Vegetation Biomass and Spectral Properties along the Eurasian Arctic Transect (EAT), as Ancillary Biodiversity Variables

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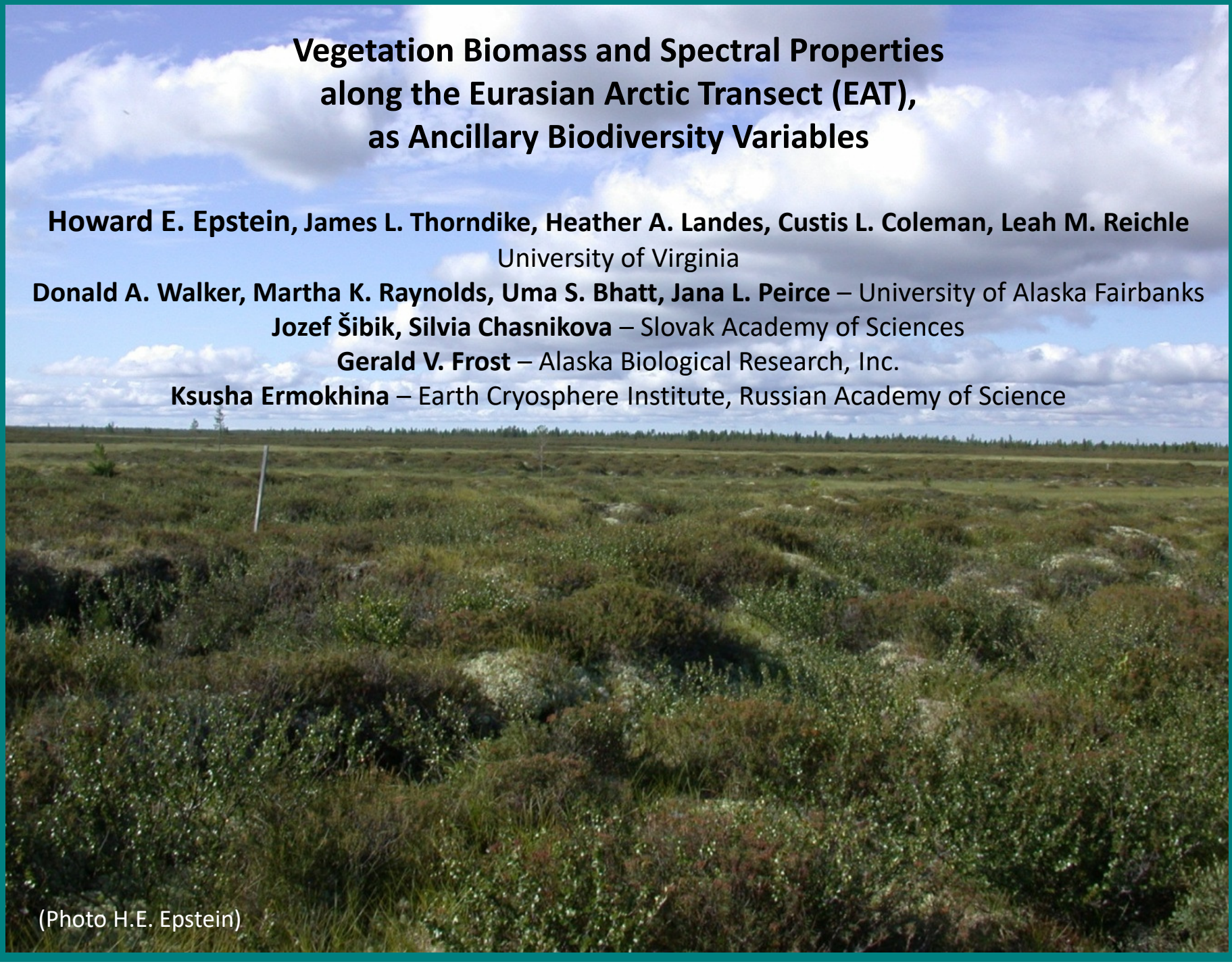
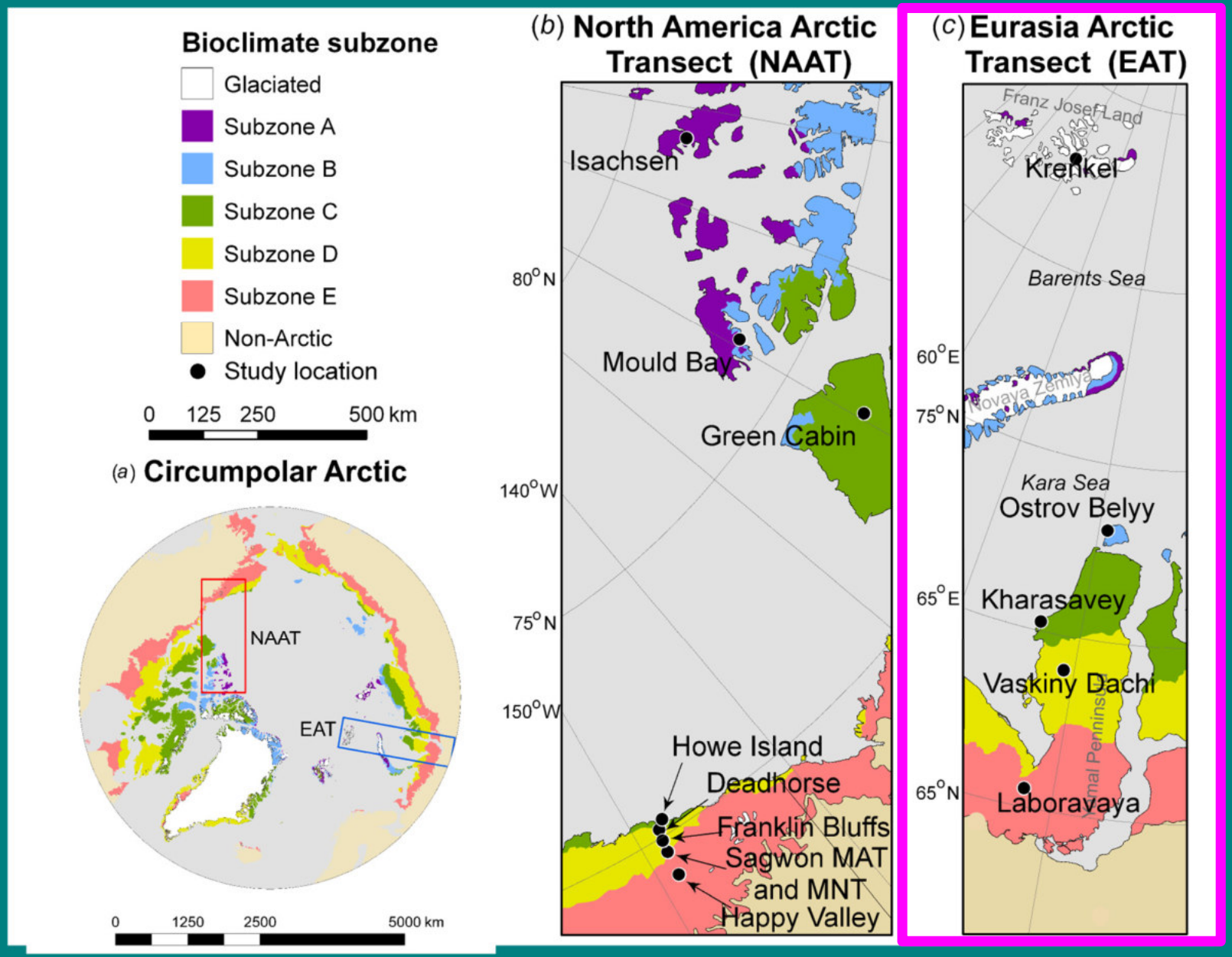


(Photo H.E. Epstein)



Raynolds et al. (2012), Walker et al. (2012)

