



Potential of RS/GIS data for GHG inventory in forest sector

Forestry and Forest Products
Research Institute

Yasumsa Hirata

FFPRI

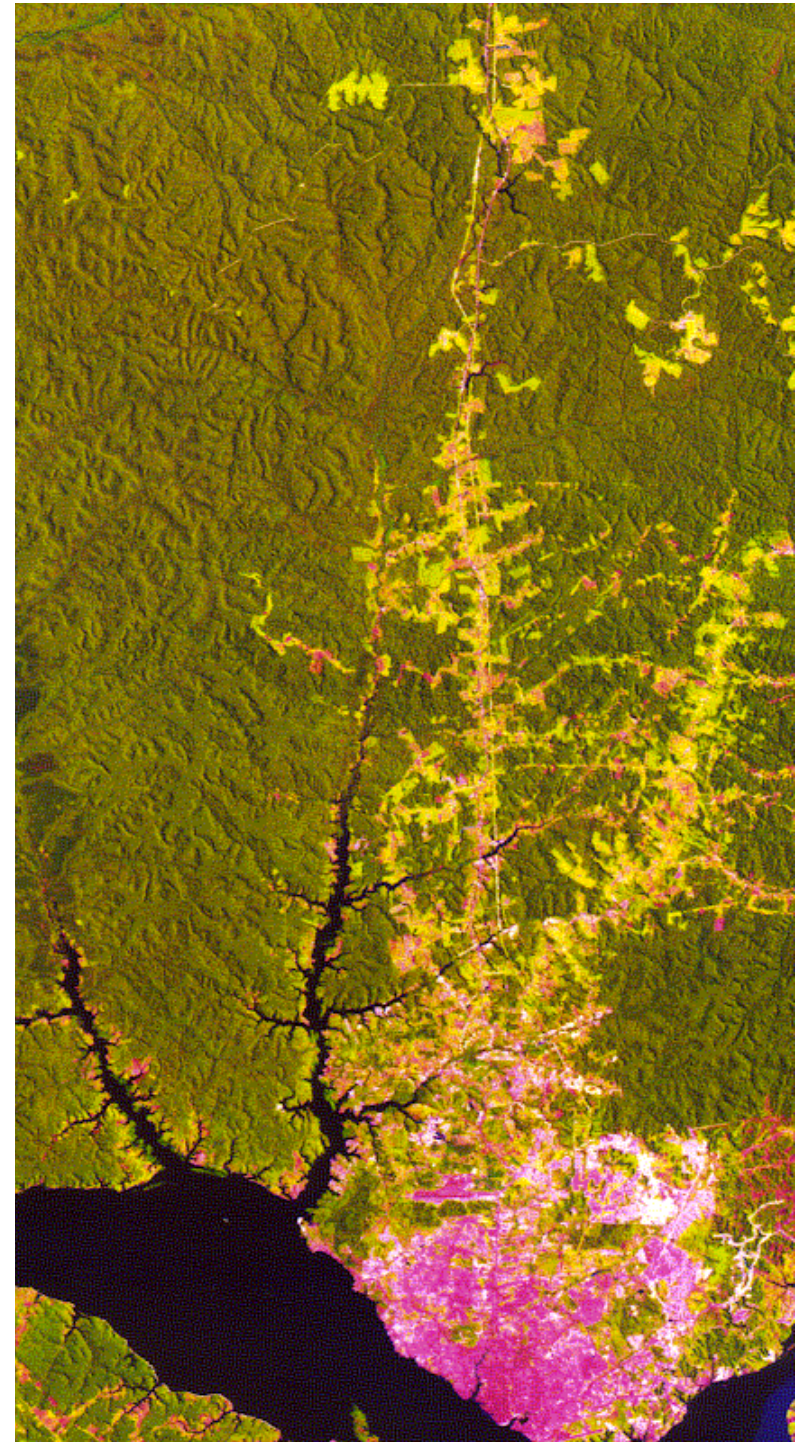




Forest monitoring using remote sensing

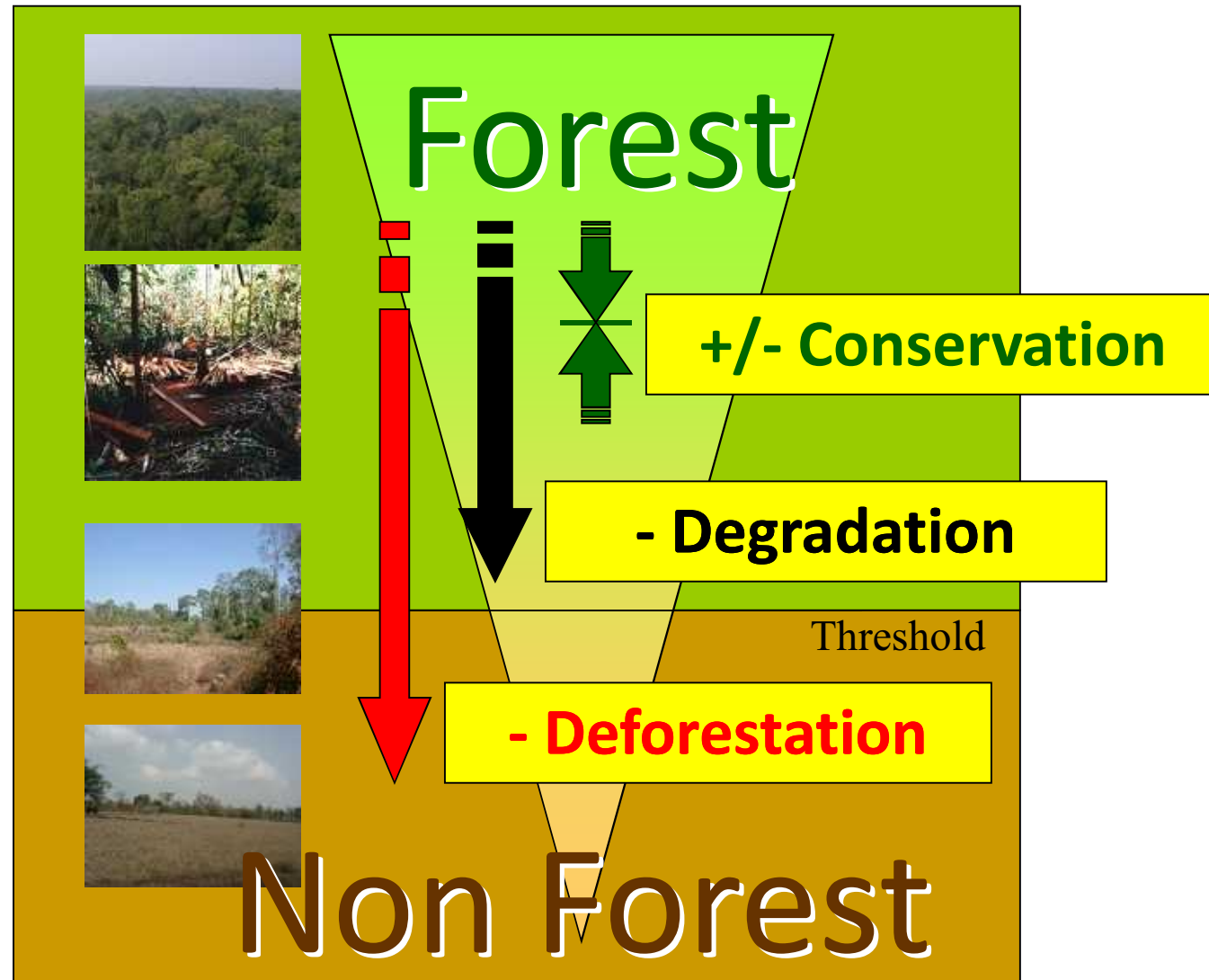
- Unique technique of forest monitoring widely and retrospectively.
- Essential tool to identify deforestation and forest degradation in developing countries

