APPLICATION OF PHOTON RECOLLISION PROBABILITY BASED FOREST REFLECTANCE MODEL FOR BOREAL FOREST LAI RETRIEVAL

J. Heiskanen[*a] M. Rautiainen[a] L. Korhonen[b] M. Mõttus[c] P. Stenberg[a]

[a] University of Helsinki, Department of Forest Sciences, P.O. Box 27, FI-00014 University of Helsinki, Finland
[c] University of Helsinki, Department of Geosciences and Geography, P.O. Box 64, FI-00014 University of Helsinki, Finland
[b] University of Eastern Finland, School of Forest Sciences, P.O. Box 111, FI-80101 Joensuu, Finland

Technical Commission VII Symposium 2010

KEY WORDS: Forestry, Vegetation, Estimation, Modelling, Satellite, Multispectral

ABSTRACT:

The realization of the full potential of remote sensing for mapping land surface biophysical variables, such as leaf area index (LAI), requires that retrieval methods can generalize in space and time. Physically-based methods hold promise for being more general than pure empirical models, which tend to be site, sensor and time specific. Although physical models have become well-established for the retrieval of biophysical variables from moderate to coarse resolution satellite data at global-scale, empirical vegetation index and regression based methods are usually applied to finer spatial resolution images. Spectral invariants ('p-theory') provide a novel approach for characterizing canopy structure in forest reflectance models. Here, we present an application of semi-physical, photon recollision probability (p) based forest reflectance model (PARAS) to retrieve LAI from fine resolution satellite images. A database of forest BRFs was simulated using LAI-2000 PCA field measurements from five conifer-dominated forest sites to parameterize the canopy structure. Needle/leaf optical properties of were estimated from the concurrent Landsat ETM+ and SPOT HRVIR images. Undergrowth reflectance was varied by spectral mixing of field measured spectra. LAI algorithms were developed using vegetation indices and two non-parametric regression methods (neural networks, kNN). For comparison, we also established empirical LAI-vegetation index relationships. All the methods were applied to SPOT HRVIR image from an independent test site in southern Finland. According to the results, LAI-Reduced Simple Ratio (RSR) relationships calibrated using model simulations and empirical data provided the best estimation accuracy when transferred to the test site.

TOPIC: Physical modeling and signatures
ALTERNATIVE TOPIC: Remote sensing applications