

K&C Phase 3 – Brief project essentials

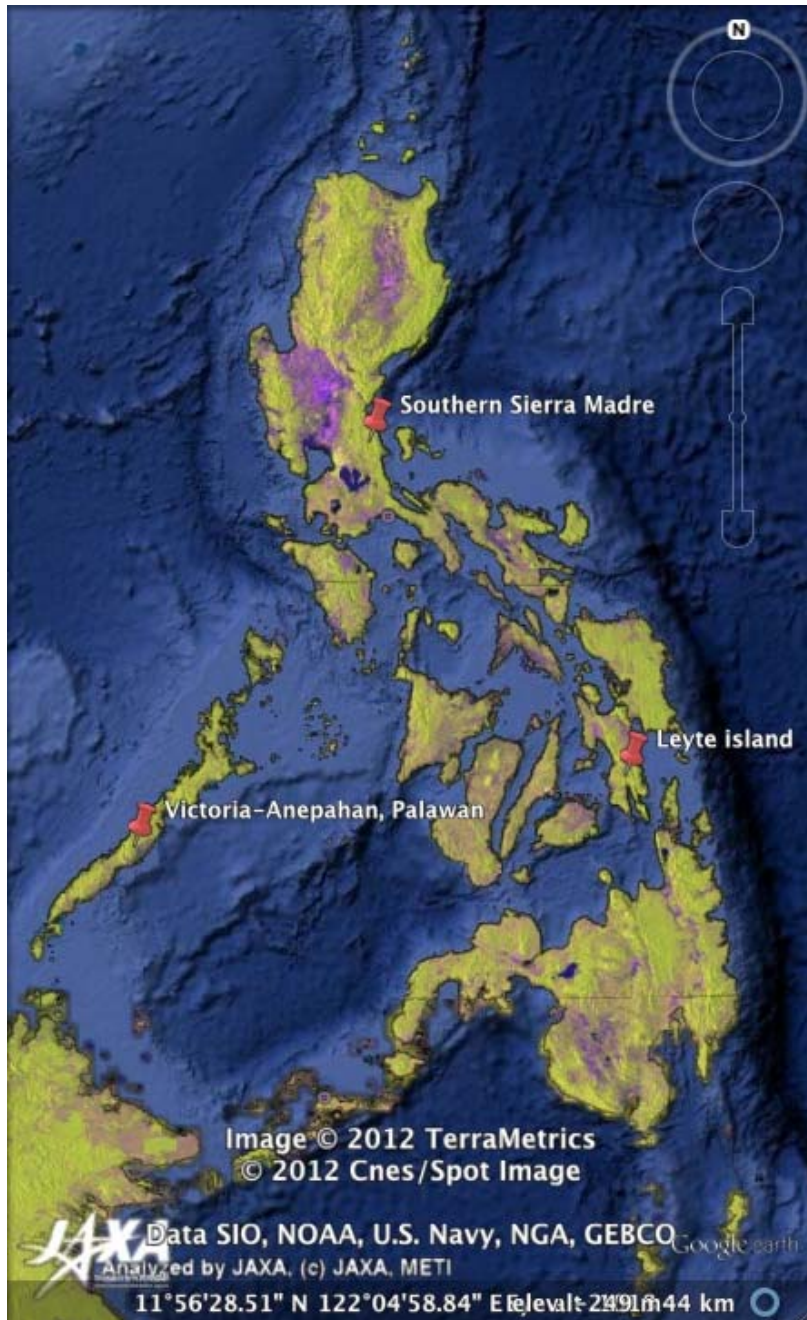
Climate-Relevant Modernization of the National Forest Policy and Piloting of REDD+ Measures in the Philippines

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Project areas: Philippines

Sub-national REDD+ Pilot Sites

1. Southern Sierra Madre mountain range (General Nakar)
2. Leyte island
3. Victoria-Anepahan mountain range, Palawan island

K&C Project Collaborators and Partners

Principal Investigator

1. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

Project Collaborators

1. Fauna & Flora International (FFI)
2. Department of Geodetic Engineering, University of the Philippines (UP-DGE)

Partners & Supporting Agencies

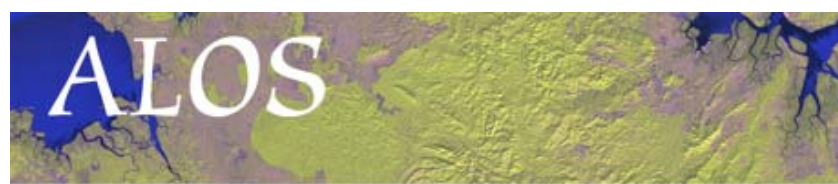
1. Department of Environment and Natural Resources: Forest Management Bureau & National Mapping and Resource Information Authority
2. Non-Timber Forest Products – Task Force / Exchange Programme
3. TEaM Energy Foundation in the Philippines
4. European Commission
5. Energy Development Corporation

Updates

LEYTE ISLAND

- Remote Sensing
- Forest Resource Assessment





Remote Sensing Methodology: image pre-processing, classification, accuracy assessment and change detection

Sept 9, 1999; Path 113, Row 53; Panchromatic Band
(15m resolution); 20 GCPs; RMSE < 0.5

