

WARMER, LONGER, GREENER?

The role of increased growing season length on shrub growth

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School of GeoSciences



@SandyAngersB

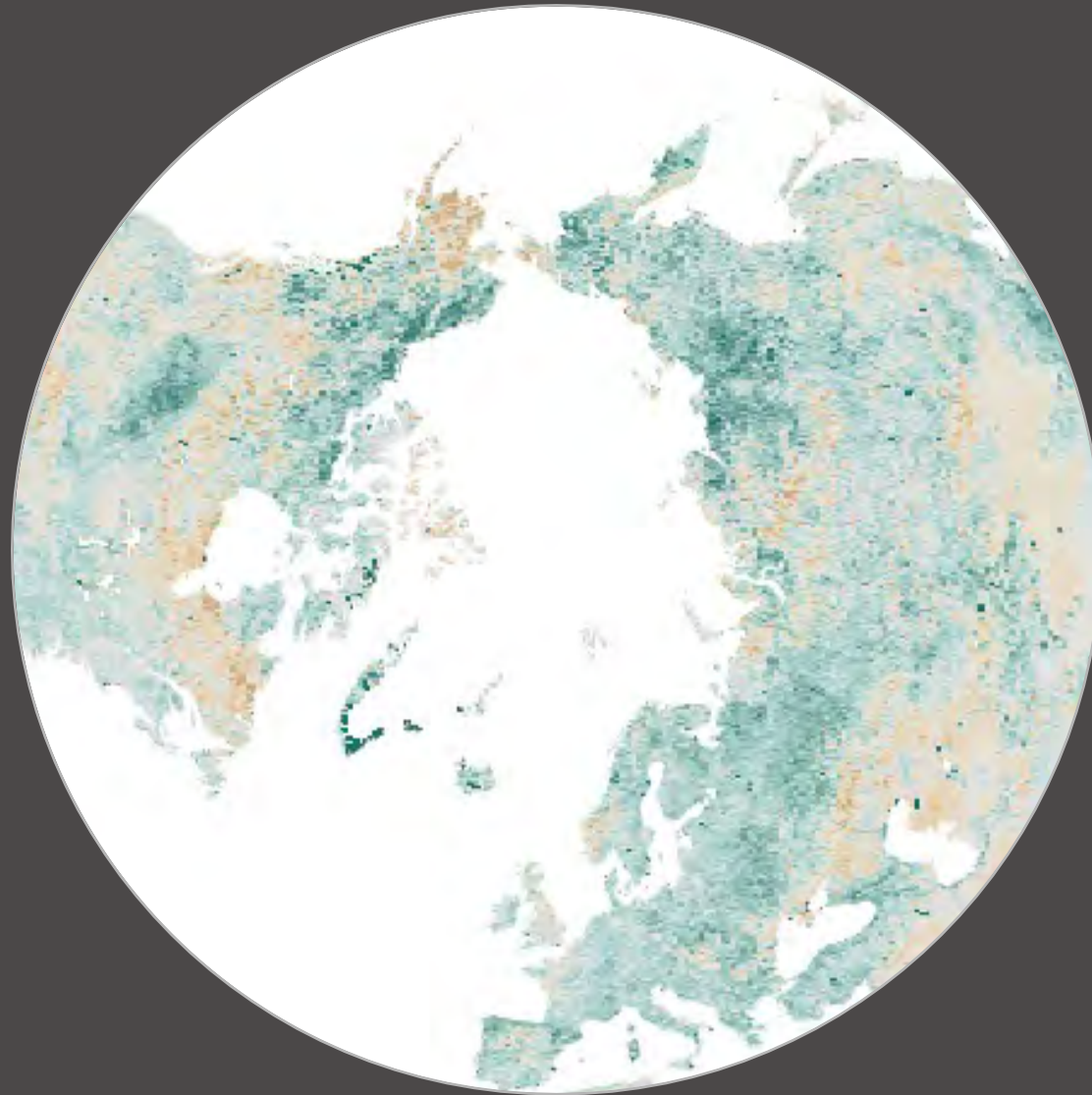


ARCTIC SUMMERS ARE GETTING WARMER AND LONGER

- Up to +2.5 °C warming since 1900
(IPCC 2013)
- Growing season advancing by 1.7 to 4.7 days per decade
(Zeng et al. 2011; Park et al. 2016)

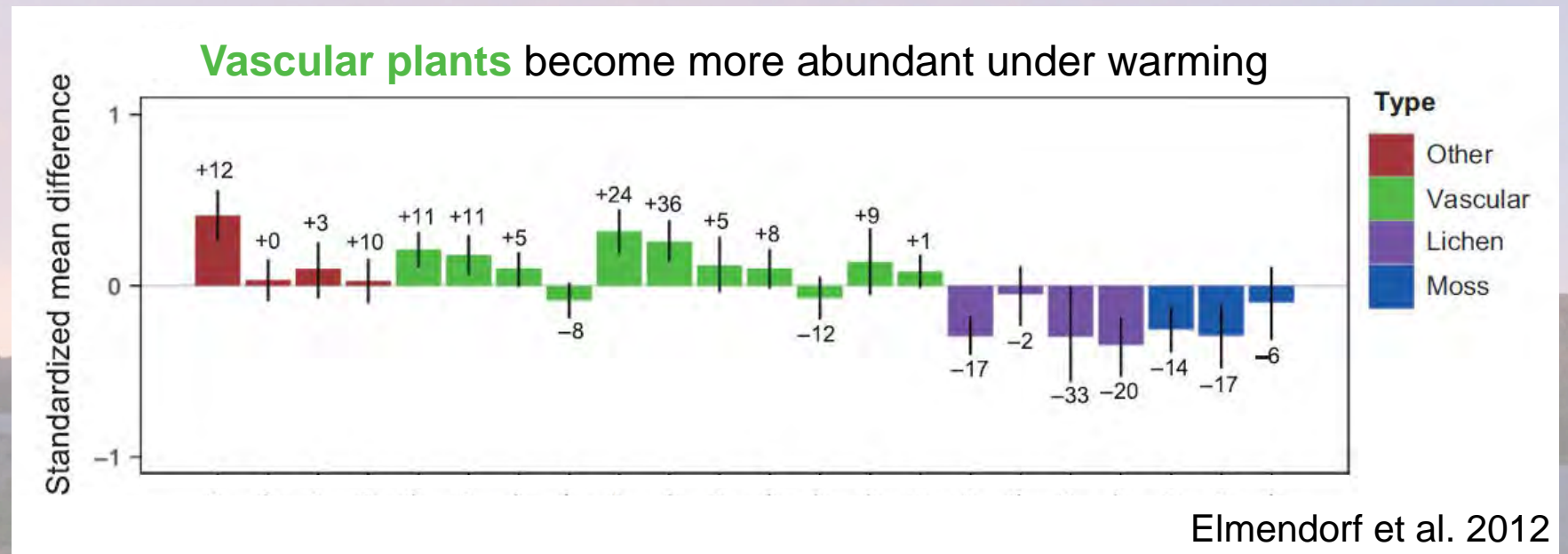


THE TUNDRA IS GREENING



GIMMS Satellite Data 1982 to 2013

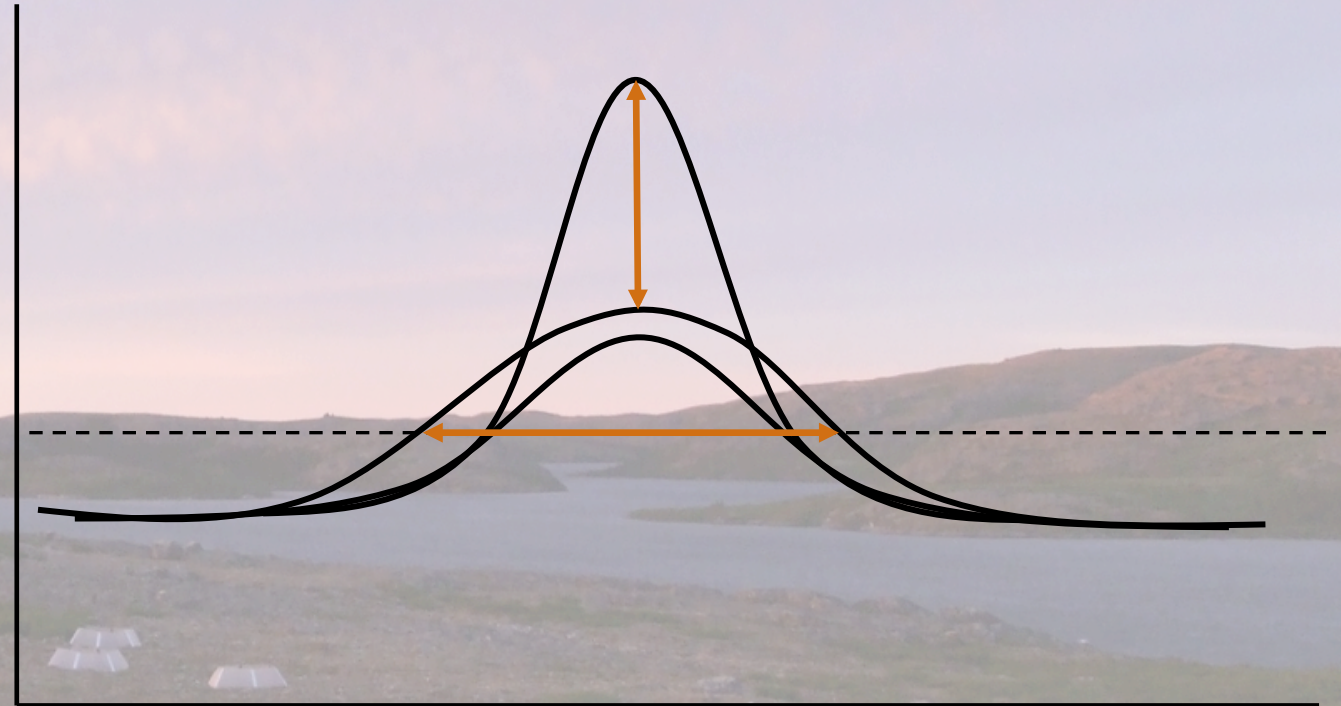
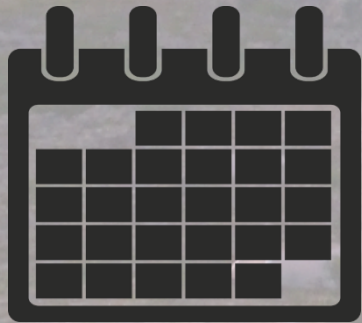
WARMER + LONGER = GREENER?



