Change Detection in Ordos Desert of China using Remotely Sensed Data

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Abstract-The objective of this study is to detect changes from 1988 to 2000 in Ordos desert area using by multi-temporal remotely sensed images (Landsat 5 TM and 7 ETM+). The Landsat TM and ETM+ images acquired on Sept. 15, 1988 and on Nov. 11, 2000. The images were classified using PCA (Principal Component Analysis) and unsupervised classification techniques. As a result, the unsupervised classification method, ISODATA, using PCA images was found to be most useful in classifying desert area using multi-spectral satellite images. From the analysis of multi-temporal changes for 12 years, it was apparent that the bare soil area has increased significantly and the others area simultaneous has decreased. Qualitatively, the bare soil area has increased from 66.77% to 76.17%, the river area has decreased from 1.60% to 0.96% and the vegetation area has decreased from 29.17% to 22.88%. As the result, ISODATA technique using PCA images is very effective in analyzing the changes in desert area.

Keywords: Chang detection; Landsat; PCA; ISODATA; Ordos desert

1. INTRODUCTION

The earth surface is constantly changed by natural factors and human activities, same time we being is adapted to various environmental changes. So we need many researches to process and analyze various data such as geological, geographical, social, statistical information and so on. The multi-spectral satellite images are acquired repeatedly and applied various research parts by characteristic of wave-length such as terrain classification, land-use mapping, change detection, mineralized zone analysis, geological environment analysis etc.

The yellow sand means minute sand dust from mainly barren land area of the north China which falling slowly. The yellow sand's quantities and damages are increasing every year, and the most of yellow sand which gives an effect to Korea occurs from Ordos desert located up stream of the Yellow River, China. Therefore, in this study, we tried to extract the change aspect of Ordos desert using Landsat TM and Landsat ETM+.

2. STUDY AREA AND DATA

Origin of the yellow sand, which effects to Korea , Yellow River basin, Ordos desert Takla Makan desert, Alashan desert in China and Gobi desert in Mongolia. Ordos desert located up stream of the Yellow River and the study area lies between the latitudes 38°17'40"N and 39°04'00"N, and longitudes 108°10'20"E and 109°23'55"E, and covers an area of approximately 9,244,000km^2 (Figure 1). The study area is being covered with soil (above 60%) and others.

For multi-temporal change detection analysis, it is important to use same or similar season and expansion of desert in the study area progressed slowly, so two Landsat images (Lndsat-5 TM(1988. 9. 15) and Landsat-7 ETM+(2000. 11. 11)) used in this study.

Figure 1. False color composite image (Landsat-7 ETM+ band 4/3/2) of the study area.

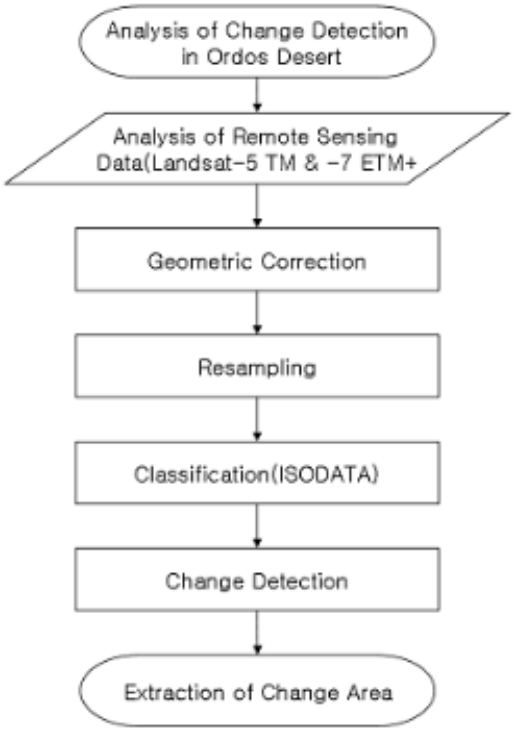


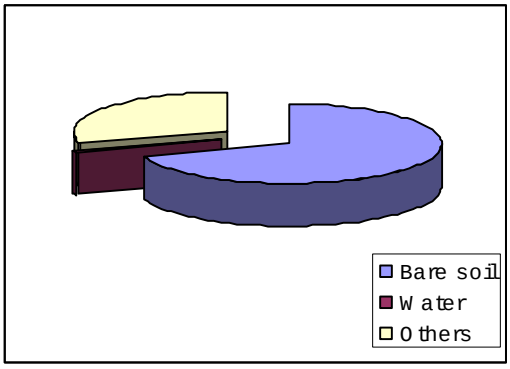
Figure 2. Flowchart for change detection

3. CHANGE DETECTION

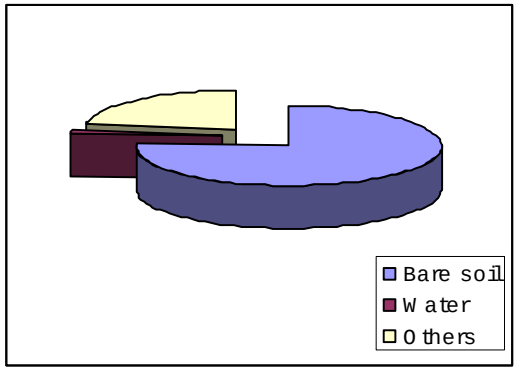
Figure 2 shows that methods are applied in change detection of Ordos desert using satellite images. Classification methods using remote sensing data are divided with unsupervised classification, supervised classification and mixed method using ancillary data. Supervised classification must be provided information about classes (training area), but unsupervised classification needed few input elements by analyst. K-means and ISODATA (Iterative Self Organizing Analysis Technique) unsupervised classification methods are very efficient and broadly used technique. For change detection, PCA (Principal Component Analysis) and ISODATA unsupervised classification are applied, because we have very few ground truth data for Ordos desert. Each class which classified by ISODATA are reclassified three classes (bare soil, water and others) refer to false color images. For change detection from 1988 until 2000, difference operation is applied.

4. RESULTS

Change detection results using remote sensing data for Ordos desert from 1988 until 2000 are shown Figure 3. From the analysis of multi-temporal changes for 12 years, it was apparent that the bare soil area has increased significantly and the others area simultaneous has decreased. Qualitatively, the bare soil area has increased from 66.77% to 76.17%, water area has decreased from 1.60% to 0.96% and the others area has decreased from 29.17% to 22.88%.



(a) 1988. 9. 15



(b) 2000. 11.11

Figure 3. Unsupervised classification result using Landsat images

Figure 4 shows the result which extracted changed area. In Figure 5, changed area appeared with approximately 27% of the whole study area. Changed area from water or others area to bare soil area more increase than from water or other area to bare soil area. Main reason is bare soil area spread and desertification of water and others area.

This research can be more relevant result add to study combine with situ data. And this study area is one part of Ordos desert, so following research will accomplish change detection of the whole Ordos desert. Result of like this could be applied with fundamental data of the yellow sand which effect to Korea every year.

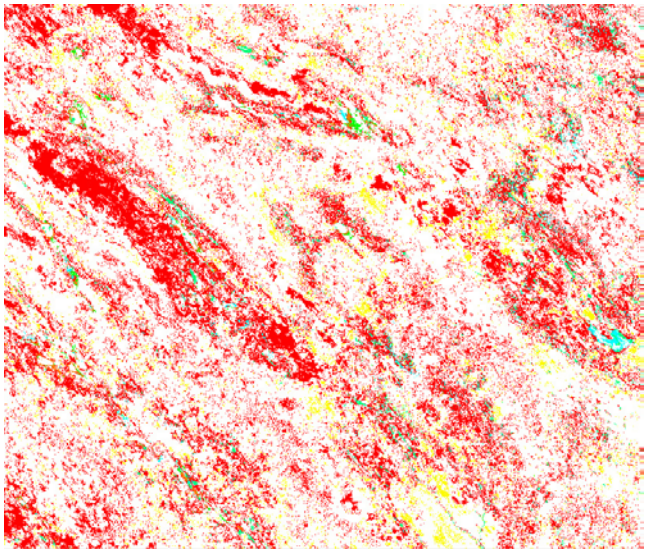


Figure 4. Pseudo-color composite image extracted by difference operation.

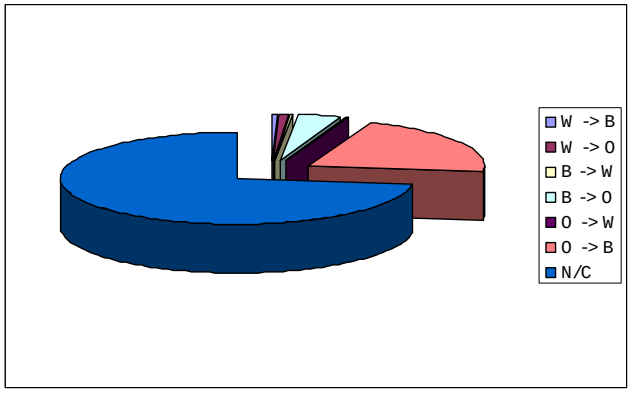


Figure 5. Change detection between 1988 and 2000.
(B: bare soil, W: water body, O: others)