MAPPING OF FOREST UNDERSTORY USING MULTI-ANGULAR MISR DATA FOR IMPROVEMENT OF GLOBAL LEAF AREA INDEX PRODUCTS

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1. INTRODUCTION

Studies of the bidirectional behavior of forest canopy have shown that the total reflectance of a forest canopy is the combination of illuminated and shaded components of the tree crown as well as the background. The vegetation background (soil/moss/grass/shrub in forests) is a recognized problem that limits the accuracy of satellite-estimated forest LAI. Previous LAI validation efforts have resulted in the recognition that understory cannot be neglected in reflectance modelling [1], especially in the case of low to intermediate canopy covers. Based on the field-tested methodology with airborne data, we estimate the background portion from the bidirectional reflection observed by Multi-angle Imaging SpectroRadiometer (MISR) instrument, which scans the earth in nine different view angles in an oblique plane relative to the sun. For the first time, monthly maps of the reflectivity of the forest background were created and used as an input into the global LAI algorithms [2]. We document the non-constant reflectivity of the forest background with changing canopy LAI, biome type, and the present spatial and temporal patterns. The new LAI maps are compared with other global LAI products. The inclusion of the derived background reflectivity maps into LAI algorithtms led to an improved quality of the LAI product and its agreement with field measurements of LAI and high resolution LAI maps obtained via the ORNL DAAC Mecury system.

2. METHODOLOGY

The nadir and 45° forward directions of the MISR images were found to be the optimal combination to derive maps of the reflectivity of the forest background based on the probabilities of viewing the illuminated tree crown and background on those view angles. The probabilities were estimated using the Four-Scale model [3], [4] and aggregated into Look-Up Tables for different forest biomes. The background retrieval algorithms are wavelength-independent. We present the background reflectivity maps calculated over red and NIR domain of the spectrum.

The global LAI algorithms [2], here used with SPOT-VGT imagery, were developed based on the simulation results, including the angle combinations, background reflectances, and canopy-level reflectances for different LAI levels. The distinguished feature of the algorithms is that the bidirectional reflectance distribution function (BRDF) is considered explicitly in the algorithm and hence removing the need of doing BRDF corrections and normalizations to the input images. Spectral reflectivity of the background in the red and NIR bands has been introduced as one of the algorithm inputs.

3. CONCLUSIONS

The typical approach in remote sensing based LAI retrieval is to place the emphasis on determining the relationship between LAI and the canopy layer properties, and the properties of understory/ground layer are given as an input based on simplifying assumptions [5]. We illustrate this approach can lead to serious biases and that the inclusion of the MISR-derived background maps improves the accuracy of canopy LAI retrievals. This study presents yet another important application of multi-angle remote sensing for delivering additional information about vegetation by means that are not possible using mono-angle data. At the same time, it is shown that the synergy of information from multiple sensors can lead to a better LAI product to the ones produced from single sensors (MODIS, CYCLOPES).

4. REFERENCES

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