K&C Phase 4 – Status report

Utilising L-Band SAR Data for Natural Resource Management in the Philippines

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Science Team meeting #22
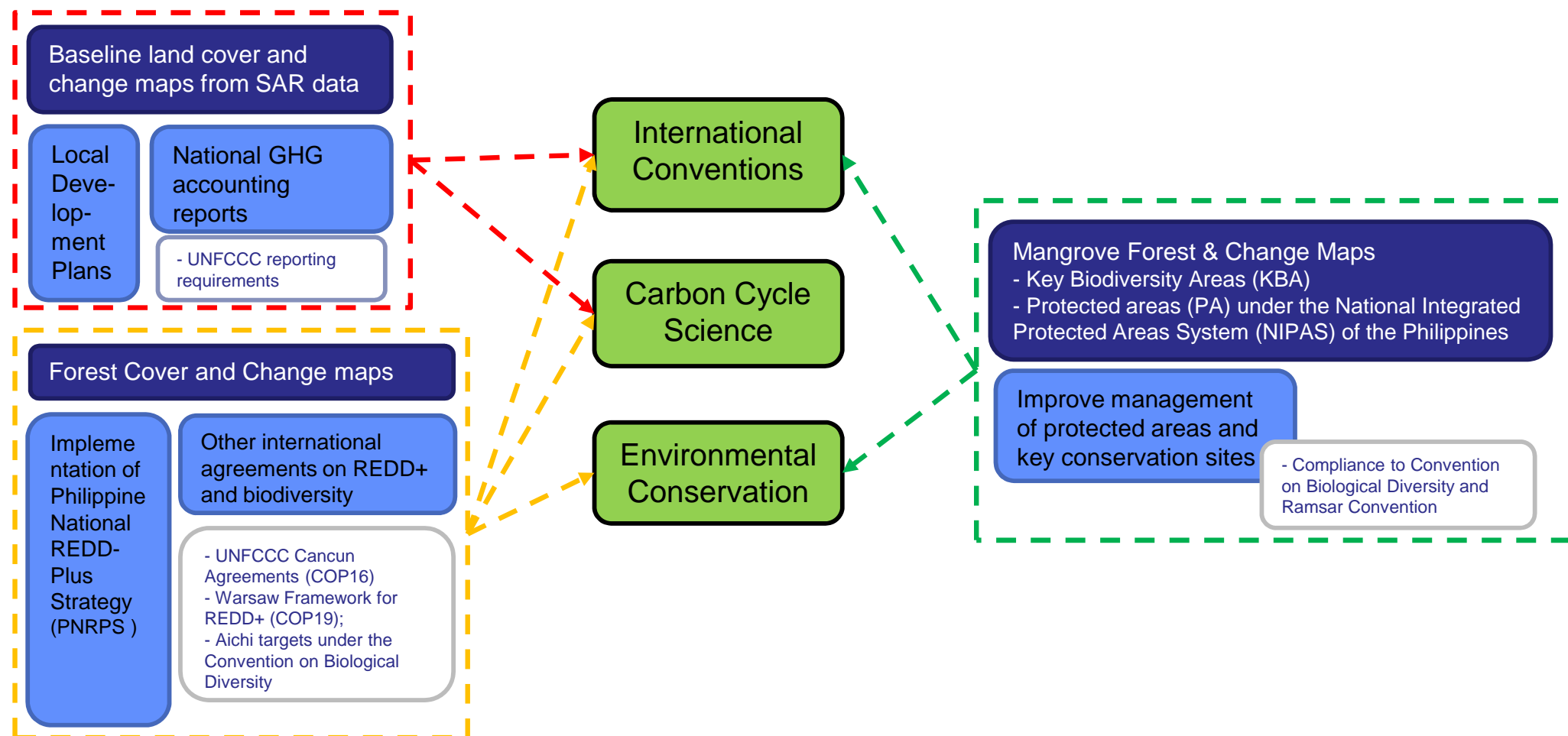Tokyo, Japan, February 16-18, 2016
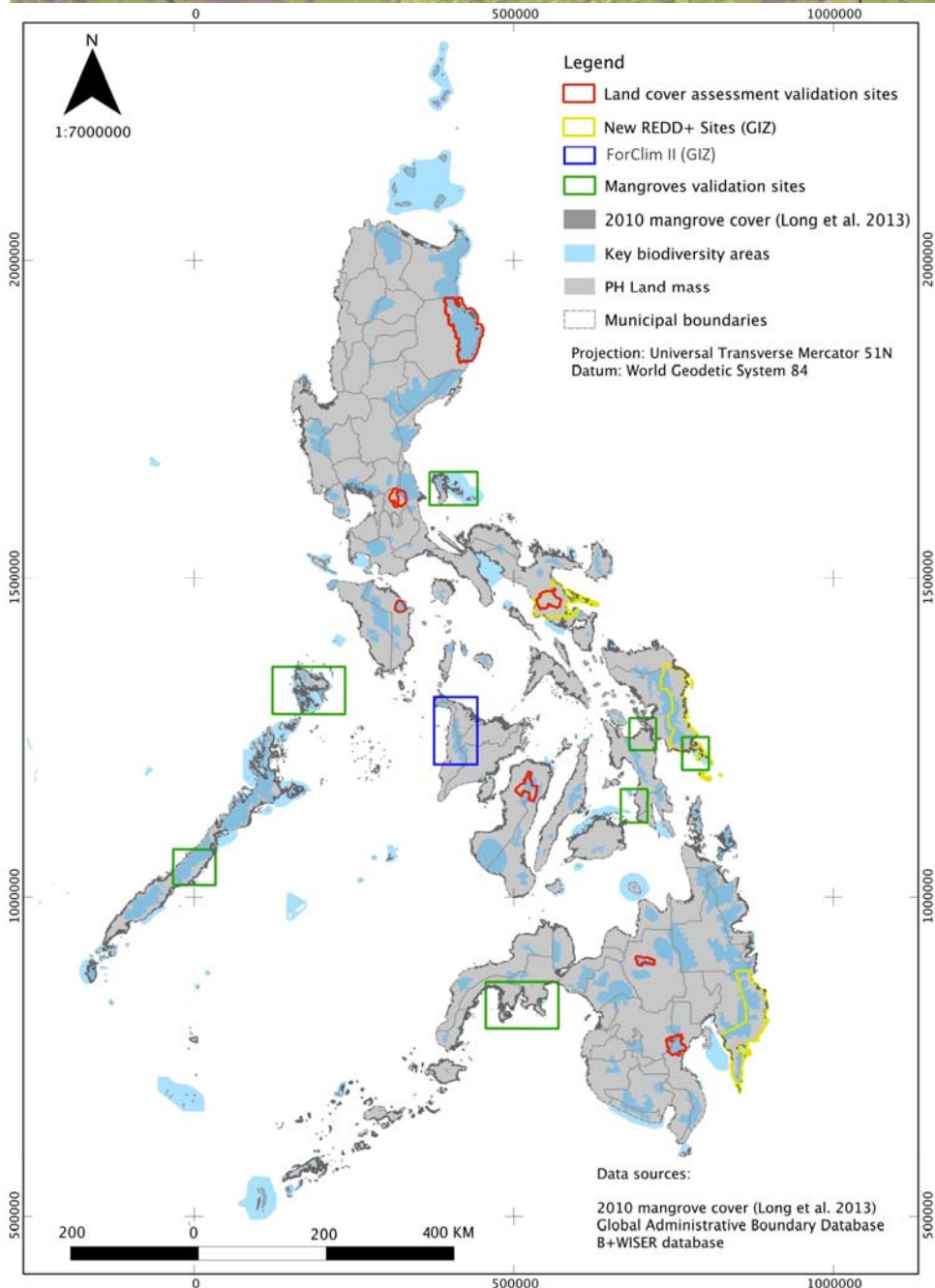
Project outline and objectives

