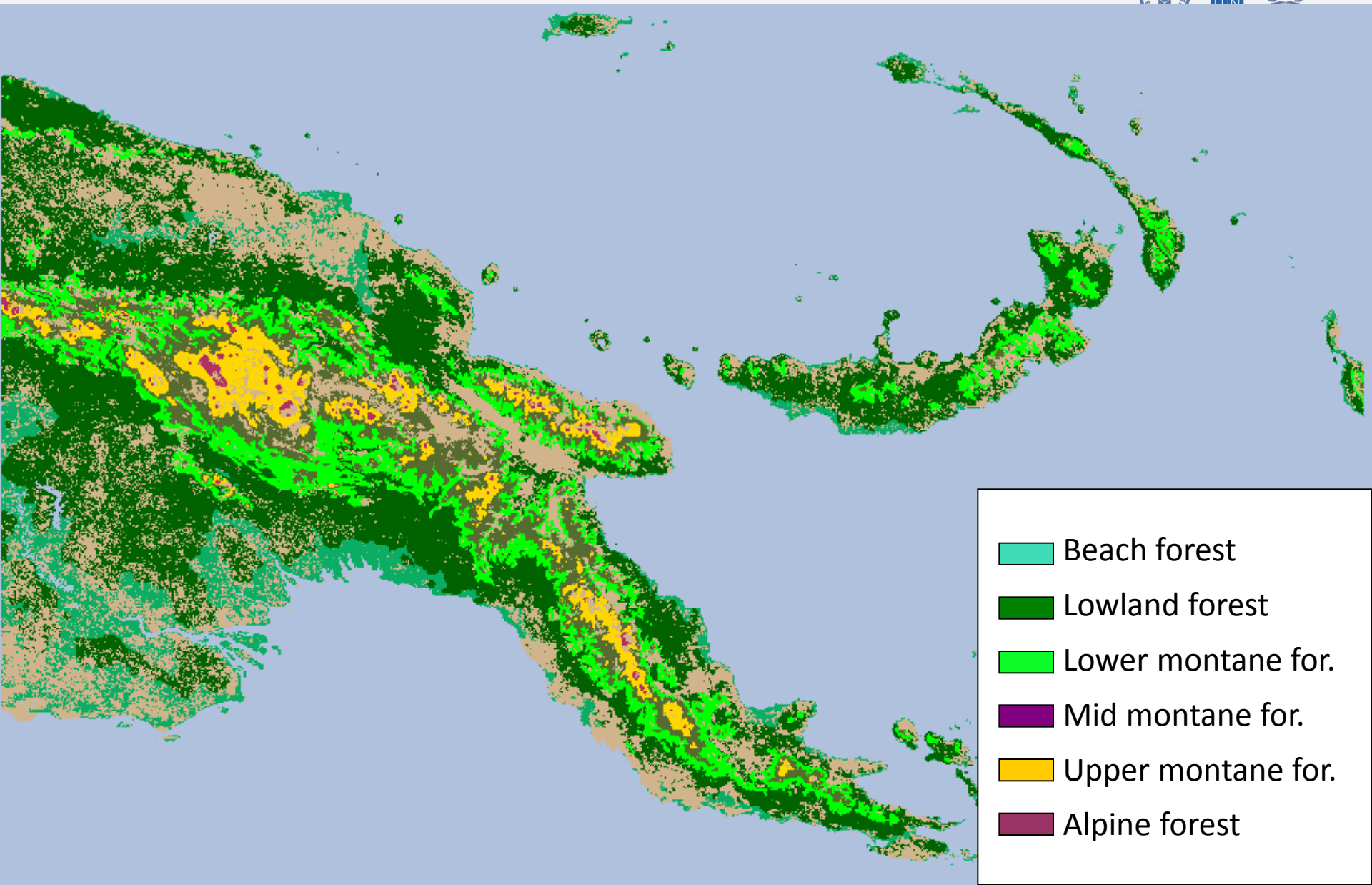
- What?
  - Division of forest area into homogenous populations/strata
- Why?
  - Facilitate UNFCCC reporting on land uses following IPCC
    - Land use categories, sub-categories, sub-divisions
  - Where different forest types are located in different areas of the country, allows a "random restricted" sampling approach
  - Allows a country to sample different forest populations/strata cost-effectively
- How?
  - Division of sampling area into non-overlapping land uses / forest types
  - Samples taken from each strata



Mongolia's Forest Land Stratification & GHG Reporting Sub-Divisions for REDD+



PNG's Preliminary Forest Stratification



Forest Stratification to support Activity Data Sub-Divisions in the GHG Inventory

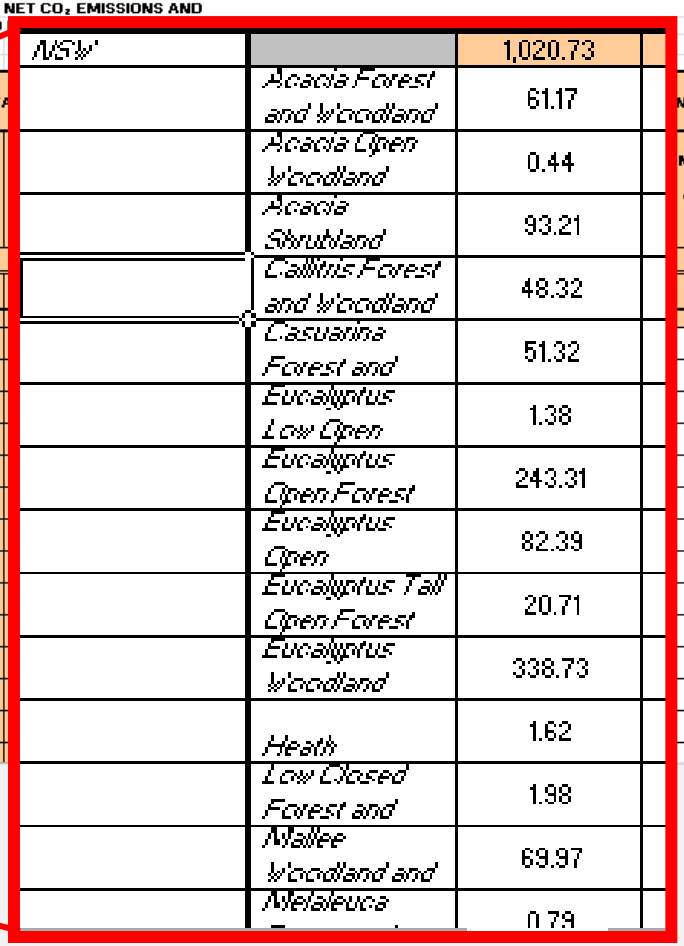
UN-REDD PROGRAMME

TABLE 5(KP-I)A.2. SUPPLEMENTARY BACKGROUND DATA ON CARBON STOCK CHANGES AND NET CO_2 EMISSIONS AND REMOVALS FOR LAND USE, LAND-USE CHANGE AND FORESTRY ACTIVITIES UNDER THE KYOTO

Article 3.3 activities: Deforestation [1]

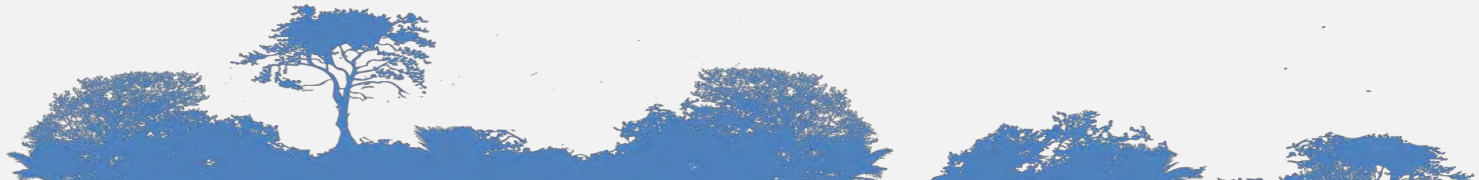
AUSTRALIA
Inventory 2011
Submission 2013 v1.1

GEOGRAPHICAL LOCATION [2]	ACTIVITY DATA			IMPLIED CARBON STOCK CHANGE FA							N STOCK [5]				
Identification code	Subdivision [3]	Area subject to the activity	Area of organic soils [4]	Carbon stock change in above-ground biomass per			Carbon stock change in below-ground biomass per			Net carbon stock change in litter per	Net carbon stock change in litter [5]	Net carbon stock change in dead wood [5]	Net carbon stock change in soils [5]		Net CO_2 emissions/ removals [5]
				Gains	Losses	Net change	Gains	Losses	Net change				Mineral soils	Organic soils [5]	
		(kha)	(kha)	(Mg C/ha)											(Gg CO_2)
Total for activity A.2.		6,501.52	NO	0.00	-0.39	-0.39	0.00	-0.17	-0.17	-0.15	-958.47	-2,185.90	-3,044.52	NO	36,244.92
NSW		1,020.73	NO	0.00	-0.80	-0.80	0.00	-0.34	-0.34	-0.33	-331.81	-416.51	-556.98	NO	9,049.08
	Acacia Forest and Woodland	61.17	NO	IE	-0.18	-0.18	IE	-0.08	-0.08	-0.14	-8.59	-10.92	0.69	NO	127.18
	Acacia Open Woodland	0.44	NO	IE	-0.52	-0.52	IE	-0.50	-0.50	-0.22	-0.10	-0.15	0.02	NO	2.49
	Acacia Shrubland	93.21	NO	IE	-0.12	-0.12	IE	-0.12	-0.12	-0.15	-14.21	-5.86	-1.38	NO	159.82
	Callitris Forest and Woodland	48.32	NO	IE	-0.46	-0.46	IE	-0.21	-0.21	-0.29	-14.15	-7.29	-9.17	NO	229.99
	Casuarina Forest and	51.32	NO	IE	-0.39	-0.39	IE	-0.18	-0.18	-0.23	-11.68	-23.06	-2.53	NO	243.29
	Eucalyptus Low Open	1.38	NO	0.19	IE	0.19	0.09	IE	0.09	-0.20	-0.28	-0.69	-0.32	NO	3.31
	Eucalyptus Open Forest	243.31	NO	IE	-1.39	-1.39	IE	-0.63	-0.63	-0.58	-140.17	-265.00	-299.61	NO	4,386.28
	Eucalyptus Open	82.39	NO	IE	-1.58	-1.58	IE	-0.66	-0.66	-0.30	-24.56	7.77	-43.77	NO	896.73
	Eucalyptus Tall Open Forest	20.71	NO	IE	-2.37	-2.37	IE	-0.31	-0.31	-0.76	-15.80	-42.64	-28.29	NO	522.03
	Eucalyptus Woodland	338.73	NO	IE	-0.62	-0.62	IE	-0.26	-0.26	-0.26	-89.27	-50.82	-134.55	NO	2,103.99
	Heath	1.62	NO	IE	-1.38	-1.38	IE	-1.35	-1.35	-0.59	-0.96	-0.81	-2.57	NO	32.09
	Low Closed Forest and	1.98	NO	IE	-0.29	-0.29	IE	-0.28	-0.28	-0.14	-0.27	-0.08	-0.61	NO	7.70
	Mallee Woodland and	69.97	NO	IE	-0.08	-0.08	IE	-0.08	-0.08	-0.11	-7.74	-5.47	-25.31	NO	181.40
	Melaleuca	0.79	NO	IE	-2.35	-2.35	IE	-1.08	-1.08	-0.19	-0.15	0.26	-0.98	NO	13.15



Key Messages

- NFIs are national decision-making tools so should be designed to meet a country's individual data / information needs
- NFIs are commonly used by countries (almost all Annex 1 countries) to assess Emission Factors for their national GHG inventory
- Changes in all five forest carbon pools should be reported on
- Two approaches set out by the IPCC for EF assessment are the Gain-Loss method (can be done using one NFI) and the Stock-Difference method (requires two NFIs)
- Land use stratification can be a useful first step to divide forest land into homogenous strata and ensure field sampling is statistically robust and cost-effective



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Thank you

Joel.Scriven@fao.org
http://www.un-redd.org

UN-REDD PROGRAMME

Tool 3. Greenhouse Gas Inventory: Reporting requirements for the forest sector

Kimberly Todd
REDD+ MRV Specialist
UNDP/UN-REDD
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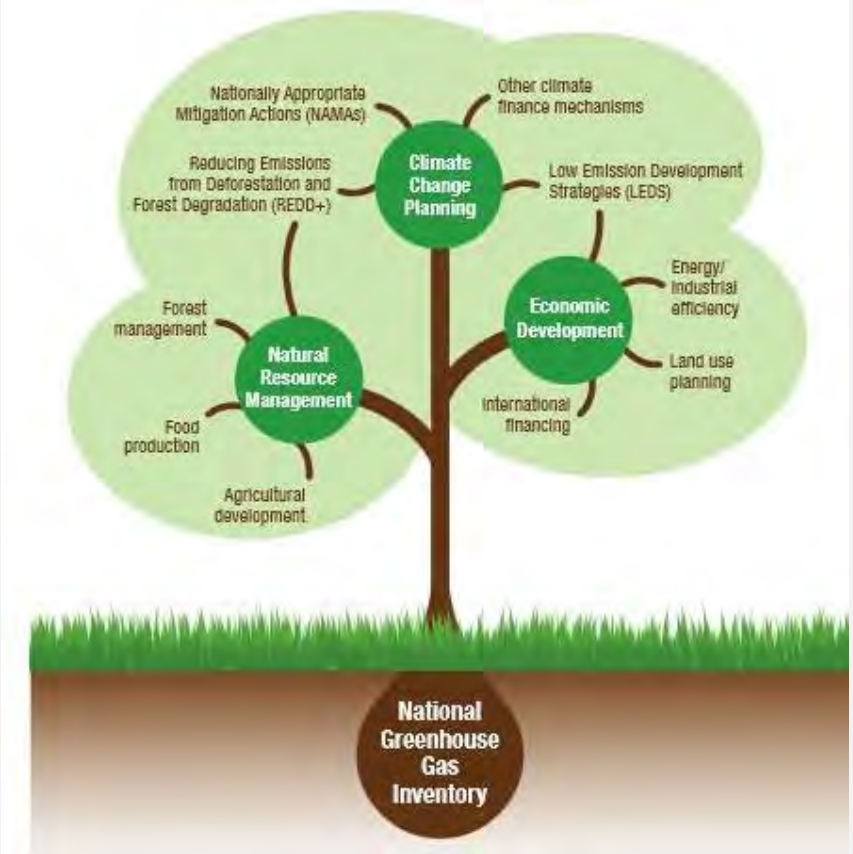
Outline

- Benefits/importance of the GHG inventory
- UNFCCC context for National Communications and Biennial Update Reports
- IPCC Methodology and Reporting Principles
- National GHG Inventory Systems
- Tools and Guidance for development of GHG inventory estimates

Importance and Benefits of Developing a National GHG Inventory

High quality GHG inventories:

- Are necessary to meet UNFCCC reporting requirements for National Communications and Biennial Update Reports
- Are a valuable tool for developing policies and programs that address climate change and economic development
- help to identify strategies for improving a country's economy and managing natural resources
- Provide a foundation for MRV required for results-based climate finance



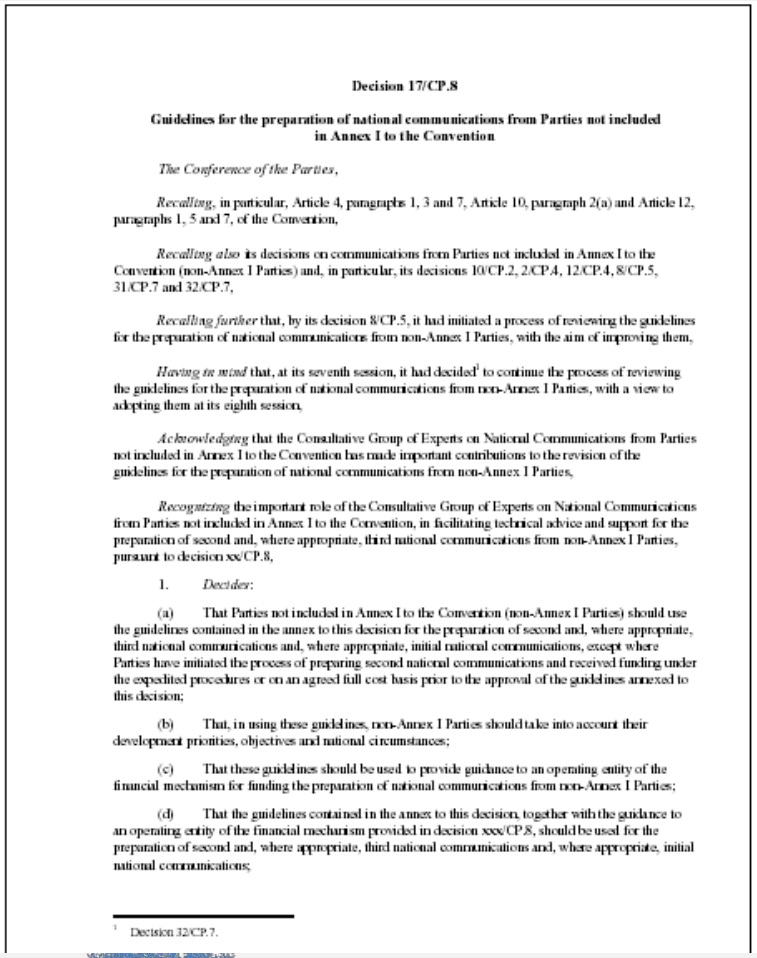
Image, US EPA

What's included in the GHG inventory report?

- gas-by-gas basis and in units of mass, estimates of anthropogenic emissions of CO2, CH4, and N2O by sources and removals by sinks
  - Encouraged to also report on anthropogenic emissions by other greenhouse gases such as carbon monoxide (CO), nitrogen oxides (NOx) and non-methane volatile organic compounds (NMVOCs).
- provide information on methodologies used
- information on the level of uncertainty associated with inventory data and their underlying assumptions, and description of uncertainty methodologies used
- Description of:
  - procedures and arrangements undertaken to collect and archive data for the preparation of national GHG inventories
  - efforts to make this a continuous process, including information on the role of the institutions involved

Decision 17/CP.8: The UNFCCC Basis for non-Annex I reporting

- Provides guidelines for Non-Annex I National Communications
  - States that NAI countries should use 1996 IPCC Guidelines
  - Encourages use of IPCC **G**ood **P**ractice **G**uidance and Uncertainty Management (2000 and 2003)



Decision 17/CP.8

Guidelines for the preparation of national communications from Parties not included in Annex I to the Convention

The Conference of the Parties,

Recalling, in particular, Article 4, paragraphs 1, 3 and 7, Article 10, paragraph 2(a) and Article 12, paragraphs 1, 5 and 7, of the Convention,

Recalling also its decisions on communications from Parties not included in Annex I to the Convention (non-Annex I Parties) and, in particular, its decisions 10/CP.2, 2/CP.4, 12/CP.4, 8/CP.5, 31/CP.7 and 32/CP.7,

Recalling further that, by its decision 8/CP.5, it had initiated a process of reviewing the guidelines for the preparation of national communications from non-Annex I Parties, with the aim of improving them,

Having in mind that, at its seventh session, it had decided[1] to continue the process of reviewing the guidelines for the preparation of national communications from non-Annex I Parties, with a view to adopting them at its eighth session,

Acknowledging that the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention has made important contributions to the revision of the guidelines for the preparation of national communications from non-Annex I Parties,

Recognizing the important role of the Consultative Group of Experts on National Communications from Parties not included in Annex I to the Convention, in facilitating technical advice and support for the preparation of second and, where appropriate, third national communications from non-Annex I Parties, pursuant to decision xx/CP.8,

1. *Decides*:

(a) That Parties not included in Annex I to the Convention (non-Annex I Parties) should use the guidelines contained in the annex to this decision for the preparation of second and, where appropriate, third national communications and, where appropriate, initial national communications, except where Parties have initiated the process of preparing second national communications and received funding under the expedited procedures or on an agreed full cost basis prior to the approval of the guidelines annexed to this decision;

(b) That, in using these guidelines, non-Annex I Parties should take into account their development priorities, objectives and national circumstances;

(c) That these guidelines should be used to provide guidance to an operating entity of the financial mechanism for funding the preparation of national communications from non-Annex I Parties;

(d) That the guidelines contained in the annex to this decision, together with the guidance to an operating entity of the financial mechanism provided in decision xxx/CP.8, should be used for the preparation of second and, where appropriate, third national communications and, where appropriate, initial national communications;

[1] Decision 32/CP.7.

