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Global Observation of Forest and Land Cover Dynamics

# Building national forest carbon monitoring capabilities for REDD

*Martin Herold*

*GOFC-GOLD Land Cover Office, FSU Jena, Germany*

*www.gofc-gold.uni-jena.de*

GTOS

# Activities of the REDD working group

OFC-GOLD
orking group est.

1st GOFC-GOLD workshop

GTOS/GOFC report


2nd GOFC-GOLD workshop

1. REDD Source-book draft


3rd GOFC-GOLD workshop

ED/GOFC SBSTA side event

ESA/GOFC Side event + booth

ESA/GOFC-GOLD side event

TNC/WINR/ GOFC-GOLD side event

GTOS/GOFC -GOLD side event

GTOS
bmission I

GTOS submission II

GTOS submission III

COP11
ontreal

SBSTA 24

COP12 Nairobi

SBSTA 26

COP13 Bali

SBSTA 28

COP14 Poznan

SBSTA 30

1st SBSTA workshop

2nd SBSTA workshop

3rd SBSTA workshop

bm. of view
y parties I

Subm. of view by parties II

Subm. of view by parties III + IV

2005 2006 2007 2008 2009

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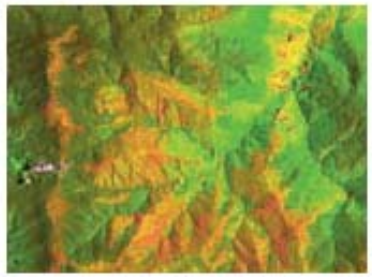
# Sourcebook version COP13.2



Version COP13.2 includes:

- Edits from comments received through international review process
- Updated sections, i.e. on fire monitoring, accuracy assessment, national forest inventories …

# Sourcebook objectives

1. to provide transparent methods that are designed to produce estimates of changes in forest area and carbon stocks from deforestation and degradation
   - in a format that is user-friendly
2. to complement the IPCC GPG-LULUCF (2003) and IPCC Guidelines-AFOLU (2006) by providing additional explanation, clarification and enhanced methodologies for obtaining and analyzing key data
3. to support REDD early actions, capacity building and readiness mechanisms on national level

# Sourcebook: Table of content

# Implementation remarks

1. Building a national forest carbon monitoring system is a process (that can start now):
   - *Assessment of existing national capacities and available data*
   - *Methods and guidance exist*
2. Capacity building as key factor for “readiness phase”:
   - *Technical monitoring capabilities*
   - *IPCC compliant estimation, accounting and reporting*
3. Start conservative with motivation to improve monitoring system over time

# Principles for Estimation Carbon Emissions

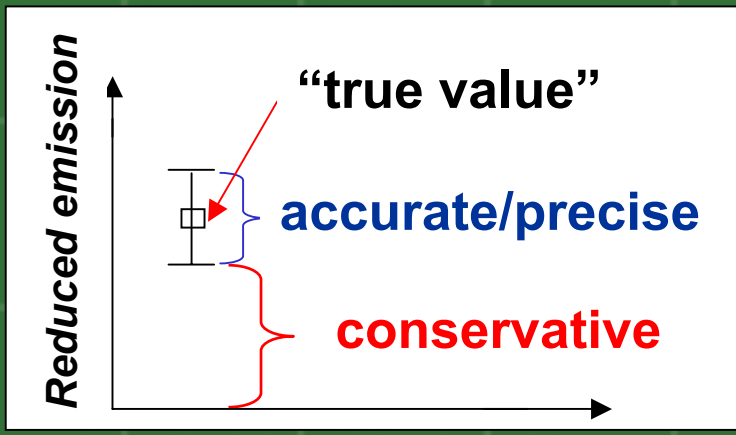
## 1. Overview of current principles:

*Transparency, Consistency, Comparability, Completeness, Accuracy*

## 2. Main challenges for developing countries:

Evidence suggest that many countries will encounter difficulties in fulfilling the principles of ***completeness*** and ***accuracy*** of estimates

**Conservativeness** approach:
*when accuracy and precision cannot be achieved, the reductions in emissions should not be over-estimated (or at least the risk of overestimating should be minimized)*



# Relevance of conservative estimates

- Conservativeness is already in the Kyoto Protocol (e.g. adjustment under Art. 5.2 KP, CDM, possibility to omit a pool)
- SBSTA 28 included for further consideration:
  - *"Means to deal with uncertainties in estimates aiming to ensure that reductions in emissions or increases in removals are not over-estimated*

Not a punitive correction of REDD estimate, but opportunity to:

- *Increase the credibility of uncertain REDD estimates*
- *Reward the quality of the estimates*: more complete/accurate likely translate in higher REDD estimates.
- *Allow flexible monitoring requirements*: if conservativeness is satisfied, Parties could choose the level of accuracy to reach.
- *Stimulate a broad participation*, i.e. allowing to join the REDD mechanism even without very complete / accurate estimates.
- *Help the comparability of estimates across countries*

