

GOFC-GOLD

Global Observation of Forest and Land Cover Dynamics



Monitoring Deforestation

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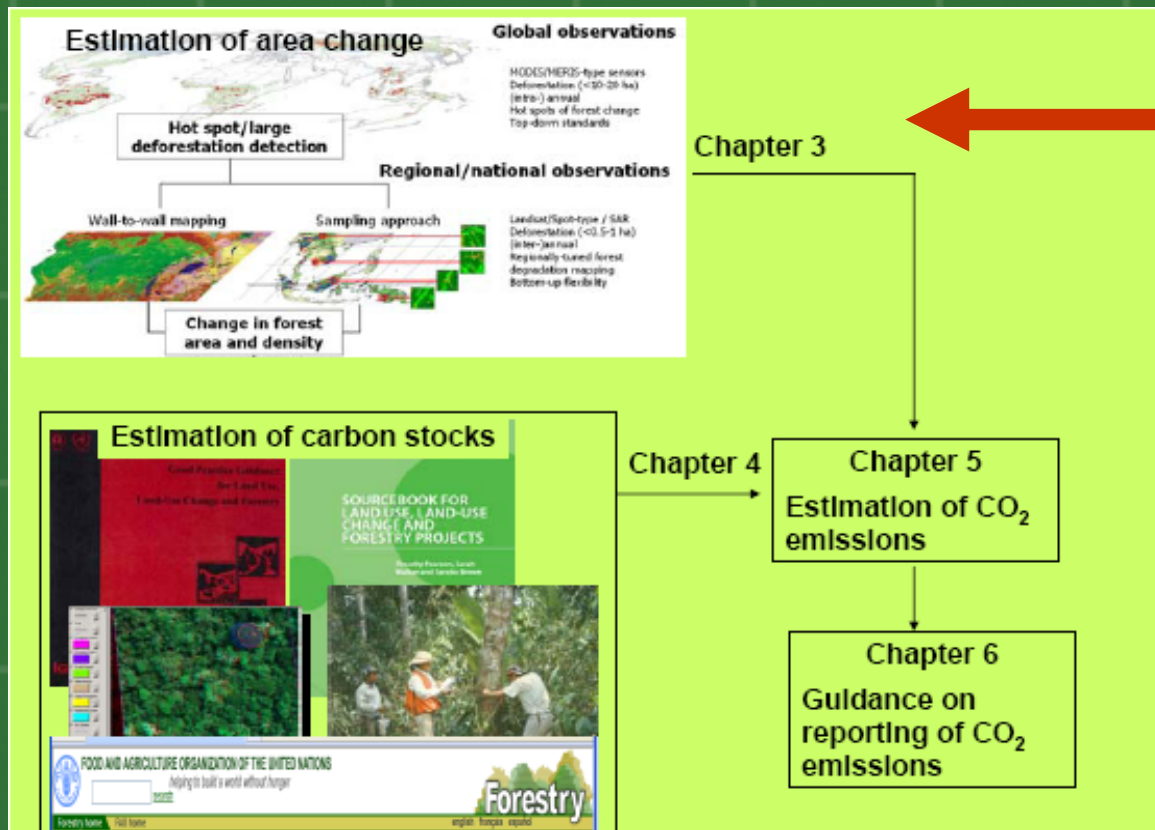
United Nations Climate Change Conference
Bali, 3 - 14 December 2007

Carbon emissions = Area deforested or degraded * change in carbon stock per area

Deforestation =
Forest land converted to
cropland, grassland,
settlements, wetlands, or
other land

