→ EARTH OBSERVATION FOR SUSTAINABLE DEVELOPMENT

Urban Development

City Academy: Geospatial Data Applications for Urban Development, Sao Paulo 16.-17.09.2019

Building Footprints and Building Heights for the Assessment of Property Tax Valuation

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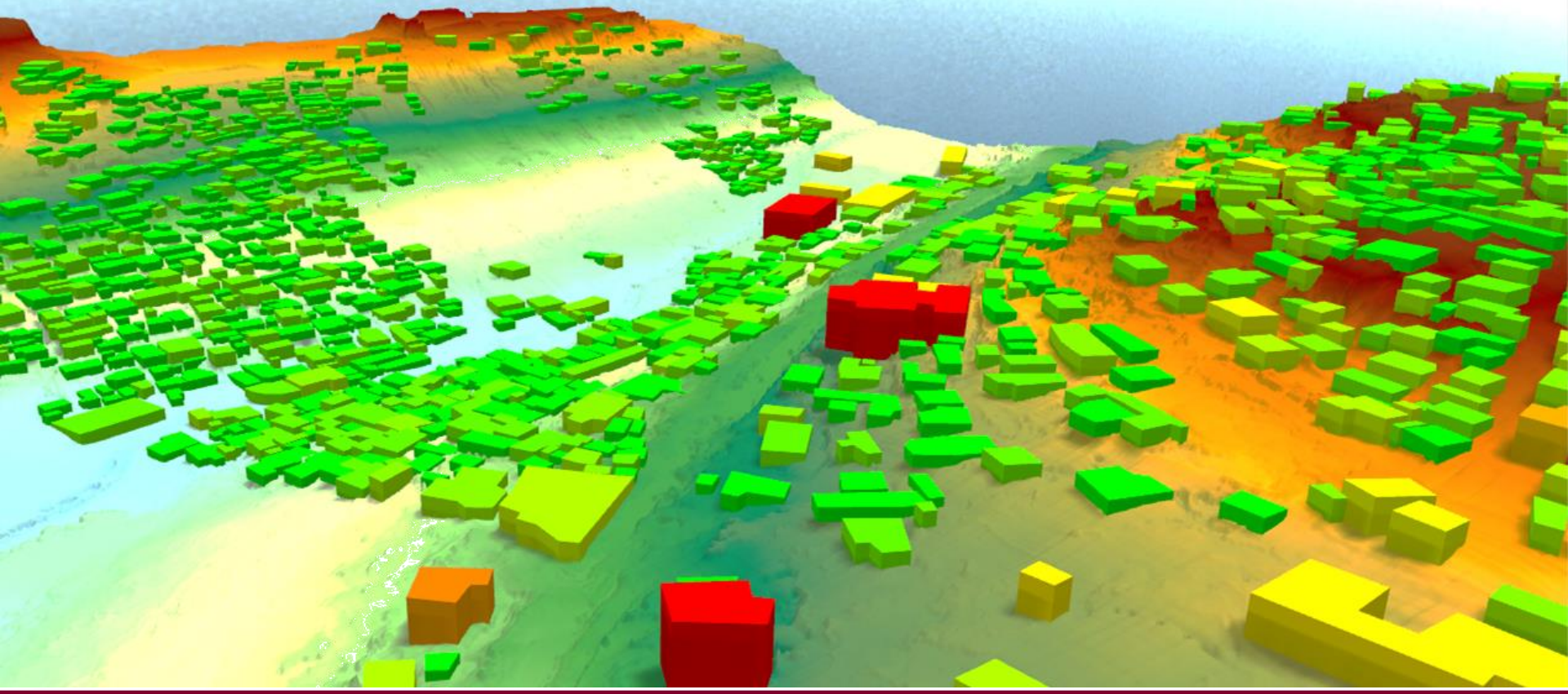
Agenda

1) Objective and Introduction
2) Generation of Building Footprints and Heights
3) Exemplary Results
4) Case Study: Kigali, Ruanda
5) Feedback and Conclusion

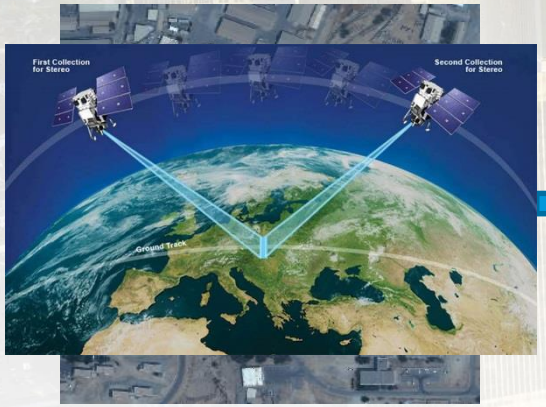
Objective

→ **Utility of remote sensing data via the use of 3D building height data and building footprints to support land property valuation and related updating tax registers**