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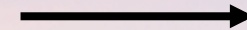
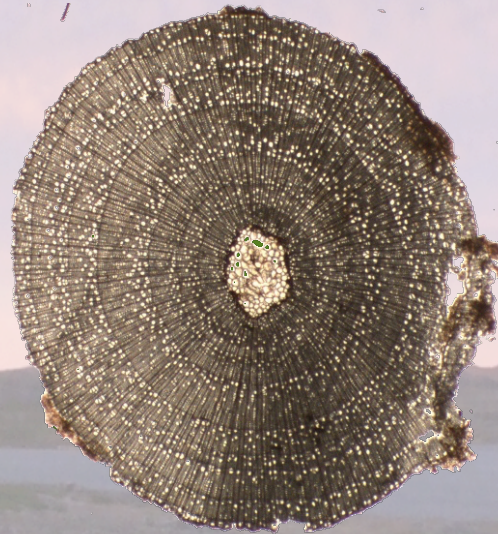
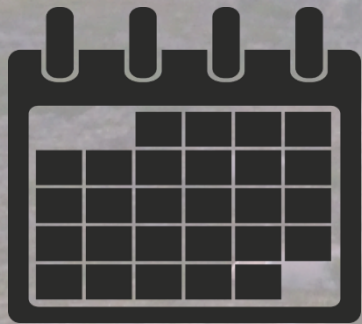


Temperature



Day of year

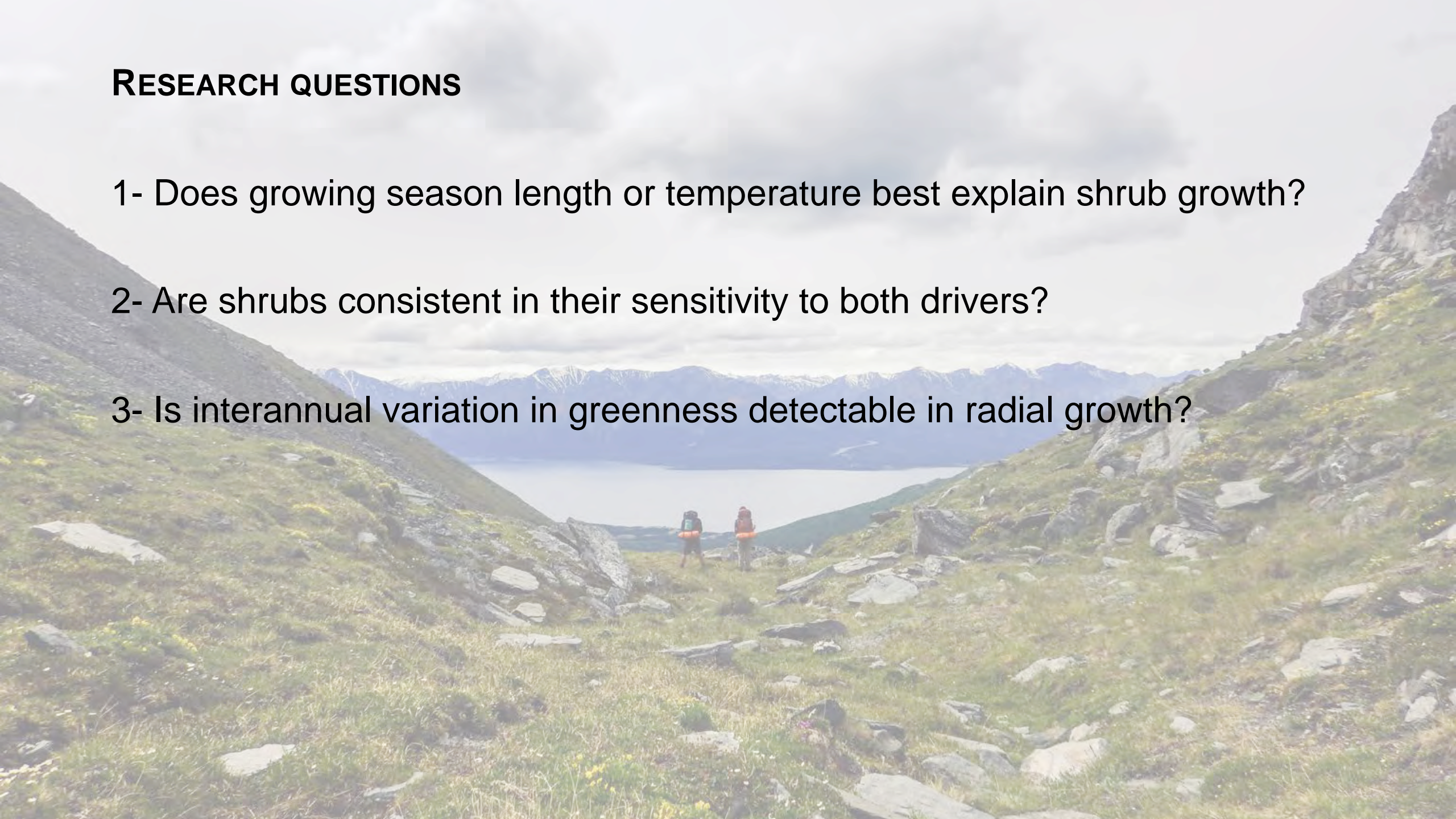
WARMER + LONGER = GREENER?



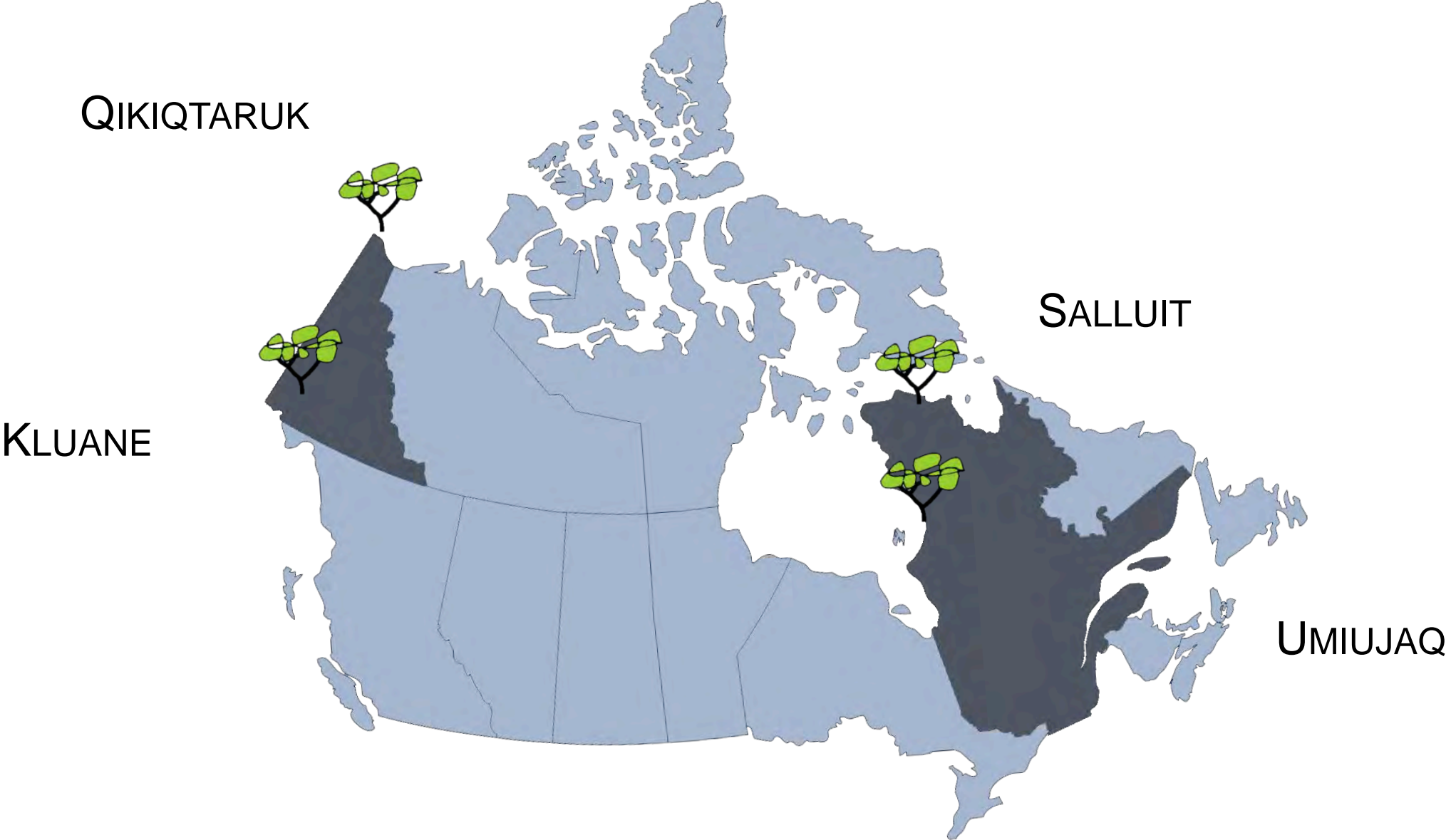
LAI (McManus et al. 2012)
Growth rings (Forbes et al. 2010;
Macias-Fauria 2012)

RESEARCH QUESTIONS

- 1- Does growing season length or temperature best explain shrub growth?
- 2- Are shrubs consistent in their sensitivity to both drivers?
- 3- Is interannual variation in greenness detectable in radial growth?