# Building national capabilities

| *Important components* | *Practical considerations* |
|---|---|
| **FOREST AREA CHANGE** | Primary source: Landsat-type satellite data |
| Deforestation | Starting point for historical assessment 1990-2005 (3 time steps minimum)<br>Build basic satellite data proc. capabilities |
| Monitoring of forest degradation<br>Forest fire and burned area | Relevance and characteristics for human-induced carbon emissions<br>Definition of suitable monitoring system |
| Accuracy assessment | Using best/transparent methods and efforts for continuous improvement<br>Prepare for statistically robust approach |
| **CHANGE in CARBON STOCKS** | Primary source: ground/inventory data |
| Existing stratifications and forest carbon estimates | Inventory of available data<br>Decide on carbon pool/TIER level to report |
| Towards improved carbon stock change estimations | New inventory including other carbon pools<br>Stratification in relevant areas/forest types |
| **ACCOUNTING & REPORTING** | Provide conservative estimates |

# Building national capabilities

| *Important components* | *Practical considerations* |
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| **FOREST AREA CHANGE** | Primary source: Landsat-type satellite data |
| Deforestation | Starting point for historical assessment<br>1990-2005 (3 time steps available)<br>Build basic satellite data proc. capabilities |

# Monitoring deforestation at national scale

Starting point to develop more detailed monitoring system:

- Build satellite data processing capacities and data archive
- Motivation to use more detailed data than 1990-00-05
- Identify hot spots of forest loss to guide further surveys and field work on degradation and carbon accounting (i.e. stratification)
- Develop understanding of historical (spatial) processes and associated factors and drivers

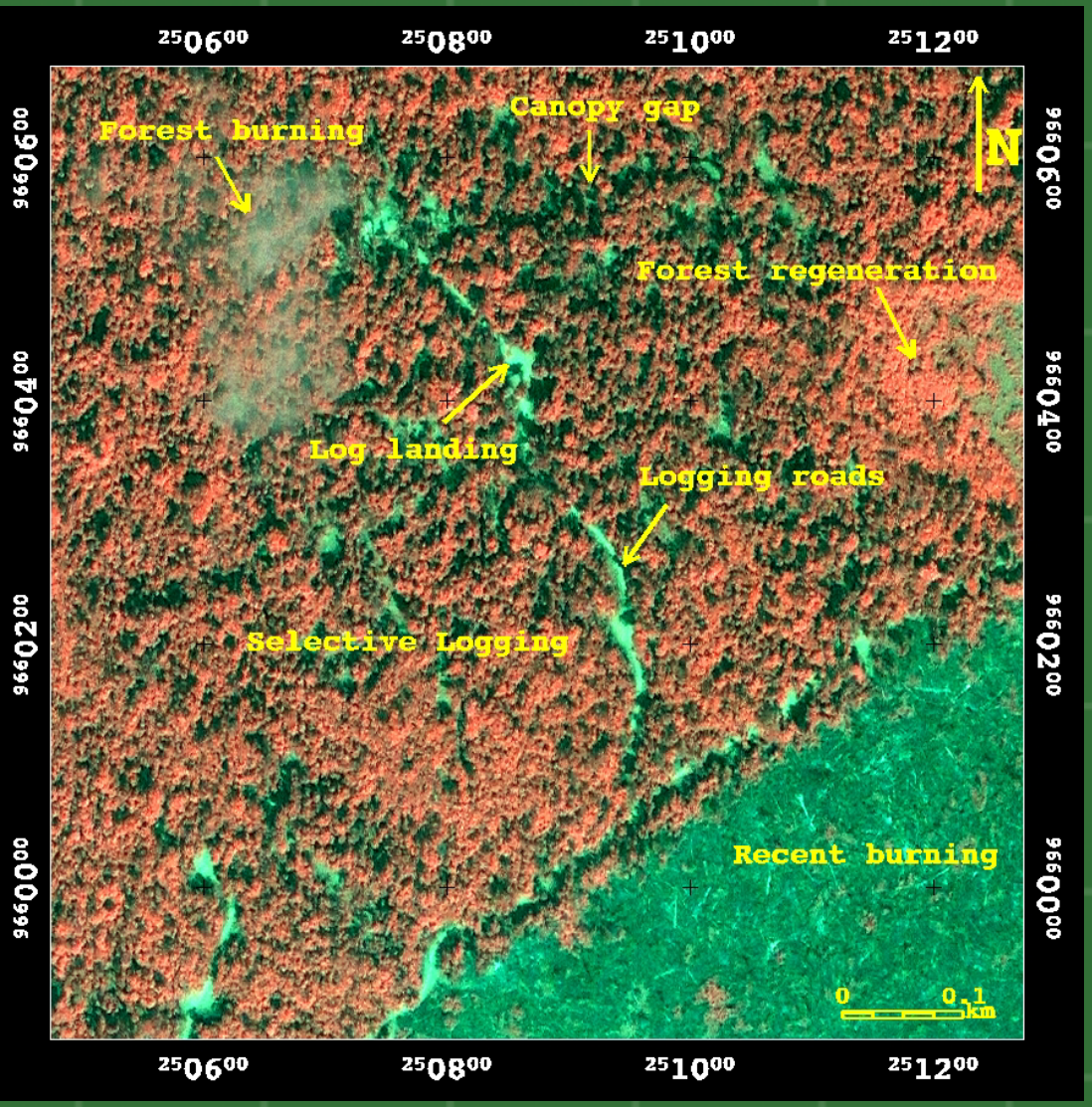
Charge to Earth Observation Community:

- Capacities to use other useful data of evolving technologies (i.e. Radar … new chapter in updated sourcebook)
- GEO is advancing global collaboration on monitoring forest carbon (http://www.earthobservations.org/meetings/meet_wss.html#past)
- GOFC-GOLD Regional Network Data Initiative

# Building national capabilities

| *Important components* | *Practical considerations* |
| --- | --- |
| | |
| Monitoring of forest degradation<br>Forest fire and burned area | Relevance and characteristics for human-induced carbon emissions<br>Definition of suitable monitoring system |

# Change in forest areas remaining as forest (degradation




Ikonos Image – Paragominas, PA

- Caused by:
  - Selective logging
  - Forest fires
  - Forest use (wood, agricuture)
  - ….
- Creates a complex environment:
  - Undisturbed forests
  - Canopy gaps
  - Exposed soils
  - Dead vegetation
- Can be precursor to:
  - Deforestation
  - Further disturbances

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# Direct approaches to detect forest degradation

| Highly Detectable | Detection limited & increasing data/effort | Detection very limited |
|---|---|---|
| • Deforestation<br>• Forest fragmentation<br>• Recent slash-and-burn agriculture<br>• Major canopy fires<br>• Major roads<br>• Conversion to three monocultures<br>• Hydroelectric dams and other forms of flood disturbances<br>• Large-scale mining | • Selective logging<br>• Forest surface fires<br>• A range of edge-effects<br>• Old-slash-and-burn agriculture<br>• Small scale mining<br>• Unpaved secondary roads (6-20-m wide)<br>• Selective thinning of canopy trees | • Harvesting of most non-timber plants products<br>• Old-mechanized selective logging<br>• Narrow sub-canopy roads (<6-m wide)<br>• Understory thinning and clear cutting<br>• Invasion of exotic species |

(using Landsat-type observations)

Peres et al., (2006) TREE

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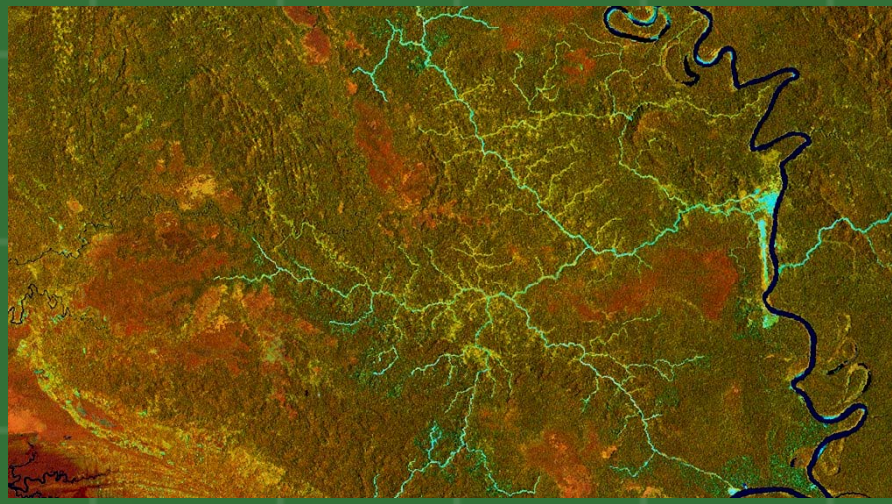
# Change in forest areas remaining as forest (degradation

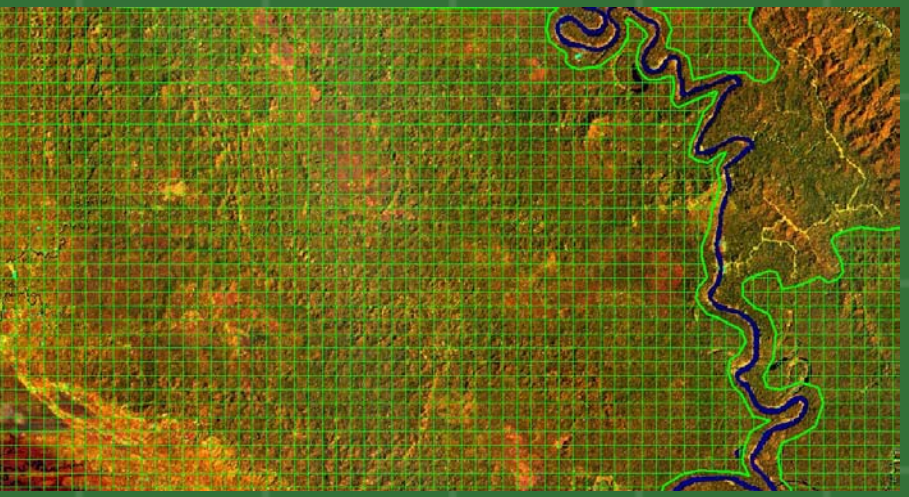
- Based on significant degradation processes present - country may decide on suitable observation approach
- Direct detection of degradation processes (canopy damage):
  - Landsat-type data with annual observations
  - Very high-resolution datasets (IKONOS type)
  - Hot spot sampling approach maybe effective
- Indirect approaches:
  - Detecting required infrastructure and its changes (roads, log landings)
  - Concept of intact versus non-intact forests
- Inventory based approaches (field surveys) and forest statistics (i.e. logging concessions and harvest esimates)
  - Operational fire monitoring systems

