Causes and Consequences of Arctic Greening

Team:

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Objectives

1. Map Plant Functional Types (PFT), chlorophyll, and carbon flux parameters from AVIRIS imagery for tundra regions within the ABoVE domain
   - Use historic ground measurements for algorithm development and testing
   - Organize and archive ground spectral measurements
2. Link the AVIRIS snapshot to temporal changes through time series of historic ground data, commercial satellite and air photo data for the region around Barrow, AK
   - examine how present distributions are related to ongoing processes, including herbivory, thermokarst, and changes in surface hydrology

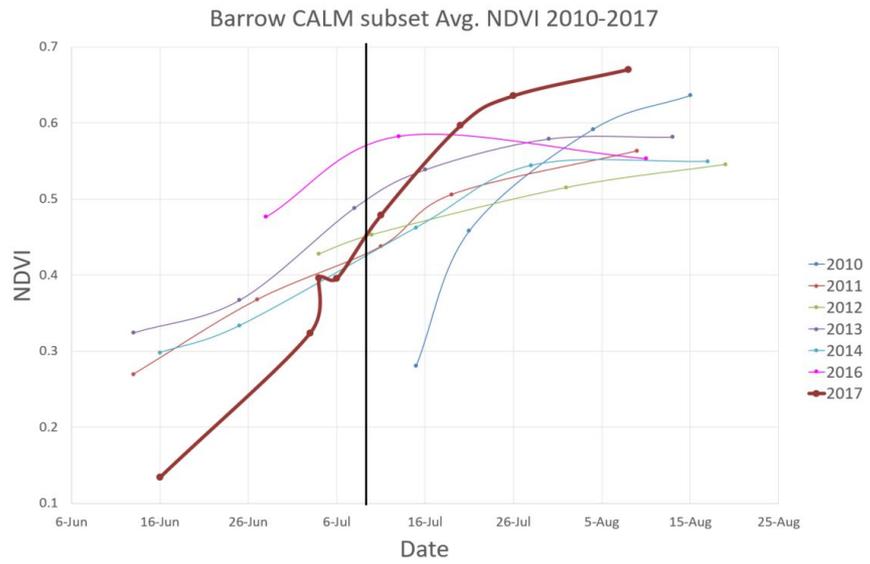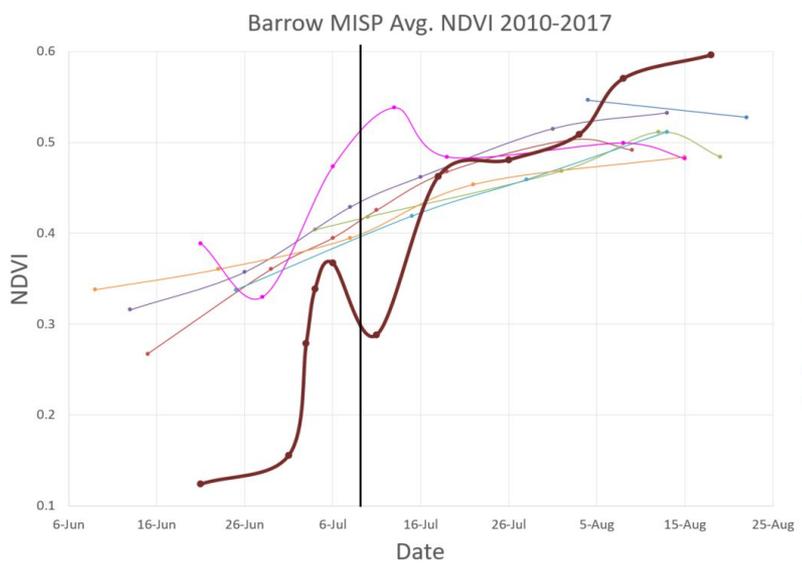# 2017 ABoVE AVIRIS NG Imagery Collections
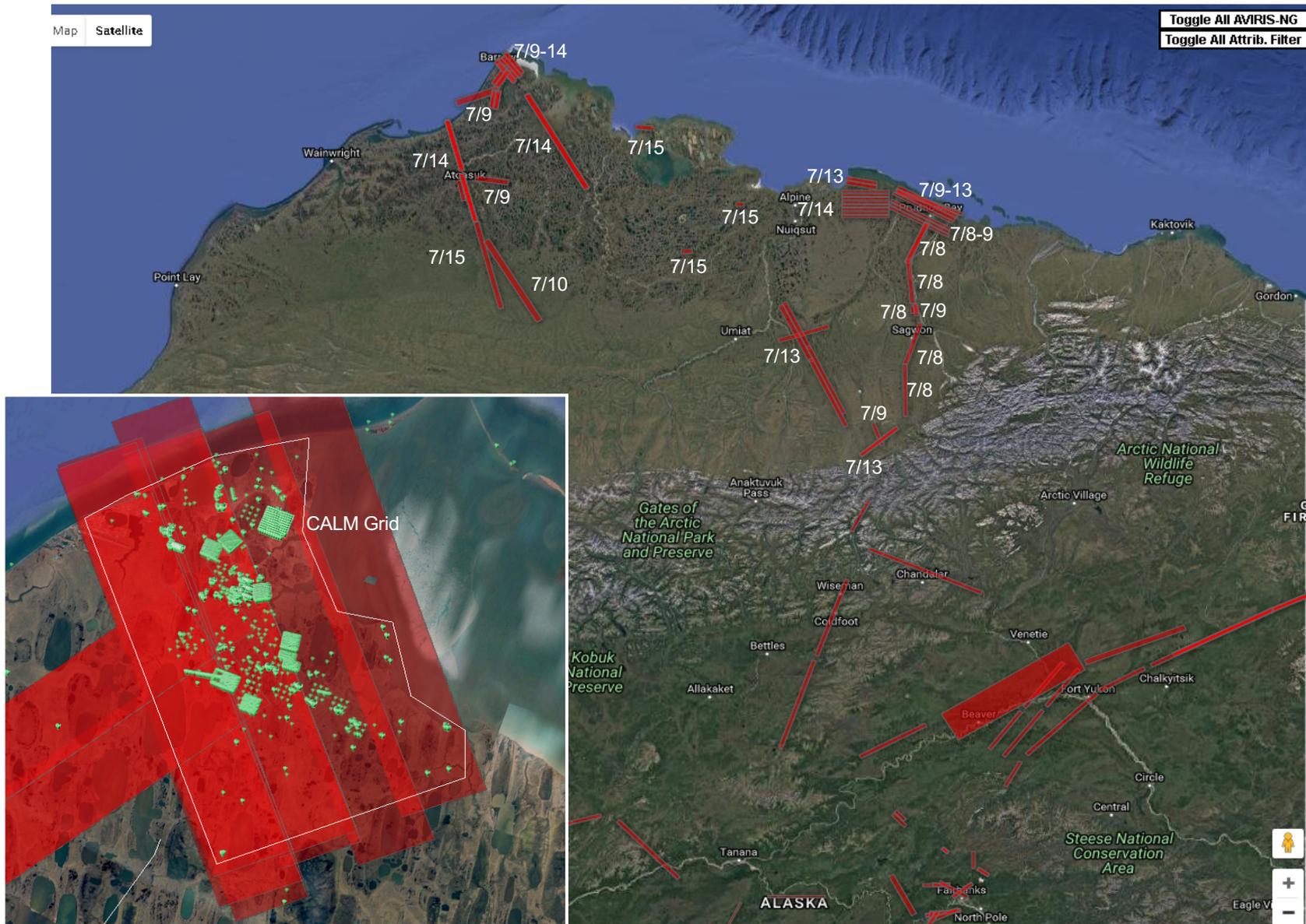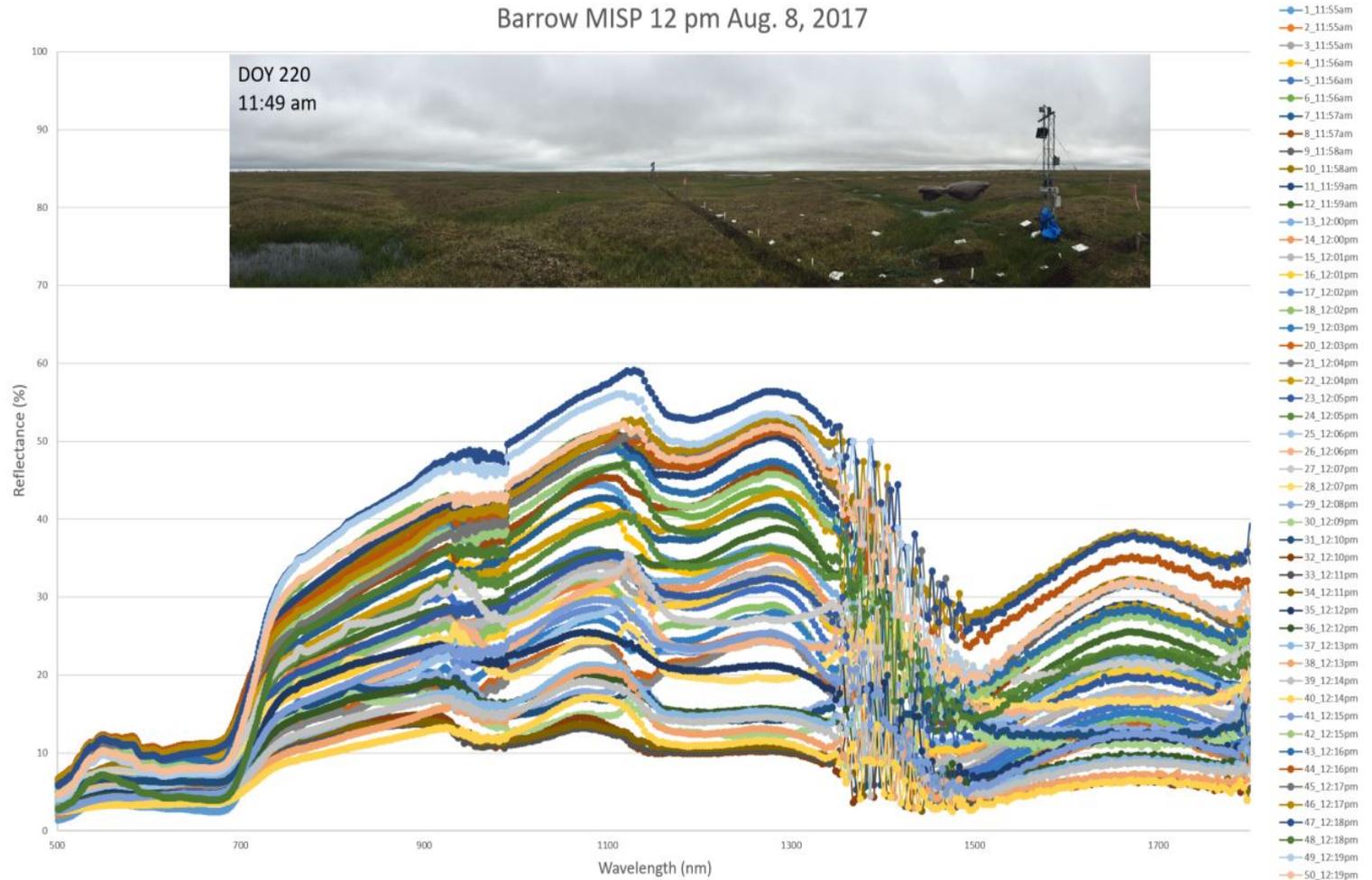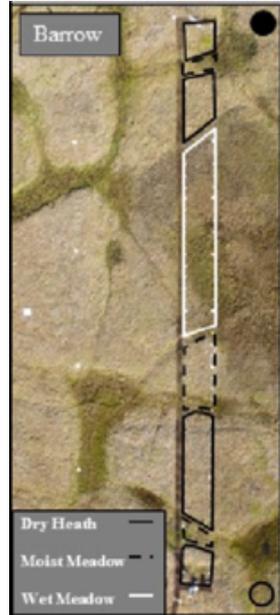
