Remote Sensing and Spatial Indicators for Detecting Urban Trajectories

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INTRODUCTION

This research work intends to explore the spatial analytical methods to identify both general trends and more subtle patterns of urban growth. In Kuala Lumpur, Manila and Singapore, where the urban areas have experienced an unprecedented rate of growth over the last 30 years. Multi-temporal remote sensing has become an important data-gathering tool for analyzing these changes. The objective of this study is to explore an approach for combining remote sensing and spatial metrics to monitor urbanization and investigate the relationship between urbanization and urban land use plans.

METHODOLOGY

- The study areas, consisting of the cities of Kuala Lumpur, Manila and Singapore, were examined using Landsat data from 1989 to 2014. In this study an spatial metric was undertaken to produce urban growth maps and evaluation the characteristics of urban composition.
- As all nine images were geometrically corrected up to orthorectified level. In this study we preferred to retain the spatial detail, original pixel size and value of each image. Therefore the images were kept without changing their pixel sizes despite the possible varying accuracy level of classification with the different spatial, spectral and radiometric resolutions. Next at the classification stage all of the images were classified by creating accurate polygons as training areas for introducing ideal classes for each image separately and by using the maximum likelihood classification method. To create a closer correspondence between the maps produced the classification was done by only considering four main classes: urban/built-up area, agriculture land, forest land (tree/park) and water (Anderson et al., 1976; Boori & Ferraro 2013).

METHODOLOGY (Cont.)

Post-classification refinement was used to improve the accuracy of the classification. In this step a 3*3 majority filter was applied to all the classified land covers. An accuracy assessment was performed at the metropolitan level. For an unbiased assessment, the stratified random sample strategy was used to select 15 samples for each class totaling 60 points per image. Generally, the accuracy of the classifications is satisfactory, with the lowest values for the 2001 image (an overall accuracy of 85.50% and a Kappa index of 0.867). the non-forest vegetation type had lower producer's accuracies than the other land cover types for the remaining eight images, ranging from 72.13% to 79.59%. This class type includes grasslands, brush, and cropland which are mixed with residential and commercial land cover types in many locations, potentially resulting in misclassifications.

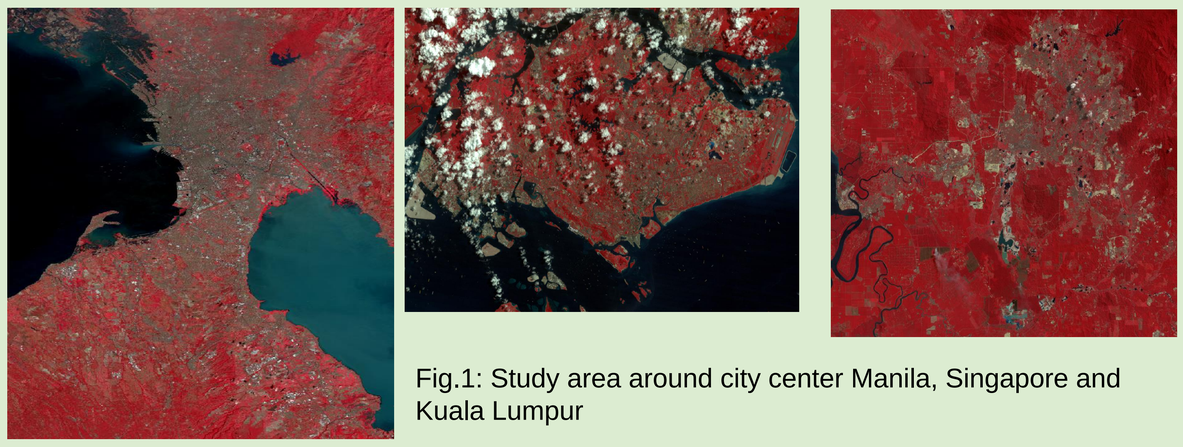
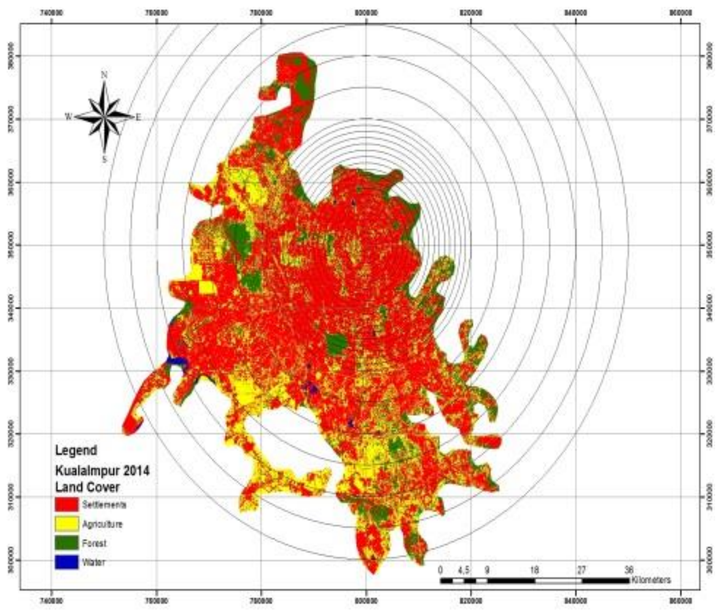


