FIG WORKING WEEK 2019

22–26 April, Hanoi, Vietnam

Presented at the FIG Working Week 2019,
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"Geospatial Information for a Smarter Life and Environmental Resilience"

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22–26 April, Hanoi, Vietnam
"Geospatial Information for a Smarter Life and Environmental Resilience"

Identification and Characterization of Informal Settlements Using Satellite Images in Support of Land Administration

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Outline

- Overview
- Need for information
- Informal settlements/slums ontology
- Feature extraction methods – Remote Sensing
- Conclusions

Overview

- Migration of people from rural to urban areas has led to rapid urbanization in many countries
- At global level, a huge task is waiting to realize the agenda in relation to tenure security
- The SDG, goal 1, target 1.4 aims for security of tenure for all, especially for the poor and the vulnerable (UNDP, 2015)
- The proliferation of slums and informal settlements clearly show the lack or failure of effective urban land use planning and land administration

Real world -Technology

To assist in solving problems

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Ontology

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Image-based Classification

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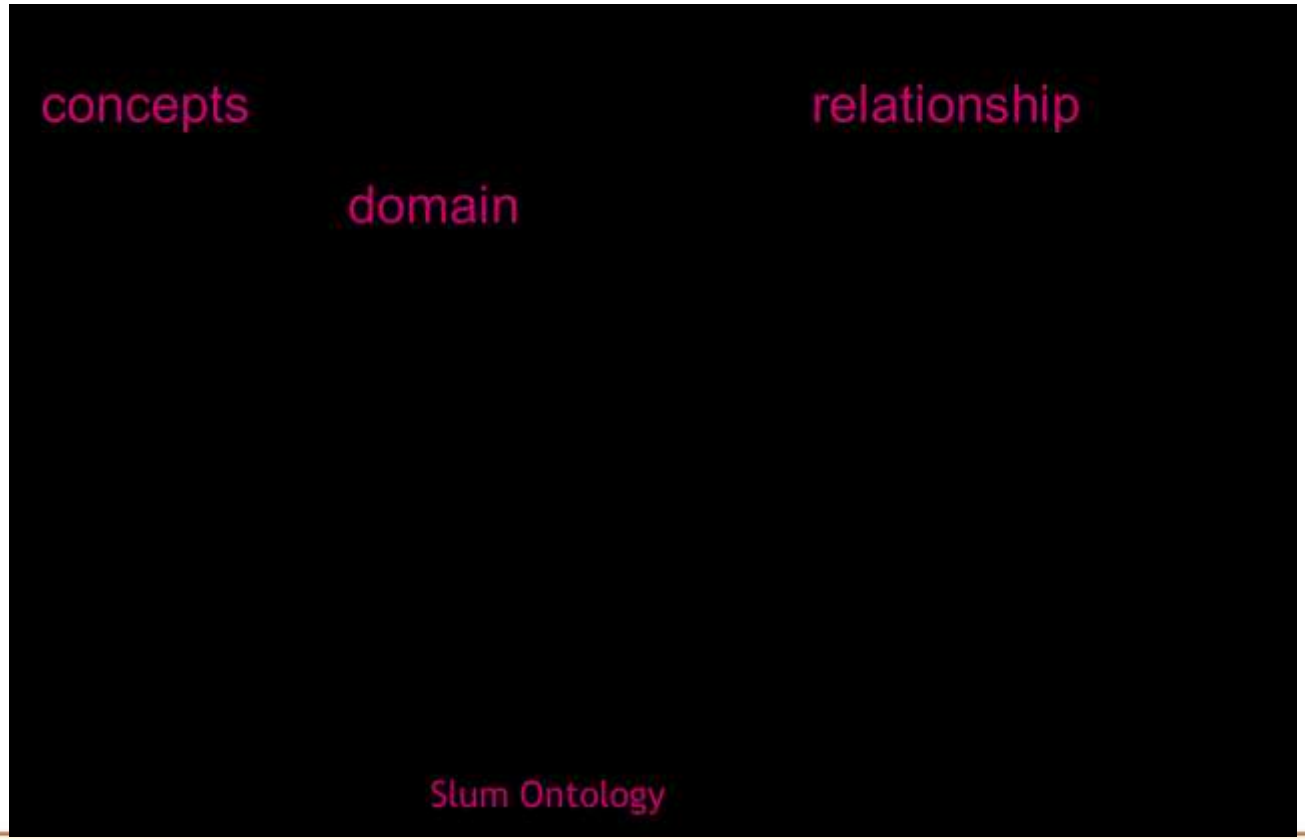
Information on slums