Satellite imagery in Manaus, Amazon





Gap between remote sensing and definitions of forest degradation and deforestation



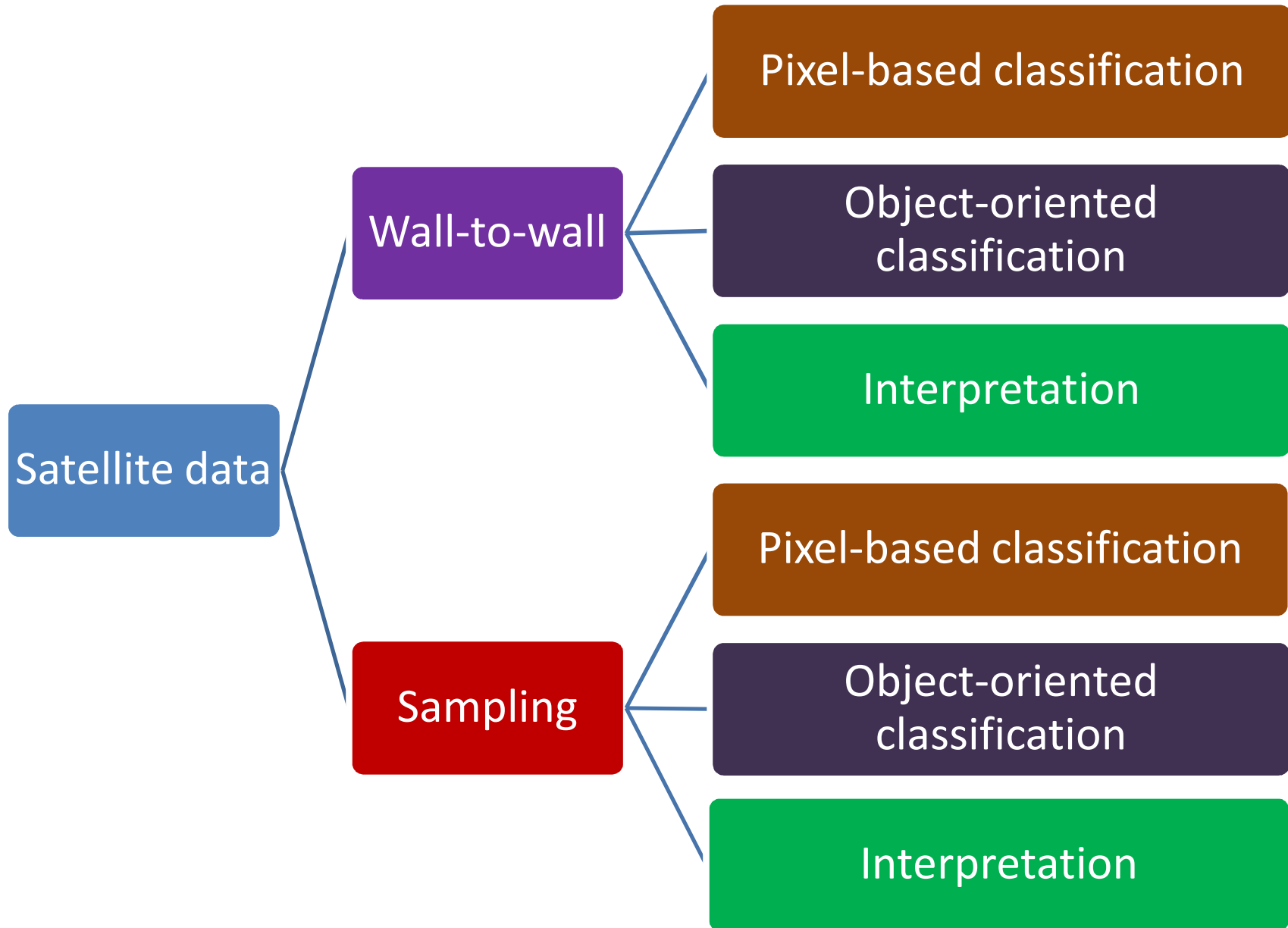
Draft decision -/CP.15

Methodological guidance for activities relating to reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries

1. (d) To establish, according to national circumstances and capabilities, robust and transparent national forest monitoring systems and, if appropriate, sub-national systems as part of national monitoring systems that:
 - (i) 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 changes;
 - (ii) Provide estimates that are transparent, consistent, as far as possible accurate, and that reduce uncertainties, taking into account national capabilities and capacities;
 - (iii) Are transparent and their results are available and suitable for review as agreed by the Conference of the Parties;

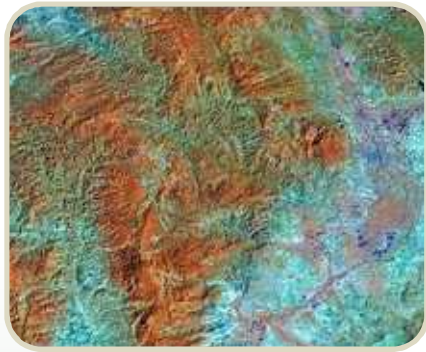


Monitoring of forests by remote sensing





Forest monitoring using satellite remote sensing



No leakage in the area.
Coat is large.
Difficulty of acquiring cloud-free data.
Applicability for local policy is large.



