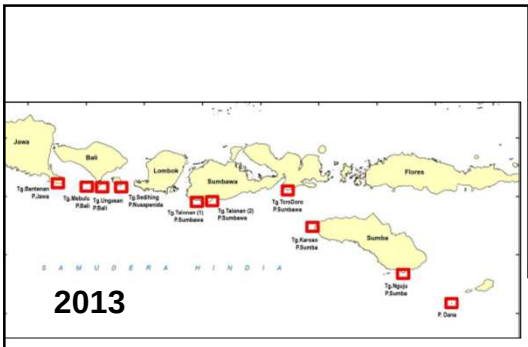
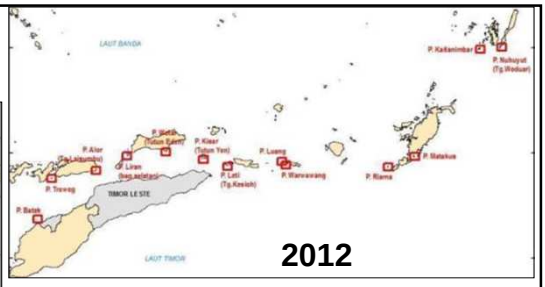




MAPPING THE OUTERMOST SMALL ISLANDS UTILIZING UAV-BASED AERIAL PHOTOGRAPHY

OUTLINE

- Purposes
- The Situation
- UAV-Based Aerial Photography
- Result and Discussion
- Conclusion

Purposes

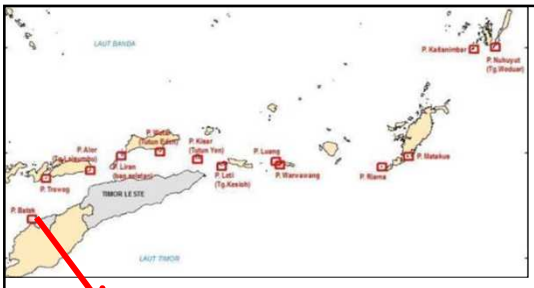
- Mapping the outer most small Island based on Aerial Photo Technique for Producing geospatial and Topographic MAP in scale 1:10.000 or Bigger
- Utilizing UAV-Based Aerial Photography for that Mapping

Accuracy	Scale 1/10.000	Scale 1/5.000
Hz	0.3mm x 10.000 3.0m	0.3mm x 5.000 1.5m
Elevation	5m	2. 5m