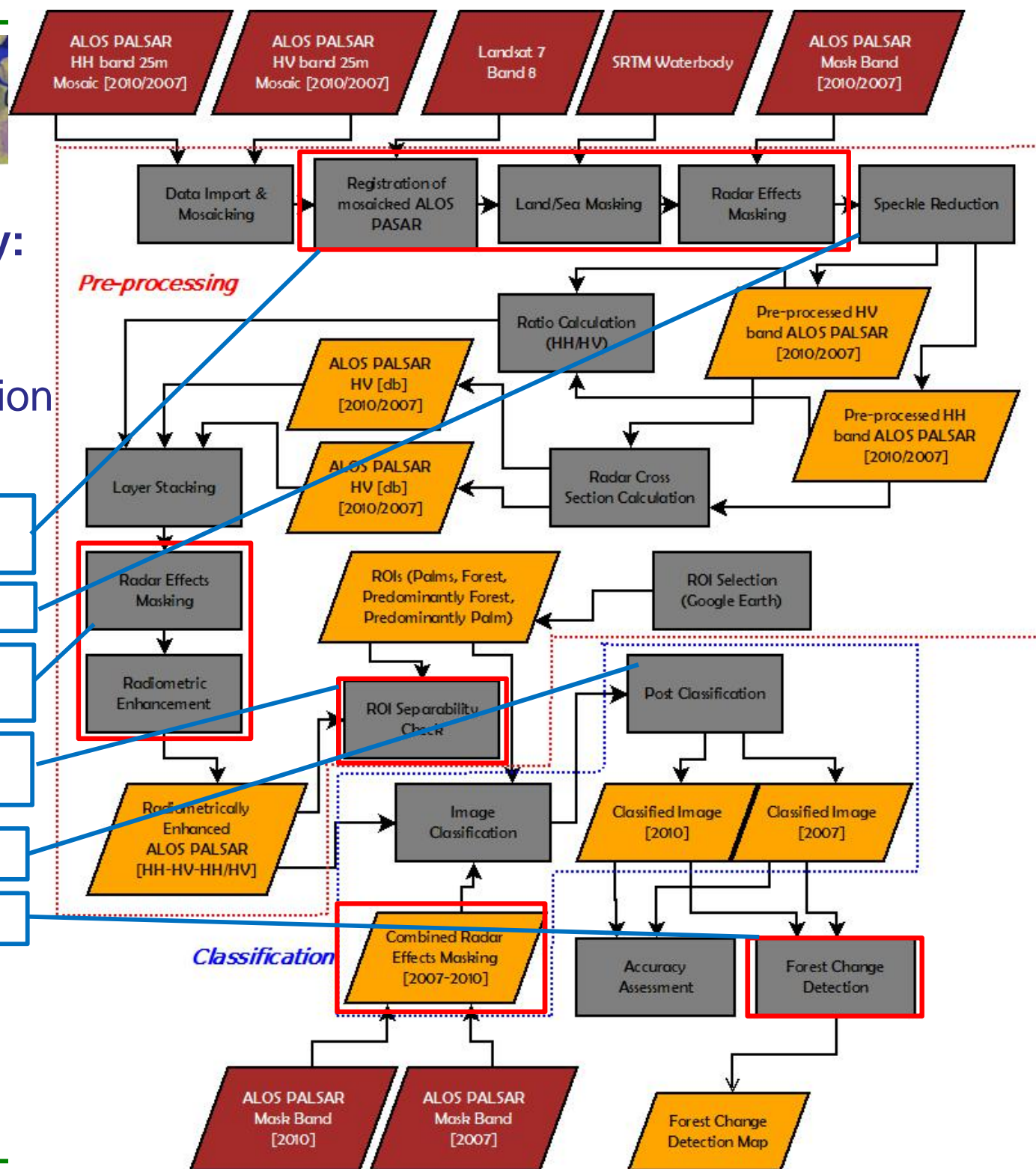
Lee Filter: 3x3 Multiplicative

Remove null/infinity values produced by speckle
filtering & radar cross-section calculation

Only palm & forest had separability values greater
than 1.

Majority Analysis, Sieve & Clump Classes

Thematic Change Detection tool (ENVI 5.0)



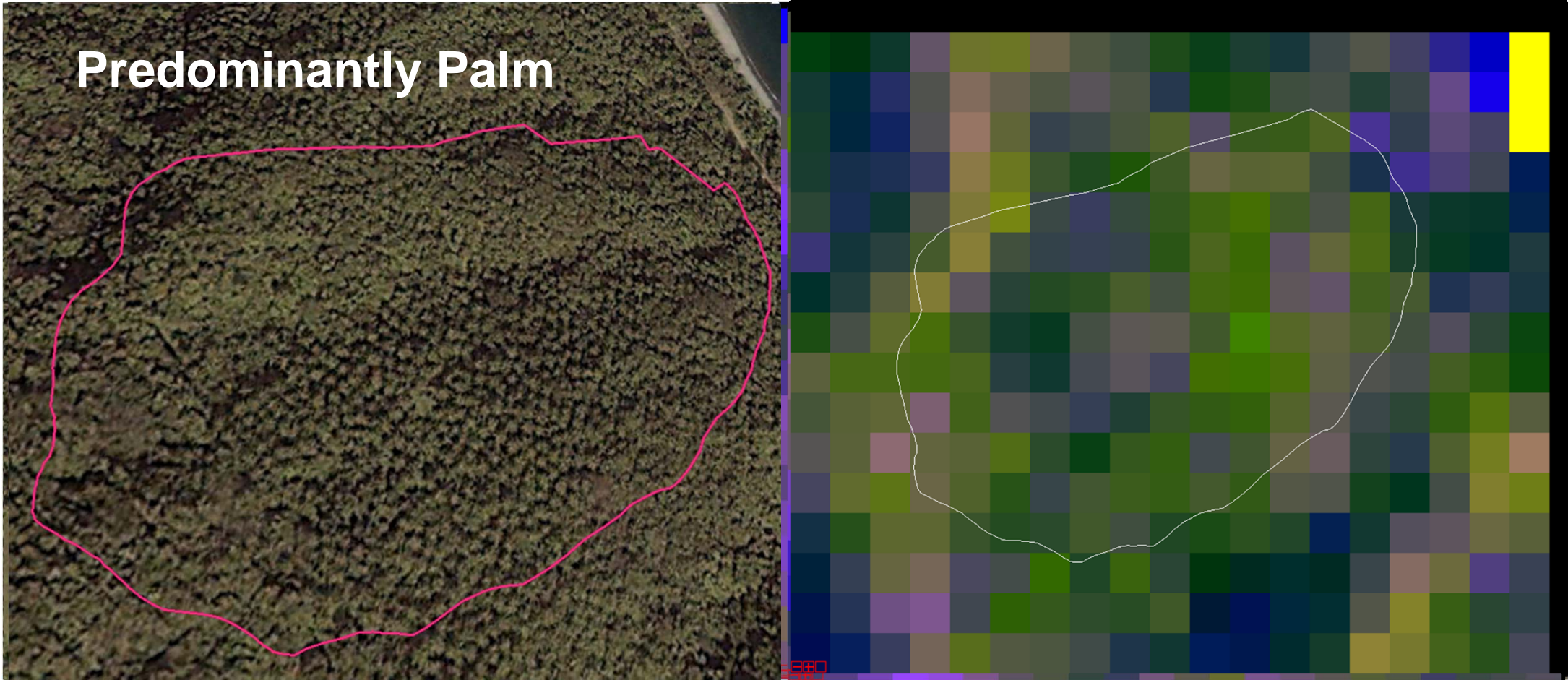
Methodology: ROI Selection

- Selected using Google Earth
- No sampling scheme used since the selection was dependent on the availability of high resolution data from Google Earth.
- Four (4) Types:
 - Forest
 - Palms
 - Pre-dominantly Palm
 - Pre-dominantly Forest
 - If it does not fall within the first 4 types, it will be classified as Non-Forest.
- 100 polygons for each ROI
 - Random generator code (Excel)
 - 50 – used for training
 - 50 – used for accuracy check



Methodology: ROI Selection

Predominantly Palm



ROI Separability & Classification

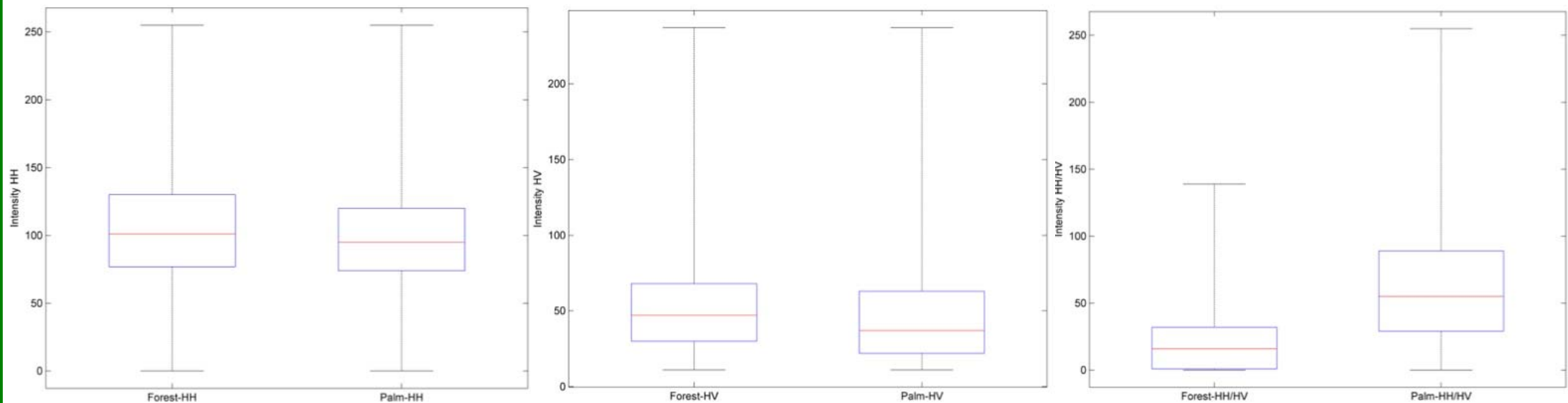
➤ ROI Separability:

- Radiometrically enhanced image was able to get a pair separability value greater than 1.0 for Palm and Forest ROIs only.

