Vegetation controls on carbon, water, and energy dynamics with implications for permafrost thaw

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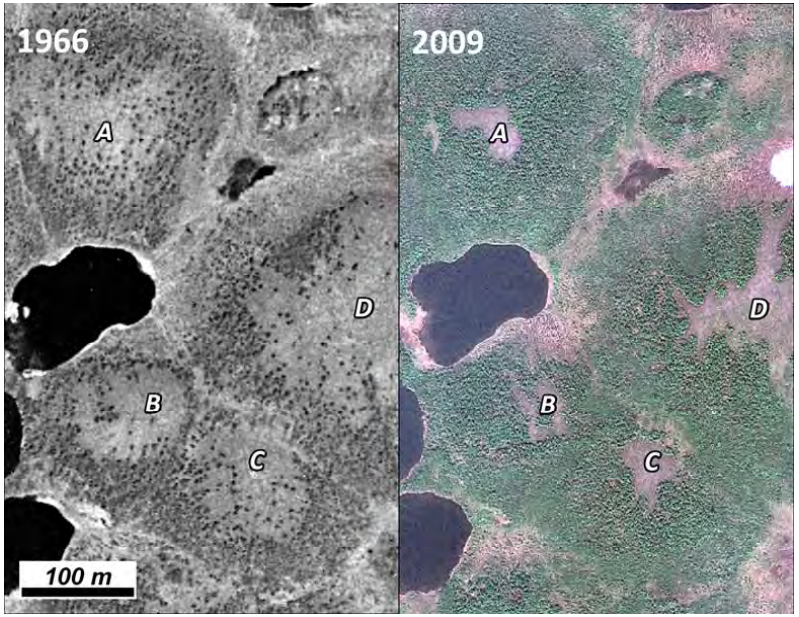
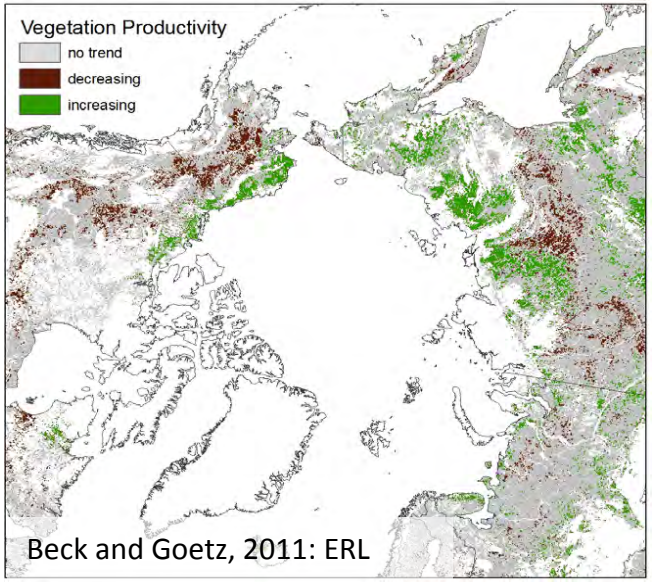
High Latitude Vegetation Change & Permafrost

We know that vegetation communities are changing, and that these changes influence soil temperatures



Frost & Epstein, In Press, GCB



Beck and Goetz, 2011: ERL

Global Change Biology

Global Change Biology (2009), doi: 10.1111/j.1365-2486.2009.02110.x

Shrub expansion may reduce summer permafrost thaw in Siberian tundra

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The Cooling Capacity of Mosses: Controls on Water and Energy Fluxes in a Siberian Tundra Site

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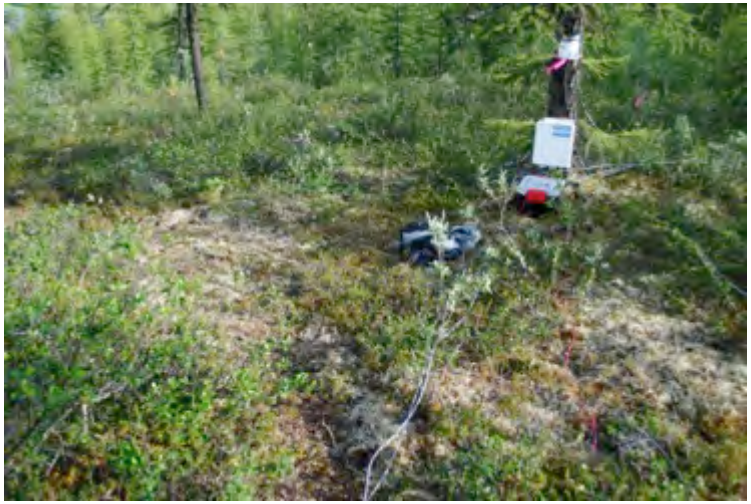
How does vegetation influence biosphere-atmosphere mass and energy exchange in permafrost ecosystems?

An example using understory vegetation communities of Siberian boreal larch forests.