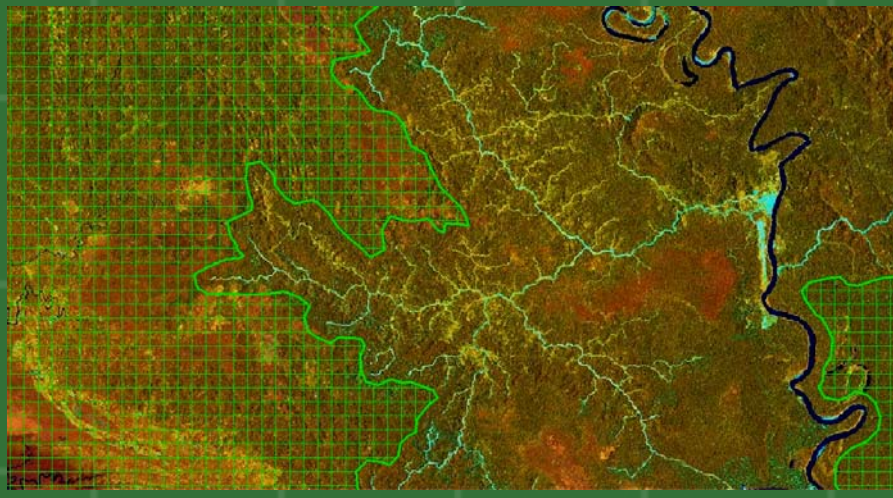
# Example for indirect approach

Landsat 1990

Landsat 2000







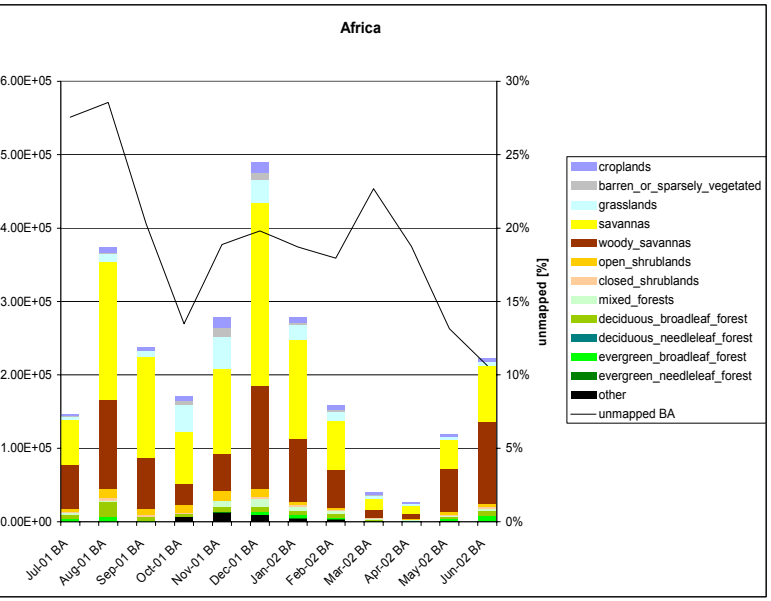
# Fire observations and their usefulness for national REDD implementation

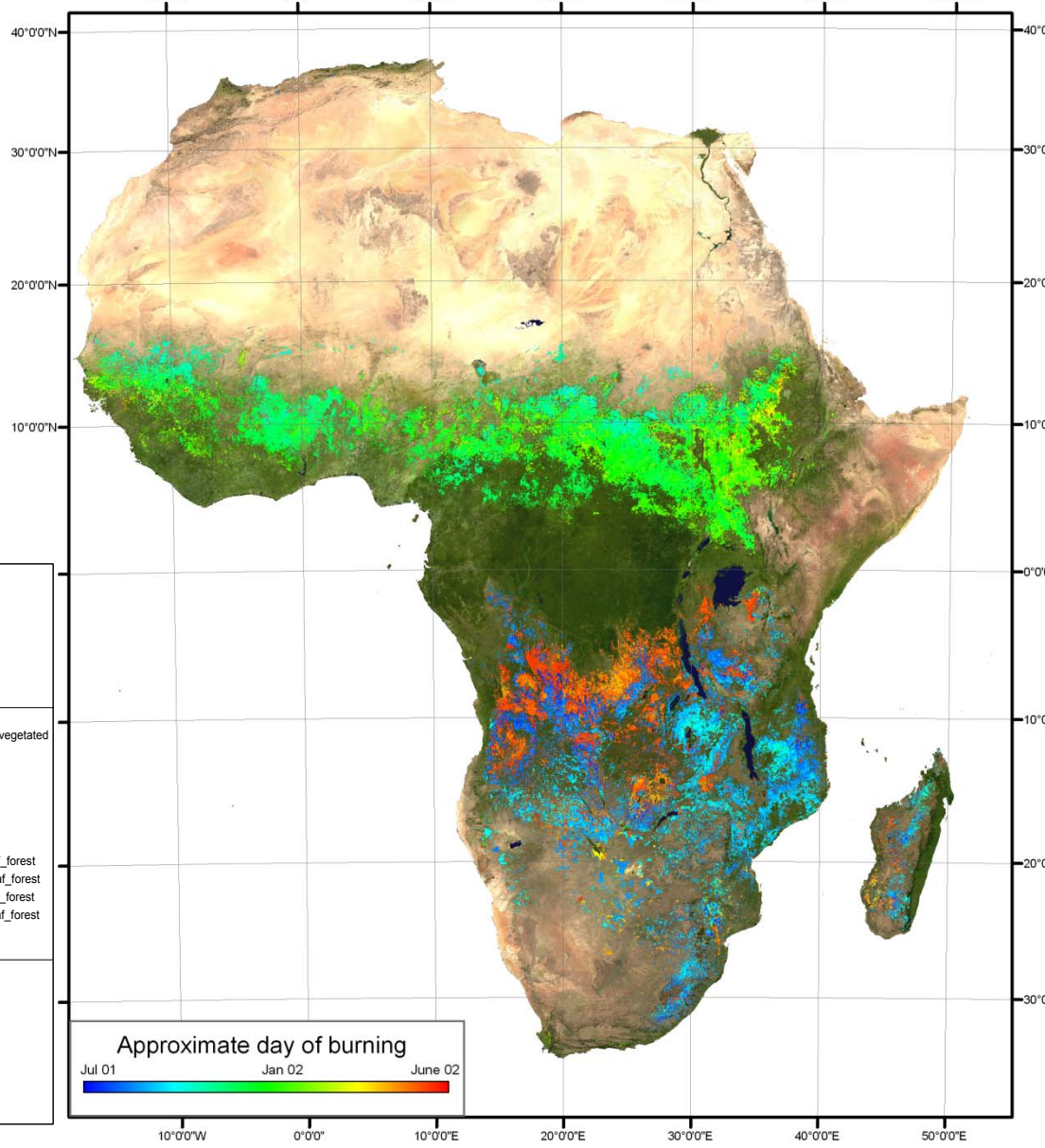
| Approach | Information | REDD objective | Suitability |
|---|---|---|---|
| Pre-fire | Early warning system | Protect forest areas at risk and address leakage and permanence | Most suitable for countries with significant amount of wildland fires and known fire regimes |
| Active fire | Hot spot satellite data | Fire relief and active emissions reduction<br>Support of in-situ actions | Most suitable for countries with large number of small-scale deforestation fires |
| Post-fire | Burned area estimates | Support estimation of areas of deforestation and degradation | All countries with forest loss due to fire |

