Phenological changes in leaf optical properties of canopy trees and canopy surface reflectance in a cool-temperature deciduous broadleaf forest

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The radiation reflectance from the canopy surface is used in the remote sensing of vegetation structure and biochemical properties, including photosynthetic capacity, water use and photoinhibition. The canopy reflectance is strongly affected by leaf are index (LAI) as well as leaf reflectance and transmittance of radiation in the canopy. Deciduous forest is characterize by the remarkable change in canopy structure such as leaf expansion in spring and leaf fall in autumn. In addition, leaf optical properties (spectral reflectance, absorption and transmittance of radiation) of the deciduous trees also changes according to the leaf growth and senescence because the leaf optical properties characterize leaf biochemical components, such as chlorophylls, carotenes, anthocyanins, nitrogen, cellulose, lignin and water, and anatomical structures.
The forest at Takayama site is a cool-temperate deciduous broadleaf forest on the northwestern slope of Mt. Norikura, in central Japan. The forest canopy is dominated by *Quercus crispula* Blume and *Betula ermanii* Cham. In this forest, we measured the leaf optical properties of these dominant trees during the growing season, from budburst in mid-May to senescence at beginning of November. The measurements were conducted in 2004, 2005, 2006 and 2010. The leaf reflectance in the red (620-670 nm), blue (459-479 nm) and green band (545-565 nm) dropped in the beginning of growing period and increased in senescing period. Near-infrared reflectance (841-876 nm) increased in the growing period. Then these leaf-level phenology was examined with the seasonal change of air temperature, and also up-scaled to canopy-level by a radiative transfer model SAIL to examine the canopy-level spectral reflectance observed at the same site from the leaf and canopy ecophysiological point of view.

Keywords: deciduous forest, phenology, remote sensing

