

The National-Scale Land Change Detection System in Taiwan

Chi-Farn Chen and Li-Yu Chang

Abstract: Because of limited land resources, an efficient land use management system to reach the sustainable development policy has become an urgent call in Taiwan. A long-term project entitled "National Land Use Monitoring Program - The establishment of a land use change detection system" has been jointly conducted by the National Central University and Ministry of Interior since 2001. The main aim of the project is to use remote sensing images to detect land use changes on a national scale. This plan has been put into practice and indeed provides an effective tool for land management.

Keyword: Land use monitoring, Land use management, Change detection, Government GIS.

1. Introduction

As the dynamics of economic and complication of land use, our land has suffered from a large amount of mismanagement. To prevent the land from illegally used and over exploitation, Center for Space and Remote Sensing Research, National Central University collaborating with Construction and Planning Administration, Ministry of Interior of Taiwan has work out an effectual measure to help monitor the use of land.

The remote sensing images, due to the periodical acquisition, large scale coverage, relatively low cost, and change detection capability, have been widely used as a useful tool to monitor the change of earth surface [1], [2], [3], [4]. In this project, we search for the great alteration on the ground with remotely sensed data every three or four months, and internet system is employed to distribute the changed information to the local governments. Basically, the project consists of three related systems, which will be introduced in the next section.

2. The Infrastructure of the system

The constituent structure of the system can be diagrammatized as Fig. 1.

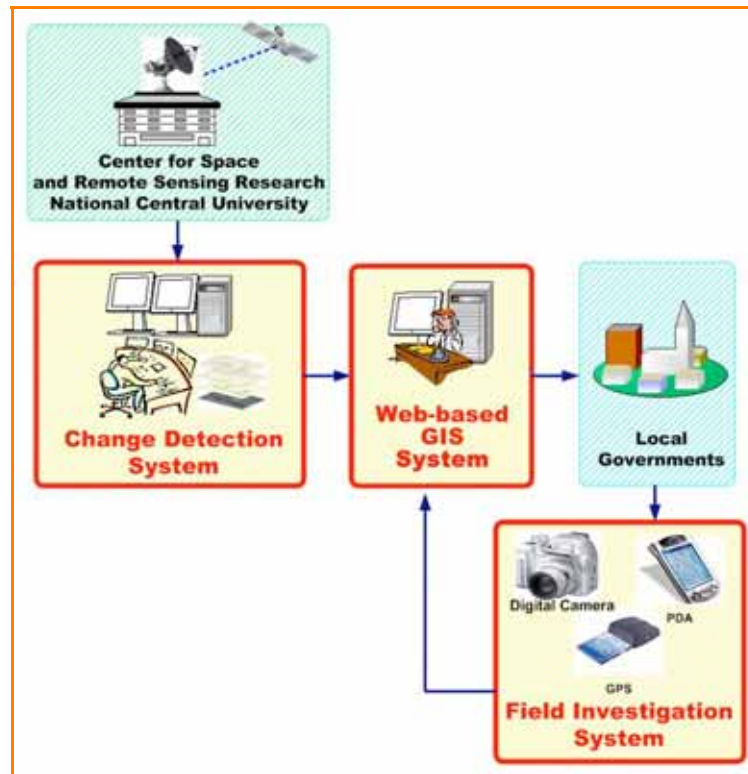


Fig.1 Infrastructure of the National-scale Land use / Land cover Change Detection System

1) Land change detection system

The program uses NDVI algorithm to detect the variation on the geocoded multi-temporal SPOT images. In the procedure, Taiwan is divided into 1/5000 scale frames, and the detections are done frame by frame. Each operation in a working area starts as automatically calculating the difference of NDVI [5]; then, the computer finds the deviation of each pixel. After the changed spots are automatically detected in the images, the operator will manually double-check these changed images with the aid of some reference data, such as aerial photographs, and land use map. After manual inspection, every change point will be given one of the attributes: 1.Suspicious 2.Fault 3.Clouds and shadows. The frames which contain clouds and shadows should be detected later with other clear satellite images. The rest of suspicious polygons will be sent to the internet system described below.

2) Web-based GIS system

This system is developed to declare the changed spots and let the field investigators fill the survey results. Once the changed spots are obtained by the above land change detection system, the related changed information are passed to the web-based GIS, and then the local land administrators will receive an E-mail which indicates that the field survey of changed spots should be done. The administrators can see and download data such as the coordinates, the maps and satellite images about the changed spots on the web-based system, then the field task could be performed with the digital field investigation system (which will be described in the next). Moreover, the administrators are required to send the survey results including the land use situation, legality, and the photographs through this system in 7 days, or the system will automatically send E-mails to admonish the case every 7 days till they return the consequences.

3) Digital field investigation system

This system is primarily combined with GPS receiver, digital camera and PDA(Personal Digital Assistance). Since the fieldworker can download the changed information from the web-based GIS system to the PDA, GPS then can lead the way to the changed areas and also measure out the azimuth of the investigator while taking a photograph toward the change point. Furthermore, the worker can record or query the field information in the PDA with the investigate program (The idea of this contrivance is to retain the data completion). Accordingly, the results of the field investigation including the pictures and the description of the agrarian usage is arranged to upload back to the web-based GIS system.

3. Results

After a series of tests and experiments conducted between central and local governments, the system has been executed fluently. One of the practical illegal cases found out by the detecting system this year is illustrated in Figs. 2, 3, 4 and 5. Fig. 2 demonstrates the changed areas overlaid with the digital maps, the map tells coordinates to lead the investigator to the changed place. Fig. 3 and Fig. 4 are the satellite images proving the variance. Fig. 5 is the documents reported by the investigator on the web-based system, which shows the dates of image reception and survey, the name of the agent, the statement and the photo. In this case, a farm house is built up without permit.



Fig.2 The map of changed points.

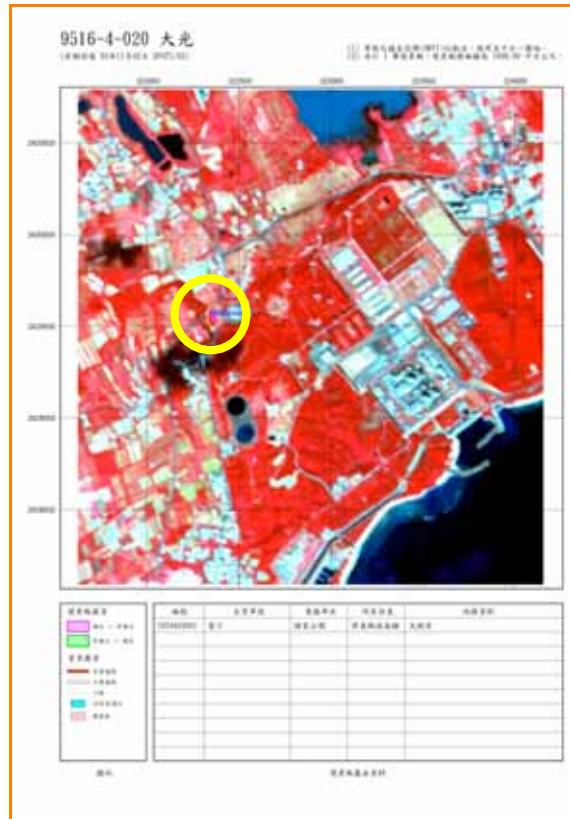


Fig.3 Changed points delineated on earlier taken satellite image.



Fig.4 Changed points delineated on later taken satellite image.

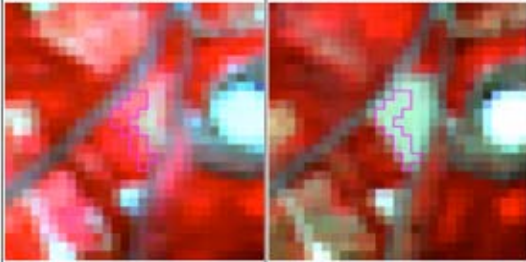

查察點圖號	9516-4-020-1	圖幅名稱	六元
前期影像日期	20041102	後期影像日期	20050316
			
目的事業主管機關	國丁	查察點查報日期	2005-5-5
查察點查報單位	國丁	查察點查報人員	張文輝
土地使用類型	國家公園	土地使用分區	農業用地
查察類型	墾地	查察結果	非法
查察點現場描述	現場為回填土壤,已由屏東縣政府依違反水土保持法查獲取締		
查察點現場照片			

Fig.5 Document filled and reported by the field investigator.

4. Conclusion

A national-scale land use / land cover change detection system is completely developed by both Center for Space and Remote Sensing Research, National Central University and Construction and Planning Administration, Ministry of Interior. The objective of this development is that the land management administration can control land use activities in digital way. The main experience of the project point out that satellite data provide a speedily reliable method of observing land change with less field work, and web-based system as well as digital field investigation system simplify the procedure of verifications.

The results indicate that the integration of remote sensing and internet GIS is undoubtedly a powerful tool for national land use management.

References

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