



25-27 June 2008, UNFCCC REDD Workshop in Tokyo



Monitoring of deforestation and forest degradation using remote sensing techniques for REDD policy implementation

Forestry and Forest Products Research Institute

Yasumasa Hirata

Outlines

- **Forest monitoring using remote sensing**
- **Forest degradation in developing countries**
- **New remote sensing technologies**
- **Technical issues**
- **Conclusions**

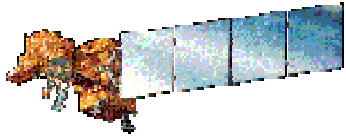


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Forest monitoring using satellite remote sensing



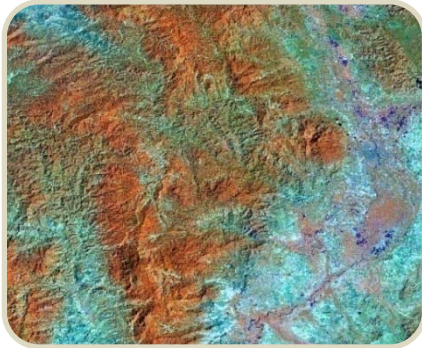
No leakage in the area.
 Coat is large.
 Difficulty of acquiring cloud-free data.
 Applicability for local policy is large.



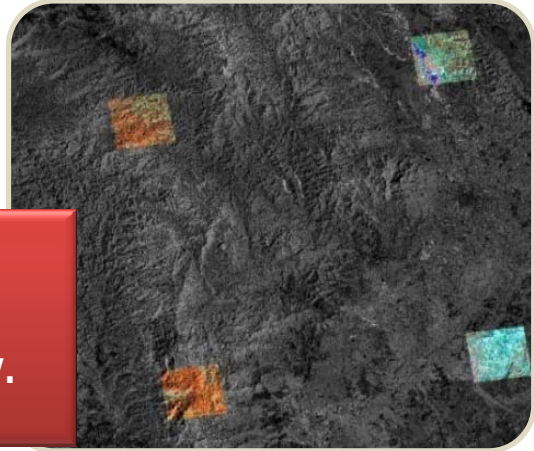
Satellite data

Wall-to-wall

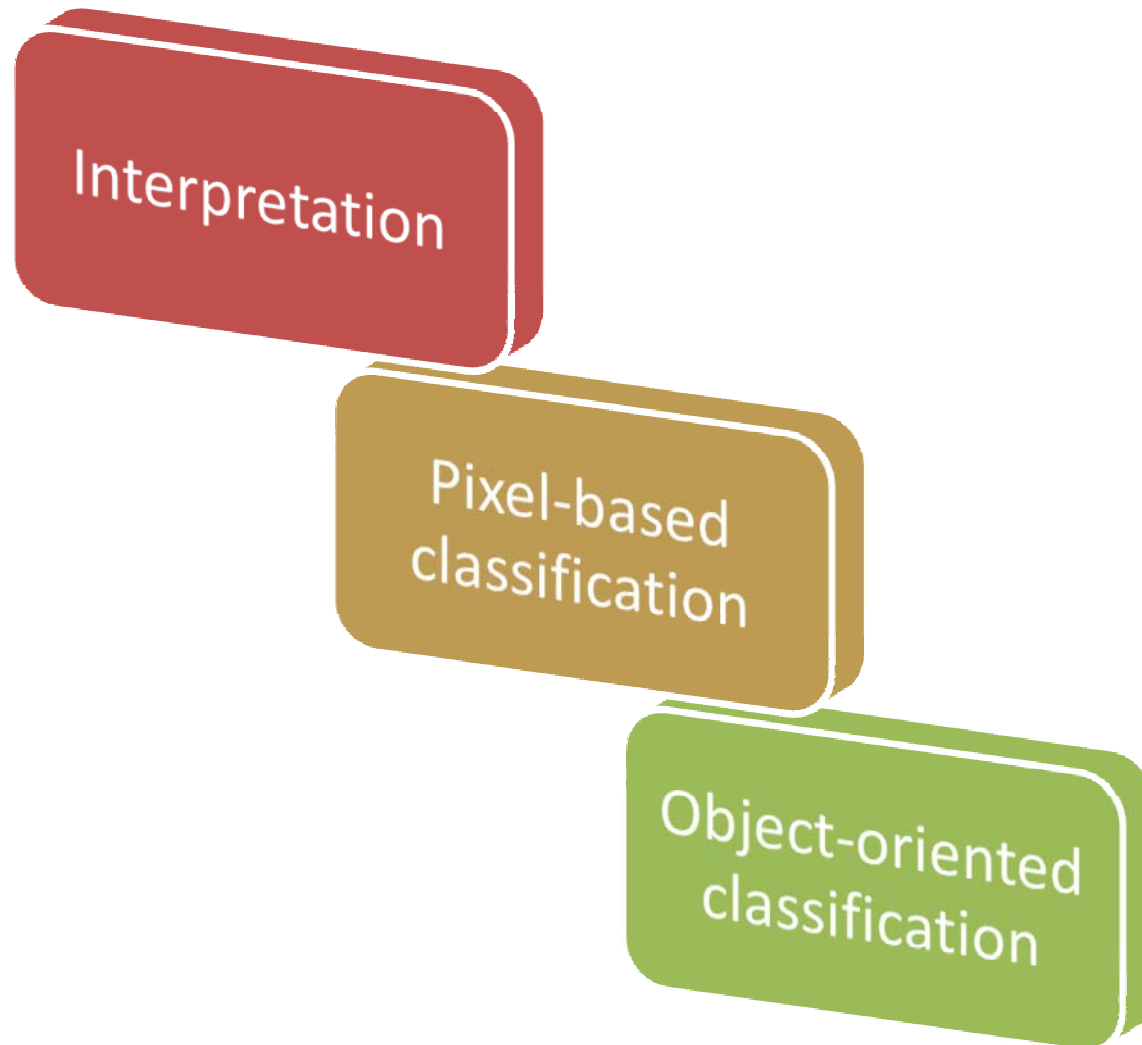
Sampling



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

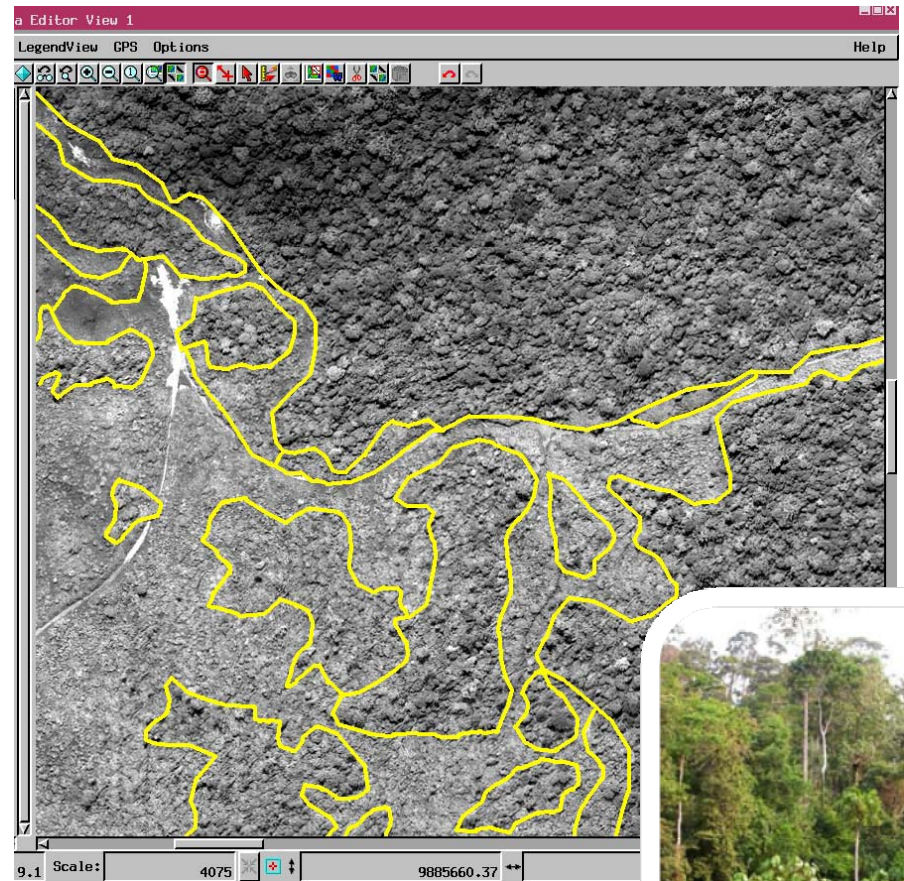


Understanding of land-cover from remotely sensed data



