CapeTraits: Patterns of functional trait variation and diversity across the Greater Cape Floristic Region and comparison with other Mediterranean ecosystems

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SPES BONA

BIOSCAPE

Main Ideas

- Understand patterns of foliar trait variation in the BioSCape domain using AVIRIS-NG, leaf measurements and phylogeny
  - Leverage other available geospatial data and plot measurements

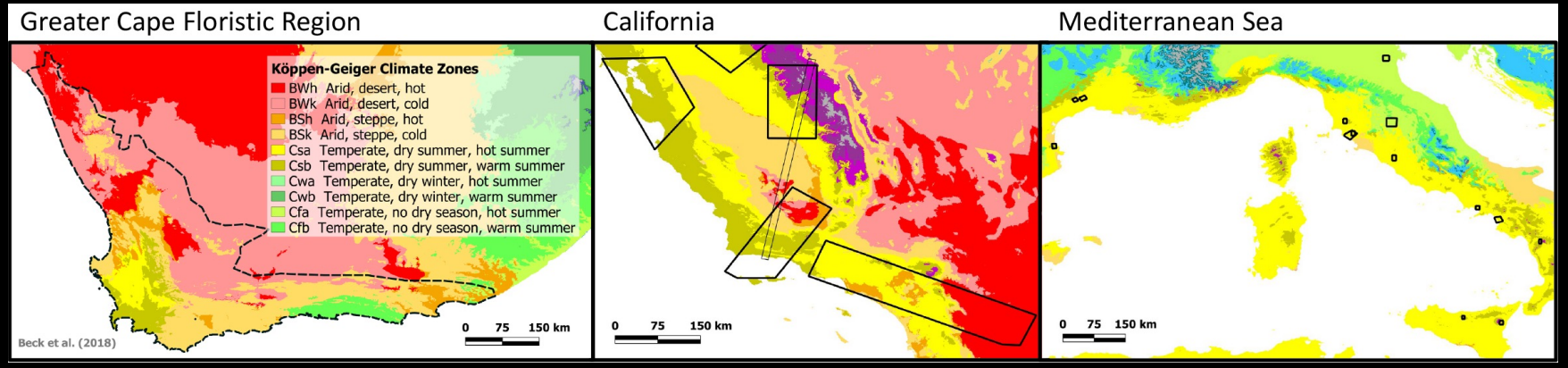
- Does functional trait composition and diversity mirror that of other Mediterranean ecosystems?
  - Theory on habitat filtering and natural selection might predict that vegetation functional traits (and trait variation) would be comparable to other Mediterranean systems due to convergent trait evolution and habitat selection by preadapted lineages in similar climates/environments
  - Alternatively, Cape flora may exhibit distinct trait values and additional variation as a consequence of its unique biogeographic and evolutionary history and geology that have resulted in its phylogenetic distinctiveness

- Trait-mapping questions: generality of algorithms within/among biomes
  - Fractional cover effects

