Spatial Variability of Canopy Structure & Function in a Moist Acidic Tussock Tundra

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Introduction

Canopy structure and function is important to link the effects of climate change on carbon, water, and energy exchanges between subarctic vegetation and the atmosphere. Interpreting vegetation spatial variability with satellite products alone is a challenge, due to the patchiness of vegetation in the Arctic ecosystems with transient cloud over during the summer season that obstructs retrieval of land surface images. To compare and correlate spatial variation of vegetation with satellite data, we collected leaf area index (LAI) and hyperspectral reflectance data in Council, Alaska. To better understand canopy structure and functional variables, we further examined subarctic leaf traits by measuring C:N ratio, leaf mass area (LMA), chlorophyll content, and hyperspectral leaf optical properties. We obtained WorldView-2 Satellite data, which has 8 multispectral bands with 2 m resolution, centered on our study site. Preliminary results showed remarkable variation in spectral reflectance and LAI across three 100-m transects. We discuss how to upscale the information from in-situ observed canopy properties into a landscape scale in tandem with the high-resolution satellite image.

Objectives

- To examine the relation between of LAI and NDVI in a tussock tundra in Council, Alaska
- To quantify C:N ratio, leaf mass area (LMA), chlorophyll content, and hyperspectral leaf optical properties
- To compare field data with WorldView-2 Satellite image, which has 8 multispectral bands with 2 m resolution, centered on our study site

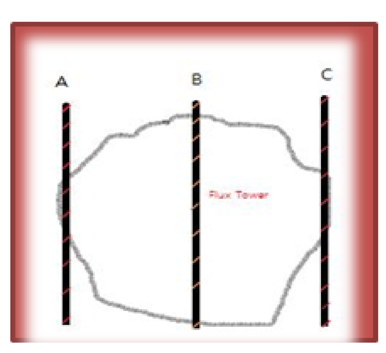
1. Leaf Samples
Purpose: Understand Leaf Traits
- Photo
- Li-6400
- Chlorophyll
- C:N
- LMA
- ASD

3 representative species, 3 samples/species = 9 samples

In a single sample:
Chl
ASD
Chl → Li-6400 → LMA -> area + dry mass → C:N -> dry leaf

2. Canopy Samples
Purpose:
- Map Leaf Traits & LAI using WorldView II
- Develop empirical equation for LAI
- ASD
- Li-2200
- Clipped LAI
- Photo

Match footprints, check background (white, orange, grey, moss)