Interpretation of satellite images

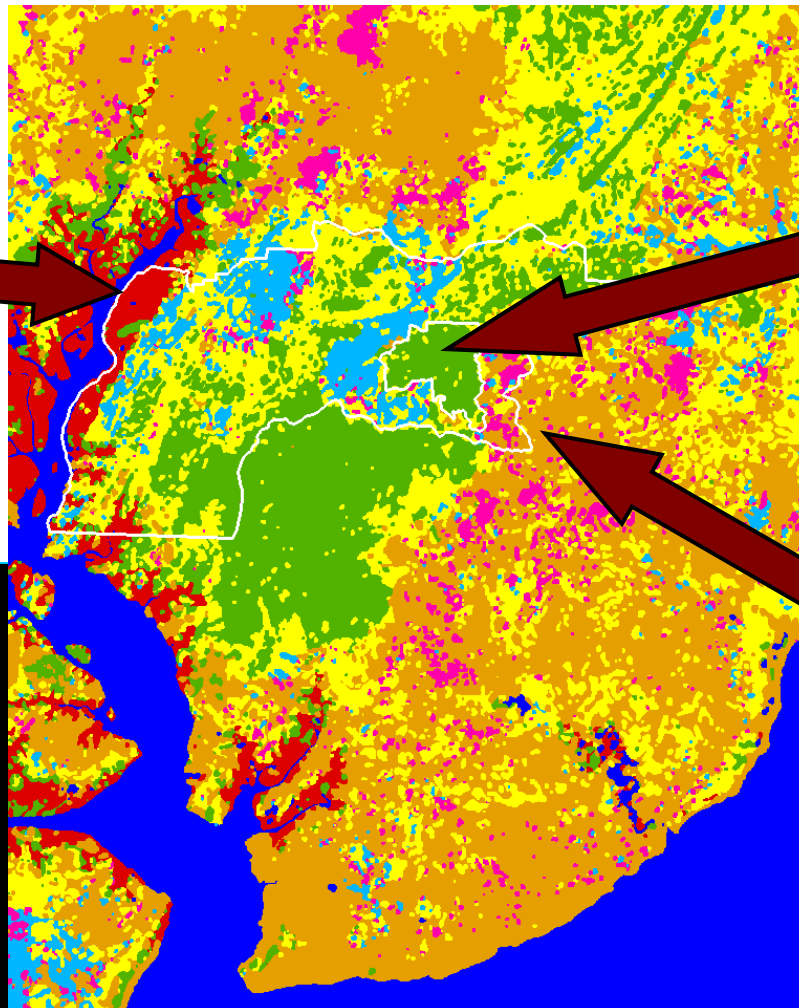
- Appropriate segmentation of ambiguous domain
- Requirement of interpretation technique
- Different outcomes by interpreter



Pixel-based classification



Mangrove forest



Natural forest

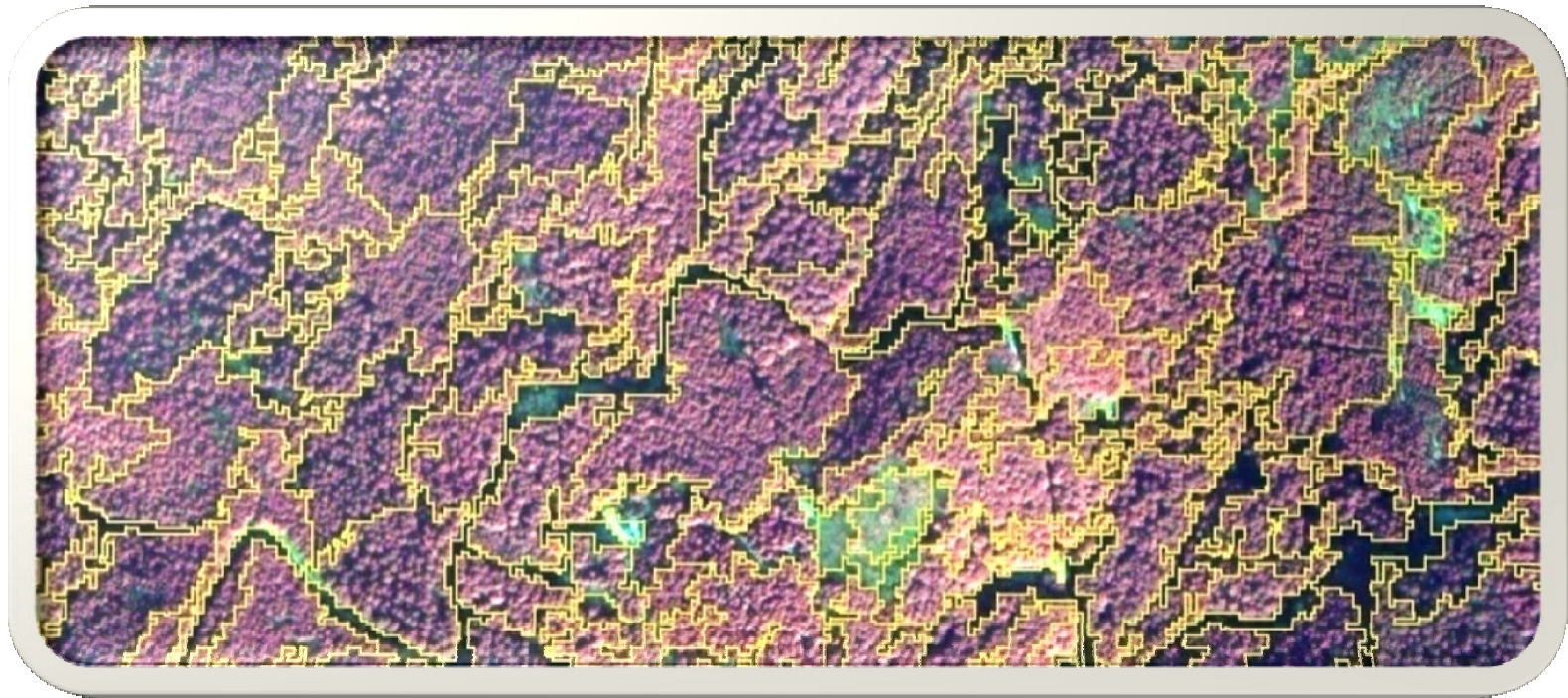


Agricultural land



Object-oriented classification

- Classification results that is similar to human interpretation
- Advantage of handling by object (segment)



Field survey and Database

Importance of ground-based data
Necessity of geo-reference for the



Field Survey at the point of Tr04



Hemispherical photo at Tr04



Site Description

Coordinates 489757E 9887762N

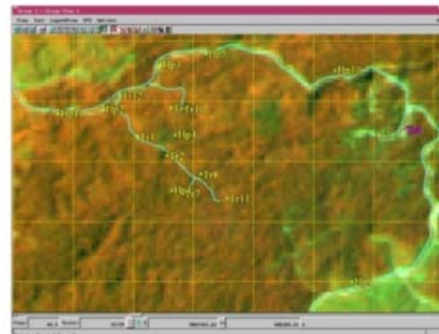
UTM Datum: Indonesian 1974 Zone: 50 South

Basal Area: 12(4) m²

Highest tree: 26.8 m

Number of Dead trees (within 10 m): 7

LAI: 0.492



The position of Tr04 on the satellite map



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 !