UAV GSD: < 20cm, Hz Accuracy 2xGSD < 0.50m

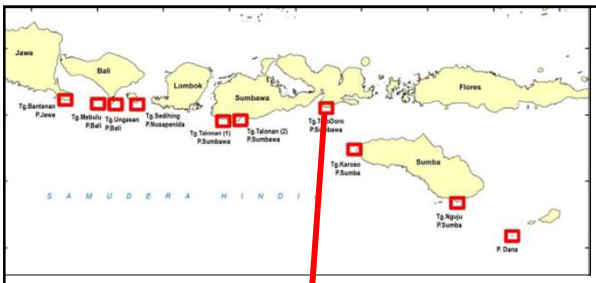
Elev. Accuracy 5xGSD < 1.20m

The Situation



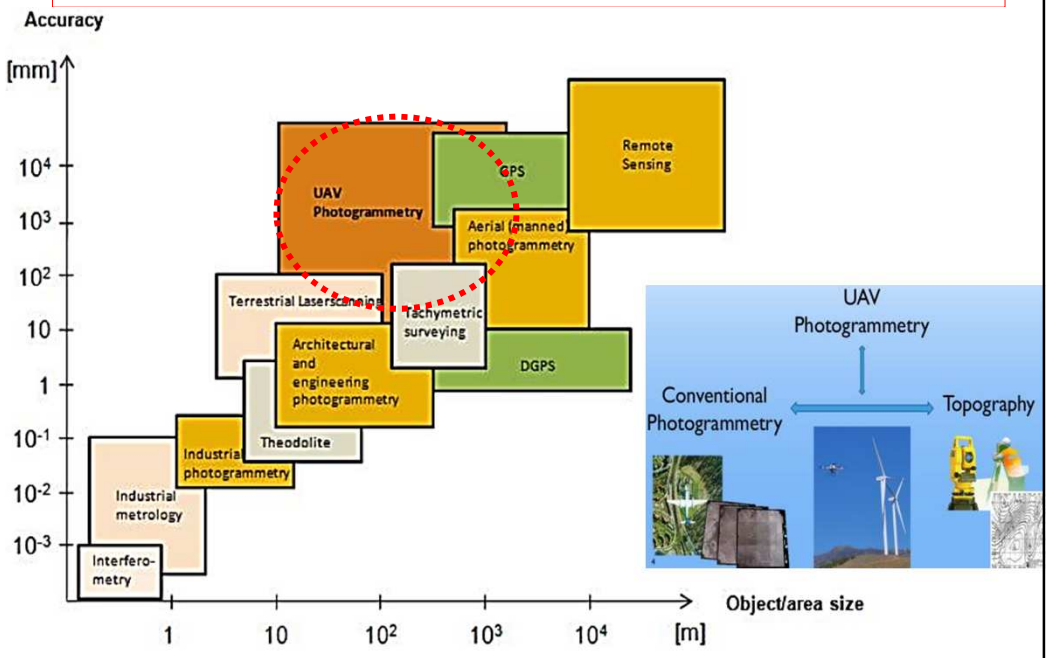
Border Point
Remote Area
No Living People

The Situation

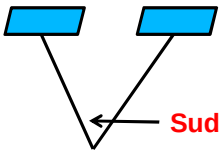


Area Less than 500Ha
Remote Area
No Infrastructure

Why UAV-Based Mapping



Stereo Viewing → B/H Ratio



Sudut Stereo = sudut paralaks = sudut konvergen

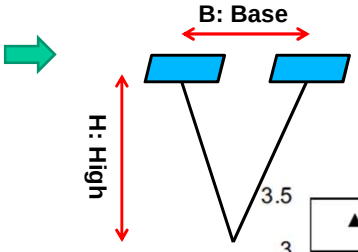
Table 1.2-2 Stereo angles for various applications

	Stereo angle
Topographic applications	
Flat terrain and high height accuracy	30°–60°
Hilly terrain	20°–40°
Mountainous areas	10°–25°
Object extraction applications	
Natural landscape	30°–50°
Suburban areas	20°–40°
Urban areas	10°–25°
Woodland	10°–25°

