Oliver Sonnentag – Statement of Research Interests

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CURRENT RESEARCH INTERESTS

My current research interests are in biogeosciences and fall into two complementary areas with space-based remote sensing as the common link. My first area of research is concerned with the field-based and remote measurement and monitoring of biophysical and canopy structure parameters such as leaf area index (LAI), foliage clumping index, and biomass using optical analyzers and spectrometers in combination with radiative transfer modelling and multi-spectral and multi-angle optical remote sensing. At the beginning of my Ph.D. at the University of Toronto under the supervision of Professor Jing M. Chen, I was involved in a field study measuring and compiling a range of biophysical and canopy structure parameters for all Fluxnet-Canada Research Network/Canadian Carbon Program (FCRN/CCP) forest sites (Chen *et al.*, 2006). LAI in forest ecosystems has traditionally been mapped based on the relationship between field-measured LAI and various spectral vegetation indices (SVI) derived from multi-spectral optical remote sensing imagery. However, established techniques based on this approach allow for the explicit biophysical quantification of the entire vegetation canopy and do not allow for a distinction between different layers of vegetation. My overall goal is to refine and extend currently used SVI-based approaches at various spatial and temporal resolutions in northern ecosystems to allow for the separate explicit biophysical quantification of various vegetation layers through the combined use of SVI, spectral unmixing, and radiative transfer modelling (e.g., Sonnentag *et al.*, in preparation a). A major additional challenge in northern ecosystems is the influence of abundant mosses and lichens on remote sensing signals. Both mosses and lichens have spectral characteristics that differ from vascular plants. My efforts so far have included the development of an application procedure for the indirect estimation of peatland shrub LAI with the LAI-2000 instrument (Sonnentag *et al.*, 2007a) and of an innovative method to separately map peatland shrub and tree LAI for an individual peatland based on field measurements (LAI-2000, ASD field spectrometer, TRAC) and spectral unmixing that takes into account the unique spectral characteristics of mosses (Sonnentag *et al.*, 2007b). The separately mapped shrub and tree LAI allow for the more realistic representation of two vegetation layers in spatially explicit, process-oriented ecosystem models.

My second major research interests focus on the spatially explicit, process-oriented ecosystem modelling of northern peatlands. As part of my Ph.D., I am investigating the influence of peatlands' topographical setting within the landscape on their ecosystem functioning, an aspect that has been neglected in previous peatland modelling studies. The overall goal of this research is to quantify the effect of meso- and macrotopographic scales in the coupled simulation of peatland hydrology and carbon cycling. Model outputs are evaluated with measured time series of energy, water vapour, and carbon dioxide fluxes from two FCRN/CCP peatland sites: the Mer Bleue bog in Ontario (Sonnentag *et al.*, submitted) and the Sandhill fen in Saskatchewan (Sonnentag *et al.*, in preparation b). To achieve this overall goal, I adapted the Boreal Ecosystem Productivity Simulator (BEPS), a process-oriented ecosystem model in a remote sensing framework, to peatland ecosystems. This version of BEPS considers topographical effects through the explicit routing of topographically-driven shallow lateral subsurface flow. The major focus of BEPS is on the adequate but simplified representation of a multiple vegetation layer canopy and the associated processes related to energy, water vapour and carbon dioxide fluxes using remotely-sensed LAI and land cover maps. A more realistic representation of the multiple layer canopy of northern peatlands in BEPS was achieved (Sonnentag *et al.*, 2007b).