Fig.1: Study area around city center Manila, Singapore and Kuala Lumpur

RESULTS



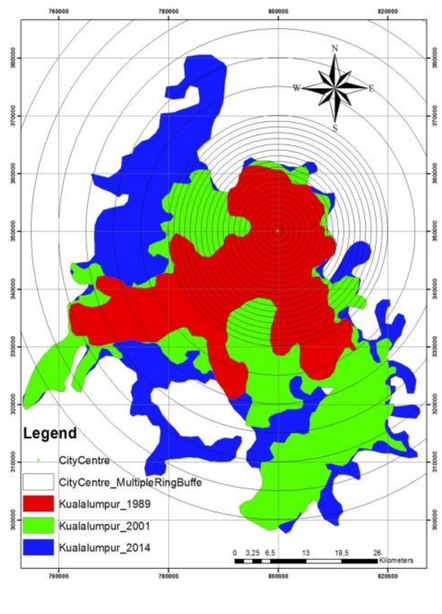
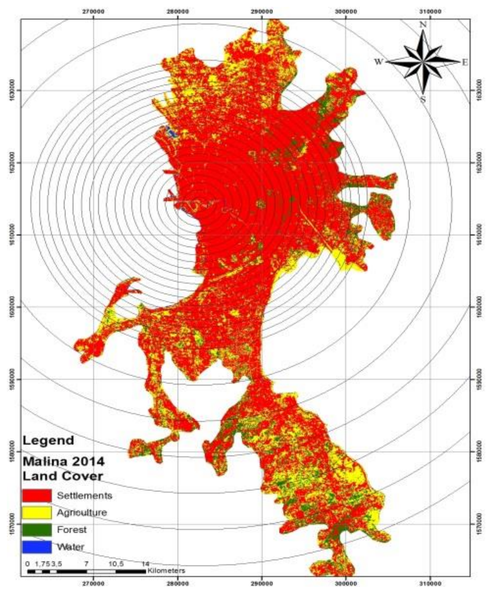


Fig.. 2: Multi-buffer ring zones around city center for 2001 and urban growth of Kuala Lumpur



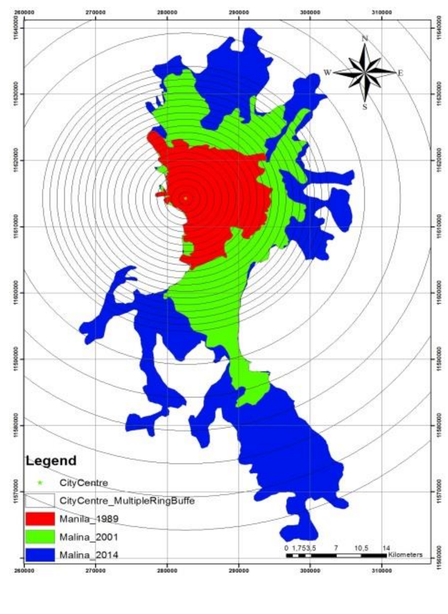


Fig. 3: Multi-buffer ring zones around city center for 2014 and urban growth (right side) of Manila

