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K&C Phase 4 – Status report

Forest Mapping of North Sumatra Province, Indonesia

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LAPAN

Science Team meeting #24
Tokyo, January 29-31, 2018

Project objective

The main objective of the project is to develop industrial forest maps of North Sumatra Province, Indonesia

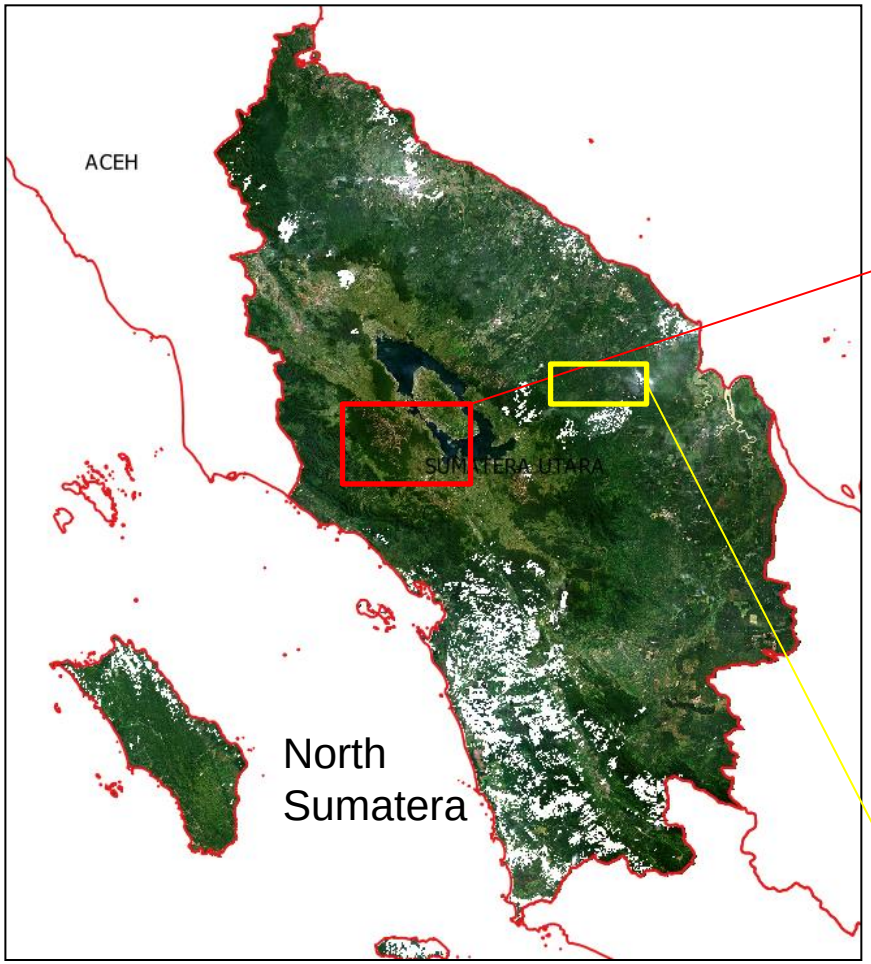
O1 : Industrial Forest mapping using ALOS2 PALSAR2 (case study : Humbang Hasundutan and Samosir Regencies)

O2 : Palm Oil Mapping (case study : Asahan Regency)

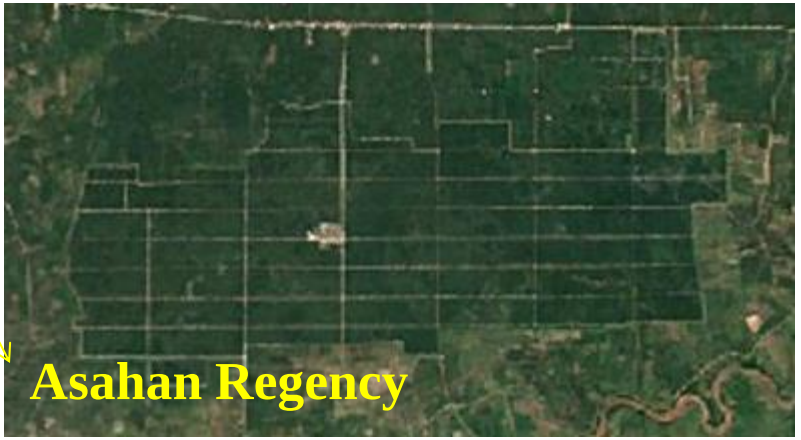
Deliverables

- Land Use/Land Use Change and Forestry (LULUCF) of North Sumatra province (Study case: Humbang Hasundutan and Samosir Regencies).
- Forest/Non-Forest change of North Sumatra province (Study case: Humbang Hasundutan and Samosir Regencies).
- Oil Palm Map in Asahan Regency
- Ground truth data in North Sumatera