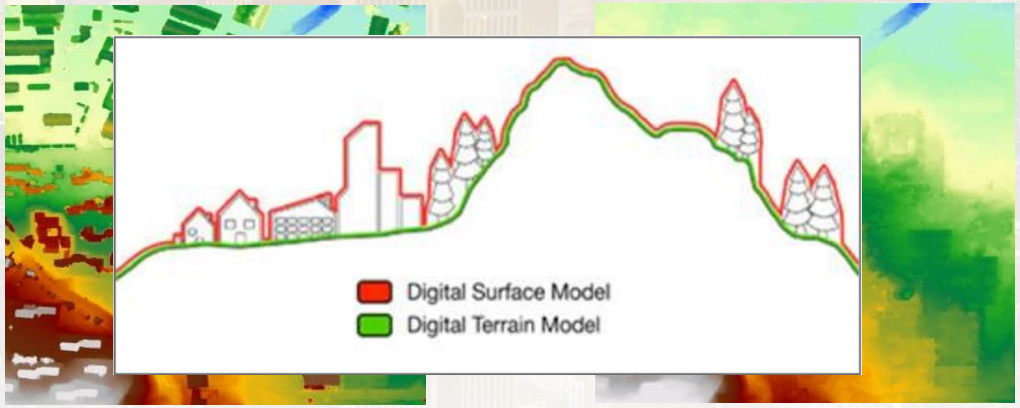
Feature Extraction (Building Heights)

Optical Stereo Satellite Image

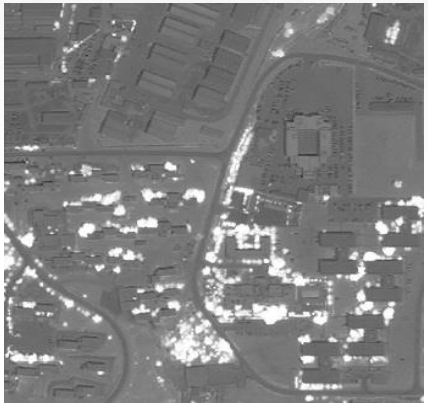


DSM

DTM

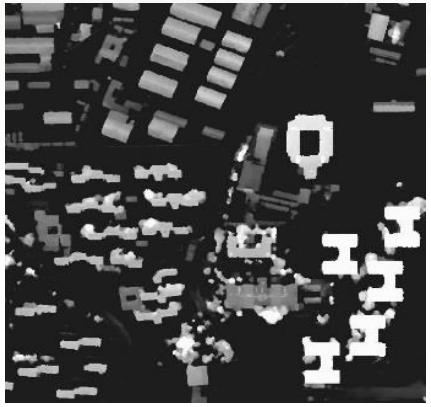


NDVI



Building Footprint

nDSM (Object Height)



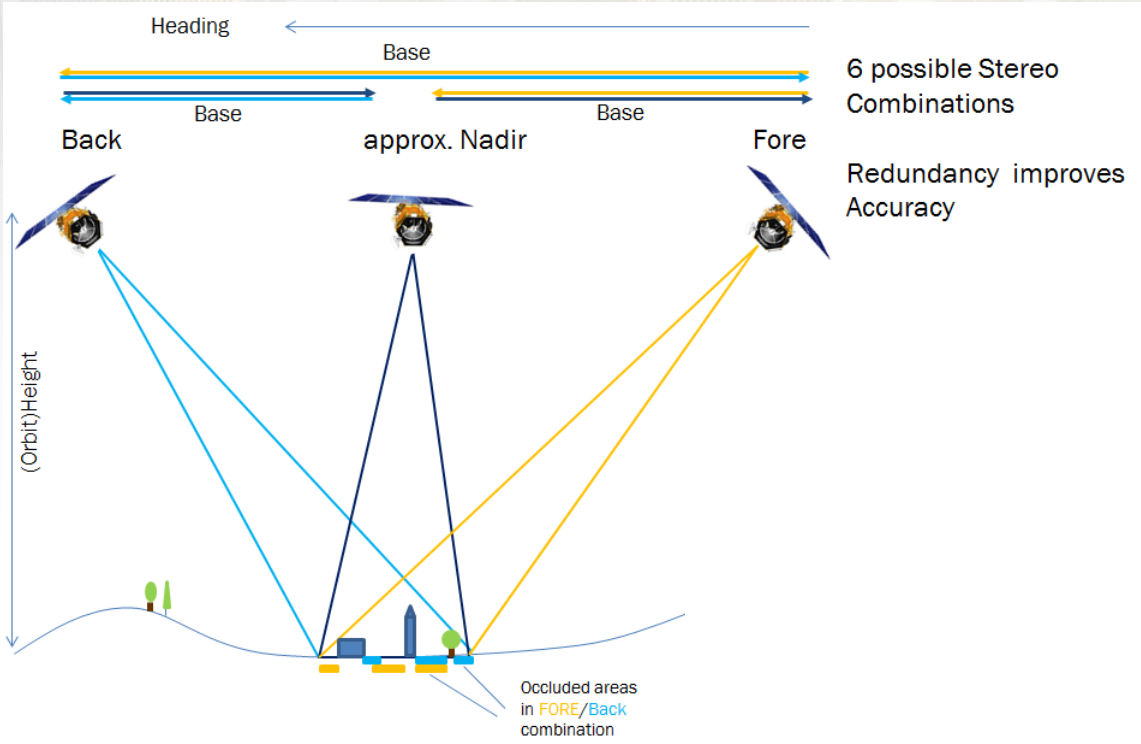
EO Data for Elevation Models – Different Approaches

