Monitoring of tropical forest changes using remote sensing techniques toward REDD and sustainable forest management

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REDD

Reducing Emissions from Deforestation

in Developing countries

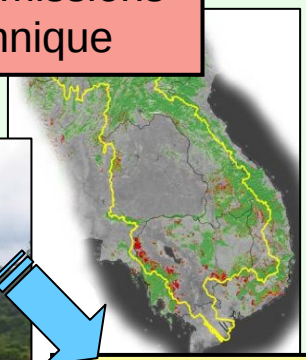
- New challenge toward next framework -

Outline

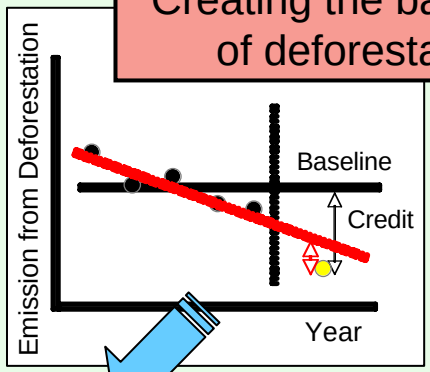
- Introduction of our feasible study on REDD in Southeast Asian countries
- Monitoring of deforestation and degradation using Remote Sensing
- Monitoring of illegal logging
- Monitoring of shifting cultivation
- Capability of remote sensing for monitoring and SFM

Research on the feasibility to estimate the GHG emissions reduction through Avoiding Deforestation

Estimating deforestation and emissions using a remote sensing technique



Creating the baselines of deforestation



Examining the feasibility and issues of AD

In Cambodia, Laos and Thailand

Social and economic analysis

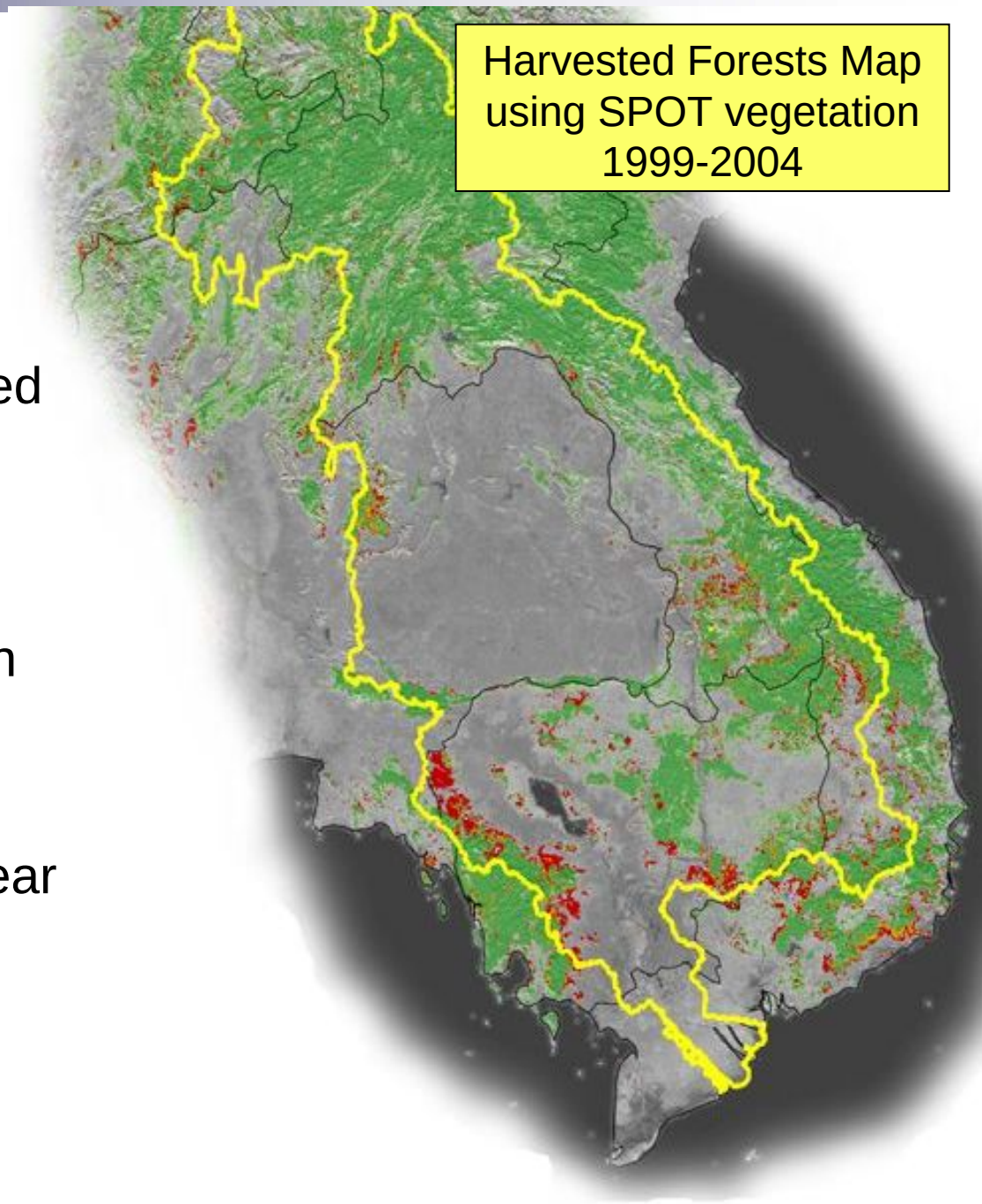
Feasibility analysis of the AD mechanism

Proposal of improvement or alternative mechanisms

Contribution to Japanese government and International disucussion thorugh COP/MOP□SBSTA□IPCC

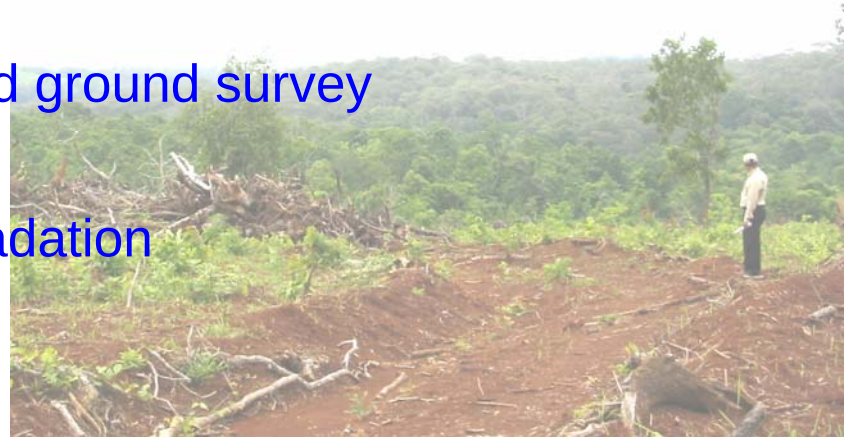
Study Fields

- Thailand
  - Deforestation happened already
- Cambodia
  - On-going deforestation
- Laos
  - Deforestation in the near future



