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Evaluation of MODIS surface reflectance products for LAI retrieval

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The accuracy of leaf area index (LAI) retrievals depends critically on the quality of the input surface reflectance. The MODIS collection 4 (C4) and its following product, the collection 5 (C5) land surface reflectance data, were used for wheat LAI retrieval. The data uncertainty in the shortwave reflectance of the two collections (C4 and C5) from both Terra and Aqua data was first analyzed, and then its influences on LAI retrieval were discussed. The discrepancy of blue and NIR reflectances between Terra and Aqua was found to be less in the C5 data than in the C4 data. For both Terra and Aqua, the C5 data had much lower blue reflectance than the C4. These can be attributed to the improvements in the atmospheric correction algorithm of the C5 data including cloud mask definition and aerosol retrieval. LAI was derived from the surface reflectance of the two collections using both empirical vegetation index (VI) and neural network (NN) inversion methods. The linear correlation between the measured LAI and several spectral indices (EVI, NDVI, MSAVI, and NDWI) from C5 dataset was much improved. A three-layer neural network was used to invert a 1-D radiative transfer model to provide LAI estimates. For daily C4 data, the correlation between modeled and measured LAI was poor and the root mean square error (RMSE) was larger than 1.1; in comparison, the RMSE for daily C5 data was only 0.7. However, LAI tended to be overestimated when the sensor was in the backscattering direction and with a large view zenith angle for both C4 and C5 collections. The error may be partially from the mismatch between the measured reflectance and the modeled reflectance from the

simple 1-D RT model in this direction, and partially from the assumption of lambertian surface in MODIS atmospheric correction. It was also found that the results from 8-day composite C4 data using both methods were much improved comparing with the results from daily C4 data. This was believed to be attributable to less cloud and aerosol contamination after compositing. In conclusion, the uncertainty in the daily C4 reflectance was not well defined comparing with the C5 product. Therefore, the daily C5 data is more preferable for LAI retrieval if it is available; if only C4 data is available, more reliable results can be derived using the 8-day composite data but its poor temporal coverage limits its application for dynamic growth monitoring.

Keywords: leaf area index; MODIS; model inversion; vegetation index