Eurasian Arctic Transect

Subzone A

Subzone B

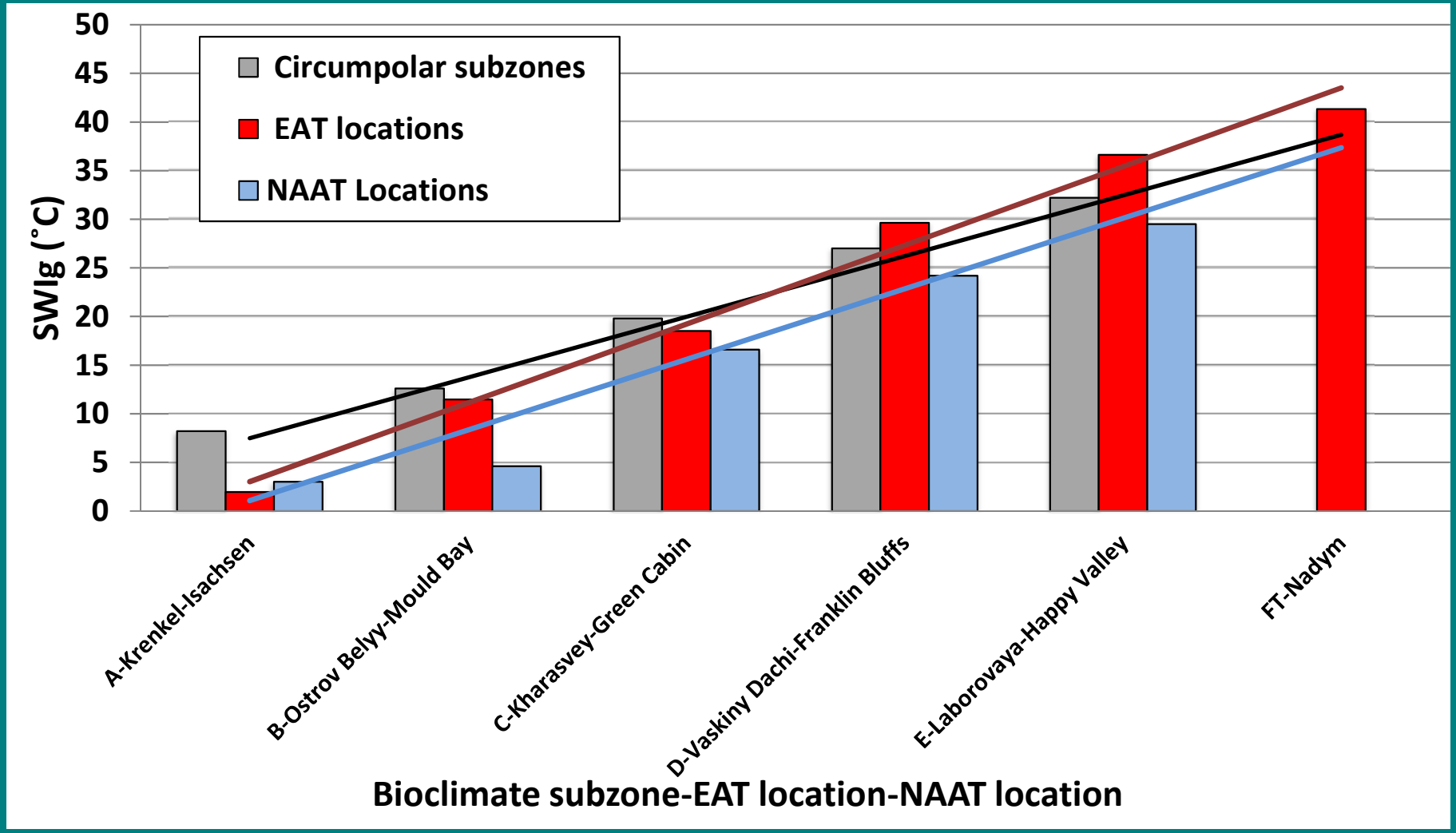
Subzone C

Subzone D

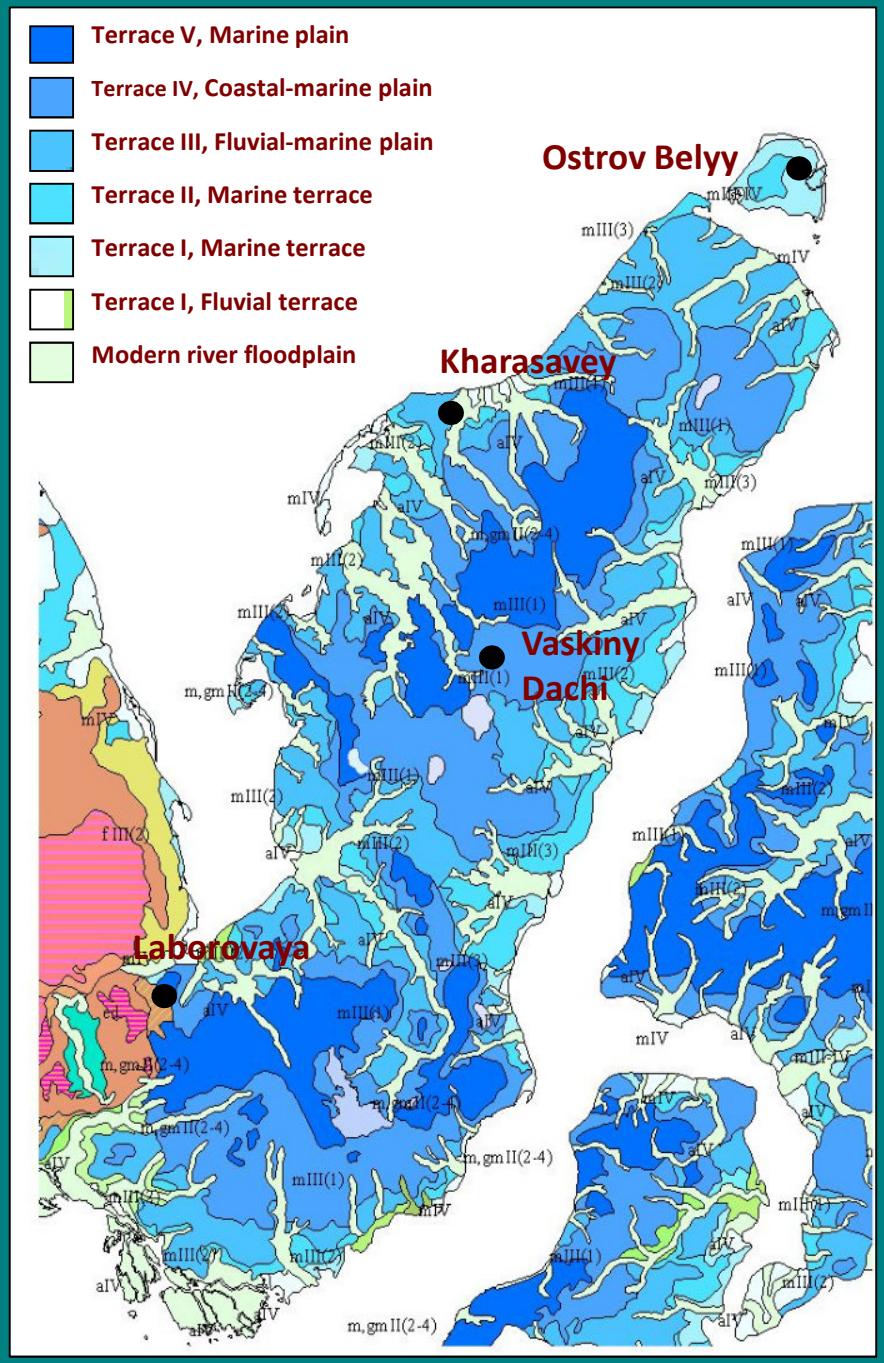
Subzone E

(Photos D.A. Walker and H.E. Epstein)

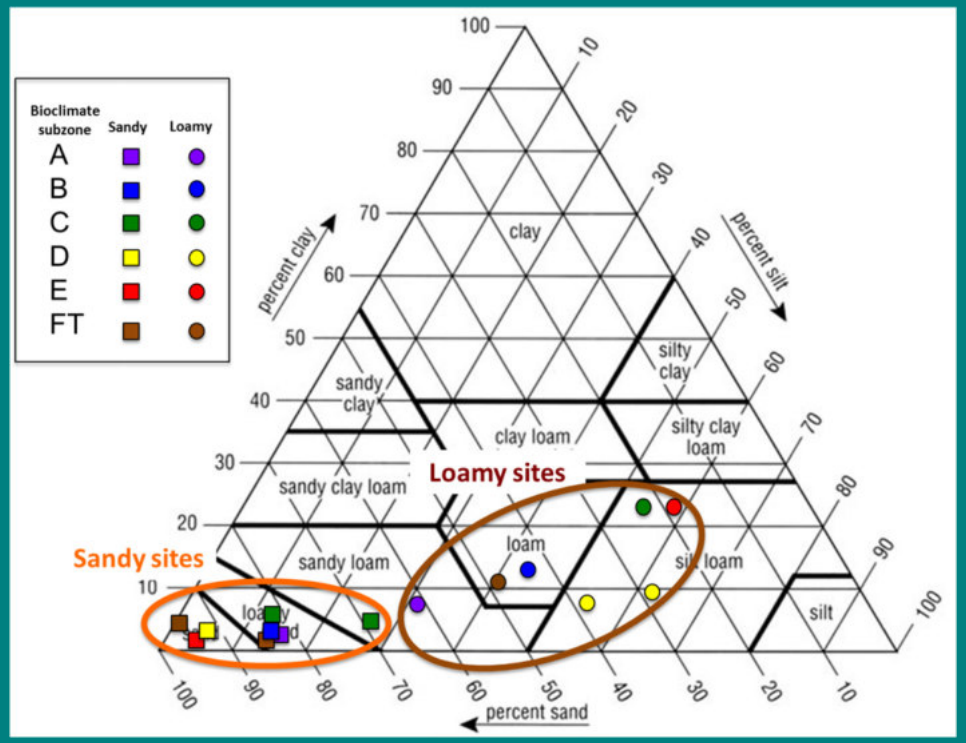
Mean summer warmth for circumpolar subzones compared to EAT and NAAT study locations



SWI_g = Ground surface mean annual sum of monthly mean temperatures >0 ˚C, determined from AVHRR satellite thermal bands (Raynolds et al. 2008).