Degradation = Forest land
remaining forest land

Forest land = tree crown
cover greater than 10 to
30%



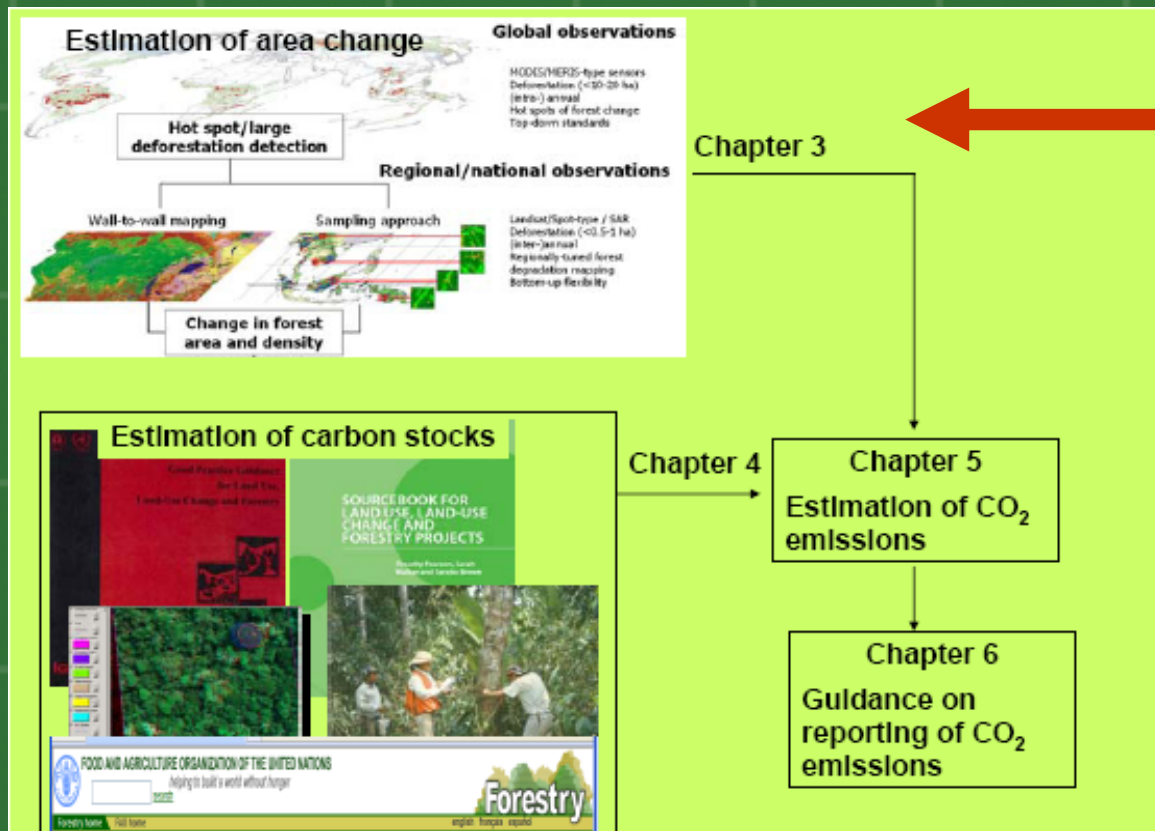
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Table 2.2. A summary of which approach can be used for the activity data and which Tier for the emission factors for estimating gross emissions of CO₂ from deforestation and degradation.

| Approach for activity data: Area change | Tiers for emission factors: Change in C stocks |
|---|---|
| 1. Non-spatial country statistics (e.g. FAO)—generally gives net change in forest area | 1. IPCC defaults |
| 2. Based on maps, surveys, and other national statistical data | 2. Country specific data for key factors |
| 3. Spatially specific data from interpretation of remote sensing data | 3. National inventory of key C stocks, repeated measurements of key stocks through time or modeling |

SUCCESSFUL NATIONAL EXAMPLES OF SATELLITE-BASED OPERATIONAL MONITORING INDICATE FEASIBILITY FOR OTHER COUNTRIES



What analysis approach should be used to assess change at repeated intervals?

benchmark forest area

sampling strategy

data sources

analysis approach

What data and analysis approach can be used to establish historical reference scenarios?

What resources are required?



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What analysis approach should be used to assess change at repeated intervals?: 1) FOREST DEFINITION AND BENCHMARK AREA

PRINCIPLES:

- * The area should include all forest within the national reference boundaries
- * A consistent forest definition and extent should be used for monitoring for future reporting

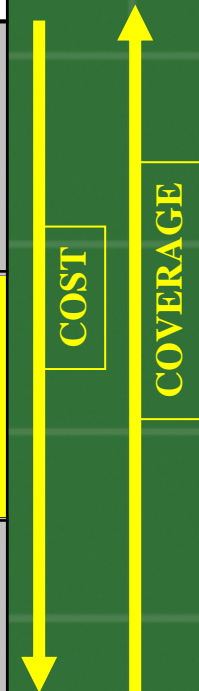


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What analysis approach should be used to assess change at repeated intervals?: 2) DATA SOURCES

Table 3.1. Utility of optical sensors* at multiple resolutions for deforestation monitoring

| Sensor & resolution | Examples of current sensors | Minimum mapping unit (change) | Cost | Utility for monitoring |
|---------------------|---|-------------------------------|---|--|
| Coarse (250-1000m) | SPOT-VGT (1998-) Terra-MODIS (2000-) Envisat-MERIS (2004 -) | ~ 100 ha ~ 10-20 ha | Low or free | Consistent pan-tropical annual monitoring to identify large clearings and locate "hotspots" for further analysis with mid resolution |
| Medium (10-60m) | Landsat TM or ETM+, SPOT HRV IRS AWiFs or LISS III CBERS HRCCD | 0.5 - 5 ha | <\$0.001/km ² for historical data \$0.02/km ² to \$0.5/km ² for recent data | Primary tool to map deforestation and estimate area change |
| Fine (<5m) | IKONOS QuickBird Aerial photos | < 0.1 ha | High to very high \$2 -30 /km ² | Validation of results from coarser resolution analysis, and training of algorithms |