# EXAMPLE APPLICATIONS

1 year of composite of MODIS burned areas, superimposed on surface reflectance to provide geographic context.

Burned area statistics for the same period, for vegetation type




http://modis-fire.umd.edu/MCD45A1.asp

Contact: Luigi Boschetti <luigi@hermes.geog.umd.edu>

# Building national capabilities

| *Important components* | *Practical considerations* |
| --- | --- |
| Accuracy assessment | Using best/transparent methods and efforts for continuous improvement<br>Prepare for statistically robust approach |

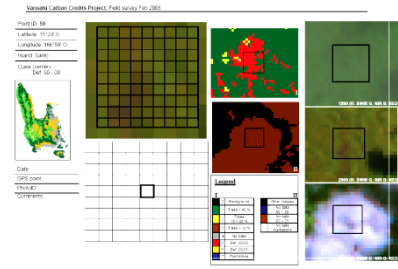
# Need for accuracy assessment

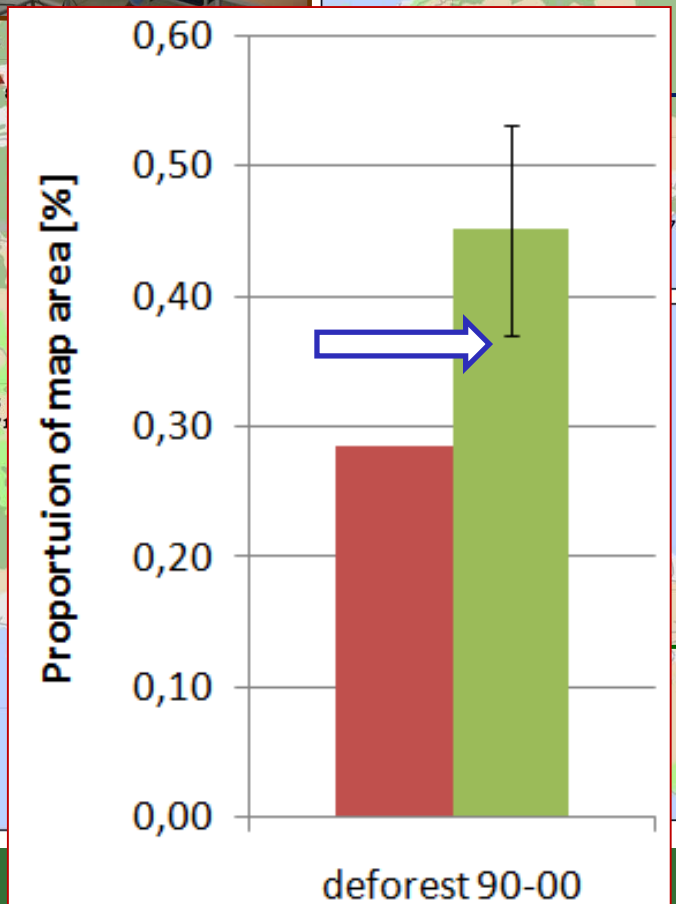
- IPCC GPG: uncertainties should be quantified and reduced as far as practicable
- Accuracy assessment using a sample of higher quality data as integral part of national monitoring/accounting
- 2 different objectives:
  - Assess accuracy and adjust area estimates (if biased)
  - Provide confidence intervals for conservative estimates
- For REDD - accuracy assessment as process:
  - Reduce sources of error by using suitable data characteristics and preprocessing, and consistent and transparent mapping
  - Using best efforts and continuous improvement while working towards a robust assessment in the future

