Task C1: *Quantify the climate sensitivities of vegetation communities across multiple temporal and spatial scales, with an emphasis on relationships among plant species diversity, life history and functional traits, and productivity*

Hollingsworth, Verbyla, Mulder

"*A community without accommodation between members would only be a collection and not worth studying.* " -Allen & Hoekstra, 1992

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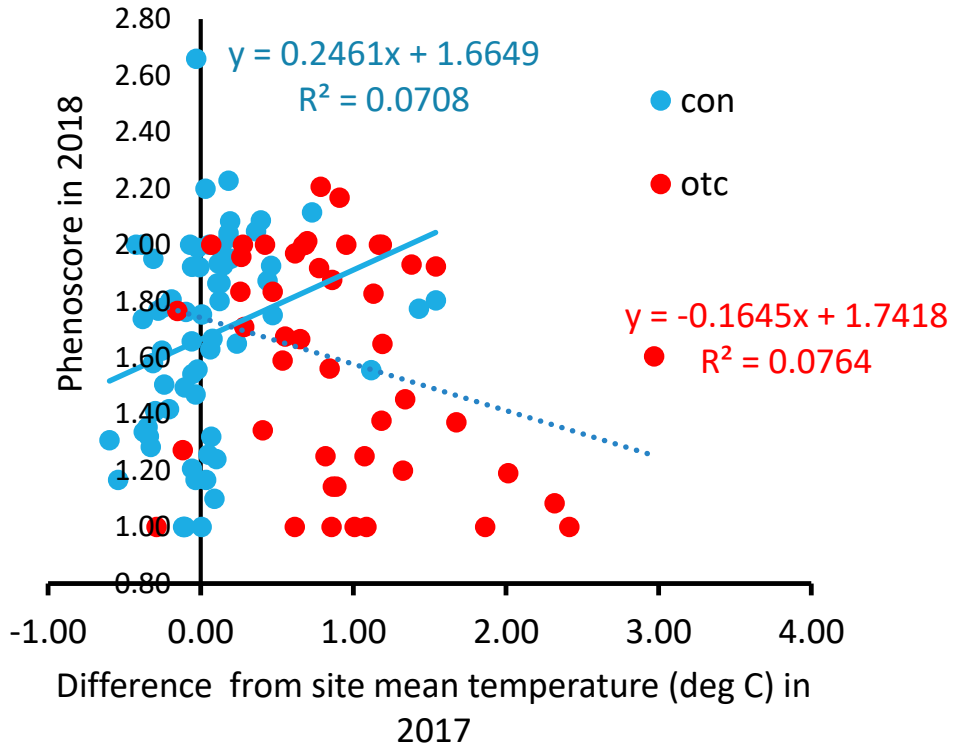
Direct effects of climate on species to landscapes:

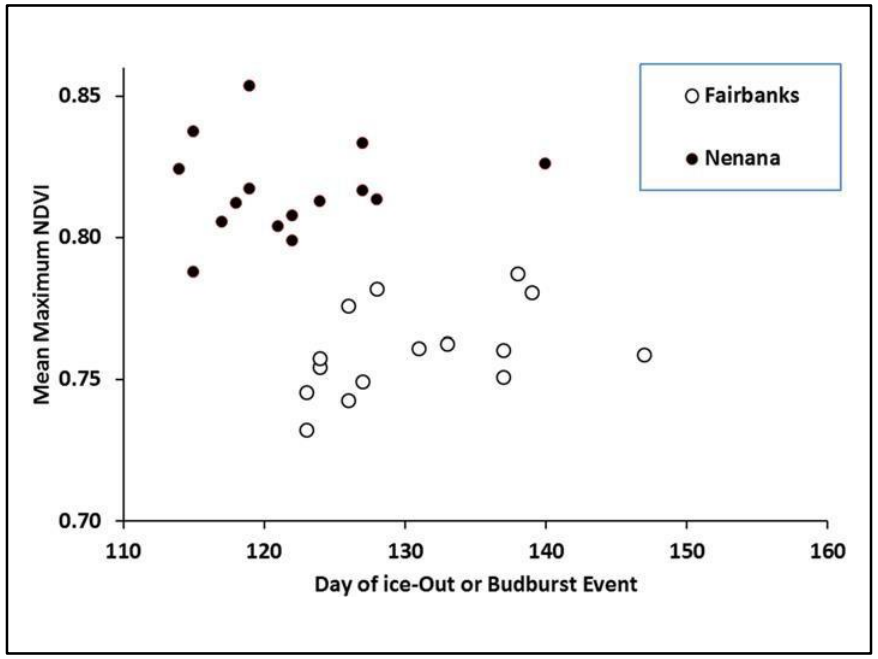
Does temperate in the year **prior** to flowering affect timing of flowering? (Mulder and Diggle)

Vaccinium vitis-idaea



- In control plots, going from cool to moderate temperatures in 2017 **advanced** flowering in 2018
- In OTCs, going from moderate to warm temperatures **delayed** flowering in 2018

What is the relationship between climate and NDVI?



At a local scale, there was no relationship between ice-out at Nenana and peak summer NDVI
or budburst at Fairbanks and peak summer NDVI.

