Airborne LiDAR and Hyperspectral Data for Flux Tower Sites

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Introduction

We present a method to attribute CO2 and H2O flux signals measured at flux towers in forested terrain to high-resolution vegetation characteristics. The approach combines flux data with airborne LiDAR, hyperspectral imaging and footprint model results and is applied to several trans-continental flux-tower sites of varying degrees of heterogeneity.

Methodology

We present a method to attribute CO2 and H2O flux signals measured at flux towers in forested terrain to high-resolution vegetation characteristics. The approach combines flux data with airborne LiDAR, hyperspectral imaging and footprint model results and is applied to several trans-continental flux-tower sites of varying degrees of heterogeneity.

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References


Study Sites, Objectives, and First Results

BERMS (Southern Boreal Forest, Saskatchewan, Canada):

Objectives: Study impact of small-scale within-site variability of vegetation structure and topography on CO2 and H2O fluxes.

Sites: Old Aspen, Old Black Spruce, Old Jack Pine; flat terrain, relatively homogeneous forest stands.

Findings: Vegetation structure and small changes in elevation significantly impact net fluxes (Chasmer et al. 2008). Accounting for within-site variability by weighting of fluxes may improve upscaling of fluxes (Chasmer et al. 2011). POSTER: Chasmer et al. “Using a Flux Footprint Model and Airborne LiDAR...”

Jack Pine Chronosequence (Saskatchewan, Canada)

Objectives: Determine growth rates using LiDAR data. Compare differences in biomass with differences in fluxes.

Sites: Four jack pine stands; 9, 17, 36, ~82 years old; relatively flat terrain. Airborne surveys in 2005 and 2008.

Findings: Three years between data collections for statistically significant growth estimate with +/- 10% accuracy.

Loobos (The Netherlands), Tharandt (Germany), Norunda (Sweden)

Objectives: Test approach for heterogeneous forests typical for Europe.

• Within-site elevation changes (Loobos, Tharandt)

• Allocate CO2 and H2O fluxes to specific tree species within a mixed forest (Tharandt, Norunda)

• Impact of disturbance (thinning, Norunda; storm felling, Tharandt)

• Combine tower data with airborne flux measurements (Loobos)

Tumbarumba, (New South Wales, Australia)

Objectives: Test maps of leaf area index, reflectance, maximum carboxylation rate, and potential rate of electron transport as input for land surface models.

Site: Eucalyptus stand situated in complex topography; selective and partial logging during recent past.

Findings: Surface atmosphere transfer model used to generate map of net ecosystem exchange. Results are validated with footprint weighted observations from flux tower. POSTER: Berni et al., “Mapping Pigment Concentration and Leaf Area Index...”. Penman-Monteith model used to estimate land surface evaporation. Results are validated with footprint weighted observations from flux tower. POSTER: van Gorsel et al., “Use of High Resolution LiDAR and Hyperspectral Data to Detect Changes in...”

Modelled Leaf Area Index and Net Ecosystem Exchange

Take Home Message

The results highlight the importance of accounting for within-site heterogeneity when linking flux-tower observations to remote sensing products to obtain realistic regional or global estimates of net ecosystem exchange and ecosystem productivity.