Forest type discrimination using polarimetric Radarsat 2 data

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Abstract:

In the south of China, SPOT 5 is the most widely used remote sensing data source for forestry inventory, which has been severely hindered by the cloudy and rainy weather. Synthetic aperture radar (SAR) provides a powerful tool for forestry inventory in these areas because of its all-weather and all-day capabilities. Nevertheless previous single or dual polarization SAR data can not meet the requirements of forest type classification. Polarimetric SAR data contained more information of targets and in this paper we investigated the capability of polarimetric Radarsat 2 data for forest type discrimination.

Guizhou province lies in the southwest of China, mountainous and with less than 50 clear days per year. Zhazuo forest farm is a representative of this province and is selected as test site for our study. There are 4 types of managed forests in the test site and 12 sample plots with various forest types and ages are set and marked in field, each about 32m×32m. An 8-temporal field experiment was designed to obtain bio-physical parameters of each sample plot, including leaf area index, canopy closure, diameter at breast height, tree density, as well as spatial structure and water content parameters of canopy and trunk of the selected 5 sample trees for backscattering simulation and analysis. All of these parameters were derived from standard forestry mensuration methods. Till now we have completed 4 times of field experiments. On the other side we plan to acquire 3-temopral polarimetric SAR data individually in autumn, winter and late spring to analyze the seasonal variation and difference of these 4 forest types. Radarsat 2 data in autumn of 2008 has been collected and data in winter and spring will be acquired individually in February and May of 2009.

Polarimetric SAR system can provide simultaneous observations of the scattering matrix at all possible linear polarization combinations and contains more information of target. The polarimetric backscattering from forest arises from several different scattering mechanisms. Using tree scattering model and calibrated Radarsat 2 data, combining with field measurements, odd, even and diffuse scattering mechanisms of forest were determined for each forest type. Then polarimetric variables including the conventional linear polarizations HH, HV, and VV, the circular polarizations RR and LR, backscattering ratios of different polarizations, polarization entropy H and α, extrema of the total scattered intensity R_{0max} and R_{0min}, extrema of the degree of polarization p_{max} and p_{min}, etc were analyzed and compared for forest type classification. Besides, relationships between radar backscattering or polarimetric parameters extracted from Radarsat 2 data and ground-measured bio-physical parameters of trees, such as LAI, age, etc for each forest type were analyzed. This also can be used in forest type discrimination.

Using these selected polarimetric variables, we adopted support vector machines method to carry out classification for the whole test area. Polarimetric SAR especially with high spatial resolution is expected to provide a new powerful data source for forest inventory and classification in cloudy and rainy areas with high discrimination accuracy.

Key words – Forest, Synthetic aperture radar; Polarimetric, Discrimination; Support vector machine