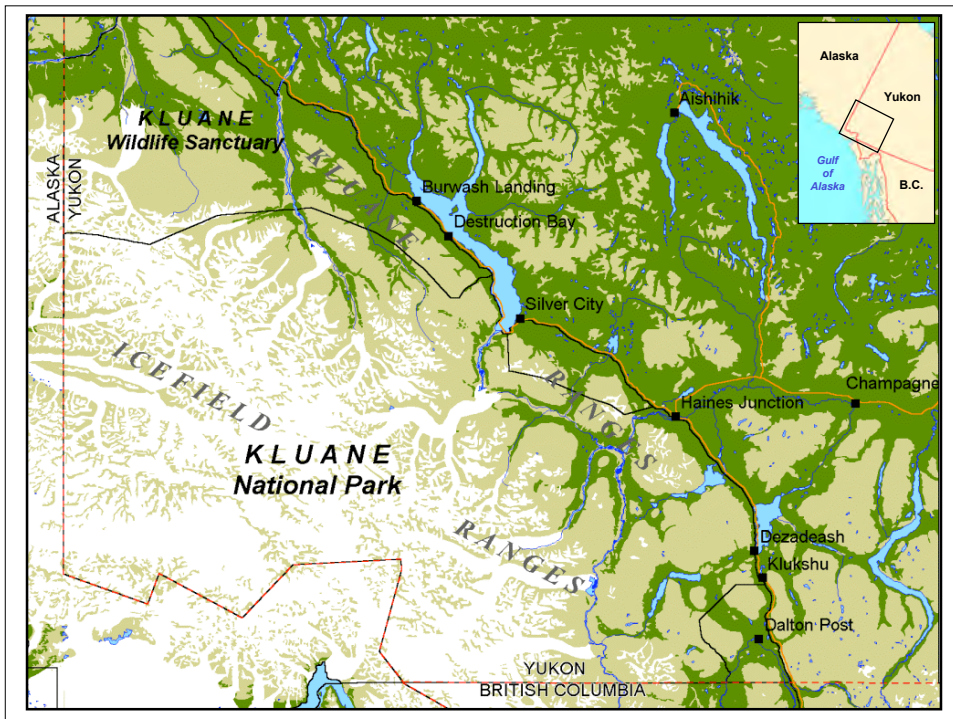
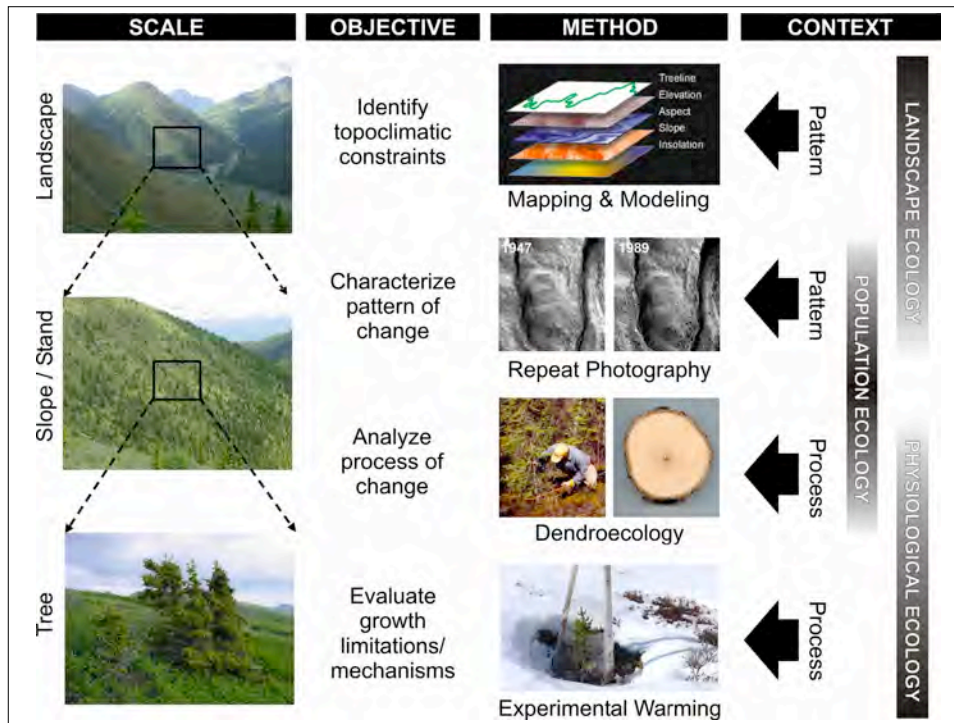