Study Area


ACEH
SUMATERA UTARA
North
Sumatera

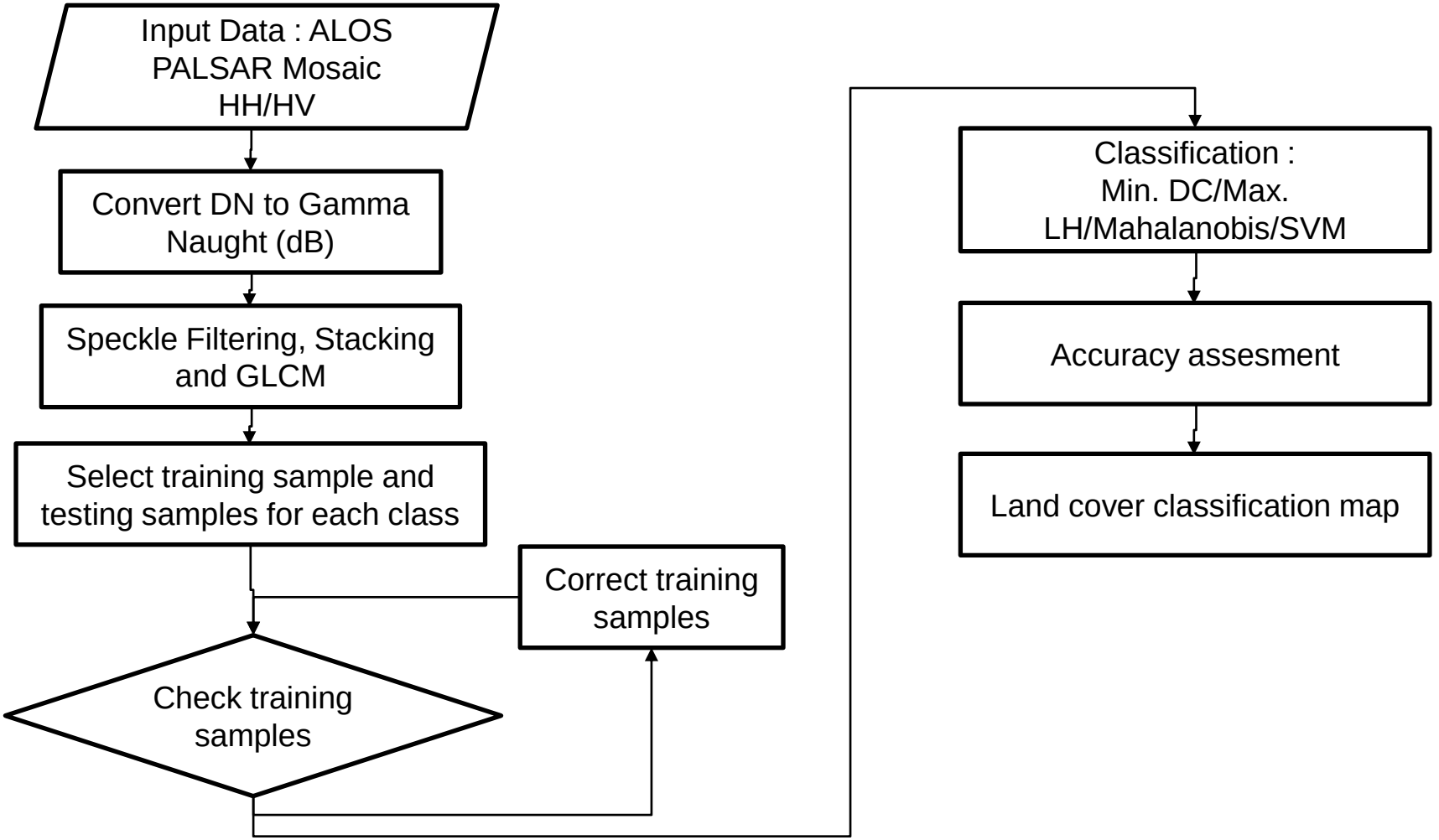

Humbang Hasundutan &
Samosir Regencies

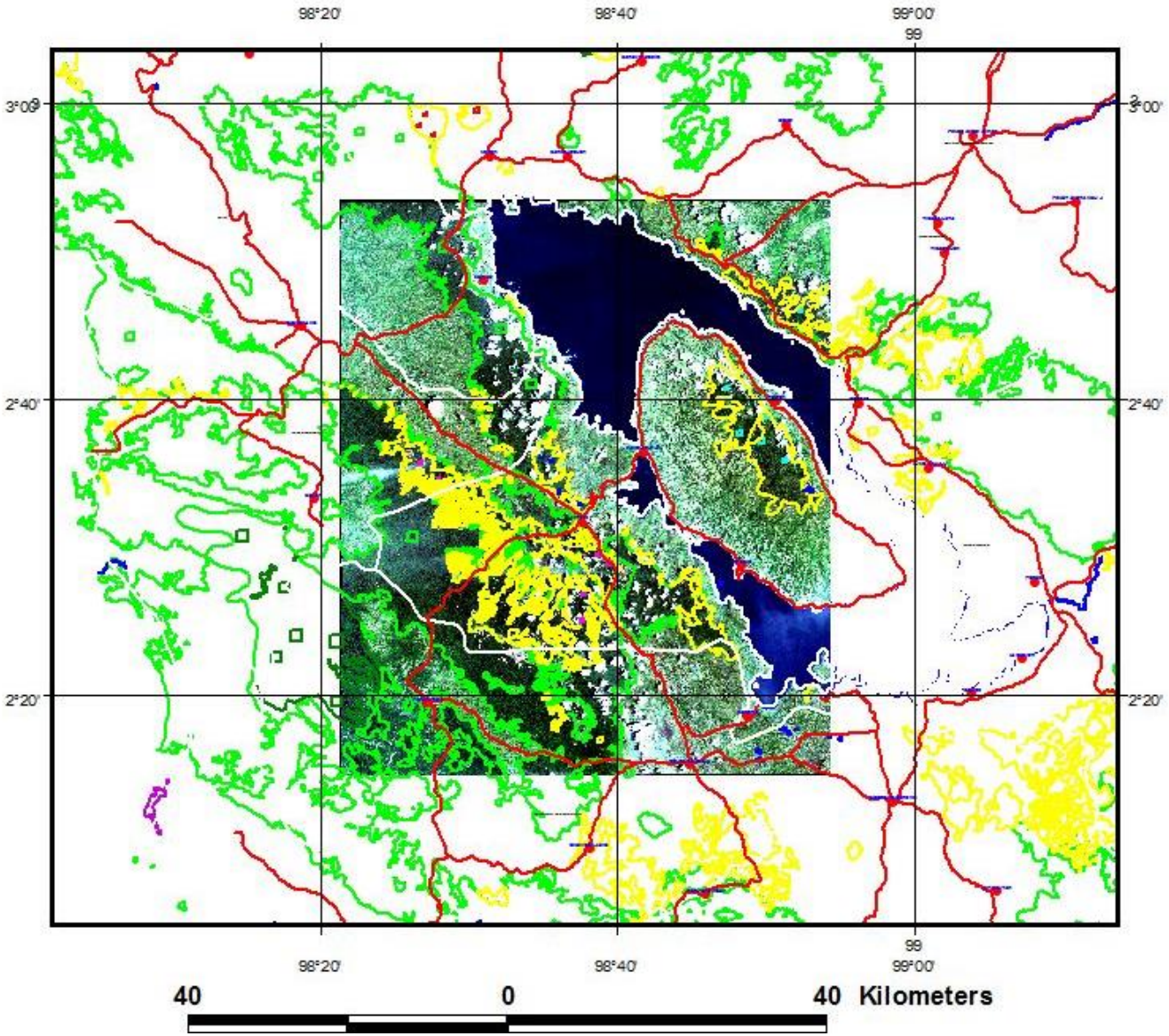

Asahan Regency

O1 : Forest mapping using ALOS2 PALSAR2 (case study : Humbang Hasundutan)

O2 : Oil Palm Mapping in Asahan Regency

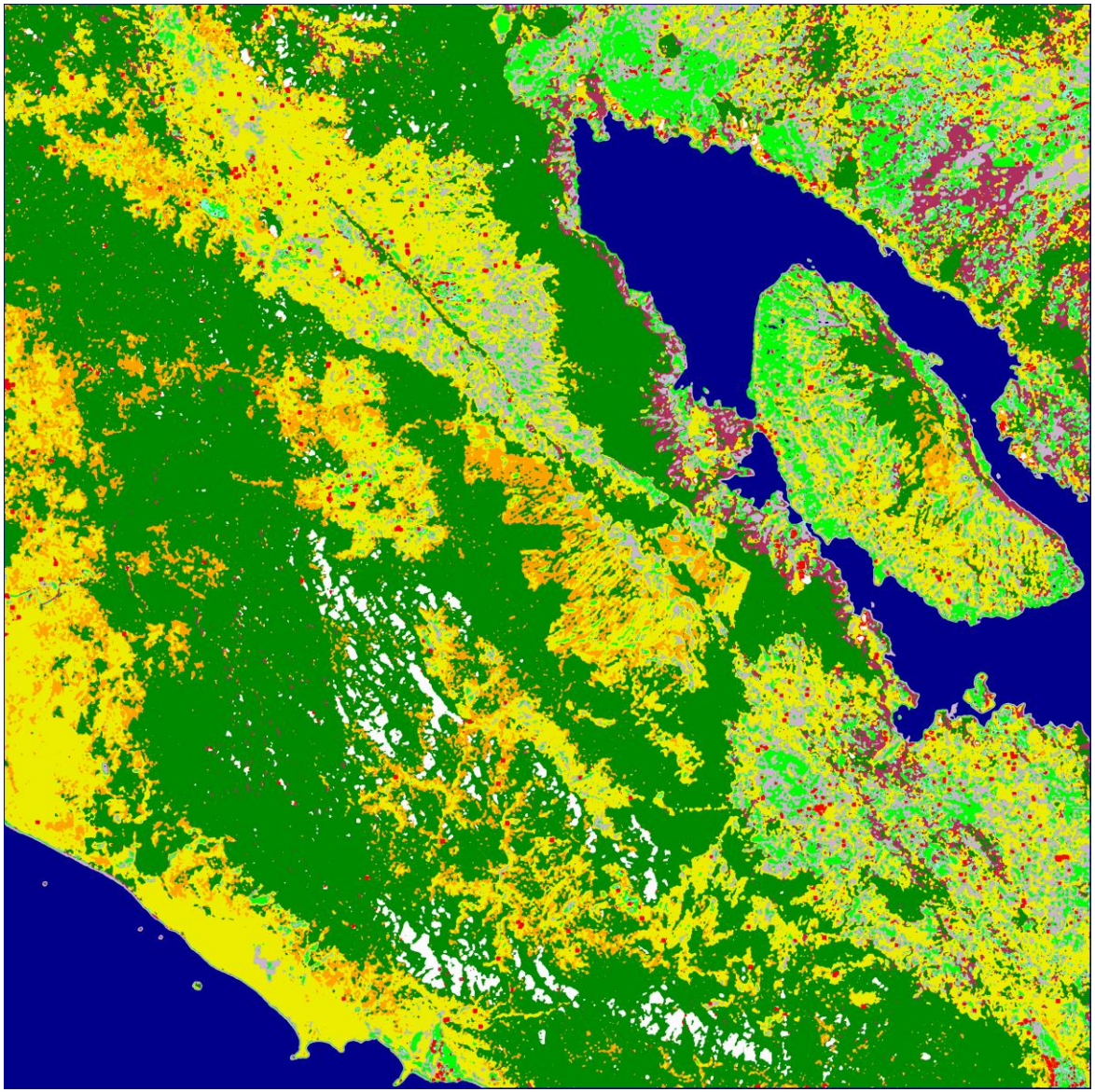
Methodology (LC Classification)





