Geophysical Research Abstracts
Vol. 12, EGU2010-6891, 2010
EGU General Assembly 2010

Modeling vegetation reflectance from satellite and in-situ monitoring data

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Vegetation can be distinguished using remote sensing data from most other (mainly inorganic) materials by virtue of its notable absorption in the red and blue segments of the visible spectrum, its higher green reflectance and, especially, its very strong reflectance in the near-IR. Different types of vegetation show often distinctive variability from one another owing to such parameters as leaf shape and size, overall plant shape, water content, and associated background (e.g., soil types and spacing of the plants (density of vegetative cover within the scene). Different three-dimensional numerical models explicitly represent the vegetation canopy and use numerical methods to calculate reflectance. These models are computationally intensive and are therefore not generally suited to the correction of satellite imagery containing millions of pixels. Physically based models do provide understanding and are potentially more robust in extrapolation. They consider the vegetation canopy to comprise thin layers of leaves, suspended in air like sediment particles in water forming a turbid medium.

Monitoring of vegetation cover changes by remote sensing data is one of the most important applications of satellite imagery. Vegetation reflectance has variations with sun zenith angle, view zenith angle, and terrain slope angle. To provide corrections of these effects, for visible and near-infrared light, was used a three parameters model and developed a simple physical model of vegetation reflectance, by assuming homogeneous and closed vegetation canopy with randomly oriented leaves. Multiple scattering theory was used to extend the model to function for both near-infrared and visible light. This vegetation reflectance model may be used to correct satellite imagery for bidirectional and topographic effects.

For two ASTER images over Cernica forested area, placed to the East of Bucharest town , Romania, acquired within minutes from one another ,a nadir and off-nadir for band 3 lying in the near infra red, most radiance differences between the two scenes can be attributed to the BRDF effect. Must be considered also topographic corrections, as hill or mountain slopes affect the observed radiance of vegetation by modifying both the irradiance received by the vegetation and the vegetation reflectance. Model validation can be done based on spectral radiances in visible and infra-red wavelengths from satellite images and in-situ spectroradiometric measurements in some test forested areas.

Based on satellite remote sensing data, can be mapped vegetation cover directly at local or regional scales from the apparent brightness measured in several spectral bands. The proposed model provides computationally efficient radiance corrections for varying sun and view zenith angles. It also provides a correction for the effect of terrain slope on vegetation reflectance, as a function of cosines of incidence and exitance angles. The proposed model can be applied for homogenous canopies over a wide range of sun zenith angles being analytically simple, facilitating rapid correction and applicable for both visible and near-infrared light. These attributes should make it for operational use in monitoring vegetation in temperate regions by remote sensing.