Satellite data

Wall-to-wall

Sampling

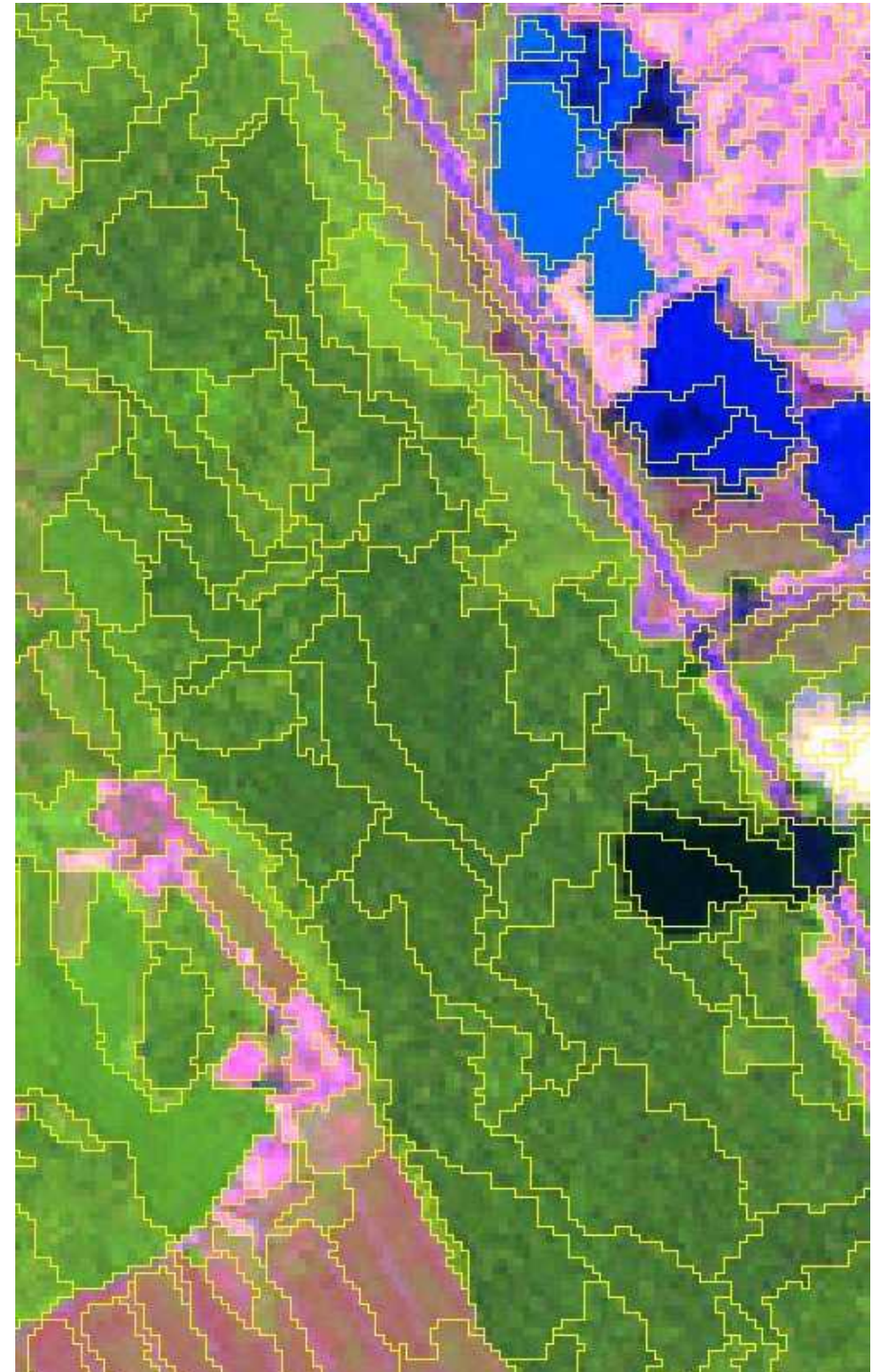
Accuracy for sampling rate.
Coat is effective.
Acquiring cloud-free data is relatively easy.
Applicability for local policy ?





Object-oriented classification

- The object-oriented approach is effective in segmenting an area that consists of various land cover types into objects with extensions of similar properties (Lamonaca et al. 2008).
- Classification results that is similar to human interpretation
- Advantage of handling by object (segment)





The challenges of forest monitoring

Deforestation (Area)

Forest vs. Non-forest

Deforestation (Carbon stock)

Classification of forest types

Degradation

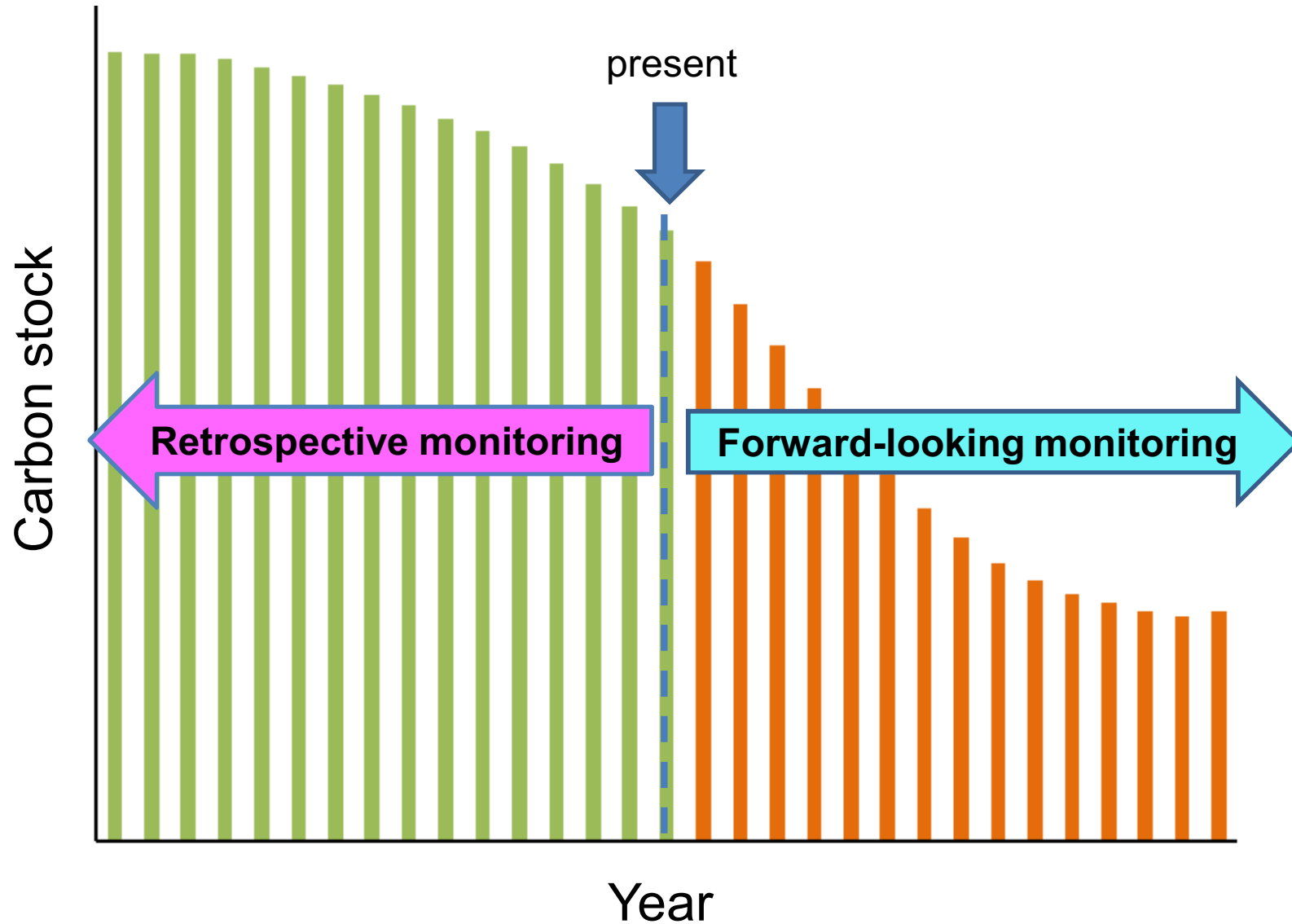
Incremental change

Crown extraction by high resolution satellite

More challenging !