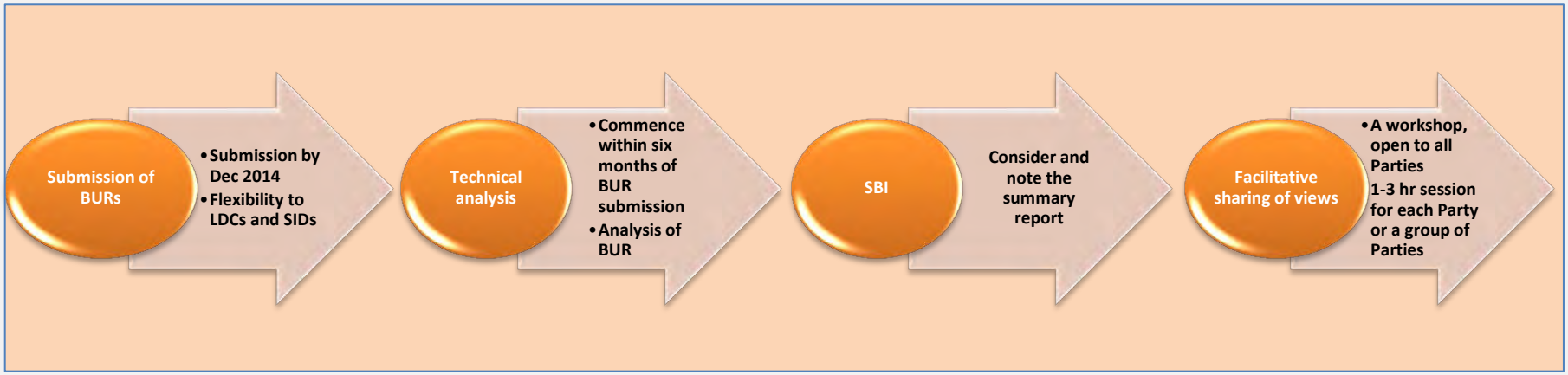
Biennial Update Reports (BURs)

- The Durban outcome recognized the guidelines for ICA of BURs as meeting the COP16 call for MRV of internationally-supported NAMAs
- The BUR serves as a summary of parts of the National Communication or interim report between NC submissions
- A BUR includes (but is not limited to):
  - **National inventory of GHG emissions and sinks**
  - Information on mitigation actions and their effects
  - Information on domestic MRV
- The first BURs are due by December 2014
  - Flexibility based on capabilities and level of support
- To be submitted every **2 years**

International Consultation and Analysis (ICA)

- Modalities and guidelines for the ICA (two-step approach) also agreed in Durban

1. **Technical analysis of BURs** by a **technical team of experts**
2. **Facilitative sharing of views**



Image, UNFCCC

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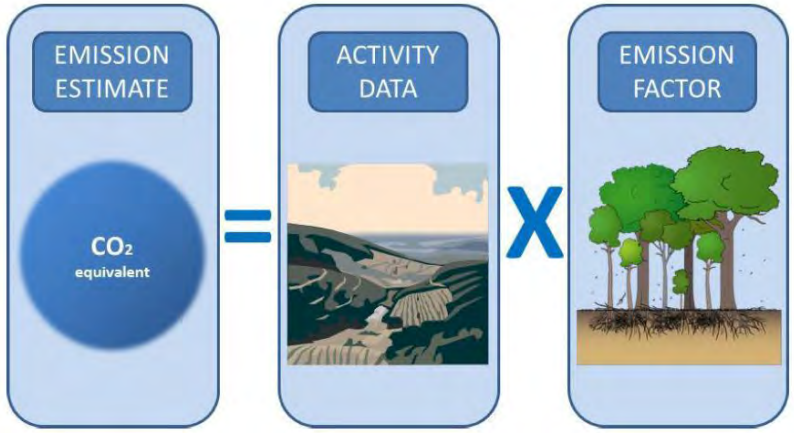
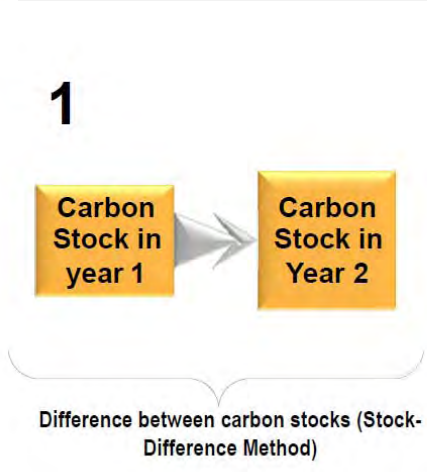
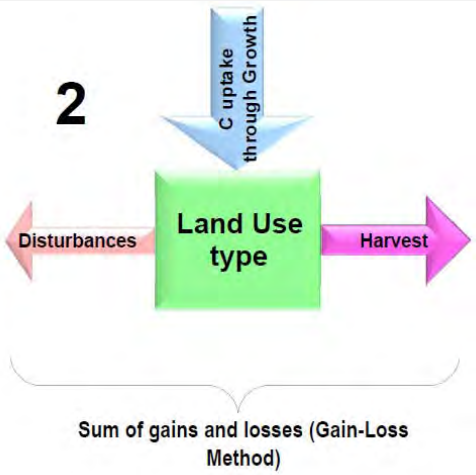
GHG Inventory Estimation for the LULUCF Sector







Forest and Grassland Conversion

MODULE	**LAND-USE CHANGE AND FORESTRY**
SUBMODULE	**FOREST AND GRASSLAND CONVERSION - CO_2 FROM BIOMASS**
WORKSHEET	5-2
SHEET	1 OF 5 BIOMASS CLEARED

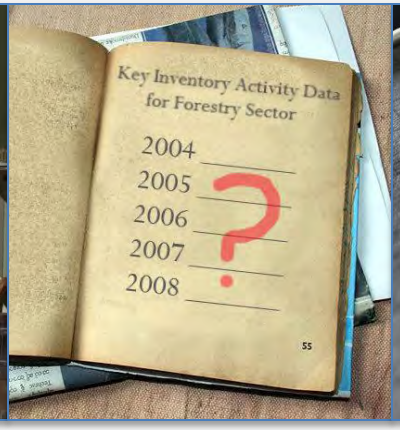
STEP 1

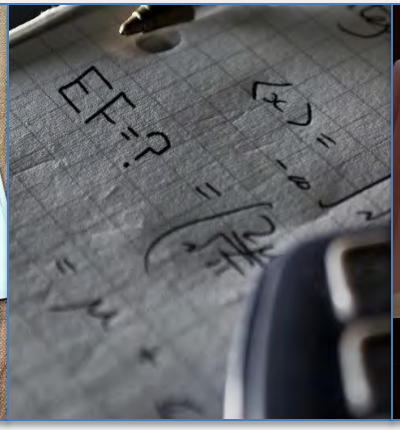
Vegetation types		A Area Converted Annually (kha)	B Biomass Before Conversion (t dm/ha)	C Biomass After Conversion (t dm/ha)	D Net Change in Biomass Density (t dm/ha)	E Annual Loss of Biomass (kt dm)
					D = (B - C)	E = (A x D)
Tropical	Wet/Very Moist					
	Moist, short dry season					
	Moist, long dry season					
	Dry					
	Montane Moist					
	Montane Dry					
Tropical Savanna/Grasslands						
Temperate	Coniferous					
	Broadleaf					
Grasslands						
Boreal	Mixed Broadleaf/ Coniferous					
	Coniferous					
	Forest-tundra					
Grasslands/Tundra						
Other						
Subtotals						

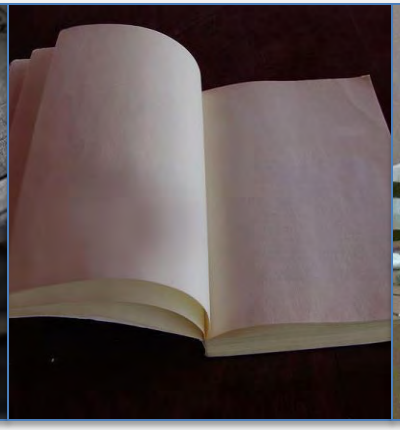
GHG Inventory Reporting Principles: "TACC"

- **T**ransparency
  - Assumptions/methods are clear; inventory can be replicated
- **A**ccuracy
  - Reflect actual emissions and removals
- **C**onsistency
  - Differences in results reflect real emissions differences
- **C**ompleteness
  - All relevant sources, sinks and geographic areas
- **C**omparability
  - Methodologies and the reporting approach allows comparisons

Challenges Faced When Establishing National Inventory Systems in NA-I Countries







Small teams with limited resources and multiple responsibilities

Incomplete or non-existent activity data

Lack of country-specific emission and stock change factors

Insufficient documentation from previous inventories

Difficulty retaining expertise

What is a National Inventory System (NIS)?

A *national inventory system* incorporates all the elements necessary to:

- Estimate, report and archive GHG emissions and removals for energy, industrial processes, solvents, agriculture, LULUCF, waste

Institutional arrangements

Legal arrangements

Procedural arrangements

➢ **High quality GHG inventory that meets needs of policy-makers, researchers and public**

What is a **Sustainable** NIS?

- Ability to develop **high quality inventory at regular intervals** (e.g., annually, every 2-4 years, etc)
  - Continually improve emissions and removals estimates
  - Focus resources on most significant key sources
  - Sources of data: identify, appropriately archive and make regularly accessible
  - Transparently document inventory process
    - an expert should be able to reproduce

A complete and accurate inventory is the foundation for analysis of a range of energy and environmental issues, as well as MRV

An Effective NIS can streamline the three main phases of the inventory process

UN-REDD PROGRAMME

1. Inventory planning

- General rules of procedure
- Source-specific rules of procedure
- Workplan, budget, timeline
- Guidance manual
- Elaborating a QA/QC plan
- Inventory improvement strategy

2. Inventory preparation

- National inventory report
- Updated improvement strategy
- QA/QC

3. Inventory management

- Documentation
- Archiving
- Reporting to UNFCCC
- Awareness raising (national level)

Institutional Arrangements

- Consist of a set of formal arrangements (e.g., regulations, MoUs, etc.) that rules the flow of resources, data, information, among elements of the NIS

- Objectives:
  1. To provide the financial and human resources as well as legal authority to ensure that NIS functions will be entirely and efficiently performed
  2. To set up the framework of provisions which rule those functions

Tools and Guidance for GHG inventory development

UN-REDD PROGRAMME

- UNFCCC NAI GHG inventory software
  - http://unfccc.int/naiisapp
- IPCC 2006 Software
  - http://www.ipcc-nggip.iges.or.jp/software/index.html
- Agriculture and Land Use (ALU) Tool
  - http://www.nrel.colostate.edu/projects/ALUsoftware/
- Consultative Group of Experts (CGE) Training Materials
  - http://unfccc.int/national_reports/non-annex_i_natcom/training_material/methodological_documents/items/349.php
- Handbook: Managing the National GHG Inventory Process (UNDP-GEF, 2005) http://ncsp.undp.org/document/managing-national-greenhouse-gas-inventory-process
- US EPA Template Workbook: Developing a National GHG Inventory System www.epa.gov/climatechange/Downloads/EPAactivities/Complete-Template-Workbook.doc

UN-REDD PROGRAMME

FAO UNDP UNEP

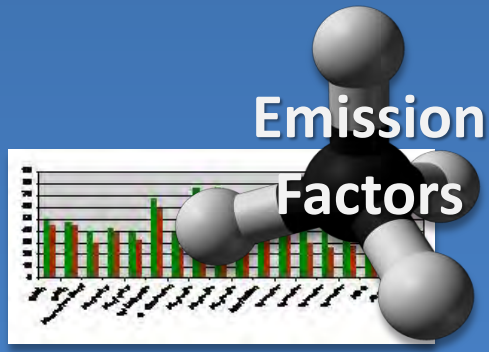
Geographic Information Systems

Land Use/ Cover Soils and Climate

Management Activity Data

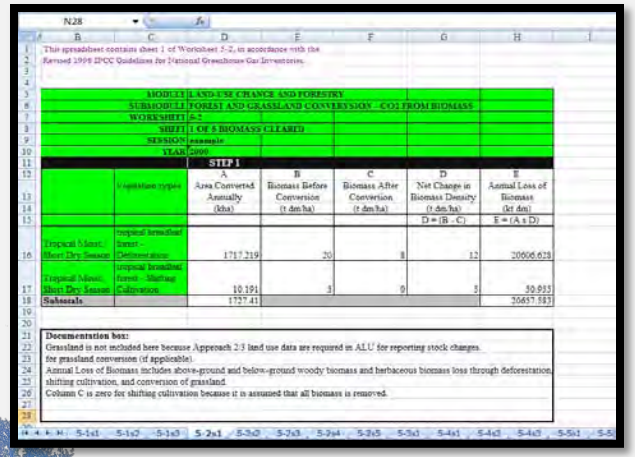
National Agriculture and Forestry Statistics

Emission Factors



IPCC Defaults or Country-Specific

ALU Inventory Software



		A	B	C	D	E
	Vegetation type	Area Converted Annually (kha)	Biomass Before Conversion (t dm/ha)	Biomass After Conversion (t dm/ha)	Net Change in Biomass Density (t dm/ha)	Annual Loss of Biomass (kt dm)
					D = (B - C)	E = (A x D)
Tropical Moist Short Dry Season	tropical broadleaf forest - Deforestation	1717.219	20	8	12	20606.628
Tropical Moist Short Dry Season	tropical broadleaf forest - shifting Cultivation	10.191	3	0	3	30.933
Subtotals		1727.41				20637.583

Generates detailed reports

Concluding Remarks

•In addition to UNFCCC commitments, a greenhouse gas (GHG) inventory can be a valuable tool for developing policies and programs that address climate change and economic development.

- Results can be achieved using different strategies, methodological approaches, and tools
  - National circumstances need to be taken into account
- National inventory systems are foundation for complete and rigorous inventories
- Documentation and archiving are critical success factors for the sustainability of the system
- Inventory development is iterative process – improving over time

UN-REDD PROGRAMME

THANK YOU FOR YOUR ATTENTION!

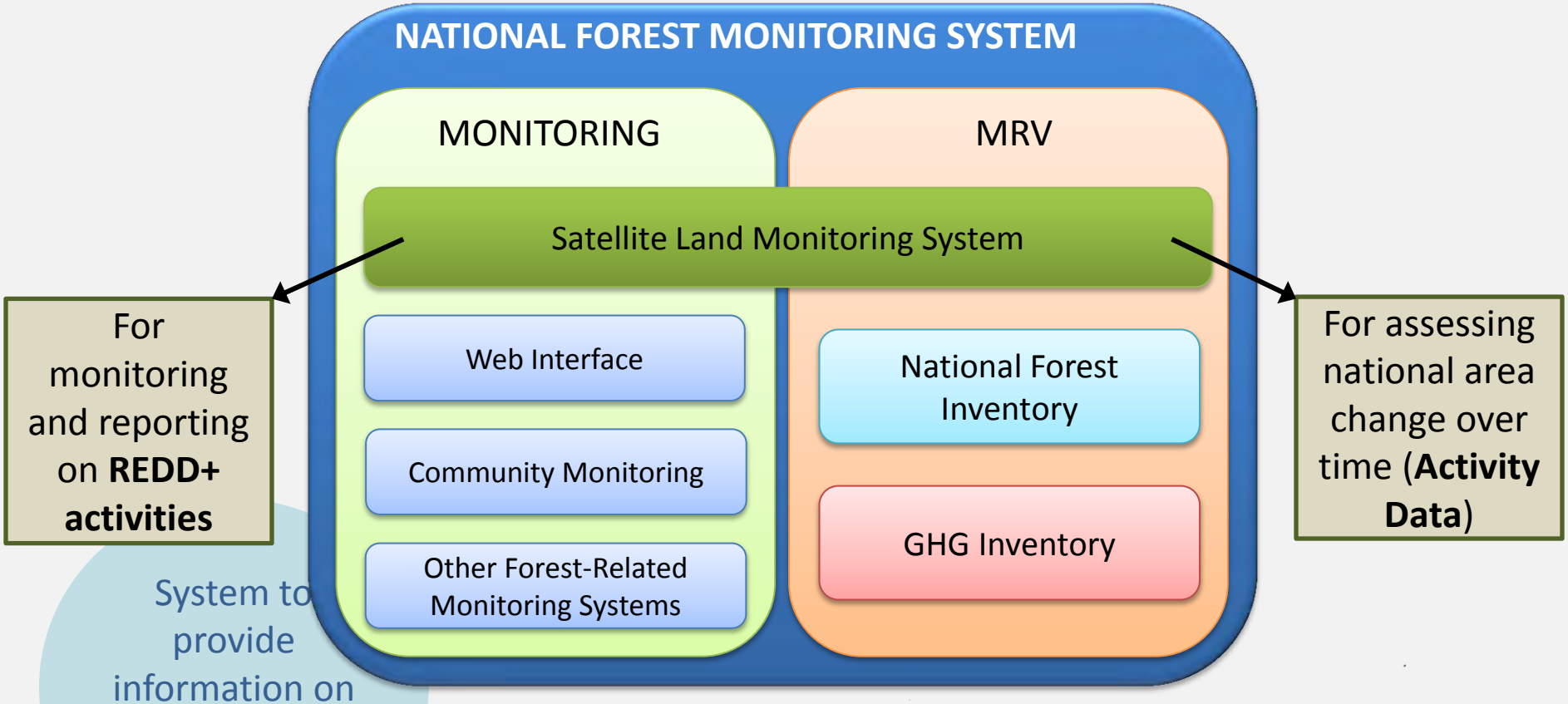
UN-REDD PROGRAMME

The ‘Monitoring’ function of NFMS for REDD+: Going beyond MRV

Bangkok

15th October 2013

Functions of the NFMS



UN-REDD PROGRAMME

The Monitoring function, in contrast with MRV…

- Is crucial to establishing what particular activities (policies/measures) are effective at addressing drivers of Deforestation and Degradation
- Draws on a wide range of potential elements:
  - Satellite Land Monitoring System
  - Forest inventory for community forests and commercial forest management units
  - Management activity records
  - Records of use/sale of forest products and services
  - Social, economic and biodiversity assessments

In contrast with MRV…

- Generates information that is necessary for good forest management, regardless of REDD+. Well managed and regulated forest sectors already generate such information
- Information generation often falls to forest rights-holders and managers, including Indigenous Peoples and Local Communities, where applicable

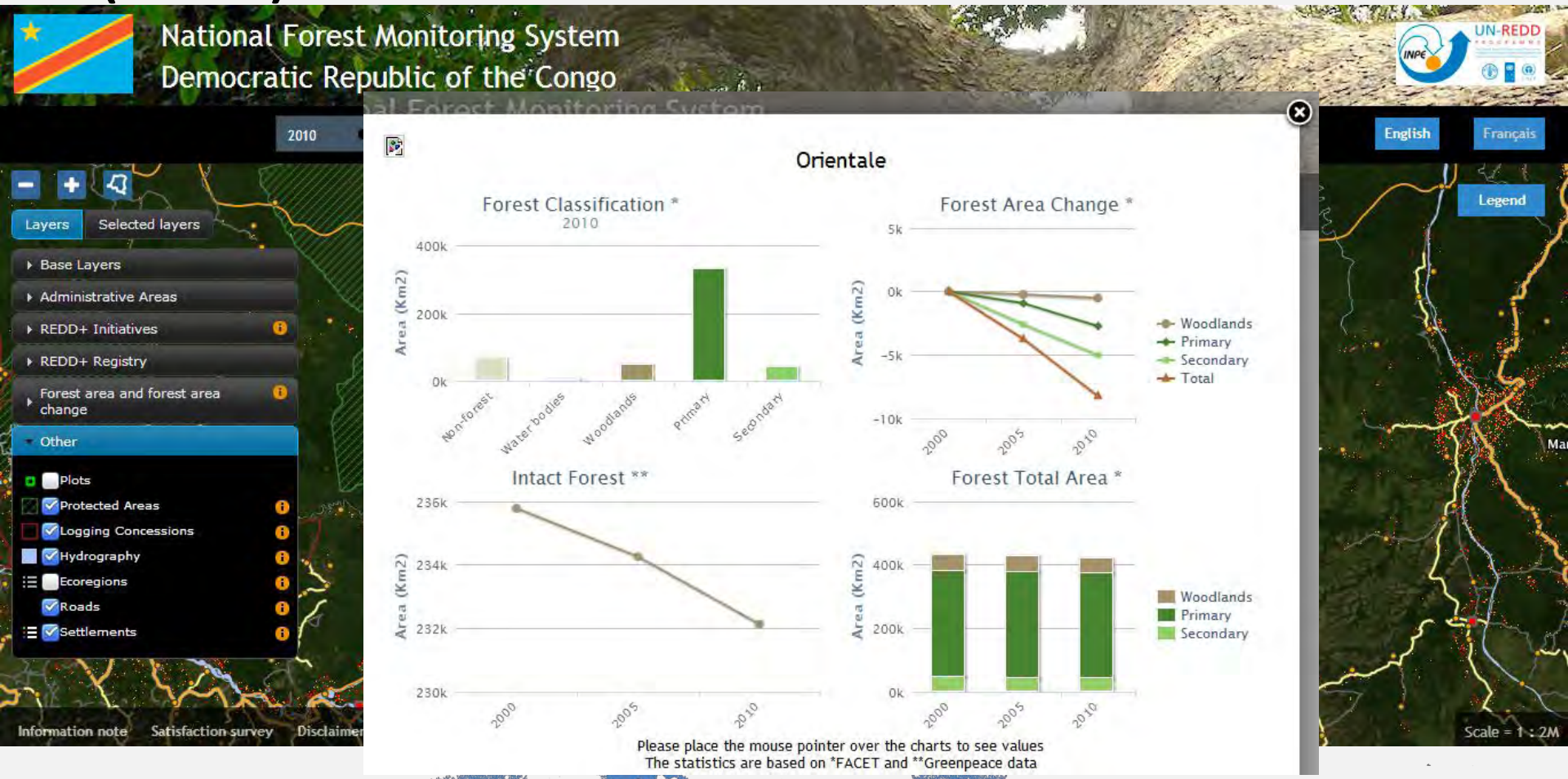
UN-REDD PROGRAMME

1. Open access database

on forests and REDD+ activities

- National Forest Inventory plot data – generally fully or partially restricted. All NFI data should be made available for REDD+
- Land classification – maps showing land use, as interpreted from SLMS and ground truthing, must be readily accessible
- Forest management plans and activities, including those under a national REDD+ programme, or voluntary projects
- Open channels for feedback and correction
- Information technology makes transparency cheaper and easier (and makes restriction of information harder)

Democratic Republic of Congo (DRC)



http://www.rdc-snsf.org

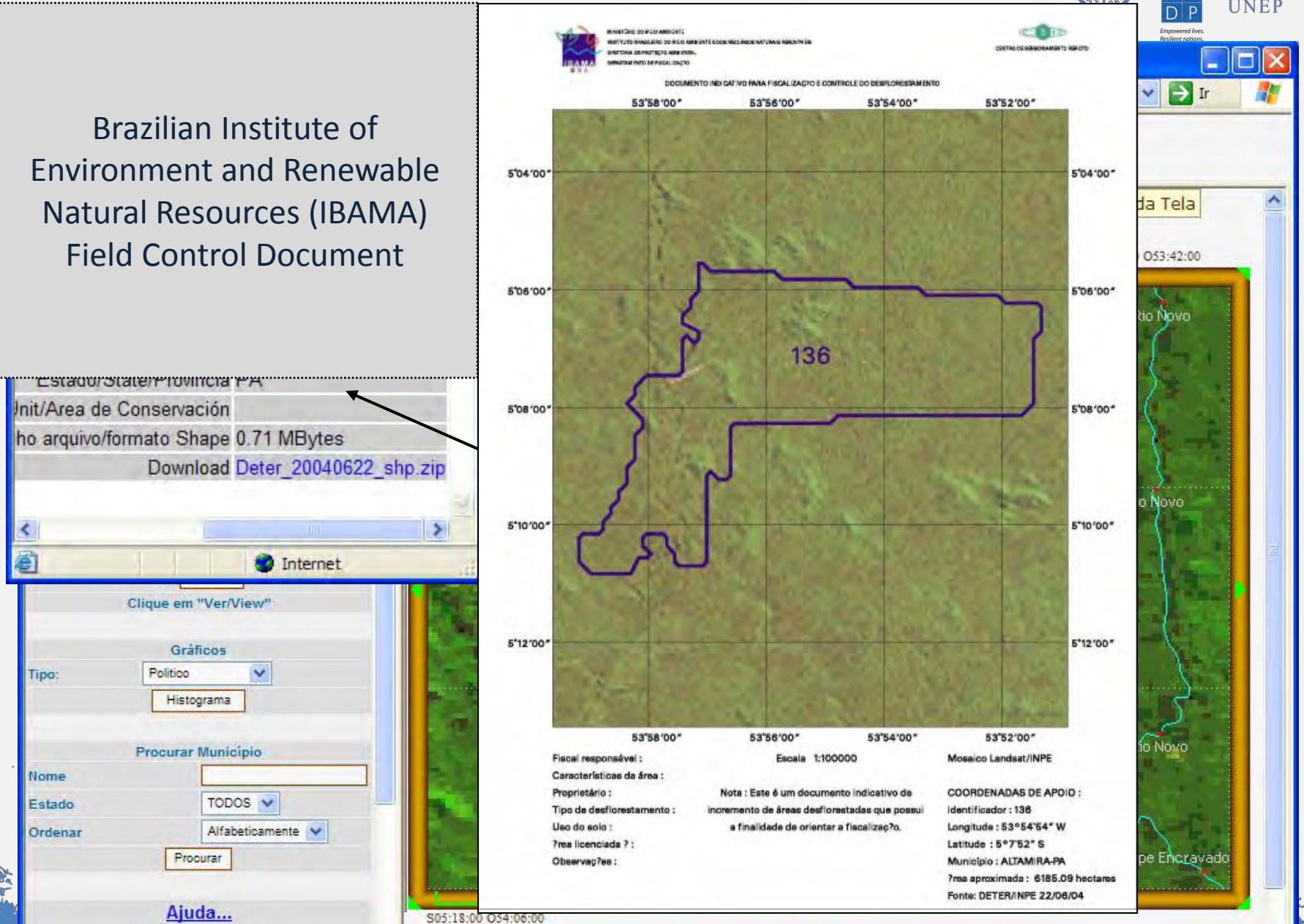
2. Monitoring implementation of REDD+ activities