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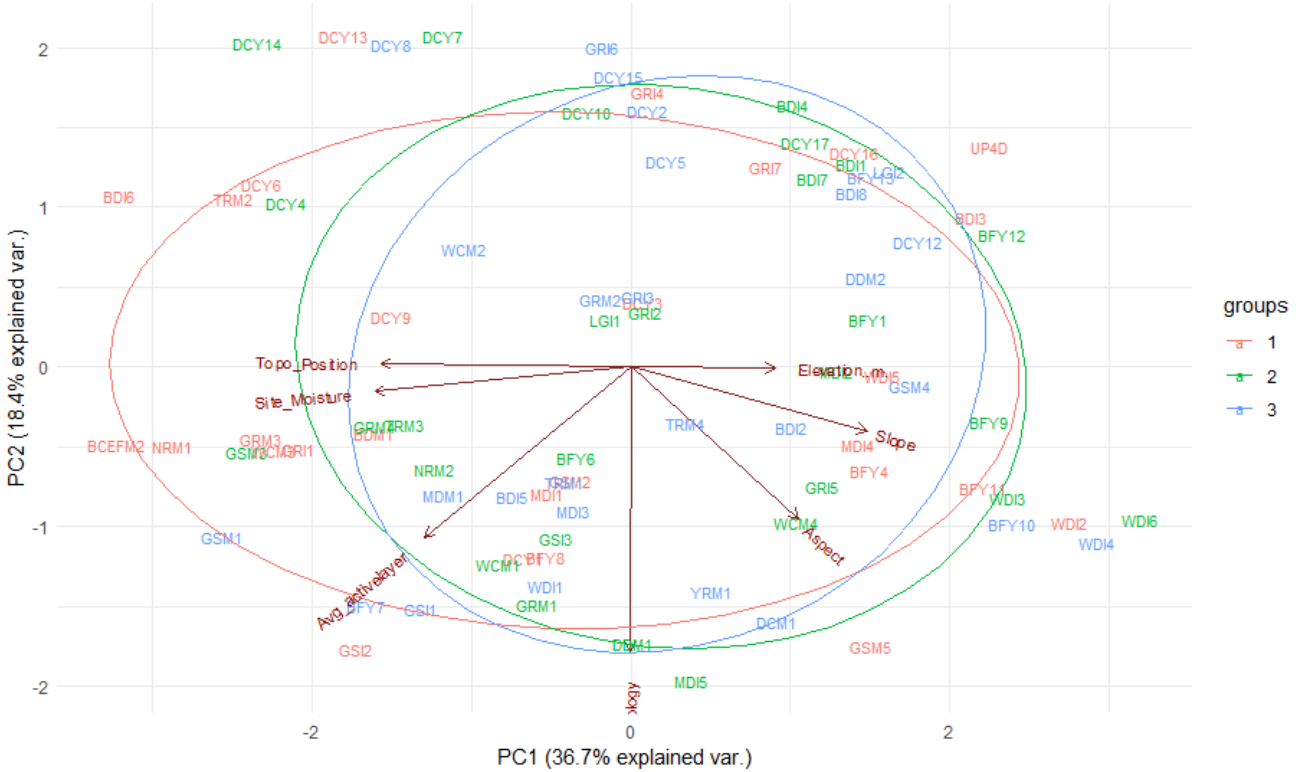
"A community without accommodation between members would only be a collection and not worth studying."

"Community ecology has its origins in an abstraction of landscapes, one where the pattern of the patchwork on the ground is replaced by abstract community types defined by species lists and proportions of species abundances."

How does space and time effect post-fire community composition?

Regional Site Network Sites



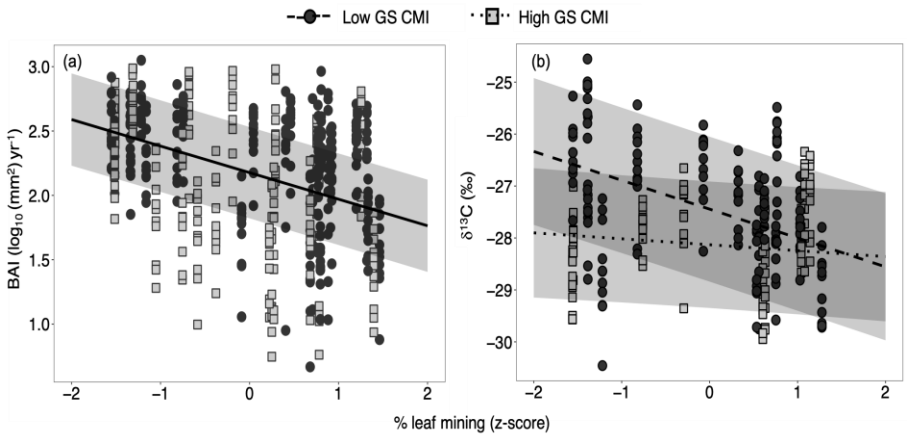
- Young recently burned sites are more highly variable in species composition and environmental space

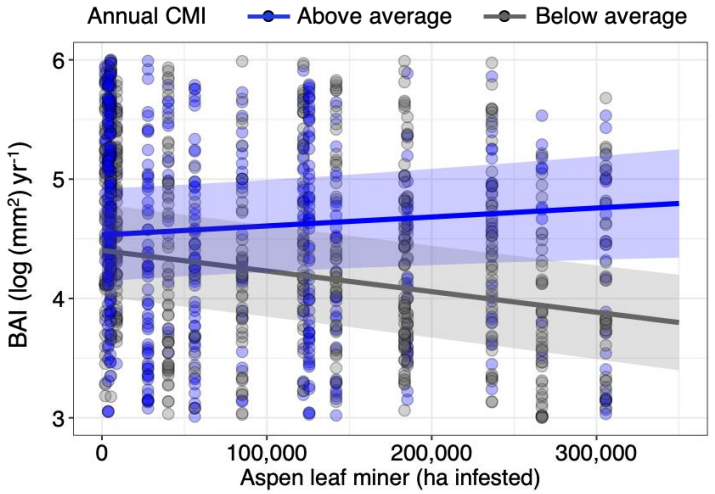
Cross-scale interactive effects (discussion)

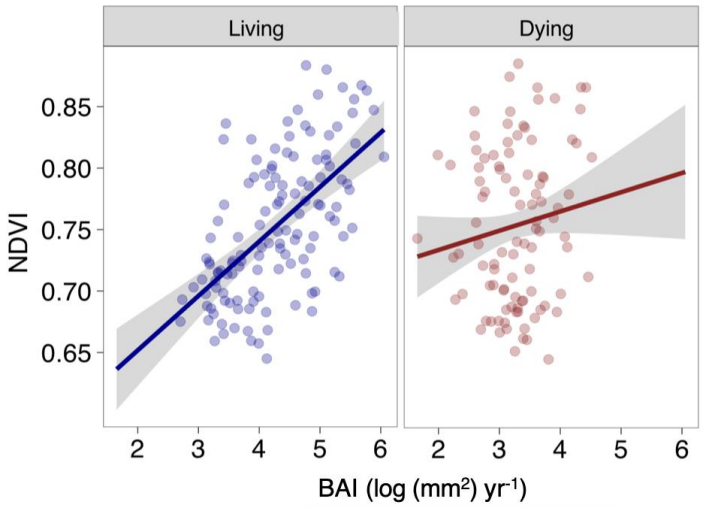
Task C2: Determine the direct and interactive effects of climate sensitivity vs. intrinsic factors on wide-spread patterns of browning in the boreal forest

