Forest Theme

Forest and biomass products using PALSAR

Thuy Le Toan, Mihai Tanase, Alexandre Bouvet
CESBIO, Toulouse, France

Lam-Dao Nguyen
GIS & RSRC, Ho Chi Minh city, Vietnam

CESBIO

OVERVIEW

- **Product name**

  Regional mapping of forest and forest biomass classes at prototype areas

- **Intended use**

  Assessment of carbon budgets in forests

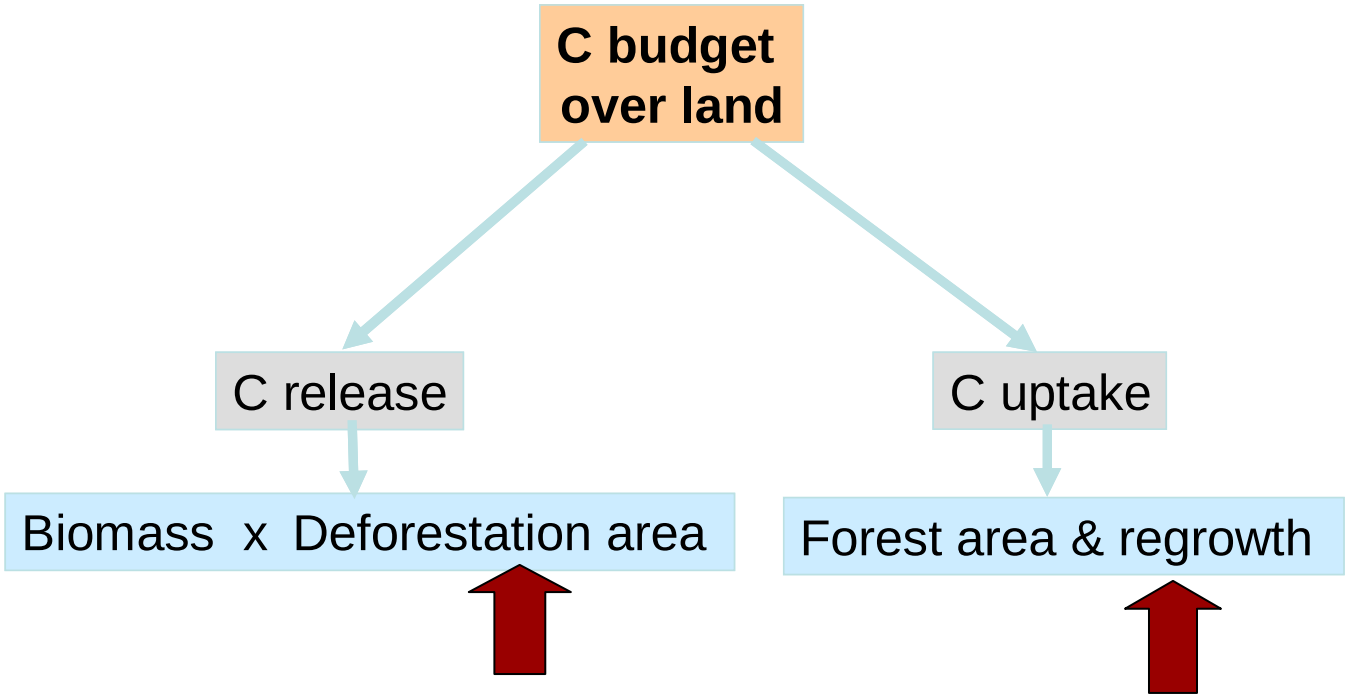
  (in particular carbon sources and sinks related to post-disturbance forest)