Training samples

- Training samples are derived from
  - High resolution optical data (SPOT 6)
  - Google earth
  - field survey data



Land Cover Classification Map of Humbang Hasundutan, North Sumatera (2016)

Max. LH method

- 0: Unclassified
- 1: Forest
- 2: Palm oil
- 3: Grass
- 4: Replanting
- 5: Tea Plantation
- 6: Rice fields
- 7: Open land
- 8: Pine tree
- 9: Terrain Error
- 10: Settlement
- 11: Water
- 12: Dry agriculture

Accuracy Assesment

Image Classification Method	Without Texture Analysis		With Texture Analysis	
	Band HH + Band HV		Band HH + Band HV	
	Overall Accuracy (%)	Kappa Coefficient	Overall Accuracy (%)	Kappa Coefficient
Minimum Distance	74,0399%	0,6381	77,3876%	0,6783
Mahalanobis Distance	75,1446%	0,6422	81,1031%	0,7227
Maximum Likelihood	78,5842%	0,6817	83,5366%	0,7561
Support Vector Machine	88.1152 %	0.803	89,9858%	0,8444

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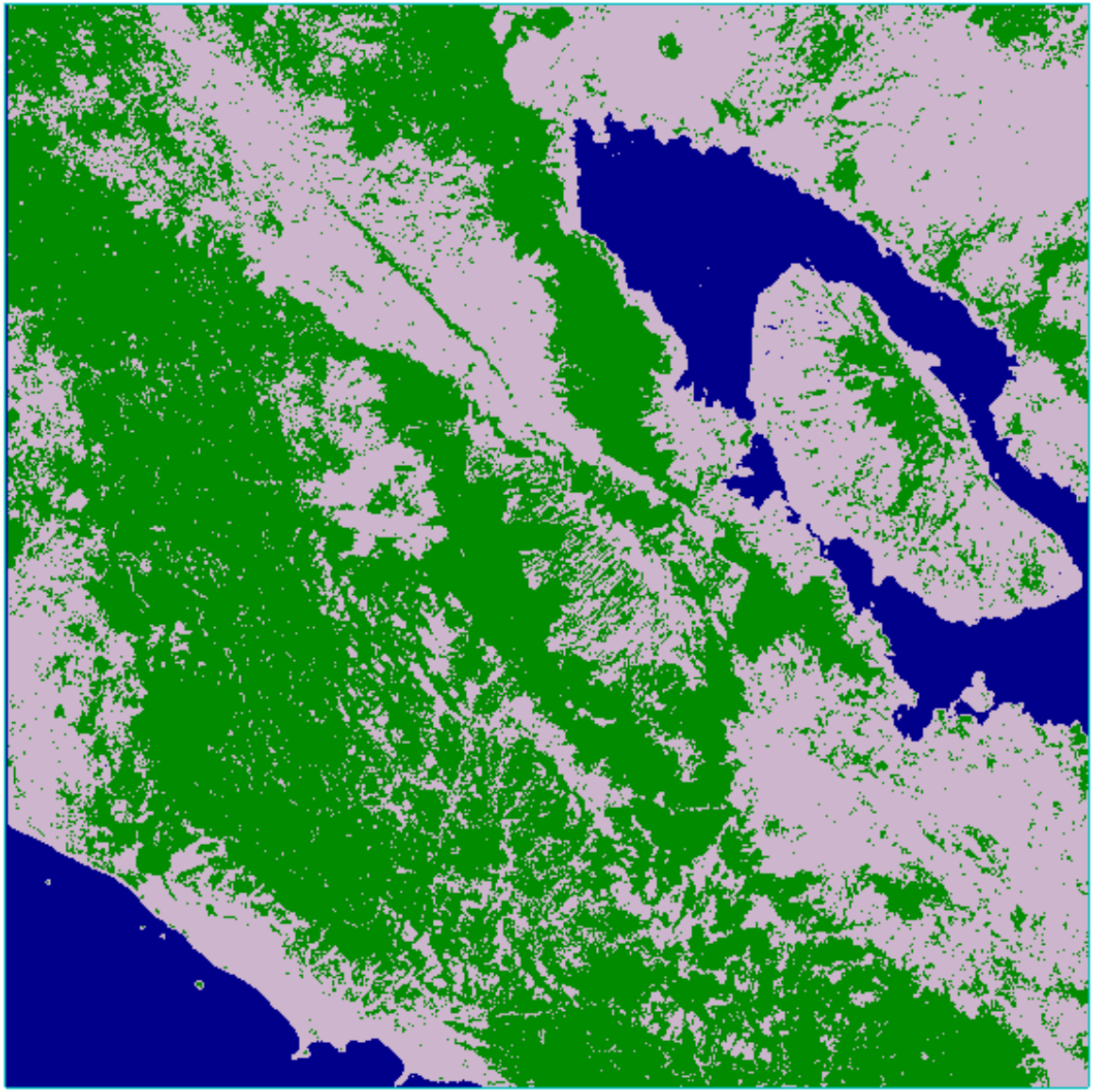
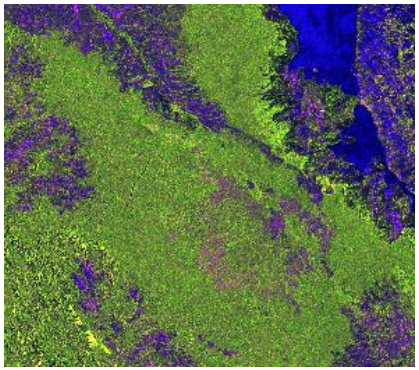


Forest / Non Forest Map of Humbang Hasundutan, North Sumatera (2016)