Dynamics of Treeline in the Kluane region

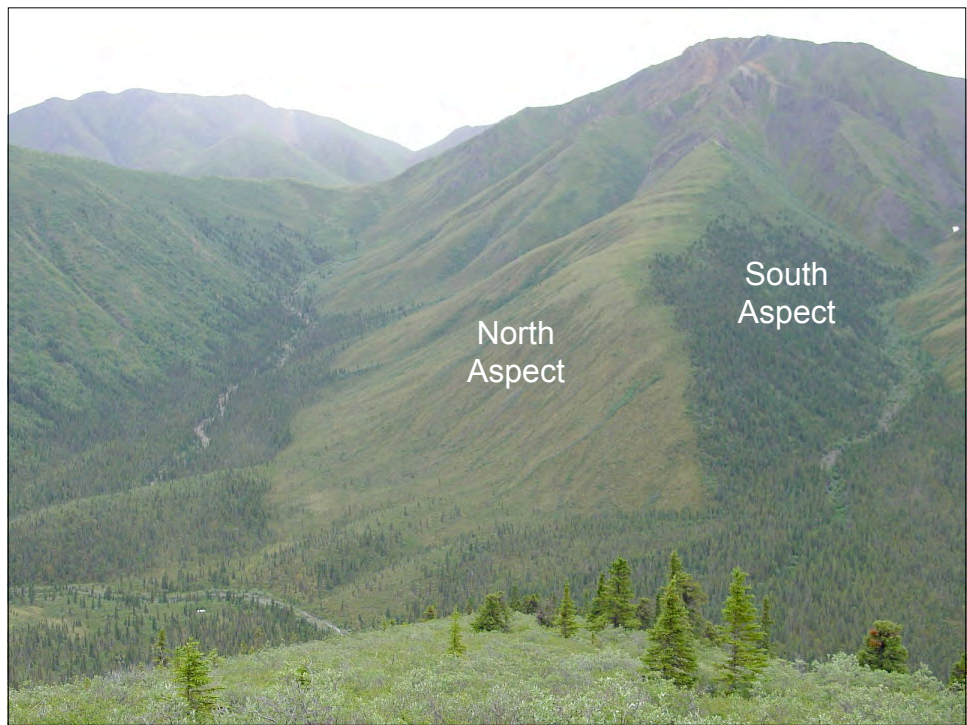
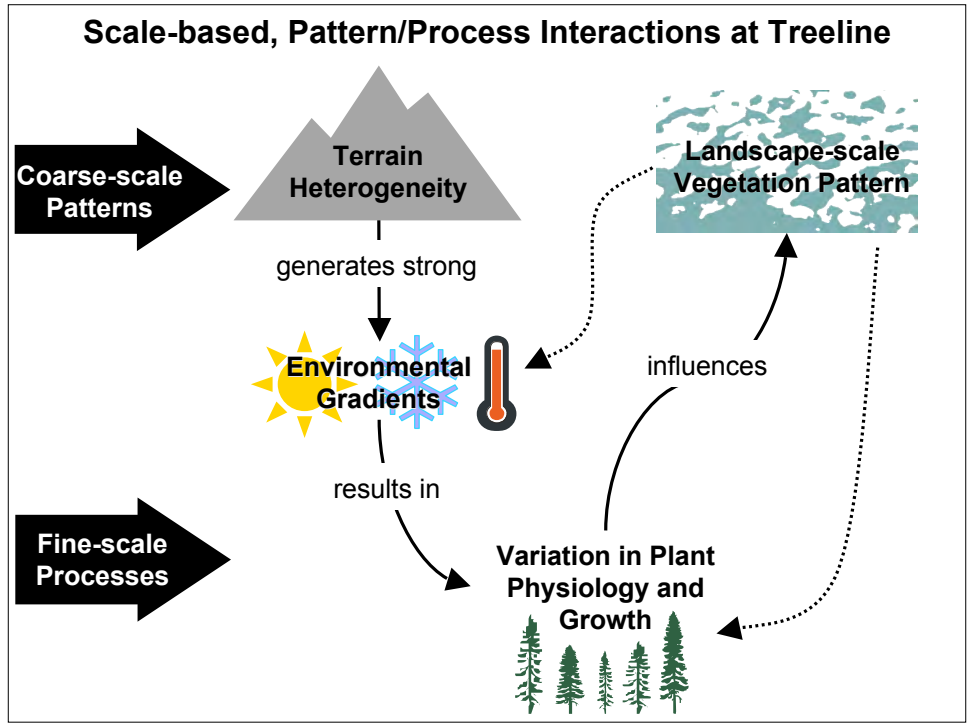