UN-Habitat Slum Definition

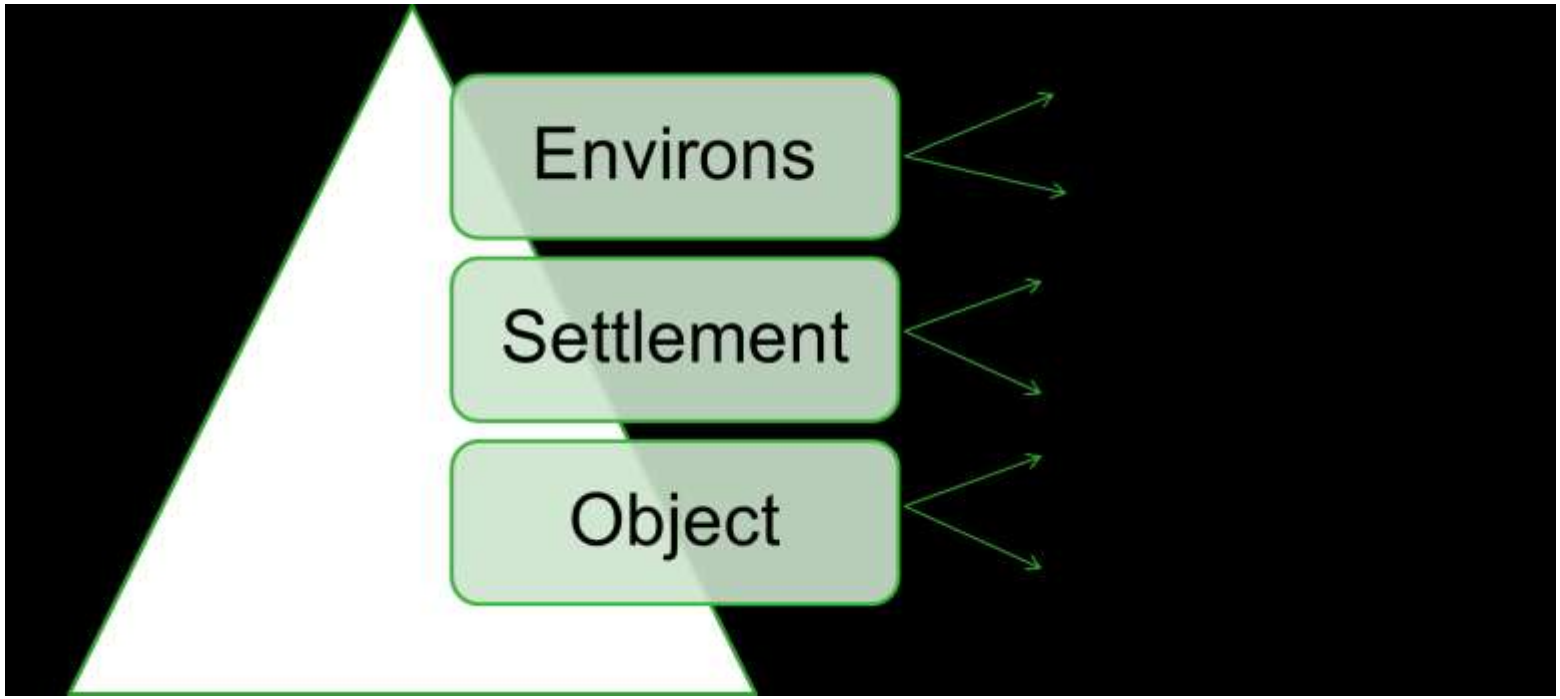
- Secure tenure
- Access to safe water
- Access to sanitation
- Sufficient living area
- Durability of housing

Earth Observation data can provide information about the poor structural quality of housing and patterns i.e. the indicator "durability"

Why Ontology?



