Abstract

Over the last few years, the interest on the use of land use, land cover and its change in the time has grown. With the appearance of satellite images and Remote Sensing techniques, this type of Earth information can be obtained in a systematic way. In addition, the development of sensor technologies increases the availability of high and medium resolution images in the optical and microwave spectrum. On the other hand, the issue of desertification in arid zones is growing joined to the global awareness for climate change. For the last decades, the Algerian government has managed initiatives and programs to combat desertification in agricultural areas and cities located in the north of the country, near Sahara desert. Recently, they have started exploiting new sources of land cover information for this purpose. In general, land use and land cover monitoring methodologies require a high degree of human intervention for training and validation steps. The main focus of this Thesis is to develop change detection techniques through semiautomatic analysis of freely available optical and microwave images, with special emphasis on the detection of desertification in the north of Algeria.

Firstly, Change Vector Analysis is studied in two different zones in order to validate this change detection technique. For that purpose, supervised classification per pixel is employed with the selection of the appropriate classes for each scene information. In this step, comparison among different types of classifiers is done and Maximum Likelihood Classifier provides the better accuracy equal to 90,71 %. Quality evaluation is given by matrices of confusion and its derived parameters, such as global accuracy and kappa coefficient. A critical point in change detection methodology is optimal threshold selection. One possibility for it is given by the classical method Double-Window Flexible Pace Search. The results of change detection are given by transition matrices, change indexes and change maps.

Secondly, change detection applied to the issue of desertification in Algeria is studied

using optical data. A methodology based on post classification comparison is developed to monitor the degradation of the Earth in a simple way. This method of change detection provides the best results with a value of 95,15 % in overall accuracy, after the comparison with Change Vector Analysis and considering different processing parameters in both methods. In this case, the Support Vector Machine classifier based on objects is the one that provides the best results with a remarkable global accuracy of 92,91 % and kappa coefficient equal to 0,91, after comparing the confusion matrices and their derived products. Consequently, a change detection method is designed and evaluated in the city of Biskra (Algeria) during a period of twenty-five years. The results are available in statistical format (transition matrices and change indexes) and in graphical format using change distribution maps. The excellent results are obtained with low operator time.

Finally, taking into account the increasing availability of microwave images, the addition of radar images to the optical data in the previously selected desertification detection methodology is carried out. After evaluating different configurations, the integration of the radar image in vertical-vertical polarization without Speckle filtering after the segmentation step is chosen. This new strategy employing optical and radar images provides a significant improvement over previous results (with a value of 97,05 % in global accuracy and 0,96 in kappa coefficient), since the properties of dry sand in the radar image make it more easily identifiable. This new semiautomatic method integrating different types of images reduces the analyst's work and produces an easily interpretable change detection report. The usefulness of this type of report lies in helping the Algerian government authorities to take appropriate actions to fight against land degradation.