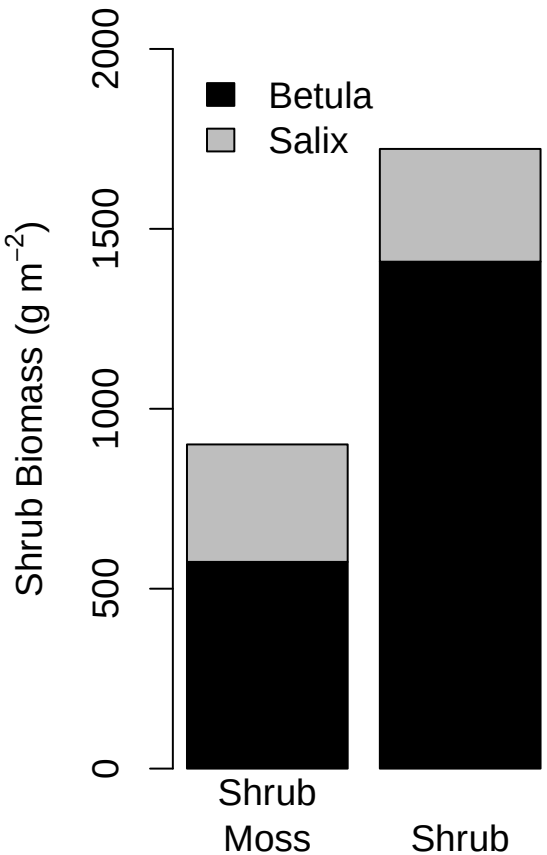
Measurements

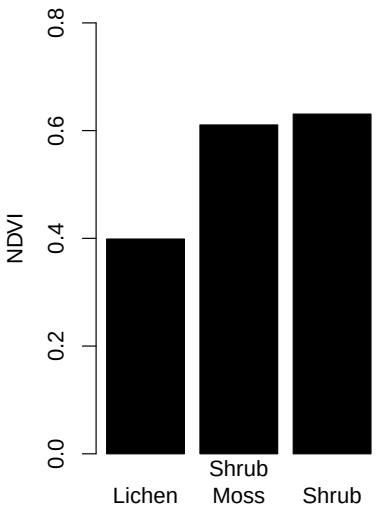
Lichen, Shrub/Moss, Shrub:
15 plots (0.25m^2)

18 Jul – 4 Aug, 2015

- Active Layer Thickness
- Surface Temperature
- Soil Temperature
- CO_2 & H_2O Flux
- NDVI
- Electrical Resistivity Profiles

Vegetation Cover



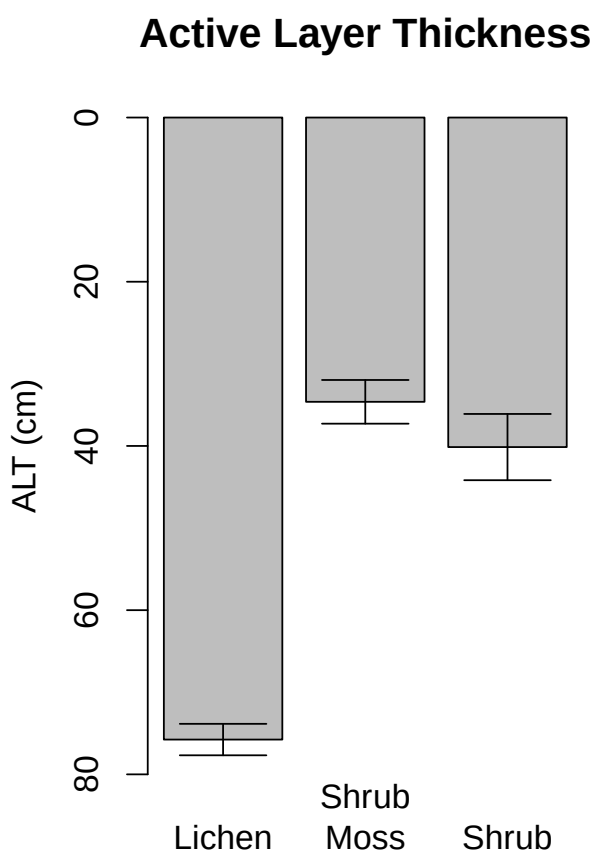


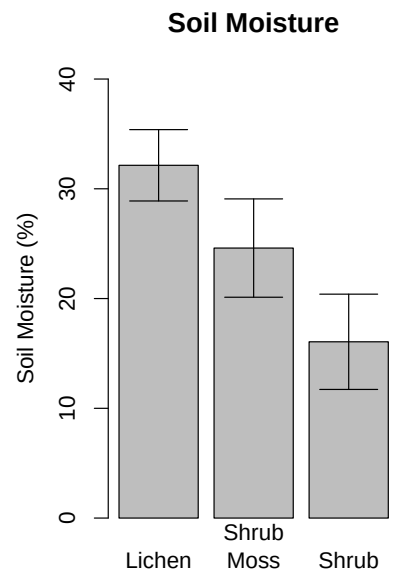
Understory Moss:

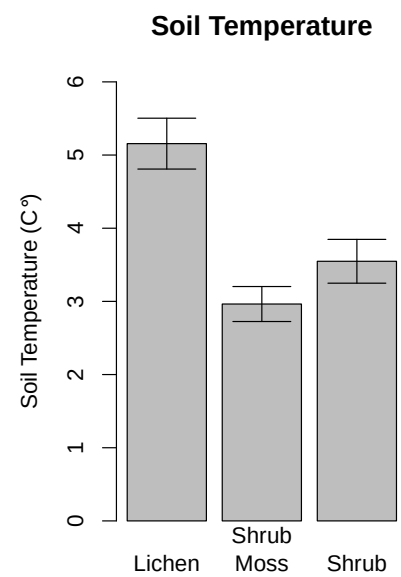
Shrub/Moss = 52%

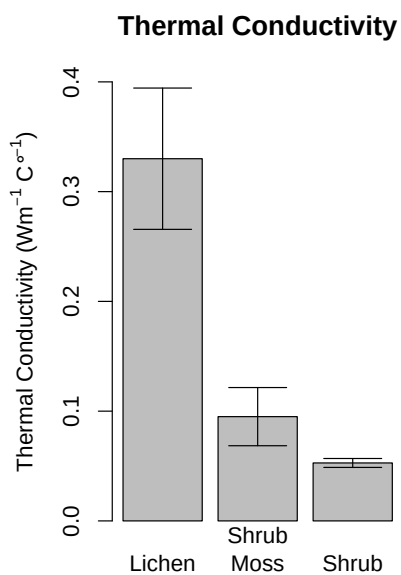
Shrub = 34%

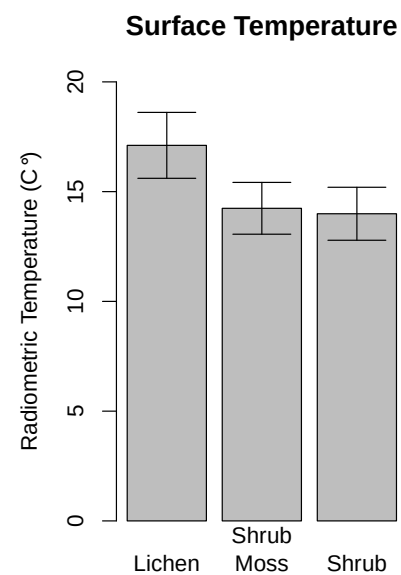
Physical Conditions











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