Concepts at three levels of generic slum ontology



Building Characteristics

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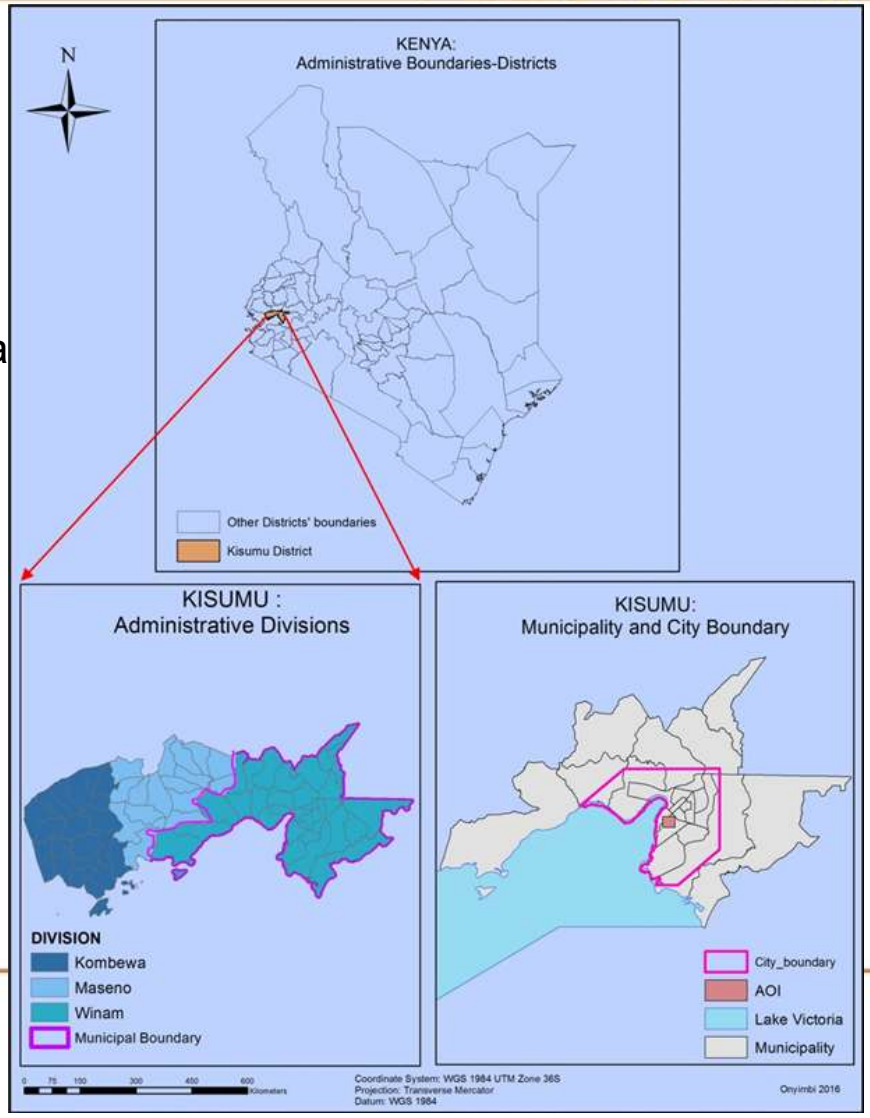
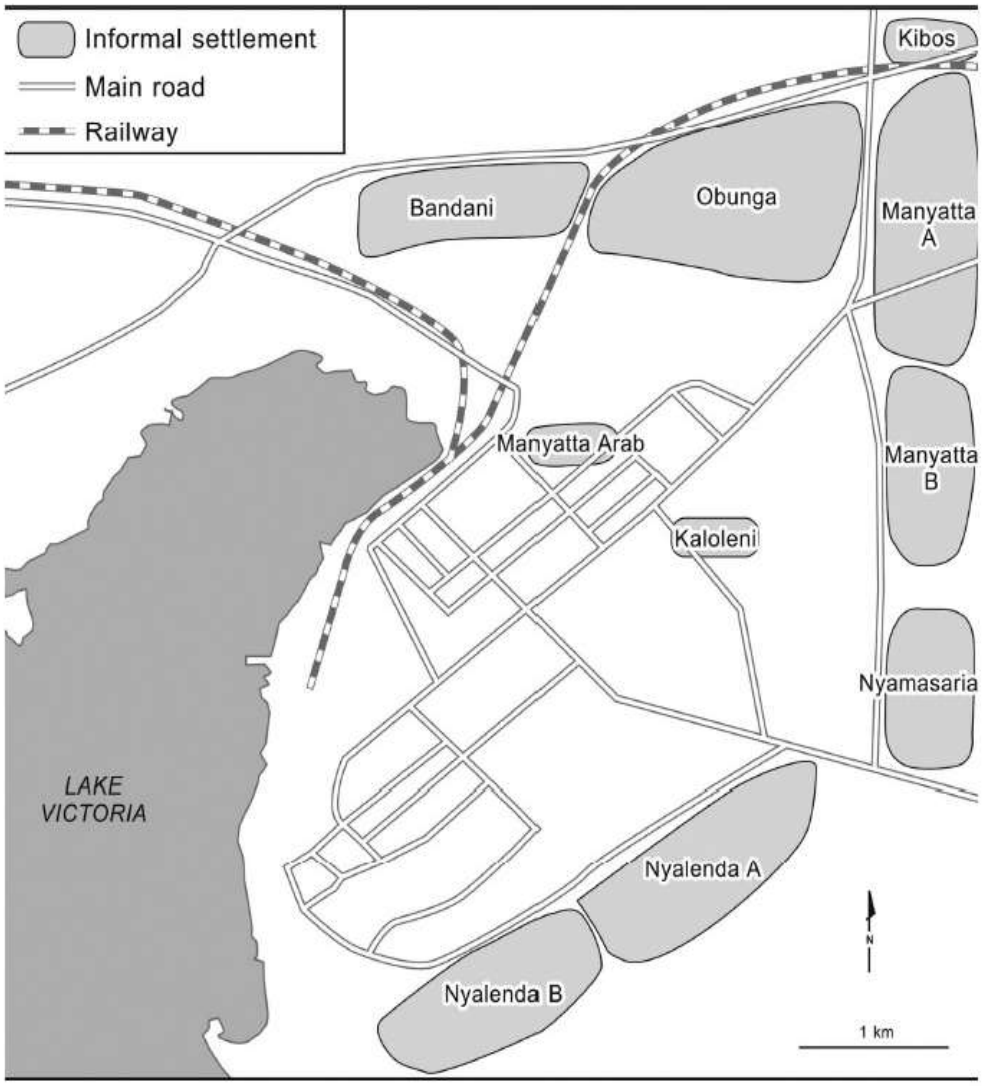
Kisumu, Kenya

