

Permafrost, Snow, Vegetation Interactions on the Seward Peninsula, Alaska

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Next Generation Ecosystem Experiment (NGEE-Arctic)

- Deliver a process-rich ecosystem model, extending from bedrock to the top of the vegetative canopy/atmospheric interface, in which the evolution of Arctic ecosystems in a changing climate can be modeled at the scale of a high-resolution ESM grid cell.

- Geomorphology
- Geophysics
- Hydrology
- Biogeochemistry
- Vegetation Dynamics
- Multi-scale modeling

"How does permafrost thaw and the associated changes in hydrology, soil biogeochemical processes, and plant community succession, affect feedbacks to the climate system?"

NGEE-Arctic Science Questions

- How does the structure and organization of the landscape control the storage and flux of carbon and nutrients in a changing climate?
- What will control rates of CO2 and CH4 fluxes across a range of range of permafrost conditions?
- How will warming and permafrost thaw affect above- and below-ground plant functional traits and what are the consequences for arctic ecosystem carbon, energy, water and nutrient fluxes?
- How will shrub distributions change and generate climate feedbacks with expected climate warming in the 21st century?
- **Where, when, and why will the arctic become wetter or drier?**
- What controls the vulnerability and resilience of Arctic ecosystems to disturbance and how do disturbances alter the physical and ecological structure and function of these ecosystems?

Snow-Vegetation-Permafrost Crosscut

Key goal: Understand and predict how spatial heterogeneity in snow interacts with vegetation composition, micro/macro topography and permafrost dynamics as climate warms and precipitation patterns change.

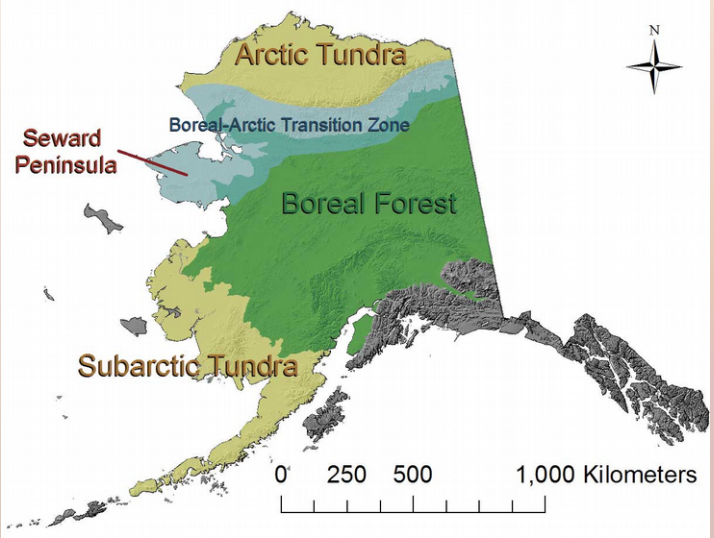
Data Collection

- Snow precipitation
- Snow depth and density
- Snow water equivalent (SWE)
- Ground temperature
- Vegetation composition and structure
- Permafrost depth

Methods of collection

- Meteorological stations
- In-situ gridded and transect-based surveys
- Ground-based geophysics
- Unmanned Aerial System mapping techniques
- Collection of data in a range of spatial and temporal scales