Ryan Danby, Queen's University
David Hik, University of Alberta

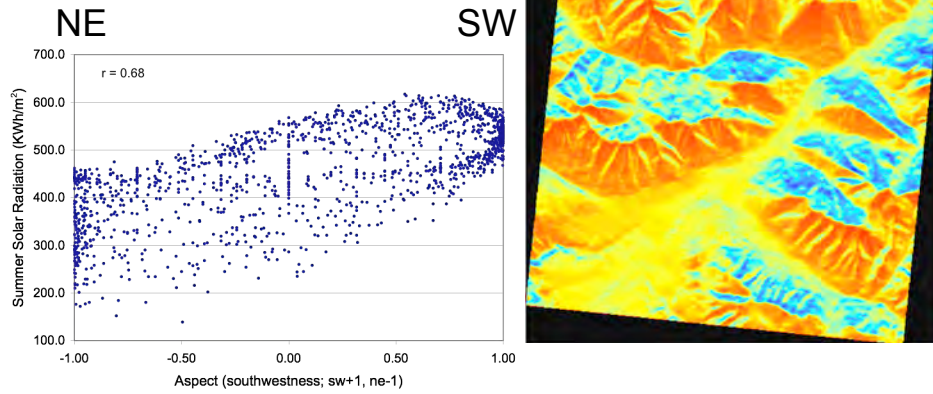




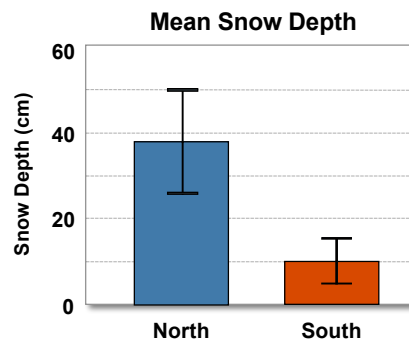
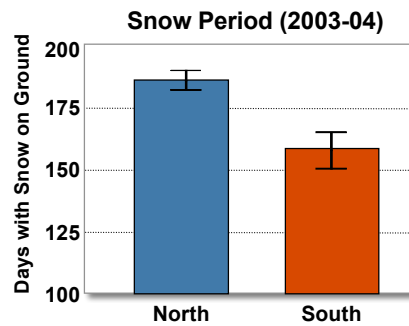
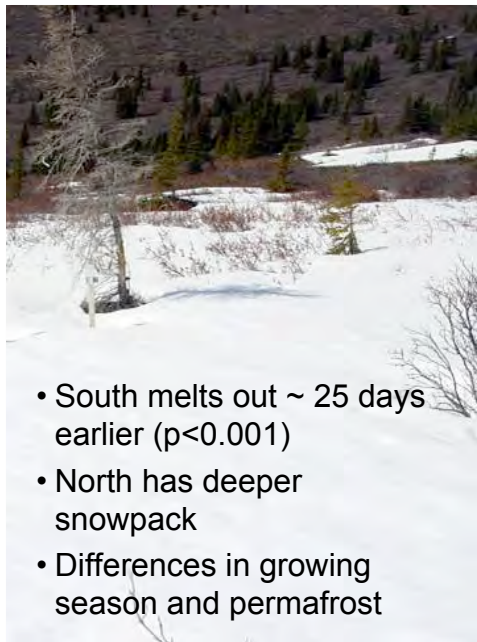




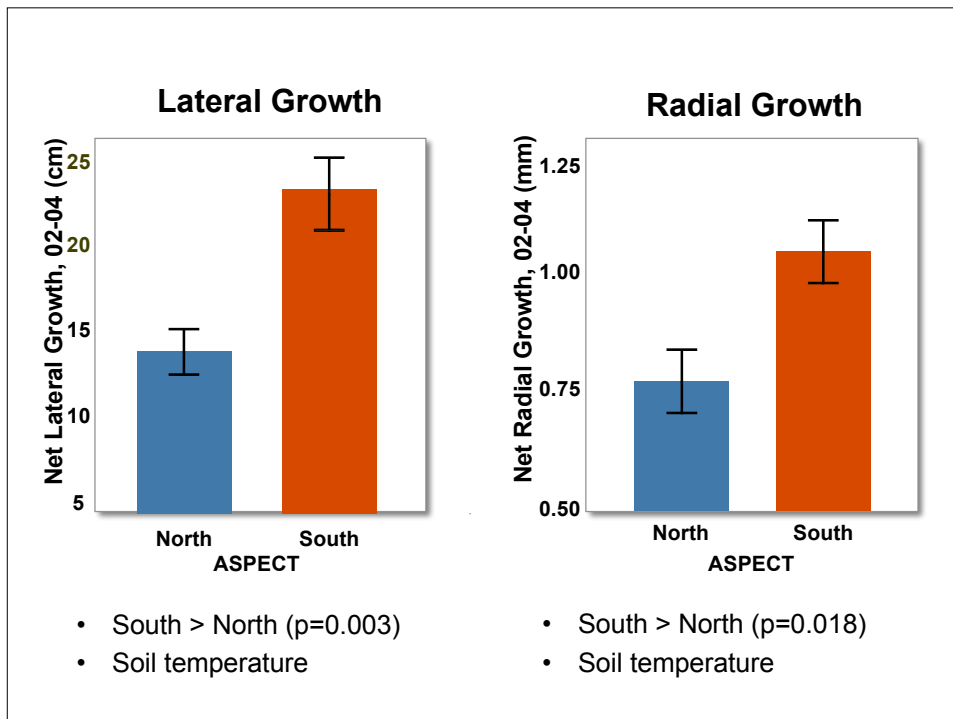
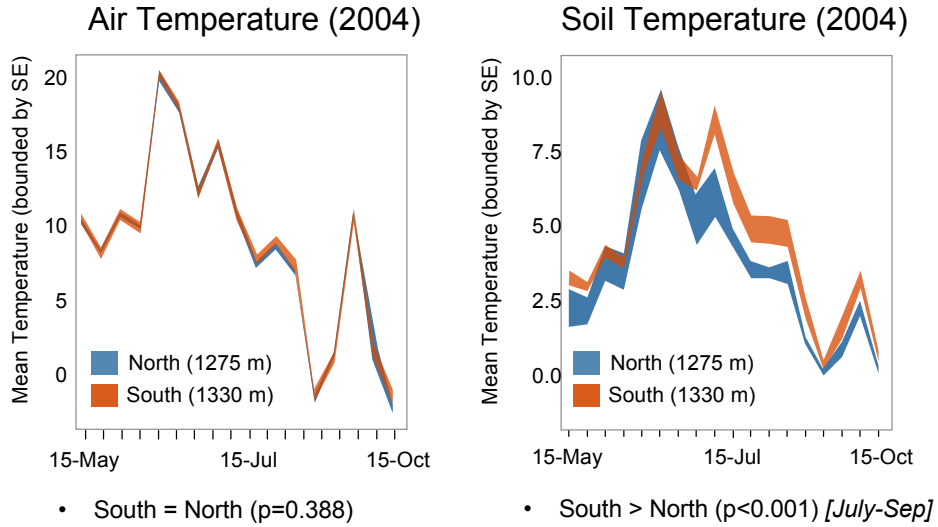
1. Solar Radiation