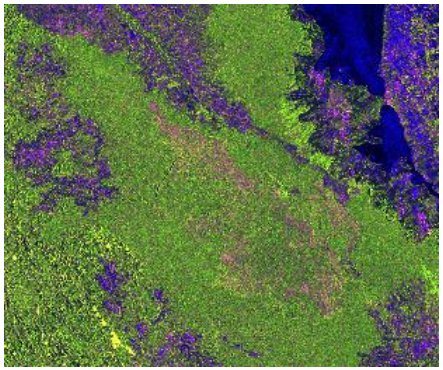
Forest	Forest
Pine Tree	
Replanting	
Oil Palm	Non forest
Tea Plantation	
Grass	
Rice Fields	
Dry Agriculture	
Open Land	
Seatlemant	
Terrain Error	
Water	Water

- Forest
- Non Forest
- Water

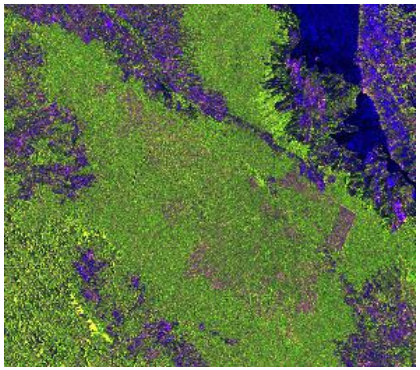
Land cover change of Industrial plantated forest



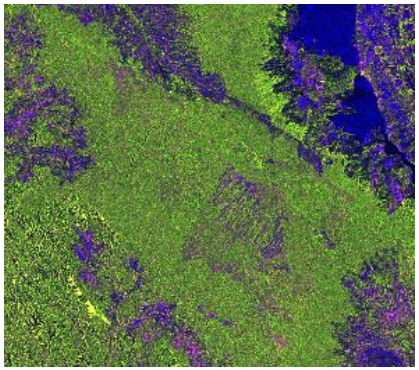
2007



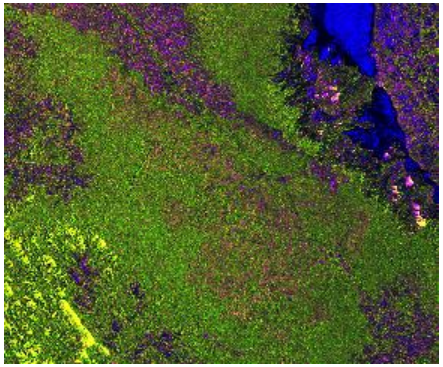
2008



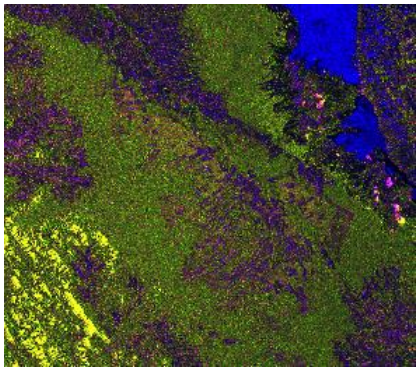
2009



2010



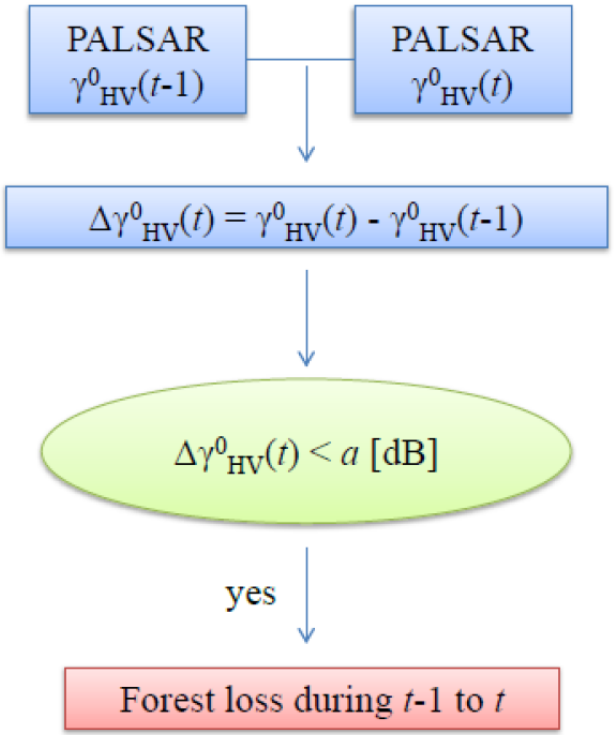
2015

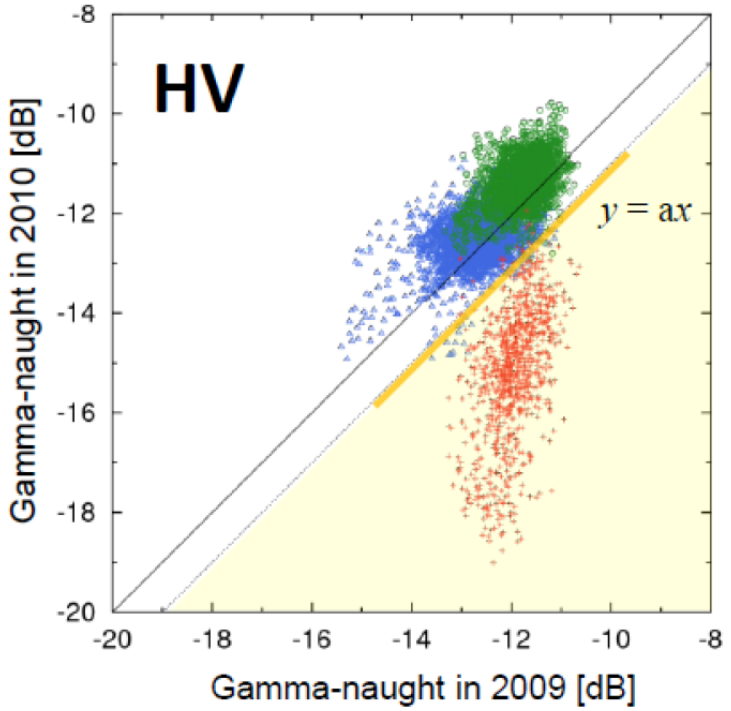


2016

Data : ALOS PALSAR MOSAIC 25m (year 2007-2010, 2015-2016)

Forest loss detection algorithm : thresholding





Red : Clear-cut during 2009-2010
Green : Natural forest
Blue : Acacia plantation

Source :
Forest change mapping using PALSAR Gamma-naught change

Takeshi Motohka (JAXA)
Takuya Ito (RESTEC)
Takahiro Otaki (RESTEC)