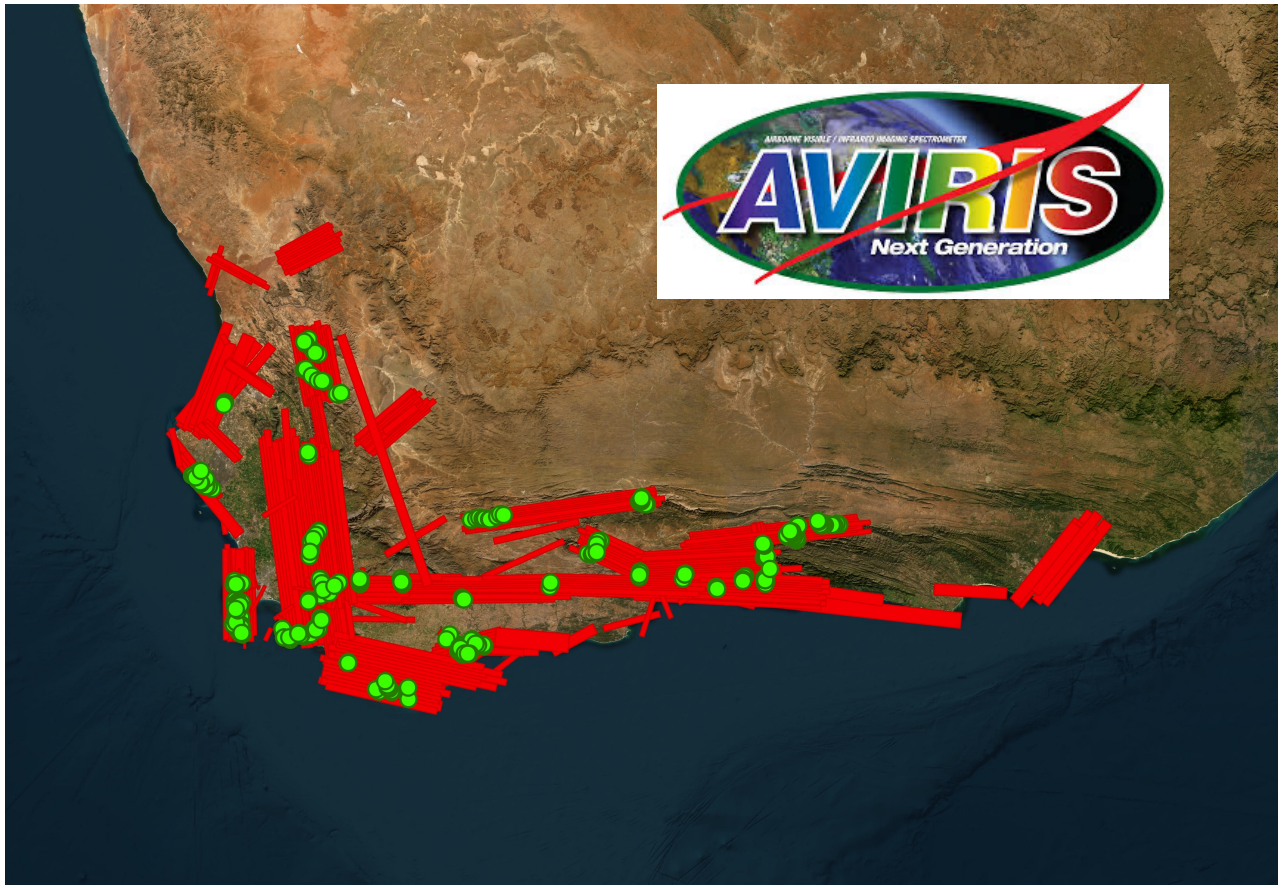
Products and Outcomes

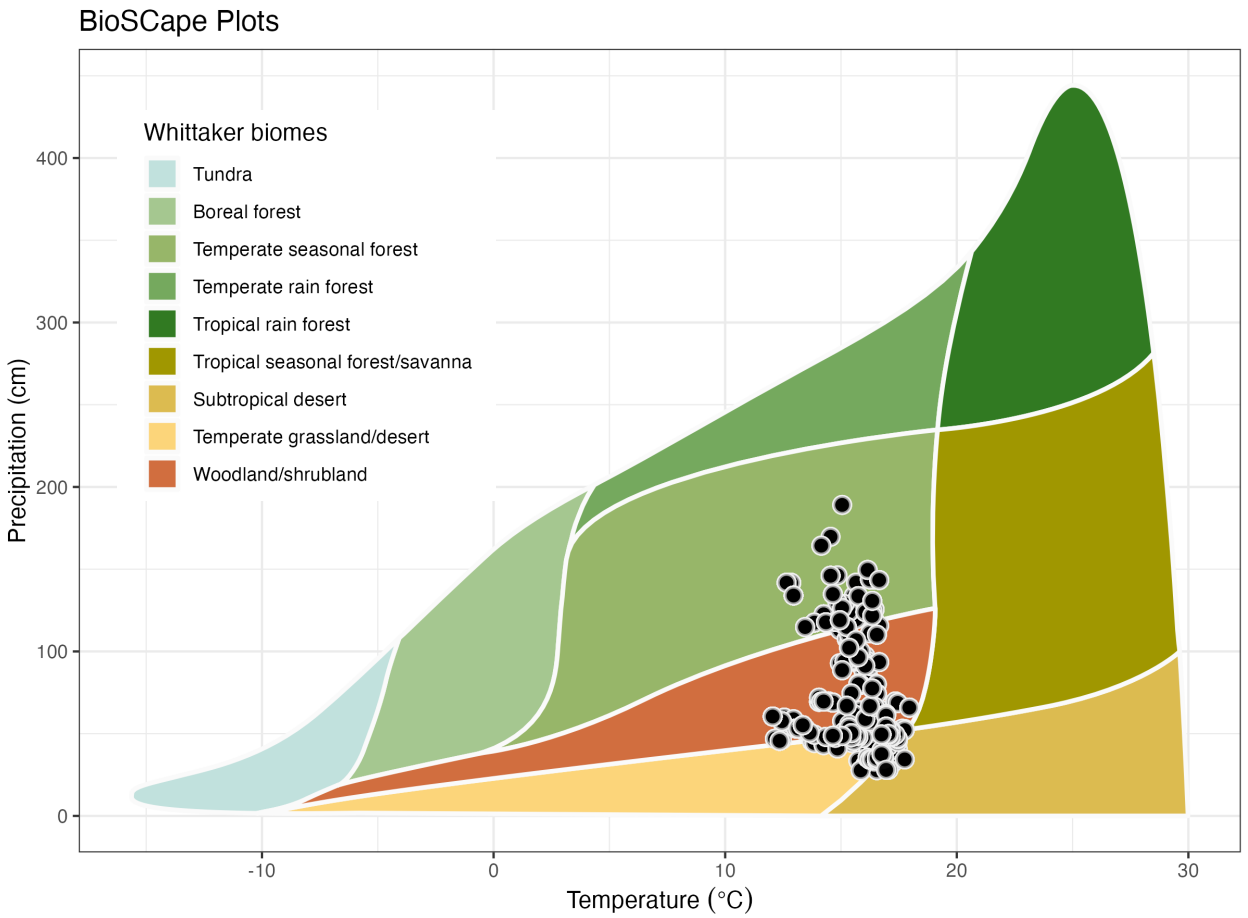
- Extensive field data set of spectra, traits and composition ☑
- Maps of foliar traits and functional diversity
- Drivers of trait patterns and trait-trait relationships
- Comparison with other Mediterranean ecosystems (California)

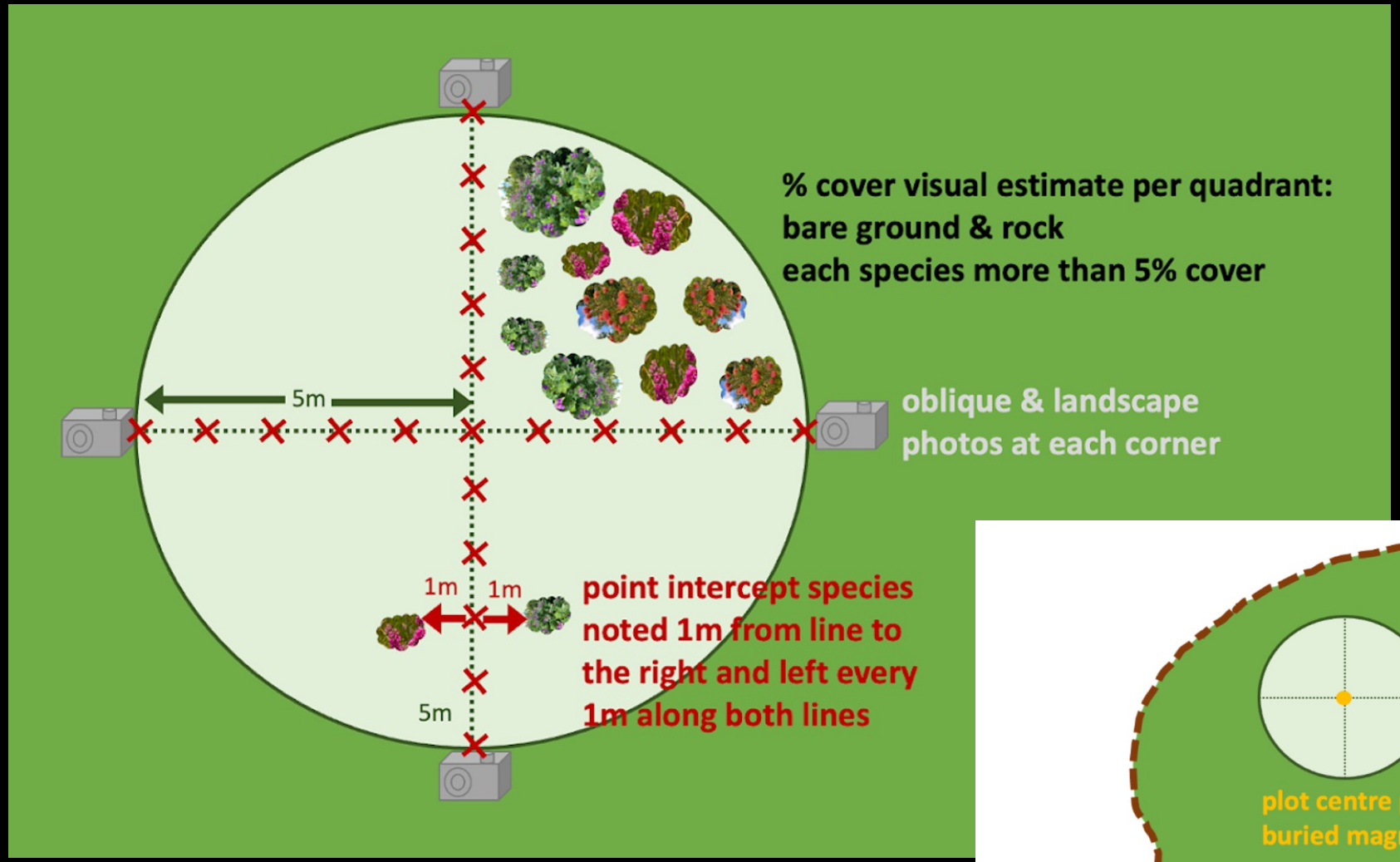
- Capacity building (field spectroscopy and trait measurements)
- South African collaborators and graduate students