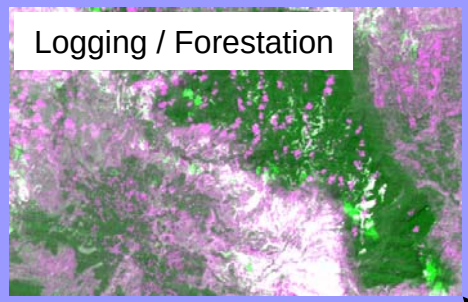
Key Points of the Project

- Mekong basin countries
  - Different scale and process of deforestation from Indonesia and Brazil
  - Each country has different stages of deforestation
- Remote sensing techniques
  - Integration of several sensors including ALOS, MODIS, TM, IKONOS
- Reference scenarios
  - Trial of socio-economics models
- Degradation
  - Combination of remote sensing and ground survey
- Socio-economics approaches
  - Process of deforestation and degradation
  - Design and Governance



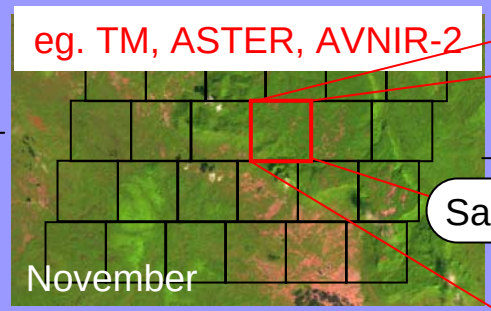
Scheme of Detecting Deforestation and Degradation

Deforestation



Hot spot mapping

Year X (beginning)

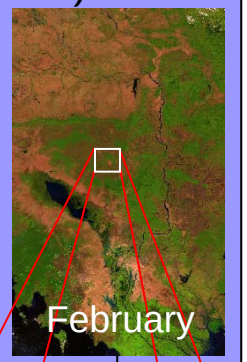


Classi-fication

Smoothing < 1ha

Comparison

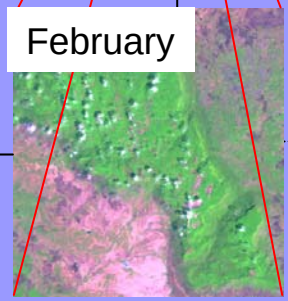
Year Y (End)



Smoothing < 1ha

Classi-fication

Phenology phase correction



Methodology development

1. Change detection using mid-resolution images
   * Phenology phase
2. Hot spot detection
3. Sampling design

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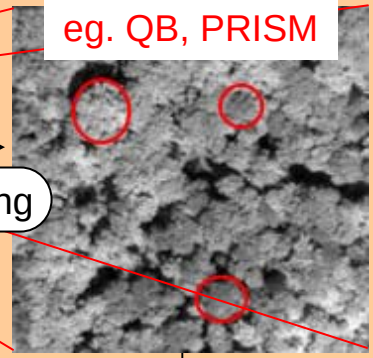
4. Interpretation design
   * Interpretation keys
5. Designing degradation index

Degradation / Deforestation



Sampling

Interpretation
1. land-use change
2. No of canopy
3. Canopy diameter

Modeling
Volume estimation for trees and stands

Comparison

Degradation index

Detection of "Deforestation" using Remote Sensing

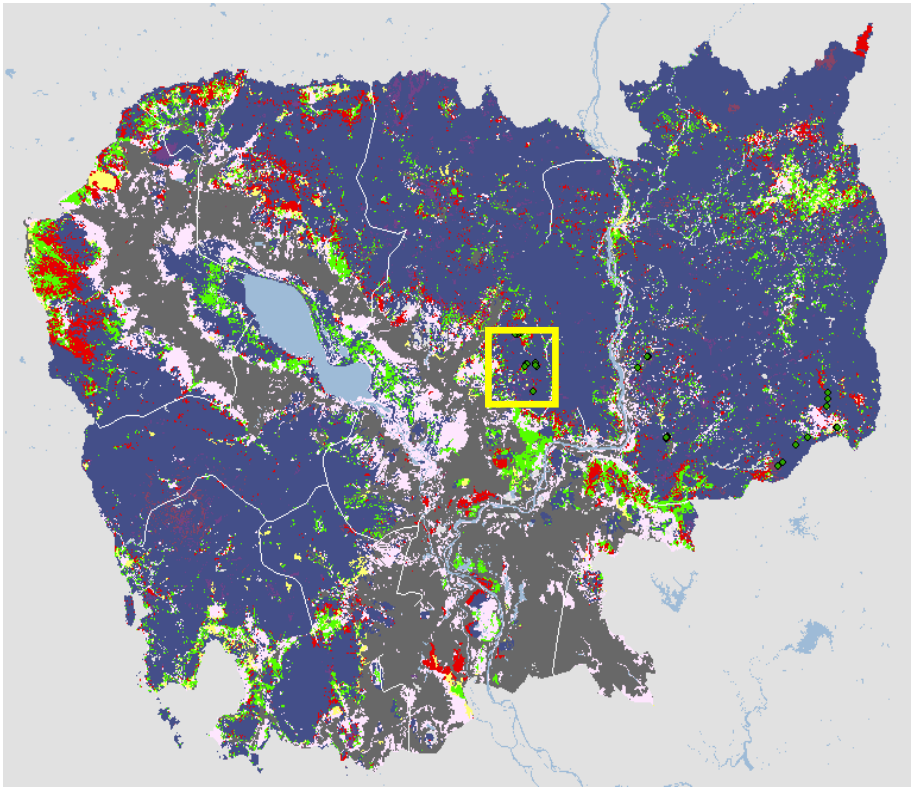


Fig. Deforestation in Cambodia (1993-2006)

