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Abstract

A Simulation Study of the Canopy Anisotropic Reflectance of Conifer–broadleaf Plantations

Murtaza Ali*

School of Forestry, Beijing Forestry University, Beijing, China

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Abstract

Background and Aim: Monoculture plantations are a global practice, but concerns have arisen about their environmental impact. China primarily relies on monoculture methods. Transitioning to mixed forests is crucial for improving quality. This study explores the relationship between the mixed pattern and the bidirectional reflectance of VHR images, in order to provide suggestions for the accurate applications of VHR images over mixed plantations.

Method: Using the DART model and reference data from Fujian Province's Jangle state-owned forest plantations in China, we created 3D forest scenes with three typical mixed patterns (single trees, stripes, and patches) containing both coniferous China fir (Cunninghamia lanceolata) and broadleaf Dandy (Michelia macclurei) species. We employed DART to simulate mixed plantation scenarios and corresponding very high spatial resolution (VHR) images under different solar-viewing geometries. We simulated VHR images for a fixed mixed plantation scene with varying solar-viewing angles, compared spectral reflectance differences, and analyzed the impact of spatial distribution patterns on bidirectional reflectance. Additionally, we simulated VHR images for mixed plantation scenes with different proportions of coniferous and broadleaved species at a single solar-viewing geometry.

Results: The findings include spectral differences between VHR images, distinct BRF patterns in monoculture and mixed forest scenes, a negative correlation between canopy BRF and needle-to-broadleaf ratio, and variability in BRF based on solar angle.

Conclusion: This research provides valuable insights into accurately applying high-resolution optical images in mixed needle-broad forests. It highlights the importance of considering anisotropic reflectance, 3D radiative transfer modeling, and mixed patterns for effective monitoring and management.

Keywords: *Anisotropic reflectance, Three-dimensional radiative transfer modeling, DART, Conifer-broadleaf mixed plantations, Mixed patterns*

***Corresponding author:** Murtaza Ali, School of Forestry, Beijing Forestry University, Beijing, China.

E-mail address: murtazaali666@yahoo.com