BIOSCAPE
Biodiversity Survey of the Cape

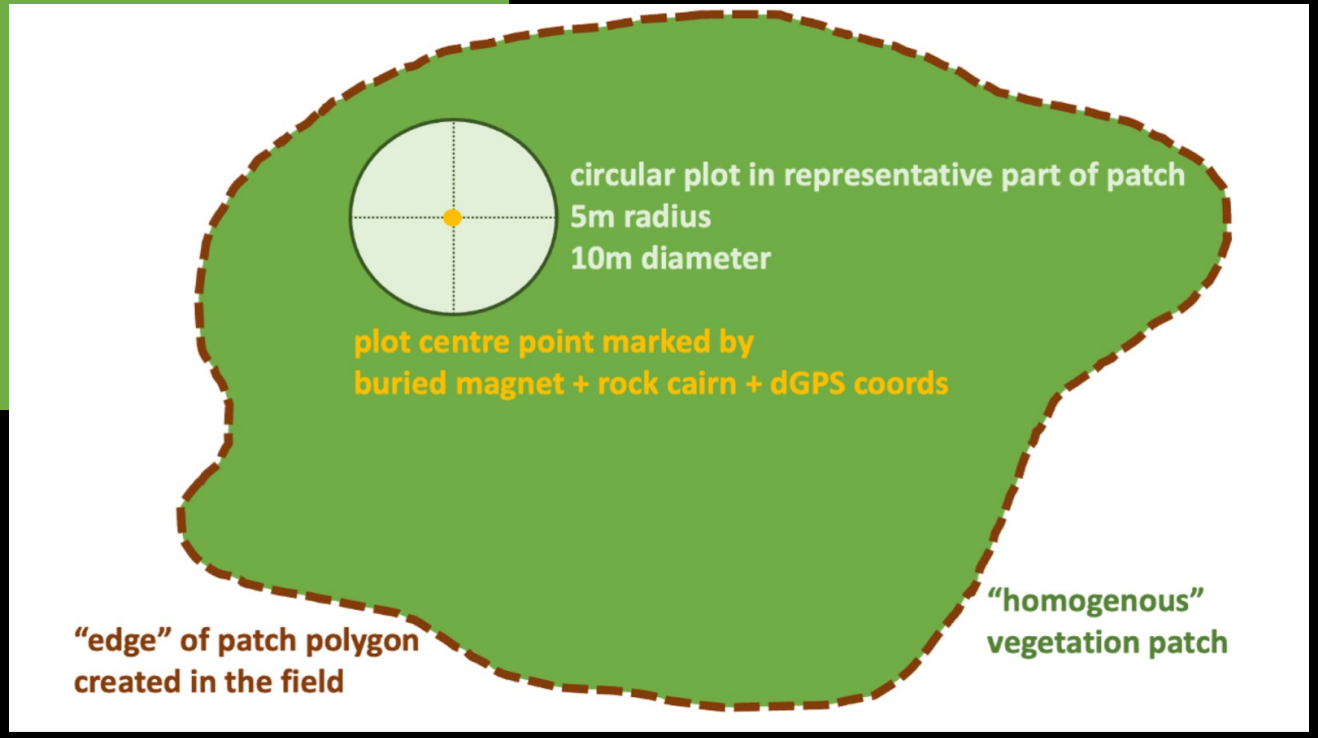






BIOSCAPE
Biodiversity Survey of the Cape

Identify species comprising 80% cover
Additional work to quantify species biodiversity using rarefaction



From BioSCape Implementation Plan

- Field sampling to support several projects
- Community-weighted mean upscaling


Coleman

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Emily McKnight Townsend
Jasper Slingsby
Kyle Kovach
Simcelile Chenge
Kagiso Nhlapo
Glenn Moncrieff
Fabian Schneider
Giulia Tagliabue
Jeannine Cavender-Bares
Steven Augustine
John Silander
Nancy Silander
Andy Hueni
Henry Frye
Brendan Heberlein
Cindy Jones


