Geophysical Research Abstracts
Vol. 17, EGU2015-3218-1, 2015
EGU General Assembly 2015

Estimation of direct, diffuse, and total FPARs from Landsat surface reflectance data and ground-based estimates over six FLUXNET sites

Wenjuan Li (1,2) and Hongliang Fang (1)

(1) LREIS, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China (fanghl@lreis.ac.cn), (2) University of Chinese Academy of Sciences, Beijing 100049, China (liwj@lreis.ac.cn)

The fraction of photosynthetically active radiation (PAR) absorbed by green elements (FPAR) is an essential climate variable (ECV) in quantifying canopy absorbed PAR (APAR) and gross and net primary production. It has been demonstrated that FPAR is larger under totally diffuse than clear sky conditions because all canopy parts can absorb lights effectively under diffuse conditions. The direct and diffuse FPARs are defined, therefore, as the FPAR values obtained under clear (most sunny) and overcast (most cloudy) conditions, respectively, and FPAR represents the summed canopy absorption efficiency for both direct and diffuse PAR.

Satellite FPAR products, such as MODIS, GEOV1, MERIS, and JRC-TIP, have been generated at different temporal and spatial resolutions. Except for JRC-TIP which generates direct and diffuse FPARs separately, all the other products typically correspond to the instantaneous black-sky FPAR under direct illumination only. However, even under fully clear sky conditions, the proportion of diffuse PAR over the surface cannot be ignored. Otherwise, FPAR will be underestimated, especially for small leaf area index (LAI) region.

To address this, the present study developed a new approach to estimate direct, diffuse, and total FPARs, separately, from Landsat 30m surface reflectance data. Field-measured direct and diffuse FPARs were first derived for crops, deciduous broadleaf forests, and evergreen needleleaf forests at six FLUXNET sites. Then, a coupled soil-leaf-canopy (SLC) radiative transfer model was used to simulate surface reflectance under direct and diffuse illumination conditions, respectively. Direct, diffuse, and total FPARs were estimated by comparing Landsat-5 Thematic Mapper (TM) data and simulated surface reflectances using a lookup table approach. The differences between the Landsat-estimated and the field-measured FPARs are less than 0.05 (10%). The diffuse FPAR is higher than the direct FPAR by up to 19.38%, whereas the total FPAR is larger than the direct FPAR by up to 16.07%. The direct APAR is higher than the diffuse APAR under clear-sky conditions, but underestimates the total APAR by -277.72 μmol s-1 m-2 on average.

We recommend that the total FPAR should be generated from current satellite sensors, and the differences in FPAR definitions should be considered in the estimation of APAR in vegetation models. More frequent field measurements are necessary to improve the accuracy of ground FPAR measurements and to validate instantaneous satellite products. The approach described here can be extended to estimate direct, diffuse, and total FPARs from other satellite data, and the obtained FPAR variables could be helpful to improve modeling of vegetation processes.