1993-97 Deforested Area

1997-02 Deforested Area

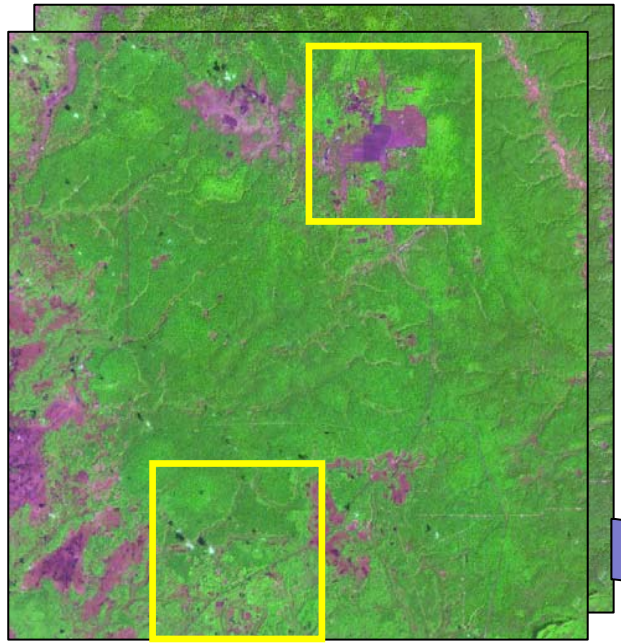
2002-06 Deforested Area

Forest

Agricultural

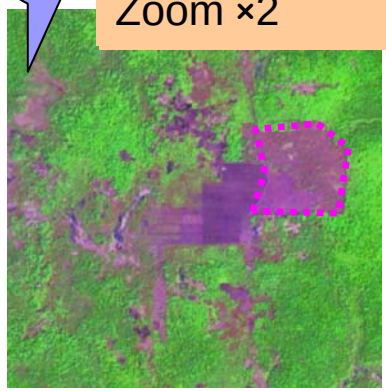
Shrub

Others

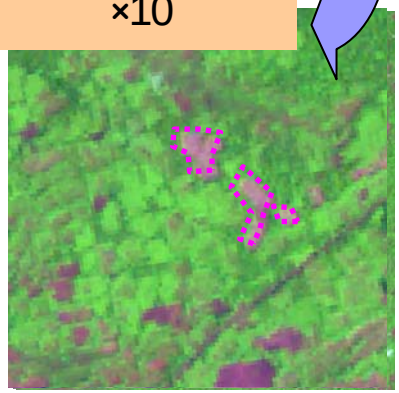


LandsatTM image(R:G:B=5:4:3)

Zoom ×2 ×10



Rubber Plantation
(Ex.Size=400ha)



Agricultural land
(Ex.Size=1-6ha)

–Clarifying the deforestation that can be stably detected using the mid-resolution imagery. *Deforestation* could be caused by a variety of background and with a variety of scale.

Detection of "Degradation" using Remote Sensing

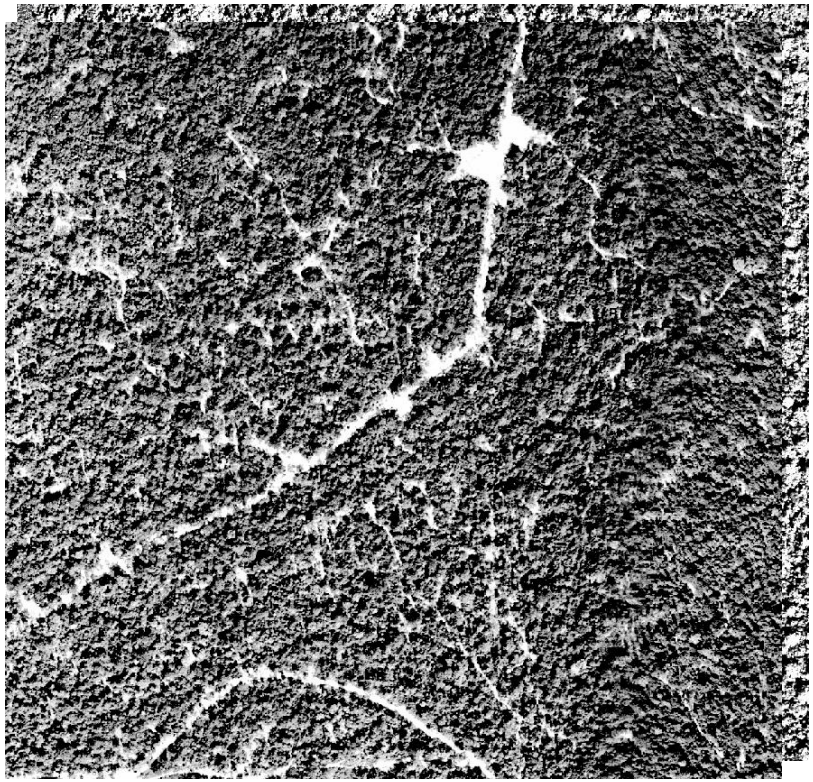
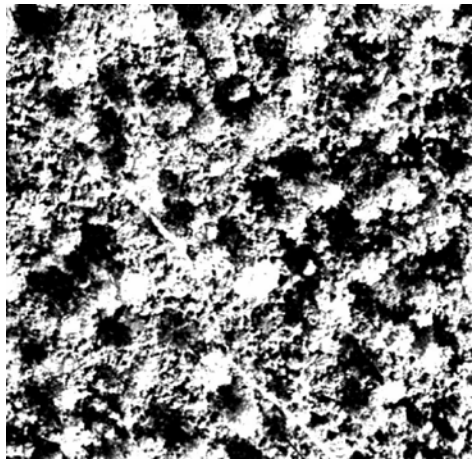
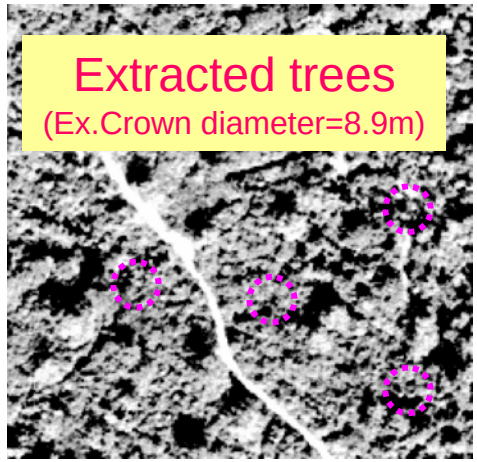


Fig. Degradation by Selective Cutting

Selective logging is common in the commercial operations. Logging roads and the traces of harvesting along the roads are visible in the high resolution imagery.



Year 1993 (Aerial photo)



Year 2001 (Aerial photo)

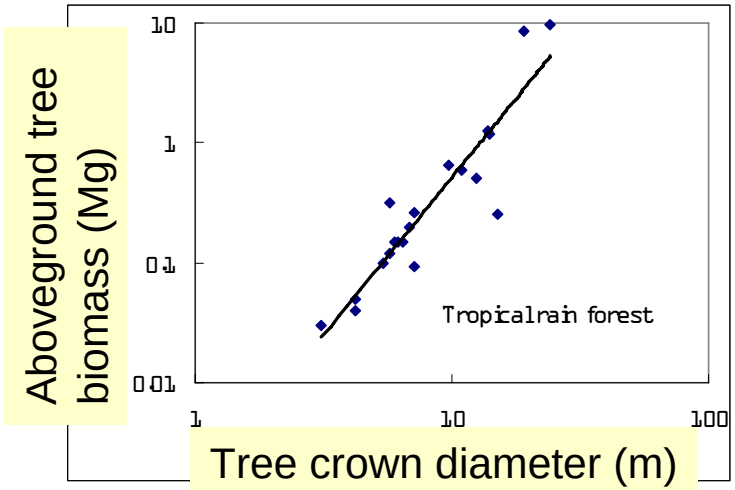
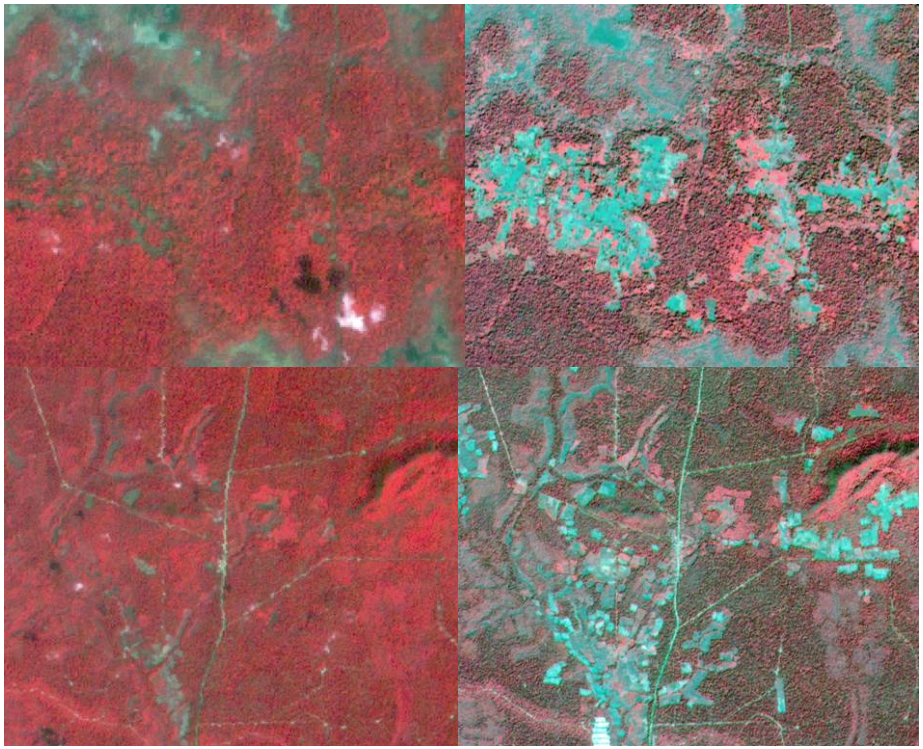


