

SUPERVISED LAND COVER CLASSIFICATION  
OF COOK COUNTY, ILLINOIS

By

Guetchine GASPARD

Ethan DEVENPORT

Ryan WENDEL

COURSE PROJECT

Advanced Remote Sensing

Department of Geography and Environmental Resources

In the Graduate School

Southern Illinois University Carbondale

May 2012

## **Abstract**

Given the difficulties to discern among features in remotely sensed images, classification proves to be a necessity. This project aims at categorizing land use land cover of Cook county area. The supervised classifier is used through ERDAS Imagine 11.0 interface coupled with ArcGIS using an aerial orthophoto as a reference. The findings indicated that supervised classification displays an overall accuracy of 87.7% and Kappa coefficient statistics of 0.85. Mainly, those differences are attributed to the selection of training areas, the choice of multiple methods in the supervised though time-consuming. Finally, temporal and seasonal inconsistencies between the image and the aerial photograph weigh a lot in the reduction of the overall accuracy of both methods.

## **Introduction**

The Chicago area is highly urbanized or transformed at least however there are several and diverse ecosystem types ranging from Grass lands to disperse trees. The wide range of land that encompasses Cook County, specifically the urbanized development is scattered with a mosaic of different deciduous forestland and other locations of interest. A lot of fields covered of grass are noticeable a part from the fact that the landscape is artificially transformed. Some water spots are found on the lands in addition to the Michigan Lake at north east.

## **Hypothesis**

Urbanization has eliminated the agriculture lands in Cook County

## **Study Area**

The study site we chose to examine in our land use land cover classification was Cook County, Illinois. Established in 1831, Cook County is a county that borders Lake Michigan in the north eastern part of Illinois. Cook County is the second largest county, in terms of population, in the United States with over 5 million residents. This county makes up 40.5 percent of all Illinois residents. In terms of geography, Cook County is only the fifth largest in Illinois with a total area of 1635 square miles; 946 square miles of land and 689 square miles of water, which is mostly Lake Michigan. Cook County is mainly urban and very densely populated, containing the City of Chicago and many suburbs.

## **Data and Methods**

To perform this study, two data were provided. First, a Landsat TM image, for Cook County, composed of six bands (TM1, TM2, TM3, TM4, TM5, and TM7) was selected. The image has a

30 m \* 30 m spatial resolution and bands 1 to 5 and 7 have the respective following wavelength intervals: 0.45-0.53  $\mu\text{m}$ , 0.52-0.60  $\mu\text{m}$ , 0.63-0.69  $\mu\text{m}$ , 0.76-0.90  $\mu\text{m}$ , 1.55-1.75  $\mu\text{m}$ , and 2.08-2.35  $\mu\text{m}$ . Second, an aerial orthophoto with three channels for the same area was used as reference. Right at the beginning of the process, the image was preprocessed in ERDAS Imagine 11.0. As a first step, the image was georeferenced to the photo using 10 ground control points with an average RMSE of 0.47 before being radiometrically corrected employing the empirical line calibration technique. At this point, several regression models were determined in order to derive the corrected stacked image. A feature space image step was taken where all the bands were graphically correlated on a two by two basis. It turned out that channels 1, 4 and 5 showed the highest variance. At that point, a covariance and correlation matrix was derived from ArcMap. Then the image was enhanced using principal component analysis. The analysis indicated the first three principal components mainly explained the composition of the image (specifically the combination 1, 3, 2 according to RGB sense). Thus, the time had come to classify the image using maximum likelihood as a parametric supervised algorithm. The land cover was categorized into five major classes which are water, built up (transformed landscape), grass land, bare soil and trees (no forest, per se, was identified). Finally, an accuracy assessment was conducted for the classification by comparing the recoded composite image to the aerial photo. The image was then mapped in ArcMap and was ready for use.

## **Results**

Below are presented a classification map for Cook County (Figure 1), a table with all the accuracies, errors and Kappa statistics for all the land cover classes. Also, the variances for the first three principal components as well as three regression models for the most important components and bands respectively are presented. The overall accuracy for the classification is 87.5 percent and the Kappa coefficient 0.85.