True stereo systems with multiple cameras:

multiple cameras with fixed mounting angles permit stereo acquisition in 1 pass
e.g. Cartosat-1, ZY-3, ALOS Prism

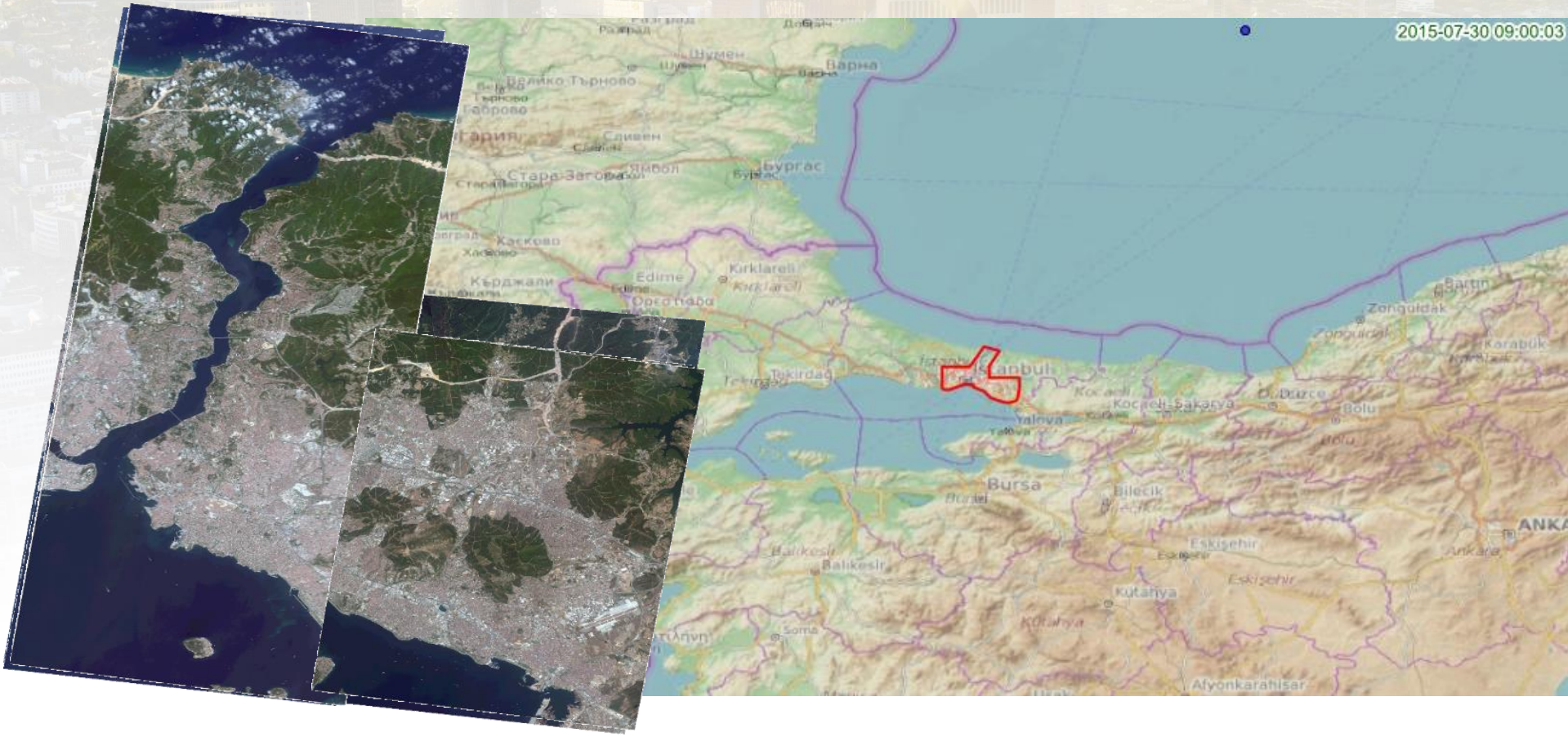
Multi-Stereo capability with one camera:

agile systems manage stereo acquisitions within 1 pass
e.g. GE-1, WV-1/-2/-3, PLE 1a/b

