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Field imaging spectroscopy investigating PRI spatial distribution of montane grassland canopy in diurnal course

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The Physiological Reflectance Index (PRI) vegetation index, computed as (R_{550}-R_{531})/(R_{550}+R_{531}) and/or (R_{570}-R_{531})/(R_{570}+R_{531}) (where R_λ is reflectance at given wavelength λ), has been found to be a quantitative measure of a zeaxanthin foliage pigment concentration at the leaf scale (Gamon et al., 1992). Zeaxanthin is part of a leaf xanthophyll cycle and plays an important role in the photoprotective mechanism through dissipating of excessive incoming light energy as heat (e.g. Bjorkman and Demmig-Adams 1994), thus lowering the leaf light use efficiency (LUE). The remote spatial estimation of LUE would improve its measurement, as well as simplify modelling of the CO_2 fluxes within a vegetation canopy. Some promising results have been reported in modelling of carbon fluxes using as inputs the PRI and the Normalized Difference Vegetation Index (NDVI) obtained from image data of the Airborne Visible Infrared Imaging Spectrometer (AVIRIS) and the Moderate Resolution Imaging Spectrometer (MODIS) satellite sensor (Rahman et al., 2001; 2004). However, as the PRI-LUE relationship is affected by many external non-physiological factors (Barton and North, 2001), more extensive research is still needed to validate the PRI applicability and improve consecutive carbon cycle modelling for the structurally and species heterogeneous canopies at higher spatial resolution.

In our work we present a partially controlled field experiment aiming to investigate detailed spatial distribution of PRI for two natural montane grassland plots with different concentration of zeaxanthin in diurnal course. The Airborne Imaging Spectrometer AISA Eagle (spectral range between 390– 940 nm) was mounted on a ladder carrier in the height of 4 m above a montane grassland canopy located at the experimental research site Bily Kriz (Czech Republic; 18.542813˚E , 49.494681˚N, altitude 898 m a. s. l.). The observed grass plot was composed by 15 herbal species, dominated by *Festuca rubra* agg., *Hieracium* sp., *Plantago* sp., *Agrostis capilaris* and *Veronica chamaedris*. The spectroscopic measurements resulted in hyperspectral images of very high spatial resolution of 4.4 mm, allowing for detailed spatial observation of PRI and the corresponding biophysical vegetation parameters. 20 AISA images were consecutively acquired each half an hour starting from 8:30 till 18:00 on September 2^{th} 2005. A blanket cover permanently shaded half of the experimental plot (extent of 1.0x1.2 m) in order to inhibit the zeaxanthin formation. Additionally, 12 leaf samples in a regular grid were collected from each plot at 8:30, 12:00 and 16:00 h. for a subsequent laboratory pigment analysis of chlorophyll a+b and zeaxanthin concentrations. Obtained results are expected to verify statistical dependence of PRI on zeaxanthin concentration at the level of grass canopy, which might later enable to use the field imaging spectroscopy for the spatial estimation of grass LUE.

Keywords: PRI vegetation index, imaging spectroscopy, grassland, AISA

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