

A preliminary study on deforestation monitoring in Sumatra Island by using PALSAR

Osamu Isoguchi (JAXA), Masanobu Shimada
(JAXA), and Yumiko Uryu (WWF)

Background

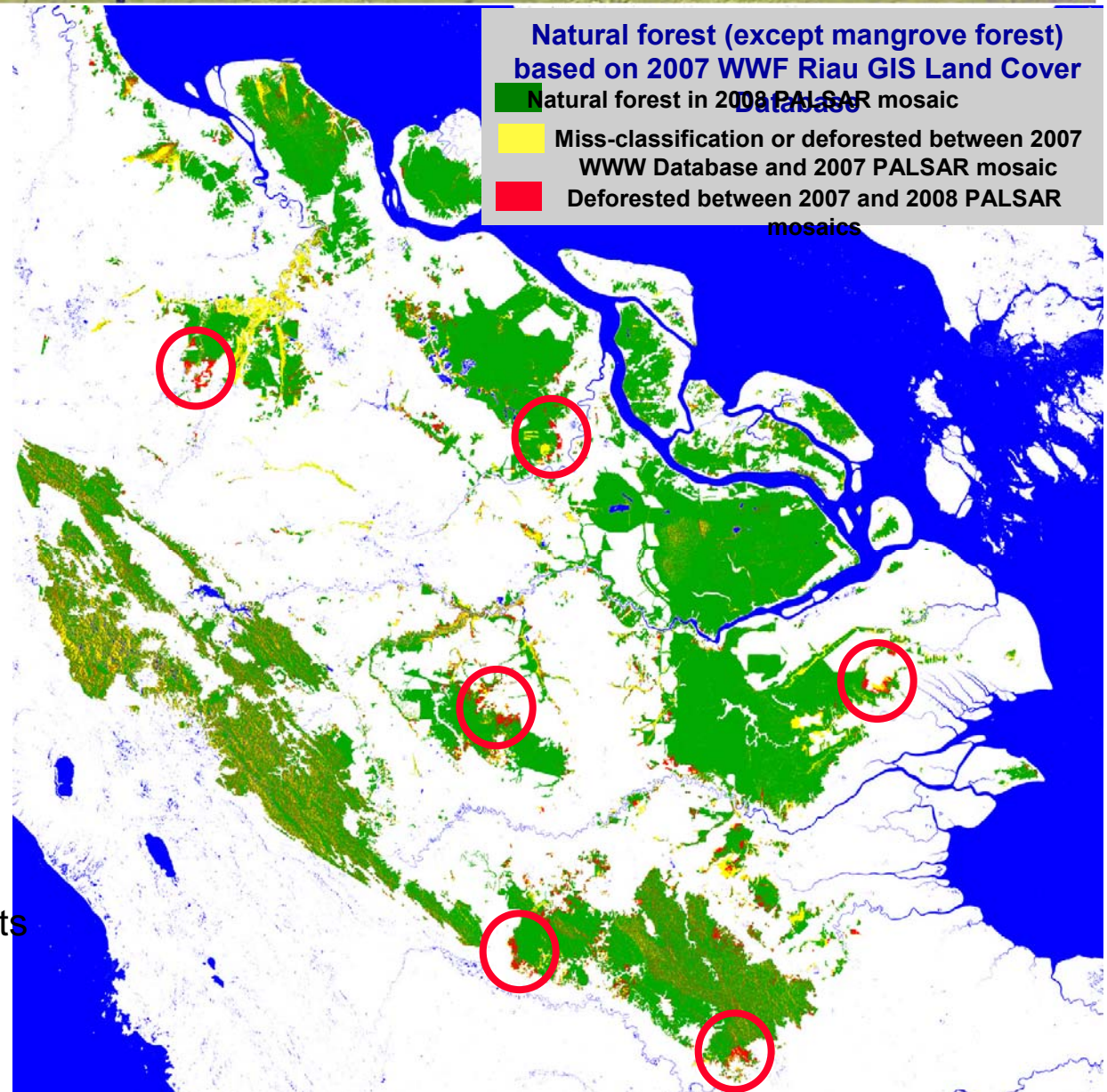
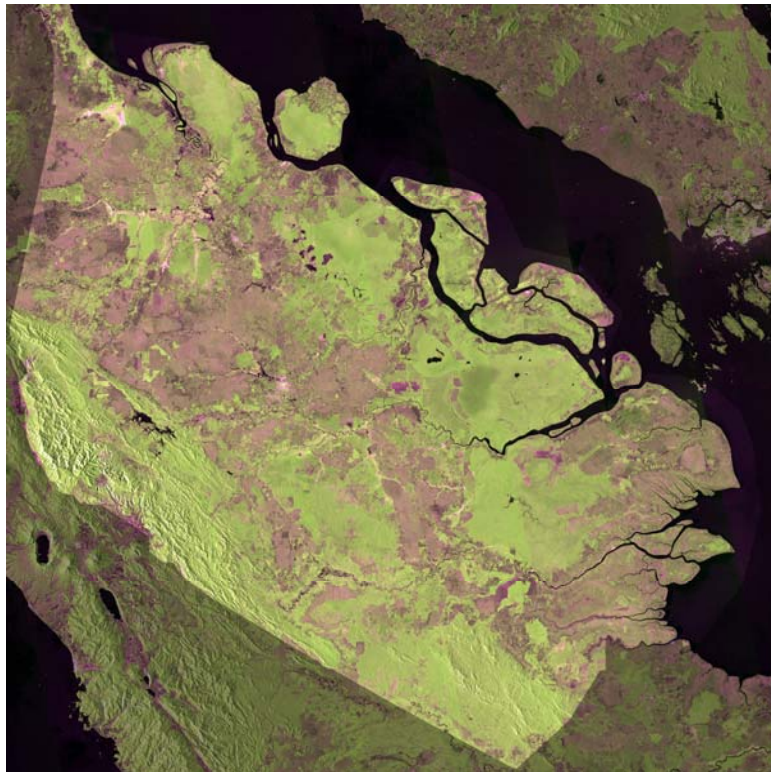
- ✓ Supervised classification (Natural forest and non-forest) by maximum likelihood method using the 2007 dual-pol mosaic:
 - ✓ 88% of natural forest defined based on **2007 Land Cover Database by WWF** was successfully classified into forest, while some plantations (**Acacia plantations**) miss-classified into forest.
 - ✓ **HV**: plantations (except for Acacia and Rubber) (-18.2dB) and cleared (-19dB) are **2-3 dB lower** than natural forest (-15.8dB). No significant difference between Acacia (-16.6dB) and Rubber (-15.8dB) plantations and natural forest.
 - ✓ **HH**: no significant difference among natural forest (-7.7dB), plantation (-8.2dB), and cleared (-8.7dB).
- ✓ **This study**
 - ✓ estimates deforested areas from 2007 to 2008 in Riau Province, Sumatra Island, by combining **the 2007 WWF Database** and **2007 and 2008 PALSAR dual-pol. mosaics**.
 - ✓ investigates signature change in (estimated) deforested area, mainly focusing on **HH** signal toward **near-real-time deforestation monitoring by ScanSAR**