2. Snow

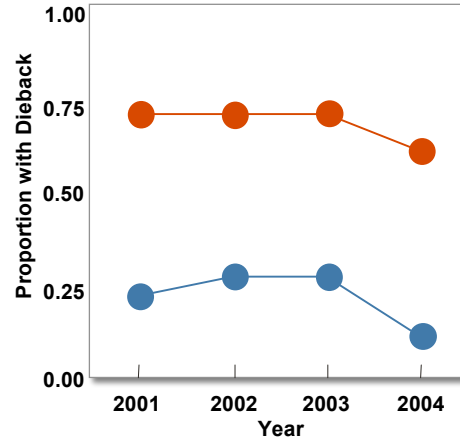


3. Temperature



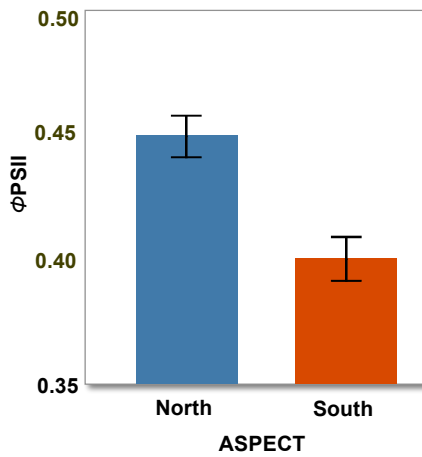


Winter Needle Mortality



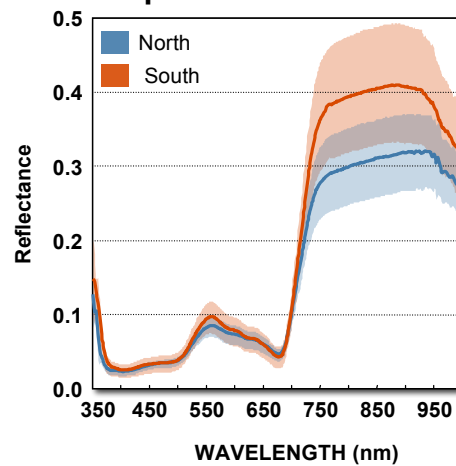
- South > North
- Winter desiccation

PSII Efficiency



- North > South ($p < 0.001$)
- Photoinhibition

Spectral Reflectance



- North \neq South
- Photoinhibition

Climate Change = Increase Number, Duration &/or Intensity of Winter Thaws

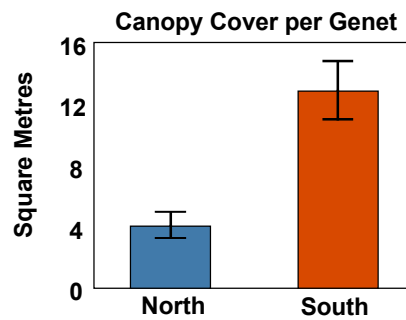
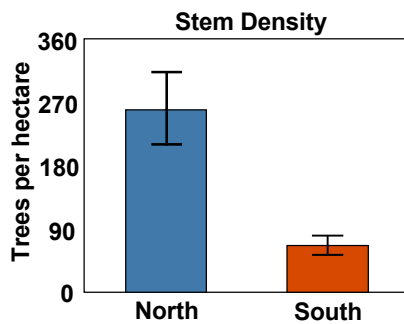
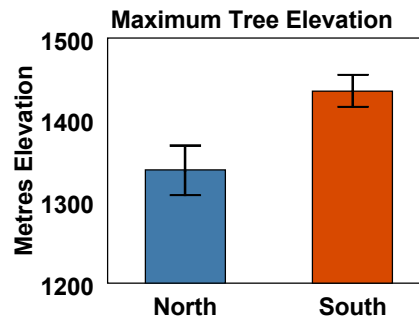
(Paul Schaberg 2000, AAAR: 378)