- Kisumu is Kenya's third largest city
- Located in the Western Highlands on Lake Victoria
- It is a rapidly growing administrative, commercial and industrial center for the Lake Victoria basin.

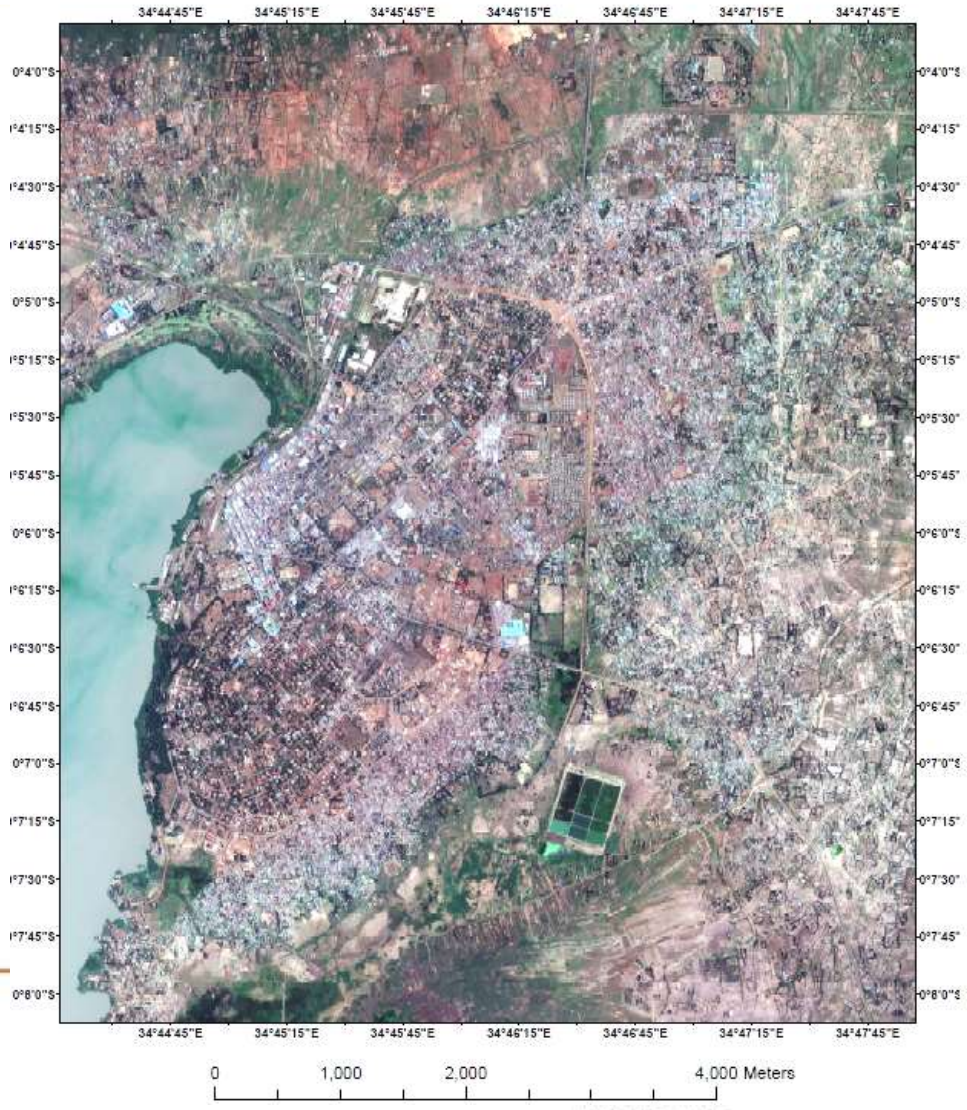


Map showing informal settlements and their boundaries in Kisumu



Source: Karanja, I. (2010). An enumeration and mapping of informal settlements in Kisumu, Kenya, implemented by their inhabitants. E*nvironment and urbanization, 22*(1), 217-239

Very high resolution image of Kisumu (Geoeye)