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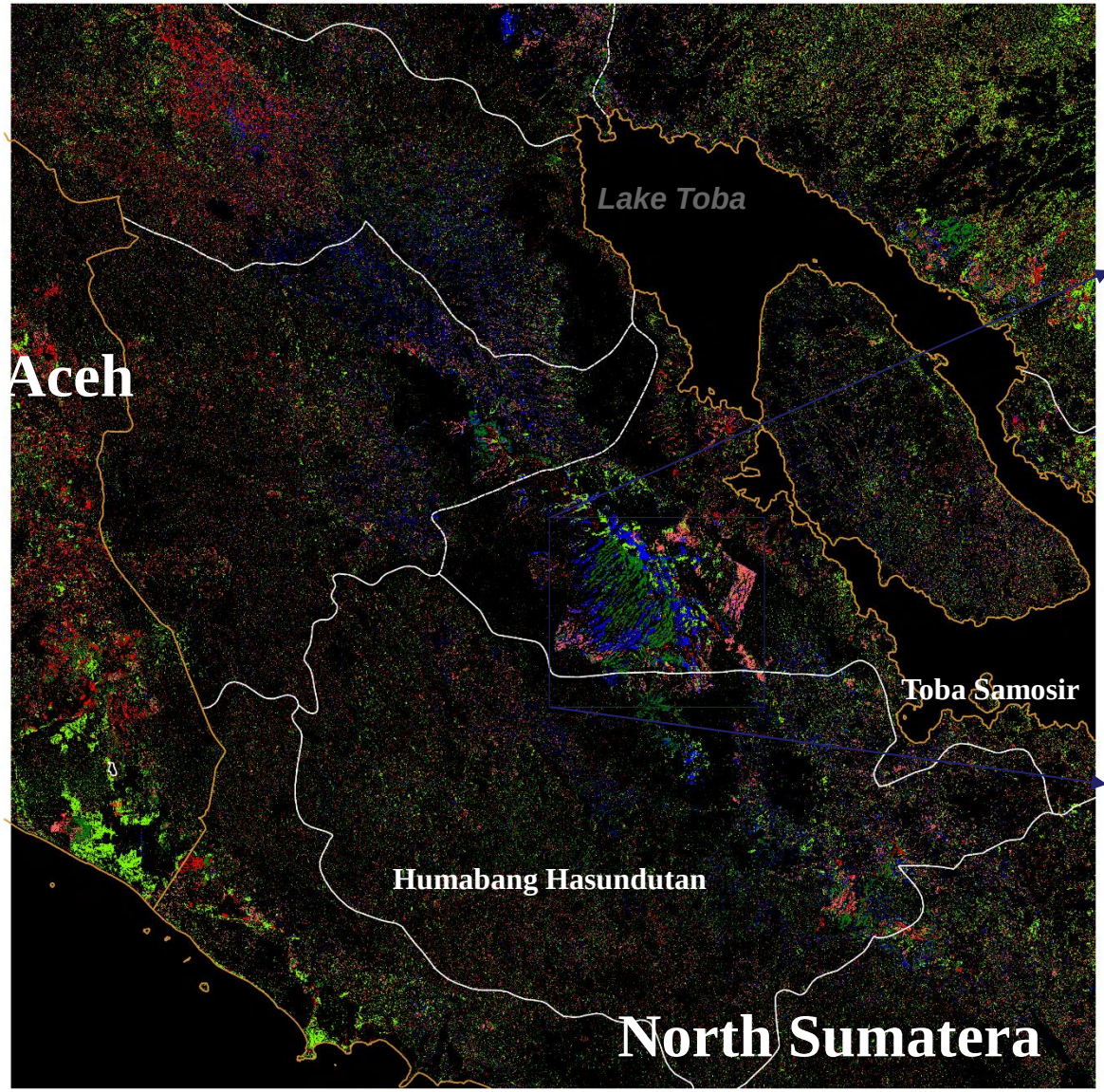
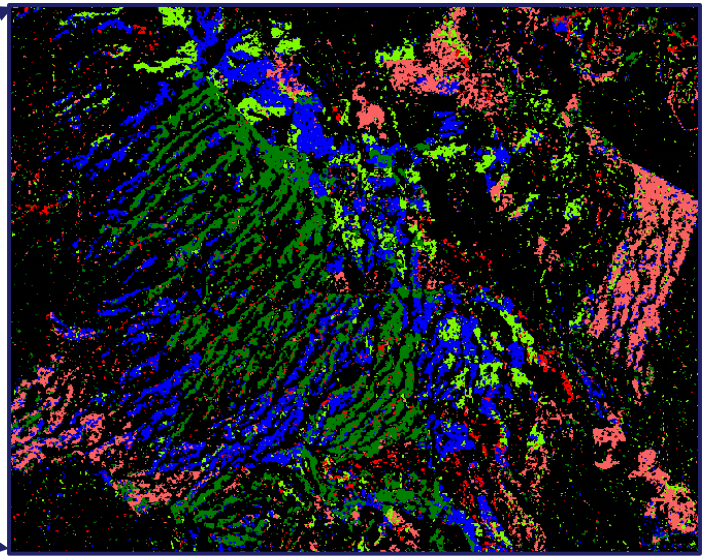
Deforestation in Humbang Hasundutan, Toba Samosir regency using ALOS MOSAIC





Deforestation year:

- : 2007 - 2008
- : 2008 - 2009
- : 2009 - 2010
- : 2010 - 2015
- : 2015 - 2016

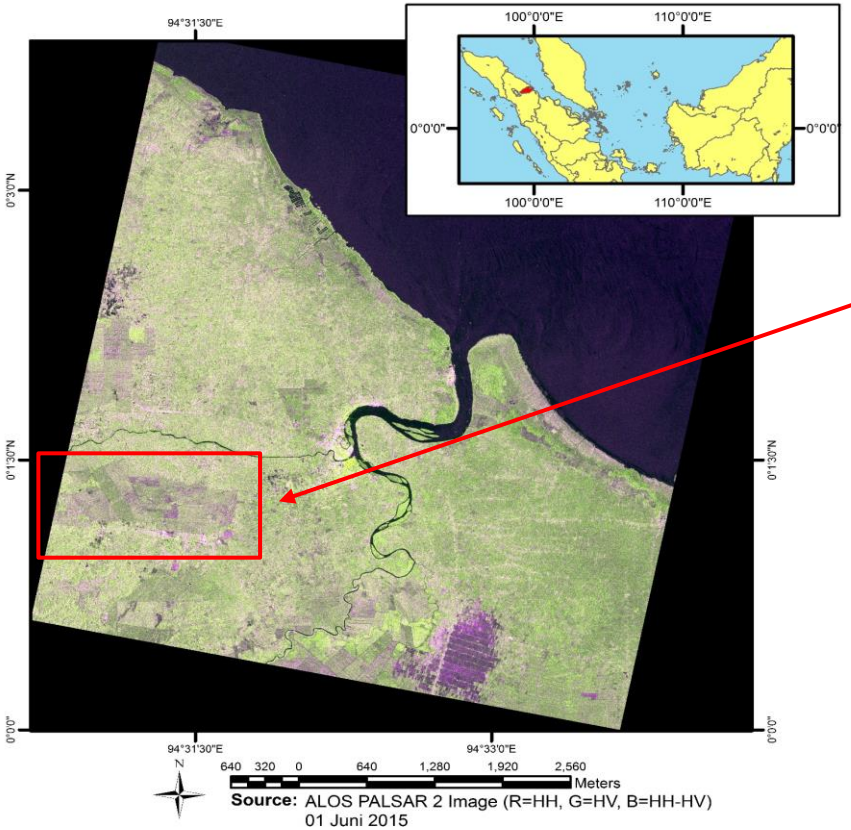
O1 : Forest mappin using ALOS2 PALSAR2 (case study : Humbang Hasundutan)