ALOS

2008 deforested area estimation from PALSAR mosaics and WWF database

K&C Initiative

an international science collaboration led by JAXA



By supervised classification

- ✓ Natural forests are penetrated from perimeters.
- ✓ **Estimated deforested area in 2007-2008:** 1,200km² ≈3.7% of natural forests in 2007
- ✓ Uncertainty: mountainous area
 - ✓ **Slope correction** should be implemented !!

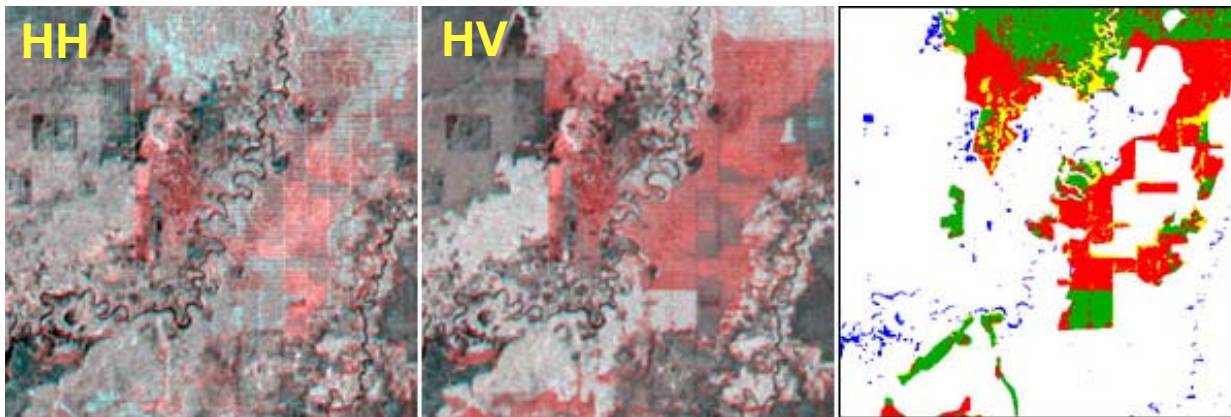
ALOS

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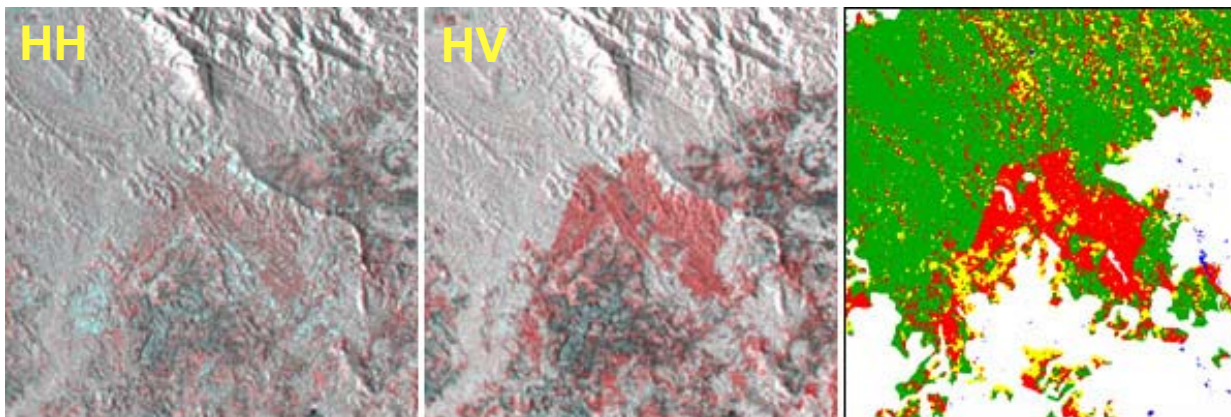
Examples of major deforested area (hot spot)

Color composite: **Red**:2007 **Blue & Green**:2008

Bright in 2007 and dark in 2008 → shown in red.



17km



Natural forest (except mangrove forest)
based on 2007 WWF Riau GIS Land Cover

Green: Natural forest in 2008 PALSAR mosaic

Yellow: Miss-classification or deforested between 2007
WWF Database and 2007 PALSAR mosaic

Red: Deforested between 2007 and 2008 PALSAR
mosaics

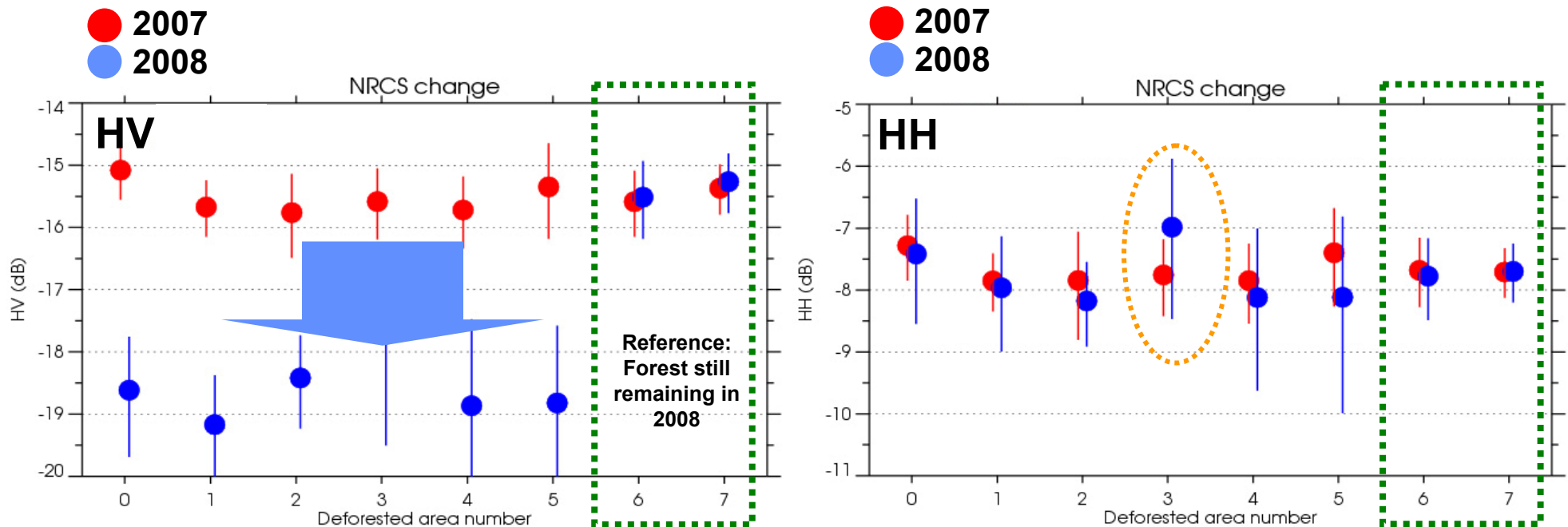
HV:

- easily identify deforested area
- contribute to estimation

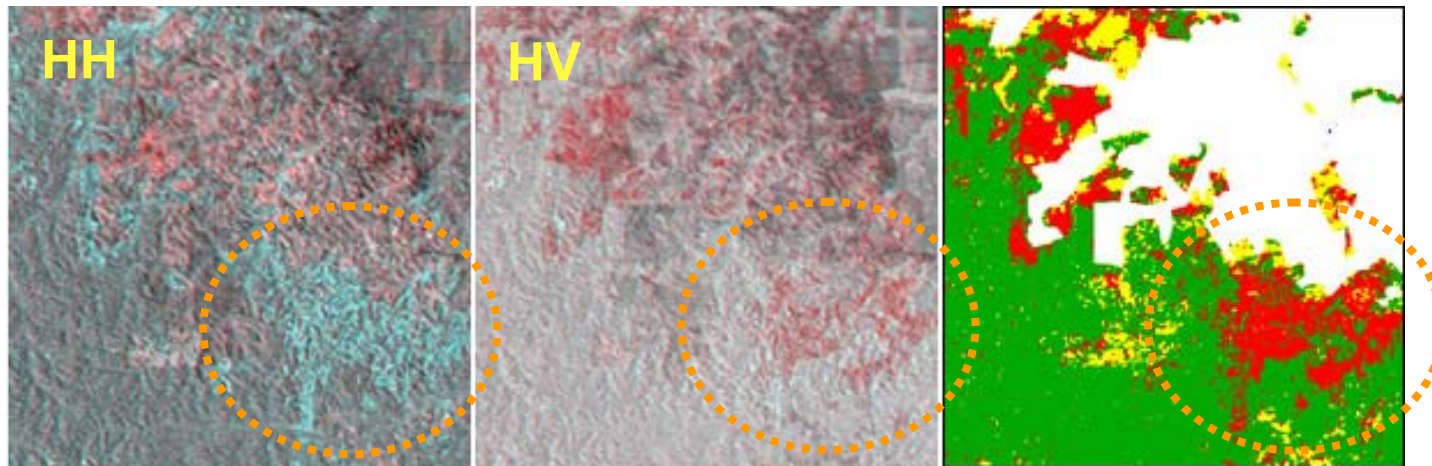
HH:

- no significant difference

HH & HV changes between 2007 and 2008 mosaics in hot spots



- ✓ **HV** decreased by $3 \pm 0.57 \text{ dB}$ for all 6 areas.
 - ✓ common signature from natural forest (-15.8 dB) to cleared (-19 dB)
- ✓ **HH** showed no significant changes ($0.13 \pm 0.49 \text{ dB}$ decrease), some of which increased by 0.8 dB.

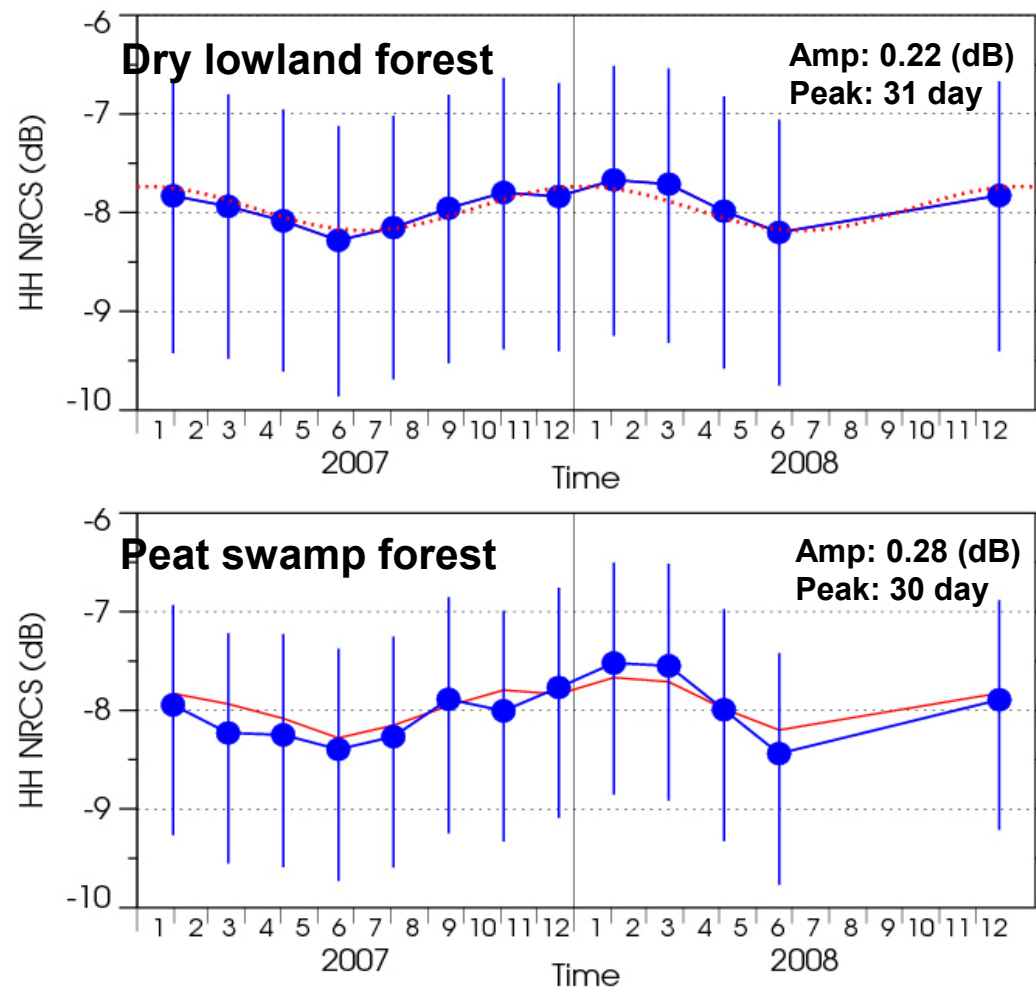


- ✓ How does HH change for deforestation ?
- ✓ Is it possible to implement near-real-time deforestation monitoring by ScanSAR data (HH single pol)?