For this K&C project, we aim to demonstrate the utility and viability of L-band SAR data for natural resources management applications in the Philippines, particularly in the following thematic areas (TA):

☐ Thematic area 1: Land cover mapping and change monitoring

☐ Thematic area 2: REDD+ and forest management

☐ Thematic area 3: Mangrove forest mapping and change monitoring

Contribution to K&C thematic drivers

The project in the Philippines, through the envisioned outputs, can contribute to achieving the ff K&C objectives:

Baseline land cover and change maps from SAR data

Local Development Plans

National GHG accounting reports
- UNFCCC reporting requirements

Forest Cover and Change maps

Implementation of Philippine National REDD-Plus Strategy (PNRPS)

Other international agreements on REDD+ and biodiversity
- UNFCCC Cancun Agreements (COP16)
- Warsaw Framework for REDD+ (COP19);
- Aichi targets under the Convention on Biological Diversity

International Conventions

Carbon Cycle Science

Environmental Conservation

Mangrove Forest & Change Maps
- Key Biodiversity Areas (KBA)
- Protected areas (PA) under the National Integrated Protected Areas System (NIPAS) of the Philippines

Improve management of protected areas and key conservation sites
- Compliance to Convention on Biological Diversity and Ramsar Convention

Project areas: Philippines

TA 1: protected areas (7 sites; red)

TA 2: REDD+ sites (3 sites; yellow)
       ForClim II (1 site; blue)

TA 3: mangrove sites (6 sites; green)

Progress and initial results (GIZ)

- Field data collection in two sites completed (Eastern Samar and Panay Island), ongoing on 1 more site (Davao Oriental)

- Python code to automatically compute acquisition date of mosaic datasets developed to help in training data selection (correct dates of samples)

- For execution: revised methodology (for forest cover maps) and newly developed methodology for forest cover change maps

- Initial tests for the forest cover change maps for Eastern Samar (2007-2010 mosaic data) have not shown significant thresholds separating Stable Forests and Deforested areas → may be due to very small number of test data used and/or erroneous samples selected (date of sample do not match PALSAR data)