O2 : Oil Palm Mapping in Asahan Regency

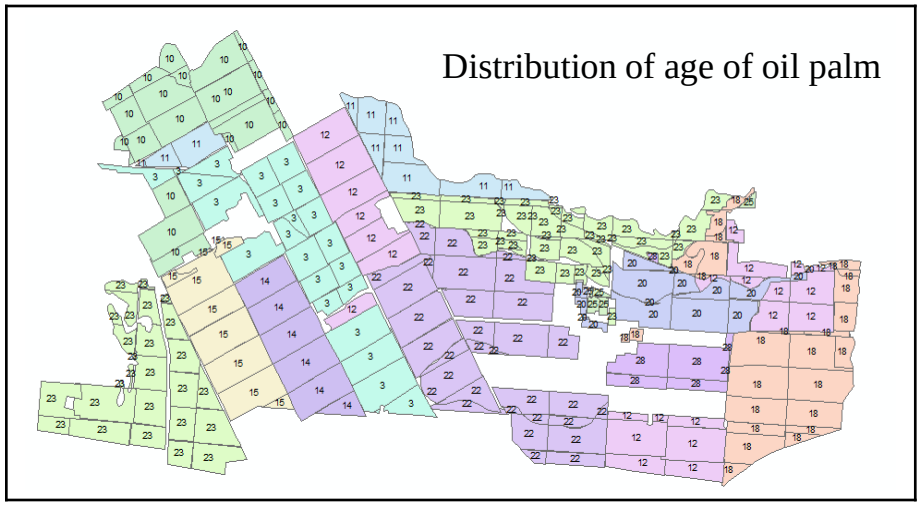
Palm Oil Mapping

Study area and Data

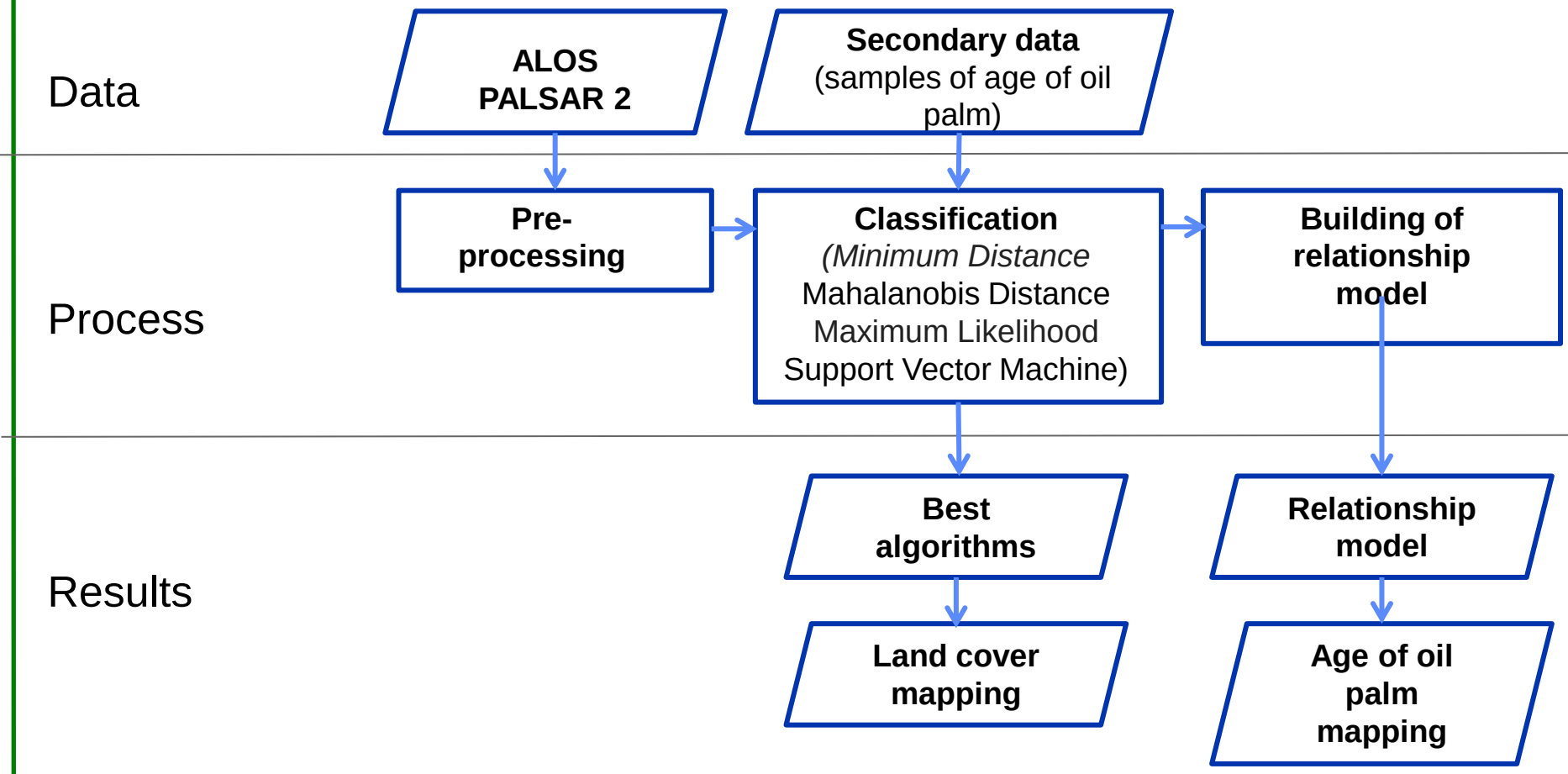
Asahan, North Sumatera
ALOS PALSAR 2, June 01 2015



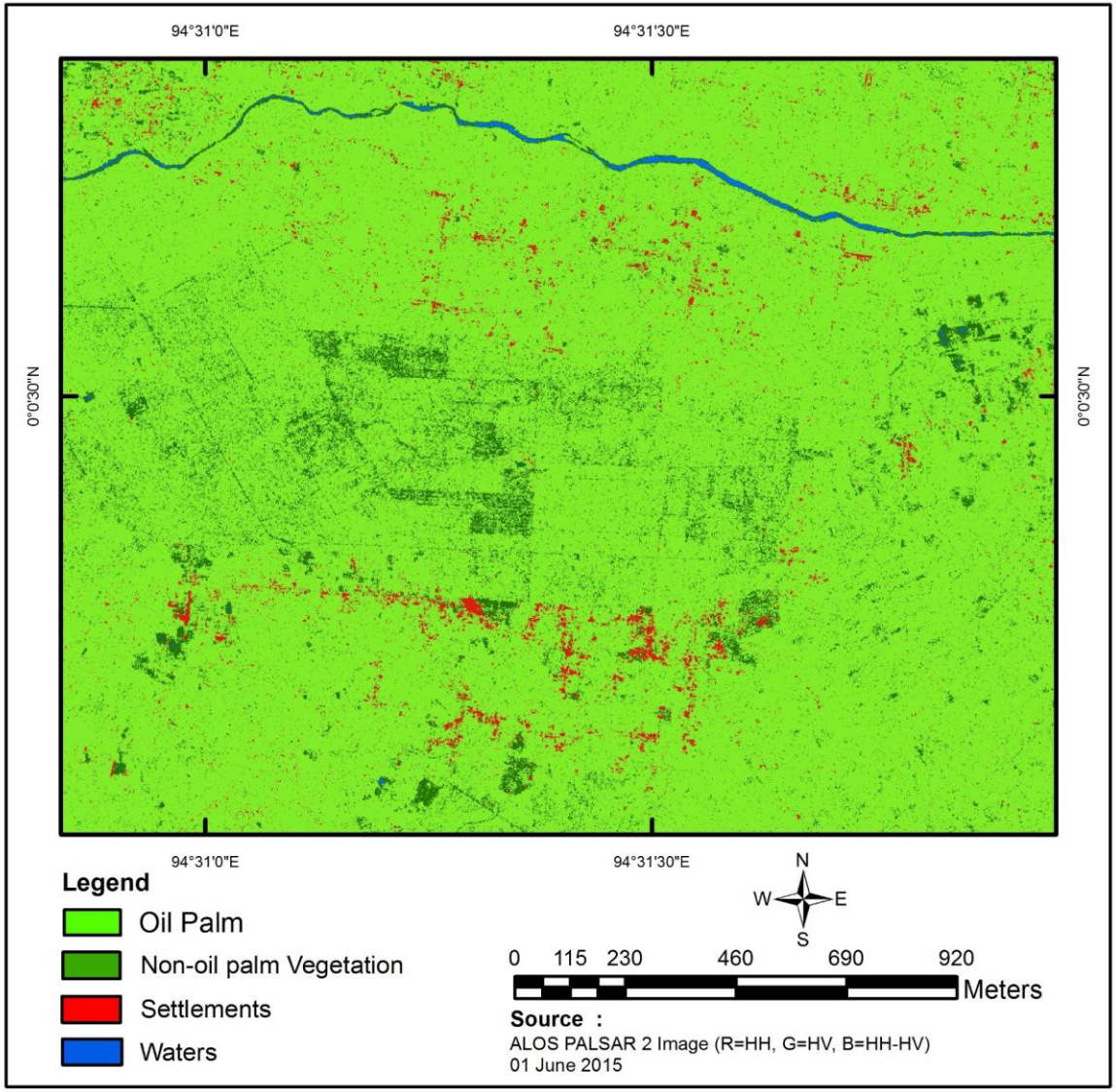
Data used on study areas (Asahan District, North Sumatera)
Source : JAXA/Lapan