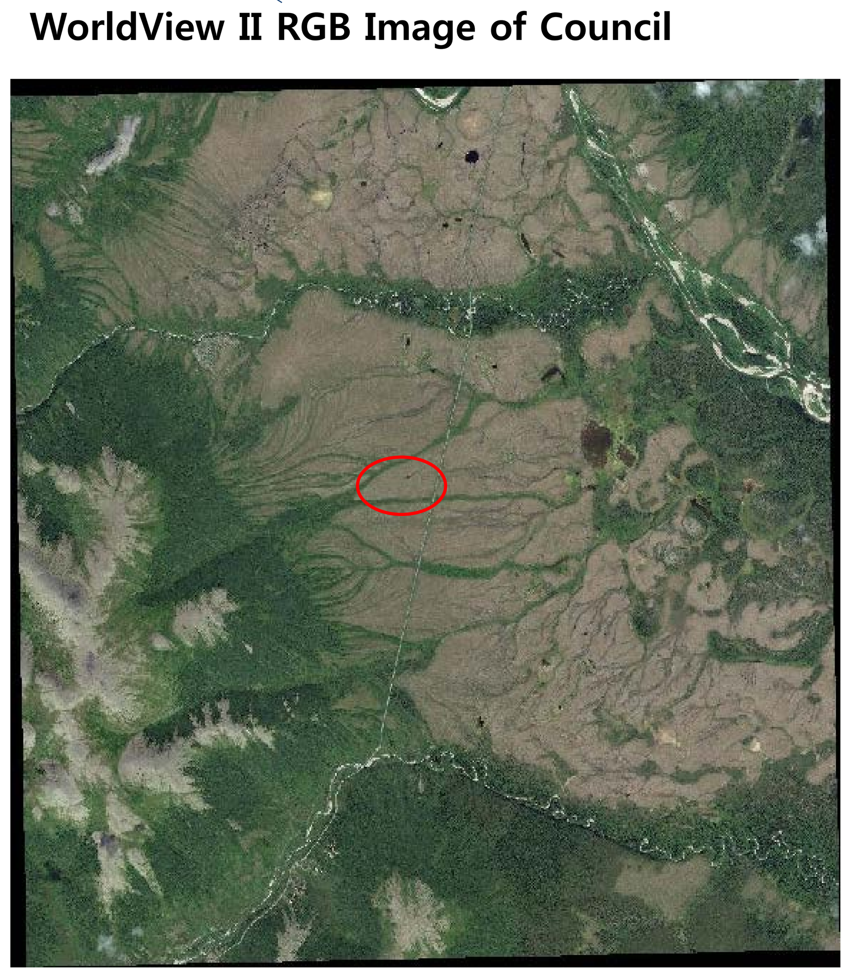
Study area & Method

- **Study area:** Alaska, Council (64.8443°N, 163.711°W)
- **Site Description**: Acidic Tussock tundra; Discontinuous permafrost
- **Field Site Period**: 1 – 10 July 2015
- **WorldView II Image Acquisition:** 4 August 2015

Preprocess WorldView II NDVI map

1. Convert Digital Number to Top-of-Atmosphere Radiance with geometric correction according to manual
2. Convert to Top-of-Atmosphere Radiance to Surface Reflectance with 6S Model

