FOREST TYPE DISCRIMINATION IN SOUTHWEST CHINA USING SPACEBORNE POLARIMETRIC SAR DATA

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ABSTRACT: Different vegetation types of forest physiognomy occupy a large area of southwest China. Deforestation is one of the main problems affecting the region. Recent data show that the conversion of forest areas by slash-and-burn practices, following agricultural and pasture activities. Deforestation caused significant environmental damage, such as habitat fragmentation, loss of biodiversity, and decrease of soil fertility. The adequate mapping of this huge region requires remote sensing data and suitable techniques to support decision makers on environmental issues, such as forest inventory, land use practices, and deforestation control, in the near future. Additionally, such data sets and maps can be used as inputs for carbon emission/reabsorption estimates resulting from large-scale land use/cover changes that affect global climate analysis.

Optical remote sensing is used in the official methodology of deforestation assessment in China, which makes it difficult to estimate forest clearings under clouds that continuously cover some parts of southwest China. Due to its ability to acquire images through clouds, synthetic aperture radar (SAR) data were tested as an alternative to optical data to map changes of land use/land cover, to estimate biophysical parameters of vegetation types, and to detect deforestation. Besides its usefulness for imaging the Earth's surface in areas with a strong cloud cover, microwave sensors deliver a huge amount of information contained in the radar response.

Land use and land cover classification using spaceborne polarimetric SAR data, such as ALOS PALSAR and RADARSAT-2, are addressed in this paper, considering a number of other possible distributions from single to full polarimetric data. The main goal of this paper is to analyze the potential of the spaceborne full polarimetric data in distinguishing the different stages of secondary succession and the different types of land cover in southwest China. The knowledge of these vegetation cover types is essential not only for mapping purposes but also for assisting forest inventory, which is an input to biodiversity assessments and carbon cycle modeling studies.

Based on field information, eight classes were considered in this study: primary forest (masson pine，armand pine, chinese fir, cryptomeria), regeneration between 6 and 12 years, regeneration younger than six years, crops/pasture, bare soil, and urban area. Multi-date and multi-bands acquisitions were acquired over the study site with spaceborne polarimetric SAR under leafy (summer) and no-leaves (winter) conditions. In addition to the conventional linear polarizations, HH, HV, and VV, various polarimetric discriminators, which were synthesized from the scattering matrix measurements, were investigated. It is shown that the radiometric intensity of the conventional C-band SAR polarizations HH, HV, and VV can only perform a limited discrimination of various tree species. The polarization information provided by fully polarimetric SARs clearly improves forest type discrimination under leafy and no-leaves conditions and permits the demonstration of the significance of SAR sensor wavelength on forest scattering mechanisms. Comparing to C-band RADARSAT-2, the low-frequency SAR (L-bands ALOS/PALSAR) is applicable to forest type discrimination because of its capability to penetrate the forest structure. In this paper, the four parameters of the scattered wave presented by Touzi, are investigated as potential polarimetric discriminators,in addition to the conventional linear polarizations HH, HV, and VV and circular polarizations. The circular polarizations RR and RL enhance the odd and even bounce scattering that might occur in C-band under leafy

conditions for a non-closed canopy. The Cloude and Pottier parameters H and α are also investigated. The information on the type of scattering provided by the Cloude and Pottier α angle confirmed the results obtained by circular polarization even though the entropy H is generally high for forest targets. The circular polarizations and the α angle appeared to be the most suitable tools for characterization of forest scattering type.