Seasonal NDVI from Barrow Ground Measurements
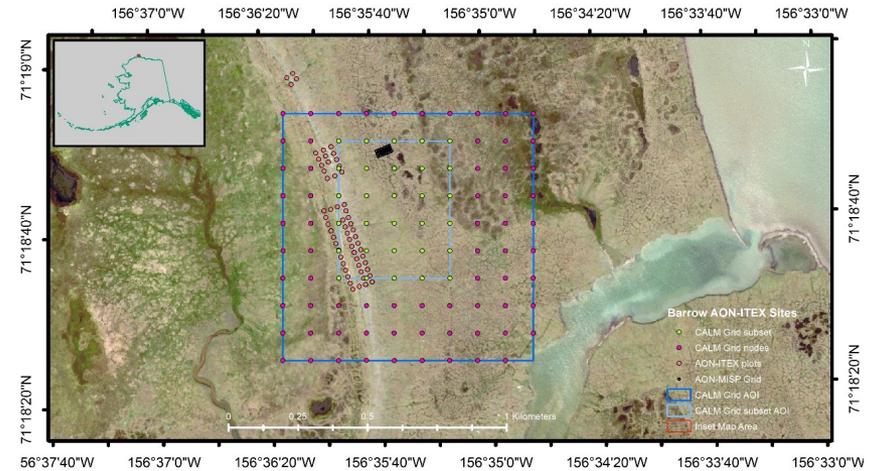
MISP Transect - Mobile Instrumented Sensor Platform
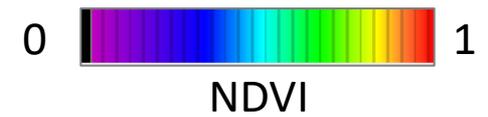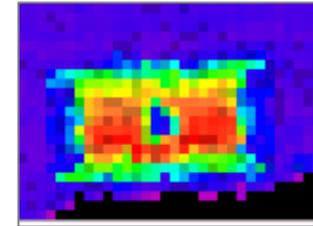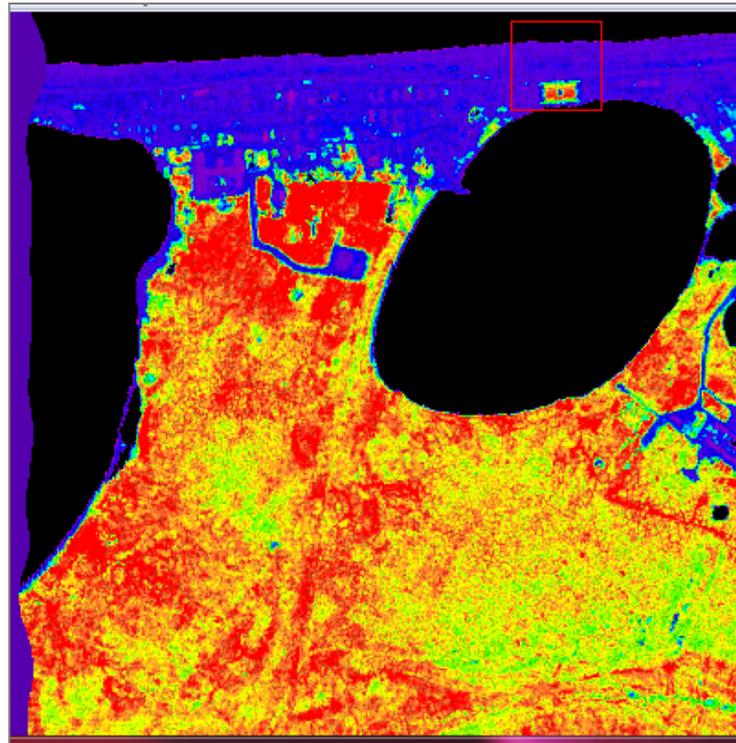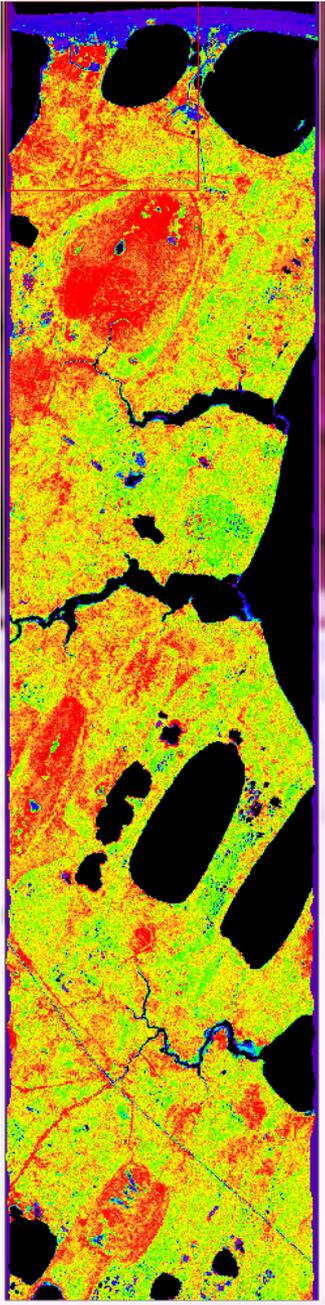Average along 50 m transect