Investigation of ScanSAR time series !

Time series of HH σ^0 from ScanSAR data from 2007 to 2008

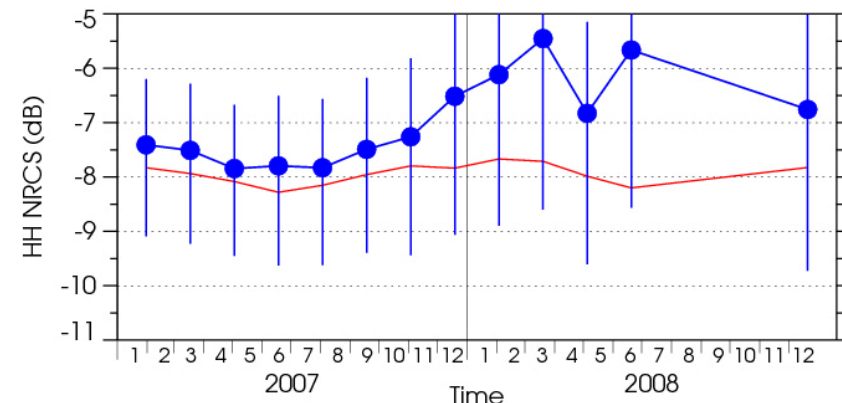
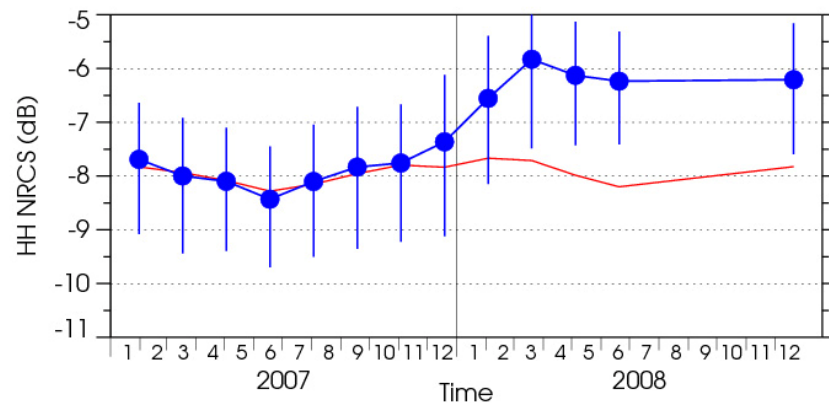
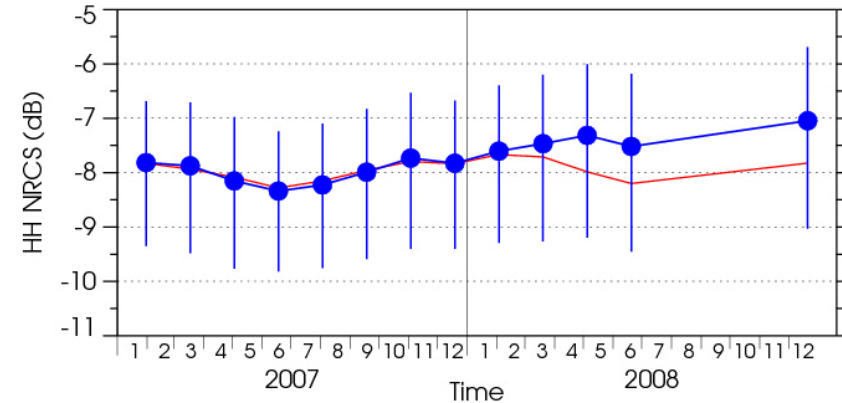
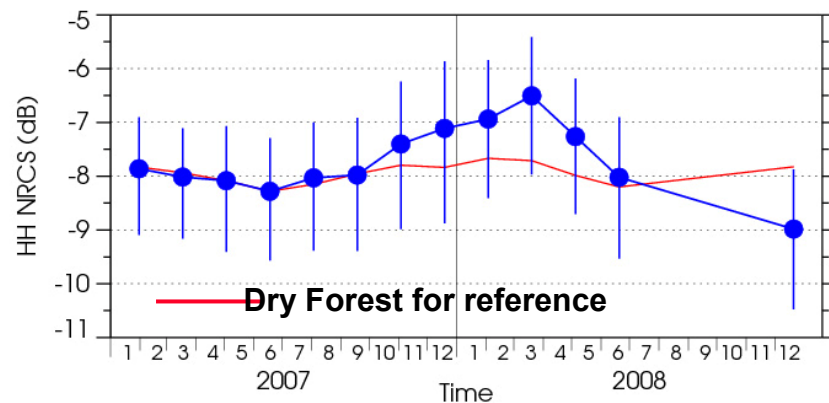
Reference



