Using time-series PALSAR data for deforestation detection in Indonesia

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Project objectives

The study aims to investigate time-series ALOS PALSAR data for more accurate/effective forest change mapping

1. Backscattering coefficient (gamma-zero, γ^0)
2. Interferometric coherence

Study area:

Riau province, Sumatra Island, Indonesia

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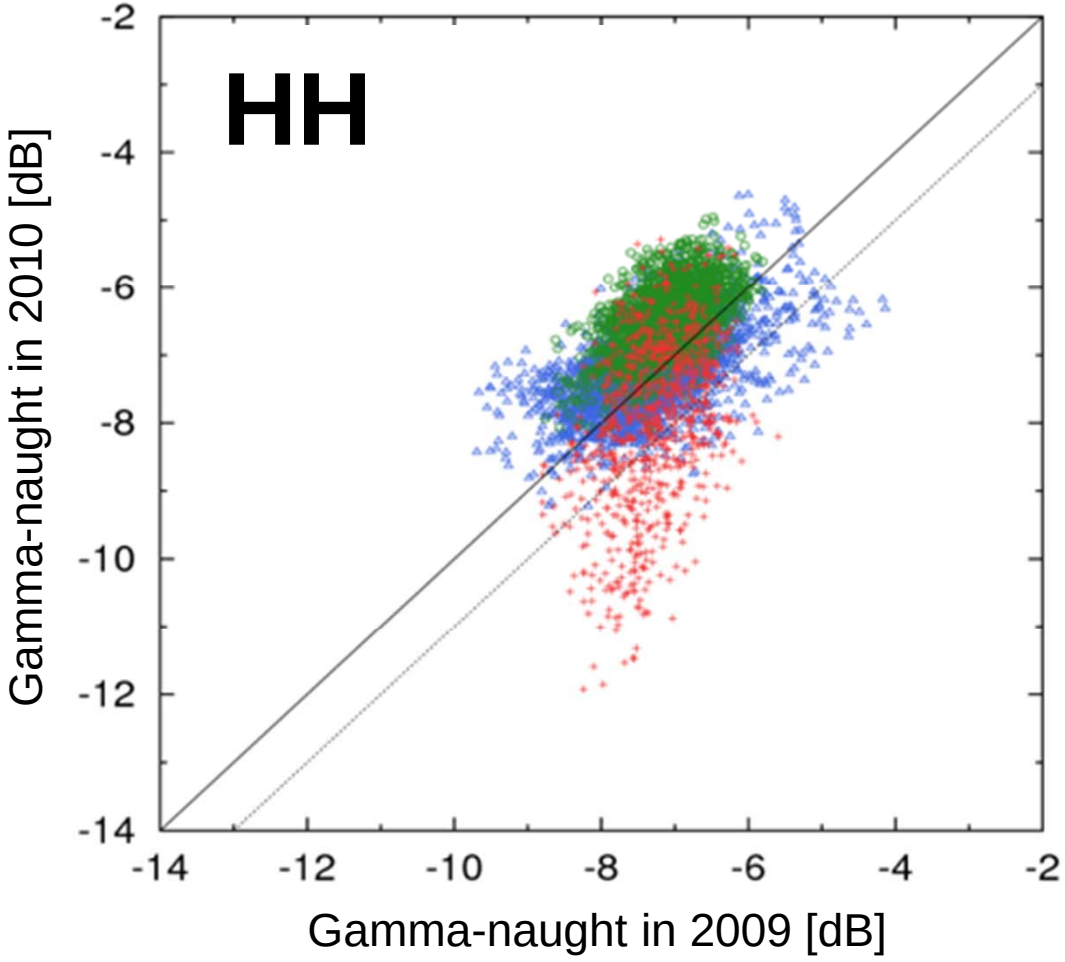
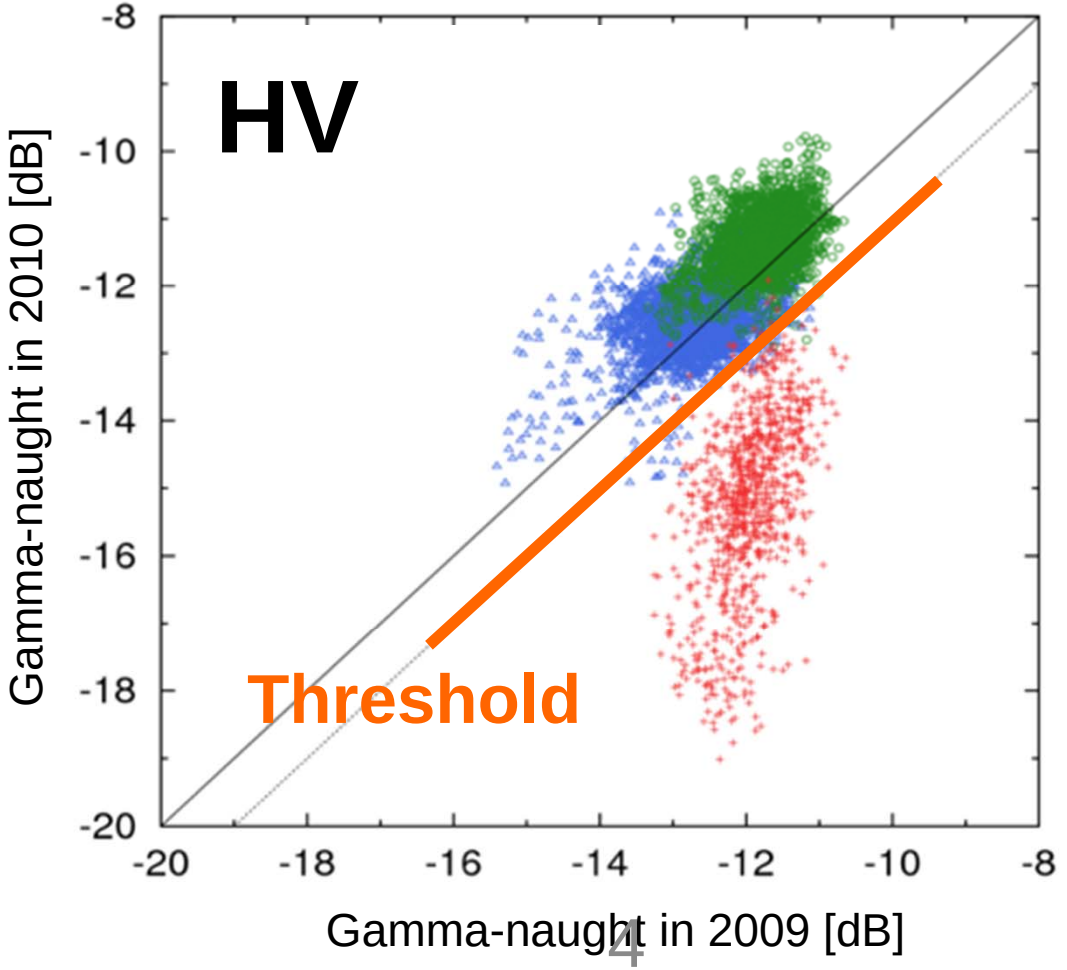
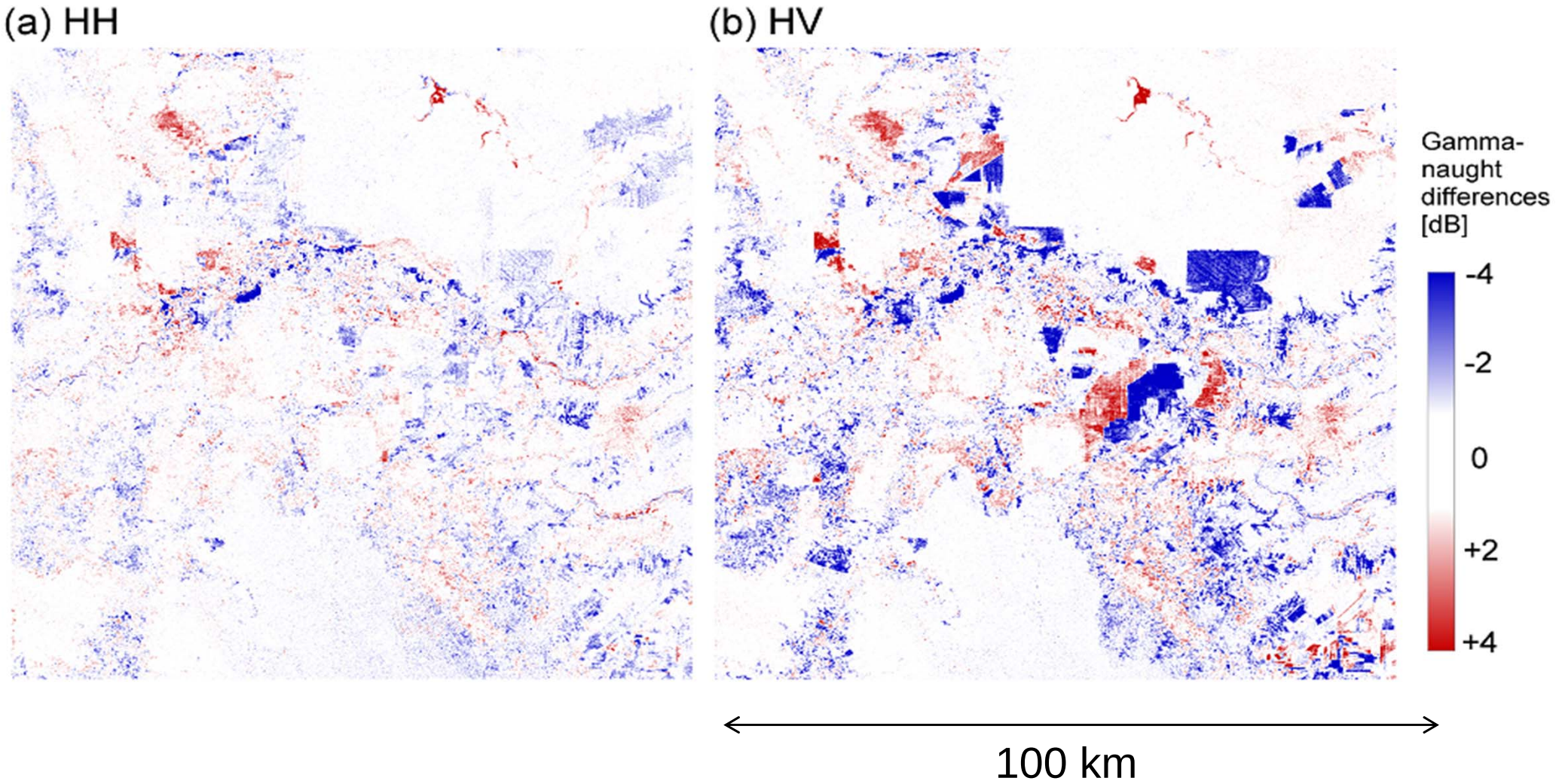
Gamma-naught before/after deforestation