Role of forest monitoring using remote sensing

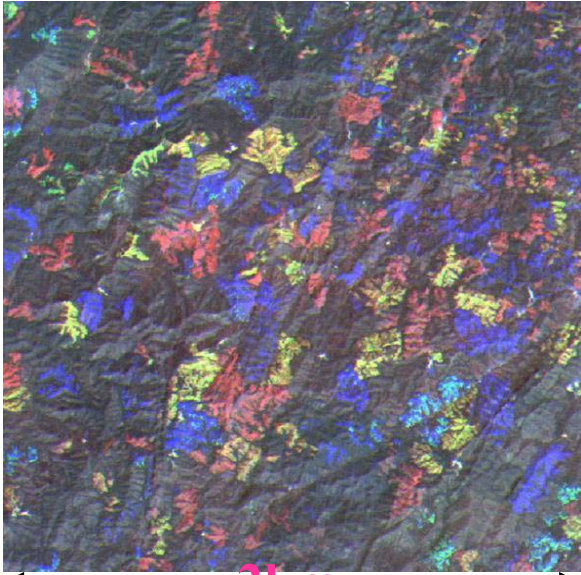
- **For clarifying historic trend of forest change**
- **For planning and implementing certain actions after assessment of forest change**

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Shifting cultivation

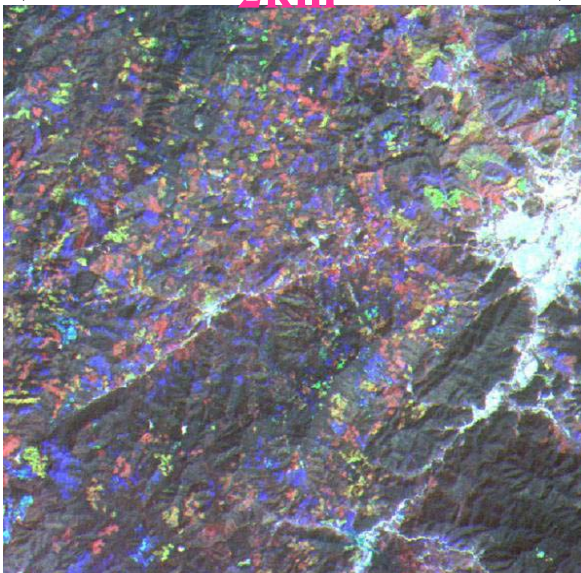


2km



Remote area (whole mountain or overall slope (30-100 ha))

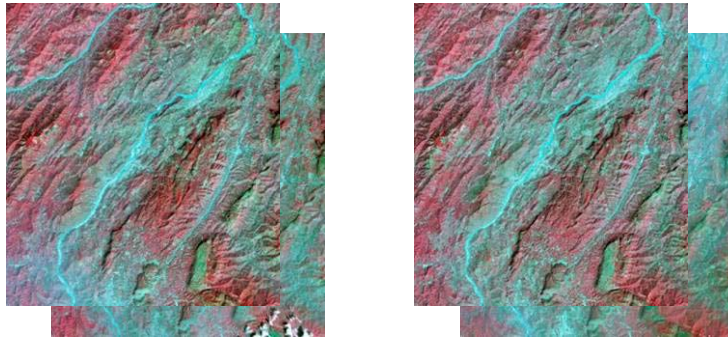
Shortening of rotation and enlargement of cultivation area



Urban forest area (ownership is clear and patch distribution, 0.5-1.5 ha)

Conversion to rubber plantation after shifting cultivation

Monitoring of shifting cultivation by ASTER images

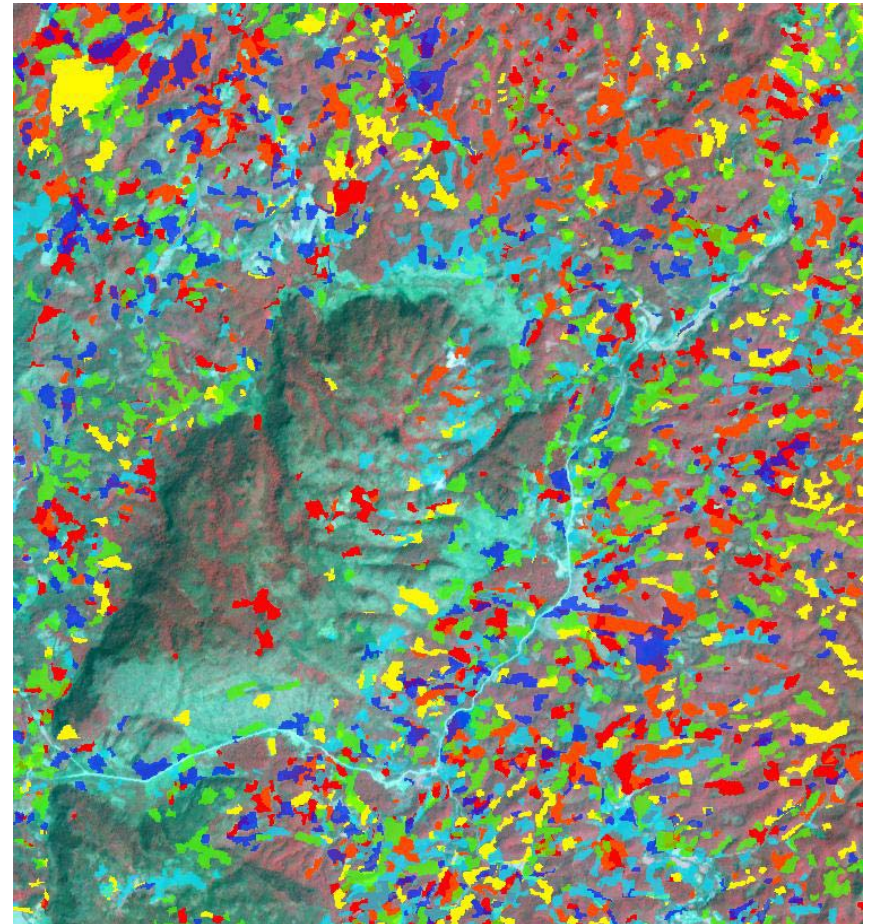
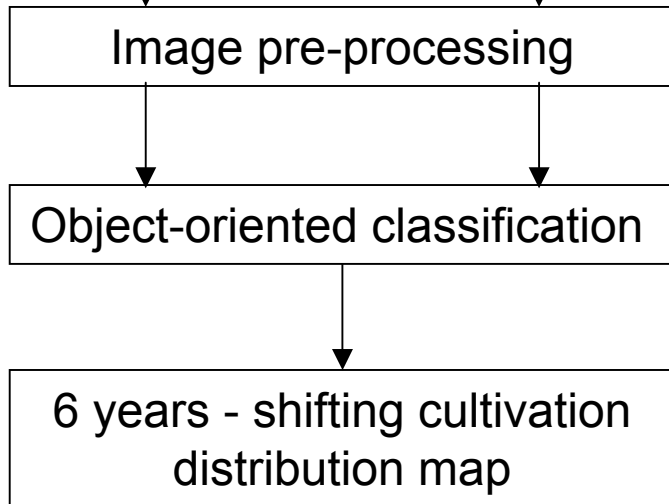








2002/2/9

2005/2/1

2003/3/16

2006/3/8



2001		2002		2003	
2004		2005		2006	

Monitoring of shifting cultivation for six years

Forest degradation due to selective logging



Forest fire

- Type of fire
 - Fire up to canopy
 - Surface fire
 - ex. Tropical seasonal forest in dry season
 - Fire in peat of underground
- Intensity of fire
- Development vs. restoration



Fire of peat

Forest is damaged by the fire gradually and continuously.