CALM Grid - Circumpolar Active Layer Monitoring
Samples 100 m apart in grid 1000 x 1000 m

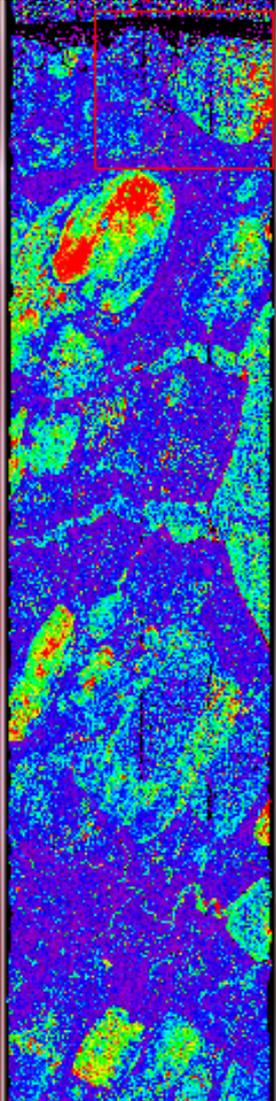# Barrow MISP Transect Reflectance Spectra

AVIRIS NG NDVI

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$$NDVI = (R_{852.68} - R_{657.35})/(R_{852.68} + R_{657.35})$$

AVIRIS NG Surface Moisture

Liquid absorption from
AVIRIS atm correction

An existing product that is a bi-product of the AVIRIS atmospheric correction is an estimate of liquid water on the surface

In the AC, spectral fitting is performed to estimate water vapor and suppress effects of ice and liquid water on the surface reflectance.
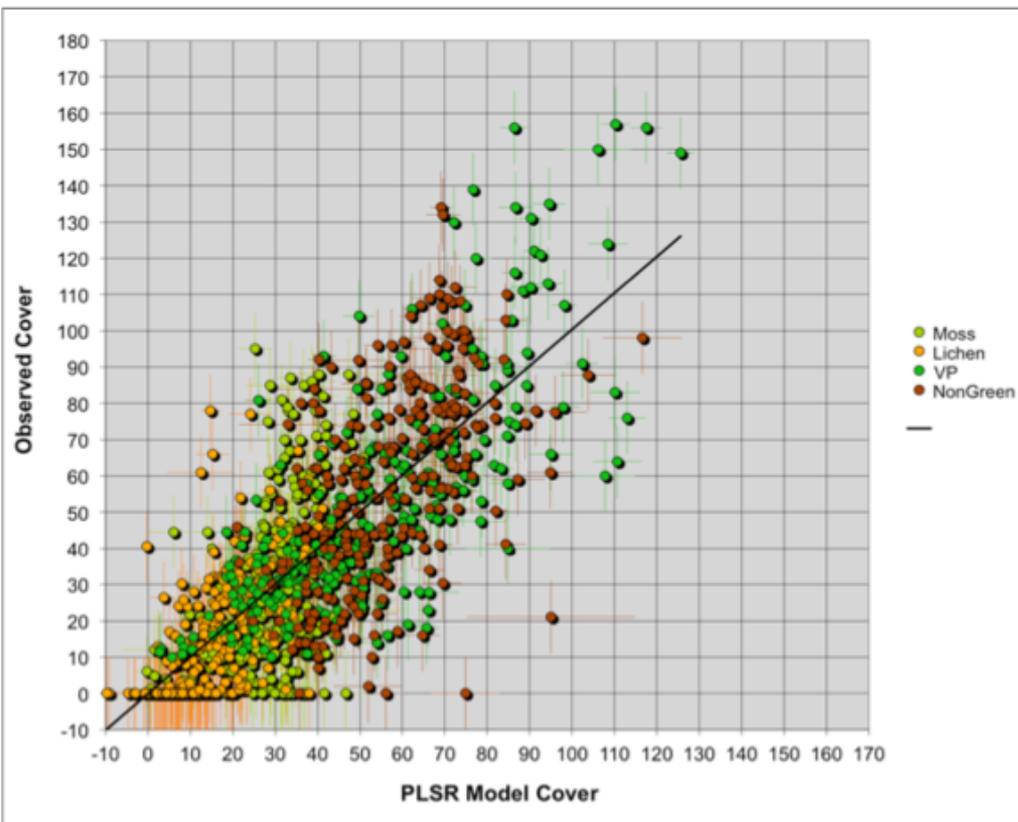Liquid water is most commonly found on the surface in the leaves of vegetation.