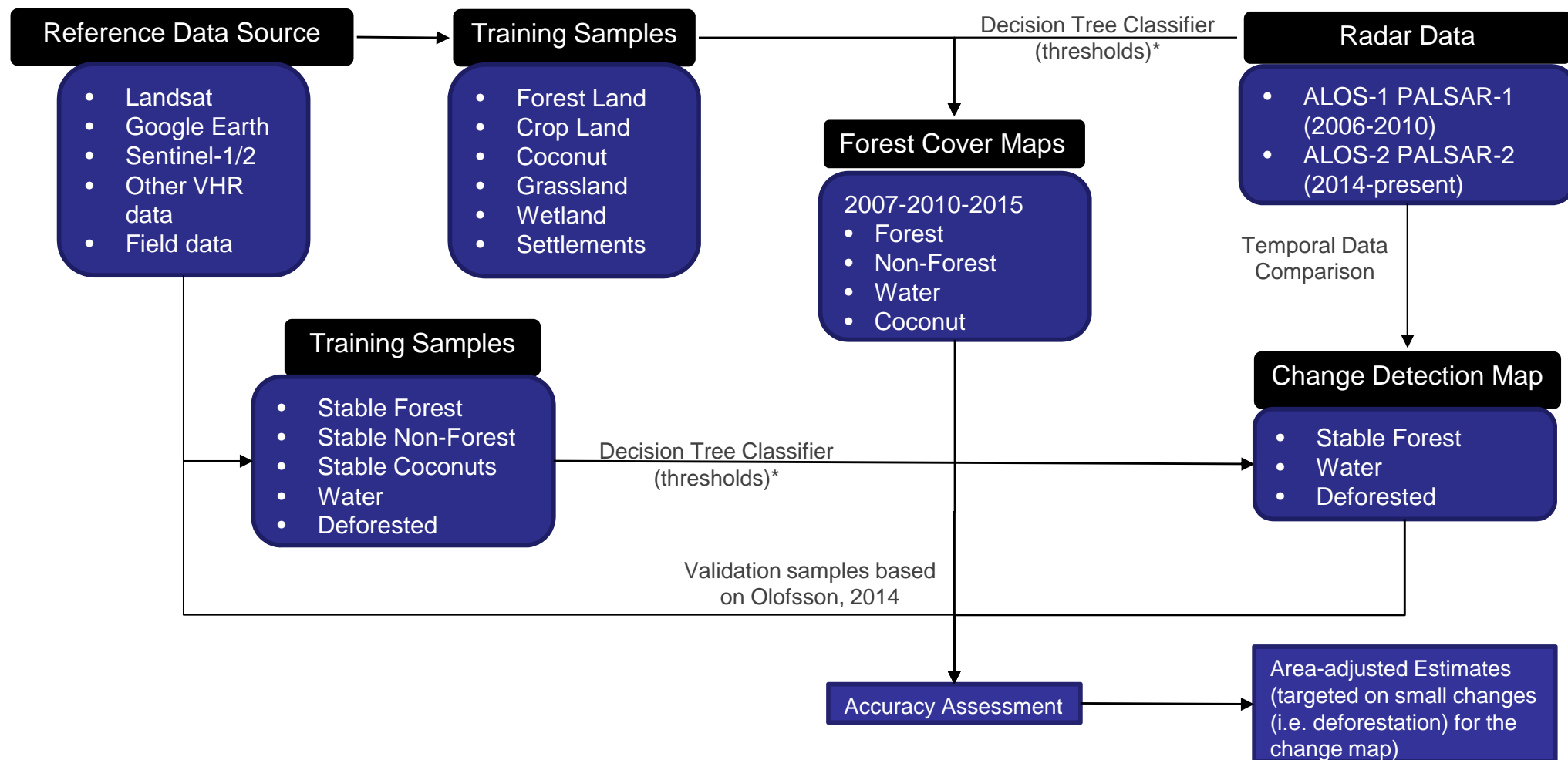# Progress and initial results (GIZ)
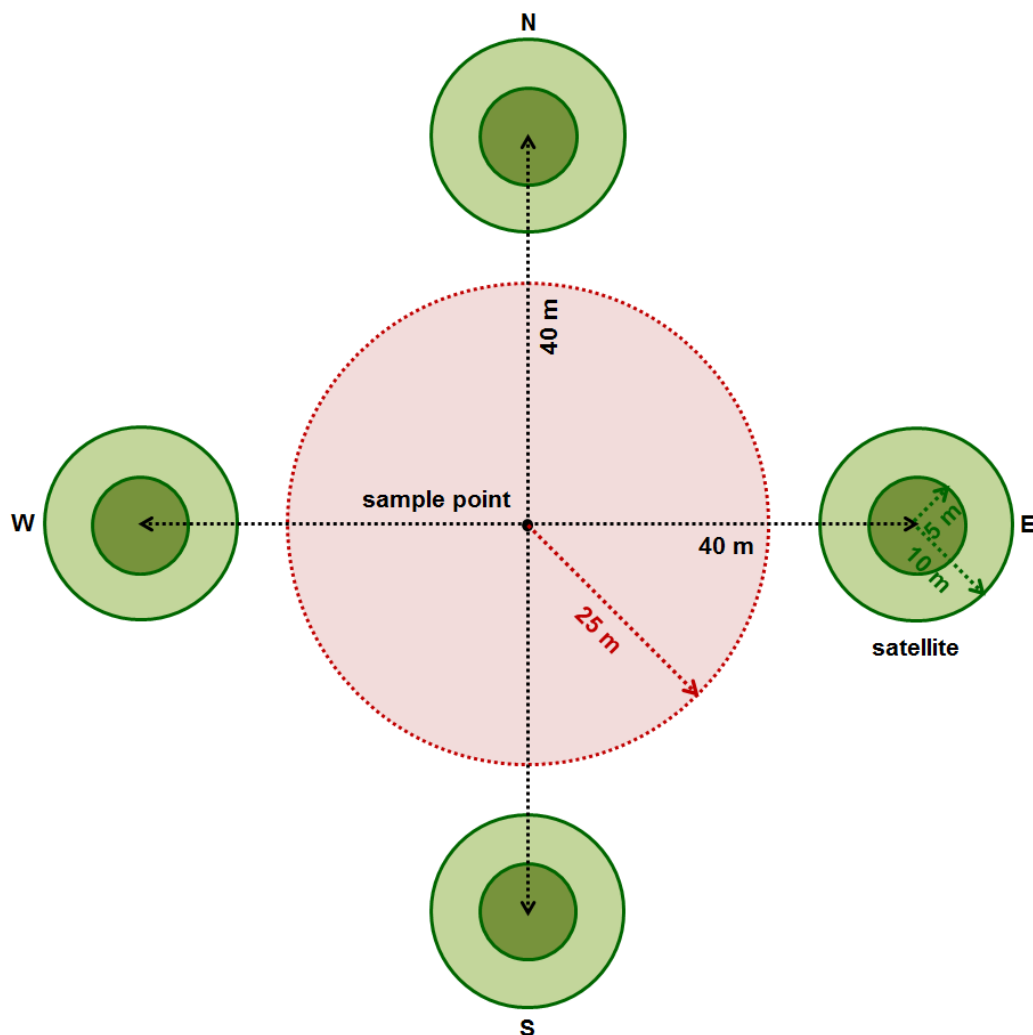
Configuration of FRA Sampling Units:

- Cluster centered on sample point, with 4 "satellites": 10 m & 5 m radius plots:

- 25 m radius plot: ocular assessment of land cover, forest type & tree crown cover (for RS training / validation data)

Province	Clusters established	Encoded in Database	To be established
Eastern Samar	120	120	completed
Davao Oriental	61	50	89
Panay Island	104	28	completed

Forest Cover and Change Detection Maps

Reference Data Source
- Landsat
- Google Earth
- Sentinel-1/2
- Other VHR data
- Field data

Training Samples
- Forest Land
- Crop Land
- Coconut
- Grassland
- Wetland
- Settlements

Decision Tree Classifier (thresholds)*

Radar Data
- ALOS-1 PALSAR-1 (2006-2010)
- ALOS-2 PALSAR-2 (2014-present)

Forest Cover Maps

2007-2010-2015
- Forest
- Non-Forest
- Water
- Coconut

Temporal Data Comparison

Training Samples
- Stable Forest
- Stable Non-Forest
- Stable Coconuts
- Water
- Deforested

Decision Tree Classifier (thresholds)*

Change Detection Map
- Stable Forest
- Water
- Deforested

Validation samples based on Olofsson, 2014

Accuracy Assessment

Area-adjusted Estimates (targeted on small changes (i.e. deforestation) for the change map)

*Based on Reiche, et al., 2013

More information available in Congalton & Green, 2009 and Olofsson, 2014

Progress and initial results (FFI)

TA1: JD De Alban[1], AK Monzon[1], M Parinas[1], SR Reyes[1], RK Veridiano[1], R Tumaneng[1]

TA2: AK Monzon[1], RK Veridiano[1], G Mendoza[2], RJ Vinluan[3], O Agoncillo[3], JD De Alban[1]