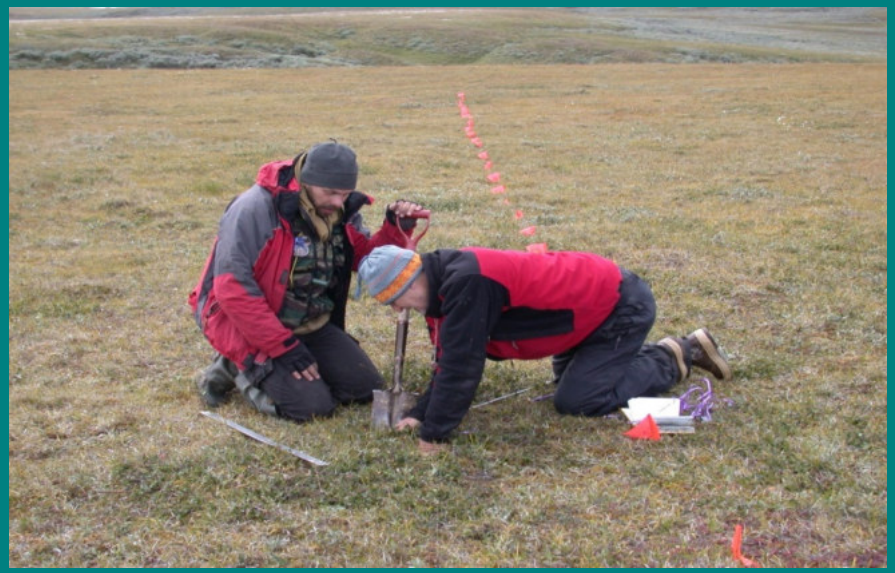


Different aged marine and fluvial terraces have different soil textures – younger landscapes have sandier soils.



Research questions

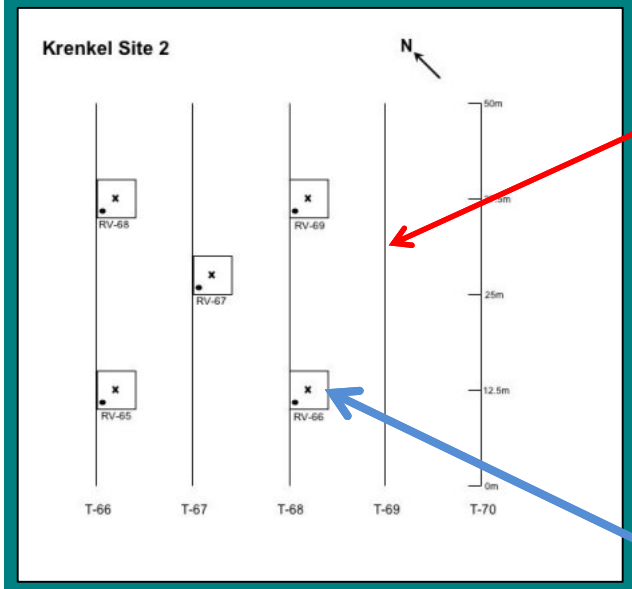
- How do different components of plant biomass vary along the temperature gradient (by soil texture)?
- How do the Normalized Difference Vegetation Index (NDVI) and the Leaf Area Index (LAI) vary along the SWI temperature gradient (by soil texture)?
- What are the relationships among biomass components, NDVI, and LAI across the dataset?

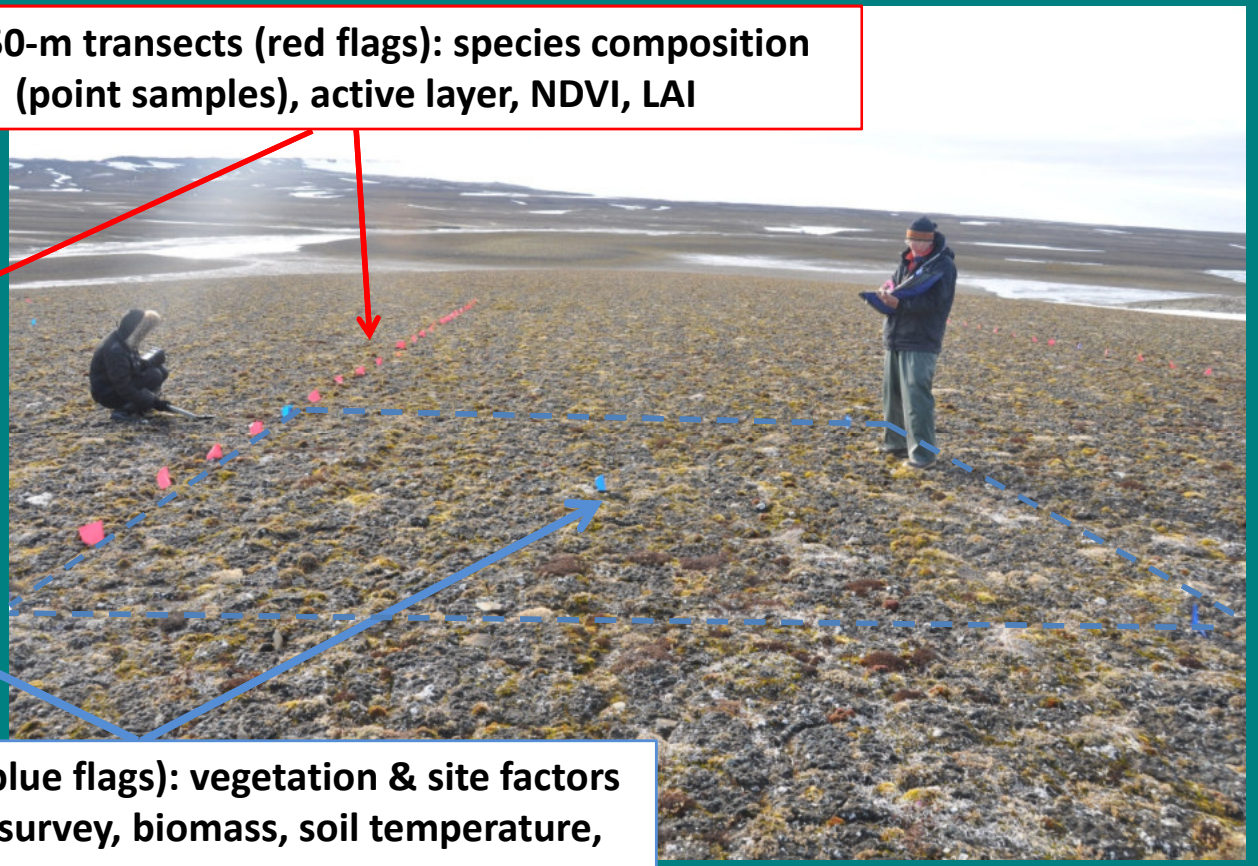


Field Data Collection

- six locations, with 2-3 sites at each location with varying soil textures
- 50 x 50 m sampling grid and five 50 m transects at each site
- NDVI (ASD PSII) at 1-m intervals along the transects
- LAI (Li-Cor LAI-2000) at 1-m intervals along the transects
- species present at 1-m intervals (composition)
- five relevés (5 x 5 m) (including additional NDVI and LAI measurements
- five aboveground biomass harvests (at relevés)
- five soil samples (top 10 cm – mineral soil)

Five 50-m transects (red flags): species composition (point samples), active layer, NDVI, LAI





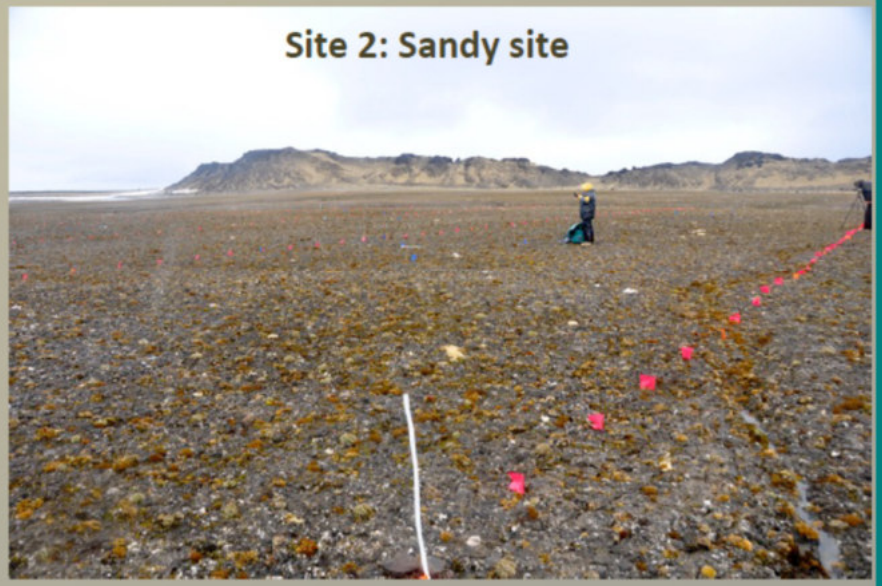
Five 5 x 5-m plots (blue flags): vegetation & site factors (plot sample), soil survey, biomass, soil temperature, NDVI, LAI

Sample grids on sandy and loamy sites at each location

Northern end of Tundra Bioclimate Zone, Subzone A, Hayes I.