➤ Supervised Classification: Maximum Likelihood

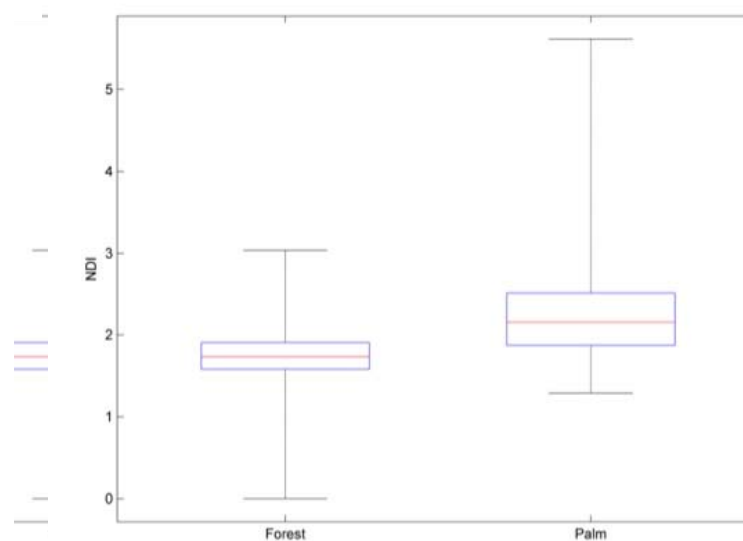
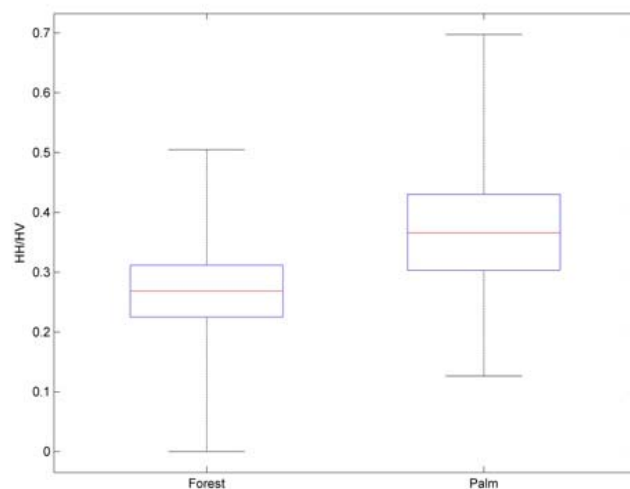
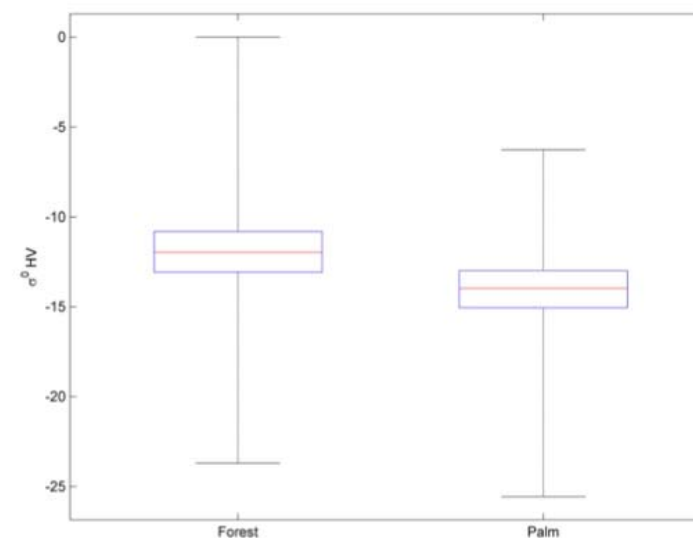
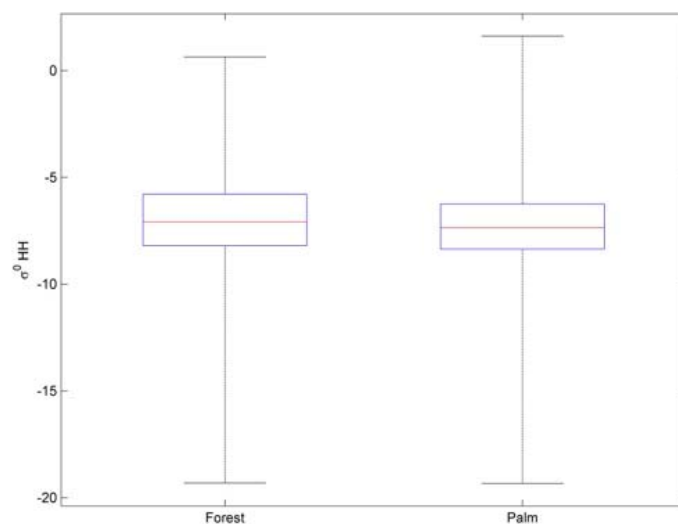
- Probability Thresholds: allowed the algorithm to exclude pixels not similar to given training pixels. Derived values were generated using trial and error.
 - ✓ Palms = 0.1
 - ✓ Forest = 0.4

Separability of DN values (after Radiometric Enhancement)



Separability of DN values for each ROI

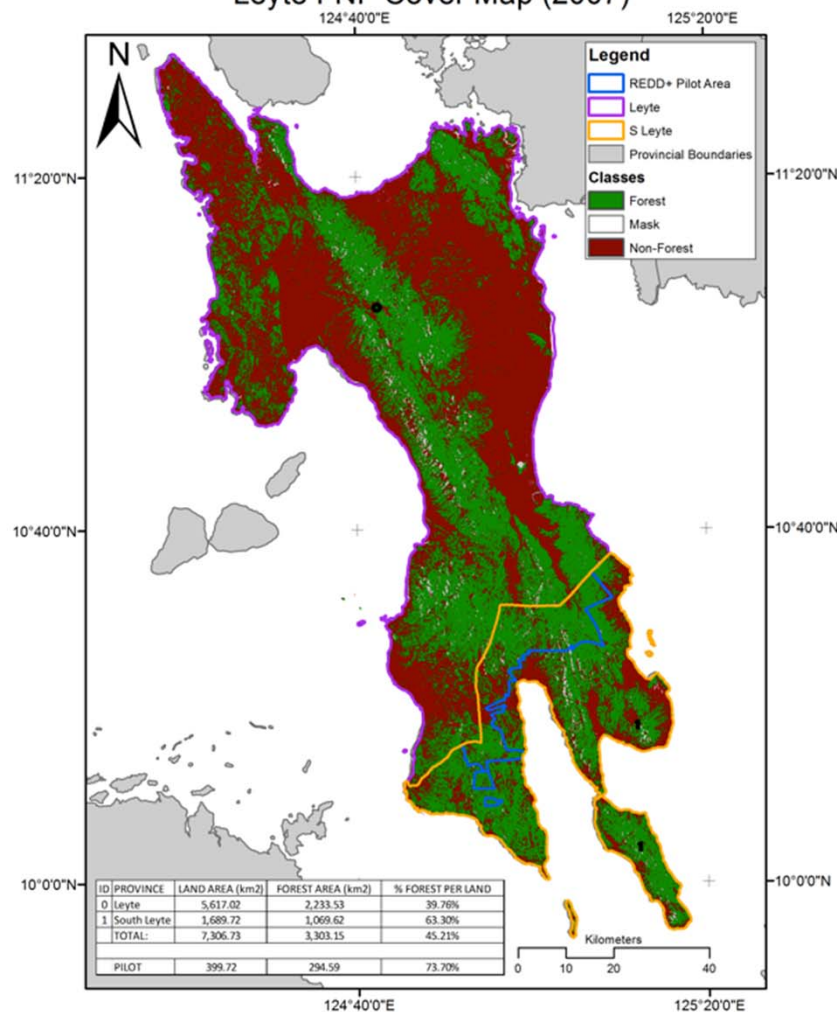
Separability of DN values (before Radiometric Enhancement)