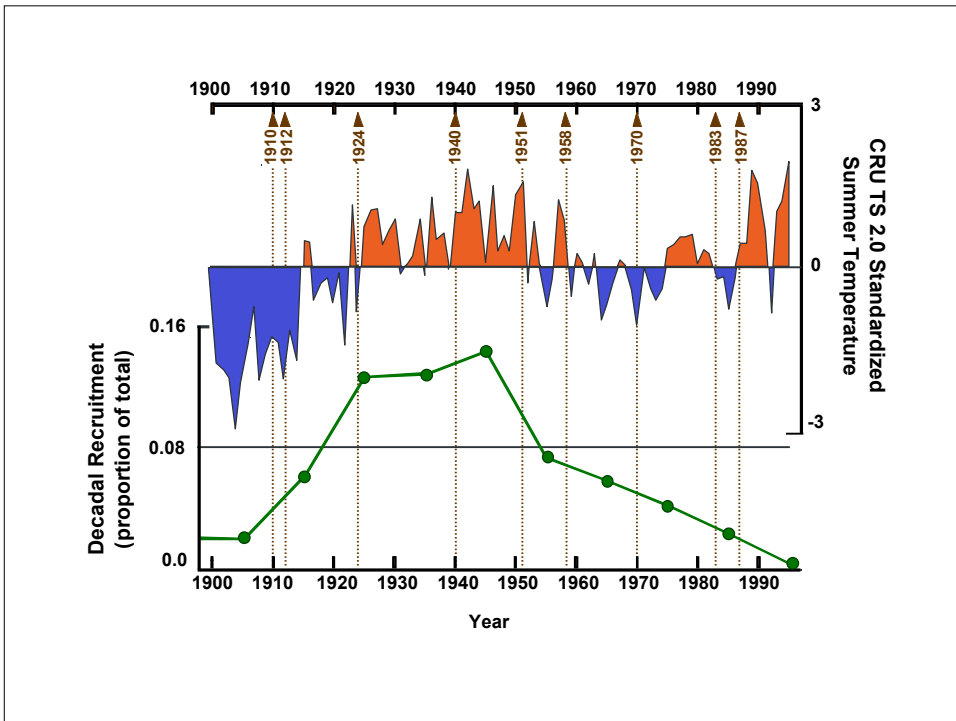
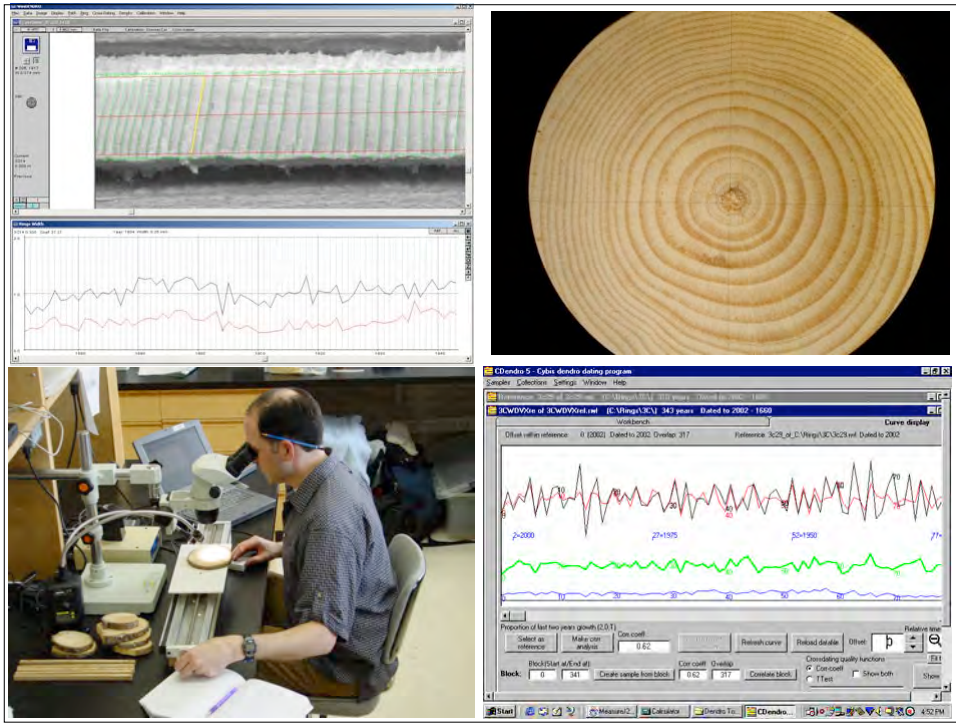


Thaw Beneficial

TRADEOFF

Thaw Detrimental

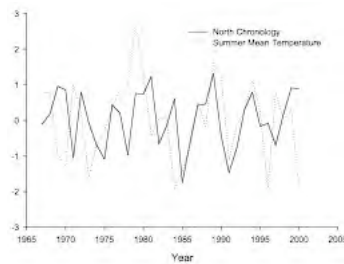
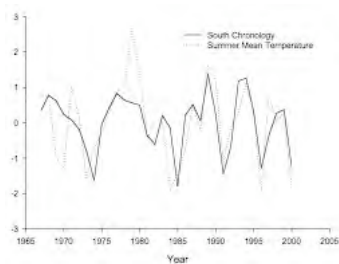




Chronologies and Climate

Table 6. Pearson correlation coefficients between south and north aspect chronologies. Summer variables included June-August mean values, Spring variables include April and May mean values. May-June represent early, and July - August late growing season. Previous July-August mean temperature refers to those months of the previous year. P-values were calculated for 0.05 confidence levels, and bold values are significant.