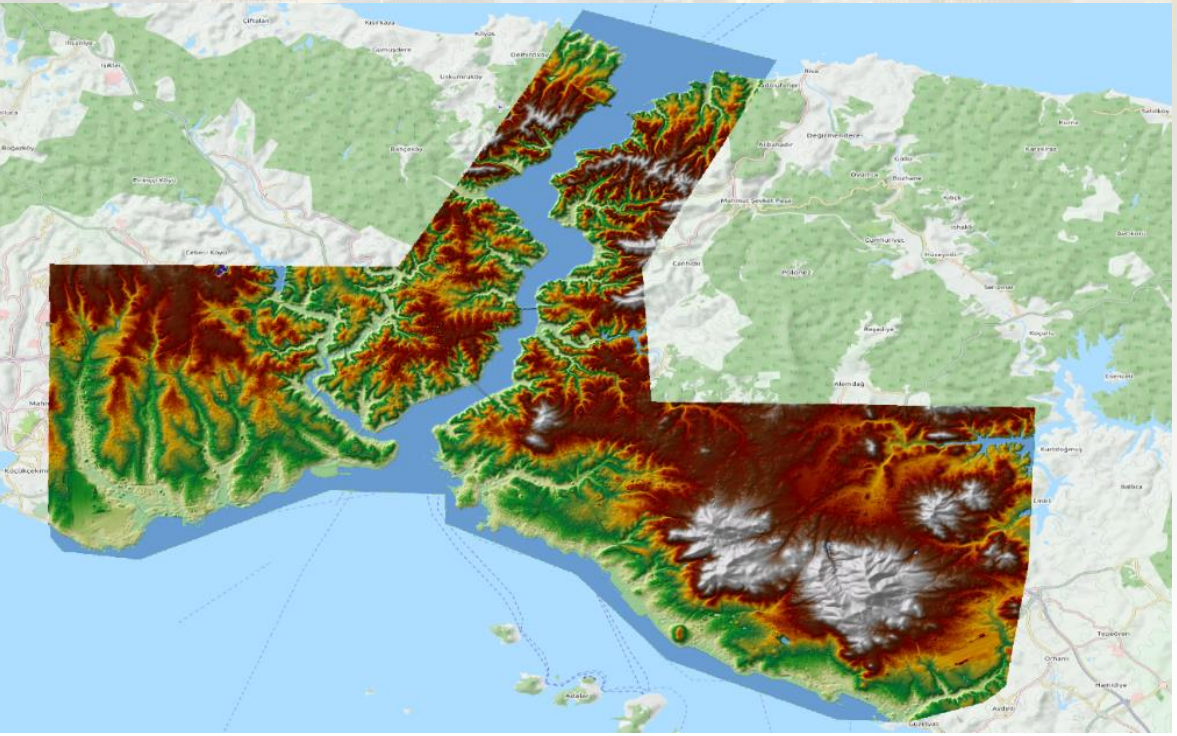


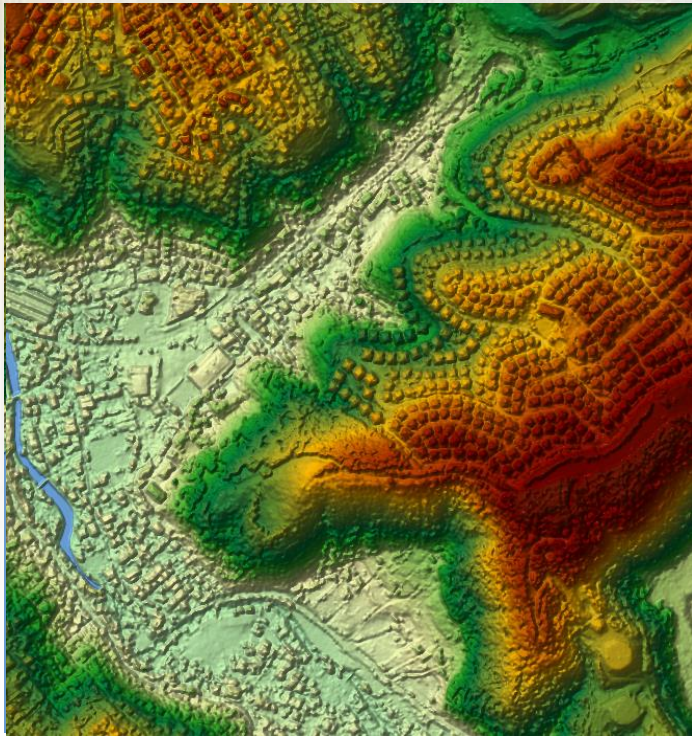
Tri-Stereo DSM
Istanbul – Triple Stereo Tasking 27.7.2015