Site 1: Sandy loam site

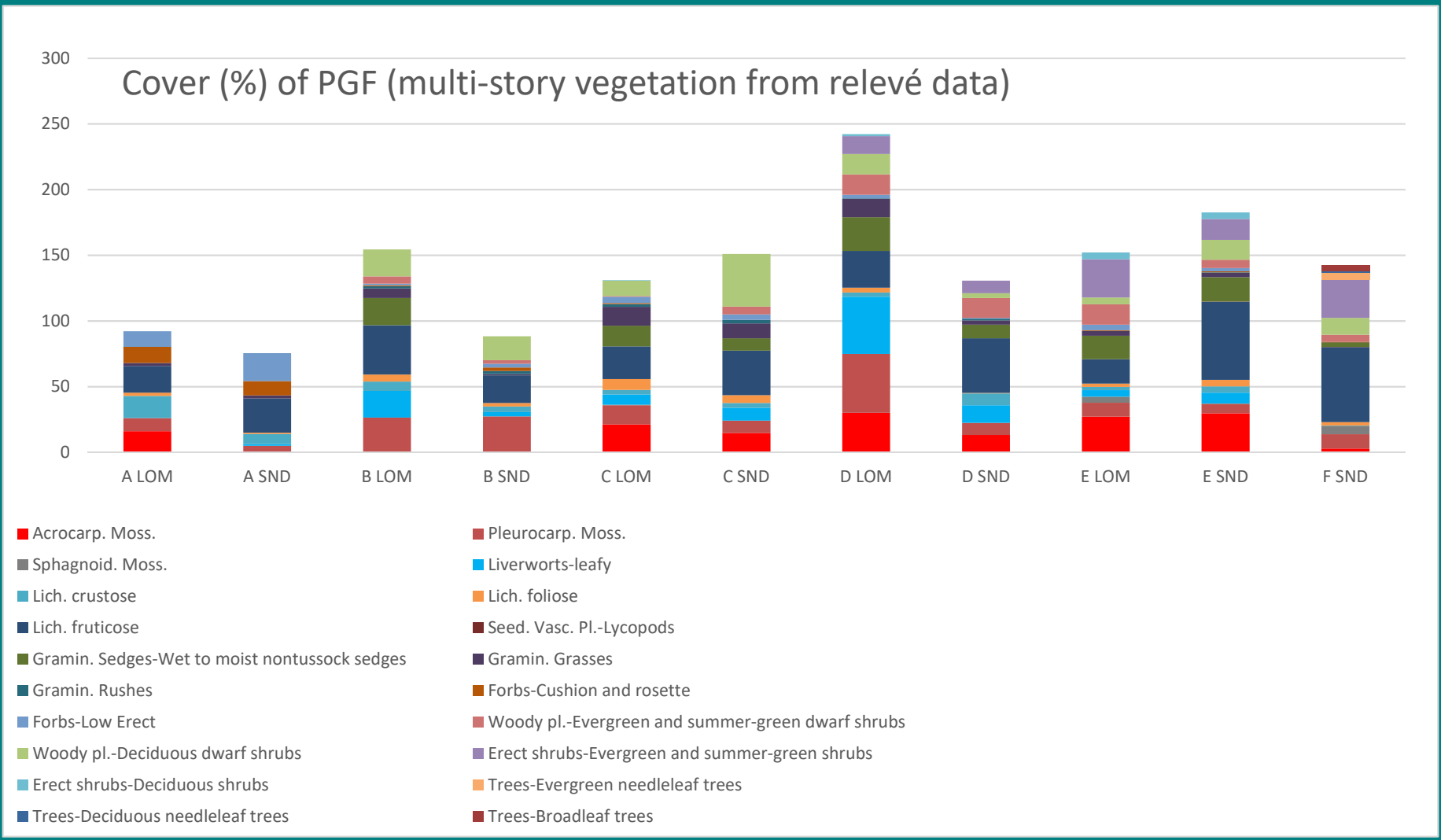
Site 2: Sandy site



Southern end, Subzone E, Laborovaya

Site 1: Loamy tundra

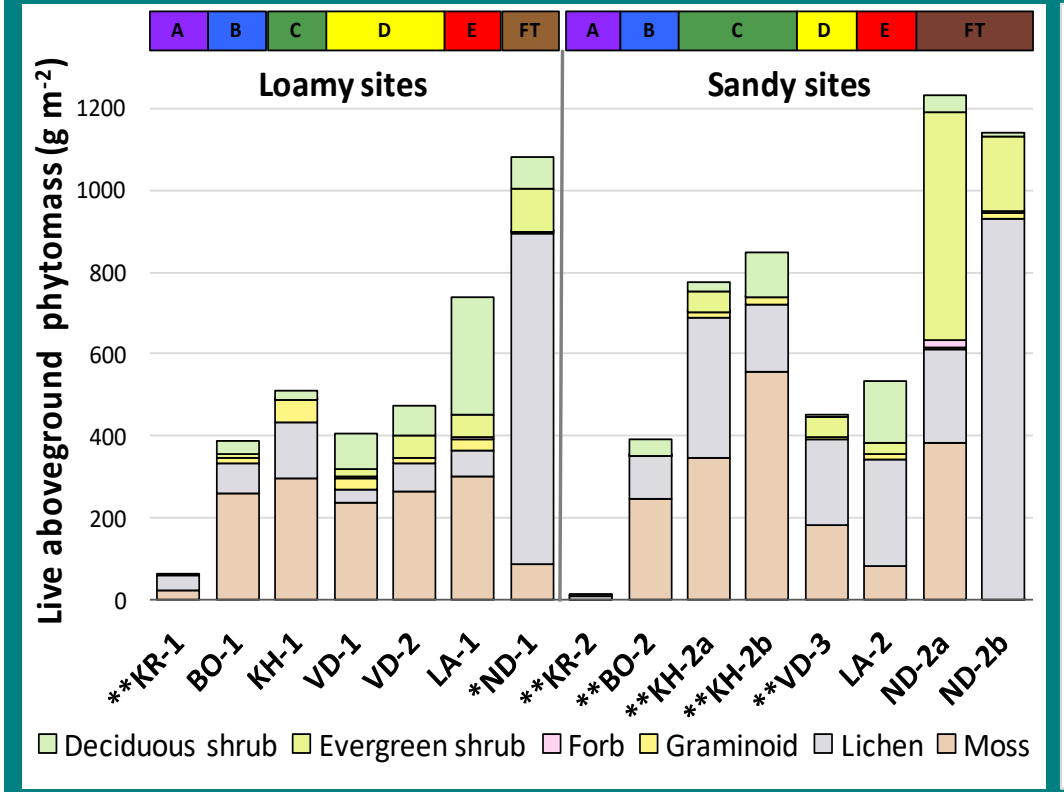
Site 2: Sandy tundra

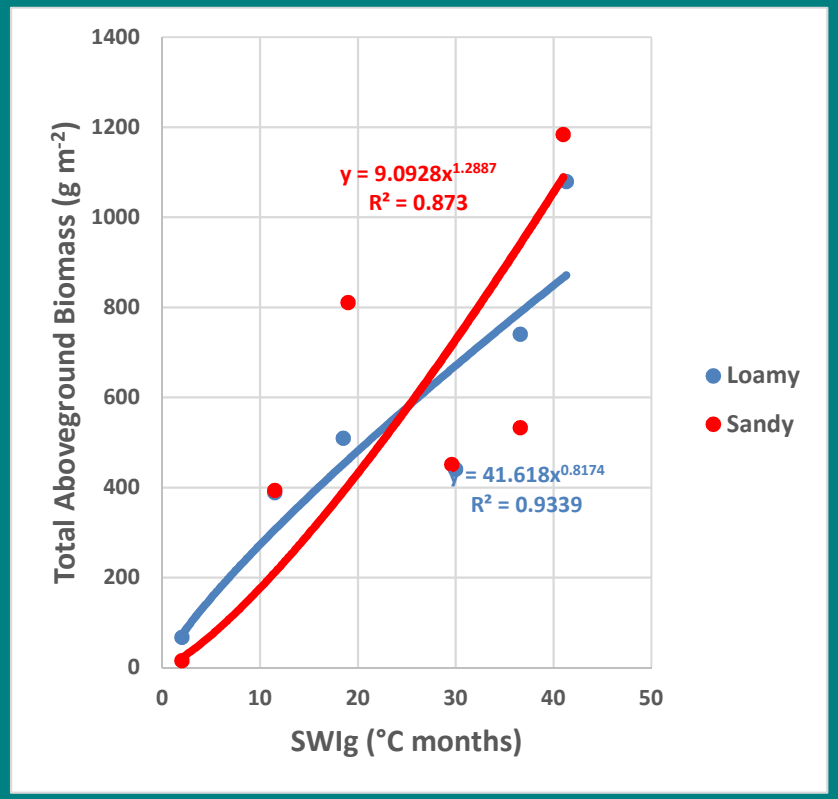


There are major differences in species composition between soil textures along the gradient.

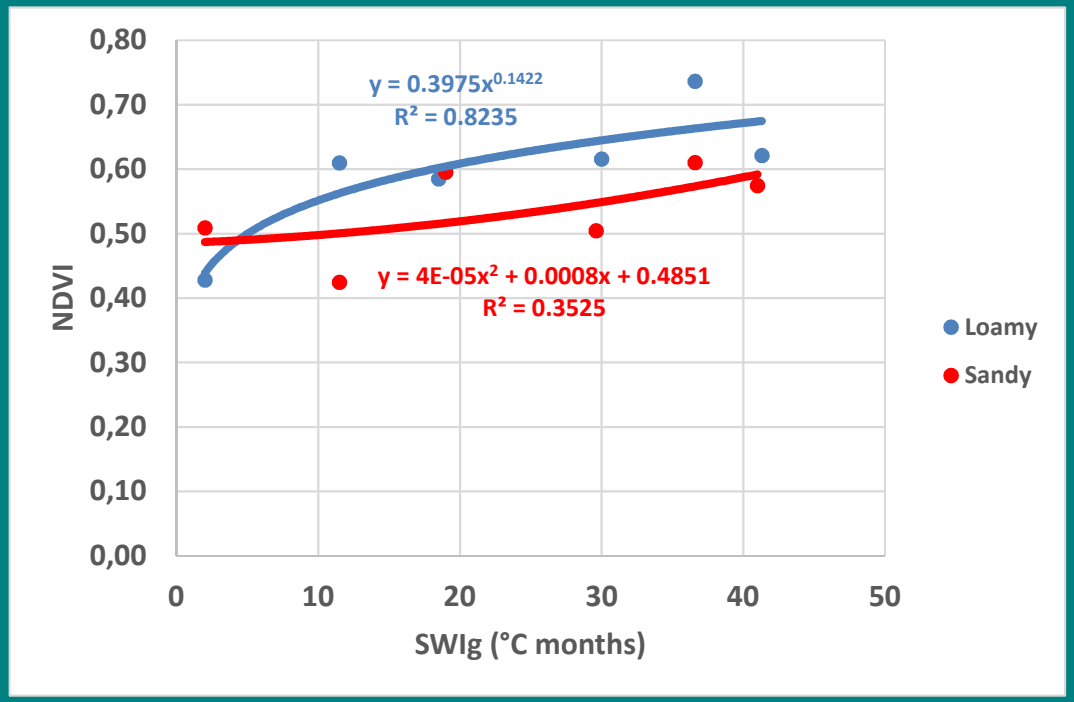
Walker et al. (2018) Applied Vegetation Science