Two types of forest monitoring required for REDD

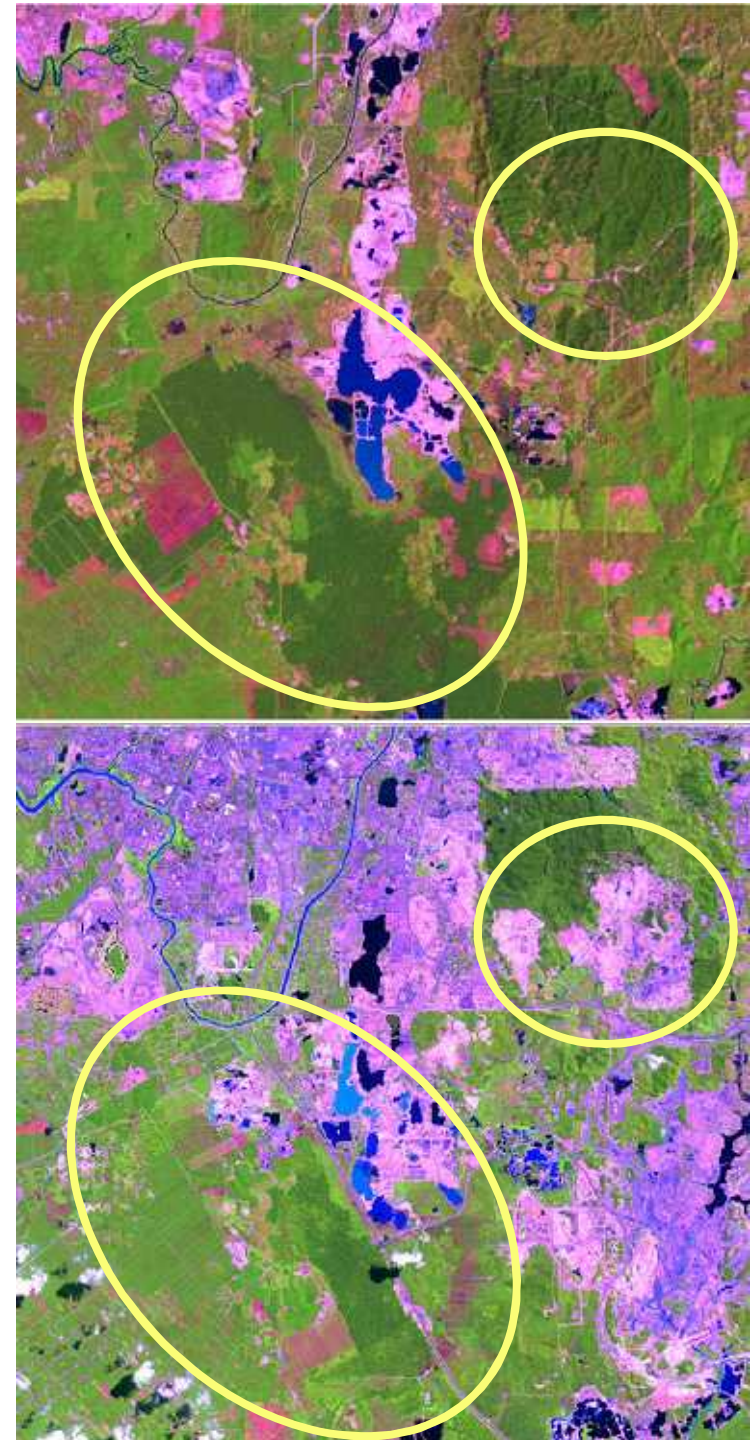




Monitoring of deforestation

- Extracting changes of land use category
- Using properties of reflectance of each category
- Comparing multi-temporal
- Available to identify forest type change

Deforestation in Malaysia
Landsat imagery
Upper 1989 yr, lower 2001 yr






You can get Landsat data from USGS free


1. Select your dataset(s)

Click on next to the category name to show a list of datasets.

 Icon means selected data within the Data Sets can be downloaded at no charge.

- Aerial Photography
- AVHRR
- Cal/Val Reference Sites
- Commercial
- Declassified Data
- Digital Elevation [\(Related Links\)](#)
- Digital Line Graphs [\(Related Links\)](#)
- Digital Maps [\(Related Links\)](#)
- EO-1
- Forest Carbon Sites
- Global Land Survey
- Land Cover
- Landsat Archive [\(Related Links\)](#)
- Landsat Legacy
- Landsat MRLC
- Radar

Selected Datasets

 None Selected

2. Enter your search criteria

Address/Place Name/ Zip Code Search:

From (mm/dd/yyyy):



To (mm/dd/yyyy):



Search these months only.

3. Search >>>



[Help](#) [Hide Map](#) [Clear My Area Selection](#) [Add Map to Selection](#)

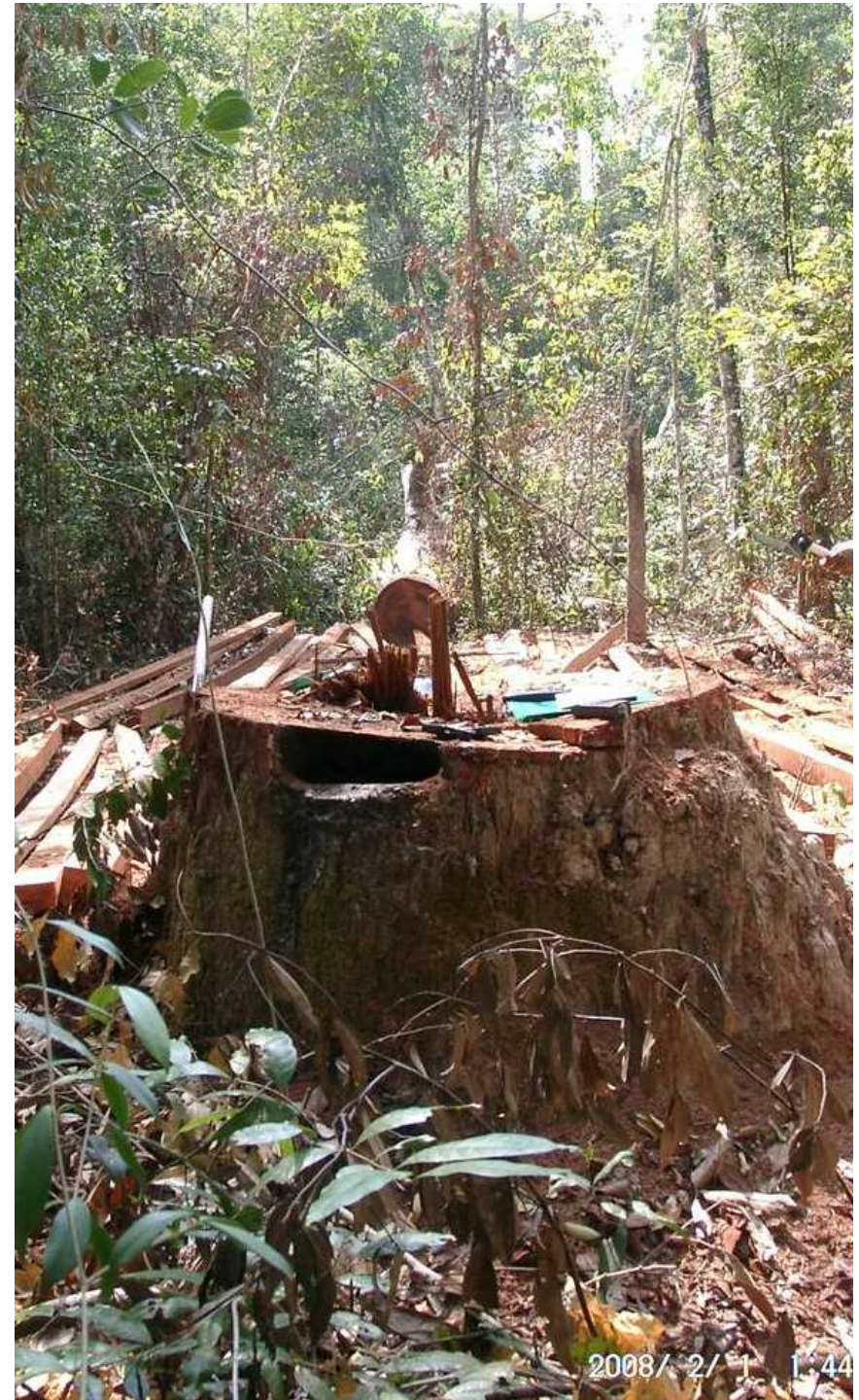
The up to date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

Area Selected



Monitoring of forest degradation

- Various causes of degradation
 - Selective (illegal) logging
 - Forest fire
 - Intensive shifting cultivation
 - development
- Development of method as to each cause of degradation is required





Which method should be selected?



