URBAN DYNAMIC CHANGE DETECTION IN SOUTHEASTERN CHINA BASED ON INTERFEROMETRIC SAR

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ABSTRACT

Synthetic Aperture Radar is the only instrument that can provide consistent remote sensing data for south China with persistent cloud cover and rain. It is generally difficult to acquire specified optical remote sensing images for interpretation due to frequent cloud and fog covers in sub-tropical area of southeastern China. Land cover mapping and timely detection of land-cover changes have become concerned issues about urbanization, which has a significant impact on our habitation, especially in the heavily populated cities. As we known, land cover classification and change detection are usually performed using the traditional optical data. Compared to optical sensors, SAR does not suffer from the limitations of cloud cover and darkness and is essentially an all-weather system.

In this paper, the potential of multi-temporal ERS and ENVISAT-1 SAR data for land cover/land use classification and urban change detection was investigated at a test area in Fuzhou city, the capital of Fujian province in southeastern China. The study region is surrounded by mountains and characterized by a wide variety of land cover types ranging from forest, urban area, river and agriculture land including rice, bare soil, vegetable field etc. Both SAR backscatter intensity characteristics and interferometric data were analyzed. Urban areas are made up of various build-up or man-made buildings with different dimensions and orientations. Comparatively, non-urban areas are associated with natural land cover categories, such as, forest, open water and agricultural field etc. In theory, urban areas are generally characterized by high backscattering intensity due to the predominance of direct backscattering from roofs or double bounce from wall-ground structures and other metallic structures. Nature land cover categories present relative low intensity value, contrarily. Therefore, to assess whether

the temporal variation of land cover could be exploited in classification, SAR backscatter signatures were studied. The coherence is a measure of the phase noise of the interferogram, and also has been successfully used as a terrain classification parameter. Coherence is influenced by a number of independent factors including the time interval between images, the difference in signals between images due to the different positions in space from which they were acquired, and other factors. From the coherence map, areas with high coherence values include residential places, bare soil and deforested areas, as low coherence areas represent the forest, water and some other vegetation.

A parcel-based approach has been implemented to overcome the limitations and weaknesses of traditional image processing methods for feature extraction from gray images. As urban areas exhibit high backscatter and high coherence both for short and long acquisition interval, information extraction was performed by using the high resolution optical data and all available information derived from SAR and InSAR data. The dataset including SPOT, tandem coherence map, long-term coherence map and backscatter intensity images was segmented into small parcels. The objects in the images were classified using a fuzzy rule base. Two methods were carried out in the urban dynamics change detection: one was post-classification comparison, and the other one was multi-temporal image ratioing. The other approach was that data are ratioed on a pixel-by-pixel basis. A pixel with no change will yield a ratio value 1. Areas of change will have values either higher or lower than one. The change detecting results from the post-classification comparison showed more macroscopical changes of the entire city. Relatively, the other method based on image ratio displayed the change in more detail, which happened in the internal city.

The validation of the land cover maps were based on confusion matrix. Contrast to the pixel-based accuracy assessment, the validation of the change maps based on areal samples is more attractive in the recent years. In this test, five 1km × 1km samples were selected as test sites for our attempt about areal samples validation. They are representative of areas with different land-cover categories not including just single landscape. Land use maps of the five samples were produced from the validation campaign. The results from both classification and urban change detection were validated by field survey data and showed promising application of ESA SAR data in southeastern China, where clouds and rains persist.