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OBJECT-BASED IMAGE ANALYSIS OF SATELLITE IMAGERY FOR POPULATION ESTIMATION IN INFORMAL SETTLEMENT KIBERA (NAIROBI, KENYA)

Abstract

Cities in Africa, and developing countries in general, are having difficulties coping with the influx of people arriving every day. Informal settlements (slums) are growing, and governments are struggling to provide even the most fundamental services to their populations. One of the tools that can be used to study these environments is satellite imagery, especially very high-resolution images coming from systems such as Ikonos, Quickbird and GeoEye.

Detection of informal settlements from satellite imagery is a challenging task due to their microstructure and irregular shapes of buildings. Higher spatial resolution is necessary to identify and extract individual buildings, especially in slum communities that are characterized by small, densely packed shanties and other structures. The Kibera (Nairobi, Kenya) slum is composed of varying housing sizes, where roofs can be a combination of many different materials, and mainly unpaved road and path network. Typically this can produce a spectral response that is difficult to interpret and makes traditional classification almost impossible.

We have applied object-based classification on GeoEye and QuickBird imagery over a tree year period (from 2006 to 2009) to help differentiate slum rooftops and unpaved roads from non-build land and therefore residential areas or grasslands. Object-based segmentation automatically delimits segments on the image into homogeneous elements, which correspond to the real urban geographical objects on the Earth's surface. In the stage of classification all these homogeneous elements are classified into most appropriate classes. In addition to determination of the detailed urban structure we were also interested in the expansion of slum areas with change detection, which was analyzed through comparison of images taken in different time sequences. The results of object-based analysis based on morphology attributes were further used to estimate the potential population density in the slum area. There is a big discrepancy between the estimation on Kibera census, ranging from 1 to 2 million people, while no field surveying was ever performed to estimate the population. Different parameters were tested to estimate the potential population density scenarios.

The paper will discuss merits and drawbacks of object-based image analysis in dense non-formal settlements analysis with remote sensing data. Overall, the use of the object-based image analysis holds great promise for dense urban environments and could be utilized in studies of urban change structure and corresponding population estimation.