FOREST RESOURCES ASSESSMENT VIA REMOTE SENSING: Using LiDAR Data for Forest Inventory

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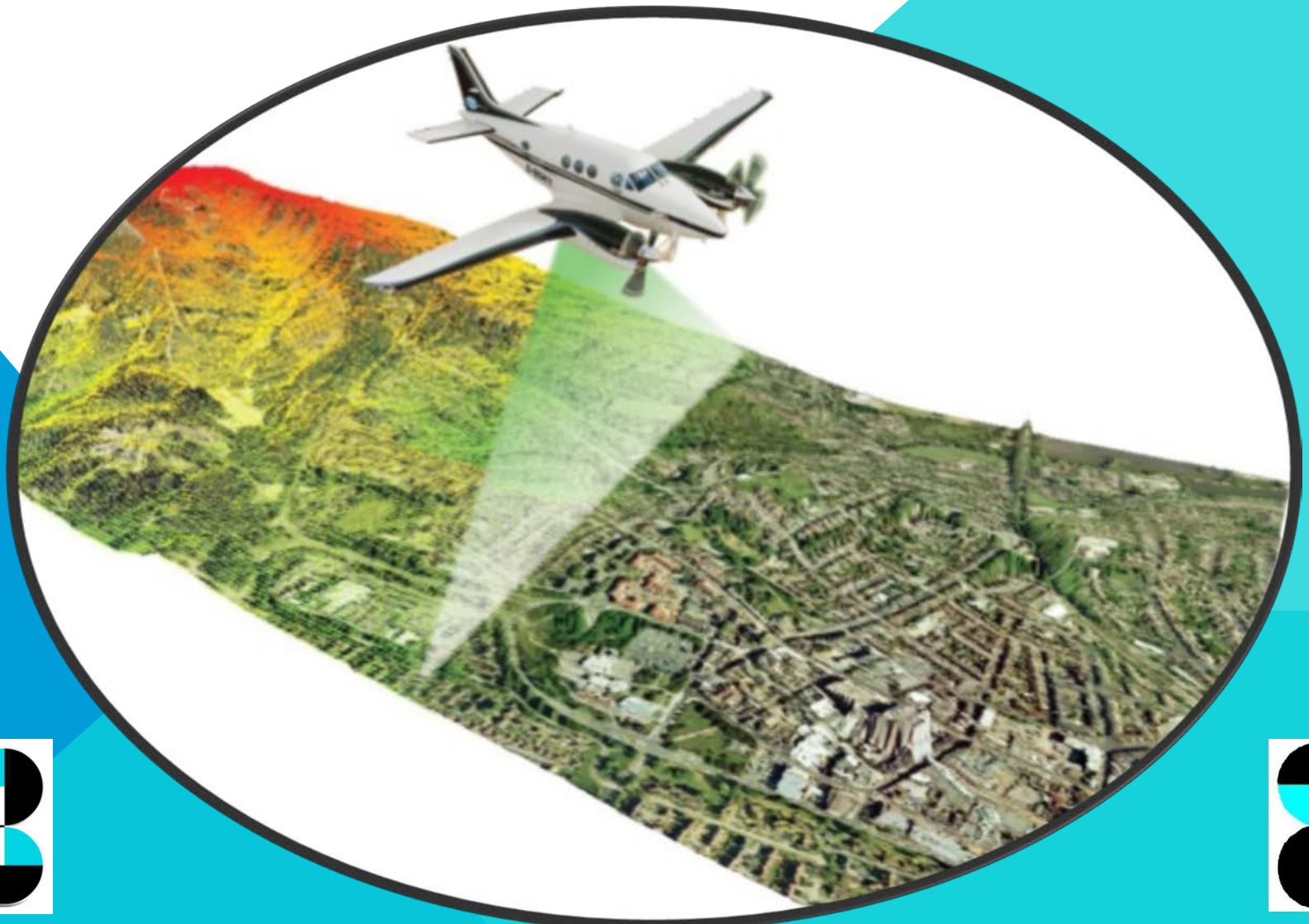
INTRODUCTION

- Conventional forest inventory
  - Extensive field work
  - Tedious sampling methods
  - Intensive measurements
- Remote sensing
  - Aerial photographs
  - Satellite data
  - Existing GIS software
- LiDAR technology
  - First time used in the Philippines for resource assessment
  - Used LiDAR data from the DREAM Project