- Voluntary REDD+ projects, REDD+ demonstration activities and, later on, implementation of REDD+ activities under phase 3, are all based on plans available on the open-access database
- This does not guarantee that these plans are followed
- Potential causes for failure to implement: poor enforcement, insufficient resources, poorly designed plan, lack of consultation etc
- Continuous monitoring of implementation allows identification of problems, and delivery of solutions
- Maintenance of physical records, audits, site visits, SLMS

Forest Monitoring for REDD+: Deter (2004)

UN-REDD

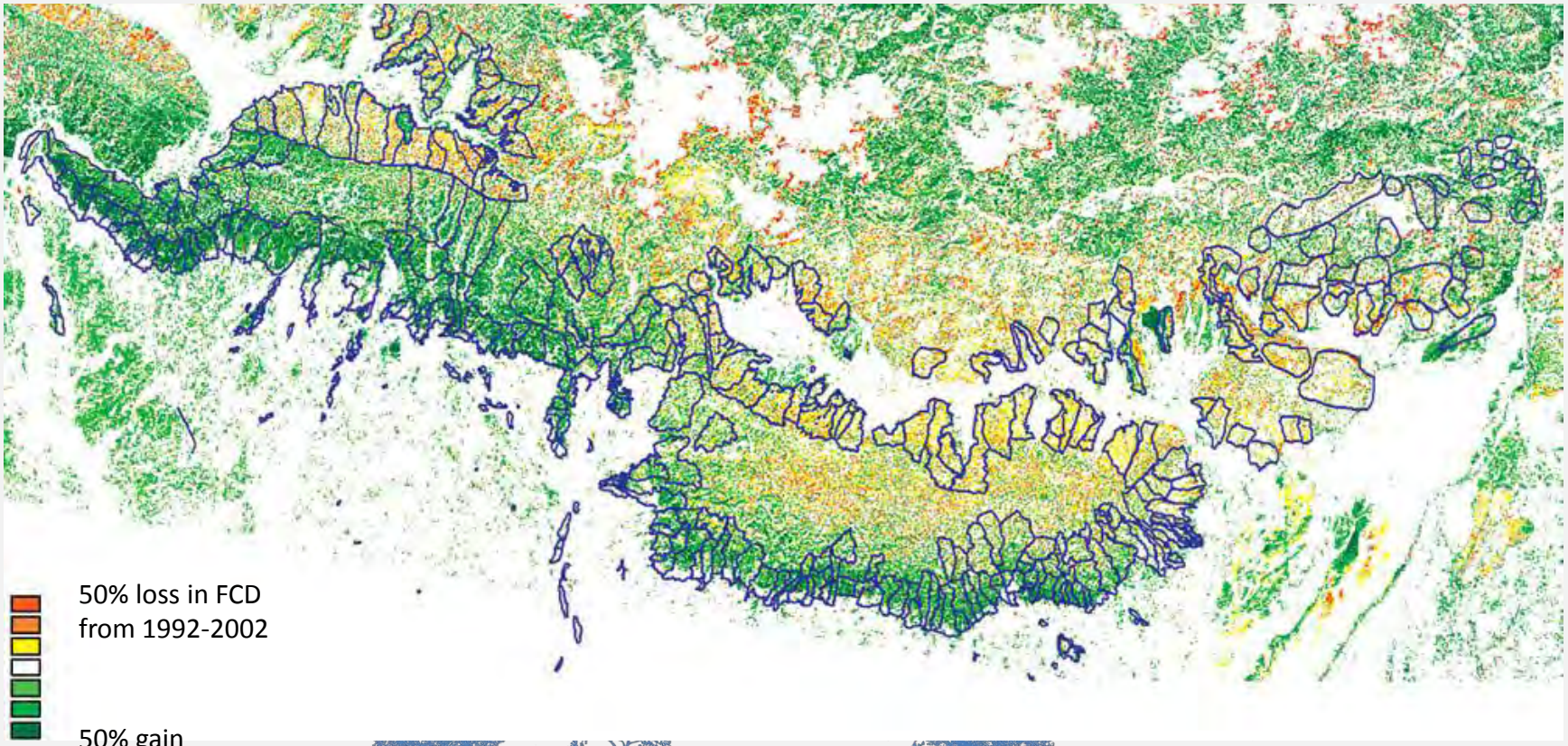
Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) Field Control Document



3. Monitoring the impact of REDD+ activities on biomass

- NFI under the MRV function does not necessarily include plots covering all specific strategies for implementing REDD+ activities
- SMF activities, for example, could include sustainable fuelwood/timber extraction in community-managed forest and in state-managed forest.
- Which strategy is more effective for REDD+, in terms of emission reductions?
- Which strategy is more cost effective for forest officials and managers (including IP/LCs) to invest in?
- Regular forest inventory by FMU; SLMS

Churia Forest Development Project, Nepal

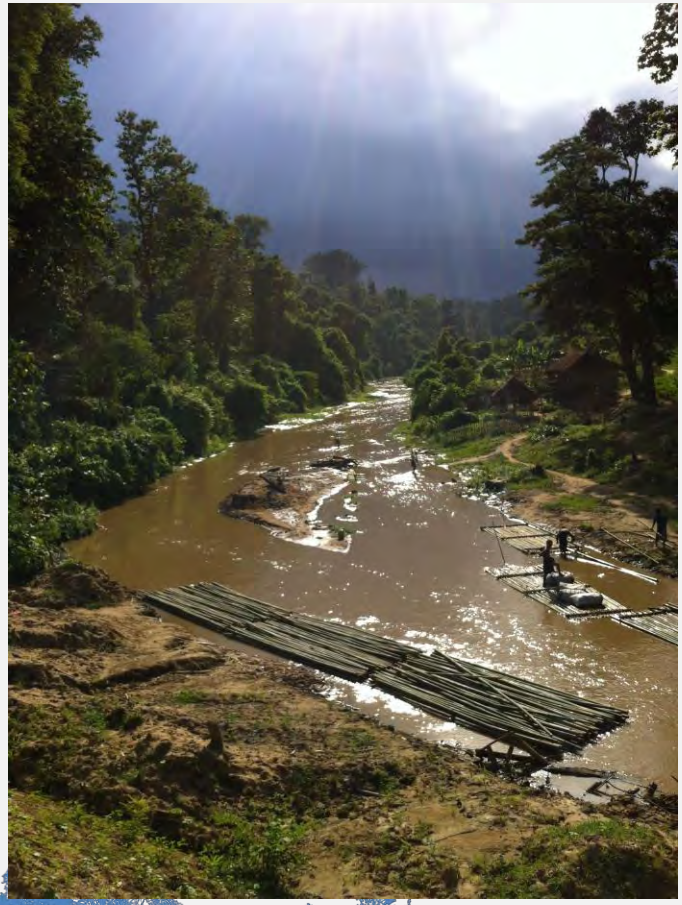


"Return of the Churia Forests", Vickers and Rana, 2005

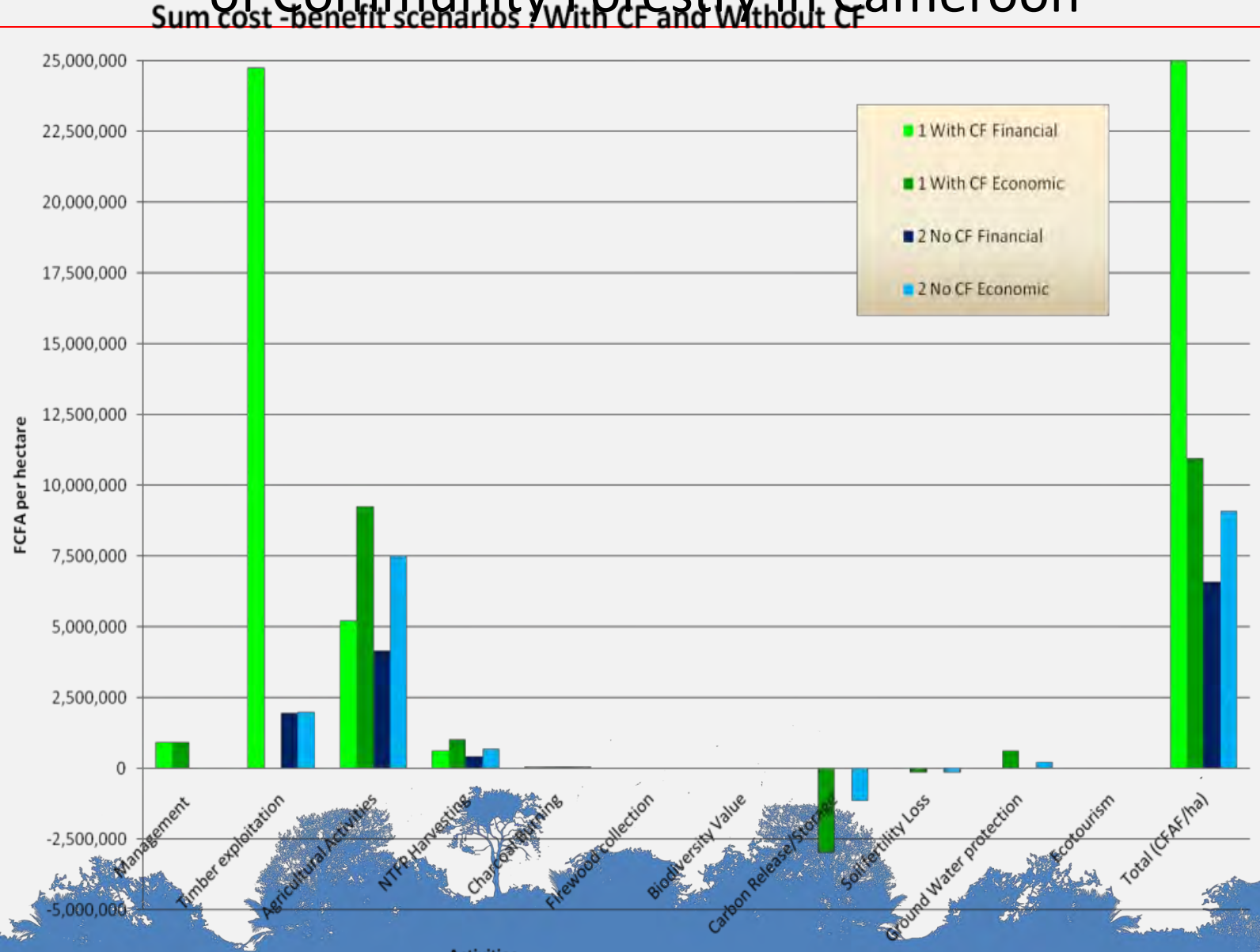
UN-REDD PROGRAMME

4.Monitoring the impact of REDD+ activities on Social and Economic Indicators

- REDD+ activities will only be viable and sustainable in the long term if they have a neutral or net positive impact on local livelihoods
- Collection of data on such impacts, though not obligatory, is crucial to assessment of demonstration activities and to design of effective REDD+ strategies
- Records of use/sale of forest products and services, socio-economic surveys
- Data may also be of use for Safeguard Information Systems



Costs, Benefits and Impacts of Community Forestry in Cameroon



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Methods for Cameroon CB study

- random household questionnaires (25% village population), semi-structured interviews stakeholders & beneficiaries, market surveys, observation
- Financial, economic and environmental cost and benefit analysis
- 2 scenarios extrapolated to 25 year CF period:
  - Scenario 1 = Current exploitation activities
  - Scenario 2 = "Without community forest' situation
- Distinction between financial and economic costs and benefits:
  - **Financial:** market priced costs and revenues from activities
  - **Economic:** Includes non-marketed incomes (inc household consumption) & opportunity costs of activities: Biodiversity value, Carbon Release/Storage, Soil fertility Loss, Ground Water protection

« Costs, Benefits and Impacts of Community Forestry in Cameroon »,
V. Ingram, E. Beauchamp, G. Lescuyer, M. Parren, C. Njomgang , A. Awono, CIFOR, 2010

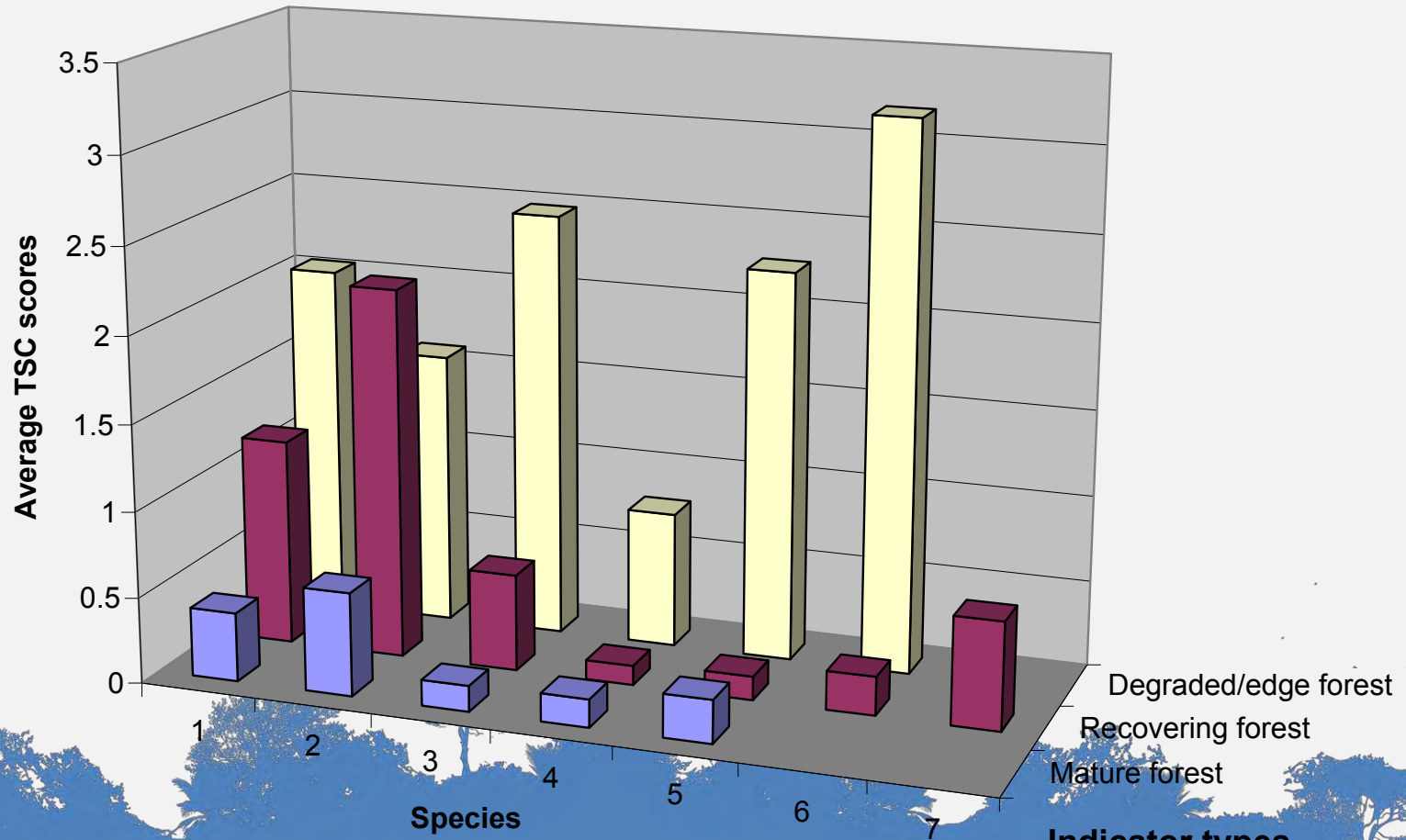
UN-REDD PROGRAMME

Monitoring impact of REDD+ activities on biodiversity indicators

- When biodiversity conservation is a stated objective of forest policy
- Expensive, intensive work
- Incorporate BD indicators into NFI, or conduct FMU/CF-specific monitoring
- Participatory monitoring including:
  - CF/FMU inventory
  - Indicator species surveys e.g. Timed Species Counts of birds
  - Sale/use records of products
  - Participatory mapping

UN-REDD PROGRAMME Timed Species Counts of 18 forest birds in Nepal

Observations of indicator bird species in ChFDP area: June-Dec '05



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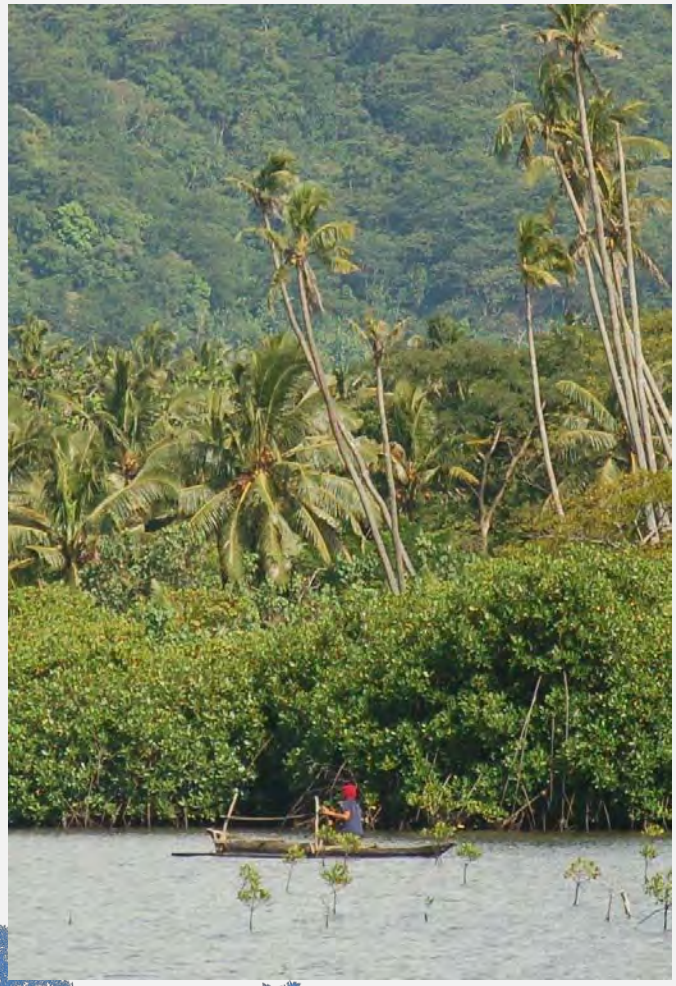
Summary

- National circumstances
- Not prescriptive
- Acquire information for designing, and improving, effective REDD+ strategies
- SLMS and community-based monitoring
- Generate information of relevance to SIS



UN-REDD PROGRAMME

Ben Vickers

ben.vickers@fao.org

Thank You

Website: http://www.un-redd.org

UN-REDD PROGRAMME

Maps for REDD+ activity planning

Lucy Goodman, UNEP-WCMC

15 October 2013

UN-REDD ASIA-PACIFIC REGIONAL WORKSHOP (FAO MRV)

Outline

- Why make maps for REDD+ planning?
- How can REDD+ spatial planning enhance the potential benefits from REDD+ and mitigate against the potential risks?
- How does this relate to NFMS?

Outline

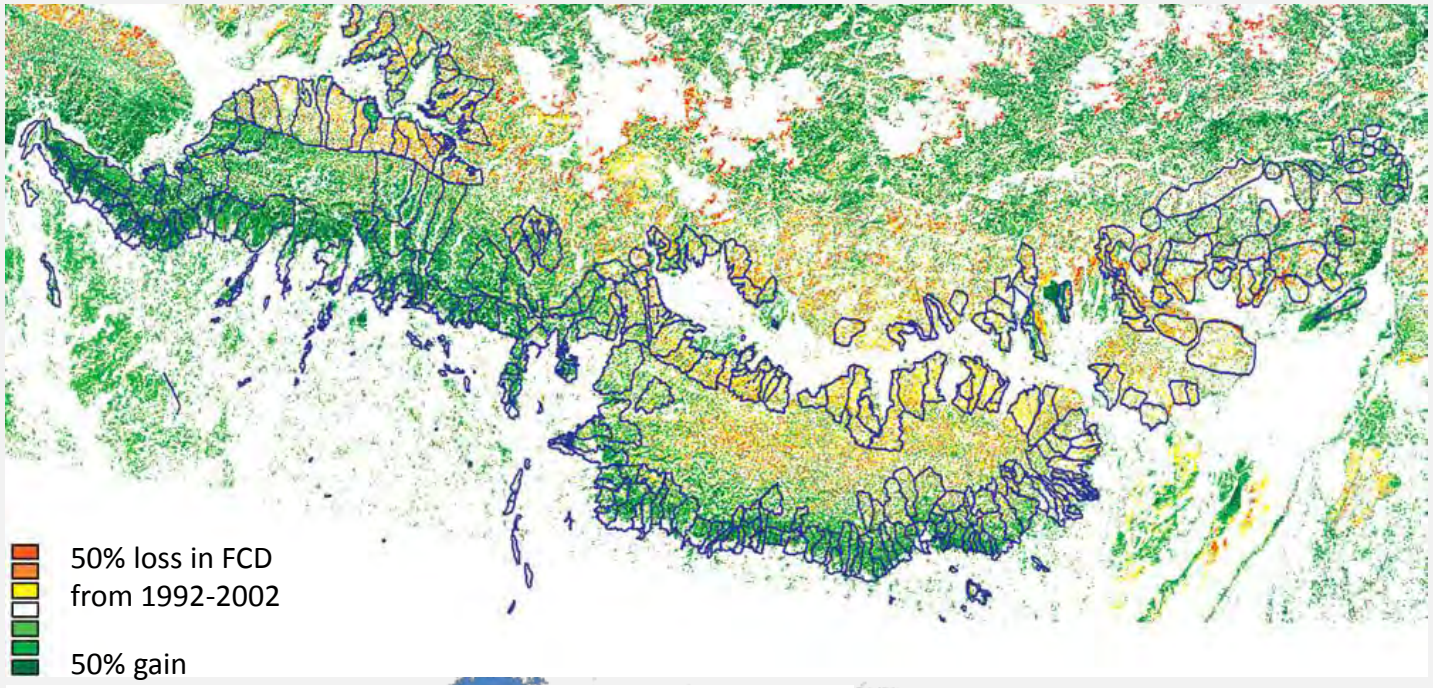
- **Why make maps for REDD+ planning?**
- How can REDD+ spatial planning enhance the potential benefits from REDD+ and mitigate against the potential risks?
- How does this relate to NFMS?