## Supervised Land Cover Classification of Cook County , Illinois

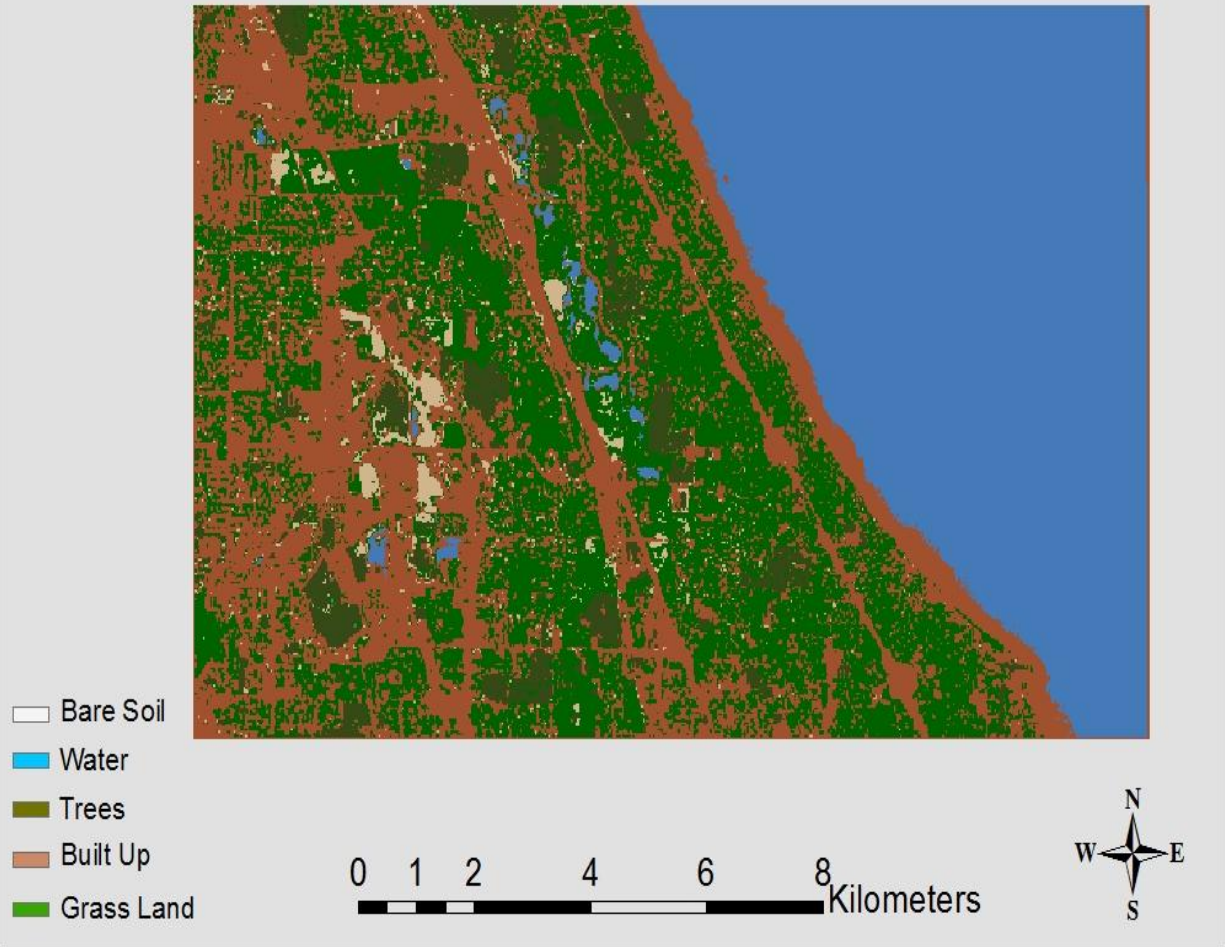