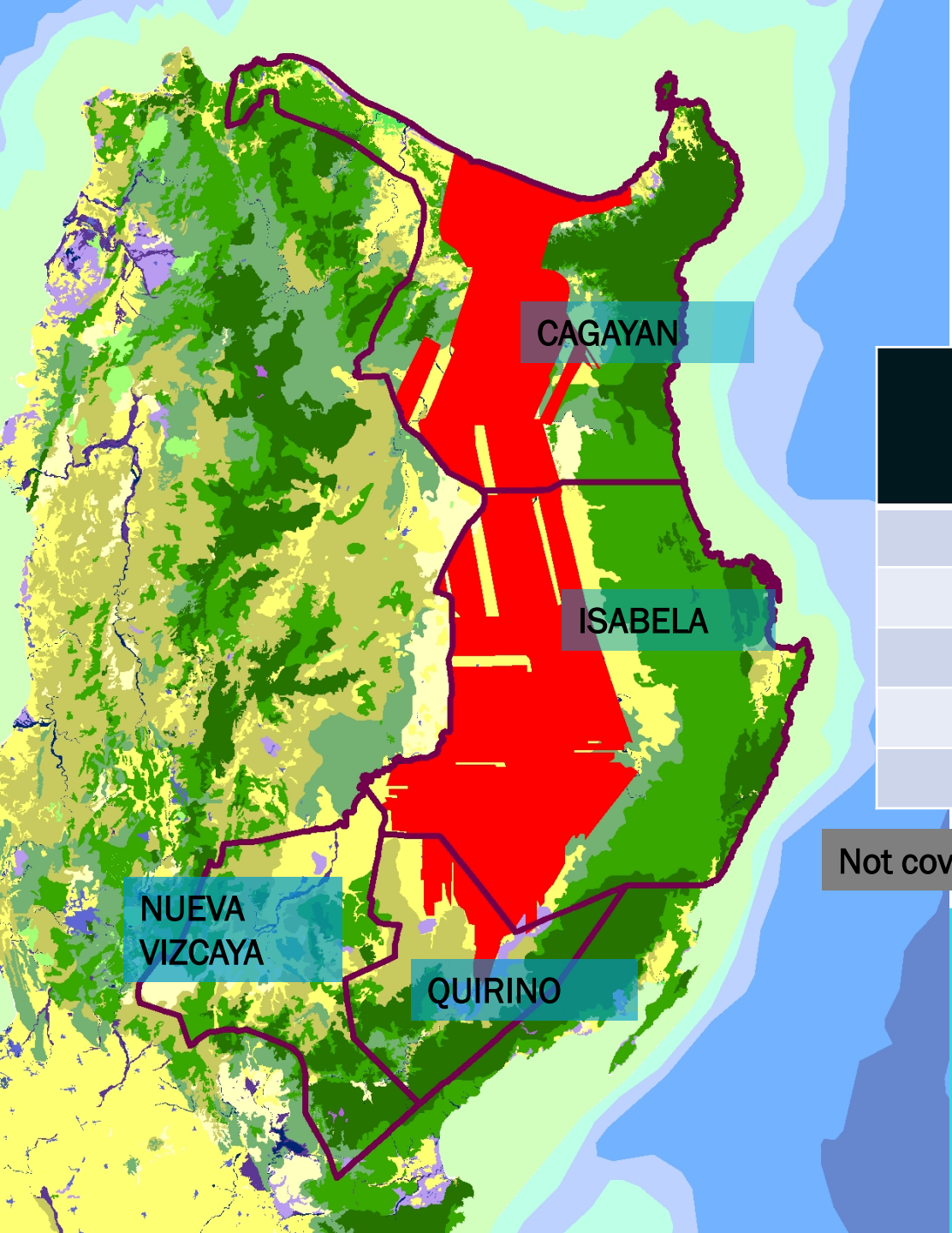
PHIL-LIDAR 2 R&D PROGRAM

LIDAR DATA PROCESSING, MODELING AND VALIDATION FOR

DETAILED RESOURCES ASSESSMENT



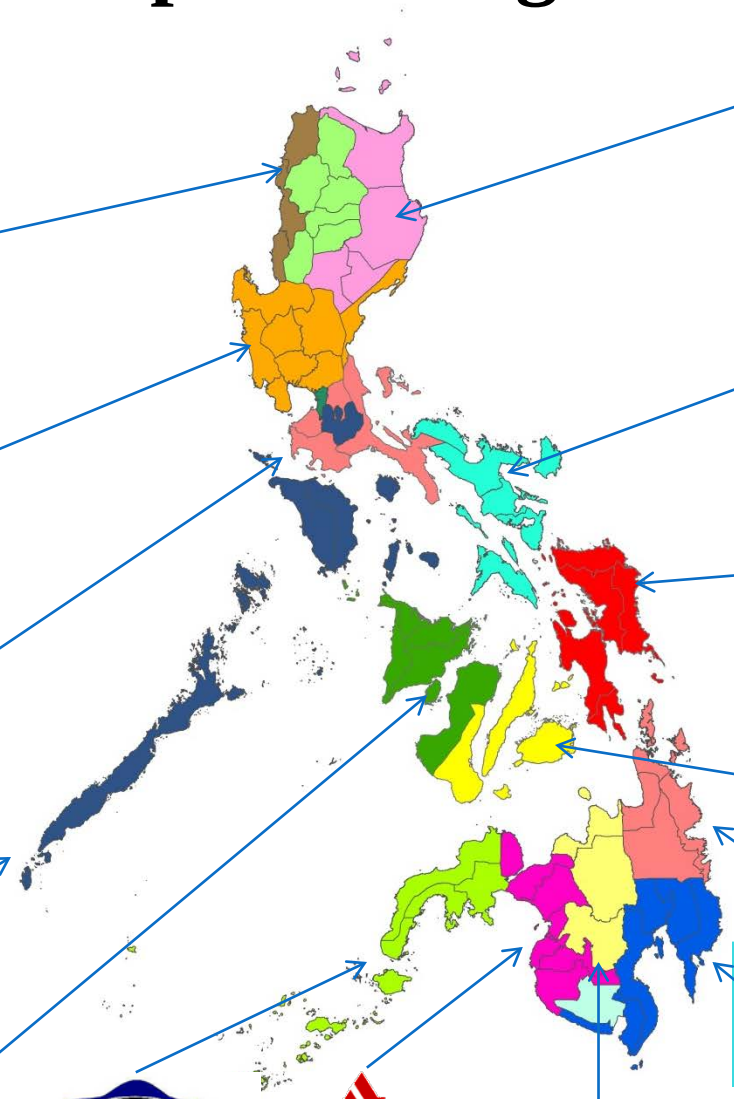
LiDAR Coverage (Partial) in Region 2



Coverage; km²/Province	Partial LiDAR	Percentage Covered by LiDAR
Cagayan	3,041.79	11.4%
Isabela	4,723.12	17.7%
