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MODIS LAI products over boreal forests of Finland: an assessment of regional and temporal variations

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Leaf area index (LAI), hemi-surface area of leaves and needles per unit ground surface area, is one of the essential climate variables (ECVs). Currently, spatio-temporal LAI datasets for land surface monitoring and modeling are best provided by moderate resolution satellite data. Moderate Resolution Imaging Spectroradiometer (MODIS) is used routinely to produce a global-scale LAI product (MODIS LAI) at 1 km spatial and 4 and 8 days temporal resolution. The validation of LAI datasets provides important feedback for the development of LAI retrieval algorithms, and hence it is important to validate new products when they become available. The objective of this study was to assess the most recent version of MODIS collection 5 (C5) LAI products over boreal coniferous-dominated forests in Finland. First, we compared MODIS LAI with fine resolution (25 m x 25 m) countrywide LAI maps to assess the regional variations in MODIS LAI over a latitudinal gradient of boreal forest types. Next, we validated the seasonal variations in MODIS LAI for a 15 square kilometer intensive study site in southern Finland over the snow free period in 2010. Field LAI measurements were upscaled to MODIS spatial resolution using empirical models and a time series of nine satellite images (SPOT4 HRVIR, EO-1 Hyperion). In both assessments, we compared MODIS LAI with two field LAI estimates: one obtained directly from the inversion of optical canopy gap fraction measurements and another corrected for shoot-level clumping. For the intensive study site, we also estimated the seasonal course of understory LAI. According to the results, saturation of MODIS main LAI algorithm occurs over large parts of Finland in summer, which explains much of the regional and temporal LAI variations. In the countrywide assessment, MODIS LAI showed relatively large LAI values in comparison to our fine resolution LAI map but there was good agreement in large scale spatial variations. The seasonal course of LAI was exaggerated in comparison to both reference PAI and total LAI. The results emphasize the use of standard LAI definitions in map inter-comparison and validation, and the need of multi-seasonal validation data sets for better understanding of LAI algorithm performance over boreal coniferous dominated forests.