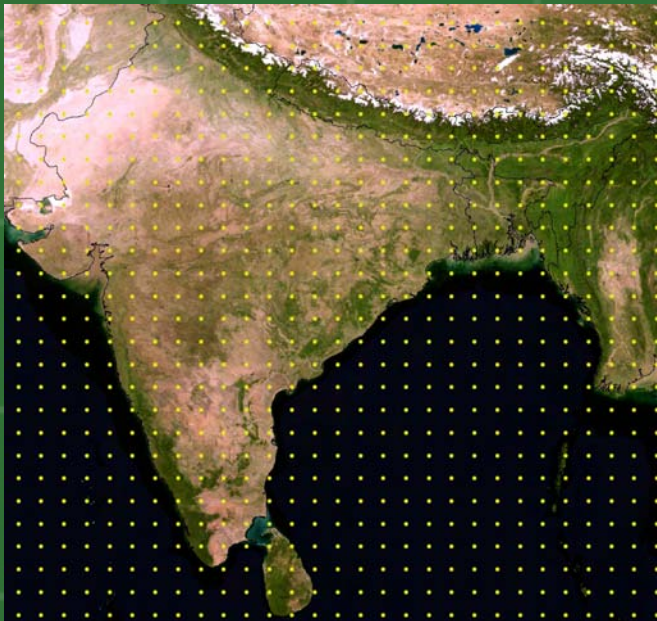


*non-optical sensors appear promising for future but no operational prototypes

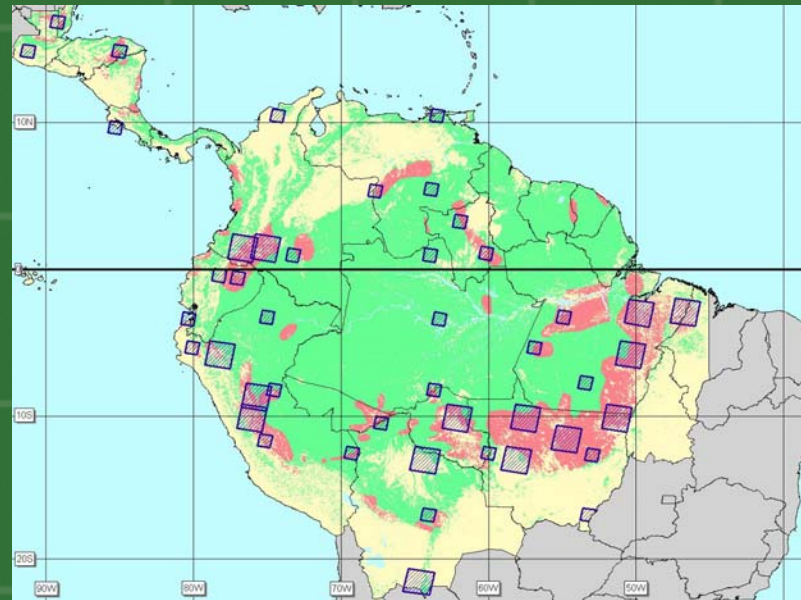


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What analysis approach should be used to assess change at repeated intervals?: 3) WALL-TO-WALL or SAMPLING



SYSTEMATIC SAMPLING



STRATIFIED SAMPLING

What analysis approach should be used to assess change at repeated intervals?: 4) DATA INTERPRETATION

Table 3.3. Main analysis methods for moderate resolution (~ 30 m) imagery

| Method for delineation | Method for class labeling | Practical minimum mapping unit | Advantages / limitations |
|----------------------------------|---|--------------------------------|--|
| Dot interpretation (dots sample) | Visual interpretation | < 0.1 ha | - closest to classical forestry inventories - very accurate although interpreter dependent - no map of changes |
| Visual delineation (full image) | Visual interpretation | 5 – 10 ha | - easy to implement - time consuming - interpreter dependent |
| Pixel based classification | Supervised labeling (with training and correction phases) | <1 ha | - difficult to implement - training phase needed |
| | Unsupervised clustering + Visual labeling | <1 ha | - difficult to implement - noisy effect without filtering |
| Object based segmentation | Supervised labeling (with training and correction phases) | 1 - 5 ha | - more reproducible than visual delineation - training phase needed |
| | Unsupervised clustering + Visual labeling | 1 - 5 ha | - more reproducible than visual delineation |

TECHNICAL CAPACITY

Reproducibility, consistency, transparency, and accuracy assessment more important than method



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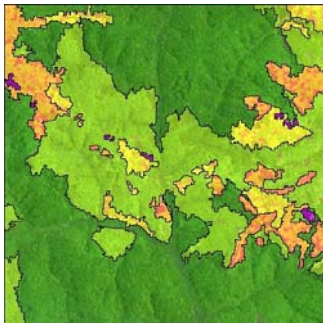
What data and analysis approach can be used to establish historical reference scenarios?