NGEE- Arctic Field Sites



https://alaska.usgs.gov

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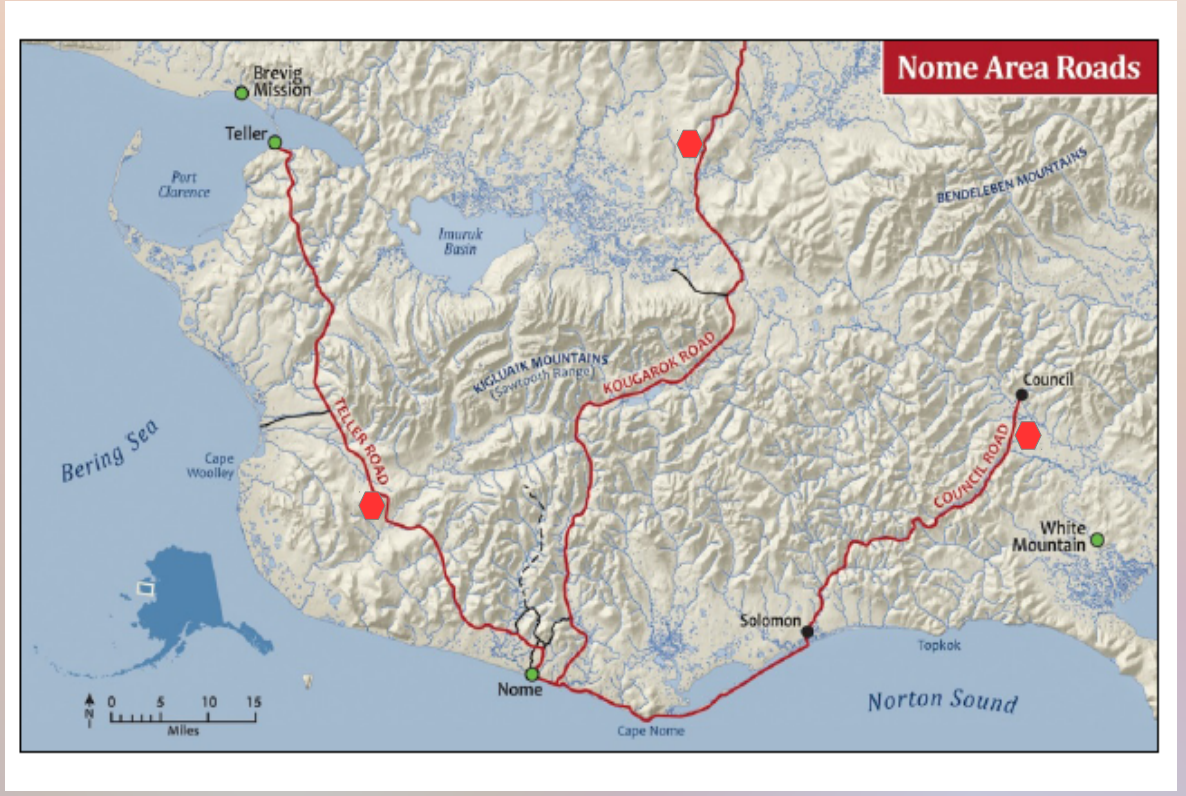
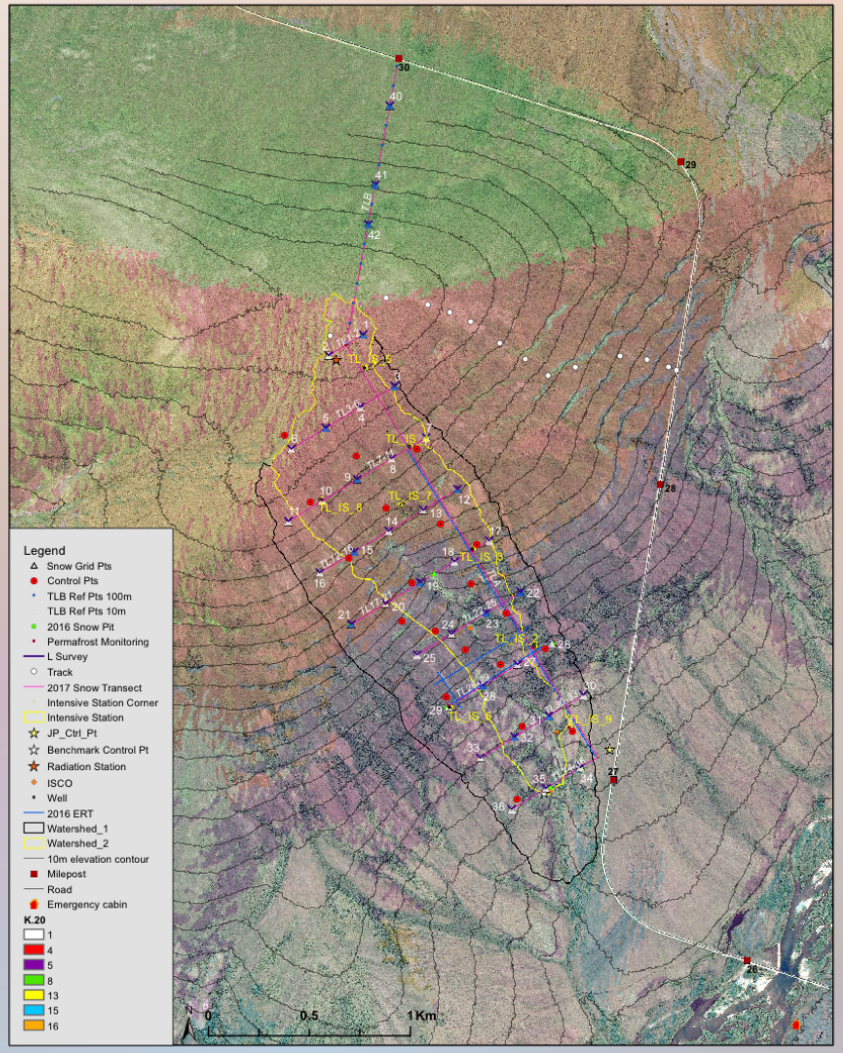
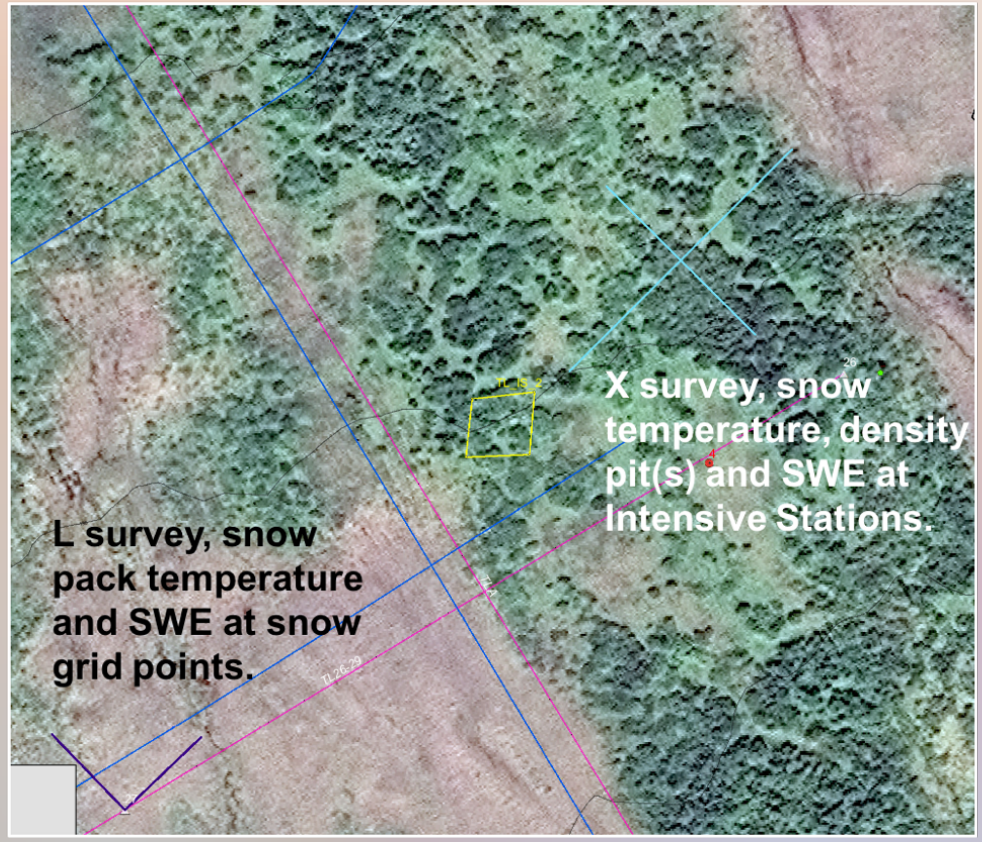