Johnstone, Mack, Goetz, Ruess, Wagner, Doak, Boyd, Walker, Rogers, Foster, Berner, McCander

- Examined impacts of leaf miner (*Phyllocnistis populiella)* outbreak on aspen productivity around Fairbanks and across interior roads
- Around Fairbanks, leaf mining had a larger impact on aspen growth and physiology than climate
  - Productivity (BAI) decreased with greater leaf mining and was not sensitive to growing season moisture
  - Climate and leaf mining interacted to influence physiology ($\delta^{13}C$), with greater mining resulting in decreased $\delta^{13}C$ when moisture availability was low
  - NDVI covaried with productivity
- Across the state, productivity was only negatively affected by leaf miner during dry years
  - Some of these sites suffered substantial mortality, but NDVI tracked growth of living trees more strongly than dying trees







Task C2: Determine the direct and interactive effects of climate sensitivity vs. intrinsic factors on wide-spread patterns of browning in the boreal forest

Future directions

- What are your plans moving forward?
  - SERDP project: explore climate sensitivity versus competition and successional dynamics for driving temporal patterns of productivity (BAI) and browning (NDVI)
  - Synthesize direct and interactive effects of climate versus pests and pathogens on productivity and mortality (aspen mining, aspen canker, spruce bark beetle, spruce budworm studies)
  - Kyoko Okano PhD: examine ^{18}O and ^{13}C in tree rings to determine patterns of water source and drought stress through post-fire succession, across deciduous and coniferous species in monoculture and in mixture

- What is limiting your efforts?
  - Personnel, time and money

Task C2: Determine the direct and interactive effects of climate sensitivity vs. intrinsic factors on wide-spread patterns of browning in the boreal forest

How do these findings inform our understanding cross-scale effects, interactions or feedbacks?

- Leaf and tree-scale pest and pathogen effects can determine sensitivity of production to regional climate
- Ontogeny, canopy position and regional climate is important for predicting resistance or resilience to mining
- [Something interesting about miner population dynamics—dispersal, dispersion, spatial patterning, climate sensitivity of these properties}

Task C2: Determine the direct and interactive effects of climate sensitivity vs. intrinsic factors on wide-spread patterns of browning in the boreal forest

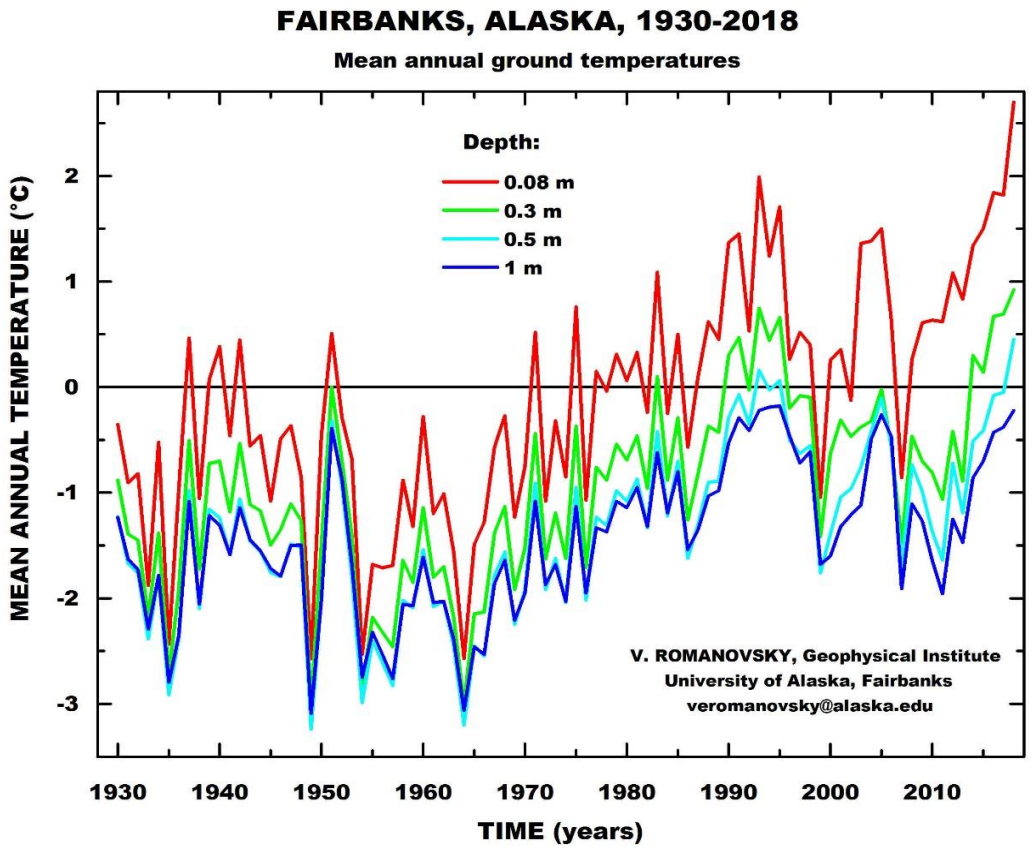
Publications

Boyd MB, Berner LT, Doak P, Goetz SJ, Rogers BM, Wagner D, Walker XJ, and Mack MC. Impacts of climate and insect herbivory on productivity and physiology of trembling aspen (*Populus tremuloides*) in Alaskan boreal forests. *Environmental Research Letters*. In review.