Tri-Stereo DSM
Istanbul – Double Triple Stereo Tasking 30.7.2015



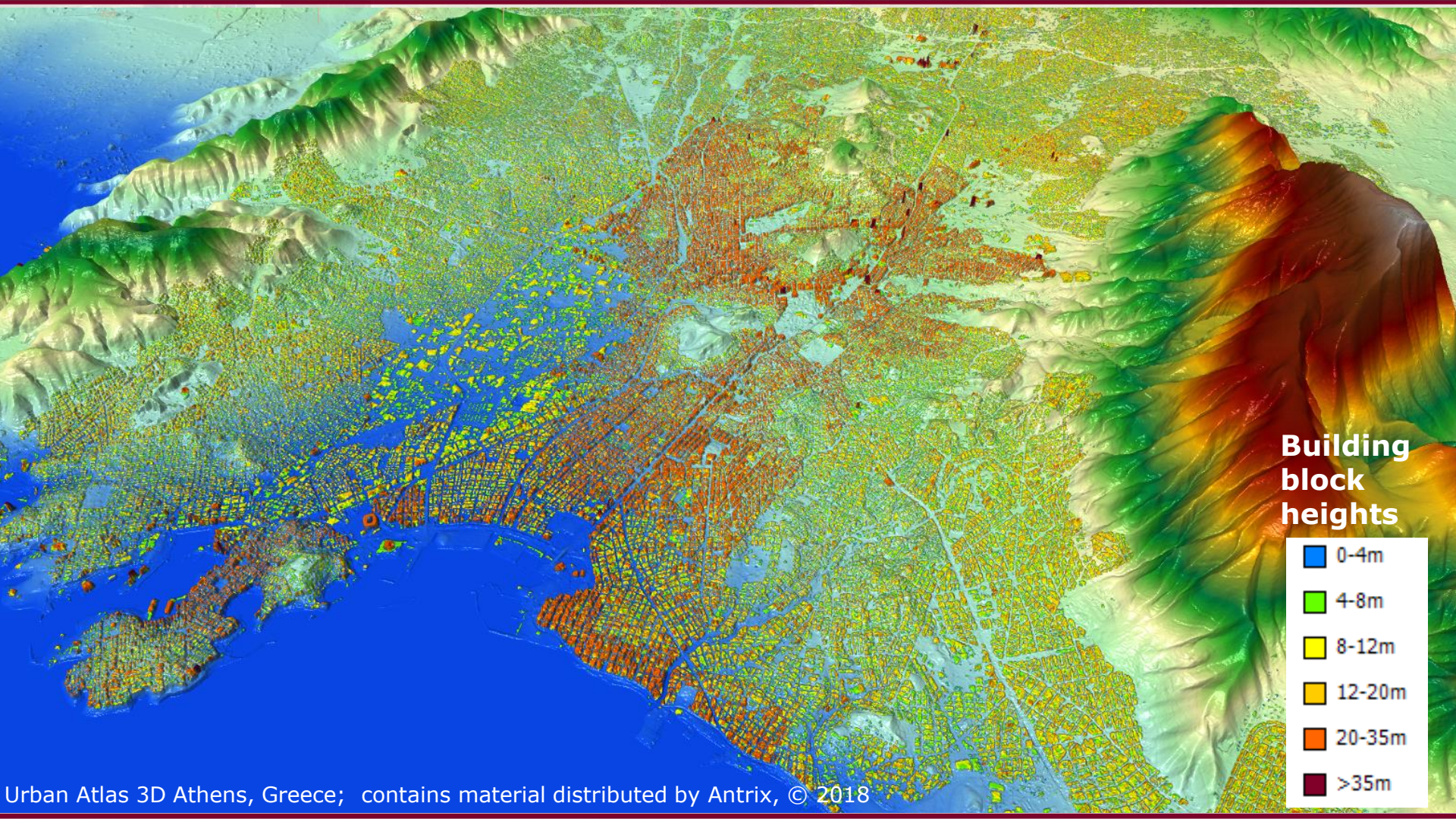
Tri-Stereo DSM
Istanbul – Region 0.5m Digital Surface Model





