Warming impacts on peak Normalized Difference Vegetation Index (NDVI) magnitude and timing across eight tundra communities in northern Alaska

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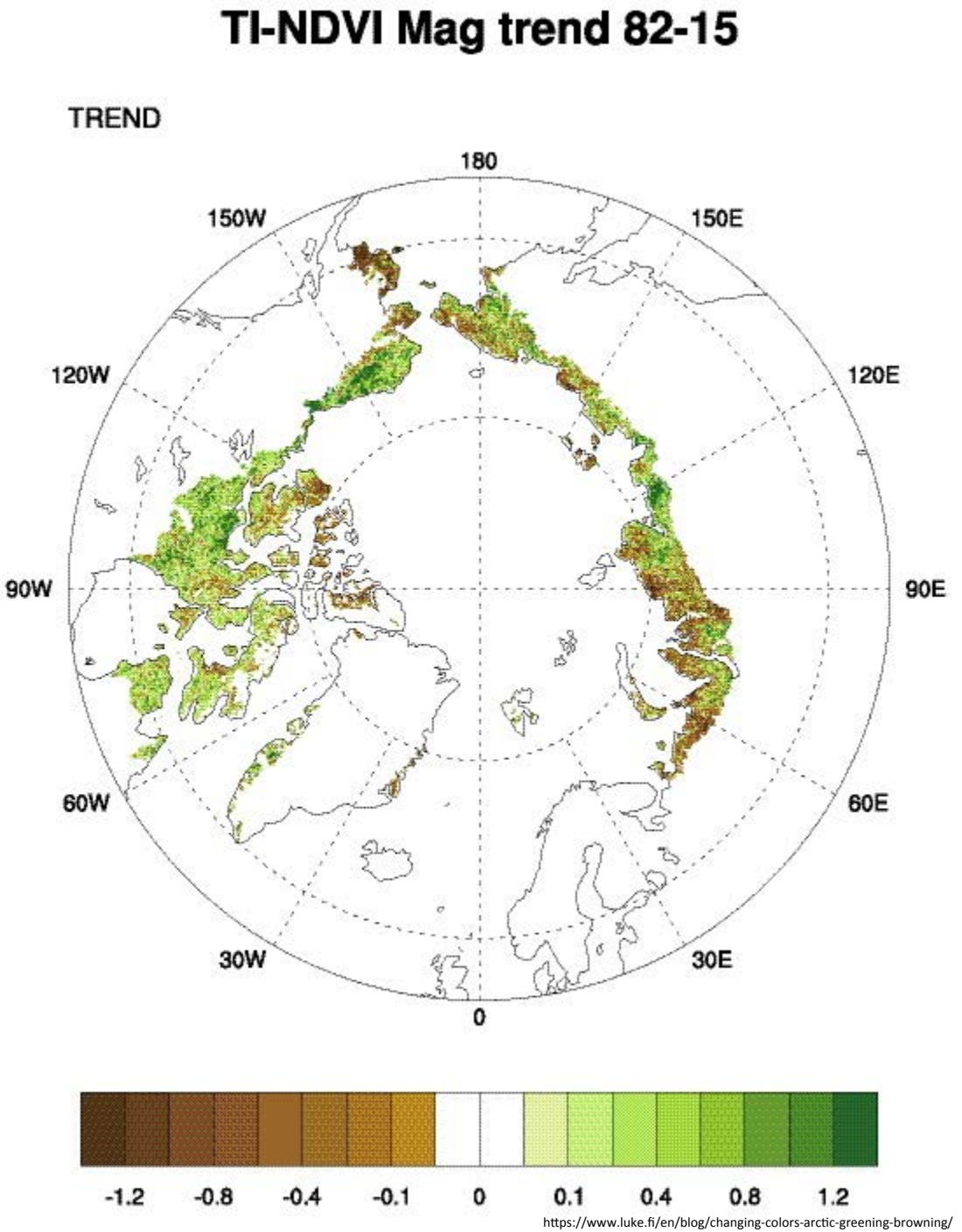
Arctic Greening (and Browning)

Warming in the Arctic lengthens growing periods, increases aboveground biomass, and alters community dominance

NDVI increases with warming but can be non-uniform (Jia 2003, Stow et al. 2007, Bhatt et al. 2010))

Recent evidence of browning in some region (Verbyla 2008, Phoenix et al. 2016)