Red: Deforested land
Green: Natural forest
Blue: Acacia plantation





Spatial pattern of γ^0 changes

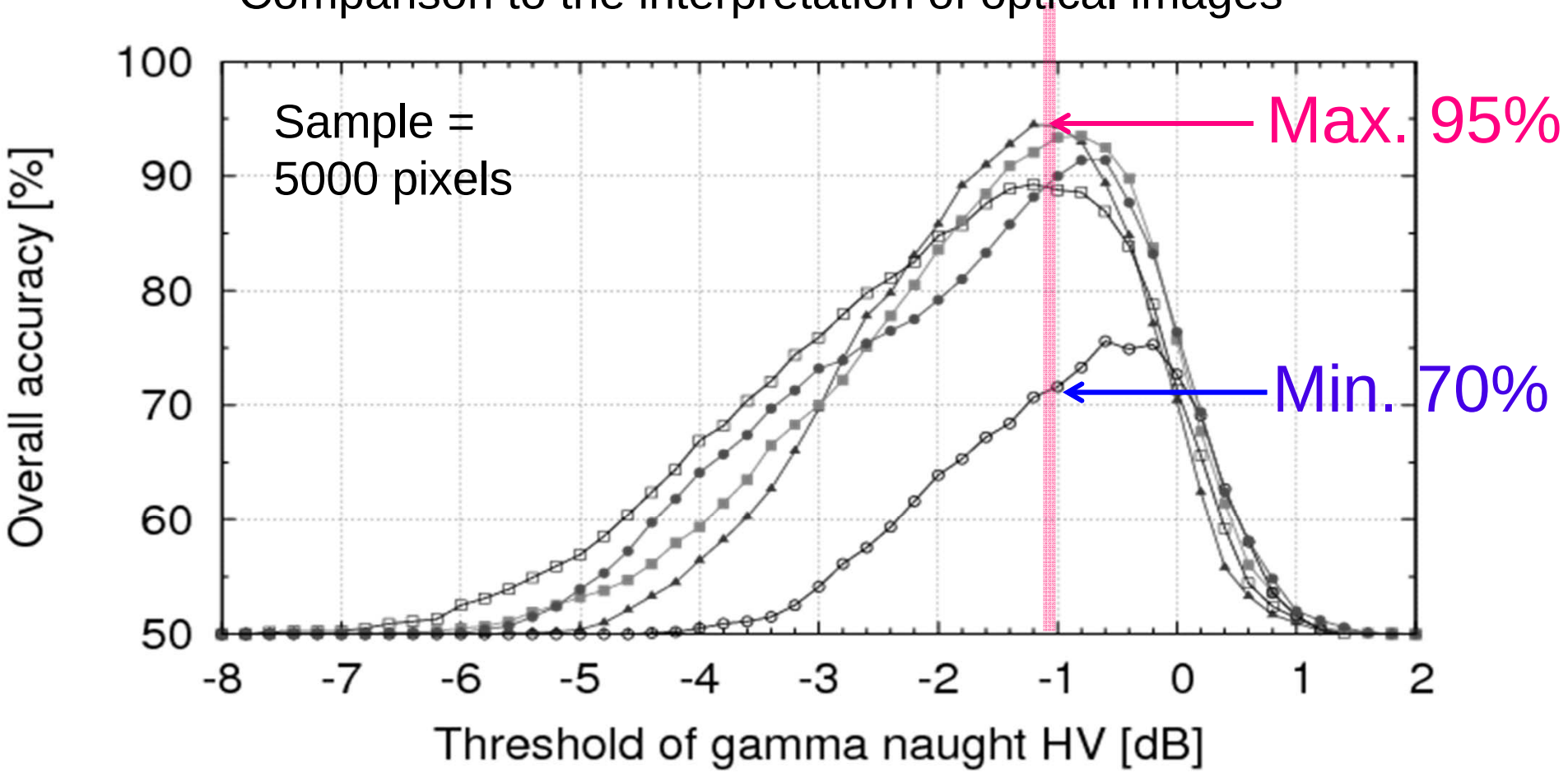


HV polarization shows clear changes and patterns

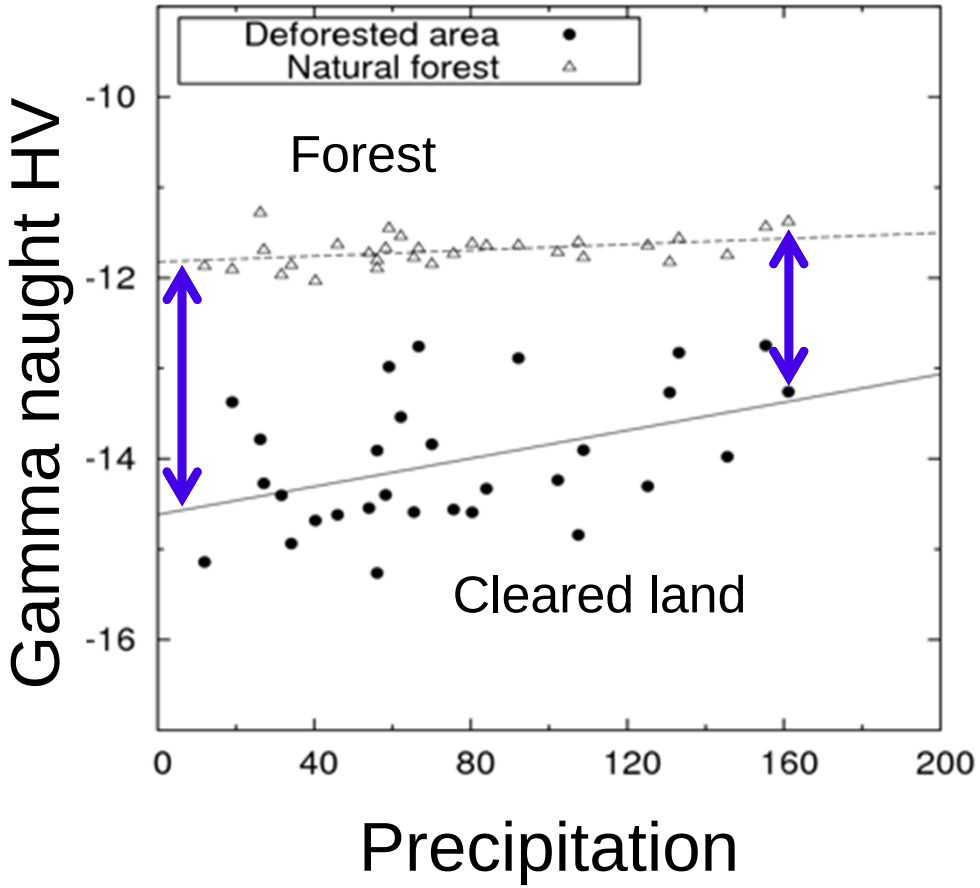
Accuracy of the deforestation detection using gamma-zero changes