# Accuracy assessment implementation

## Capacity building

## Reference data interpretation




## In situ visits

## Discussing deforestation histor

Resource Mapping Unit (RMU)

Roads

midheight Forest

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# Practical considerations

- Robust approach may not be achievable or practicable i.e. monitoring historical land changes in developing countries
- Verification should build confidence, improve knowledge of potential errors and continuously enhance estimates
- If no thorough accuracy assessment is practicable:
  - apply the best suitable mapping method in a transparent manner
  - consistency assessment allow some estimation of the quality
  - work backwards from most recent time (more reference data)
- Information without a proper statistical sample can be useful in understanding the basic error structure:
  - Confidence values provided by interpretation or classification
  - Qualitative examinations/comparison with other maps
  - Systematic review and judgments by local and regional experts
  - Comparisons with non-spatial and statistical data

# Building national capabilities

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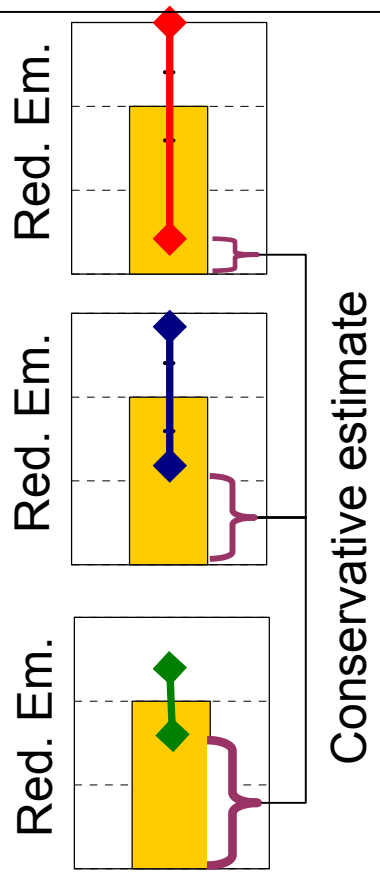
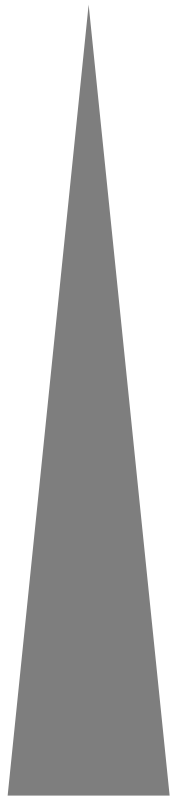
# Carbon stock change from deforestation/degradation

| Tiers (C pool change) | Certainty | REDD | Cost |
|---|---|---|---|
| **1. IPCC default values:**<br>➢ biomass in forest types by region and ecol. stratification, carbon fraction etc. |  | Simple & conservative starting point<br><br>Motivation to improve monitoring system over time<br><br>Accurate & established emissions monitoring |  |
| **2. Country specific data:**<br>Inventories (date, focus)<br>Ecological monitoring plots<br>Project studies/field samples | | | |
| **3. Full inventory of C stocks:**<br>➢ Comprehensive assessment<br>➢ Consider different carbon pools and assessment for all associated changes | | | |