UAV : 15-25
Lansecape Camera

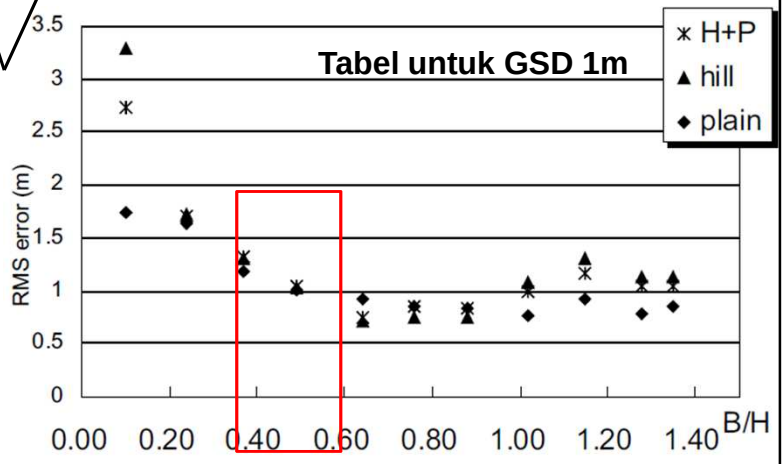
7

B/H Ratio

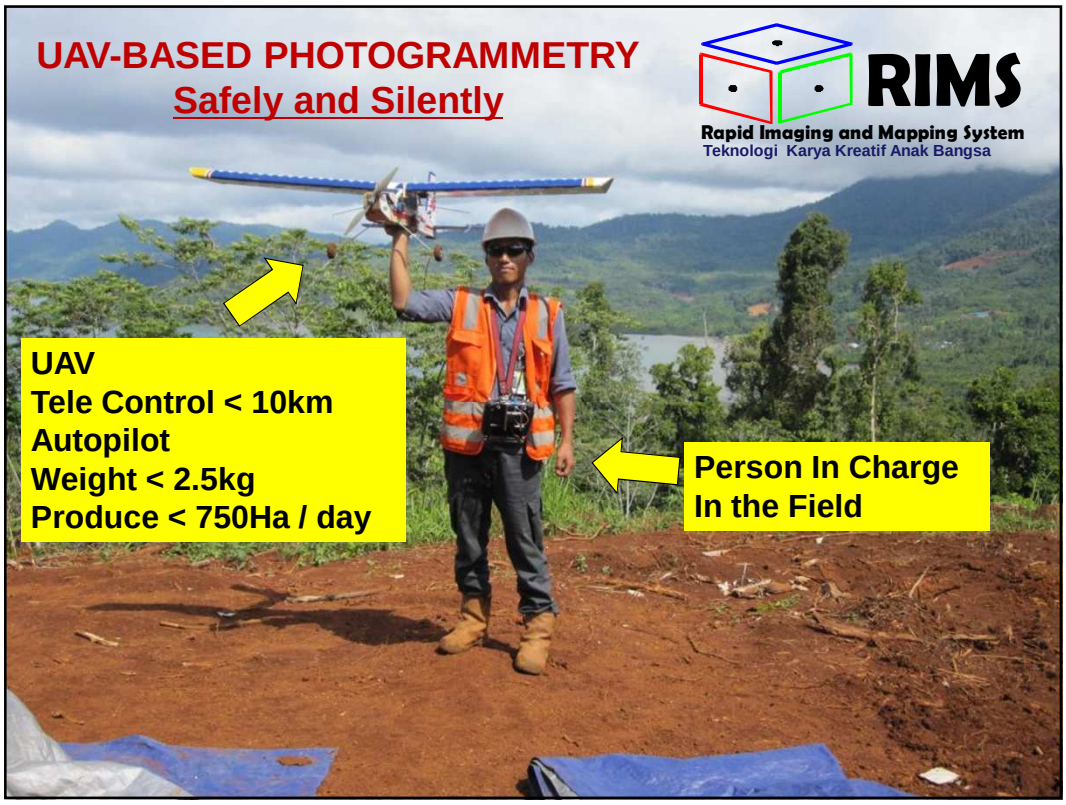


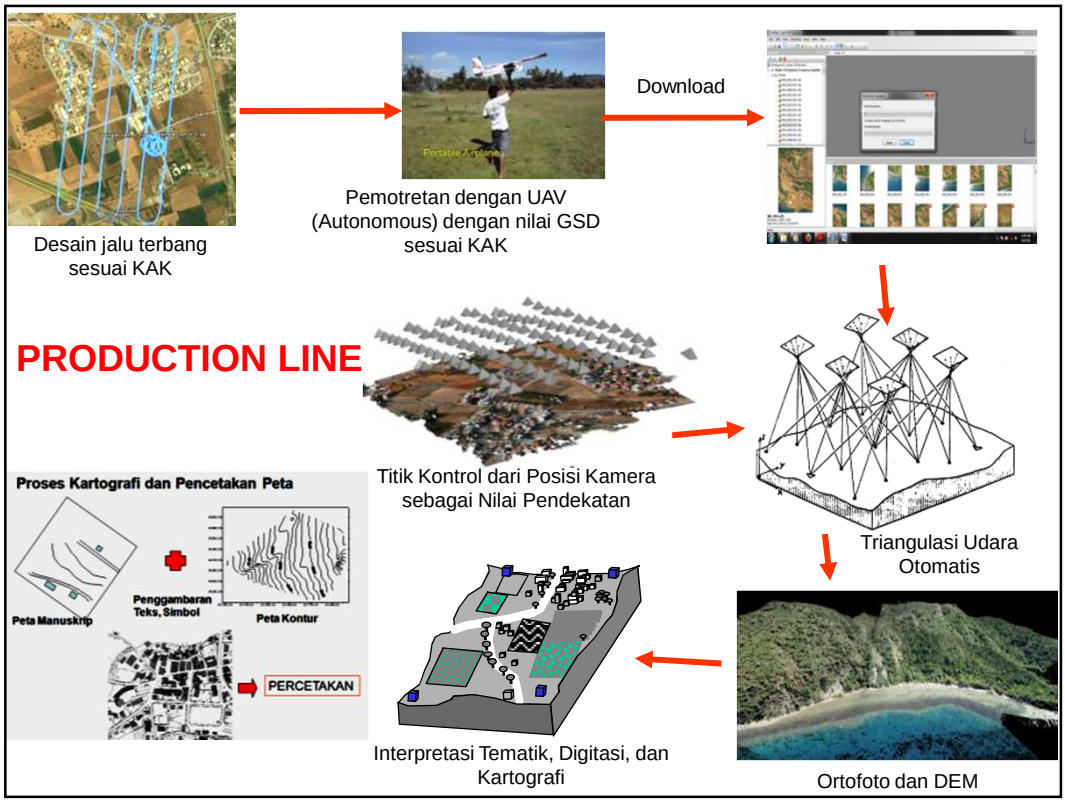
UAV B/H Ratio: 0.40 – 0.45

→ Resolusi elevasi: H/B x GSD
(1 / 0.4) x 20cm = 50cm



UAV GSD: 5cm – 20cm


UAV-BASED PHOTOGRAMMETRY
Safely and Silently
RIMS
Rapid Imaging and Mapping System
Teknologi Karya Kreatif Anak Bangsa
UAV
Tele Control < 10km
Autopilot
Weight < 2.5kg
Produce < 750Ha / day
Person In Charge
In the Field


Desain jalu terbang sesuai KAK
Pemotretan dengan UAV (Autonomous) dengan nilai GSD sesuai KAK
Download
PRODUCTION LINE
Titik Kontrol dari Posisi Kamera sebagai Nilai Pendekatan
Triangulasi Udara Otomatis
Proses Kartografi dan Pencetakan Peta
Peta Manuskrip
Penggambaran Teks, Simbol
Peta Kontur
PERCETAKAN
Interpretasi Tematik, Digitasi, dan Kartografi
Ortofoto dan DEM

Flight Plan → Mission Planner

Tg. Sedihing, Nusa Penida

- Tinggi terbang wahana UAV: 400 meter
- Jarak antar jalur terbang: 400 meter
- Pertampalan samping : 20%
- Resolusi foto yang dihasilkan : 15 cm
- Interval shutter : 4 detik
- Terdapat 1 Jalur CROSS TRACK sebagai kontrol

Mobilization

The Ground Station position in the Island

Wilayah Maluku Barat Daya, Pada umumnya terdapat Pantai berpasir

yang baik untuk lokasi Ground Station

Setup Ground Station and GCP

di lokasi Ground Station

PPP-GPS For Ground Control Point

Untuk menghasilkan akurasi < 1.5m (memenuhi akurasi skala peta 1/10.000)

TakeOff UAV

Proses Takeoff UAV

Pada umumnya dengan lemparan tangan (hand Launching)

Autonomous Flight Monitoring

Proses Photo Flight

Dimonitor dari Ground Station

Untuk memperoleh ketinggian sesuai rencana dan coverage area telah mencakup rencana Area of Interest

Sometimes NETT-Landing

Proses Landing

Pada pulau dengan gunung karang dan tidak ada pantai mendatar, maka dilakukan dengan NETT Landing