Aboveground Biomass

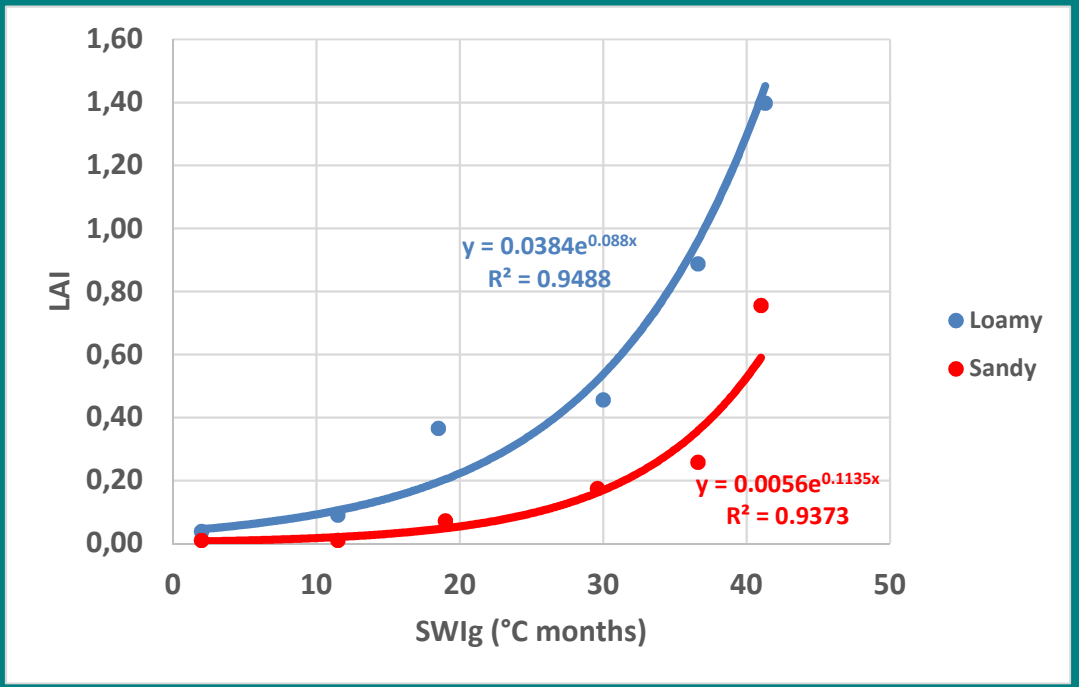




NDVI (handheld measurements)



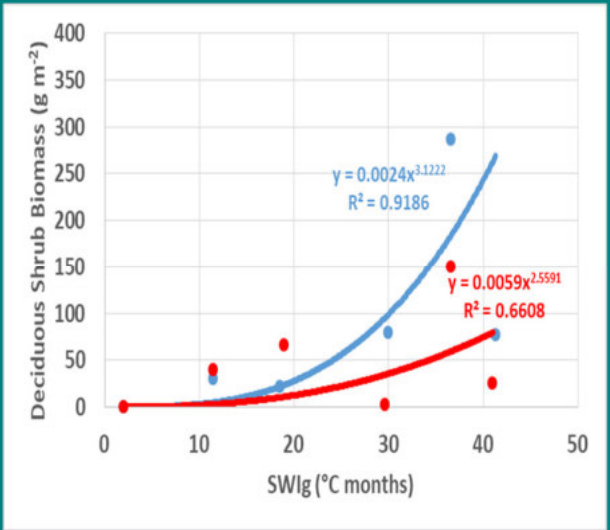
LAI
(effectively overstory Plant-AI)

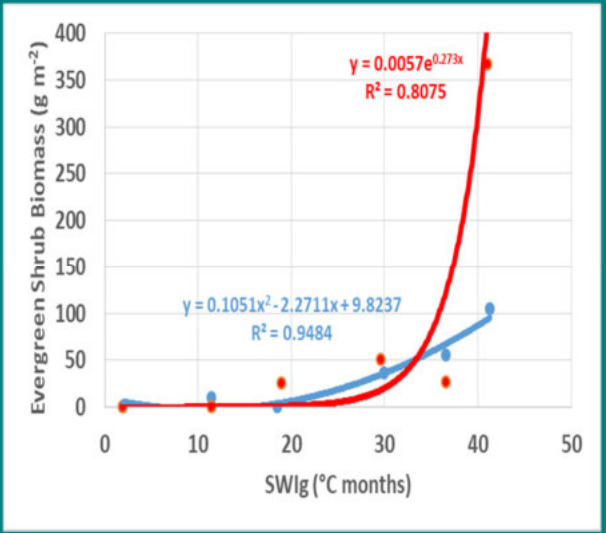


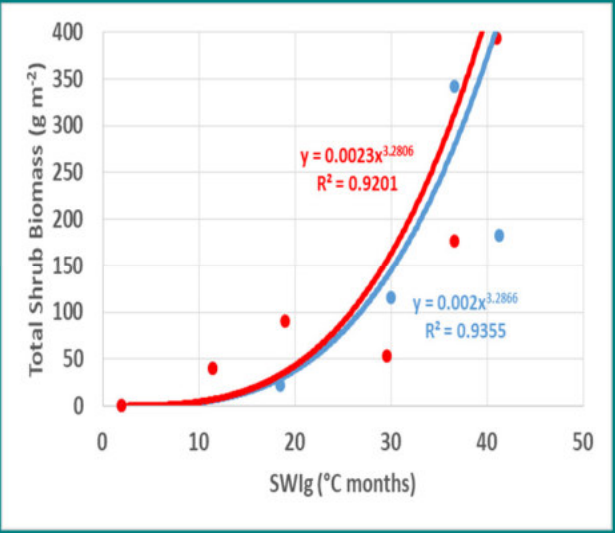
Differences by soil texture at the plant growth form (PGF) level