CapeTraits Hall of Fame


Doug


Henry
Nuwekloofpas


Jasper


Chenge


Emily


CHECK UNDER YOUR CAR
FOR PENGUINS


THE NORTH FACE

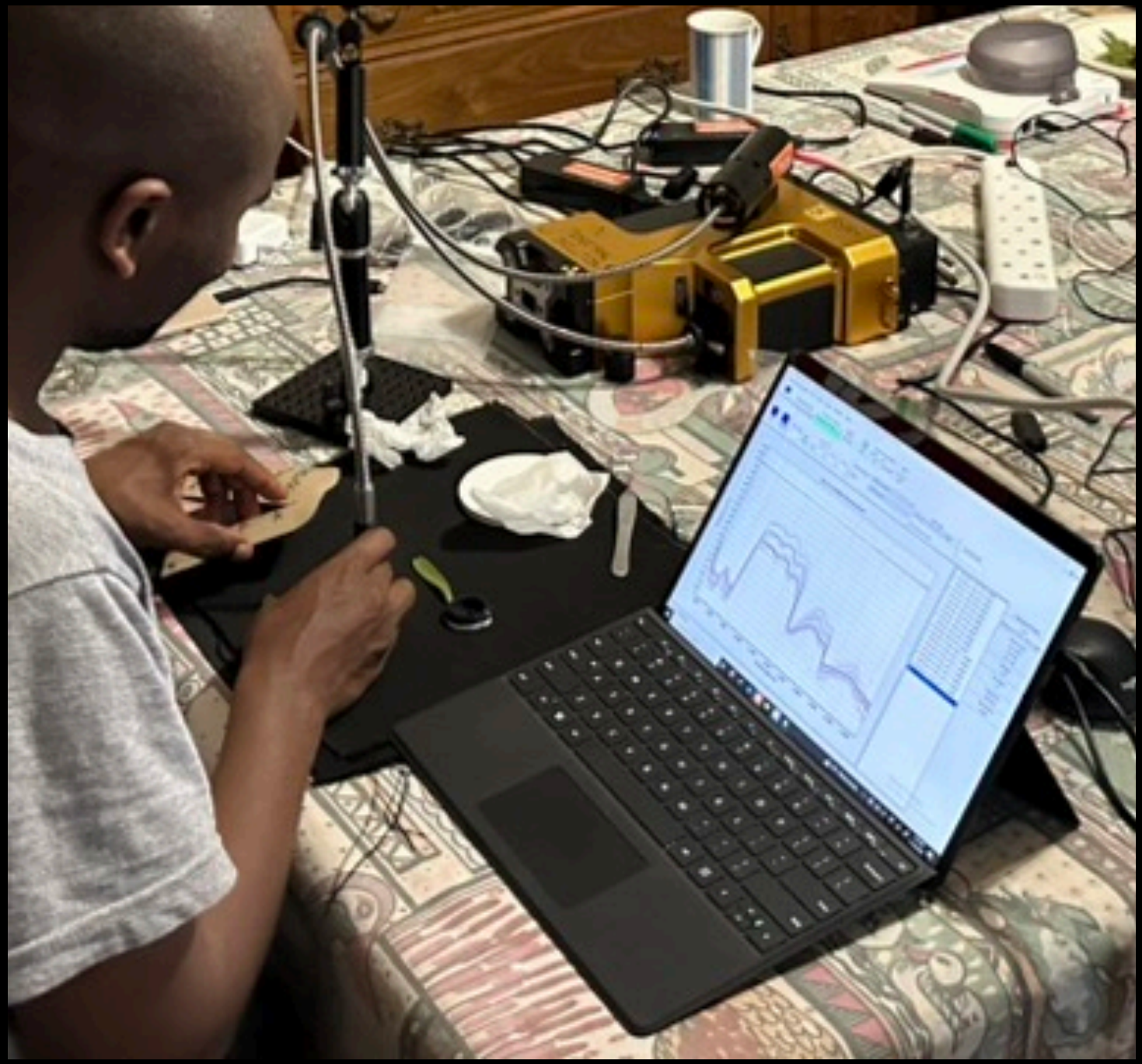
Activity	Sample Size
BioSCape Plots	173 out of 179 total
Opportunistic Plots	475 (265%!!!)
TOTAL PLOTS	648
Number of Vegetation Samples	~1,025*
Number of Species	~624
Foliar Spectra Collected	7885 of at least 423 species from 61 families

*An earlier NSF Dimensions of Biodiversity project led by John Silander sampled ~1286 species, of which we are collecting dry spectra to supplement this study (Henry's talk, next). We currently have 676 species.

Number of species in Cape Floristic Region (CFR) ~ 9,383 (Goldblatt & Manning Flora)

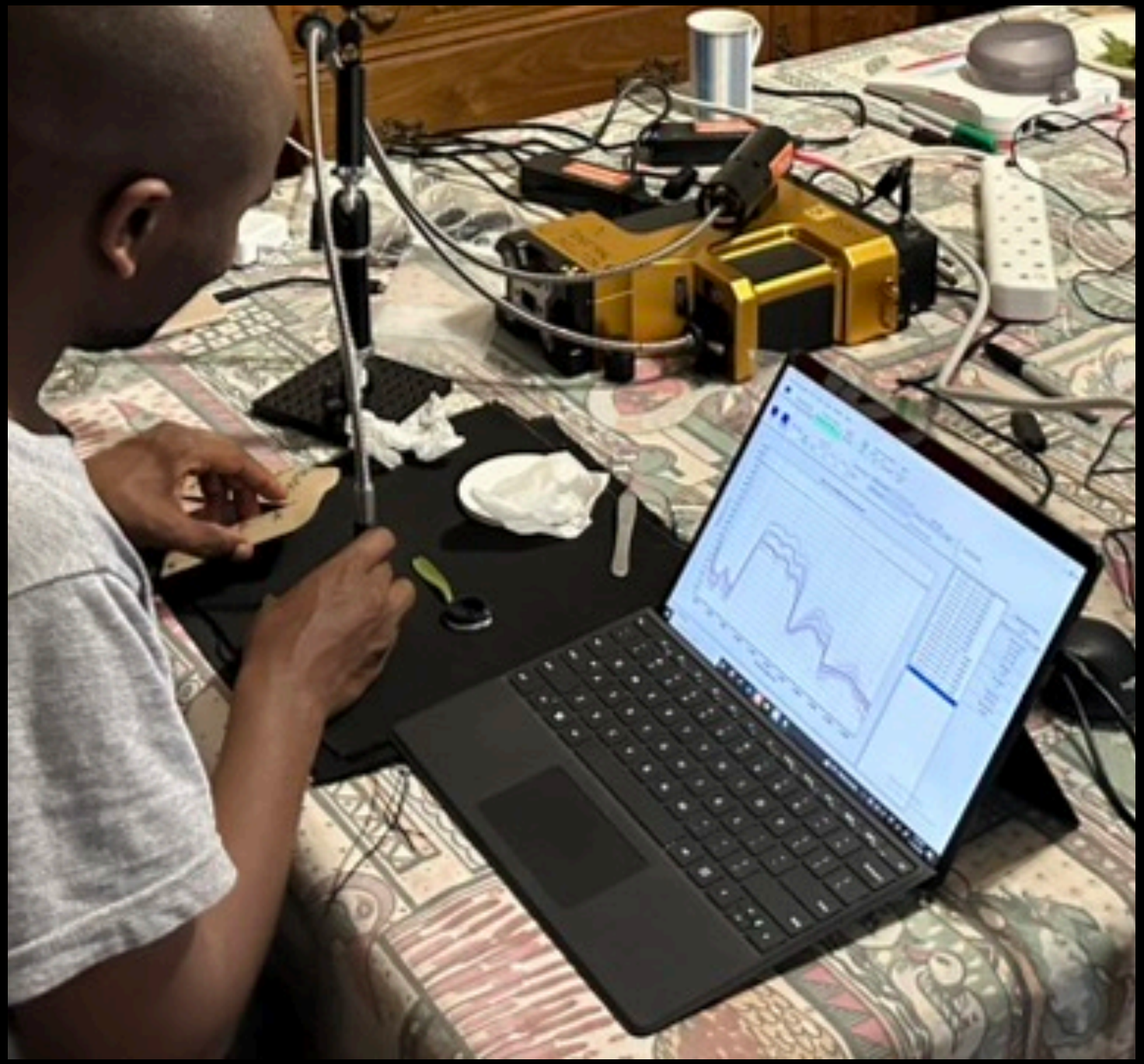
We sampled the "remote sensing richness" of the biome (species that occurred with >5% cover), but certainly not total species diversity (~7% of all species). Our ongoing analyses are designed to help us identify whether we sampled the diversity sufficiently to capture functional diversity.