Source : Research centre of oil palm
North Sumatera



[Darmawan, 2016]



Land cover mapping of Oil palm in Asahan Regency, North Sumatera

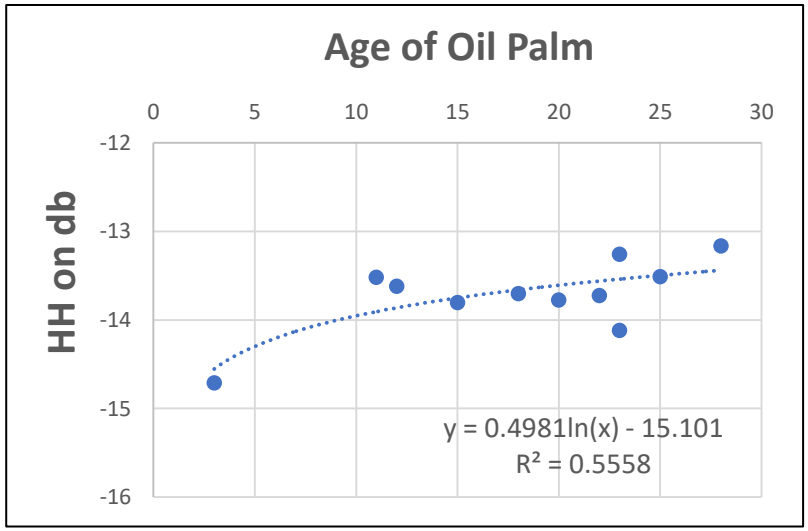
Support Vector Machine algorithm

Overall accuracy 85 %

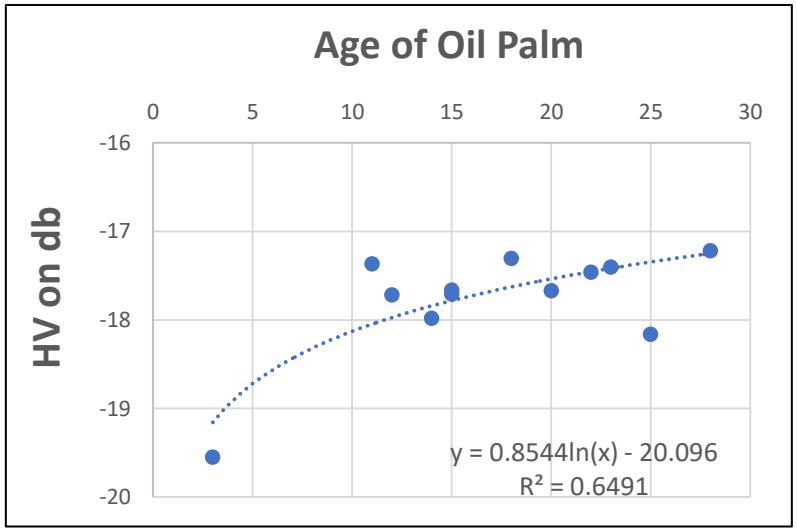
Accuracy Assessment

Image Classification Method	Band Combinations			
	Band HH + Band HV		(R= HH, G= HV, B= HH-HV)	
	Overall Accuracy (%)	Kappa Coefficient	Overall Accuracy (%)	Kappa Coefficient
Minimum Distance	68.7686	0.4164	66.1085	0.3846
Mahalanobis Distance	73.1401	0.5004	74.6206	0.5249
Maximum Likelihood	74.5752	0.5308	77.0043	0.5682
Support Vector Machine	84.6867	0.6645	85.2112	0.6763

Relationships Model



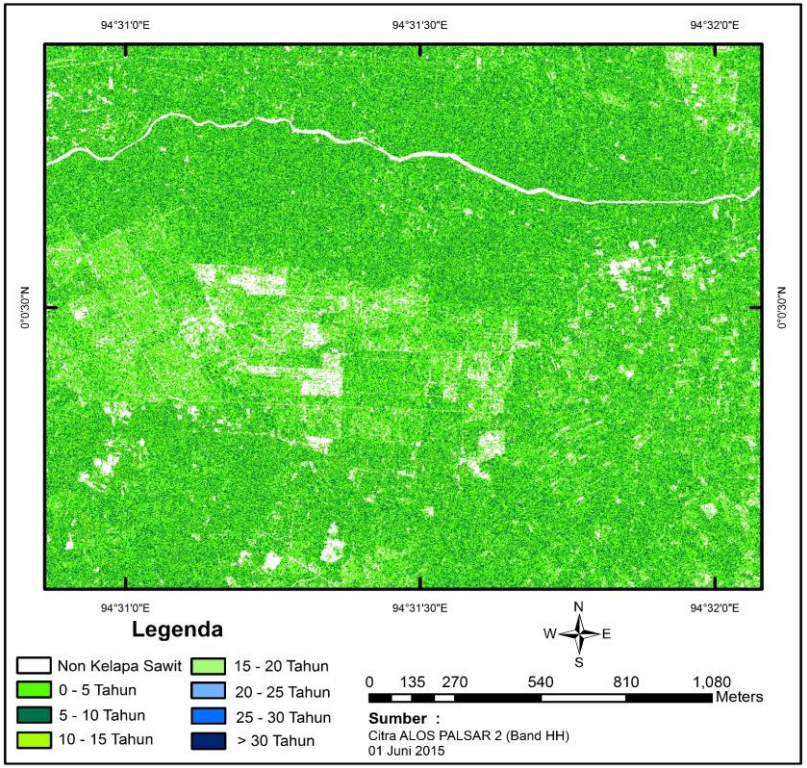
(a)



