COMPARISON OF CROP CLASSIFICATION CAPABILITY OF SPACEBORNE MULTI-PARAMETERS SAR DATA

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ABSTRACT

The capabilities of multi-parameter space-borne Synthetic Aperture Radar (SAR) to discriminate crop types are compared in this paper by object-based classification method. The multi-frequency SAR data compared include single and dual-polarization Envisat ASAR, dual-polarization TerraSAR-X Spotlight SAR, ALOS PALSAR data, and polarimetric RADARSAT-2 data. Each kind of SAR data is composed of multi-temporal collection in 2008, and according to the acquisition date, several nearly-real-time field works were carried out at the test site, Haian County, Jiangsu Province, China, where the rice is the dominant food crop and the mulberry is the main economic crop.

In the first step, a crop field database was created by extracting parcel boundaries from the archived SPOT-5 image and by updating some boundaries using on-screen digitizing based on visual interpretation of the newly acquired ALOS PALSAR data.

In the second step, two backscattering matrix processing methods were applied to polarimetric and dual-polarization SAR data respectively. For polarimetric RADARSAT-2 data, the method of [7] for transforming the covariance matrix into backscatter intensities was used to describe the polarimetric target properties. This transformation is also helpful for image segmentation using the conventional segmentation approaches normally utilized for optical image [7, 9]. For dual-polarization TerraSAR-X, ALOS PALSAR and Envisat ASAR data, the complex multivariate Wishart distribution function was introduced to delineate their covariance matrix [3, 4, 10, 11].

However, it has been found that the HH polarization of L-Band ALOS PALSAR SAR data does not serve the turn of rice discrimination in many areas of our test site, where the Bragg Resonance occurs due to the special

rice sowing ways [14]. Accordingly, in this polarization, the backscatter coefficient of rice area is nearly as high as the building's, which make this crop type be hardly discriminated from its surroundings. To avoid misclassifying the rice areas, we only used its HV polarization in this study to do the classification process.

Afterwards, the maximum likelihood classifiers for all polarization composition were used to address quantitative classification accuracy and their capabilities [12]. In our test site, several main crop types including rice, corn, mulberry, vegetable and etc., were incorporated in the resulting crop maps with the accuracy higher than 80% for most individual crops and overall accuracies about 80%. Interestingly and significantly, we found that the L-Band SAR can uniquely identify the mulberry from the dry-land crops, such as corn and vegetable. As it has been proved in many previous studies that the C-Band has the advantage in discriminating the rice from other crops [1, 2, 5, 6, 8, 13, 15], the polarimetric RADARASAT-2 data can identify the rice with accuracy more than 85% and X-Band TerraSAR-X Spotlight data is able to discriminate the rice better mainly due to its higher resolution than polarimetric RADARSAT-2 data. Nevertheless, both of them can hardly separate the mulberry from the other dry-land crops if phenological properties of these crops can be not well detected from the multi-temporal dataset.

Moreover, taking multi-temporal Envisat ASAR data as the demonstration, we also compared the resulting maps from two kinds of incidence angle images, IS2 and IS6 mode. According to the quantitative comparison of the crop classification abilities of above on-board spaceborne SAR, this study can offer some clues for optimally selecting the temporal and frequency, the combination of polarizations and even the acquisition mode for various crops mapping applications.

Keywords: Object-Based Classification, Image segmentation, Polarimetric SAR, Bragg Resonance

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