N.Vizcaya	0.00	0%
Quirino	411.28	1.54%
	8,176.20	30.7%

Not covered : 18,452.77 69.3 %

Implementing HEIs



MAJOR PROJECT OUTPUTS

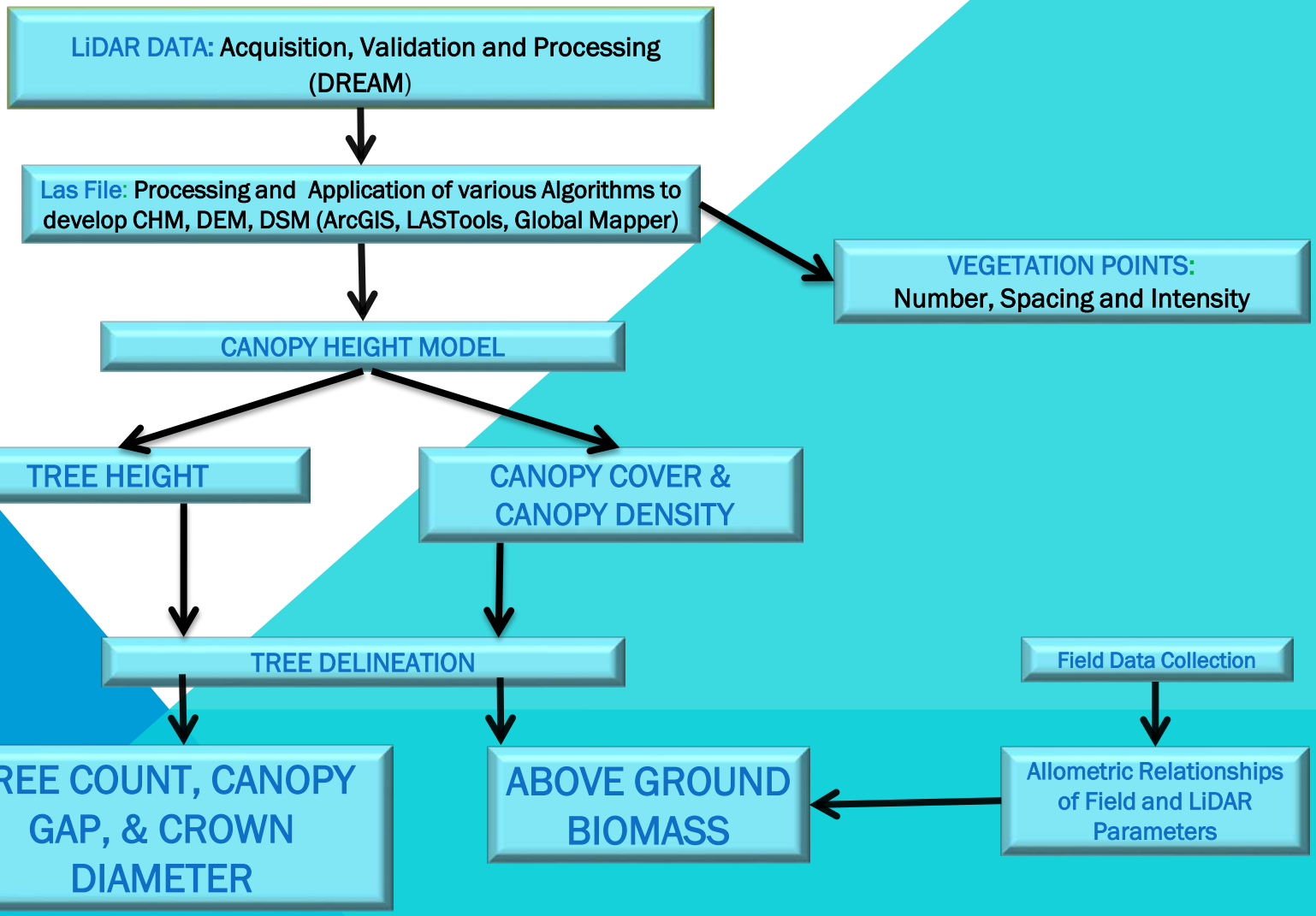
Detailed high-accuracy maps:
Provide more reliable (science-based) information for decision-making regarding agriculture, forest, aquatic, water and energy resources in the Philippines.

