Seasonal Reflectance Courses of Hemiboreal Birch Forests

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[Poster presentation]

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Satellite remote sensing offers an efficient method for observing vegetation dynamics – MODIS, AVHRR and SPOT VEGETATION data sets have been used to monitor continental and global on-set dates of greening and forest phenology. However, seasonal forest reflectance variation has only preliminarily been linked to stand structure or changes in leaf spectra and biochemistry. The seasonal reflectance course of a boreal forest is a sum of the temporal reflectance cycles of both tree canopy and understory layers. In other words, changes in forest reflectance are explained by the seasonal evolution of biochemical composition and geometrical structure of plants, and monthly and diurnal trends in solar illumination.

Our poster presents a case study on the reflectance seasonality of hemiboreal birch stands in Estonia from budburst to initial senescence (Rautiainen et al. 2009a, Rautiainen et al. 2009b). We assembled a smoothed time series of 32 Landsat TM, ETM+ and SPOT HRVIR, HRV satellite images collected between April and September at approximately 10-day intervals covering the Järvselja Training and Experimental Forestry District. The objectives of our study were (1) to track the seasonal reflectance changes of mature hemiboreal birch stands, (2) to evaluate the main driving factors for the observed seasonal reflectance courses through radiative transfer modeling, and (3) to compare our local results to routinely produced MODIS LAI and phenology products.

The radiative transfer model was able to mimic the measured seasonal reflectance dynamics; only minor quantitative differences were noted between the simulated and empirical data sets. The seasonal reflectance courses were mainly governed by the phenological cycle of total stand leaf area, and marginally by changes in leaf chlorophyll and forest water contents. Our LAI estimates and the MODIS LAI product were fairly similar; the largest differences were observed in early spring and at midsummer. Senescence started systematically later in the MODIS data than in our simulations. MODIS products also indicated a longer plateau in the LAI values during midsummer than our simulations. Our results indicated that future work on detecting stand-level phenological phases from medium-resolution satellite images in the hemiboreal zone should focus on (1) quantifying the role of debris and forest floor water and snow on stand reflectance during the early phases of leaf development in the spring, and (2) better characterizing the highly variable surface roughness and seasonality of the abundant understory layer.

Keywords: boreal forest, phenology, reflectance modeling.

References

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