Fig. relationship between Crown size and tree biomass

–Making *Degradation Index* using visual interpretation of the high resolution imagery

Site of illegal logging in Cambodia

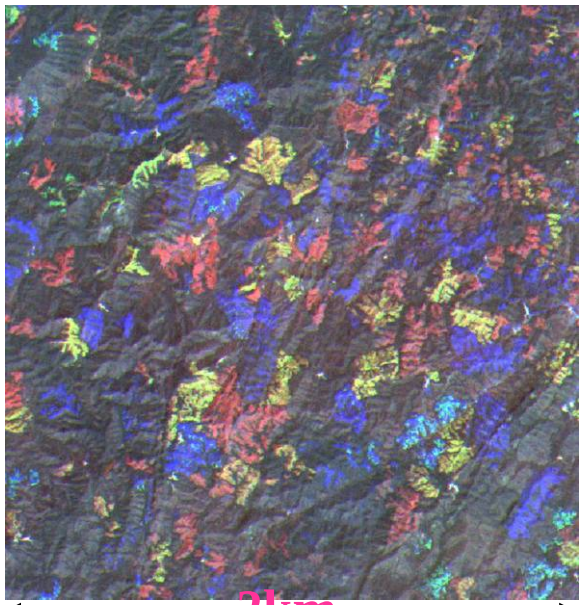
Patterns of deforestation in Cambodia

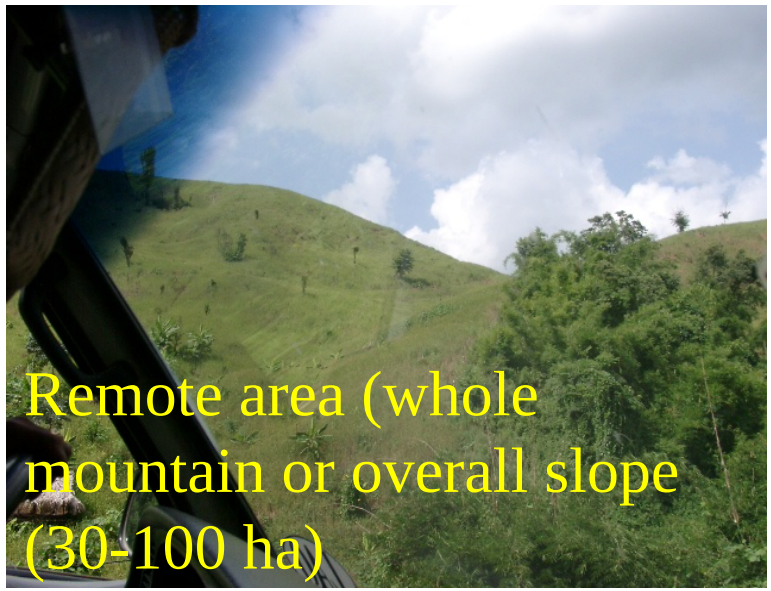


- Conversion to farmland development by small-scale farmers(1-5 ha)

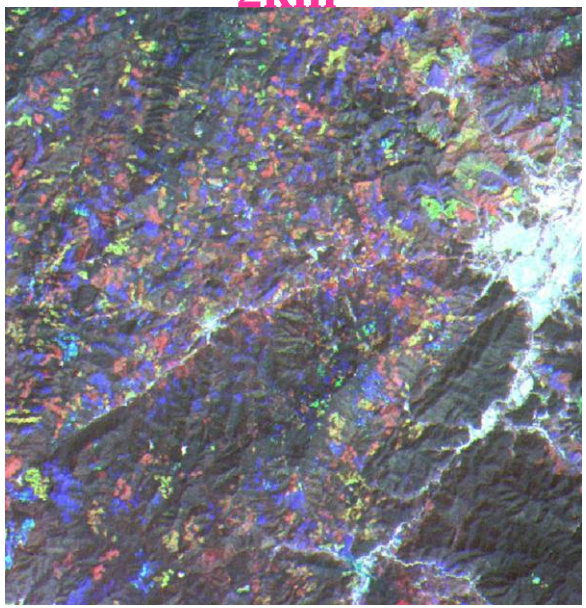
- Large-scale development by concession (rubber plantation, acasia plantation?)(10-1000 ha)