Turnover Ceremony, 4 December 2015
Great Eastern Hotel, Quezon City, Metro Manila

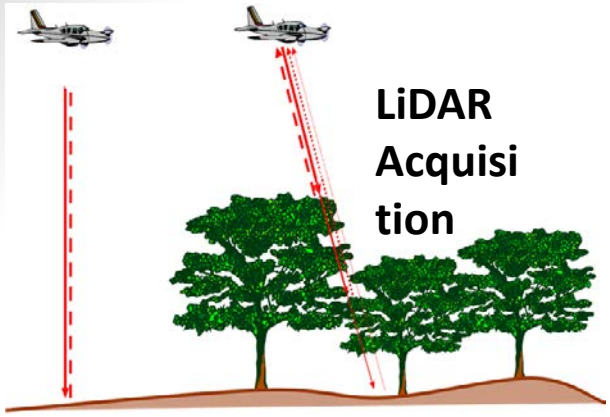
PROJECT COMPONENTS

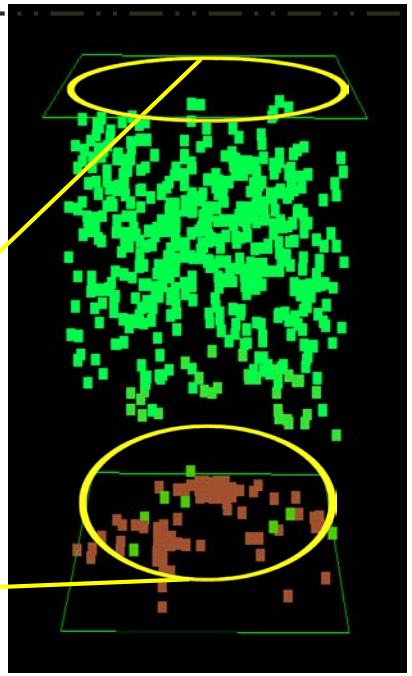
1. **Agricultural Resources Assessment using LiDAR (PARMap)**
2. **Coastal Resources Assessment using LiDAR (COASTMap)**
3. ***Forest Resources Assessment using LiDAR (FRExLS) ******
4. **Development of the Philippine Hydrologic Datasets for Watersheds using LiDAR (PHD)**
5. **Renewable Energy Resources Mapping using LiDAR (REMap)**