Boyd MB, Berner LT, Foster AC, Goetz SJ, Rogers BM, Walker XJ, and Mack MC. Drivers of trembling aspen (*Populus tremuloides*) productivity decline and mortality in boreal forests of interior Alaska. *Ecosystems.* In prep.

Task C4: Permafrost change ~ f(climate, climate x disturbance, climate x ground ice)

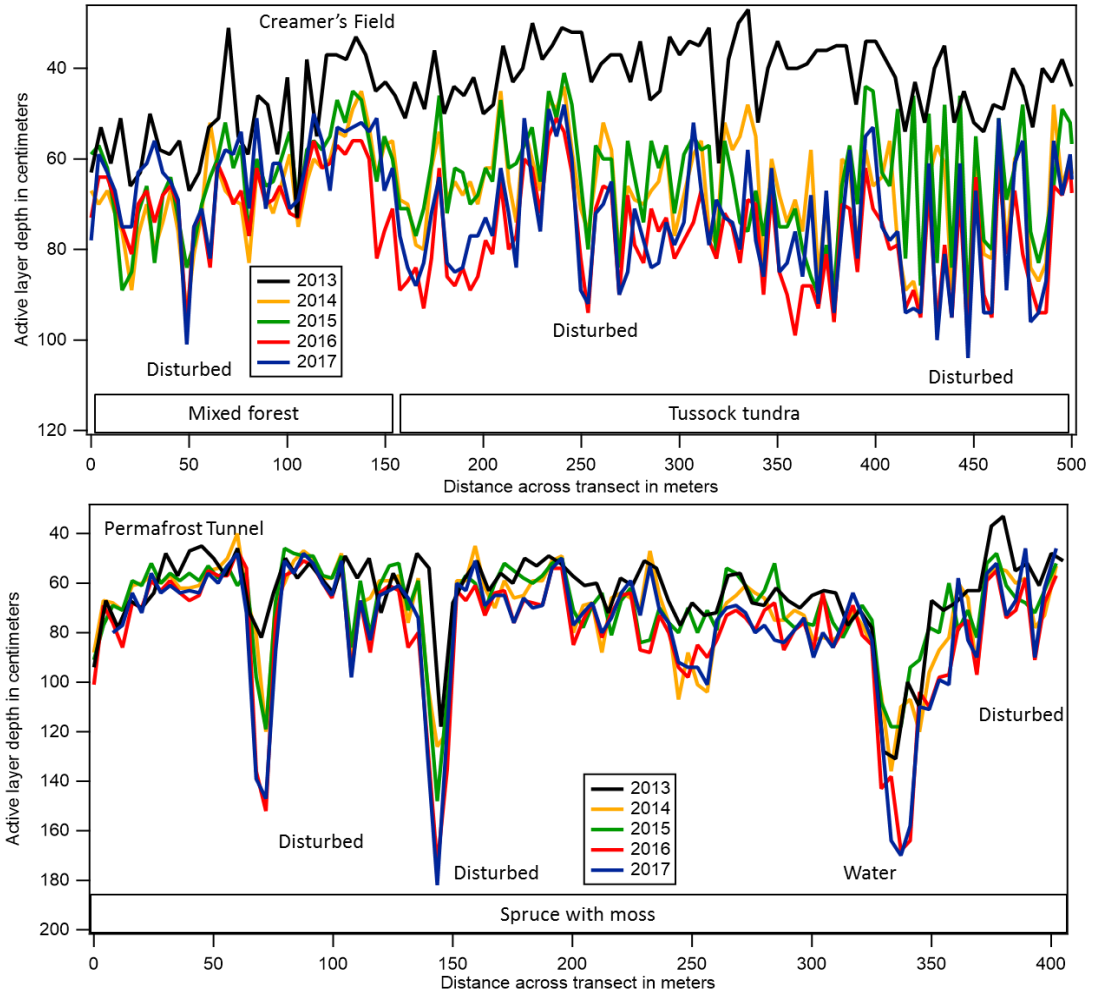
Turetsky, Schuur, Romanovsky, Douglas, Cox (new PhD student!), others?

