Introduction

Different classification techniques are able to identify different features more thoroughly. A remote sensing imagery contains six bands in total and each layer combination portraits better on different features due to the reflectance on each colour of each object. For instance, layer combination 4, 3 and 2 defines vegetation the best while all layer 4 or 5 defines water body the best. Classification processing on the digital imageries help us to create themes for different groups of features. The objective of this study is to create unsupervised and supervised classifications on a selected area and to compare pros and cons of each classification technique based on the results.

Methodology

A 512px x 512px subset image (Figure 1) of Niagara region was derived from the original image of Southern Ontario. The subset image mainly contain four various areas: urban, forest, croplands and waterbodies. Area in bright blue represents urban area as low IR is being reflected on infrastructures. Area in dark blue colour represents water body because water absorbs IR. Area with combinations of different colours represents croplands as the area has combination of manmade infrastructure (e.g. roads) and fields that reflect relatively high IR. The area of dark red colour represents forest area as vegetation reflects high IR. Unsupervised classification and supervised classification were performed using the same subset imagery.

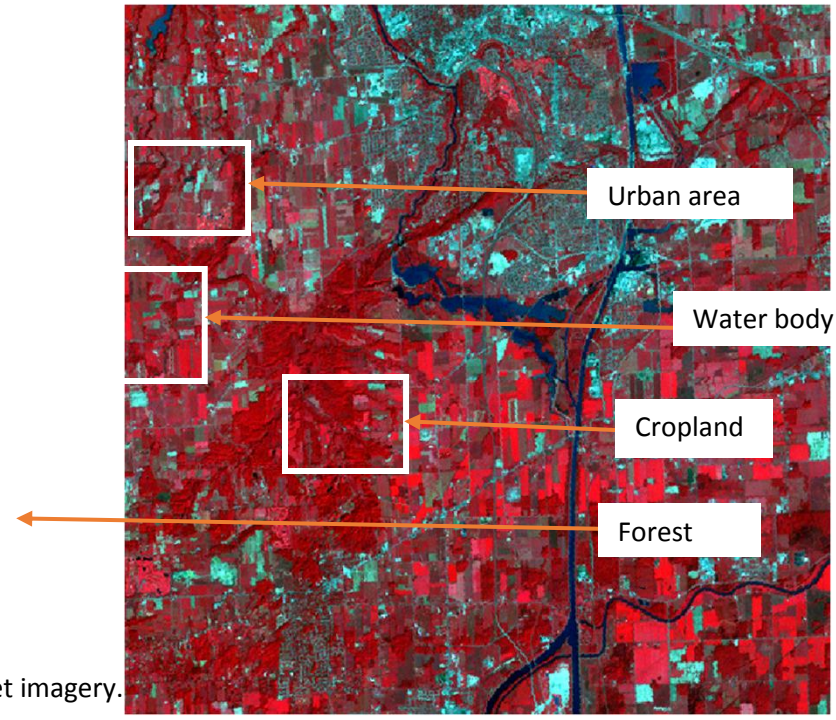


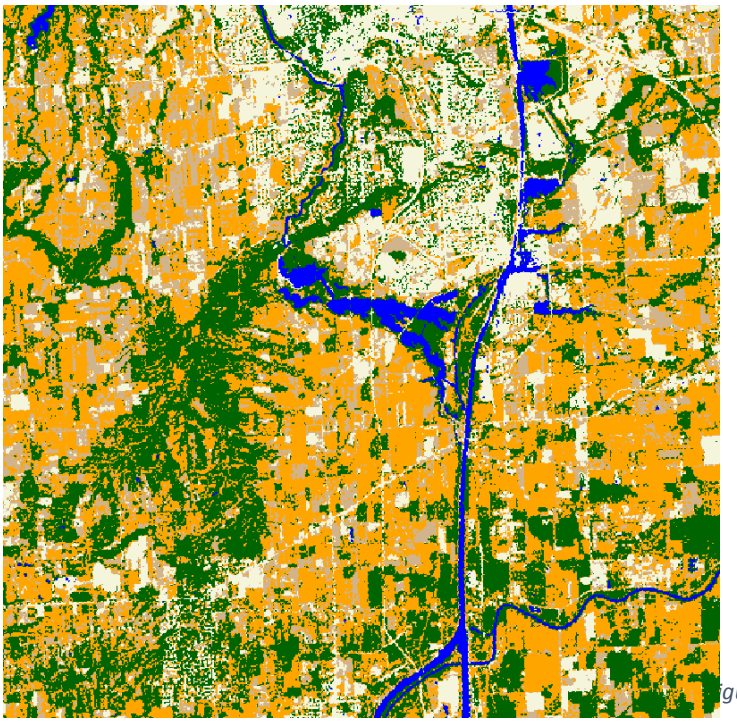
Figure 1 Original subset image with band layer 4, 3 and 2 (false colour)