Representative Analysis of Ecotype – Topotype Units

Teller Site (Mile 27)

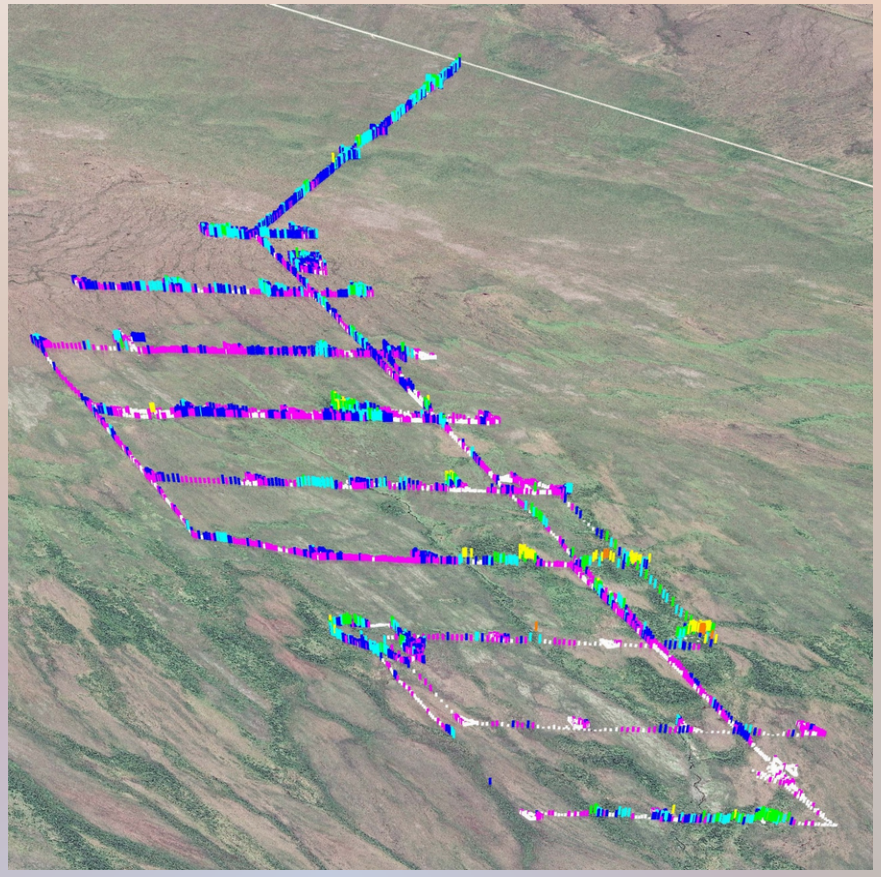




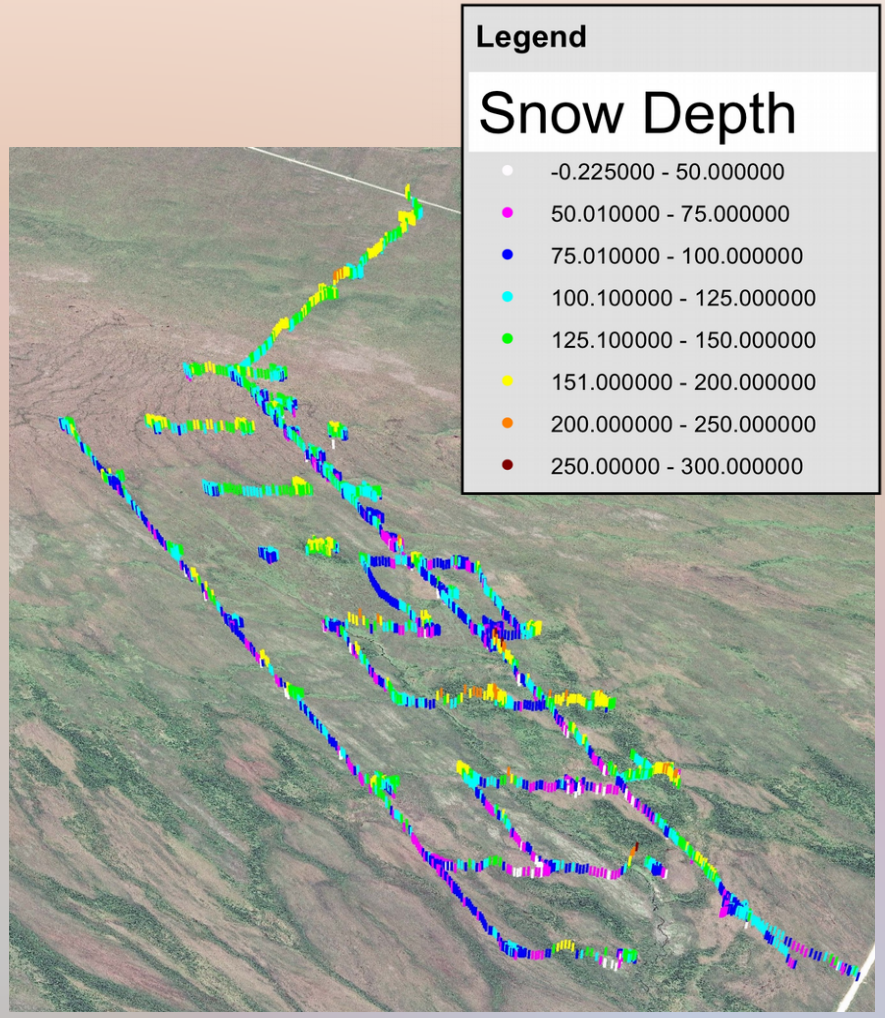
Sampling strategy was determined by ecotype and topotype analysis as well as wind direction