WHERE WE WORK

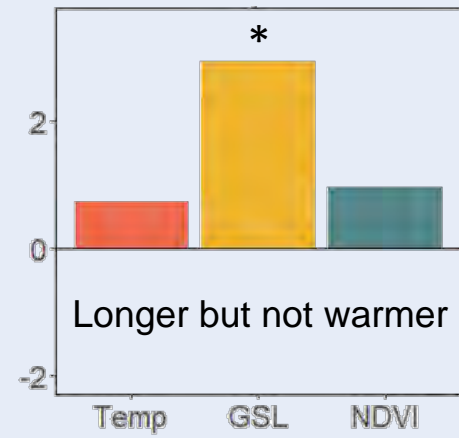


QIKIQTARUK



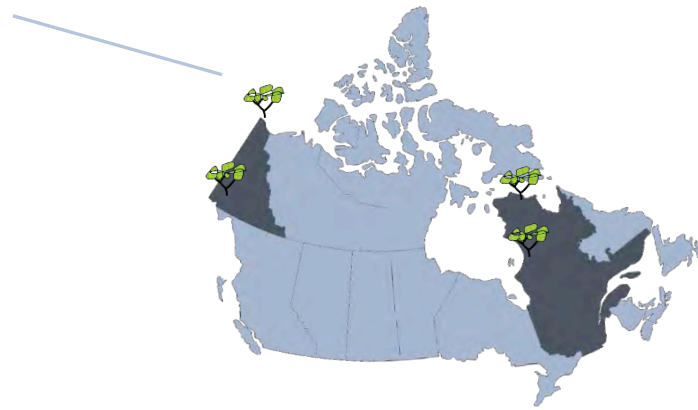
Summer T: 

GSL: 

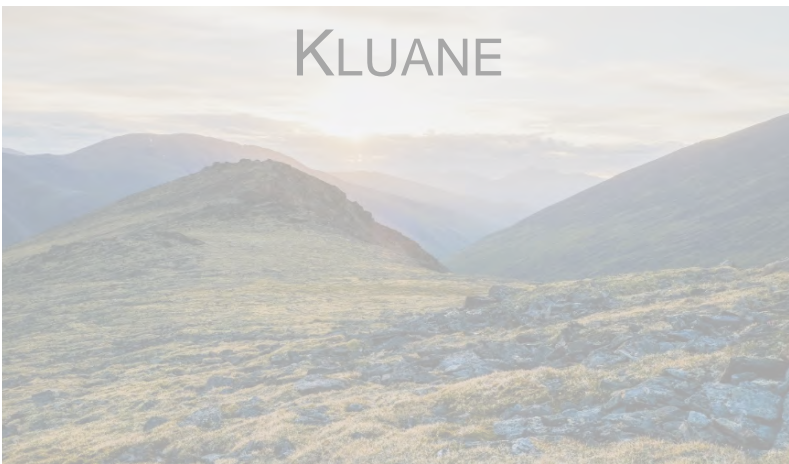


Longer but not warmer

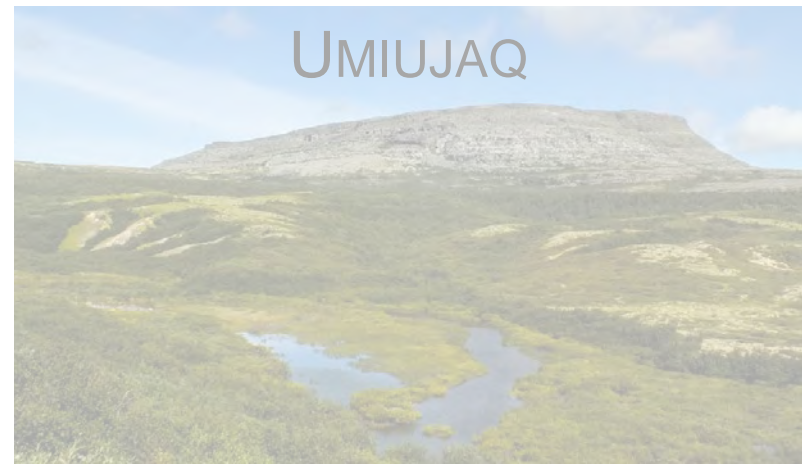
SALLUIT



KLUANE



UMIUJAQ

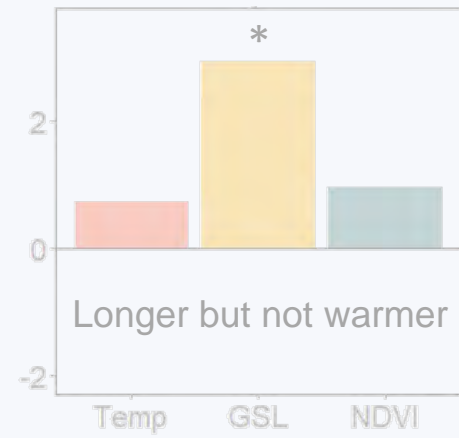


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Summer T: 

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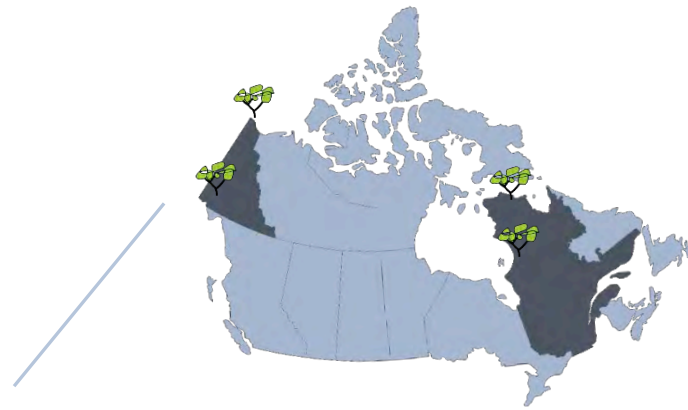
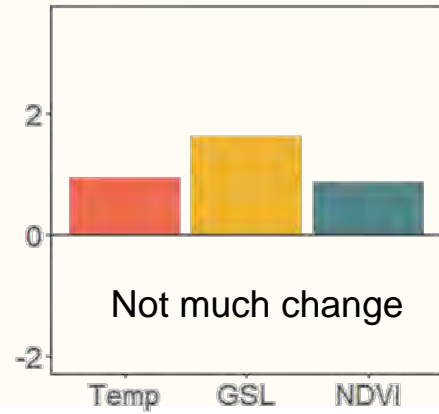


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Summer T: 

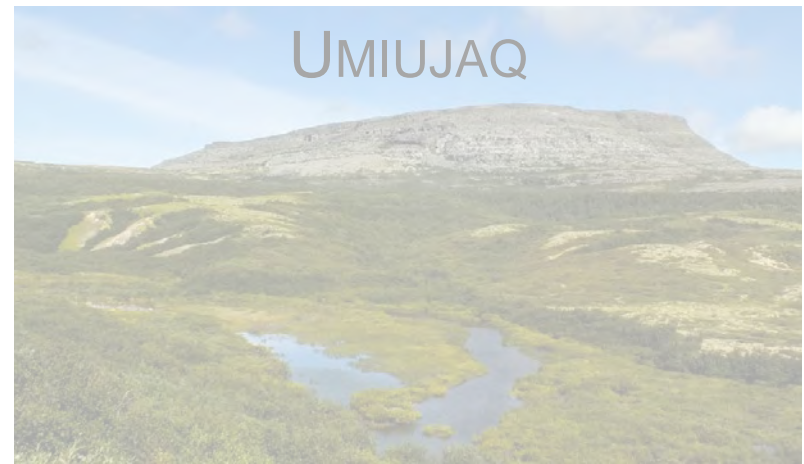
GSL: 



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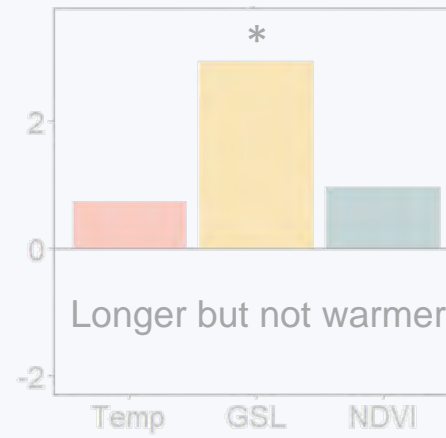


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Summer T:  

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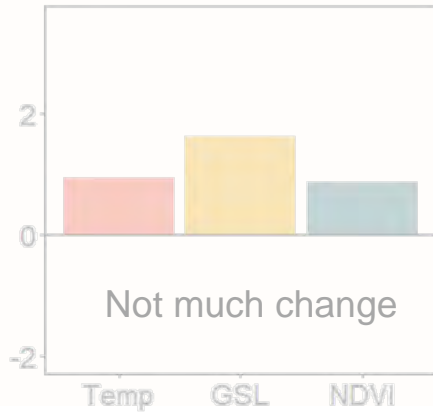