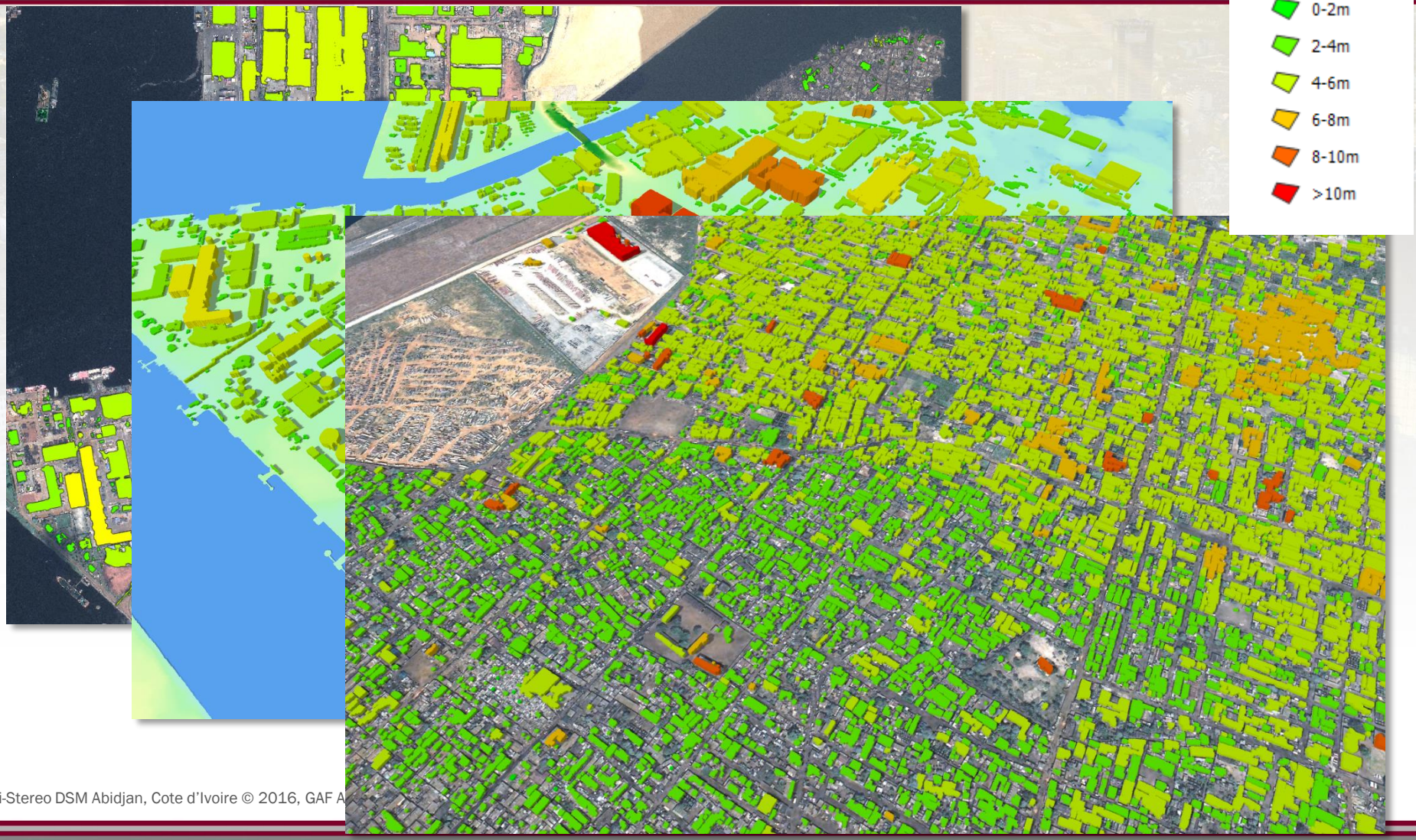
Tri-Stereo DSM Istanbul, Turkey © 2015, GAF AG, includes DigitalGlobe Material

Building Block Heights
Athens, Greece



Urban Atlas 3D Athens, Greece; contains material distributed by Antrix, © 2018

Building Footprints and Heights
Example: Abidjan, Ivory Coast



Tri-Stereo DSM Abidjan, Cote d'Ivoire © 2016, GAF A

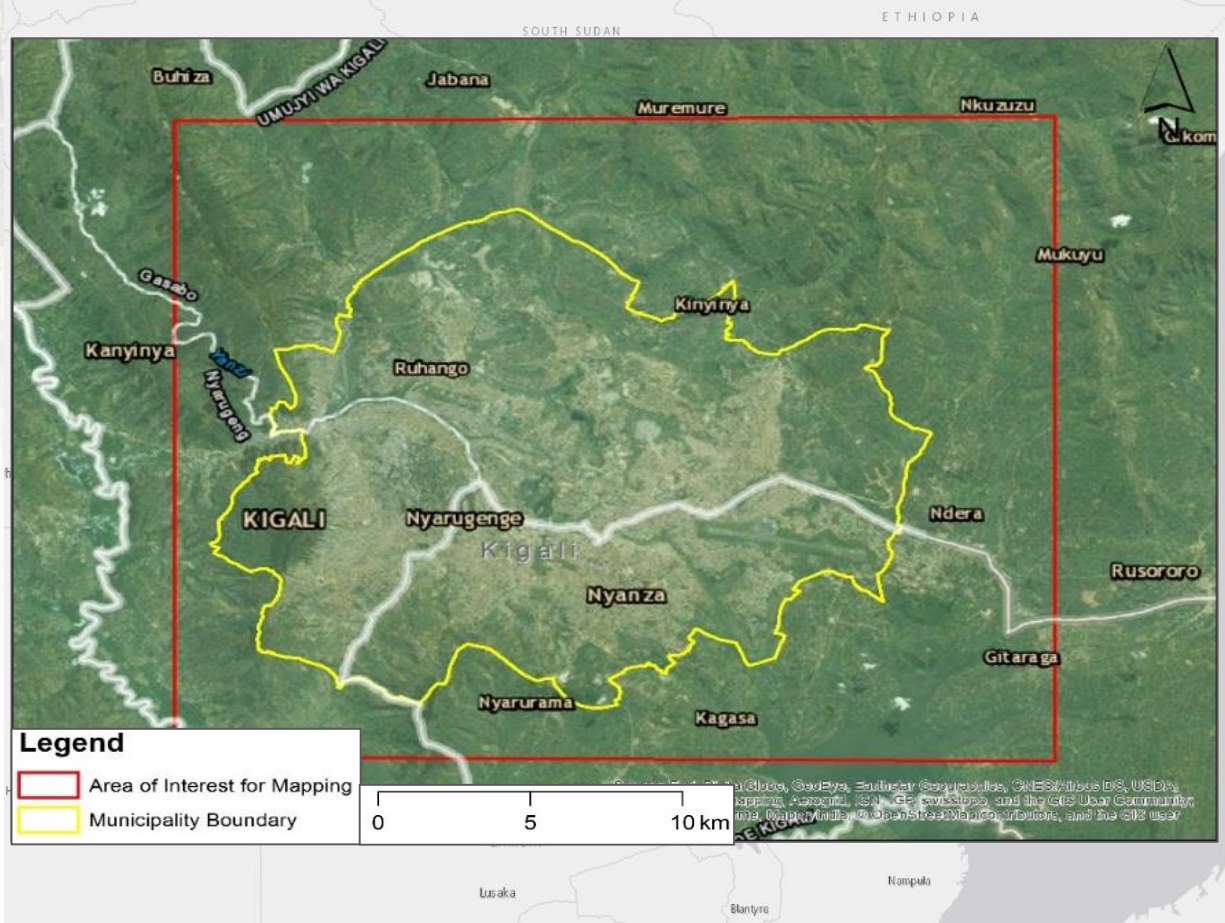
Building Footprints and Heights
Example: Beijing, China

