Satellite vs Drone: Mapping of Mangroves in Setiu Wetland, Malaysia

Ruwaimana Monika[1,2,3], Aidy Mohd Muslim[3], Behara Satyanarayana[3], Dries Raymaekers[4], Nico Koedam[2], Farid Dahdouh-Guebas[1,2]

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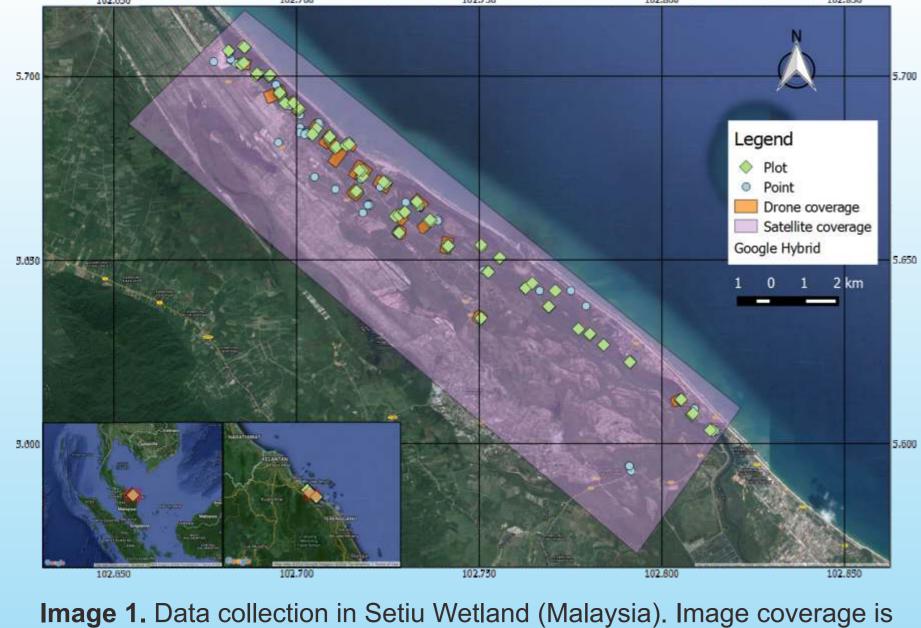
A. INTRODUCTION

- Mangrove areas are usually difficult to penetrate, resulting in logistically demanding field surveys [1,2].

- Remote sensing provides more effective and economical ways to survey and to map mangroves. However, high spatial resolution images are relatively costly [1,3-5].

- Air-borne photography can easily be acquired through space and over time and has been proven to be advantageous for monitoring mangrove swamps and riparian systems [5-7].

- Availability of drones or UAVs (Unmanned Aerial Vehicle) is decreasing the production cost of aerial photographs, offering a great potential for remote sensing research [5,6].

- Modifying the regular RGB camera by changing the IR filter to Blue is potentially useful for vegetation mapping, and this needs to be tested [5,7,8].

B. OBJECTIVES

- To assess the advantages, limitations and authenticity of air-borne drone technology for mangrove species mapping compared to space-borne and ground-truth inventory.

- To create a high resolution and comprehensive species-level mangrove vegetation map of Setiu Wetland as a baseline for future researchs.

C. STUDY AREA

Image 1. Data collection in Setiu Wetland (Malaysia). Image coverage is delineated by the polygons. Tree measurement plots are marked with triangles, and visual description points are marked with dots (see Materials and Methods point 3)

- Setiu Wetland is an ecosystem that features sea, beach, mudflat, lagoon, estuary, river, islands, coastal forest and mangroves[9].

- This wetland is supporting local livelihoods, mainly in aquaculture and fisheries[10], as well as a source of wild honey and *Nypa* palm for crafting (pers. obs.)

- Currently, the Terengganu Government is in the process of making this area a State Park Reserve[11].

D. MATERIALS AND METHODS

1. SATELLITE IMAGERY

Specification
- **Type** : Pleiades 1b
- **Year** : 2013 & 2014
- **Resolution** : 0.5m
- **Bands** : RGB & NIR

Processing
- True Color Composite (TCC)
- False Color Composite (FCC)

Classification (ongoing)

Mapping (ongoing)

2. AIR-BORNE PHOTOGRAPHY

Aircraft - Quadcopter DJI Phantom 2 + DJI 2.4G Datalink + Zenmuse Gymbal + Flytrex Core 2
- **Flight control** - Autopilot by DJI 2.4G Datalink & DJI Ground Station Vers.04 from PC
- **Flight track** - Altitude 100 m, 19 transects, speed 4 m/s, covering ± 4ha each.
- **Camera** - Regular SJ4000 & IR SJ4000 modified by IRPro. 12MP, wide angle, focal length 24mm and CMOS sensor 22x36mm. Stabilized by Zenmuse gimbal. Time lapse of 2 second.