SALLUIT

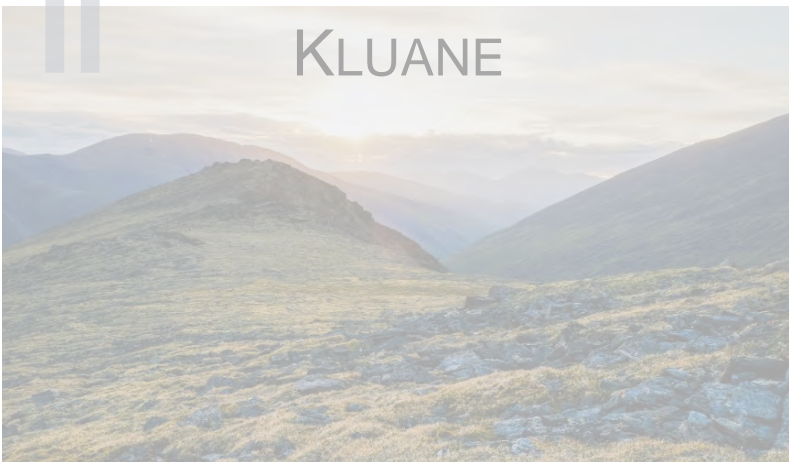





Summer T:  

GSL: 

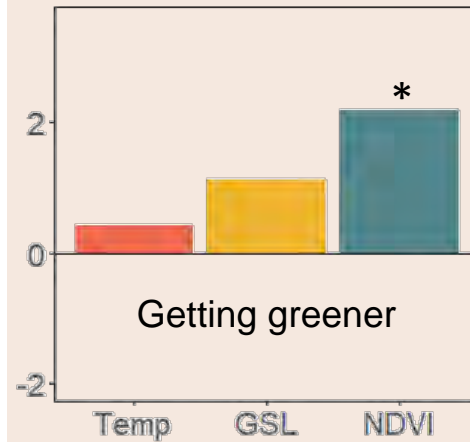


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Summer T:   

GSL:   



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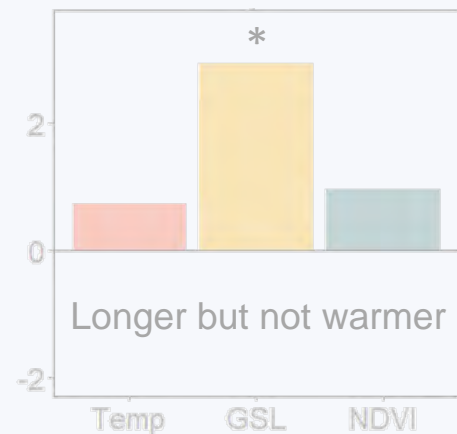


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Summer T: 

GSL: 

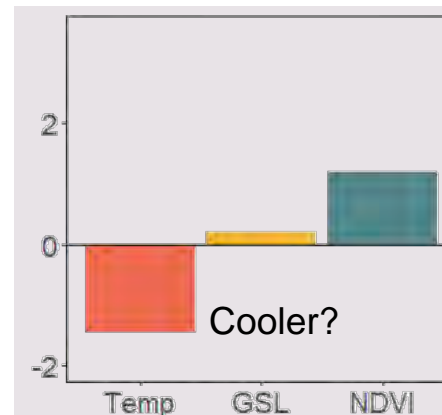
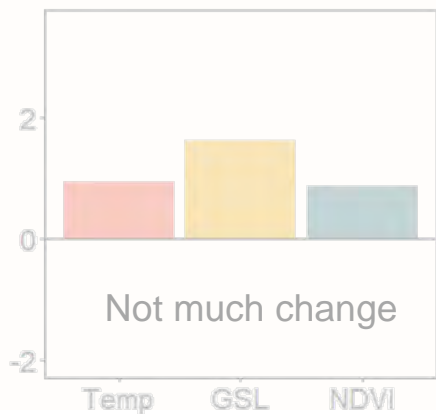



SALLUIT



Summer T: 

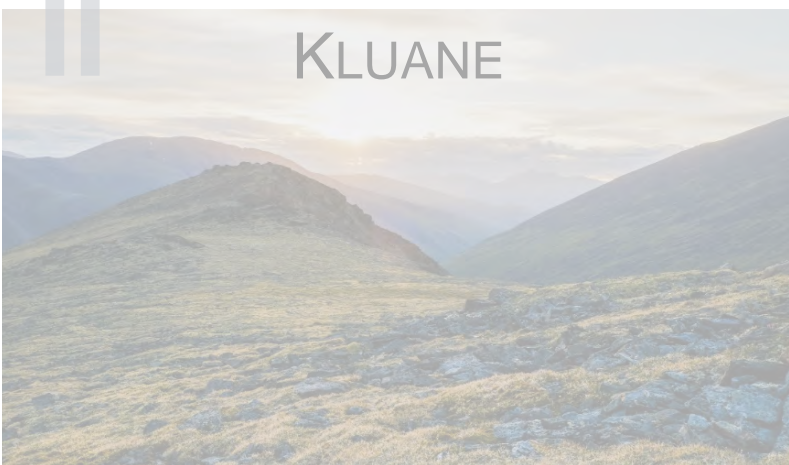
GSL: 



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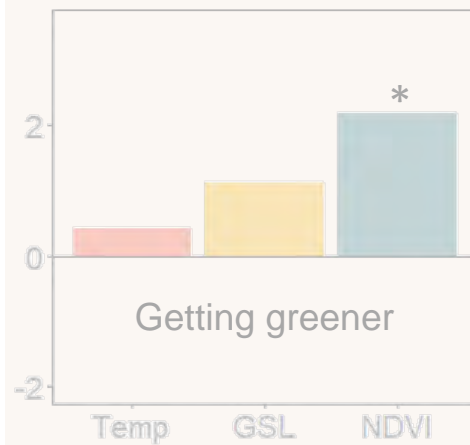
GSL:  

KLUANE

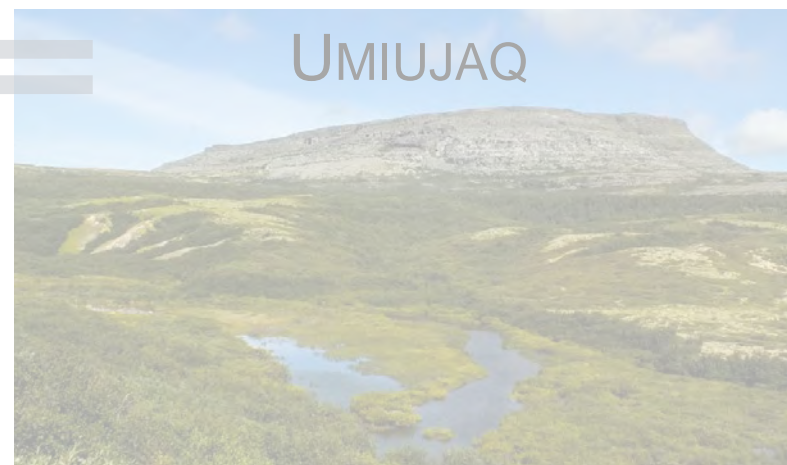


Summer T:   

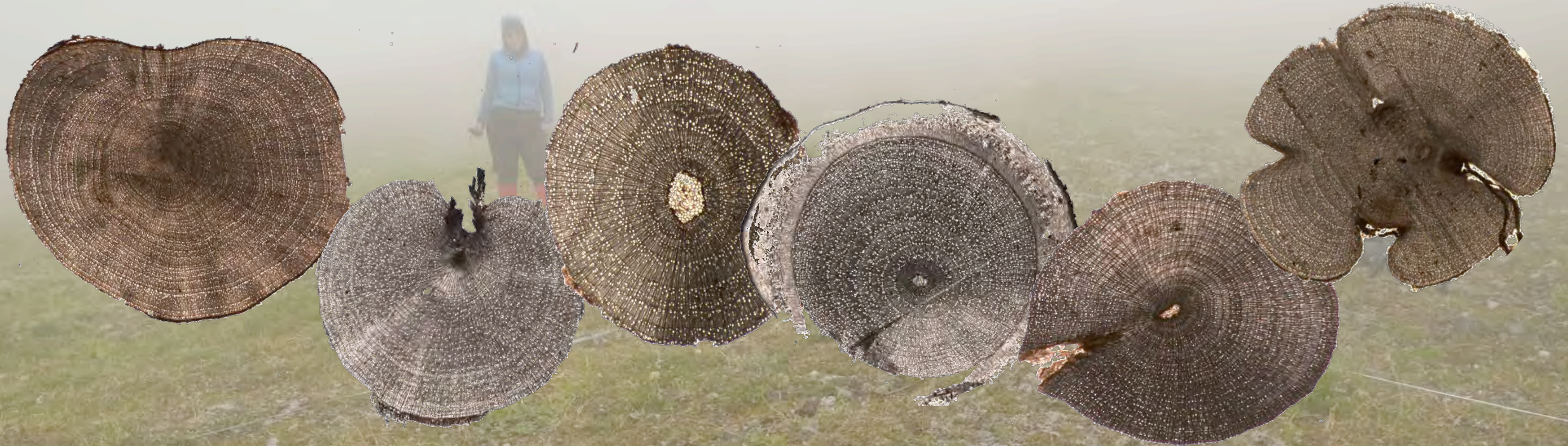
GSL:   