Others NETT-Landing

Proses Landing

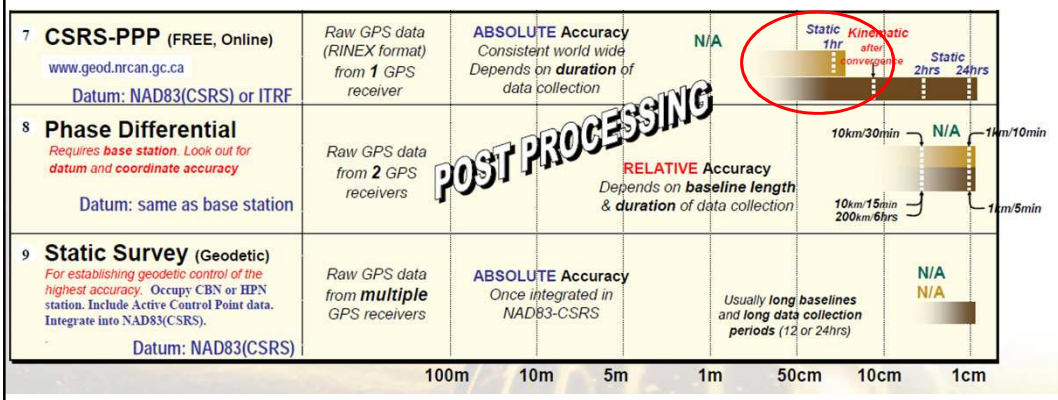
Pada pulau dengan gunung karang dan tidak ada pantai mendatar, maka dilakukan dengan NETT Landing

GPS-PPP → GCP Survei

Pengamatan GPS di titik Marking

Dekat dengan Ground Station UAV

PROSES Survei GPS metode Statik PPP



DATUM ITRF, WGS 1984, dan DGN1995 memiliki nilai parameter elipsoid yang Identik, hanya berbeda pada Epoch originnya.

Hitungan CSRS-PPP menggunakan ITRF

PROSES Survei GPS metode Statik PPP

Titik GCP ditentukan dengan survei GPS (L1) statik metode Precise Point Positioning (PPP) yang menghasilkan ***akurasi Sub-meter*** atau setara dengan tipe **GPS for GIS**. Proses hitungan secara Online PPP di laman CSRS

CSRS-PPP (V 1.05 05211)

IJO2

Data Start	Data End	Duration of Observations
2012-11-08 23:17:00.000	2012-11-09 02:07:30.000	2h 50m 30.00s

Apri / Aposteriori Code Std: 2.0m / 0.365m

Observations	Frequency	Mode
Code	L1	Static

Elevation Cut-Off	Rejected Epochs	Observation & Estimation Steps
10.000 degrees	0.00 %	10.00 sec / 10.00 sec

Antenna Model	APC to ARP	ARP to Marker
NAP100	Ant. not in PPP (0 m)	1.725 m

(APC = antenna phase center; ARP = antenna reference point)

Estimated Position for luan3133.12o

	Latitude (+n)	Longitude (+e)	Ell. Height
ITRF08 (2012)	-8° 10' 21.5866''	128° 41' 42.2529''	293.606 m
Sigmas(95%)	0.503 m	0.562 m	1.362 m

