10th Geo Mundus Conference

NOVA IMS - Universidade Nova de Lisboa - Portugal

7th and 8th December, 2018

Erasmus Mundus

UAV fixed-wing survey for cadastre in coastal area: accuracy assessment

UNIVERSITÄT BONN

zef Center for Development Research University of Bonn

FTH Feryandi and Manfred Denich

Center for Development Research, University of Bonn, Germany

Background and motivation

Need to speed land registration in Indonesia's coastline areas by providing detailed cadastral base maps (i.e., large-scale base maps).

However, the currently available base map is limited for the coastal areas, and cadastral mapping technologies such as terrestrial, large-format photogrammetry, and very high resolution remote sensing imagery are expensive in providing update and real-time base maps, whereas free satellite imagery is very low in detail and spatial resolution.

Does the Unmanned Aerial Vehicle (UAV) as a promising small-format photogrammetry technology for acquiring near-real time maps achieves required accuracy standards for Indonesian cadastral base maps?

Objectives

Assessing the geometric accuracy of UAV-fixed wing orthophoto

Methodology

Study area:

A coastline area in Kepulauan Riau, Indonesia

Software and tools:

GNSS RTK Trimble Net R9 & R4, Skywalker T-tail UAV fixed-wing, Camera Sony Sony QX10 18, Mission Planner, Agisoft Photoscan

Methods:

- GNSS static survey of 30'-60' for Ground Control Points (GCPs, 8 points) used for geometric correction and Independent Control Points (ICPs, 7 points) for the references of the accuracy checking.
- Image acquisition: Flight height = 300 m, sidelap/overlap = 70%/75%, Photo recording: autoshutter by distance
- Orthorectification technique: Structure for motion (SfM)
- Accuracy test:
  - RMSE of the points' distance
  - Horisontal accuracy (CE 90) = RMSE * 1.5175

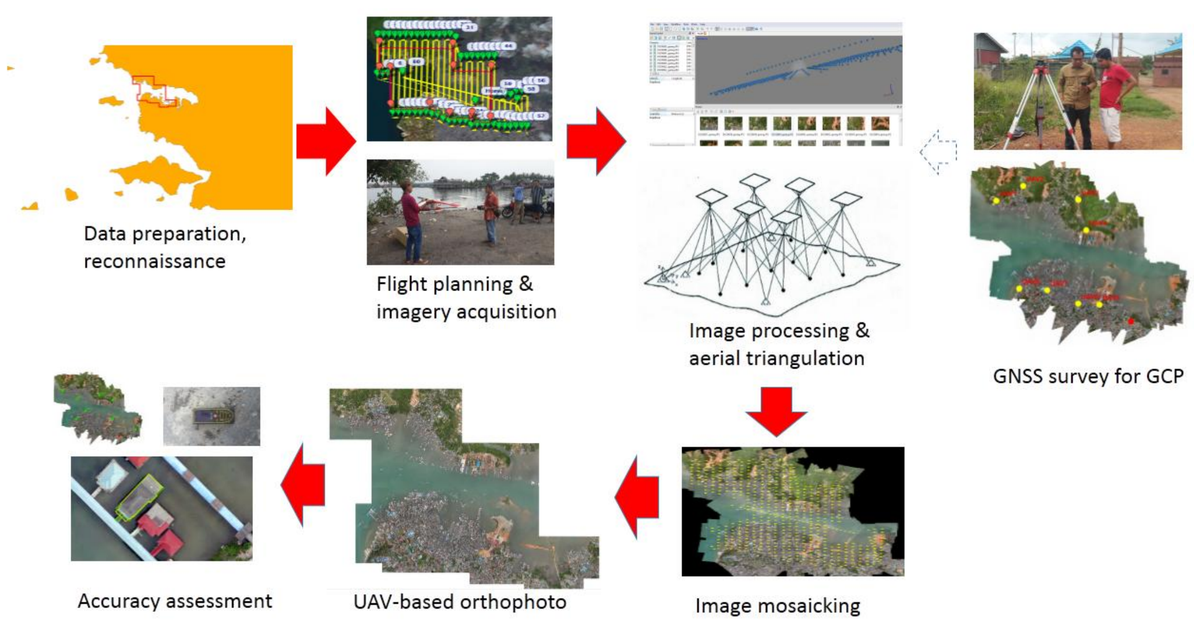

Figure 1. Research activities

Results

- Ground Sample Distance (GSD) = 0.0865 m ~ 8.6 cm
- RMSE total = 13.4 cm/0.134 m, horizontal accuracy (CE90) = 20.3 cm/0.203 m