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EXHAUSTIVE (AND EXHAUSTING!) SAMPLING OF SHRUB PLOTS



Salix richardsonii



Salix pulchra

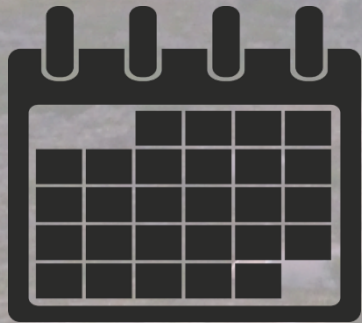


Salix planifolia

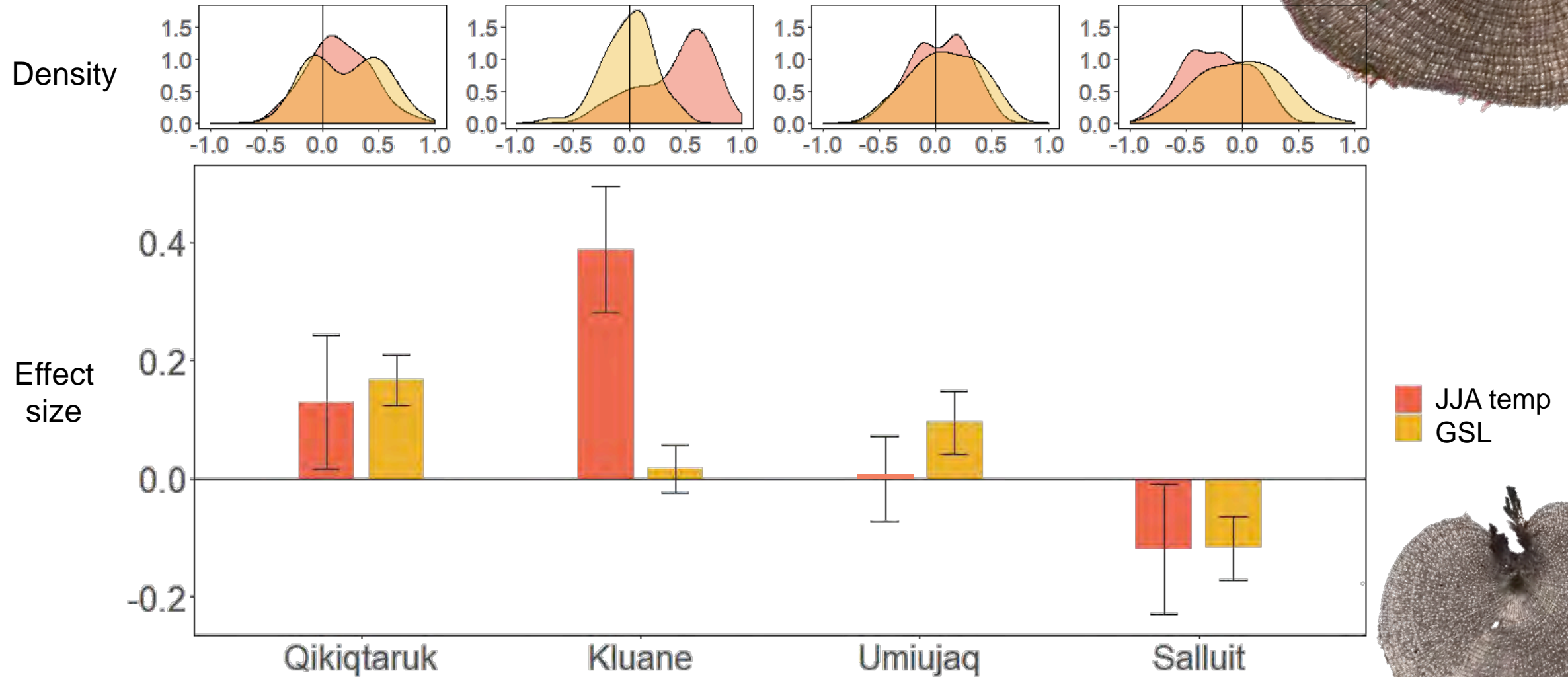


Betula glandulosa

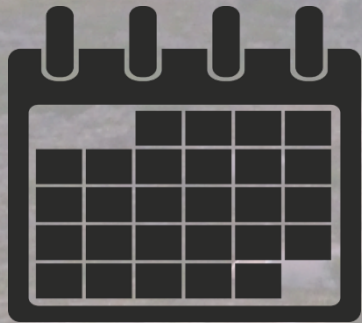
H1: TEMPERATURE HAS THE STRONGEST CONTROL ON SHRUB GROWTH



NO CONSISTENT DRIVER OF SHRUB GROWTH

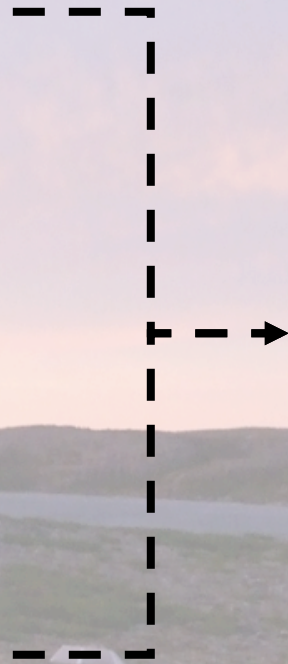
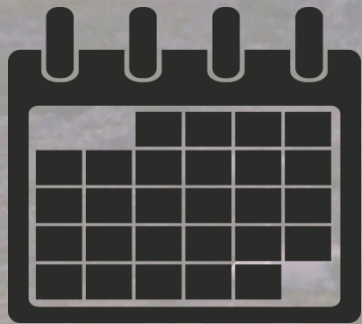


~~H1: TEMPERATURE HAS THE STRONGEST CONTROL ON SHRUB GROWTH~~



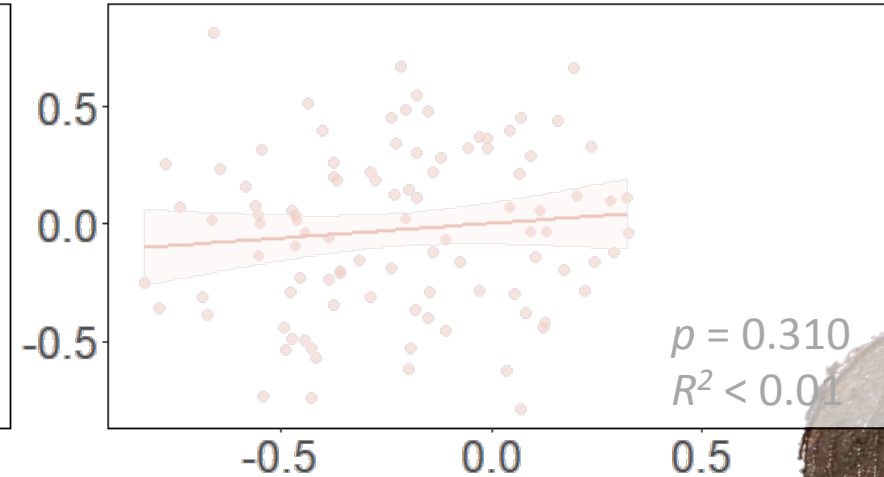
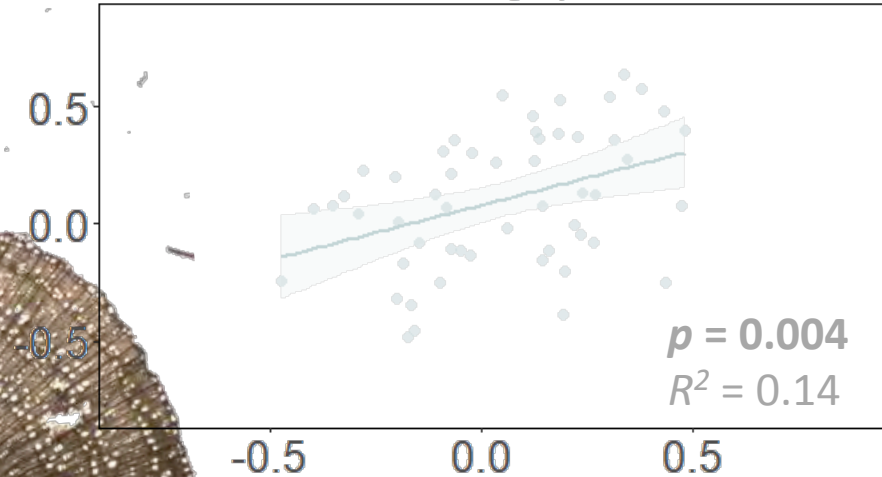
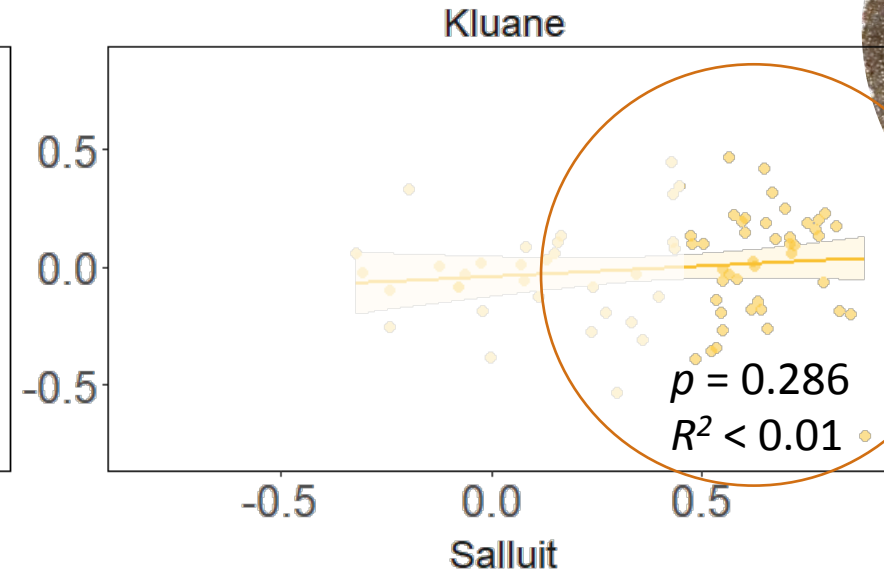
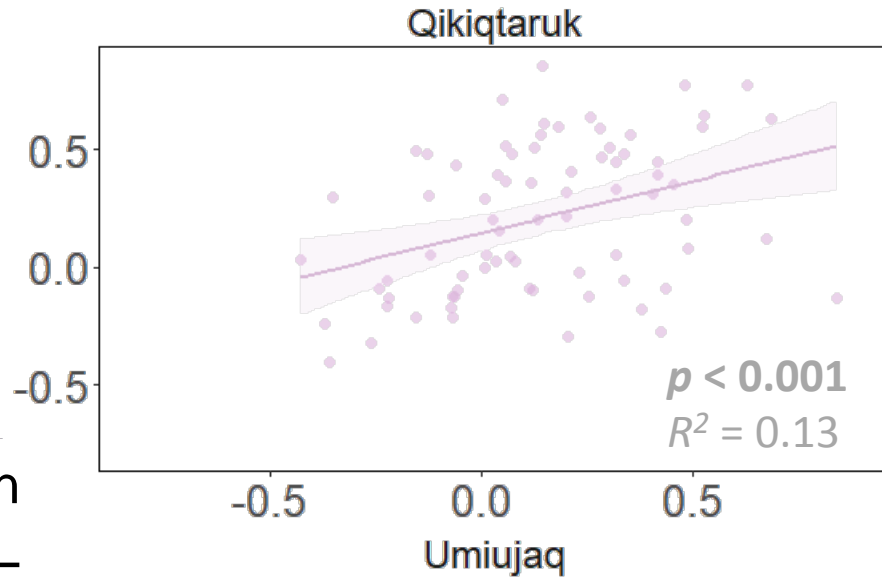
~~H1: TEMPERATURE HAS THE STRONGEST CONTROL ON SHRUB GROWTH~~