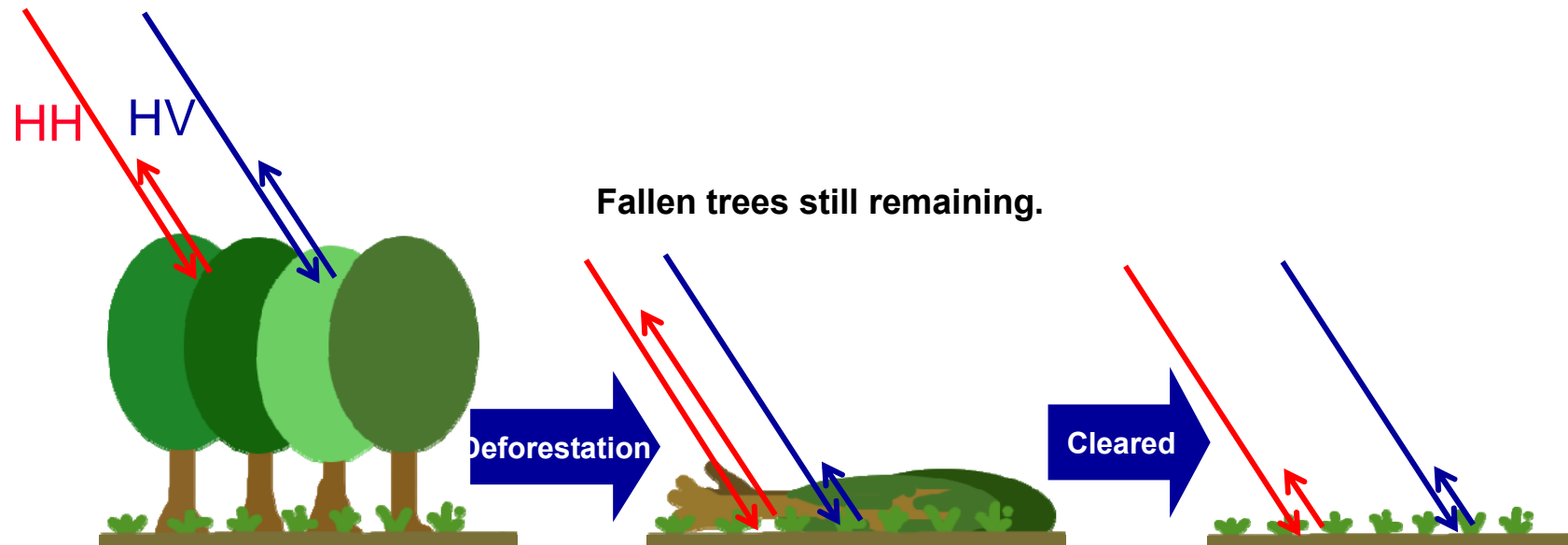
- ✓ Annual cycle with **maximum** (minimum) peak in **wet** (dry) season.
- ✓ Similar seasonal change in Amazon dense forest (Shimada, 2005).
 - ✓ Seasonal change in the moisture contents of canopy and ground reasonably explain σ^0 change

Time series of HH σ^0 from ScanSAR data from 2007 to 2008

Hot spots



- ✓ HH signal in hot spots once increases departing from the annual cycle of natural forest probably at the time when deforestation had started.
- ✓ After peak, some case decreases lower than common forest, whereas some keep higher status.



HH: high

HV: high

extremely high
(double-bounce scattering ↗ ?)