Shifting cultivation in northern Laos



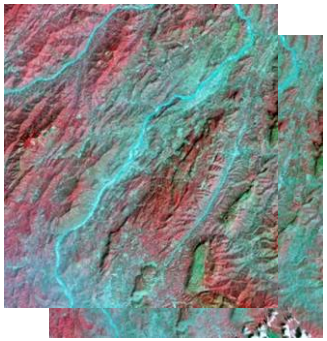


Shortening of rotation and enlargement of cultivation area



Conversion to rubber plantation after shifting cultivation

Monitoring of sifting cultivation by ASTER images



2002/2/9

2003/3/16

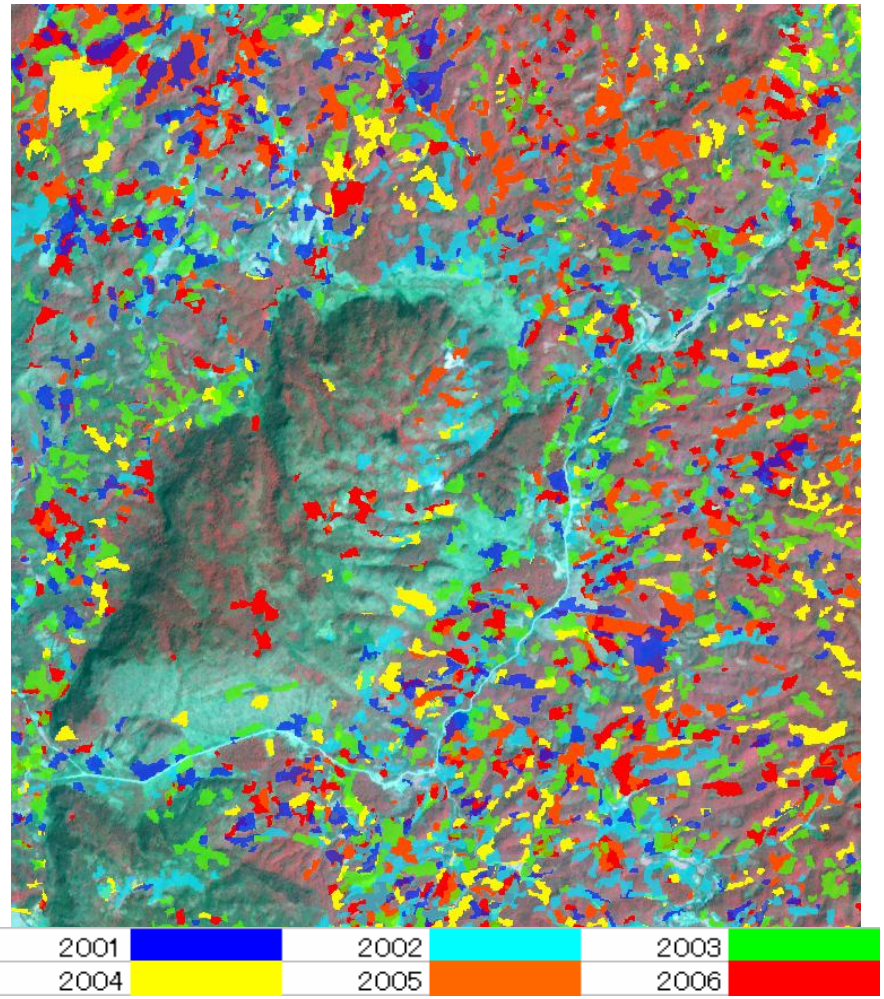
2005/2/1

2006/3/8

Image pre-processing

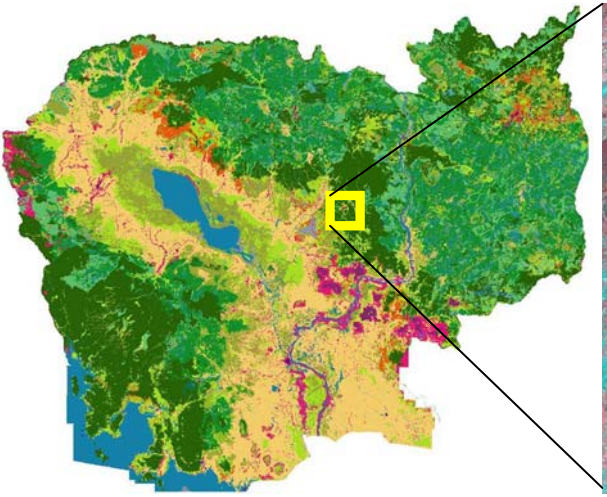
Object-oriented classification

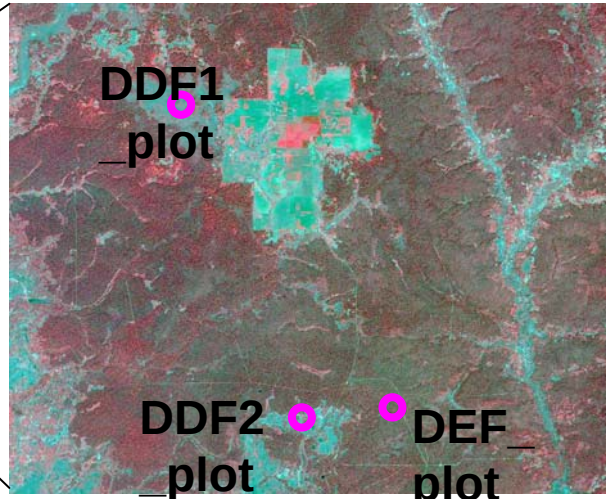
6 years - shifting cultivation distribution map



