Poster #1-12

Characterizing Sources and Sinks of CO_2 and CH_4 Across Polygonal Tundra: A Multi- Scale Approach

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Identifying sources and sinks of carbon dioxide (CO_2) and methane (CH_4) fluxes in heterogeneous Arctic ecosystems, such as polygonal tundra, represents challenges not experienced in lower latitudes. Polygons, ice-wedge features that result from cycles of freezing and thawing of the active layer can extend several tens of meters across. Polygons at the NGEE Arctic Utqiaġvik (formerly Barrow) Alaska site can be categorized as high-centered, low- centered, and flat-centered polygons, each representing different micro topography and hence surface, soil, and hydrological properties. We are measuring net CO_2 and CH_4 fluxes at landscape level with an eddy covariance (EC) tower. While data are sampled many times per second, they are typically averaged to half hourly values. However, these ecosystem scale fluxes can be temporally "dissected" to locate or identify localized sources and sinks on the order of less than 5 m. We are attempting to localize these fluxes by combining a variety of measurements methods and techniques to better understand the carbon and energy budgets of this complex environment. To do so we employ refined geostatistical and geospatial analysis by integrating a high resolution elevation model to identify and extract individual polygons by type and extend (60 polygons were surveyed (Wainwright et al. 2015) and are used as ground truthing), combined with stationarity tested 5-min averaged EC data with accompanying footprint analyses (fetch distance of up to 250 m – wind direction and atmospheric stability dependent), bivariate polar plots and cluster analysis in order to depict seasonal and inter-annual photosynthetic properties of individual polygons and polygon types in regards to environmental changes (wet vs dry, cold vs. warm growing seasons). Once these high-resolution, multi-layered datasets have been assembled we are then amalgamating them by applying sophisticated machine learning techniques in order to advance our understanding of these ecosystems, which can be implemented into earth system models and improve the fidelity of model predictions.

Wainwright et al. (2015). Identifying multiscale zonation and assessing the relative importance of polygon geomorphology on carbon fluxes in an Arctic tundra ecosystem. Journal of Geophysical Research: Biogeosciences, 120(4), 788-808.