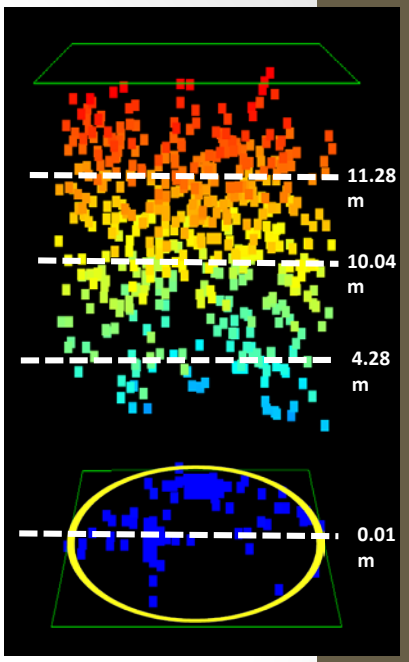
METHODOLOGY



LiDAR Method

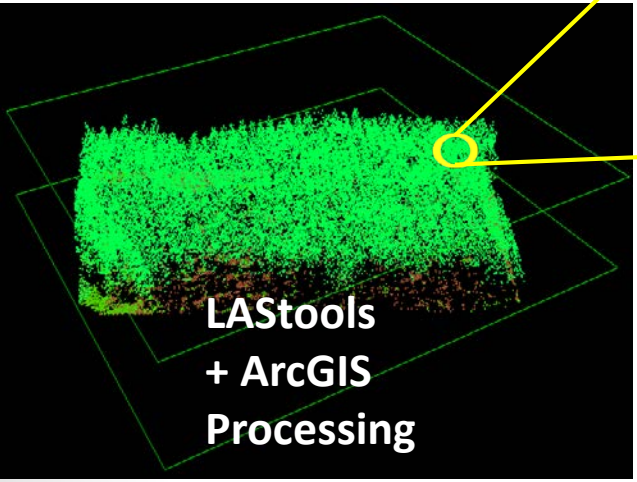




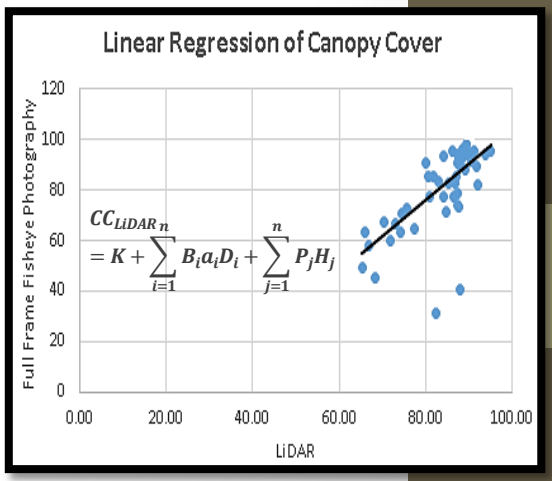


Height Bins

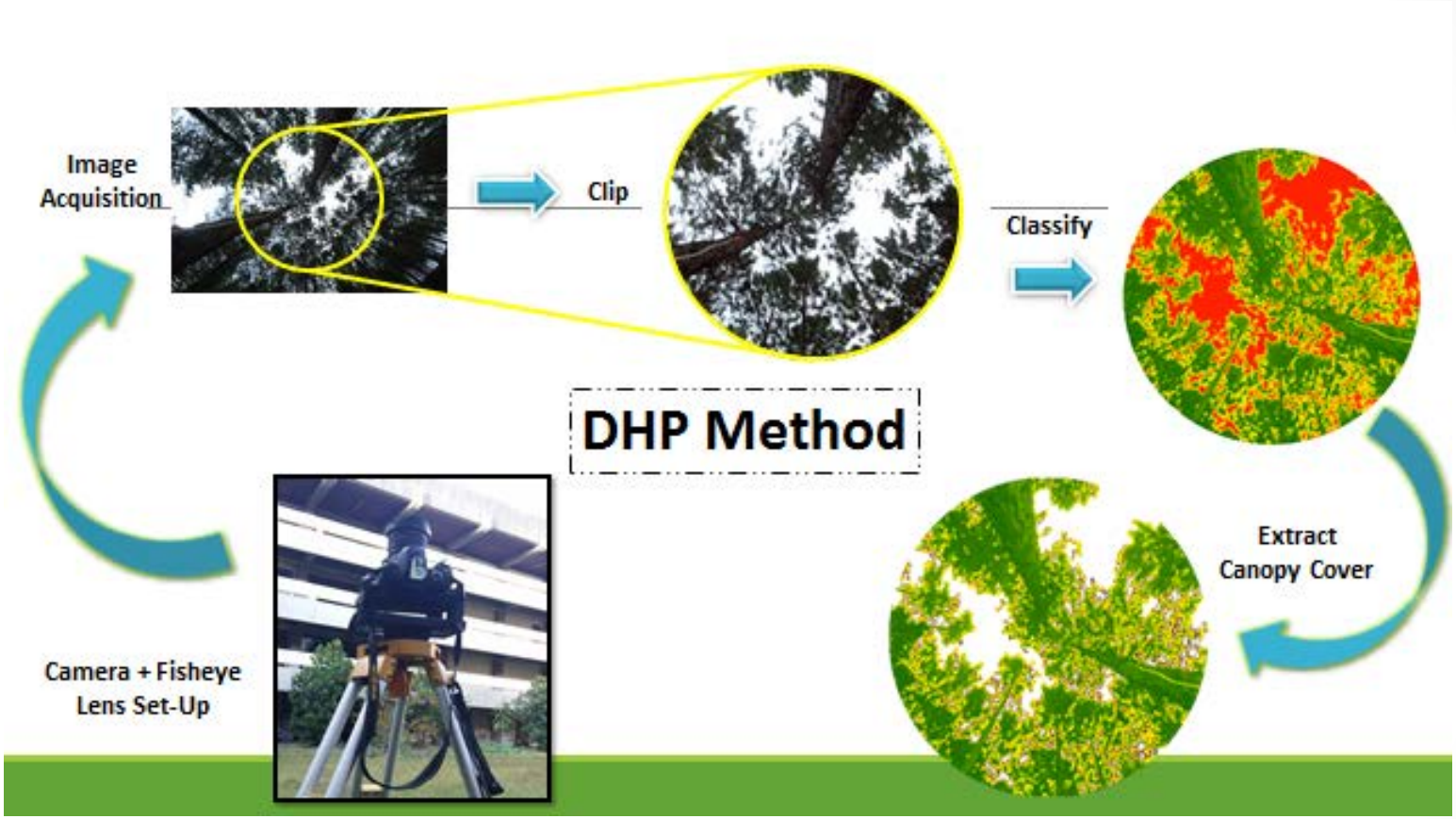
Clip



Regress



DHP Method using Fish-eye lens Camera



Models being evaluated

- **Canopy Height Model (CHM)**– height of trees; from ground to the top of the trees.
- **Aboveground Biomass** –all living biomass above the soil including stem, stump, branches, bark, seeds and foliage
- **Carbon Stock**– quantity of carbon in a a reservoir or system which has the capacity to accumulate or release carbon
- **Diameter-at-breast-Height (DBH)**– tree diameter measured at 1.3 meters above the ground
- **Canopy Cover Model (CCM)** – area covered by crowns of individual trees vertically projected at the outermost perimeter (small openings included)
- **Digital Hemispherical Photography (DHP)** – hemispherical images acquired using a wide-angle-lens (fisheye) camera