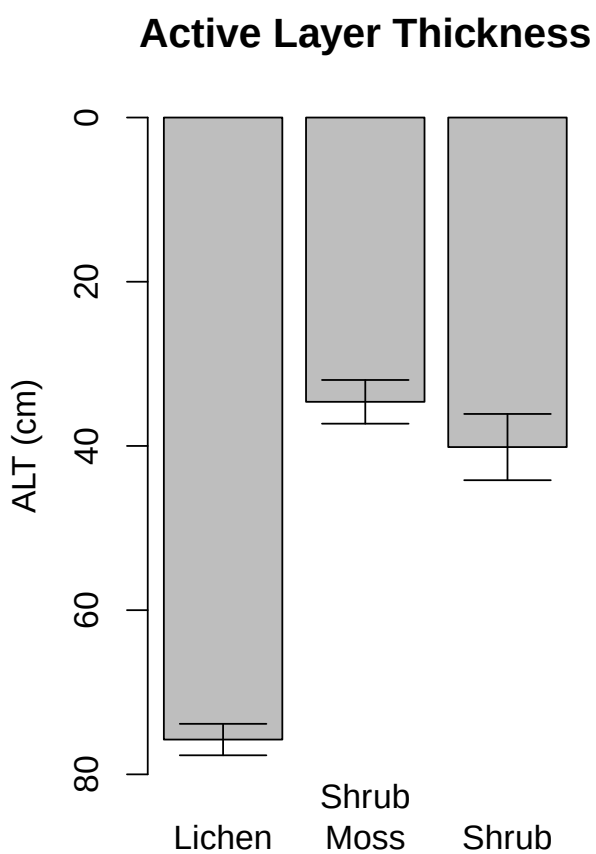
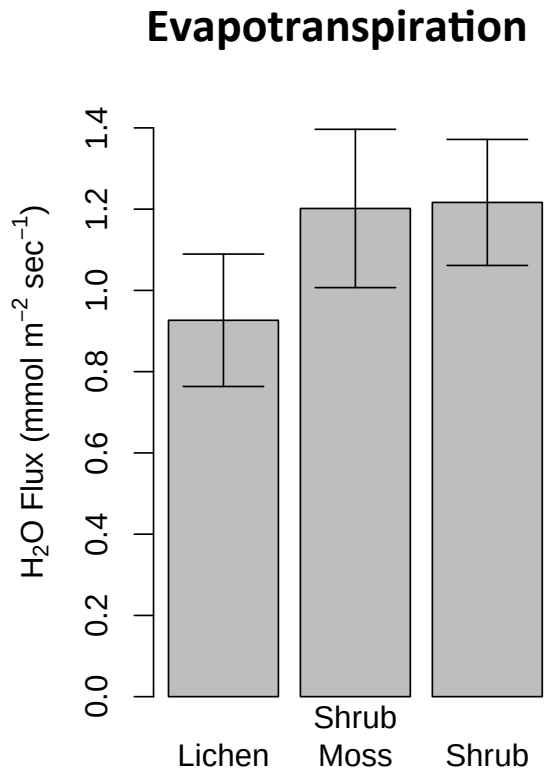
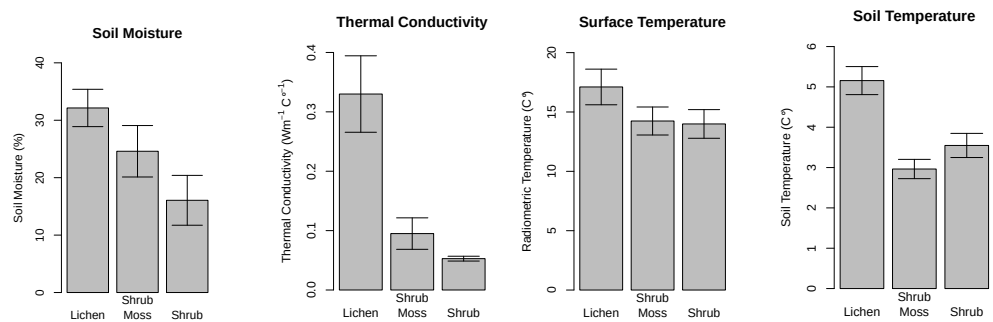
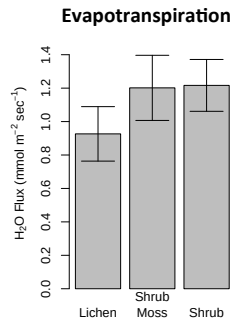
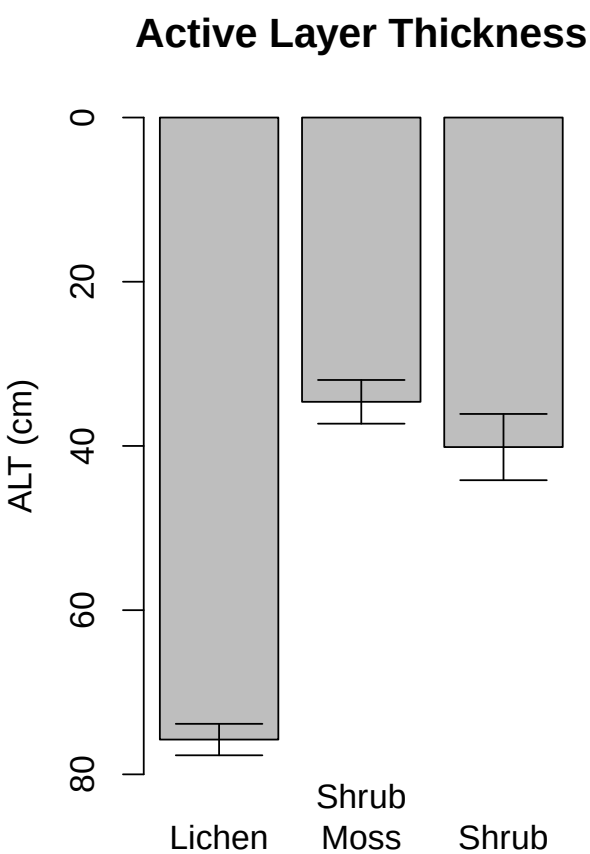


