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Classification Using Worldview-2 Imagery of Giant Panda Habitat in Wolong, Sichuan Province, China

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Abstract : The giant panda (Ailuropoda melanoleuca) is an endangered species, mainly live in central China, where bamboos act as the main food source of wild giant pandas. Knowledge of spatial distribution of bamboos therefore becomes important for identifying the habitat of giant pandas. There have been ongoing studies for mapping bamboos and other tree species using remote sensing. WorldView-2 (WV-2) is the first high resolution commercial satellite with eight Multi-Spectral (MS) bands. Recent studies demonstrated that WV-2 imagery has a high potential in classification of tree species. The advanced classification techniques are important for utilising high spatial resolution imagery. It is generally agreed that object-based image analysis is a more desirable method than pixel-based analysis in processing high spatial resolution remotely sensed data. Classifiers that use spatial information combined with spectral information are known as contextual classifiers. It is suggested that contextual classifiers can achieve greater accuracy than non-contextual classifiers. Thus, spatial correlation can be incorporated into classifiers to improve classification results. The study area is located at Wuyipeng area in Wolong, Sichuan Province. The complex environment makes it difficult for information extraction since bamboos are sparsely distributed, mixed with brushes, and covered by other trees. Extensive fieldworks in Wuyingpeng were carried out twice. The first one was on 11th June, 2014, aiming at sampling feature locations for geometric correction and collecting training samples for classification. The second fieldwork was on 11th September, 2014, for the purposes of testing the classification results. In this study, spectral separability analysis was first performed to select appropriate MS bands for classification. Also, the reflectance analysis provided information for expanding sample points under the circumstance of knowing only a few. Then, a spatially weighted object-based k-nearest neighbour (k-NN) classifier was applied to the selected MS bands to identify seven land cover types (bamboo, conifer, broadleaf, mixed forest, brush, bare land, and shadow), accounting for spatial correlation within classes using geostatistical modelling. The spatially weighted k-NN method was compared with three alternatives: the traditional k-NN classifier, the Support Vector Machine (SVM) method and the Classification and Regression Tree (CART). Through field validation, it was proved that the classification result obtained using the spatially weighted k-NN method has the highest overall classification accuracy (77.61%) and Kappa coefficient (0.729); the producer's accuracy and user's accuracy achieve 81.25% and 95.12% for the bamboo class, respectively, also higher than the other methods. Photos of tree crowns were taken at sample locations using a fisheye camera, so the canopy density could be estimated. It is found that it is difficult to identify bamboo in the areas with a large canopy density (over 0.70); it is possible to extract bamboos in the areas with a median canopy density (from 0.2 to 0.7) and in a sparse forest (canopy density is less than 0.2). In summary, this study explores the ability of WV-2 imagery for bamboo extraction in a mountainous region in Sichuan. The study successfully identified the bamboo distribution, providing supporting knowledge for assessing the habitats of giant pandas.

Keywords : bamboo mapping, classification, geostatistics, k-NN, worldview-2
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