RESULTS

Correlation: Actual Field Data vs Model-generated from LiDAR Data

Forest Type	Plots (20x20m)	Subplots (10x10m)	FIELD DATA			LIDAR-DERIVED DATA		
			Ave. Height (m)	Total DBH per subplot (cm)	Aboveground Biomass (kg)	Canopy Height(m)	Total DBH (cm)	Aboveground Biomass (kg)
OpenBroadleaf	Plot 1	1	7.397	148.62	1229.051	7.79	503.87	5866.62
		2	7.076	121.75	787.574			
		3	7.276	150.94	1086.652			
		4	5.91	90.94	404.441			
	Plot 2	1	8.47	132.96	1009.634	10.82	306.13	2990.91
		2	9.75	149.46	1554.428			
		3	6.5	67.80	898.147			
		4	8.054	141.04	1518.374			
BroadleafPlantation	Plot 1	1	16.66	159.57	3183.033	19.26	693.51	5986.01
		2	11.70	87.89	1066.241			
		3	13.00	90.75	1522.125			
		4	10.18	118.44	1176.901			
	Plot 2	1	20.33	81.30	5210.925	24.07	494.83	5447.45
		2	21.48	128.90	6161.664			
		3	15.60	15.60	579.546			
		4	16.80	50.40	1667.045			
NaturalMangrove	Plot 1	1	4.35	164.57	3723.98	4.039	297.394	2497.99
		2	3.58	120.96	259.73			
		3	3.44	206.58	640.07			
		4	3.62	180.80	752.80			
	Plot 2	1	3.97	203.08	3249.70	2.834	315.039	3692.93
		2	7.54	98.36	2336.60			
		3	4.03	189.08	1628.08			
		4	3.63	12.10	25.96			

