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

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

- Estimated deforested area in 2007-2008: 1,200km² ≈3.7% of natural forests in 2007.
- Uncertainty: mountainous area.
  - **Slope correction** should be implemented.
Examples of major deforested area (hot spot)

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

HH: - easily identify deforested area
    - no significant difference

HV: - easily identify deforested area
    - contribute to estimation
HH & HV changes between 2007 and 2008 mosaics in hot spots

- HV decreased by $3\pm0.57\text{dB}$ for all 6 areas.
  - common signature from natural forest (-15.8 dB) to cleared (-19dB)
- HH showed no significant changes ($0.13\pm0.49\text{dB}$ decrease), some of which increased by 0.8 dB.
Investigation of ScanSAR time series!

- How does HH change for deforestation?
- Is it possible to implement near-real-time deforestation monitoring by ScanSAR data (HH single pol)?
Time series of HH $\sigma^o$ from ScanSAR data from 2007 to 2008

- **Dry lowland forest**
  - Amp: 0.22 (dB)
  - Peak: 31 day

- **Peat swamp forest**
  - Amp: 0.28 (dB)
  - Peak: 30 day

- 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 $\sigma^o$ change.
Time series of HH $\sigma^o$ from ScanSAR data from 2007 to 2008.

- 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.
Fallen trees still remaining.

**HH:** high

extremely high

(double-bounce scattering ↑ ?)

**HV:** high

low

(volume scattering down ↓ ?)

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±0.57dB**, whereas HH showed no significant changes (0.13±0.49dB 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.