Spectral/species/trait "accumulation" curves – do the samples we have fill the spectral and/or trait "space" representing the CFR?

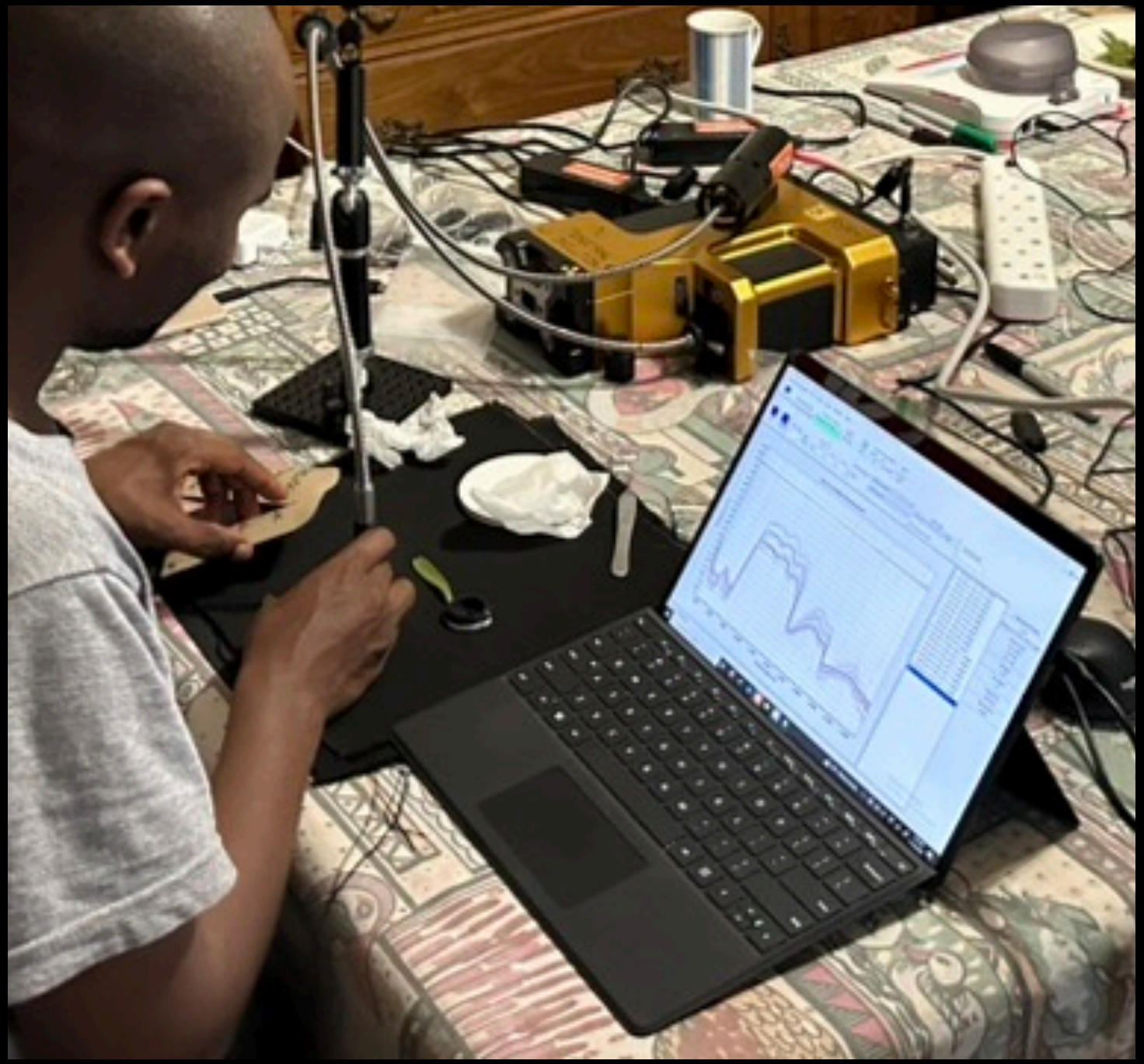


Development of small leaf probe apparatus and measurement methodology

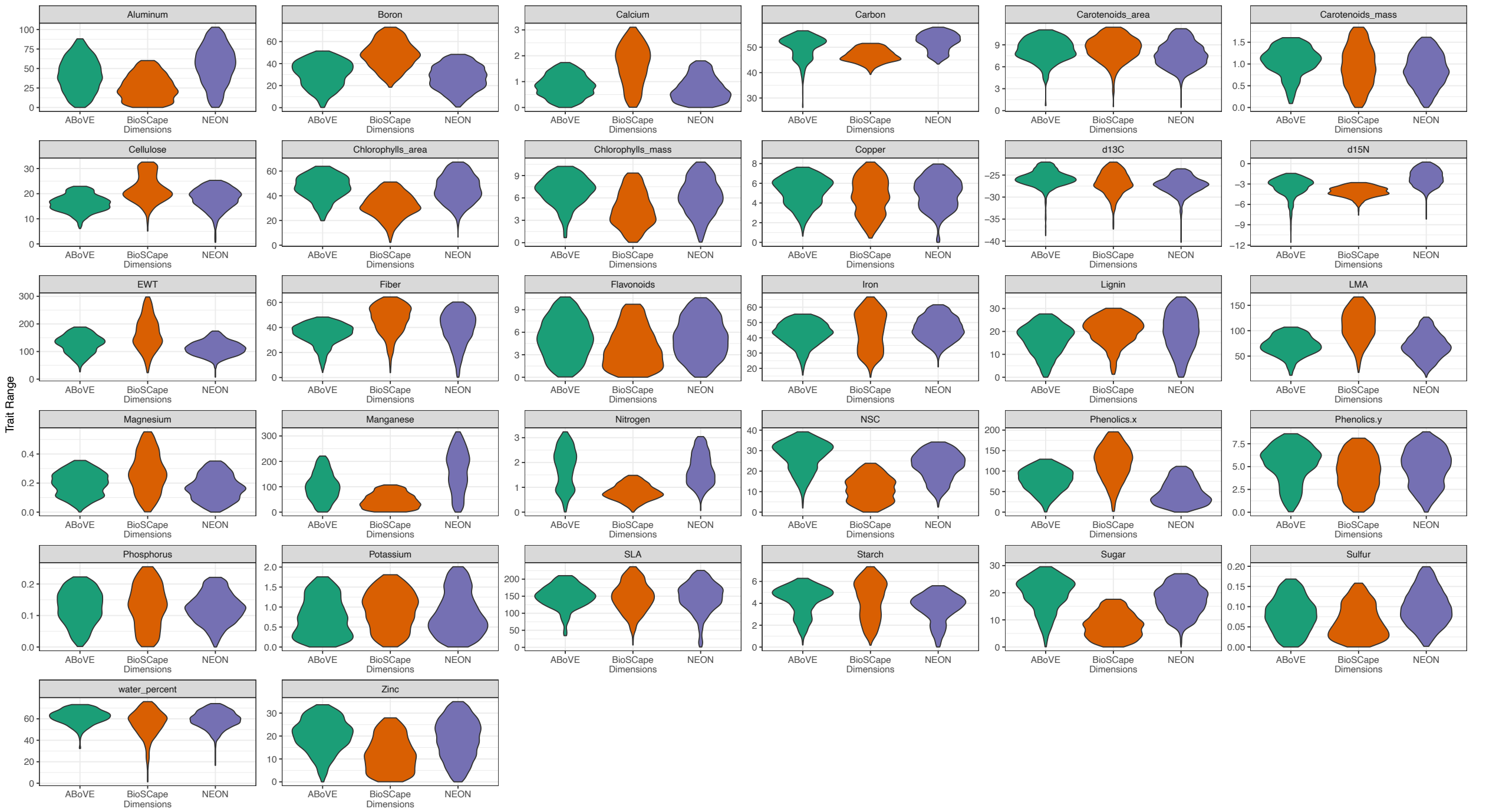
(Spectral Evolution and ASD)