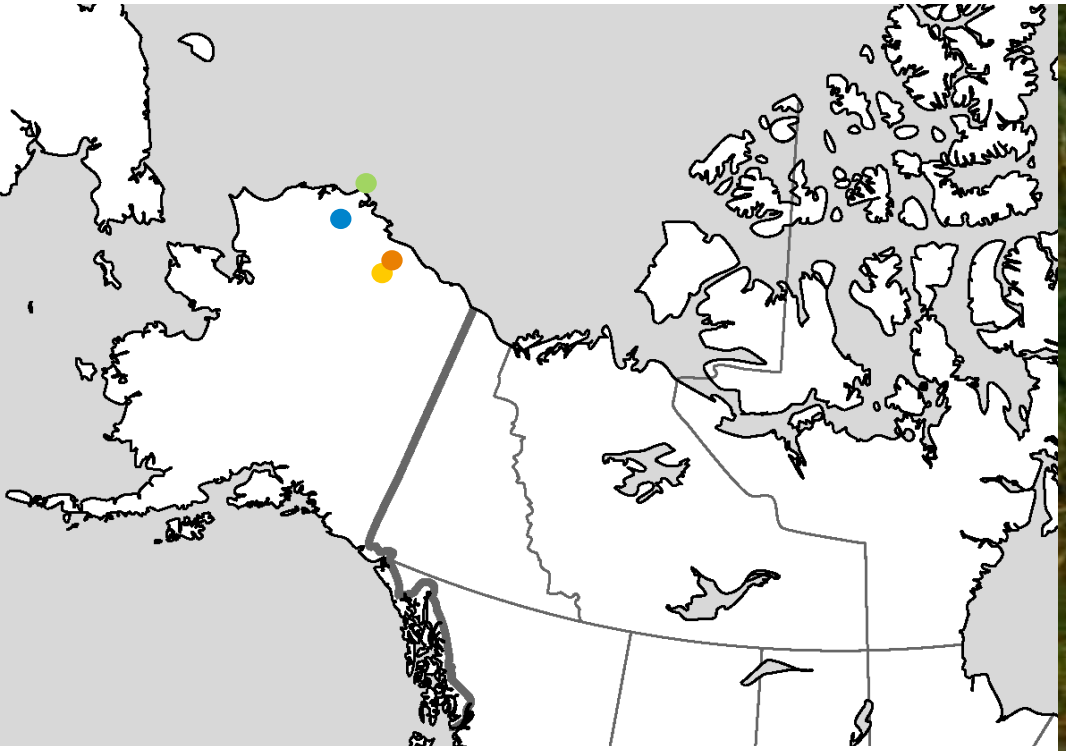
https://www.luke.fi/en/blog/changing-colors-arctic-greening-browning/

Objectives

Warming effects of daily NDVI rates of change during spring greening and autumn senescence