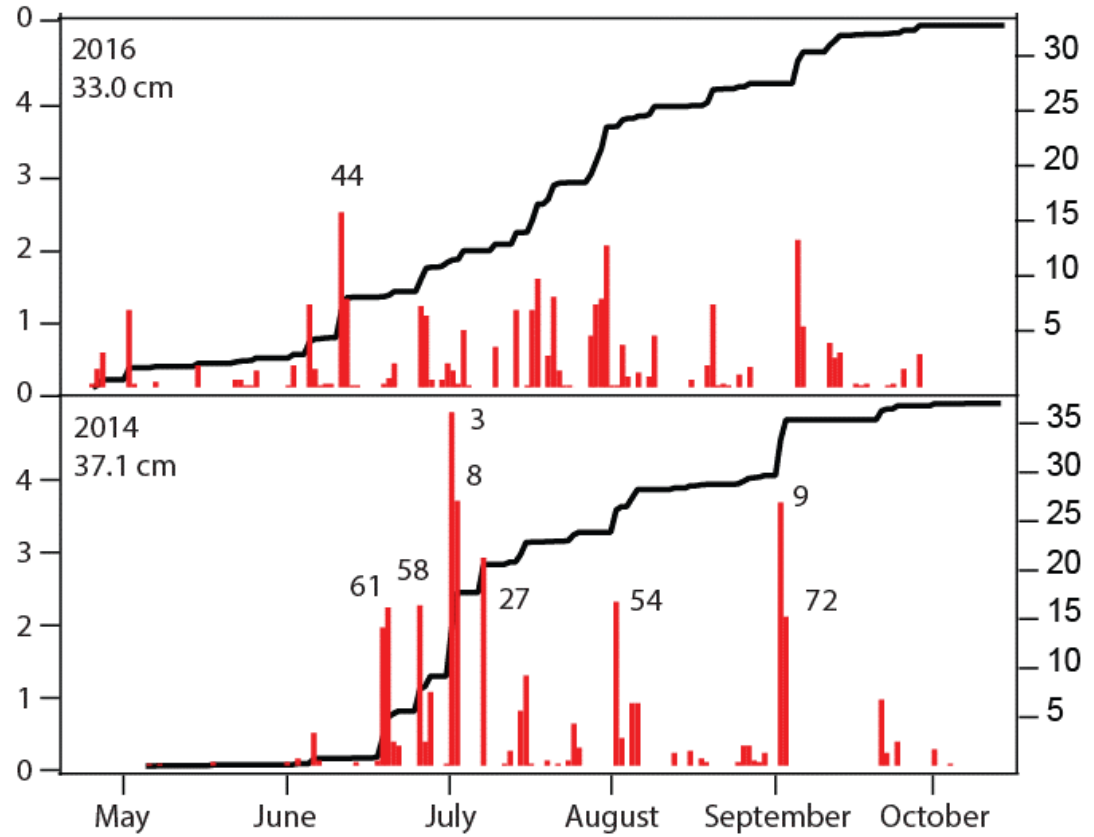


Intensive ground temperature monitoring

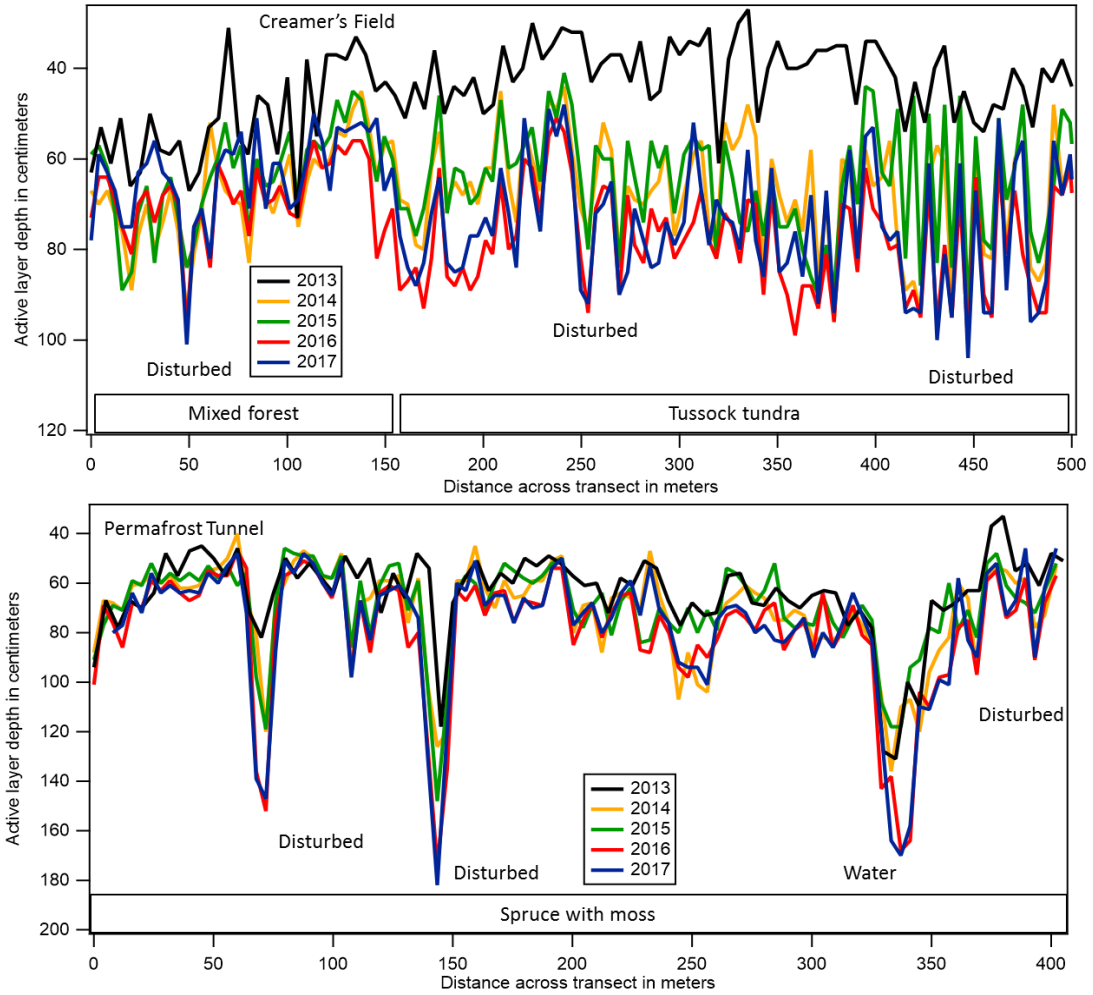
- Strong warming trend since 2010
- Threshold? The active layer at the GI unburned Bonanza Creek LTER site did not re-freeze this winter

Extensive monitoring of active layer along vegetation/disturbance transects (Douglas & Turetsky, in review)