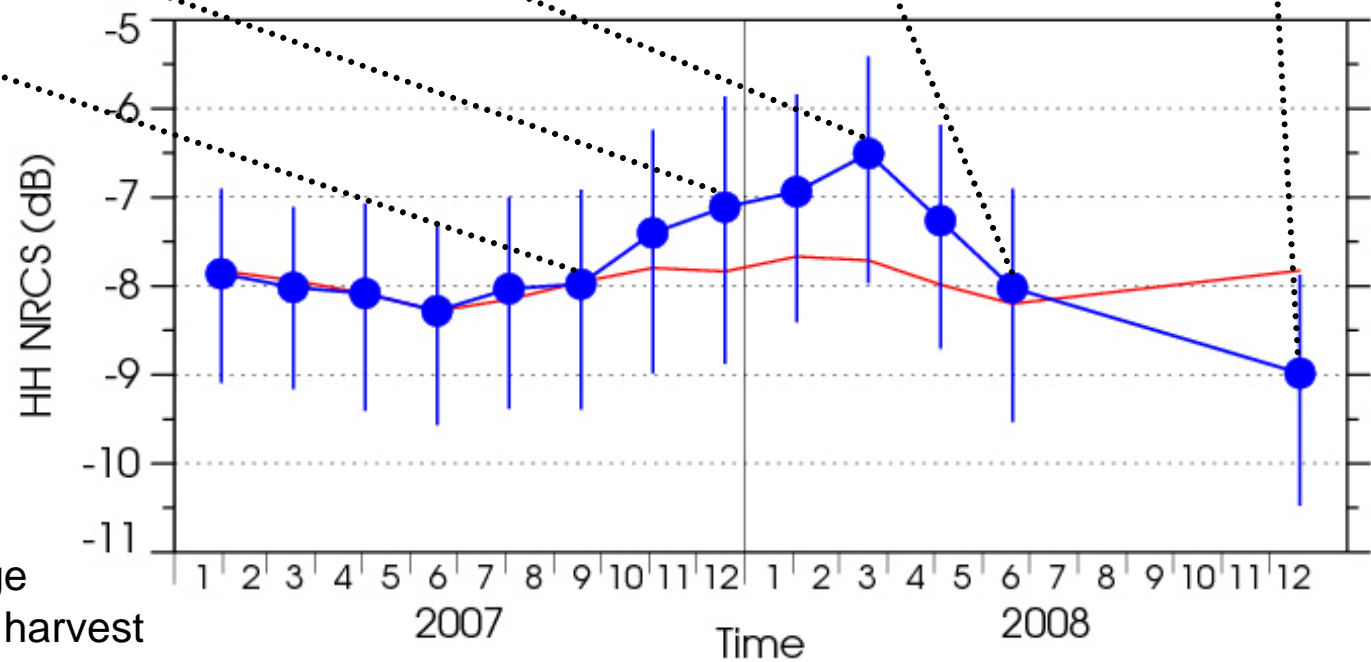
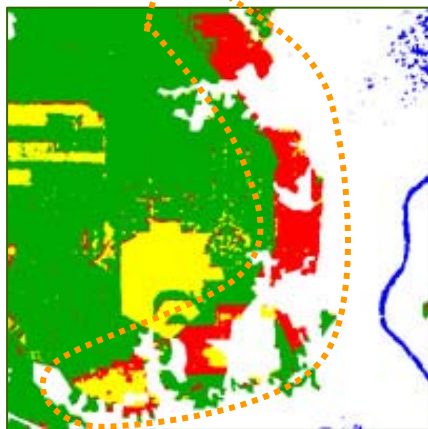
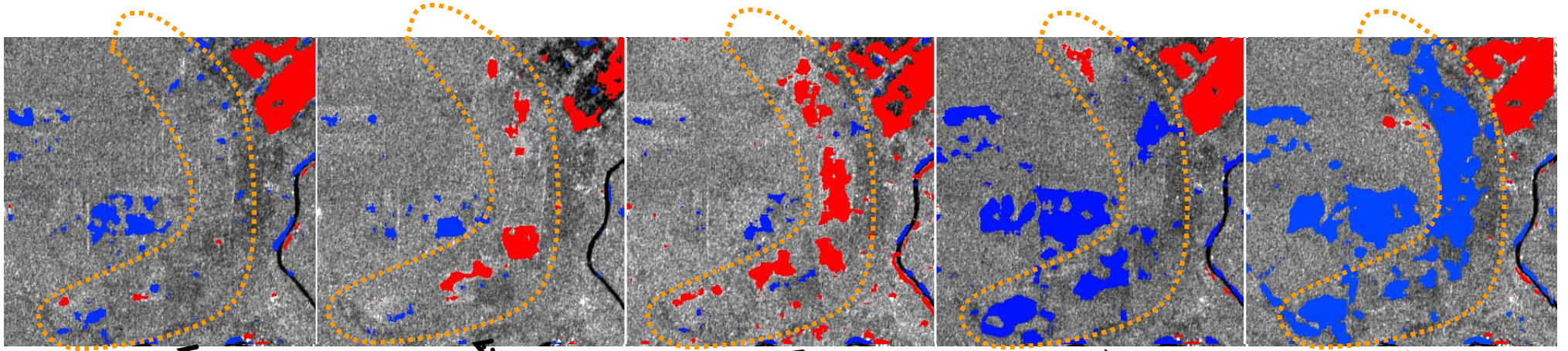
low
(volume scattering down ↘ ?)