	Summer Mean Temperature	Spring Mean Temperature	Total Snow (CM)	Spring Rain (mm)	Summer Rain (mm)	May-June Mean Temperature	July- August Mean Temperature	Previous July-August mean Temperature
South								
R	0.597	0.483	-0.126	0.045	-0.392	0.484	0.415	0.297
P-Value	0.001	0.004	0.477	0.799	0.022	0.004	0.015	0.094
North								
R	-0.082	-0.207	-0.128	0.041	-0.178	0.067	-0.210	-0.326
P-Value	0.646	0.241	0.469	0.818	0.313	0.706	0.233	0.064

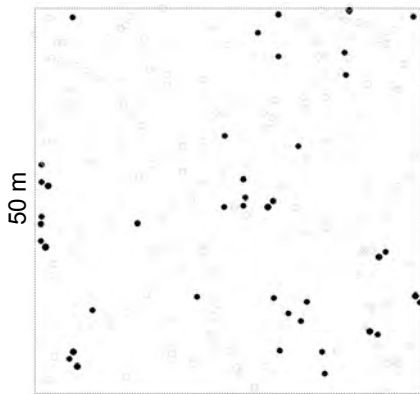


Demontigny et al.

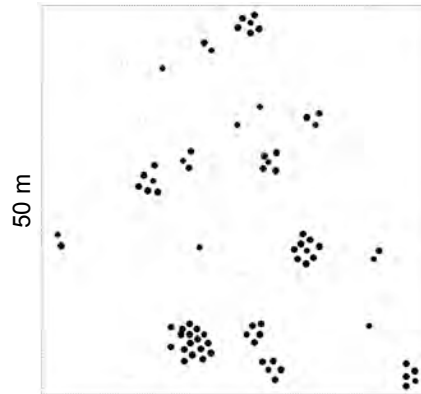


***Picea glauca* Stems Greater than 2 m
(PPS definition of a tree)**

North Aspect



South Aspect

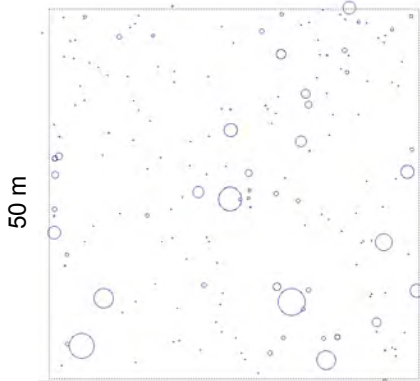


● Stem >2.0 m ○ Stem <2.0 m

Relative Canopy Area of *Picea glauca* Genets