TA3: AK Monzon[1], SR Reyes[1], JD De Alban[1], M Parinas[1], RK Veridiano[1], R Tumaneng[1], P Sanchez[4], NM Rocas[4], DM Dela Torre[1]

[1] Fauna & Flora International (FFI)
[2] Biodiversity & Watersheds Improved for Stronger Economy and Ecosystem Resilience Programme (B+WISER)
[3] United States Agency for International Development (USAID)
[4] Forest Management Bureau, Department of Environment and Natural Resources (FMB-DENR)

Progress and initial results
(Summary)

- Field data collection in all sites completed

- ENVI/IDL codes for pre-processing SAR mosaic data (1996, 2007-2010) developed; can be executed for 2015 mosaic data

- Test eCognition rulesets for mangrove classification using SAR and Landsat data developed

- Initial forest/non-forest change and mangrove cover change maps and statistics produced for some sites

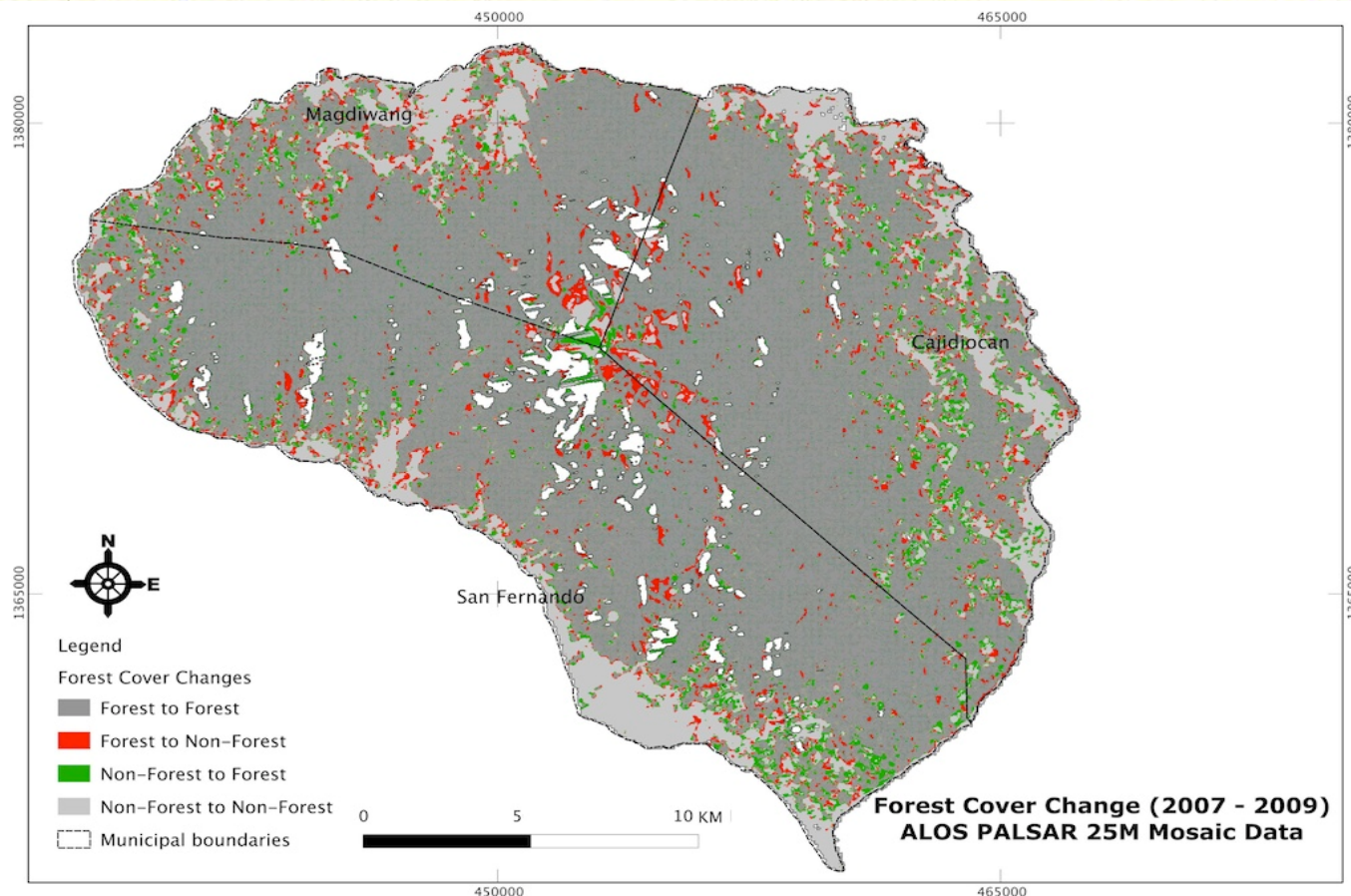- Initial write-up of methods and results documentation prepared

A semi-automated image pre-processing module for 25m JERS-1/PALSAR mosaic data developed using ENVI/IDL software

- Software module developed for semi-automated batch pre-processing of L-band mosaic data of entire Philippines