H2: INDIVIDUALS ARE CONSISTENT IN THEIR RESPONSE TO BOTH DRIVERS



SHRUBS ARE INCONSISTENT IN THEIR INDIVIDUAL RESPONSE

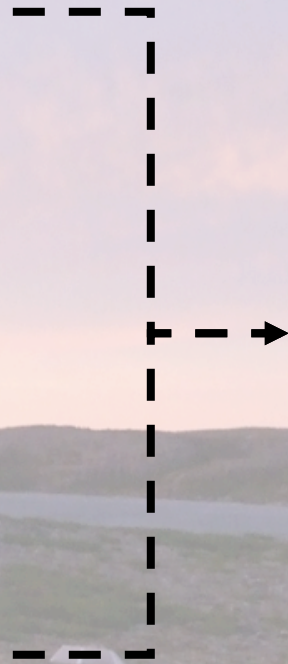
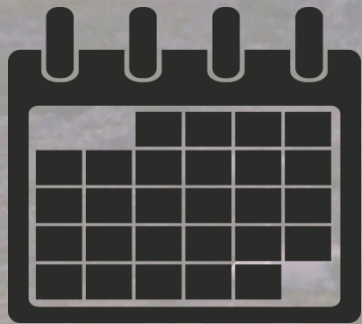
Correlation
to GSL



Correlation to summer temperature

~~H1: TEMPERATURE HAS THE STRONGEST CONTROL ON SHRUB GROWTH~~

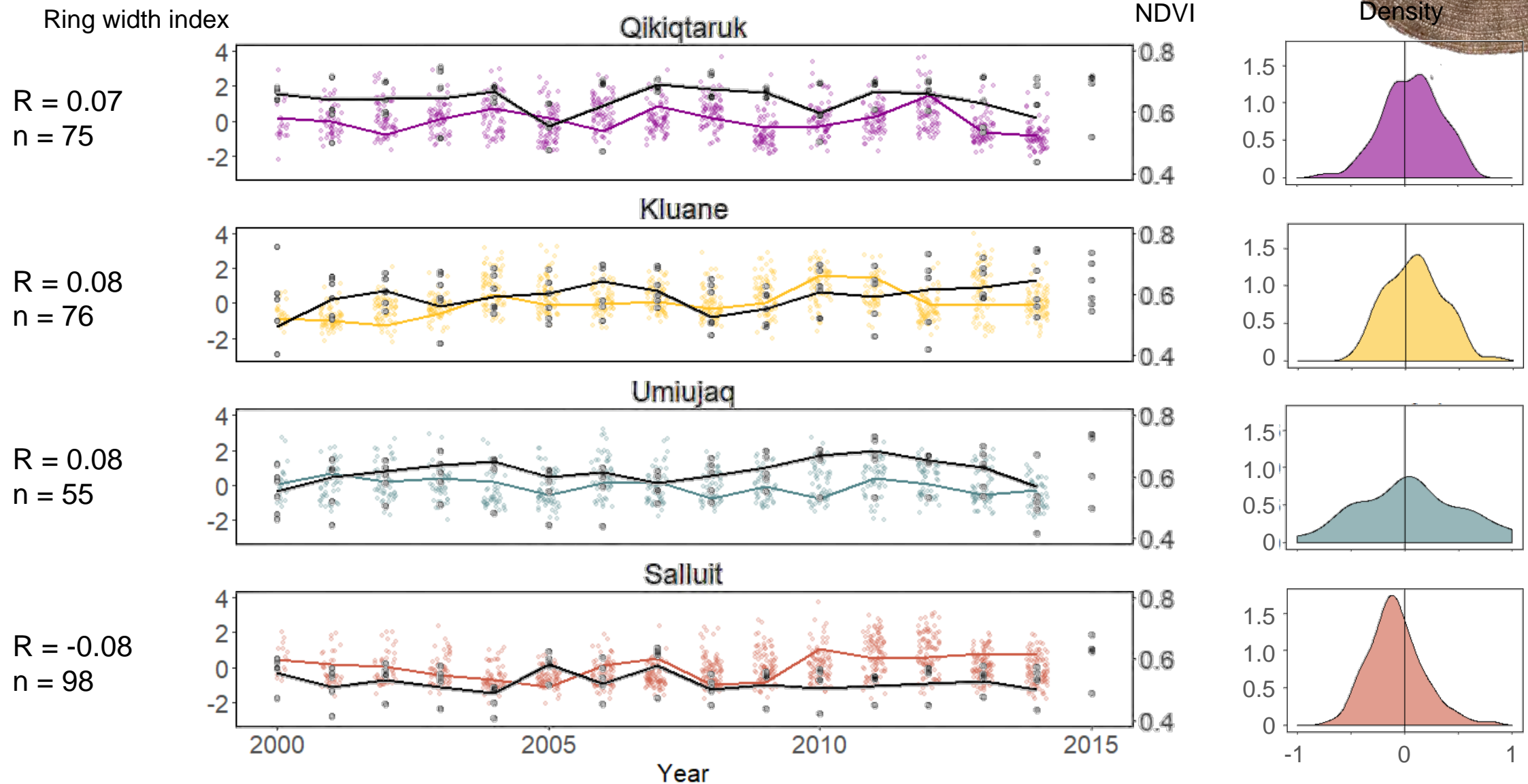
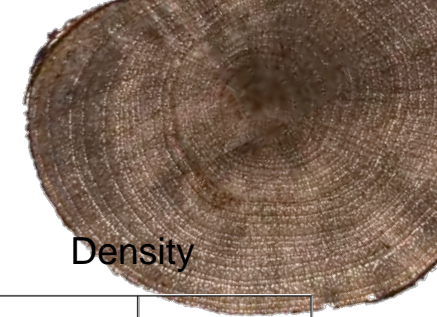
~~H2: INDIVIDUALS ARE CONSISTENT IN THEIR RESPONSE TO BOTH DRIVERS~~



H3: RADIAL GROWTH TRACKS SATELLITE-DERIVED GREENNESS



SATELLITE-DERIVED GREENING IS NOT TRACKED BY RADIAL GROWTH

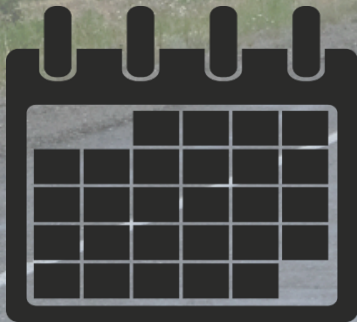


FOR THE ROAD...

Magnitude and direction of sensitivity variable across sites

Reading between the rings: ~~p~~ primary vs secondary growth

Environmental context is important. Measure, biotic interactions...



What are the controls?