Unsupervised classification

The subset image was classified using unsupervised classification technique (Figure 2). The image was processed as 10 categories using the function *Unsupervised Classification*. ISODATA algorithm is used to perform unsupervised classification on the satellite image. In this study for unsupervised classification the image was categorized into 10 classes initially. When the colour of each class has changed manually associated with the feature such as water is in blue colour and forest is in green colour. Two classes are being combined as they represent similar features. Combining similar classes can avoid confusion in identifying features. The image was then being classified into five layers as shown below (Table 1).

Layer	Colour	Caption
1		Water body
2		Forest
3		Croplands (high IR reflection)
4		Croplands (lower IR reflection)
5		Urban Area

Table 1 Unsupervised classification layers



gure 2 Unsupervised classification on subset imagery

Supervised classification

Same subset image was used to perform supervised classification. Areas that have similar colour theme (i.e. dark red) has been selected and grouped together as one layer. Six thematic classes were created using this procedure. X-axis on the histogram represents the range of colour pixels from 0 – 256. Y-axis represents the frequency on the colour present in the image. Maximum likelihood was chosen as the parametric rules as the result of the supervised classification image.

Layer	Colour	Caption
1		Water body
2		Forest
3		Croplands (high IR reflection)
4		Croplands (lower IR reflection)
5		Urban Area
6		Commercial Area

Table 2 Supervised classification layers

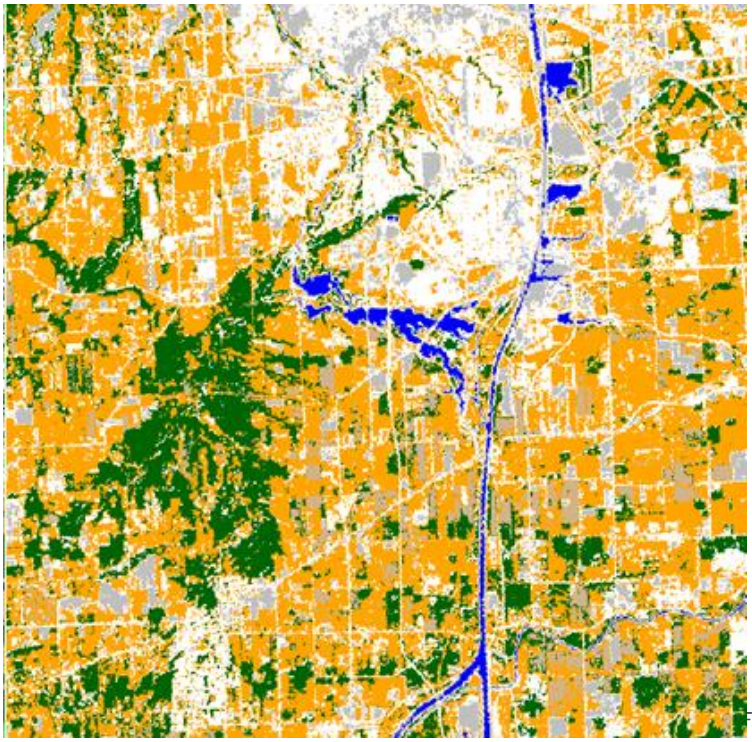


Figure 3 Supervised classification on subset imagery

Result and Analysis

Urban area

The urban area under the supervised classification detection is larger than the one with unsupervised classification. The urban area in unsupervised classification contained the mixture of forest area (green) and the water body (blue). On the other hand, the area in supervised classification contained less mixtures with other classes. Roads in thin, white lines can be easily identified in the supervised classification while it is hard to be seen in unsupervised classification. Commercial area in grey colour can be easily seen on the supervised classification image as well. By comparing the original subset imagery the unsupervised classification represents each feature more accurately. The urban area in the subset imagery contains more vegetated areas than what the supervised imagery showed.