- Module can also be applied for PALSAR-2 mosaic data

ALOS/PALSAR 25m Mosaic Dataset Preprocessing Workflow
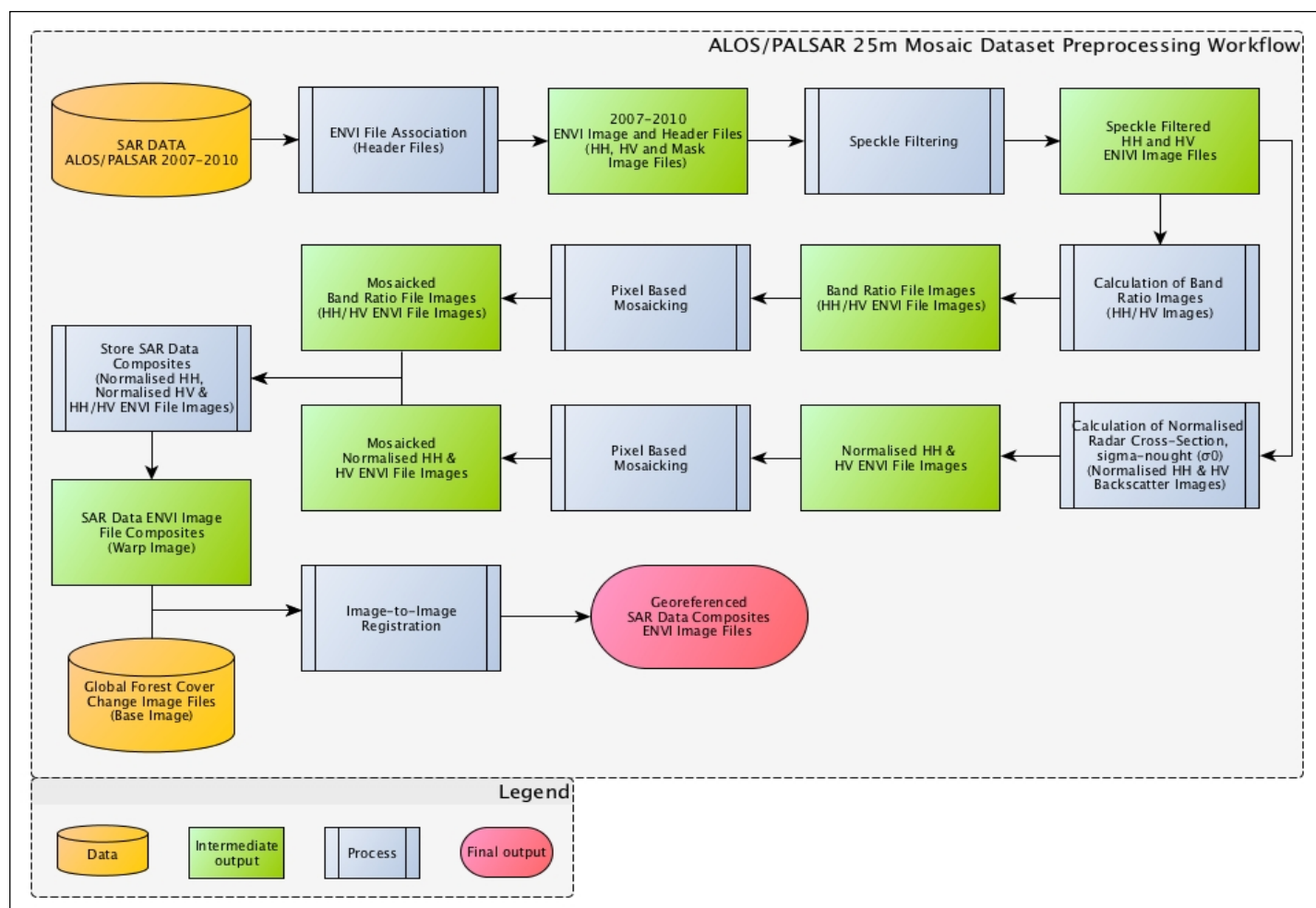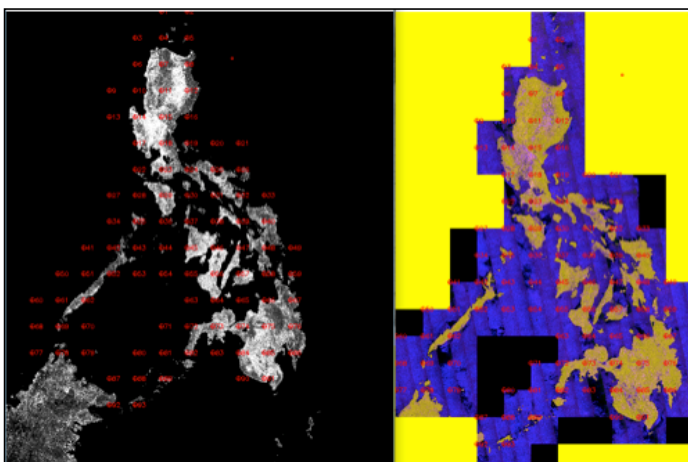
Forest change detection (2007 to 2009) derived from ALOS/PALSAR mosaics

- Study area: Sibuyan Island, Romblon province

- Annual deforestation rate in the island was computed at 0.36%

- ALOS/PALSAR data was helpful in providing spatially explicit information on forest cover change within protected area and ancestral domain within the island

Legend
Forest Cover Changes
- Forest to Forest
- Forest to Non-Forest
- Non-Forest to Forest
- Non-Forest to Non-Forest
- Municipal boundaries

0   5   10 KM

Forest Cover Change (2007 - 2009)
ALOS PALSAR 25M Mosaic Data

Municipalities	Land Area	Forest (in ha)		Non-Forest (in ha)		Net Change (in ha)
		2007	2009	2007	2009	
Cajidiocan	15,160.94	12,226.06	12,182.32	2,934.87	2,978.62	↓43.75
Magdiwang	9,064.93	7,162.69	6,945.47	1,902.26	2,119.47	↓217.21
San Fernando	18,616.26	15,370.24	15,379.83	3,246.02	3,236.43	↑9.59
Sibuyan Island	**42,842.13**	34,758.99	**34,507.62**	8,083.15	**8,334.52**	↓251.37