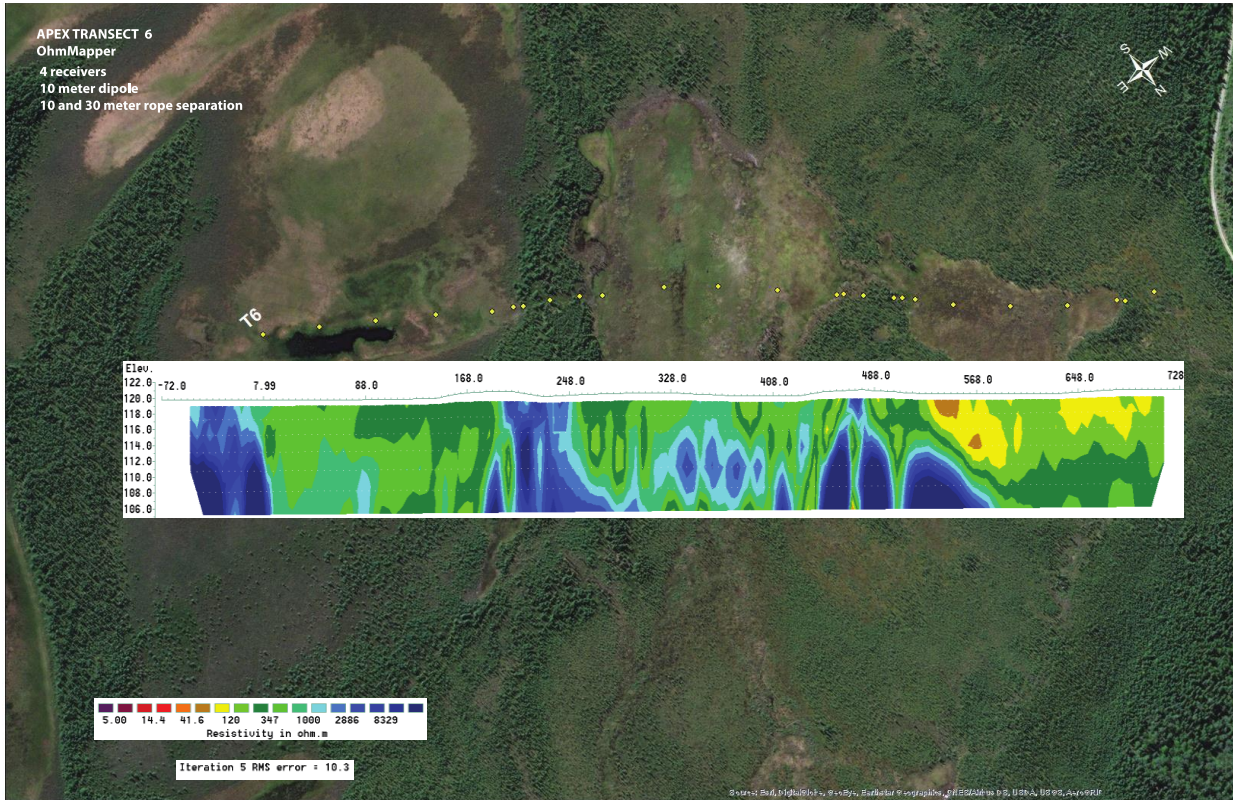


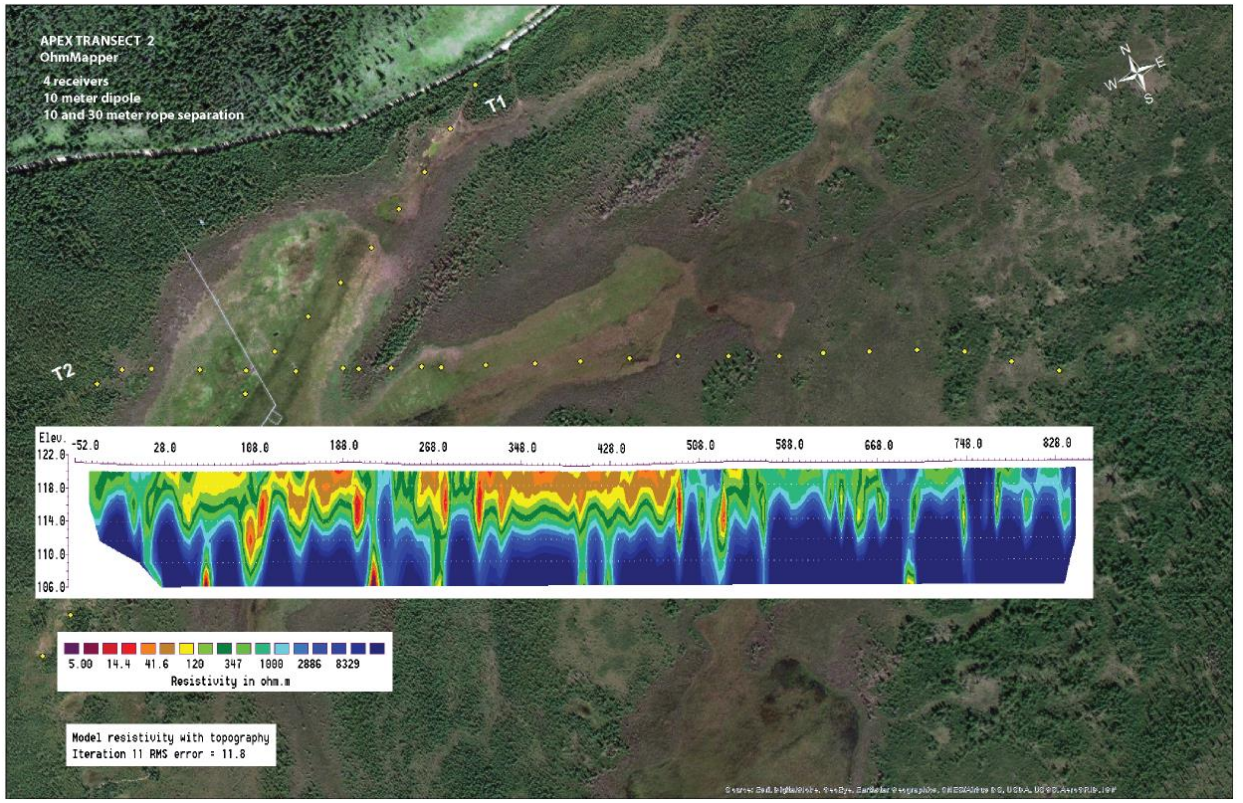
Extensive monitoring of active layer along vegetation/disturbance transects (Douglas & Turetsky, in review)