LOAMY is BLUE
SANDY is RED

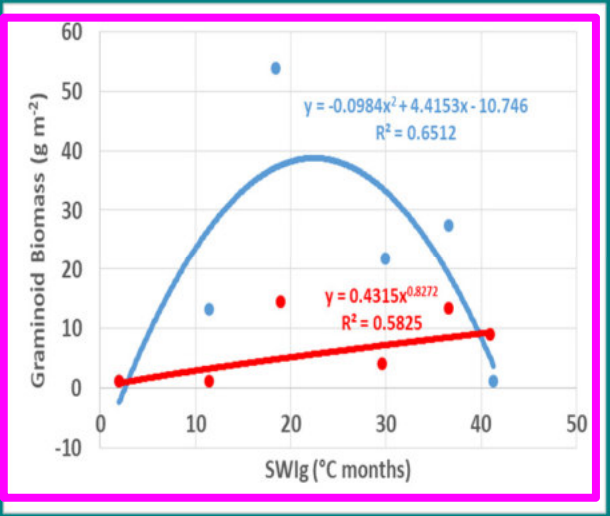
SHRUBS

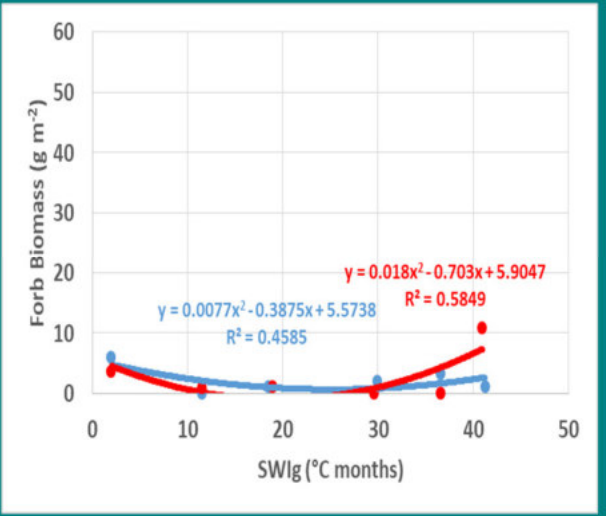


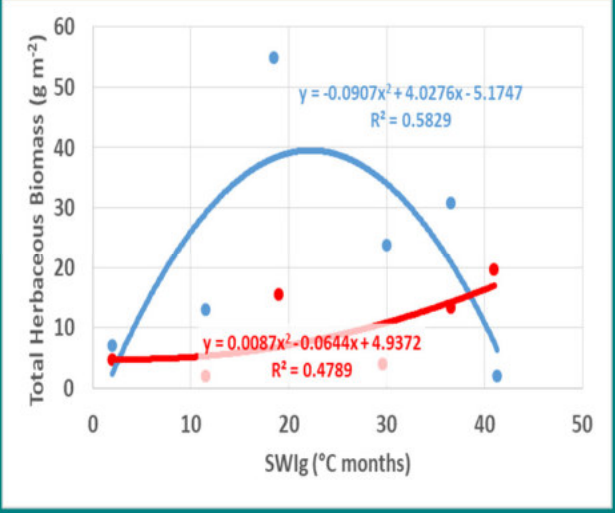




HERBACEOUS

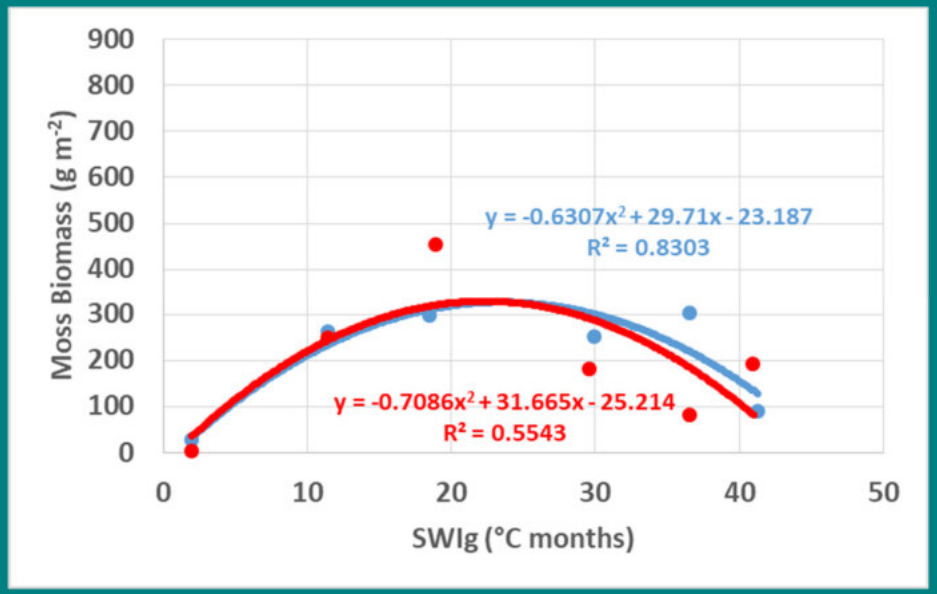


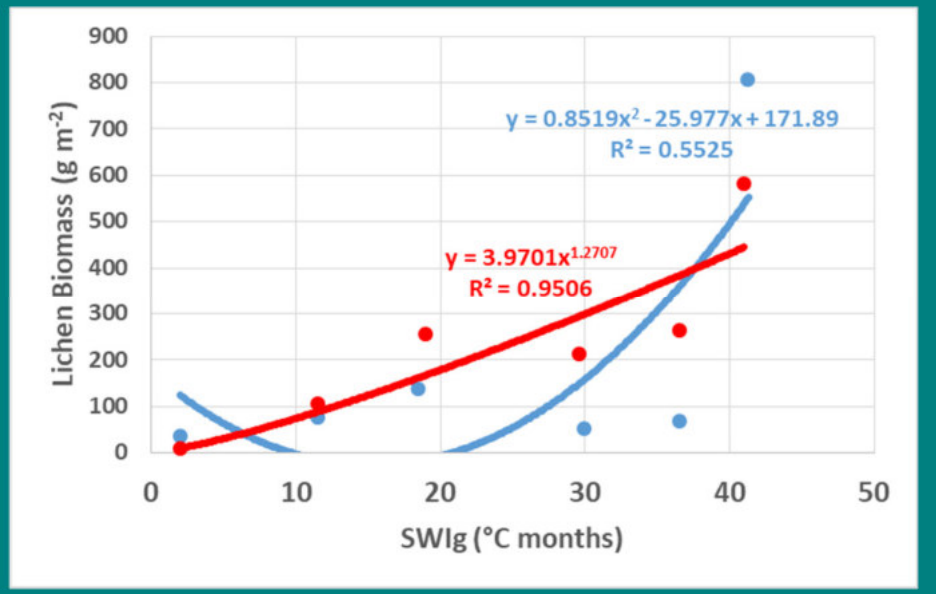




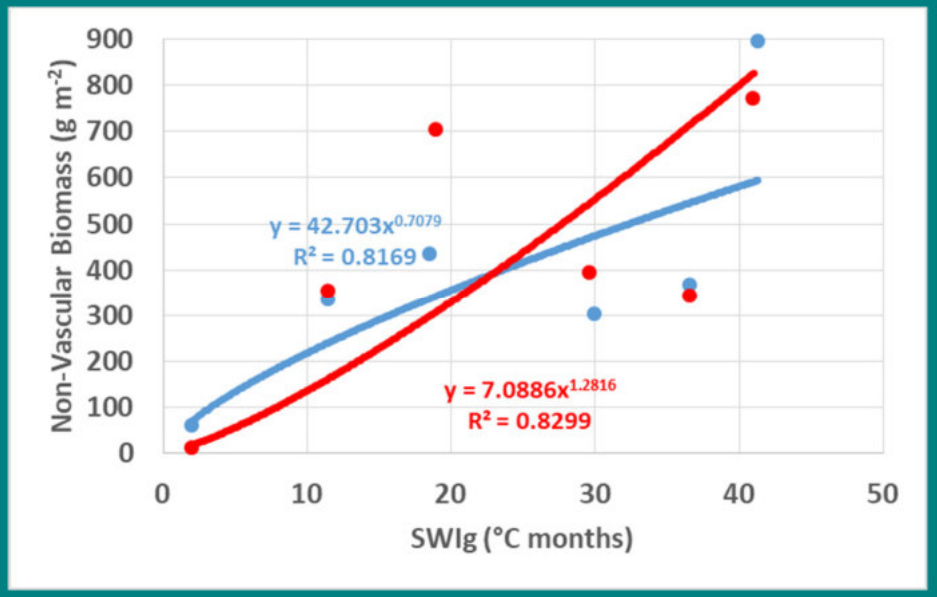
LOAMY is BLUE
SANDY is RED