Box 3.4. Example of results of interpretation for a 10 km x 10 km sample in Congo Basin

Landsat image (TM sensor) of year 1990



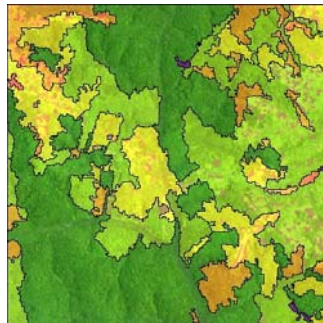
Image interpretation of year 1990



Landsat image (ETM sensor) of year 2000



Image interpretation of year 2000



Legend: green = Dense forest, light green = degraded forest, yellow = forest/agriculture mosaic, orange = agriculture & fallow.

Free global
Landsat
coverage for
1990, 2000, and
2005 most
feasible option

Accuracy
assessment more
challenging



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What resources are required?

Data

Hardware

Software

Training

Implementation (including accuracy assessment)



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Key points

- * **Availability and access to mid-resolution (~30m) data is critical**
- * **Multiple approaches appropriate depending on national circumstances**
 - *many analysis and sampling approaches*
 - *reproducibility, consistency, transparency, and accuracy assessment more important than method*
- * **Existing national examples indicate that operational deforestation monitoring is feasible goal for many countries but capacity needed**

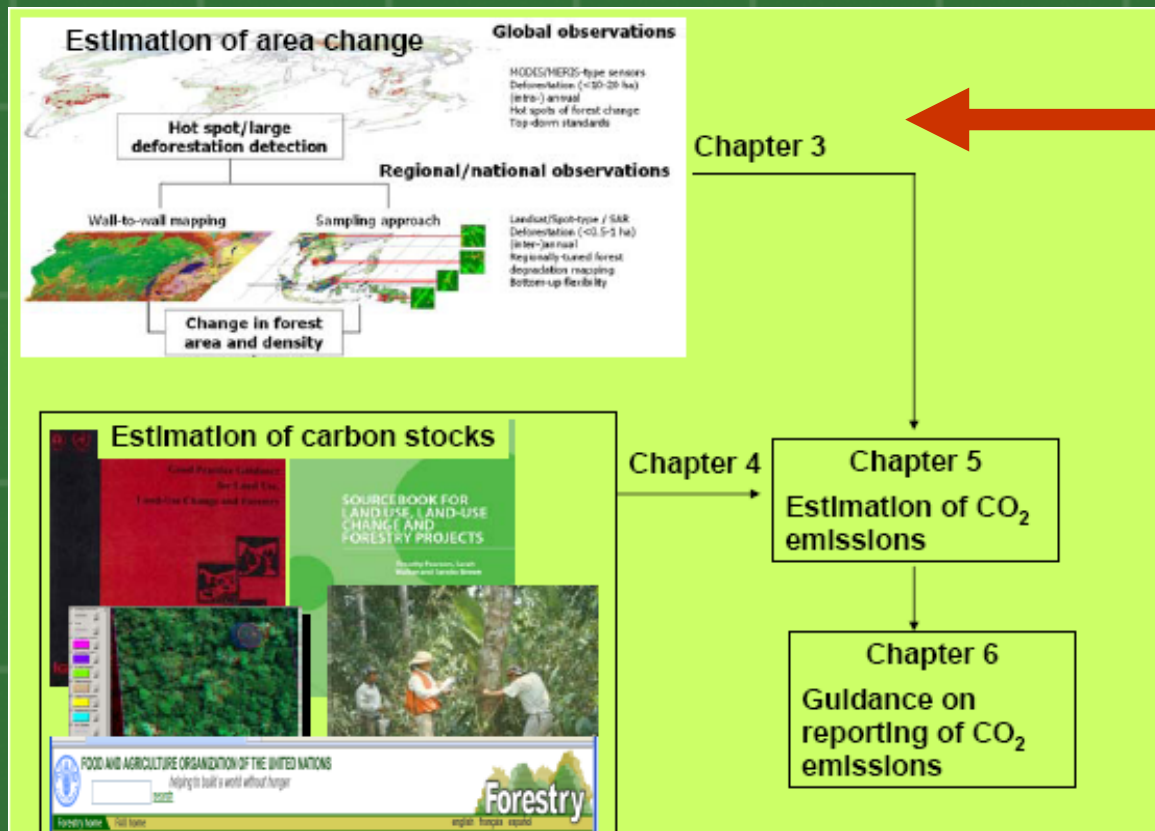


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