Warming effects on magnitude and timing of peak NDVI values

Correlation between taxa canopy cover and peak NDVI value magnitude and timing



Methods

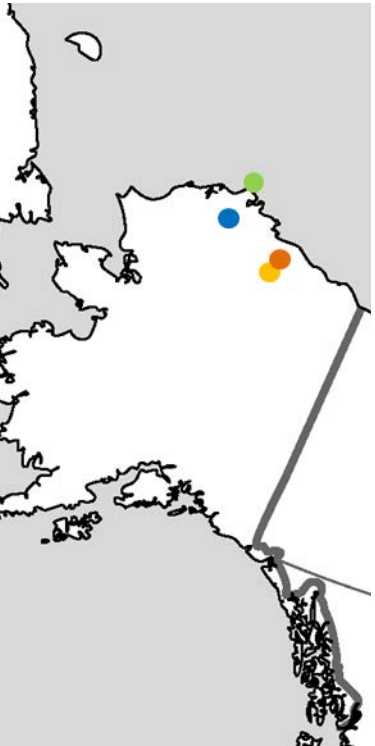
Near-daily NDVI measurements

Point framing conducted in 2016 and 2017 for canopy taxon cover

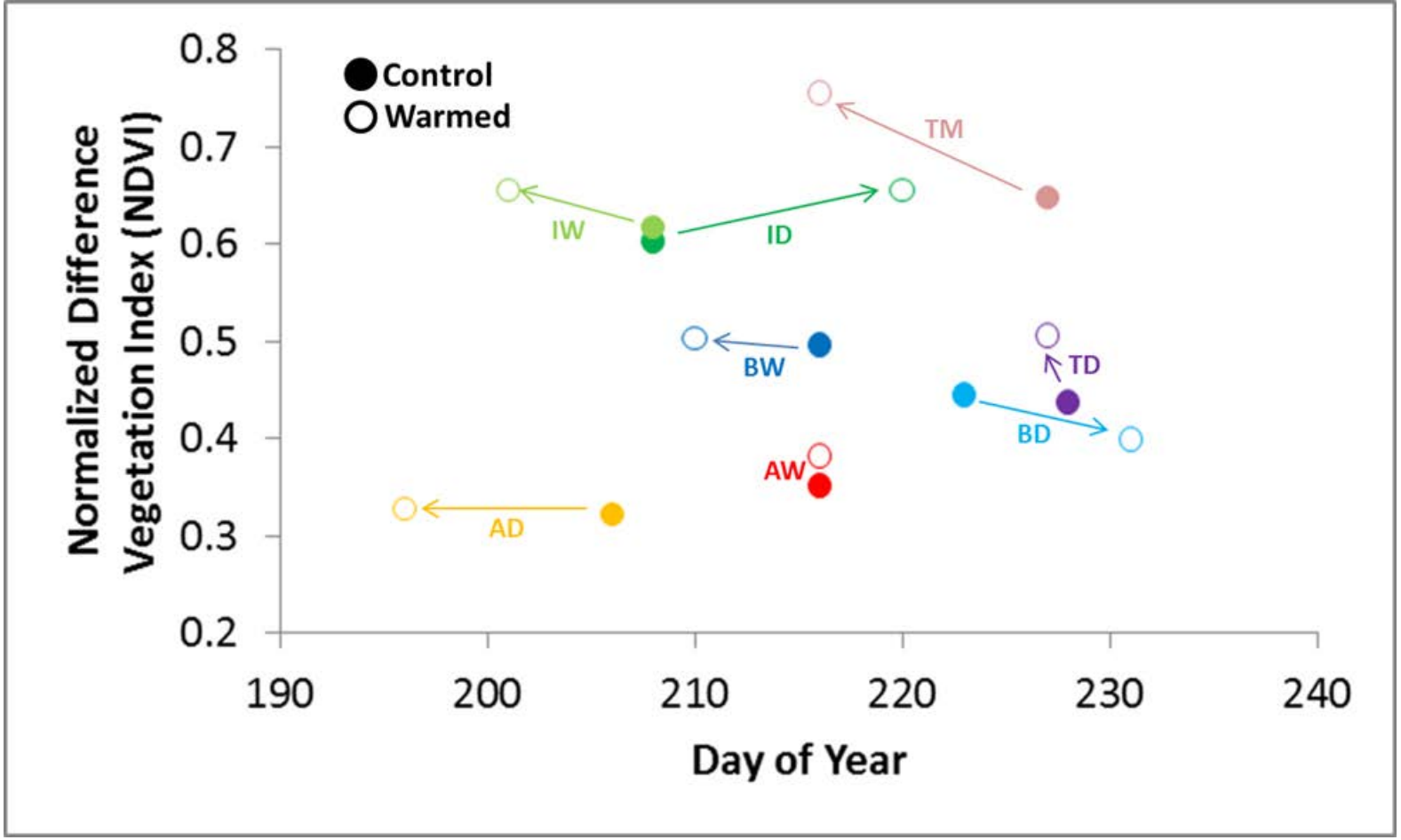
Each site consists of a dry and moist/wet site