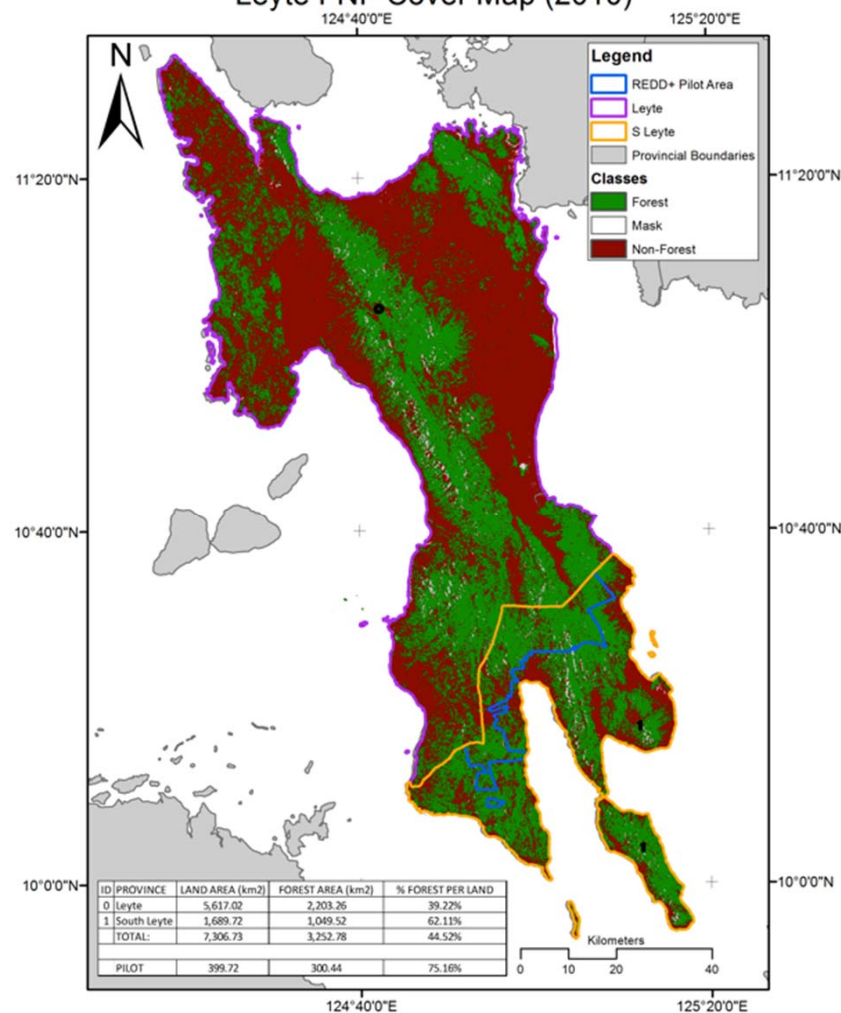
NDI = Normalized
Difference Index =
$$\frac{|HH - HV|}{|HH + HV|}$$

Forest Cover Maps 2007 & 2010

Leyte FNF Cover Map (2007)



Leyte FNF Cover Map (2010)



Accuracy Assessment (against ROIs from Google Earth)

Confusion Matrix for Forest Cover 2007

Ground Truth (%)			
Class	Palms	Forest	Total
Unclassified	7.27	3.93	4.63
Palms	56.28	1.75	13.20
Forest	36.45	94.32	82.17
Total	100.00	100.00	100.00

Accuracy (%)

Class	Palms	Forest
Producer's	56.28	94.32
User's	59.54	90.69
Overall	86.33	
Kappa	0.5771	

Confusion Matrix for Forest Cover 2010

Ground Truth (%)			
Class	Palms	Forest	Total
Unclassified	4.33	5.66	5.38
Palms	68.22	2.12	16.12
Forest	27.45	92.23	78.50
Total	100.00	100.00	100.00

Accuracy (%)

Class	Palms	Forest
Producer's	68.22	92.23
User's	89.66	92.59
Overall	87.1418	
Kappa	0.6296	

*Classification w/ ~10,000 pixels

Accuracy Assessment (against available FRA data)

Accuracy Assessment Result

2010	Class	Actual				Total (w/ field records)
		Non-Forest	Forest	No Field Record	Total	
Predicted	Non-Forest	40	24	7	71	64
	Forest	137	565	16	718	702
	Total	177	589	23	789	766
Accuracies	Producer's	22.6%	95.9%		Overall	79 %
	User's	62.5%	80.5%		Kappa	0.2239

Change Detection Results (FNF)

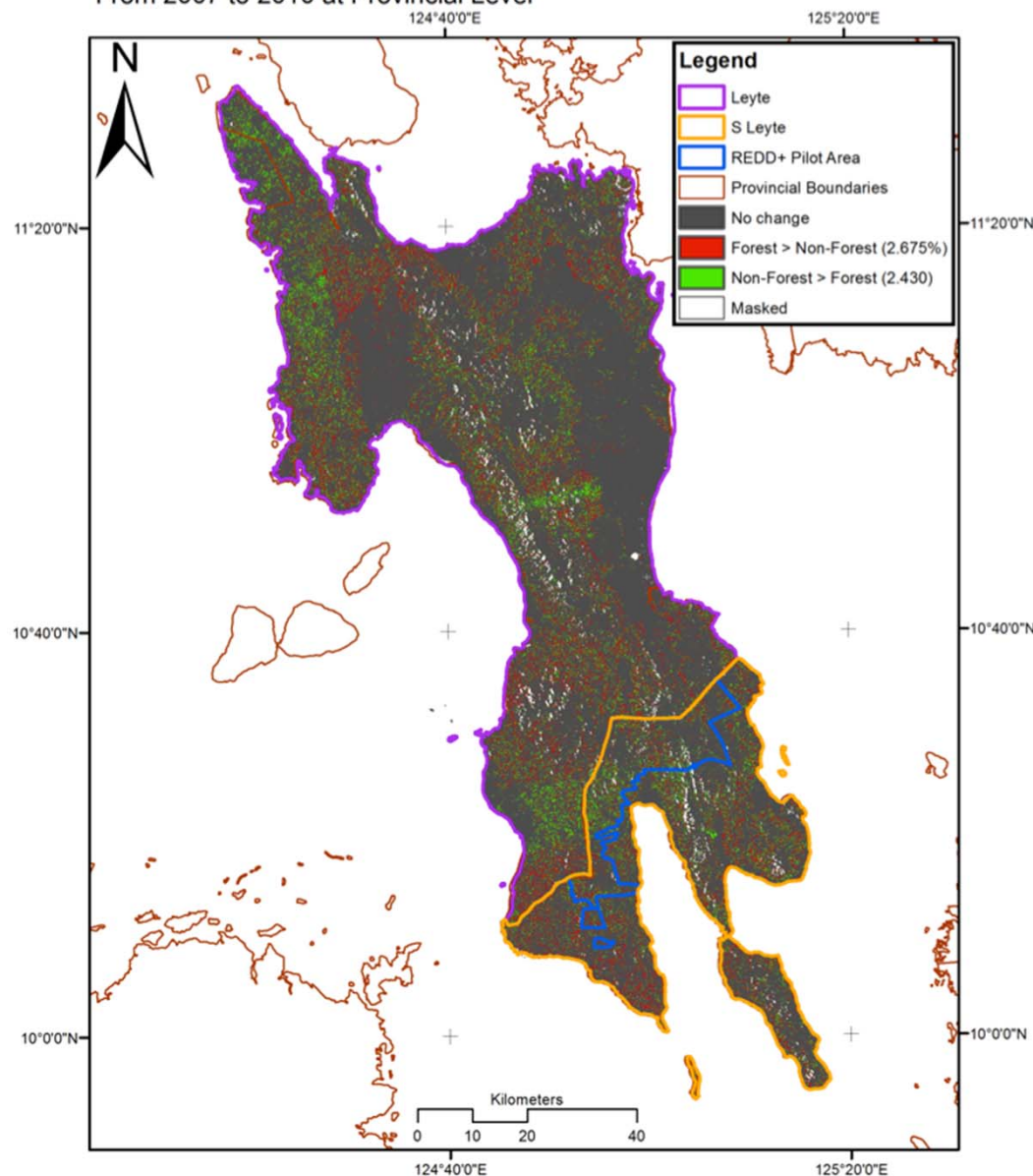
- Combined: Palms & Non-Forest class > Non-Forest before change detection analysis