- **Content**

  1. Assessment of forest and biomass lost in Central Siberia
  2. Maps of forest and biomass classes in Vietnam

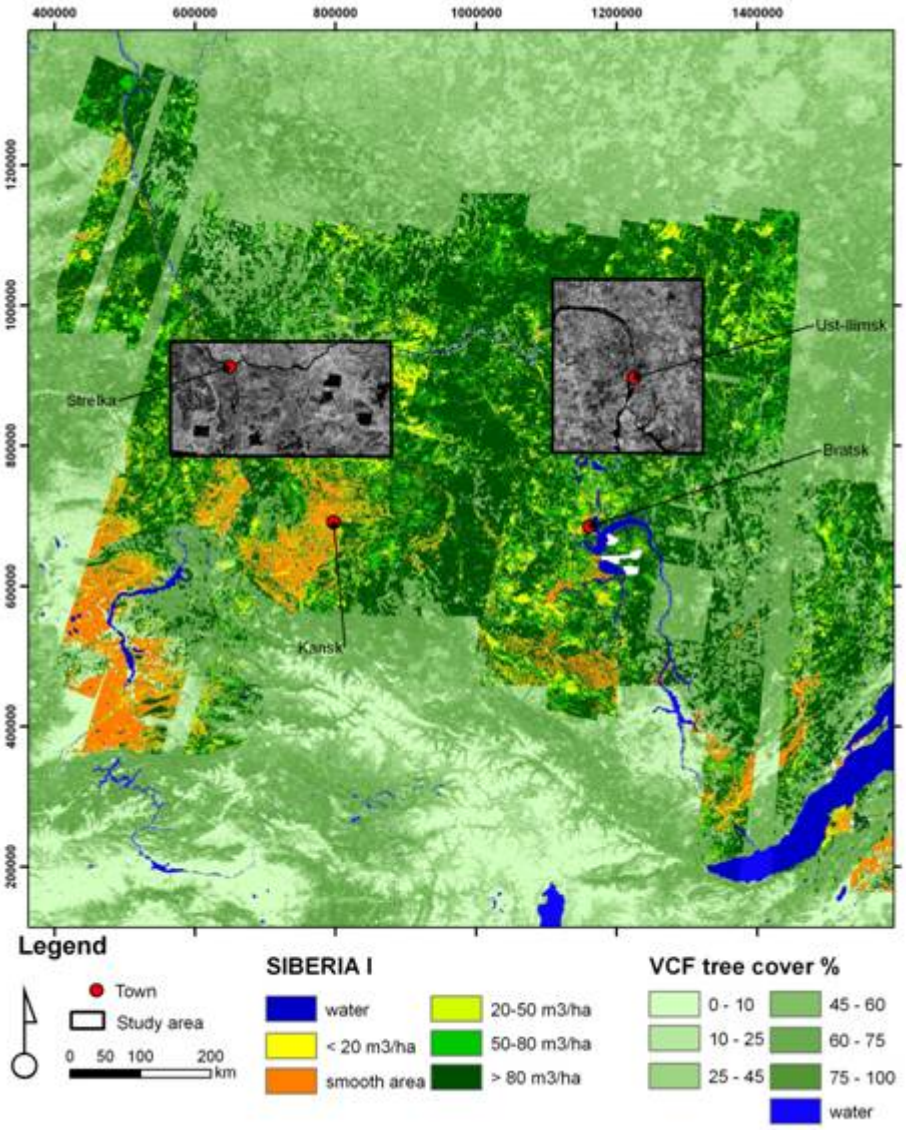
Forest and biomass lost in Central Siberia

- Siberia plays an important role as a terrestrial C pool
- Not much is known about C lost by deforestation in Siberia
- Forest regrowth could be a C source in Siberia



Objectives

- Estimation of changes in forest area (and in biomass) over the last ten years in Central Siberia
- Approach
  - mapping of forest area and biomass classes using ALOS PALSAR FBD – 2007
  - detection of changes in forest area and biomass class surface by comparison with SIBERIA-I forest and biomass – 1997



Two 50.000 km^2 regions (Krasnoyarsk and Irkutsk), were chosen (coverage of PALSAR and small unclassified pixels in SIBERIA-I).

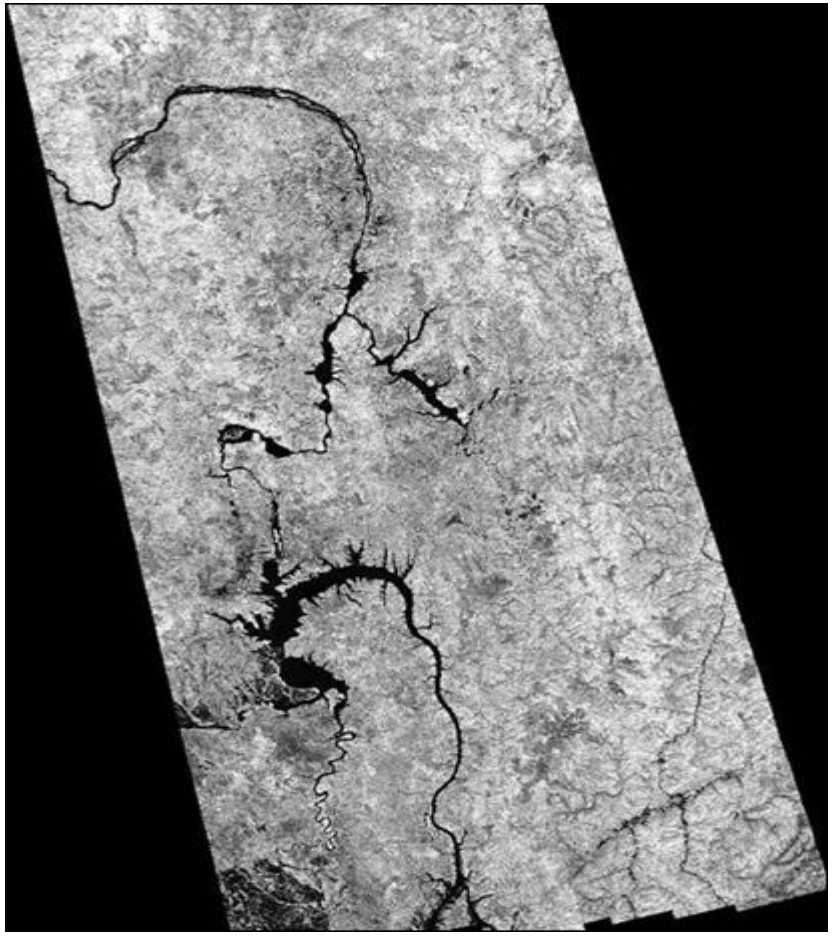
- PALSAR FBD (HH+HV) data,
  cycles 12 and 13 (summer 2007)
  paths 460 to 468 for site 1 (Irkutsk)
  473 to 484 for site 2