Why make maps?

Planning

UN-REDD PROGRAMME

- Which strategy is more effective for REDD+, in terms of emission reductions?



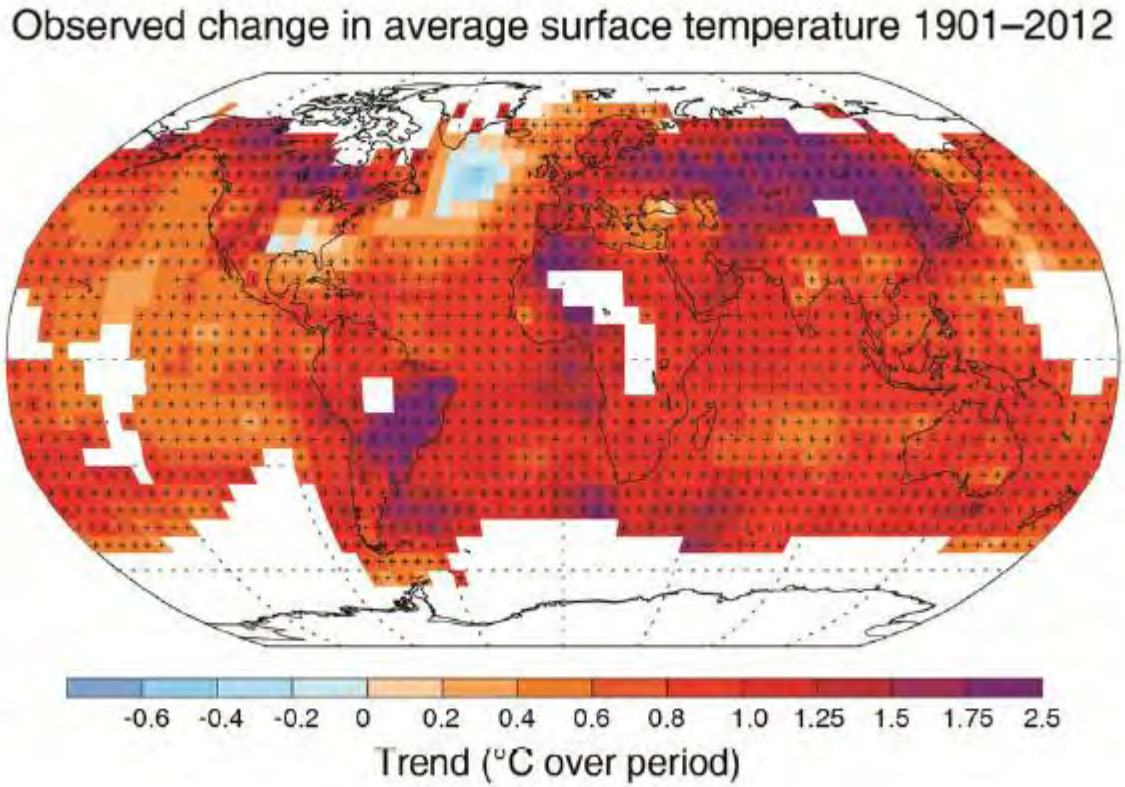
Churia Forest Development Project, Nepal "Return of the Churia Forests", Vickers and Rana, 2005

Why make maps?

Engagement

Why make maps?

Awareness raising



IPCC WGI AR5

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Outline

- Why make maps for REDD+ planning?
- **How can REDD+ spatial planning enhance the potential benefits from REDD+ and mitigate against the potential risks?**
- How does this relate to NFMS?

UN-REDD PROGRAMME

The potential benefits from REDD+ are unevenly distributed across the landscape

UN-REDD PROGRAMME

Different REDD+ interventions may be **implemented** in **different regions**

UN-REDD PROGRAMME

Where you implement different **REDD+** interventions will have variable **impacts** on the potential **benefits from REDD+**

UN-REDD PROGRAMME

Where you implement different REDD+ interventions will also impact on the **potential risks**

Outline

- Why make maps for REDD+ planning?
- How can REDD+ spatial planning enhance the potential benefits from REDD+ and mitigate against the potential risks?
- **How does this relate to NFMS?**

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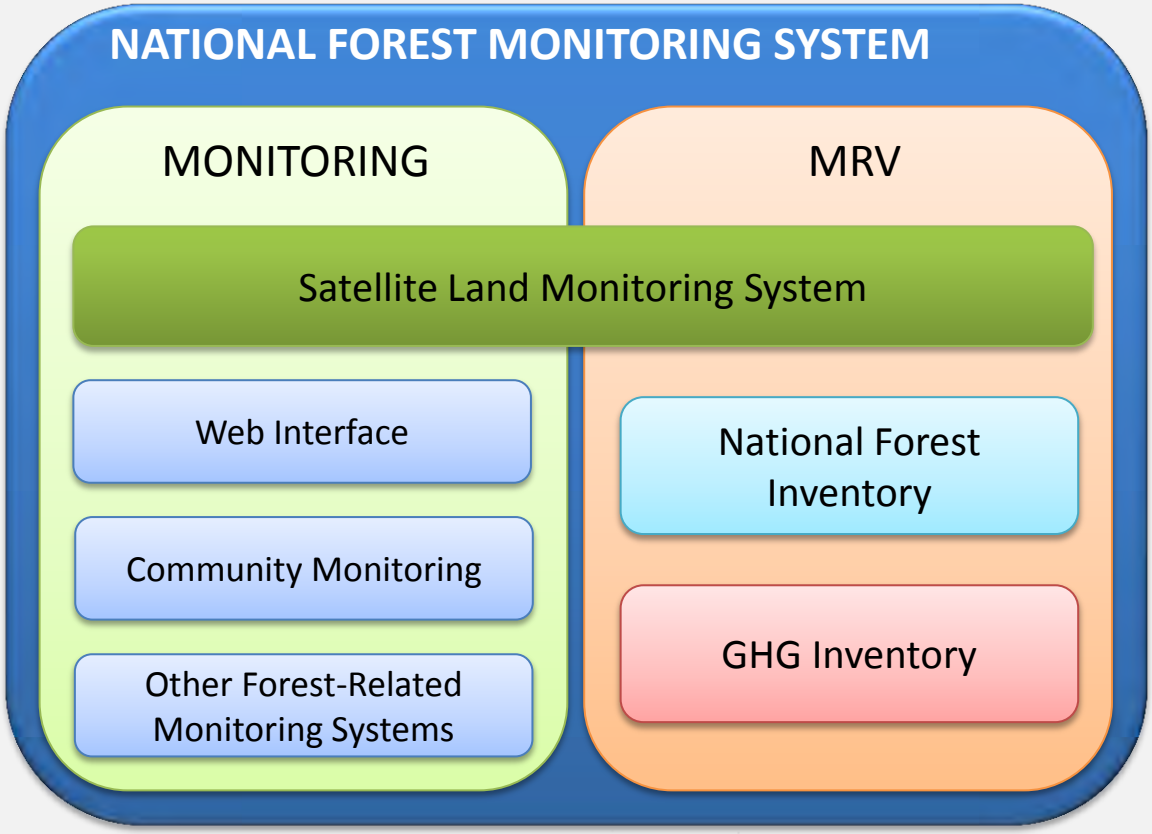
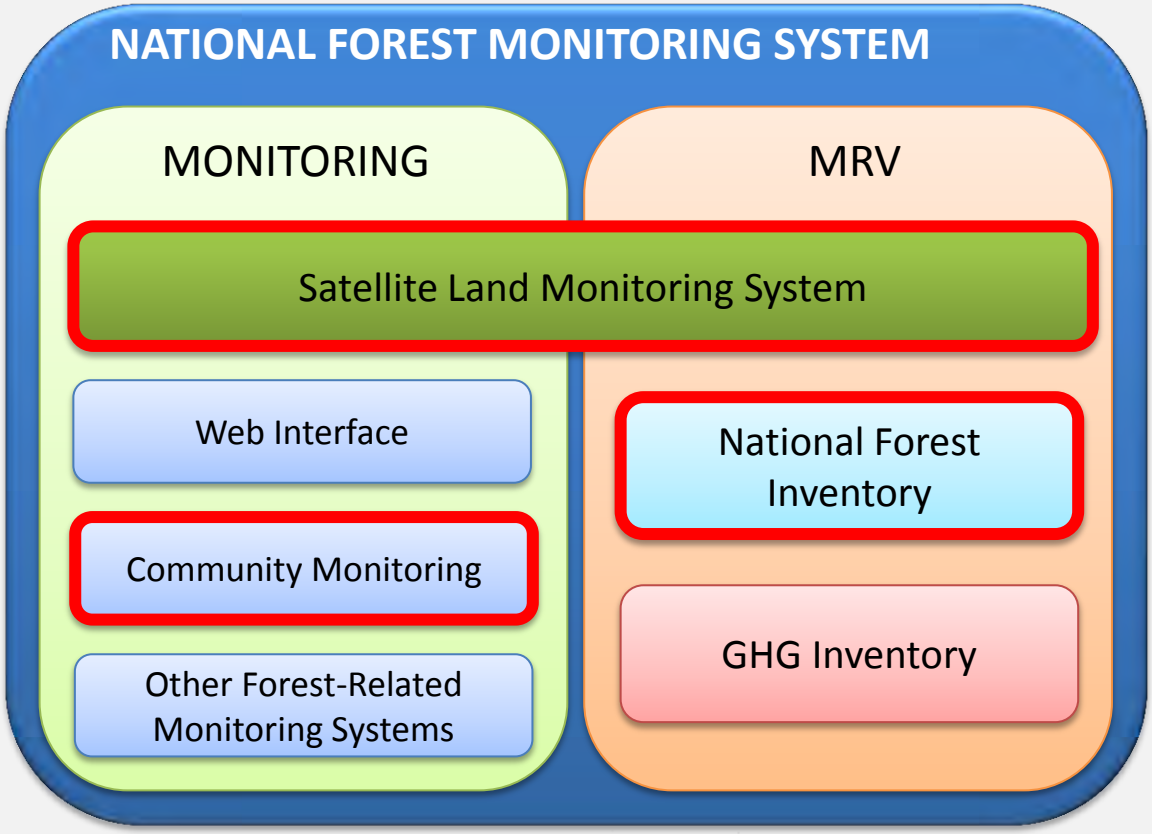
So...

If maps are useful – how to get the spatial data?

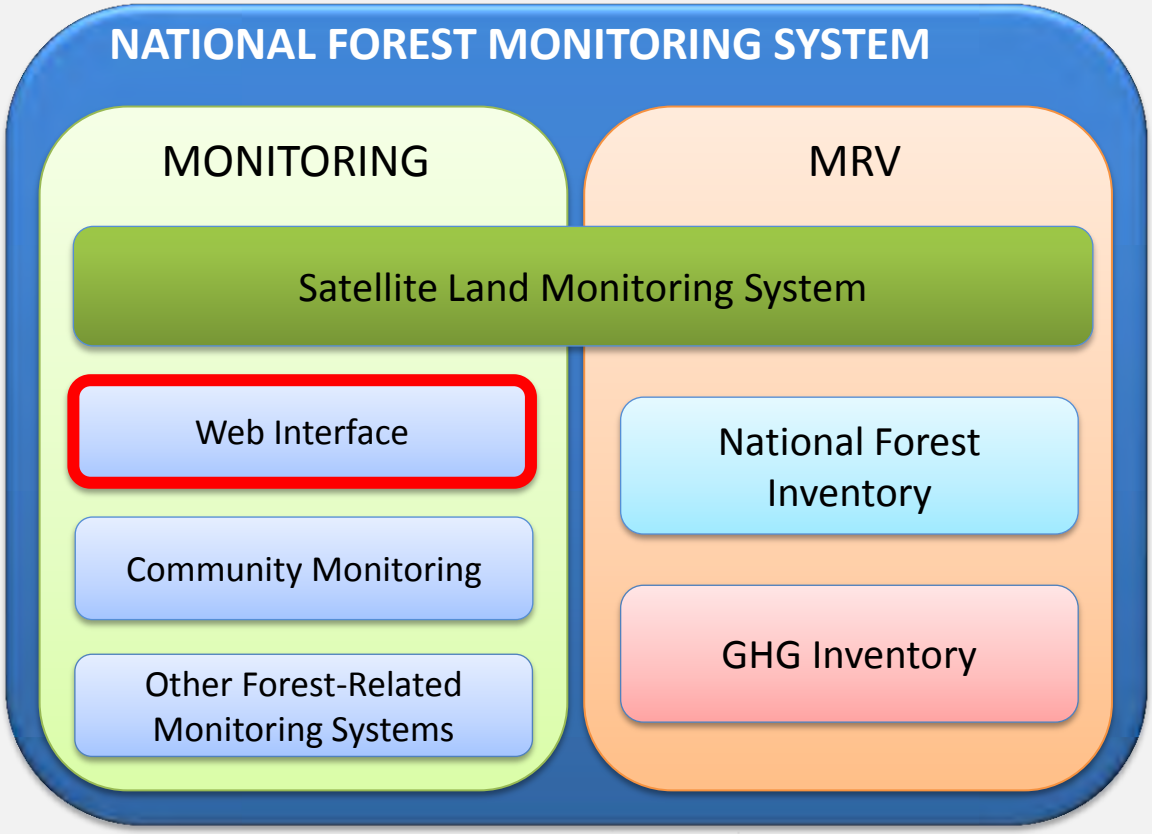
NFMS – a system which is already needed



NFMS – provides spatial information



NFMS –platforms that can be used to profile spatial information



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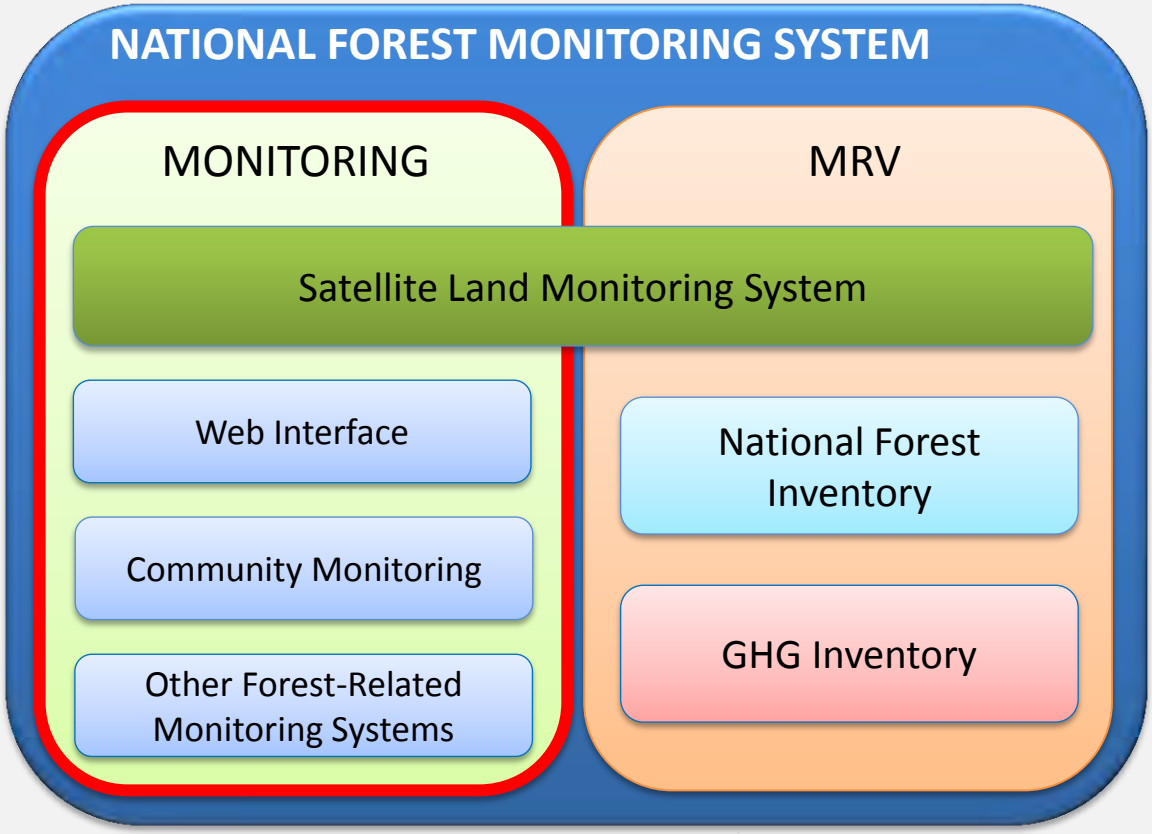
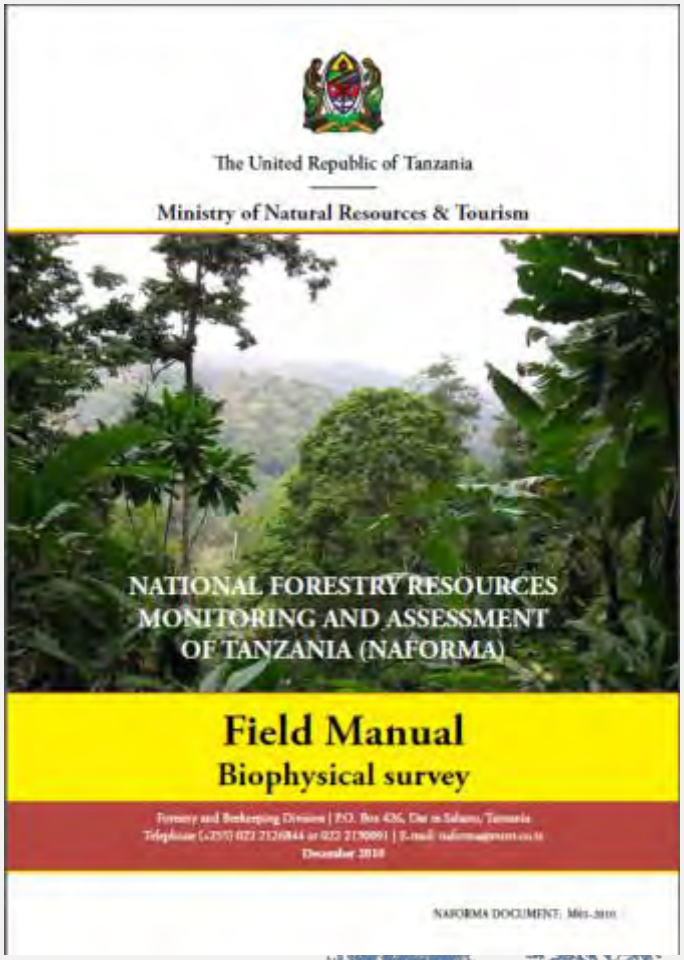
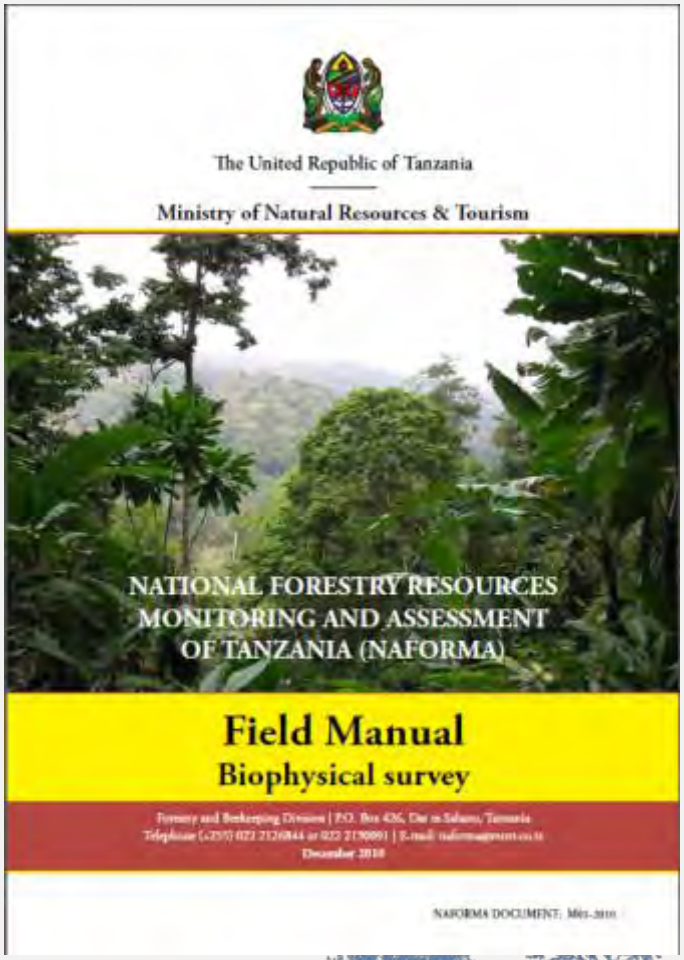
NFMS – and can tell you which potential REDD+ inventions are more effective

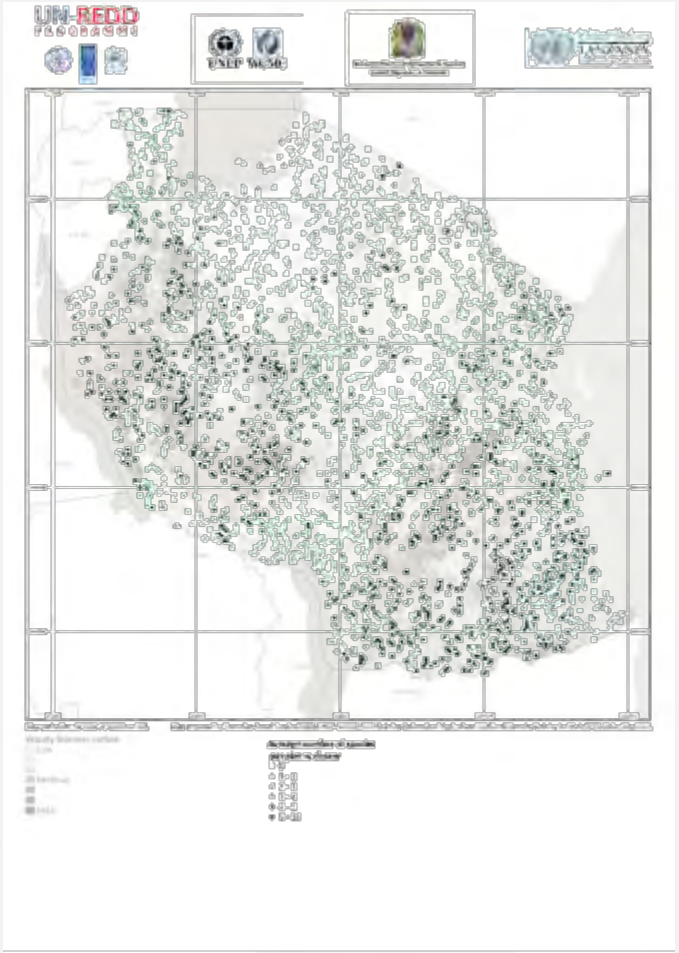


Example – Tanzania



Example – Tanzania





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Thank you!

lucy.goodman@unep-wcmc.org

Decision support outputs – produced collaboratively with FAO

Cancun safeguards (2010):

- "[REDD+] Actions are consistent with the conservation of natural forests and biological diversity, ensuring that actions referred to in paragraph 70 of this decision are not used for the conversion of natural forests, but are instead used to incentivize the protection and conservation of natural forests and their ecosystem services, and to enhance other social and environmental benefits"

Cancun Agreement: FCCC/CP/2010/7/Add.1 Appendix I

Tanzania example

Natural forest

Forest composed of indigenous trees, not planted by man.