Thematic Change Detection Statistics (FNF only)

Change	Area (ha)	Percentage
F > NF	55,103	-2.68%
NF > F	50,041	2.43%
Net	-5,062	-0.25%
*F - Forest, NF - Non-Forest		

Leyte Forest Change Detection Map

From 2007 to 2010 at Provincial Level



Change Detection (including Palm class)

➤ Forest, Non-Forest and Palm Classes

- Dubious change: palms changing back to forest in 3 years' time.
- This could be due to the very low accuracy of palms classes.

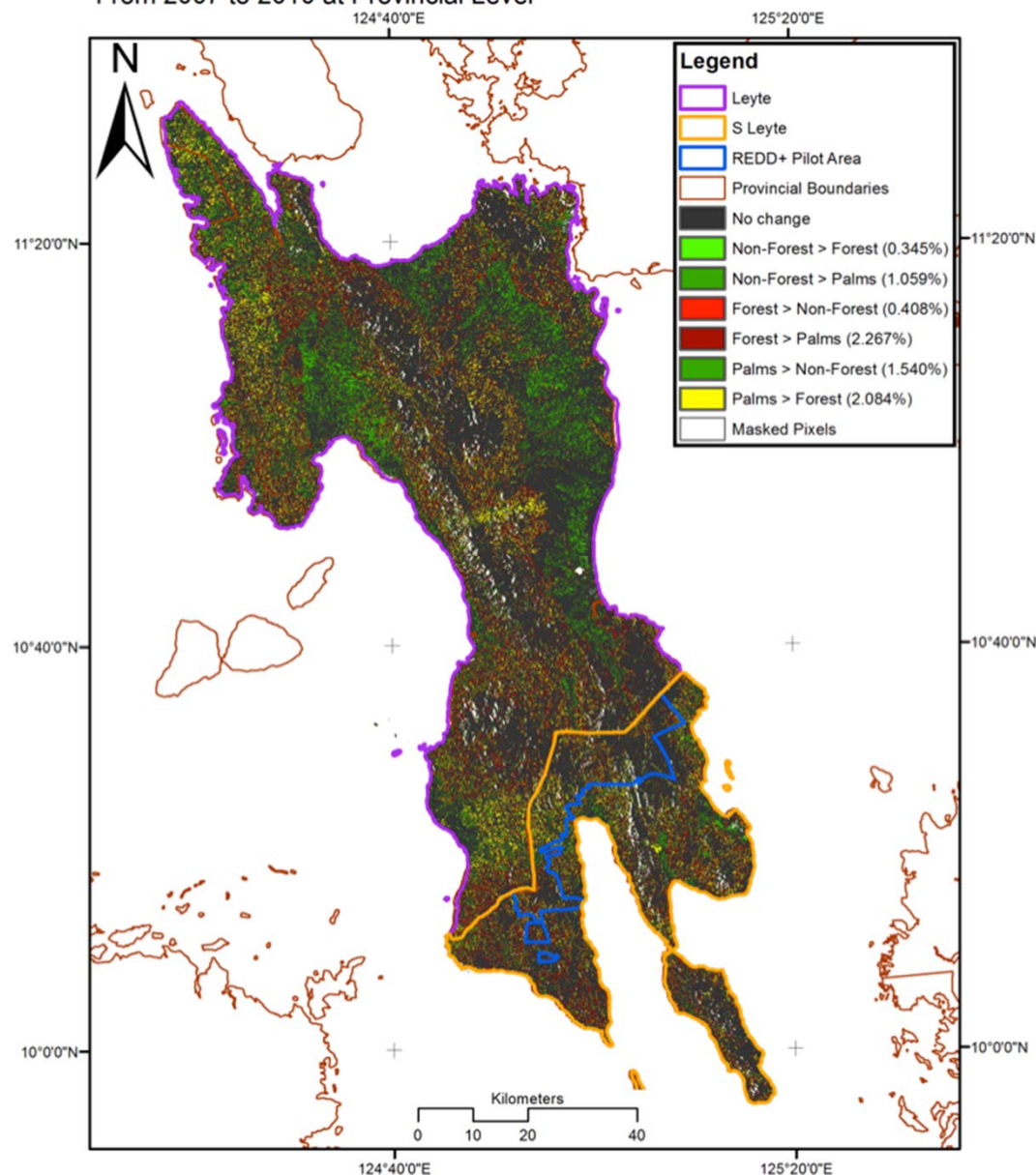
Thematic Change Detection Statistics

Change	Area (ha)	Percentage
NF > F	7,103	0.35%
NF > P	21,821	1.06%
F > NF	8,405	-0.41%
F > P	46,689	-2.27%
P > NF	31,721	1.54%
P > F	42,932	2.08%

*F - Forest, NF - Non-Forest,
P - Palms

Leyte Forest Change Detection Map

From 2007 to 2010 at Provincial Level



Conclusions

- The acquired forest cover maps exceeded the minimum accuracy required, which is 75% (MESA CONSULT 2012), therefore it can be concluded that the classification was able to achieve a result that is fairly consistent with reality.
- Post-classification comparison, similar to the method used in this study, is the most accurate way of detecting change (J.-F. Mas, 1999) and generally, the change map will be as accurate (or less accurate) as the accuracies of the individual classification results (Stow, 1980).