Conventional Remote Sensing

Field Survey

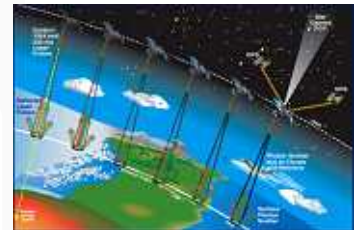
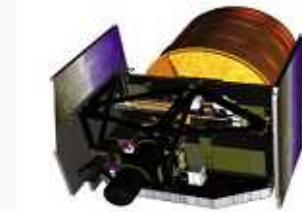
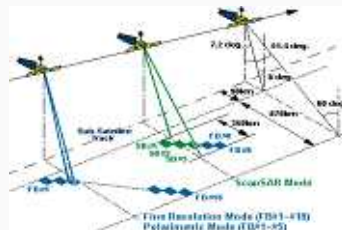
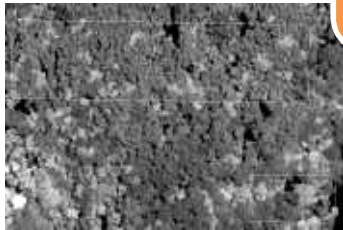


VHR satellite



SAR

LiDAR



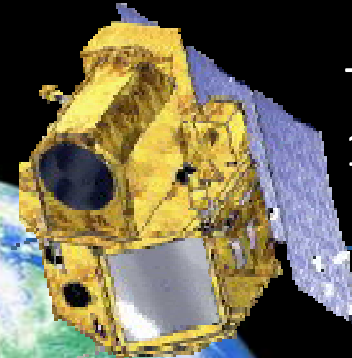
Keeping sharp eyes out for the Earth



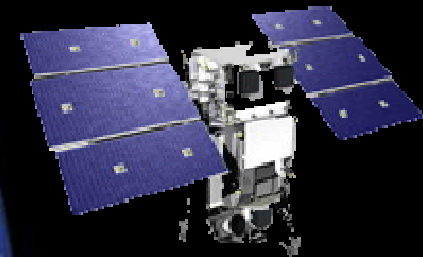
IKONOS – 0.82m
9. 1999



THEOS – 2.5m
10. 2008



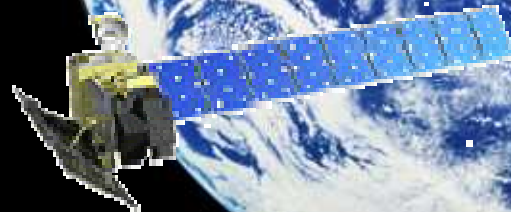
QuickBird - 0.61m
10. 2001



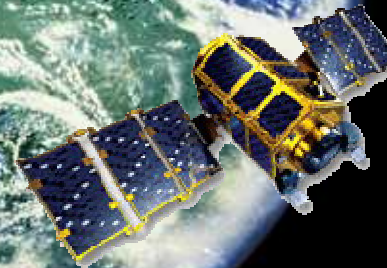
WorldView– 0.5m
9. 2007



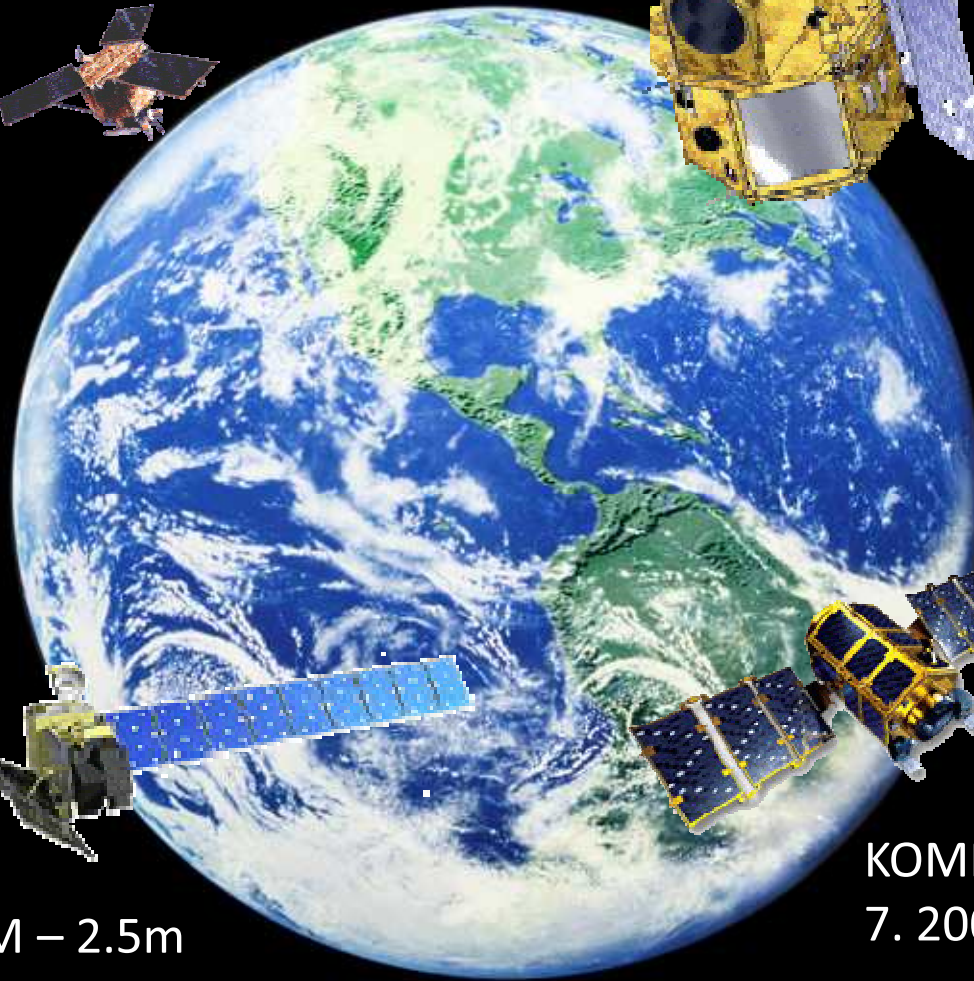
SPOT-5 – 2.5m
5. 2002



ALOS PRISM – 2.5m