Geotagging Images
- Flytrex Core 2 - generate flight log
- Flytrex website - converted log to .txt csv files
- Microsoft Excel® - synchronize time with Setiu local time (UTC+8),
- Gpsvisualizer® - convert to .gpx
- Geosetter® - synchronize and tag images with .gpx

Mosaic Images - Agisoft Photoscan®
- Add images
- Align image low-setting
- Generate point cloud low-setting
- Generate mesh low-setting
- Texture low-setting
- Add GCPs and adjusted by Google Earth Pro
- Reply the step Align Image to Texture with high-setting
- Export as TIFF + world file

Classification (ongoing)

Mapping (ongoing)

3. GROUND TRUTHING

	Plots	Points
Number	100	155
Size	5×5 m[2]	
Location	chosen randomly over the mangrove area	not always over mangrove
Equipment	Garmin GPS, tape marker, diameter tape, compass, Toolscraft LDM 50T, Haga Altimeter	Garmin GPS
Activities	Measuring, identification and counting: adult trees (height ≥1.3 m and D₁.₃, ≥2.5 cm), D₃₀ or measure 30 cm above the highest prop-root[12-14]; saplings (≤3 leaf pairs, propaguls were nearly absent) & young trees[14].	Visual observation of surrounding vegetation

Analysis [12,15-18] (ongoing)
- density (nos ha⁻¹)
- basal area (m² ha⁻¹)
- relative density (%)
- relative dominance (%)
- relative frequency (%)
- diversity indexes & taxonomy distinctness
- ordination statistics

Mapping (ongoing)
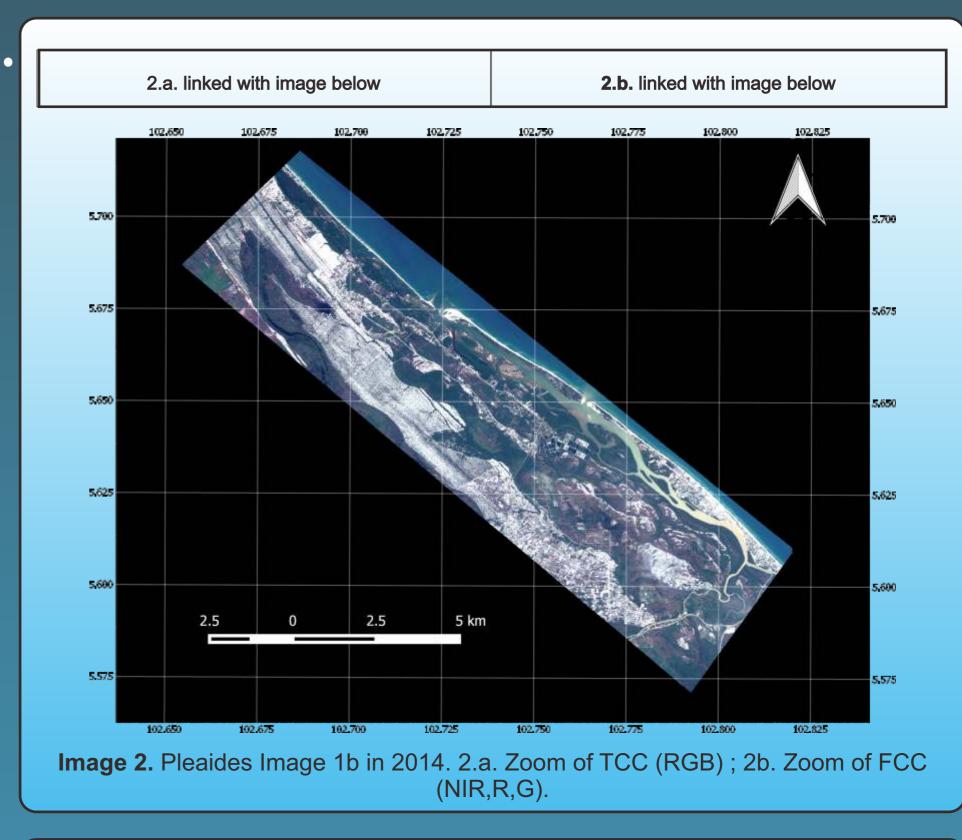
4. COMPARISON & COMPLETE MAP

Table 1. Methods Comparison (ongoing)

	Satellite	Drone	Ground sampling
Data acquisition +/-	?	?	?
Data processing +/-	?	?	?
Analysis +/-	?	?	?
Accuracy	?	?	?
Resolution	?	?	?
Costs & benefits	?	?	?

Comprehensive Map of Setiu Mangrove (ongoing)

E. PRELIMINARY RESULTS

Image 2. Pleaides Image 1b in 2014. 2.a. Zoom of TCC (RGB) ; 2b. Zoom of FCC (NIR,R,G).

Image 3. Drone Photographs area; 3.a. & 3.c. RGB Camera sample; 3.b. & 3.d. IR Camera Sample

Image 4.a. *Nypa* stands in front of *Rhizophora* on one of the islets. 4.b. Stands of dwarf *C. tagal*. 4.c. *Dolbergia candenatensis* (Denno) / *Prain*, one of under canopy species.

Image 5. Resolution comparison. From left to right: Pleaides TCC; Camera RGB; Pleaides FCC; Camera IR.

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