Models Accuracy

- Canopy Height Model

  r = 0.9824

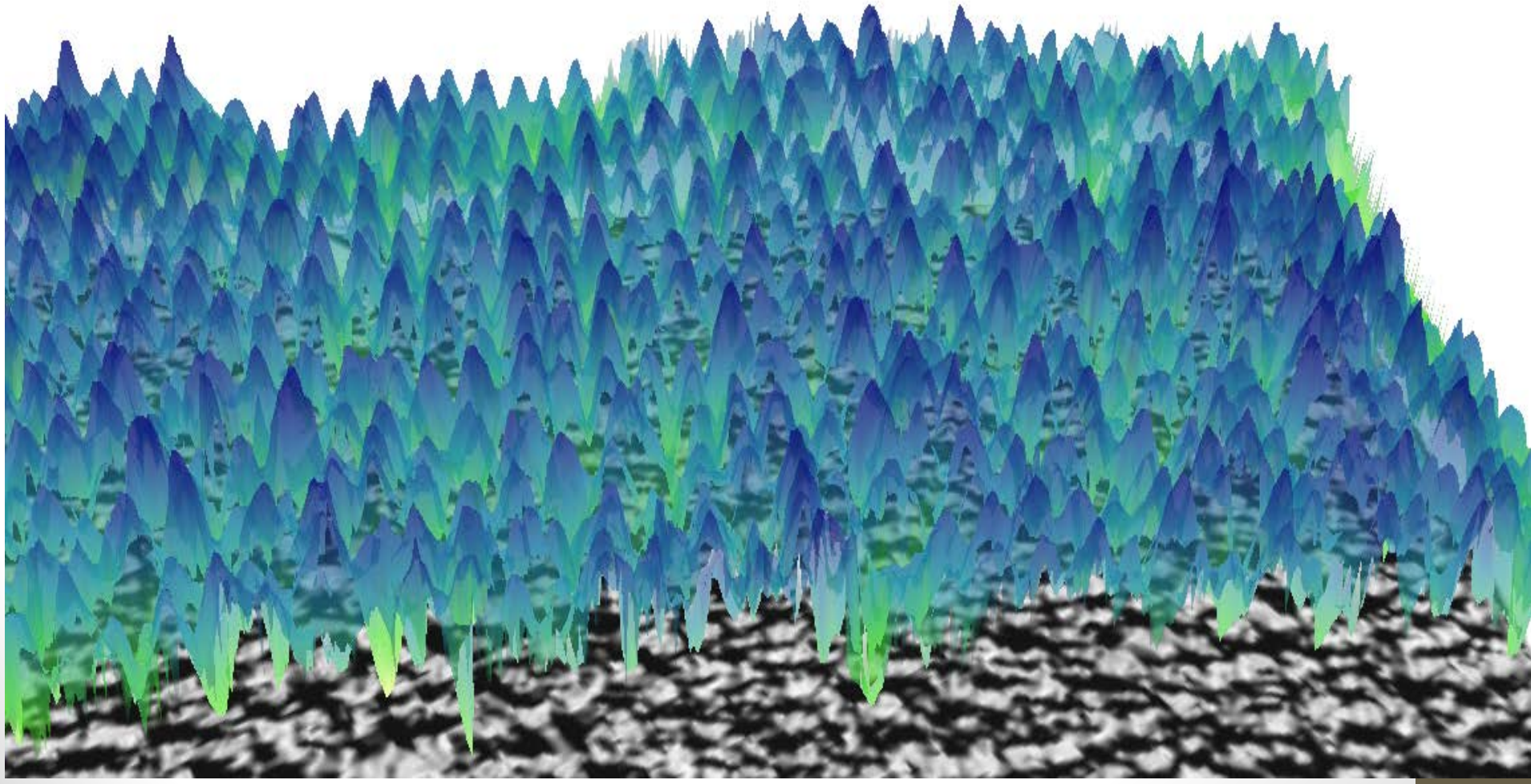
- Aboveground Biomass

  r = –0.4648

- Carbon Stock

  r = 0.2743

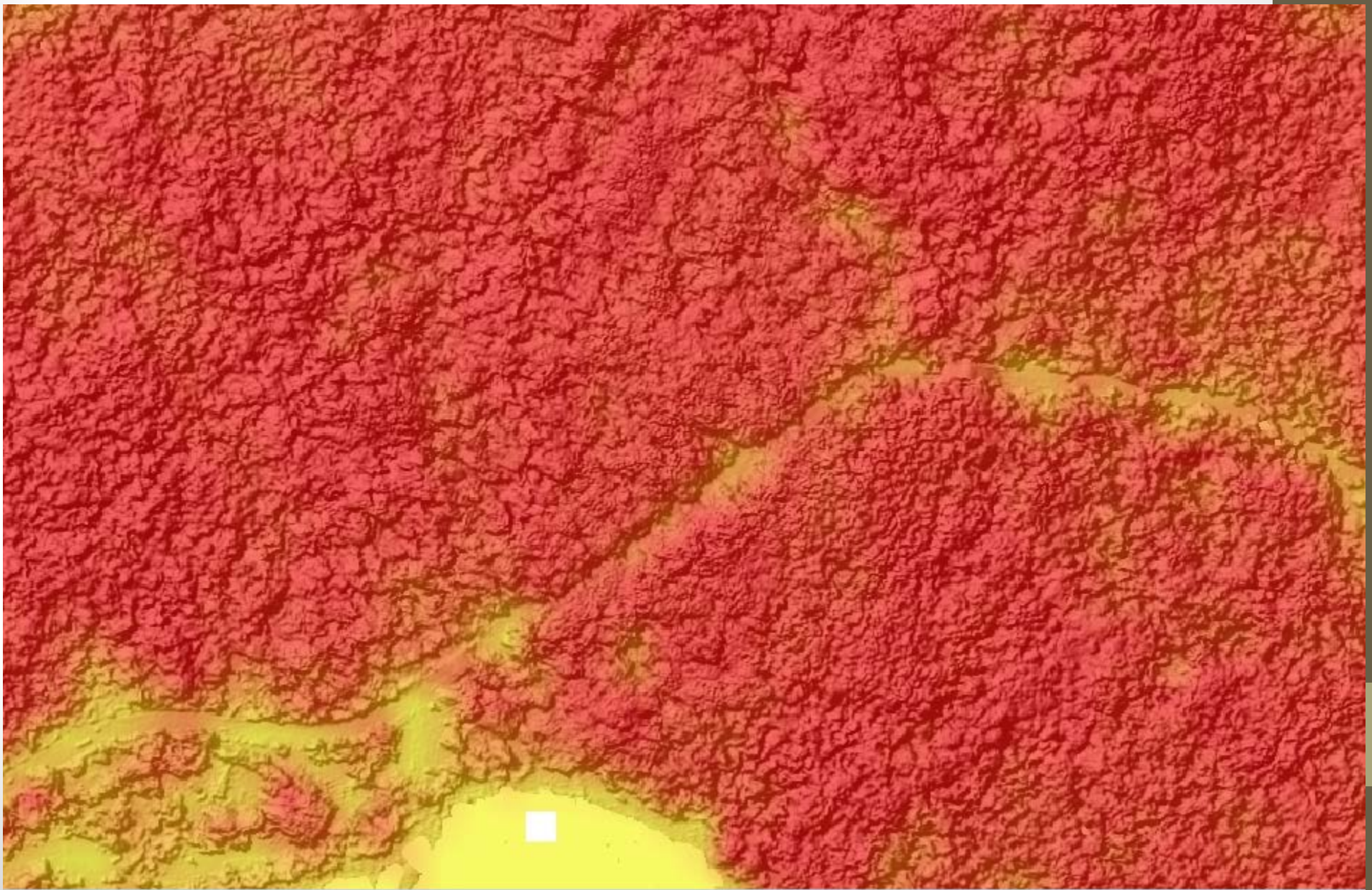
Map from LiDAR-derived Canopy Height Model (CHM): [*Broadleaf Plantation*]