Riau province, Indonesia

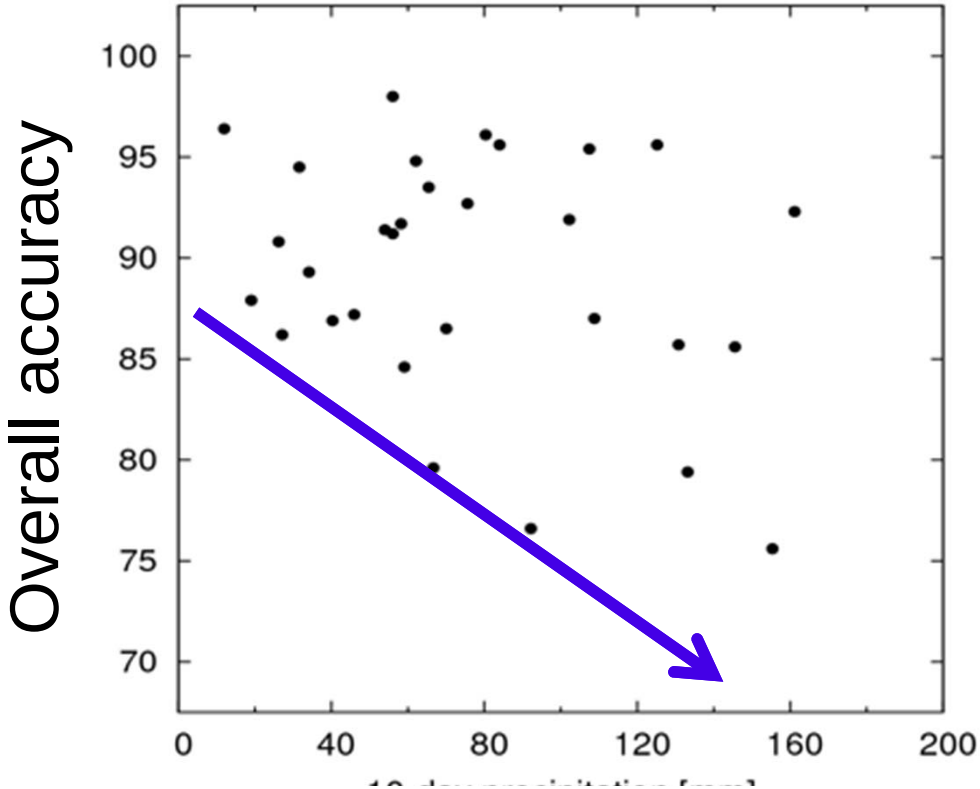
Comparison to the interpretation of optical images



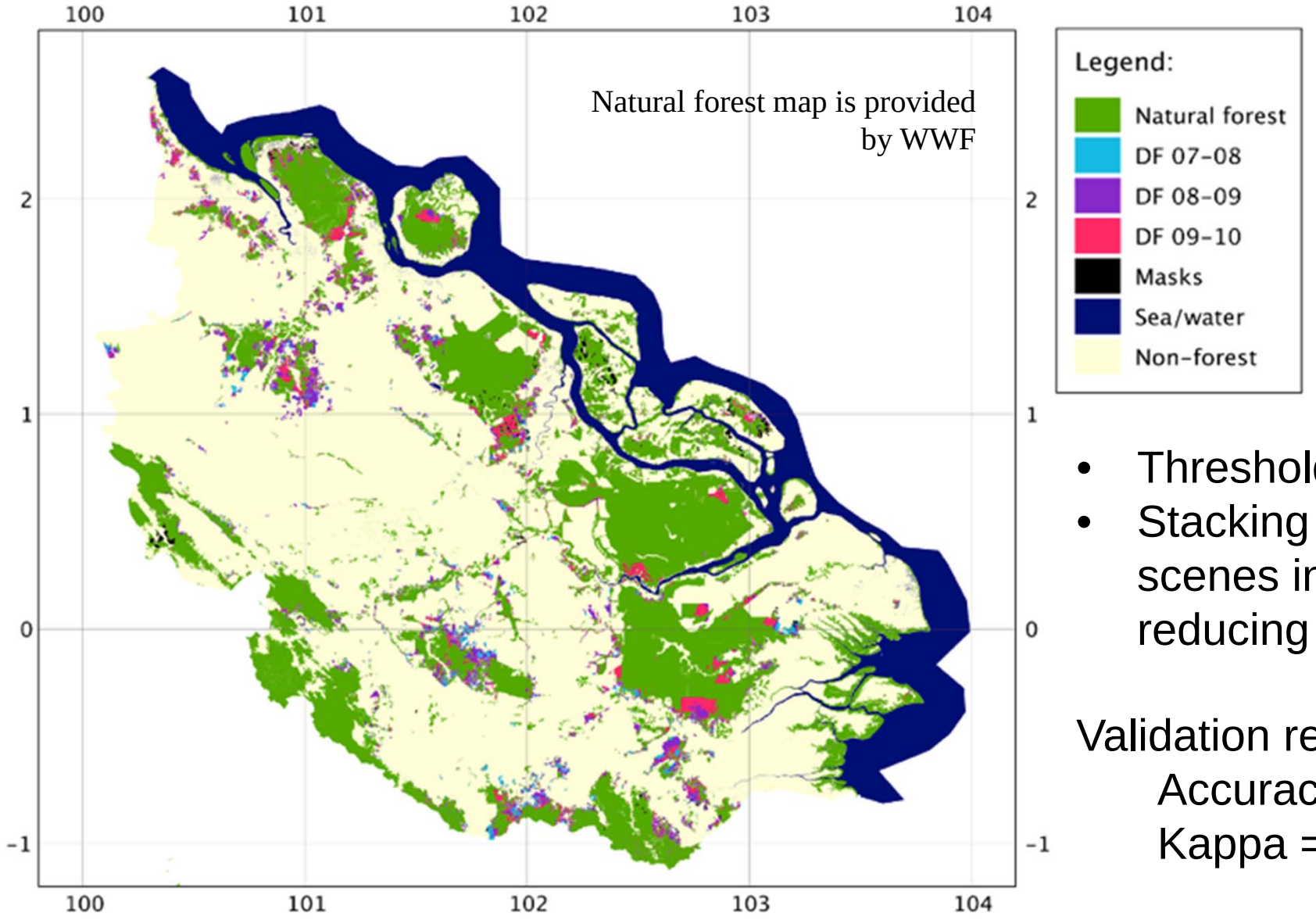
Gamma-zero HV vs. TRMM 10-day precipitation



Detection accuracy vs. TRMM 10-day precipitation



Annual deforestation map of Riau, Indonesia



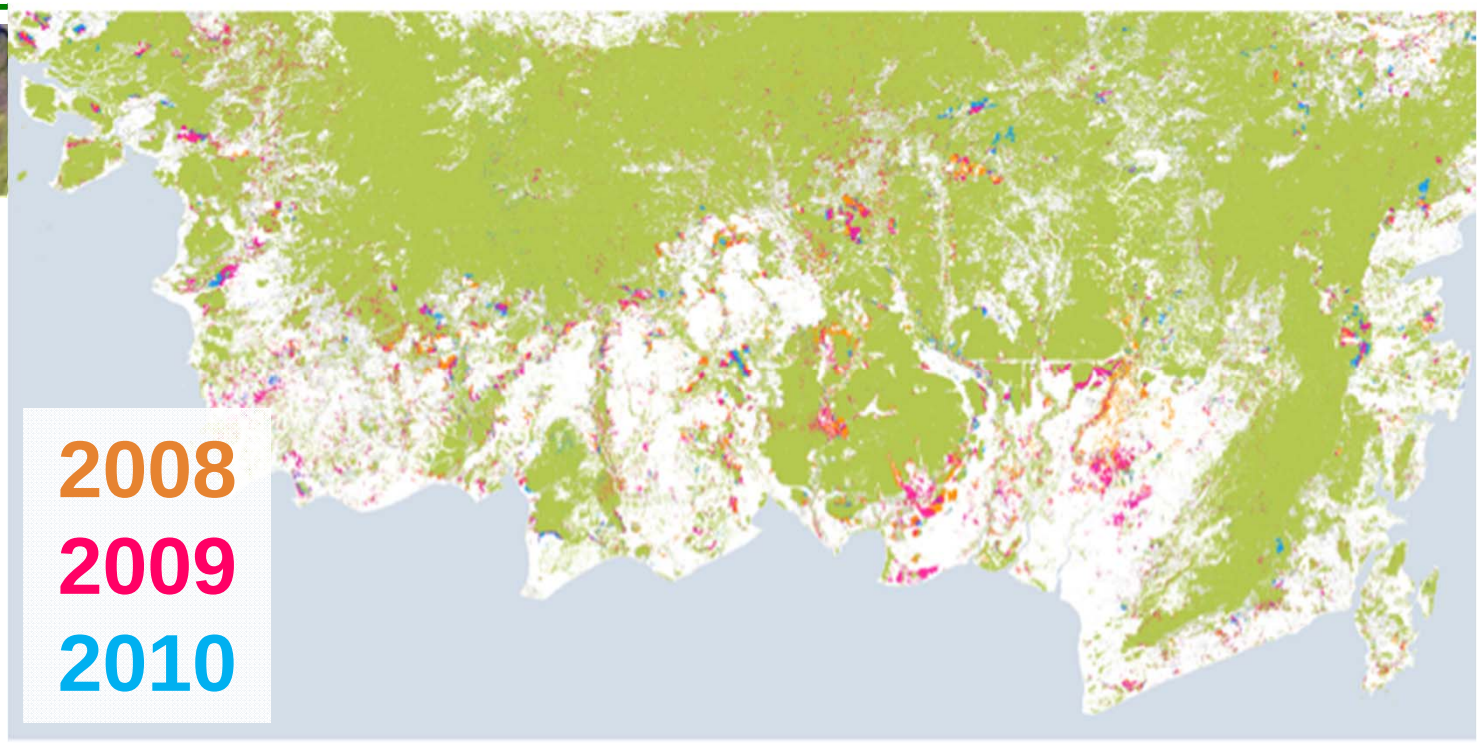
- Threshold = -1dB
- Stacking several scenes in each year for reducing errors

Validation result:

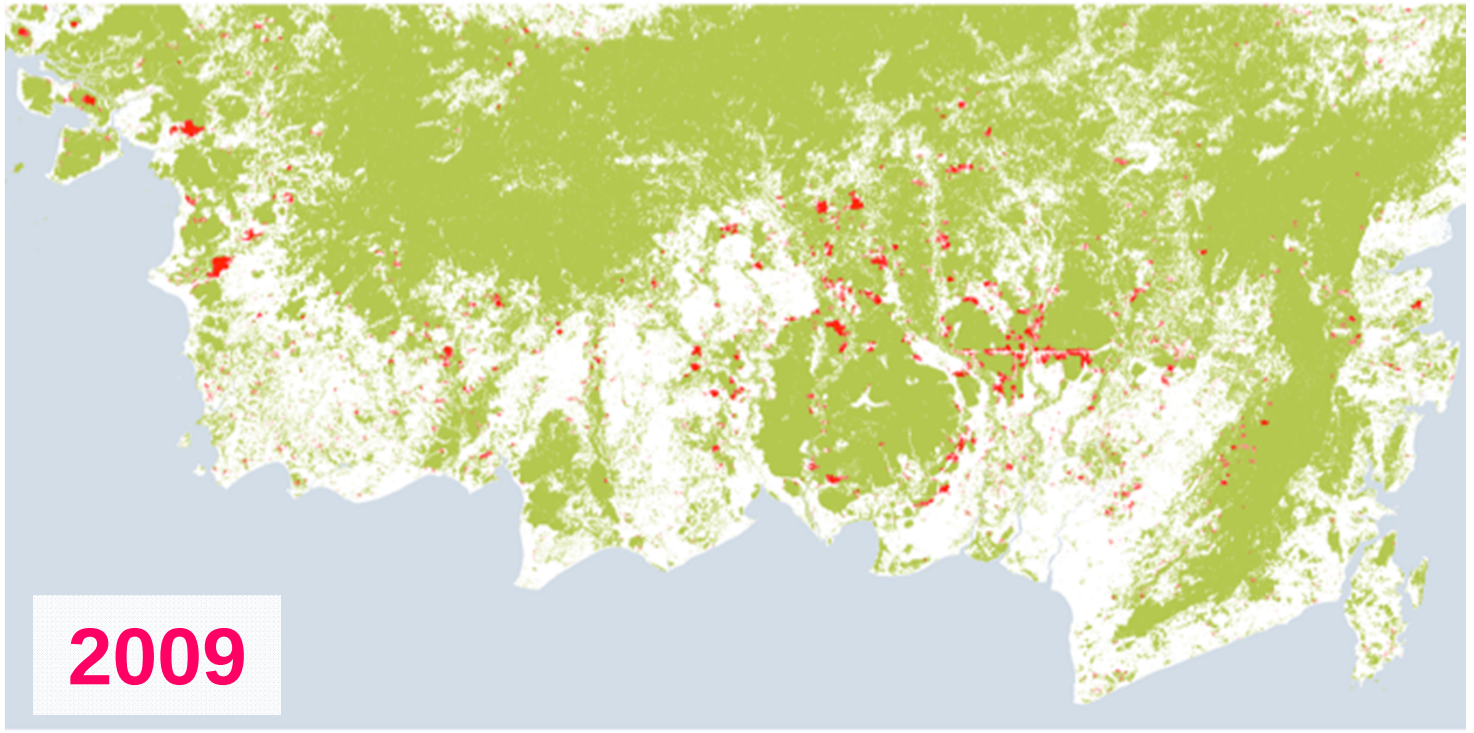
Accuracy = 92%

Kappa = 0.89

Deforestation
（PALSAR）

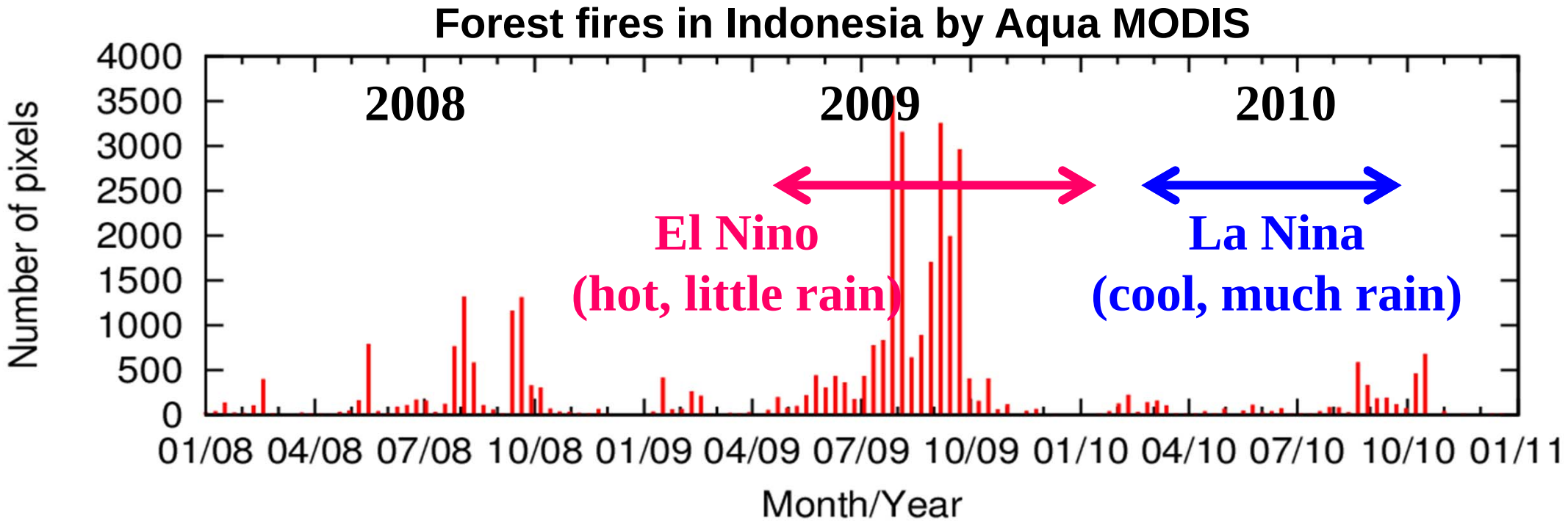


Forest fire hotspots
(Aqua MODIS)



Forest loss trends in Indonesia by PALSAR (1000 ha)

	Loss, 2008	Loss, 2009	Loss, 2010
Sumatra	661	898	452
Kalimantan	467	845	363
Indonesia Total	**1,634**	**2,342**	**1,041**



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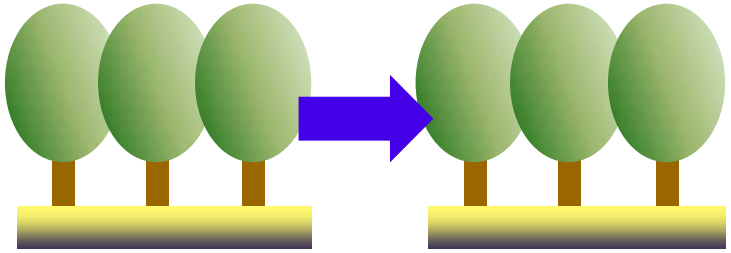
Forest change detection using coherence change

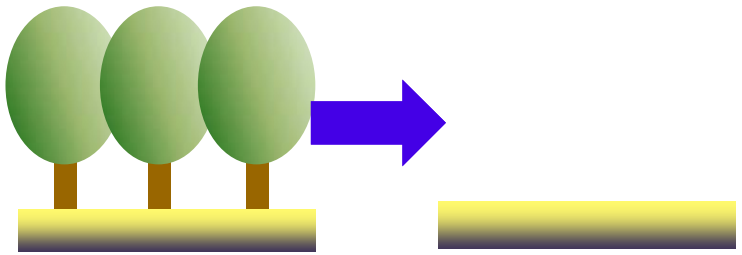
No change
(natural forest)