GreenSeeker®

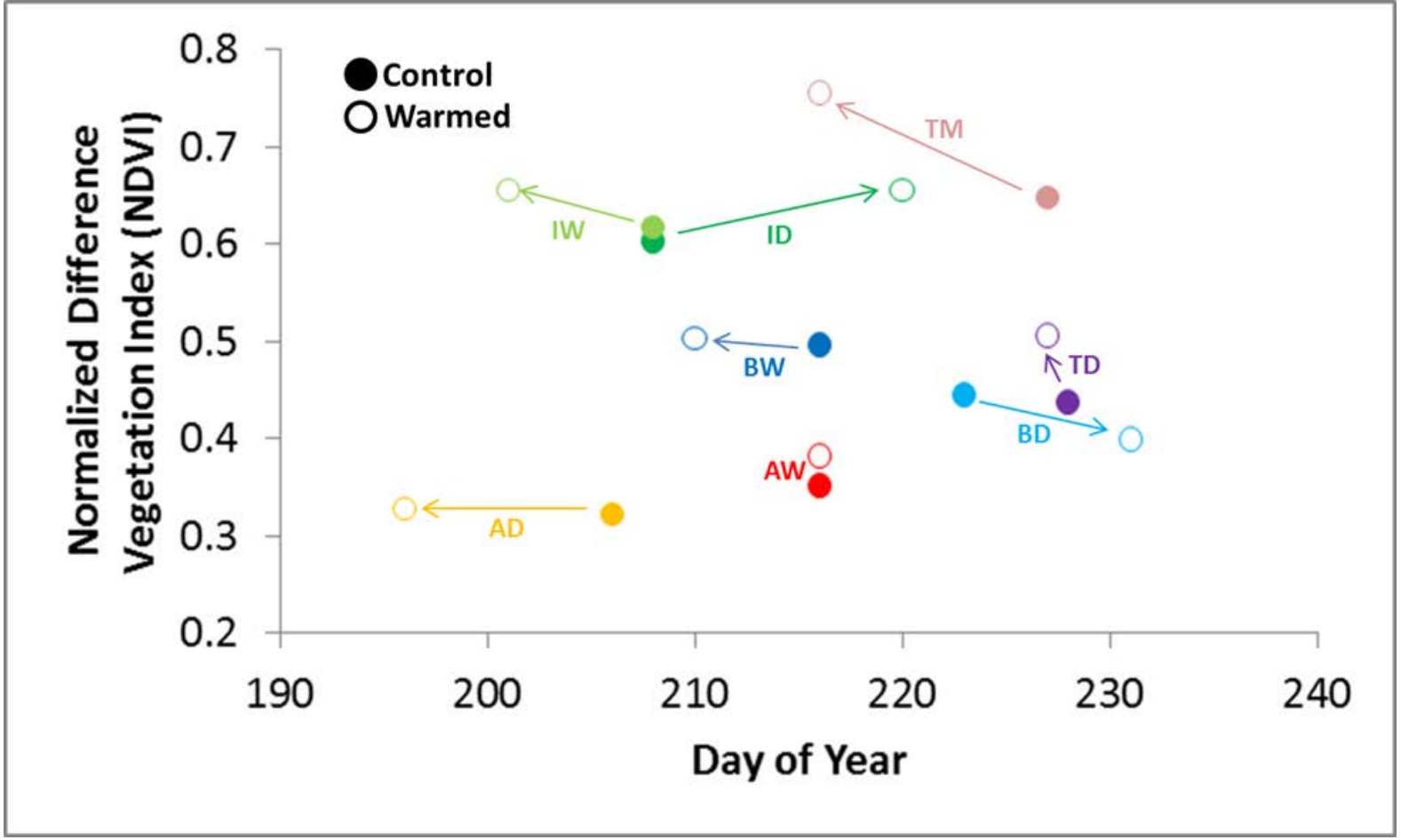
$$NDVI = \frac{NIR_{774} - Red_{656}}{NIR_{774} + Red_{656}}$$



Barrow	Dry Heath	Wet Meadow
Atqasuk	Dry Heath	Wet Meadow
Imnavait Creek	Dry Heath	Wet Acidic
Toolik Lake	Dry Heath	Moist Acidic

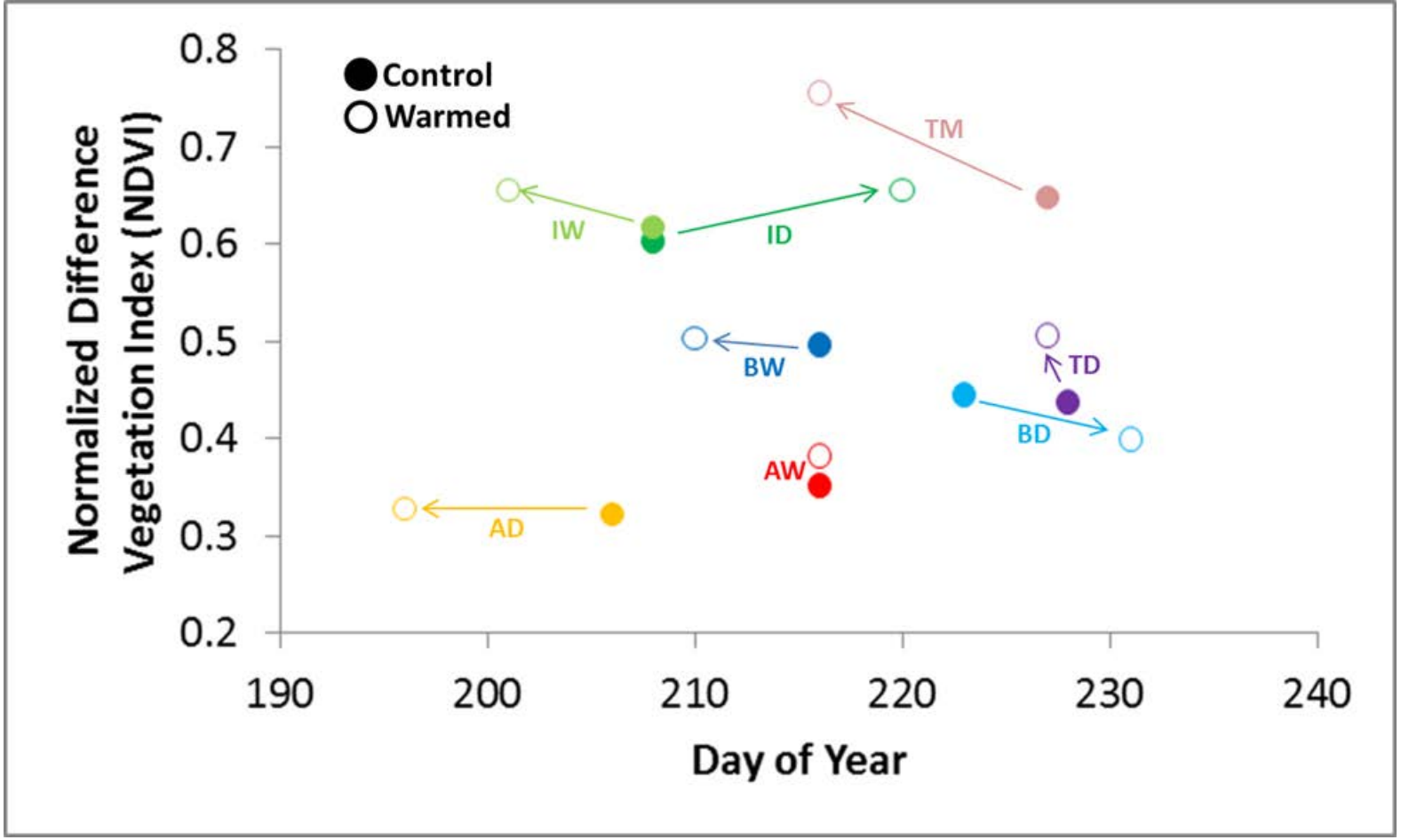


Warming effect on peak NDVI magnitude was mixed but more pronounced at southernmost sites



Warming effect on peak NDVI magnitude was mixed but more pronounced at southernmost sites