Forest change detection (2007 to 2010) derived from ALOS/PALSAR mosaics

- Study area: Southern Negros island, Negros Oriental province
- ALOS/PALSAR data was helpful in providing spatially explicit information on forest cover change within municipalities and a geothermal development area
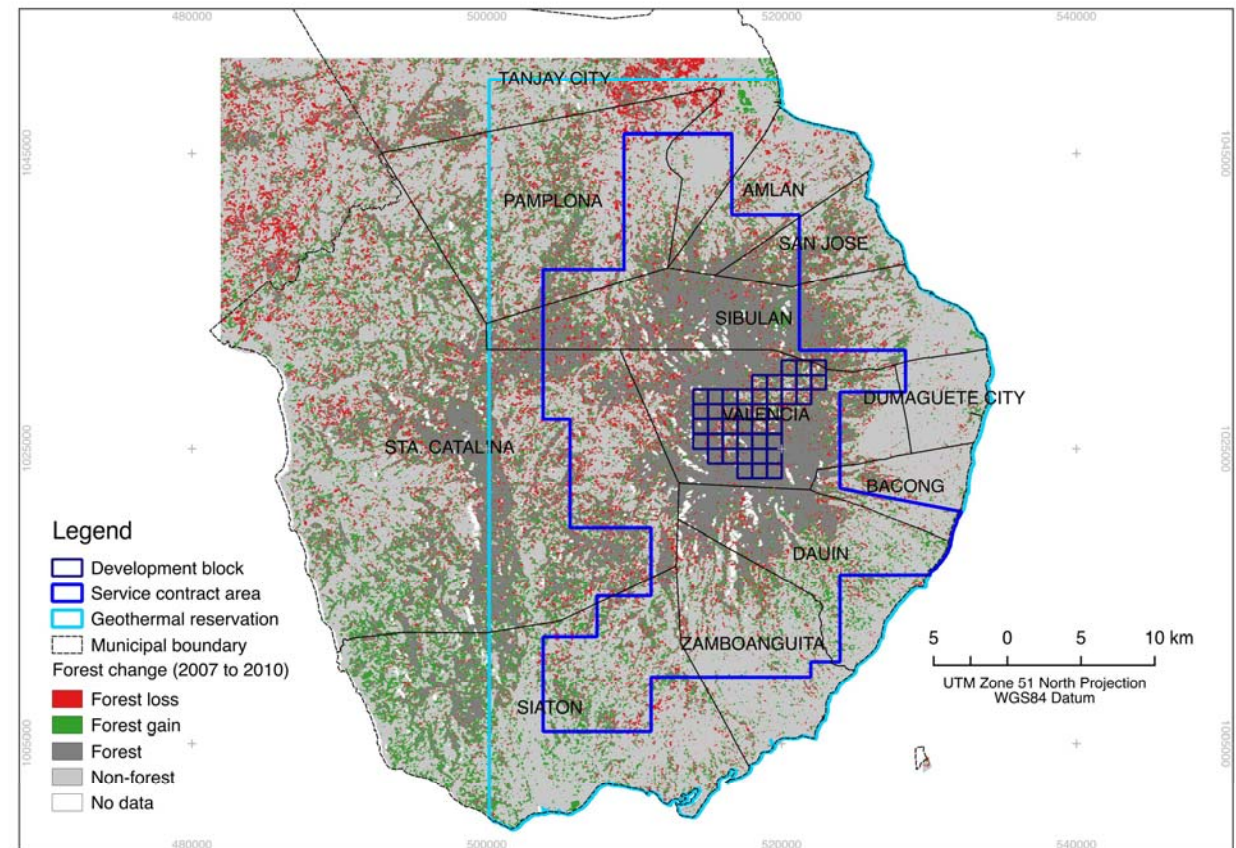

Legend
- Development block
- Service contract area
- Geothermal reservation
- Municipal boundary

Forest change (2007 to 2010)
- Forest loss
- Forest gain
- Forest
- Non-forest
- No data

UTM Zone 51 North Projection
WGS84 Datum

Table 3. Forest cover change statistics of municipalities in Southern Negros island.

Municipality	Land area (ha)	Forest (no change; ha)	Forest loss (ha)	Forest gain (ha)	Net change (ha)
Dauin	11,003	3,157	673	1,385	712
Dumaguete City	3,457	27	60	104	44
Siaton	28,947	3,506	1,458	5,233	3,775
Sibulan	15,222	6,791	1,389	1,585	196
Sta Catalina	57,900	14,521	5,977	8,234	2,257
Valencia	14,136	7,987	1,272	1,135	(137)
Zamboangita	11,126	941	652	1,037	385

Table 4. Forest cover change statistics within Southern Negros geothermal area.

	Land area (ha)	Forest (no change; ha)	Forest loss (ha)	Forest gain (ha)	Net change (ha)
Reservation	135,191	33,006	11,855	14,859	3,004
Service Contract		22,593	5,956	6,988	1,032

Mangrove mapping and change detection (1996, 2007-2010) derived from ALOS/PALSAR mosaics

- Study area: entire Philippines

- Testing of rulesets for mangrove/non-mangrove classification

- Initial mangrove cover and change maps and statistics produced using 1996-2007-2010 SAR (JERS-1 and ALOS/PALSAR) data and Landsat data