- SIBERIA-I from ERS 1/2 and JERS) acquired during 1997 and 1998

- Forest database from IIASA

Methodology

1. PALSAR preprocessing: conversion to σ^0, geocoding, incidence angle normalisation, mosaicking, co-registration to SIBERIA-I



2. Backscatter Analysis:

- using 280 polygons from QuickBird (2005-2007) for classes of:
open areas,
low biomass forests,
high biomass forests,
smooth fields and water

- using 1067 forest plots (>35 ha) from IIASA database

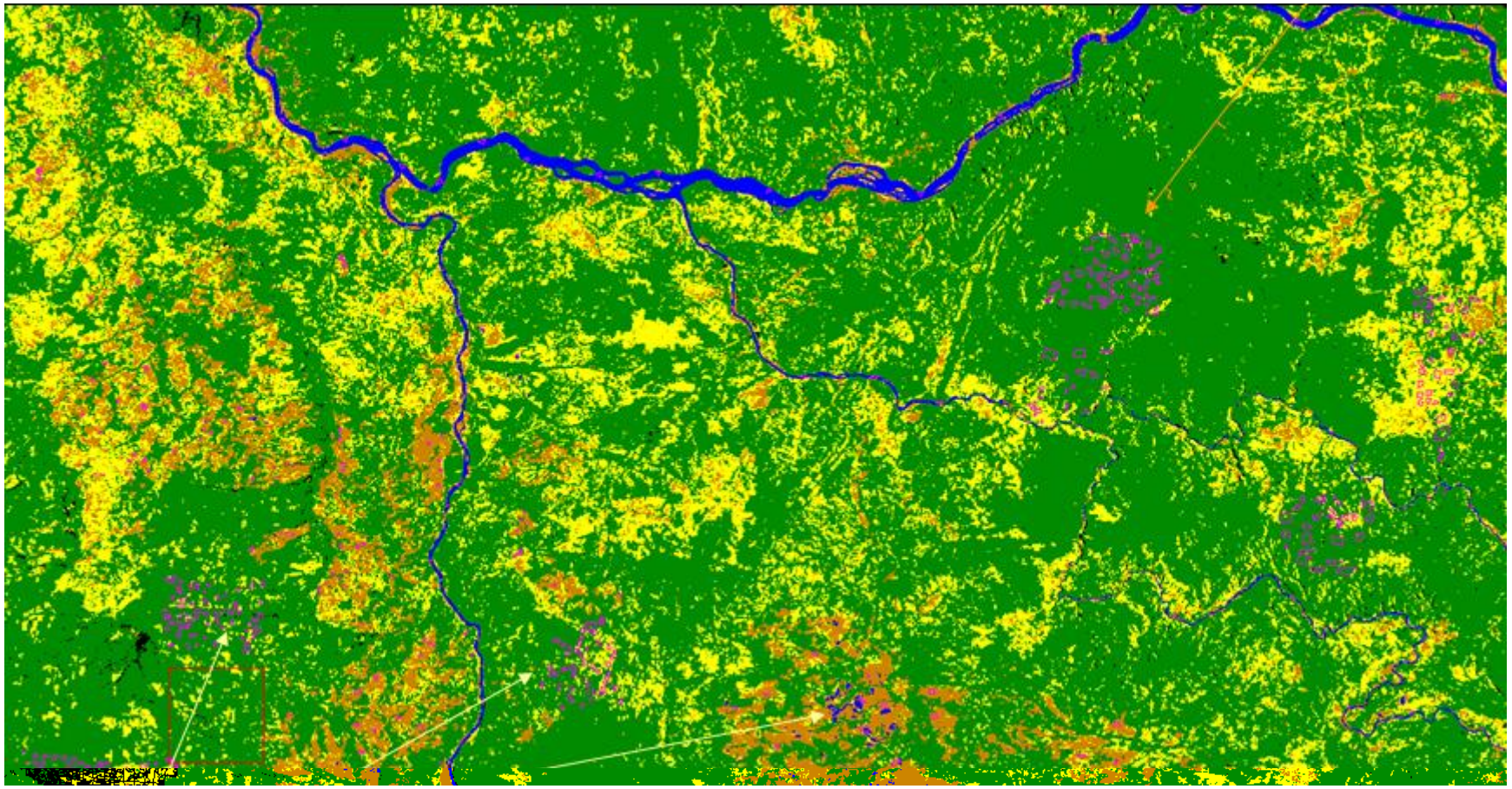
3. Classification

knowledge based classifier

PALSAR forest and biomass classes

Site 2- Krasnoyarsk

IIASA database