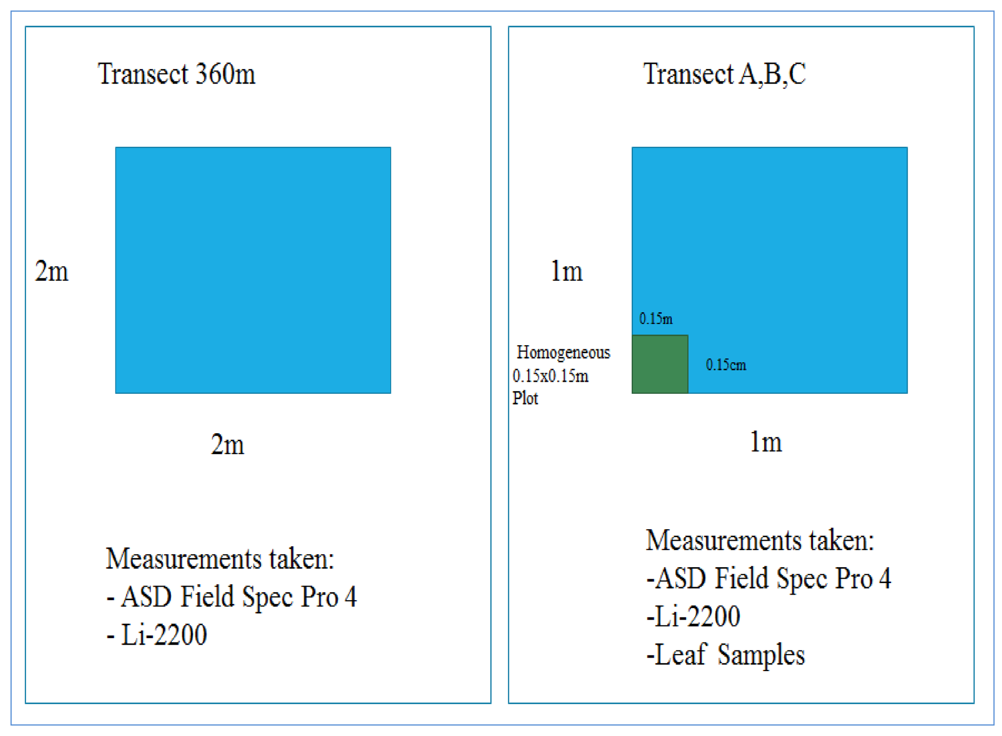
WorldView II RGB Image of Council

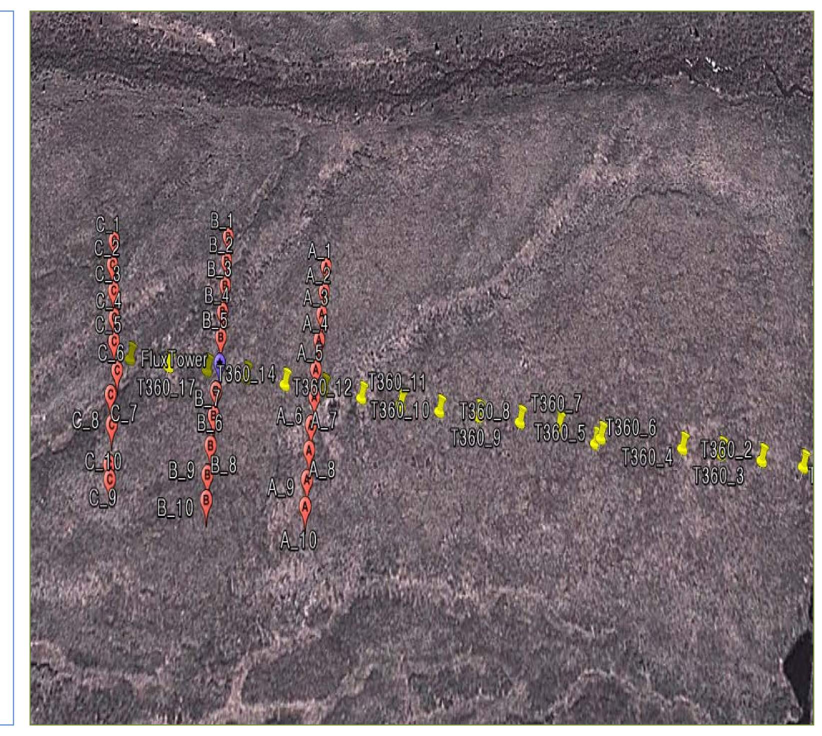


Instruments:
- ASD
- LI-2200
- LI6400
- WorldView II

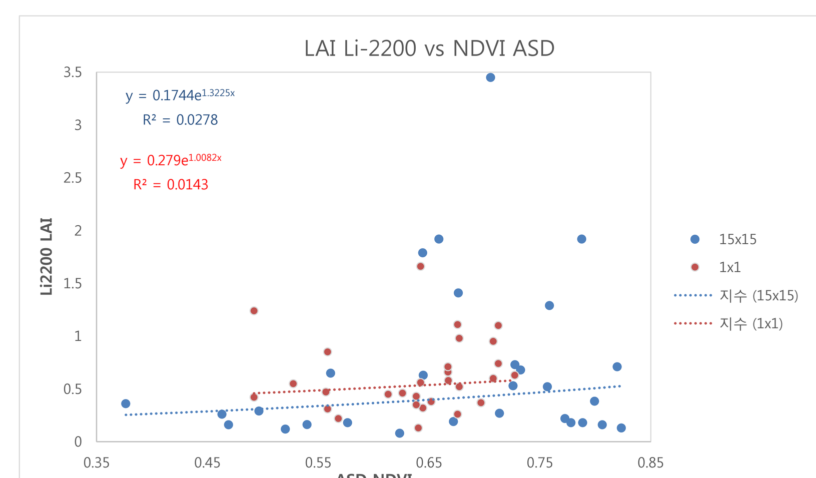
Research Approaches

Systematic Sampling Design