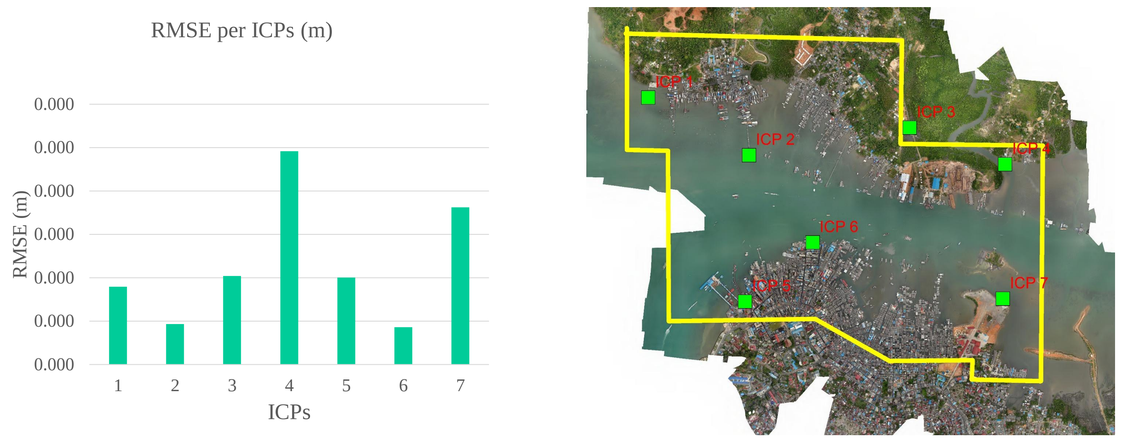

Figure 2. RMSE for every ICP and its distribution

Standard for cadastral base map:

- Ministry of Agrarian Regulation No. 3 of 1997 (BPN, 1997) states that the RMSE = 0.3 mm x map scale. So, the fitted map scale = RMSE/0.3 mm = 13.4 cm/0.3 mm = 446.7. It fits the recommendation of urban area cadastral map, which is 1:1000 or larger. We conclude that the UAV orthophoto can fulfill the PMNA 3/97 standard.
- Indonesian Geospatial Agency No. 15 of 2014 (BIG, 2014):

Accuracy	Class 2 Standard Map Scale		
	1:1000	1:2500	1:10000
Required horizontal accuracy (CE90)	0.3 m	0.75 m	3 m

The achieved CE90 is 0.203 m, so the UAV orthophoto fits the requirement of map by scale of 1:1000.

- International Association of Assessing Officers (2015) requires RMSE of 30 cm or less of the cadastral maps for urban areas and 2.4 m for rural areas. The UAV fulfills this standard.
- American Society for Photogrammetry and Remote Sensing (ASPRS, 1990)

RMSE (m)	Map scale
0.050	1:200
0.125	1:500
0.25	1:1000
0.50	1:2000
1.00	1:4000

According to ASPRS, with RMSE 13.4 cm the UAV orthohoto fits the map scale between 1:500 and 1:1000

Conclusions

The UAV fixed-wing orthophoto achieve the accuracy standards and hence can be used as a cadastral base map for land registration activities at the scale of smaller than 1:500. Considering the small number of the ICPs, the preferable scale is 1:1000 or a little larger than that.

Recommendations and future works

Further analysis of cadastral boundary accuracy is required.

References

ASPRS, 1990. ASPRS Accuracy Standards for Large-scale Maps.

BIG, 2014. Technical Guidance for Base Map Accuracy.

BPN, 1997. Provision on the implementation of government regulation No. 24 of 1997 concerning land registration.

IAAO, 2015. Standard of Digital Cadastral Maps and Parcel Identifiers.

Acknowledgments

This research was funded by BMZ Germany via DAAD