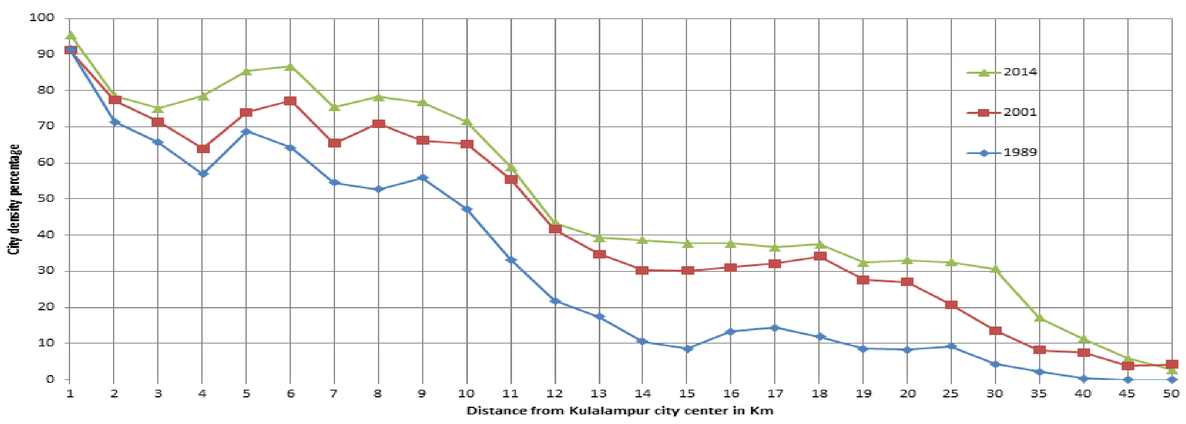


Fig. 4. Kuala Lumpur urban density from 1 to 50km distance for 1989, 2001 and 2014.

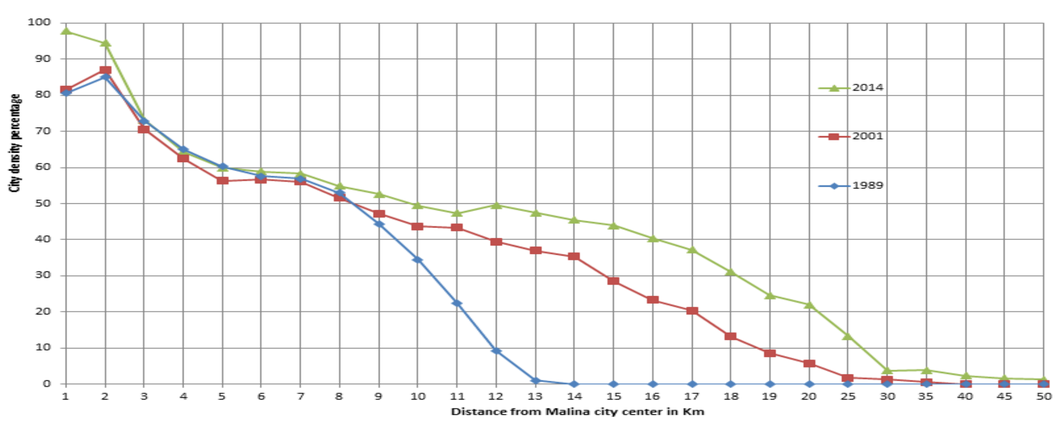


Fig. 5. Manila urban density from 1 to 50km distance for 1989, 2001 and 2014

RESULTS

Remote sensing and spatial metrics provides an innovative method for analyzing urban growth patterns. In this study, a detailed analysis of urban growth in Kuala Lumpur, Manila and Singapore over a three decade period was performed and the results were presented using urban change maps. Using these results, we were able to examine the changes in the urban land use of three cities over time. Over the past three decades, urbanization has significantly modified the land cover of metropolitan Kuala Lumpur, Manila and Singapore city. The built-up land markedly increased, mostly at the expense of the agricultural land, for all the study cities as well as for the metropolitan area as a whole, while forestland remained relatively unchanged at the metropolitan level. City based analyses identified fast and slow sprawling spots of the metropolitan area.

CONCLUSIONS

This research work identified the landscape effects and spatial patterns of built-up land expansion. As a general trend at the metropolitan level, non-forest vegetation and forestland patches became more fragmented as a result of the increase of built-up area over the period of study. These types of studies can provide complementary information on urban land conversion when solely using population based indices may skew the interpretation.

REFERENCES

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