IIASA database

> 80 m^3/ha | 50-80 m^3/ha | < 50 m^3/ha | smooth area | water | unclassified

4. Accuracy Assessment

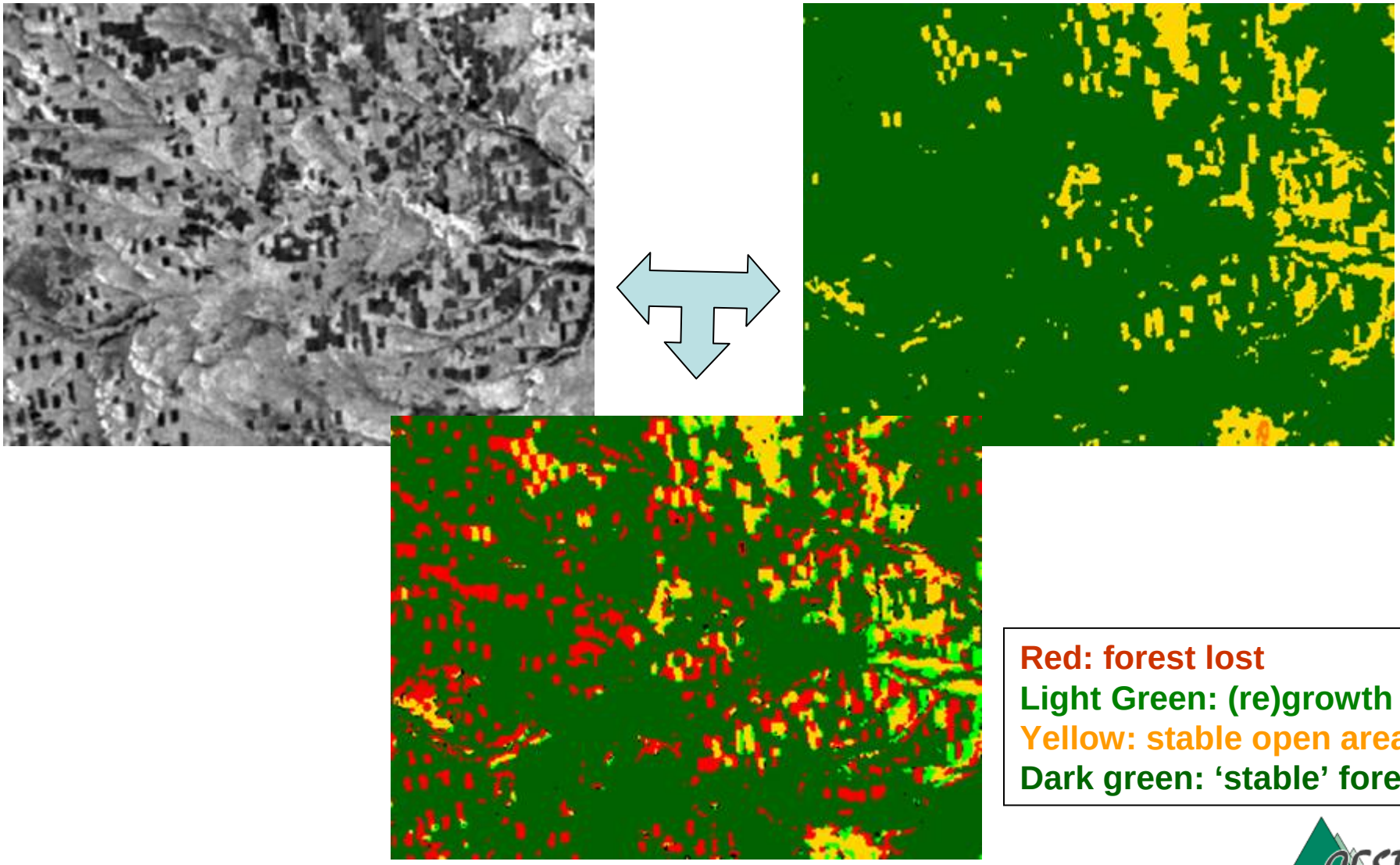
Ground data →	> 80 m^3/ha	50-80 m^3/ha	< 50 m^3/ha	smooth areas	water	Total	user`s acc.
forest > 80 m^3/ha	213832	15267	17478	0	8	**246585**	87 %
forest 50-80 m^3/ha	35750	11647	16513	0	0	**63910**	18 %
forest < 50 m^3/ha	4568	5850	68561	2	1	**78982**	87 %
smooth areas	170	59	6240	13817	269	**20555**	67 %
water	4	0	24	523	5439	**5990**	91 %
Total	**254324**	**32823**	**108816**	**14342**	**5717**	**416022**	
prod. Acc.	84%	36 %	63 %	96 %	95 %		**75.3 %**