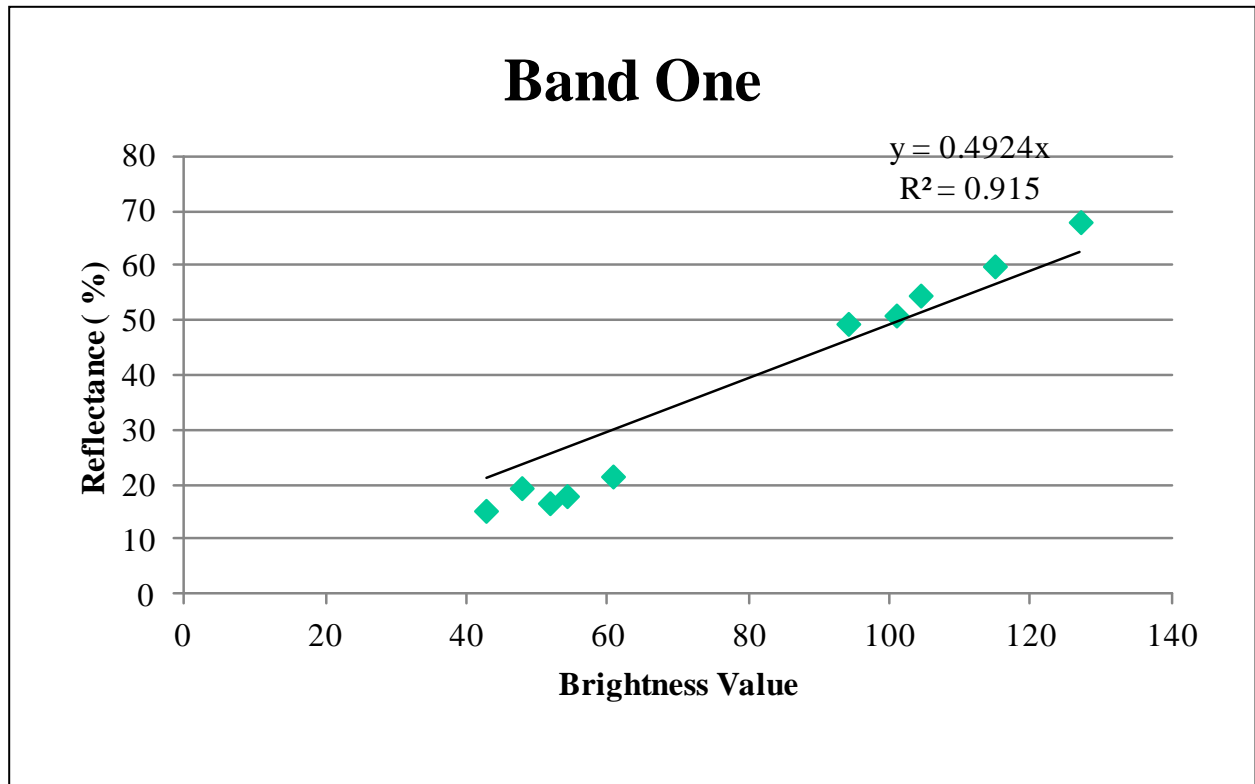
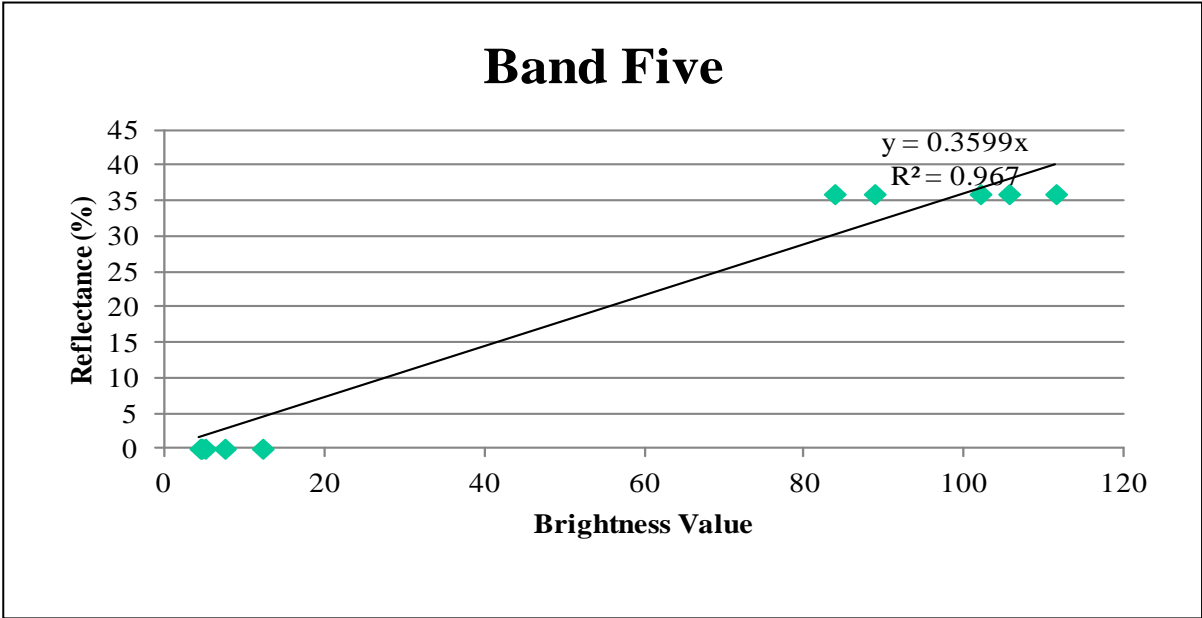
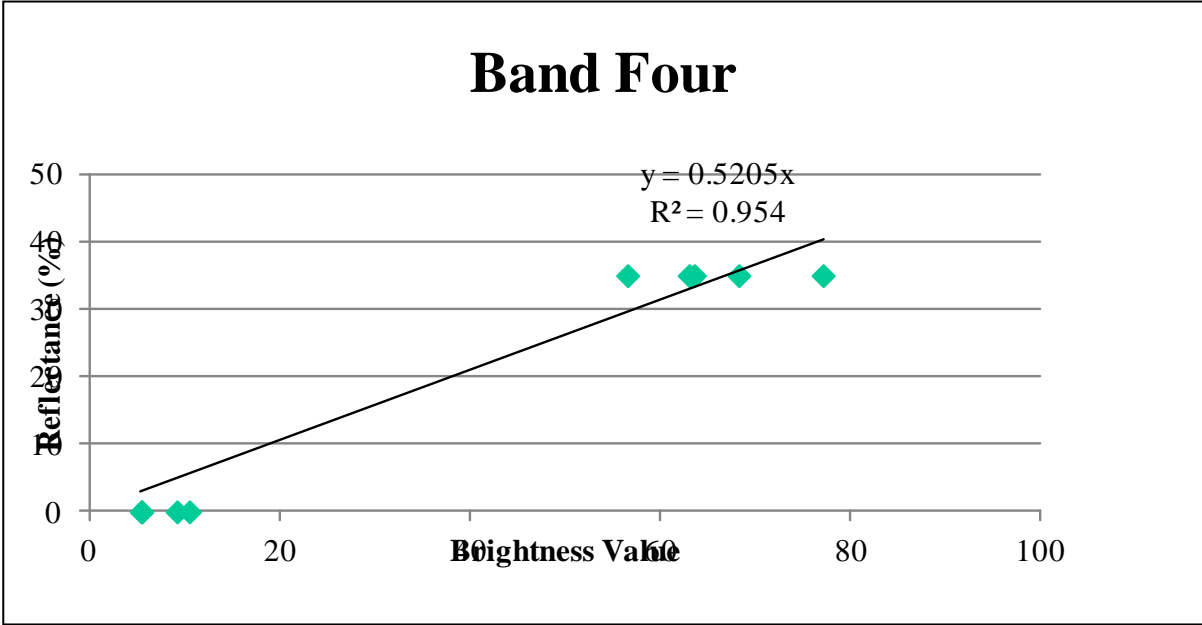