A subset of GeoEye image of Kisumu city

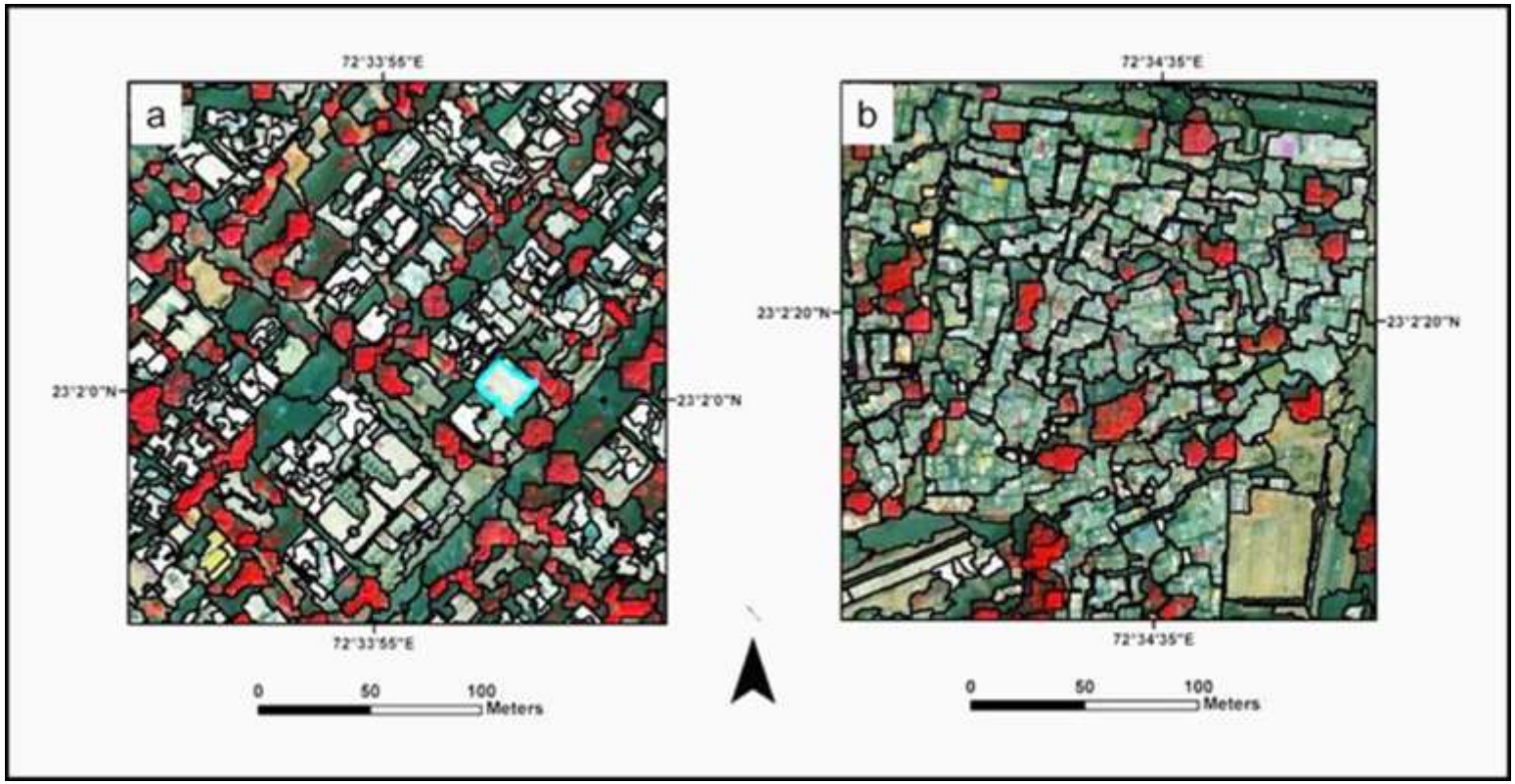
Analysis at three levels of ontology

- Environs
  - Close to the lake/swamps, major roads, surrounded by farmlands
- Settlement
  - Irregular shape of the overall settlements, basically encircling the planned center areas.
  - Variable densities among various slum-clusters.
- Object
  - The majority of the roofs are constructed from rusty iron sheets
  - Irregular patterns of buildings with variable orientation
  - Irregular access roads with variable widths

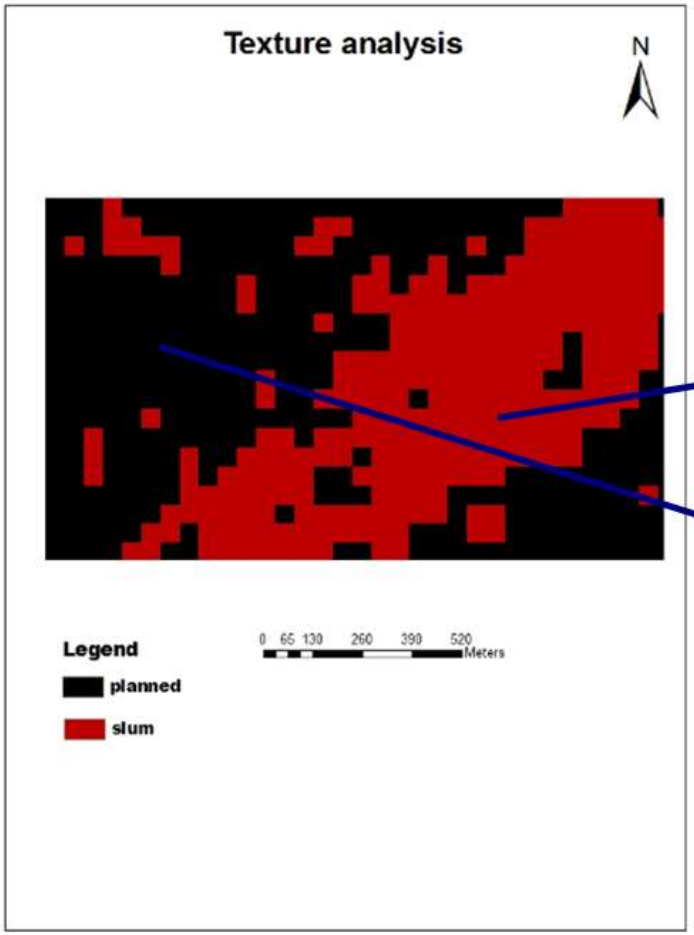
Local ontology for slums in Kisumu

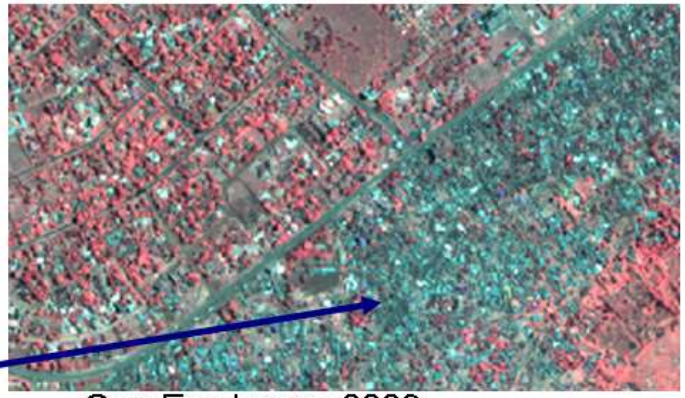
Level	Land cover	Interpretation element	Observation from the image
Object level	Roads	Shape colour	Irregular road network Unpaved roads
	Buildings	Shape Colour Orientation Size	Roof mostly rectangular Most range from bright grey to dark brown, few have bright blue and red. Variation is high even in the same building where there are different colours of the roof. Haphazard buildings with no order Small and Medium
Settlement Level	Informal settlement	Pattern Density	Irregular and have no linear arrangement Slums follow the road network The density of the buildings is high
Vicinity Level	Local contrast to the formal neighbourhood	Texture Association	Coarse textured because of heterogeneous character of slums Mostly unfenced grouped buildings surrounded by narrow roads or streets farmlands, bare ground and /or permanent swamp Slum buildings are surrounding the planned areas