Low coherence



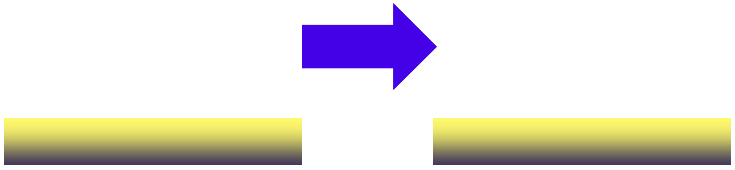
Deforested

Low coherence

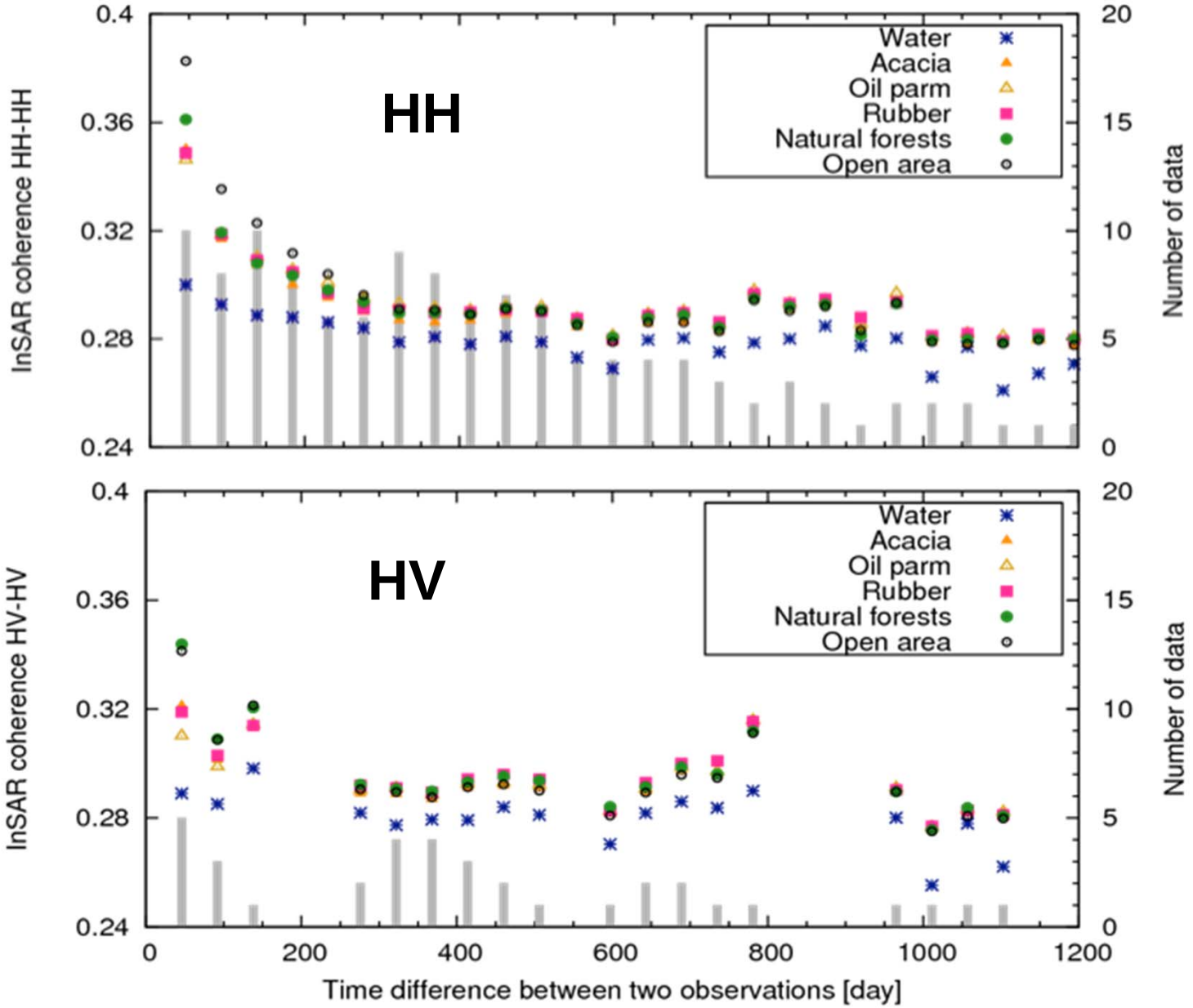


No change
(cleared land)

High coherence



PALSAR coherence and temporal baseline



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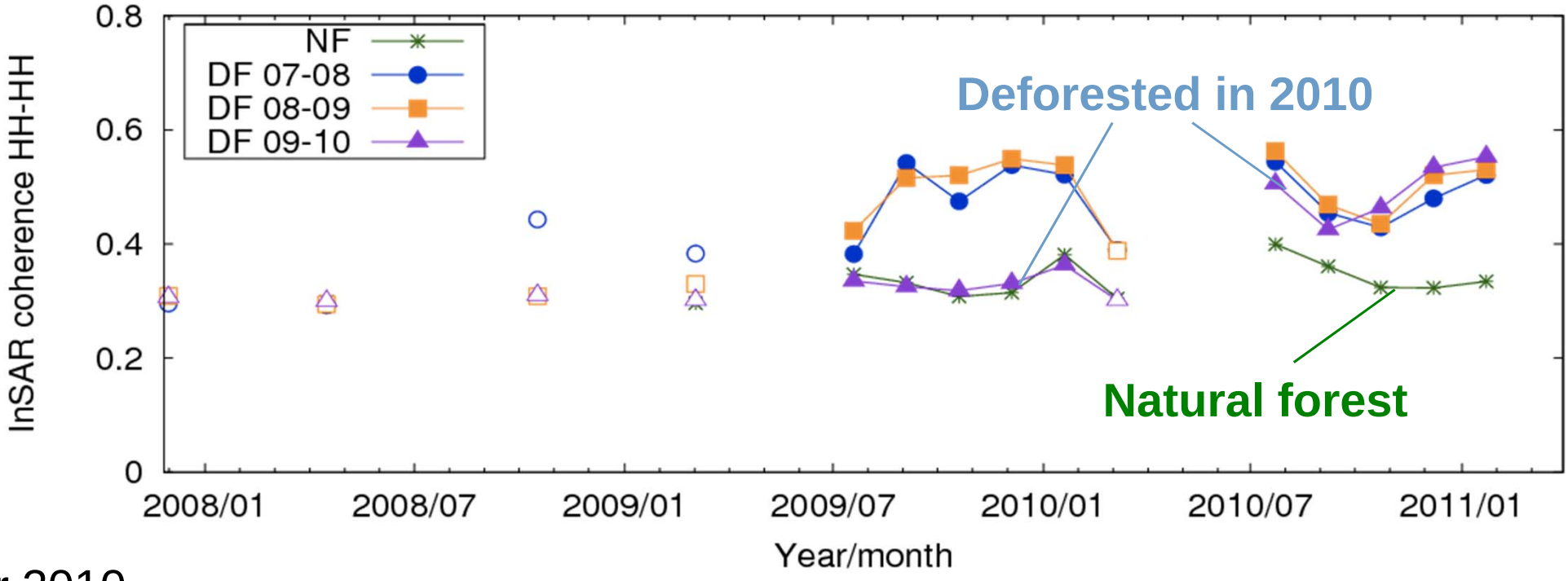
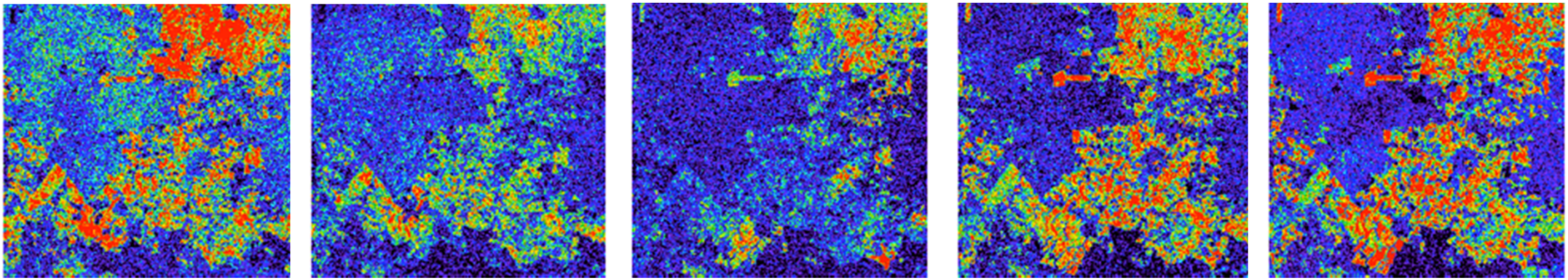
Characteristics of PALSAR 46-days coherence