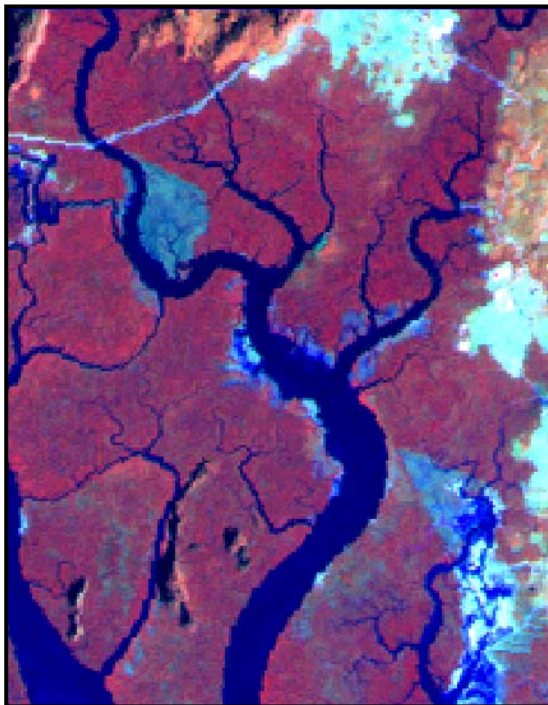


*on 4 September 2002
In East Kalimantan, Indonesia*

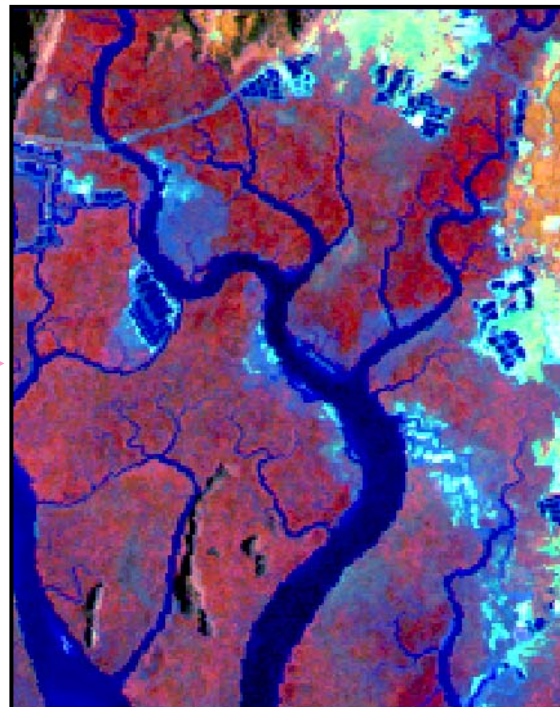
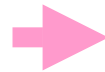


Degradation of mangrove forest caused by shrimp farm

Land use change (deforestation) and consequently degradation



4 Feb. 1989



14 April 1997



DEFORESTATION



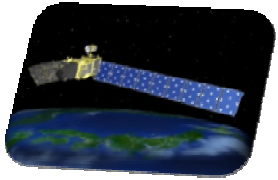
DEGRADATION

Outlines

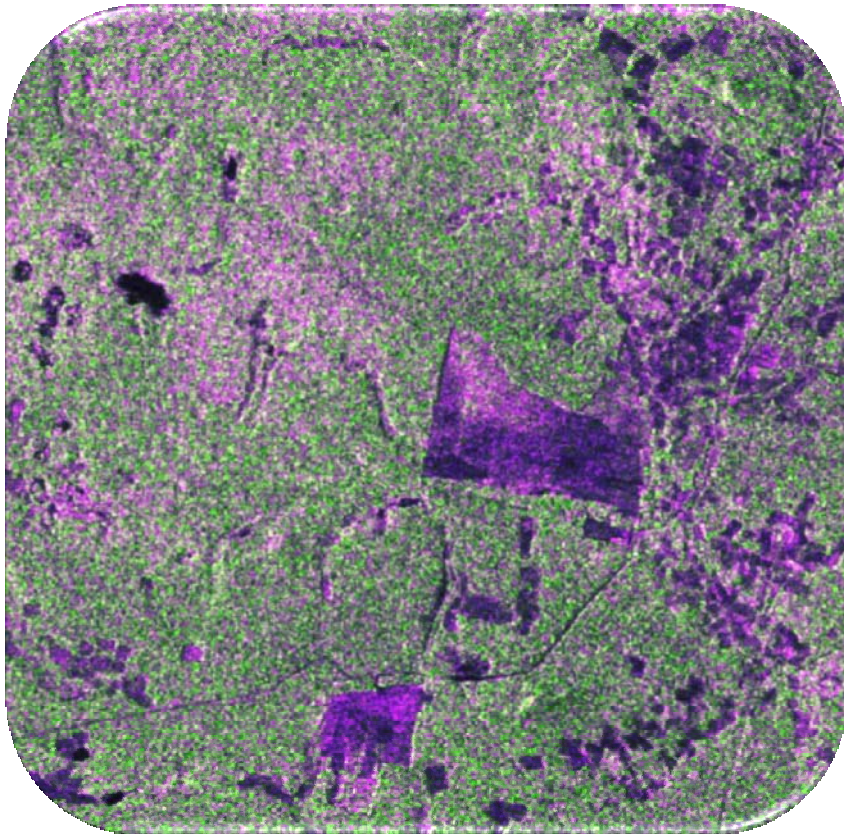
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Comparability between SAR and optical sensor



ALOS PALSAR data

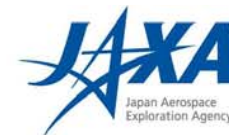


ALOS AVNIR II data (optical)

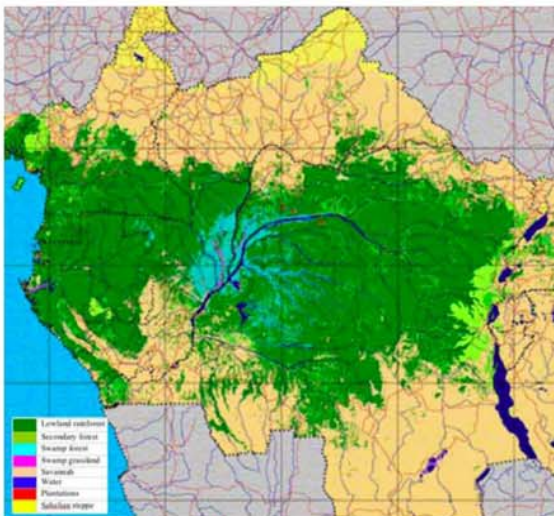


ALOS Kyoto & Carbon Initiative

Offered by Dr. M. Shimada
(JAXA)



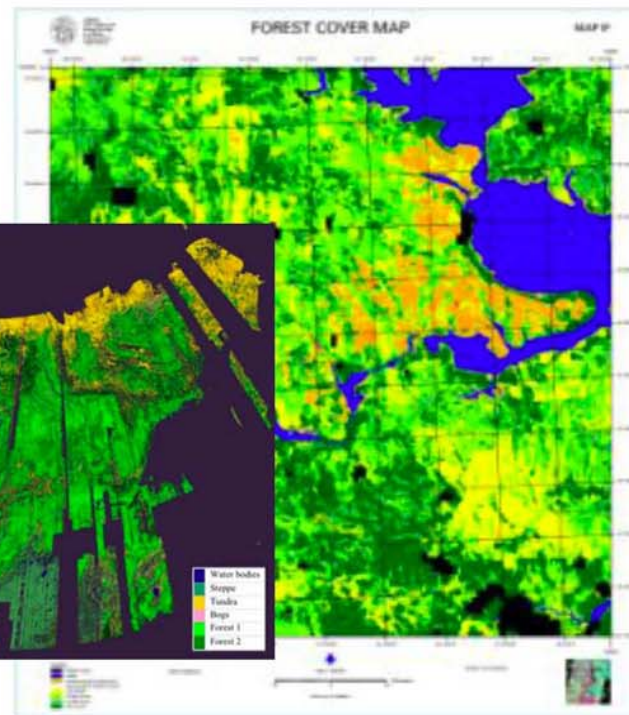
Forest Theme Land Cover mapping



Forest and land Cover
Central African woodlands
Joint Research Centre (E.U.)