Warming has a larger effect on timing than magnitude

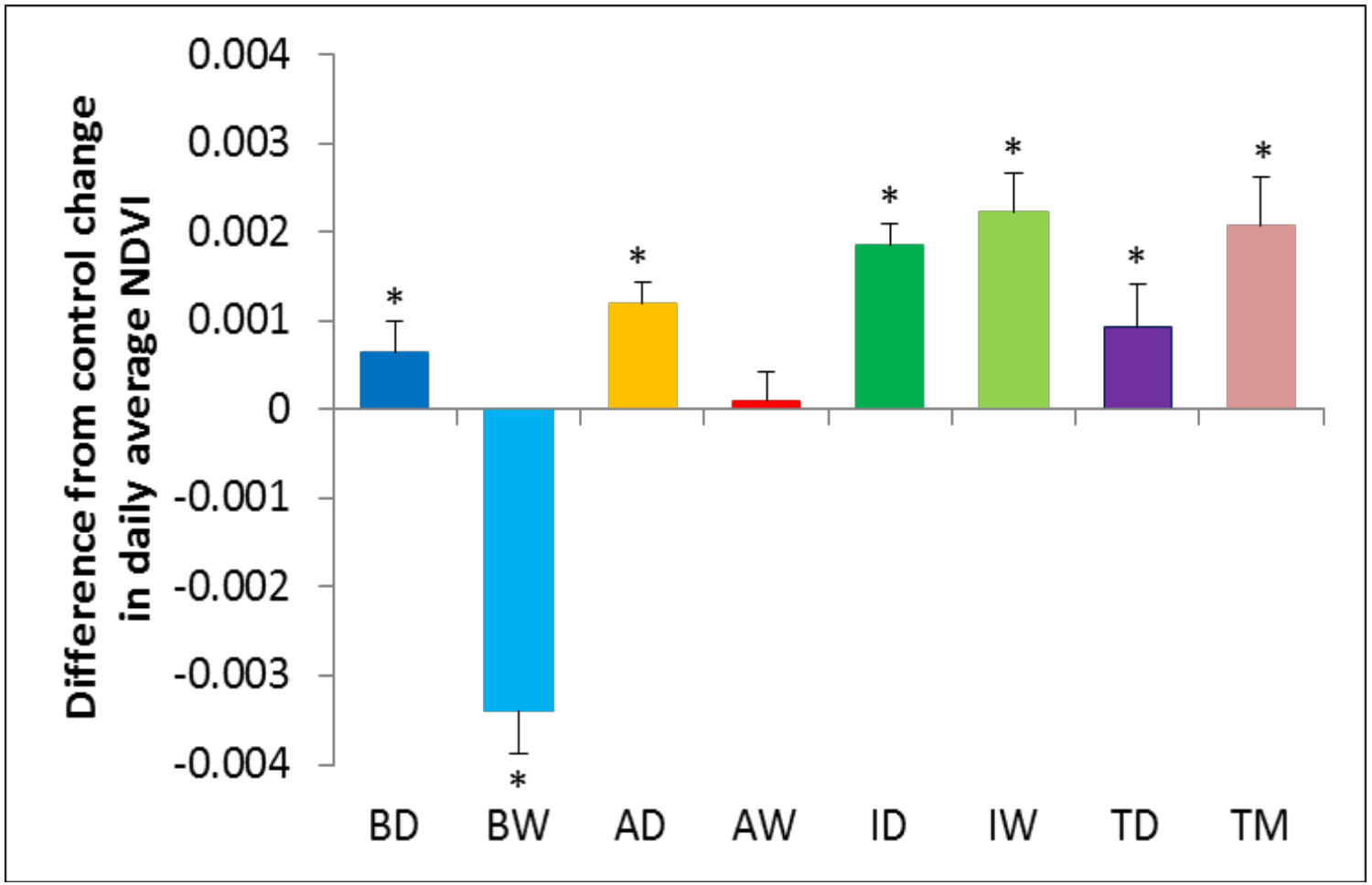


Warming effect on peak NDVI magnitude was mixed but more pronounced at southernmost sites

Warming has a larger effect on timing than magnitude

All wet/moist had earlier peak with warming but dry heath mixed depending on dominant cover