year 2010



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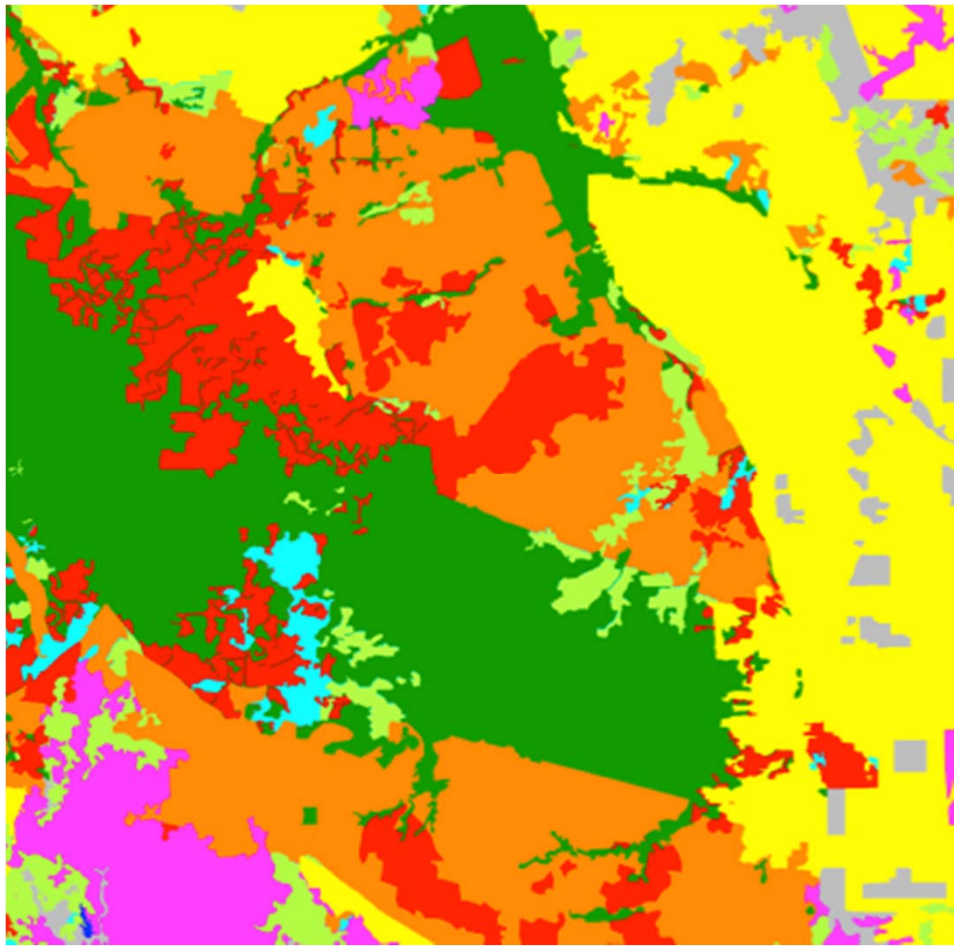
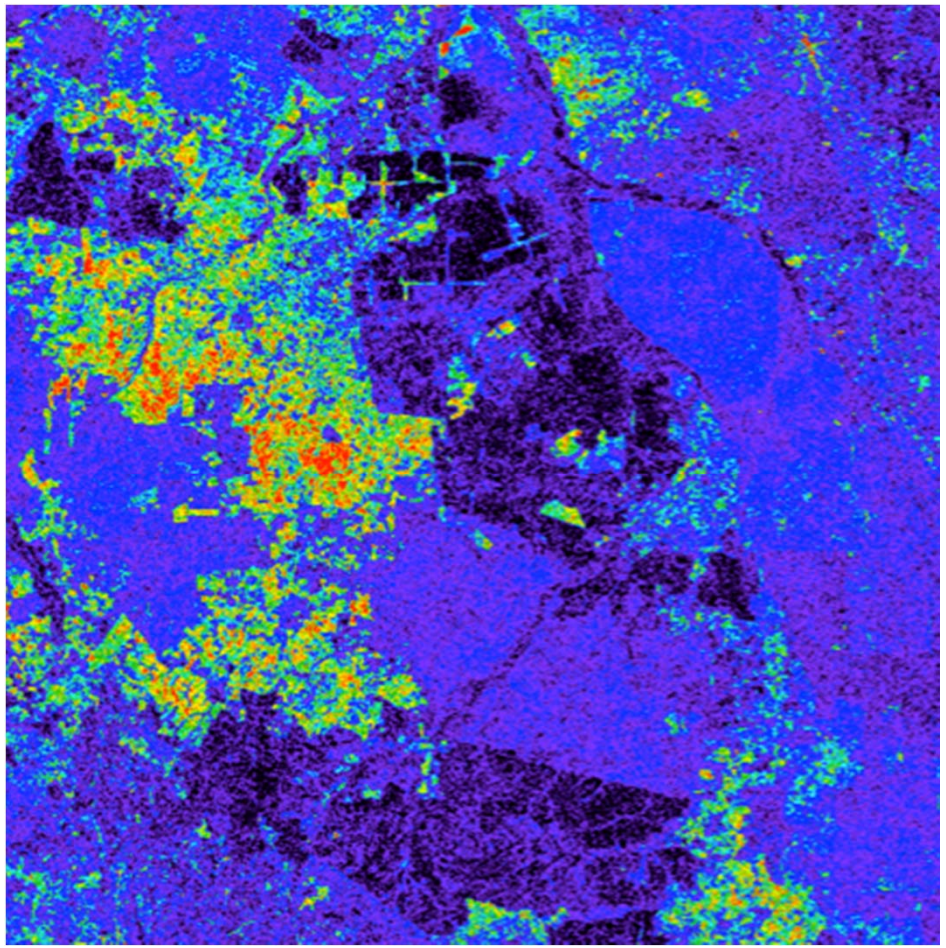
Land cover (WWF map)

- Natural forests
- Acacia
- Oil palm
- Rubber
- Open land
- Others



Time-series average coherence (2010)

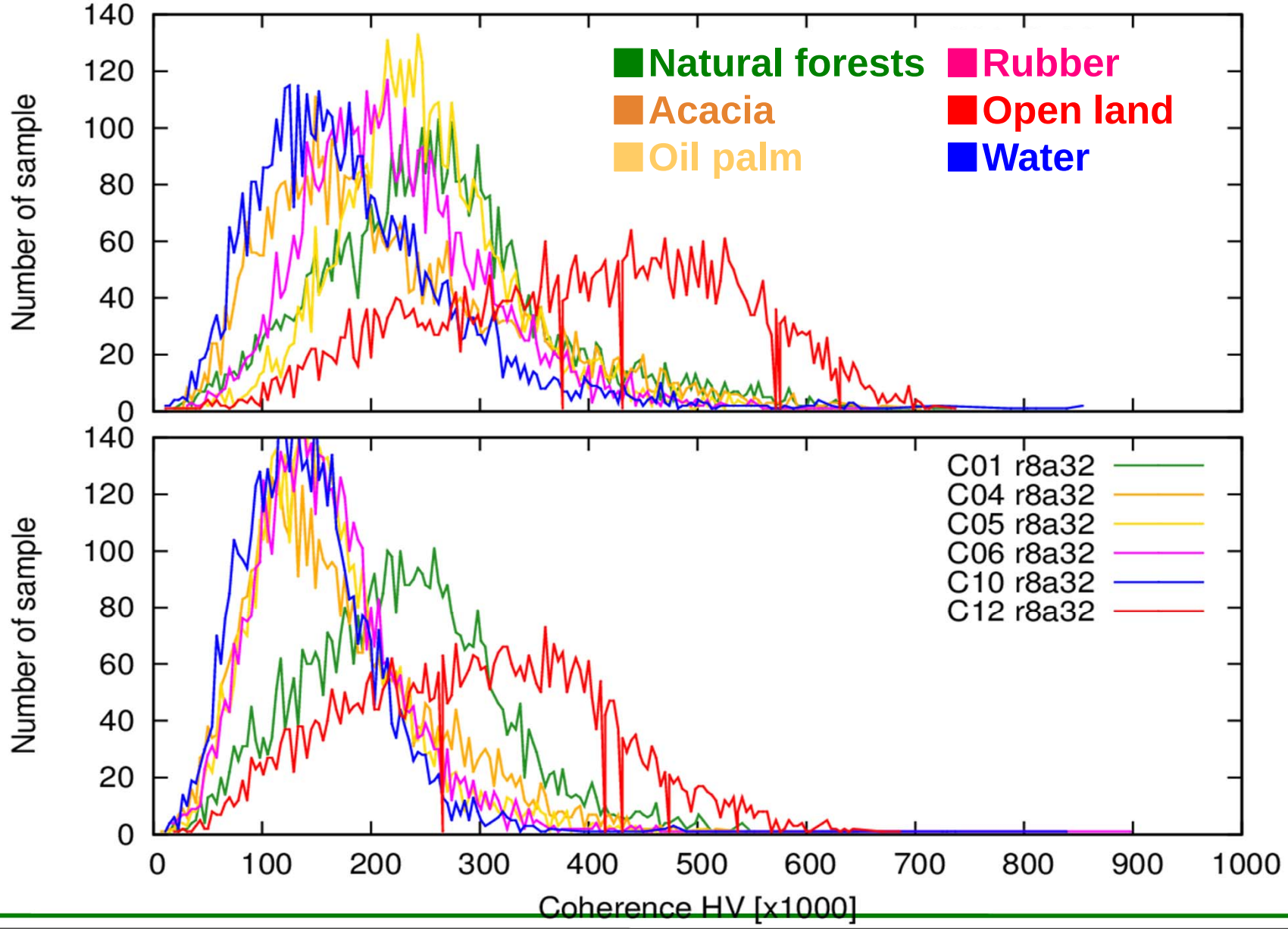
0.2 0.4 0.6



Coherence of each land cover type

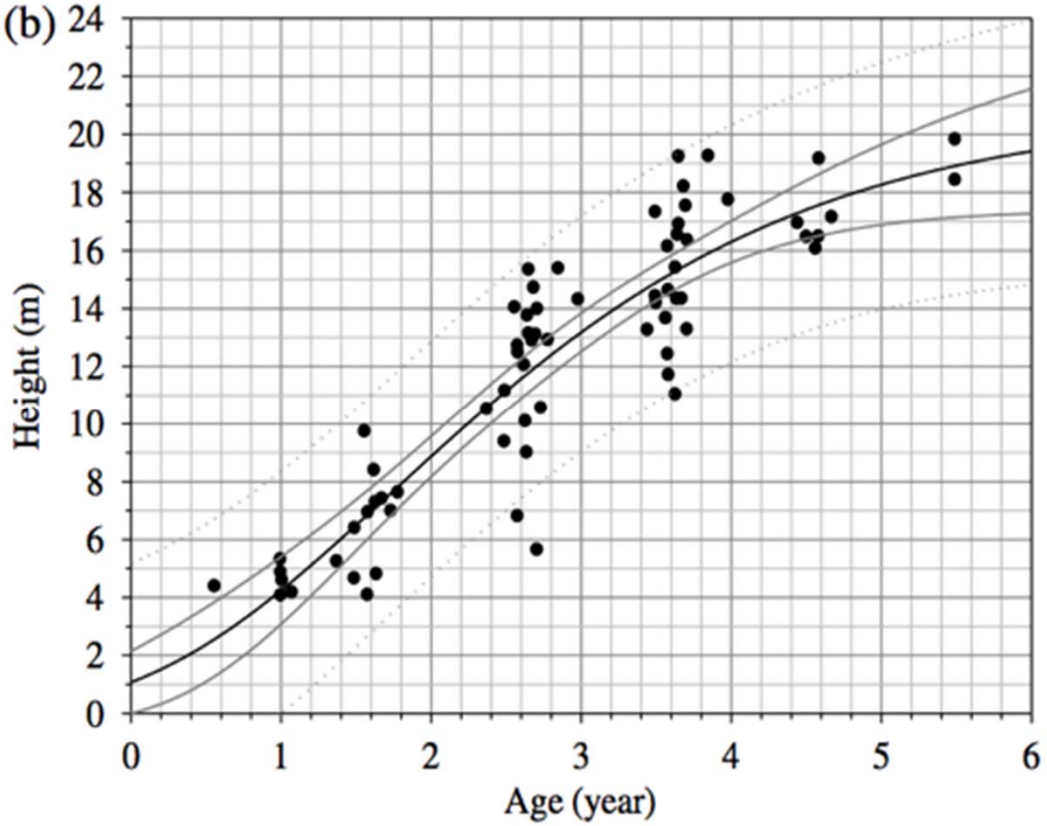
HH

HV



Low coherence at acacia plantations <- rapid growth ?