Lama Observasi

L1 pseudo-range observation

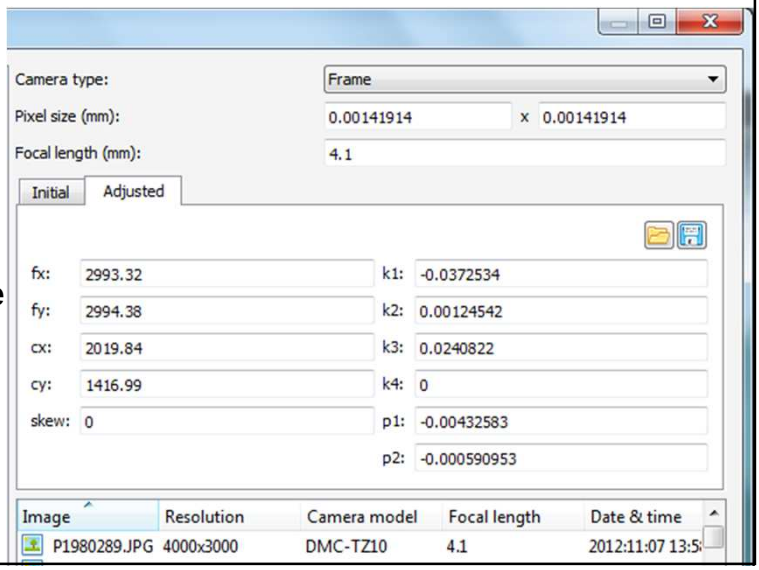
DATUM Jaringan IGS Dunia

Presisi Pengamatan

InFlight Calibration

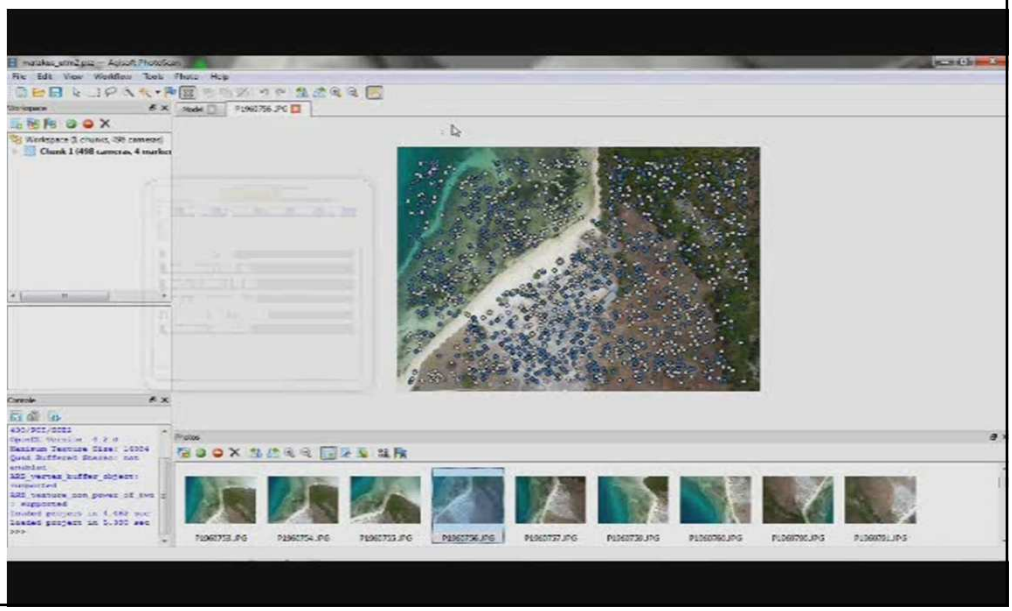
- Prosedur In-Flight Calibration memberikan hasil perbaikan yang signifikan
- Penggunaan camera yang tidak stabil, maka pilihan yang terbaik adalah in-flight calibration

