Poster #1-11

Multiscale Data Integration for Scaling Land-atmosphere Carbon Exchange and Soil Properties in Ice-wedge Polygon Tundra

Haruko M. Wainwright[1*] Baptiste Dafflon[1], Rusen Oktem[1], Sigrid Dengel[1], John B. Curtis[1], Margaret S. Torn[1], Jessica Cherry[2], Florian Soom[1], Craig Ulrich[1], Timothy Kneafsey[1], Yuxin Wu[1], and Susan S. Hubbard[1]

[1]Earth and Environmental Sciences, Lawrence Berkeley National Laboratory, Berkeley, CA
[2]NOAA National Weather Service, Alaska-Pacific River Forecast Center, Anchorage, AK

Contact: hmwainwright@lbl.gov

Program: TES
Project: NGEE Arctic
Project Website: http://ngee-arctic.ornl.gov/

This study presents approaches to upscale land-atmosphere carbon exchange and key soil properties from point measurements to the field scale. We developed new methods to estimate net ecosystem exchange (NEE) and soil properties in high resolution (0.5 m by 0.5 m) over the ice-wedge polygon tundra using laboratory through field-based soil analysis, tram and flux tower measurements. We demonstrate our approach at the NGEE Arctic site near Barrow (recently renamed Utqiaġvik), AK. Understanding the spatial distribution of soil properties is critical for predicting future ecosystem behavior. We measured organic matter content, bulk density and ice content from a limited number of cores and also performed nondestructive X-ray computed tomography (CT) scans along the entire length of numerous cores. We trained a neural network algorithm and used it to estimate the fraction of soil constituents along these CT-scans. The classified map of geomorphological features is then used to estimate the distribution of soil characteristics at the landscape scale (750m by 750m). Comparison with ground-based geophysical imagery shows consistent large-scale variation in ice content over the site. The use of CT scans and neural network estimation approaches was shown to be a valuable method for bridging the spatial gap between laboratory and geophysical and remote sensing measurements to provide soil composition information over field relevant scales. A key goal of the NGEE Arctic project is to develop and document approaches for scaling fluxes through considering ‘local’ scale measurements (such as those obtained from cores or in-situ point field measurements) and larger scales (such as those measured by airborne sensors). We developed a Kalman filter method to explore the scaling of measurements and associated NEE at the site. To do this, we integrated multi-scale, multi-type datasets (including those collected from an automated mobile sensor system, or tram system), as well as airborne lidar and imagery. The tram system provided high-frequency measurements of normalized difference vegetation index (NDVI) along a 68-meter transect, capturing spatial heterogeneity associated with microtopography. We take advantage of the significant correlations between NDVI and NEE from the chamber measurements sparse in time and space. We find that data correlations were most informative when the spatial heterogeneity of NDVI and NEE is high in the peak season, which enabled successful estimation. The results of the NEE estimation using the multi-scale data were compared to the flux tower data by averaging the flux within the tower footprint.