Recommendations

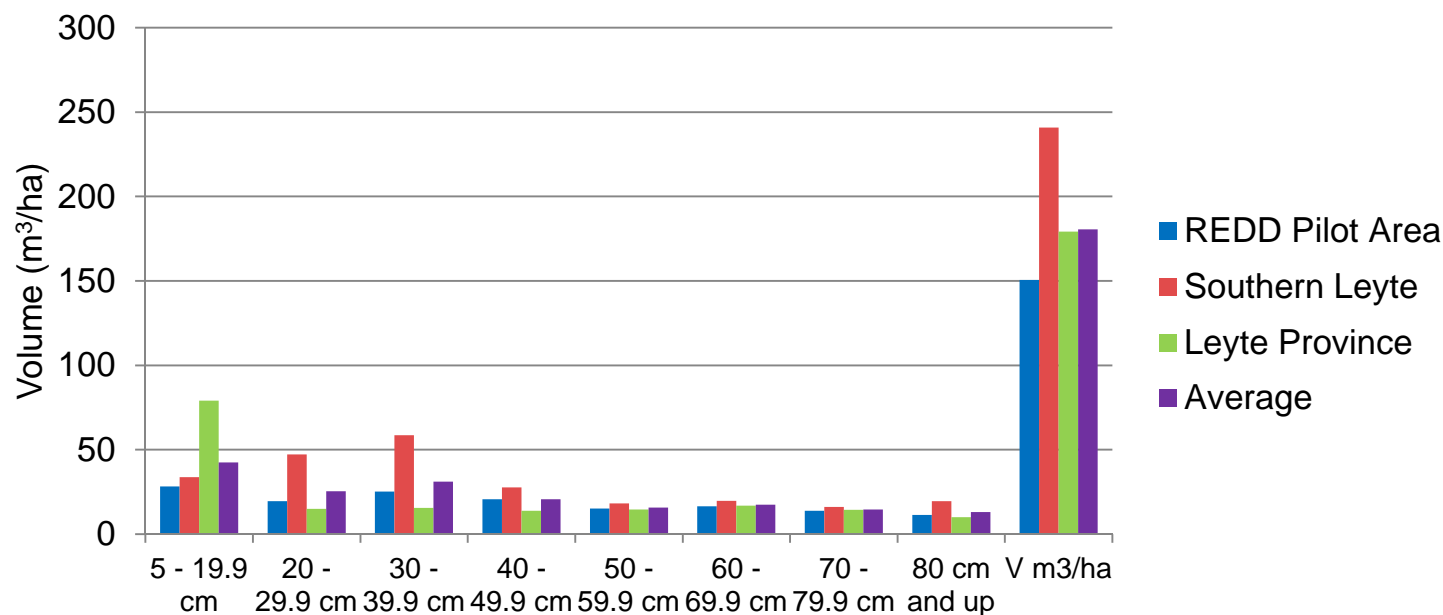
- Test other methods to improve the separation of coconut palms and forest class.
 - Incidence angle of far and near range and separate classification
 - Support vector machine as classification algorithm
 - Use JAXA's processing tool (gamma-naught change and LUC) for forest cover mapping and forest change detection.
 - Process the non-radiometrically enhanced image and include NDI in the analysis.

Forest Resource Assessment

Field Sampling Results by Diameter Class (Volume data for respective areas)

Inventory Area	5 - 19.9 cm	20 - 29.9 cm	30 - 39.9 cm	40 - 49.9 cm	50 - 59.9 cm	60 - 69.9 cm	70 - 79.9 cm	80 cm and up	V m ³ /ha	Biomass t/ha	Carbon t/ha
REDD Pilot Area	28.2	19.5	25.2	20.6	15.2	16.6	13.8	11.4	150.6	204.0	102.0
Southern Leyte	33.7	47.3	58.6	27.7	18.2	19.7	16.2	19.5	240.9	302.6	151.3
Leyte Province	79.0	14.9	15.5	13.8	14.7	16.8	14.4	10.1	179.2	307.9	154.0
Average	42.4	25.4	31.2	20.6	15.8	17.4	14.6	13.1	180.5	254.9	127.4

Comparison of Volume Data of the three Inventory Areas



Total Forest Carbon Pool

Carbon Pool	Carbon t/ha	Total ha ¹⁾	Total Carbon t ²⁾	in %
REDD Pilot Area				
Trees	102.0	30,044	3,064,488	96.8%
Deadwood	1.7	30,044	51,075	1.6%
Litter/Duff	1.7	30,044	51,075	1.6%
Total			3,166,638	
Leyte Island				
Trees	127.4	325,278	41,440,417	96.7%
Deadwood	2.2	325,278	715,612	1.7%
Litter/Duff	1.7	325,278	552,973	1.3%
Mangroves	20.6	6,451	132,891	0.3%
Total			42,841,892	
¹⁾ Forest area data from GIZ REDD+ analysis of PALSAR radar data				
²⁾ Allometric equation used is by Sandra Brown, et. al.				

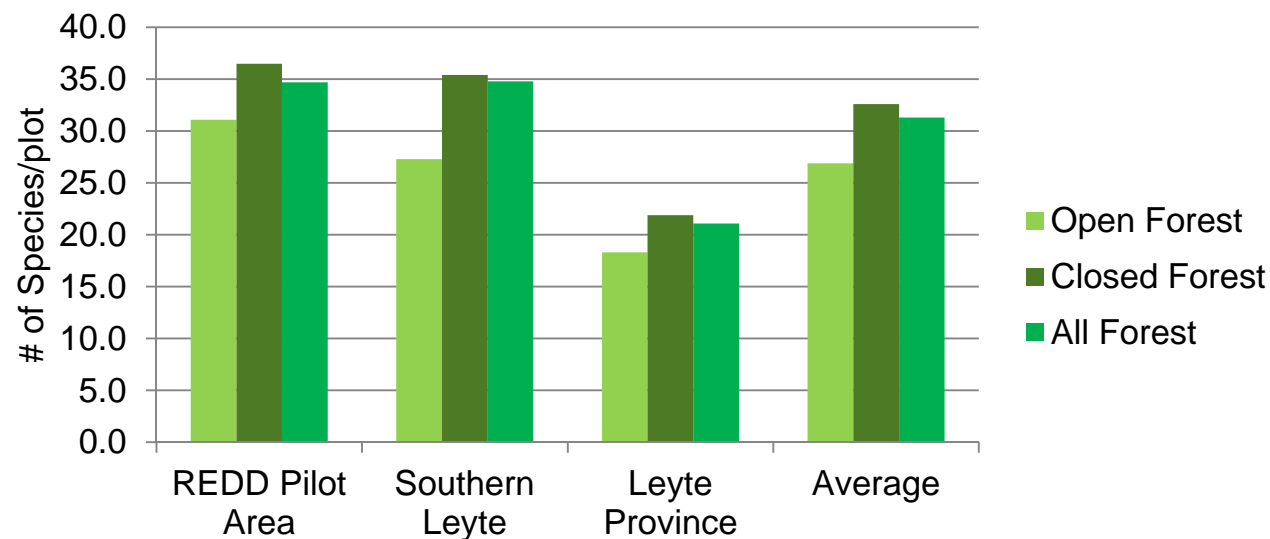
Biodiversity

Number of Vascular Plant Species

Inventory Area	Open Forest	Closed Forest	All Forest
REDD Pilot Area	31.1	36.5	34.7
Southern Leyte	27.3	35.4	34.8
Leyte Province	18.3	21.9	21.1
Average	26.9	32.6	31.3