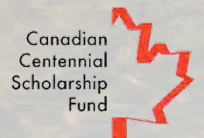
Thank you



@SandyAngersB



**CRSNG
NSERC**



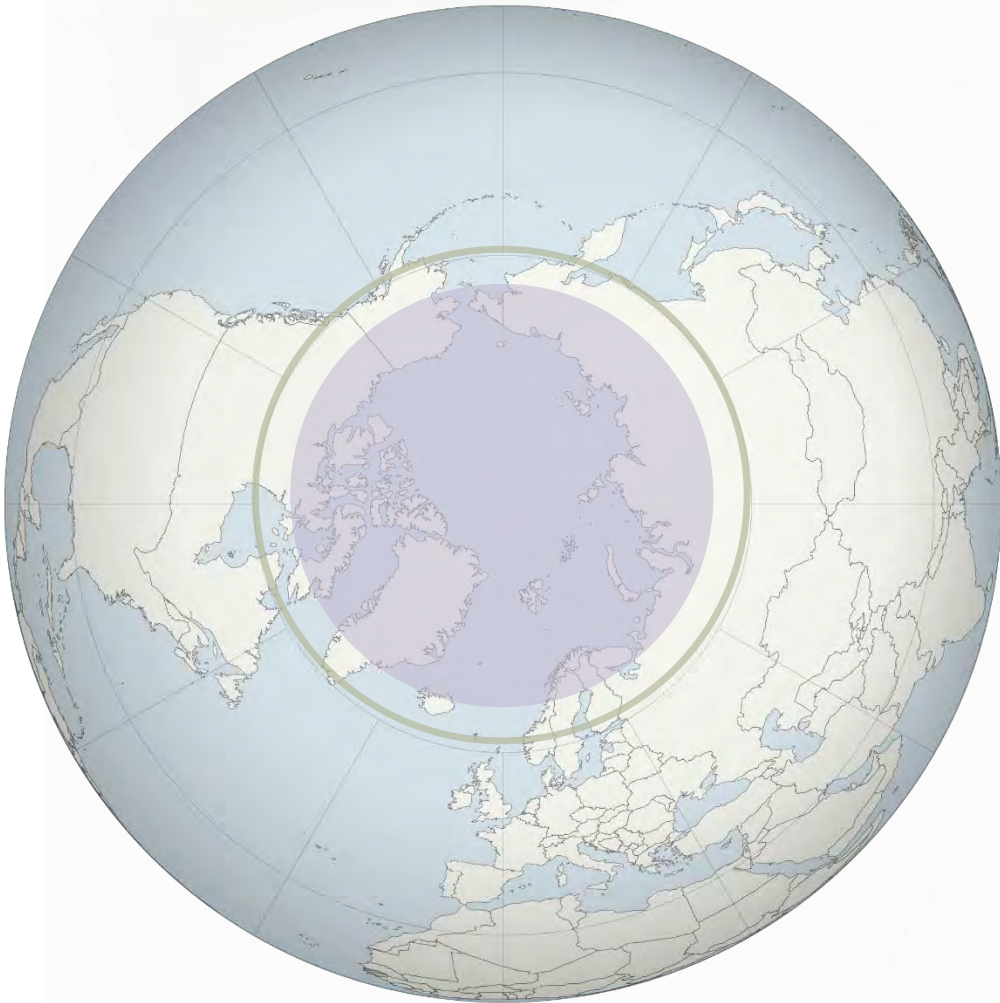
Greater temperature sensitivity
of **phenology** at colder sites

(Prev y et al. 2017; Post et al. 2018)

vs

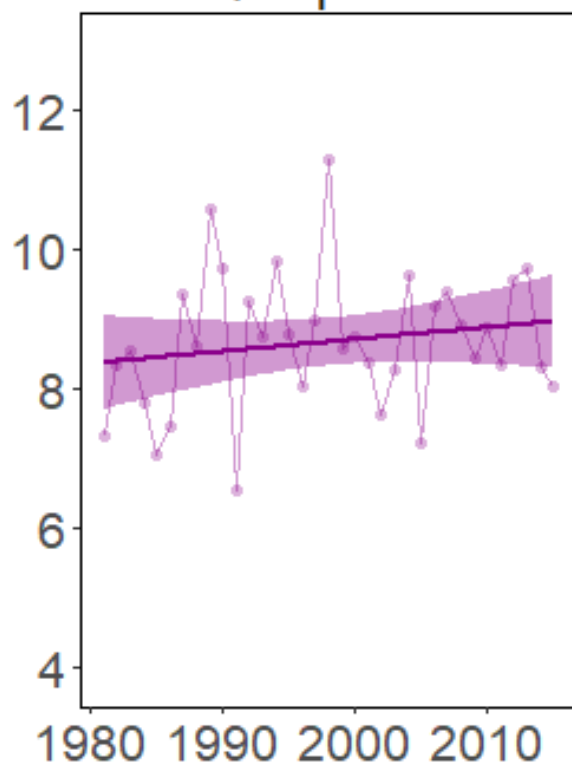
Greater temperature sensitivity
of **growth** at mid-latitude sites

(Myers-Smith et al. 2015)

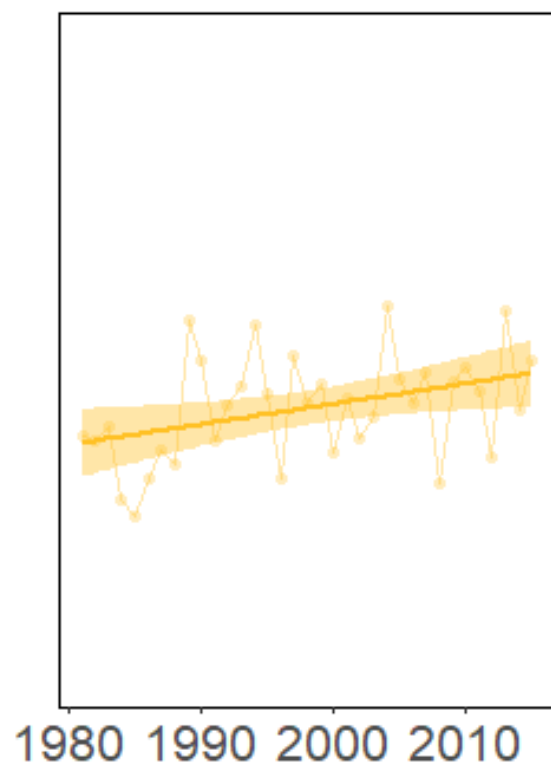


Mean summer (JJA) temperature (C)