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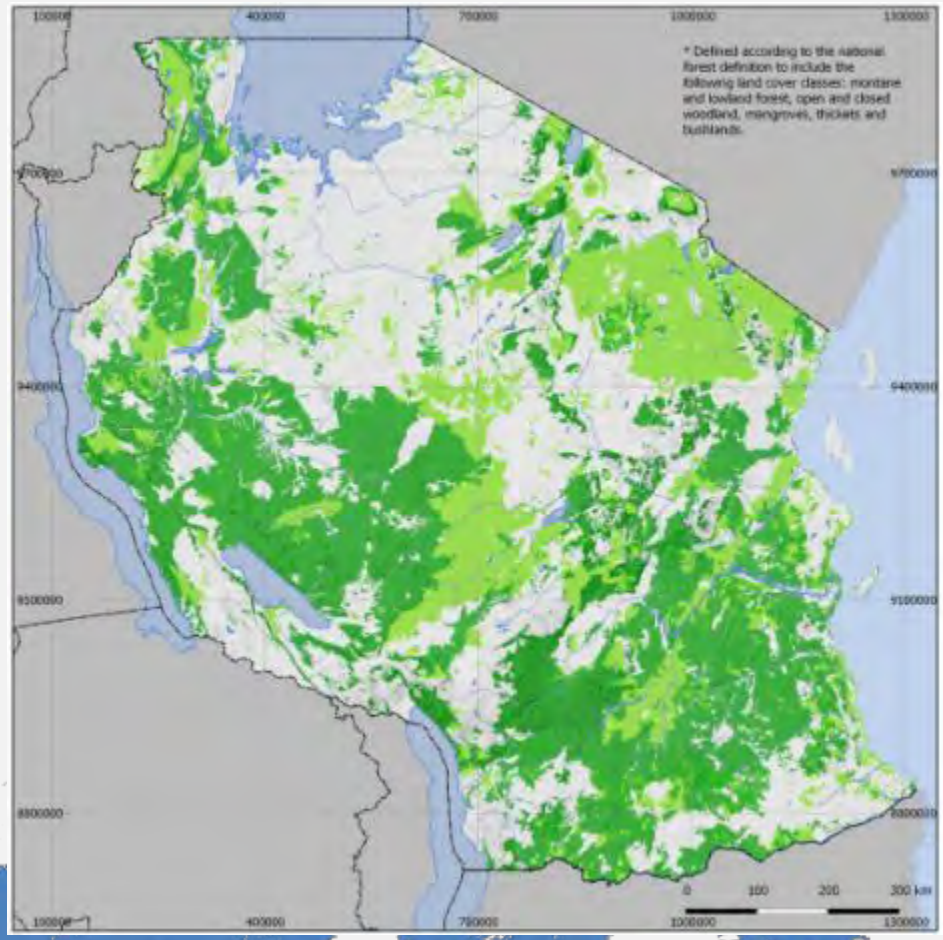
Tanzania example



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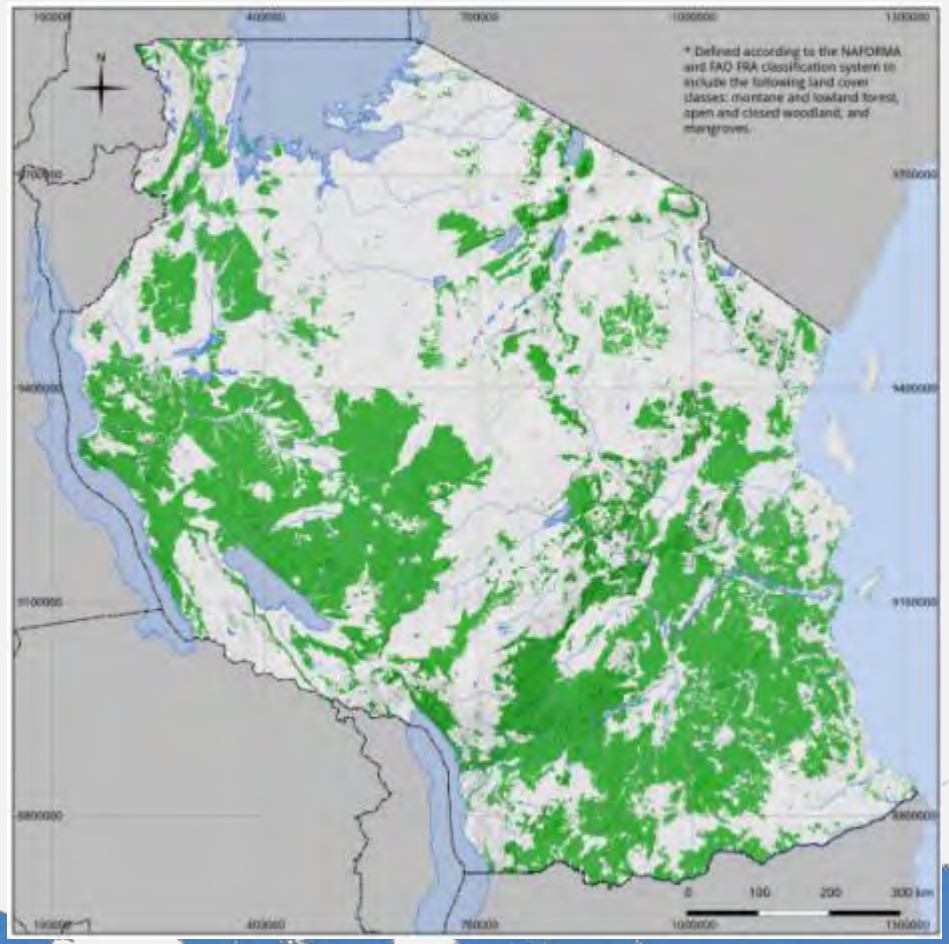
Tanzania example

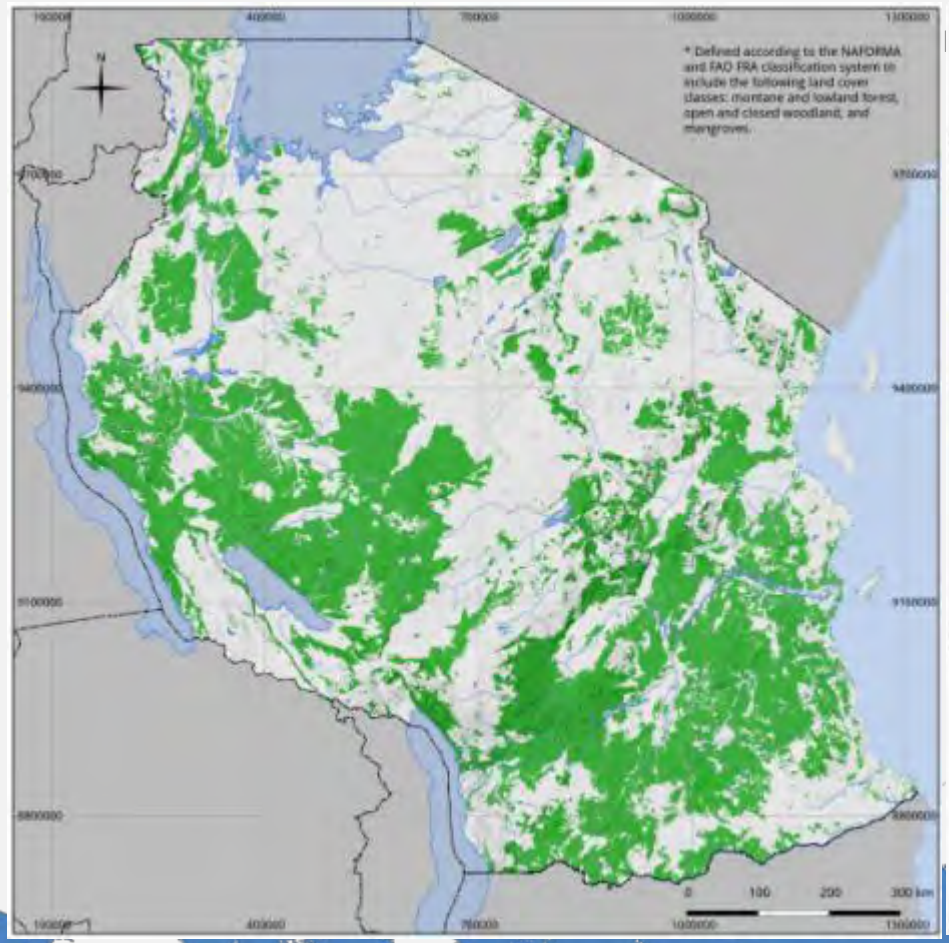
	For afforestation and reforestation project activities - Host Party's selected single minimum:		
	A single minimum tree crown cover value between 10 and 30 per cent	A single minimum land area value between 0,05 and 1 hectare	A single minimum tree height value between 2 and 5 metres
United Republic of Tanzania	10	0.05	2

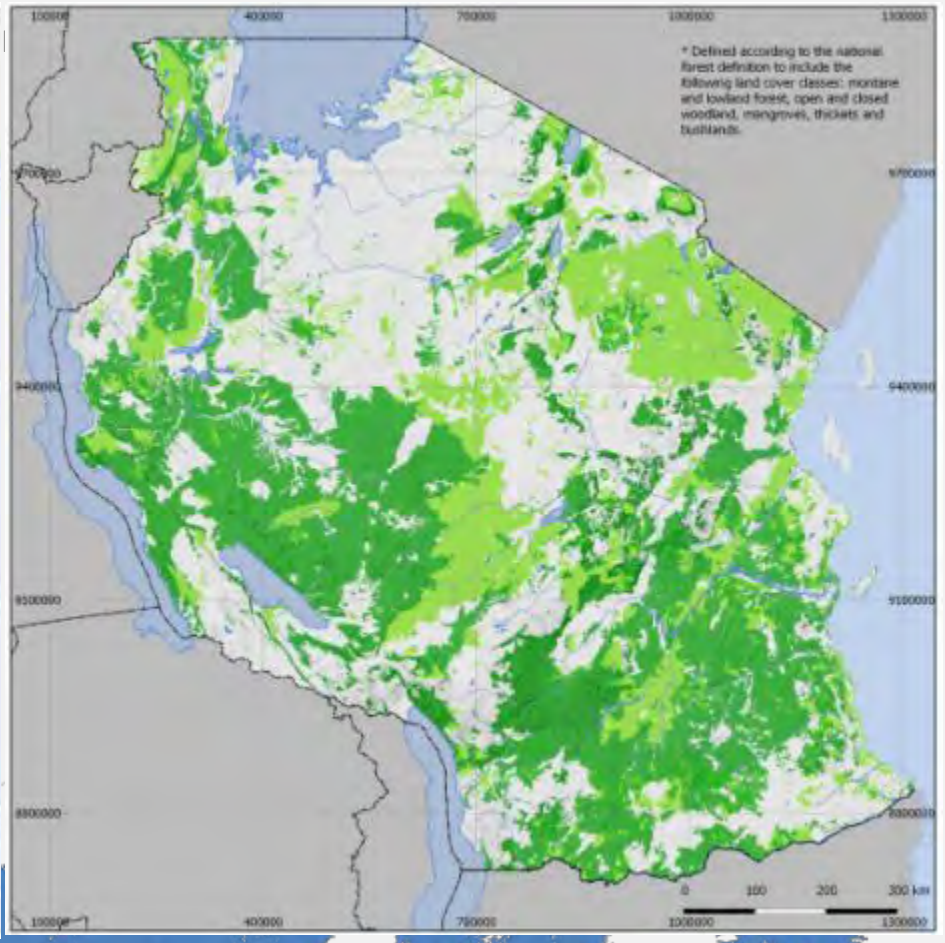
Tanzania example



UN-REDD PROGRAMME

Tanzania example

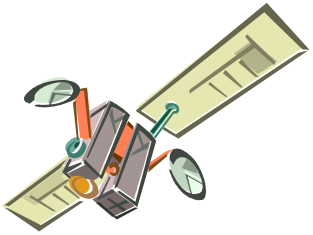




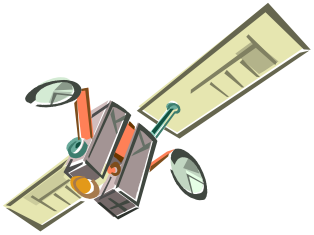
Remote Sensing data and tools for REDD+

Danilo Mollicone FAO Forestry Department

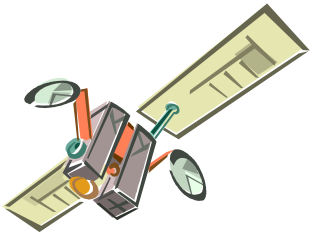
This presentation will provide an overview on free resources, data and tools to monitor forest through remote sensing



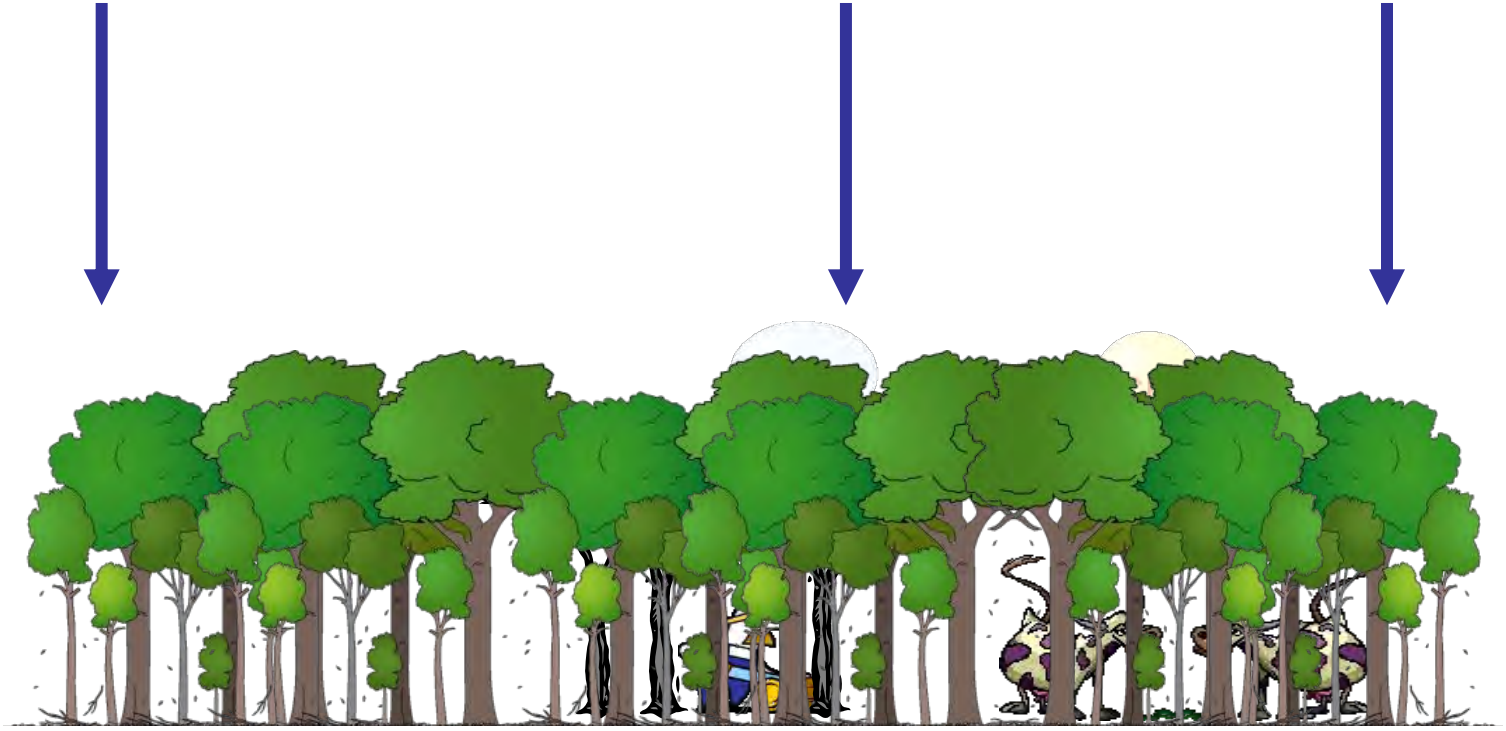
1990



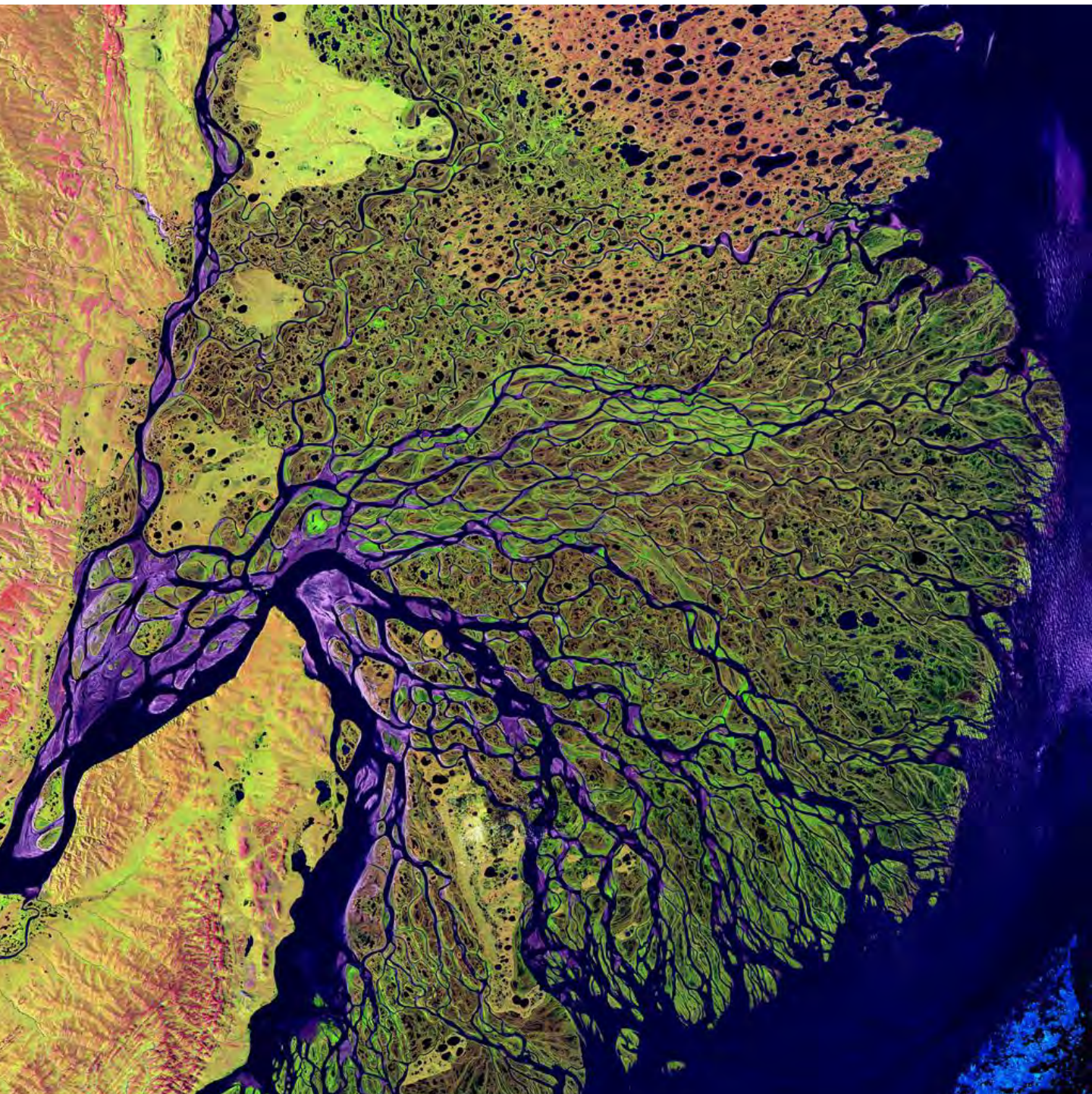
2000



2015



Remote Sensing data



Landsat 8 www.landsat.usgs.gov

From Wikipedia, the free encyclopedia

Improved spectral and radiometric properties

Where to download Landsat data: Landsat Look Viewer

http://landsatlook.usgs.gov/

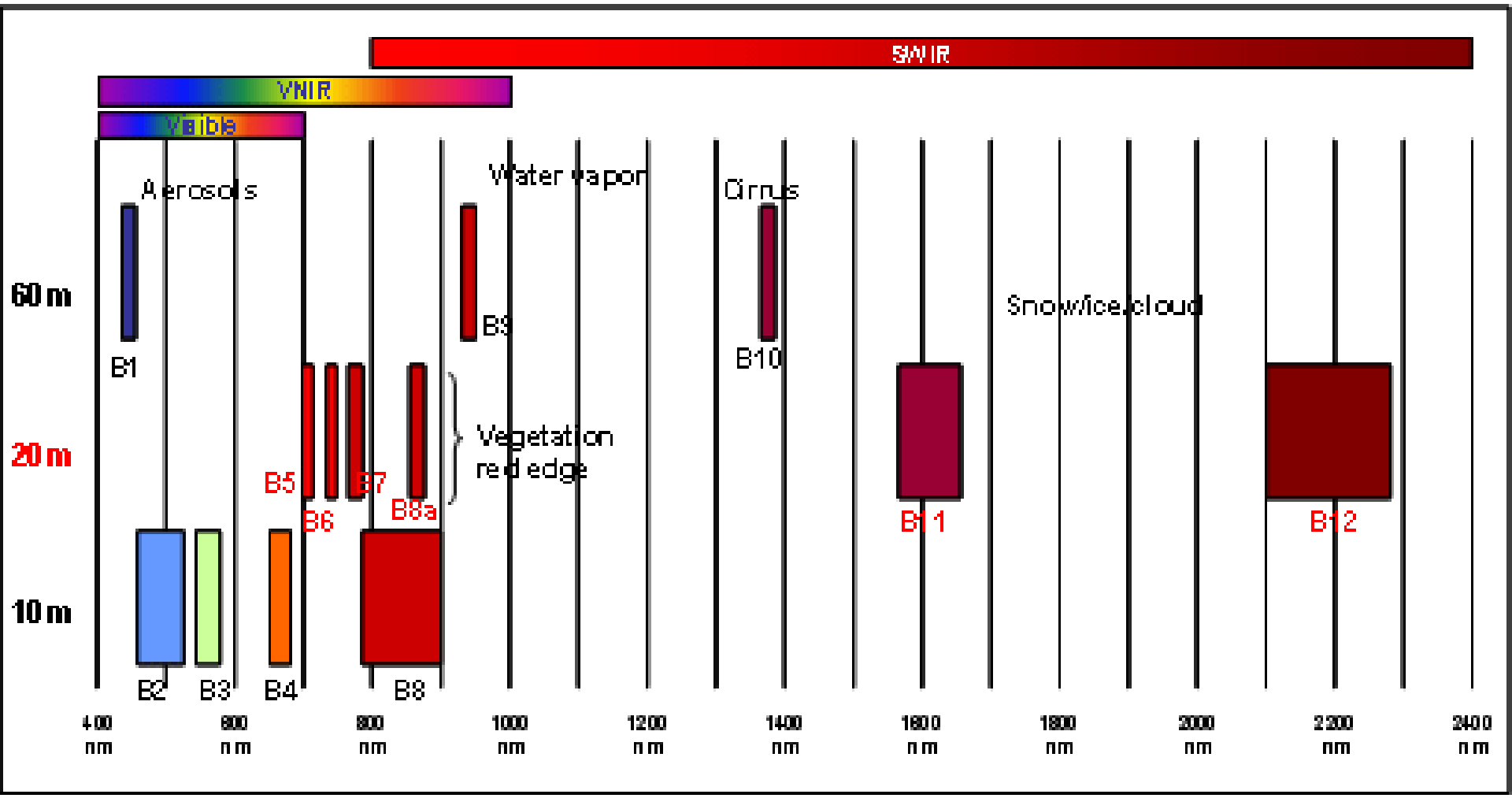
USGS
science for a changing world

Due to the Federal government shutdown, usgs.gov and most associated web sites are unavailable.