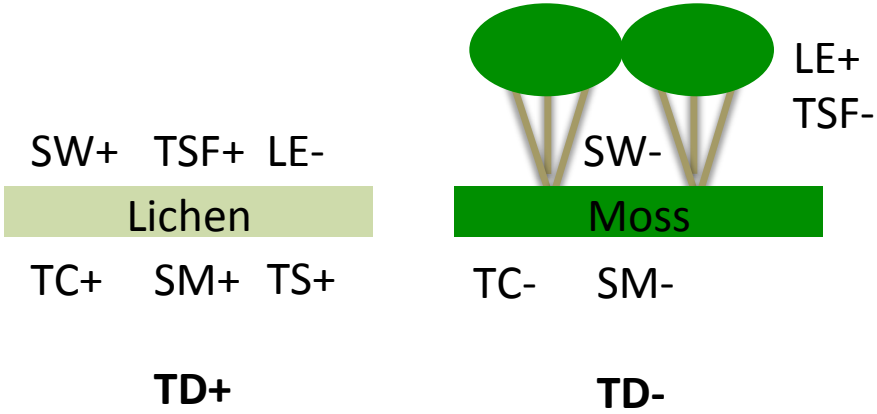


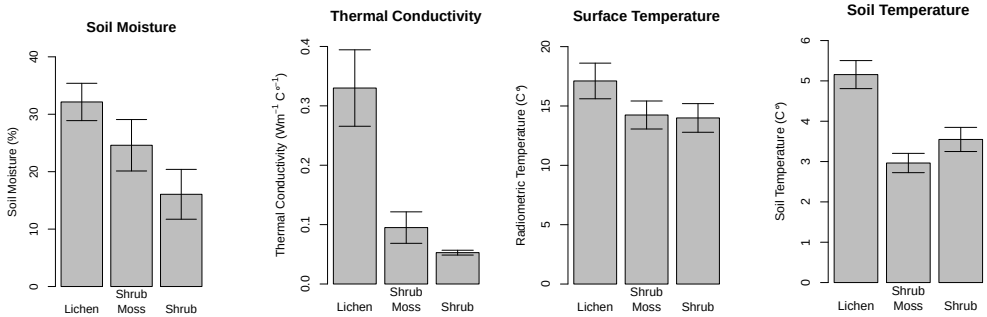


Physical Conditions



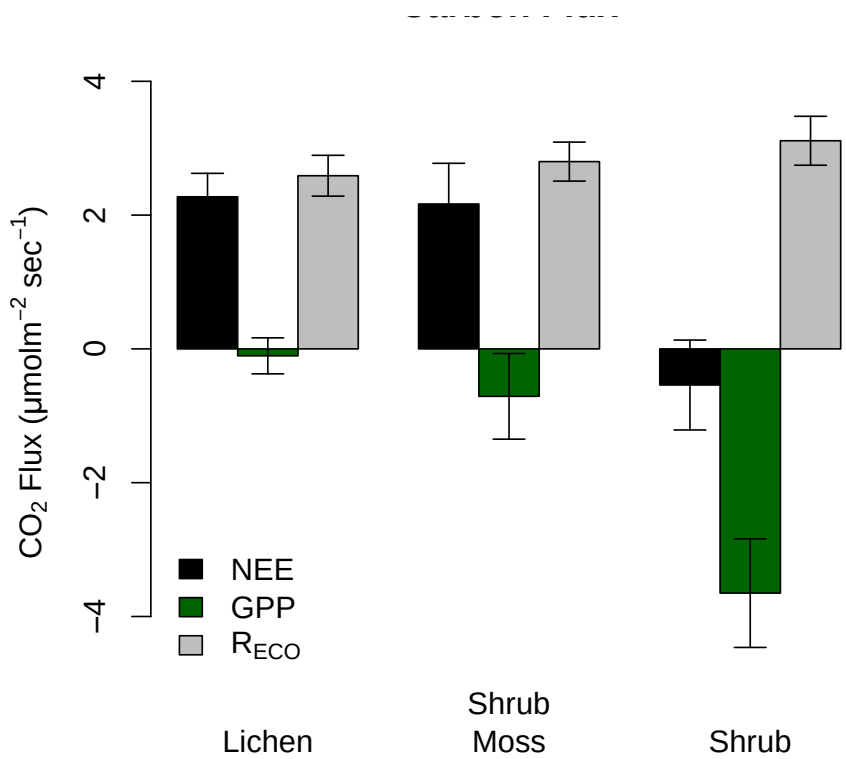




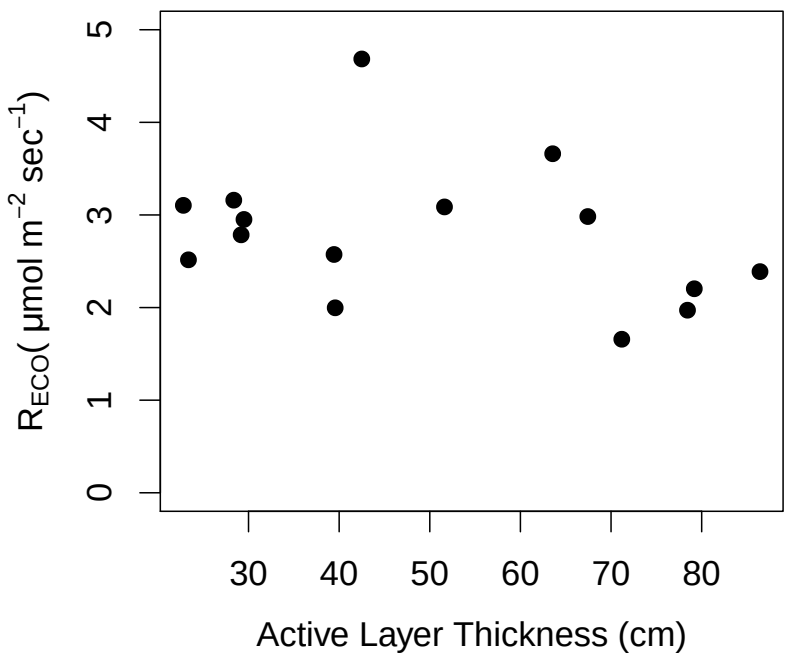


Carbon Dynamics

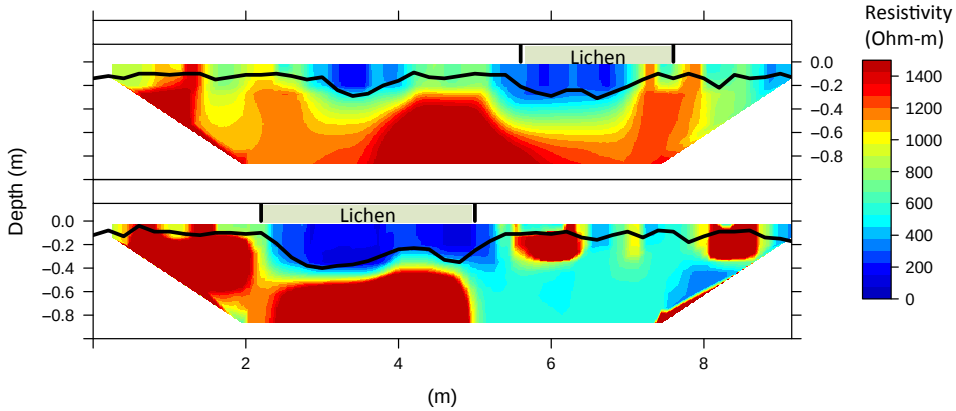
GPP drives net carbon flux



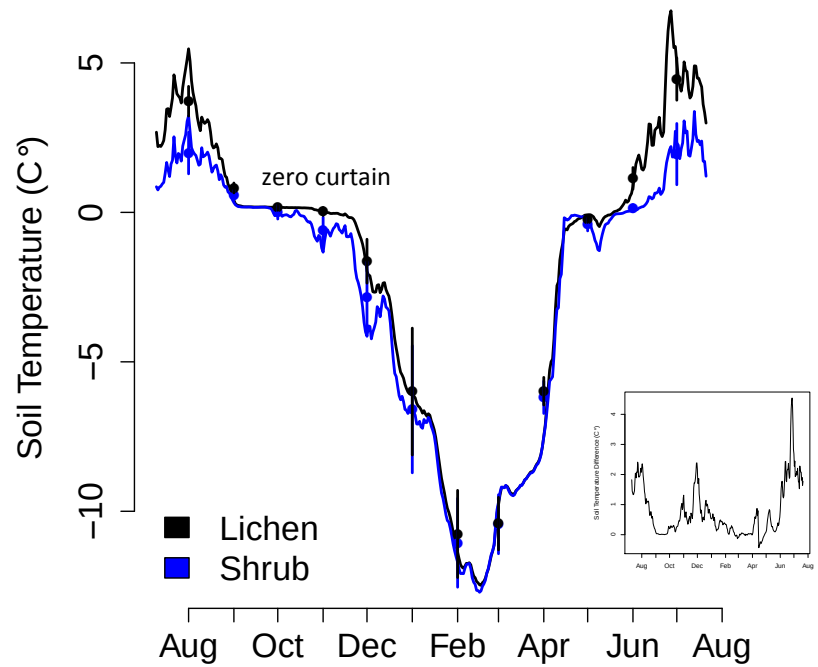