- Fine-tuning of segmentation and classification rulesets
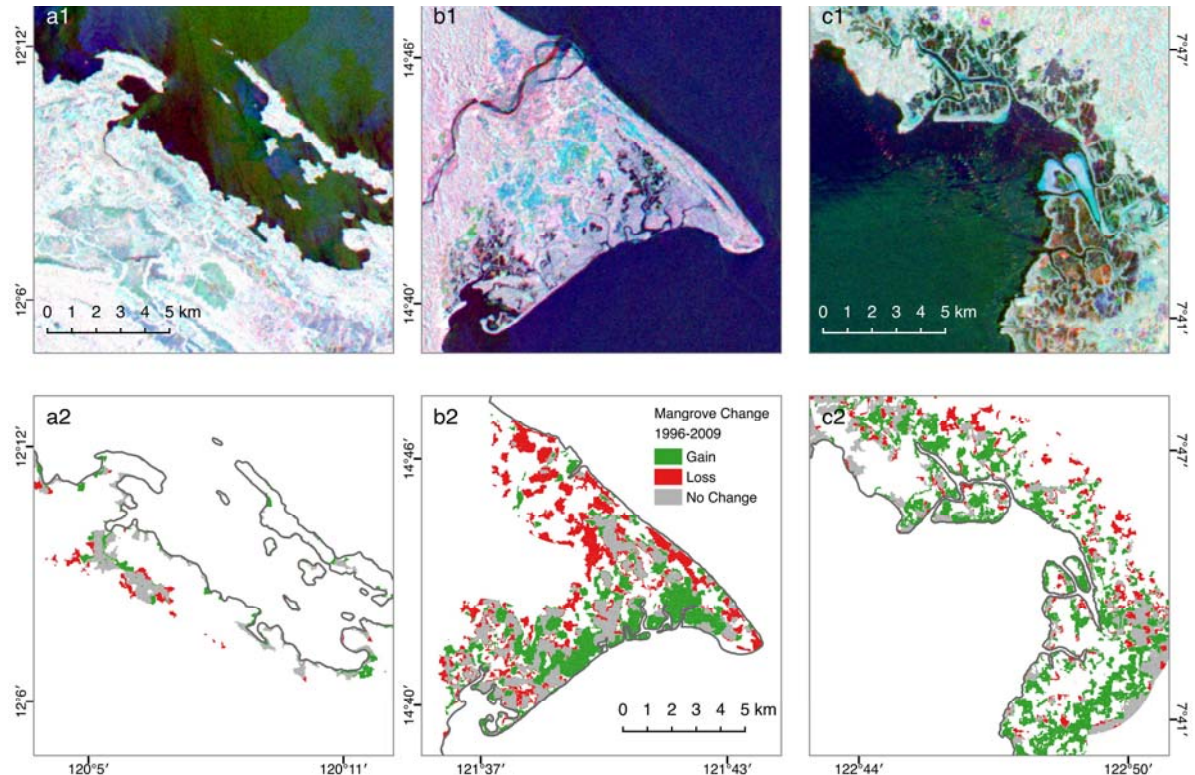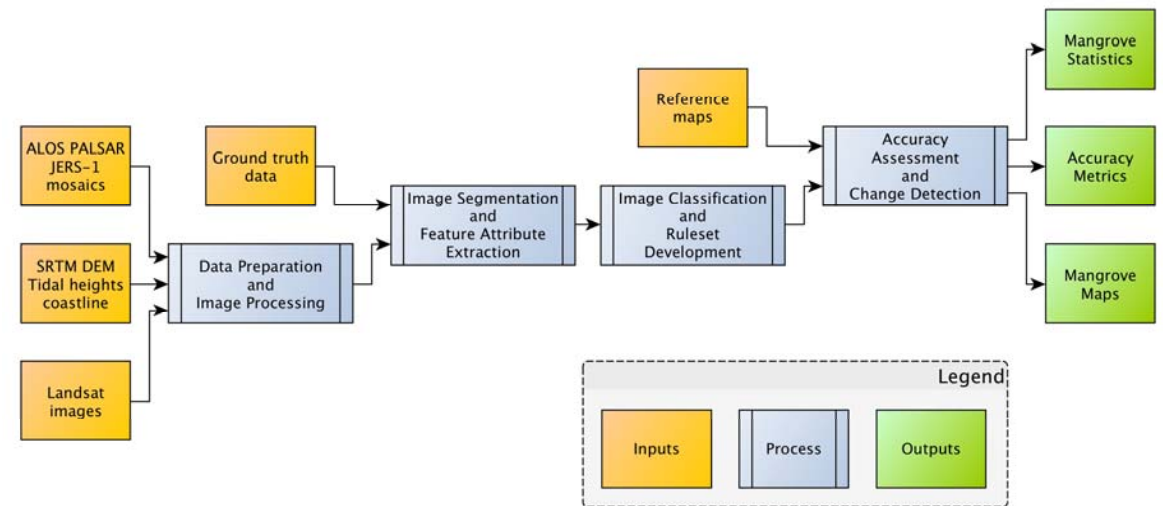
Aboveground forest biomass mapping (2015) using ALOS-2/PALSAR-2 standard product

- Study area: Northern Sierra Madre Natural Park, Isabela province

- 62 circular nested forest inventory plots

- Highest R2 obtained using PALSAR-2 HH+HV+VH+VV combination and 20m-radius plots

- Low R^2 correlation observed possibly due to: (a) small plot sizes (20m radius circular plots or smaller); (b) specific dbh ranges of trees were measured in each nested plot

Legend
- Forest carbon plots
- Northern Sierra Madre Natural Park

AGB prediction t/ha (model 4)
- 0
- 1 to 50
- 50 to 100
- 100 to 200
- 200 to 300
- 300 to 400

Table 2. Computed R-squared for biomass (t/ha) - radar (dB) regressions. The AGB estimates (t/ha) correspond to the total AGB estimates of plots; and the dB values correspond to the mean backscatter values per band (HH, HV, VH, VV) of the respective plot areas. Regression models were computed using mean backscatter values for each single polarization, dual-polarisation (HH+HV), and quad-polarisation (HH+HV+VH+VV).

Plot radius (m)	Plot area (ha)	HH	HV	VH	VV	HH+HV	HH+HV+VH+VV	n
4	0.005	0.033	0.072	0.051	0.026	0.373	0.438	32
14	0.062	0.003	0.042	0.052	0.003	0.308	0.356	62
20	0.126	0.008	0.132	0.098	0.002	0.481	0.508	46
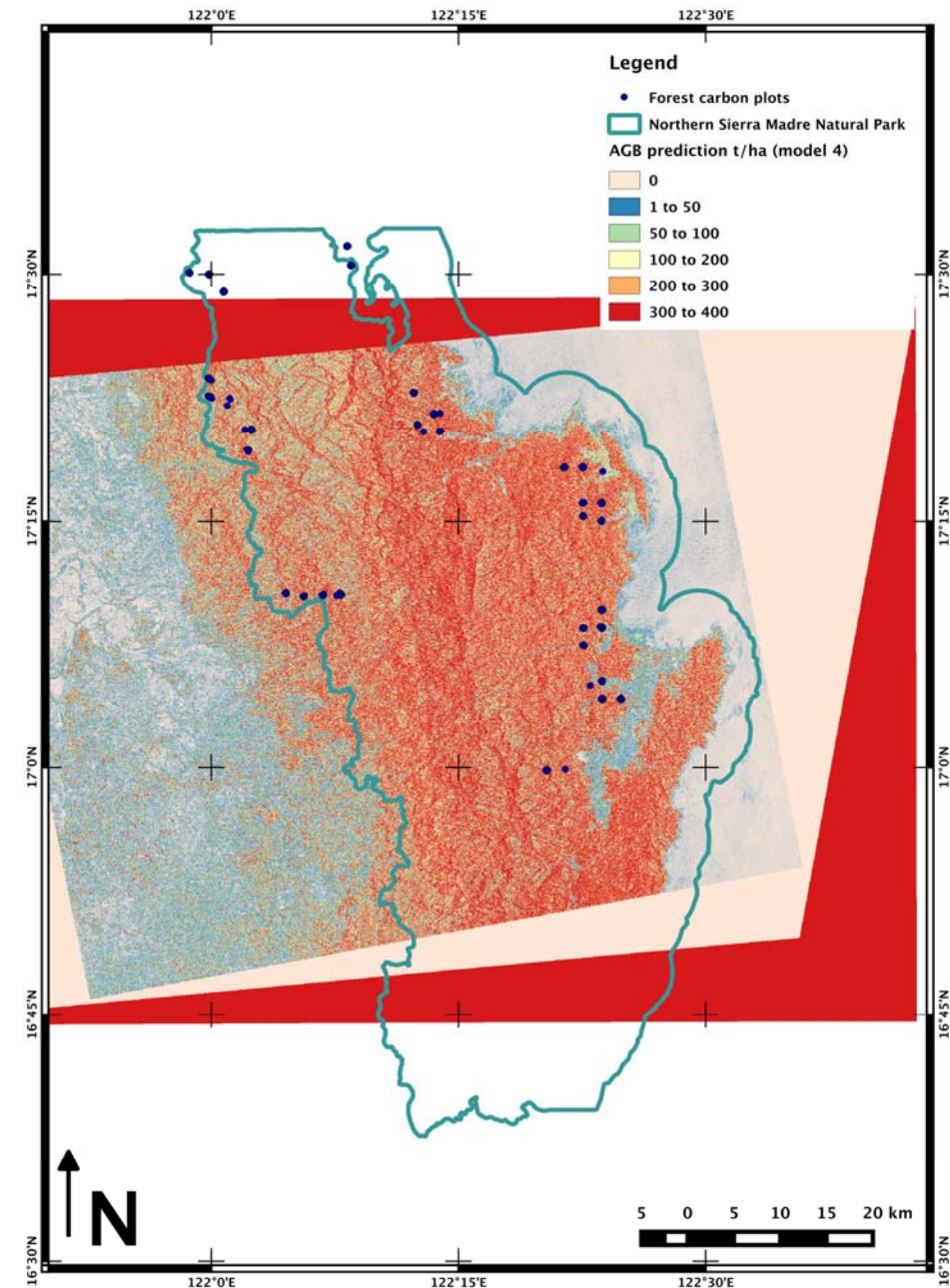
Project Milestones (revised)