Reduce Point and Shoot camera type less than 1.5pix



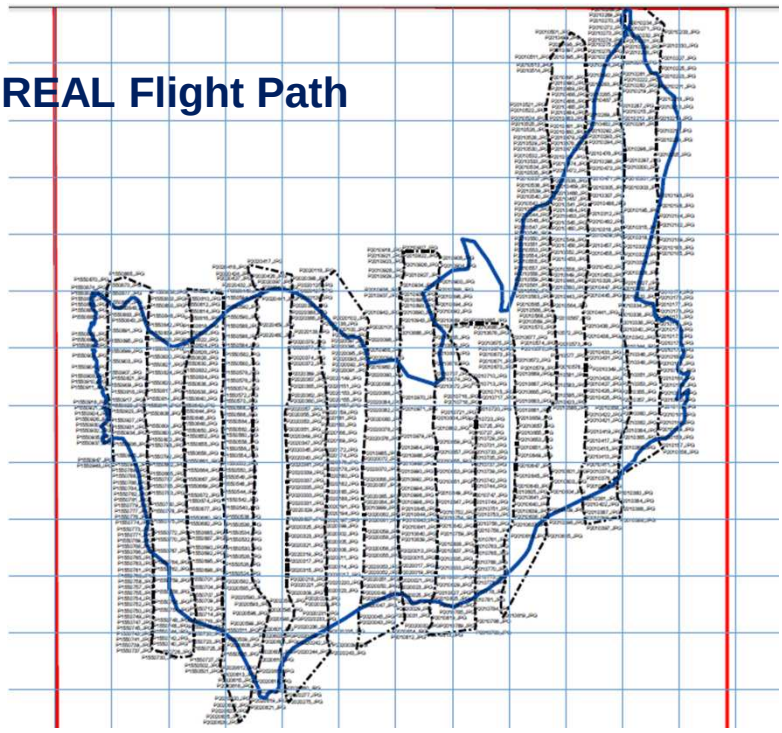
Structure From Motion

Tie-point dan matching → bundle adjustment with selft calibration → DEM dari tie point → Orthophoto → Absolut Orientation with GCP



Aerial Photo

The REAL Flight Path



The Result

Adjustment Precission **< 2.5 piksel = < 0.38m**

Survey Data

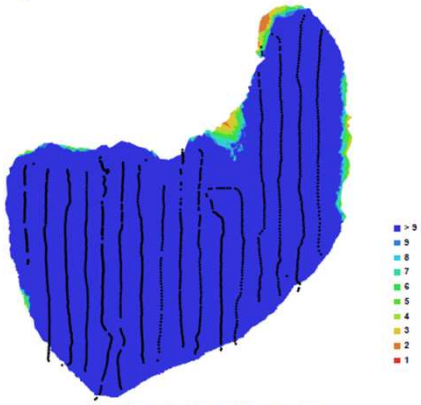


Fig. 1. Camera locations and image overlap.

Number of images:	1625	Camera stations:	1625
Flying altitude:	625.129 m	Tie-points:	413476
Ground resolution:	0.149684 m/pix	Projections:	1782633
Coverage area:	17.9751 sq km	Error:	1.63732 pix

x ukuran 1 pix CCD = 2.9micron

Camera Model	Resolution	Focal Length	Precalibrated
DMC-TZ10	4000 x 3000	4.1 mm	EXIF

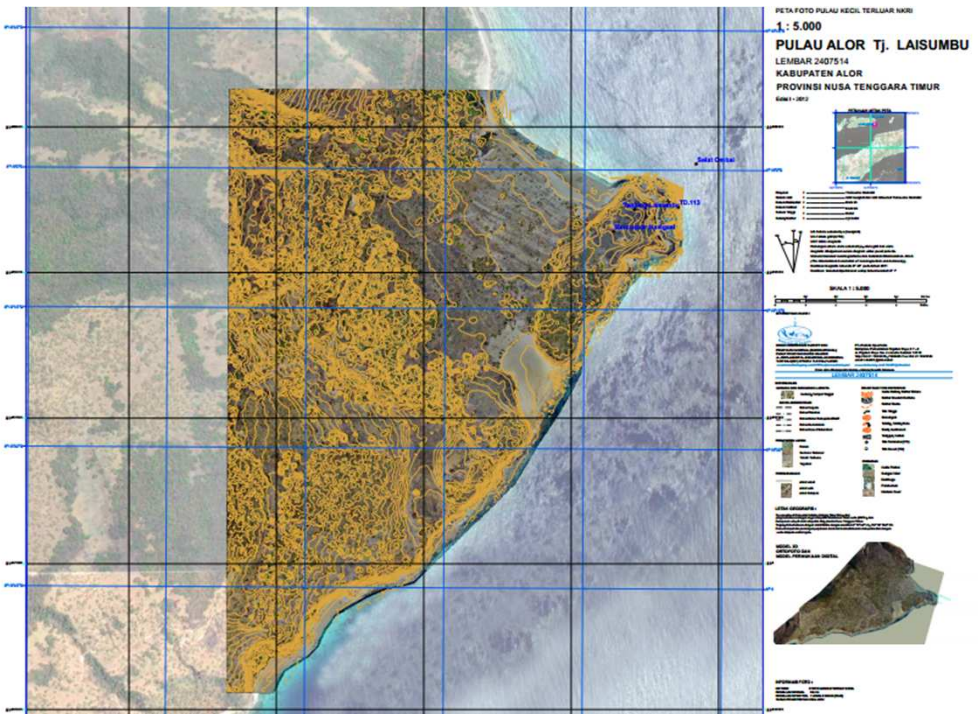
Table. 1. Cameras.

