Chlorophyll Fluorescence effects on Leaf and Canopy Reflectance: Experimental Results and Model Simulation

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ABSTRACT

This work provides a description of the investigations carried out to assess whether chlorophyll fluorescence can be detected using hyperspectral reflectance data. The study was focussed on study sites of *Acer saccharum* M. in Canada, where field measurements, laboratory-simulation experiments, and hyperspectral CASI imagery were collected between 1997 and 2000 campaigns. Radiative transfer theory and modelling assumptions are applied at laboratory and field scales in order to define the link between leaf reflectance and transmittance, chlorophyll fluorescence, and canopy hyperspectral data.

Research work related to chlorophyll fluorescence estimation consisted of a series of laboratory and field measurements of spectral reflectance under artificial and natural light conditions which demonstrate that effects of natural chlorophyll fluorescence are observable in the reflectance red edge spectral region. Leaf samples from the study sites were used for reflectance and transmittance measurements with the Li-Cor Model 1800 integrating sphere apparatus coupled to an Ocean Optics Model ST1000 fibre spectrometer with and without fluorescence-exciting radiation. A study of the diurnal change in leaf reflectance spectra, combined with fluorescence measurements with the PAM-2000 Fluorometer show that the difference spectra are consistent with observed diurnal changes in fluorescence. Small canopies of *Acer saccharum* M. were used for measurements in the laboratory and under natural light conditions in diurnal trials, in which the variation of measured reflectance was shown experimentally to be consistent with a fluorescence signature imposed on the inherent leaf reflectance signature. The Fluorescence-Reflectance-Transmittance (FRT) leaf radiative transfer model was developed to theoretically simulate the effects of fluorescence emission on the apparent reflectance. Optical indices were identified to track fluorescence emission effects on the observations of apparent reflectance at the leaf and canopy level.

To Presentation

To Agenda