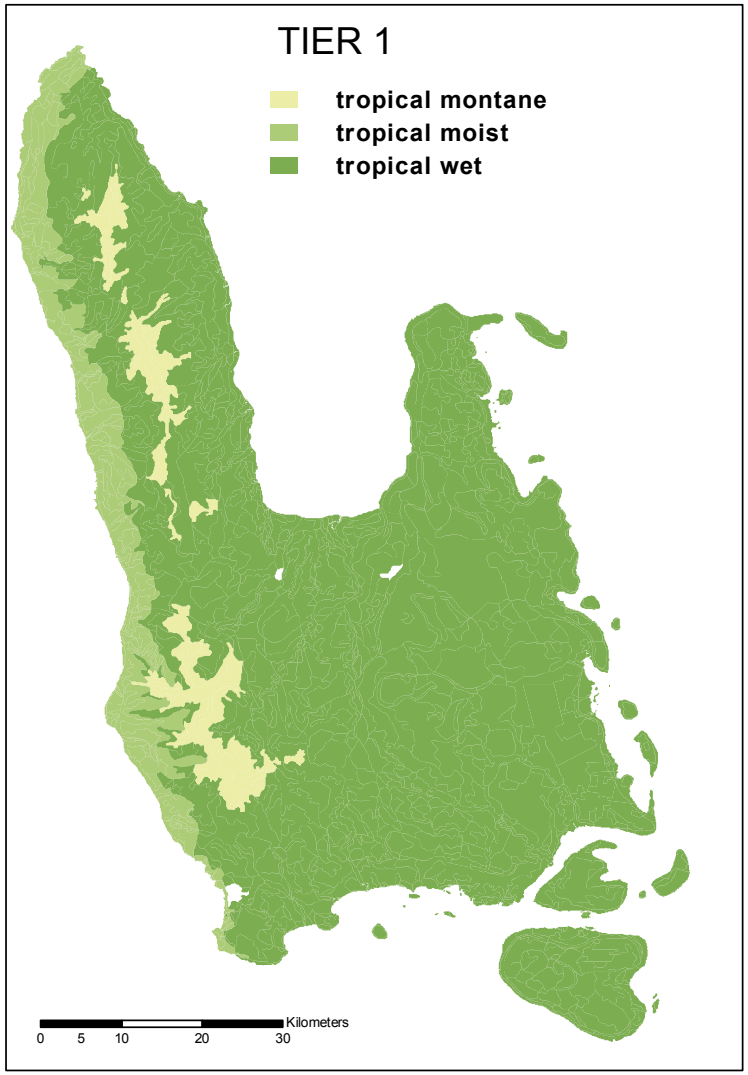


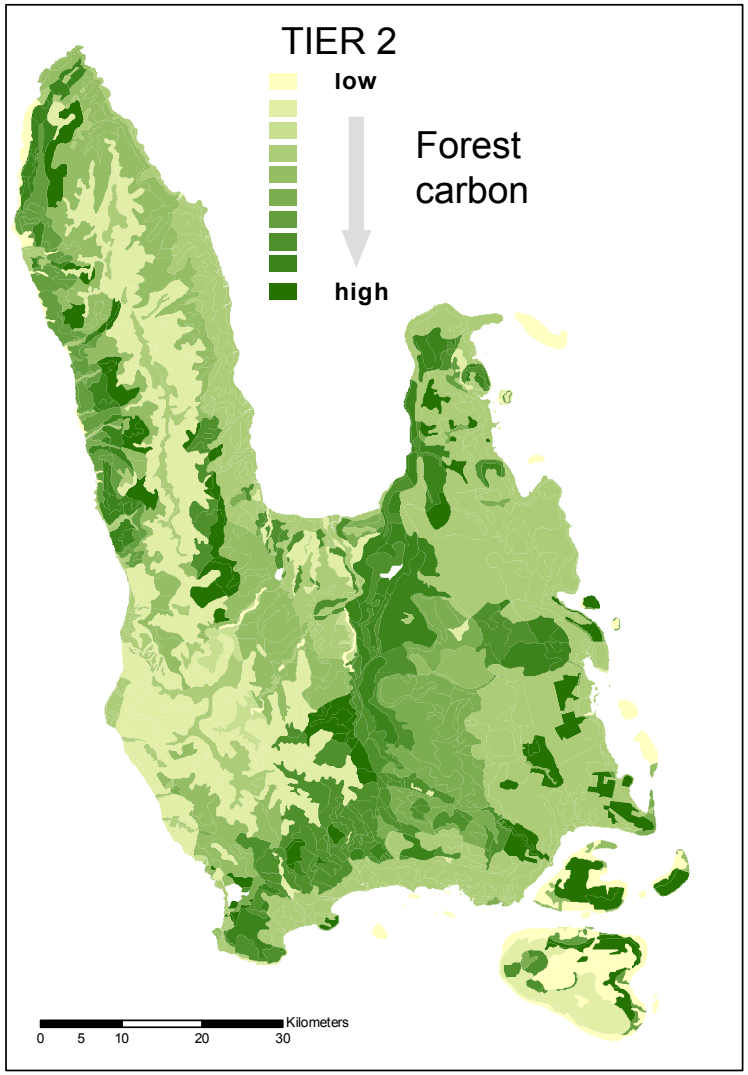
Conservative estimates:

)**Incomplete**: a pool which is a source due the deforestation (e.g. soil) may be omitted