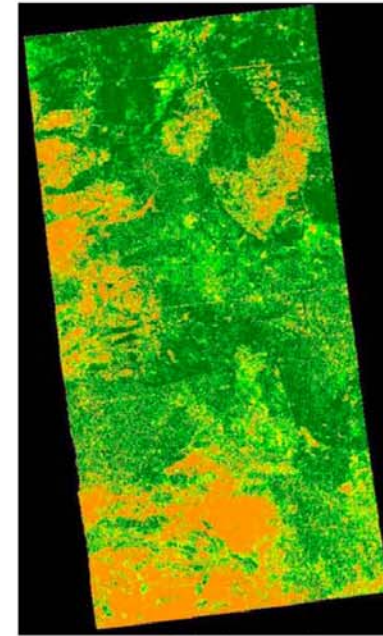
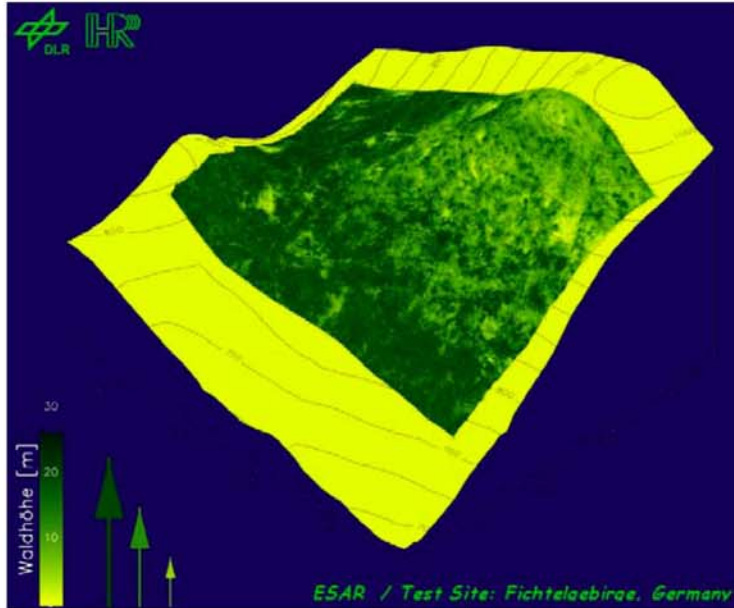
GLI-250 Land Cover map
East & South-East Asia (GLI-250)
Chiba University (Japan)



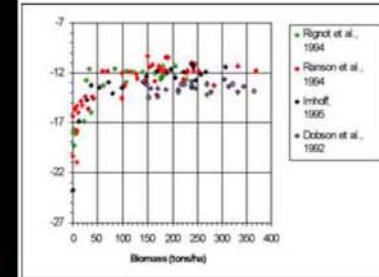
Forest and land Cover
Siberia
Joint Research Centre (E.U.) &
F.S. University, Jena (Germany)

Forest Theme

Above-ground Biomass (R/D)

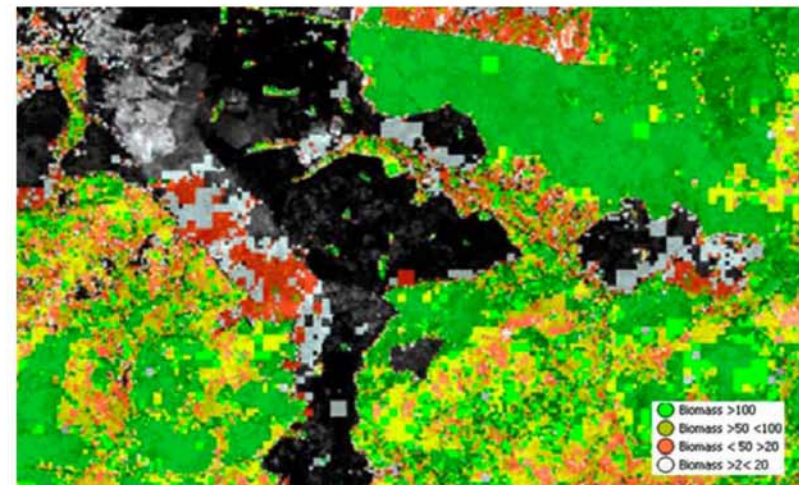
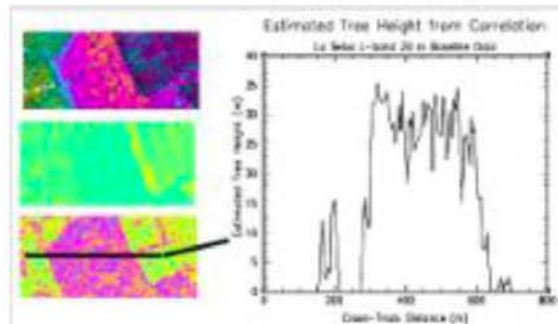


Boreal biomass
Central Siberia
CESBIO (France)