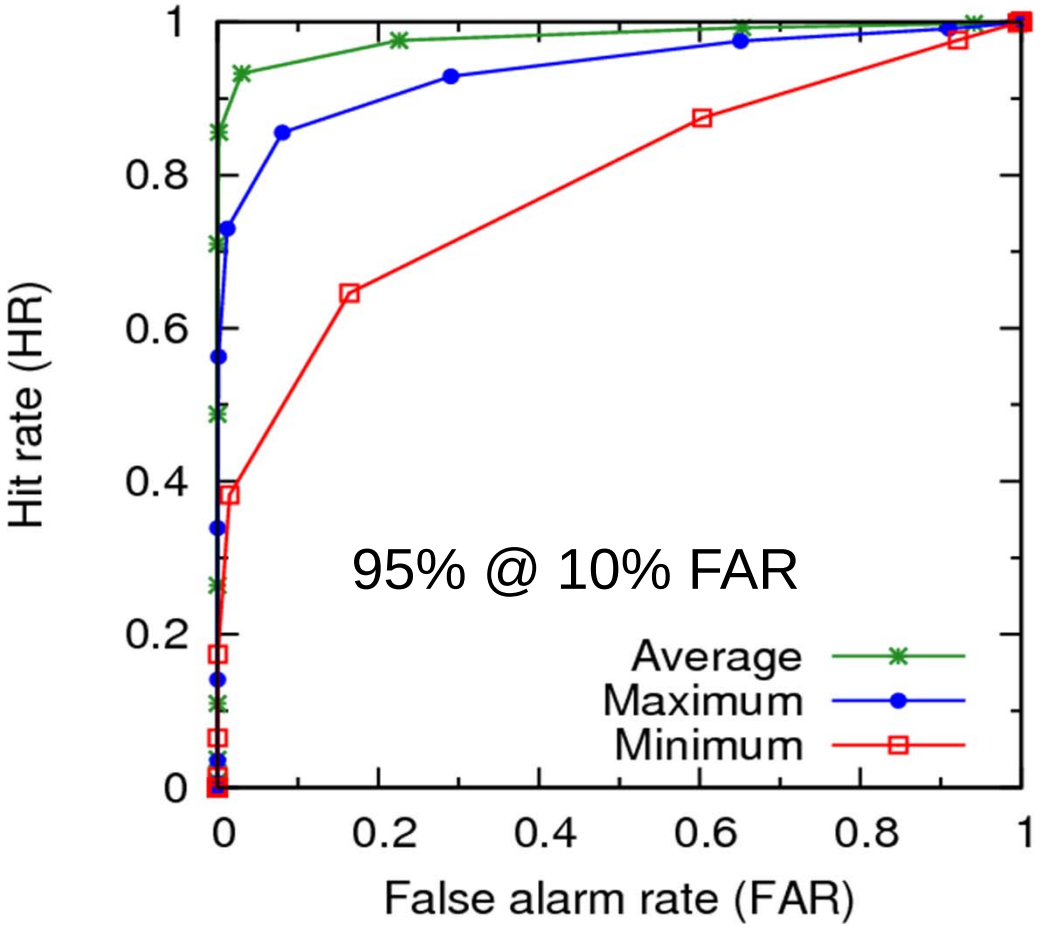
Fig. 2 Forest plantation of *Acacia mangium* in the targeted area: (a) 1st year, (b) 3rd year, (c) 4th year, (d) 5th year and (e) 6th year. A permanent sample point (PSP) pole can be seen in the foreground of images (a) and (d).



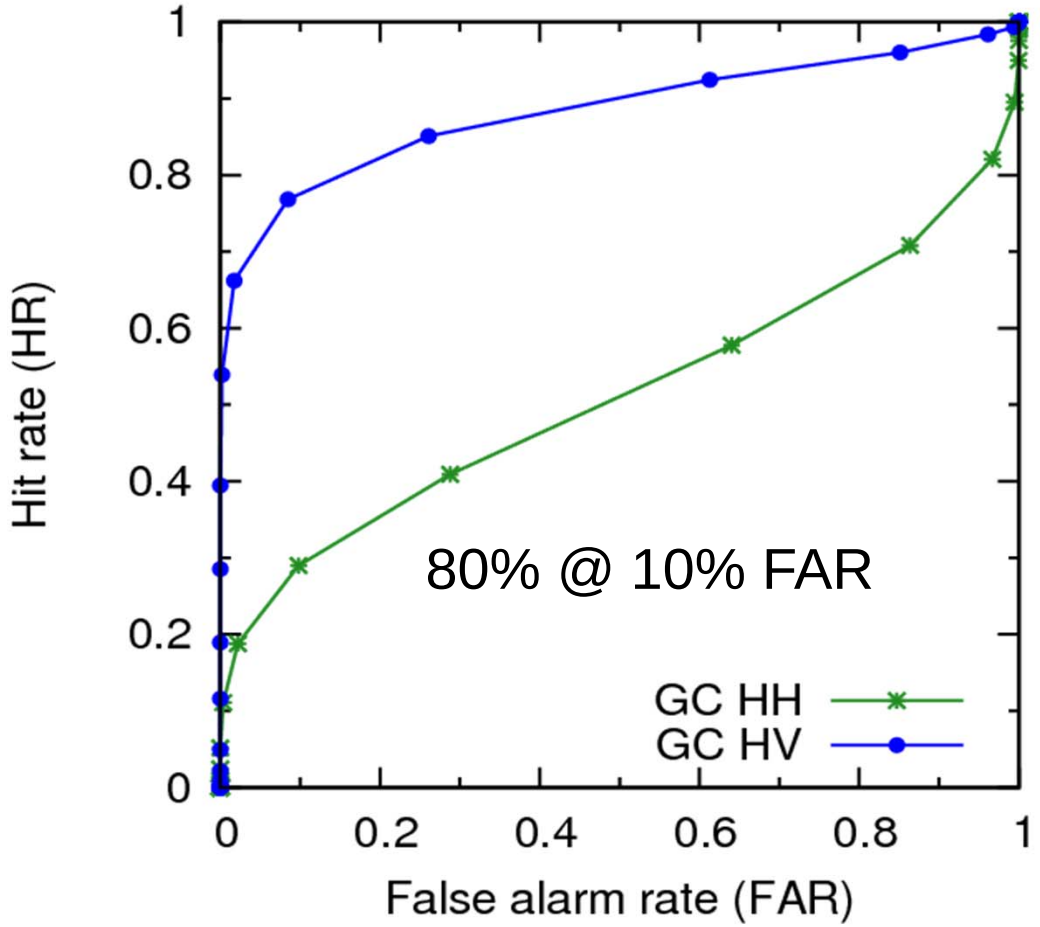
Kobayashi et al., 2012

Detection accuracy of the coherence change method (ROC curve)

