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Tree Species Classification in a Highly Diverse Subtropical Forest Integrating UAV-Based Photogrammetric Point Cloud and Hyperspectral Data

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摘要 The use of remote sensing data for tree species classification in tropical forests is still a challenging task, due to their high floristic and spectral diversity. In this sense, novel sensors on board of unmanned aerial vehicle (UAV) platforms are a rapidly evolving technology that provides new possibilities for tropical tree species mapping. Besides the acquisition of high spatial and spectral resolution images, UAV-hyperspectral cameras operating in frame format enable to produce 3D hyperspectral point clouds. This study investigated the use of UAV-acquired hyperspectral images and UAV-photogrammetric point cloud (PPC) for classification of 12 major tree species in a subtropical forest fragment in Southern Brazil. Different datasets containing hyperspectral visible/near-infrared (VNIR) bands, PPC features, canopy height model (CHM), and other features extracted from hyperspectral data (i.e., texture, vegetation indices-VIs, and minimum noise fraction-MNF) were tested using a support vector machine (SVM) classifier. The results showed that the use of VNIR hyperspectral bands alone reached an overall accuracy (OA) of 57% (Kappa index of 0.53). Adding PPC features to the VNIR hyperspectral bands increased the OA by 11%. The best result was achieved combining VNIR bands, PPC features, CHM, and VIs (OA of 72.4% and Kappa index of 0.70). When only the CHM was added to VNIR bands, the OA increased by 4.2%. Among the hyperspectral features, besides all the VNIR bands and the two VIs (NDVI and PSSR), the first four MNF features and the textural mean of 565 and 679 nm spectral bands were pointed out as more important to discriminate the tree species according to Jeffries-Matusita (JM) distance. The SVM method proved to be a good classifier for the tree species recognition task, even in the presence of a high number of classes and a small dataset.

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