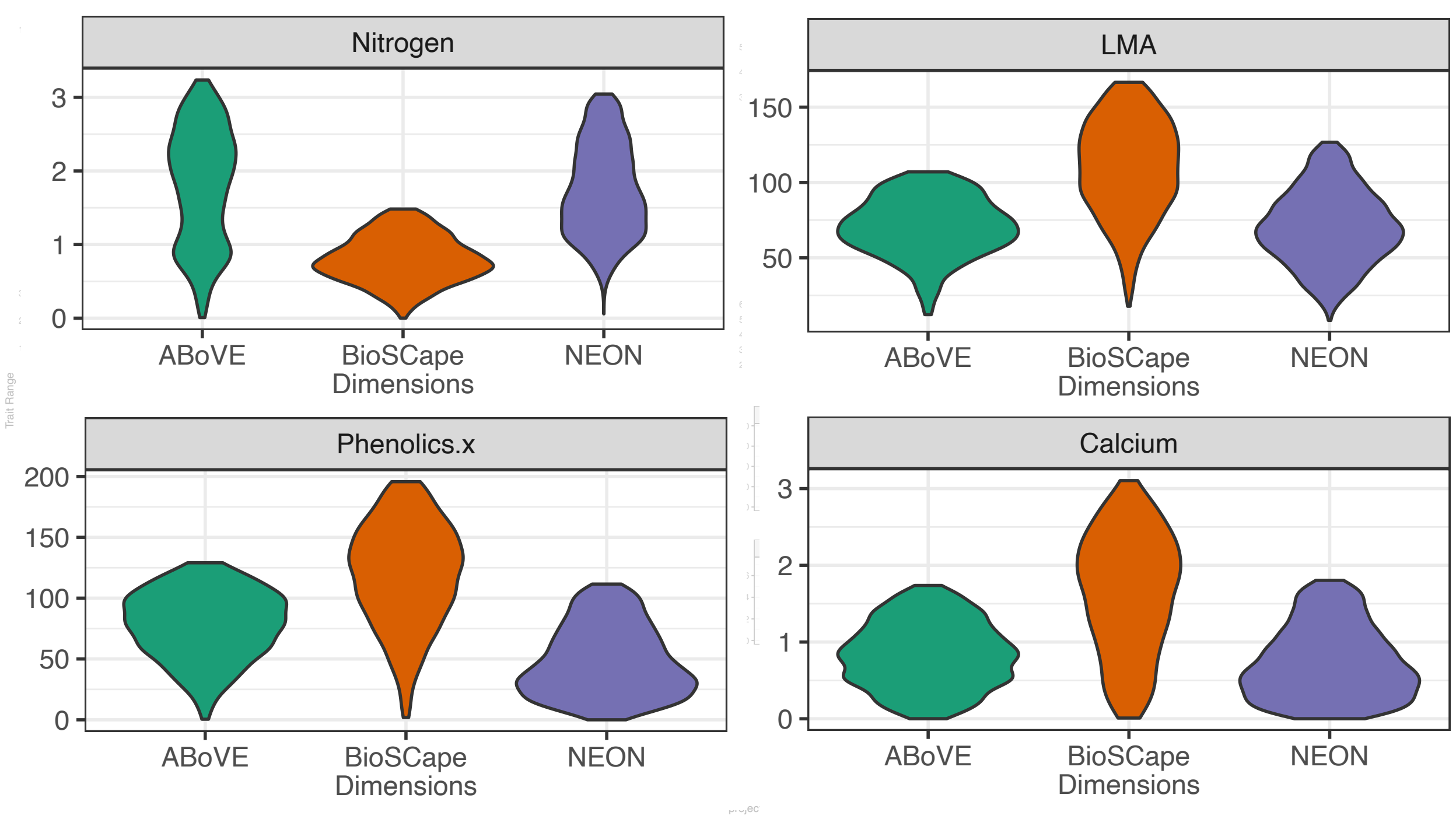



Restio spp.




Restio spp.
NOT *Restio spp.*


Aluminum
Boron
Calcium
Carbon
Carotenoids_area
Carotenoids_mass
Cellulose
Chlorophylls_area
Chlorophylls_mass
Copper
d13C
d15N
EWT
Fiber
Flavonoids
Iron
Lignin
LMA
Magnesium
Manganese
Nitrogen
NSC
Phenolics.x
Phenolics.y
Phosphorus
Potassium
SLA
Starch
Sugar
Sulfur
water_percent
Zinc
ABoVE
BioSCape Dimensions
NEON
Trait Range
project


Nitrogen
3
2
1
0
ABoVE
BioSCape
Dimensions
NEON
LMA
150
100
50
ABoVE
BioSCape
Dimensions
NEON
Phenolics.x
200
150
100
50
0
ABoVE
BioSCape
Dimensions
NEON
Calcium
3
2
1
0
ABoVE
BioSCape
Dimensions
NEON

FlexBRDF Normalization

Normalizations for:

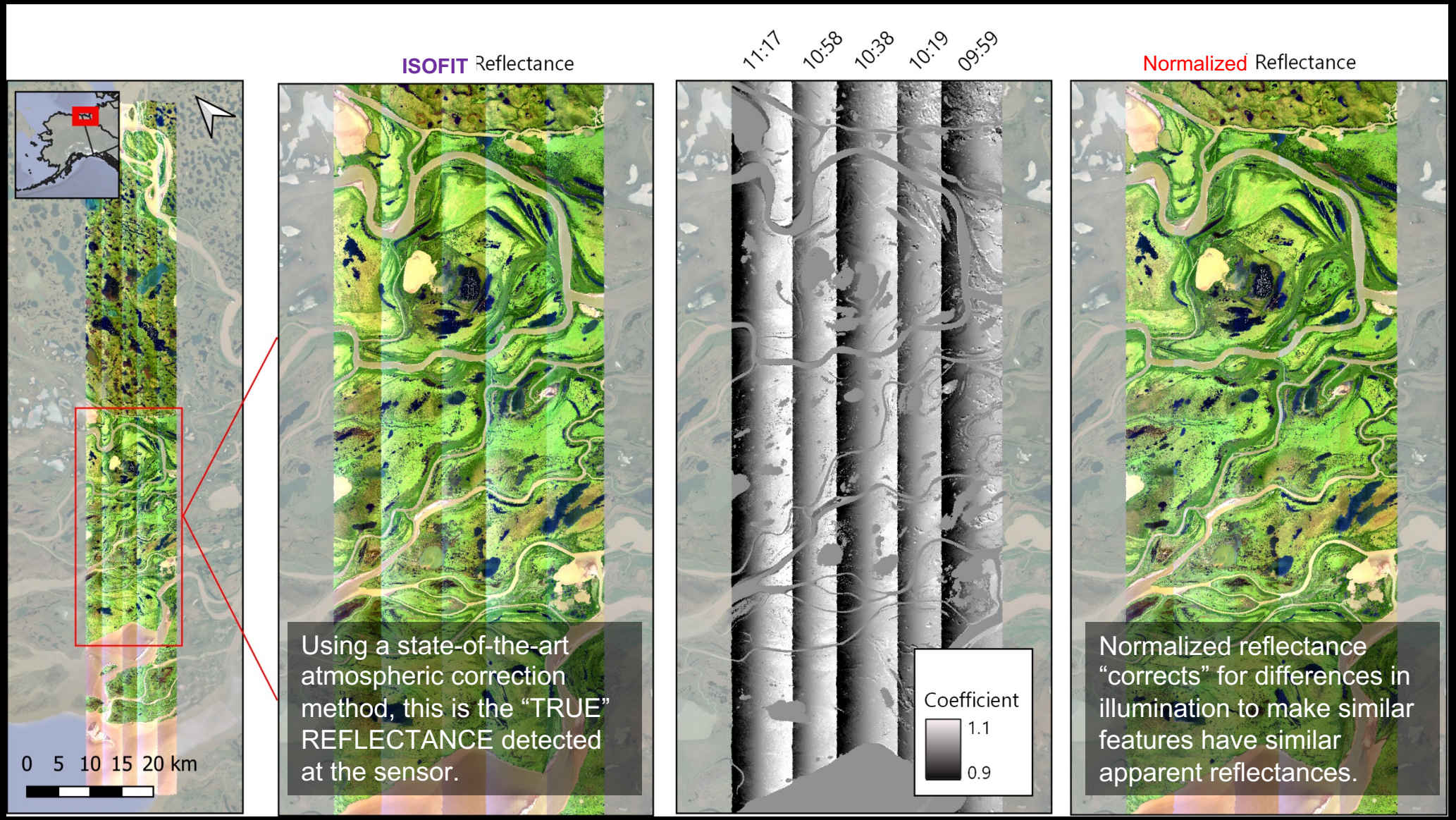
- Brightness gradients (“BRDF”)
- Topographic shading
- Solar zenith angle
- Sun glint

Queally et al. 2022 doi: 10.1029/2021JG006622
Greenberg et al. 2022 doi: 10.1029/2021JG006712

Distribution:

- Visions portal, provenance = current JPL distribution
- ORNL DAAC (concurrent to JPL delivery)

This is so confusing. Which data set should I use?