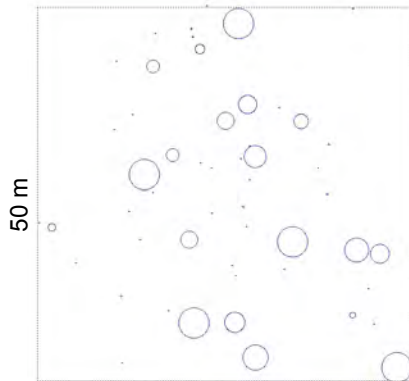
North Aspect

8.5% spruce canopy cover

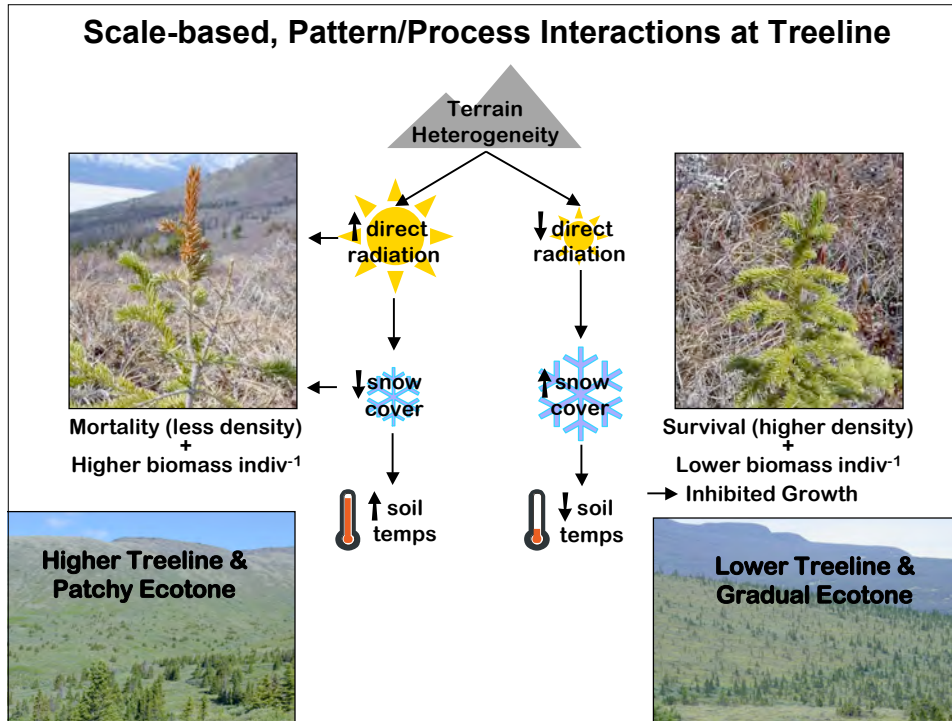


South Aspect

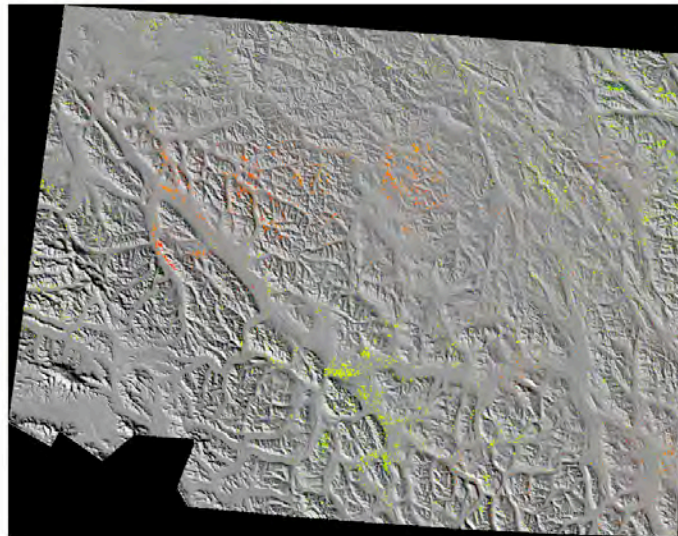
9.9% spruce canopy cover



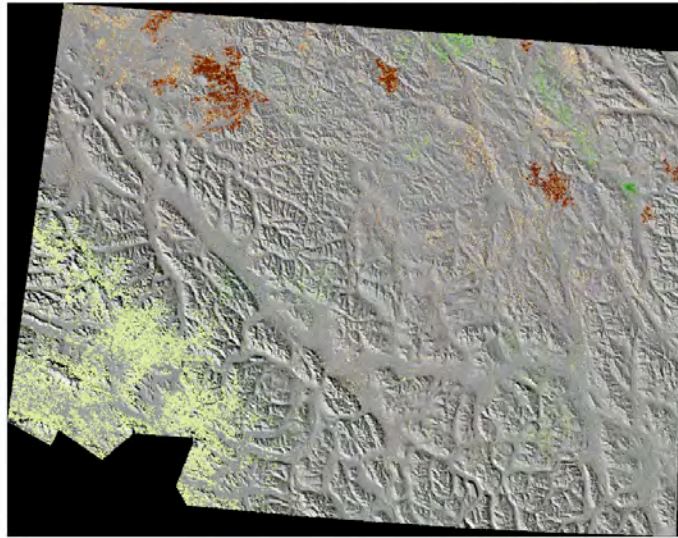
Scale-based, Pattern/Process Interactions at Treeline



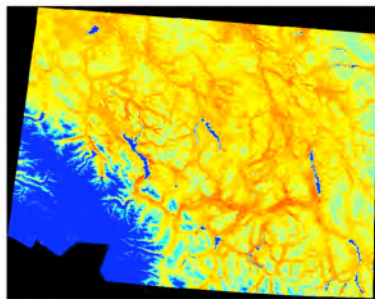
Trends in the Duration of Snow Cover, 2000-07



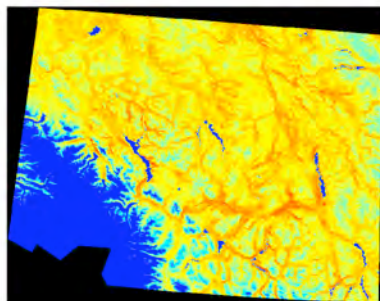
Trends in NDVI, 2000-07



- Decrease in NDVI ($p < 0.05$)
- Increase in NDVI ($p < 0.05$)
- No significant trend



Mean Annual Maximum NDVI

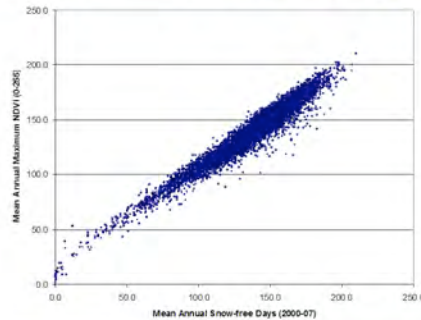


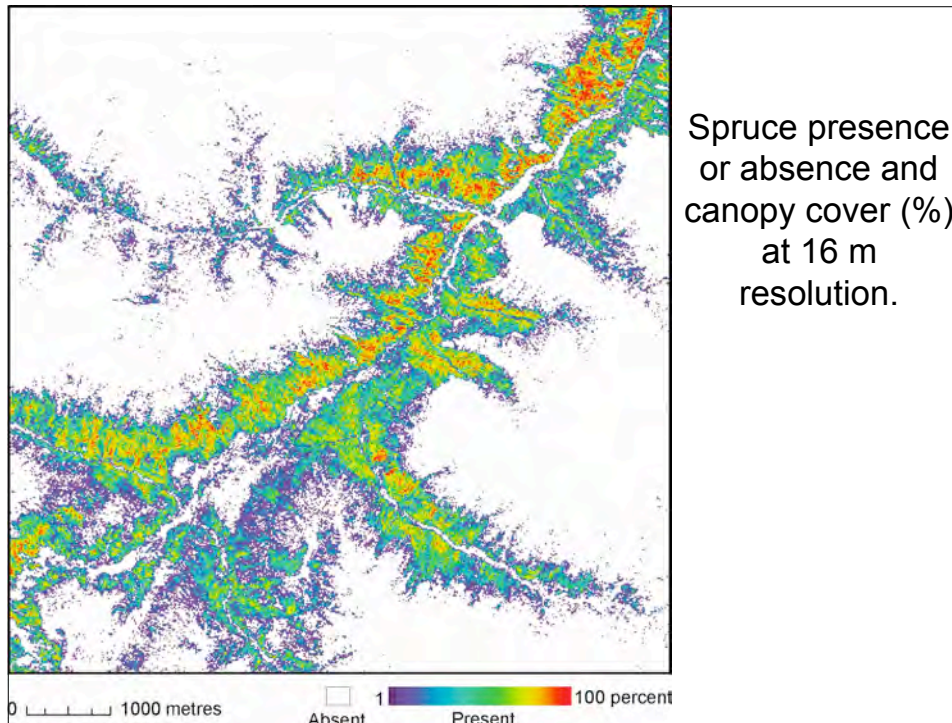
Mean Annual Snow Free Days

Areas of highest NDVI also tend to be the areas where the snow-free season is longest