¹⁾ recorded plant species within plot of 6 m radius

Number of Vascular Plant Species

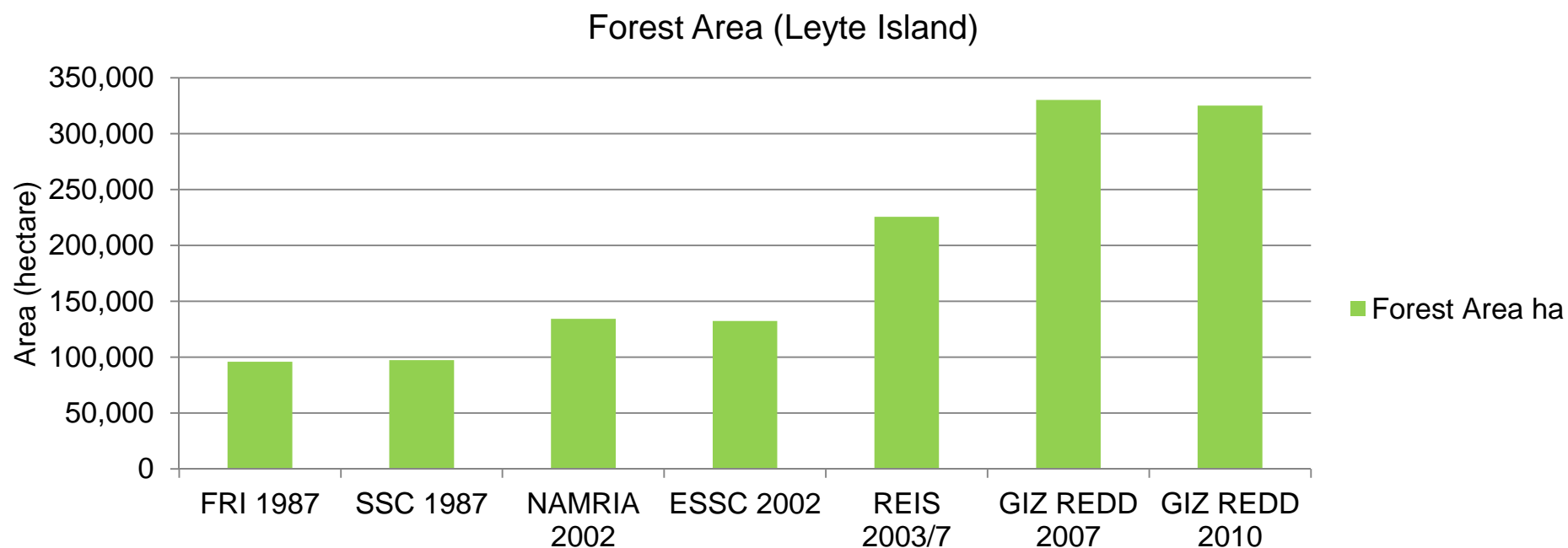


Tree Species Distribution

Mayapis	9.9%
Red Lauan	12.1%
Tanguile	5.5%
White Lauan	10.3%
Yakal	2.1%
Other Dipterocarps	2.9%
Bitanghol	3.5%
Hamindang	2.8%
Haras/Ituma	1.1%
Lingo-lingo	1.2%
Milipili	1.2%
Nato	1.1%
Sagimsim	8.5%
Saungan	2.3%
Sudiang	1.1%
Tiga	1.1%
Ulaian/Oak	5.8%
Other species	27.6%

Forest Cover Assessment in Leyte Island

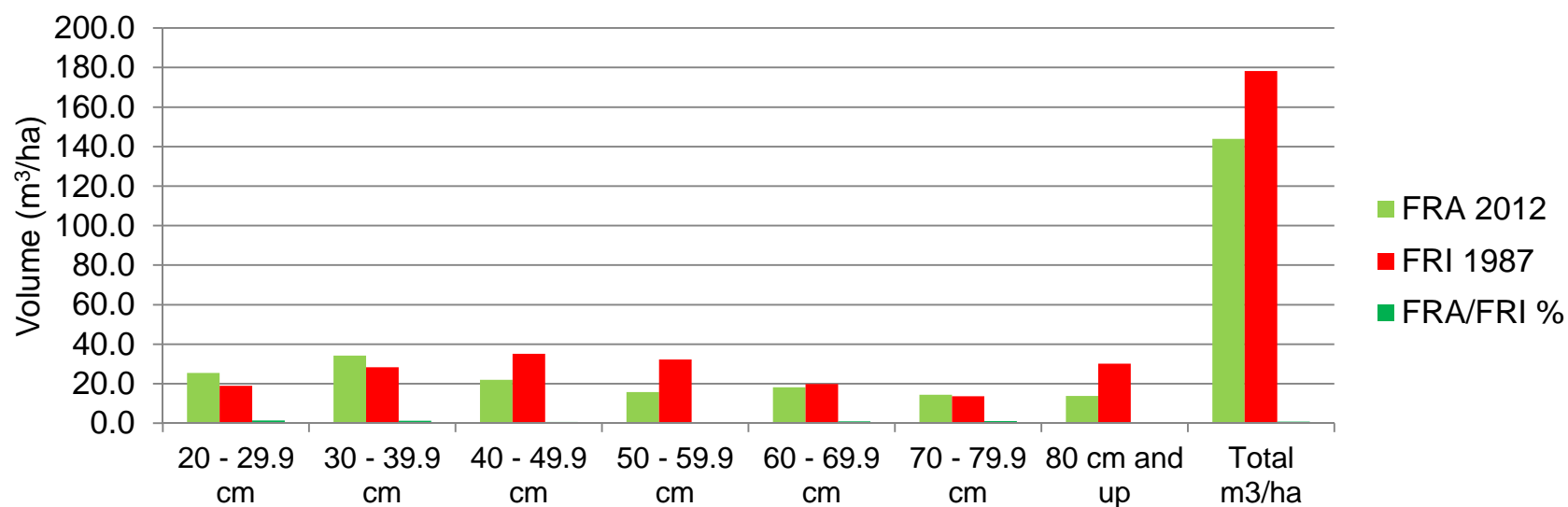
Assessment Leyte Island	Images	Forest Area ha
FRI 1987	Landsat & ground verification	95,991
SSC 1987	SPOT	97,410
NAMRIA 2002	Landsat	134,467
ESSC 2002	Landsat	132,520
REIS 2003/7	SPOT	225,623
GIZ REDD 2007	Palsar Radar	330,315
GIZ REDD 2010	Palsar Radar & ground verific.	325,278



Development of Forest Structure (1987 vs. 2012)

Inventory	20 - 29.9 cm	30 - 39.9 cm	40 - 49.9 cm	50 - 59.9 cm	60 - 69.9 cm	70 - 79.9 cm	80 cm and up	Total m3/ha
FRA 2012	25.4	34.2	22.0	15.8	18.2	14.4	13.8	143.9
FRI 1987	18.9	28.3	35.1	32.2	19.9	13.6	30.1	178.2
FRA/FRI %	134.1%	120.8%	62.9%	49.1%	91.3%	105.5%	45.8%	80.7%

FRA vs. FRI



ALOS

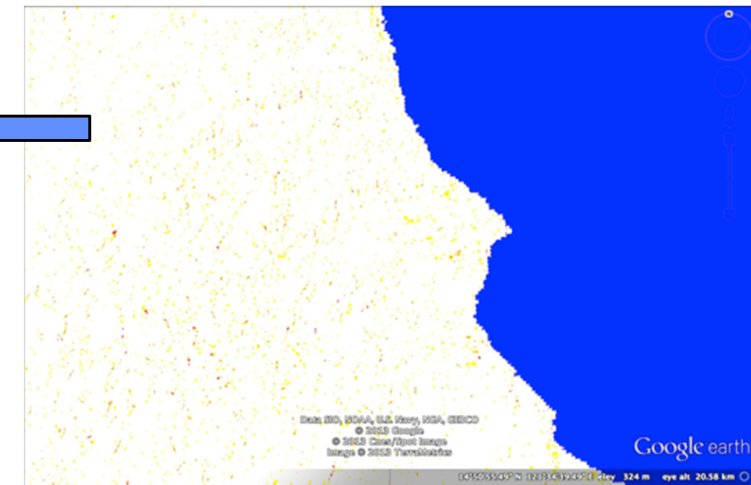
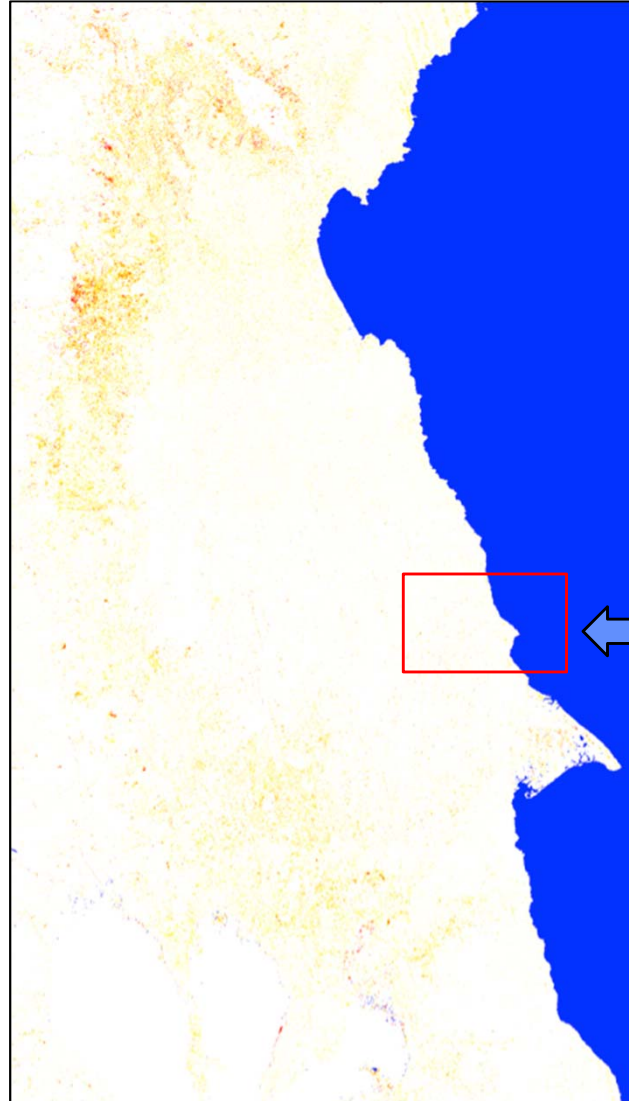
K&C Initiative
An international science collaboration led by JAXA