low

low

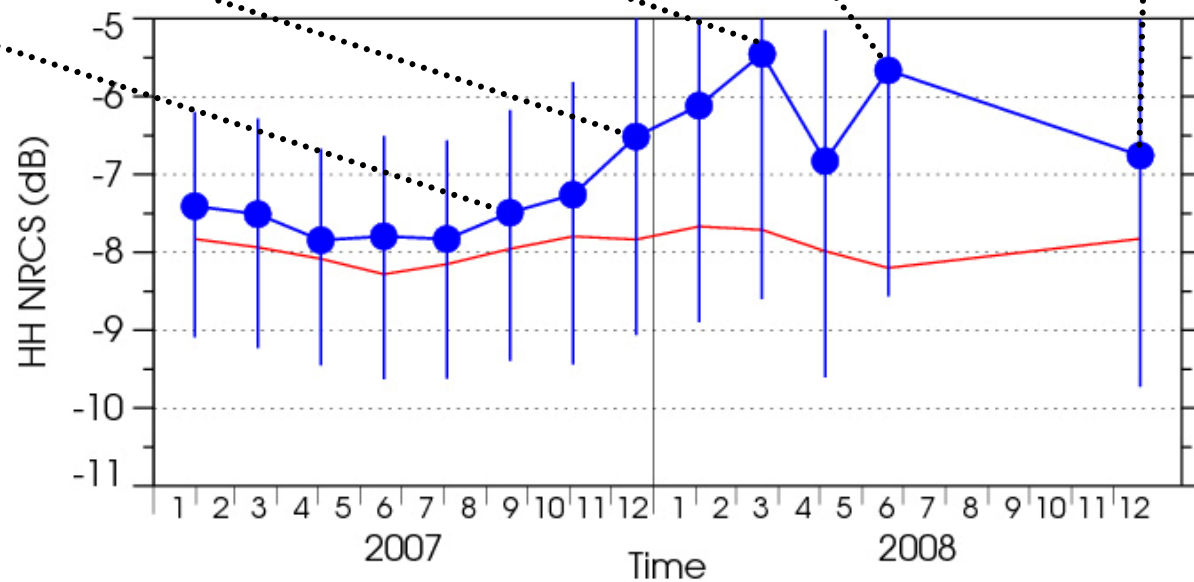
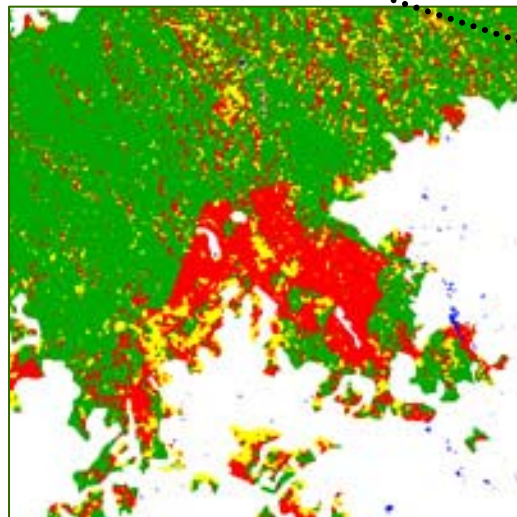
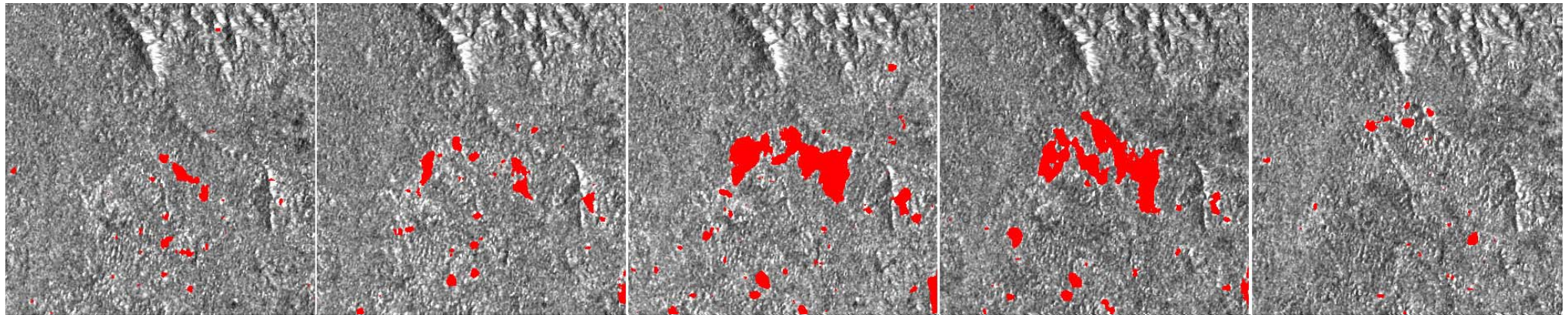
Ground truth is needed for better understanding!!

Red: > 1.5 dB (taking the forest annual cycle into account) than reference Blue: < 1.0 dB than reference



Plantations have similar large variability probable due to a harvest cycle.

ed: > 1.5 dB (taking the forest annual cycle into account) than reference



Summary

- ✓ On the basis of **the 2007 WWF database** and by using **the PALSAR dual-pol. mosaics**, deforested area from 2007 to 2008 was estimated in Riau Province as about **1,200km²**, 3.7% of natural forest in 2007.
 - ✓ **Slope correction** should be implemented in the future for more accurate estimation.
- ✓ Signature change in deforested area from **the dual-pol mosaics: HV** significantly decreased by **$3 \pm 0.57\text{dB}$** , whereas **HH** showed **no significant changes** ($0.13 \pm 0.49\text{dB}$ decrease).
 - ✓ **HV** is effective for deforestation monitoring.
- ✓ Time series of HH signal in hot spots from **ScanSAR**: HH once **increased departing from the annual cycle** and some decreased lower than usual after peak.
 - ✓ Ground truth is needed for better understanding and its dependency on radar-look angle and environmental condition.
- ✓ The result suggests the feasibility of **near-real-time deforestation monitoring** by (HH single) ScanSAR data.
 - ✓ Careful evaluation is need for **plantations** and **flooded forests**, which show similar large seasonal variability and careful consideration for **incidence angle** dependence.