Increases to 87.6% when reduced to 2 classes: < 50 m^3/ha and > 50 m^3/ha

1997-2007 Changes in forest cover in Central Siberia

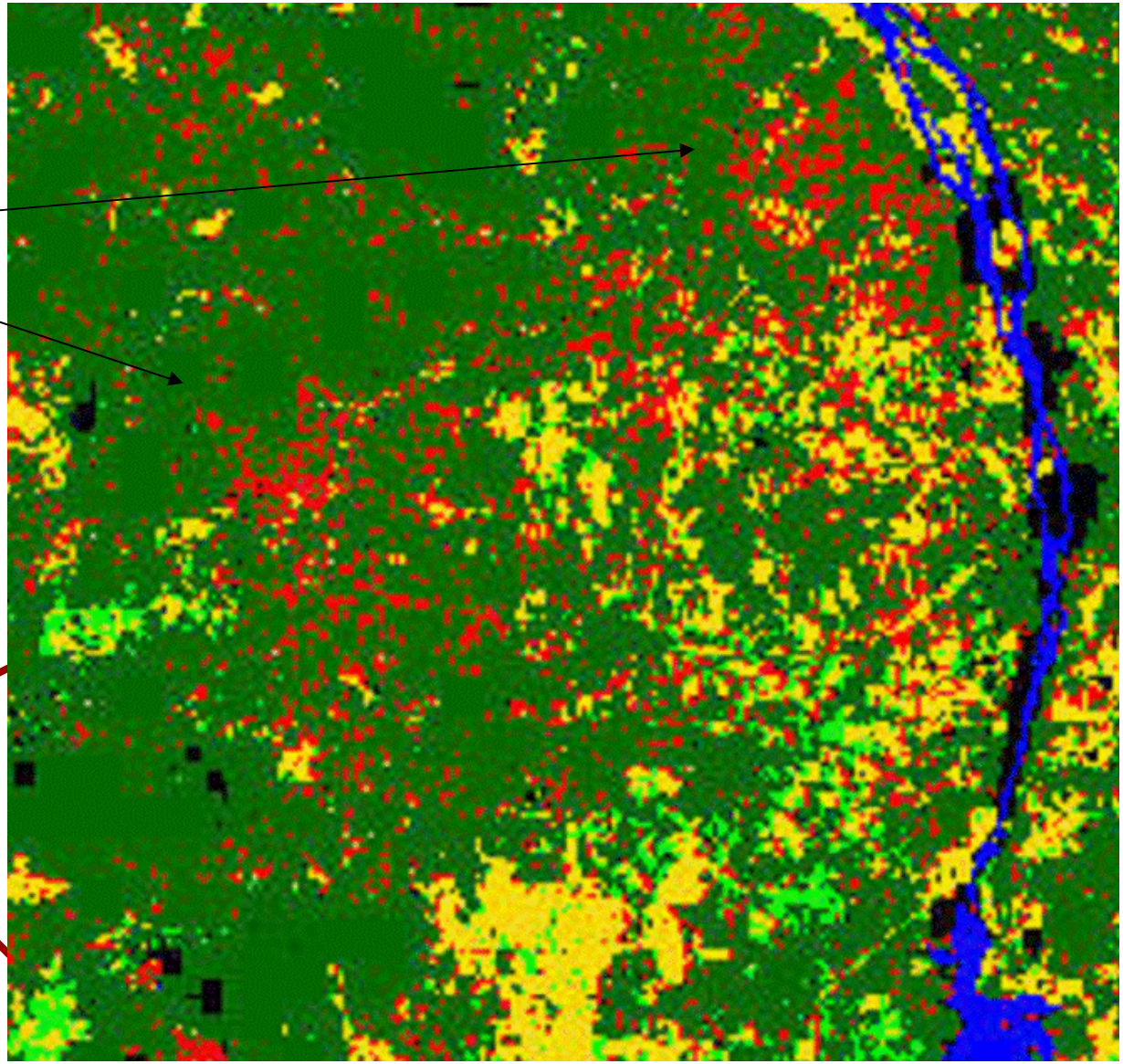
PALSAR 2007

SIBERIA-I 1997



Red: forest lost
Light Green: (re)growth
Yellow: stable open areas
Dark green: 'stable' forest

Central Siberia change map



Scattered forest clear-cuts with geometric shapes

Regrowth after fire?

Red: forest loss
Light Green: (re)growth
Yellow: stable open areas
Dark green: 'stable' forest

Change detection results

Class	SIBERIA → PALSAR FBD	Irkutsk (%)		Krasnoyarsk (%)	
Deforestation	Forest > 50 m^3/ha→ Forest < 50 m^3/ha	9.6		11.4	
	Forest > 50 m^3/ha→Smooth areas	1.1	**12.2**	1.2	**16.0**
	Forest < 50 m^3/ha→ Smooth areas	1.5		3.4	
Afforestation	Smooth areas→ Forest < 50 m^3/ha	0.1		0.1	
	Smooth areas→ Forest > 50 m^3/ha	0.02	**3.2**	0.04	**4.5**
	Forest < 50 m^3/ha→ Forest > 50 m^3/ha	3.1		4.4	
Stable forest	Forest > 50 m^3/ha ←→ Forest > 50 m^3/ha	69.1		58.5	
Stable smooth fields & open areas	Smooth areas←→ Smooth areas	0.5		2.3	
	Forest < 50 m^3/ha←→ Forest < 50 m^3/ha	7.9		6.7	
Water	Water →Water	2.7		1.2	
	Not classified → Water	0.3		0.3	
Other changes	all other changes	0.4		0.4	
Not classified	not classified Siberia or Palsar	3.8		10.1	