Data Collection

Snow-Vegetation-Topography Interaction

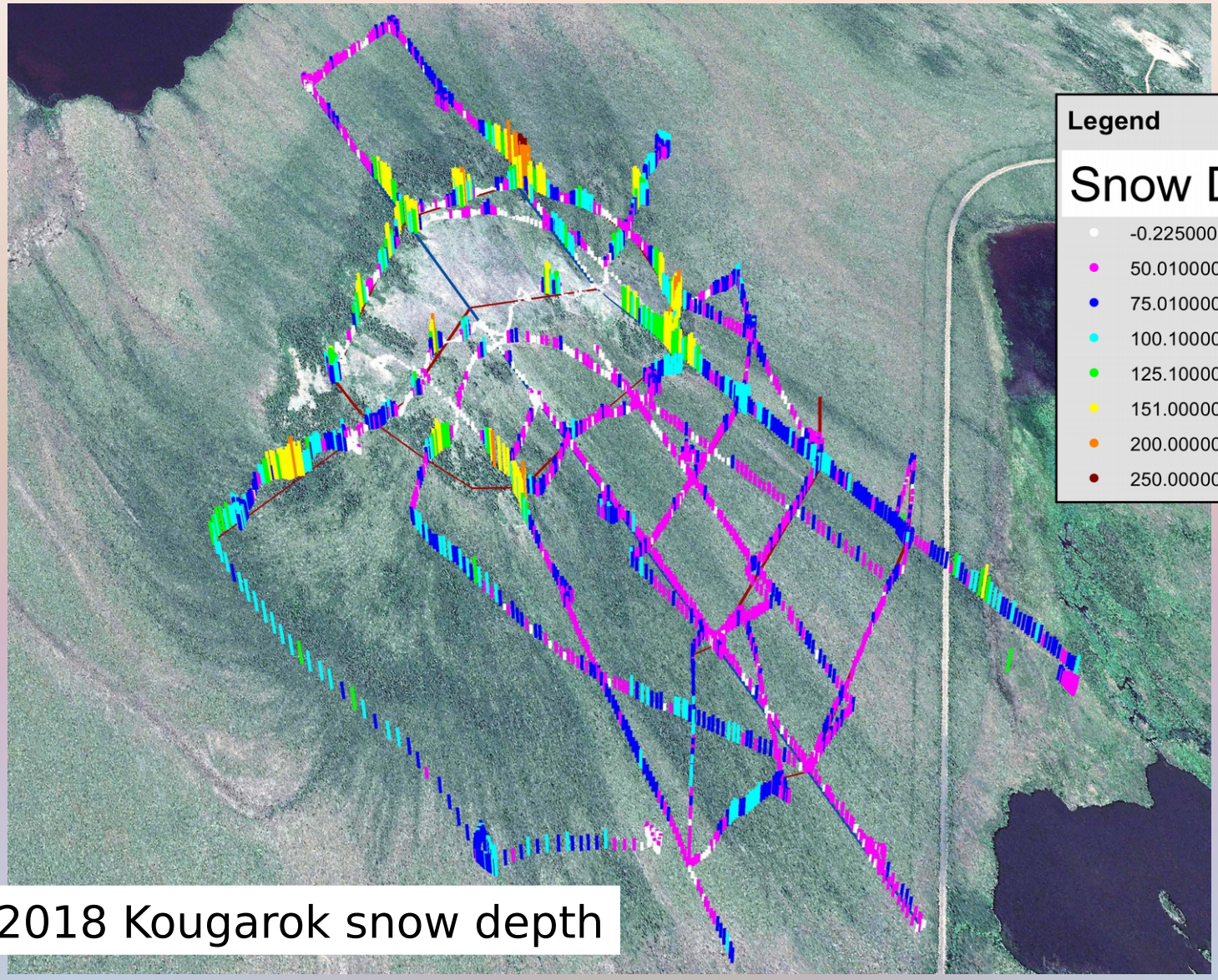


2017 Teller snow depth



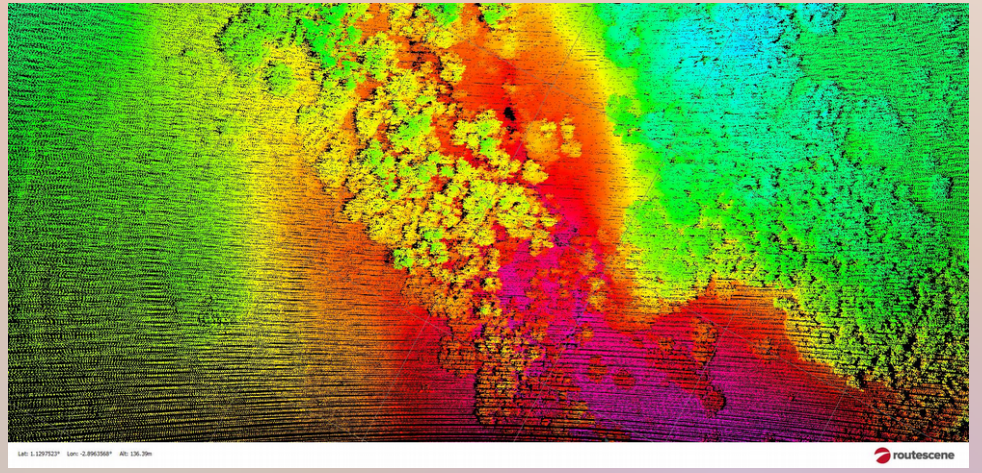
2018 Teller snow depth

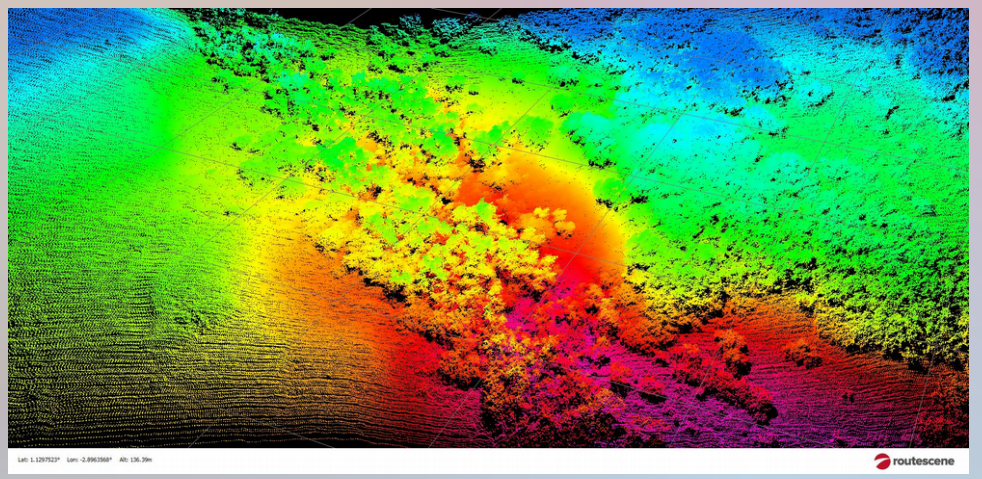
Snow-Vegetation Relationship



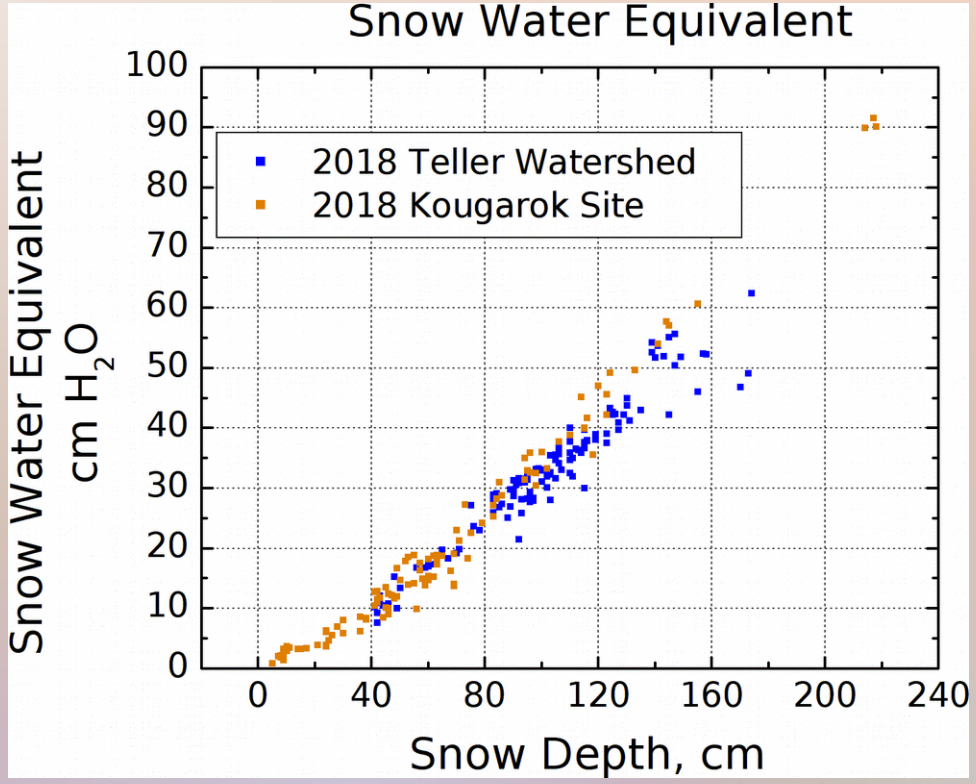