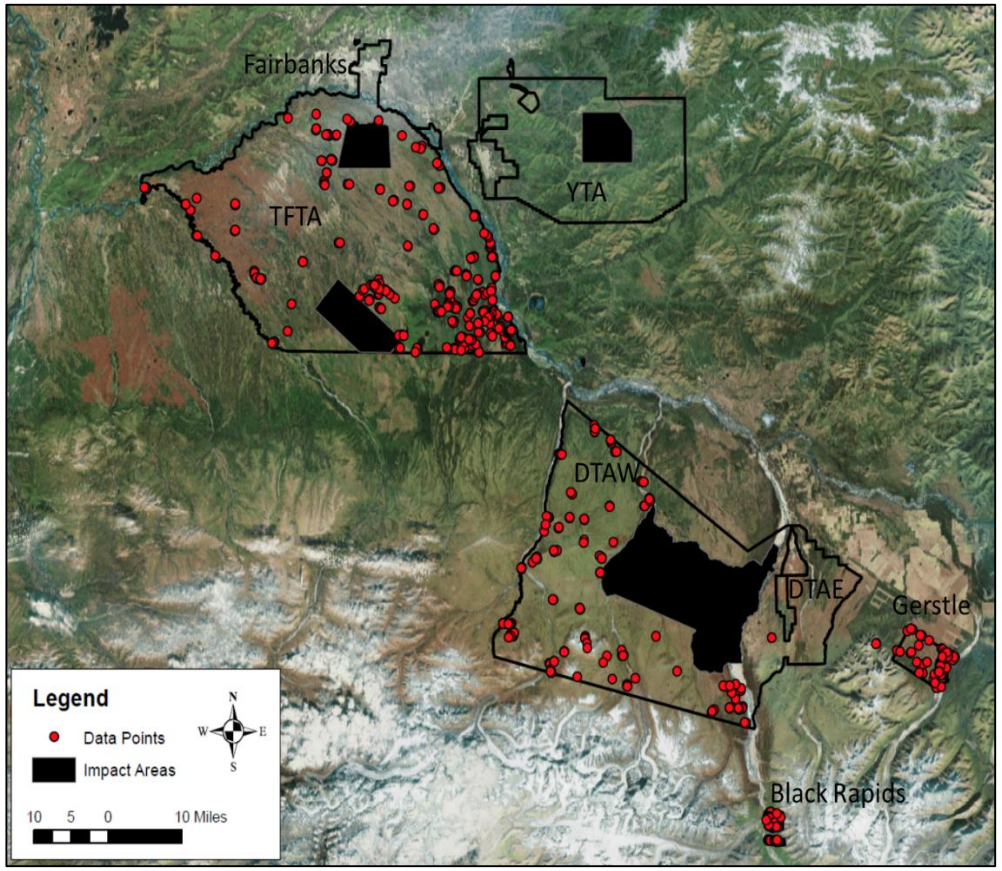
- Synthesized and analyzed 2700 end-of-season thaw probe measurements. Measurement period included two years with high summer rainfall (2016, 2014)
- For every 10 cm increase in rainfall, thaw depth increased by 7 cm.
- Rain-induced thaw was greatest in disturbed and wetland environments

Ongoing activities: Using geophysics and soil/vegetation transects to understand how disturbance and vegetation govern permafrost changes over time (APEX, Creamer's Field, Farmer's Loop, Tunnel)

