The relationship between carbon dioxide flux, methane flux, hyperspectral reflectance, leaf area index (LAI), and albedo for multiple land cover types in Arctic Beringia

D. Lin¹, C.E. Tweedie¹, Y.A. Teh², T. Christensen³, J. Gamon⁴, S. Oberbauer⁵, R. Rhew⁶

1 - Department of Biological Sciences, University of Texas at El Paso, El Paso, TX 79968
2 - Division of Ecosystem Sciences, Department of Environmental Science, Policy, and Management, University of California at Berkeley, 137 Mulford Hall #3114, Berkeley, CA 94720-3114, United States
3 - Department of Physical Geography and Ecosystems Analysis, Lund University, 12 Sylvegatan, Lund, 223 62, Sweden
4 - Department of Biological Sciences, California State University at Los Angeles, 5151 State University Dr., Los Angeles, CA 90032, United States
5 - Department of Biological Sciences, Florida International University, 11200 SW 8th Street, Miami, FL 33199, United States
6 - Atmospheric Biogeochemistry Laboratory, Department of Geography, University of California at Berkeley, 507 McConé Hall #4740, Berkeley, CA 94720-4740, United States
cwweedie@utep.edu

The US NSF-funded Beringia project employs a novel rapid assessment technique to quantify decadal time-scale change in radiative forcing potential (RFP) in the Beringia region. During the 2005, 2006 and 2007 summer seasons, 16 sites throughout the Beringia region were visited. As participants of the Swedish Polar Research Secretariat's Beringia 2005 expedition, we were able to visit locations spanning Chukotka and Wrangel Island in the Russian arctic. Additional sites on the eastern side of Beringia were located within the North Slope, and the Seward Peninsula. At each site, study plots were established in dominant land cover types (dry, moist, wet, aquatic, tussock, shrub) and the radiative forcing potential (RFP) was determined for each over a three-day sampling period. This report examines the relationship between trace gas exchange (CO₂ and CH₄), hyperspectral reflectance, surface albedo, soil moisture, species cover, leaf area index (LAI), active layer depth, and above-ground plant biomass for different land cover types at each of the study sites.

Gross Ecosystem Productivity (GEP) showed significant correlations with normalized difference vegetation index (NDVI, R² = 0.42), and leaf area index (LAI, R² = 0.43). Soil moisture content showed positive correlation with relationship with methane (CH₄) efflux, where higher soil water content lead to greater ecosystem CH₄ efflux. While wet and aquatic sites were generally the greatest CO₂ sinks, they were also the largest sources of CH₄ to the atmosphere. These findings underscore the importance of accounting for CH₄ exchange when calculating ecosystem RFP. In some cases, the calculated RFP of sites changed from negative to positive when accounting for CH₄ in addition to CO₂. General trends in the direction of net CO₂ and CH₄ fluxes appear to be conserved across land cover types at different locations, but the magnitude of the respective fluxes is highly variable across landscapes. Surface albedo is also known to be an important aspect of land cover RFP. While the significance of measurements on tussock dominated land cover are limited by the small number of sites sampled (n=3), initial results show tussock tundra to have a high albedo, and a high ratio of CO₂ uptake to CH₄ efflux compared to the other tundra land cover types sampled.