Figure 1. *Land cover Classification*

		Reference data										
Classified data		unclassified	Water	Built up	Grass Land	Bare soil	Trees	X <sub>i+</sub>	UA%	CE%	C.K.	
	Unclassified	0	0	0	0	0	0	0	0	0	0	0
	Water	0	8	0	0	0	0	8	100	0	1	
	Built up	0	0	6	0	2	0	8	75	25	0.7	
	Grass land	0	0	1	7	1	0	9	87.5	12.5	0.84	
	Bare soil	0	0	0	1	7	0	8	87.5	12.5	0.84	
	Trees	0	0	0	1	0	7	8	87.5	12.5	0.85	
	X <sub>+j</sub>	0	8	7	8	10	7	-	-	-	-	
	ProdA %	0	100	86	88	70	100	-	-	-	-	
	OE%	0	0	14	12	30	0					
Overall Accuracy								87.5%				
overall kappa statistics								0.85				





$VAR_{PC1} (\%) = 80.95$

$VAR_{PC2} (\%) = 15.77$

$VAR_{PC3} (\%) = 2.55$

## **Discussion of Conclusion**

The Supervised classification, maximum likelihood, displays an important overall accuracy eighty seven point five percent (87.5%) as well as a Kappa coefficient of eighty five percent (85%). That result tells us that effectively the Chicago area is essentially occupied by urban, grass land with some a small portion sparse trees, bare soil, inland water. These good results are due to the robustness of the methodology adopted for the study. The prediction that agriculture is no longer practiced in Cook County is verified. However, one must be very careful as to the generalization of that conclusion and its use since the spatial resolution of the aerial photograph is not fine enough discriminate all the details on the ground. The interpretation errors, the dates of the images among other factors must be accounted for. Finally, potential temporal and seasonal inconsistencies between the image and the aerial photograph weigh a lot in the reliability of classification. Consequently, some agriculture lands on the image might have appeared as bare soil or grass lands on the aerial photograph. Additionally, the supervised classification performed well by providing land cover classes that are similar to the existing literature, especially for grass lands and built up area. However, above all those differences and inconsistencies, the classification is limited for the simple fact that five categories are not large enough to classified land use land cover for the Chicago area. It is recommended that further researches subdivide features into more classes such as agriculture, wetland for instance, in addition to the previous ones in order to reduce the error margin. Also, same age images and photographs should be analyzed in similar studies.

## **References and Acknowledgements**

- John R. Jensen. 2005. Introductory Digital Image processing: A Remote Sensing Perspective, 3rd edition, Pearson Prentice Hall
- Campbell, J. B & R. H. Wynne. 2001. Introduction to Remote Sensing. Fifth Edition. Guilford Press, 72 Spring Street, New York 10012.

We thank Professor Guangxing Wang for preparing us to be able to perform professional tasks with remote sensing.