)**Uncertain**: use confidence intervals

# Moving from Tier 1 to Tier 2



# Remote sensing support for carbon estimation

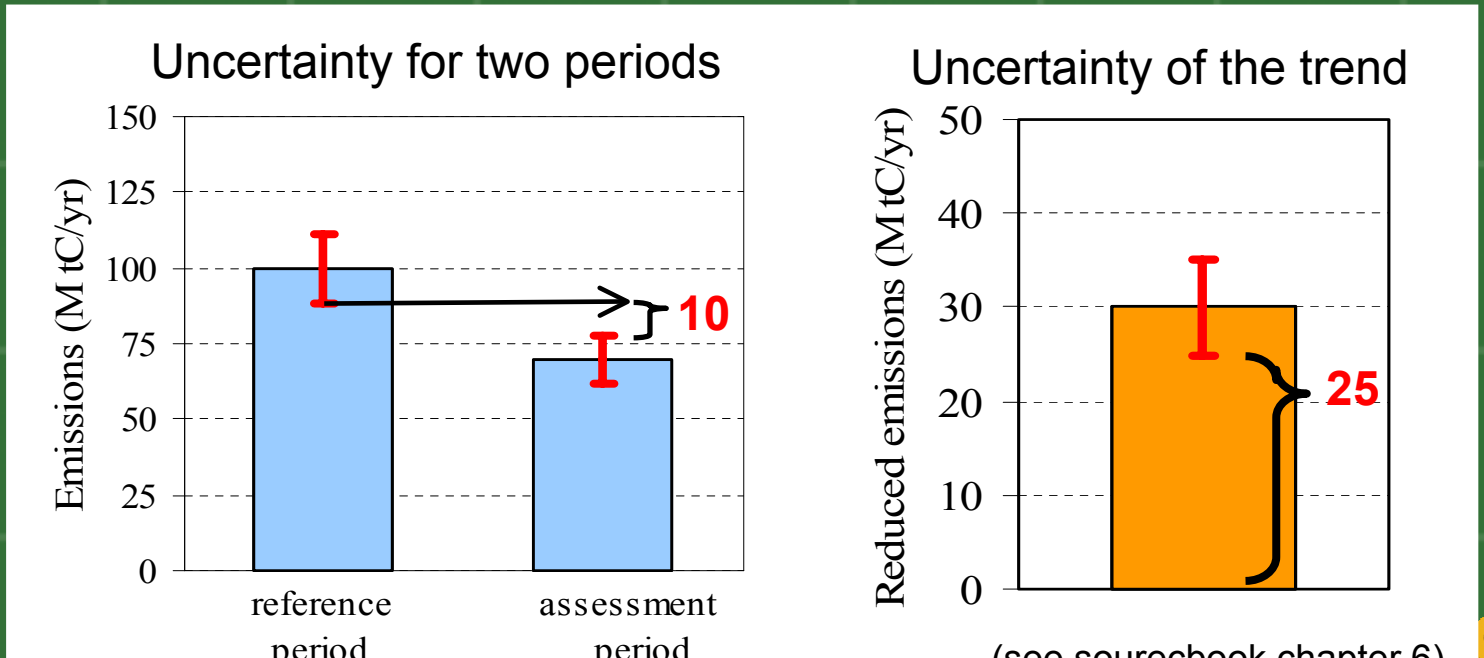
- Direct biomass mapping from space remains a challenge
- Existing capabilities:
  - Satellite observation may help to map some specific forest types (i.e. mangroves, plantations, evergreen / deciduous etc.)
  - Targeted remote surveys to support carbon monitoring:
    - *Very high resolution satellite or airborne data of air-photo quality to assist field surveys*
    - *Sensitivity of LIDAR and long-wave RADAR observations (few regional examples)*
    - *Integration of in-situ and satellite data for large scale biomass mapping*
    - *Direct estimation of emissions from fire radiative power*
  - Technologies are not operational globally but evolving

# Building national capabilities

| *Important components* | *Practical considerations* |
| --- | --- |
| **ACCOUNTING & REPORTING** | Provide conservative estimates |

# Examples of conservativeness applied to REDD

1. **Incomplete estimate:** IF the area deforested decreased, a pool which is a source due the deforestation (e.g. soil) may be omitted: the resulting estimate will not be complete but will conservative.
2. **Uncertain estimate:** similarly to Art. 5.2 of KP, proposal to use the confidence interval to be conservative
3. **Trend estimate**: Instead of using the confidence interval of both periods (left), we propose to be conservative using the uncertainty of the emission reduction (IPCC: *uncertainty of the trend, right*)




(see sourcebook chapter 6)

# Concluding remarks

1. Starting point to start process of building a national carbon monitoring & accounting system:
   - *Methods and guidance exist*
   - *Start conservative with motivation to reduce uncertainties over time*
2. Capacity building and engagement with national and international partners
3. Build databases and understanding of historical forest change and associated carbon emissions
4. Stimulate national REDD implementation strategy and activities

# Sourcebook development

1. Updated draft available: *www.gofc-gold.uni-jena.de/redd*
2. Engagement with IPCC LULUCF/AFOLU expert panel:
   - *Background paper on satellite remote sensing in LULUCF sector*
   - *GOFC-GOLD report 33: www.fao.org/gtos/gofc-gold/series.html*
3. Engagement with Group on Earth Observations (GEO) activities to improve forest monitoring for tracking carbon (2009-2011 work plan task)
4. Further methods and technical details to be specified and added with evolving negotiations and decisions
5. Updated & revised version for COP 14
   - *new sections (i.e. on evolving technologies)*
6. Next workshop planned for 13/14. Oct 2008 in Jena
   - *www.gofc-gold.uni-jena.de*

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# Acknowledgement


**Sponsors of the Global Terrestrial Observing System:**

FAO FIAT PANIS · ICSU · UNEP · UNESCO · WMO

**Sourcebook authors:**

***Core authors***: *Frederic Achard, Sandra Brown, Ruth De Fries, Giacomo Grassi, Martin Herold, Danilo Mollicone, Carlos Souza Jr.*

***Contributing authors***: *Barbara Braatz, Ivan Csiszar, Diane Davies, Bill de Groot, Sandro Federici, Nancy Harris, Suvi Monni, Devendra Pandey, Tim Pearson, David Shoch, Curtis Woodcock*

**Support for GOFC-GOLD REDD working group and Sourcebook preparation:**

esa · START IHDP • IGBP • WCRP · NASA · Canada · The Nature Conservancy · CSA ASC

# Web resources

- **GOFC-GOLD REDD sourcebook:**
  - http://www.gofc-gold.uni-jena.de/redd
- **Global Terrestrial Observing System (GTOS):**
  - http://www.fao.org/gtos/
- **GOFC-GOLD:**
  - http://www.fao.org/gtos/gofc-gold/
- **GOFC-GOLD land cover project office:**
  - http://www.gofc-gold.uni-jena.de/