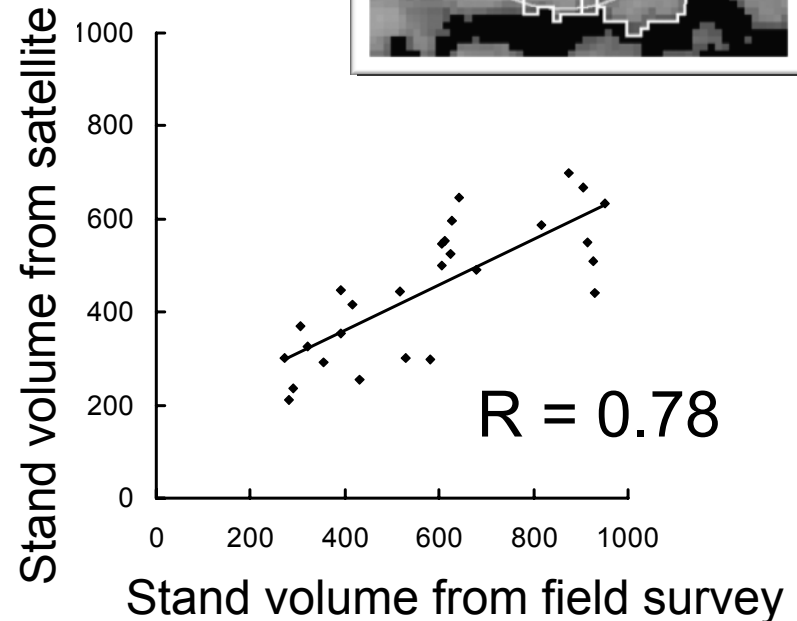
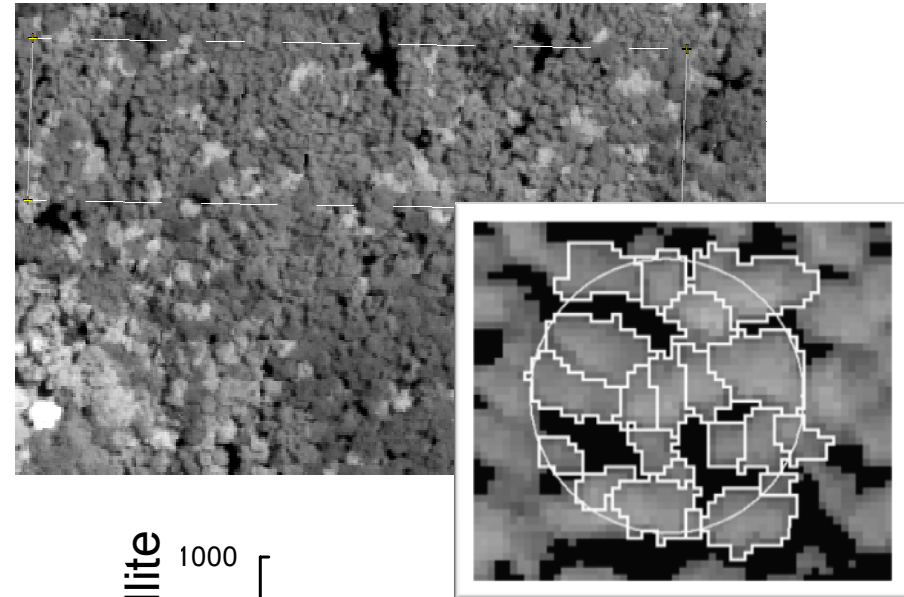
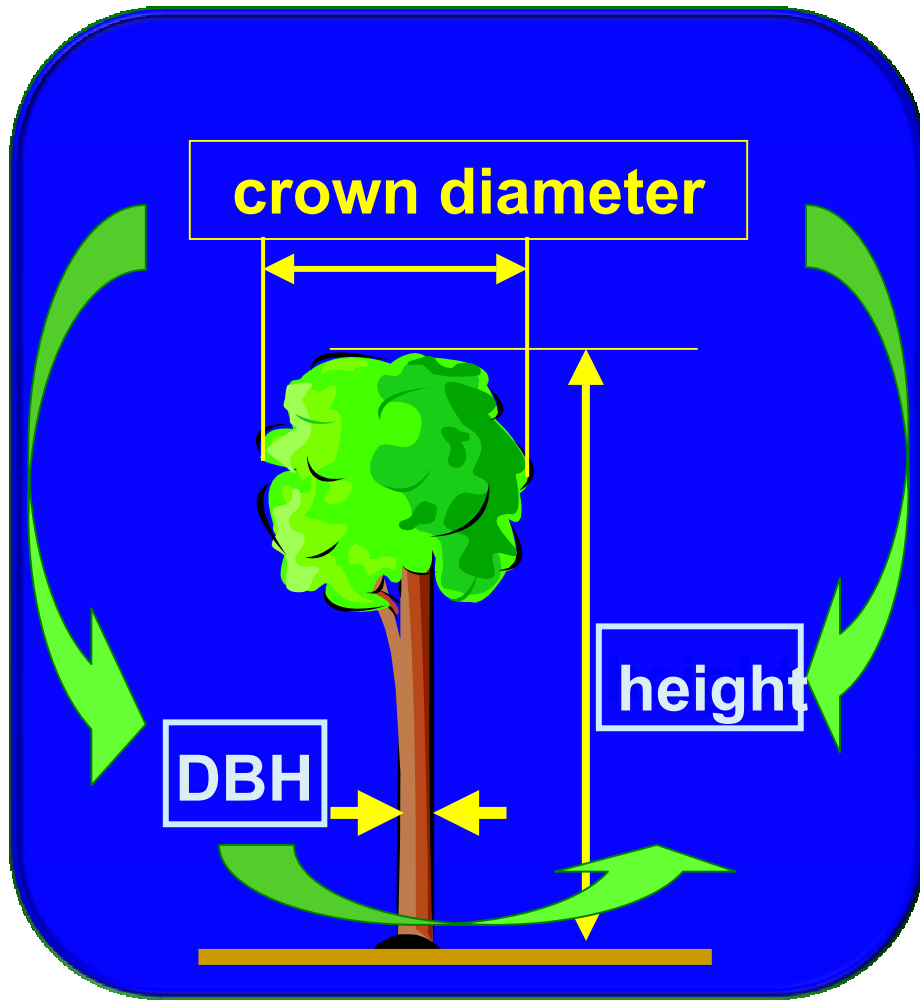


Forest height by Pol-InSAR and InSAR coherence
60 global test sites
German Aerospace Research Center (Germany)
University of Massachusetts (USA)

Woody biomass
Queensland, Australia
University of Wales Aberystwyth (U.K.)



Estimating biomass using high resolution satellite data

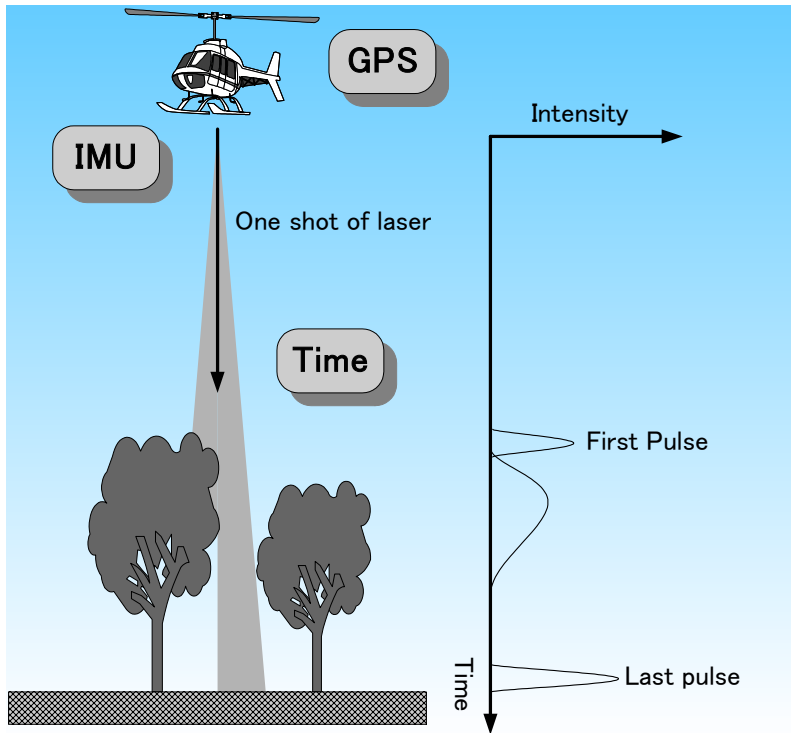
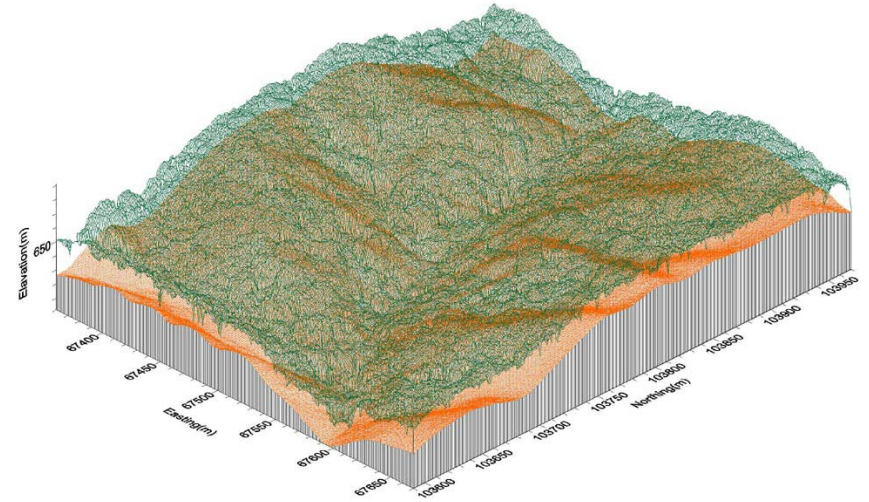