Tri-Stereo DSM Beijing, China © 2017, GAF AG, © C

World Bank Pilot Study
Improved Method for Land Valuation

DECRG Pilot Study supports the Government of Rwanda to improve methods of land valuation.

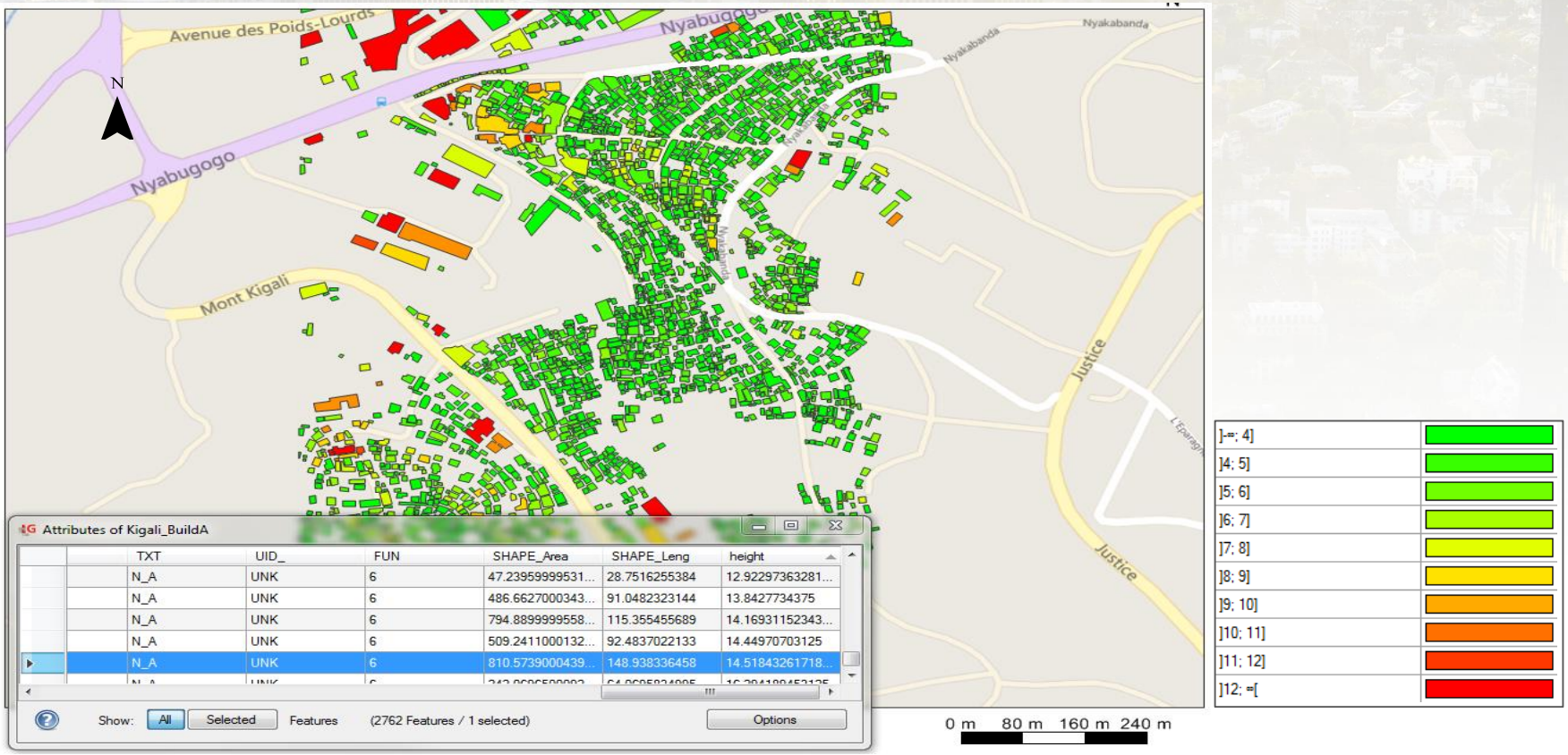
The Location: Kigali City



The Policy Research Working Paper "Using Satellite Imagery to Revolutionize Creation of Tax Maps and Local Revenue Collection" by Ali et al. (2018) can be downloaded here: http://documents.worldbank.org/curated/en/347231526042692012/Using-satellite-imagery-to-revolutionize-creation-of-tax-maps-and-local-revenue-collection

Study Objective

To assess methods for using actual land transaction data from the country with the land cadastral map and basic building height data (from EO data) to simulate different property values and related tax rates.



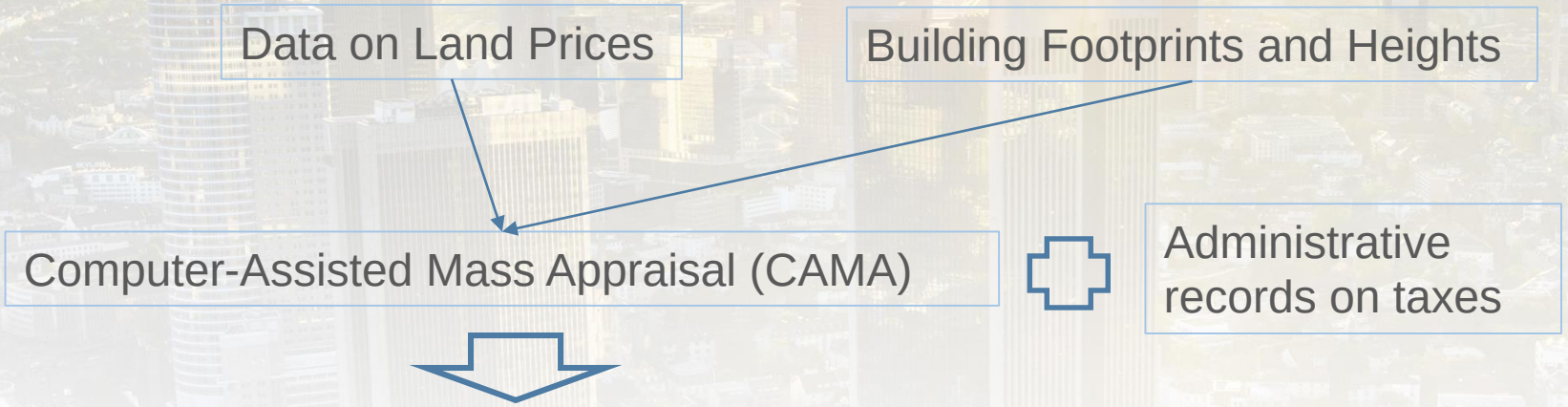
Attributes of Kigali_BuildA

	TXT	UID_	FUN	SHAPE_Area	SHAPE_Leng	height
	N_A	UNK	6	47.23959999531...	28.7516255384	12.92297363281...
	N_A	UNK	6	486.6627000343...	91.0482323144	13.8427734375
	N_A	UNK	6	794.8899999558...	115.355455689	14.16931152343...
	N_A	UNK	6	509.2411000132...	92.4837022133	14.44970703125
▶	N_A	UNK	6	810.5739000439...	148.938336458	14.51843261718...

Show: All Selected Features (2762 Features / 1 selected) Options

Building Heights in Kigali

The Model



Provides information on:

- potential revenue gains from full collection of current lease fees
- Likely yields from and incidence of a uniformly applied 1 % tax on residential land and property, and
- The implicit cost of exemptions currently being discussed by Rwandan policy makers.

Feedback and Conclusion

→ Data and CAMA model was tested for Kigali and published by the WB in 2018

(Ali et. al. (2018): Using Satellite Imagery to Revolutionize Creation of Tax Maps and Local Revenue Collection, WB Policy Research Working Paper)

- EO-derived Building Height data can be used to support property tax evaluation
- EO data can significantly reduce the cost of establishing and updating tax registers

→ high resolution remotely sensed imagery can be used to reliably check the completeness of valuation rolls and if data on land values are available, also run land valuation models at a fraction of the time and resources required by more traditional technologies.

Thank you for your attention!

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