2018 Kougarok snow depth

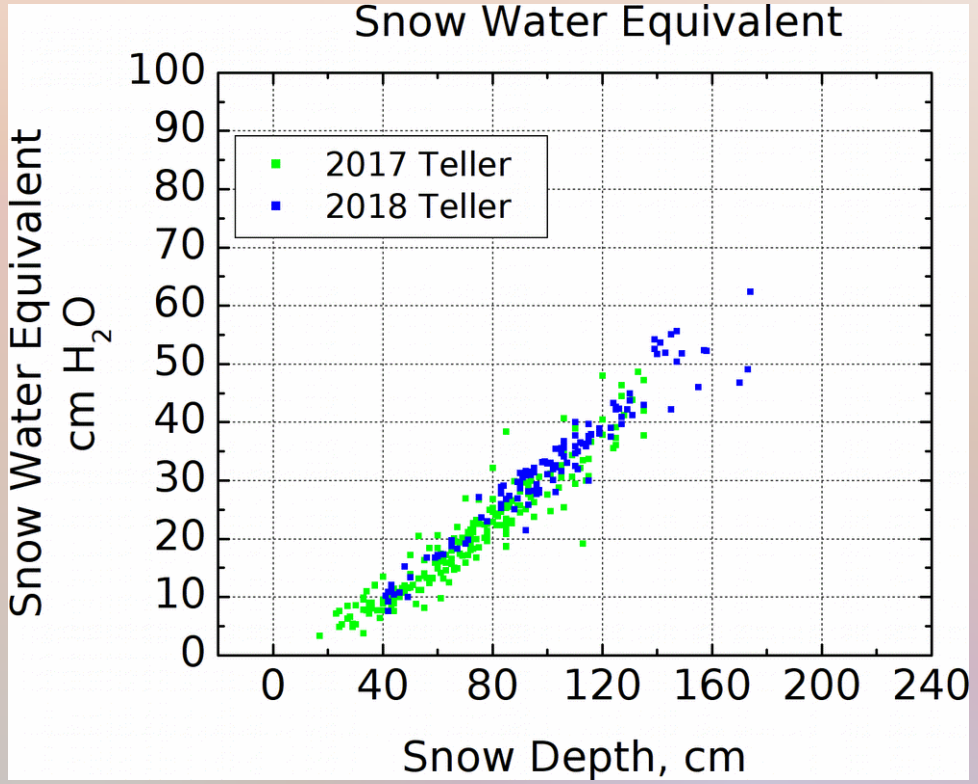
Aerial Survey





Snow-Vegetation Relationship





Vegetation – Permafrost Interactions

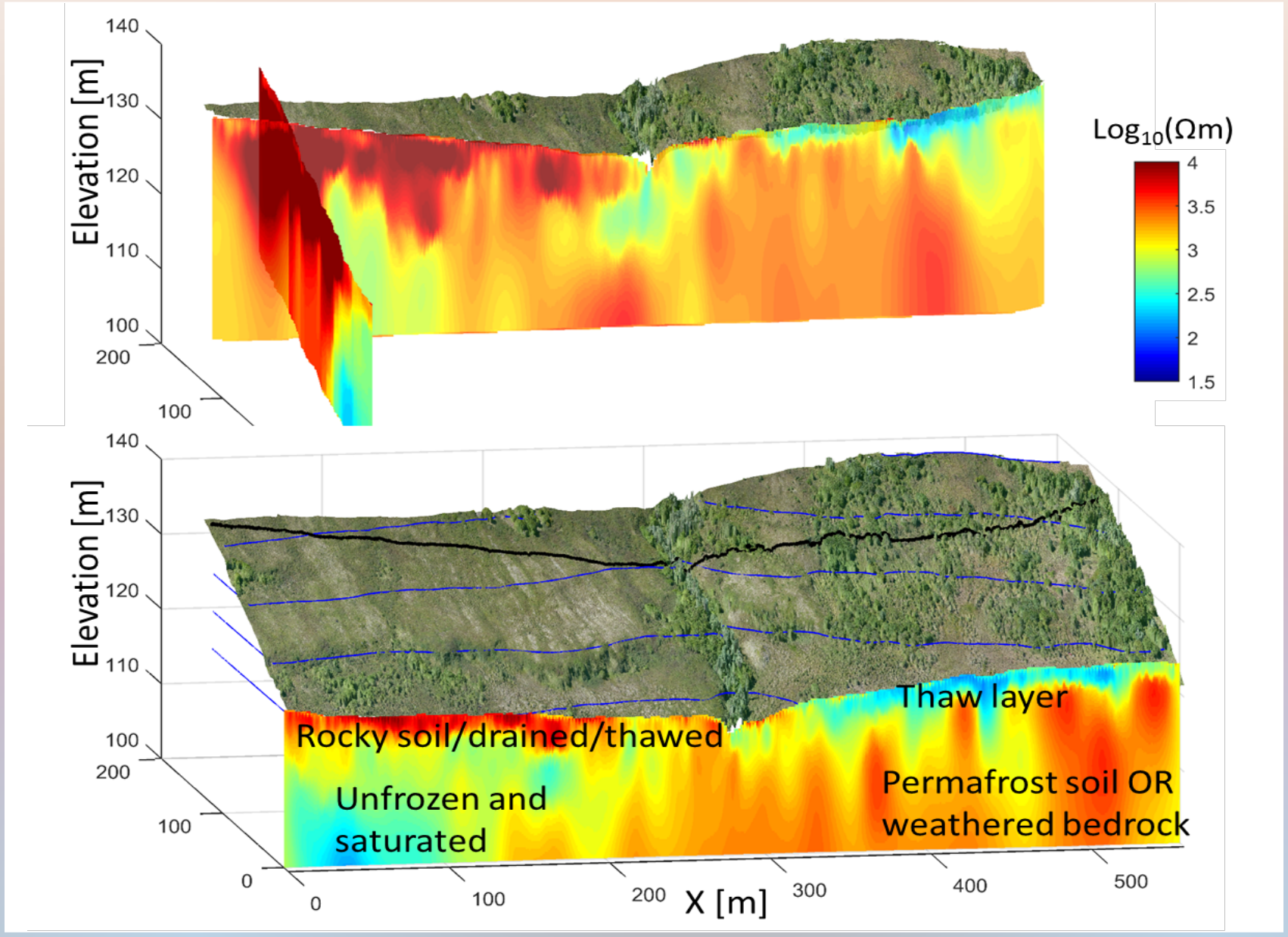
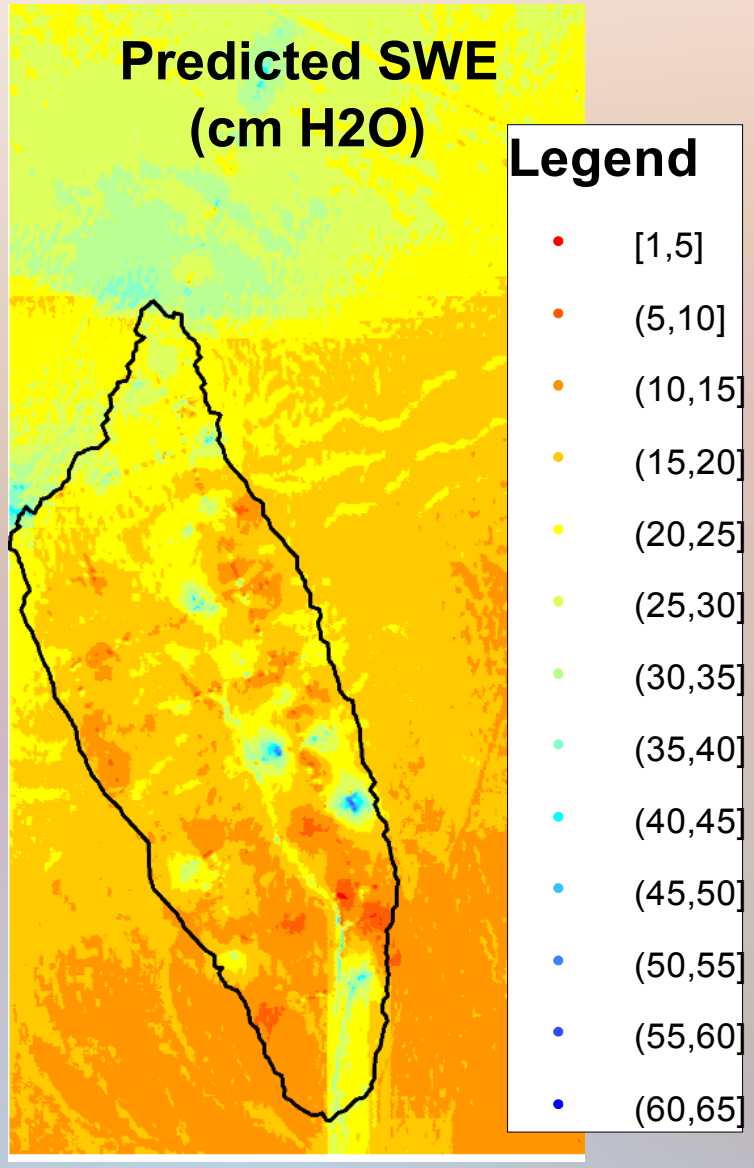
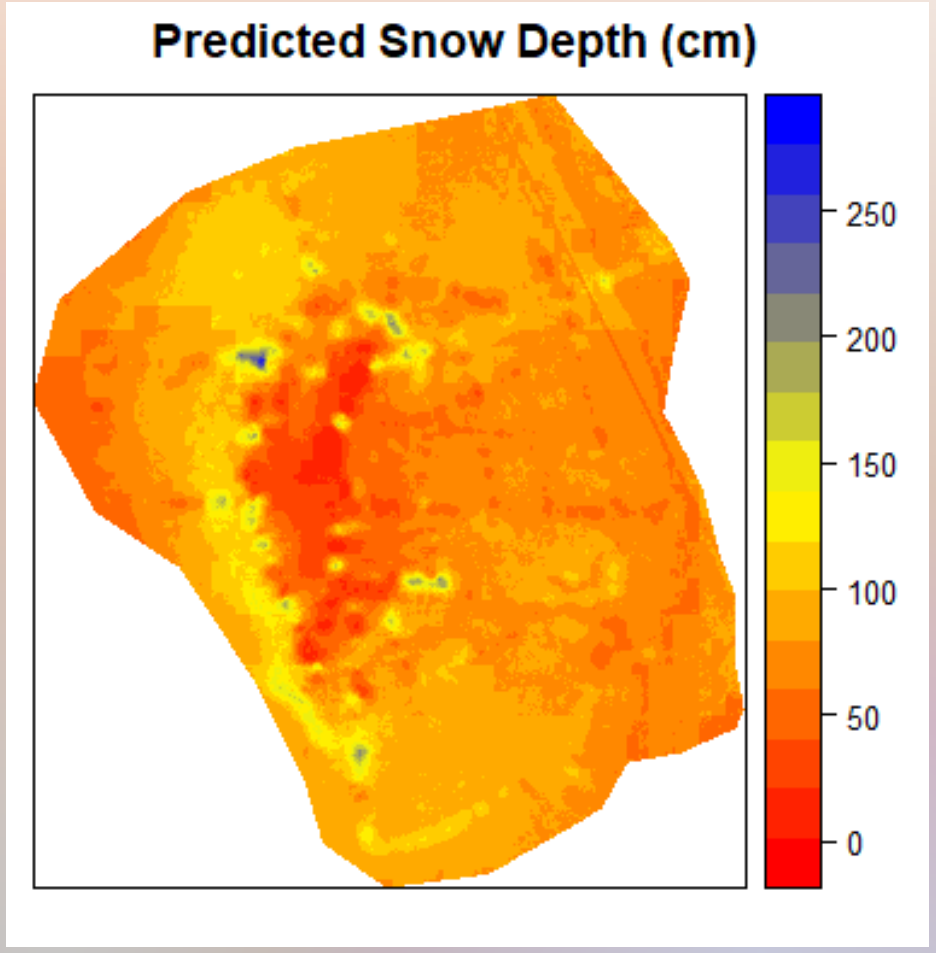


Image courtesy of B. Dafflon, LBNL

Statistical Model Development





Topographic, climatologic, and vegetation factors

Discussion

- The vegetation and topographic factors identified in the statistical models explain 42% of the variation in snow distribution at the Teller Road and 67% at Kougarok Road field sites.
- Improving our understanding of the role vegetation size and structure has in trapping snow
- Apply the statistical model of snow distribution from the watershed- to the regional-scale

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