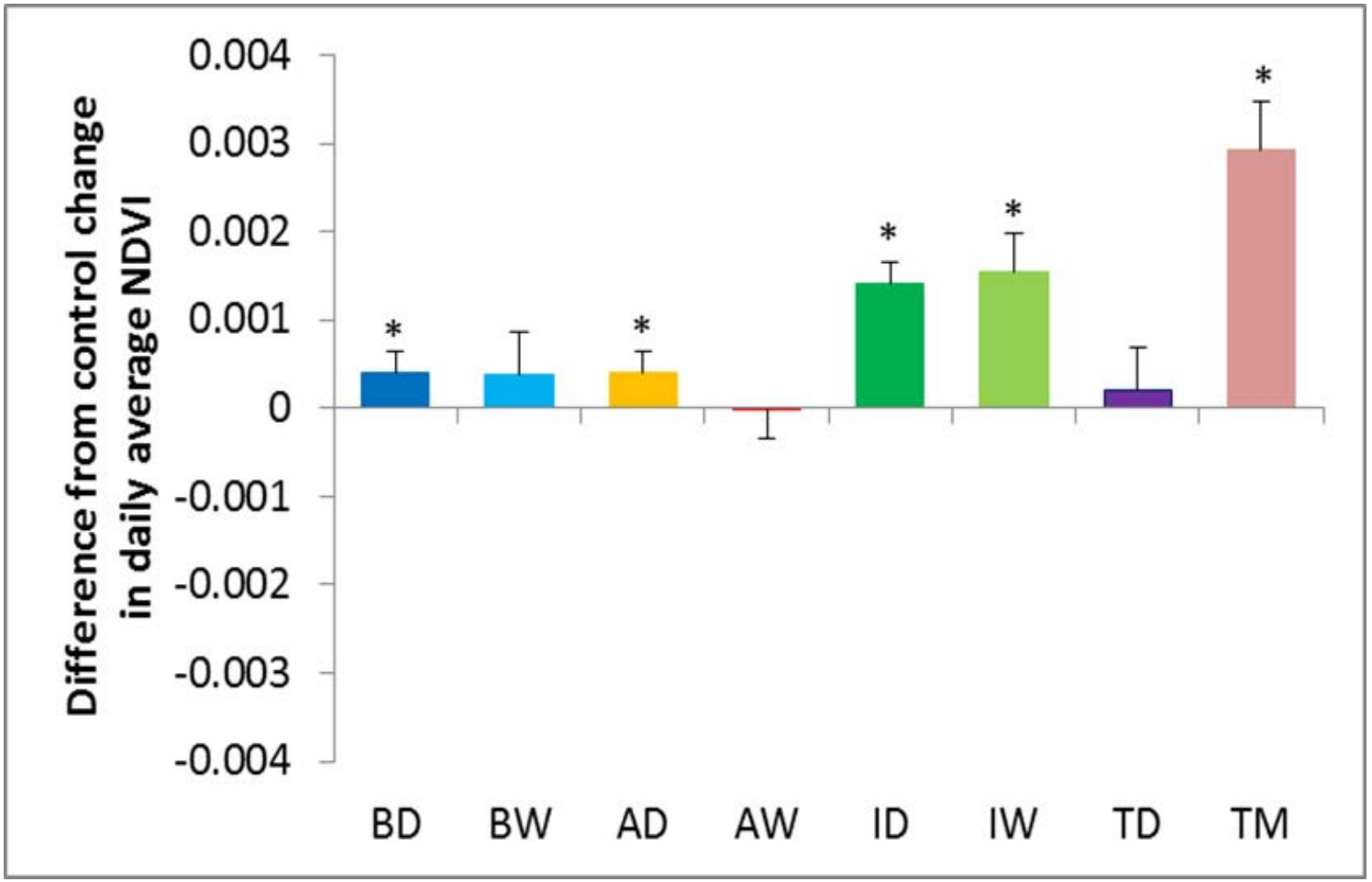
Spring Greening



Almost all sites increased rate of greening with warming

Only the Barrow Wet Meadow slowed

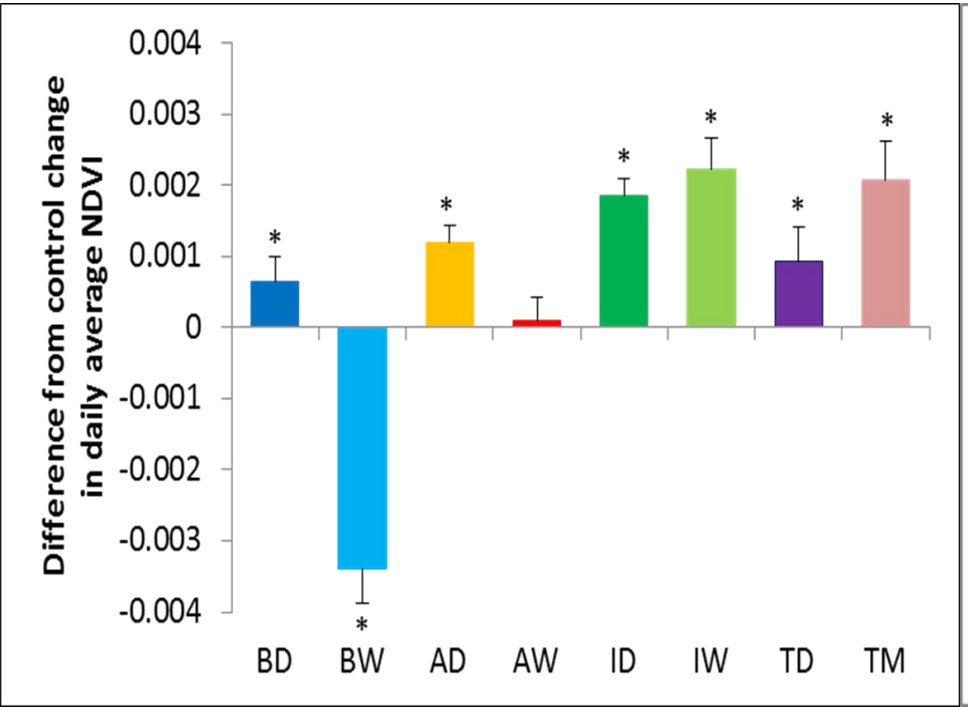
Autumn Senescence



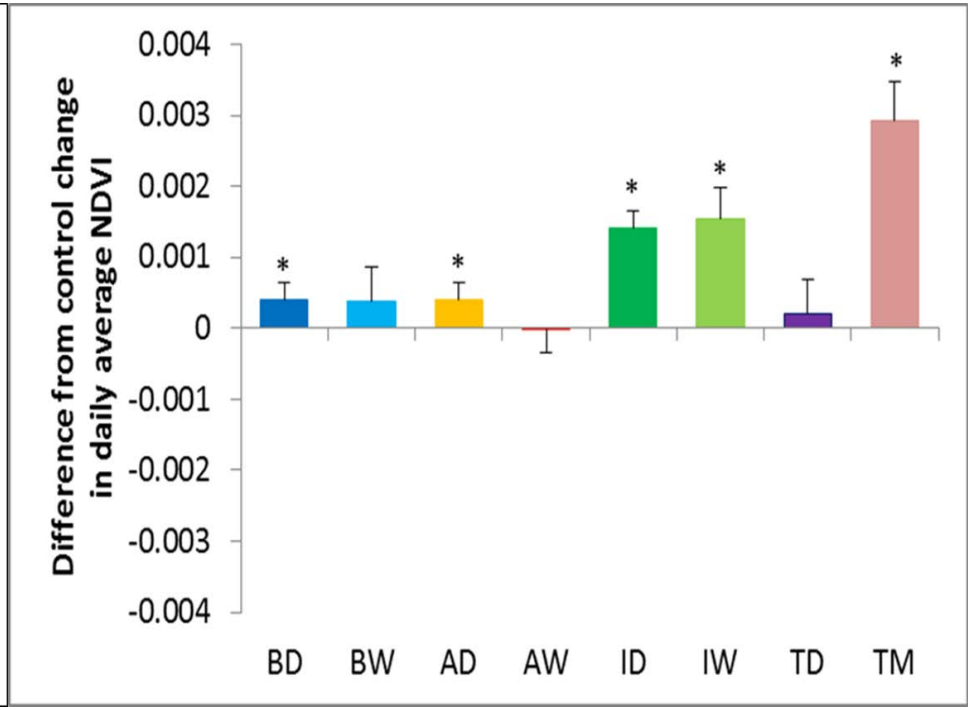
Warming slowed senescence at most sites

Southernmost sites showed most pronounced differences

Spring Greening



Autumn Senescence



Increased greening rate

Slowed senescence

Prolonged growing periods

Likely one reason that peak NDVI timing shifts more than magnitude

Taxa Influence on peak NDVI magnitude

	Bryophyte	Lichen	Forb	Deciduous Shrub	Evergreen Shrub	Graminoid	Shrub and Graminoid	Vascular
				Barrow				
Dry Heath	0.003	-0.146	-0.079	**0.516**	**0.368**	-0.127	**0.364**	**0.497**
Wet Meadow	0.175	-0.016	-0.226	0.165	-	**0.481**	**0.577**	**0.572**
				Atqasuk				
Dry Heath	-0.134	**-0.385**	**-0.443**	0.181	0.232	**0.362**	**0.486**	0.456
Wet Meadow	-0.122	-	0.009	**0.532**	-	**0.383**	**0.573**	0.578
				Imnavait Creek				
Dry Heath	0.012	-0.312	0.113	**0.326**	**0.451**	0.211	**0.353**	0.313
Wet Acidic	0.112	-0.034	0.126	0.263	**0.411**	**0.392**	**0.376**	**0.341**