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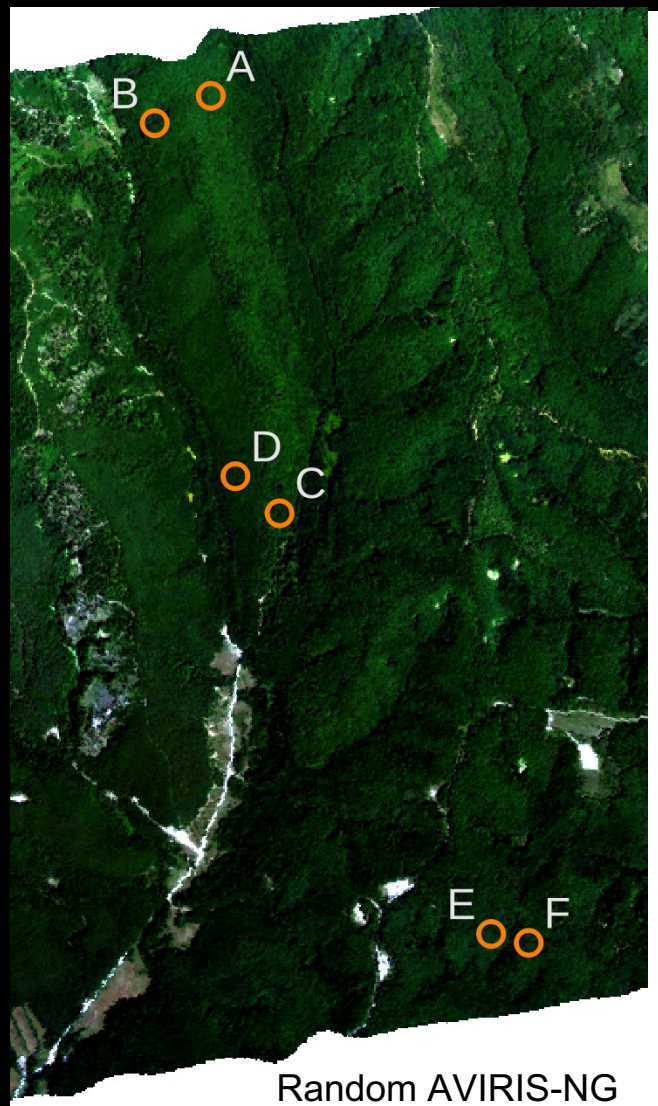
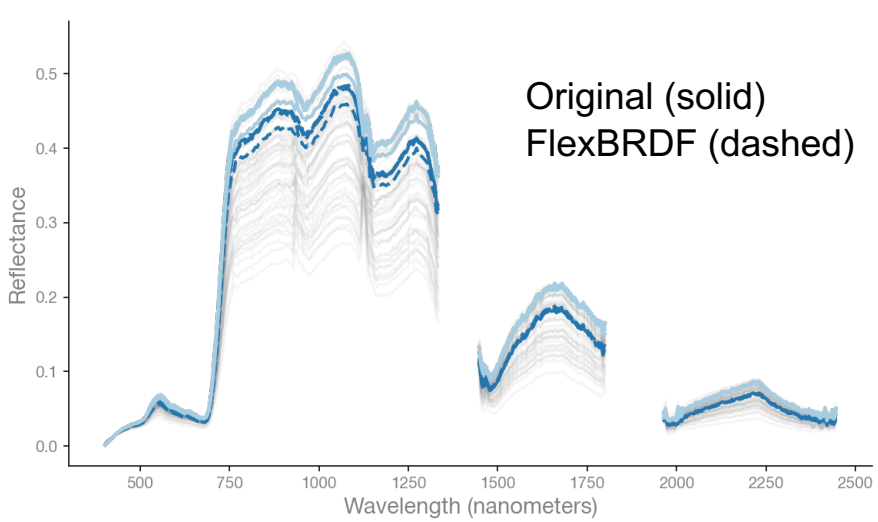
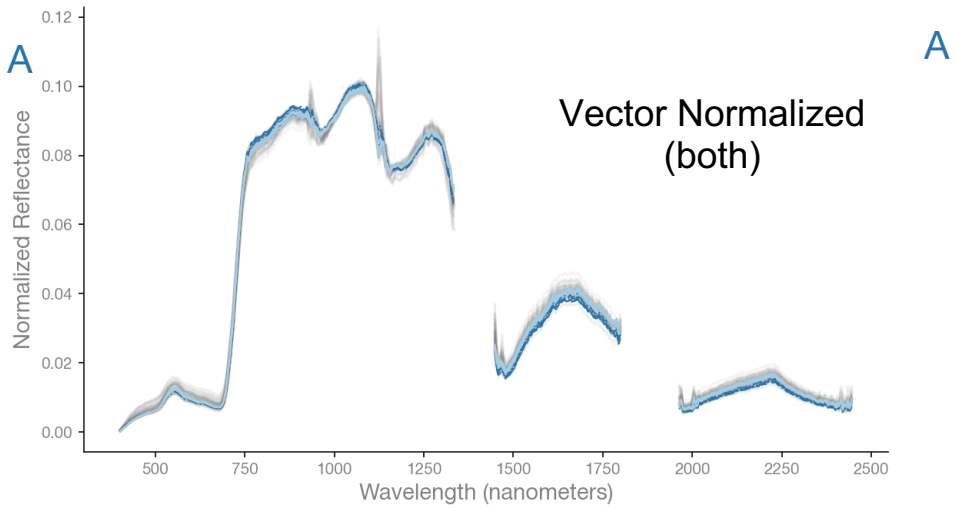
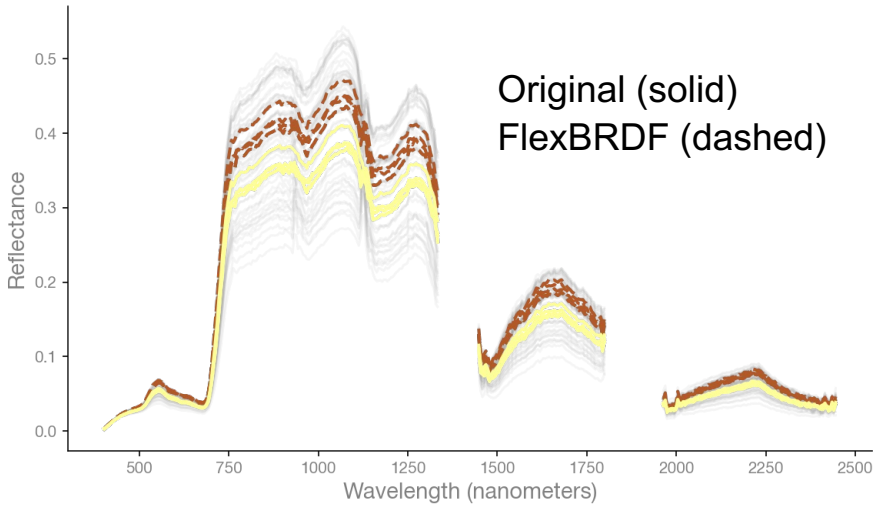
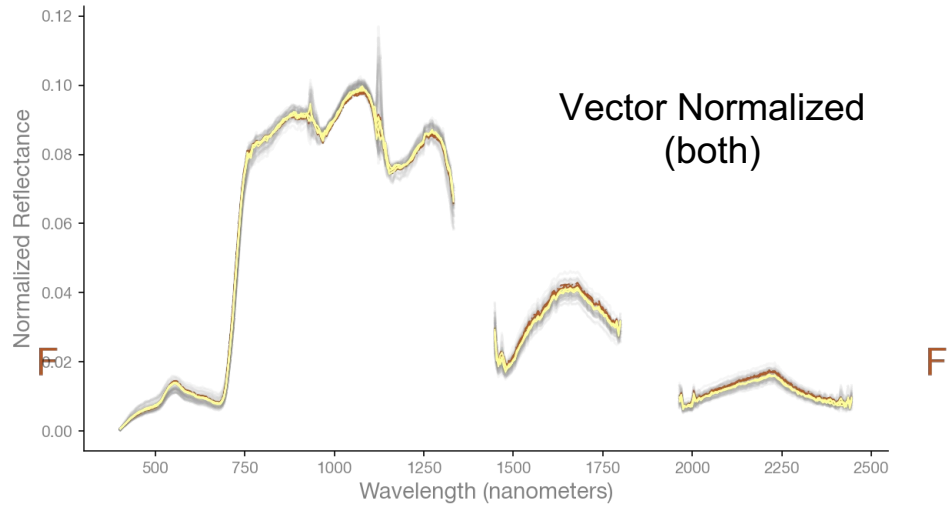


Random AVIRIS-NG flight line from 2021 in Romania.










Normalized


Original

This is so confusing. Which data set should I use?

- When in doubt, stick with the original data, but some initial advice:
  - Anything with a radiative transfer model, start with the original data
  - Most unmixing methods for mapping should be relatively insensitive
- For mapping applications:
  - Data-driven methods
  - Machine/deep learning methods will likely benefit
  - Happy to provide more advice and caveats

More about what's forthcoming: