Land use/ land cover change monitoring using ALOS PALSAR data in Fuzhou, China

Prof. Qinmin Wang, Dr.Feilong Ling, Dr. Xiaoqin Wang, Dr.Yunzhi Chen, Dr.Henglin Chen
Fuzhou University, Level 13, Science Building,No.523 Gongye Rd., 350002, Fuzhou, China
E-mail: qmwang@fzu.edu.cn, lfl@fzu.edu.cn, wangxq@fzu.edu.cn

Abstract
Remote sensing techniques have an important contribution to make in sustainable development. The objective of the project is to develop and validate methodology using ALOS PALSAR data on land use/land cover classification with emphasis on urban and agricultural areas and land use/land cover changes using historical and archived JERS-1 SAR data. The paper presents the basic information of the project, the status of the research and preliminary results including data acquisition, data processing and data analysis. The results show that accurate urban and agricultural field distribution maps can be produced from PALSAR data by exploiting multi-polarisation and multi-temporal characteristics separately.

Keywords: SAR, land use, ALOS

1. INTRODUCTION

China's urban population continues to grow and the standard of living is rising. These two factors combine to exert increasing pressure on the agricultural land surrounding cities. As diet improves, shifting away from the national staple of rice, farmers are adapting by switching to more lucrative crops like fruit and vegetables. At the same time, the ever-advancing urban fringe is consuming these agriculture areas, placing greater demand on the remaining land. These changes need to be carefully monitored to ensure that future growth is sustainable.

Remote Sensing and Geographic Information System techniques have an important contribution to make in sustainable development, particularly in area such as southern China, where productive agriculture land is being lost to rapid urban development. Repeat acquisitions of satellite remote sensing images provide a unique source of information for recording and monitoring the rate and distribution of changes in land cover[1,2]. SAR data are important because of the persistent cloudy conditions experienced in southern China.

The objective of this project(JAXA 2nd Announced Project, PI347) is to develop and validate methodology using ALOS PALSAR data on land use/land cover classification with emphasis on urban and agricultural areas and land use/land cover changes using historical and archived JERS-1 SAR data. The paper presents the status of the research and preliminary results.

2. TEST SITE AND DATASET

The test site is located in the Fuzhou district inFujian province in southeast China. Zhangzhou District lies between 118°08′-120°31′E and 25°15′-26°39′N, belonging to the subtropical regions. Its economy has continued to develop rapidly since China's open policy began and the urban development has been quite fast in recent years.

The PALSAR data ordered and downloaded from AUIG are listed in table 1.

Table 1 Parameters of PALSAR data in the test site

Acquisition Date	Polarisation	Incidence angle(degree)	Product level
20060606	HH	47.3675	1.1
20060722	HH	47.3675	1.1
20060906	HH	47.3675	1.1
20060621	HH/HV	38.7362	1.1
20060921	HH/HV	38.7362	1.1

A local DEM at the scale of 1:50 000 and a Landsat TM image in 1998 were used for data processing and analysis.

3. DATA PROCESSING

The five PALSAR images acquired for Fuzhou are single look complex data. These data were processed in two different ways to produce backscatter images and interferometric coherence maps separately. The backscatter images were produced by performing multi-looking, geocoding with the local DEM, speckle filtering and dB transformation to the level 1.1 data.

For coherence estimation, the accuracy of co-registration between the master and slave image is critical. Unfortunately, none of the multitemporal data pairs gave coherence maps. The vulnerable weather conditions during the summer in southeast China may be the potential reason for this.

4. DATA ANALYSIS

The polarimetric features of PALSAR data were investigated as well as the multitemporal characteristics to test their potential for land use classification with emphasis on urban and agricultural area.

4.1. Polarisation

The two polarisations, HH and HV, were investigated by manual interpretation and quantitative examination of a color composite image as shown in Fig.1.

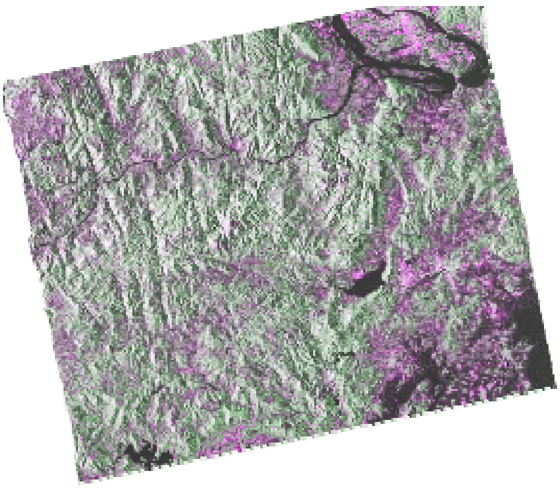

Figure 1 Image of dual palorisation data (Acquisition date: September 21, 2007. R, G, B: HH, HV, HH)

The forest area presents green color because of its high backscatter coefficient in cross-polarisation (HV) image due to volume backscatter mechanism. The purple color in Fig.1 indicates the high backscatter of urban area in co-polarisation image (HH). The fact that urban area presents bright purple color is caused by the double bounce backscatter phenomena from the manmade structures like buildings.

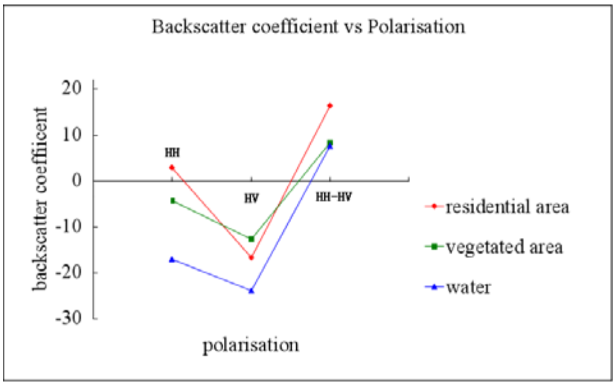

Figure 2 Backscatter coefficient of land covers as a function of polarisation

Further investigation of the polarisation effect on different land cover types was made by comparison of their backscatter signatures as shown in Fig.2. It is clear from Fig.2 that water has much lower backscatter than the other land cover types. In HH polarisation, the residential area including urban area has stronger backscatter responses than the vegetated area, whereas, the situation in HV polarisation is inverse. The difference image from HH and HV images acts as a good discriminator between residential area and vegetated area, which can also be seen from Fig.2.

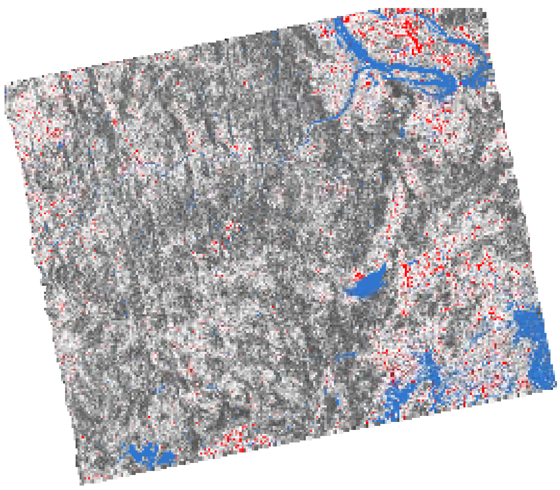

Figure 3 Classification maps of residential area and water superimposed on HH/HV difference image

From the above analysis, classification was performed to the difference image of HH and HV by simple thresholding. The classification map was shown in Fig.3. Land use/land cover changes was observed in many areas by comparison of the classification map and a Landsat TM image acquired in 1998.

4.2. Multitemporal data

Many previous studies show that rice field and some other agricultural field exhibit large variability in their radar responses [3]. This is the basis of the approach to agricultural field mapping relying on temporal change measurement. The single polarisation data acquired on June 6, 2007, July 22, 2007 and September 6, 2007 were composed to make a color image shown in Fig.4. The rich color contained in Fig.4 indicates great changes in radar backscatter responses of different agricultural types with time. It is promising to get a good agricultural distribution map with these data with a good knowledge of the crops' calendar.

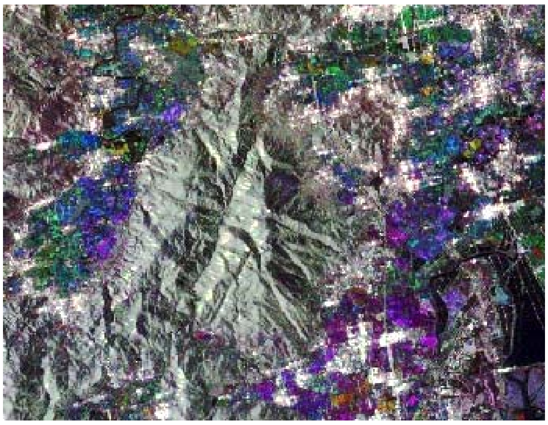

Figure 4 Color composite image from multitemporal data (R, G, B: 20070606, 20070722, 20070906)

5. CONCLUSION AND FURTHER WORK

The polarisation and multitemporal characteristics of PALSAR data were investigated in the respect of land use/land cover classification and change monitoring. From the data analysis, conclusions can be drawn: (1)The HH/HV combination has the high potential to give good urban maps; (2) It is promising to get a good agricultural distribution map with these data with a good knowledge of the crops' calendar.

Further work is needed to investigate other polarisation features of PALSAR data, VV and VH. For agriculture mapping, the key data according to the crop calendar is to be ordered. Classification methods are to be developed to better utilize the features of the data. Interferometric coherence maps are very good dataset for forest and urban area mapping. Coherence estimation is to be investigated by using different data and tools. For any methodology development and application of remote sensing technology the validation is always very important and hard to be performed. A good validation method for the classification is to be developed before entering into the land use/ land cover change monitoring research phase.

ACKNOWLEDGEMENT

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