Retrieval of understory NDVI in sparse needleleaf forests over Alaska by MODIS BRDF data

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Abstract: Global products of leaf area index (LAI) usually show large uncertainties in sparsely vegetated areas. The reason is that the understory contribution is not negligible in reflectance modeling for the case of low to intermediate canopy cover. Therefore many efforts have been carried out on inclusion of understory properties in the LAI estimation algorithms. Compared with conventional data bank method, estimation of forest understory property from satellite data is superior in the studies at global or continental scale during long periods. However, the existing remote sensing method based on multi-angular observations is very complicated to implement. Alternatively, a simple method to retrieve understory NDVI (NDVIu) for sparse boreal forests was proposed in this study. The method is based on the property that the bi-directional variation of NDVIu is much smaller than that of the canopy-level NDVI. To retrieve NDVIu for a certain pixel, linear extrapolation was applied using the pixels within a 5×5 target-pixel-centered window. The NDVI values were reconstructed from the MODIS BRDF data corresponding to eight different solar-view angles. NDVIu was estimated as the average of the NDVI values corresponding to the position where the stand NDVI has the smallest angular variation. Validation by noise-free simulation dataset yielded high agreement between estimated and true NDVIu with R^2 and RMSE of 0.99 and 0.03, respectively. Using the MODIS BRDF data, we got the estimate of NDVIu close to the in situ measured value (0.61 vs. 0.66 for estimate and measurement, respectively), and also reasonable seasonal patterns of NDVIu in 2010-2013. The results imply a potential application of the retrieved NDVIu to improve the estimation of overstory LAI for sparse boreal forests, and ultimately benefit the

studies on carbon and water cycles in high latitude areas.

Key words: Understory NDVI; boreal sparse forests; MODIS; BRDF