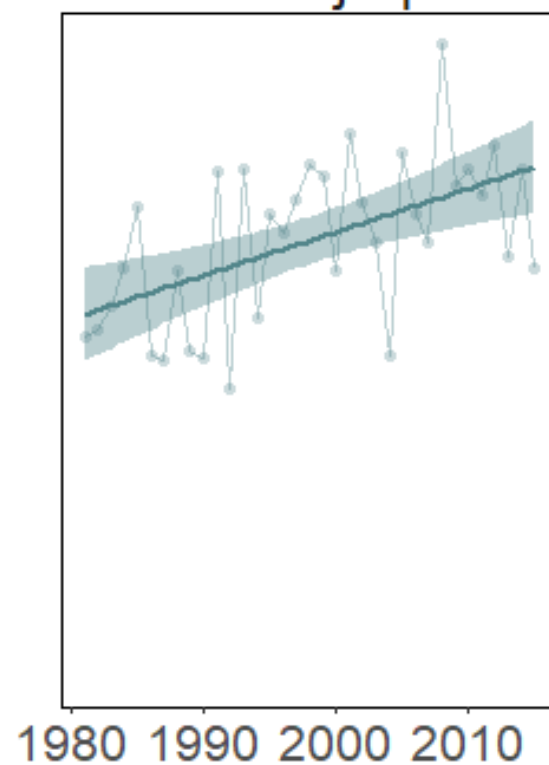
Qikiqtaruk



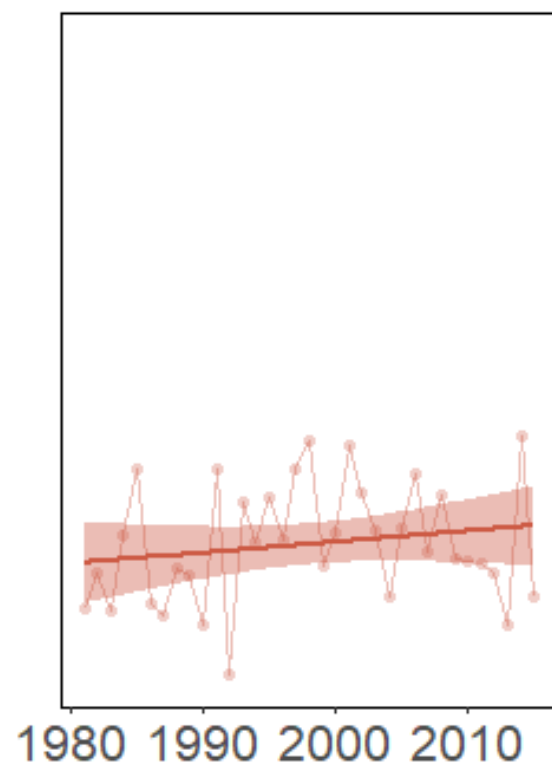
Kluane



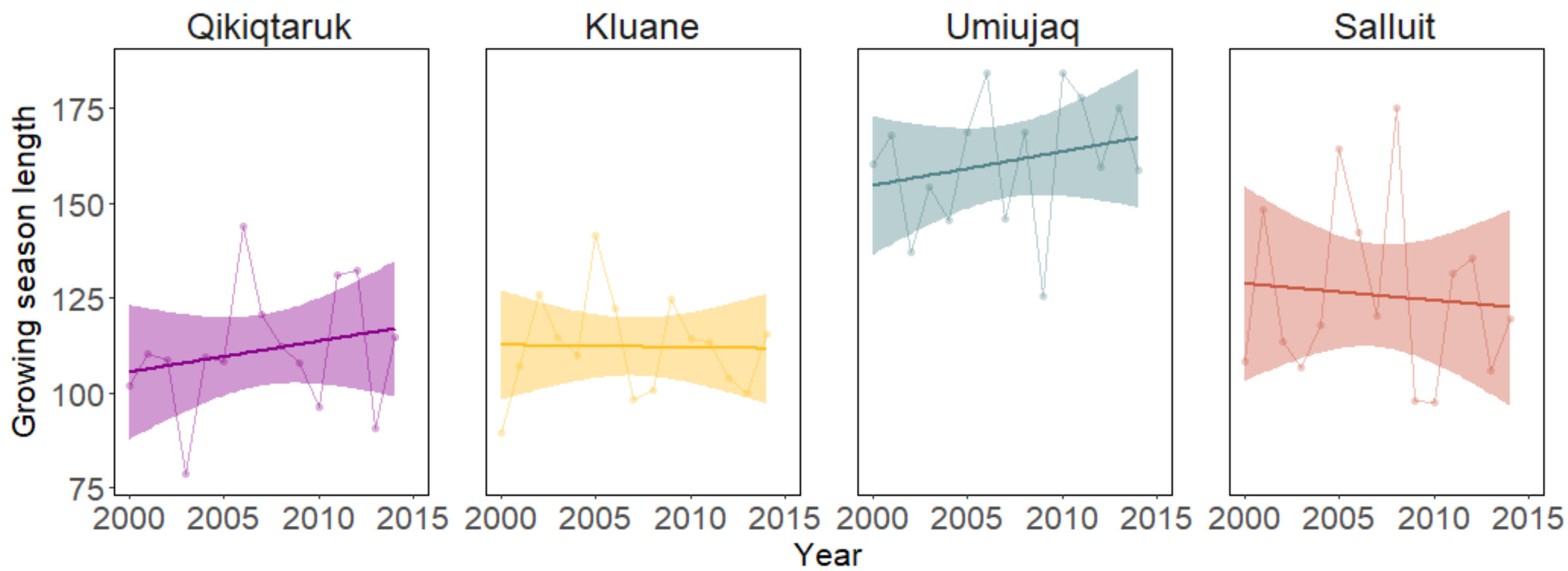
Umiujaq

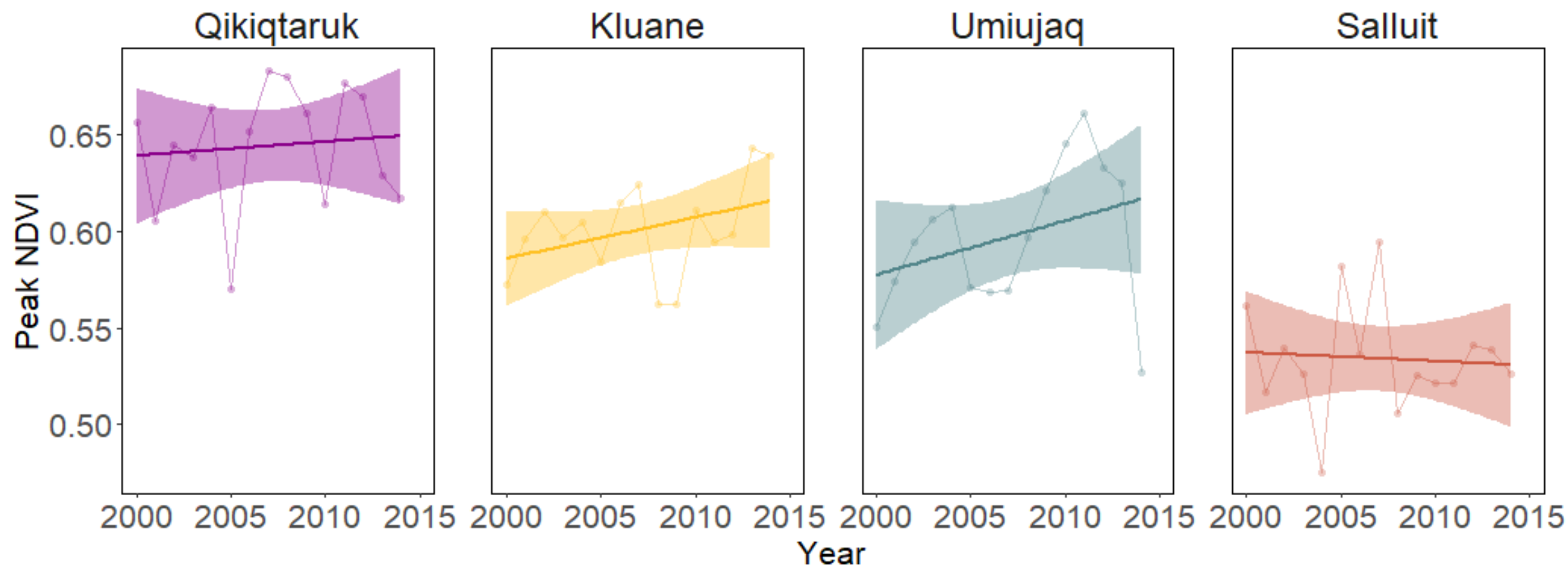


Salluit

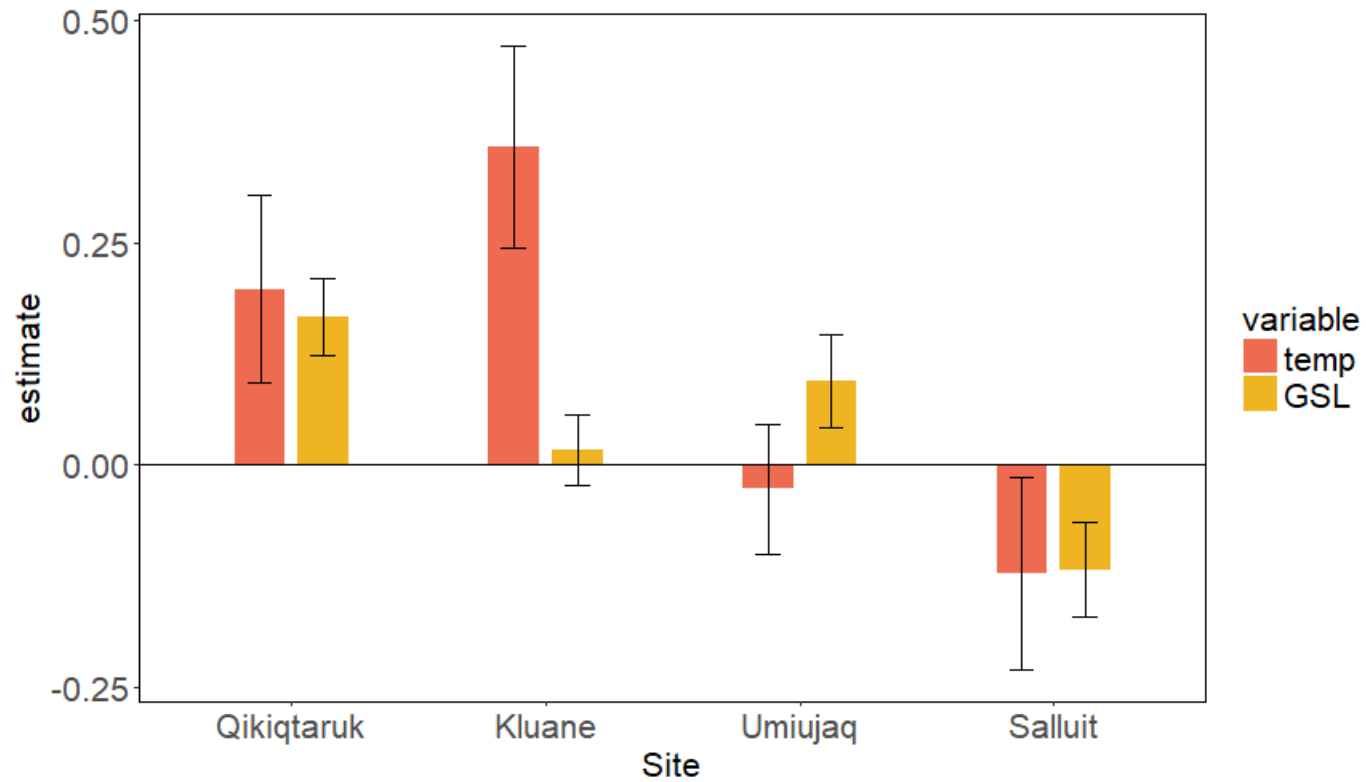
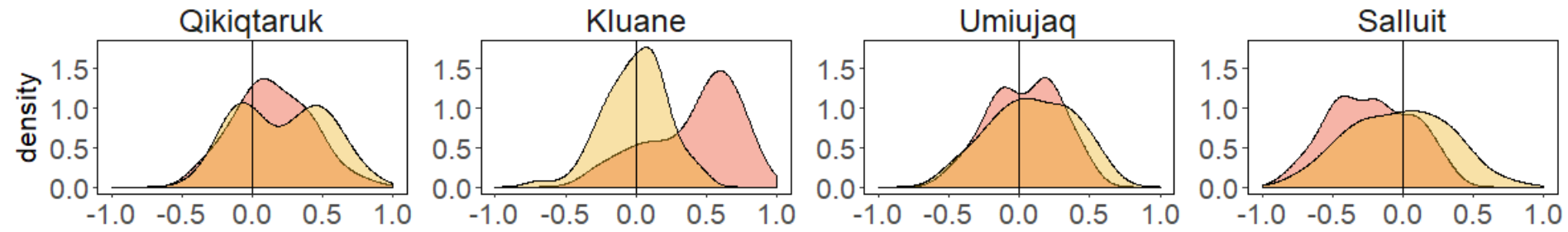


Year





NO CONSISTENT DRIVER OF SHRUB GROWTH



Site	Plot	n	timespan
Qikiqtaruk	HF	41	28
Qikiqtaruk	HR1	15	26
Qikiqtaruk	HR2	19	25
Kluane	K1	32	30
Kluane	K2	20	25
Kluane	P3	24	25
Umiujaq	U1	4	24
Umiujaq	U3	36	25
Umiujaq	U4	15	25
Umiujaq	U6	13	28
Salluit	S1	21	25
Salluit	S4	32	21
Salluit	S5	45	17