Source: Hirata (2008) *Journal of Forest Research* 14

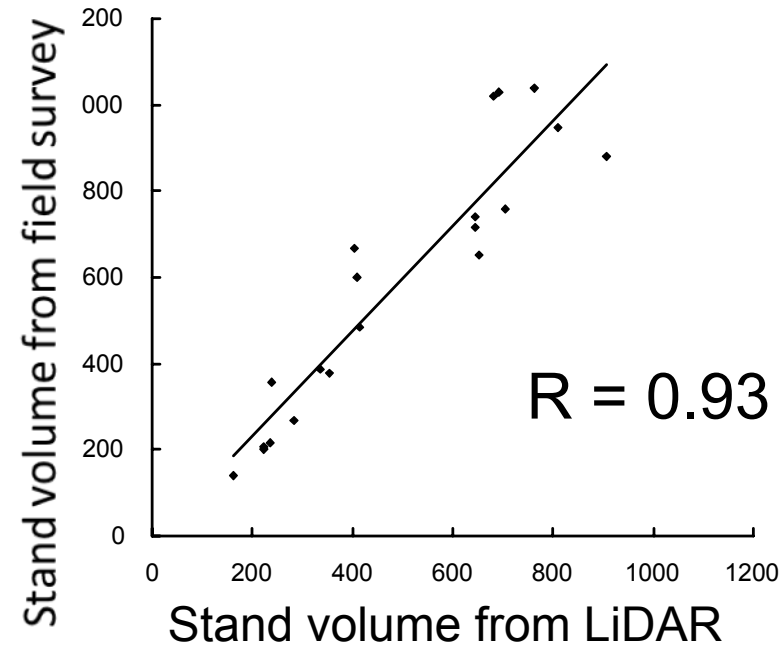
3-D forest measurement with LiDAR



A part of the laser beam reflects on canopy .
The rest goes through canopy and reflects on the ground.



Measurement of ground and canopy surface

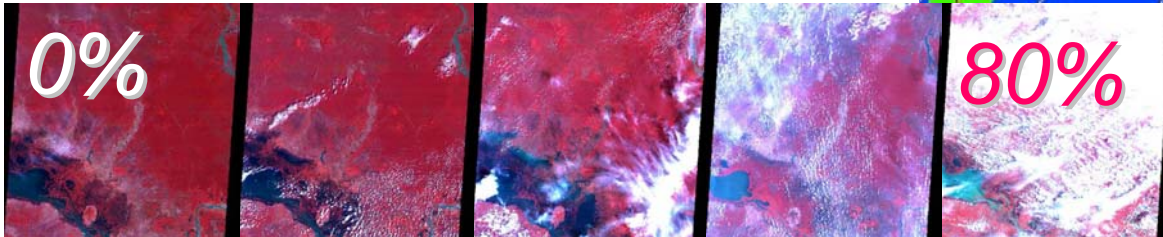
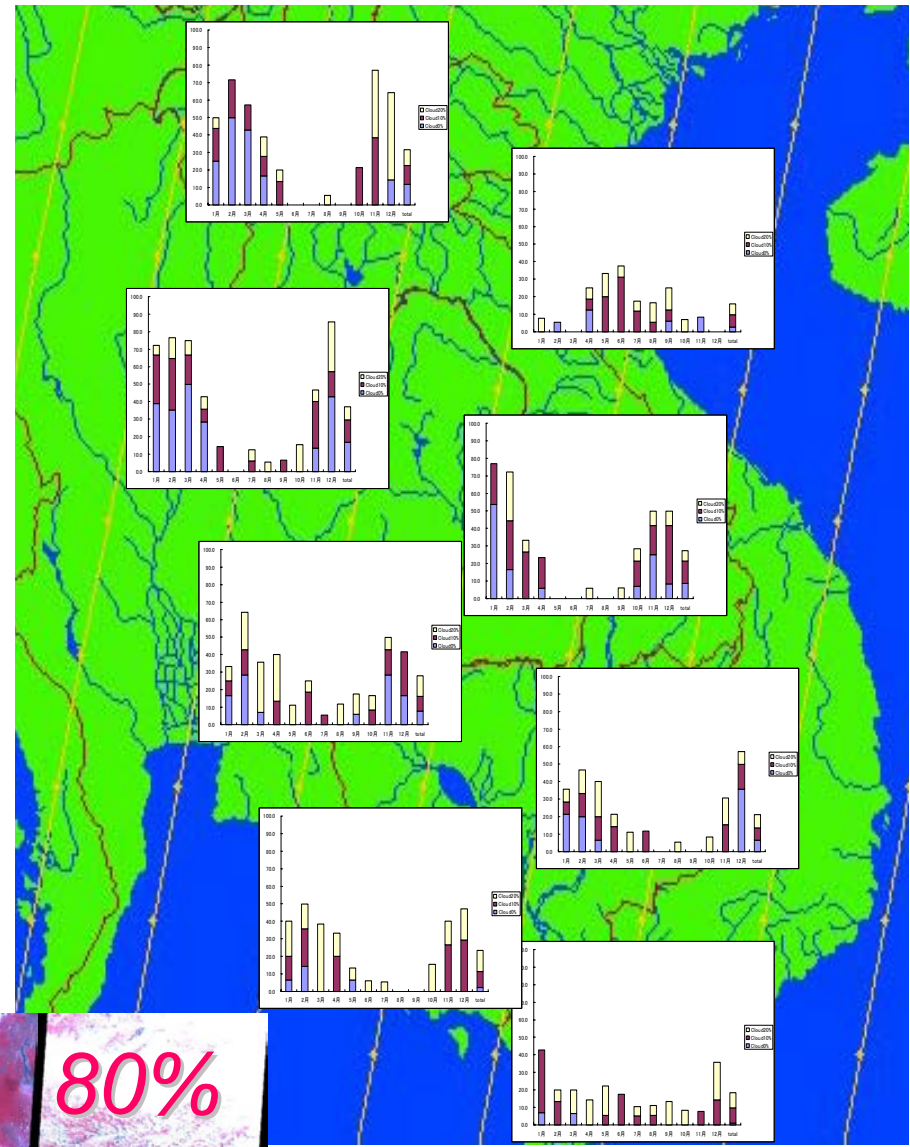
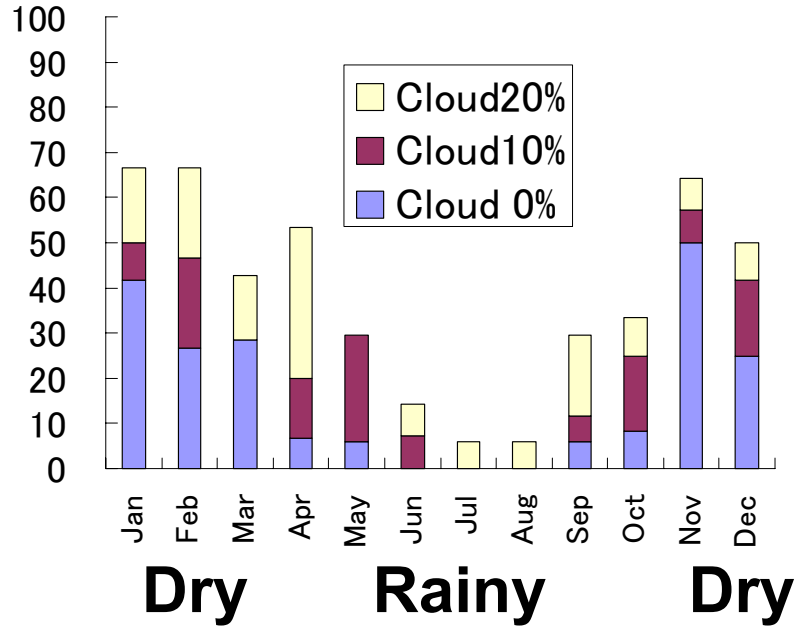


