Remote sensing as a tool for leaf area index estimation

Abstract

Jakub Černý
Forestry and Game Management Research Institute (FGMRI)
Strnady 136, 252 02 Jíloviště, Czech Republic

Canopies are loci of numerous biological, physical, chemical, and ecological processes, most of which are affected by canopy structures. Moreover, foliage is a production unit of primary assimilates forming biomass. In contrast, sapwood, connecting the root system with the leaves or needles, delivers water and nutrients as another primary biomass component. Therefore, accurate, rapid, non-destructive, and reliable measures of forest canopy are crucial to a wide range of studies including hydrology, carbon and nutrient cycling, and global climate change. One of the key canopy structural characteristics is the leaf area index (LAI), defined as half of the total leaf surface area per unit of horizontal ground surface area. Besides the description of forest stands, LAI serves as a suitable parameter for the detached evaluation of stands' health status.

Unfortunately, direct LAI determination is too laborious and time-consuming, destructive (i.e. non-repetitive) and not well compatible with large-scale implementation and the long-term monitoring of spatial and temporal dynamics of leaf area development. To the contrary, indirect methods of LAI estimation, such as indirect optical methods and remote sensing (e.g. satellite data), are suitable for LAI quantification at larger spatial resolution. However, validation of especially remotely sensed LAI values based on terrestrial "*in situ*" LAI measurements is utterly required.

Main objectives of the proposed project are (i) LAI estimation by remote sensing methods (MODIS and Sentinel-2 satellite data products) in selected forest stands, and (ii) the validation of LAI values determined using these remote methods based on terrestrial "*in situ*" LAI measurements, involving analysis of digital hemispherical photographs (Regent Instruments Inc. Canada), as well as the LAI estimation by the LaiPen LP 100 (PSI, Czech Republic) optical device in the same stands.

Key words: MODIS; Sentinel-2; optical methods for LAI estimation; LAI validation; *in situ* measurements.