The liquid water image is a function of the strength of the liquid water absorption feature in the spectrum.
It is consistently calculated and can be compared across images.

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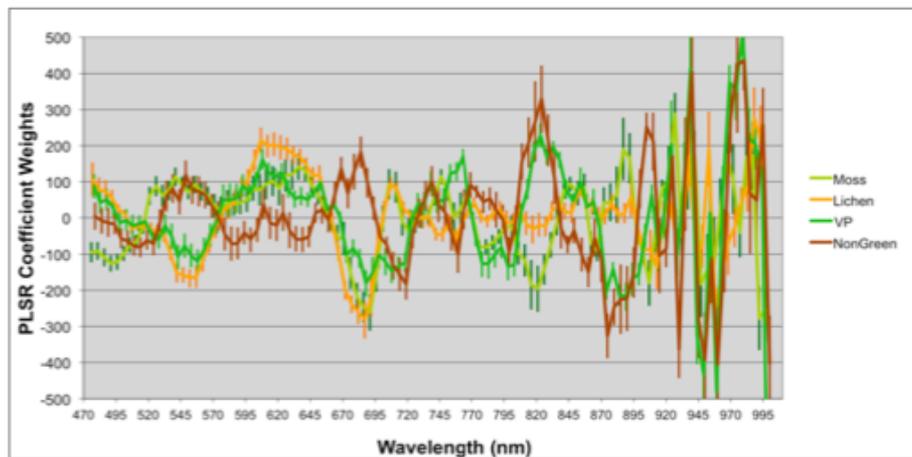# Plant Functional Type Coverage from Ground Measurements

Use spectral information to scale from ground measurements to the region

Used coverage estimates from 266 observations from MISP transects and CALM grids in Barrow and Atqasuk

PLSR applied to spectral reflectance of plot cover estimates

- In contrast to using spectral endmembers to unmix.
- Only visible-near IR bands available for these ground data, cannot make use of all the available AVIRIS NG bands
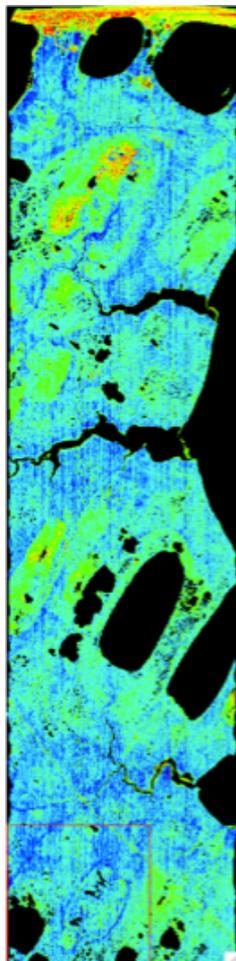- R^2 = 0.59 for all cover types, St Err = 19.5% cover