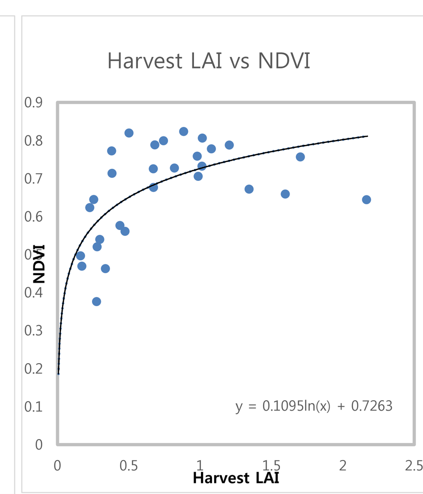


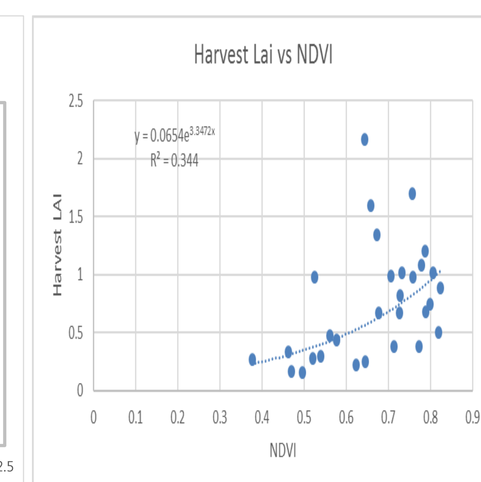


Correlation of NDVI and LAI (Li 2200) across transect A,B,C

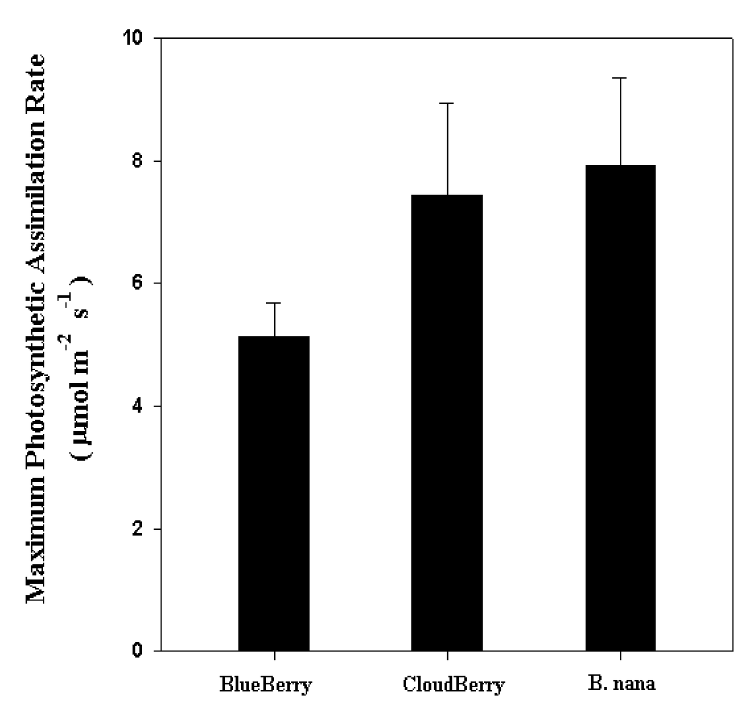


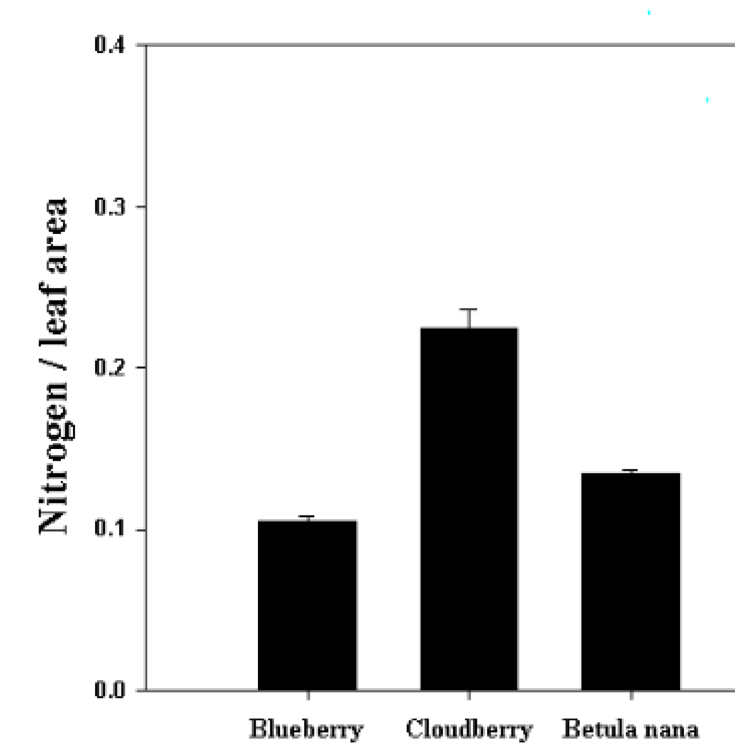
Correlation of NDVI and harvest LAI across transect A,B,C 0.15x0.15m