1. 2006



KOMPSAT– 1.0m
7. 2006

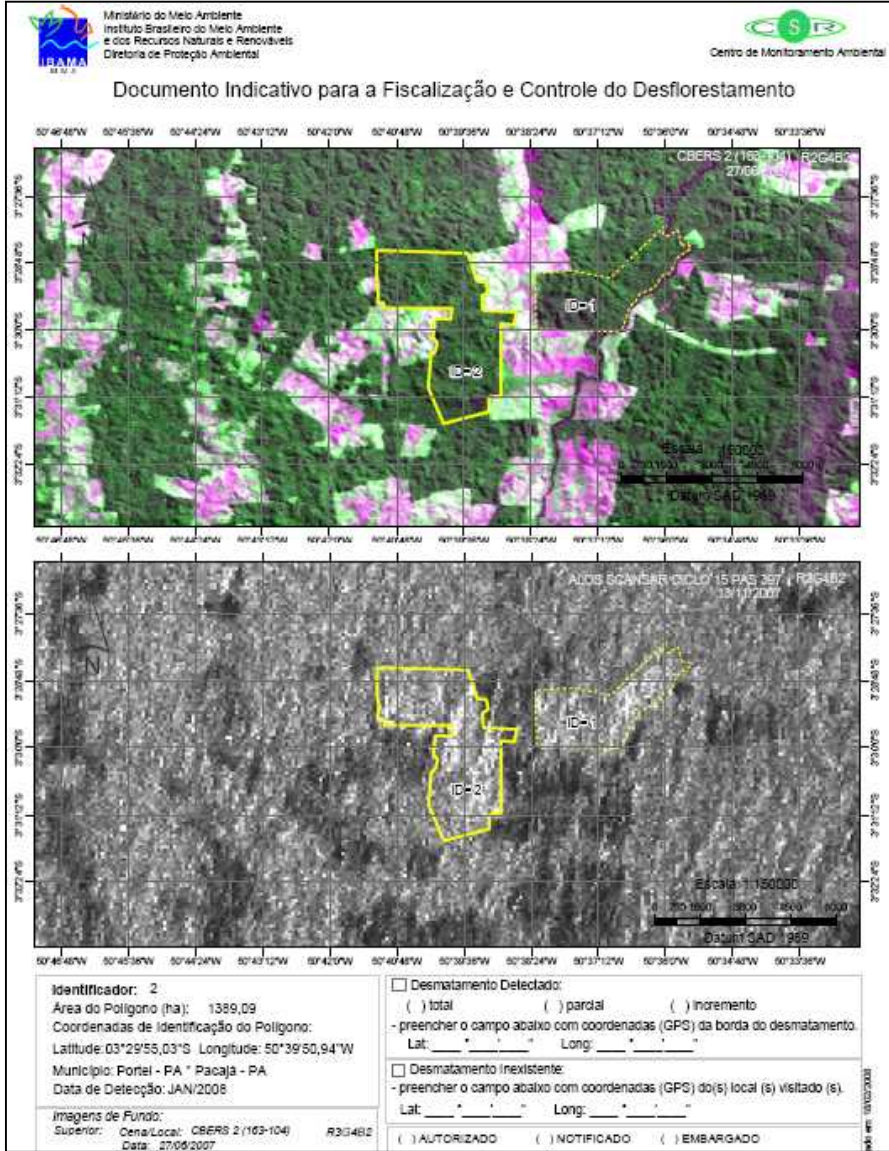




Another Choice: Google Earth



Detection of illegal deforestation using ALOS-PALSAR





Observation



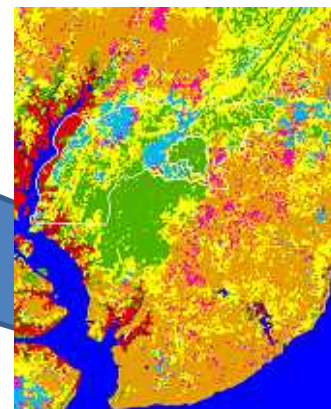
Sensor

Transformation



Data

Analysis



Thematic map

Use

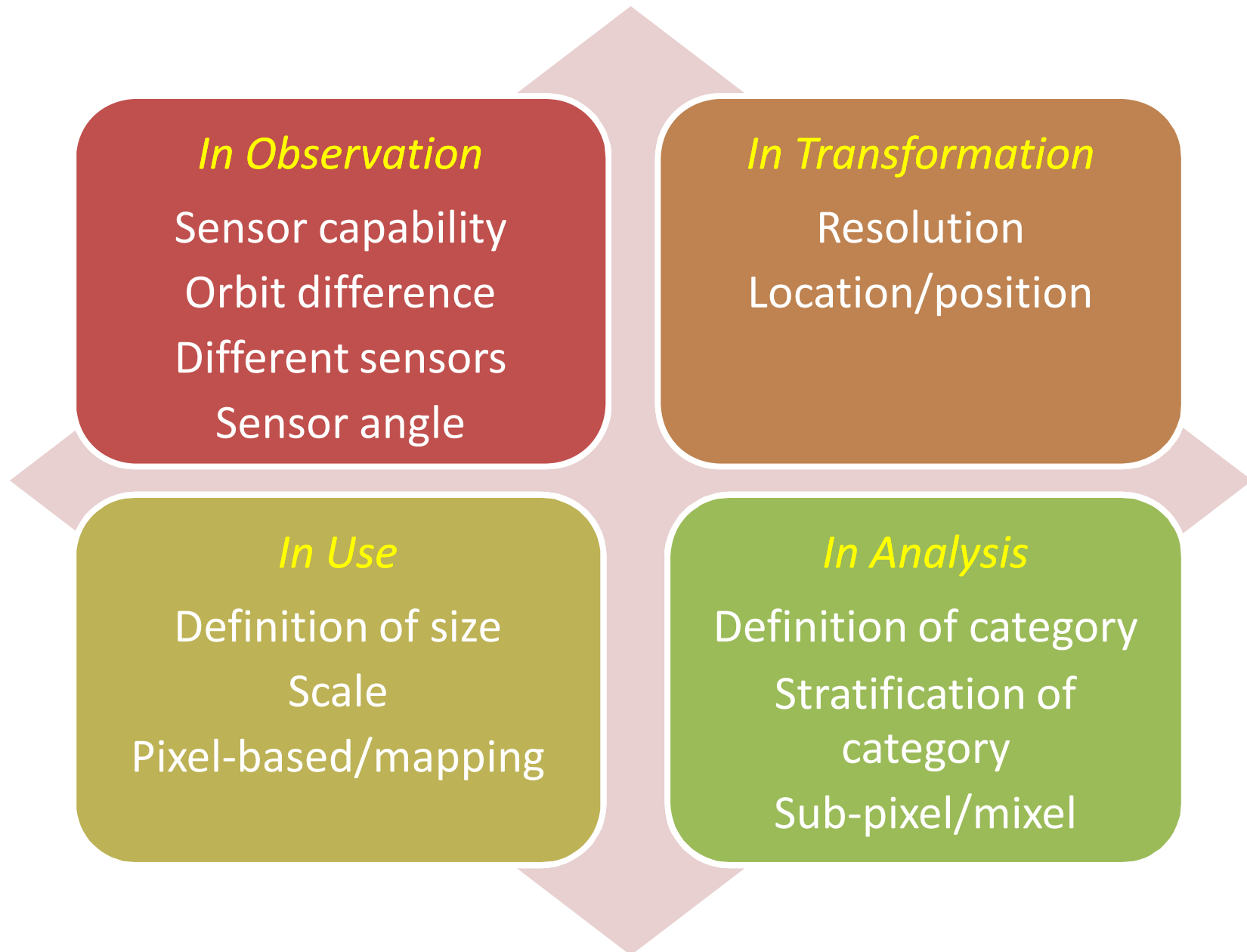


Real World

Sources of uncertainty in various steps



Uncertainty in various steps





Uncertainty in definition

- for category or class of classification -

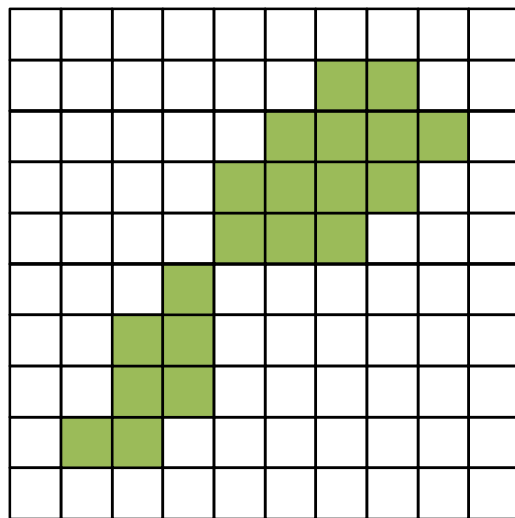
- Some land surface cannot be assigned to a certain category
- Gap between definition of category and remote sensing observation



