Geophysical Research Abstracts
Vol. 17, EGU2015-2861-2, 2015
EGU General Assembly 2015

Estimation of sunlit/shaded light-use efficiency of cropland using tower-based multi-angle remote sensing data and eddy covariance flux measurements

Dongjie Fu (1), Baozhang Chen (2), and Lifu Zhang (1)

(1) Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, China (fudongjie@gmail.com, zhanglf@radi.ac.cn), (2) State Key Laboratory of Resources and Environmental Information System, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, 11A, Datun Road, Beijing, China (baozhang.chen0808@gmail.com)

The light-use efficiency (LUE) is one of critical parameters in the terrestrial ecosystem production studies. However, it is still a challenge how to up-scale LUE from canopy to the landscape/regional scales. One potential solution is to use automated multi-angle tower-based remote sensing platforms, which observe canopy reflectance with high spatial, temporal, spectral and angle resolution. Although some published paper on the LUE in boreal and temperate forests had used continuous multi-angle measurements of the surface reflectance, lack of study in literature investigated the vegetation physiological parameters of cropland using the surface reflectance with high spatio-temporal and high spectral data with multiple angles. To improve our understanding of physiological status of cropland, the maize within the footprint of the Daman Superstation flux tower site of Heihe Watershed Allied Telemetry Experiment Research (HiWATER) was employed in this study. Based on the observed reflectance and flux data, a Bidirectional Reflectance Distribution Function (BRDF) of vegetation index (Photochemical Reflectance Index, PRI and Vegetation Index using the Universal Pattern Decomposition method, VIUPD) at continuous time series was established by integrating of a semi-empirical kernel-driven BRDF model (RossThick-LiSparse), a footprint model (the Simple Analytical Footprint model on Eulerian coordinates for scalar Flux, SAFE-f) and a LUE model. Besides, based on the sky-condition (direct/diffused radiation) data, the relationships between the vegetation index (PRI and VIUPD) and sunlit/shaded LUE under corresponding sky conditions were established. Taking maize field as an example, the measurements were obtained during June to August, 2012. The relationships between PRI and LUE for sunlit and shaded leaves were: PRI_{su}=0.06339$\times$log(LUE_{su}) + 0.04882, PRI_{sh}= 0.02675$\times$log(LUE_{sh}) + 0.01619, where, the subscript su, sh represent sunlit and shaded leaves respectively; p$<$ 0.0001, R^2 (Coefficient of determination) equal 0.6443 and 0.6081 for sunlit and shaded, respectively. Then the LUE was up-scaled to landscape/regional scales based on these relationships and sky conditions, and it can be used for the estimation of gross primary productivity (GPP) of cropland using a LUE-based model with high accuracy.