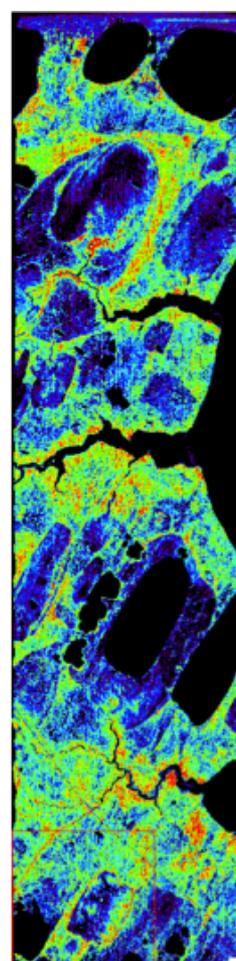# Plant Functional Type Coverage from Ground Measurements

Map coverage by applying PLSR coefficients from ground data to AVIRIS NG imagery
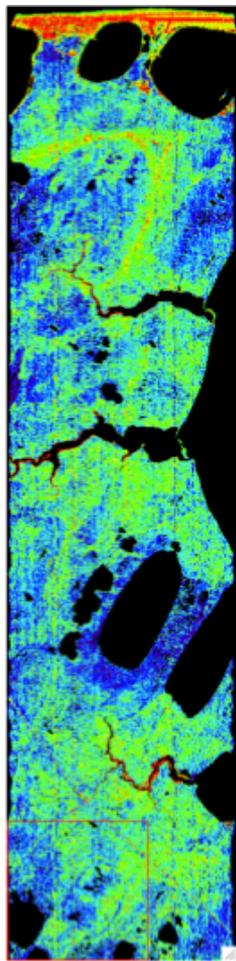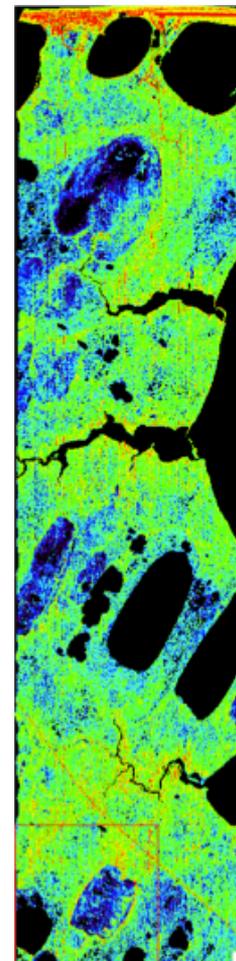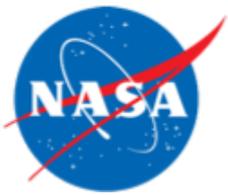

Lichens

Moss

Vascular Plants

NonGreen
(dead plants and bare ground)

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Different scales used in each image

Spectral Library

Develop spectral library/database to store, manage, share, and visualize data

Challenge 2 Big DATA

- Collected over +1000 spectral reflectance data records during summer 2017 alone
- Other projects within UTEP SEL to compile and include data
    - AON ITEX 2010-2017
    - Bio-complexity Experiment Spectral library 2007-2009
    - IBP and BTF
    - Approx. 300,000 data files total need to be documented and shared

Challenge 3 Formatting

- Data formats and types
    - RAW (radiance) vs processed (reflectance)
    - File types
    - Processed vs Unprocessed
    - Different instruments
    - Adopt EcoSis, BAID, AOV spectral libraries and web apps
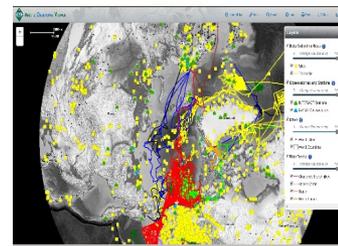
Web Mapping fused with Spectral Library

Next Steps

Organize and archive data in spectral library

We are in the prototyping stage in the bottom-up algorithm development

 Use more ground data sets for algorithm development and
  testing

 - NGEE, MISP, ITEX, CALM, etc. datasets

Apply algorithms to AVIRIS imagery

 - Compare with Tweedie's high resolution land cover for Barrow

 - Scale up to Landsat/MODIS

 - Process more flight lines, esp. Atqasuk and Toolik areas

Continue top-down analysis of AVIRIS data

 - Derive endmember spectra, compare with ground
  measurements

Plan for next summer data collections

 - Possible flights (G-LiHT, AVIRIS NG)?

 - Tweedie's group will be in Barrow and can make some ground
  measurements