Cryptogams had marginal or negative effect

Shrubs and graminoids strong positive effect (especially combined)

Taxa Influence on peak NDVI timing

	Bryophyte	Lichen	Forb	Deciduous Shrub	Evergreen Shrub	Graminoid	Shrub and Graminoid	Vascular
				Barrow				
Dry Heath	0.371	0.313	0.097	-0.153	-0.409	0.075	-0.341	-0.317
Wet Meadow	0.175	-0.181	-0.453	0.191	-	0.212	0.297	0.182
				Atqasuk				
Dry Heath	0.05	0.201	-0.316	0.173	-0.261	0.071	-0.053	-0.104
Wet Meadow	0.314	-	-0.153	0.173	-	0.482	0.371	0.362
				Imnavait Creek				
Dry Heath	0.183	-0.321	0.091	-0.368	-0.392	-0.014	-0.321	-0.262
Wet Acidic	0.226	-0.117	0.288	-0.275	-0.384	0.395	0.024	0.006

Results were more mixed

Cryptogams had little effect

Shrub shifted earlier and graminoids later (often cancelling out)

Conclusions

Warming has a larger effect on NDVI timing than magnitude

Daily rate of NDVI change suggests a lengthening of growing season

Taller statured taxa increase peak NDVI magnitude

Taxa have mixed effects on peak NDVI timing

Questions?

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