Only web sites necessary to protect lives and property will be maintained.

- Ecosystems
  - Disease Maps
  - National Wildlife Health Center
- Imagery and Geospatial Information
  - USGS Hazards Data Distribution System (HDDS) satellite and aerial imagery portal
- Natural Hazards
  - USGS coastal erosion hazards information
  - USGS earthquake information
  - USGS information on geomagnetic activity
  - USGS landslide information
  - USGS volcano information
- Water

Please see doi.gov for more shutdown information.



Improved spectral, spatial and radiometric properties

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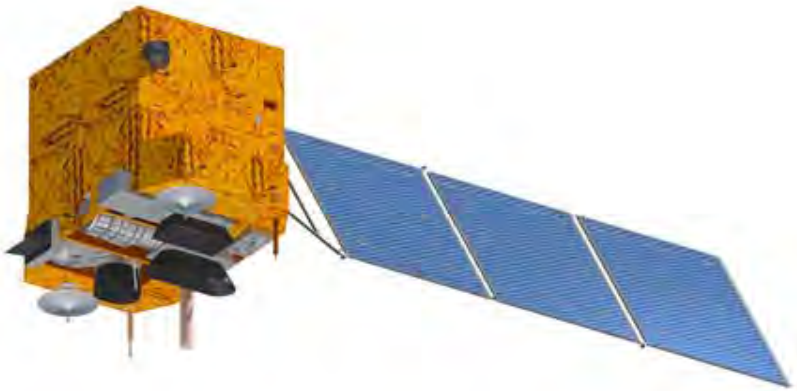
CBERS 3 AND 4 LAUNCHING

Due to the success of CBERS-1 and 2, the two governments decided, in November 2002, to give continuity to the CBERS program by signing a new agreement for the development and launching of two more satellites, CBERS-3 and 4.

Brazilian participation in this program will be enlarged up to 50%. CBERS-3 will be launched at the end of 2012, and CBERS-4 is scheduled to be launched two years later.

CBERS-3 and 4 satellites represent an evolution of CBERS-1 and 2. Four cameras will be present in the payload module, with improved geometrical and radiometric performance.

They are: PanMux Camera-PANMUX, Multi-spectral Camera-MUXCAM, Infrared Scanning Medium Resolution Scanner-IRSCAM, and Wide Field Imaging Camera-WFICAM.



http://www.cbers.inpe.br/ingles/satellites/launching_cbers3_4.php

Fig. 1 - CBERS-3 and 4

REALIZATION

National Institute For Space Research

AEB
Brazilian Space Agency

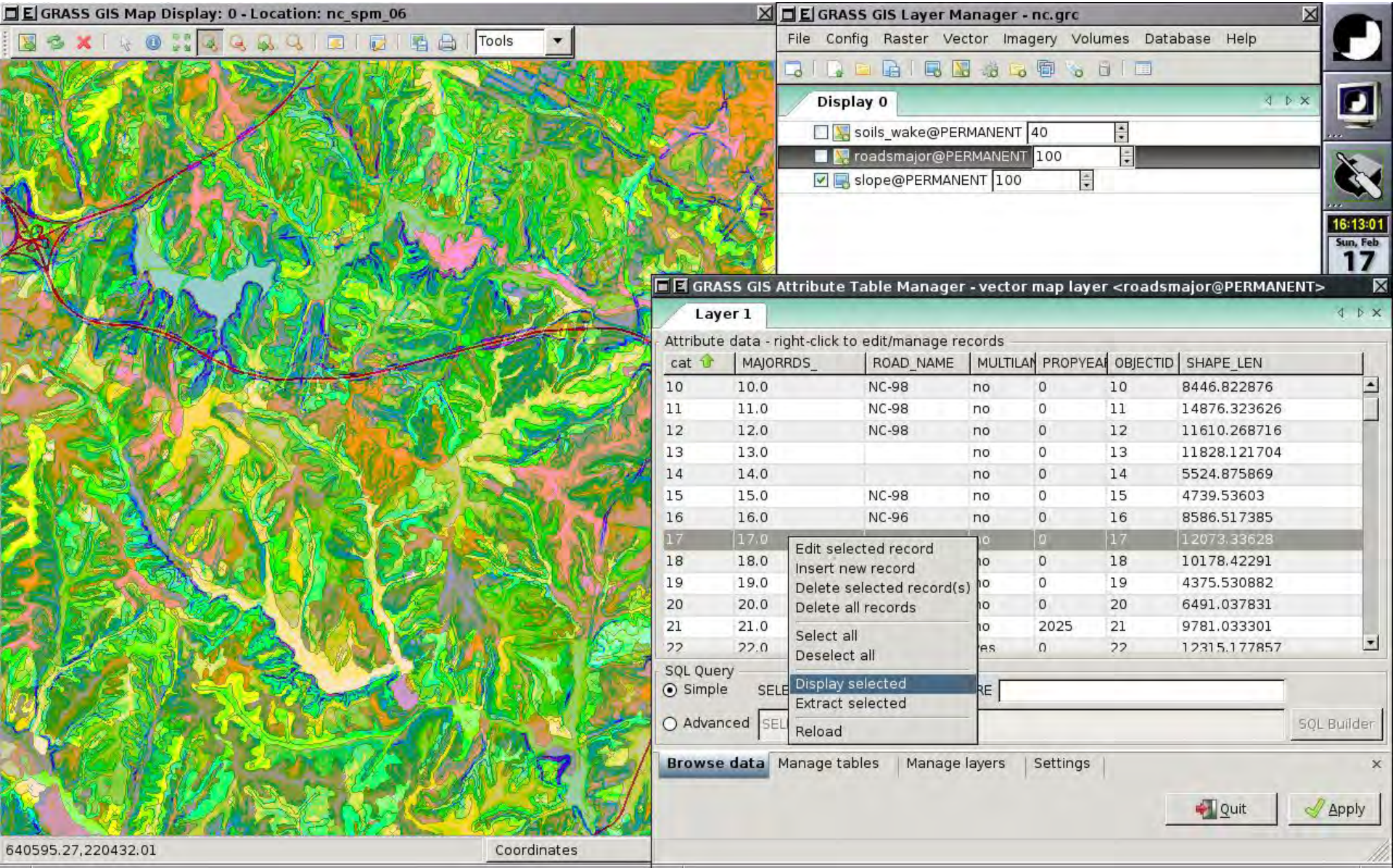
CAST
Chinese Academy of Space Technology

China National Space Administration

IMAGE CATALOG

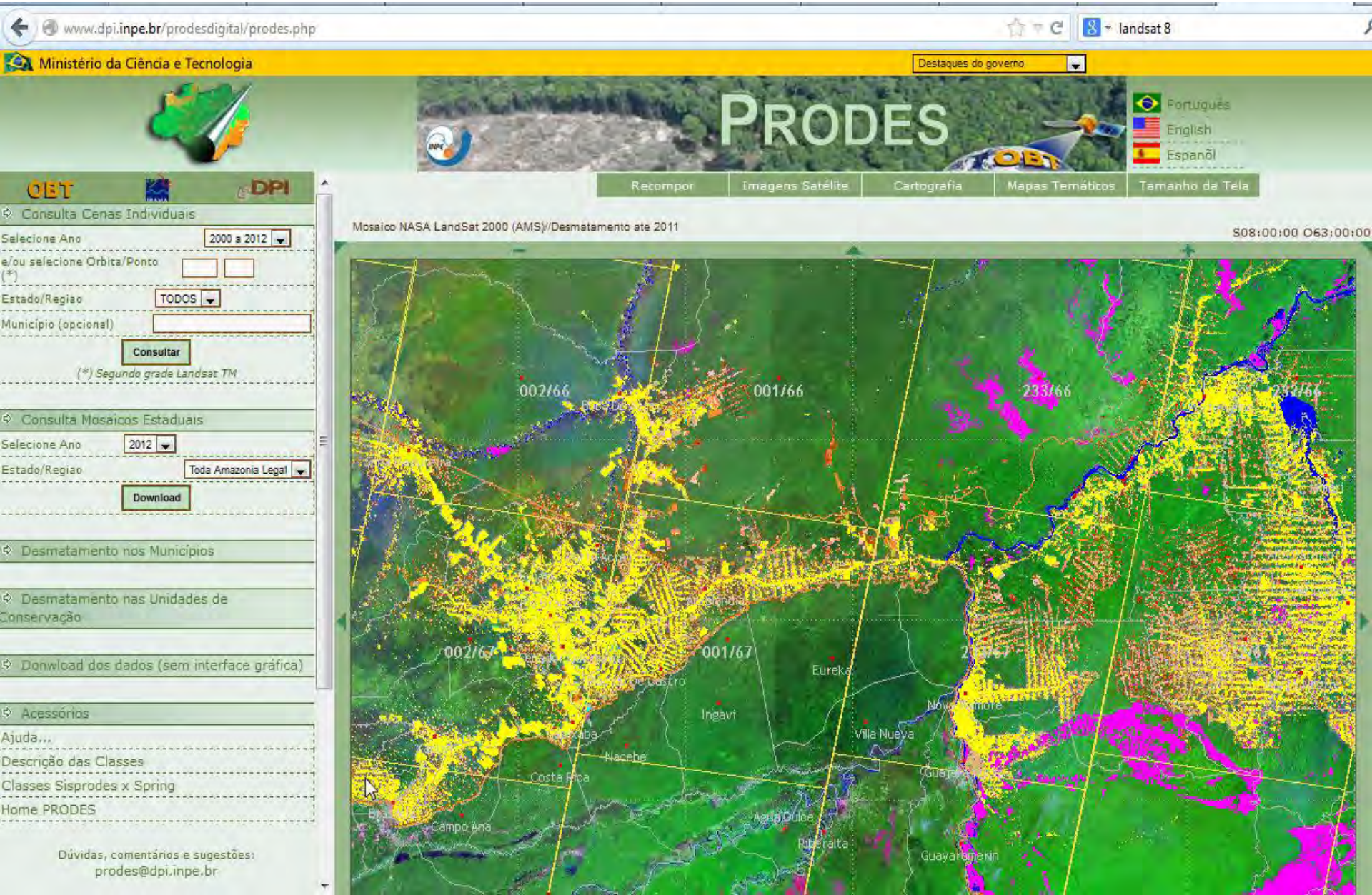
Catálogo de Imagens CBERS

Remote Sensing tools



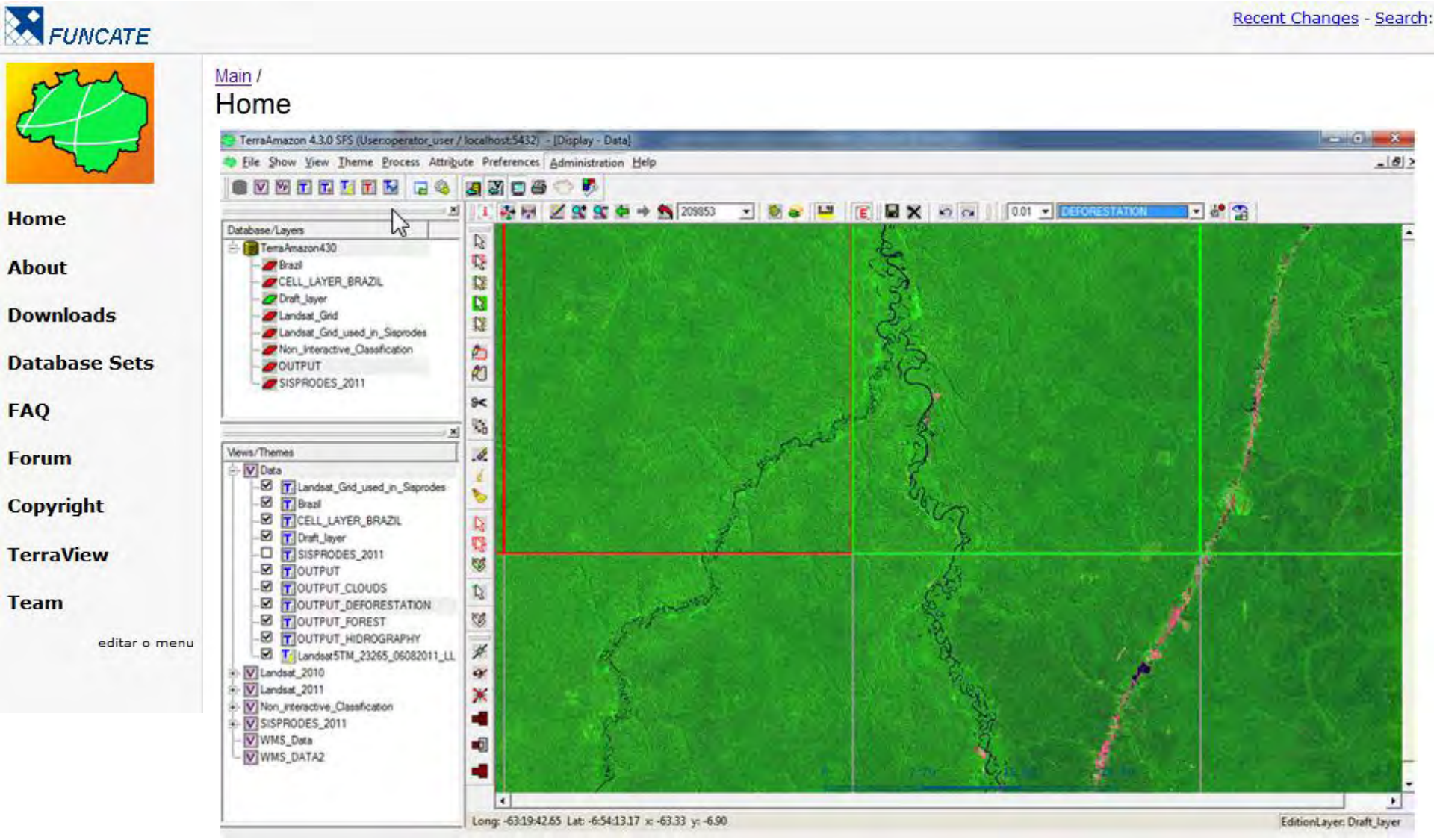
PRODES: the Brazilian system to monitor forest in Amazon

http://www.dpi.inpe.br/prodesdigital/prodes.php



TerraAmazon: forest and land use monitoring system

http://www3.funcate.org.br/geo//available/wiki-v01-TerraAmazon/pmwiki.php/Main/Home



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TerraAmazon is a GIS tool designed to be a multi-user editor of geographic vectorial data stored in a TerraLib model database in corporate environment.

TerraAmazon keeps work time records for project control. It´s functionalities are extensible through plugins, such as the already existing TerraImage (DIP), Cloud Detection and TerraPrint.

TerraAmazon engages land use and land cover classification tools as well as spatial operations between vector data, allowing transitions analysis among other applications.

TerraAmazon is Free.

http://earthengine.google.org/#intro

earthengine.google.org/#intro

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Earth Engine

A planetary-scale platform for environmental data & analysis

Google Earth Engine brings together the world's satellite imagery — trillions of scientific measurements dating back almost 40 years — and makes it available online with tools for scientists, independent researchers, and nations to mine this massive warehouse of data to detect changes, map trends and quantify differences on the Earth's surface. Applications include: detecting deforestation, classifying land cover, estimating forest biomass and carbon, and mapping the world's roadless areas.

To learn more, view product videos and the Featured Gallery (below). Or visit the Data Catalog to explore our archive of satellite imagery. Certain features (such as data download) are restricted to members of our trusted tester program.

New! On February 11, NASA launched Landsat 8, the latest in a series of Earth observation satellites which started collecting information about the Earth in 1972. We're excited to announce that on May 30th, the USGS began releasing operational data from the Landsat 8 satellite, which are now available on Earth Engine. Explore the gallery below to see how we've used Landsat data to visualize thirty years of change across the entire planet. Congratulations to NASA and USGS for a successful launch!

Earth Engine Access

Develop, access and run algorithms on the full Earth Engine data archive, all using Google's parallel processing platform.

Access to Earth Engine is currently available as a limited release to a small group of partners. If you are interested in developing on the Earth Engine platform, let us know.

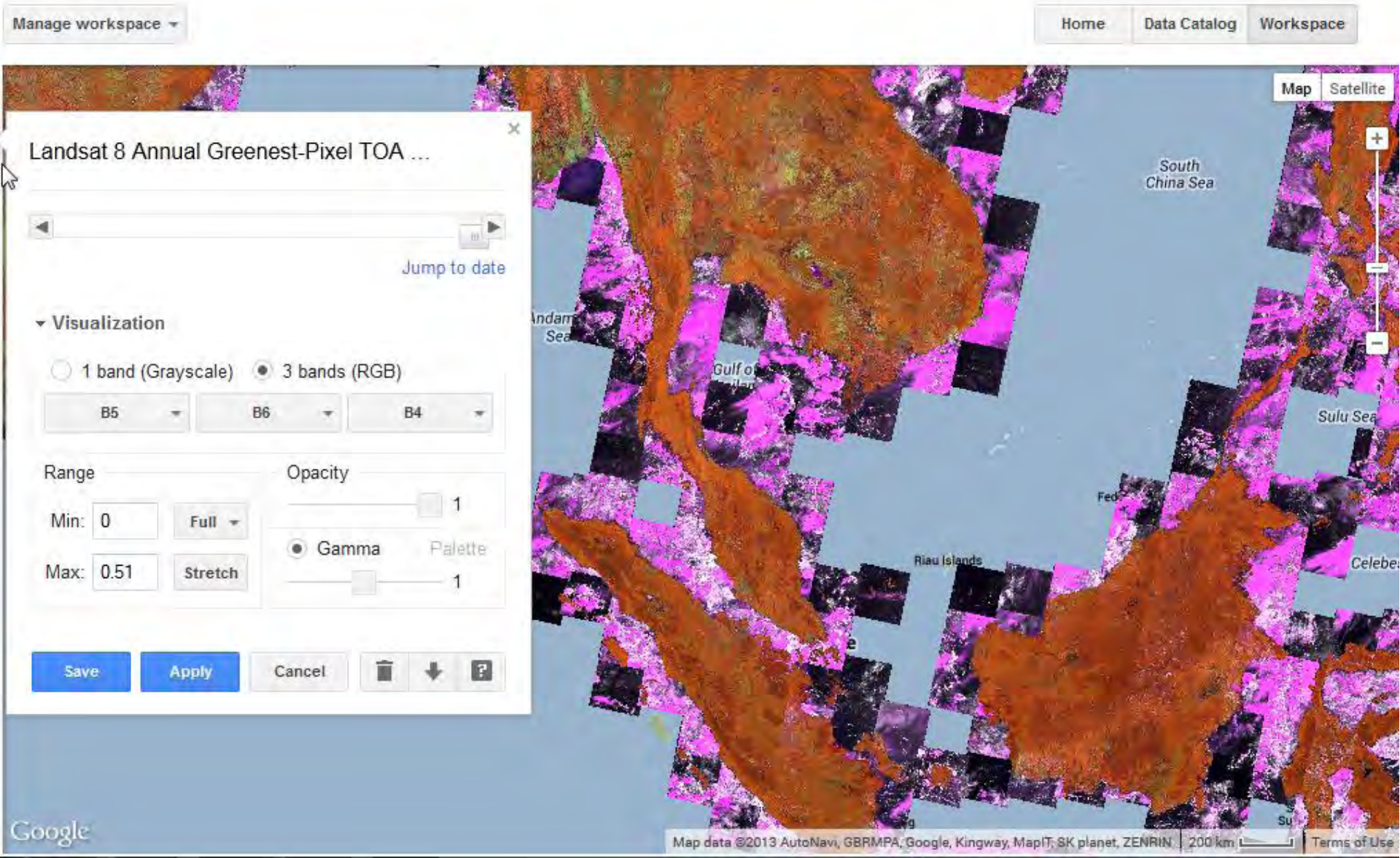
Featured Sites: Landsat Annual Timelapse 1984-2012

Explore different views into this global timelapse built from global, annual composites of Landsat satellite images. Watch change across the planet's surface beginning as early as 1984.

Growth of Las Vegas, Nevada
Interactive Landsat timelapse of urban expansion and water resources in the Nevada desert, 1984-2012.

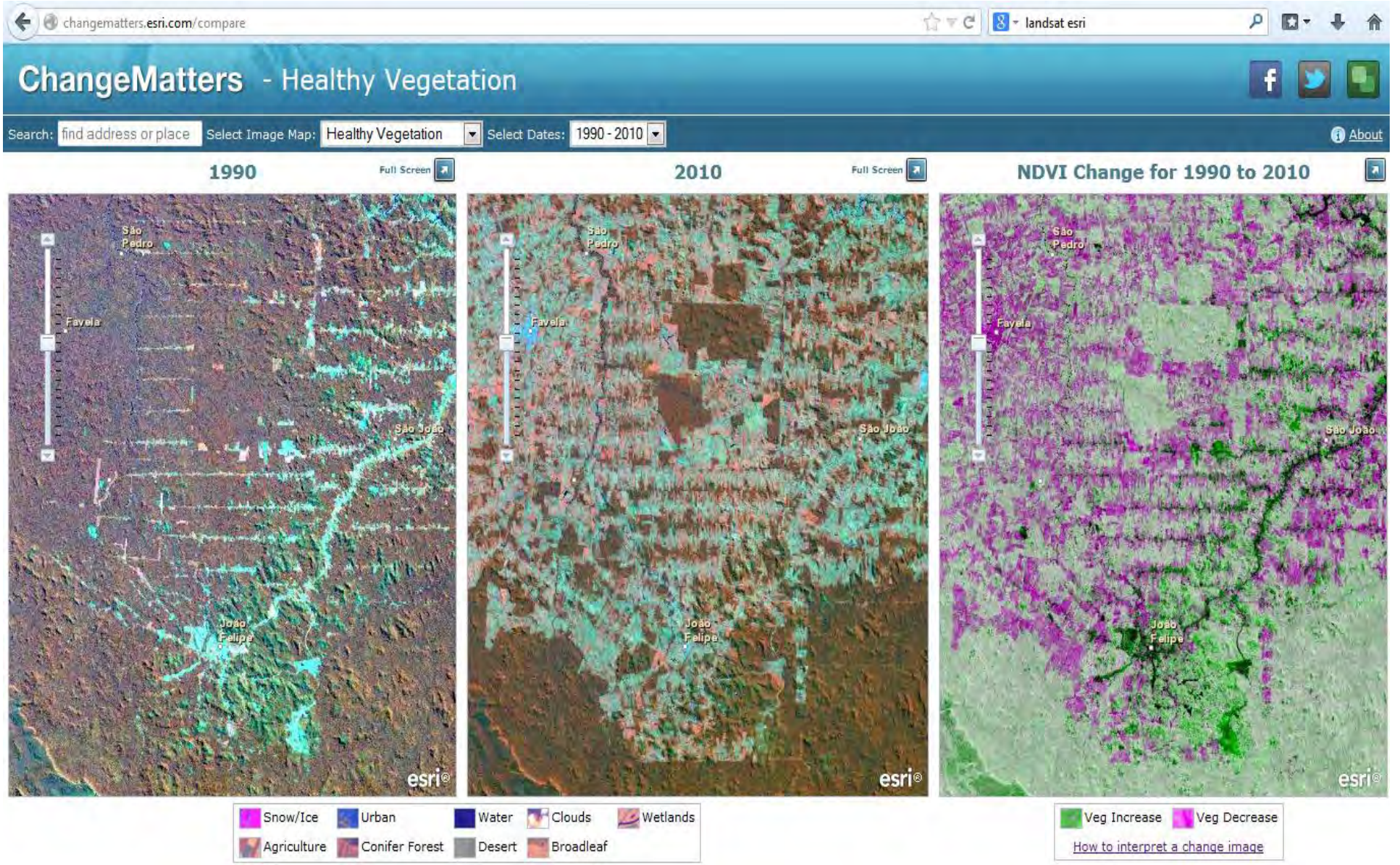
Amazon Deforestation, Brazil
Interactive Landsat timelapse of deforestation of the Amazon rainforest, 1984-2012.

Google Earth Engine: real time access to all Landsat and Modis data



ESRI free web tools

http://www.esri.com/software/landsat-imagery/viewer

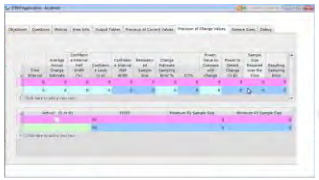


Open Foris Initiative

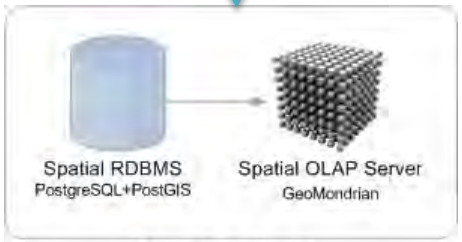
http://www.fao.org/forestry/fma/openforis/en/

Potential architecture

Offline Analytics
TerraX, R, GRASS,
Excel, MADCAT, etc.



Design Tool for Inventory and Monitoring (DTIM)

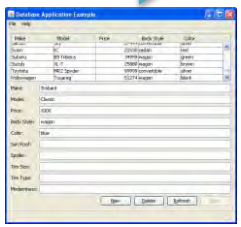


Open Foris Server
Data Warehouse

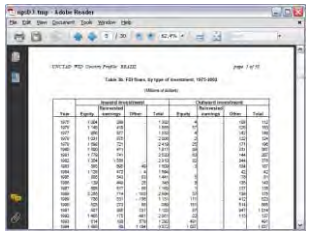
Open Foris Portal
Managed content & dynamic maps, charts, stats, reports

Open Foris Collect
Offline/online data entry, cleansing, aggregation

Open Foris Collect *Mobile*
Android and/or Windows Mobile



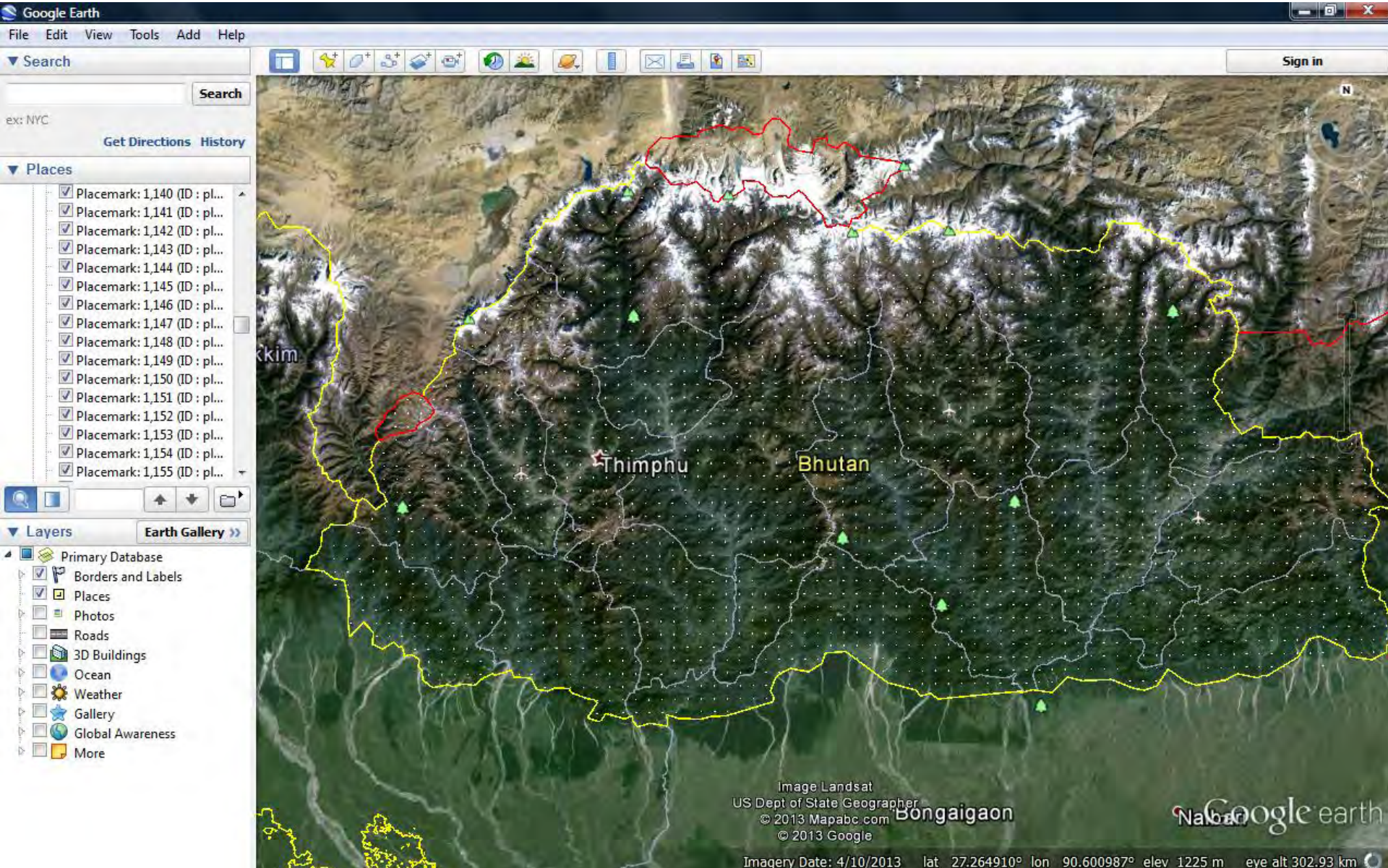
Open Foris Species Editor
Offline/online species list maintenance



Open Foris Calc
Forest modeling and estimation

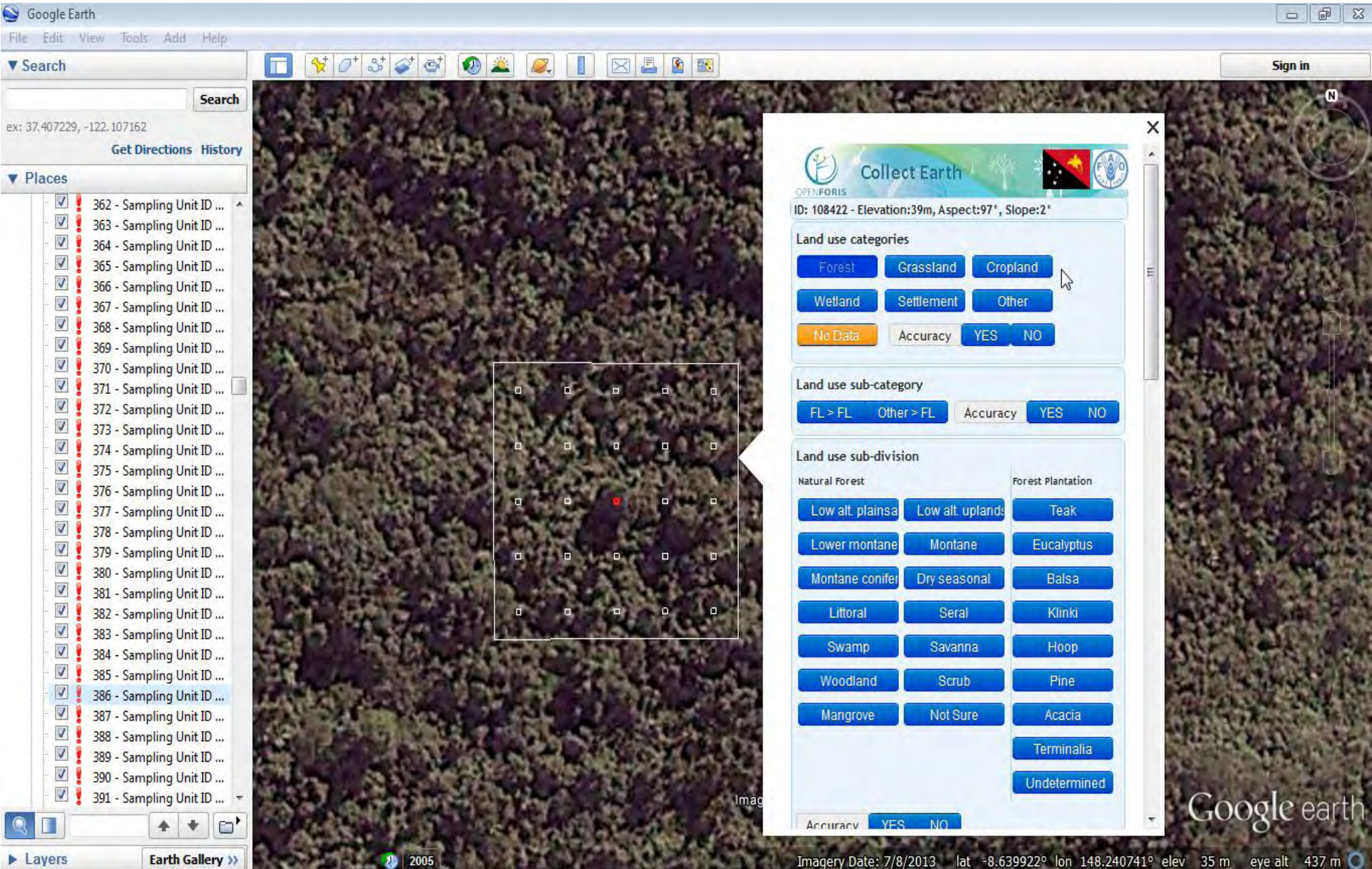
Open Foris Collect Earth:

sampling with open source software and free Google internet resources



Open Foris Collect Earth Papua New Guinea:

support to 1st phase NFI and LULUCF REDD+ activity data assessment



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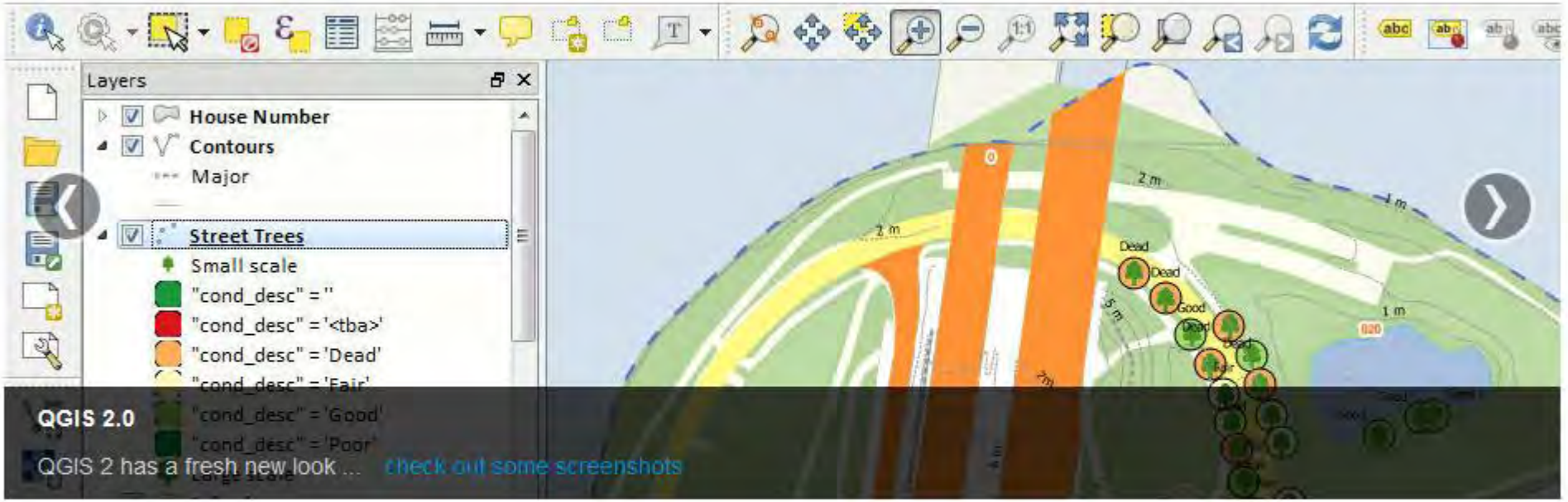
A Free and Open Source Geographic Information System



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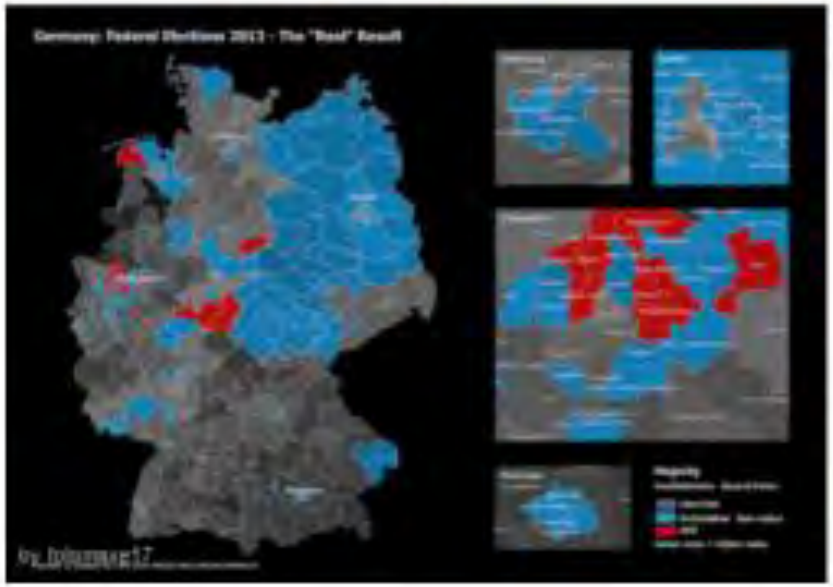

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1306 users mapped

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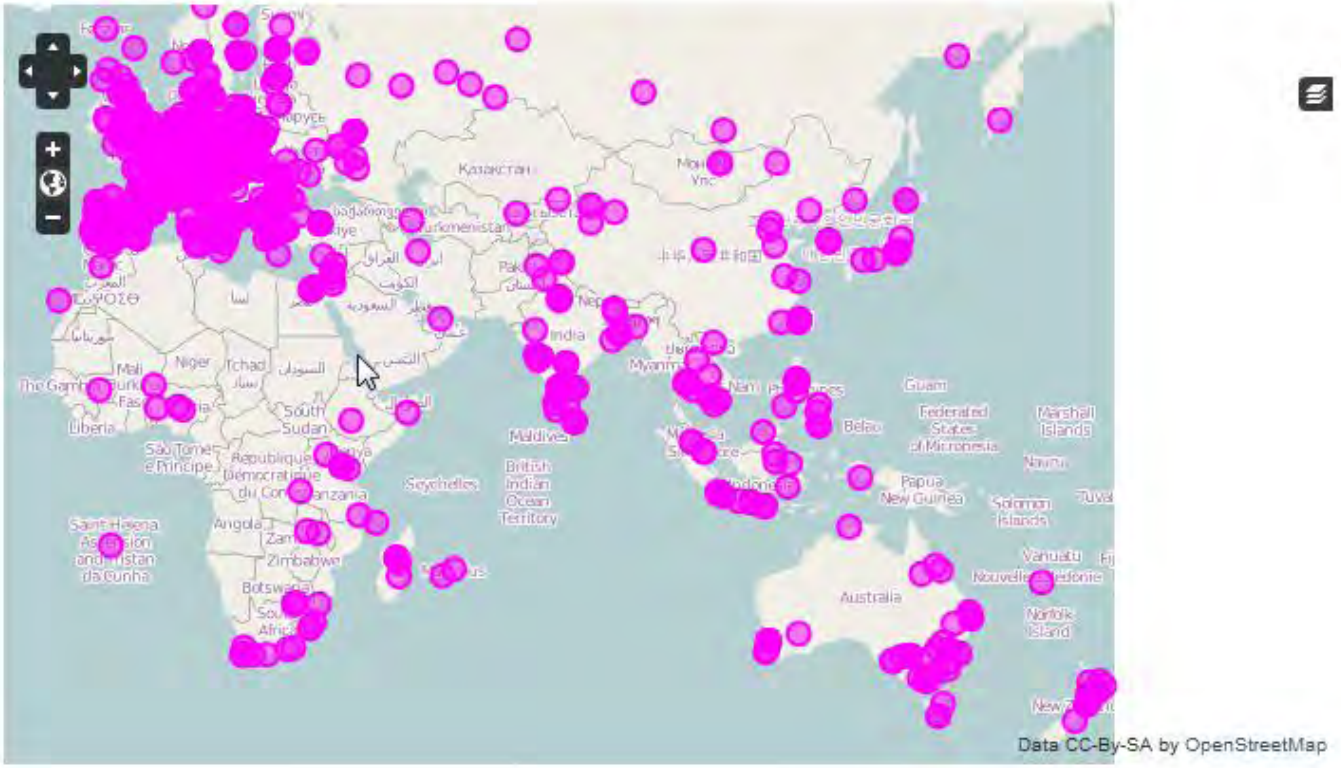
Simon Nitz



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SAGA GIS

SAGA

System for Automated Geoscientific Analyses

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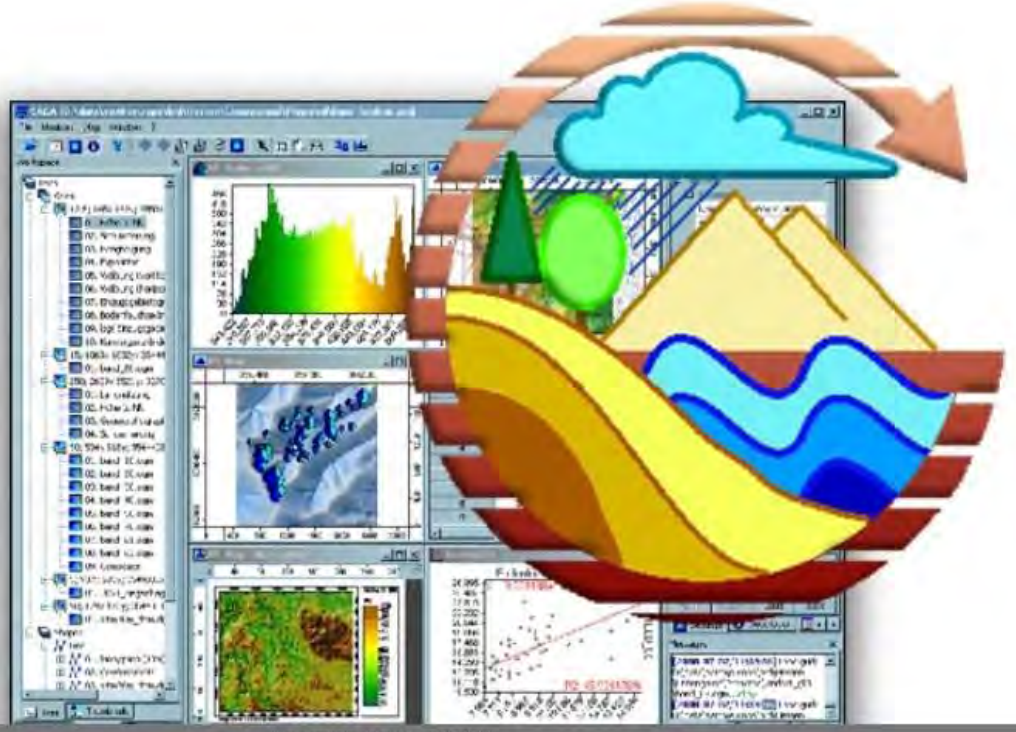

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Global Forest Watch: a little excursion into the future