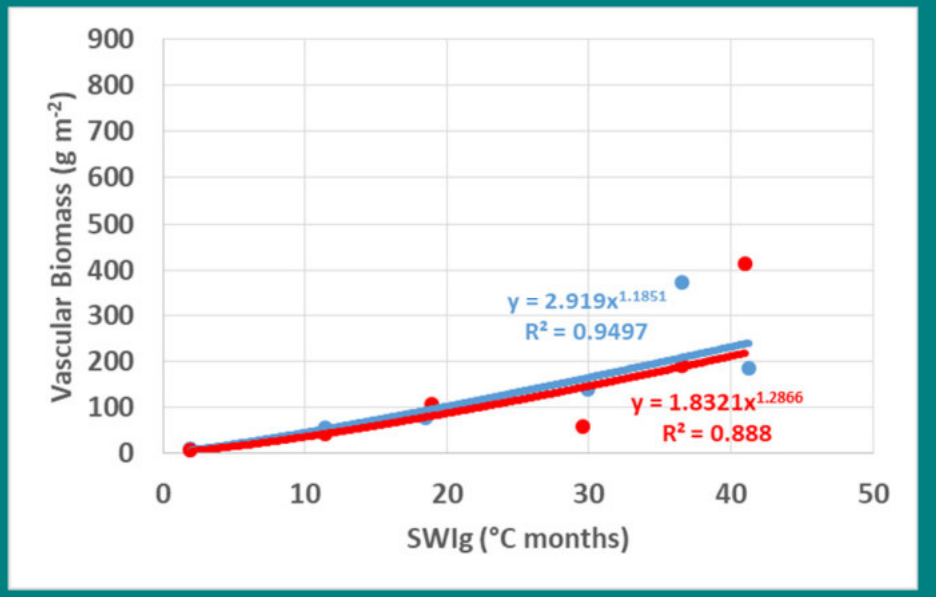
NON-VASCULAR



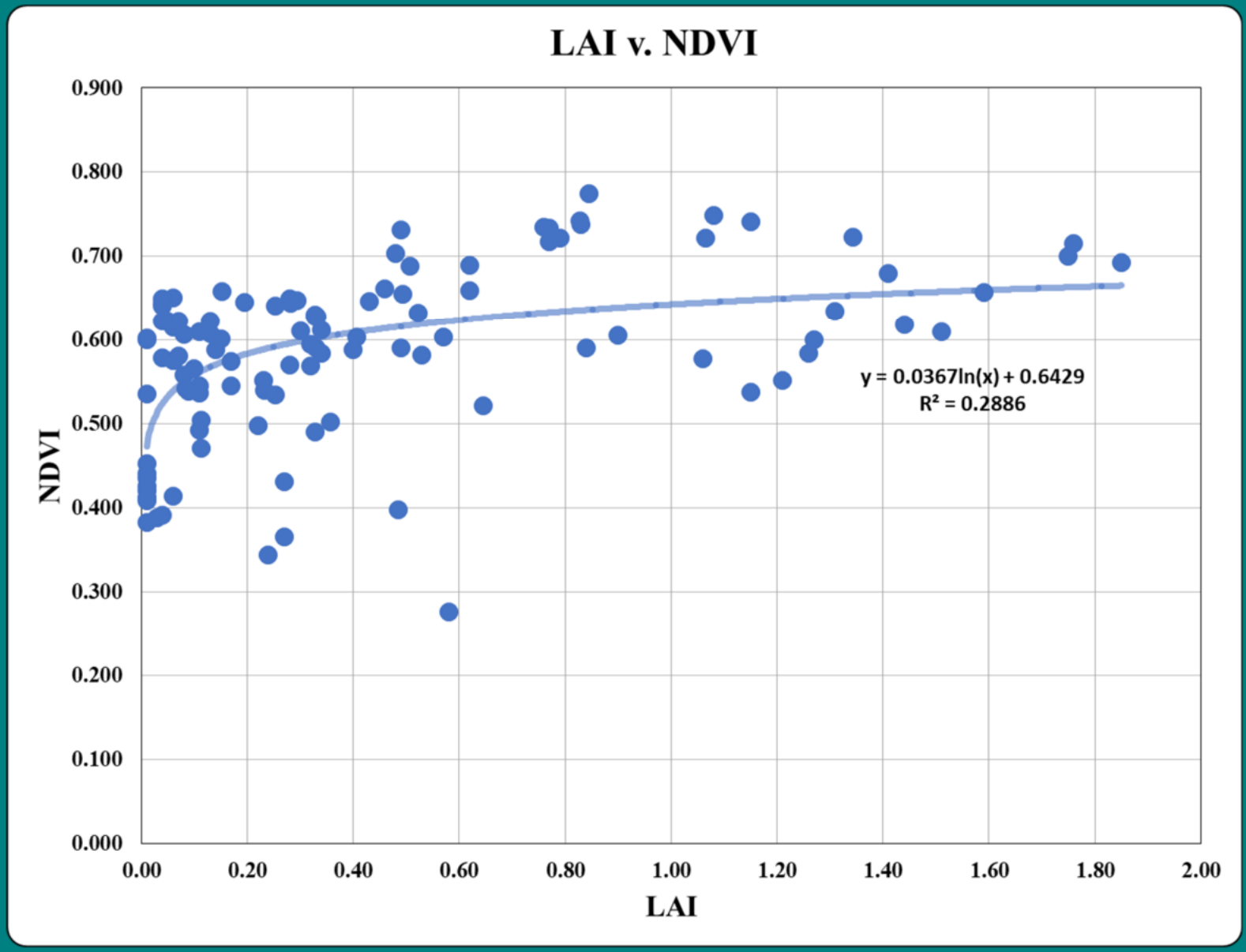


TOTALS

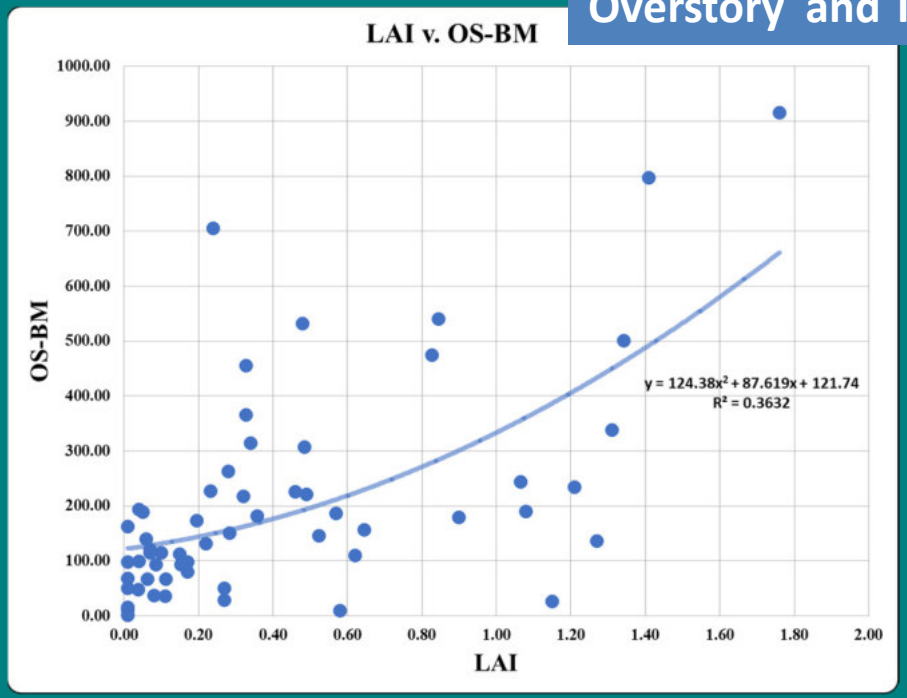


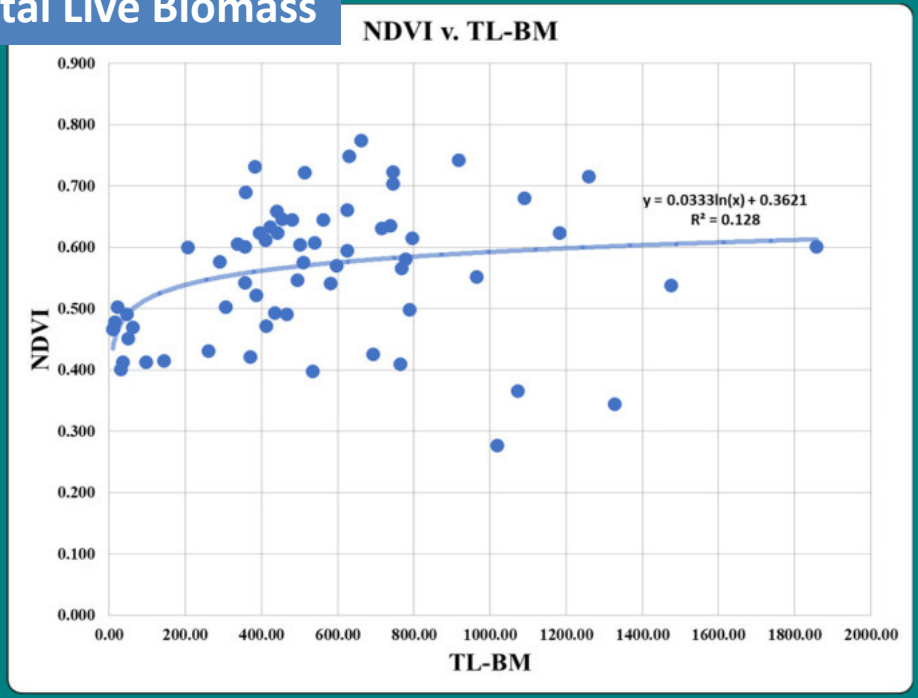


For comparisons between vegetation variables, we can analyze at the resolution of individual relevés (5 x 5m) – five relevés per grid, 2-3 grids per location