Monitoring of sifting cultivation for six years

Field survey for validation of remote sensing results in Cambodia

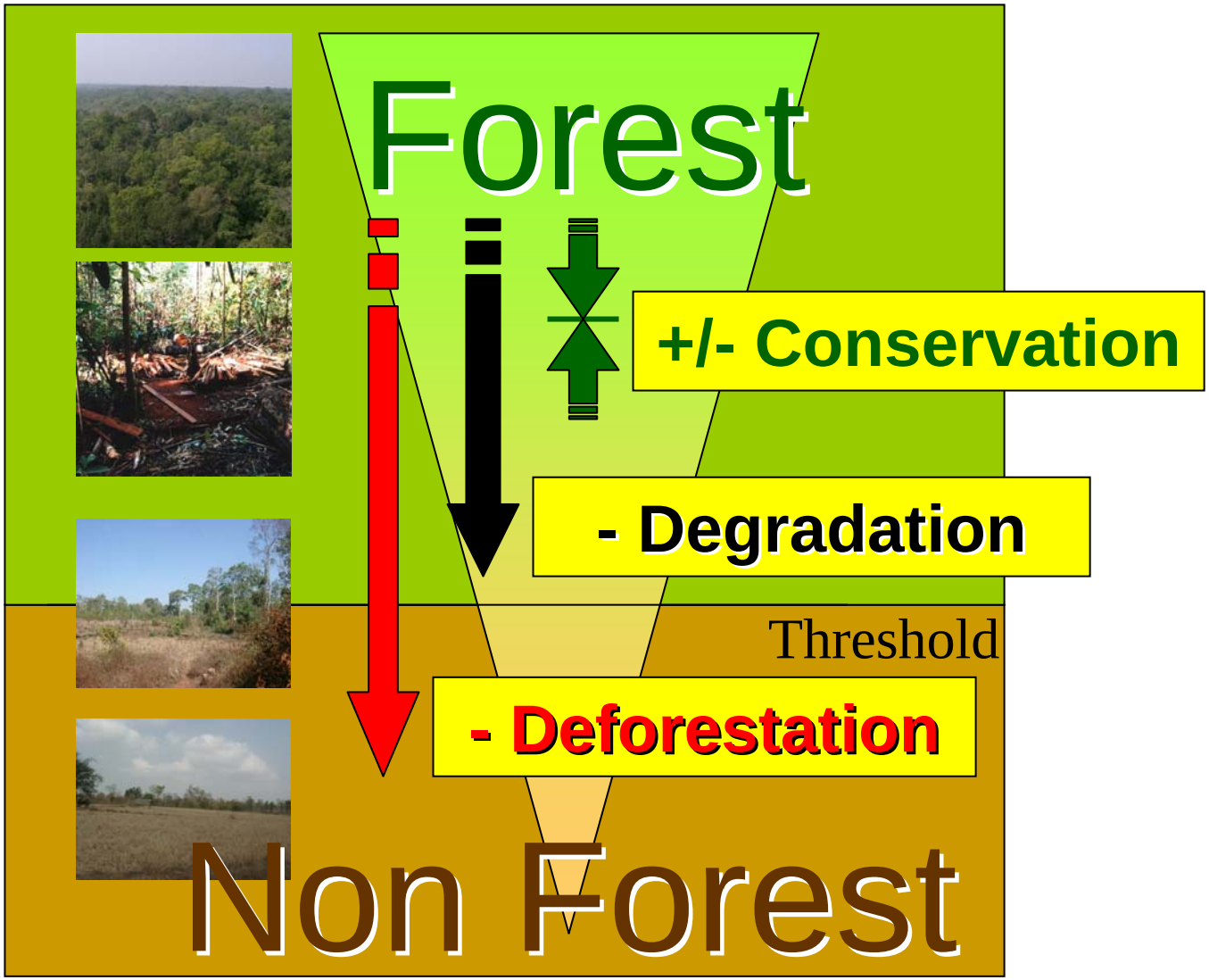




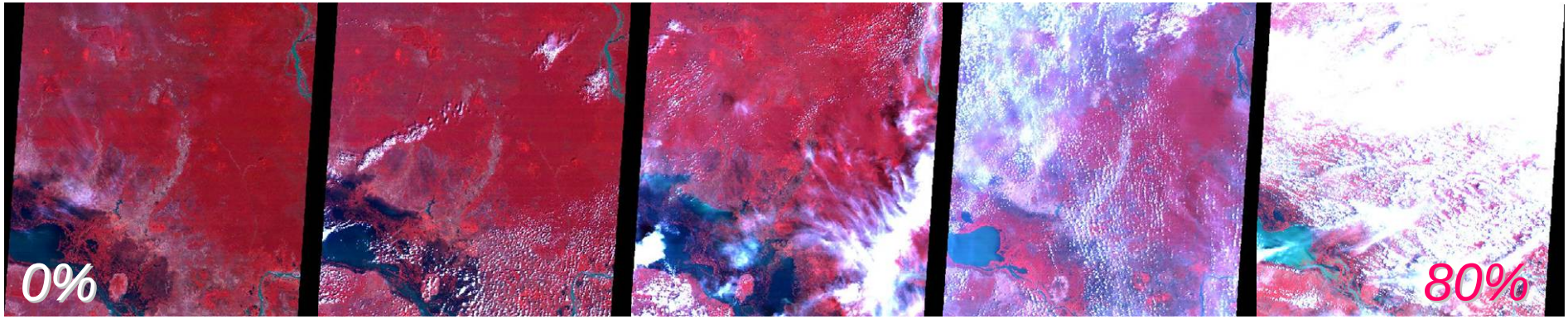
Capability of remote sensing for monitoring and SFM

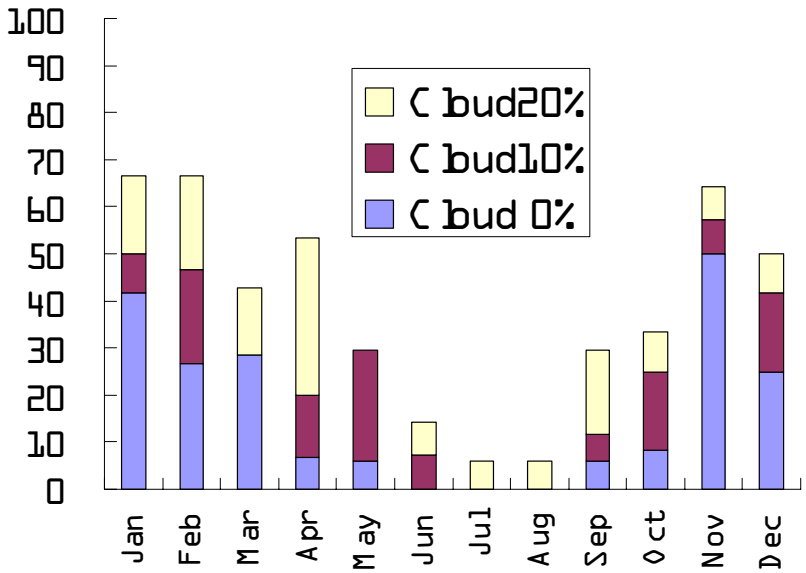
- Different definitions and difference between land use and land cover
- Limit of data acquisition of optical sensor
- Possibility and limit of SAR data
- Selection of method for change detection