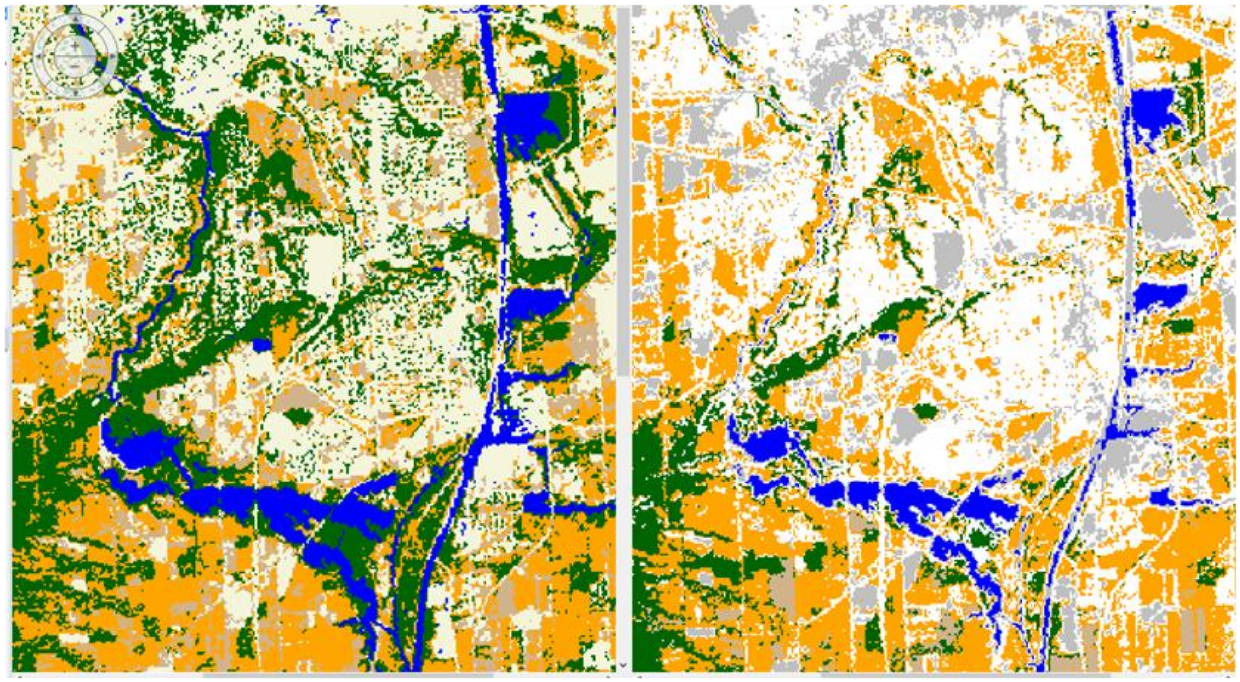


Figure 4 Urban area in white colour in unsupervised classification technique (left) and supervised classification technique (right)

Water body

The unsupervised classification portraits larger water body area than the supervised classification one. More vegetated area surround the water body on the unsupervised classification while the water body seems to be merged and overlapped with the urban area and croplands (orange) on the supervised classification. Welland canal (long, straight line on the right side of the image) does not appear to be

continuous on the supervised classification and it seems to be overlapped by commercial area (grey). On the other hand the canal is being portrayed clearly on the unsupervised classification imagery. Based on the observations on the water bodies and the Welland canal on both imageries, the unsupervised classification demonstrates a more accurate results on identifying water bodies.

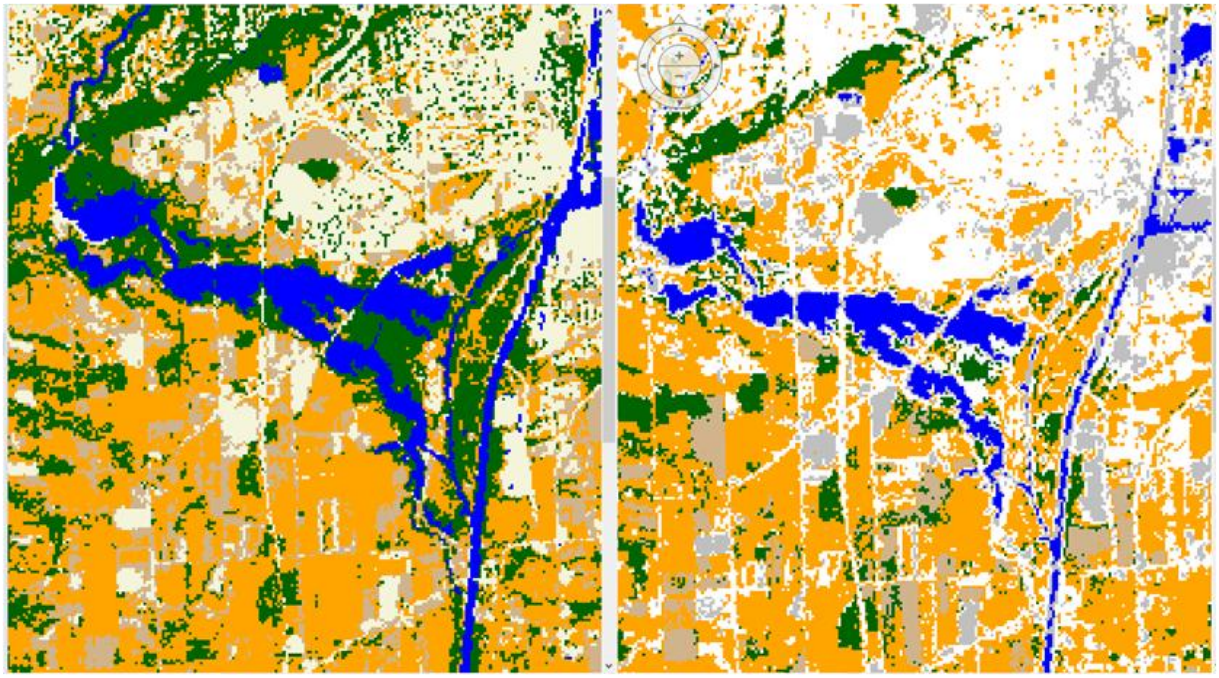


Figure 5 Water body in blue colour in unsupervised classification technique (left) and supervised classification technique (right)

Croplands

Croplands are being represented in two classes in both classification methods. Orange colour represents croplands that contain vegetation hence it reflects higher in IR. It could be interpreted than the croplands are growing products. Tan colour represents croplands that reflect lower IR in comparison which could mean the cropland is currently not in operation. The imagery with supervised classification showed a less grey colour compared to the unsupervised classification one. Commercial areas (grey) are located in the supervised imagery where it does not semm logical for commercial areas locating between croplands. Based on the analysis above it is concluded that the unsupervised classification imagery represents the croplands more accurately than the one with supervised classification.

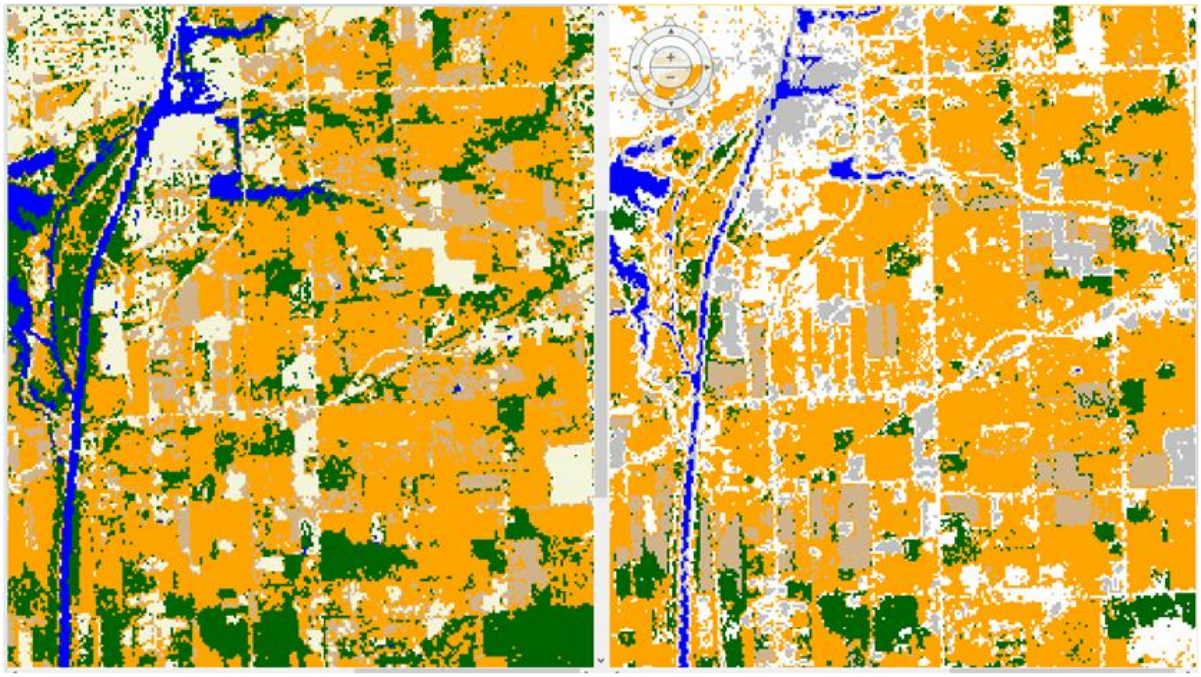


Figure 6 Croplands in mixture of orange and other colours in unsupervised classification technique (left) and supervised classification technique (right)

Forest

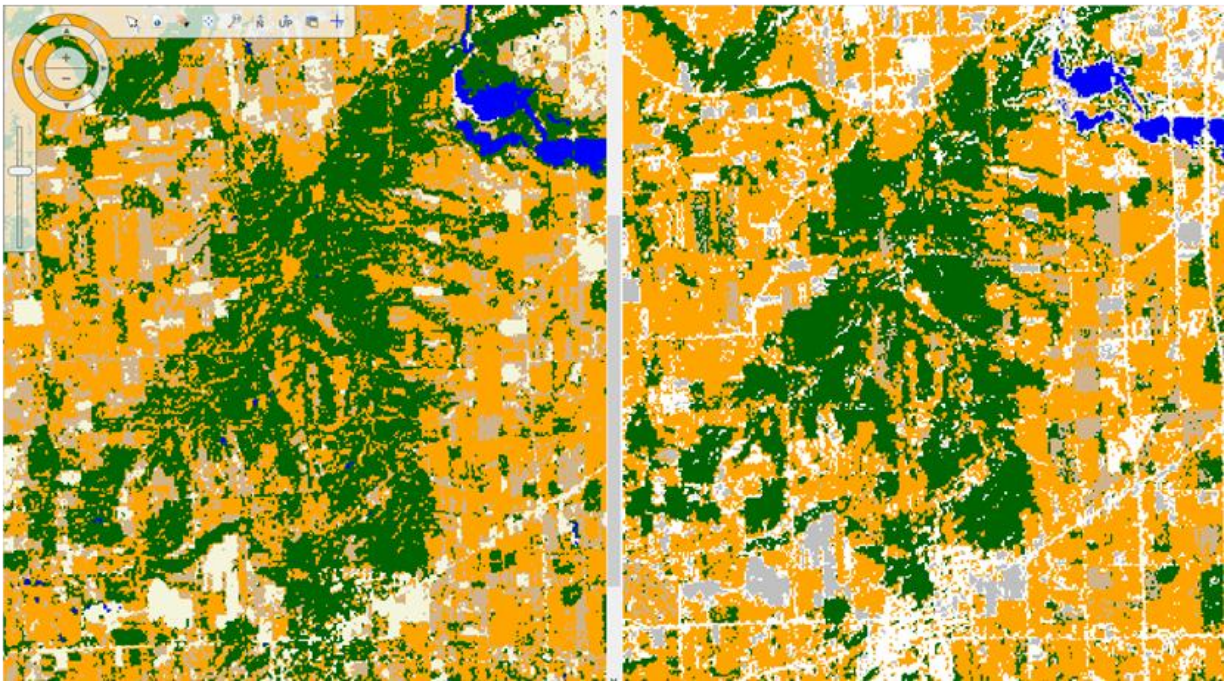


Figure 7 Forest area in green colour in unsupervised classification technique (left) and supervised classification technique (right)

The overall forest area on the unsupervised classification imagery is larger and more detailed than the one on supervised classification. The size of the green area is directly associated with the amount of IR the area reflects. Cropland in orange colour covers larger range of reflected IR on the supervised classification therefore the forest area is smaller. Also on the bottom center of the image a small urban area is clearly seen while it is being covered on the unsupervised classification image. Based on the analysis above the unsupervised classification covers a larger range of the forest area hence it is more accurate compared to the supervised classification image.

Other factors affect results of the classification techniques

Supervised classifiacation relies on the area of interest group that were selected by the user. Classes maybe underrepresented when the number of samples are not enough. The more samples for the area of interest the better result the supervised classification would be. Different parametric rules on supervised classification also affect the distribution of the classes. Using different algorithms on each method the pixels can be represented differently in ranges (Figure 8).

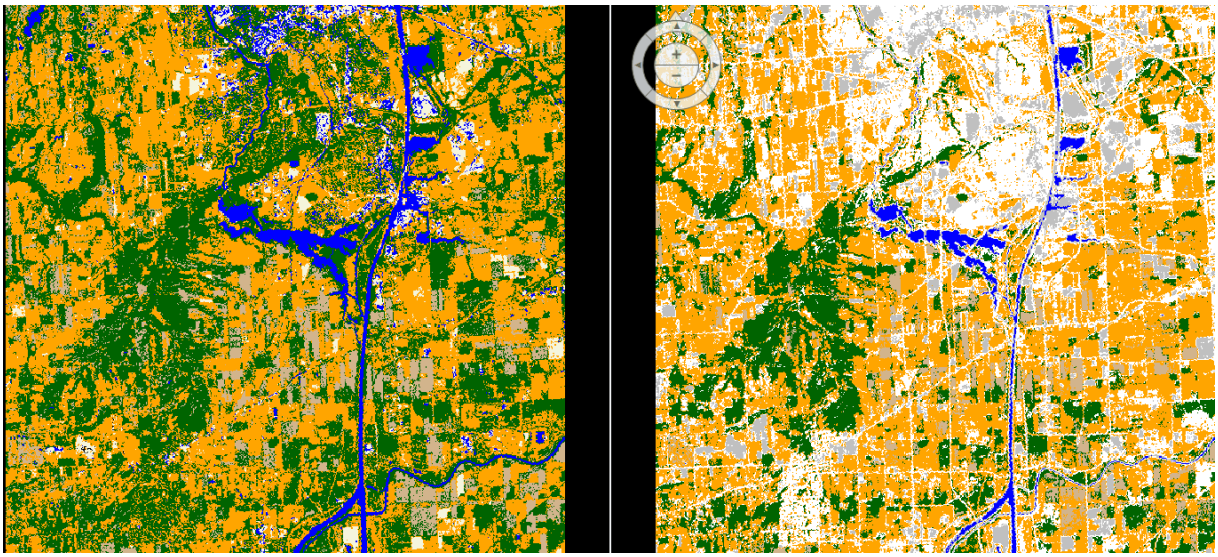


Figure 8 Supervised classification using spectral correlation (left) maximum likelihood (right) parametric rules

Conclusion

Based on the analysis above, unsupervised classification presents an more accurate result than the supervised classification associated with each region. Accuracy of supervised classification can be improved by more samples being selected.