R_{ECO} does not increase with ALT



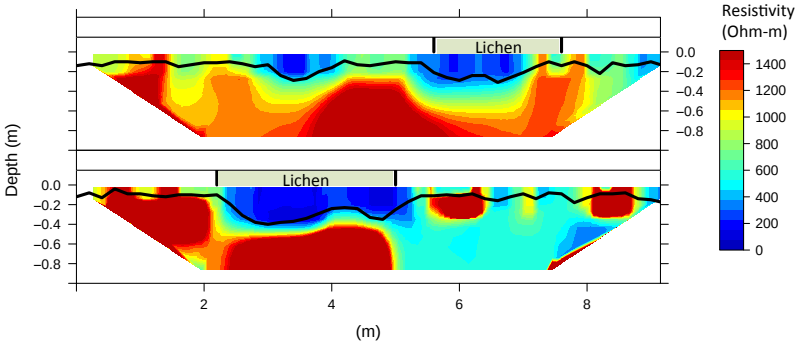
Subsurface Conditions

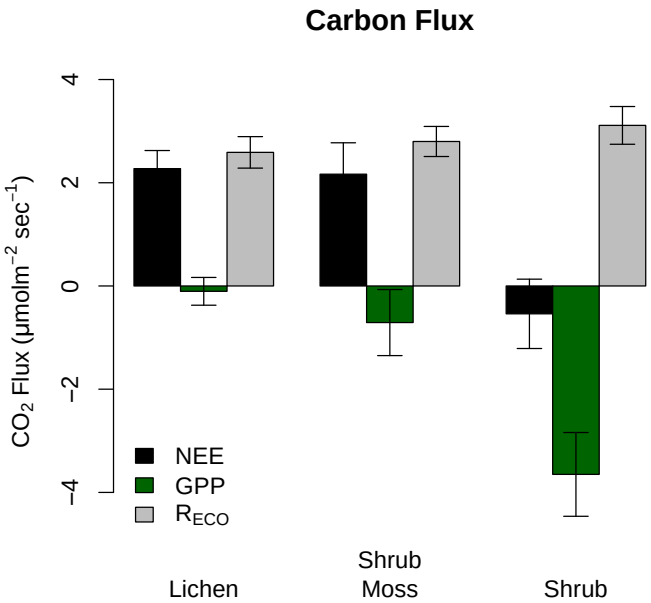


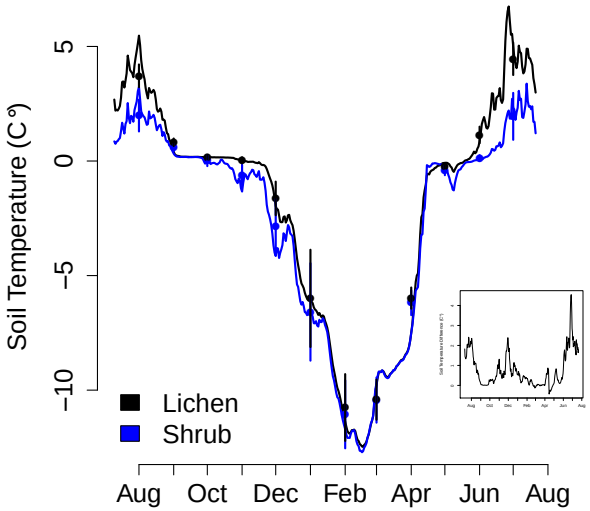
Consistent & Persistent Temperature and Moisture Differences



This is a small data set from one site, but what can we learn?