Main Activities	2014		2015		2016		2017	
	S1	S2	S1	S2	S1	S2	S1	S2
1. Image processing								
2. Field data collection and assessments								
3. Image post-processing, modeling, and analysis								
4. Report writing								

Legend:
- Land cover mapping
- REDD+ and forest management
- Forest and climate protection
- Mangrove mapping and change detection

Data sharing
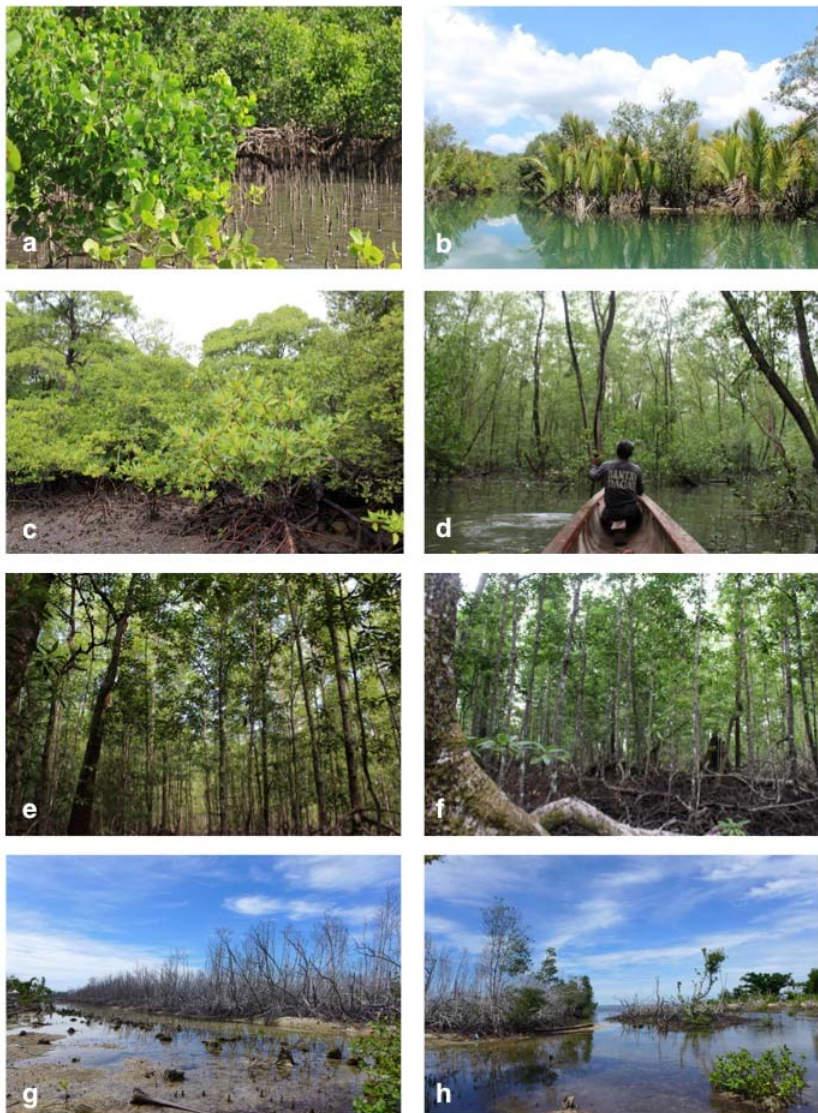
Thematic Area	Description	Status
TA 1	• FFI: land cover and habitat ground-truth data collected from 2014-2015 in seven sites; GPS coordinates, photos	Collection completed
TA 2	• GIZ: FRA in 2015 • Eastern Samar (120) • Panay Island (104) • Davao Oriental (150)	Collection completed Ongoing
	• FFI/B+WISER: forest inventory data collected in 2015 from one site; 62 plots	Collection completed
TA 3	• FFI: mangrove ground-truth data collected from 2014-2015 in six sites; GPS coordinates, photos	Collection completed

Deliverables

Thematic Area	Description	Status
TA 1	• Land cover/FNF cover and change maps, 2007-2010-2015 • Documentation report	On-going completion
TA 2	• Forest and non-forest cover and change maps (4 sites) • Forest Biomass Maps (except Albay) • Documentation report • Baseline carbon stock assessment from Forest Resources Assessments (except Albay)	On-going. On-going completion.
TA 3	• Mangrove cover and change maps 1996, 2007-2010, 2015 • Documentation report	On-going completion
Others	• Conference papers published/presented in: 14th World Forestry Congress (4) and 36th Asian Conference on Remote Sensing (3)	Done

Collaborators

Partners

- Biodiversity and Watersheds Improved for Stronger Economy and Ecosystem Resilience (B+WISER) Programme
- United States Agency for International Development
- Foundation for the Philippine Environment
- Philippine Tropical Forest Conservation Foundation
- Energy Development Corporation

Acknowledgements

Thank you!