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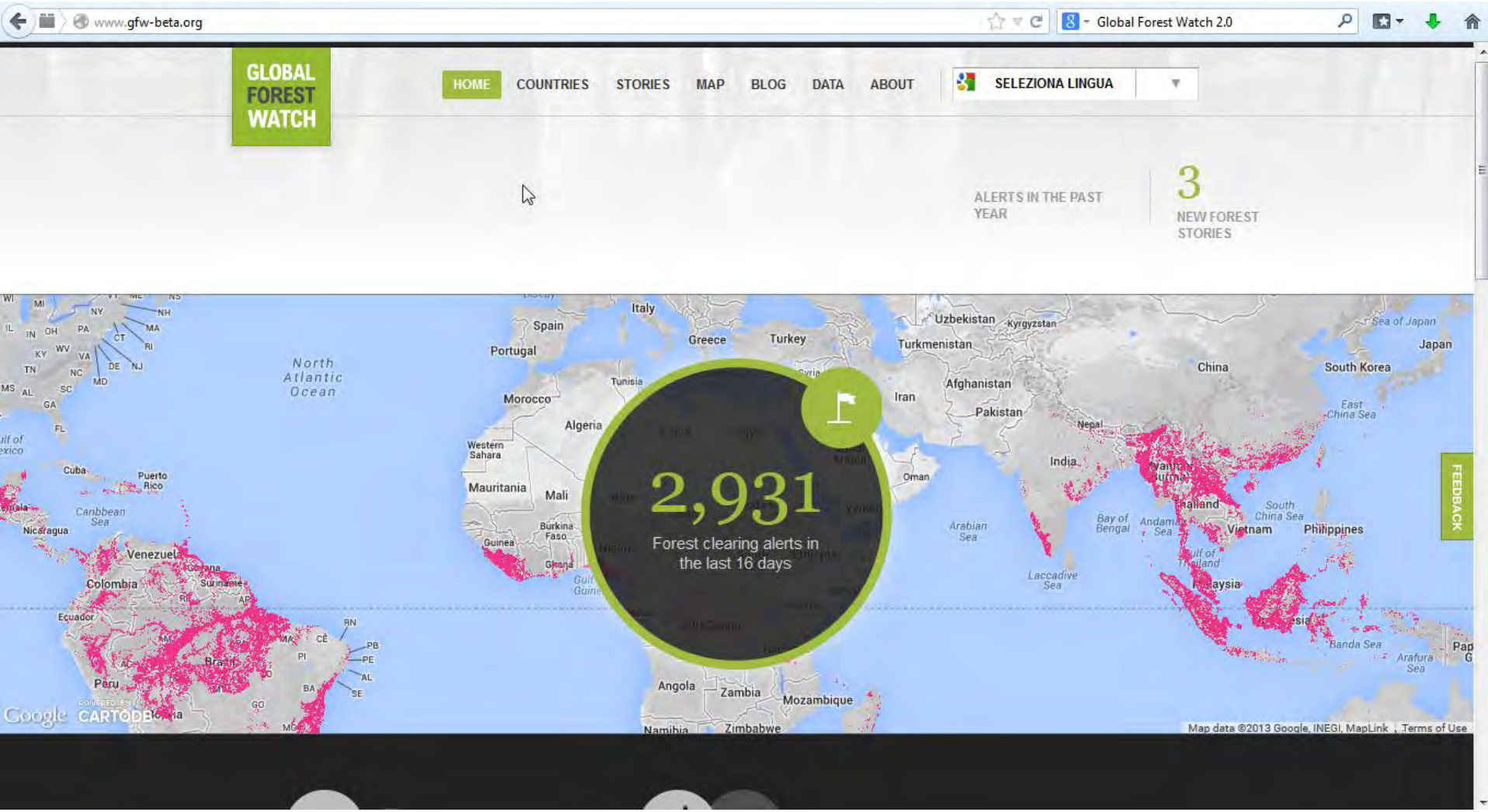

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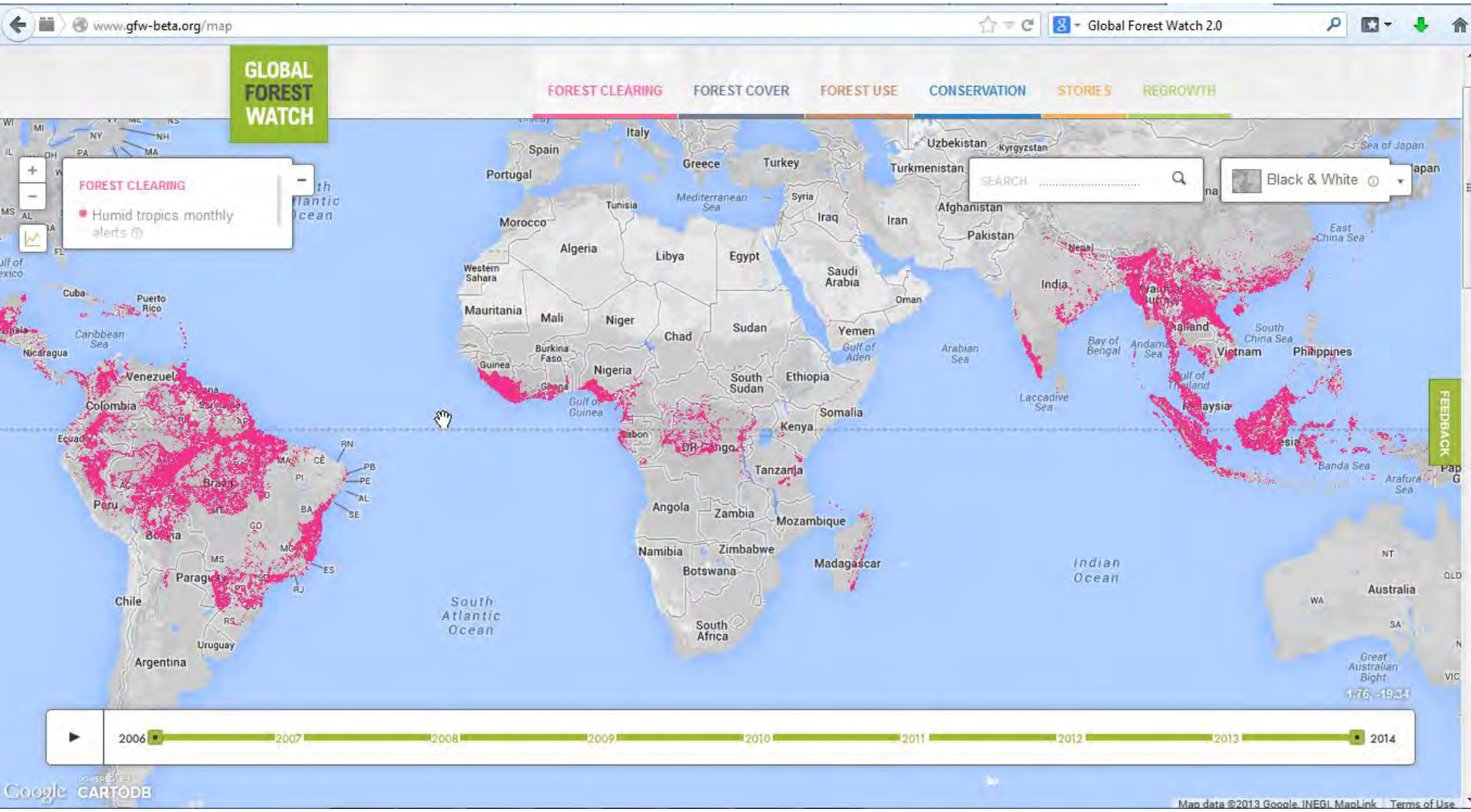
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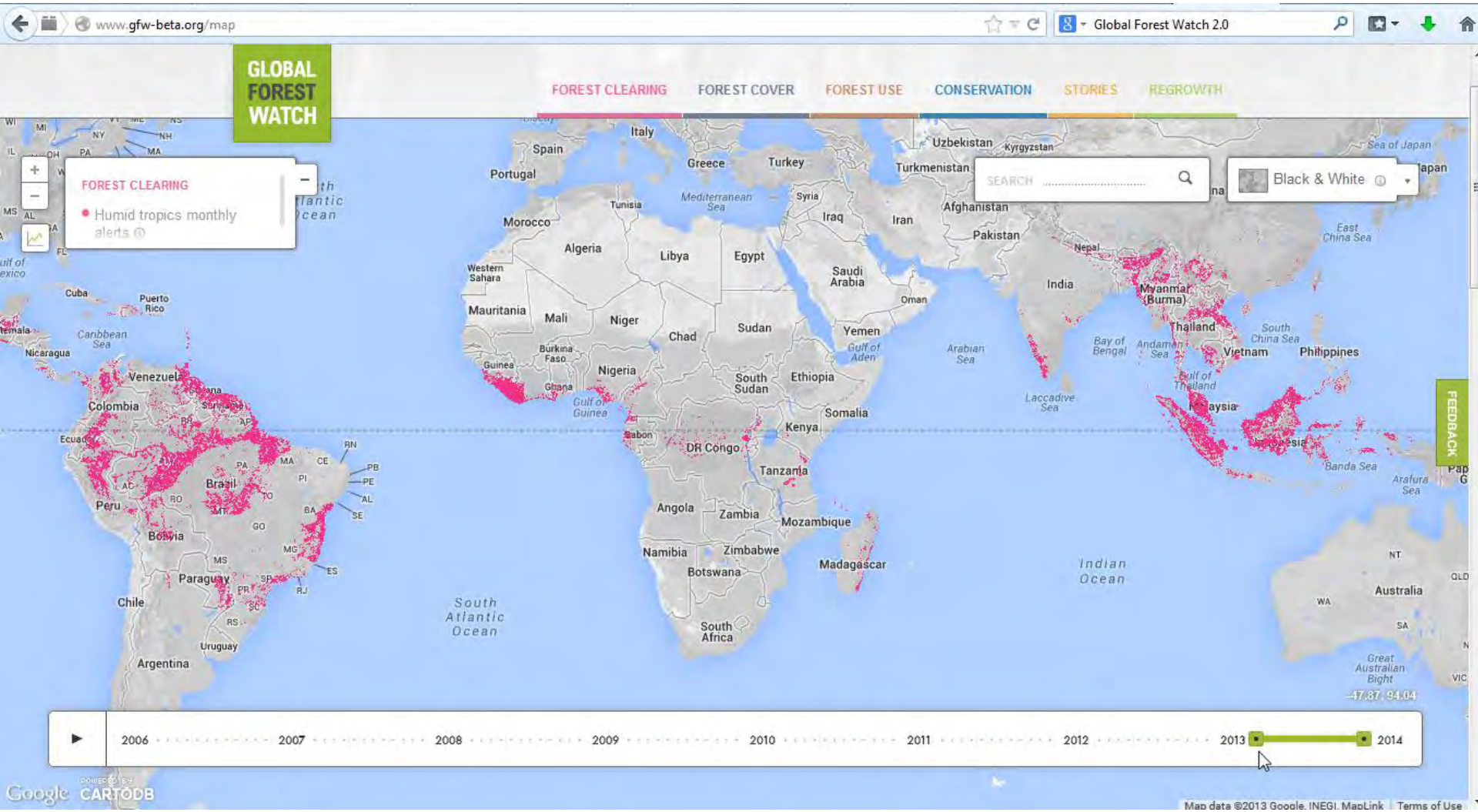
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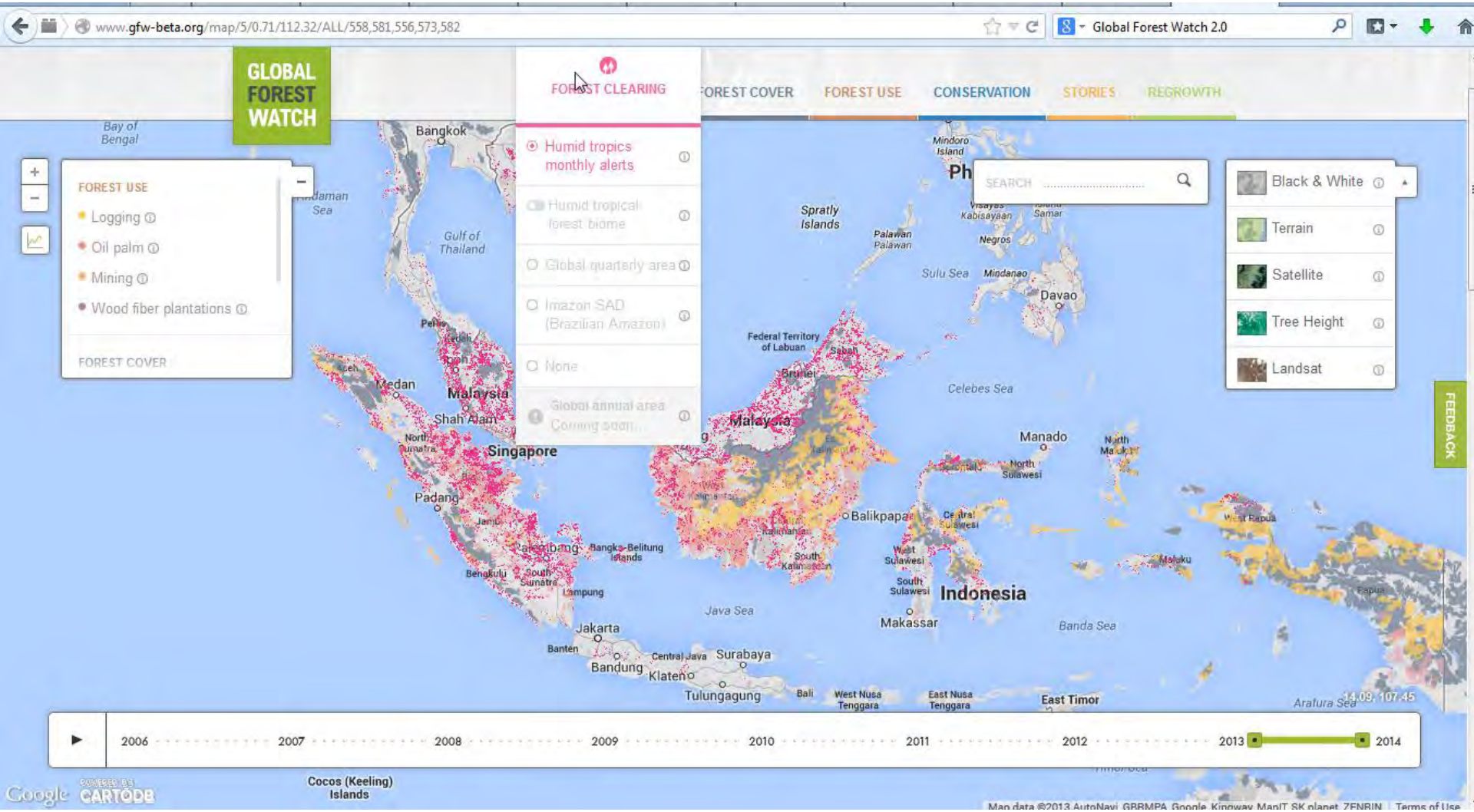
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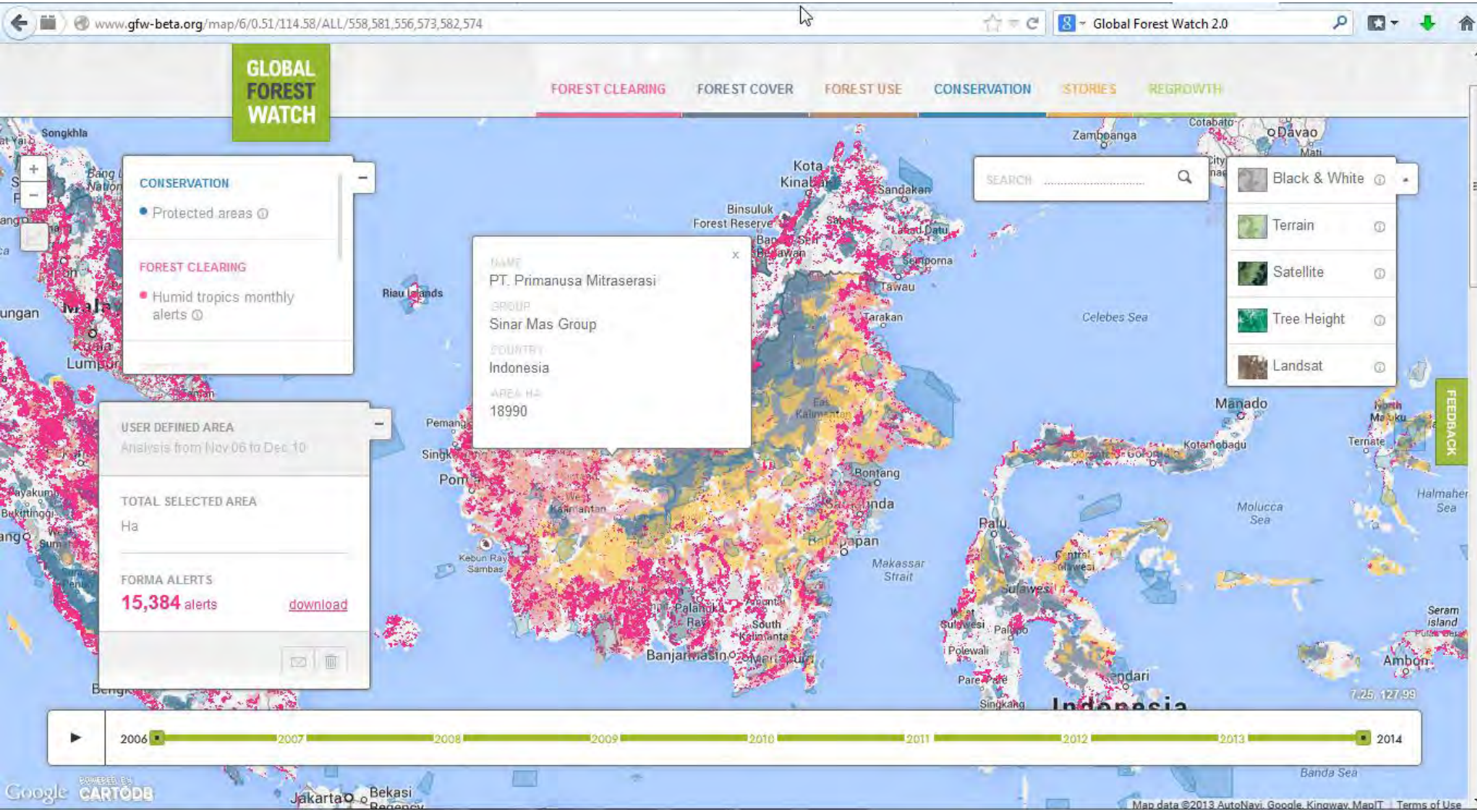
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GLOBAL FOREST WATCH

Malaysia

Monitoring Steps

October 27, 2011

The following inventory and monitoring steps are used by the National Inventory and Monitoring Applications Center (NIMAC) of the Forest Inventory and Analysis (FIA) program, US Forest Service. These were developed in collaboration over the years with The Nature Conservancy, NatureServe, and the Food and Agriculture Organization (FAO) of the United Nations. For more information, contact Chip Scott, 610-557-4020, ctscott@fs.fed.us or Carla Ramirez Carla.Ramirez@fao.org.

A. Planning Component

1. Information needs and priorities
    a. Identify the customers and their related activities
    b. Set broad objectives (consider multiple sources, scales, and sectors)
    c. Select the monitoring questions and other information needs
    d. Select attributes
        i. Identify and prioritize the attributes
        ii. Select terms and definitions for attributes from regional or international standards, else specify terms and definitions
        iii. For any modified terms and definitions for attributes, such as land use change and forest type, harmonize them with other partners and countries.
2. Assemble and evaluate existing data and other information to answer the questions
    a. Identify the gaps in terms of spatial and temporal resolution and of attributes
3. Set time/cost and precision constraints
    a. Specify other requirements, such as time scale.
4. Outline the main components of the monitoring system
    a. Define the system components or modules (Remote Sensing/GIS, Greenhouse Gas (GHG) inventory for forestry sector, National Forest Inventory (NFI) Sustainable Forest Management (SFM), NFI-biodiversity, Socioeconomic, governance, etc).
    b. Components for REDD+ often include remote sensing for classification and stratification, forest inventory, associated socio-economic survey, allometric models for volume, biomass or carbon; and carbon prediction models for different management options.
    c. Identify the needs to cover the gaps within and between these components
    d. Evaluate existing data systems by component for processing and reporting

B. Remote Sensing Component

1. Analyze the availability of remote sensing sources, and their spatial and temporal resolution
2. Remote sensing methodologies
    a. Determine the remote sensing methods to support forest classification and stratification

b. For forest monitoring, evaluate whether to use wall-to-wall imagery or sampling methods (based on costs and spatial-temporal resolution).
c. Determine methods and imagery to evaluate historic deforestation to support Reference Emission Level (REL) and Reference Level (RL)
d. Determine methods to evaluate uncertainty (QC/QA), including a statistical accuracy assessment.

3. Remote sensing implementation
    a. Staff contracting
    b. Training
    c. Pre-processing implementation
    d. Remote sensing processing and analysis (un-supervised/supervised classification in connection with step 4)
    e. Land use change analysis (historic data and further REDD+ monitoring)
4. Ground data collection (in connection with other field work)
    a. Planning
    b. Data collection guide
    c. Equipment and materials
    d. Training
    e. Data collection
    f. Data processing
5. Uncertainty analysis and reporting

C. Inventory Design and Data Collection Component

This component applies to forest inventory, development of allometric models of volume, biomass and carbon, and development of forest dynamics modeling, such as for prediction of carbon stocks and trends.

1. Sampling methodology
    a. Identify alternative methodological approaches
    b. Identify sampling frame
    c. Plot design
    d. Sampling design
    e. Estimation methods
    f. Use existing data or pilot survey data to evaluate variability
    g. Sample size requirement
    h. Sample location
2. Quality Assurance/Quality Control plan
    a. Develop QA/QC plan for data collection and QC materials for supervisors
    b. Information management system plan and guide
3. Preparing for field work and data collection
    a. Logistics
    b. Contact local communities for acceptance and local support
    c. Contracts
    d. Equipment and materials
    e. Data collection guide
    f. Training materials

    g. Conduct training
    h. Certify data collectors
4. Conduct pilot test of the methodology (and as required for variability – see 1f)
5. Data collection
    a. Collect data
    b. Supervise and provide continued training and QC

D. Processing, Reporting and Dissemination Component

1. Design and develop data information systems by component
    a. Data base
    b. Data entry system
    c. Data checking and editing
    d. Compilation system
    e. Analysis system
2. Enter and store data
    a. Enter the data either at the point of measurement or from forms
    b. Run edit checks and edit as needed
3. Process (compile) the data
    a. Add and integrate auxiliary information, such as adding map attributes to plots
    b. Apply allometric and other models
    c. Prepare the data for analysis (e.g., add sampling design information) and link with the remote sensing data for estimation, such as stratification.
4. Analyze the data
    a. Perform analyses to answer the monitoring questions (1c)
    b. Disseminate the data via the web
    c. Create and disseminate reports
5. Re-evaluate information needs and monitoring methodologies
6. Evaluate results for strategic planning