Object based image analysis (OBIA)



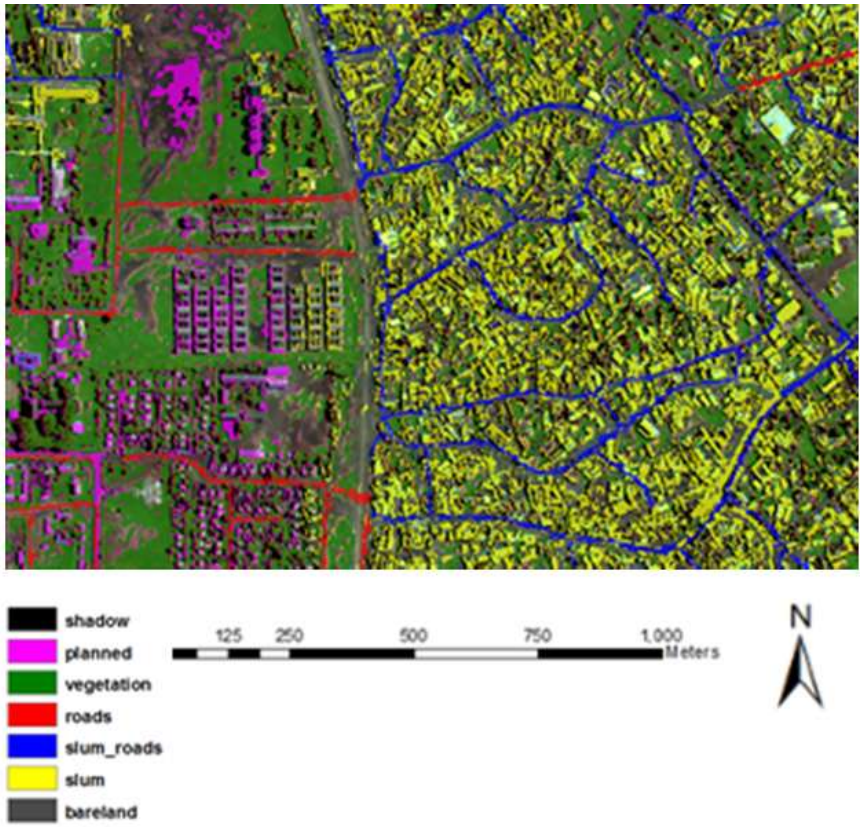
Results-Linking ontology with OBIA-Density