Several reasons for this and are currently being explored

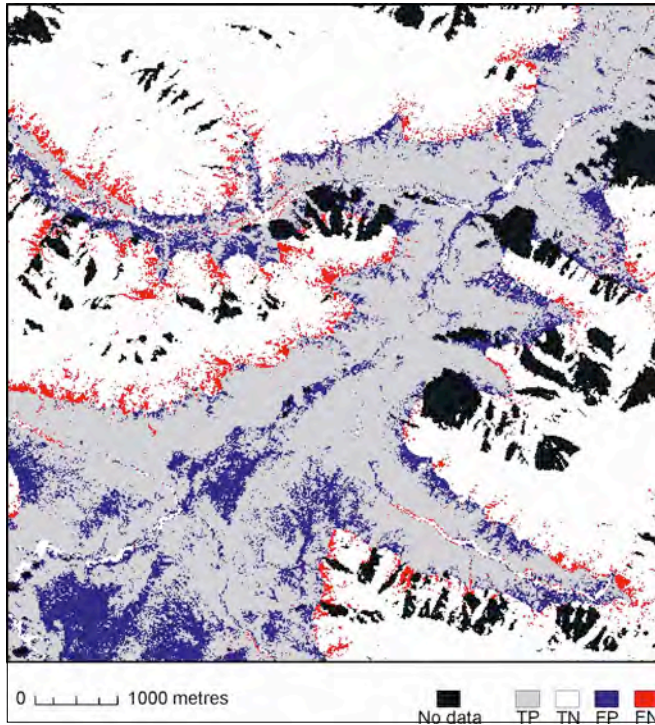
Implication for treeline not necessarily obvious



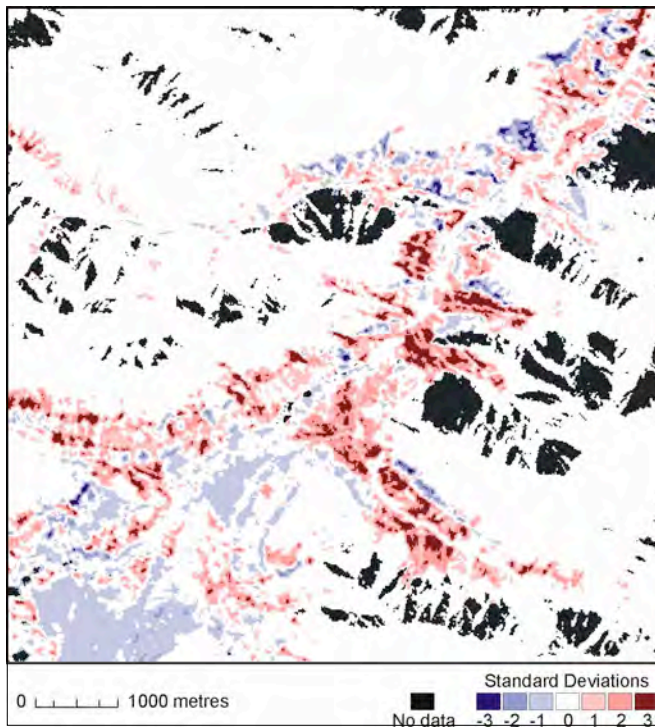


Environmental variables used as independent variable in Quickbird CART

Name	Description	Source	Range ($\bar{x} \pm SD$)	Rationale
elev	Elevation (metres)	Original DEM	931 – 2138 (1402.6 \pm 223.0)	Controls vertical temperature gradient
slp	Slope gradient (degrees)	SAGA GIS	0 – 51.0 (22.6 \pm 11.2)	Influences drainage and soil development
srad	Direct solar radiation, Jun 1-Aug 31 (kW/m ²)	ArcView Solar Analyst	77 – 639 (444.8 \pm 110.8)	Influences air and soil temperature, snowmelt and evapotranspiration
curv	Slope curvature (categorical)	SAGA GIS	9 classes	Influences snow accumulation and drainage
wet	Topographic wetness (unitless)	SAGA GIS	3.8 – 17.6 (6.7 \pm 1.8)	Measure of soil moisture potential
geol	Bedrock geology (categorical)	Israel <i>et al.</i> 2005	14 classes	Substrate influences soil type which may influence vegetation
rock	Rock & gravel (percent of pixel)	QuickBird MS image	0 – 100 (10.4 \pm 24.7)	Surrogate for soil depth



Comparison of observed white spruce distribution with predictions based on classification tree model.



Regression tree residuals

Reds = underprediction,

Blues = overprediction

