Pixel-based and hybrid pixel/object-based land use/cover classification techniques: A comparative study

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(1) Purpose: The main purpose of this study is to compare pixel-based and hybrid pixel/object-based land use/cover (LUC) classification techniques.

(2) Data and methods: A 2006 QuickBird satellite image of the eastern part of Tsukuba City, Japan (Fig. 1), and a 2009 Landsat TM satellite image of Bangkok, Thailand (Fig. 2) were used in this study.

First, both images were classified using a pixel-based classification technique (maximum likelihood supervised classification). Five LUC categories were classified from the QuickBird image, while three categories were classified from the Landsat image. Second, the object-based SEGMENTATION module in IDRISI® software was employed for both images. The pixel-based classified LUC maps and the segments generated were both used as inputs to the SEGCLASS module in the same software to produce a hybrid classified LUC maps. And third, the individual accuracy of all the classified LUC maps (two for each study site) was determined.

(3) Results and Discussion: Fig. 1c shows the pixel-based classified LUC map, while Fig. 1d shows the hybrid classified LUC map for the QuickBird image. Fig. 2c shows the pixel-based classified LUC map, while Fig. 2d shows the hybrid classified LUC map for the Landsat image. The results show that the pixel-based classified LUC maps exhibited a much higher degree of 'salt and pepper' than the hybrid classified LUC maps. Some patterns of linear features (e.g., roads), however, were more evident in the pixel-based classified LUC maps than in the hybrid classified LUC maps.

In terms of classification accuracy, the hybrid classified LUC maps for the two images/study sites had a much higher overall accuracy than the pixel-based classified LUC maps (Table 1). The Landsat-based classifications also showed a much higher overall accuracy than the QuickBird-based classifications. This can be due to the number of LUC categories used in the classifications, i.e., five for the QuickBird image but only three for the Landsat image.

Table 1: Overall classification accuracy (%).

Image/Study site	Pixel-based	Hybrid
QuickBird/Tsukuba [a]	80.00	85.65
Landsat/Bangkok [b]	84.57	89.64

Number of reference points: [a] = 620; [b] = 473

(4) Conclusion: Based on the overall classification accuracy, the hybrid pixel/object-based technique outperformed the pixel-based technique for both the QuickBird image (high resolution) and Landsat TM image (medium resolution). The hybrid technique shows a potential for a more accurate satellite remote sensing-based LUC mapping.

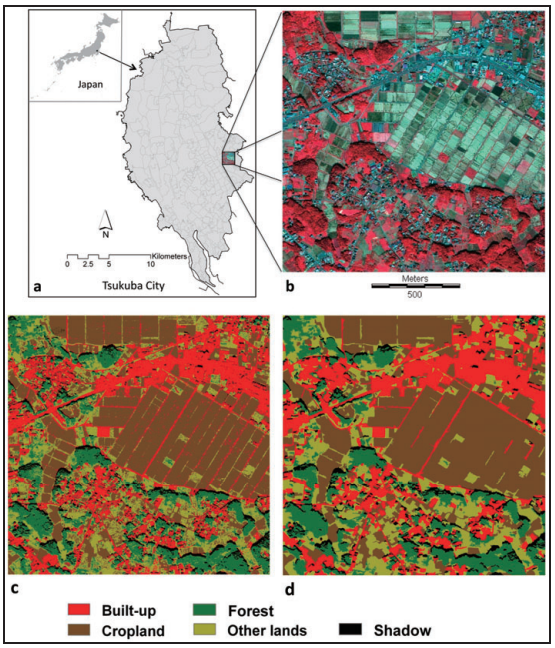

Fig. 1: (a) Location of Tsukuba City, Japan; (b) 2006 QuickBird (RGB = 432); (c) Pixel-based classification; and (d) Hybrid classification.

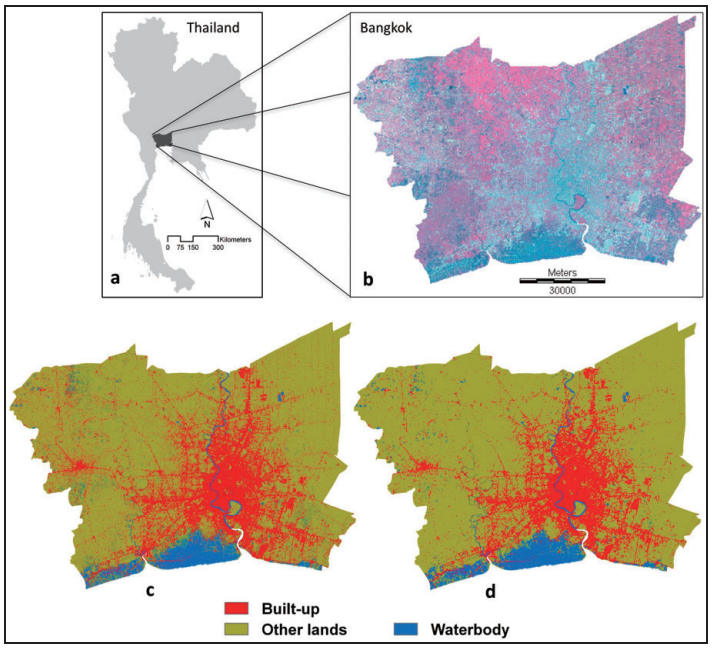

Fig. 2: (a) Location of Bangkok, Thailand; (b) 2009 Landsat TM (RGB = 432); (c) Pixel-based classification; and (d) Hybrid classification.