



Estimating the seasonal dynamics of the leaf area index using piecewise LAI-VI relationships based on phenophases

Kun Qiao, Wenquan Zhu, and Zhiying Xie
Beijing Normal University, Beijing, China (qk@mail.bnu.edu.cn)

The leaf area index (LAI) is not only an important parameter used to describe the geometry of vegetation canopy but also valuable for ecological models. The vegetation index (VI) is commonly used for LAI estimations. However, the LAI-VI relationships had high seasonal variabilities. In this study, the LAI-VI relationships in different phenophases and for different VIs (i.e., the normalized difference vegetation index (NDVI) and enhanced vegetation index (EVI)) were investigated based on LAI observed data and the Moderate Resolution Imaging Spectroradiometer (MODIS) VI products at 13 FLUXNET sites (10 deciduous forests sites and 3 crop sites). Significant LAI-VI relationships were observed during the vegetation growing and declining periods. There were weak LAI-VI relationships during the flourishing period. The accuracies for the LAIs estimated with the piecewise LAI-VI relationships based on different phenophases were significantly higher than those estimated based on a single LAI-VI relationship for the entire year. The average root mean square error (RMSE) \pm standard deviation (SD) values for the LAIs estimated with the piecewise LAI-VI relationships were 0.37 ± 0.12 (based on the NDVI) and 0.39 ± 0.13 (based on the EVI). While, they were 0.45 ± 0.14 (based on the NDVI) and 0.57 ± 0.16 (based on the EVI) for those estimated with a single LAI-VI relationship. The performance of the NDVI and EVI in estimating the LAI also varied among phenophases. During the growing period, the mean RMSE \pm SD values for the LAIs estimated based on the LAI-NDVI relationship and those estimated based on the LAI-EVI relationship were 0.30 ± 0.11 and 0.36 ± 0.11 , indicating the NDVI produced significantly better LAI estimations than the EVI. In contrast, the EVI produced better LAI estimations than the NDVI in most sites during the declining period. The mean RMSE \pm SD values for the LAIs estimated based on the LAI-EVI relationship and those estimated based on the LAI-NDVI relationship were 0.42 ± 0.20 and 0.44 ± 0.16 . Hence, the piecewise LAI-VI relationships based on different phenophases were recommended for the estimations of the LAI instead of a single LAI-VI relationship. Furthermore, the optimal VI in each phenophase should be selected for the estimations of the LAI according to the characteristics of vegetation growth.