Definitions of forest, non forest, conservation, degradation and deforestation



Cloud cover in optical sensor

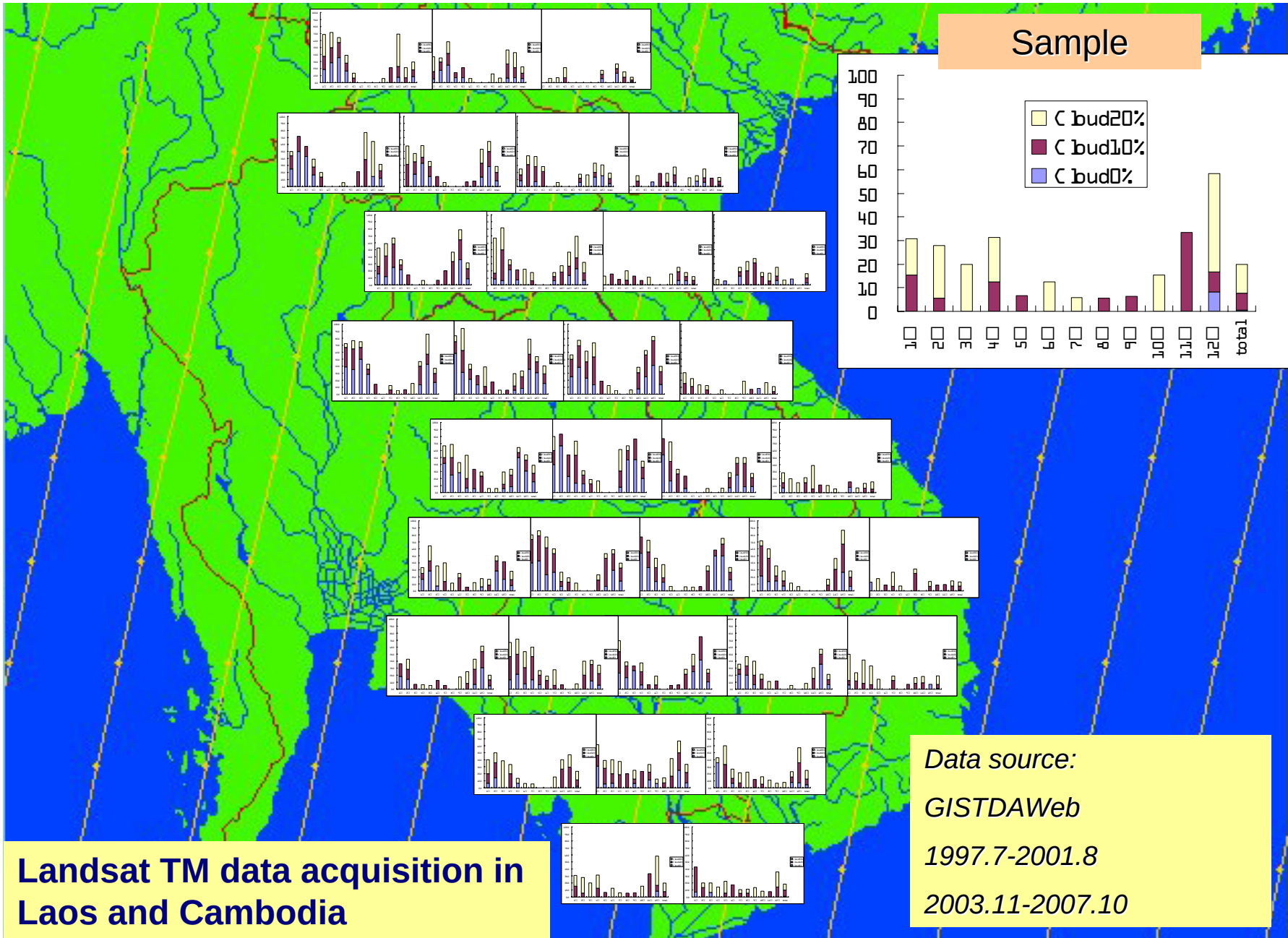




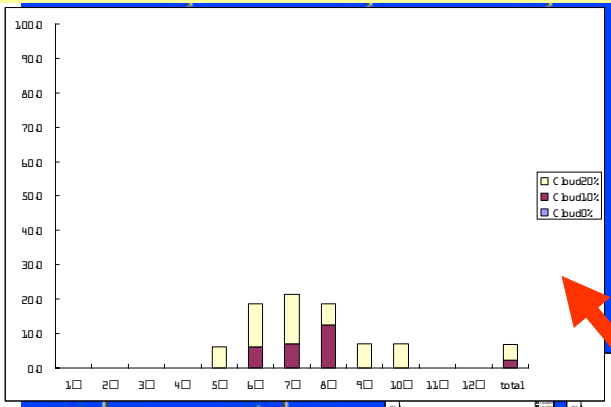
Rate of Acquisition

$$= \frac{\text{Frequency of certain cloud cover}}{\text{Frequency of data acquisition}}$$

Locality and seasonality of data acquisition



Landsat TM data acquisition in Borneo Island



Data source:

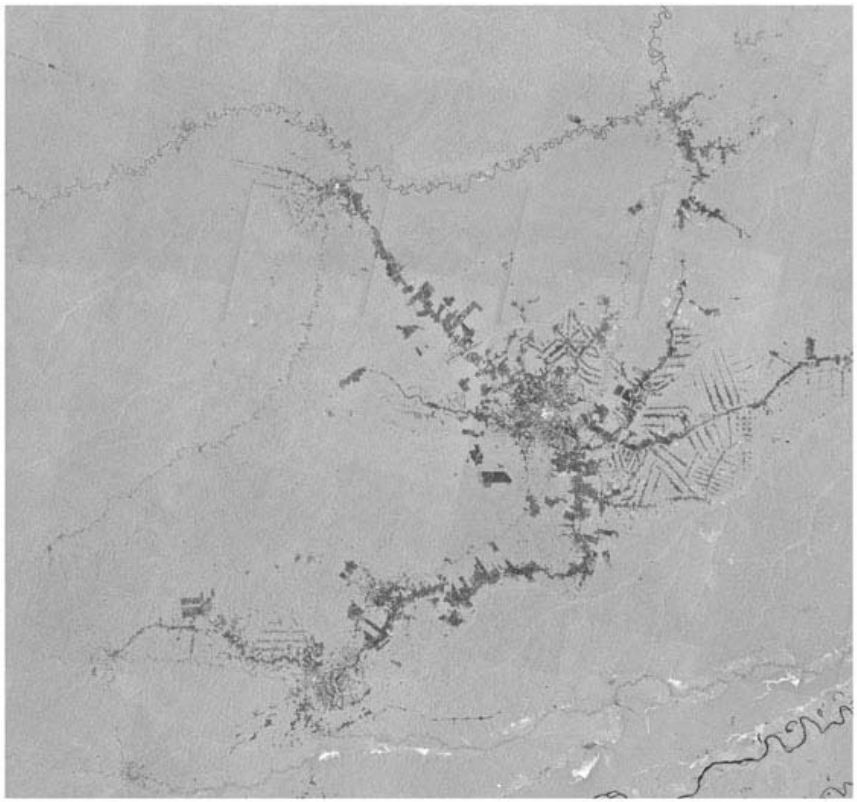
GISTDAWeb

1997.7-2001.8

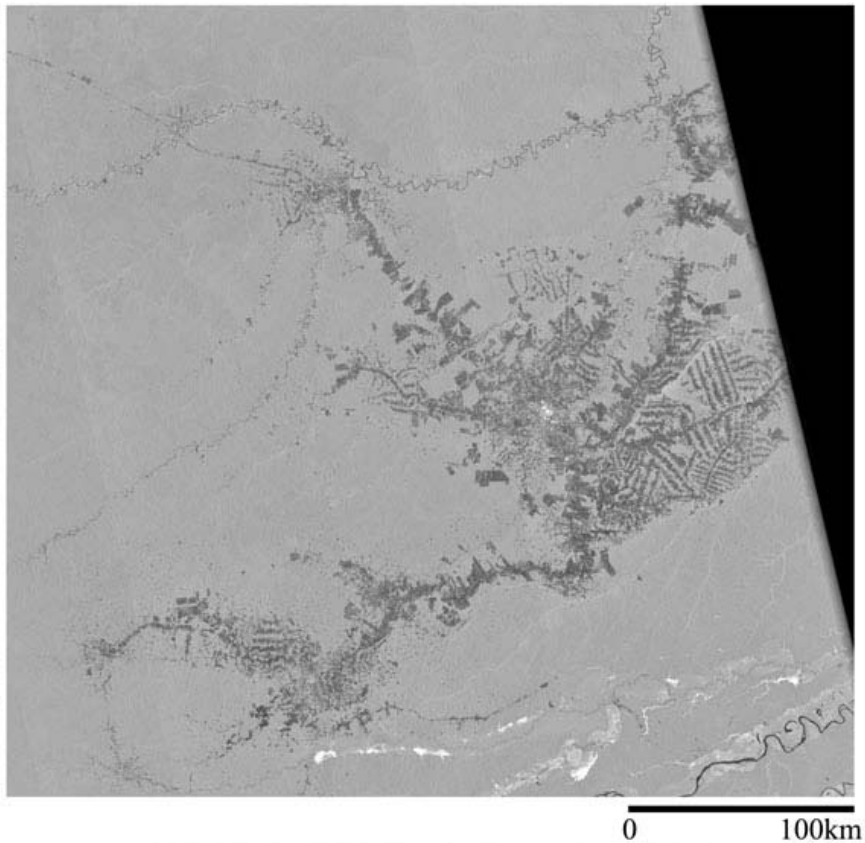
2003.11-2007.10

Change detection in Amazon using SAR images

Amazon mosaic(Rondonia area)