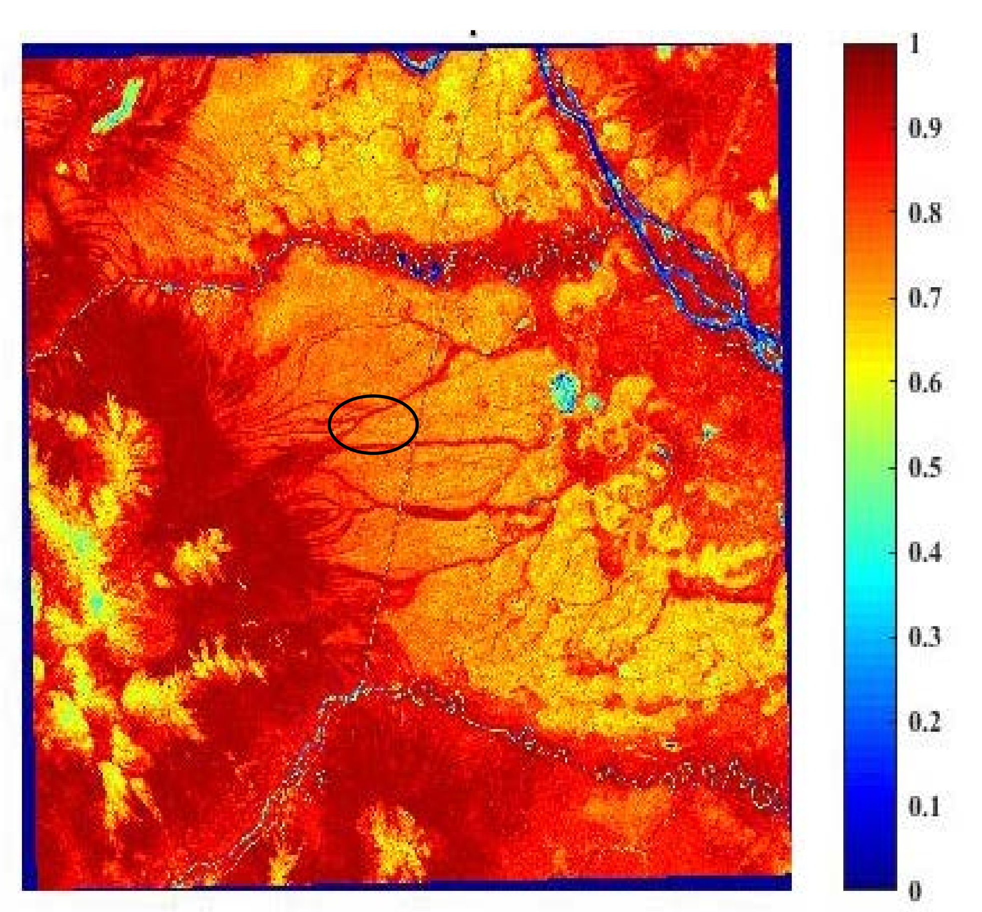


C:N ratio and Leaf Mass Area

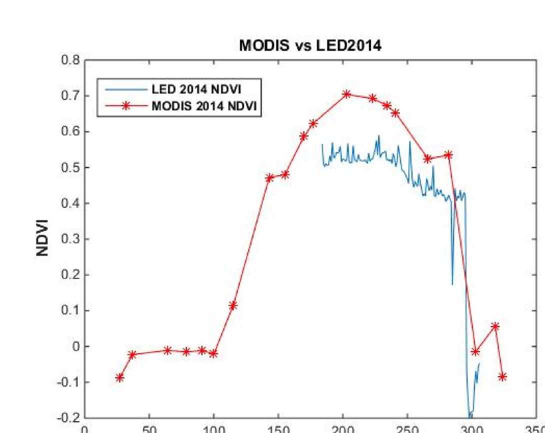


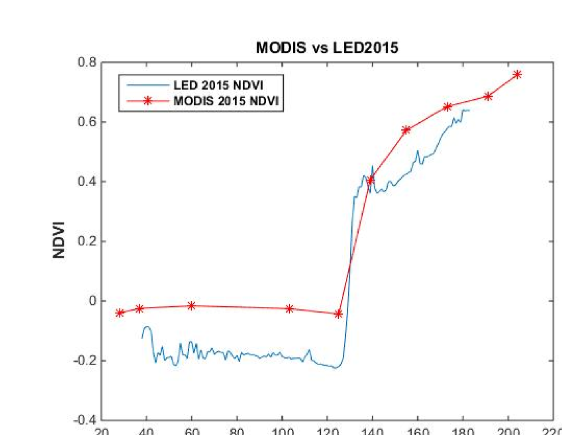


Worldview II NDVI map



MODIS and LED Sensor





Conclusion

The spatial variation of vegetation was more heterogeneous than expected.

Acknowledgement

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