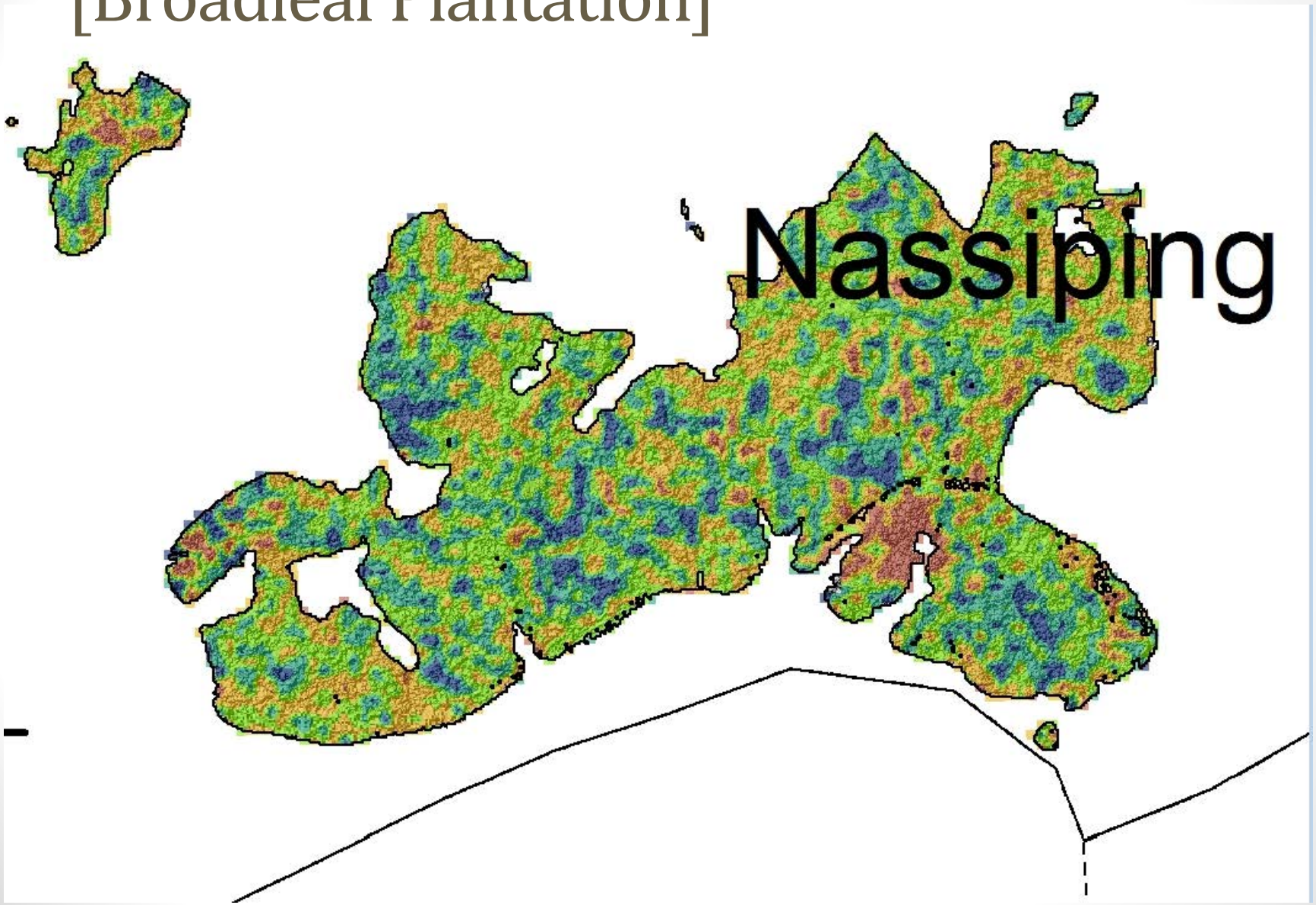
CHM Map of Buguey, Cagayan [*Natural Mangroves*]

CHM Map Nassiping, Gattaran, Cagayan [*Broadleaf Plantation*]

CHM Map Nassiping, Gattaran, Cagayan [*Broadleaf Plantation*]



Map of Aboveground Biomass [Broadleaf Plantation]



Conclusion and Recommendation

- Computer modelling using LiDAR data can be used for forest resources assessment
- Canopy height, above-ground biomass, and carbon stock can be modeled from LiDAR data
- Very high accuracy for canopy height; above biomass & carbon stock results are less precise
- It is recommended other forms of models should be pursued for other forest parameters

Thank You