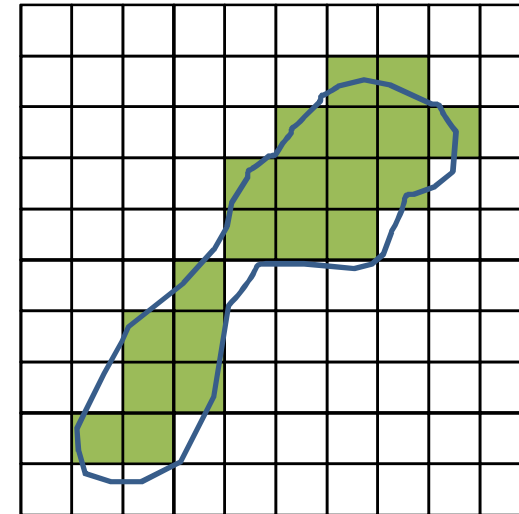
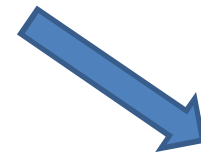
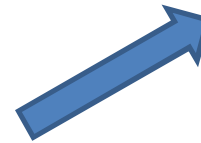


Uncertainty about definition - minimal size and continuity -

Continuity or discontinuity?

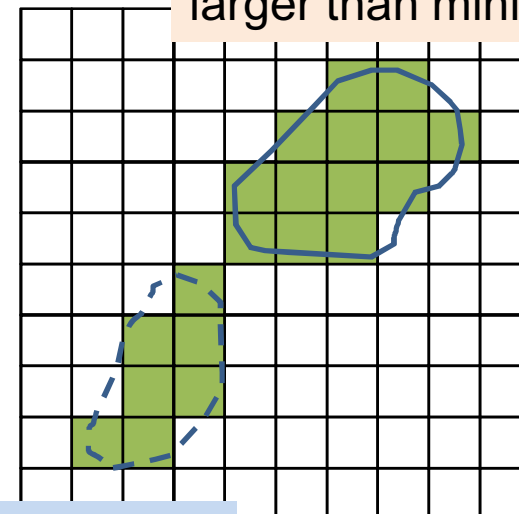


Area: 20 pixel unit



About 20 pixel unit

larger than minimal size



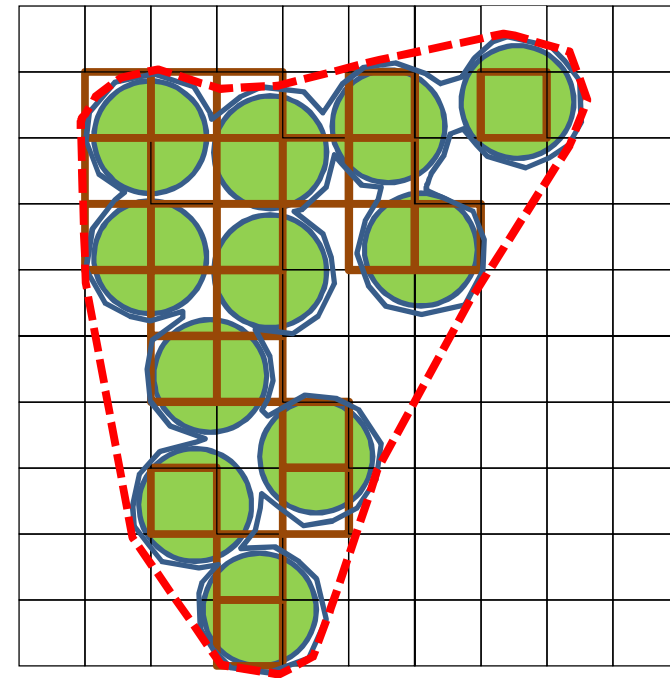
Smaller than minimal size

About 13 pixel unit



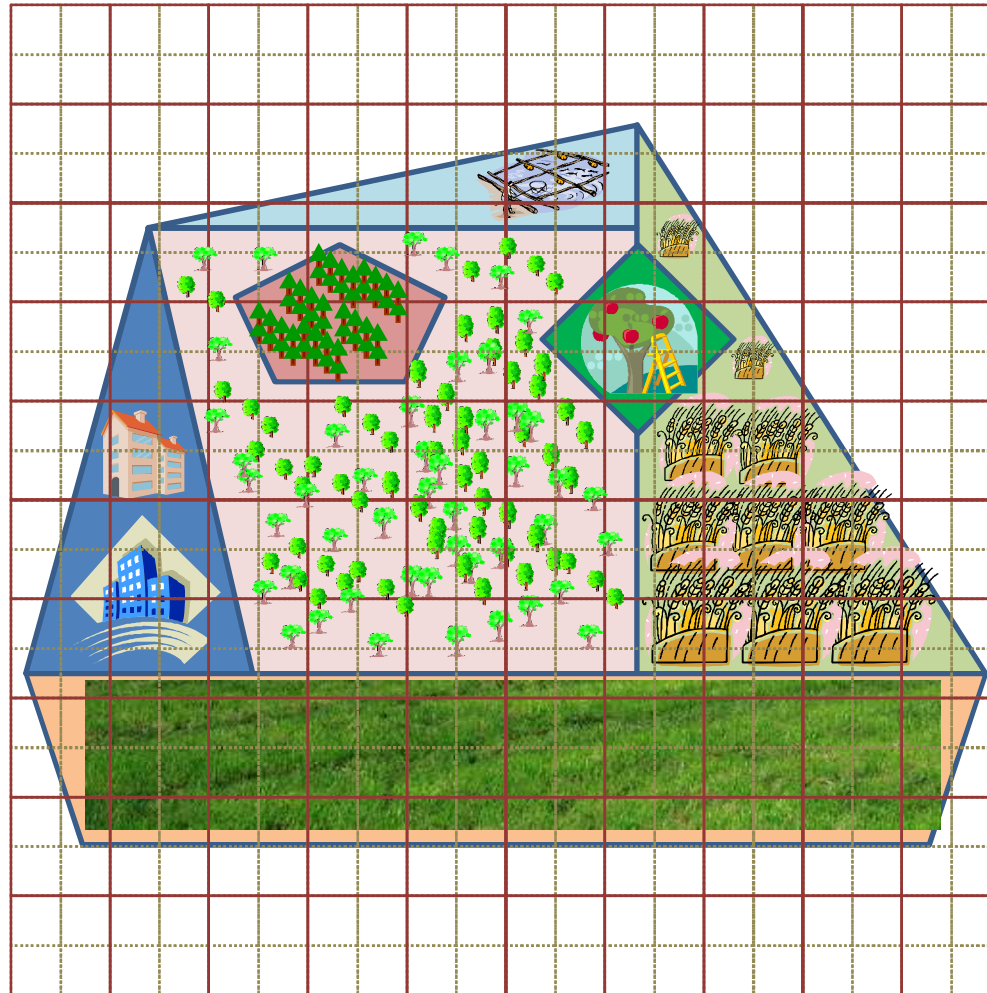
Uncertainty of boundary

- Boundary cannot be decided certainly
- Rule of recognition is required
- Effect on area estimate of category