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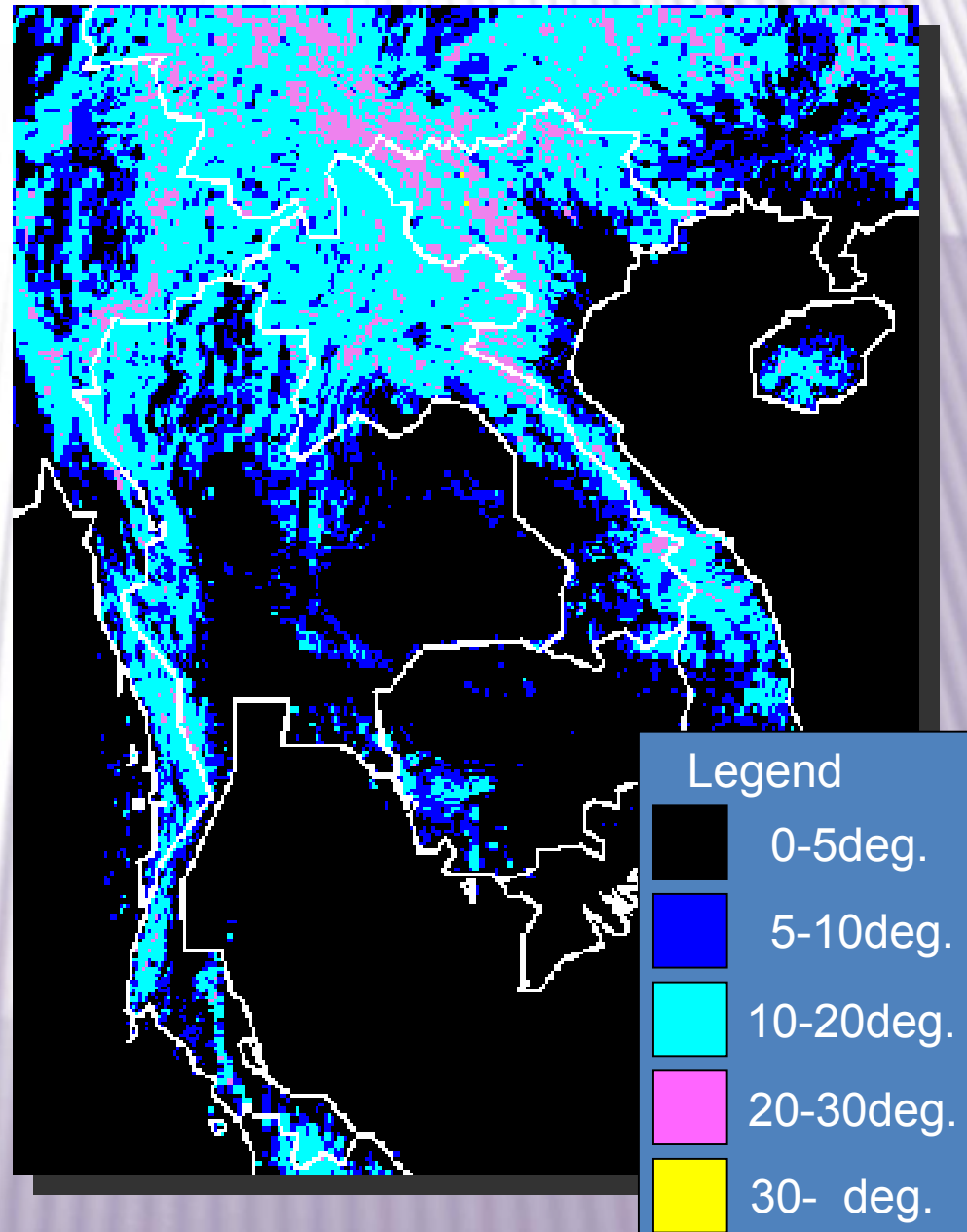


Locality and seasonality of data acquisition



Topographic effect

- Forest remains in mountainous area.
- Effect of topography on both SAR and optical sensor data



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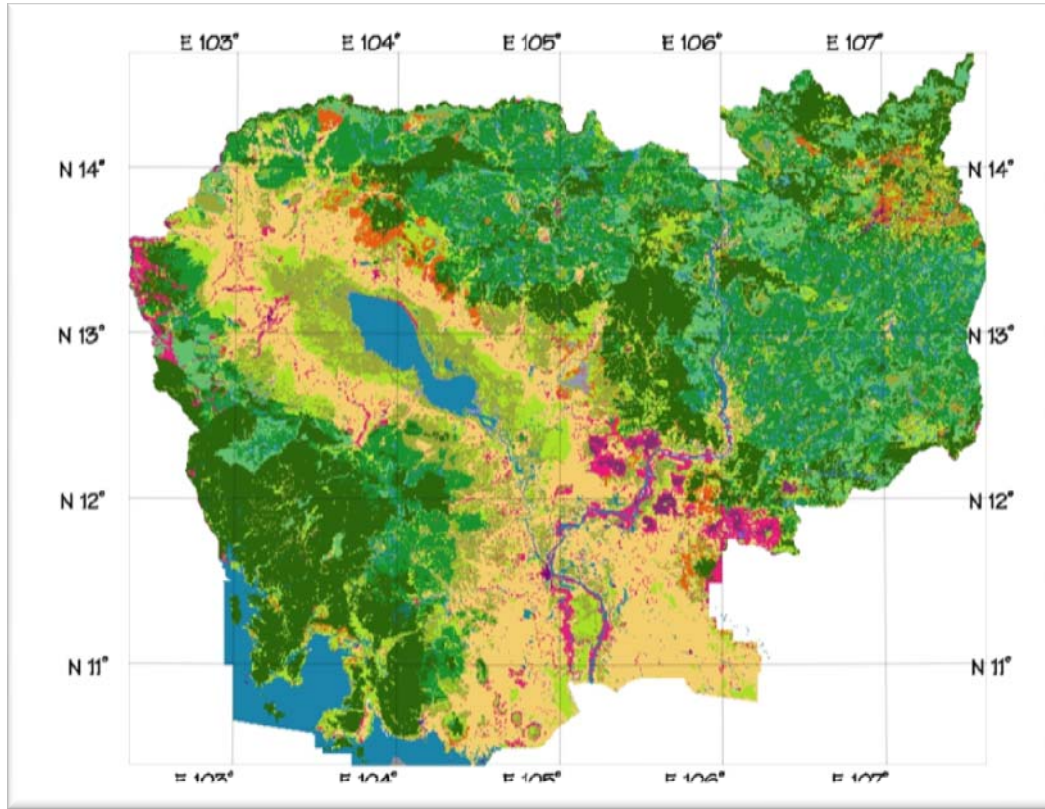
Conclusions

- Consistency of satellite data and the results
- Determining methodology
- Issue of definition
- Importance of field survey
 - There is much ground-based data, which was collected by **different** organizations, for **different** factors with **different** formats, **without** geo-reference
- Established methods and further challenging studies





Thank you for your attention!



Grass land



Shrub land



Rubber Plantation

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Evergreen



Mixed forest



Deciduous forest