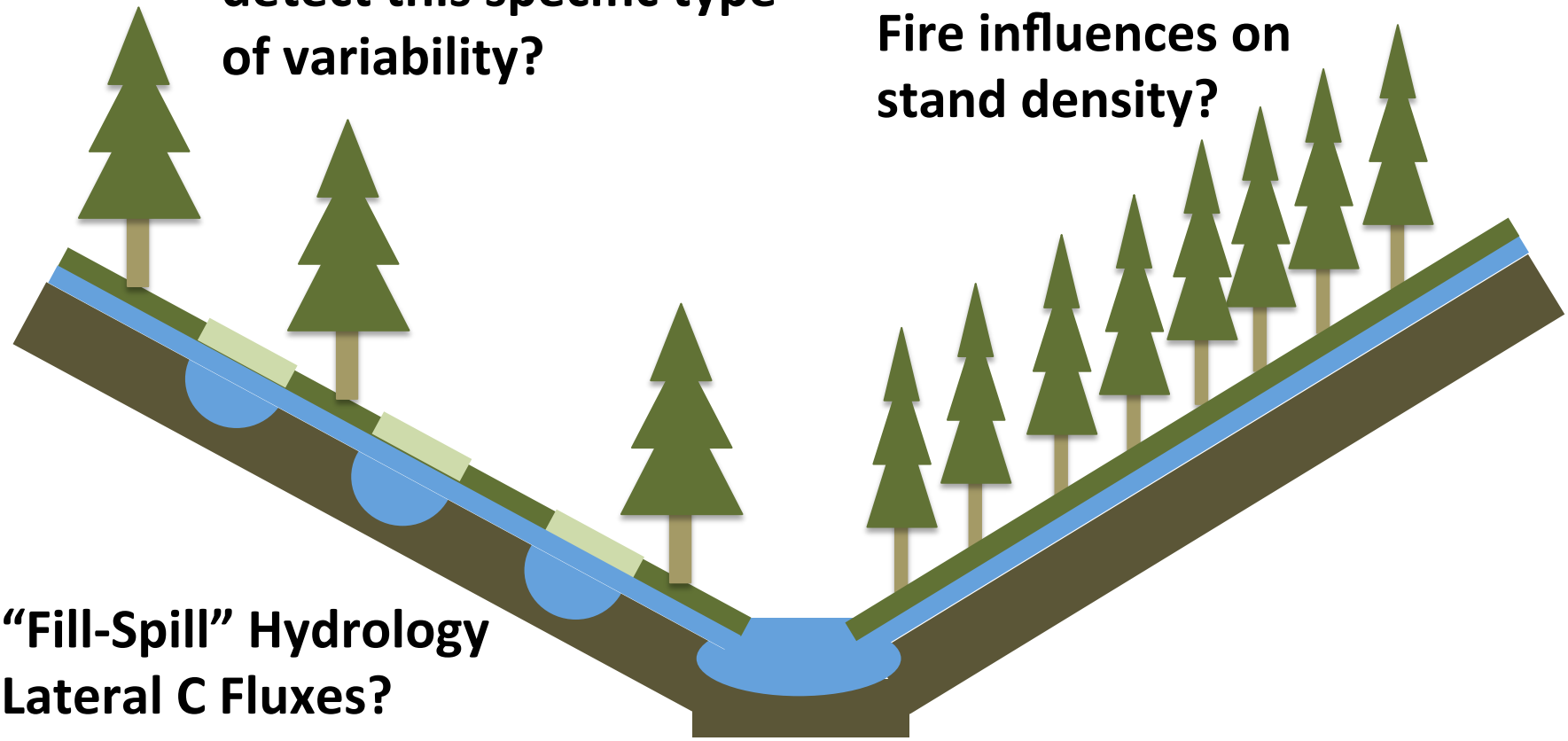




Ecosystem Implications

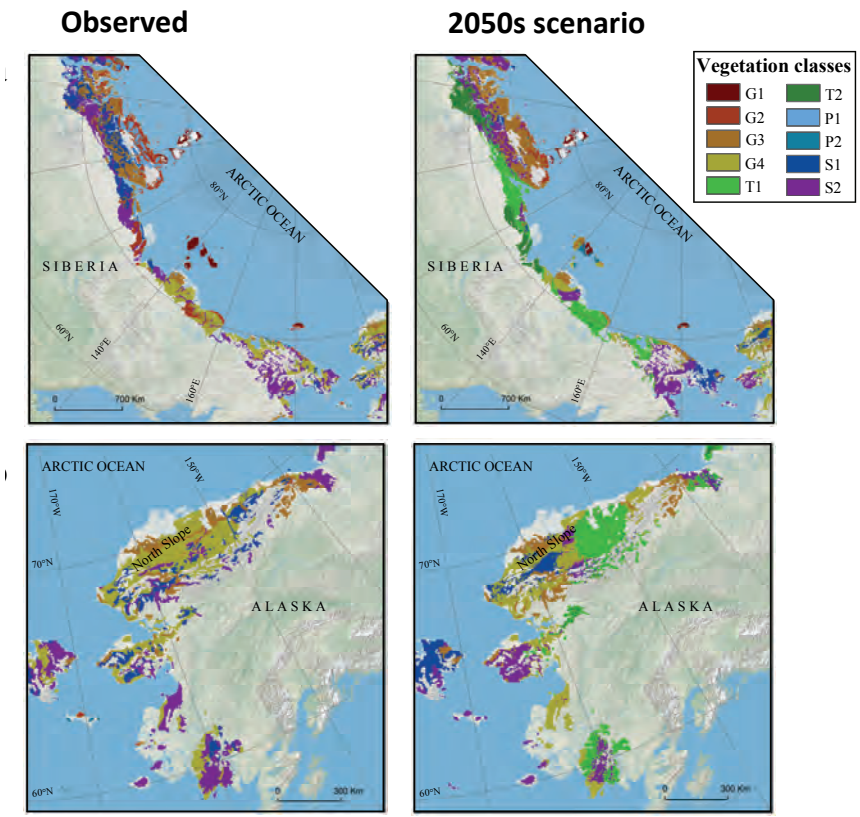
Can we use satellites to detect this specific type of variability?

Fire influences on stand density?



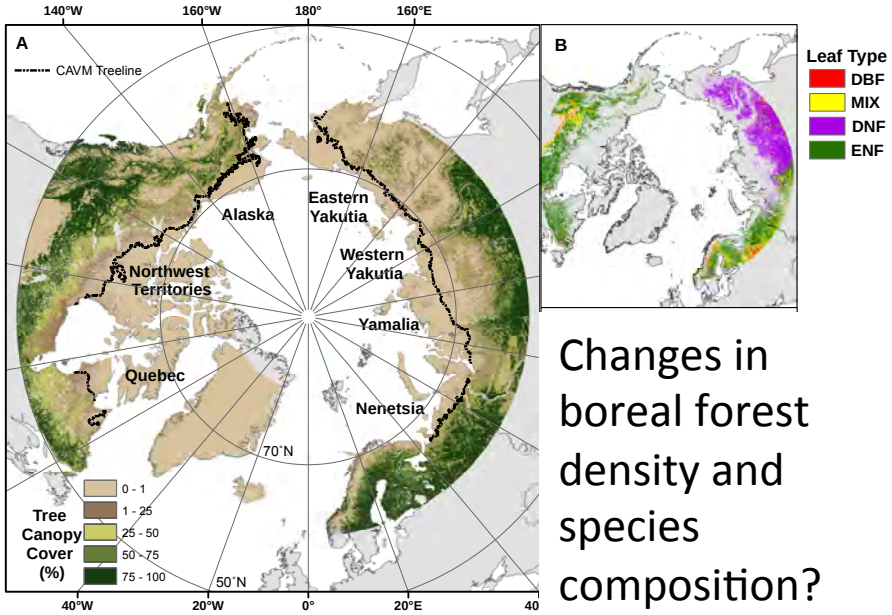
"Fill-Spill" Hydrology
Lateral C Fluxes?

Implications at Larger Scales?



Pearson et al, 2013, NCC

Are similar phenomenon occurring with other types of vegetation change?



Changes in boreal forest density and species composition?

Loranty et al, In Press, GCB

Acknowledgements

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