Deforestation: 12% and 16% at Irkutsk and Krasnoyarsk
Regrowth: 3.2% and 4.5%

Rough estimates of biomass and carbon loss

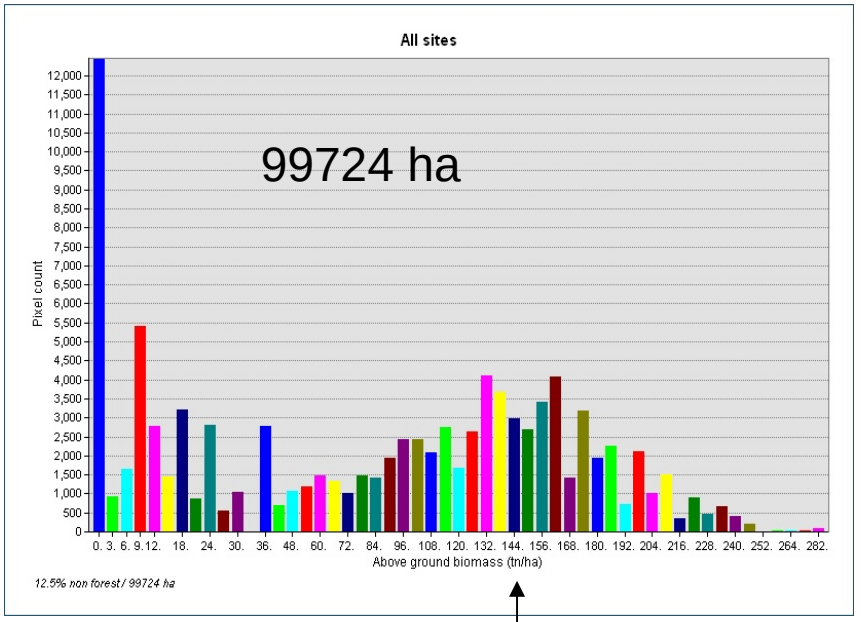
- Forest loss by logging and fire:
  12 to 16% of area in 10 years:
  ~140,000 ha for 1 M ha at Irkutsk and Krasnoyarsk

- Assume biomass density of lost mature forest =150 ± 30 t/ha

- For the 2 sites:
  loss of biomass 2.1 M t / yr
  loss of above-ground C:
  1.05 M t C / yr

- Biomass gain from 10 yrs regrowth needs to be estimated in the budget

Distribution of biomass from IIASA forest databases



Mature forest =150 ± 30 t/ha

Forest, reforestation & plantations in Vietnam

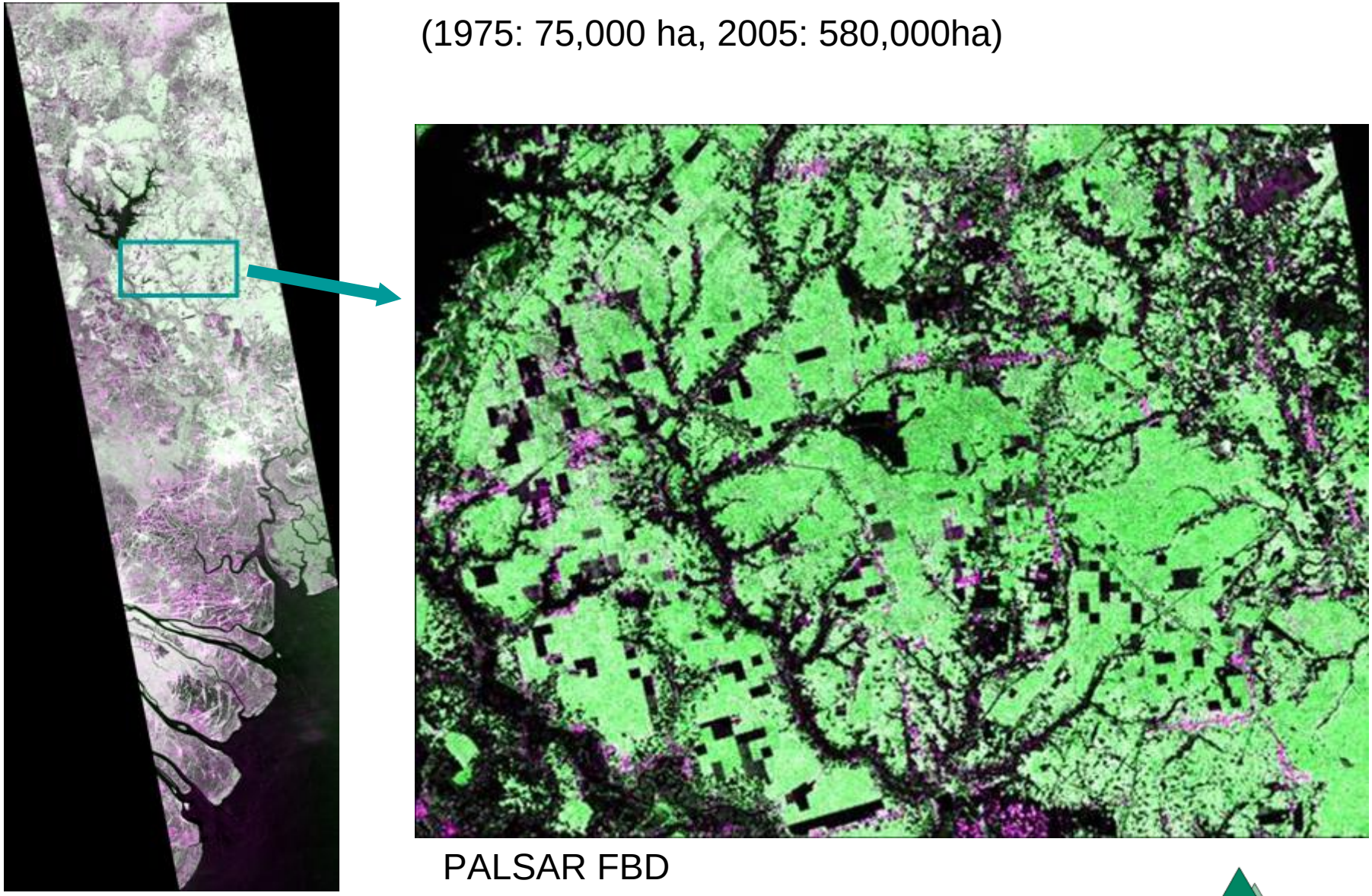
- Vietnam: one of the largest deforestation rates in the world over the last 40 years
- Reforestation and plantation of industrial crops have become a high national priority in the last 10 years
- Uncertainties in regional and national statistics (due to subsidies)