Ground Control Points

Fig. 2. GCP locations.

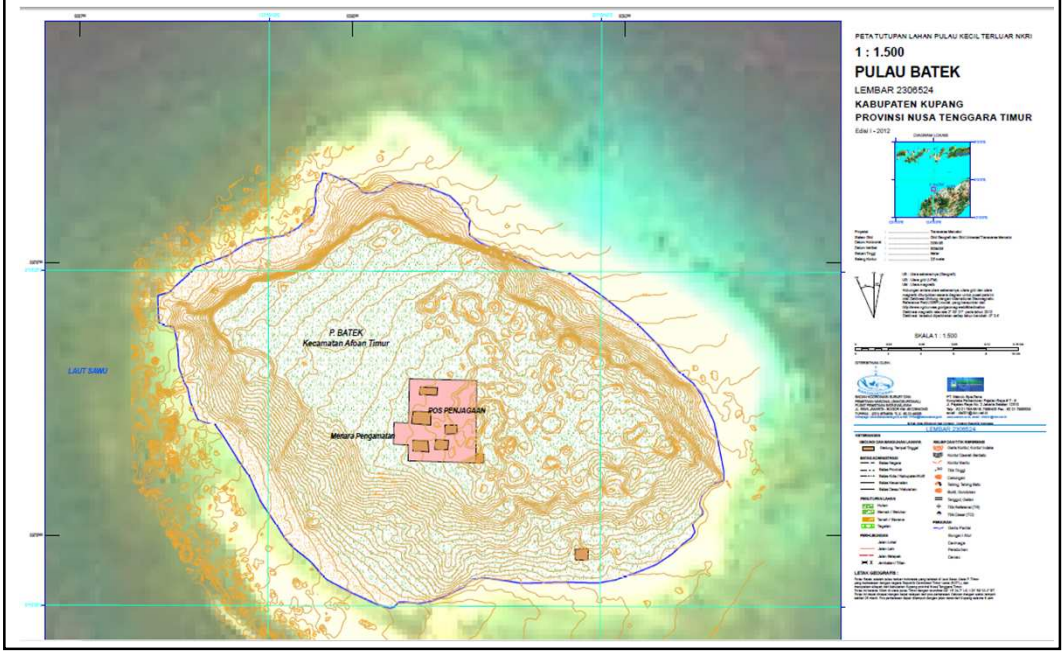
Label	X error (m)	Y error (m)	Z error (m)	Error (m)	Projections	Error (pix)
point 1	0.152804	-0.423105	-0.160102	0.477493	19	0.000000
point 2	-0.142317	0.276415	-0.036573	0.313045	42	0.000000
point 3	-0.438739	0.049811	0.152830	0.467258	34	0.000073
point 4	0.299132	-0.169964	-0.470204	0.582631	32	0.000000
point 5	0.129920	0.265924	0.509989	0.589647	48	0.000000

Table. 2. Control points.



Land Cover Thematic MAP

Derived from “On Screen Digitation”



Conclusion

1. Implementing Utilizing UAV-Based Aerial Mapping in the outermost Small Island is a good alternative.
2. The Geometric Accuracy fulfill for map scale 1/5.000
3. Some flight plan modification in the field should be implemented due to weather and wind condition.