MULTI-ANGLE IMAGING SPECTRORADIOMETER

The MISR instrument on the Earth Observing System (EOS) Terra platform orbits the Earth about 15 times each day. There are 233 distinct orbits, called paths, which are repeated every 16 days, and since the paths overlap, near global coverage is obtained in 9 days. The MISR instrument views symmetrically about the nadir in forward and backward directions along the spacecraft flight track. Images are acquired with nominal view zenith angles relative to the surface reference ellipsoid of 0.0, 26.1, 45.6, 69.9, and 78.5° in four spectral bands (468, 558, 862, and 869 nm). The MISR data are distributed from the NASA Langley Atmospheric Science Data Center (http://eosweb.larc.nasa.gov/).

MULTI-ANGLE IMAGING SPECTRORADIOMETER

Angular signatures of five land covers

Grasses and Cereal Crops

MISR LAI

Reference LAI

Shrubs

Broadleaf Forests

Needleleaf Forests

POTENTIAL OF MISR DATA TO PREDICT FOREST VERTICAL STRUCTURE

Empirically demonstrated relationships between MISR data and canopy heights suggest the ability of MISR data to predict the vertical structure of forest canopies (Kimmins et al., 2006, Heiskanen, 2006). What is the physics behind the observed correlation?

The wavelength independent escape probability and multi-angle spectral data convey comparable amount of information about the canopy height

The probability that a scattered photon will escape the vegetation canopy in a given direction (escape probability) is derived from MISR (red and NIR) data over the Harvard Forest EOS Core Validation site. A linear regression model was used to predict the NBR height from an MISR height and from the directional escape probabilities (black dots). Lines are predicted versus measured NBR heights from the Harvard Forest EOS Core validation site. Red and Green spectral bands are used for comparison.

The use of single band multi-angle data results in weaker correlations

The Multi-angle Imaging Spectro Radiometer (MISR) on NASA’s Terra satellite provides global imagery at nine discrete viewing angles and four visible/near-infrared spectral bands. An algorithm for the estimation of the Leaf Area Index (LAI) and the Fraction of absorbed Photosynthetically Active Radiation (FPAR) has been developed and implemented for operational use with the MISR instrument, and LAI and FPAR products with known accuracy, precision and uncertainty are being validated for data generated starting in October 2002. The algorithm performs an accurate separation of the background reflectance from the canopy surface system and estimates the fraction of ground shaded area, fractional ground cover, and escape/absence probabilities, but only LAI and FPAR are being archived. This paper discusses the feasibility of reliably retrieving the vertical structure of vegetation canopies generated by the operational MISR LAI/FPAR algorithm, which in turn can further be used to obtain new information about the 3D canopy structure for use in the Community Land Model (CLM), e.g., multi-shaded leaf area indices, and ecological models, e.g., the aspect ratio. This paper also discusses a physical interpretation of empirically demonstrated relationships between MISR data and lidar canopy heights and how the physics behind this relationship can be used to develop synergistic approaches to interpretation of multi-angle, hyperspectral and lidar data.

Retrieving canopy structure from MISR

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Abstract

The Multi-angle Imaging Spectro Radiometer (MISR) on NASA’s Terra satellite provides global imagery at nine discrete viewing angles and four visible/near-infrared spectral bands. An algorithm for the estimation of the Leaf Area Index (LAI) and the Fraction of absorbed Photosynthetically Active Radiation (FPAR) has been developed and implemented for operational use with the MISR instrument, and LAI and FPAR products with known accuracy, precision and uncertainty are being validated for data generated starting in October 2002. The algorithm performs an accurate separation of the background reflectance from the canopy surface system and estimates the fraction of ground shaded area, fractional ground cover, and escape/absence probabilities, but only LAI and FPAR are being archived. This paper discusses the feasibility of reliably retrieving the vertical structure of vegetation canopies generated by the operational MISR LAI/FPAR algorithm, which in turn can further be used to obtain new information about the 3D canopy structure for use in the Community Land Model (CLM), e.g., multi-shaded leaf area indices, and ecological models, e.g., the aspect ratio. This paper also discusses a physical interpretation of empirically demonstrated relationships between MISR data and lidar canopy heights and how the physics behind this relationship can be used to develop synergistic approaches to interpretation of multi-angle, hyperspectral and lidar data.