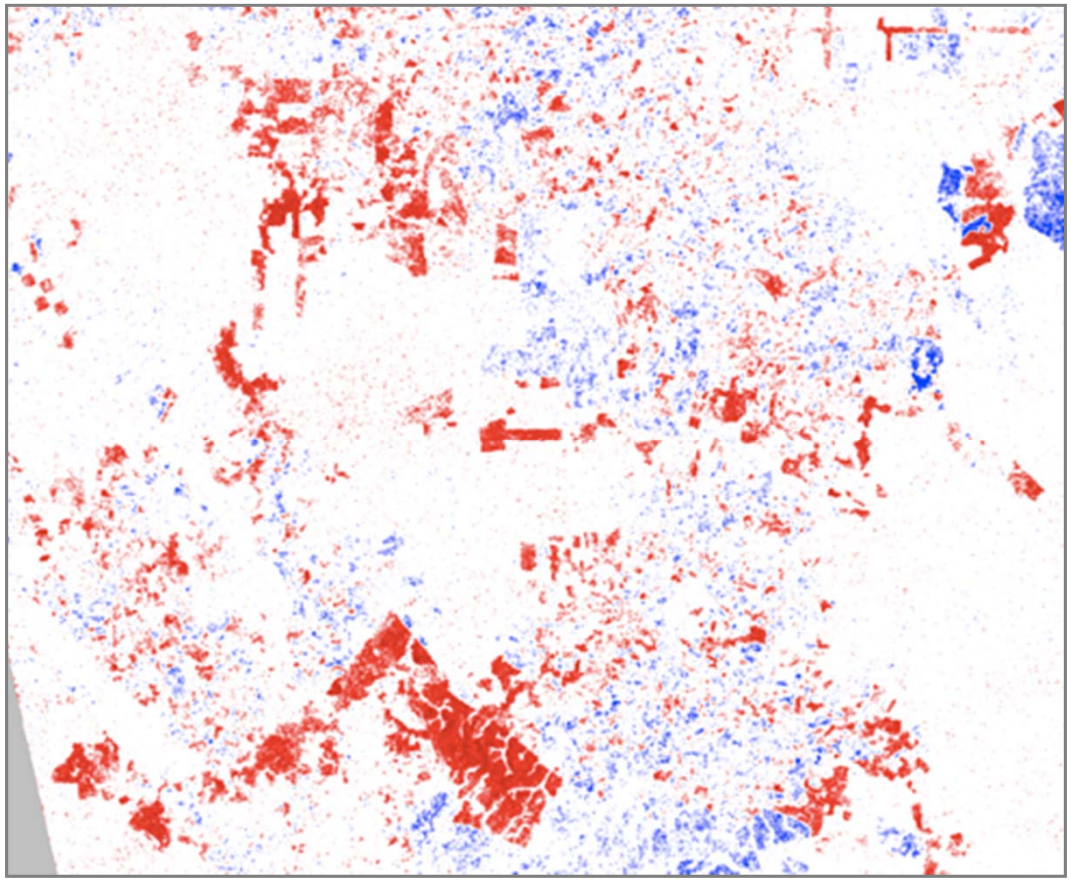
Coherence based



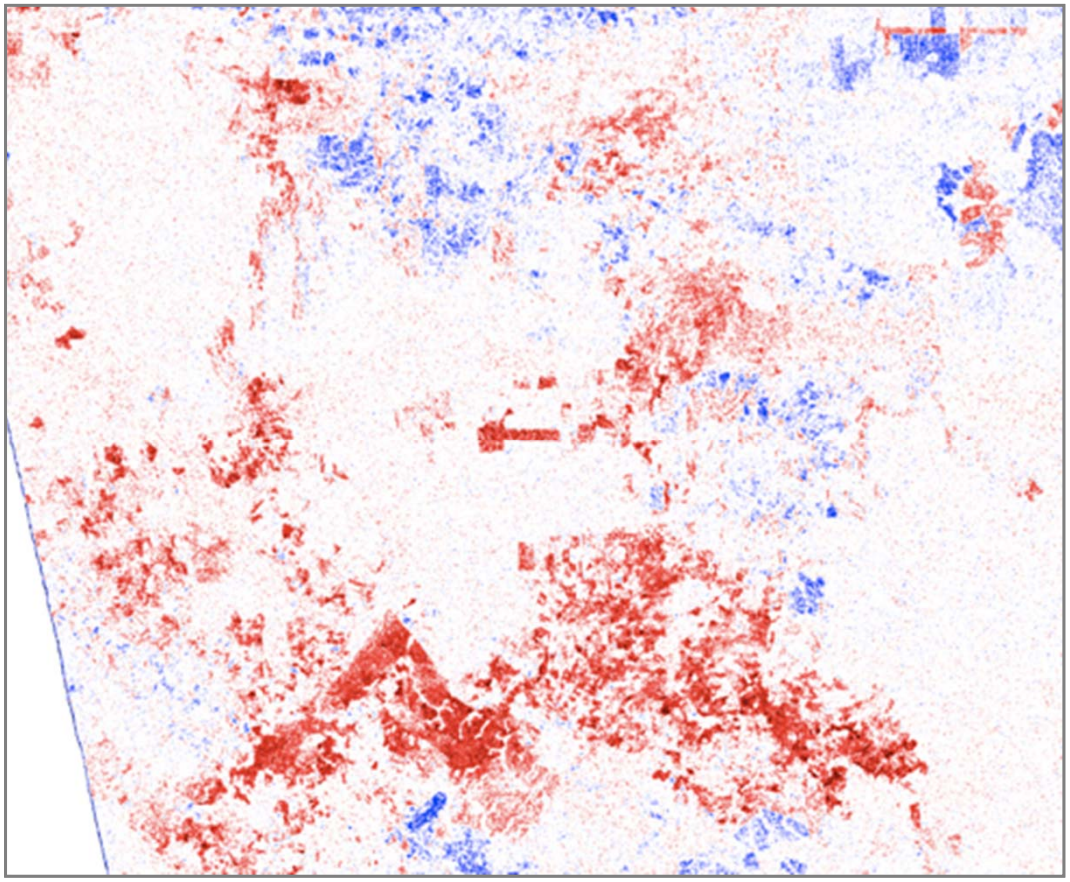
Gamma-zero based



Coherence based



Gamma-zero based



16 looks, averaging filter for 5 x 5 pixels

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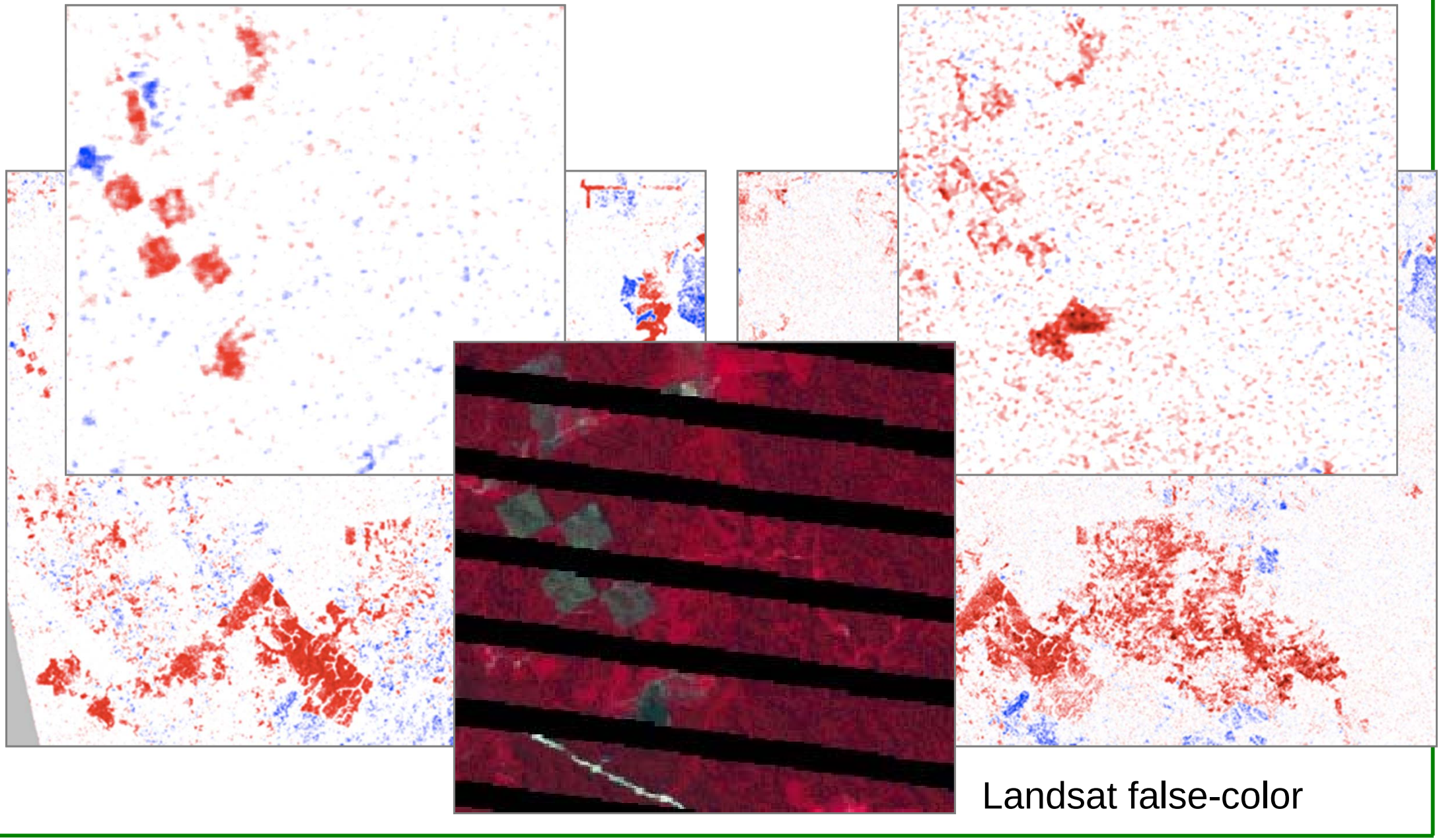

Landsat false-color

Summary

- **Gamma-zero based forest change detection**
  - Polarization: HV
  - Automatic, low computation cost
  - Accuracy: > 70%
  - Application: early warning (illegal deforestation, forest fires, etc.)

- **Coherence based forest change detection**
  - Polarization: HH (many FBS mode data can be used)
  - Automatic, high computation cost (InSAR process)
  - Low latency: more than two acquisitions after deforestation are required.
  - Accuracy: > 90%
  - Application: inventory