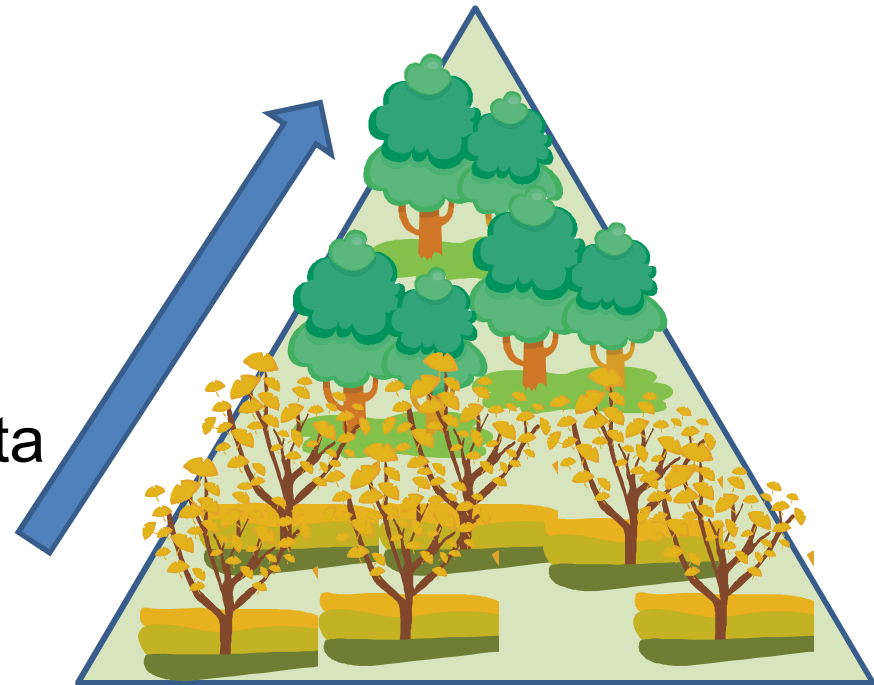
Further issues: Spatial resolution and mixel





Further issues: Phenology or seasonality

- Elevation
- Latitude
- Annual change of fallen leaves
- Probability of acquiring data



Dryness (in tropical seasonal forest)



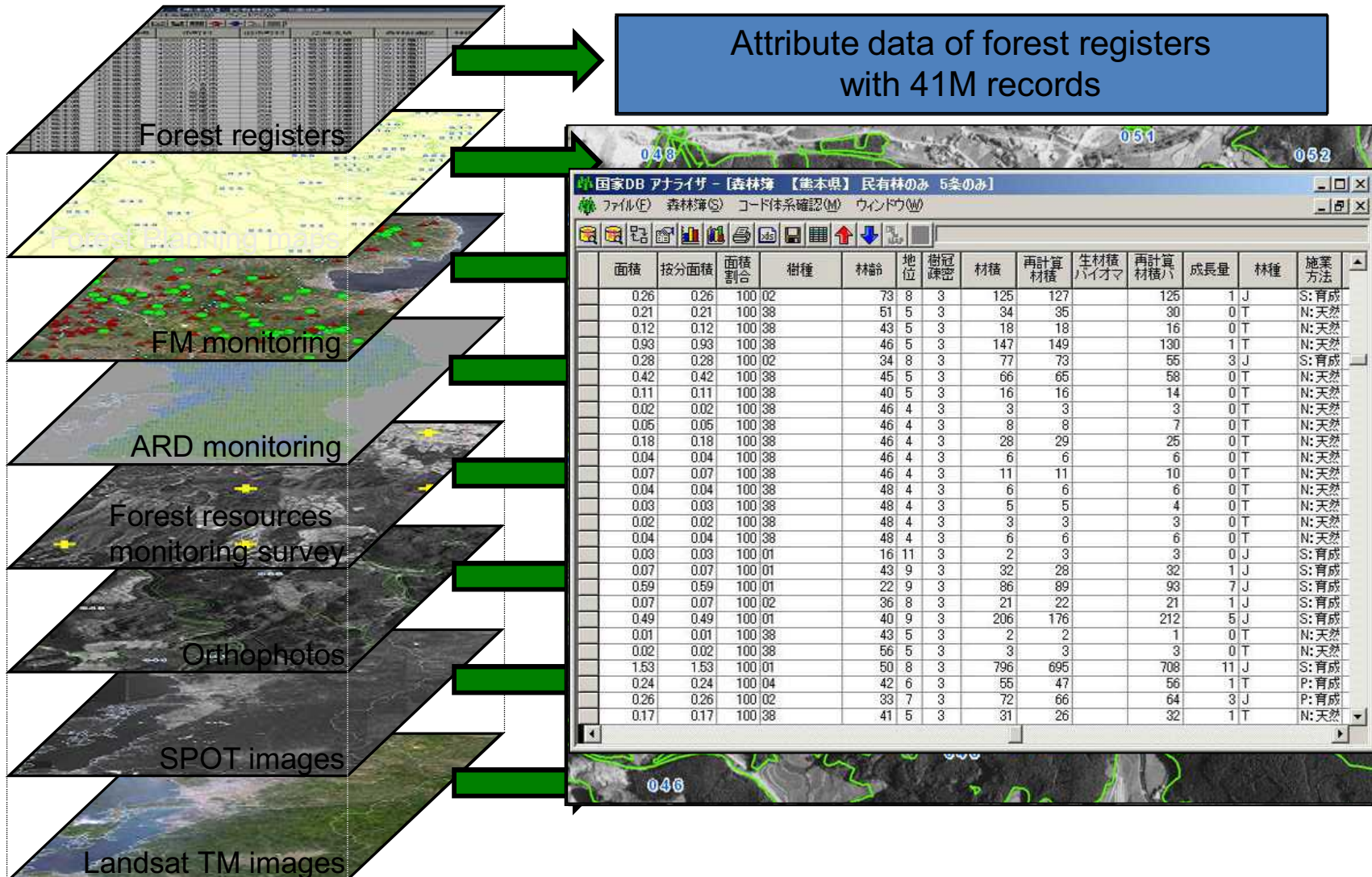
Further issues: Agricultural land with trees

- Rubber plantation vs. plantation for timber production
- Shifting cultivation
 - Fallow land vs. abandoned area?
- Orchard vs. forest
- Similar reflectance of canopy surface





Japanese National Forest Resources Database for forest inventory



FFPRI