OBJECTIVE

Use of PALSAR to assess changes in forest area and biomass

Intensive conversion of forest and old growth plantation into new rubber plantations

(1975: 75,000 ha, 2005: 580,000ha)

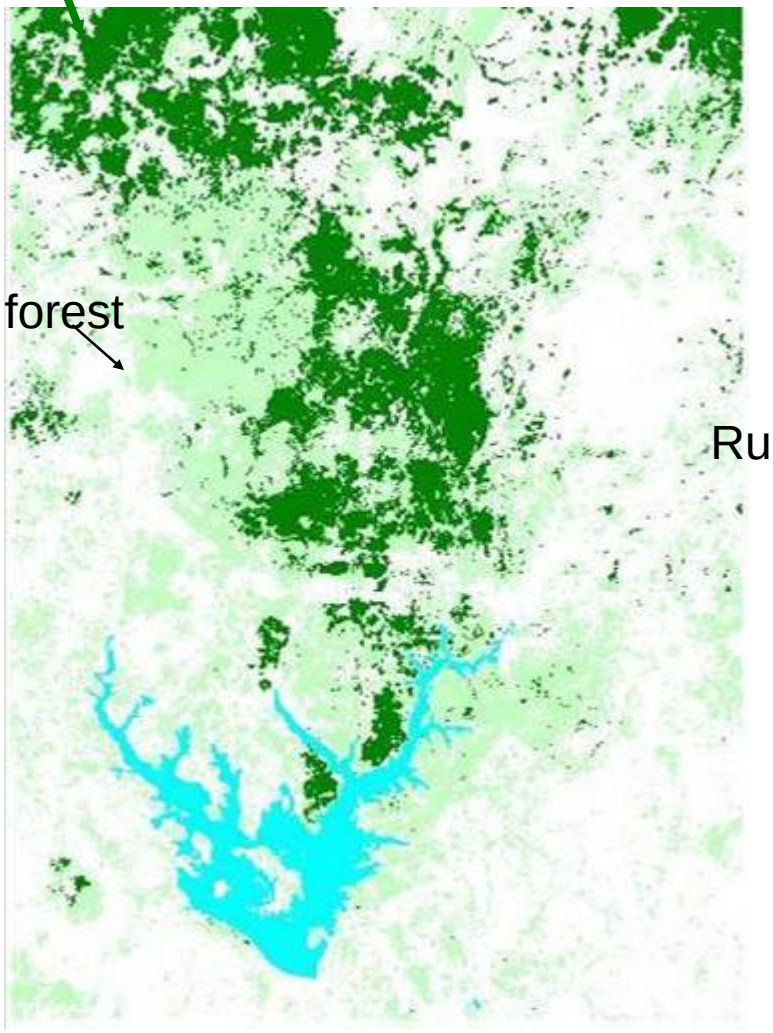


PALSAR FBD

Change in forest cover

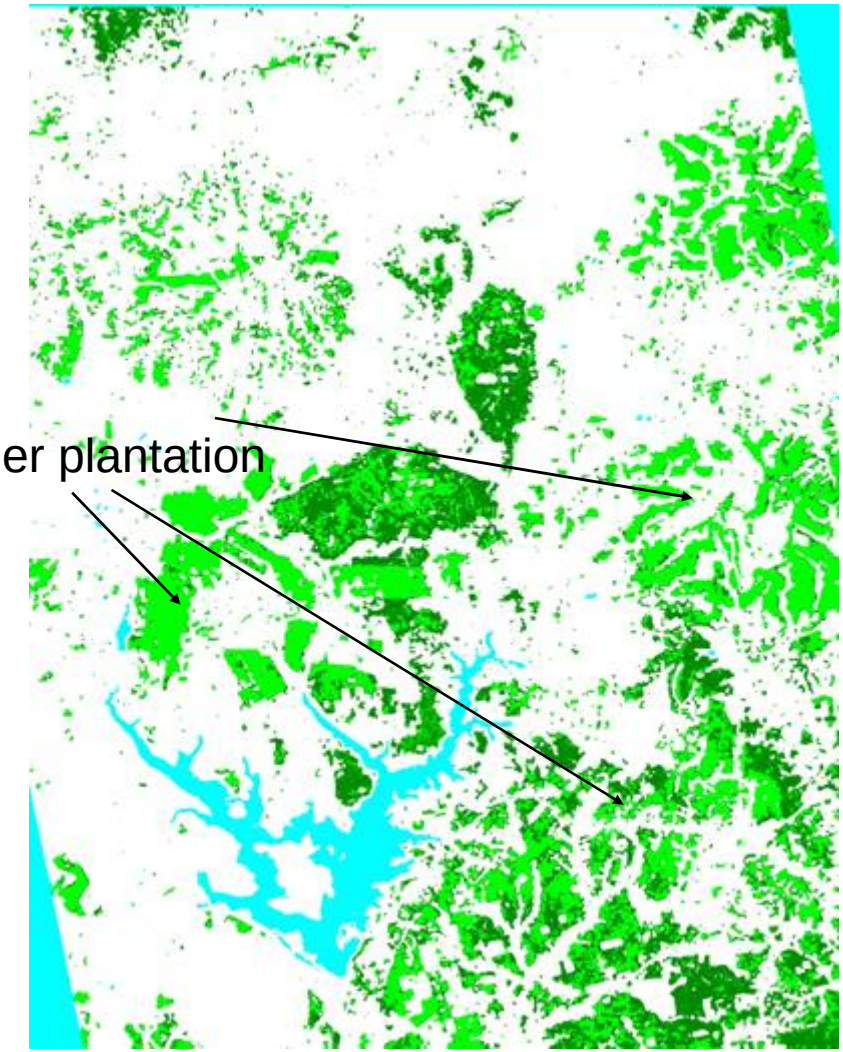
Closed forest

Open forest



Forest map, 1989

Rubber plantation

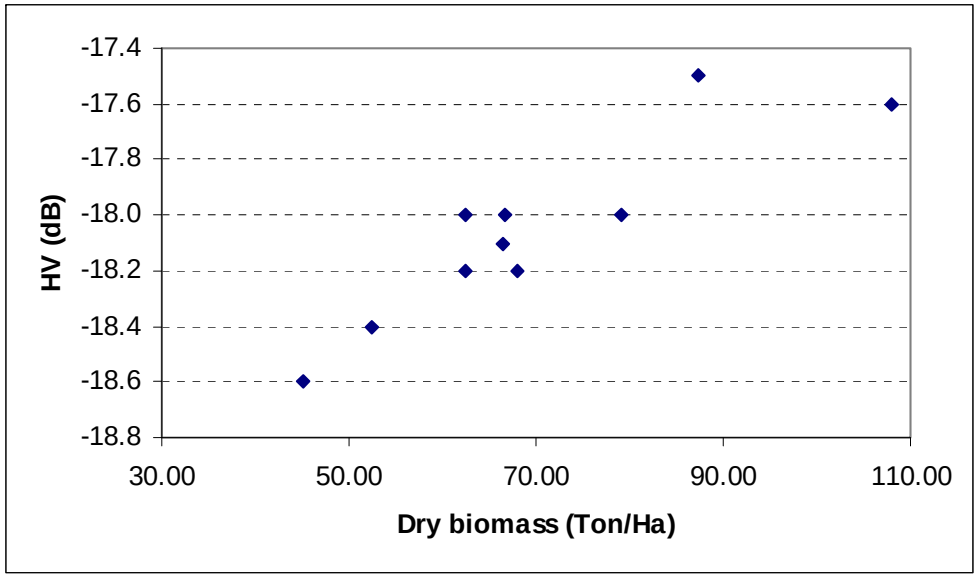


PALSAR forest map, 2007

Forest biomass analysis

• Field survey in *Acacia auriculiformis* x *A. mangium* forest area in June – July, 2007

PALSAR strip S431 acquired in June 2007



Field measurement of biomass in 2009 for different forests in South, Centre and North Vietnam: collaboration with Vietnam Forest Institute

Forest biomass map from PALSAR

- 10-20 tons/ha
- 20-30 tons/ha
- 30-50 tons/ha
- 50-70 tons/ha
- +70 tons/ha