Updates

SOUTHERN SIERRA MADRE & PALAWAN



Gamma0 Change Map – General Nakar

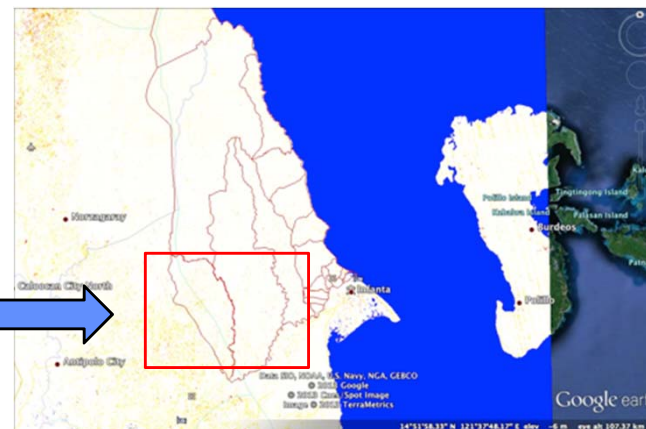
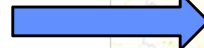


Forested areas are located on mountainous areas. The Gamma0 change is fragmented across the landscape.

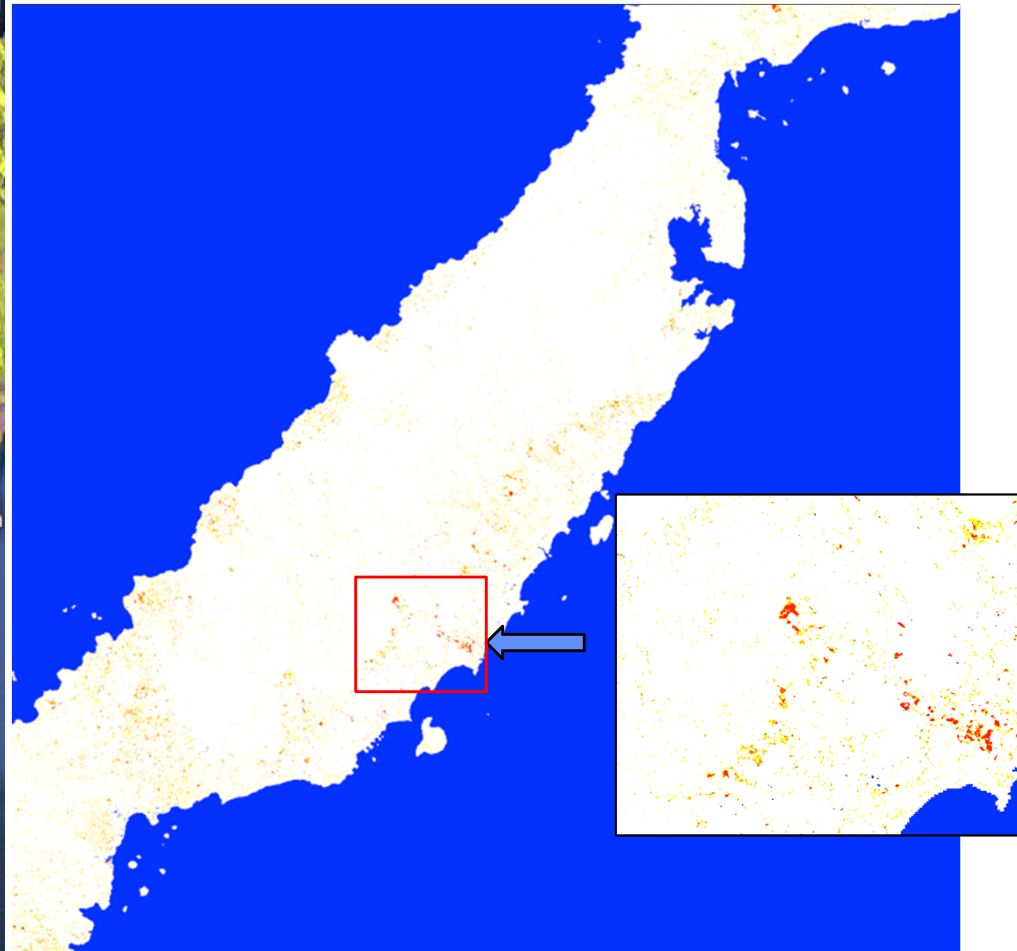
Upcoming Activities on General Nakar

- Forest Inventory Survey and Ground truthing will be conducted on Q3 of 2013.
- ALOS PALSAR datasets (Forest / Non-Forest Layer) will be used for VM009 of the VCS methodology
- Brgy. Lumutan, General Nakar as the proposed project area for the EUREDD project

Brgy. Lumutan



Gamma0 Change Map – General Nakar



Forested areas are also located on mountainous areas. The Gamma0 change tool is detecting more changes on the surrounding landscape of the forest, in which agriculture areas are more likely present.

Upcoming Activities on Palawan

- ☐ **Permits and clearances were awarded in February 2013.**
- ☐ **Forest Inventory Survey and Ground truthing will be conducted on April - June of 2013.**

Support to JAXA' s global forest mapping effort

1. Sharing of in-situ data from forest inventories and other field activities from REDD+ sites
2. Validation of JAXA forest/non-forest cover maps and land use/land cover change maps
3. Input to development of algorithms for forest classification, carbon stock assessment, and forest stratification

The in-situ data that will be shared with JAXA includes: broad habitat and land cover types; location/GPS coordinates; tree diameter, merchantable tree height, and tree species; tree canopy cover; leaf litter; and deadwood.

Deliverables

Deliverables required	LEYTE	PALAWAN	GENERAL NAKAR
1. Forest cover and change maps produced	Complete *	Ongoing	Ongoing
2. Deforestation rates determined	Complete *	Ongoing	Ongoing
3. Baseline forest carbon stocks established	Complete *	Ongoing	Ongoing
4. Image processing methodologies and accuracy assessments documented	Complete *	Ongoing	Ongoing

* for improvement