JERS (Sep/Dec, 1995, pixel spacing=100m)

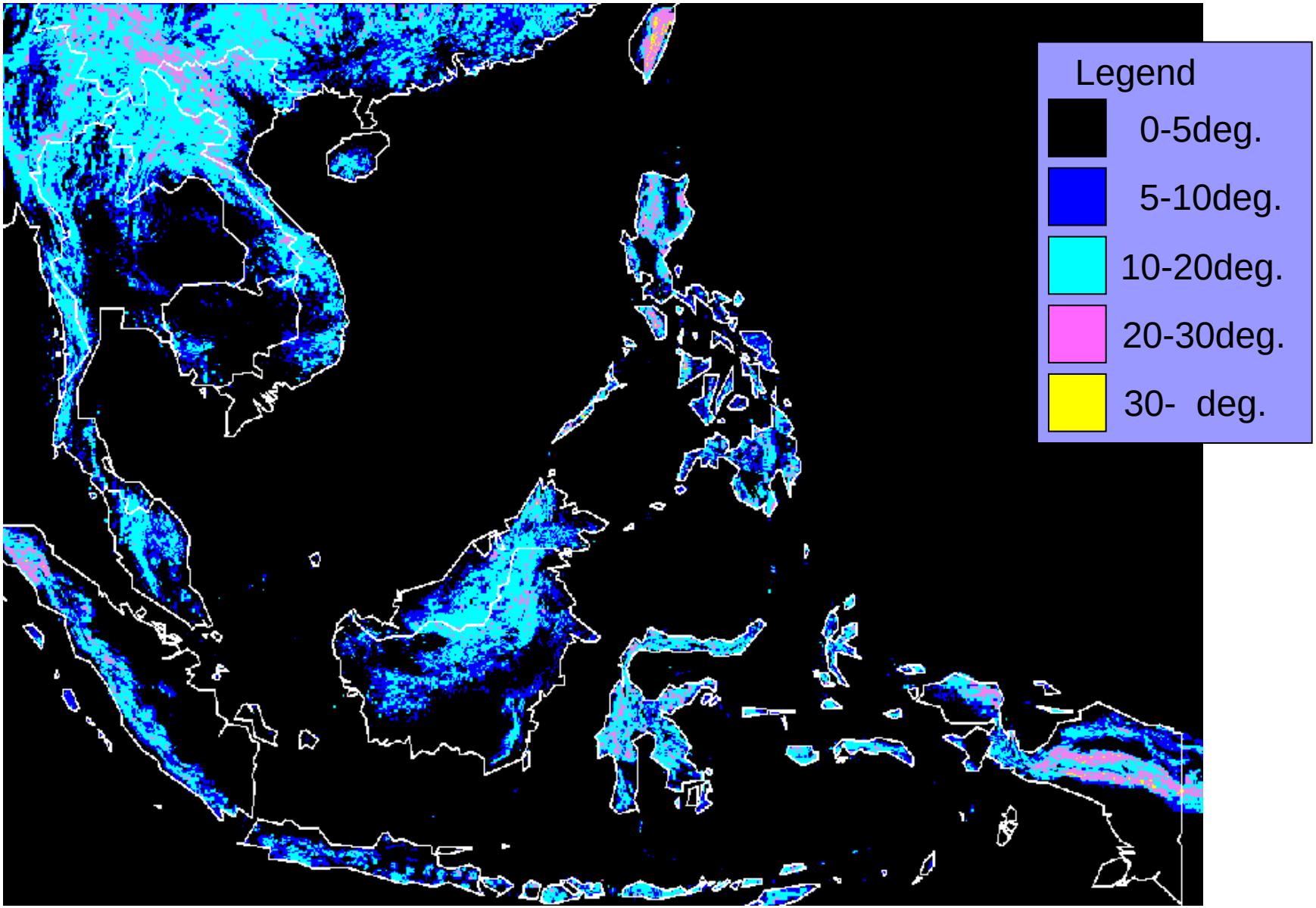


PALSAR (2006, pixel spacing=50m)

Mode : FBS41.5[deg]
Polarization : HH
Map projection : Mercator

JAXA Japan Aerospace Exploration Agency

Topography of Southeast Asia from Space Shuttle (SRTM-3)



Comparison of methods for change detection

Method	Advantage	Fault	Accuracy
Difference	Simple and good result	Change of land cover types is not identified	High
PCA using two scenes	Cutting are and plantations appear in certain PC	Results are influenced by seasonal changes of vegetation and land cover	Medium
Change Vector Analysis	Properties of changes are clarified	Analysis of change vectors is complicated	Medium
Comparison between classification results	Land cover types are clarified	Accuracy of classification is different between two scenes	Low

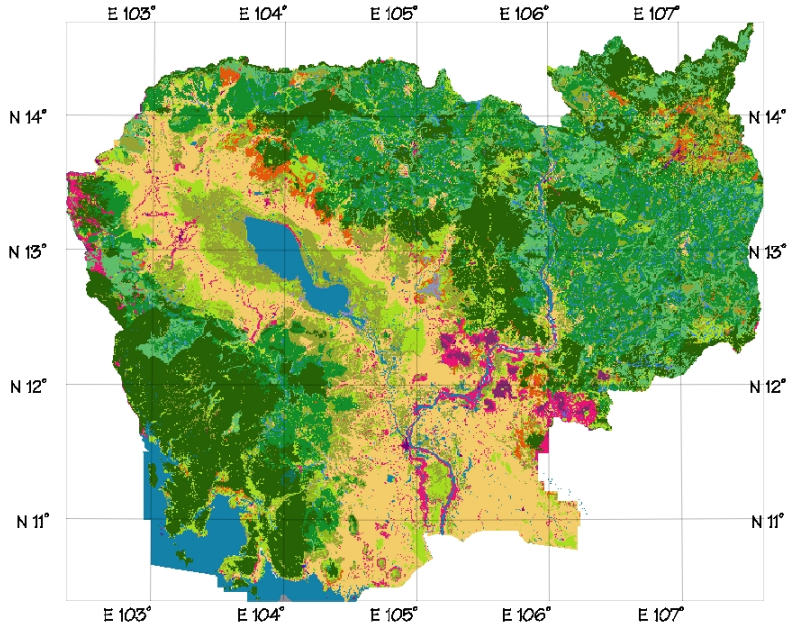
Remarks

- Monitoring with remote sensing has advantages and limits for various types of deforestation.
  - Forest fire, sifting cultivation,… ?
- The difficulty of creating baseline from complicated factors of deforestation
  - How to simplify it or other ideas?
- It is very important how to act after monitoring of deforestation.
  - Strategy, requirements….


Evergreen forest


Mixed forest


Deciduous forest



Any questions?

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Rubber Plantation


Shrub land


Grass land