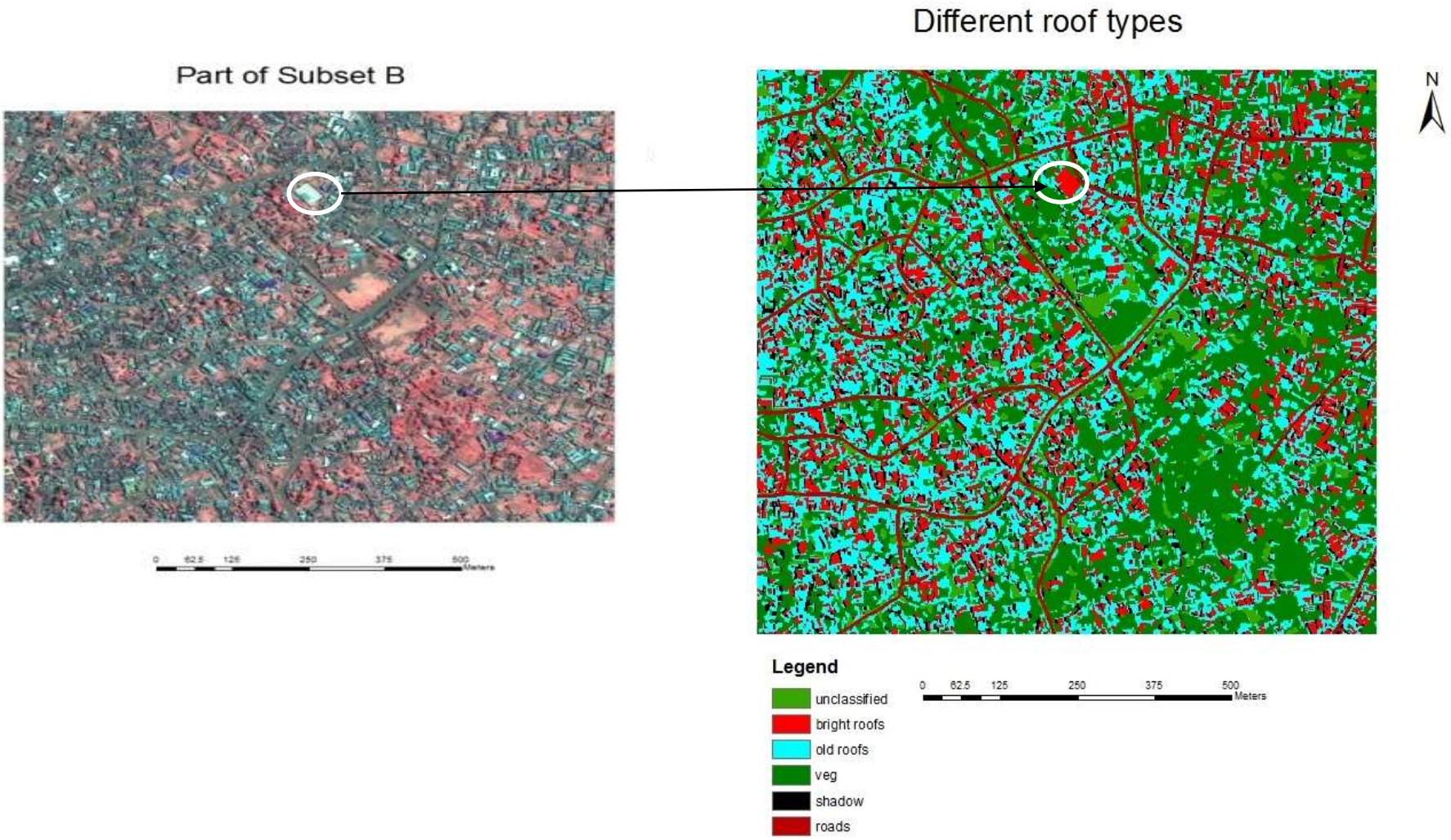


Geo Eye Image,2009

Classified image of Kisumu showing planned and slum areas.



Linking ontology to OBIA-Building characteristics



Mathenge, C. W. (2011). *Application of object oriented image analysis in slum identification and mapping: the case of Kisumu, Kenya*: University of Twente Faculty of Geo-Information and Earth Observation (ITC).

Conclusions

- There is a lack of updated land and housing stock information in informal areas
- Image based identification can help identify settlements on government land and private land – facilitate possibilities of upgrading
- Detailed maps can also show how a need for space to be cleared for new infrastructure within or around informal settlements
- These maps can help to minimize dislocation for the inhabitants

Conclusions

- Updated information could also be useful to find relocation sites

- With the availability of multi-temporal data, updated maps can be generated and can act as appropriate base maps for land management and property registration

References

- Alemie, B. K., Bennett, R. M., & Zevenbergen, J. (2015). A socio-spatial methodology for evaluating urban land governance: the case of informal settlements. *Journal of Spatial Science, 60*(2), 289-309. doi:10.1080/14498596.2015.1004654
- Definiens. (2009). *eCognition Developer 8 User Guide* Retrieved from http://www.ecognition.com/
- Karanja, I. (2010). An enumeration and mapping of informal settlements in Kisumu, Kenya, implemented by their inhabitants. *Environment and urbanization, 22*(1), 217-239. doi:10.1177/0956247809362642
- Kohli, D., Sliuzas, R., Kerle, N., & Stein, A. (2012). An ontology of slums for image-based classification. *Computers, Environment and Urban Systems, 36*(2), 154-163. doi:10.1016/j.compenvurbsys.2011.11.001
- Mathenge, C. W. (2011). *Application of object oriented image analysis in slum identification and mapping: the case of Kisumu, Kenya*: University of Twente Faculty of Geo-Information and Earth Observation (ITC).
- Sliuzas, R. V., Kerle, N., & Kuffer, M. (2008). *Object-oriented mapping of urban poverty and deprivation*. Paper presented at the EARSeL worshop on Remote Sensing for Developing Countries in Conjunction with GISDECO 8, Istanbul, Turkey.

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