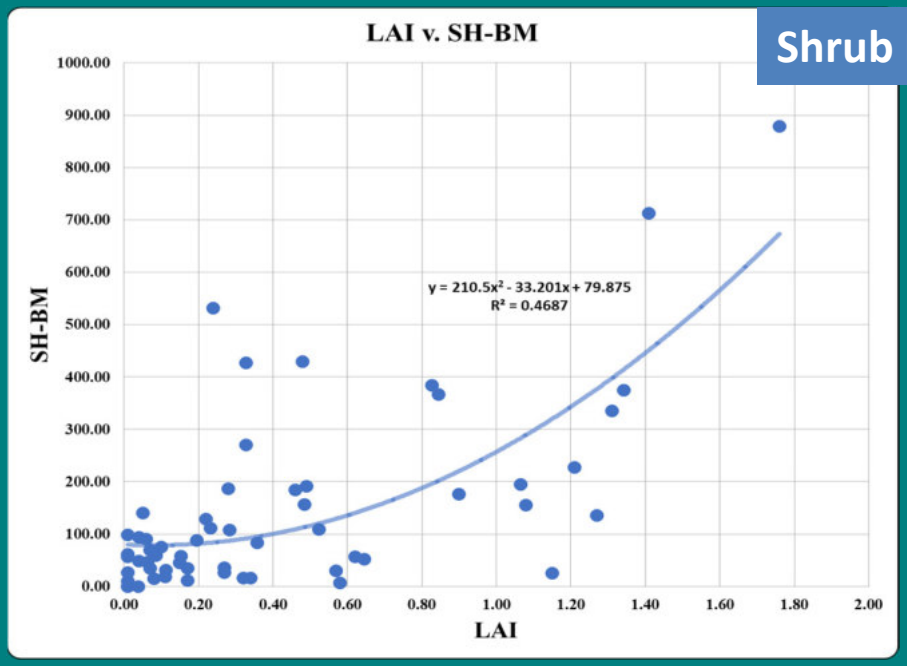


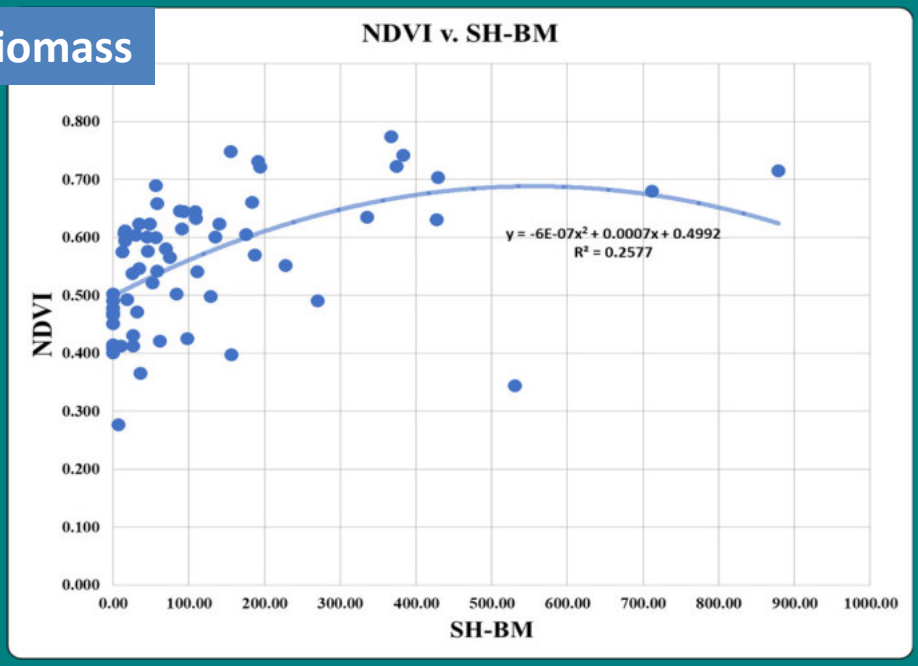
Overstory and Total Live Biomass



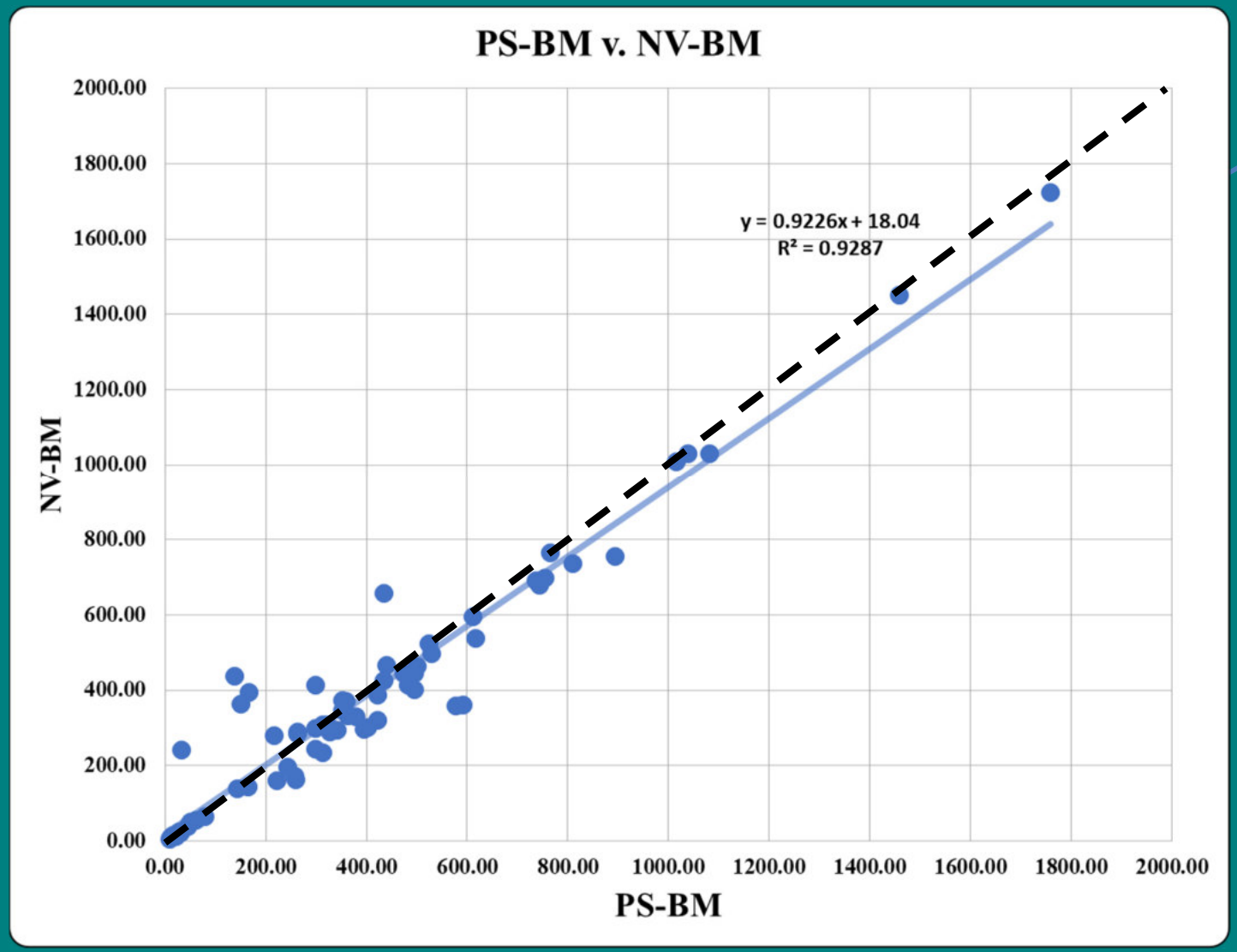


Shrub Biomass





Non-vascular biomass on the EAT is on average 76% of the total live biomass, and 92% of the photosynthetic biomass

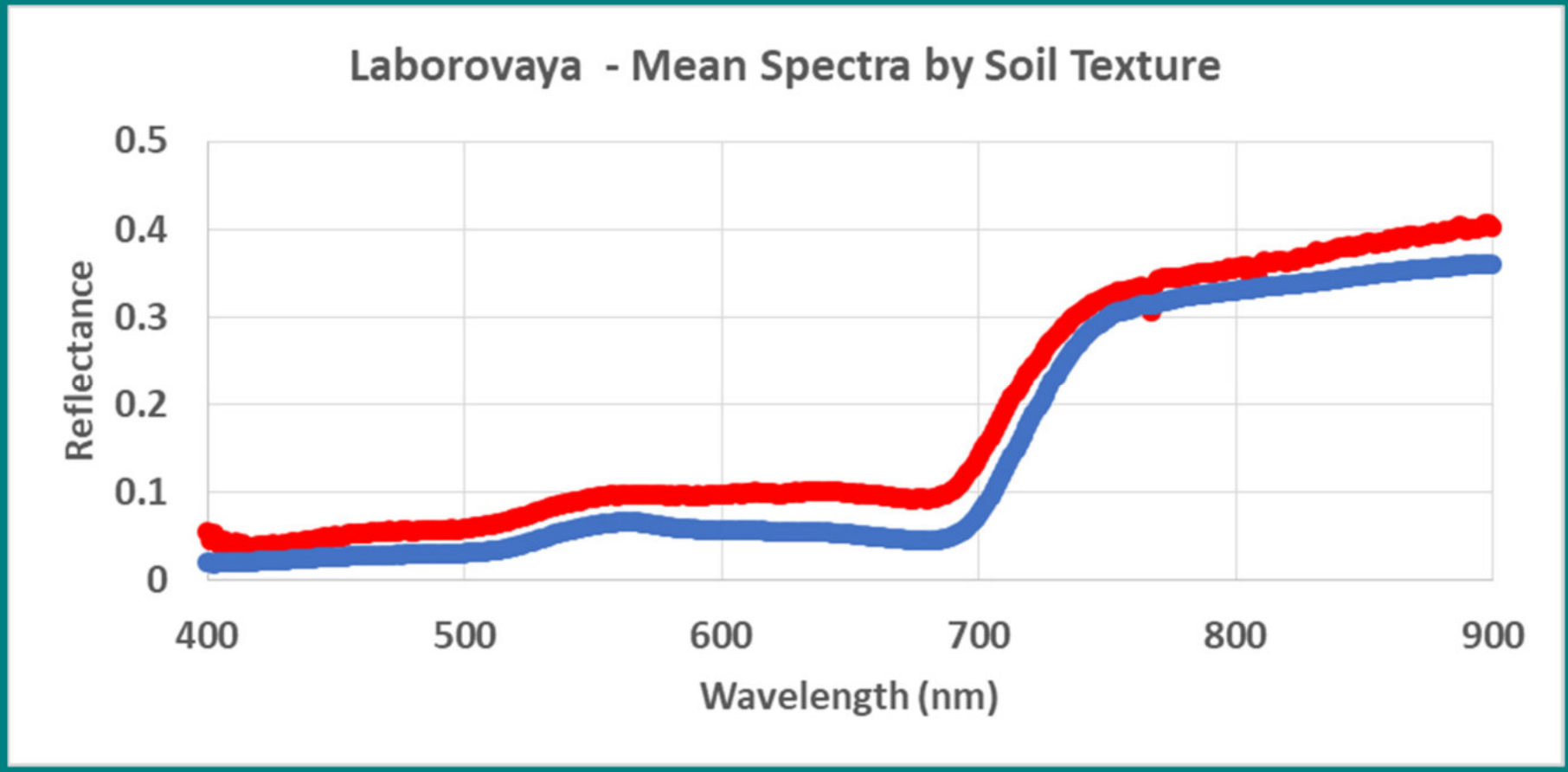


Non-Vascular Biomass (g m^{-2})

Photosynthetic Biomass (g m^{-2})

Continuing to work on the hyperspectral data across the EAT and different soil–textured sites

LOAMY is BLUE
SANDY is RED



Future Work:

1) Analyze patterns of hyperspectral data across soil textures and the SWI gradient
2) Compare EAT biomass and spectral patterns with those of the NAAT

Thoughts with regard to Biodiversity

1) Plant growth form and tissue type biomass as a component of diversity; some aspects differed with soil texture, others did not.

2) Spectral diversity along environmental gradients in the arctic tundra

3) What are the relationships between biomass and vegetation community composition and diversity?

4) How does spectral diversity related to species diversity (potential for scaling)?

5) Note that non-vascular biomass was a major component of the aboveground total and live biomass along the EAT.

6) These data (biomass and spectral information) are likely highly useful as ancillary data in the development of an Arctic Vegetation Archive.

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