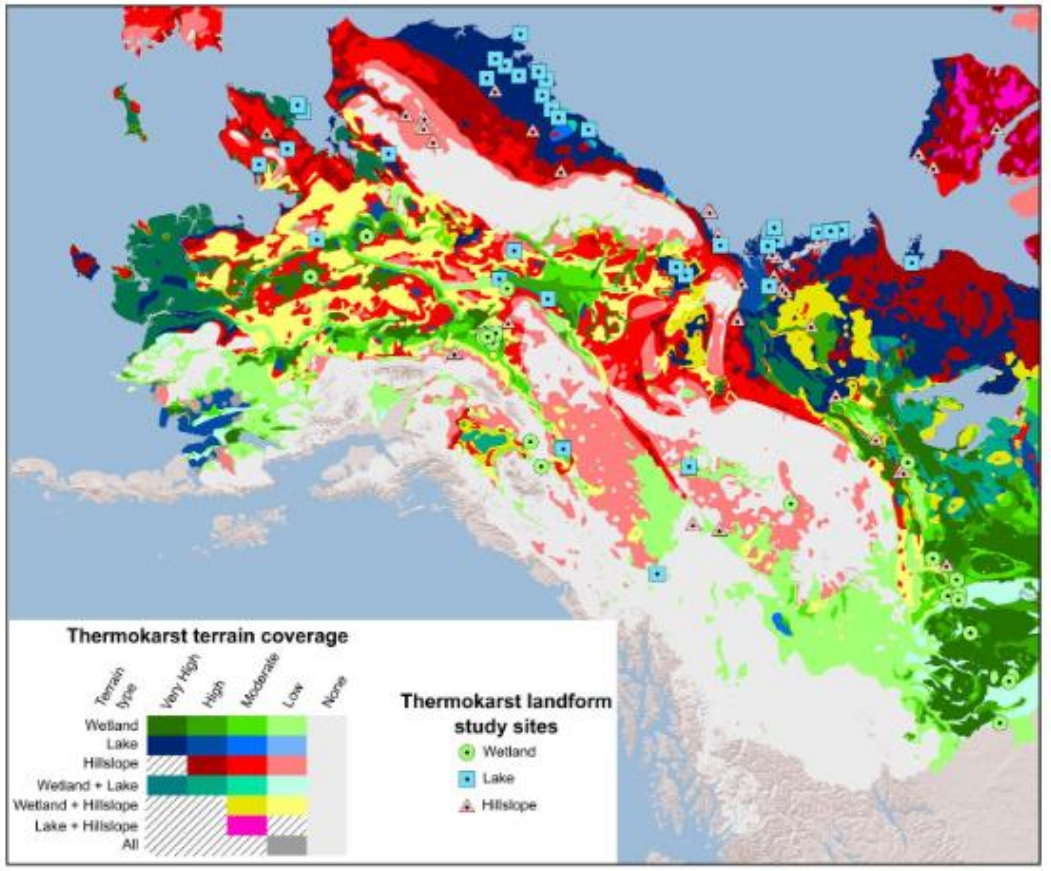




Future plans: improve regional ground ice and thermokarst maps

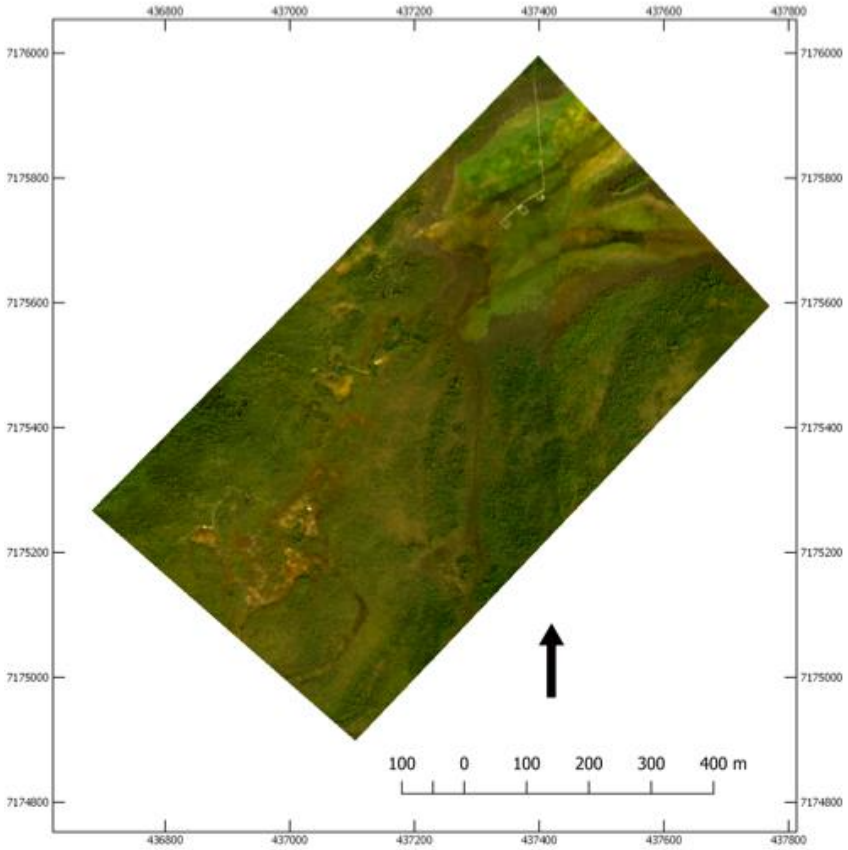


Rescue, synthesize, and interpret ground ice data in interior Alaska (NRCS, Army drill logs)



Improve thermokarst vulnerability mapping but also develop hazards and risk maps

Future plans: capitalize on repeat hyperspectral imagery and LiDAR to find hotspots of vegetation change and subsidence, relate to changes in permafrost. Will's thesis!



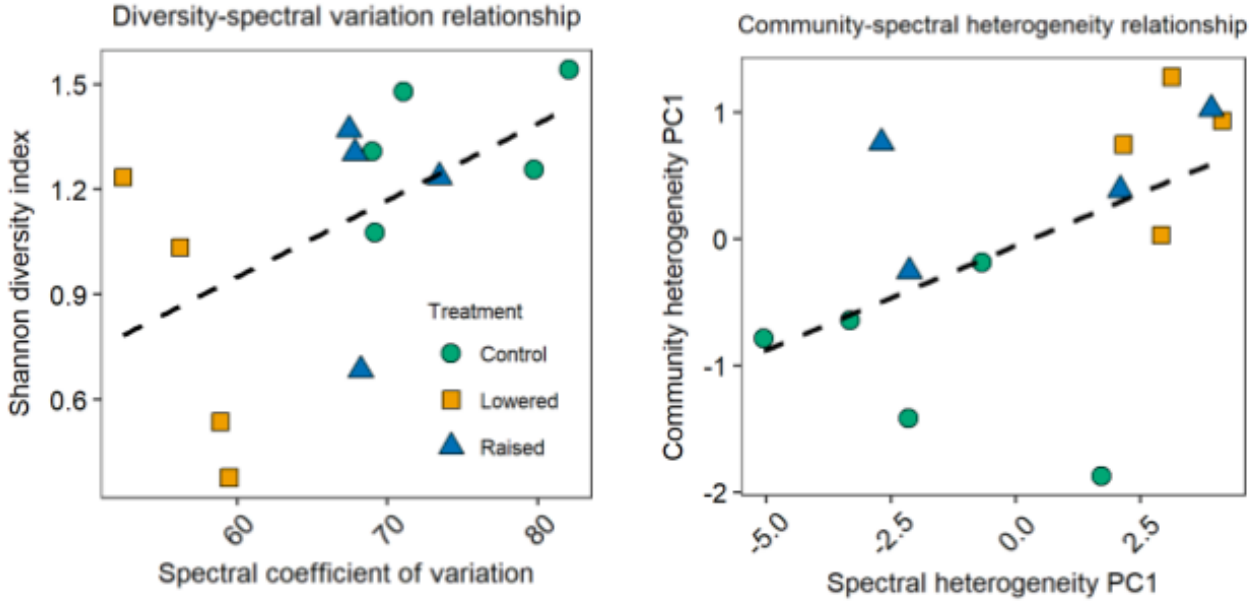


Figure 7: Linear relationship between spectral and community variation. Left: Shannon diversity and spectral coefficient of variation. Right: Spectral heterogeneity and community heterogeneity measured as Euclidian distance for a global centroid calculated using a PCA.

McPartland et al. in review

How does C4 inform understanding of cross-scale interactive effects?

- Changes in temperature and precipitation will impact permafrost differently depending on vegetation, ground ice, hydrology. We cannot simulate the consequences of permafrost change at any scale without understanding these interactions. Is there one aspect of this interaction that can be explored in the modeling section?

- We are analyzing how hotspot changes in ice-rich permafrost manifest across a broad range of biophysical conditions. We know these changes impact terrestrial and aquatic hydrology at larger scales. Are we doing enough as a group to capture this?

- Community planning and risk assessment must be based on good permafrost hazard mapping!