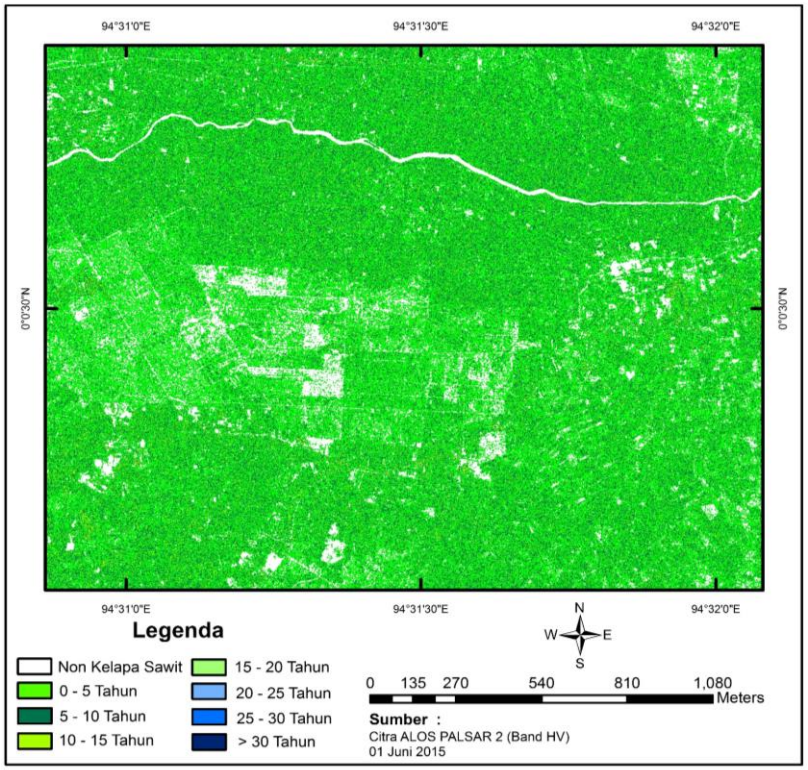
(b)

Relationship model between (a) HH and age of oil palm and (b) HV and age of oil palm

Spatial Distribution of Age of Oil Palm based on ALOS PALSAR 2



Spatial Distribution of Age of Oil Palm Based on HH



Spatial Distribution of Age of Oil Palm Based on HV

Spatial Distribution of Age of Oil Palm

Percentage value from each class interval of age of oil palm

Age of Oil Palm	Band HH	Band HV
	Percentage (%)	Percentage (%)
0 - 5	22.079	62.363
5 - 10	24.335	25.411
10 - 15	41.946	2.357
15 - 20	8.212	0.019
20 - 25	1.495	0.006
25 - 30	0.429	0.003
≥ 30	0.208	0.001

Still needed validation

Conclusion and future works

Conclusion

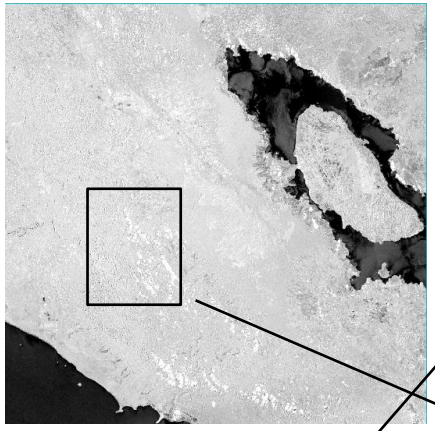
- Land Cover Maps were generated experimentally (include texture analisys) using four classifiers (Min. Distance, MLH, Mahalanobis, SVM),
- Forest loss detection using the simple threshold can provide consistent result.
- Oil palm plantation in Asahan Regency can be identified accurately using PALSAR data.

Future Works

- Additional training samples from other areas of Sumatera island for validation
- LC classification needs further analysis and verification.

ALOS2 PALSAR2 Issue

2015 HH



2016 HH

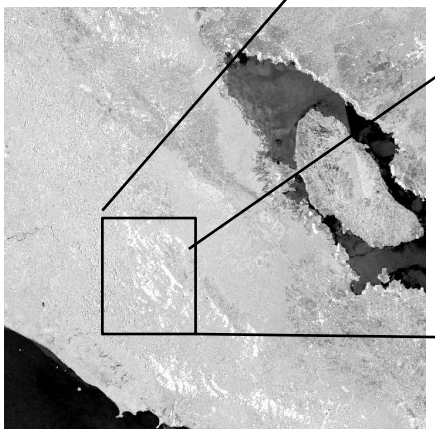
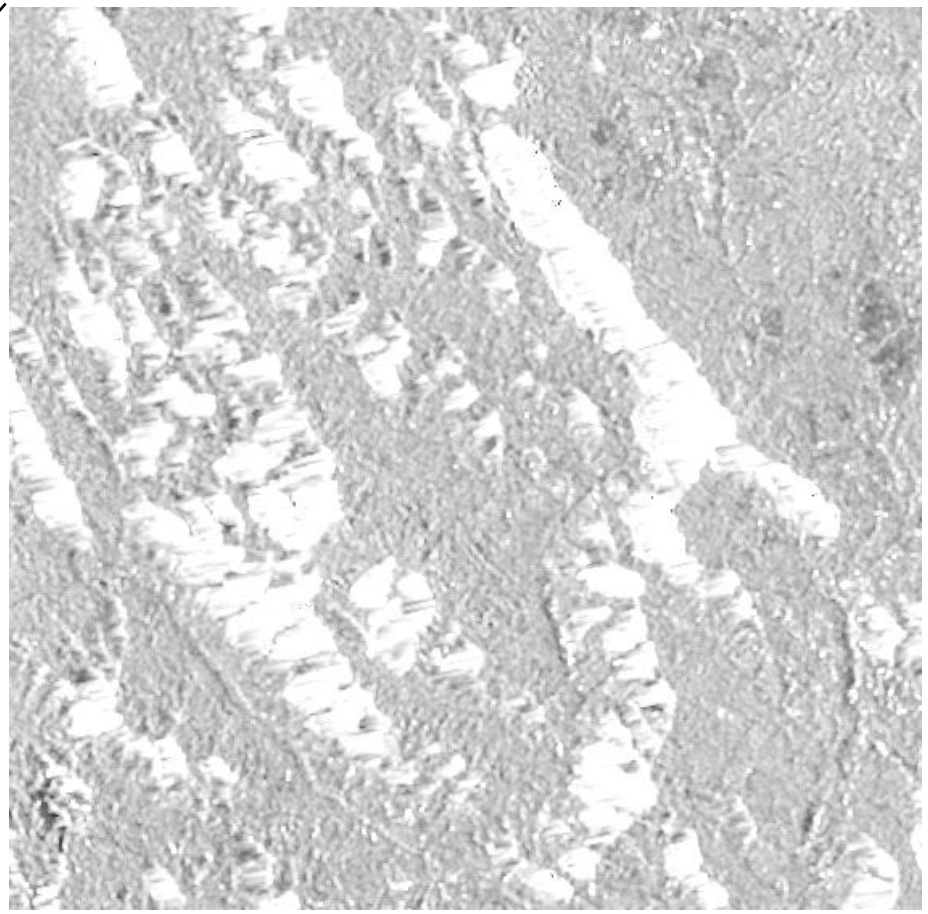


Image Distortion ?



THANK YOU

Dataset provided by JAXA

- PALSAR mosaic data, 2007-2016, Spatial resolution : 25m, orthorectified and slope corrected, Dual polarization : HH and HV
- ALOS2 PALSAR2, 2015, Spatial resolution : 10m, Format : FBD 1.5, Polarization : HH and HV